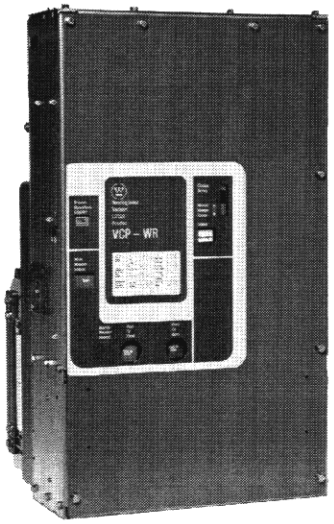
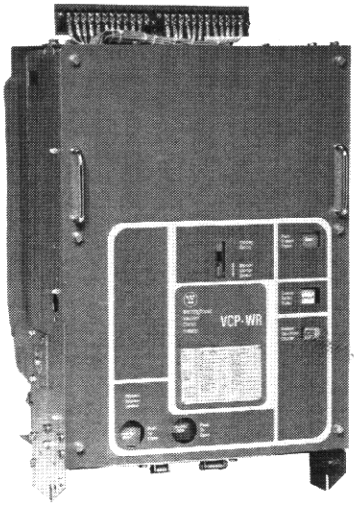
Instructions for the Use, Operation and Maintenance of The Red Line Type VCP-WR Vacuum Circuit Breaker Elements

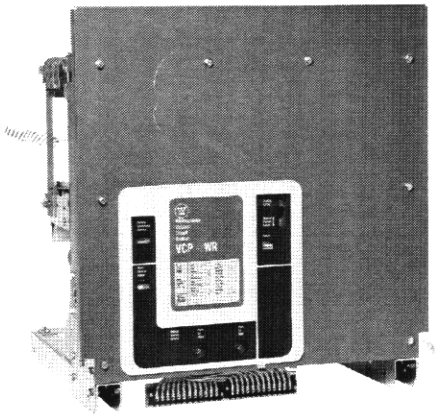
I.B. 8295A61H01



VCP-WR Series 20



VCP-WR Series 18



VCP-WR Series 29

WARNING

IMPROPERLY INSTALLING OR MAINTAINING THESE PRODUCTS CAN RESULT IN DEATH, SERIOUS PERSONAL INJURY, OR PROPERTY DAMAGE.

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

INSTALLATION OR MAINTENANCE SHOULD BE ATTEMPTED ONLY BY QUALIFIED PERSONNEL. THIS INSTRUCTION BOOK SHOULD NOT BE CONSIDERED ALL INCLUSIVE REGARDING INSTALLATION OR MAINTENANCE PROCEDURES. IF FURTHER INFORMATION IS REQUIRED, YOU SHOULD CONSULT WESTINGHOUSE ELECTRIC CORPORATION.

Cutler-Hammer Inc.
Westinghouse &
Cutler-Hammer Products
Power Distribution Component Division
Pittsburgh, PA 15220

Effective September 1, 1994

WARNING

THESE CIRCUIT BREAKER ELEMENTS ARE DESIGNED TO BE INSTALLED PURSUANT TO AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) STANDARD C37.59. SERIOUS INJURY, INCLUDING DEATH, CAN RESULT FROM FAILURE TO FOLLOW THE PROCEDURES OUTLINED IN THIS INSTRUCTION MANUAL. THESE CIRCUIT BREAKER ELEMENTS ARE SOLD PURSUANT TO A NON STANDARD PURCHASING AGREEMENT WHICH LIMITS THE LIABILITY OF THE MANUFACTURER.

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INTRODUCTION

The purpose of this book is to provide instructions for unpacking, storage, use, operation and maintenance of Type VCP-WR Vacuum Circuit Breakers. VCP-WR is a vacuum interrupting element designed for value added construction. The VCP-WR Red Line family of circuit breaker elements is comprised of three element types (Series 18, Series 20 and Series 29). The nominal widths are 18 inches for Series 18, 20 inches for Series 20 and 29 inches for Series 29. Any one of the three available elements can be used as a retrofitting drawout breaker when the customer provides and combines the appropriate cell interface, truck, levering mechanism, secondary connections, interlocks and other accessory items with the VCP-WR element. VCP-WR elements can also be used for fixed breaker applications with others responsible for all required interfaces.

WARNING

SATISFACTORY PERFORMANCE OF THESE BREAKERS IS CONTINGENT UPON PROPER APPLICATION, CORRECT INSTALLATION AND ADEQUATE MAINTENANCE. THIS INSTRUCTION BOOK MUST BE CAREFULLY READ AND FOLLOWED IN ORDER TO OBTAIN OPTIMUM PERFORMANCE FOR LONG USEFUL LIFE OF THE CIRCUIT BREAKERS.

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

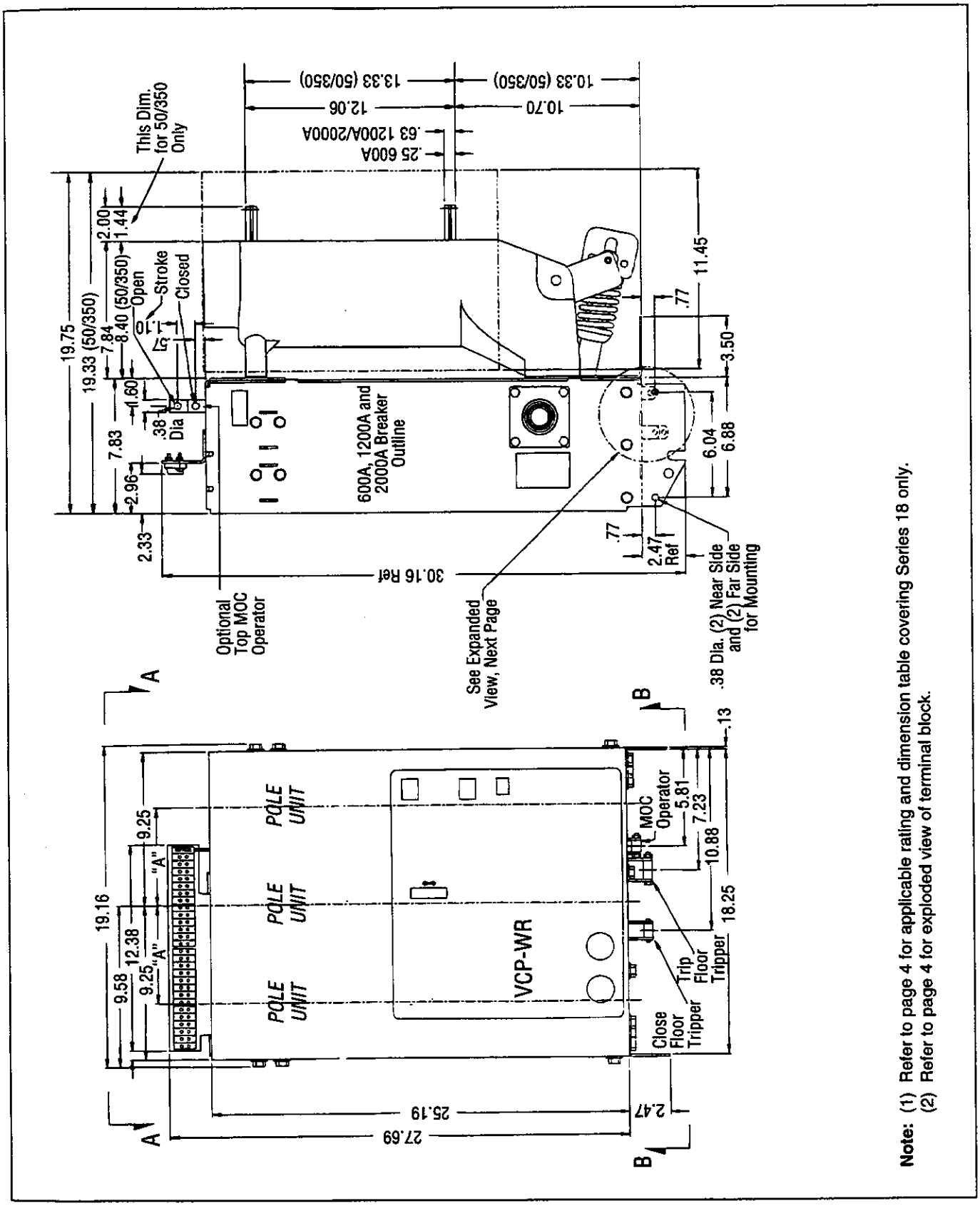
All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance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

1.1 Type VCP-WR Breaker Ratings

Table 1-1 *VCP-WR*

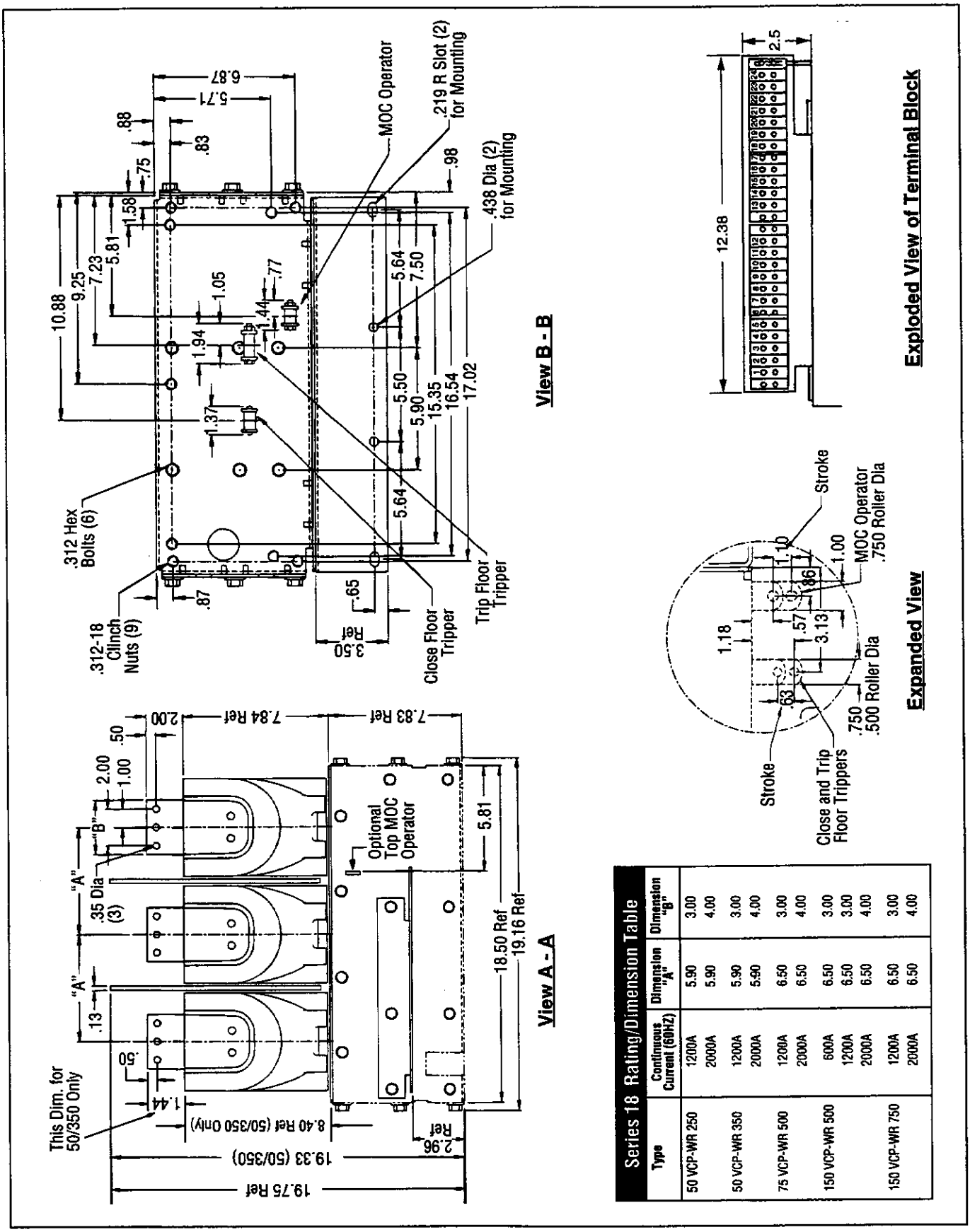
Identification		Rated Values											Related Required Capabilities		
		Current		Nominal	Nominal	Voltage		Insulation Level		Rated	Rated	Rated	Current Values		
		Rated Continuous Current at 60 Hz	Rated Short Circuit Current (at Rated Max. kV)	Voltage Class	3-Phase MVA Class	Rated Max. Voltage	Rated Voltage Range Factor	Rated Withstand Test Voltage		Interrupting Time	Permissible Tripping Delay	Max. Voltage Divided by K	Maximum Sym. Interrupting Capability	3 Sec. Short Time Current Carrying Capability	Closing and Latching Capability (Momentary)
													K Times Rated Short Circuit Current		2.7 K Times Rated Short Circuit Current
								Normal Frequency	Impulse						
Circuit Breaker Type	Series Width (in)	Amps	I kA rms	kV Class	MVA Class	E kV rms	K	kV rms	kV Crest	Cycles	Sec.	E/K kV rms	kA rms	kA rms	kA Crest
VCP-WR Vacuum Circuit Breaker															
50 VCP-WR 250	18, 20, 29 18, 20, 29 29	1200 2000 3000	29	4.16	250	4.76	1.24	19	60	5	2	3.85	36	36	97
50 VCP-WR 350	18, 20, 29 18, 20, 29 29	1200 2000 3000	41	4.16	350	4.76	1.19	19	60	5	2	4.0	49	49	132
75 VCP-WR 500	18, 29 18, 29 29	1200 2000 3000	33	7.2	500	8.25	1.25	36	95	5	2	6.6	41	41	111
150 VCP-WR 500	18 18, 29 18, 29 29	600 1200 2000 3000	18	13.8	500	15	1.30	36	95	5	2	11.5	23	23	62
150 VCP-WR 750	18, 29 18, 29 29	1200 2000 3000	28	13.8	750	15	1.30	36	95	5	2	11.5	36	36	97
150 VCP-WR 1000	29 29 29	1200 2000 3000	37	13.8	1000	15	1.30	36	95	5	2	11.5	48	48	130

1.2 Type VCP-WR Outlines and Dimensions



Note: (1) Refer to page 4 for applicable rating and dimension table covering Series 18 only.
(2) Refer to page 4 for exploded view of terminal block.

Figure 1.1 *VCP-WR Series 18 Element Outlines and Dimensions (inches)*



Series 18 Rating/Dimension Table			
Type	Continuous Current (60HZ)	Dimension "A"	Dimension "B"
50 VCP-WR 250	1200A	5.90	3.00
	2000A	5.90	4.00
50 VCP-WR 350	1200A	5.90	3.00
	2000A	5.90	4.00
75 VCP-WR 500	1200A	6.50	3.00
	2000A	6.50	4.00
150 VCP-WR 500	600A	6.50	3.00
	1200A	6.50	3.00
	2000A	6.50	4.00
150 VCP-WR 750	1200A	6.50	3.00
	2000A	6.50	4.00

Figure 1.1 *VCP-WR Series 18 Element Outlines and Dimensions (inches) -continued*

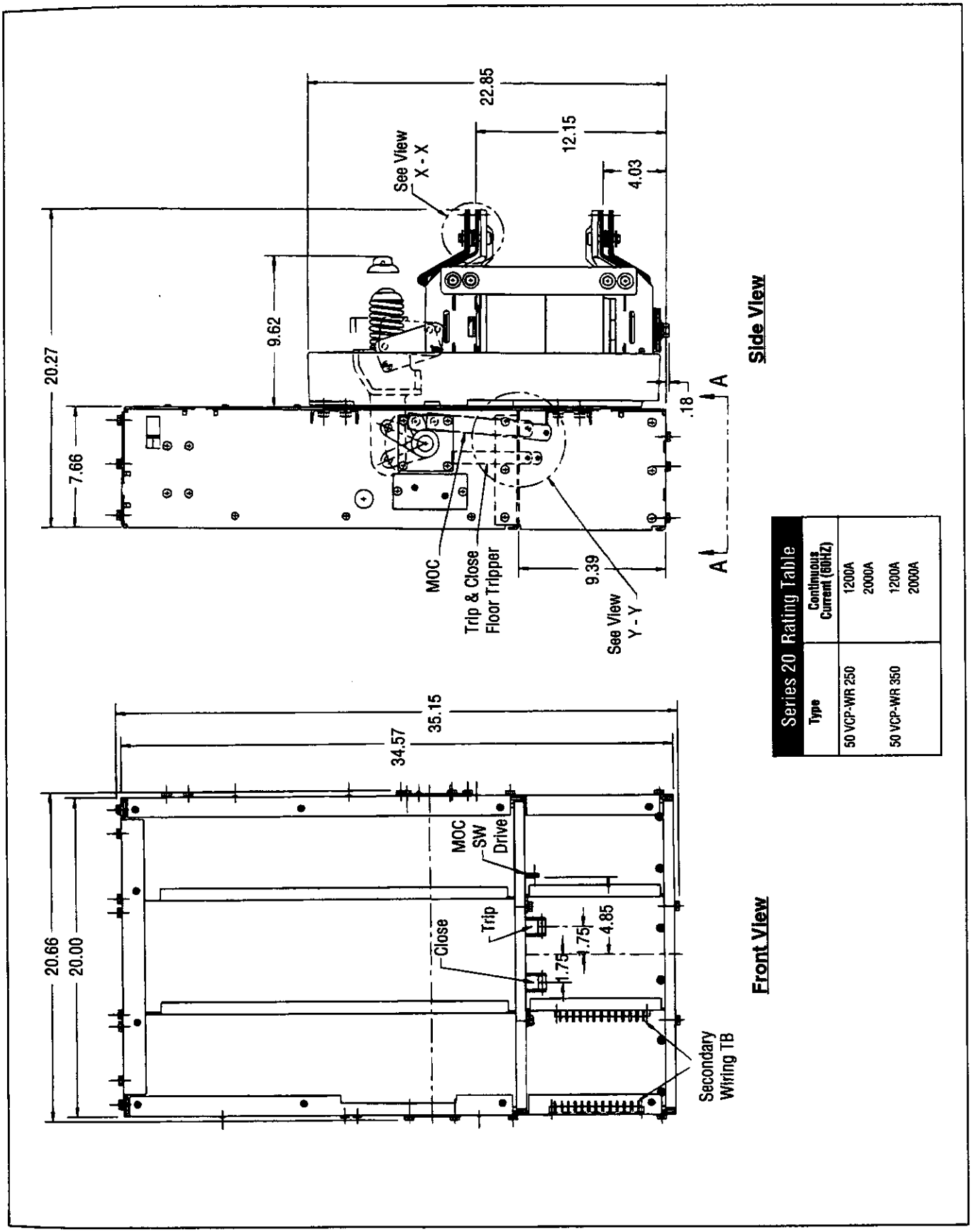
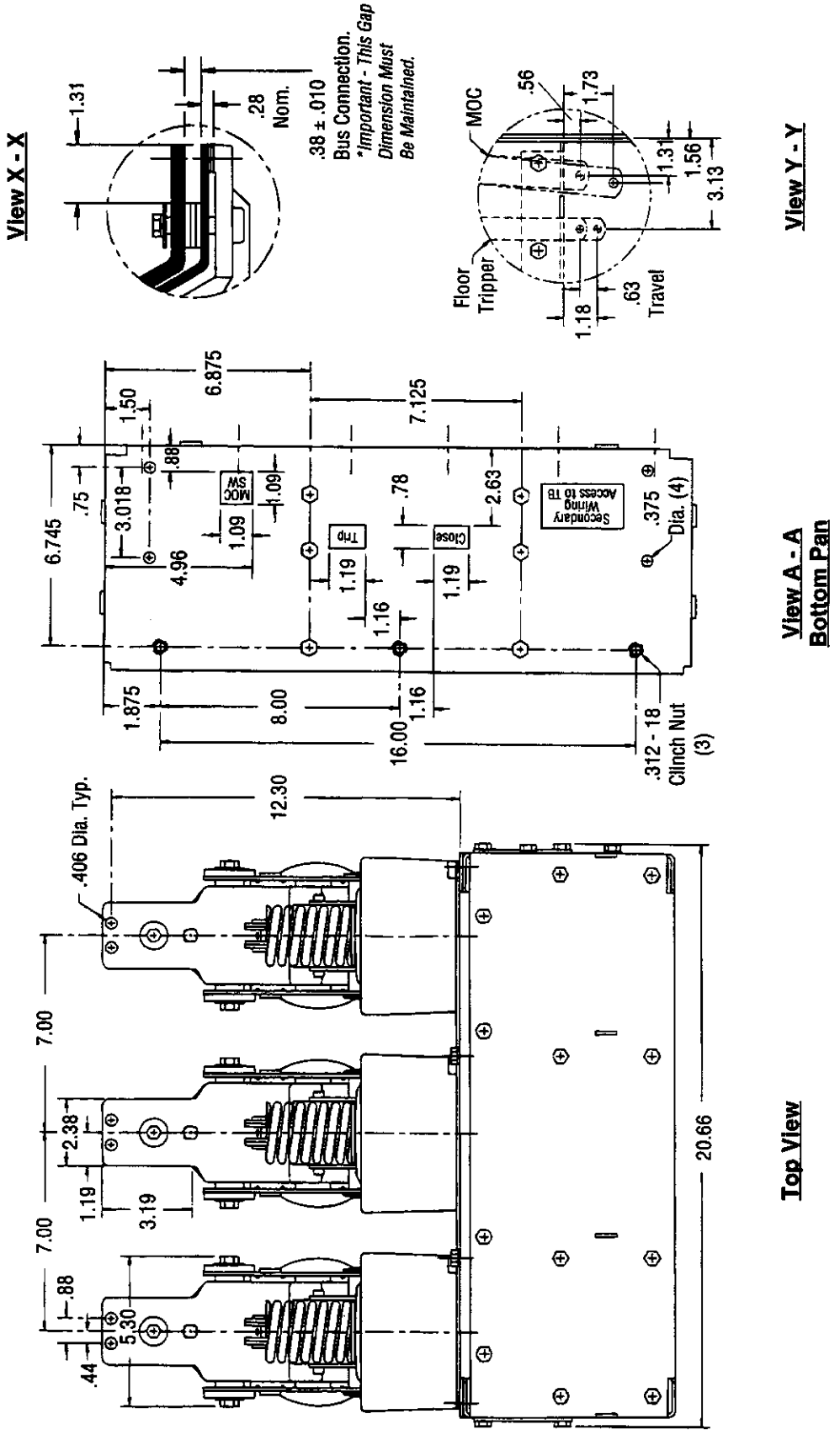


Figure 1.2 *VCP-WR Series 20 Element Outlines and Dimensions (inches)*



Note: Refer to page 5 for applicable rating table covering Series 20 only.

Figure 1.2 *VCP-WR Series 20 Element Outlines and Dimensions (inches) -continued*

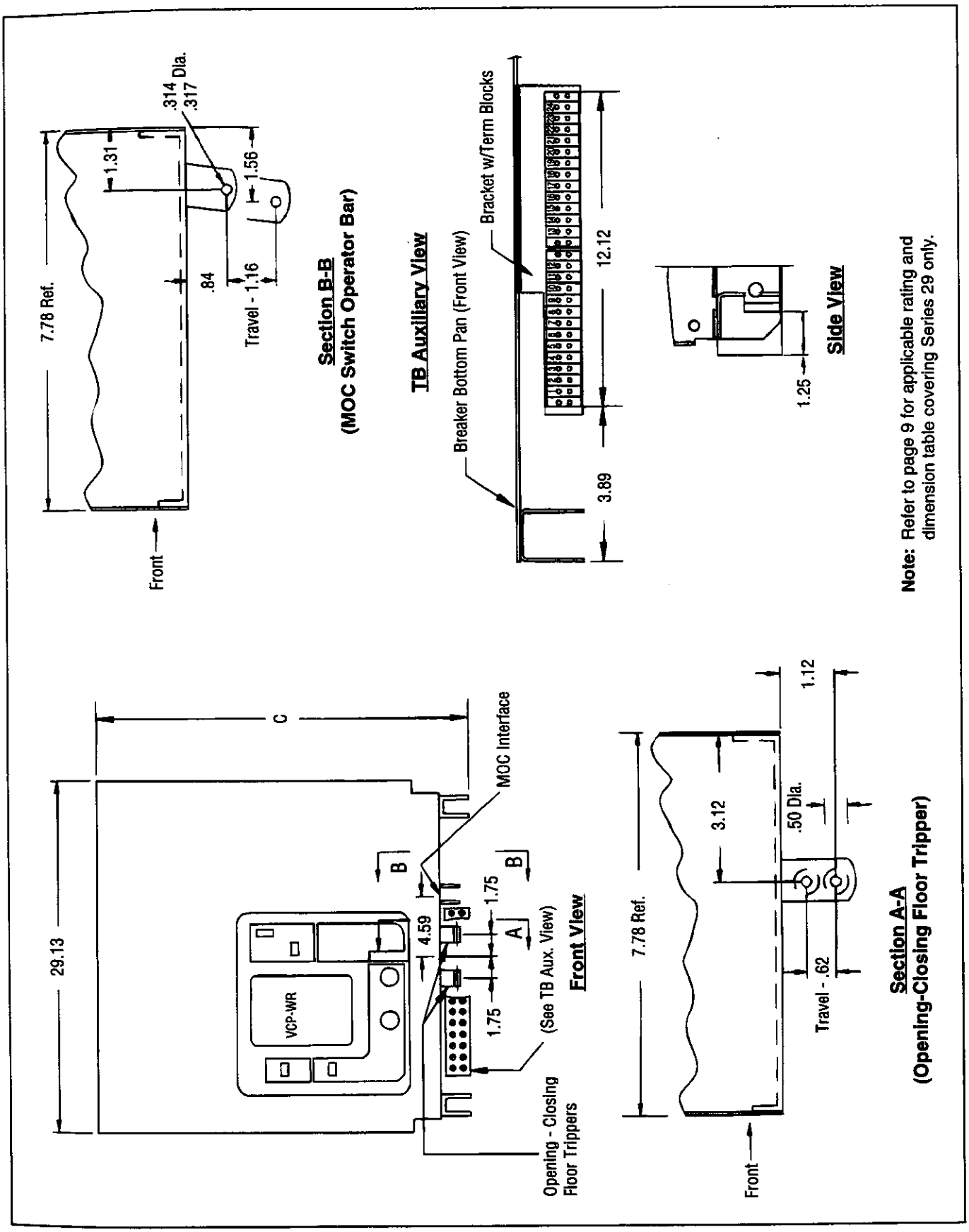


Figure 1.3 *VCP-WR Series 29 Element Outlines and Dimensions (inches)*

Note: Refer to page 5 for applicable rating table covering Series 20 only.

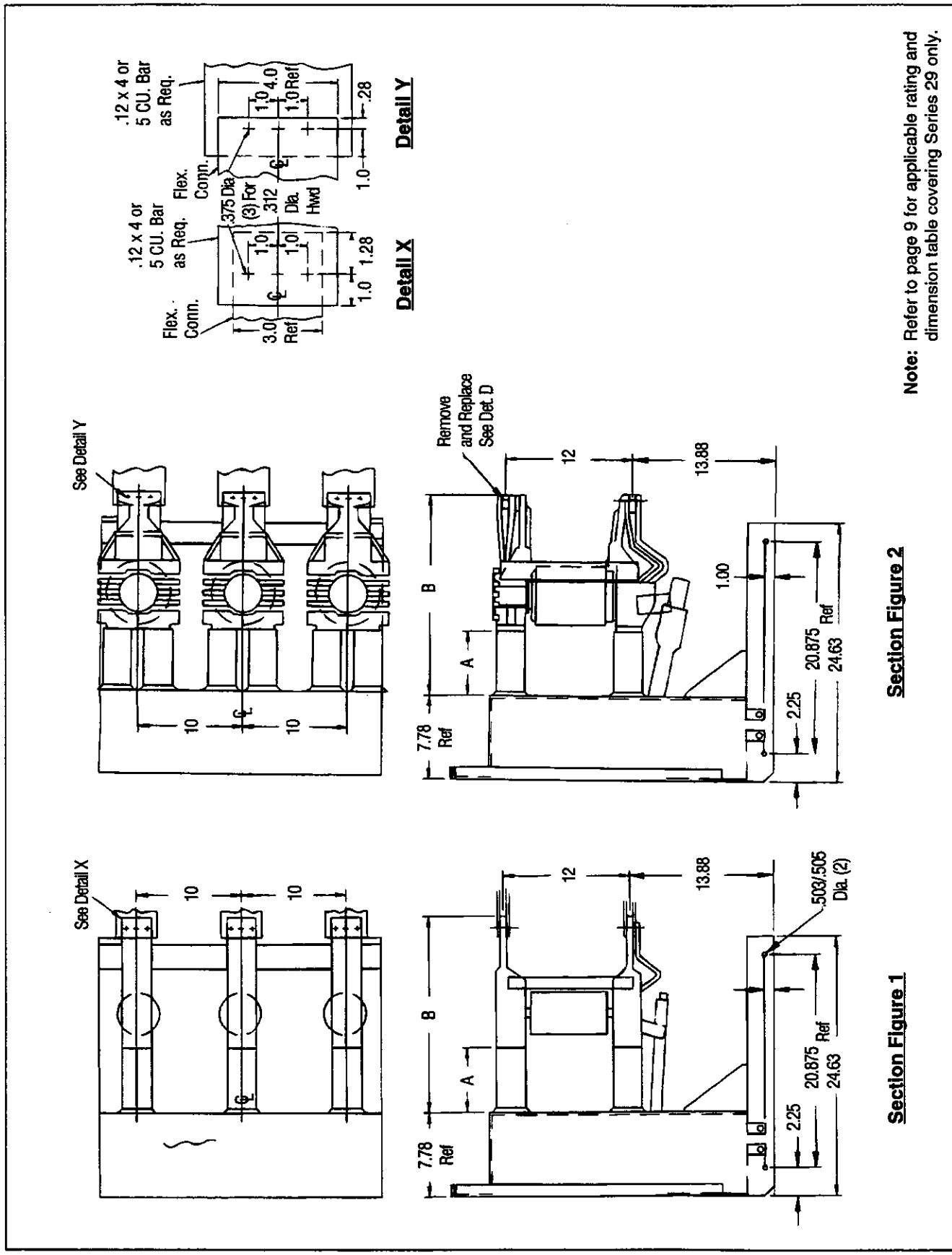


Figure 1.3 *VCP-WR Series 29 Element Outlines and Dimensions (inches) -continued*

Section Figure 1

Section Figure 2

Note: Refer to page 9 for applicable rating and dimension table covering Series 29 only.

Series 29 Rating/Dimension Table						
Type	Continuous Current (60Hz)	Stud Detail	Insulator -A-	-B-	-C-	Figure
50 VCP-WR 250	1200A	A	3.5	17.38	29.19	1
	2000A	C	3.5	17.38	29.19	1
	3000A	D	3.5	16.38	30.97	2
50 VCP-WR 350	1200A	B	3.5	17.38	30.97	1
	2000A	C	3.5	17.38	30.97	1
	3000A	D	3.5	16.38	30.97	2
75 VCP-WR 500	1200A	A	6.0	19.88	29.19	1
	2000A	C	6.0	19.88	29.19	1
	3000A	D	6.0	18.88	30.97	2
150 VCP-WR 500	1200A	A	6.0	19.88	29.19	1
	2000A	C	6.0	19.88	29.19	1
	3000A	D	6.0	18.88	30.97	2
150 VCP-WR 750	1200A	A	6.0	19.88	29.19	1
	2000A	C	6.0	19.88	29.19	1
	3000A	D	6.0	18.88	30.97	2
150 VCP-WR 1000	1200A	B	6.0	19.88	30.97	1
	2000A	C	6.0	19.88	30.97	1
	3000A	D	6.0	18.88	30.97	2

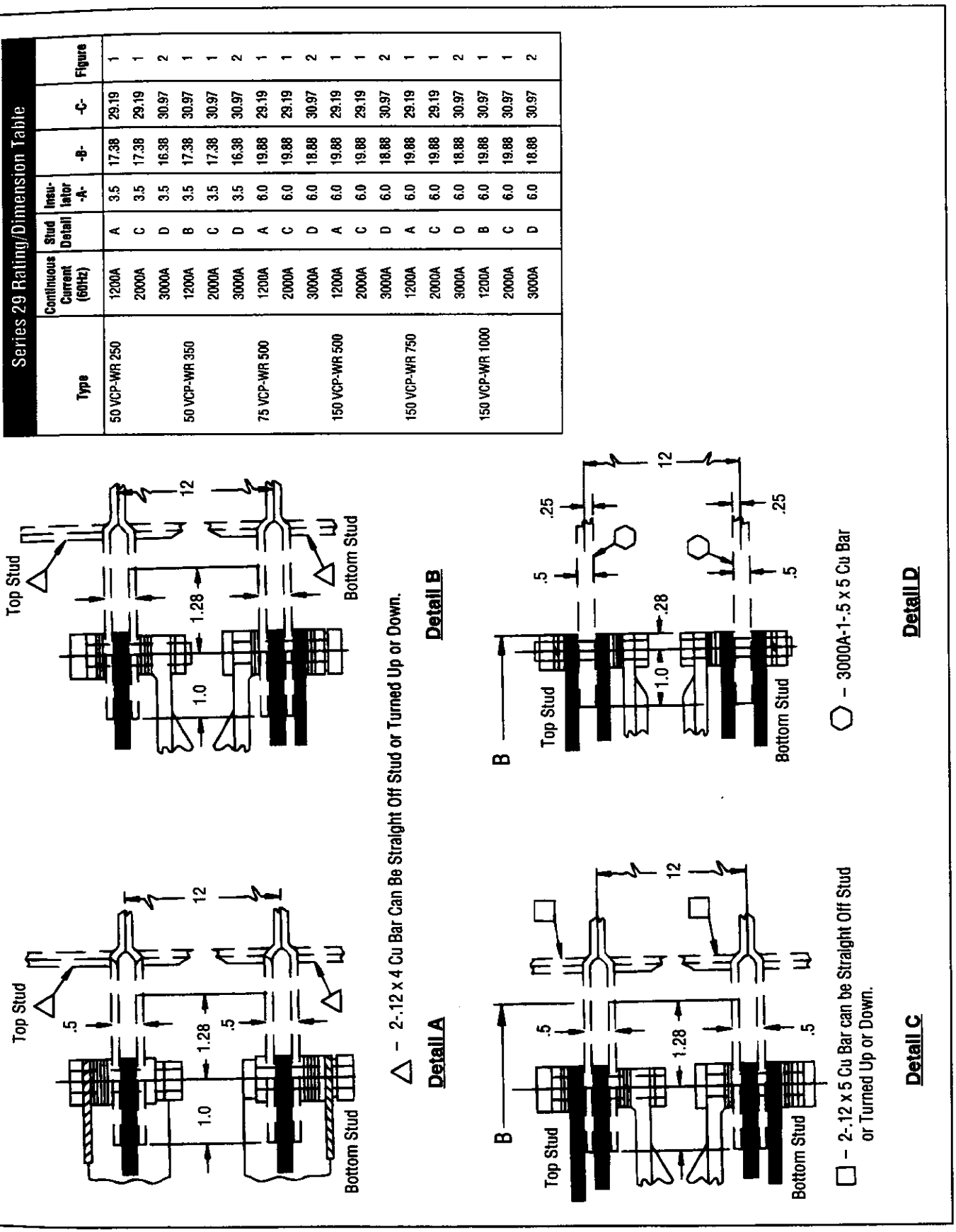


Figure 1.3 *VCP-WR Series 29 Element Outlines and Dimensions (inches) -continued*

SAFE PRACTICES

Type VCP-WR 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. Cell interlocks, used for drawout breakers only, are meant to interface with the appropriate cell interface, truck and levering mechanism supplied by the customer. Details of the VCP-WR element interfaces are shown in Figures **1.1**, **1.2** and **1.3** and discussed in Section 6. It is the customers responsibility to insure that all such interfaces are supplied and appropriate tests conducted to adequately prove proper functioning.

WARNING

TO PROTECT THE PERSONNEL ASSOCIATED WITH INSTALLATION, OPERATION, AND MAINTENANCE OF THESE BREAKERS, THE FOLLOWING PRACTICES MUST BE FOLLOWED:

- Only qualified persons, as defined in the National Electrical Safety Code, who are familiar with the installation and maintenance 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 breakers.
- If the final breaker design is drawout, always remove the breaker from the enclosure before performing any maintenance. If the breaker is applied in a fixed configuration, always make sure that primary and secondary power are disconnected from the breaker. Failure to do so could result in electrical shock leading to death, severe personal injury or property damage.
- Do not work on a drawout breaker with a secondary test coupler engaged. Failure to disconnect the test coupler could result in an electrical shock leading to death, personal injury or property damage.
- Do not work on a closed breaker or a breaker with closing springs charged. The closing springs should be discharged and the main contacts open before working on the breaker. Failure to do so could result in cutting or crushing injuries.
- Do not use a circuit breaker by itself as the sole means of isolating a high voltage circuit, if possible. Remove the breaker to the Disconnect position and follow all lock-out and tagging rules of the National Electrical Code and any and all applicable codes, regulations and work rules.
- Do not leave a drawout breaker in an intermediate position in the cell. Always have the breaker either in the Test or Connected position. Failure to do so could result in a flash over and possible death, personal injury or property damage.
- Always remove the maintenance tool from the breaker after charging the closing springs.
- Breakers are equipped with safety interlocks. **Do Not** defeat them. This may result in death, bodily injury or equipment damage.
- Do not work on a circuit breaker suspended from a lifting yoke or chains. Maintenance work should be performed on a properly supported cart or table.

RECEIVING, HANDLING AND STORAGE

Type VCP-WR 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. The optional maintenance tool is shipped separately.

3.1 Receiving

Until the breaker is ready to be used, DO NOT remove it from its container. If the breaker is to be placed in storage, maximum protection can be obtained by keeping it packed as shipped.

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

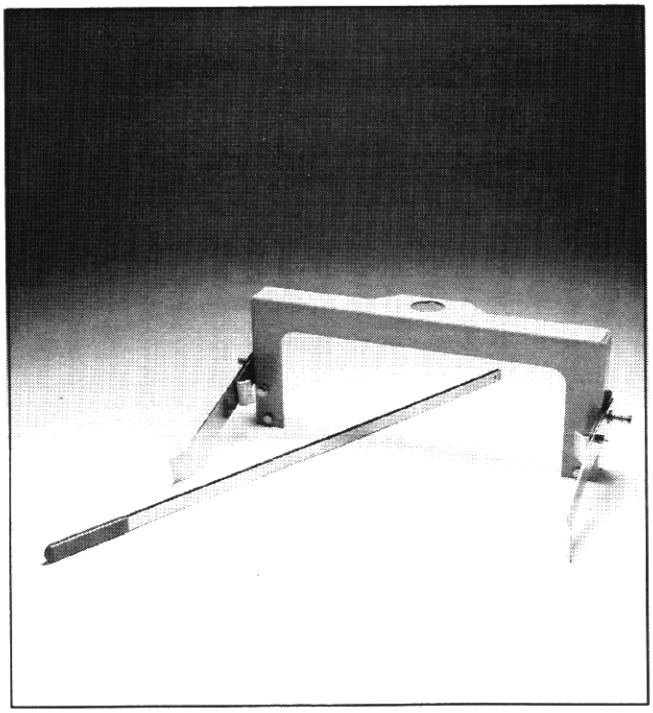


Figure 3.1 *Typical VCP-WR Tools and Accessories*

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.

Tools and Accessories

Maintenance Tool: Used to charge the closing springs. (Style 8064A02G01)

Lifting Yoke: Optional item used to lift the breaker. (Series 18—Style 8794C67G01)
(Series 20—Style 8794C67G03)
(Series 29—Style 691C607G01)

3.2 Handling

WARNING

DO NOT USE ANY LIFTING DEVICE AS A PLATFORM FOR PERFORMING MAINTENANCE, REPAIR OR ADJUSTMENT OF THE BREAKER OR FOR OPENING, CLOSING THE CONTACTS OR CHARGING THE SPRINGS. THE BREAKER MAY SLIP OR FALL CAUSING SEVERE PERSONAL INJURY. ALWAYS PERFORM MAINTENANCE, REPAIR AND ADJUSTMENTS ON A WORKBENCH CAPABLE OF SUPPORTING THE BREAKER.

Type VCP-WR breaker shipping containers are designed to be handled either by use of

a rope sling and overhead lifting device or by a fork lift truck. If containers must be skidded for any distance, it is preferable to use roller conveyors or individual pipe rollers.

Once a breaker has been inspected for shipping damage, it is best to return it to its original shipping container until it is ready to be used.

When a breaker is ready for use, a lifting yoke in conjunction with an overhead lifter or portable floor lifter can be used to move a breaker. If the breaker is to be lifted, position the lifting yoke over the breaker and insert lifters into the breaker side openings with the lifting hole toward the interrupters. Once the lifting yoke is securely seated in the holes, the breaker can be carefully lifted and moved.

3.3 Storage

If the circuit breaker is to be placed in storage, maximum protection can be obtained by keeping it packed as shipped. Before placing it in storage, checks should be made to make sure that the breaker is free from shipping damage and is 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 maintenance tool in the manual charge socket opening (Figure **3.8**). Charge the closing springs by pumping the handle up and down approximately 38 times until a 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 maintenance tool. Push the "manual close" button. The breaker will close as shown by the breaker contacts "closed" (red) indicator. Push the "manual trip" 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".

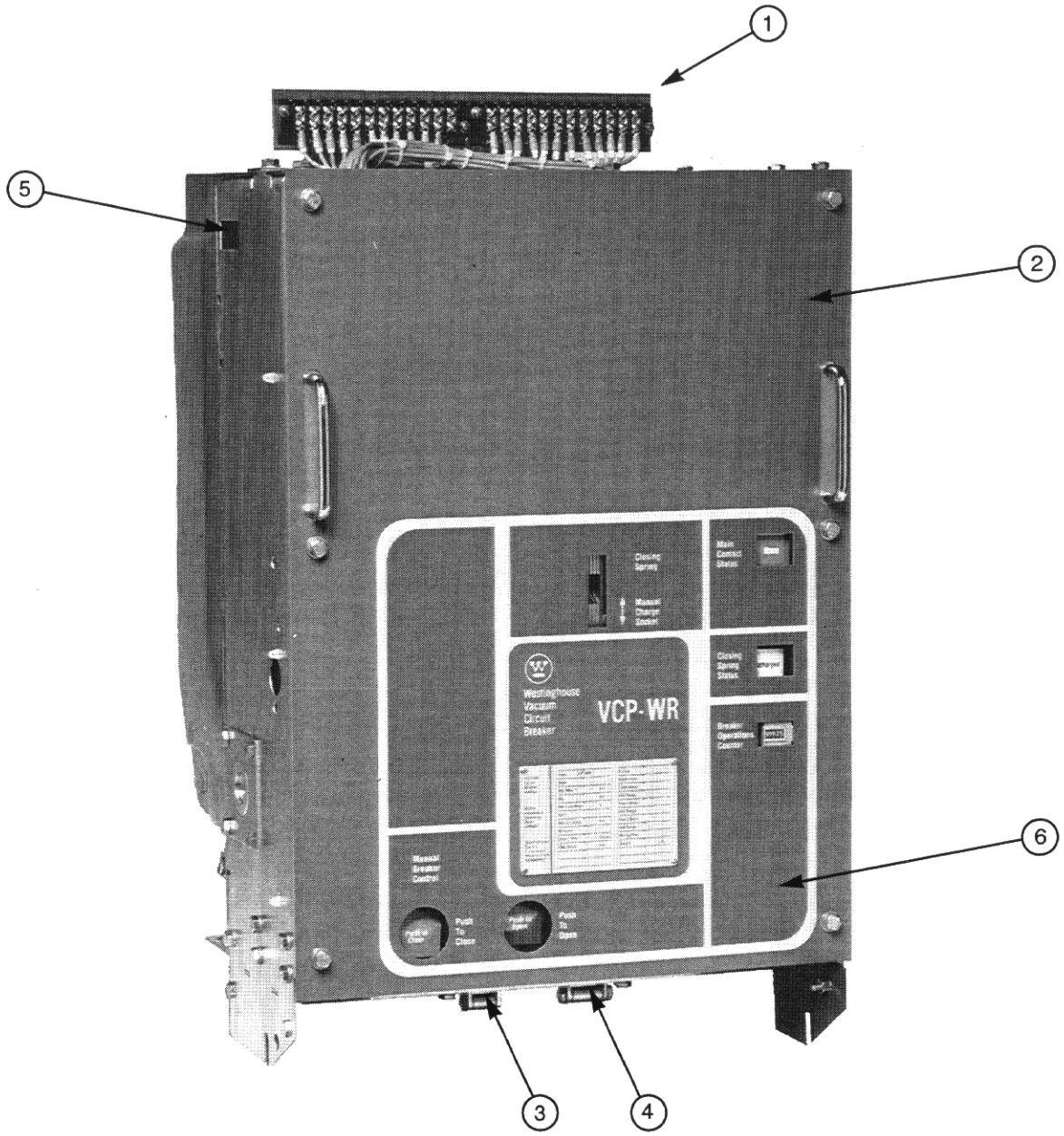
Outdoor storage is NOT recommended. If unavoidable, the outdoor location must be well drained and a temporary shelter from sun, rain, snow, corrosive fumes, dust, dirt, falling objects, excessive moisture, etc. must be provided. Containers should be arranged to permit free circulation of air on all sides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

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.

3.4 Type VCP-WR Breaker Weights

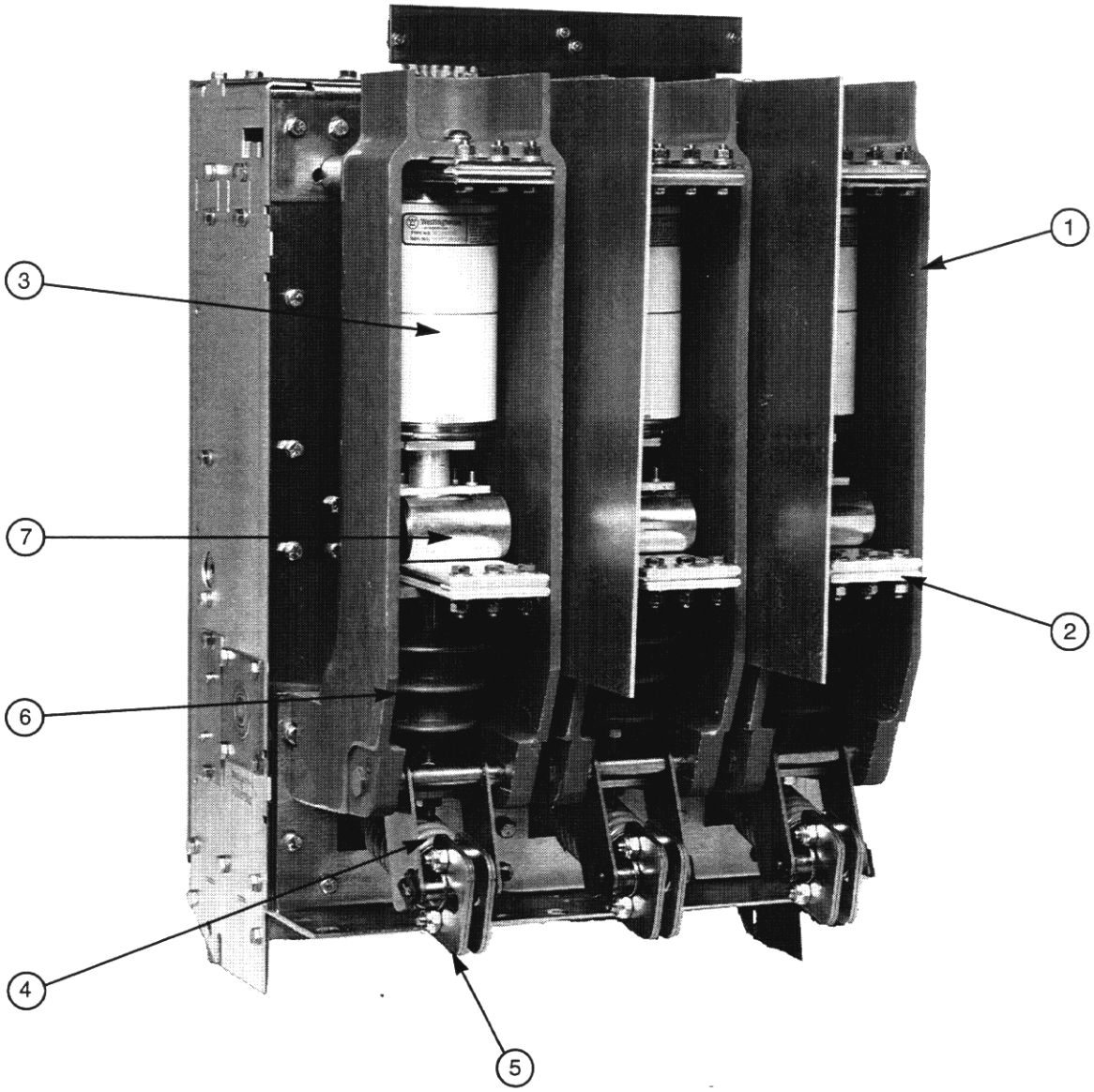
Table 3-1 *VCP-WR Breaker Weights (pounds)*

Rating		Series 18	Series 20	Series 29
50 VCP-WR 250	1200	267	325	340
	2000	275	400	395
	3000			500
50 VCP-WR 350	1200	275	385	450
	2000	305	415	475
	3000			500
75 VCP-WR 500	1200	267		365
	2000	275		395
	3000			500
150VCP-WR 500	600	267		
	1200	267		340
	2000	275		395
	3000			500
150VCP-WR 750	1200	267		340
	2000	275		395
	3000			500
150VCP-WR 1000	1200			450
	2000			475
	3000			500



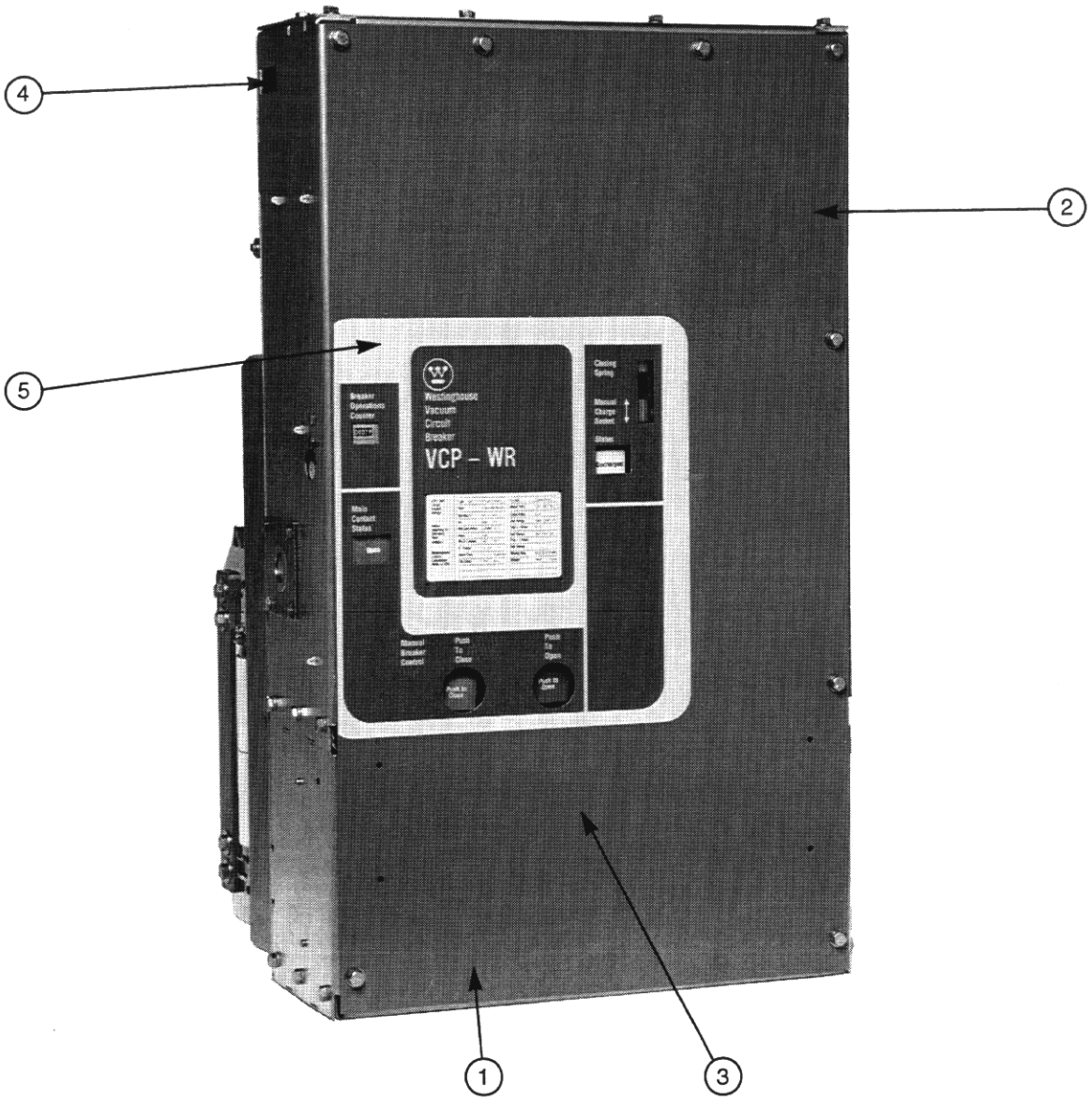
1. Seconday Terminal Block
2. Front Panel
3. Close Floor Tripper
4. Trip Floor Tripper
5. Lifting Yoke Opening
6. Escutcheon (Figure **3.8** for Details)

Figure 3.2 *Front View VCP-WR Series 18*



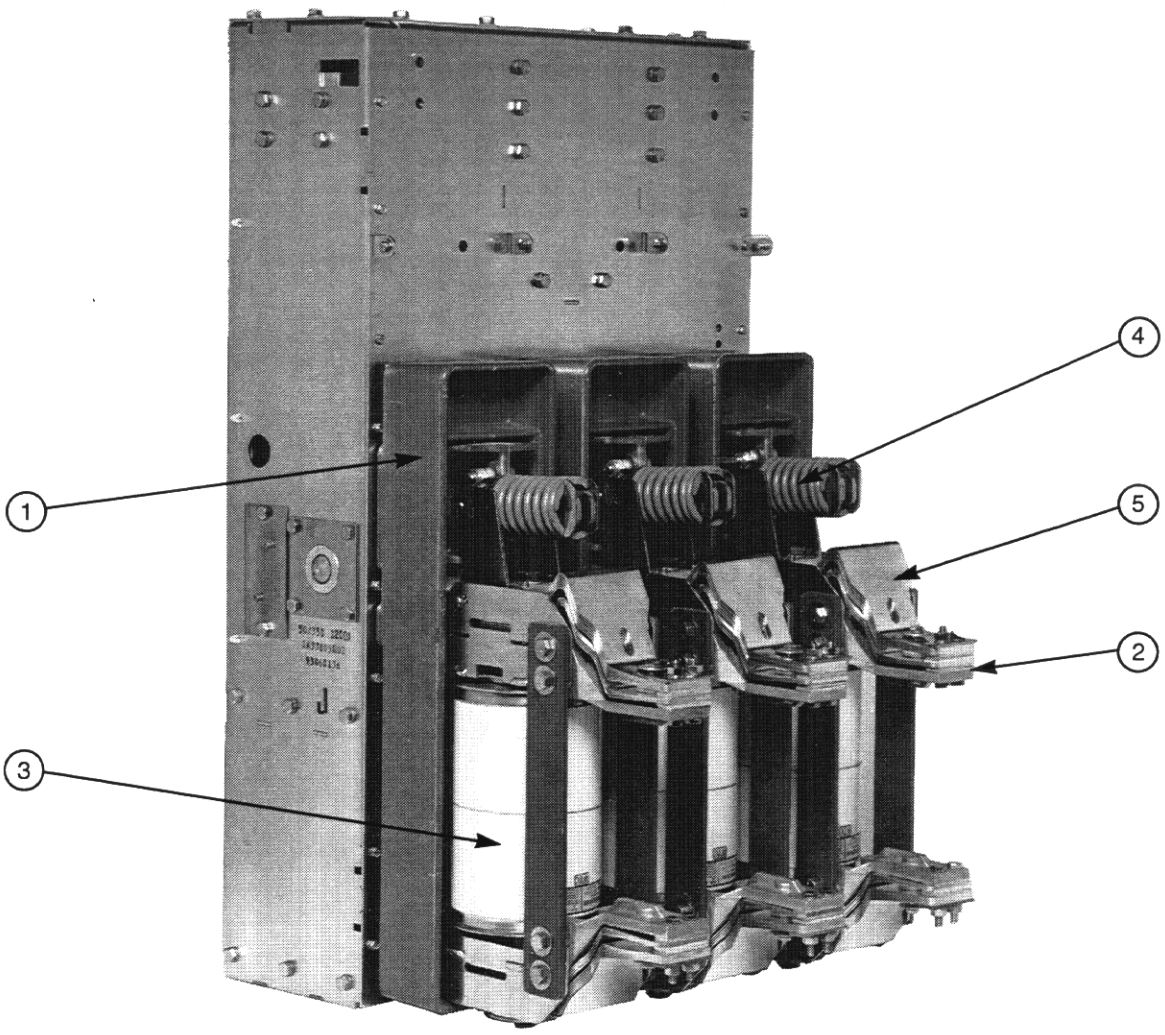
1. Support Insulator
2. Primary Conductor Interface
3. Vacuum Interrupter
4. Contact Loading Spring (Wipe Spring)
5. Operating Rod
6. Drive Insulator
7. Flexible Connector

Figure 3.3 *Rear View VCP-WR Series 18*



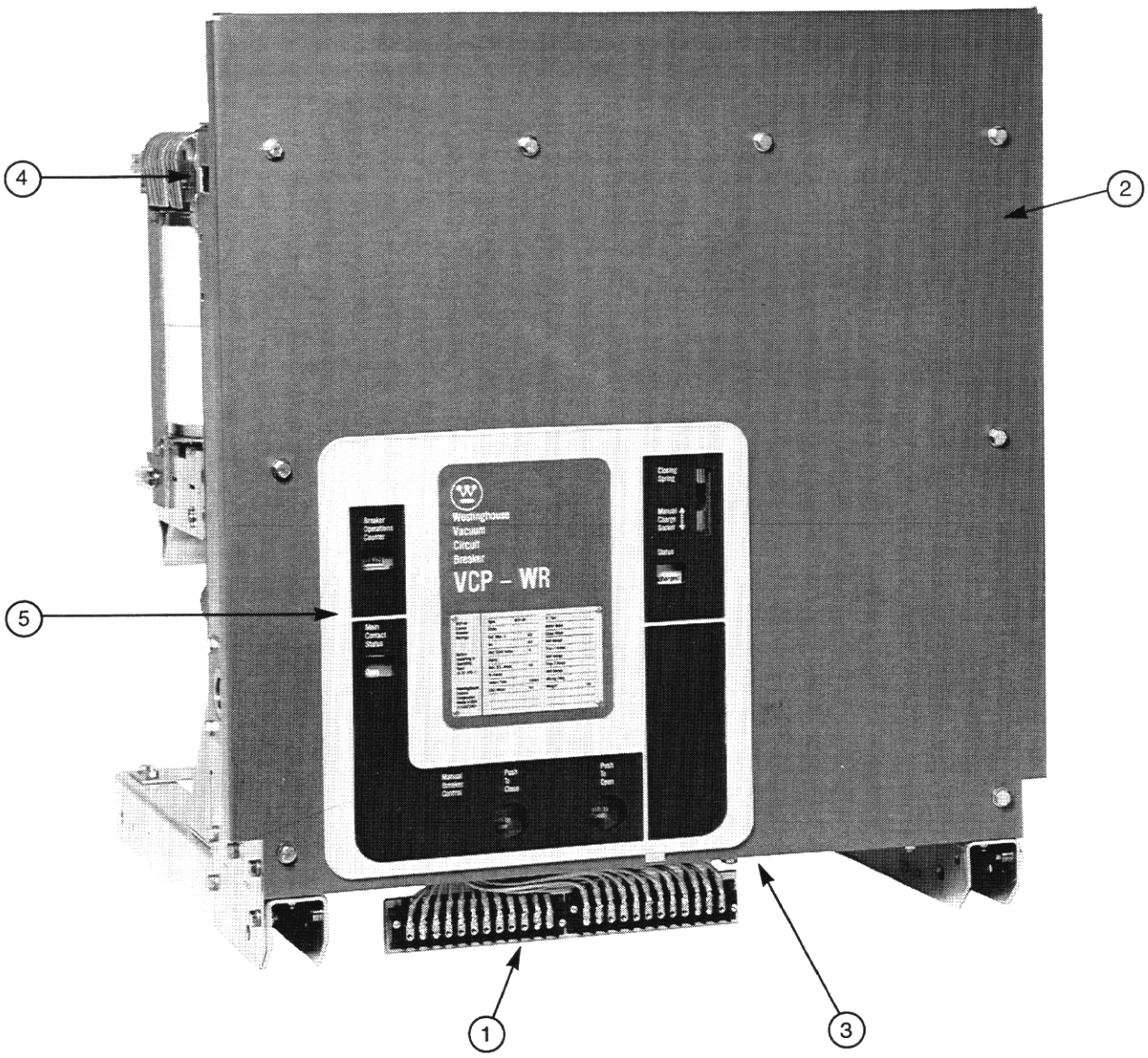
1. Secondary Terminal Block (Behind Front Panel)
2. Front Panel
3. Floor Trippers (Behind Front Panel)
4. Lifting Yoke Opening
5. Escutcheon (Figure **3.8** for Details)

Figure 3.4 *Front View VCP-WR Series 20*



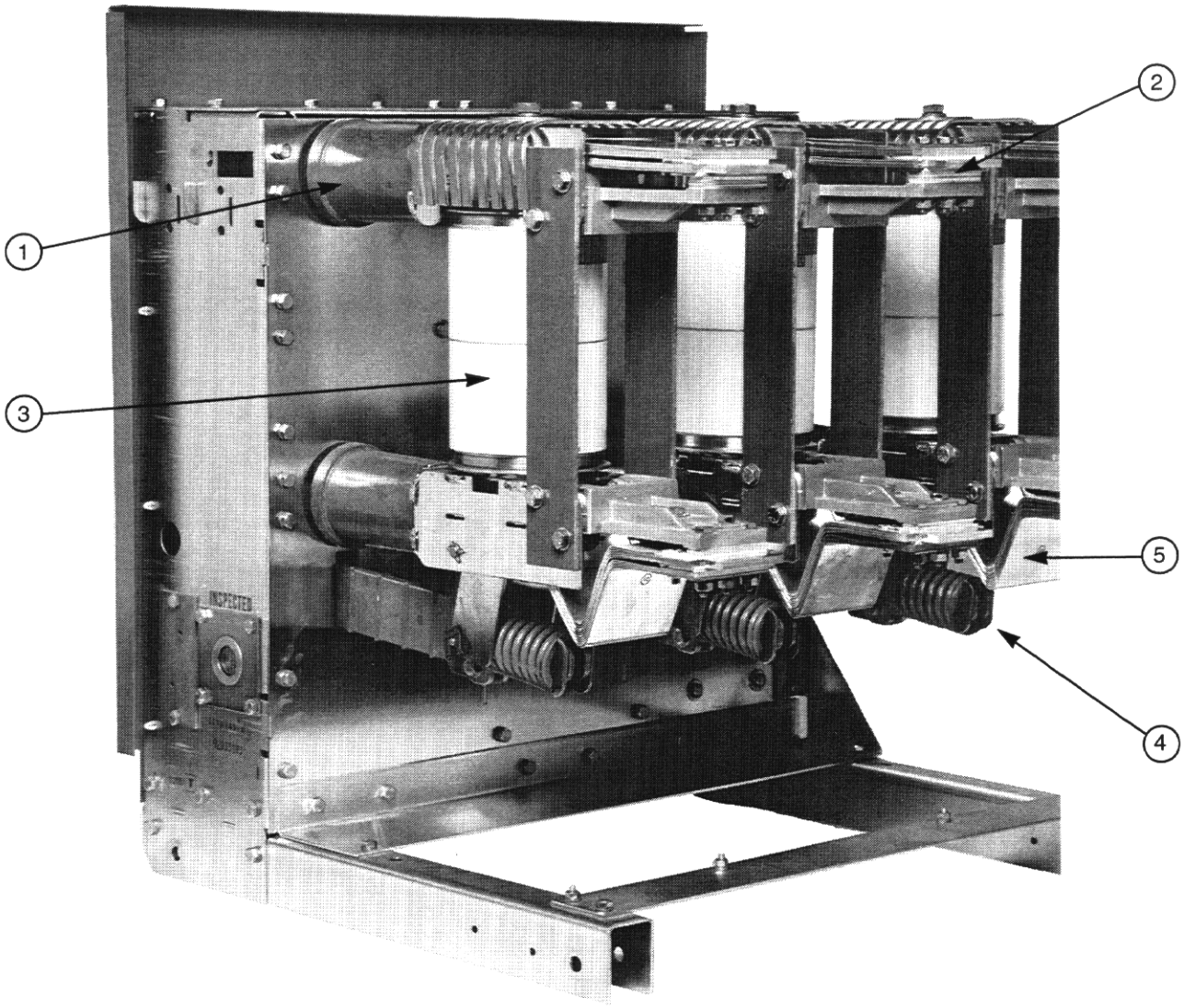
1. Support Insulator
2. Primary Conductor Interface
3. Vacuum Interrupter
4. Contact Loading Spring (Wipe Spring)
5. Flexible Connector

Figure 3.5 *Rear View VCP-WR Series 20*



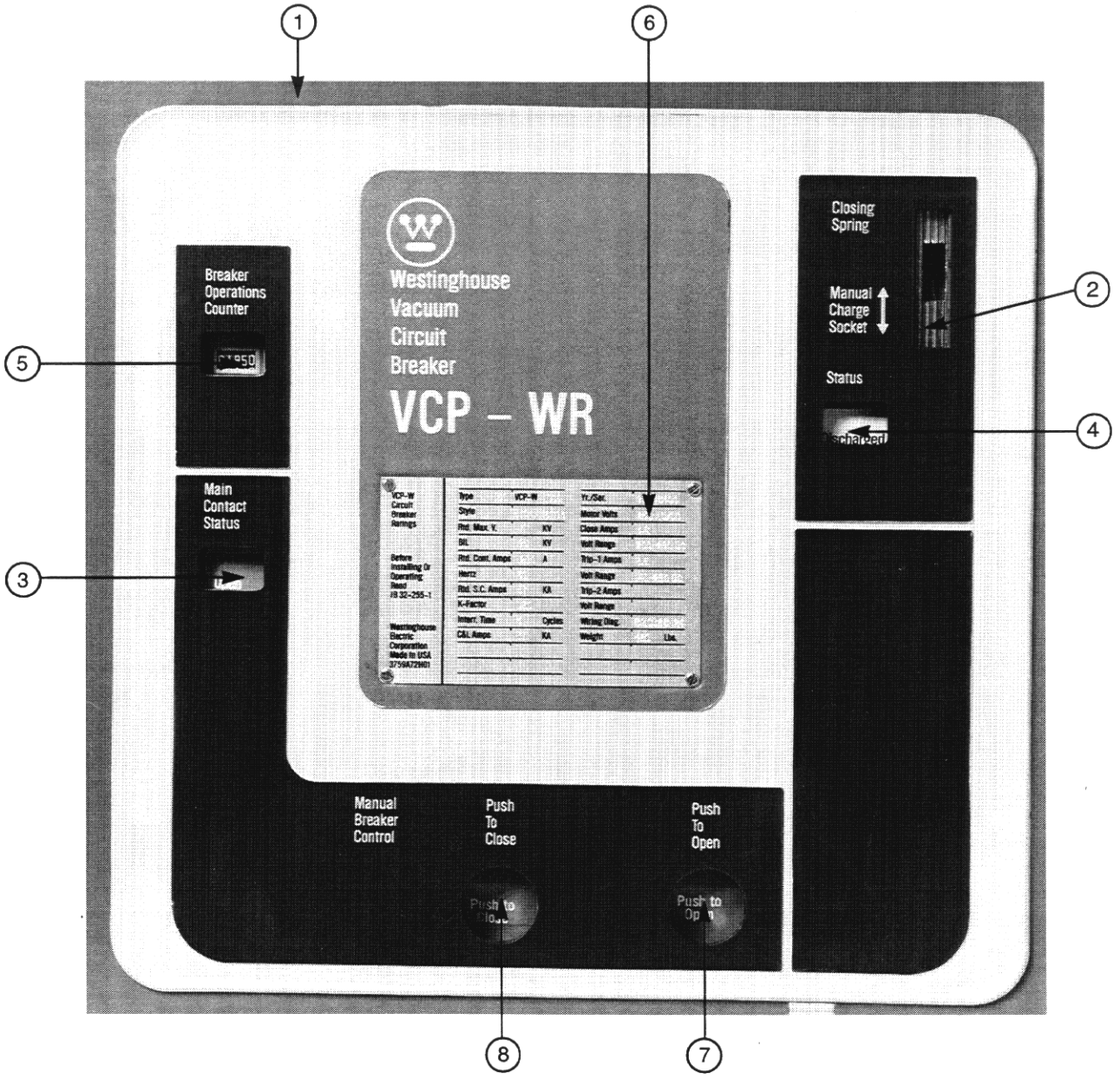
1. Secondary Terminal Block
2. Front Panel
3. Floor Trippers (Not Visible)
4. Lifting Yoke Opening
5. Escutcheon (Figure **3.8** for Details)

Figure 3.6 *Front View VCP-WR Series 29*



1. Standoff Insuator
2. Primary Conductor Interface
3. Vacuum Interrupter
4. Contact Loading Spring (Wipe Spring)
5. Flexible Connector

Figure 3.7 *Rear View VCP-WR Series 29*



1. Front Panel
2. Manual Charge Socket
3. Open-Closed Indicator
4. Spring Charged/ Discharged Indicator
5. Operation Counter
6. Nameplate
7. Manual Open Button
8. Manual Close Button

Figure 3.8 *Typical VCP-WR Escutcheon*

INSPECTION AND OPERATION

4.1 Initial Inspection

Before attempting to use or put a breaker into service, examine it for loose or obviously damaged parts. In addition, compare the breaker nameplate with associated drawings, shipping papers and ordering information for compatibility. A breaker should also be operated manually.

In the case of a drawout breaker application, an electrical operations check will be performed later after the breaker has been combined with its drawout truck, secondary wiring has been completed and an appropriate structure with required interlocks provided. For fixed breaker applications, an electrical operations check should be performed after the breaker is appropriately mounted, secondary wiring completed, and appropriate interphase barriers installed.

4.2 Manual Operation Check

The breaker element should be on a solid, stable work surface. Place the maintenance tool into the manual charge socket opening and charge the closing springs with approximately 38 up and down strokes of the handle (Figure **3.8**). When charging is complete, the closing crank goes over center with an audible "click" and the springs Charged/ Discharged indicator shows "Charged".

Note: If the springs are to be charged on a closed breaker, no click is heard at the end of the charging operation. Discontinue charging and remove the maintenance tool as soon as the "Charged" flag is fully visible.

Remove the maintenance tool. Close and trip the breaker several times using the manual trip and close buttons on the front of the circuit breaker (Figure **3.8**).

4.3 Interface Verification

It is the customer's responsibility to insure that all drawout circuit breakers interface and operate properly in conjunction with their breaker compartments. This will include but not be limited to verification that customer supplied trucks interface correctly with Westinghouse supplied breaker elements and the customer's complete drawout circuit breaker interfaces properly with the breaker compartment. All ANSI required interlocks between the drawout circuit breaker and the breaker compartment are the customer's responsibility.

DESCRIPTION AND OPERATION

Westinghouse Type VCP-WR breaker elements are vacuum type interrupting elements designed to offer value added construction. The VCP-WR Red Line family of circuit breaker elements is comprised of three element types (Series 18, Series 20 and Series 29). The nominal widths are 18 inches for Series 18, 20 inches for Series 20 and 29 inches for Series 29 (Figures **3.2**, **3.4** and **3.6**). Any one of the three available elements can be used as a retrofitting drawout breaker when others provide and combine the appropriate cell interface, truck, levering mechanism, secondary connections, interlocks and other accessory items with the VCP-WR element. VCP-WR elements can also be used for fixed breaker applications with the customer responsible for all required interfaces and interphase barriers. The appropriately sized interphase barriers must be installed to comply with individual rating electrical clearance requirements as described in Section 6. A movable truck and levering mechanism would not be required for a fixed breaker application. Details concerning mechanical and electrical interfacing needs associated with the use of a VCP-WR breaker element are found in Section 6 of this instruction book.

5.1 Circuit Breaker Elements

Series 18, 20 and 29 VCP-WR circuit breaker elements are designed and tested for use and installation in keeping with ANSI Standard C37.59. The three circuit breaker element designs can be used for drawout or fixed applications depending upon how others use and/or retrofit the VCP-WR breaker elements. All safety interlocks required by ANSI Standards are part of the breaker element and are integral to all three designs. Certain required interlocks, however, are only complete when compatible cell interlock devices are provided. The matching cell interlocks, whether mechanical or electrical, are the total responsibility of the customer. Interfacing information is provided in this instruction manual to simplify the interfacing task.

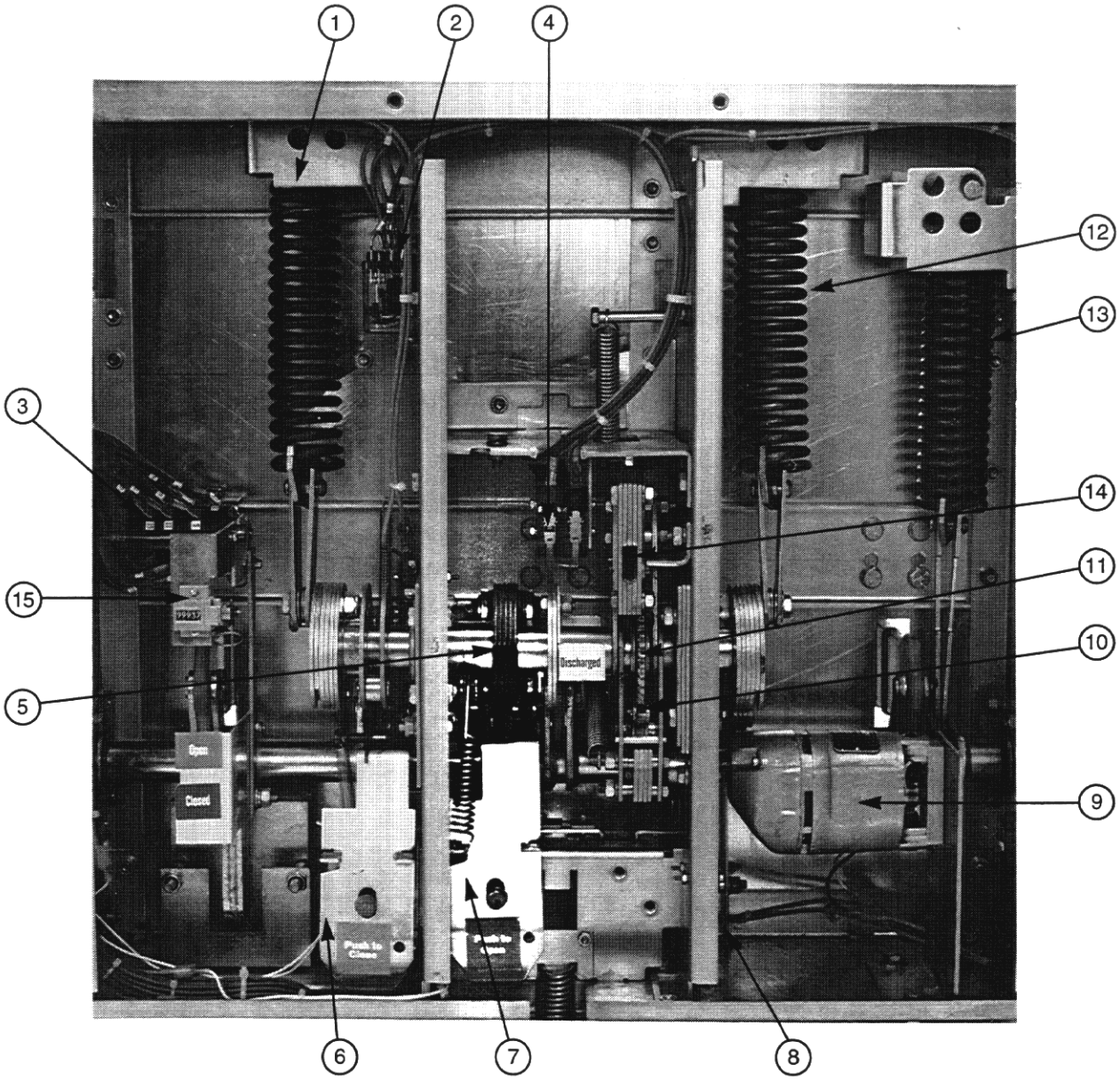
The highly reliable mechanisms for all three designs are similar front, vertically mounted spring stored energy types. The designs not only aid with personal safety, but also provide for simplified inspections and servicing accessibility (Figure **5.1**).

Circuit breaker duty vacuum interrupters are used to close and open primary circuits. The vacuum interrupters used have a proven record for reliability, long life and minimal maintenance (Figures **3.3**, **3.5** and **3.7**).

The standard primary insulation used on all VCP-WR breaker elements is high strength, flame retardant glass polyester. Cycloaliphatic epoxy primary insulation is an available option with the Series 29 VCP-WR breaker element. Type SIS AWG #14 wire is used on all VCP-WR control circuits.

5.2 Interrupter Assembly

Vacuum interrupters are mounted vertically and supported from the fixed stem fastened to the top or bottom conductor, depending upon which VCP-WR breaker series. The Series 20 VCP-WR breaker element clamps the fixed stems to the bottom conductors (Figure **5.2**). The Series 18 and 29 breaker elements clamp the fixed stems to the top conductors (Figures **5.3** and **5.4**). All configurations, however, utilize the Westinghouse patented V-flex non-sliding current transfer system.



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. Opening Spring
14. Manual Charge Socket
15. Operation Counter

Figure 5.1 *Typical VCP-WR Front Mounted Mechanism*

The current transfer system consists of a series of tin-plated, high-conductivity copper leaf conductors that are swaged onto the movable interrupter stem. This provides a multi-point contact resulting in low electrical and thermal resistance. Since the current transfer from the movable stem to the circuit breaker conductor is a non-sliding design, no maintenance is required.

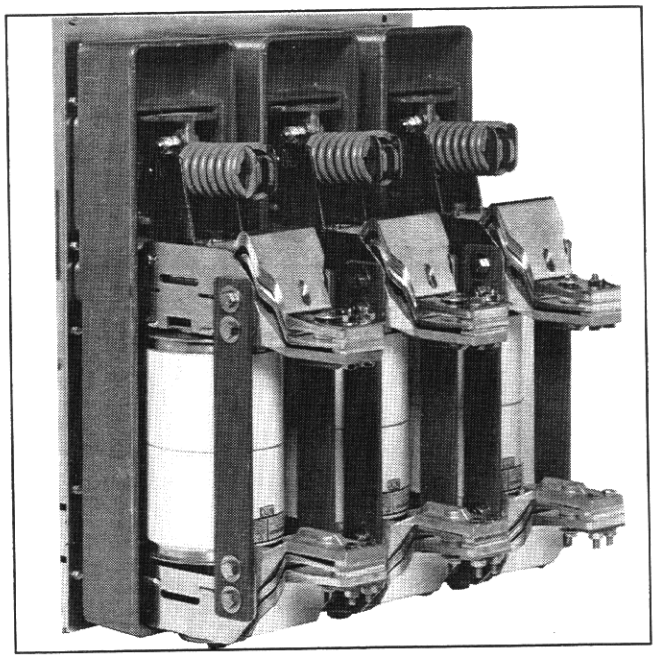


Figure 5.2 *Type VCP-WR Series 20 Interrupter Assemblies*

5.2.1 Vacuum Interrupter

Type VCP-WR breaker elements utilize vacuum interrupters for interruption and switching functions (Figure **5.5**). Vacuum interruption offers the advantages of enclosed interrupters, reduced size and weight, short interrupting time, long life, reduced maintenance, and environmental compatibility.

Arc interruption is simple and fast. In the closed position, current flows through the interrupter. An arc is drawn between the contact surfaces when the contacts are opened. It is rapidly moved around the slotted contact surfaces by a self-induced magnetic force which prevents gross contact erosion as well as the formation of contact surface hot spots. The arc burns in an ion-

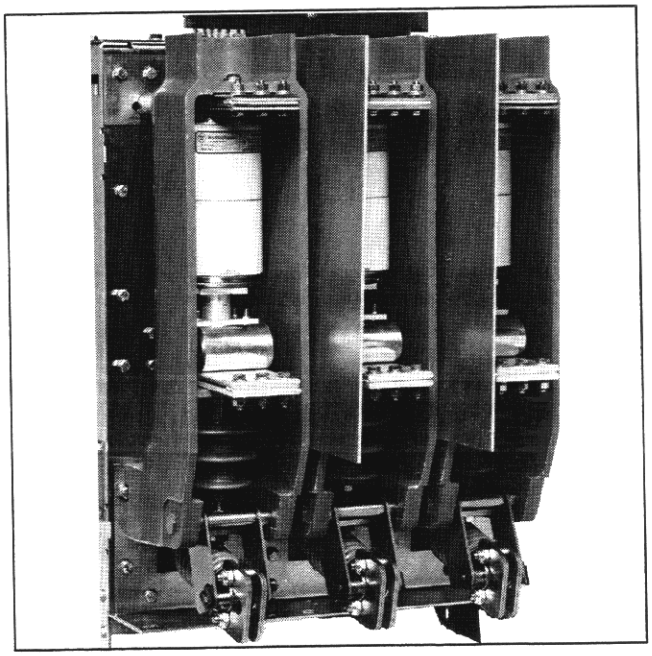


Figure 5.3 *Type VCP-WR Series 18 Interrupter Assemblies*

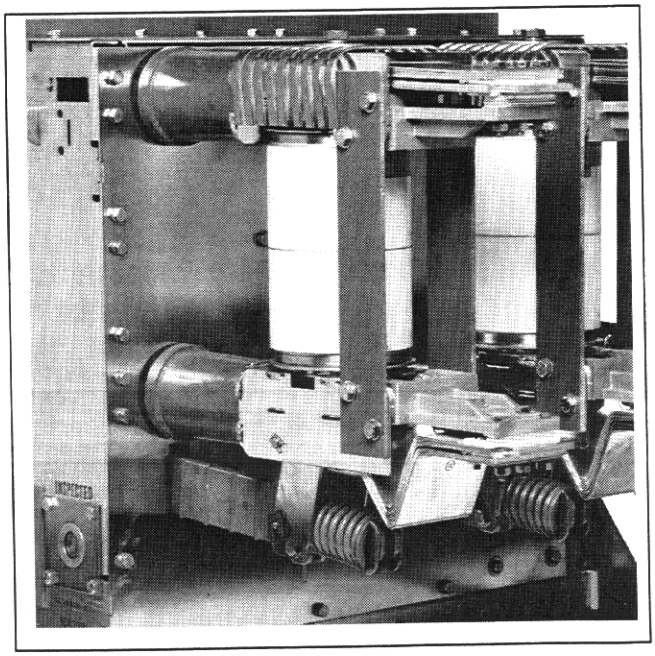


Figure 5.4 *Type VCP-WR Series 29 Interrupter Assemblies*

ized metal vapor which continually leaves the contact area and condenses on the surrounding metal shield. At current zero the arc is extinguished and vapor production ceases. Very rapid dispersion, cooling, recombination, and deionization of the metal vapor plasma together with fast condensation of metal vapor products cause the vacuum to be quickly restored. Hence, the opened contacts withstand the transient recovery voltage.

5.2.2 Contact Erosion Indicator

The purpose of the contact erosion indicator is to monitor any erosion of the vacuum interrupter contacts. Contact erosion is, however, very minimal over time with Westinghouse vacuum interrupters utilizing copper-chrome contact material. If contact erosion reaches 1/8 inch, the interrupter must be replaced. A contact erosion indicator mark is located on the moving stem of the interrupter (Figures **7.2** and **7.3**)

In order to determine if the contacts have eroded to the extent that the interrupter must be replaced, observe the erosion mark placed on each moving stem from the rear of the breaker with the breaker closed. The interrupter is satisfactory if the mark on the stem is visible with the breaker closed. The entire interrupter assembly must be replaced if the mark is no longer visible.

The erosion indicator is easily viewed from the rear of the breaker on Series 18 and 29 VCP-WR breaker elements. Because the Series 20 VCP-WR breaker element's interrupter assembly is inverted relative to Series 18 and 29 configurations, the erosion indicator is not easily viewed. It is possible to observe the Series 20 indicator using a light and a dental type mirror.

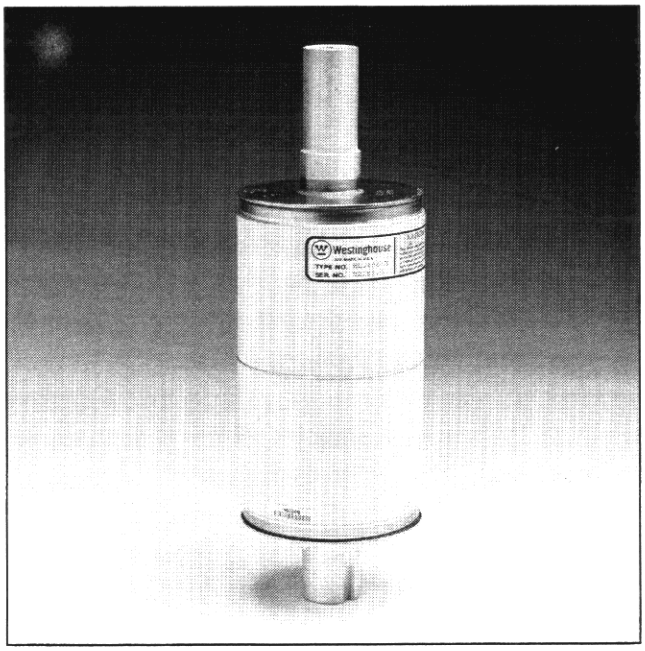


Figure 5.5 *Typical Westinghouse Circuit Breaker Duty Vacuum Interrupter*

5.2.3 "T" Cutout Loading Spring Indicator

The "T" cutout loading spring indicator is an additional method provided to indicate conditions within the interrupter, as well as the overall system condition. The visible "T" indicator is used to indicate whether the loading springs are maintaining the proper contact pressure to keep the contacts closed. Severe contact erosion would result in an unacceptable indication from the "T" indicator (Figures **7.4** and **7.5**).

5.2.4 Contact Wipe and Stroke

Contact wipe is the indication of (1) the force holding the vacuum interrupter contacts closed and (2) the energy available to hammer the contacts open with sufficient speed for interruption.

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

The circuit breaker mechanism provides a fixed amount of motion to the operating rods. The first portion of the motion is used to close the contacts (i.e. stroke) and the remainder is used to further compress the preloaded wipe spring. This additional compression is called wipe. Wipe and Stroke are thus related to each other. As the stroke increases due to the erosion of contacts, the wipe decreases. A great deal of effort has been spent in the design of all Westinghouse vacuum breakers, in order to eliminate the need for field adjustments of wipe or stroke.

Caution

THERE IS NO PROVISION FOR IN SERVICE ADJUSTMENTS OF CONTACT WIPE AND STROKE. ALL SUCH ADJUSTMENTS ARE FACTORY SET AND SHOULD NOT BE ATTEMPTED IN THE FIELD.

5.3 Stored Energy Mechanism

WARNING

KEEP HANDS AND FINGERS AWAY FROM THE BREAKER'S INTERNAL PARTS WHILE THE BREAKER CONTACTS ARE CLOSED OR THE CLOSING SPRINGS ARE CHARGED. THE BREAKER CONTACTS MAY OPEN OR THE CLOSING SPRINGS DISCHARGE CAUSING A CRUSHING INJURY. DISCHARGE THE SPRINGS AND OPEN THE BREAKERS BEFORE PERFORMING ANY BREAKER MAINTENANCE, INSPECTION OR REPAIR.

The spring stored energy operating mechanism is arranged vertically in front of all VCP-WR breakers. It includes all the elements for storing the energy, closing and tripping of the breaker, as well as manual and electrical controls. The manual controls are all front accessible. Motion to close and open the interrupter contacts is provided through operating rods connecting the mechanism pole shaft to the bell cranks of the interrupter assemblies.

5.3.1 Operation of Stored Energy Mechanism

The mechanism stores the closing energy by charging the closing springs. The mechanism may rest in any one of the four positions shown in Figure **5.6** and 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

5.3.2 Charging

Figure **5.7** is a schematic view 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 drive shaft to which are attached two closing spring cranks (one on each end), the closing cam, drive plates, and a free-wheeling ratchet wheel. The ratchet wheel is actuated by an oscillating mechanism driven by the motor eccentric. 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 are 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 the fully charged position.

Closing springs may also be charged manually. Insert the maintenance tool in the manual charging socket. Move it up and down approximately 38 times until a clicking sound is heard, and the closing springs charging indicator indicates "Charged". Any further motion of the maintenance tool will result in free wheeling of the ratchet wheel.

5.3.3 Closing Operation

Figure **5.6** shows the position of the closing cam and tripping linkage. Note that in Figure **5.6a** in which the breaker is open and the closing springs are discharged, the trip "D" shaft and trip latch are in the unlatched position.

Once charged, 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 spring rotates the cam shaft through the spring cranks. The closing cam, being attached to the cam shaft, in turn rotates the pole shaft through the main link to close the breaker.

In Figure **5.6c** the linkage is shown with the breaker in the closed position before the closing springs have been recharged. Interference of the trip "D" shaft with the trip latch prevents the linkage from collapsing, and the breaker is held closed.

Figure **5.6d** shows the breaker in the closed position after the closing springs have been recharged. Note that the spring charging rotates the closing cam by one half turn. Since the cam surface in contact with the main link roller is cylindrical in this region, the spring charging operation does not affect the mechanism linkage.

Since the primary contacts are completely enclosed in the vacuum interrupter and not adjustable in any way, a "Slow Close" capability is not provided with VCP-WR breakers.

5.3.4 Tripping Operation

When the trip "D" shaft is turned either by the trip button or trip coil, all links return to the original "open" condition shown in Figure **5.6a**.

5.3.5 Trip Free Operation

When the manual trip button is held depressed, any attempt to close the breaker results in the closing springs discharging without any movement of the pole shaft or vacuum interrupter stem.

5.4 Control Schemes

There are two basic control schemes for each series of Type VCP-WR breakers, one for DC control and one for AC control voltages (Figures **6.2**, **6.5** and **6.8**). There may be different control voltages or more than one tripping element, but the principal mode of operation is as follows:

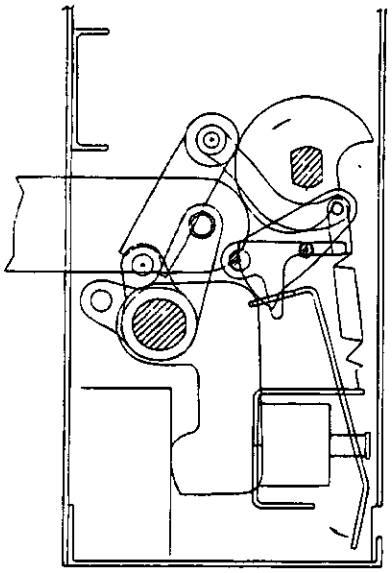


Figure 5.6a *Breaker open and closing spring discharged.*

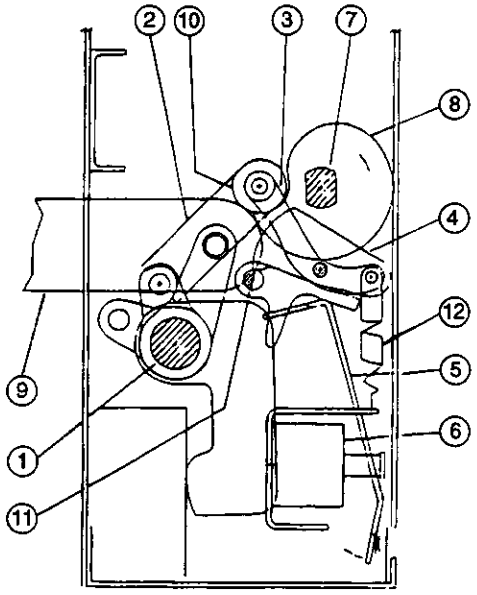


Figure 5.6b *Breaker open and closing spring charged.*

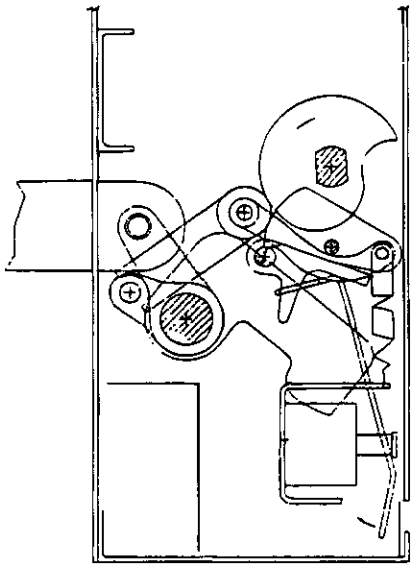


Figure 5.6c *Breaker closed and closing spring discharged*

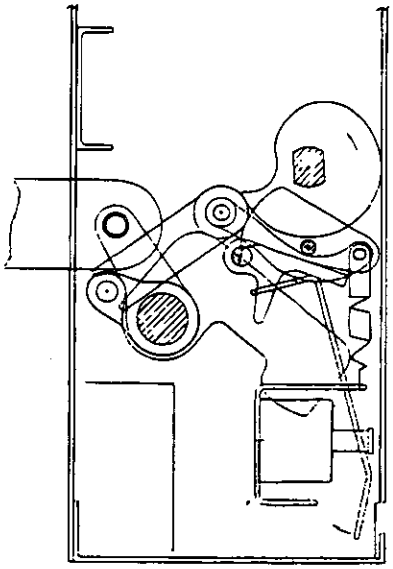
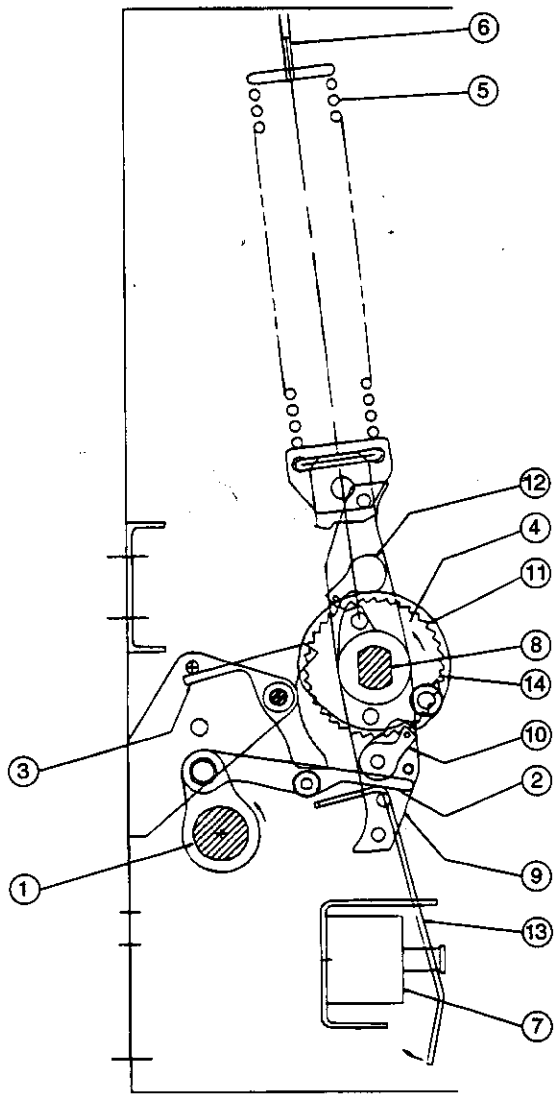


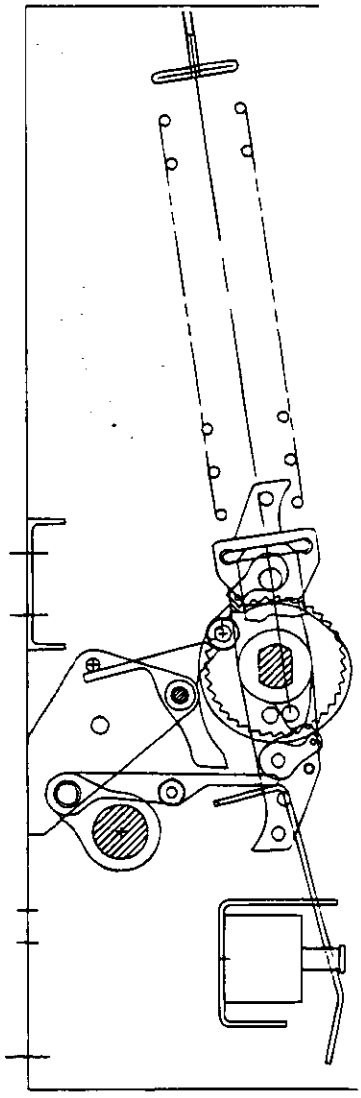
Figure 5.6d *Breaker closed and closing spring charged*

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
⑫ Trip Latch Reset Spring

Figure 5.6 *Closing Cam and Trip Linkage.*



Breaker Open, Springs Discharged



Breaker Closed, Springs Charged

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
14. Spring Release Latch (Close Roller)

Figure 5.7 *Charging Schematic*

As soon as the control power is applied, the spring charging motor automatically starts charging the closing spring. When the springs are charged, the motor cut off LS1/bb switch turns the motor off. The breaker may be closed by making the 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 the control switch (CS/T) contacts.

Note the position switch (PS1) contact in the spring release circuit in the scheme. This contact remains made while the breaker is being levered between the TEST and CONNECTED positions for appropriately retrofitted breakers. Consequently, it prevents the breaker from closing automatically, even though the control close contact may have been made while the breaker is levered to the CONNECTED position.

When the CS/C contact is made, the SR closes the breaker. If the CS/C contact is maintained after the breaker closes, the Y relay is picked up. The Y/a contact seals in Y until CS/C is opened. The Y/b contact opens the SR circuit, so that even though the breaker would subsequently open, it could not be reclosed before CS/C was released and remade. This is the anti-pump function.

5.4.1 Timing

The opening and closing times for the circuit breakers vary depending upon the control voltage and the power rating. Typical values for VCP-WR breakers are shown in Table **5-1.**

5.4.2 Terminal Blocks

All VCP-WR breaker elements are supplied with 2 12-point secondary control terminal blocks for simple secondary control access. A number of points are used for breaker operation with a number of spare contacts for customer use. Refer to the control schemes of Figures **6.2, 6.5** and **6.8** for exact contact useage and availability.

The terminal blocks are in different locations for each series of VCP-WR breakers. Series 18 terminal blocks are located at the top of the breaker element (Figure **3.2**). Series 20 terminal blocks are located behind the breaker faceplate in the front, lower left portion of the breaker with control wire access from the bottom. Series 29 terminal blocks are located at the bottom of the breaker element (Figure **3.6**).

5.5 Operations Counter

All breakers are equipped with a mechanical operations counter. As the breaker opens, the linkage connected to the pole shaft lever advances the counter reading by one (Figure **3.8**).

Table 5-1 *Breaker Timing*

Event	Milliseconds (maximum)
Closing Time (From Initiation of Close Signal to Contact Make)	75
Opening Time (Initiation of Trip Signal to Contact Break)	45
Reclosing Time (Initiation of Trip Signal to Contact Make)	190

BREAKER ELEMENT INTERFACING

6.1 Introduction

WARNING

- THE CUSTOMER SHOULD READ AND UNDERSTAND THE WARNINGS PRESENTED ON THE FRONT COVER AND IN SECTION 1 OF THIS INSTRUCTION BOOK BEFORE ANY ATTEMPT IS MADE TO ALTER, ADD TO OR INTERFACE WITH THE BREAKER ELEMENT AS SUPPLIED BY WESTINGHOUSE.
- IT IS IMPERATIVE THAT ANSI STANDARD C37.59 BE COMPLIED WITH IN EVERY RESPECT AND THAT NO COMPROMISES ARE MADE WITH RESPECT TO ITS GUIDELINES OR INTENT.
- ADDITIONS TO THE BREAKER ELEMENTS AS SUPPLIED BY WESTINGHOUSE CAN BE MADE IN KEEPING WITH ANSI STANDARD C37.59 AND THE INSTRUCTIONS PRESENTED IN THIS INSTRUCTION BOOK. UNDER NO CIRCUMSTANCES, HOWEVER, SHOULD ALTERATIONS TO THE WESTINGHOUSE SUPPLIED BREAKER ELEMENT BE MADE UNLESS THE ALTERATION IS SPECIFICALLY ADDRESSED AND PERMITTED BY THIS INSTRUCTION BOOK.

6.2 General Guidelines

This section addresses interfacing guidelines for the Series 18, Series 20 and Series 29 VCP-WR breaker elements. General guidelines applicable to all three breaker elements are presented first. Specific guidelines for each individual breaker element are presented after the general guidelines. Read, understand and follow the general guidelines first followed by the guidelines for the specific series of breaker element purchased.

6.2.1 Electrical Clearances

It is the responsibility of the customer to insure that the proper electrical clearances are maintained on the circuit breaker, in the assembly structure and between the circuit breaker and its assembly structure. These required electrical clearances must be in keeping with the appropriate ANSI standard and the specific BIL level of application. The BIL Rating associated with a particular breaker element is clearly indicated on the breaker's nameplate located on the front cover.

6.2.2 Interphase Barriers

ANSI standards requires specific minimum air space clearances between poles for specific BIL application levels. It is the customer's responsibility to insure that proper interphase barriers are in place on all circuit breakers prior to inserting a circuit breaker into a cell and/or placing a circuit breaker in service.

Interphase barriers must be designed to fulfill the ANSI requirements. They must be constructed of an appropriate insulating material, such as a one eighth inch thick high strength, track resistant glass-mat polyester.

6.2.3 Front Cover (Faceplate)

All VCP-WR breaker elements are supplied with a front cover faceplate already installed (Figures **3.2**, **3.4**, and **3.6**). The front cover

is constructed of a heavy gauge steel and solidly attached to the breaker element. The front cover, as supplied, prevents front access to the breaker mechanism and primary voltage parts. A breaker specific nameplate and operational windows are also a part of the front cover (Figure **3.8**).

If a new front cover must be constructed for a specific circuit breaker design or application, all of the above mentioned features of the original faceplate must be carried over to the new faceplate. The new faceplate must reflect the following as a minimum (Figure **6.1**):

- A front cover should clearly indicate all of the information presented on the original nameplate.
- A front cover should prevent front access to the breaker's operating mechanism and any primary voltage parts once the breaker is installed.
- A front cover should include properly placed and sized windows so that operational indicators, such as main contact status and closing spring status, are clearly visible.
- A front cover should include properly placed and sized windows for access to breaker operating devices, such as manual open/close buttons and the manual charging socket.

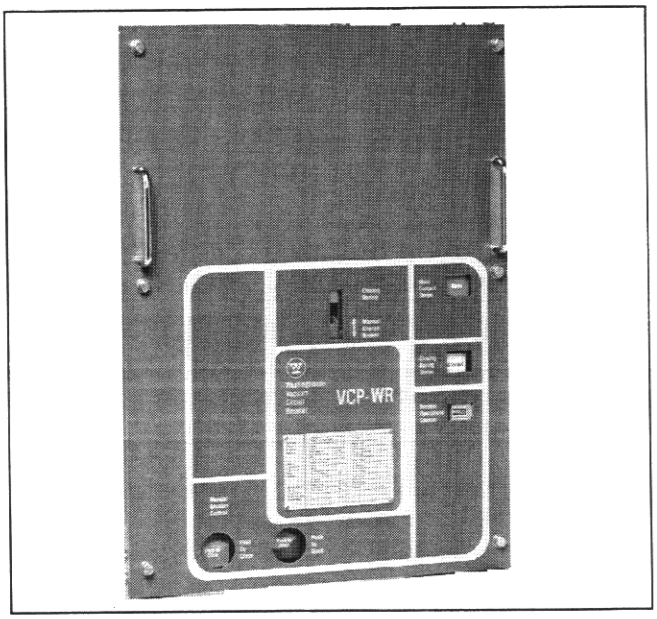


Figure 6.1 *Typical VCP-WR Front Cover, Nameplate and Operational Indicators*

6.2.4 Compartment Interface Verification

Refer to paragraph **4.3** in this instruction book for details.

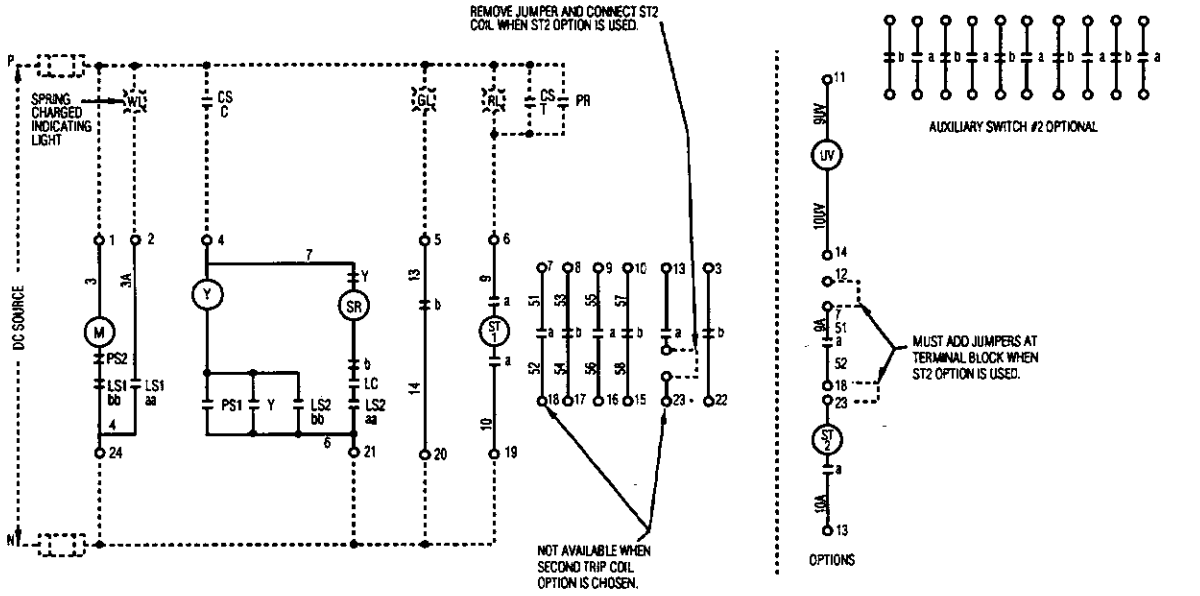
6.3 Series 18 Breaker Element Interfaces

The Series 18 breaker element can be used for drawout or fixed breaker applications. As supplied by Westinghouse, the breaker element is of the fixed breaker configuration and must be altered and added to by the customer for use as a drawout breaker. Specific electrical and mechanical interfacing details relative to the breaker element are provided in this section to assist the customer with its specific application and/or retrofit of the Series 18 breaker element.

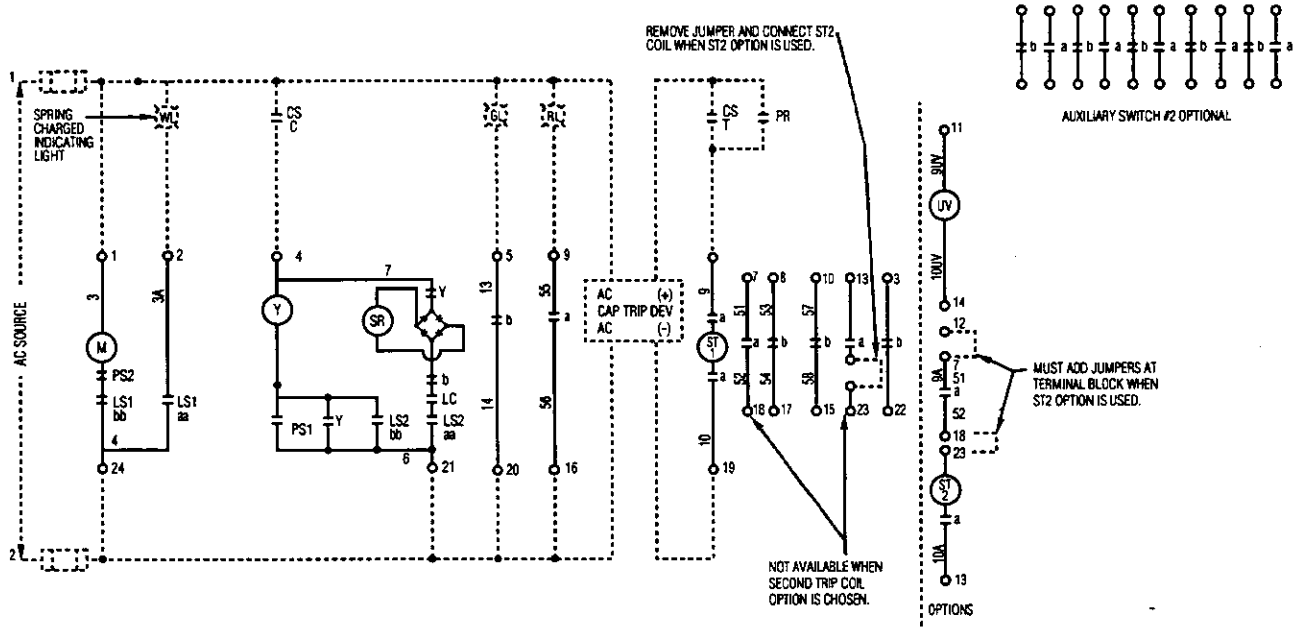
6.3.1 Initial Interfacing Steps

- Read and understand paragraphs **6.1** and **6.2** in their entirety before proceeding.
- Review the details presented in Table **1-1** and Figures **1.1**, **3.2**, **3.3**, **3.8** and **5.1**.
- Review the Series 18 specific control scheme (Figure **6.2**) and the outline drawing (Figures **1.1**) presented earlier before proceeding.

VCP-WR (18 SERIES) BREAKER DC CONTROL SCHEMATIC



VCP-WR (18 SERIES) BREAKER AC CONTROL SCHEMATIC



CS C	–	Breaker Control Switch – close
CS T	–	Breaker Control Switch – trip
Y	–	Anti Pump Relay
SR	–	Spring Release Coil (Close Coil)
M	–	Spring Charging Motor
ST	–	Shunt Trip Coil
PR	–	Protective Relay
O	–	Terminal Block or Accessible Terminal
PS1	–	Position Switch 1
PS2	–	Position Switch 2

	OPERATION	SWITCH TERMINAL	
LS1 aa	Open until springs are fully charged	'C' and 'NC'	Brown Switch
LS1 bb	Closed until springs are fully charged	'C' and 'NO'	
LS2 aa	Open until springs are fully charged	'C' and 'NC'	Black Switch
LS2 bb	Closed until springs are fully charged	'C' and 'NO'	
LC	Open until mechanism is reset	'C' and 'NO'	
PS1	Open in all except between 'Test' and 'Connected' positions	'C' and 'NC'	Black Switch
PS2	Closed in all except between 'Test' and 'Connected' positions	'C' and 'NO'	Brown Switch

Figure 6.2 *Typical Series 18 "DC" and "AC" Control Schematics*

6.3.2 Electrical Interfaces

Secondary control access is provided by 2 12-point secondary control terminal blocks located at the top front of the breaker element (Figure **3.2**). The Series 18 control scheme indicates which points are used for breaker operation and which are available for customer use (Figure **6.2**).

6.3.3 Mechanical Interfaces

The customer is responsible for providing all required mechanical interfaces to insure that the Series 18 element is properly installed and applied in a fixed or drawout configuration. Depending upon the final applied configuration, the customer is responsible for but not limited to the following:

- An appropriate truck and levering mechanism for drawout breaker designs.
- The appropriately sized and secured primary connections for fixed or drawout designs. Refer to the following specific details entitled "Primary Connections."
- The entire cell structure for drawout configurations with appropriate interlocks, levering mechanisms, barriers and circuit breaker interfaces to insure compliance with applicable ANSI Standards.
- Properly designed and proven by test interfaces necessary to operate Series 18 breaker element supplied interlocks and auxiliary switch operators, if required.

Primary Connections

The customer is responsible for providing all properly sized primary connections to the VCP-WR breaker element, whether the connections take the form of cable or bus bar (Figure **6.3**). The Series 18 outline drawing (Figure **1.1**) provides breaker element primary connection details, such as primary spacings and hole patterns.

Floor Tripper Interlocks (Drawout Designs)

Open and closing floor tripper interlocks are operated by the interaction between the floor tripper rollers on the bottom of the breaker element and the carriage or cradle assembly provided by the customer (Figure **6.4**). The functions they are intended to perform are as follows:

1. The breaker is held mechanically trip free during racking. The latch check switch is also held open, thus preventing any electrical close signal from closing the breaker.
2. The breaker is permitted to be withdrawn in the safe mode (breaker open/springs discharged) when bringing the breaker to the Withdrawn position or to the Connected position.

The two outlined functions are accomplished by pushing up the tripper rollers.

When required, the customer is responsible for providing the proper interfaces with the Series 18 opening/closing floor trippers. Refer to the Series 18 outline drawing (Figure **1.1**) for specific details as to exact locations and the amount of travel associated with each tripper.

MOC Operator

The MOC (Mechanism Operated Control) switch operator is coupled to the pole shaft. As a breaker closes, the operator moves to change the MOC switch contact position.

Figure 6.3 *Series 18 Primary Connection*

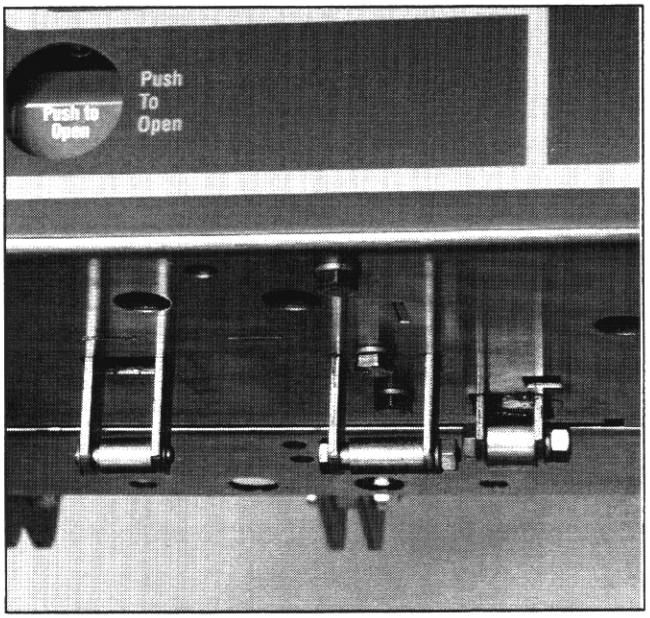


Figure 6.4 *Series 18 Showing Bottom Accessed Interlocks and MOC Operator*

MOC switch contacts operate in the same manner as the auxiliary switch contacts in the breaker. The MOC switch operator is located on the bottom of the Series 18 breaker element (Figure **6.4**). An optional additional top MOC drive is available in the form of a kit (Style 8794C82G01).

When an MOC switch is required, it is the customer's responsibility to provide the proper interface with the Series 18 MOC operator. Refer to the Series 18 outline drawing (Figure **1.1**) for specific details as to the operator's location and amount of travel.

6.4 Series 20 Breaker Element Interfaces

The Series 20 breaker element can be used for drawout or fixed breaker applications. As supplied by Westinghouse, the breaker element is of the fixed breaker configuration and must be altered and added to by the customer for use as a drawout breaker. Specific electrical and mechanical interfacing details relative to the breaker element are provided in this section to assist the customer with its specific application and/or retrofit of the Series 20 breaker element.

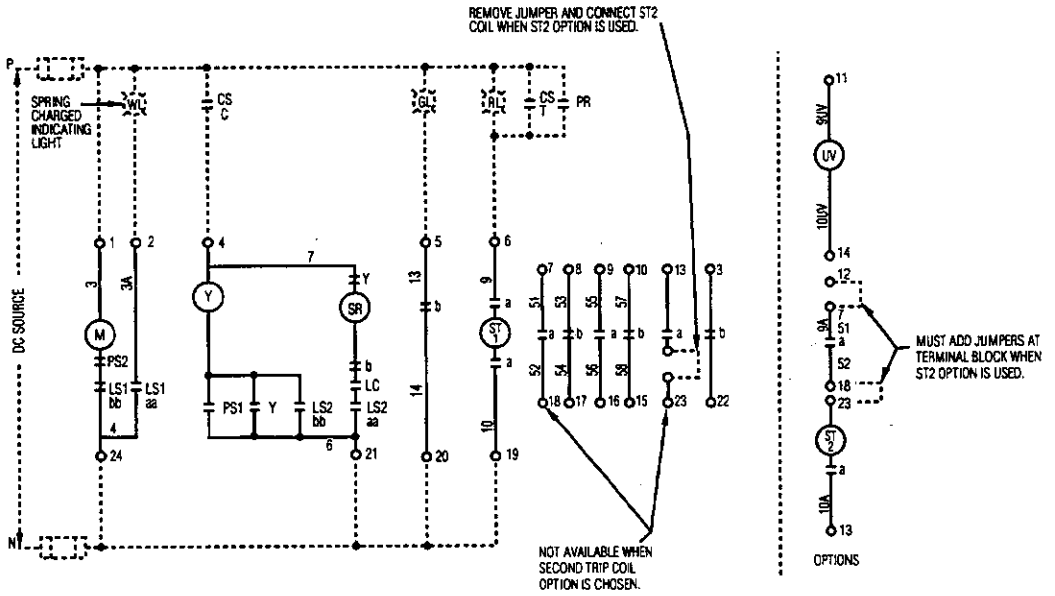
6.4.1 Initial Interfacing Steps

- Read and understand paragraphs **6.1** and **6.2** in their entirety before proceeding.
- Review the details presented in Table **1-1** and Figures **1.2**, **3.4**, **3.5**, **3.8** and **5.1**.
- Review the Series 20 specific control scheme (Figure **6.5**) and the outline drawing (Figure **1.2**) presented earlier before proceeding.

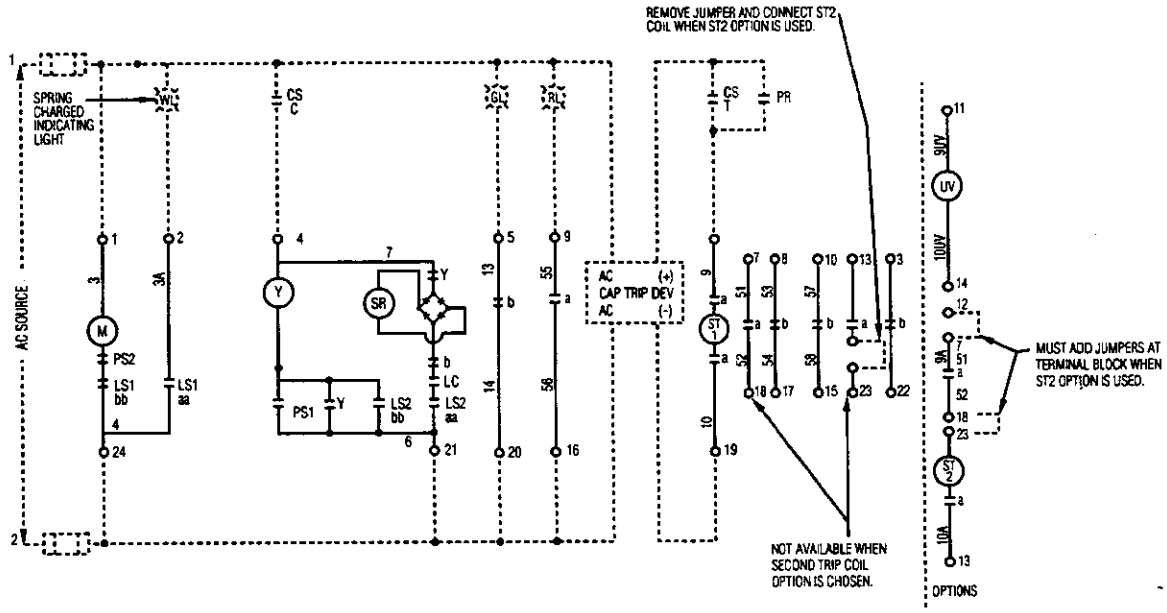
6.4.2 Electrical Interfaces

Secondary control access is provided by 2 12-point secondary control terminal blocks located behind the breaker faceplate in the front, lower left portion of the breaker. The Series 20 control scheme indicates which points are used for breaker operation and which are available for customer use (Figure **6.5**).

VCP-WR (20 SERIES) BREAKER DC CONTROL SCHEMATIC



VCP-WR (20 SERIES) BREAKER AC CONTROL SCHEMATIC



CS C	–	Breaker Control Switch – close
CS T	–	Breaker Control Switch – trip
Y	–	Anti Pump Relay
SR	–	Spring Release Coil (Close Coil)
M	–	Spring Charging Motor
ST	–	Shunt Trip Coil
PR	–	Protective Relay
O	–	Terminal Block or Accessible Terminal
PS1	–	Position Switch 1
PS2	–	Position Switch 2

	OPERATION	SWITCH TERMINAL	
LS1 aa	Open until springs are fully charged	'C' and 'NC'	Brown Switch
LS1 bb	Closed until springs are fully charged	'C' and 'NO'	
LS2 aa	Open until springs are fully charged	'C' and 'NC'	Black Switch
LS2 bb	Closed until springs are fully charged	'C' and 'NO'	
LC	Open until mechanism is reset	'C' and 'NO'	
PS1	Open in all except between 'Test' and 'Connected' positions	'C' and 'NC'	Black Switch
PS2	Closed in all except between 'Test' and 'Connected' positions	'C' and 'NO'	Brown Switch

Figure 6.5 *Typical Series 20 "DC" and "AC" Control Schematics*

6.4.3 Mechanical Interfaces

The customer is responsible for providing all required mechanical interfaces to insure that the Series 20 element is properly installed and applied in a fixed or drawout configuration. Depending upon the final applied configuration, the customer is responsible for but not limited to the following:

- An appropriate truck and levering mechanism for drawout breaker designs.
- The appropriately sized and secured primary connections for fixed or drawout designs. Refer to the following specific details entitled "Primary Connections."
- The entire cell structure for drawout configurations with appropriate interlocks, levering mechanisms, barriers and circuit breaker interfaces to insure compliance with applicable ANSI Standards.
- Properly designed and proven by test interfaces necessary to operate Series 20 breaker element supplied interlocks and auxiliary switch operators, if required.

Primary Connections

The customer is responsible for providing all properly sized primary connections to the VCP-WR breaker element, whether the connections take the form of cable or bus bar (Figure **6.6**). The Series 20 outline drawing (Figure **1.2**) provides breaker element primary connection details, such as primary spacings and hole patterns.

Kits which include primary finger clusters applicable to drawout breaker designs are available from Westinghouse as an optional item.

Floor Tripper Interlocks (Drawout Designs)

Open and closing floor tripper interlocks are operated by the interaction between the floor tripper rollers on the bottom of the breaker element and the carriage or cradle assembly provided by the customer (Figure **6.7**). The functions they are intended to perform are as follows:

1. The breaker is held mechanically trip free during racking. The latch check switch is also held open, thus preventing any electrical close signal from closing the breaker.
2. The breaker is permitted to be withdrawn in the safe mode (breaker open/springs discharged) when bringing the breaker to the Withdrawn position or to the Connected position.

The two outlined functions are accomplished by pushing up the tripper rollers.

When required, the customer is responsible for providing the proper interfaces with the Series 20 opening/closing floor trippers. Refer to the Series 20 outline drawing (Figure **1.2**) for specific details as to exact locations and the amount of travel associated with each tripper.

MOC Operator

The MOC (Mechanism Operated Control) switch operator is coupled to the pole shaft. As a breaker closes, the operator moves to change the MOC switch contact position. MOC switch contacts operate in the same manner as the auxiliary switch contacts in the breaker. The MOC switch operator is located on the bottom of the Series 20 breaker element (Figure **6.7**).

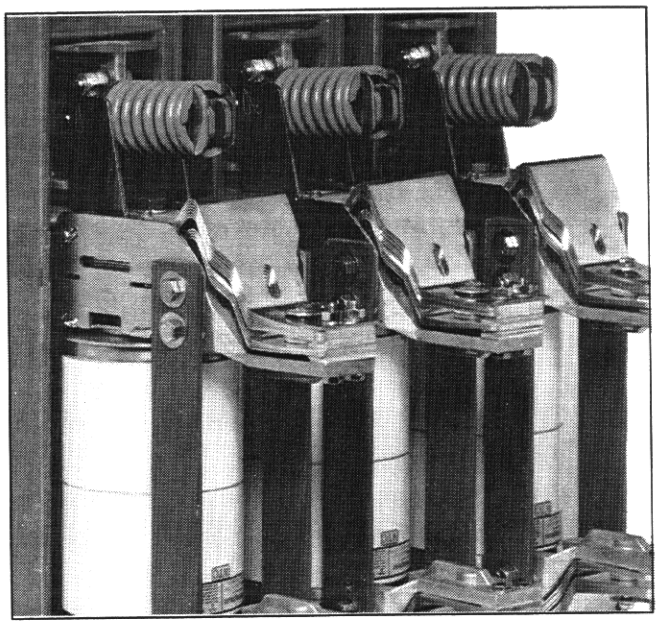


Figure 6.6 *Series 20 Primary Connection*

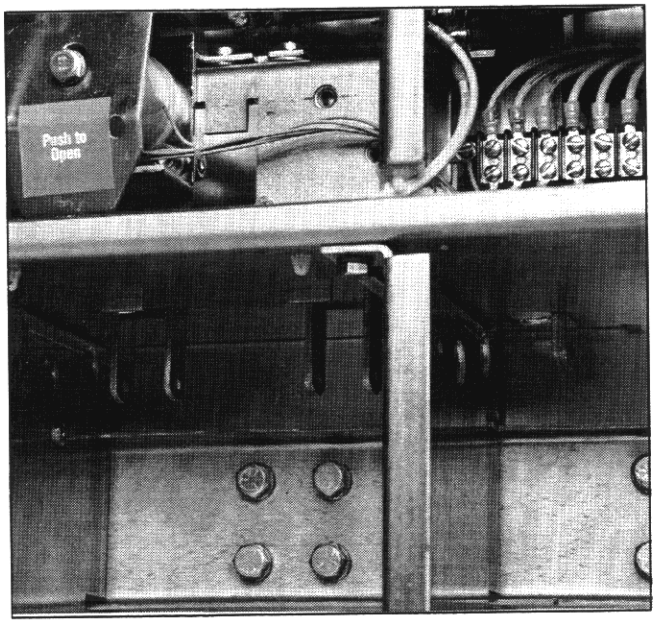


Figure 6.7 *Series 20 Showing Bottom Accessed Interlocks and MOC Operator*

When an MOC switch is required, it is the customer's responsibility to provide the proper interface with the Series 20 MOC operator. Refer to the Series 20 outline drawing (Figure **1.2**) for specific details as to the operator's location and amount of travel.

6.5 Series 29 Breaker Element Interfaces

The Series 29 breaker element can be used for drawout or fixed breaker applications. As supplied by Westinghouse, the breaker element is of the fixed breaker configuration and must be altered and added to by the customer for use as a drawout breaker. Specific electrical and mechanical interfacing details relative to the breaker element are provided in this section to assist the customer with its specific application and/or retrofit of the Series 29 breaker element.

6.5.1 Initial Interfacing Steps

- Read and understand paragraphs **6.1** and **6.2** in their entirety before proceeding.
- Review the details presented in Table **1-1** and Figures **1.3**, **3.6**, **3.7**, **3.8** and **5.1**.
- Review the Series 20 specific control scheme (Figure **6.8**) and the outline drawing (Figure **1.3**) presented earlier before proceeding.

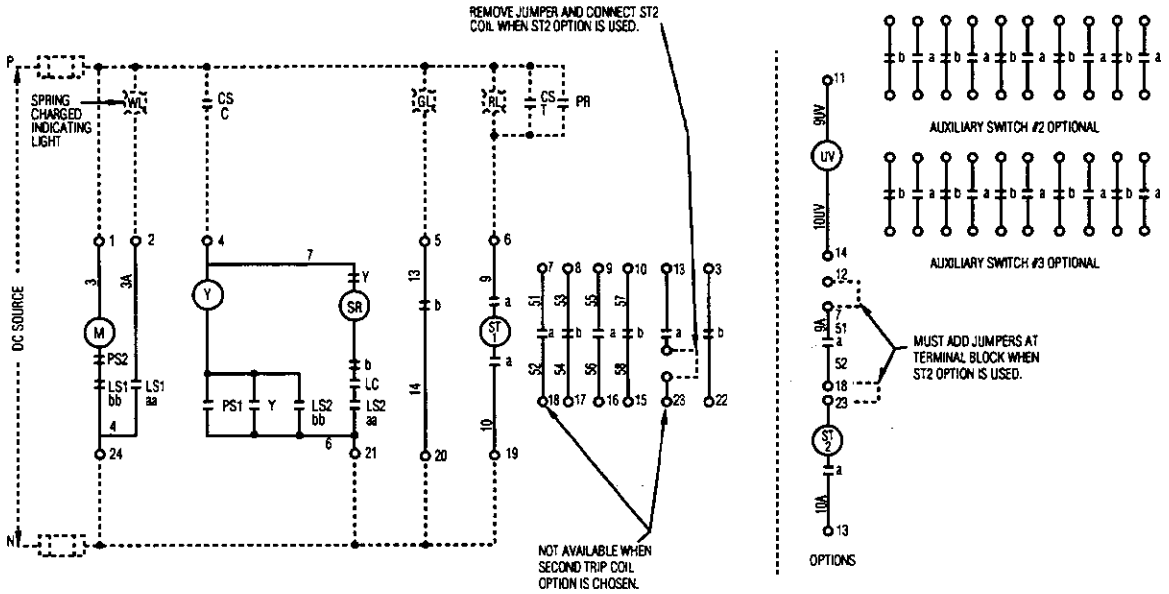
6.5.2 Electrical Interfaces

Secondary control access is provided by 2 12-point secondary control terminal blocks located at the bottom of the breaker element (Figure **3.6**). The Series 29 control scheme indicates which points are used for breaker operation and which are available for customer use (Figure **6.8**).

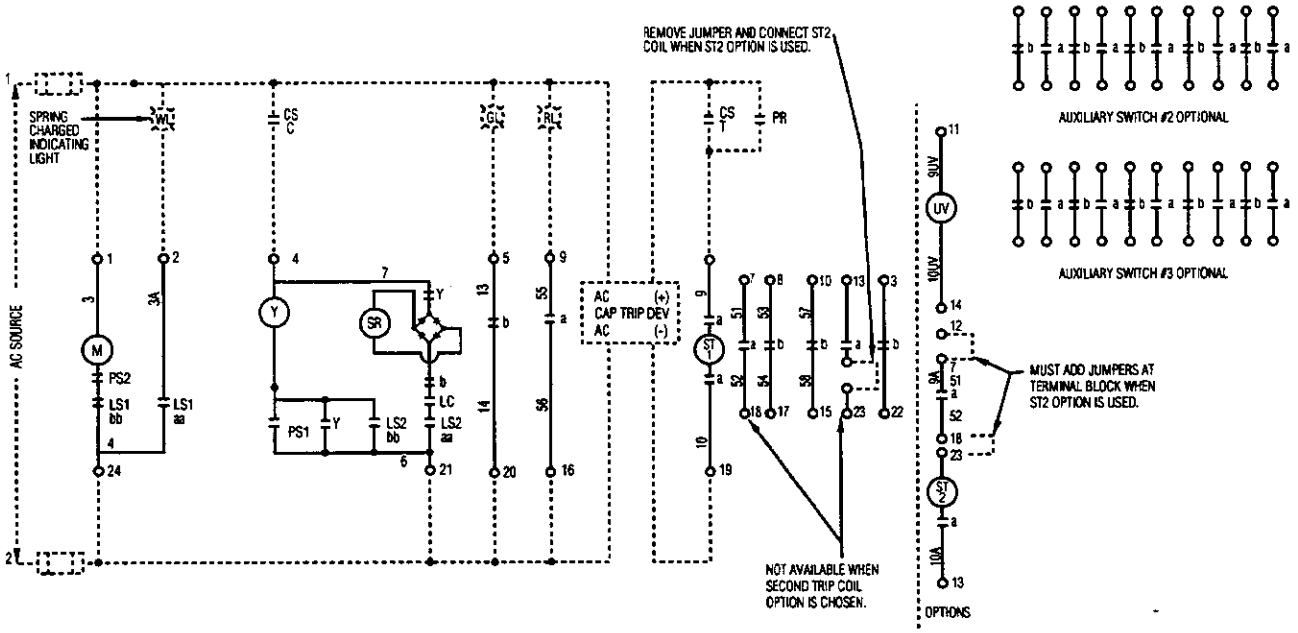
6.5.3 Mechanical Interfaces

The customer is responsible for providing all required mechanical interfaces to insure that the Series 29 element is properly installed and applied in a fixed or drawout configuration. Depending upon the final applied con-

VCP-WR (29 SERIES) BREAKER DC CONTROL SCHEMATIC



VCP-WR (29 SERIES) BREAKER AC CONTROL SCHEMATIC



CS C	–	Breaker Control Switch – close
CS T	–	Breaker Control Switch – trip
Y	–	Anti Pump Relay
SR	–	Spring Release Coil (Close Coil)
M	–	Spring Charging Motor
ST	–	Shunt Trip Coil
PR	–	Protective Relay
O	–	Terminal Block or Accessible Terminal
PS1	–	Position Switch 1
PS2	–	Position Switch 2

	OPERATION	SWITCH TERMINAL	
LS1 aa	Open until springs are fully charged	'C' and 'NC'	Brown Switch
LS1 bb	Closed until springs are fully charged	'C' and 'NO'	
LS2 aa	Open until springs are fully charged	'C' and 'NC'	Black Switch
LS2 bb	Closed until springs are fully charged	'C' and 'NO'	
LC	Open until mechanism is reset	'C' and 'NO'	
PS1	Open in all except between 'Test' and 'Connected' positions	'C' and 'NC'	Black Switch
PS2	Closed in all except between 'Test' and 'Connected' positions	'C' and 'NO'	Brown Switch

Figure 6.8 *Typical Series 29 "DC" and "AC" Control Schematics*

figuration, the customer is responsible for but not limited to the following:

- An appropriate truck and levering mechanism for drawout breaker designs.
- The appropriately sized and secured primary connections for fixed or drawout designs. Refer to the following specific details entitled "Primary Connections."
- The entire cell structure for drawout configurations with appropriate interlocks, levering mechanisms, barriers and circuit breaker interfaces to insure compliance with applicable ANSI Standards.
- Properly designed and proven by test interfaces necessary to operate Series 29 breaker element supplied interlocks and auxiliary switch operators, if required.

Primary Connections

The customer is responsible for providing all properly sized primary connections to the VCP-WR breaker element, whether the connections take the form of cable or bus bar (Figure **6.9**). The Series 29 outline drawing (Figure **1.3**) provides breaker element primary connection details, such as primary spacings and hole patterns.

Floor Tripper Interlocks (Drawout Designs)

Open and closing floor tripper interlocks are operated by the interaction between the floor tripper rollers on the bottom of the breaker element and the carriage or cradle assembly provided by the customer (Figure **6.10**). The functions they are intended to perform are as follows:

1. The breaker is held mechanically trip free during racking. The latch check switch is also held open, thus preventing any electrical close signal from closing the breaker.
2. The breaker is permitted to be withdrawn in the safe mode (breaker open/springs discharged) when bringing the breaker to the Withdrawn position or to the Connected position.

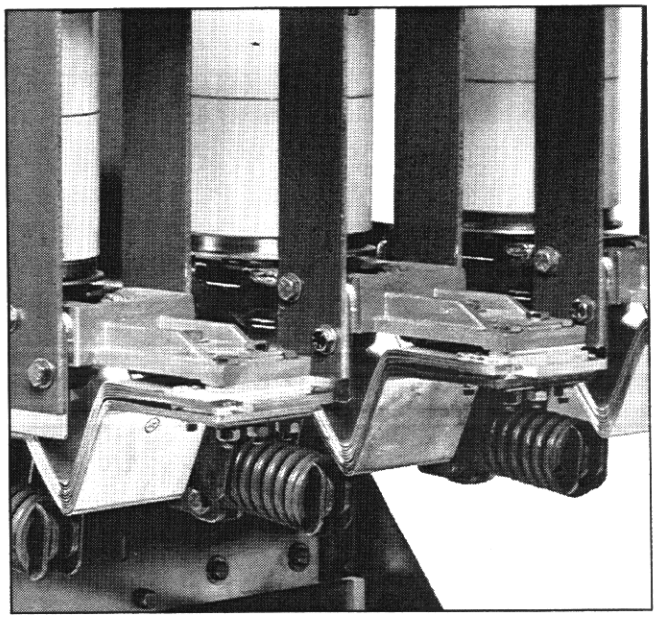


Figure 6.9 *Series 29 Primary Connection*

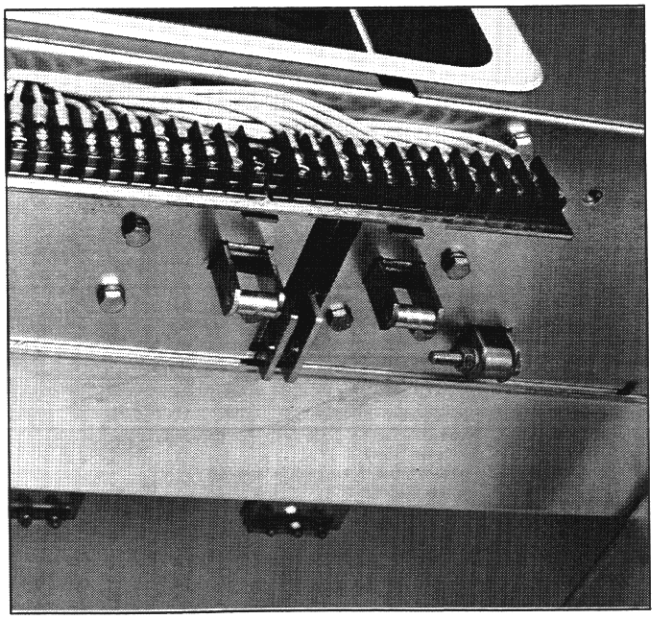


Figure 6.10 *Series 29 Showing Bottom Accessed Interlocks and MOC Operator*

The two outlined functions are accomplished by pushing up the tripper rollers.

When required, the customer is responsible for providing the proper interfaces with the Series 29 opening/closing floor trippers. Refer to the Series 29 outline drawing (Figure **1.3**) for specific details as to exact locations and the amount of travel associated with each tripper.

MOC Operator

The MOC (Mechanism Operated Control) switch operator is coupled to the pole shaft. As a breaker closes, the operator moves to change the MOC switch contact position. MOC switch contacts operate in the same manner as the auxiliary switch contacts in the breaker. The MOC switch operator is located on the bottom of the Series 29 breaker element (Figure **6.10**).

When an MOC switch is required, it is the customer's responsibility to provide the proper interface with the Series 29 MOC operator. Refer to the Series 29 outline drawing (Figure **1.3**) for specific details as to the operator's location and amount of travel.

INSPECTION AND MAINTENANCE

7.1 Introduction

WARNING

- DO NOT WORK ON A BREAKER IN THE "CONNECTED" POSITION.
- DO NOT WORK ON A BREAKER WITH SECONDARY DISCONNECTS ENGAGED.
- DO NOT WORK ON A BREAKER WITH SPRINGS CHARGED OR CONTACTS CLOSED.
- DO NOT DEFEAT ANY SAFETY INTERLOCKS.
- DO NOT LEAVE MAINTENANCE TOOL IN THE SOCKET AFTER CHARGING THE CLOSING SPRINGS.
- DO NOT STAND LESS THAN ONE METER AWAY FROM THE BREAKER WHEN TESTING FOR VACUUM INTEGRITY.

FAILURE TO FOLLOW ANY OF THESE INSTRUCTIONS MAY CAUSE DEATH, SERIOUS BODILY INJURY, OR PROPERTY DAMAGE. SEE SECTION 2-SAFE PRACTICES FOR MORE INFORMATION.

7.2 Frequency of Inspection

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 the following page for maintenance and inspection check points.

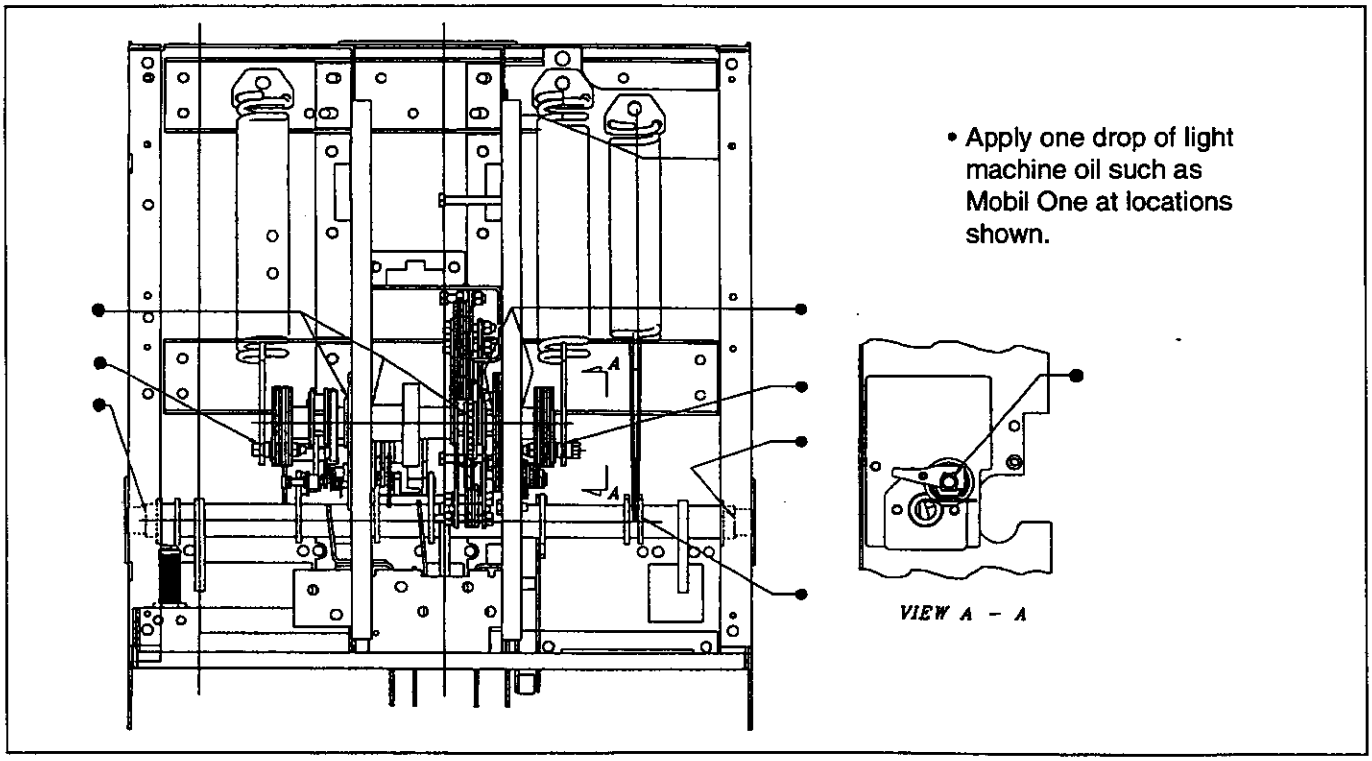


Figure 7.1 *Lubrication Points*

7.3 Inspection and Maintenance Procedures

No./Section	Inspection Item	Criteria	Inspection Method	Corrective Action
1. Insulation	Drive Insulator and Molded Pole Unit Support	No dirt	Visual Check	Clean with lint-free cloth.
		No cracking	Visual Check	Replace cracked unit
Insulation Integrity	Main Circuit to Ground	Withstand	Hipot Tester	Clean and retest or replace
	Between Main Circuit Terminals.	Withstand	Hipot Tester	Clean and retest or replace
	Controls Circuit to Ground	Withstand	Hipot Tester	Clean and retest or replace
2. Power Elements	Vacuum Interrupters	Visibility of Contact Erosion Mark	Visual-Close the breaker and look for green mark on moving stem from the rear of the breaker *(see Figure 7.2 and 7.3).*	If mark is not visible, replace pole unit assembly.
		Contact wipe visible	Visual *(Figures 7.4 and 7.5)*	Replace pole unit assembly
		Adequate Vacuum	See *Section 7.4*	Replace pole unit assembly
		Dirt on ceramic body	Visual Check	Clean with dry lint-free cloth.
3. Control Circuit Parts	Closing and Tripping Device 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	Smooth, Normal Operation	Functional Test	Replace brushes or motor
	Tightness of Hardware	No loose or missing parts	Visual and tighten with appropriate tools	Tighen or reinstate if necessary
4. Operating Mechanism	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 deformaton or wear	Visual and operational	Remove cause and replace parts
	Manual Operation	Smooth operation	Manual charging, closing and tripping	Correct per trouble-shooting chart if necessary

7.4 Vacuum Interrupter Integrity Test

Vacuum interrupters used in Type VCP-WR 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 of these parameters can be readily checked by a one minute ac high potential test. (See Table **7-1** for appropriate test voltage.) During this test, the following warning must be observed:

WARNING

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 sitting solidly on the floor or secured in a fixed position, 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. Start the machine at zero potential, increase to appropriate test voltage and maintain for one minute.

Successful withstand indicates that all interrupters have satisfactory vacuum level. 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 the equipment must be capable of delivering 5 milliamperes for one minute to avoid ambiguity due to field emission or leakage currents and the test voltage shall be as shown in Table **7-1**.

The current delivery capability of 25 ma ac and 5 ma dc apply when all three VIs are tested in parallel. If individual VIs are tested, current capability may be one third of these values.

Caution

SOME DC HIGH POTENTIAL UNITS, OPERATING AS UNFILTERED HALF-WAVE 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.

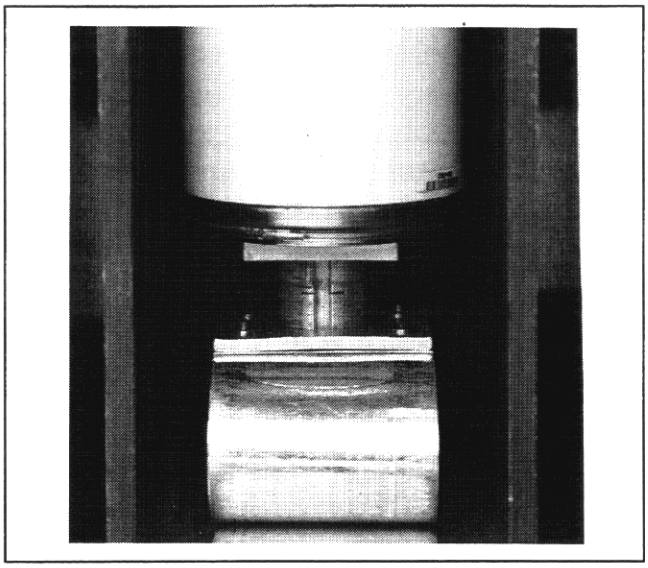


Figure 7.2 *Vacuum Interrupter Showing Contact Erosion Indicator with Breaker Open (Shown here for Clarity Purposes Only).*

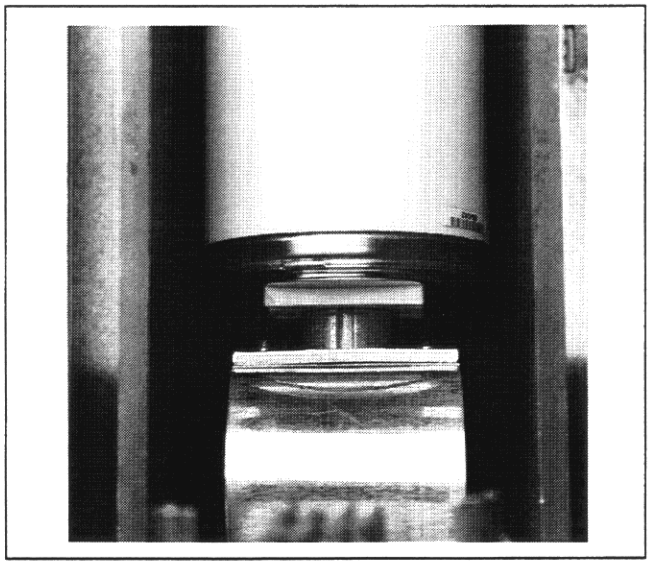


Figure 7.3 *Vacuum Interrupter Showing Contact Erosion Indicator With Breaker Closed (Indicators are Checked Only When Breaker is Closed).*

Table 7-1 *Test Voltage*

Breaker Rated Maximum Voltage	Vacuum Interrupter Integrity Test Voltage	
	ac 60 Hz	dc
Up to and including 15.0kV	27 kV	40kV

7.5 Contact Erosion and Wipe

Since the contacts are contained inside the interrupter, they remain clean and require no maintenance. However, during high current interruptions there may be a minimum 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 the mark on each stem is visible, erosion has not reached maximum value thus indicating satisfactory contact surface of the interrupter. If the mark is not visible, the pole unit assembly must be replaced (Figures **7.2** and **7.3**).

The adequacy of contact wipe can also be determined by simply observing the indicator on the drive rod toward the front of the closed breaker. If the wipe is adequate, the entire vertical portion of the indicator "T" will be visible along with all or a portion of the horizontal part of the indicator "T" (Figures **7.4** and **7.5**). If none of the horizontal portion shows with the breaker closed, the wipe is not adequate, and the pole unit assembly must be replaced.

WARNING

FAILURE TO REPLACE A POLE UNIT ASSEMBLY WHEN CONTACT EROSION MARK IS NOT VISIBLE OR WIPE IS UNSATISFACTORY, WILL CAUSE THE BREAKER TO FAIL TO INTERRUPT AND THEREBY CAUSE PROPERTY DAMAGE OR PERSONAL INJURY.

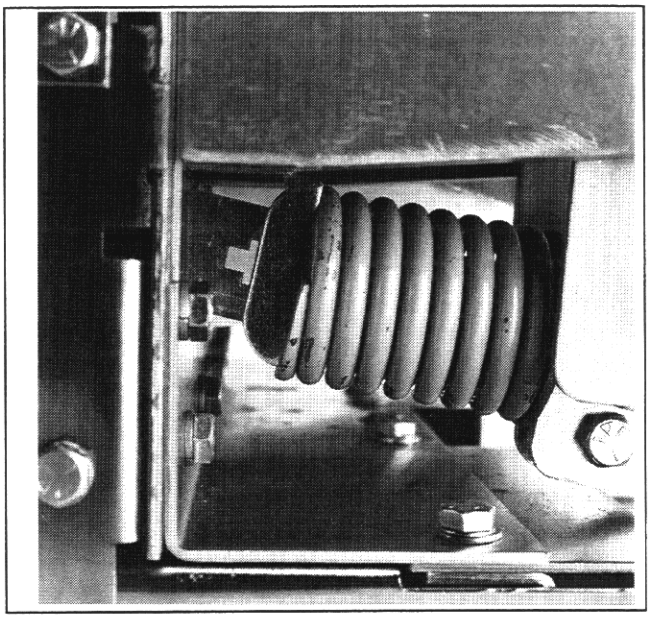


Figure 7.4 *Typical "T" Contact Wipe Indicator.*

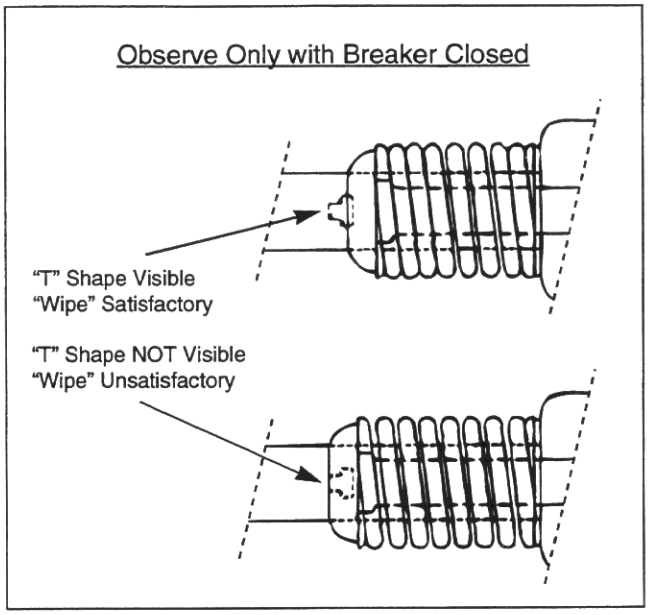


Figure 7.5 *Typical Wipe Indication*

7.6 INSULATION

In VCP-WR breakers, insulation maintenance primarily consists of keeping all 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. 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 55812CA or commercial equivalent. Secondary control wiring requires inspection for tightness of all connections and damage to insulation.

7.7 Insulation Integrity Check

Primary Circuit:

The integrity of primary insulation may be checked by the AC high potential test. The test voltage depends upon the maximum rated voltage of the breaker. For the breakers rated 5 kV, 12 kV and 15 kV the test voltages are 15 kV, 21 kV and 27 kV rms 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 a 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:

Isolate the motor by disconnecting two motor leads provided for this purpose. Connect all points of the secondary terminal block 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

1500 volts rms. Maintain the voltage for one minute. Successful withstand indicates satisfactory insulation strength of the secondary control circuit. Remove the shooting wire and reconnect the motor leads.

7.8 Primary Circuit Resistance Check

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

If desired, the DC resistance of the primary circuit may be measured as follows: close the breaker, pass at least 100 amps DC current through the breaker. With the low resistance instrument, measure resistance across the studs on the breaker for each pole. The resistance should not exceed the values shown in Table **7-2.**

7.9 Mechanism Check

Make a careful visual inspection of the mechanism for any loose parts such as bolts, nuts, pins and rings. Check for excessive wear or damage to the breaker components. Operate the breaker several times manually and electrically. Check the closing and opening times to verify that they are in accordance with the limits in Table **5-1**.

7.10 Lubrication

All parts that require lubrication have been lubricated during the assembly with molybdenum disulphide grease. Westinghouse M No. 53701QB. Over a period of time, this lubricant may be pushed out of the way or degrade. Proper lubrication at regular intervals is essential for maintaining the reliable performance of the mechanism. Once a year or every 2000 operations whichever comes first, the breaker should be relubricated. The locations shown in Figure **7.1** should be lubricated with a drop of light machine oil.

After lubrication, operate the breaker several times manually and electrically.

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, dirt or parts are dismantled for some reason.

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

Table 7-2 *Typical Resistance Measurements*

Rated Continuous Current (amperes)	Resistance (microohms)
600	46
800	39
1200	39
1600	26
2000	26

7.11 Troubleshooting Chart

SYMPTOM	INSPECTION AREA	PROBABLE DEFECTS
Fails To Close		
• Closing Springs not charged	• Control Circuit	• Control Power (fuse blown or switch off) • Secondary Disconnects • Motor Cut-off Switch (Poor or burned contacts, Lever not operational) • Terminals and connectors (Poor or burned contacts) • Motor (Brushes worn or commutator segment open)
	• Mechanism	• Pawls (Slipping or Broken) • Ratchet Wheel (Teeth worn or broken) • Cam Shaft Assembly (Sluggish or jammed) • Oscillator (Reset spring off or broken)

SYMPTOM	INSPECTION AREA	PROBABLE DEFECTS
Fails To Close		
• Closing Spring charged but breaker does not close	• No Closing Sound (Close Coil does not pick up) →	• Control Power (Fuse blown or switch off) • Secondary Disconnects • Anti-Pump Relay (Y relay N. C. contact open or burned or relay picks up) • Close Coil (Open or burned) • Latch Check Switch (Contact open-bad switch or trip bar not reset) • Auxiliary Switch (b contact open or burned) • Motor Cut-off (Contacts open or burned) • Trip Coil Assembly (Clapper fails to reset)
	• Closing Sound but no close →	• Pole Shaft (Not open fully) • Trip Latch Reset Spring (Damaged or Missing) • Trip Bar-D Shaft (Fails to remain reset) • Trip Latch-Hatchet (Fails to remain reset) • Trip Floor Tripper (Fails to remain reset) • Close Latch (Binding) • Close Latch Roller (Binding) • Trip Circuit Energized
Undesirably Closes	• Control Circuit →	• Close Circuit (CS/C Getting Shorted)
	• Mechanism →	• Close Release Latch (Fails to reset) • Close Floor Tripper (Fails to reset)

SYMPTOM	INSPECTION AREA	PROBABLE DEFECTS
Fails To Trip		
• No Trip Sound →	• Control Circuit →	• Control Power (Fuse blown or switch off)
		• Secondary Disconnect
		• Auxiliary Switch (a contact not making, poor or burned)
		• Trip Coil (Burned or open)
		• Terminals and 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)

RENEWAL PARTS

8.1 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, depending upon the service severity and continuity requirements. Each customer should develop his own stock level based on operating experience (Table **8-1**).

8.2 ORDERING INSTRUCTIONS

a.) Always specify the breaker rating information and shop order number.

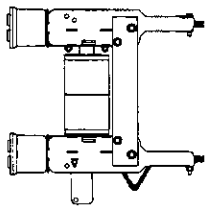
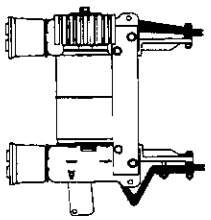
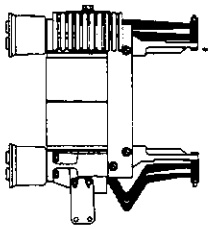
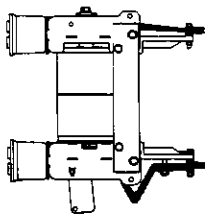
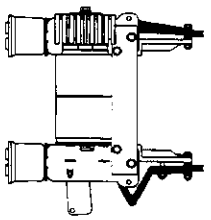
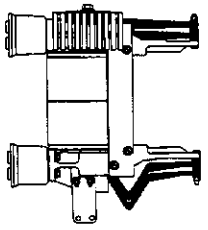
b.) Describe the item, give the style number, and specify the quantity required.

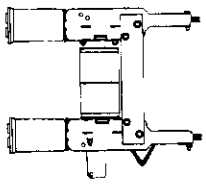
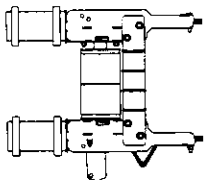
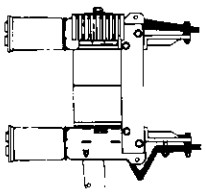
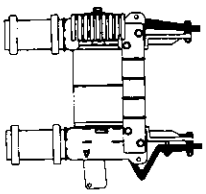
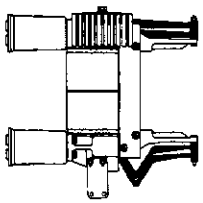
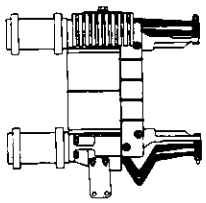
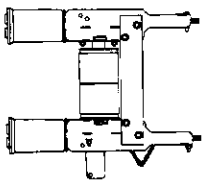
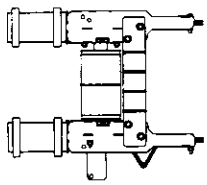
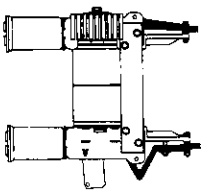
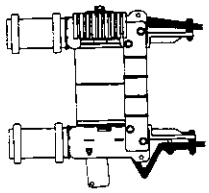
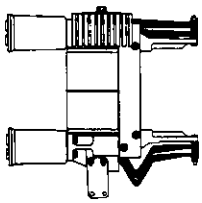
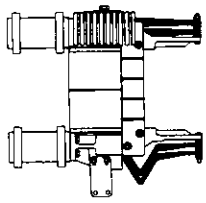
c.) Specify the voltage for electrical components.

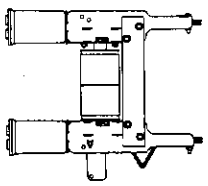
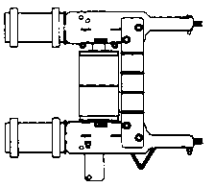
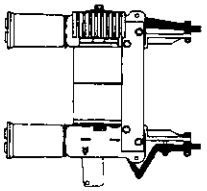
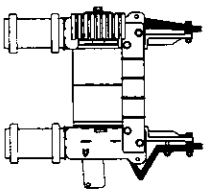
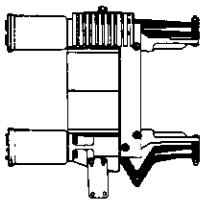
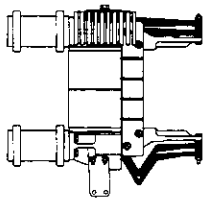
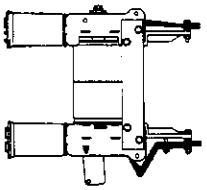
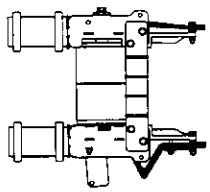
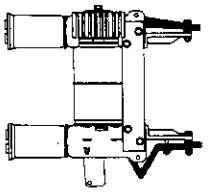
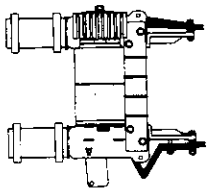
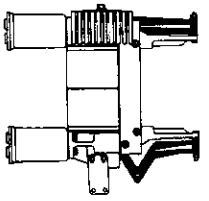
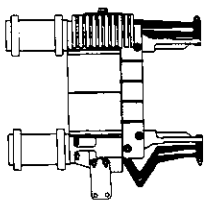
d.) Specify the method of shipping desired.

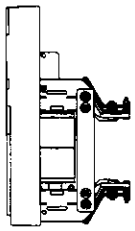
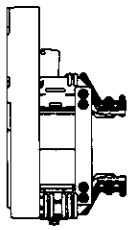
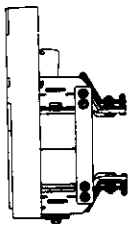
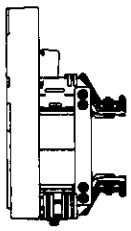
e.) Send all orders or correspondence to the nearest Westinghouse sales office.

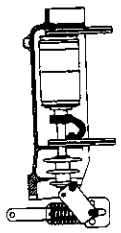
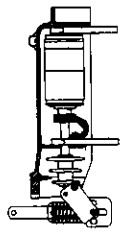
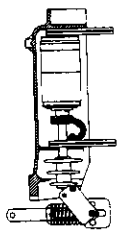
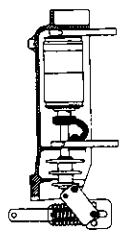
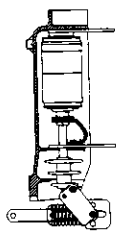
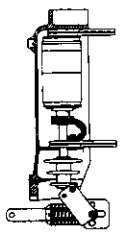
Table 8-1 *Recommended VCP-WR Spare Parts*

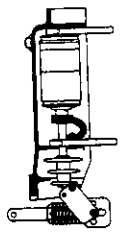
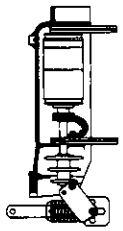
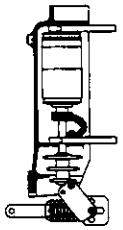
Description Type, Cont. Current, C&L	Style Number VCP-29WR		Style Number VCP-29WRSE
Interrupter Assembly 50/250, 1200A - 58kA	3A73901H01		
50/250, 2000A - 58kA	3A73902H01		
50/250, 3000A - 58kA	3A73903H01		
50/350, 1200A - 78kA	3A73904H01		
50/350, 2000A - 78kA	3A73905H01		
50/350, 3000A - 78kA	3A73906H01		

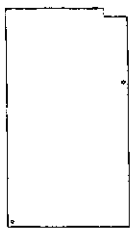
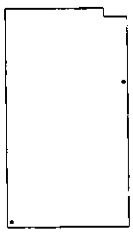
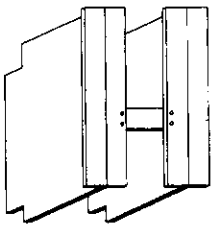
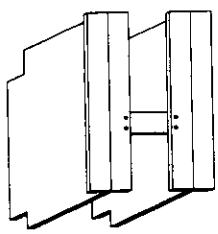
Description Type, Cont. Current, C&L	Style Number VCP-29WR		Style Number VCP-29WRSE	
75/500, 1200A - 66kA	3A73907H01		3A73907H02	
75/500, 2000A - 66kA	3A73908H01		3A73908H02	
75/500, 3000A - 66kA	3A73909H01		3A73909H02	
150/500, 1200A - 37kA	3A73910H01		3A73910H02	
150/500, 2000A - 37kA	3A73911H01		3A73911H02	
150/500, 3000A - 37kA	3A73912H01		3A73912H02	

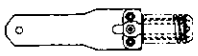
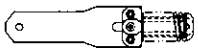
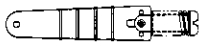
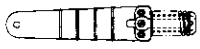
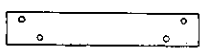
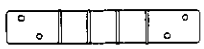
Description Type, Cont. Current, C&L	Style Number VCP-29WR		Style Number VCP-29WRSE	
150/750, 1200A - 58kA	3A73913H01		3A73913H02	
150/750, 2000A - 58kA	3A73914H01		3A73914H02	
150/750, 3000A - 58kA	3A73915H01		3A73915H02	
150/1000, 1200A - 77kA	3A73916H01		3A73916H02	
150/1000, 2000A - 77kA	3A73917H01		3A73917H02	
150/1000, 3000A - 77kA	3A73918H01		3A73918H02	

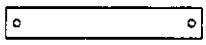
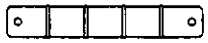
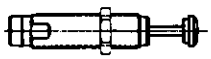
Description Type, Cont. Current, C&L	Style Number VCP-20WR	
50/250, 1200A - 58kA	3A73919H01	
50/250, 2000A - 58kA	3A73920H01	
50/350, 1200A - 78kA	3A73921H01	
50/350, 2000A - 78kA	3A73922H01	

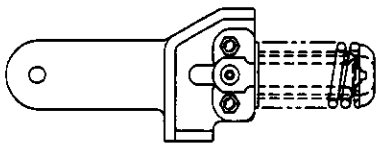
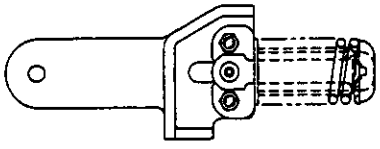
Description Type, Cont. Current, C&L	Style Number VCP-18WR	
50/250, 1200A - 58kA 50/350, 1200A - 78kA	3A73923H01 3A73932H01	
50/250, 2000A - 58kA 50/350, 2000A - 78kA	3A73924H01 3A73933H01	
75/500, 1200A - 66kA	3A73925H01	
75/500, 2000A - 66kA	3A73926H01	
150/500, 600A - 37kA	3A73927H01	
150/500, 1200A - 37kA	3A73928H01	

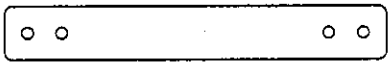
Description Type, Cont. Current, C&L	Style Number VCP-18WR	
150/500, 2000A - 37kA	3A73929H01	
150/750, 1200A - 58kA	3A73930H01	
150/750, 2000A - 58kA	3A73931H01	

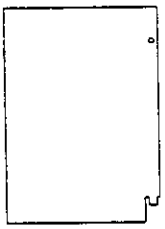
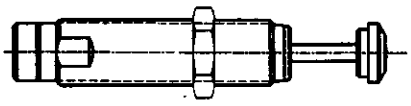
Description	Style Number VCP-29WR		Style Number VCP-29WRSE	
Phase Barriers Up to 15kV	691C176H01		691C176H01	
Up to 15kV all 3000A Breakers	691C648G01		691C648G01	

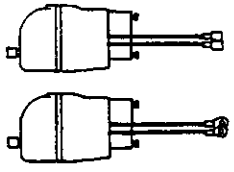
Description	Style Number VCP-29WR		Style Number VCP-29WRSE	
Push Rod Assemblies Up to 5kV BLUE SPRINGS	692C799G01			
Up to 5kV RED SPRINGS	692C799G02			
Up to 15kV WHITE SPRINGS	691C650G01		691C650G02	
Up to 15kV BLUE SPRINGS	691C651G01		691C651G02	
Up to 15kV RED SPRINGS	691C651G03		691C651G04	
Tie Bars Up to 15kV	3619A09H01		691C271H01	

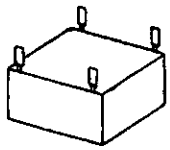
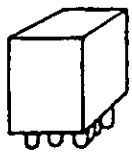
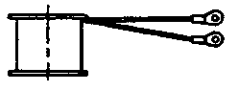
Description	Style Number VCP-29WR		Style Number VCP-29WRSE	
Lower Support Up to 15kV 350, 1000MVA 1200, 2000A	5697B19H01		686C575H01	
Shock Absorber Up to 15kV 350, 1000MVA 1200, 2000A	5677B26H01		5677B26H01	

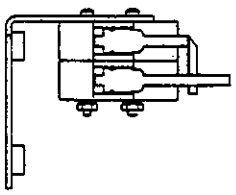
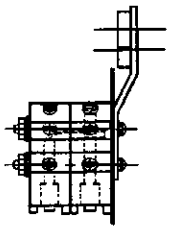
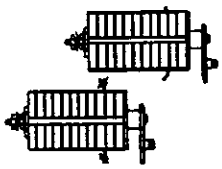
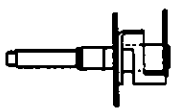
Description	Style Number VCP-20WR	
Phase Barriers Up to 5kV	690C846H01	
Push Rod Assemblies Up to 5kV BLUE SPRINGS	690C854G01	
Up to 5kV RED SPRINGS	690C854G02	

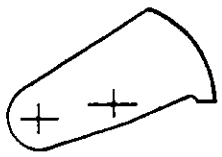
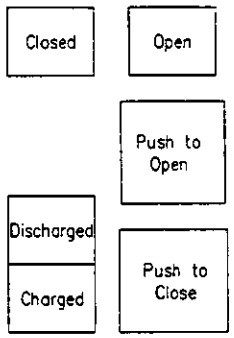
Description	Style Number VCP-20WR	
Tie Bars Up to 5kV	690C818H01	

Description	Style Number VCP-18WR	
Phase Barriers Up to 15kV *(except)* 50/350, 1200A/2000A	5677B34H01 5677B36H01	
Shock Absorber	5677B26H01	

Description	Style Number				
	VCP-29WR	VCP-29WRSE	VCP-20WR	VCP-18WR	
Charging Motor 48VDC 125VDC/120VAC 250VDC/240VAC	699B196G06 699B196G04 699B196G05	699B196G06 699B196G04 699B196G05	699B196G06 699B196G04 699B196G05	699B196G06 699B196G04 699B196G05	

Description	Style Number				
	VCP-29WR	VCP-29WRSE	VCP-20WR	VCP-18WR	
Motor Brush Kit	8063A77G01	8063A77G01	8063A77G01	8063A77G01	
Spring Release Coils 48DC 125VDC/120VAC 250VDC/240VAC	 3759A76G11 3759A76G12 3759A76G13	 3759A76G11 3759A76G12 3759A76G13	 3759A76G11 3759A76G12 3759A76G13	 3759A76G11 3759A76G12 3759A76G13	
Rectifier 120/240VAC	 3759A79G02	 3759A79G02	 3759A79G02	 3759A79G02	
Anti Pump (Y) Relay 48VDC 125VDC 250VDC 120VAC 240VAC	 8237A27H03 8237A27H04 8237A27H05 8237A27H01 8237A27H02	 8237A27H03 8237A27H04 8237A27H05 8237A27H01 8237A27H02	 8237A27H03 8237A27H04 8237A27H05 8237A27H01 8237A27H02	 8237A27H03 8237A27H04 8237A27H05 8237A27H01 8237A27H02	
Shunt Trip Coils 48VDC 125VDC/120VAC 250VDC/240VAC	 3759A76G11 3759A76G12 3759A76G13	 3759A76G11 3759A76G12 3759A76G13	 3759A76G11 3759A76G12 3759A76G13	 3759A76G11 3759A76G12 3759A76G13	
UV Trip Coils 48VDC 125VDC 250VDC 120VAC 240VAC	 8064A19G01 8064A19G02 8064A19G03 701B615G07 701B615G08	 8064A19G01 8064A19G02 8064A19G03 701B615G07 701B615G08	 8064A19G01 8064A19G02 8064A19G03 701B615G07 701B615G08	 8064A19G01 8064A19G02 8064A19G03 701B615G07 701B615G08	

Description	Style Number				
	VCP-29WR	VCP-29WRSE	VCP-20WR	VCP-18WR	
Motor Cutoff Switch	699B199G04	699B199G04	699B199G04		
Motor Cutoff Switch				5677B02G11	
Latch Check Switch	699B147G01	699B147G01	699B147G01	699B147G01	
Position Switch 1 Position Switch 2	699B147H01 3759A93H02	699B147H01 3759A93H02	699B147H01 3759A93H02	699B147H01 3759A93H02	
Auxiliary Switch	5697B02G02	5697B02G02	5697B02G02	5697B02G02	
Trip D Shaft	694C638G01	694C638G01	694C638G01	694C638G01	

Description	Style Number				
	VCP-29WR	VCP-29WRSE	VCP-20WR	VCP-18WR	
Trip Latch (Hatchet)	699B040G03	699B040G03	699B040G03	699B040G03	
Labels Kit	8295A45G01	8295A45G01	8295A45G01	8295A45G01	

VCP-WR Field Installation Kit	Style Number		
	VCP-29WR	VCP-20WR	VCP-18WR
SHUNT TRIP Number 2	8794C84G11; 48VDC 8794C84G12; 125VDC/120CAP 8794C84G13; 250VDC/240CAP 8794C84G14; 24VDC	8794C84G11; 48VDC 8794C84G12; 125VDC/120CAP 8794C84G13; 250VDC/240CAP 8794C84G14; 24VDC	8794C84G01; 48VDC 8794C84G02; 125VDC/120CAP 8794C84G03; 250VDC/240CAP 8794C84G04 24VDC
AUXILIARY SWITCH One Additional Two Additional	8188A82G01 8188A82G02	NONE NONE	8794C83G01 NONE
MOC Top Exit Drive	NONE	NONE	8794C82G01
UNDERVOLTAGE 48VDC 125VDC 250VDC 120VAC 240VAC	8794C81G01 8794C81G02 8794C81G03 8794C81G04 8794C81G05	8794C81G01 8794C81G02 8794C81G03 8794C81G04 8794C81G05	8794C81G01 8794C81G02 8794C81G03 8794C81G04 8794C81G05

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