Oil Switches

COOPER Power Systems

Types VR, VCR, VLR Maintenance Instructions

S260-20-9
Service Information

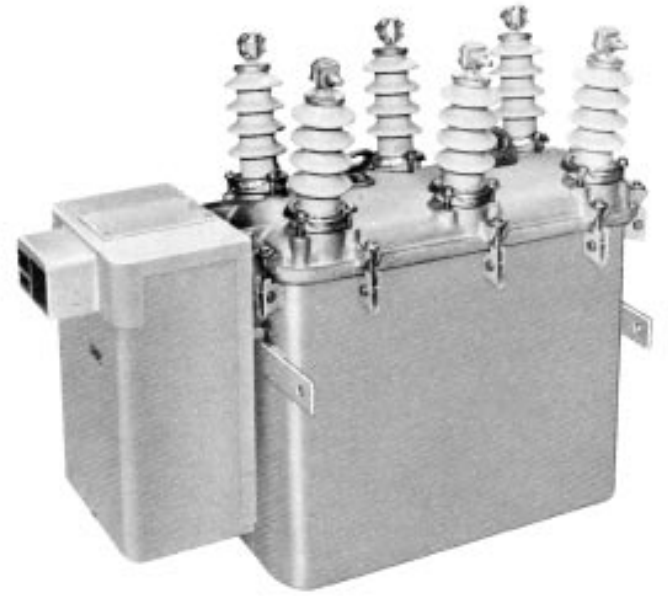

Figure 1.
Type VR, VCR and VLR electronically controlled three phase oil switch.

CAUTION: Do not energize this equipment out of oil.

CONTENTS

These instructions do not claim to cover all details or variations in the equipment, procedure, or process described, nor to provide directions for meeting every contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, please contact your Cooper Power Systems sales engineer.

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INTRODUCTION

Service Information S260-20-9 covers the maintenance instructions for Types VR VCR, and VLR motor operated oil switches. This includes their general description, operating principles and instructions for periodic inspection, testing, trouble shooting and shop repairs. A service parts list, keyed to exploded view drawings of the equipment is included at the back of the manual.

NOTE: Maintenance instructions for early (pre1970) versions of these switches is covered in the original service bulletin 287-10SB-1.

GENERAL DESCRIPTION

These oil-filled, electrically-operated devices provide, three-phase switching for general purpose loads (Type VR) capacitive loads (Type VCR) and inductive loads (Type VLR) on manual or automatic command. These switches utilize a common operating mechanism and package configuration, and are differentiated by their contact assemblies.

The Type VCR switch utilizes a set of wedge-shaped moving contacts for arcing and a set of bayonet-type contacts for load-carrying. In addition, resistors in series with the arcing contacts damp both the magnitude and frequency of transient inrush currents for parallel capacitor bank switching applications (Figure 2).

The Type VR switch utilizes two sets of wedge-shaped moving contacts, one set for arcing and the second for load-carrying (Figure 3).

The Type VLR switch utilizes a set of bayonet-type moving contacts which operate within self-blast interrupter-chambers for quick and effective arc interruption when switching inductive loads (Figure 4).

The contact structures for all three phases are linked with bell cranks to a common torque shaft operated by the actuator mechanism located in the cabinet on the front of the switch.

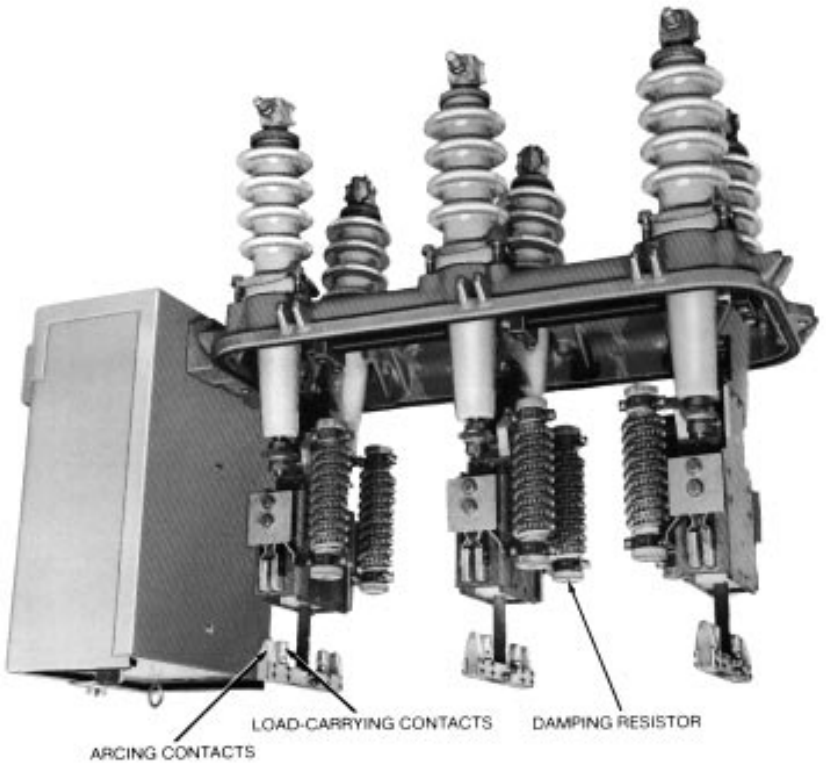

Figure 2.
Untanked Type VCR switch.

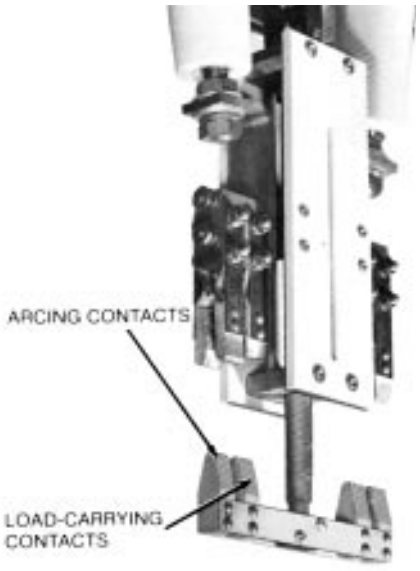

Figure 3.
Type VR contact arrangement.

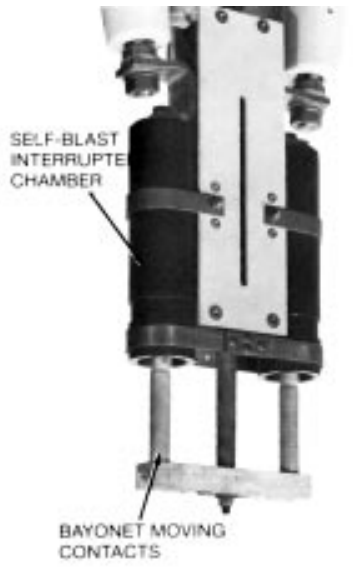

Figure 4.
Type VLR contact arrangement.

DESCRIPTION OF OPERATION

Standard Actuator

These switches are equipped with a motor-operated actuator mechanism (Figure 5) for remote closing. Remote tripping is accomplished by energizing a trip-open solenoid which unlatches a spring-loaded operating mechanism to open the main switch contacts. Subsequent closing is accomplished by operating the motor which loads the opening springs, latches the operating mechanism, and extends the opening spring until it overtoggles and closes the main switch contacts. Time of the closing operation is approximately 10 seconds.

A mechanical schematic diagram showing a single set of contacts connected to a straight line motion linkage and a stored energy actuator is used to illustrate operating principles. With the contacts closed (Figure 6), the opening spring is held extended by a rigidly latched toggle mechanism. When the opening circuit is energized, the trip solenoid breaks the latch to collapse the toggle and open the main contacts (Figure 7). Both springs are relaxed; the contacts cannot be tripped closed accidentally.

When the closing circuit is energized, the motor operates to drive the crankarm on the gear reduction which extends the toggle until it latches and extends both the opening and closing springs (Figure 8). Further travel of the crank arm overtoggles the closing spring to close the switch and carry the rigid toggle (and extended opening springs) to the position shown in Figure 6, ready for another trip operation.

The selector switch provides orderly transition from trip to close and from close to trip. The selector switch is operated from the main shaft. When the main contacts are closed the trip circuit is enabled and the close circuit is disabled. When the main switch contacts are open the trip circuit is disabled and the close circuit is enabled. Figure 9 shows the circuit diagram for the standard actuator.

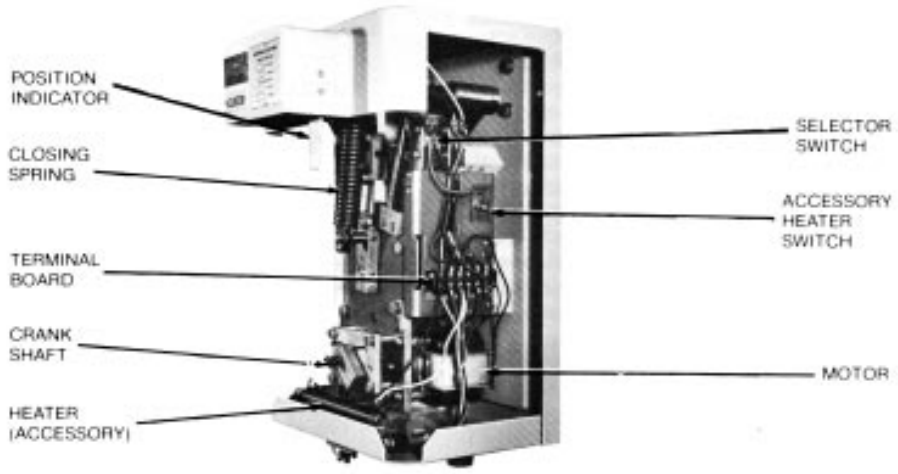

Figure 5.
Standard actuator.

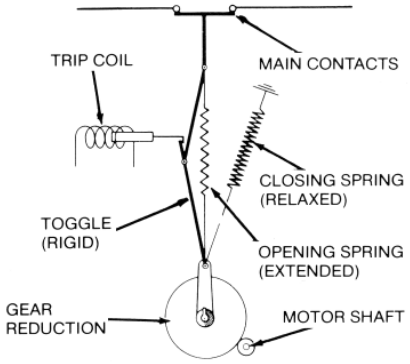

Figure 6.
Status of mechanism with switch closed.

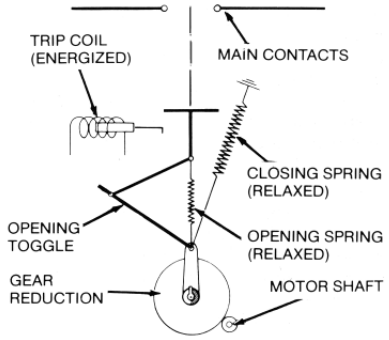

Figure 7.
Status of mechanism with switch open.

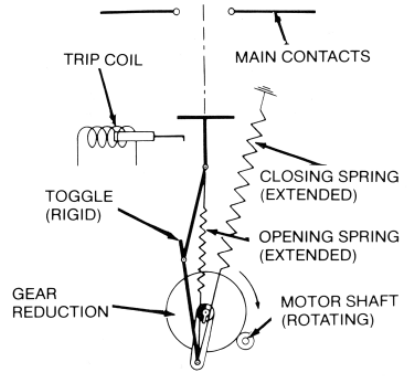

Figure 8.
Status of mechanism during closing operation.

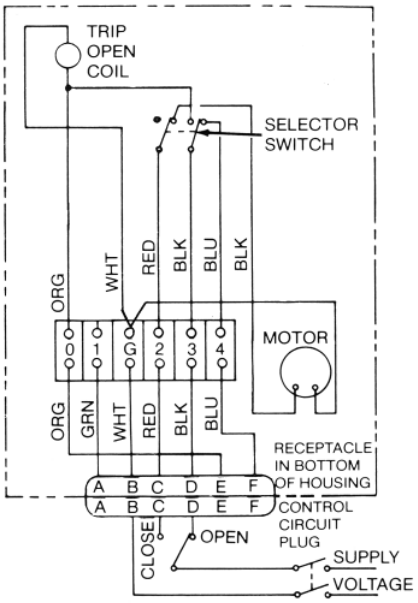

Figure 9.
Standard actuator circuit diagram.

Quick-Close Actuator

When equipped with the quick-close actuator (Figure 10) the main switch contacts close in 2.5 to 5 cyc/es after energizing the closing circuit (compared to 10 seconds for the standard operator). However, at least 10 seconds lapse between an opening and closing operation to allow the motor operator to preload the closing springs. The accessory includes a cam-operated cutout switch to allow the motor to preload the closing mechanism and a solenoid-operated latch to release the preloaded closing mechanism.

With the contacts closed, mechanism status is the same a shown in Figure 6. When the opening circuit is energized, the trip solenoid breaks the latch to collapse the toggle and open the switch contacts (Figure 7). At the same time, the closing motor is energized and drives the crank arm to extend the toggle until it latches and extends both the opening and closing springs. The closing mechanism is latched in the preloaded position by the closing solenoid (Figure 11). When the closing circuit is energized the closing solenoid releases the overtoggled mechanism to close the switch and return the mechanism to the status shown in Figure 6.

Figure 12 shows the circuit diagram for a control equipped with the quick-close feature with the main contacts open. A close signal energizes the quick-close coil, closing the main switch contacts. The selector switch is operated to the left to disable the quick-close coil circuit and enable the trip circuit. An open operation energizes the trip coil, opening the main switch contacts. The selector switch is operated to the right to disable the open circuit and the cutout switch is operated to the left to energize the motor. The motor operates to preload the closing spring. At the completion of this operation the cam on the crank arm operates the cutout switch to the right to de-energize the motor.

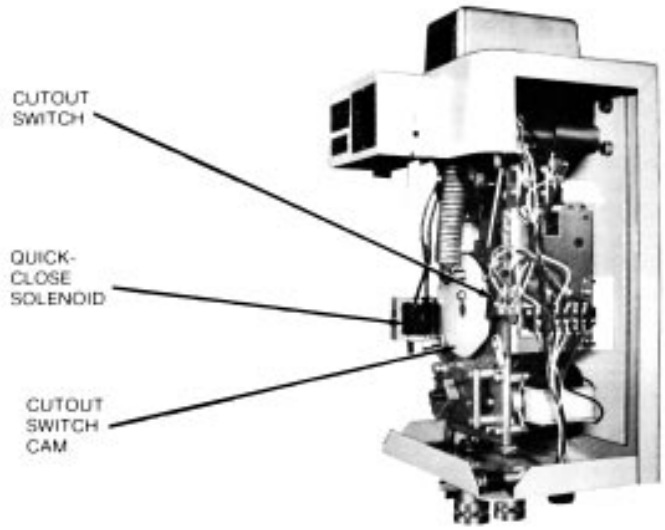

Figure 10.
Quick-close actuator.

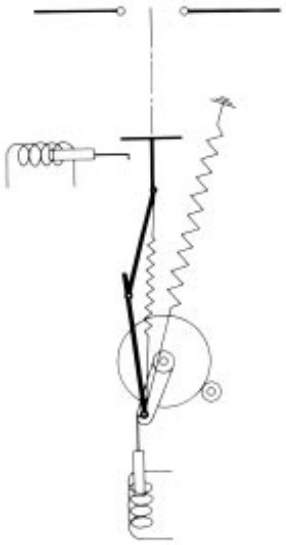

Figure 11.
Status of actuator with closing spring preloaded.

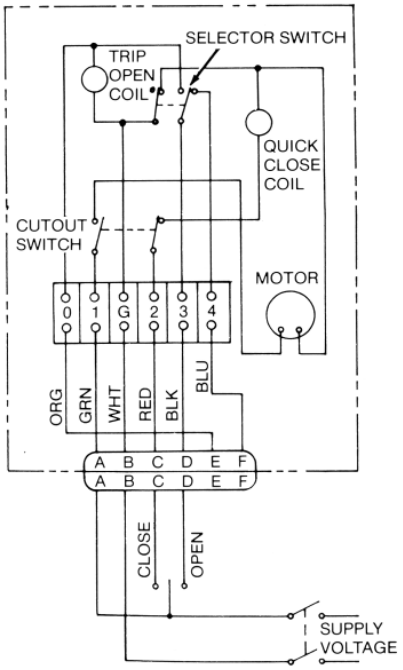

Figure 12.
Quick-close actuator circuit diagram.

RATINGS AND SPECIFICATIONS

Table 1
Electrical Ratings

Rated maximum voltage (kv rms)	15.5
Nominal system voltage (kv rms)	2.4-14.4
Rated impulse withstand voltage (BIL) (kv cress)	110
60-Hz insulation level withstand (kv rms)	
Dry, 1 minute	50
Wet, 10 seconds	45
Rated continuous current (amps)	400

Table 2
Load Switching Ratings

Switch Type	Application	Power Factor	Rated Current (amps)	
VR	Capacitive current switching	—	300	
			7.2 kv	14.4 kv
	Inductive load switching	75-100	400	200
		50-75	200	100
		10-50	100	50
VCR	Capacitive current switching*	—	400	
VLR	Inductive load switching	10-100	400	

Table 3
Short-Time Current Ratings

Rated momentary asymmetrical current (amps)	20,000
Rated 1/2-second symmetrical current (amps)	13,500
Rated 1-second symmetrical current (amps)	10,000
Rated 4-second symmetrical current (amps)	6,000
Rated asymmetrical making current (amps)	20,000

Table 4
Actuator Operating Data

Closing motor:	
Nominal operating voltage (vac)	120
operating voltage range (vac)	95-130
Inrush current (amps)	6
Stead-state current (amps)	3
Running time (see)	10
Trip coil current at 120 vac (amps)	5

MAINTENANCE

Frequency of Maintenance

Because these switches are applied under widely varying operating and climatic conditions, maintenance intervals are best determined by the user based on actual operating experience. Cooper Power Systems recommends the switch be inspected and serviced yearly until experience indicates a more advantageous schedule. In no case should the service interval extend beyond 1200 operations.

Periodic Maintenance Inspection

Each periodic maintenance inspection should include at least the following:

1. By-pass and remove the switch from service.

2. Inspect external components.
- A. Clean the bushings and inspect for chips, cracks and breaks. Replace as necessary. (See page 7 for procedure.)
- B. Check for paint scratches and other mechanical damage. Paint to inhibit corrosion.

3. Perform a dielectric withstand test to determine the insulation level. (See page 6 for procedure.)

4. Loosen the head bolts and remove the mechanism from the tank. Be careful not to damage the gasket, if the tank and head must be pried apart to break the seal.

5. Allow the oil to drain off the mechanism.

6. Clean the internal components.
- A. Remove all traces of carbon by wiping with a clean, lint-free cloth.
- B. Flush the internal components with clean transformer oil.

CAUTION: Never use volatile solutions, detergents, or water-soluble cleaners.

7. Check the moving and stationary contacts.
- A. Slight pitting and discoloration can be dressed with crocus cloth or a fine-tooth file.
- B. Replace *both* the moving and stationary contacts if they are severely eroded. (See page 7 for procedures.)

  NOTE: The contacts should be replaced before erosion of the load-current transfer surfaces impairs their effectiveness.

8. Manually close and trip the switch several times to check that all components perform properly. (See page 6 for manual closing procedure.)

9. Inspect the tank wall liners. Soft or spongy areas indicate that water has

been absorbed. Replace liners if this condition is detected or even suspected.

10. Check the dielectric strength of the insulating oil.
   A. A sample taken near the bottom of the tank should have a dielectric strength of not less than 22 kv rms.
   B. Low dielectric strength indicates the presence of water or carbon deposits; replace the oil. (See Oil Condition.)

11. If oil must be replaced, drain the tank and discard the tank wall liners.

12. Thoroughly clean out all sludge and carbon deposits and rinse the tank with clean oil.

13. Install new tank wall liners and fill the tank with clean, new insulating oil to within 1-1/4" of the top of the tank flange. Oil capacity is approximately 19 gallons.
   NOTE: Use only new, or like new reconditioned transformer oil which conforms to the specifications in Cooper Power Systems Reference Data R280 901, "Oil Specifications and Test".

14. Clean and examine the head gasket. Replace if it is damaged or has taken a permanent set.

15. Clean the head gasket seat and retank the switch.
   A. Replace the head bolts and torque to 12-15 ft-lbs. Apply clamping force gradually and equally, in rotation, to each bolt to achieve an evenly distributed gasket sealing pressure.
      NOTE: Maximum gap between tank flange and head casting shall be 3/16 inch.

16. Check the oil level with the dipstick in the head and adjust the level to the upper line on the stick.

17. Electrically operate the switch to check for proper operation.

18. Repeat the high voltage dielectric withstand test (Step 3) to make sure the dielectric clearances within the tank have not been compromised.

Operating Instructions

ELECTRICAL OPERATION

The switch may be opened and closed electrically by applying rated operating voltage directly to the terminal block of the actuator. See nameplate for rated operating voltage for the control.

Standard Actuator

Refer to the connection diagram for the standard actuator (Figure 9) and proceed as follows:

TO CLOSE SWITCH—Apply rated operating voltage across terminals 2 and G long enough for the motor to complete its closing cycle (approximately 10 seconds).

TO OPEN SWITCH—Momentarily apply rated operating voltage across terminals 3 and G to energize the trip solenoid.

Quick-Close Actuator

Refer to the connection diagram for the quick-close actuator (Figure 12) and proceed as follows:

TO CLOSE SWITCH—Apply rated operating voltage across terminals 1 and G. If the closing spring is not preloaded, the motor will operate to extend the spring (approximately 10 seconds). When closing spring is preloaded, temporarily jumper terminals 1 and 2 to energize the quickclose solenoid.

TO OPEN SWITCH—Apply rated operating voltage across terminals 3 and G to energize the trip solenoid.

MANUAL OPERATION

A crank is included in the bottom of the actuator cabinet for closing the switch manually.

To Close Switch

STANDARD ACTUATOR—Apply crank to shaft on the front of the mechanism (Figure 13) and turn crank clockwise until the closing spring overtoggles and closes the switch (approximately 42 turns).

QUICK CLOSE ACTUATOR — Apply crank to shaft on the front of the mechanism (Figure 13) and turn crank clockwise until the closing spring drive crank hits its mechanical stop (approximately 42 turns). Then mechanically operate the quickclose solenoid to release the spring and close the switch.

Figure 13.
Manually cranking actuator to close switch.

To Open Switch

For both the standard and quick-close actuators, pull down the pull ring underneath the actuator cabinet to mechanically operate the trip solenoid.

Oil Condition

Oil plays an important role in the proper functioning of the switch. It provides the internal insulating barrier between phases and from phase to ground, and acts as an arc quencher. Switching operations cause reductions of some of the oil into chemical compounds, free carbon and gases. Some of these compounds form water-absorbing particles which reduce the dielectric strength of the oil. For effective switch operation the oil must be replaced before it deteriorates below a safe level. Oil that has been contaminated with carbon sludge or has a dielectric strength of less than 22 kv should be replaced.

Used oil must be reconditioned before using. Filtering may remove absorbed and free water, and other contaminants to raise the dielectric strength to an acceptable level. However, it does not always remove water absorbing contaminants. Thus, the dielectric strength of the oil may fall rapidly after the switch is returned to service. Therefore the switch should be filled with new oil or oil that has been restored to like-new condition. Oil used in these switches conforms to ASTM Standard D3487, Type I; its property limits are listed in Reference Data R280-90-1; "Oil Specifications and Tests".

New oil should always be filtered before using even though it is obtained from an approved source. Passing oil through a blotter press will remove free water and solid contaminants such as rust, dirt, and lint. When filtering the oil, aeration should be kept to a minimum to prevent moisture in the air from condensing in the oil and lowering its dielectric strength.

Insulation Level Withstand Tests

High-potential withstand tests provide information regarding the dielectric condition of the switch. Testing is performed at 75% of the rated low-frequency withstand voltage (37.5 kv). Proceed as follows:

TEST 1: Proceed as follows:

1. Close the switch.

2. Ground switch tank and head.

3. Connect together all three bushings on one side of the switch.

4. Apply test voltage (37.5 kv) to the connected bushings.
   • The switch should withstand the test voltage for 60 seconds.

TEST 2: Proceed as follows:
1. Close the switch.
2. Ground switch tank and head.
3. Ground the outer two bushings (Phase A and Phase C).
4. Apply test voltage (37.5 kv) to the center bushing (Phase B).
- The switch should withstand the test voltage for 60 seconds.

TEST 3: Proceed as follows:
1. Open the switch.
2. Ground switch tank and head.
3. Connect and ground all three bushings on one side of the switch.
4. Connect together the three bushings on the other side of the switch.
5. Apply test voltage (37.5 kv) to the ungrounded side of the switch.
- The switch should withstand the test voltage for 60 seconds.

6. Reverse the test and ground connections to the bushings.
7. Again apply test voltage (37.5 kv) to the ungrounded bushings.
- The switch should withstand the test voltage for 60 seconds.

TEST RESULTS: These high potential withstand tests provide information on the dielectric condition of the switch.
A. If the switch passes the closed contacts tests (Test 1 and 2) but fails the open contacts test (Test 3) the cause is likely to be in one or more of the main contact assemblies.
B. If the switch fails the closed contacts tests (Test 1 and 2) the cause is likely to be a diminished electrical clearance or failed insulation.
C. After correcting the problem, retest to confirm the repair.

SHOP REPAIR PROCEDURES

The procedures described in this section should be performed under the cleanest possible conditions. No special tools are required for any of the repair procedures.

Bushings

Bushing replacement generally consists of a thorough cleaning and careful examination for chips, cracks, or other mechanical damage during the periodic maintenance inspection. Bushings must be replaced whenever damage is discovered.

Note that the contact structures are supported from the bottom of the bushings. If more than one bushing is damaged, replace only one bushing at a time to maintain contact alignment.

To replace a bushing refer to Figure 14 and proceed as follows:

1. With the switch untanked, remove the nut, lockwasher and flatwasher holding the contact structure to the lower end of the bushing rod.

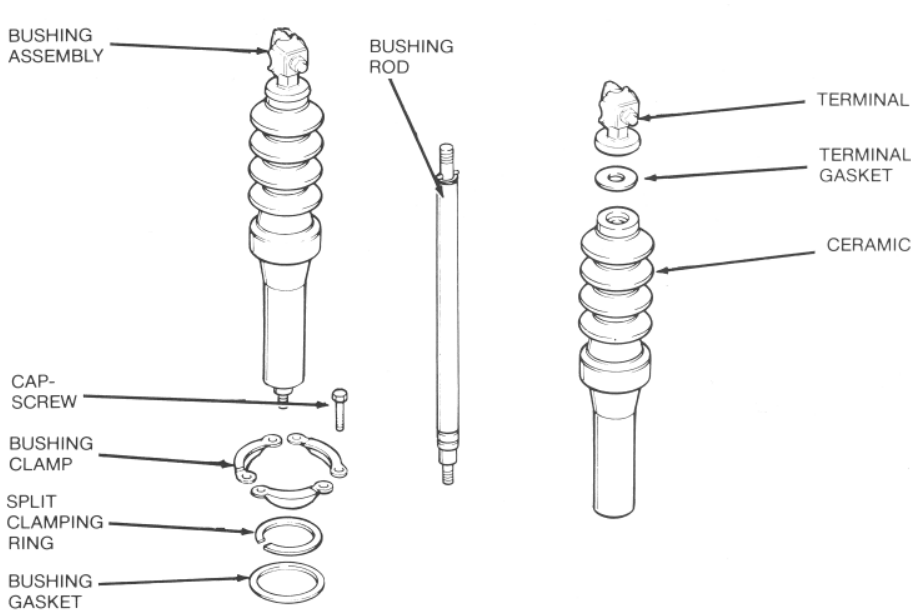

Figure 14.
Bushing parts.

2. Remove the three hex head capscrews and clamps that secure the bushing to the head and lift out the complete bushing assembly.
3. Remove and discard the lower bushing gasket.
4. The complete bushing assembly can be replaced or new porcelain only can be installed depending upon the extent of damage. If new porcelain only is to be installed, proceed as follows:
A. Unscrew the bushing terminal and withdraw the rod from the bottom of the porcelain; discard the terminal gasket.
B. Insert the rod assembly all the way into the new porcelain, making sure the roll pin is seated in the locking groove in the top of the bushing.
C. Assemble the terminal to the bushing rod using a new terminal gasket; tighten to a torque of 35 ft-lbs.
NOTE: Apply a very small amount of petroleum jelly to the knurled surface of the inside face of the terminal before assembling the terminal to the bushing rod.
5. Twist off the split aluminum clamping ring from the old bushing and reuse if it is in good condition; replace the ring if damaged.
NOTE: The clamping ring cushions and distributes the pressure between the porcelain and the clamps. DO NOT OMIT.
6. Install the bushing assembly (new or reworked) into the head casting using a new lower bushing gasket. Position the bushing with the stud-end of the terminal pointing outward.
7. Position the clamping ring with the split centered between two clamping bolts.
8. Reassemble the bushing to the head casting. Tighten the clamping bolts evenly, a little at a time, to a torque of 6-10 ft-lbs.
NOTE: Clamping forces must be applied gradually and equally in rotation to each bolt. This results in an evenly distributed gasket sealing pressure.
9. Reconnect the bushing to the contact structure.
10. Recheck contact alignment as specified on page 9 or 12.

Contacts

The Type VR switch utilizes two sets of wedge-shaped moving contacts; one set for arcing, the second set for load-carrying (Figure 3). The Type VCR switch utilizes a set of wedge-shaped contacts for arcing, a set of bayonet-type contacts for load carrying, and resistors in series with the arcing contacts for damping capacitor switching transients (Figure 2). Contact service and alignment procedures are similar for both switches.

NOTE: The contact structure for Type VCR switches below serial 1770 uses wedge-shaped contacts for load-carrying as well as arcing. It is strongly recommended that these old-style contact assemblies be replaced with the updated version. A contact assembly kit, KA704VCR is available for this purpose. Three kits are required per switch. Instructions for replacing the contact structure are included in the kit.

The Type VLR switch utilizes a set of bayonet-type moving contacts which operate within self-blast interrupter chambers (Figure 4). Separate service and alignment procedures are included for the Type VLR switch.

Contact service and alignment will be greatly simplified if the head assembly is inverted; bushings down. The head assembly can be supported on its bushings.

TYPE VR AND VCR SWITCHES

If it has been determined that the contacts must be replaced, refer to Figures 15 or 16, as appropriate, and proceed as follows.

1. Remove and discard the moving contact assembly by removing the two screws and stop nuts that attach the assembly to the contact rod.

2. Remove the stationary contact assembly.

A. Type VR switch (Figure 15)

(1) Remove the hardware that attaches the stationary contact assembly block to the contact support housing and discard the entire contact assembly.

Type VCR switch (Figure 16)

(1) Disconnect the resistor from the bracket attached to the arcing contact assembly.

(2) Remove the attaching hardware that secures the entire stationary contact assembly to the contact housing.

(3) Remove the spacer, the arcing contact assembly and the insulator.

(4) Complete the disassembly by removing the stud, lockwasher, and load-carrying contact assemblies.

(5) Discard the arcing and load-carrying contact assemblies.

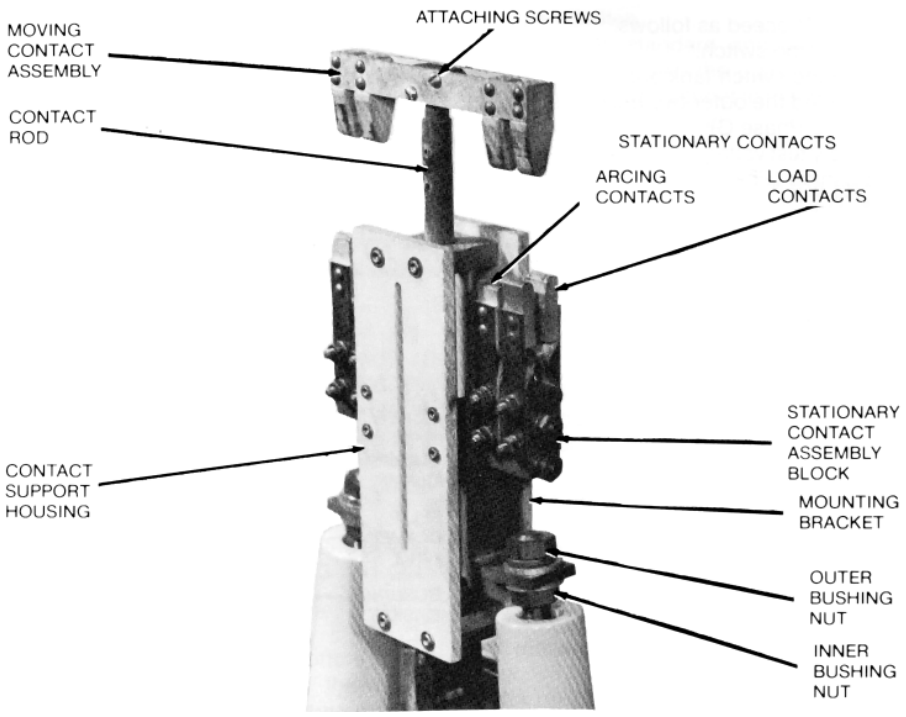

Figure 15.
Type VR contact structure.

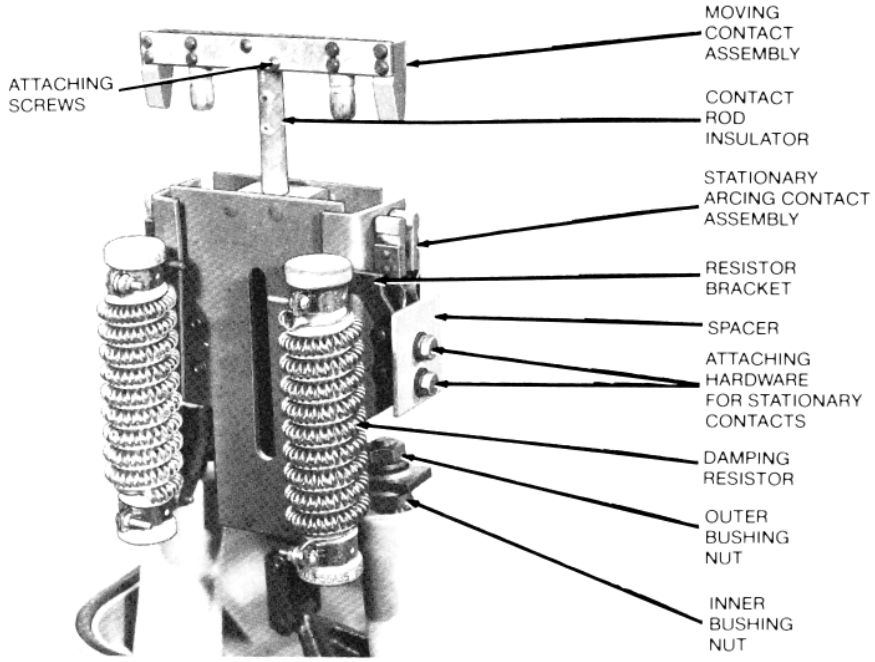

Figure 16.
Type VCR contact structure.

3. Inspect the contact support housing and contact rod for damage. If replacement is not required proceed to step 5. If replacement is required, proceed as follows:

A. Disconnect the contact rod from the operating link by removing the C-ring and link pin. (Figure 17)

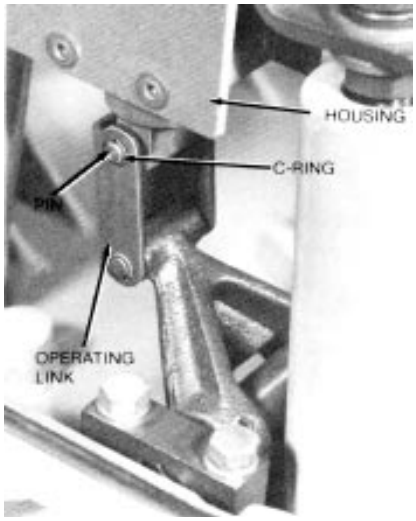

Figure 17.
Contact rod linkage.

B. Remove the outer hex nut, lockwasher and flat washer from the bushing rod and lift contact housing off the bushing rods.

C. To remove the contact rod from the housing drive out the roll pin and pull off the movable contacts anchor block. (Figure 18)

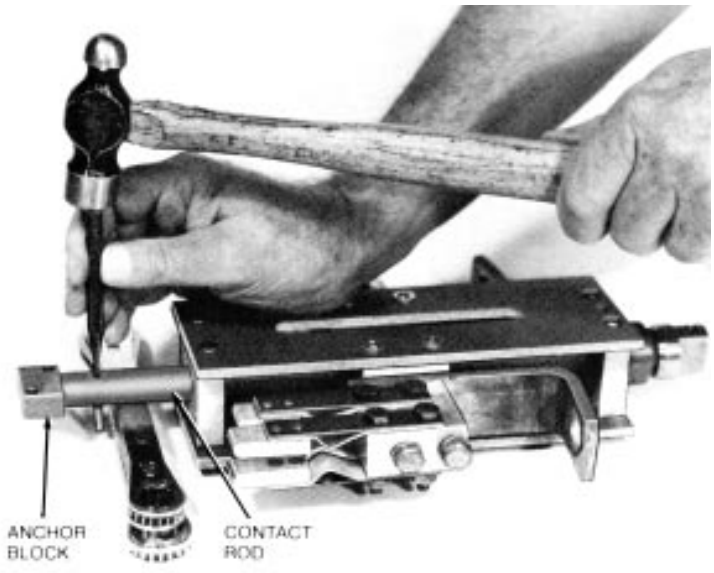

Figure 18.
Contact rod removal.

D. Replace the damaged assemblies and reassemble the contact rod to the housing.

4. Reinstall the contact support housing and contact rod.

A. Set the contact housing assembly on the bushing rods. See Figure 2 to determine the proper orientation of the damping resistors on each phase of the Type VCR switch.

B. Visually check that the contact housing support brackets are approximately centered on the bushing rods.

C. Reassemble the flat washers, lockwashers and outer hex nuts to both bushing rods. Check that a flat washer is assembled above *and* below each contact support bracket. Jam nuts should be snugged down but not tightened completely until after contact alignment has been completed.

D. Reconnect the contact rod to the operating link with the link pin; secure the pin with a C-ring.

E. With the switch mechanism in the open position, the top edge of the dashpot piston on the contact rod should be approximately 1/32 inch above the top surface of the dashpot. (See Figure 19.) Adjust the nuts on the bushing rods to move the contact housing up or down as required.

5. Reassemble the stationary contact assembly using new contacts.

A. Type VR switch

(1) Attach the block of the new stationary contact assembly to the support housing with the hardware removed in step 2A(1).

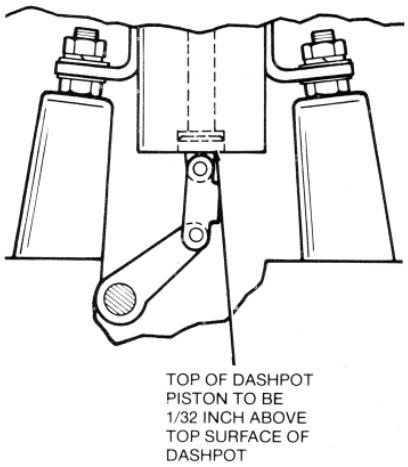

Figure 19.
Initial adjustment.

B. Type VCR switch

(1) Attach the load-carrying contact assembly to the support housing with the studs and internal tooth lockwashers removed in step 2B(4).

(2) Reassemble the insulator, arcing contact assembly and spacer onto the studs and secure with the attaching hardware removed in step 2B(2).

(3) Reconnect the resistor to the bracket.

6. Install a new moving contact assembly to the anchor block of the bushing rod and secure with the screws and stop nuts removed in step 1.

7. Align the contact assemblies.

A. Using a combination square placed across the machined edges of the head casting, square the edge of the contact housing with the head casting as shown in Figure 20. obtain proper alignment by adjusting the *inner* hex nut.

NOTE: The “sailboat” alignment fixture described on page 40 can be used to square VR and VCR contact structures.

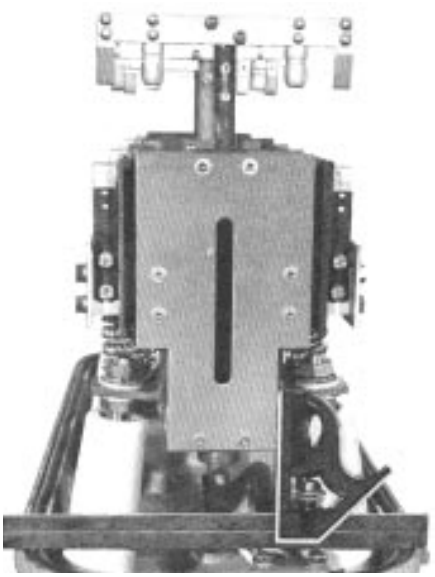

Figure 20.
Lateral vertical alignment.

B. With the contact housing squared, tighten both outer hex nuts without disturbing the position of the inner nuts.

C. Using a flat plate spanning the head casting as a base, square the side of the contact housing as shown in Figure 21. If not square the contact housing can be forced into the squared position.

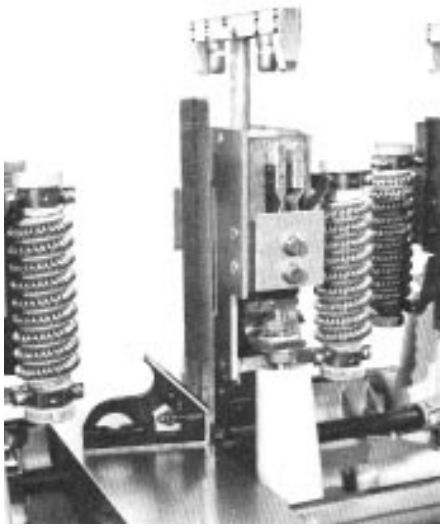

Figure 21.
Longitudinal vertical alignment.

D. Unhook the closing spring from the drive stud on the front of the actuator mechanism. Install the manual closing crank and crank clockwise until the drive stud reaches 7 o'clock position; approximately 42 revolutions.

E. Crank slowly from this point, to bring the moving contacts toward the stationary contacts.

NOTE: If the switch is equipped with the quick-close feature, the mechanism will latch in the 7 o'clock position. To release, push the plunger of the quickclose solenoid up into the solenoid.

F. As the moving arcing contacts approach engagement with the stationary contacts, observe their alignment. See Figures 22 and 23. The moving contacts in Figure 22 will engage the stationary contacts evenly, making simultaneous contact on both sides and with equal contact force. The moving contacts in Figure 23 might make entry into the stationary contacts but with unequal contact force.

Contact misalignment can be corrected by twisting the moving contact assembly about its shaft. The link at the end of the contact rod will permit enough twist to obtain the required adjustment.

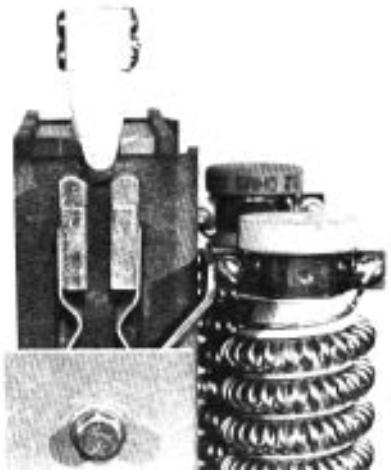

Figure 22.
Contacts aligned.

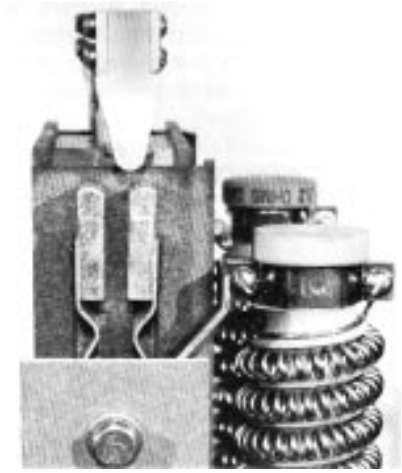

Figure 23.
Contacts misaligned.

G. Viewing the contact assembly from the end of the switch, as in Figure 24, check that the moving contacts are entering squarely into the moving contacts. A visual check that the moving contact bar is parallel to the edge of the housing is adequate assurance of this adjustment.

If adjustment is needed, loosen the two stop nuts slightly and shift the moving contact bar. Tighten stop nuts securely.

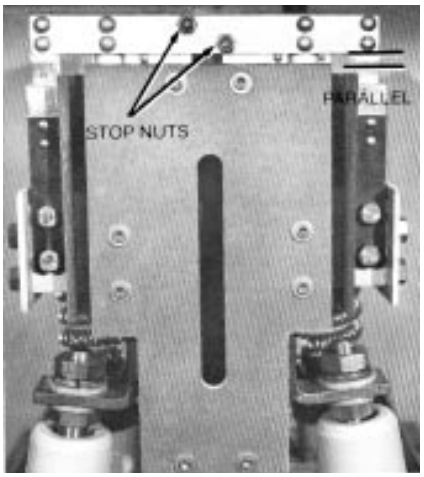

Figure 24.
Moving contact bar must be parallel to end of contact housing.

H. To confirm proper contact engagement, crank the actuator mechanism to the fully closed position. Check clearance between the moving contact bar and the contact rod guide block, Figure 25. Clearance must be between 1/32 and 1/16 inch.

If clearance is outside these limits adjust the hex nuts on the bushing rods to move the stationary contact assembly up or down as required. Often, a half turn of each nut provides the adjustment required

Be careful to move the contact housing evenly so as not to disturb its vertical alignment.

I. With the housing adjusted to provide the required gap, tighten the bushing rod nuts securely. Hold the inner nut in place with one wrench while tightening the outer nut with another wrench.

NOTE: Recheck the clearance (Step H) and the vertical alignments (Steps A and B) after bushing rod nuts are tight.

J. After all three phases have been reworked, reconnect the closing spring to the drive stud.

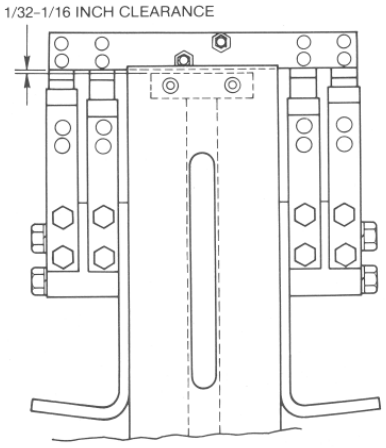

Figure 25.
Final contact clearance.

8. Check contact pressure.

A. Using a pressure gage as shown in Figure 26 check the contact pressure. Force on the gage rod must be applied at right angles to the contact surface. The force required to separate a stationary contact from its moving contact should be 7.5 ± 0.5 lb.

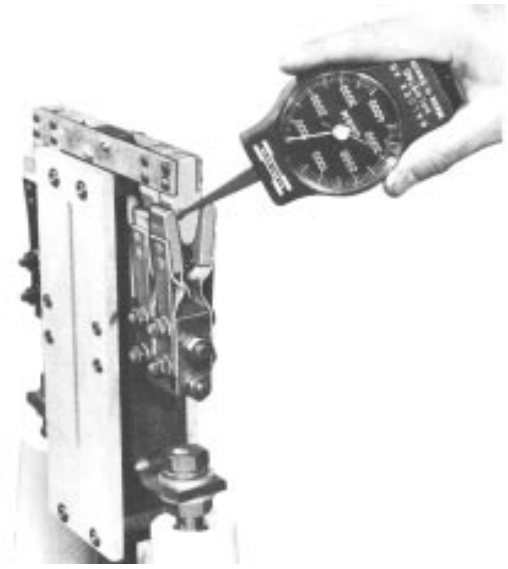

Figure 26.
Measuring fixed contact holding force.

NOTE: To help determine when the applied force causes contact separation, an electrical continuity check can be used. The faces of all contacts except the set being measured are isolated with strips of thin insulating material.

B. The separating force on a new set of contacts is generally greater than 7.5 lb. Therefore, the adjustment of new contacts will be in the direction of reducing contact pressure.

C. To reduce contact pressure:

(1) Insert a screwdriver between the stationary and moving contact tips and pry in the direction to move the stationary contact away from the moving contact tip. Adjust the pressure toward the high side.

NOTE: A “feel” for applying proper leverage is easily determined after the first trial. Make small changes in pressure until experience has been gained.

D. To increase contact pressure:

(1) With the switch open, bend each contact finger inward. Then close switch and repeat step C.

E. Equalize the pressure on each side of a set of contacts as closely as possible.

F. After all contact pressure adjustments have been made, check that the contacts have a gap of 1/4 (+1/32 -1/16) inch. (See Figure 27.)

9. Manually operate the switch a few times to observe contact alignment and clearances to verify that all parts have been properly secured.

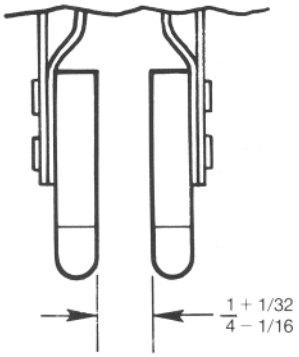

Figure 27.
Stationary contact gap.

TYPE VLR SWITCH

If it has been determined that the contacts must be replaced, refer to Figure 28 and proceed as follows:

1. Remove the movable contact yoke assembly.

A. Remove the stop nut and flat washer from the end of the contact rod.

B. Remove the yoke positioning spacers and drive out the roll pin.

C. Note the flat washer arrangement above and below the movable contact yoke. Be sure to replace in the same order.

D. Remove and discard the movable contact yoke assembly.

2. Remove the stationary contact as sembly.

A. Remove the brass hex nuts, lockwashers and flatwashers attaching the mounting brackets to the bushing rods.

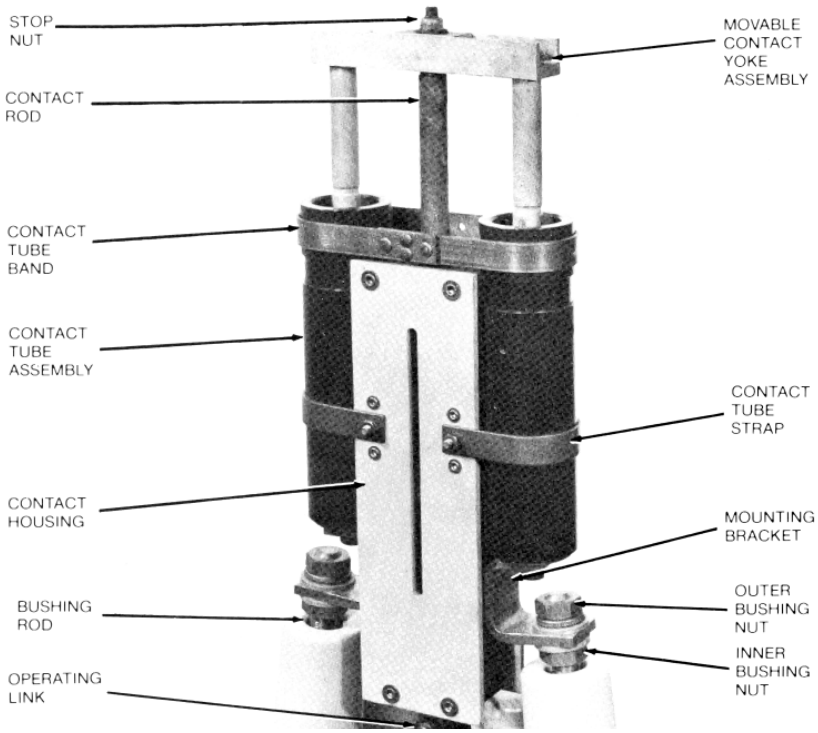

Figure 28.
Type VLR switch contact assembly.

B. Lift the entire contact housing assembly from the bushings and the contact rod, which remains attached to the operating link.

3. Disassemble the stationary contact assembly.

A. Remove the contact tube straps by removing the round head machine screw and associated hardware.

B. To free the contact tubes from the housing, grasp a tube firmly in each hand and with a slow steady movement spread the tubes away from the housing, as shown in Figure 29, until the band is released from the tubes.

C. Remove and discard the stationary contact tube assemblies.

4. Reassemble the stationary contact structure with new contact tube assemblies.

A. Use the reverse order of step 3B and Figure 29 to reassemble the tubes and tube band, making sure the notch in the tube lines up with the tab in the band.

B. Secure the tubes to the housing with the tube straps.

5. Reinstall the stationary contact structure into the switch.

A. Install the assembly over the contact rod and attach to the bushing rods with the flat washers, lockwashers, and brass nuts; do not tighten.

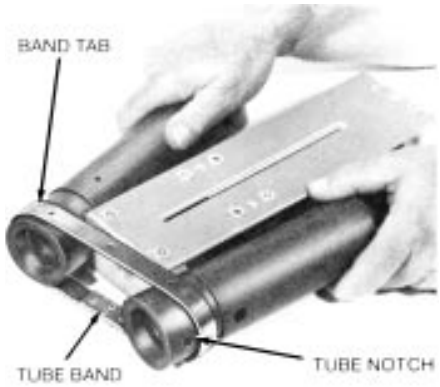

Figure 29.
Dismantling contact tubes.

6. Align the stationary contact assembly.

A. With the switch mechanism in the open position, the top of the dashpot piston on the contact rod should be 1/32 inch above the top surface of the dashpot. (See Figure 19.) Adjust the nuts on the bushing rod to move the contact housing up or down as required.

B. With a "sailboat" alignment fixture spanning the machined surfaces of the head casting, check the axial squareness of the contact housing as shown in Figure 30. obtain proper squareness by adjusting the bushing nuts while

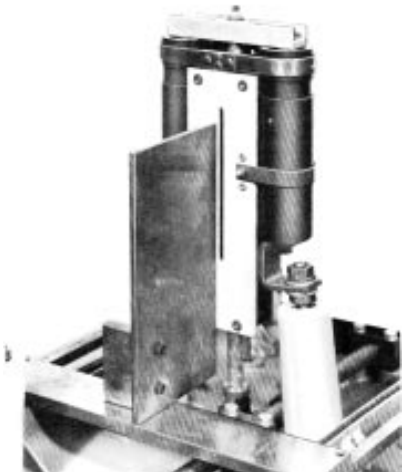

Figure 30.
Checking axial and longitudinal squareness with "sailboat" alignment fixture.

maintaining the alignment of step 6A.

NOTE: A typical sailboat alignment fixture is shown in Figure 31. If a fixture is not available the procedure for aligning VR and VCR contact boxes, described on page 31, can be used.

C. With the contact housing squared, tighten both outer bushing nuts securely without disturbing the position of the inner nuts.

D. Square the side of the contact housing with the head casting as shown in Figure 30. If misalignment exists, adjust by bending the entire structure as required.

7. Install and align the movable contact yoke assembly.

A. Replace the correct number of washers above and below the contact yoke as noted in Step 1 C during disassembly.

B. Reinstall roll pin, spacers, washer and stop nut to complete the reassembly.

C. Unhook the closing spring from the drive stud and manually crank the mechanism until the drive stud reaches the 7 o'clock position; approximately 42 revolutions.

D. Crank slowly from this point to bring moving contacts toward the stationary contacts.

NOTE: If switch is equipped with quickclose accessory, the mechanism will latch in the 7 o-clock position. To release, push the quick close solenoid plunger up into the solenoid.

E. As the moving contacts approach the stationary contacts observe their alignment. Misalignment can be corrected by twisting the

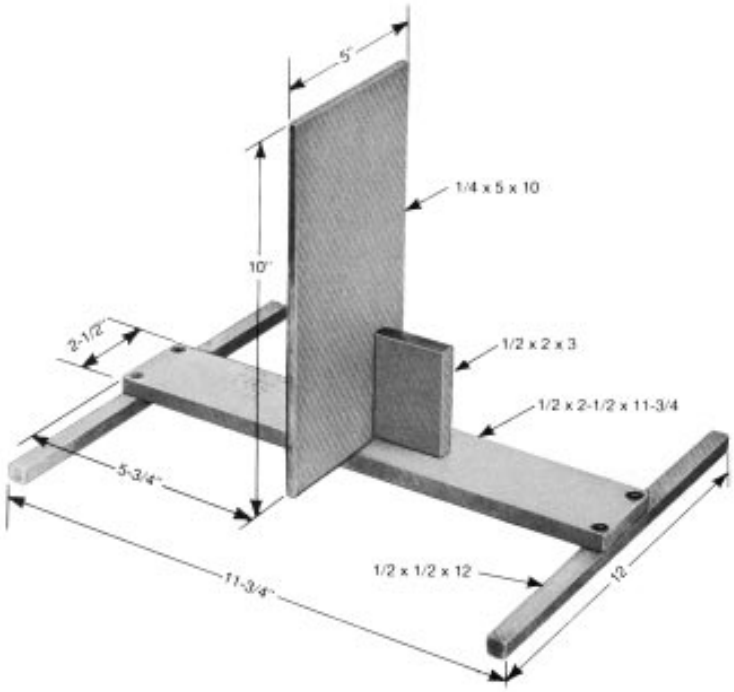

Figure 31.
Typical "sailboat" fixture for aligning contact housing.

rected by twisting the moving contact yoke about the contact rod. The link at the end of the rod will permit enough twist to obtain the adjustment required.

F. To confirm proper contact engagement, crank the mechanism to the fully closed position. Check clearance between the movable contact yoke and the top of the contact tubes as shown in Figure 32. Vary the number of washers above and below the yoke assembly to obtain the proper clearance.

G. Manually trip open the switch and reattach the closing spring.

8. Manually operate the switch a few times to observe contact alignment and clearances to verify that all parts have been properly secured.

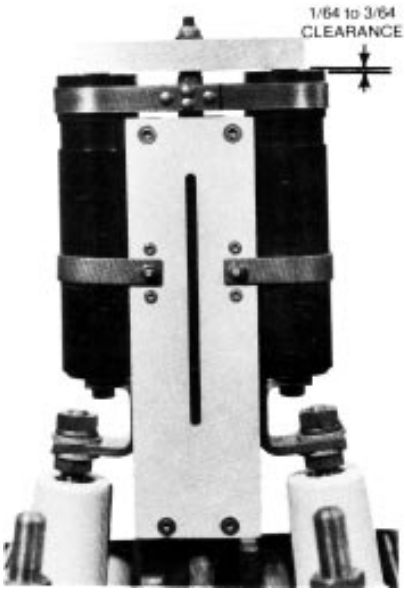

Figure 32.
Type VLR switch contact engagement.

Actuator Mechanism

Normally, little maintenance is required on the actuator mechanism. However, periodic checks should be made to assure trouble-free operation.

ELECTRICAL COMPONENTS

If the switch does not operate electrically but can be manually opened and closed, check the electrical components.

1. Make a continuity check for broken or loose wiring.

2. Manually operate the miniature control switches and check contact operation.

3. Apply rated operating voltage to the motor and solenoids to verify their operation.

Replace any components or wiring found defective. The connection diagram for the standard operator is shown in Figure 33; and for the quick-close operator in Figure 34.

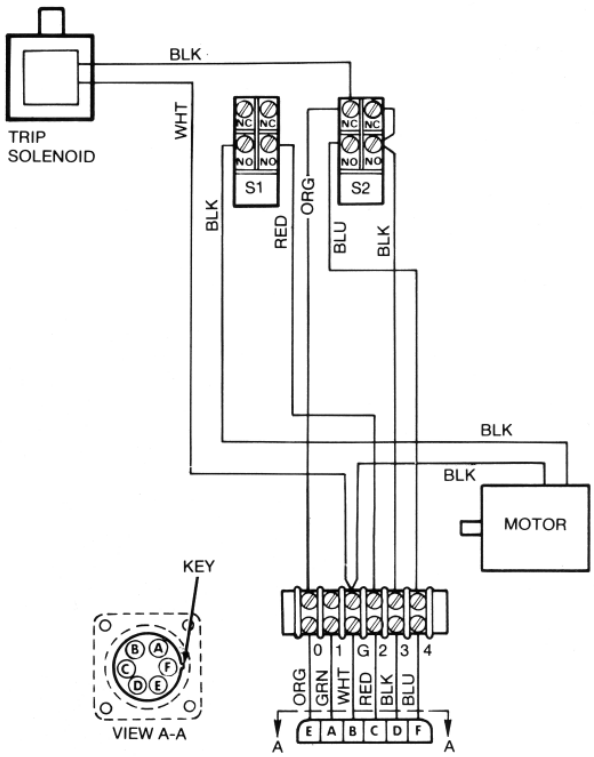

Figure 33.
Connection diagram for standard operator.

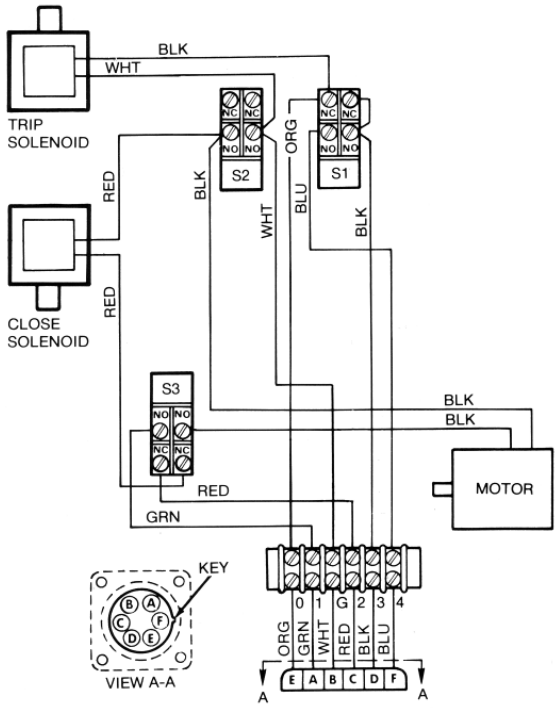

Figure 34.
Connection diagram for quick-close operator.

TRIP SOLENOID

If the trip solenoid plunger becomes rusted, it can be cleaned with crocus cloth. A severely eroded plunger and/or frame, or a faulty solenoid necessitates the replacement of the entire trip solenoid assembly. Proceed as follows:

1. Remove the speed-nut and washer-from the upper end of the manual trip rod to free the trip solenoid mounting plate.

2. Remove the screws and lockwashers attaching the mounting plate to the speed reducer frame, and lift out the mounting plate as shown in Figure 35.

3. To replace the solenoid assembly, first remove the retaining ring attaching the plunger link to the toggle lever, then cut the black solenoid leads close to the coil and remove the attaching hardware to free the solenoid frame from the mounting plate.

4. Install new solenoid assembly, reconnect the plunger link to the toggle trip lever, and secure with a C-ring. Splice the white and black leads to the solenoid leads.

5. Attach mounting plate to the speed reducer frame and reinstall the washer and speed-nut to the upper end of the manual trip rod. Be sure the crook of the pull rod extends above the plunger pin.

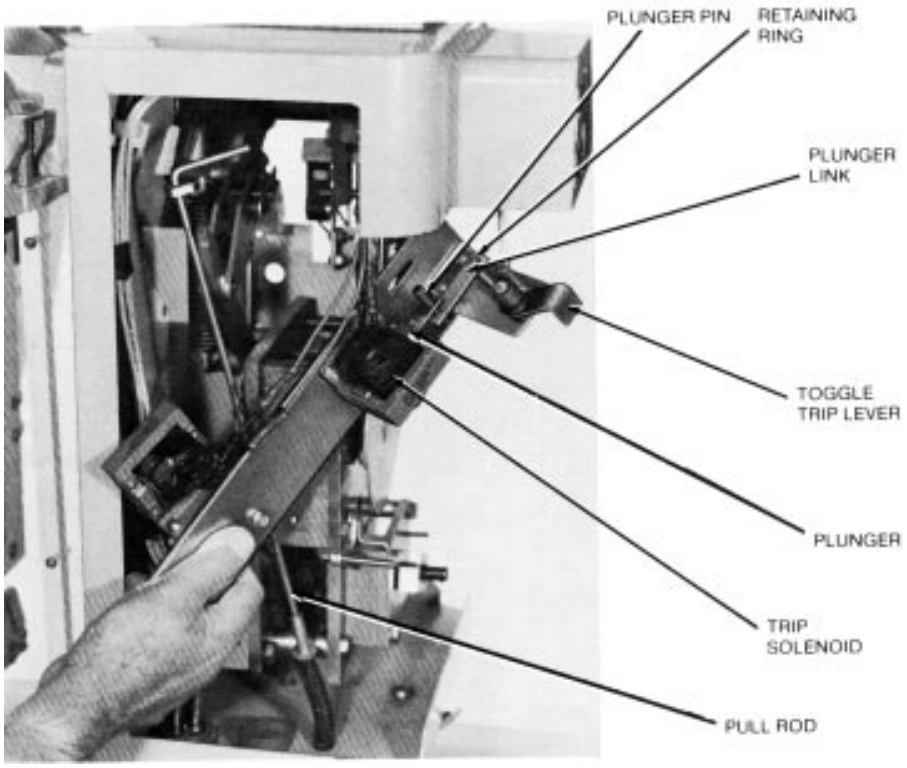

Figure 35.
Detaching mounting plate.

MOTOR REPLACEMENT

The actuator motor used in Type VR, VCR, and VLR switches with serial numbers below those listed in Table 4 is no longer available. To adapt the new motor to these switches a motor replacement kit, KA725VR, is available. The kit includes the new motor and all parts required for the adaptation. Replacement instructions are included with the kit.

Switches with serial numbers above those referenced in Table 4 have the new design motors installed during manufacture and do not require the replacement kit. They may be replaced directly on a one-to-one basis.

To replace a motor simply disconnect the motor leads and remove the attaching hardware. Make sure the drive gear on the motor shaft meshes correctly with its mating reduction gear when installing the new motor.

Table 4
Switches Requiring Motor Replacemnt Kit.

Type	Below Serial Number
VR	2809
VCR	2344
VLR	1208

SPEED REDUCER

Speed reducer maintenance is limited to a periodic greasing of gears with an allweather, non-freezing grease. If speed reducer must be replaced, refer to Figure 36 and proceed as follows:

1. With the main switch contacts open, remove the closing spring from the crank lever drive pin.
2. Disconnect the two black motor leads.
3. Remove the pull rod and the mounting plates. See page 45.
4. Remove the C ring, identified in Figure 37, to free the toggle assembly pin. Raisethetripleverandpulloutthepin, releasing a spacer and freeing the spring link and toggle from the shaft lever.

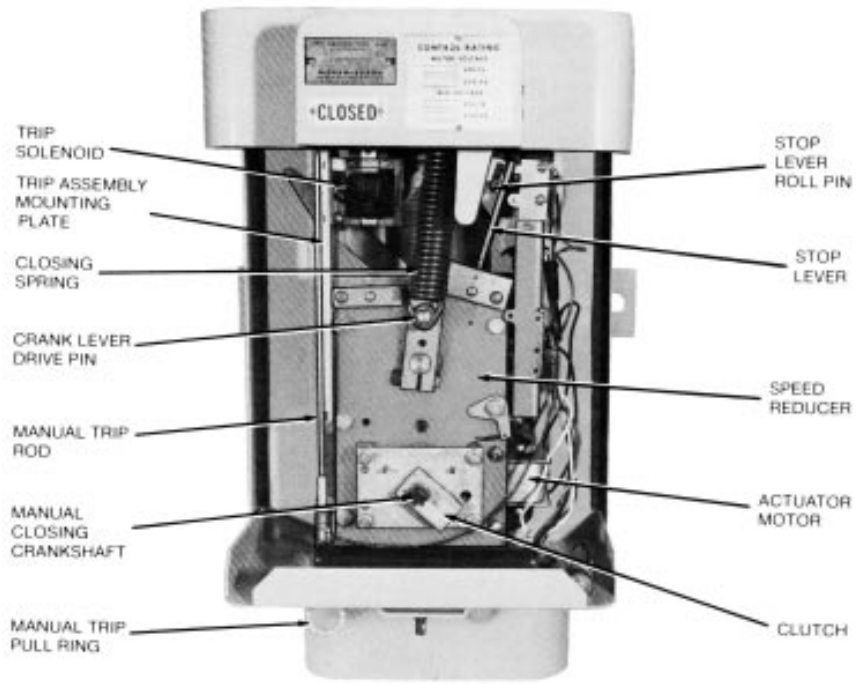

Figure 36.
Actuator parts identification.

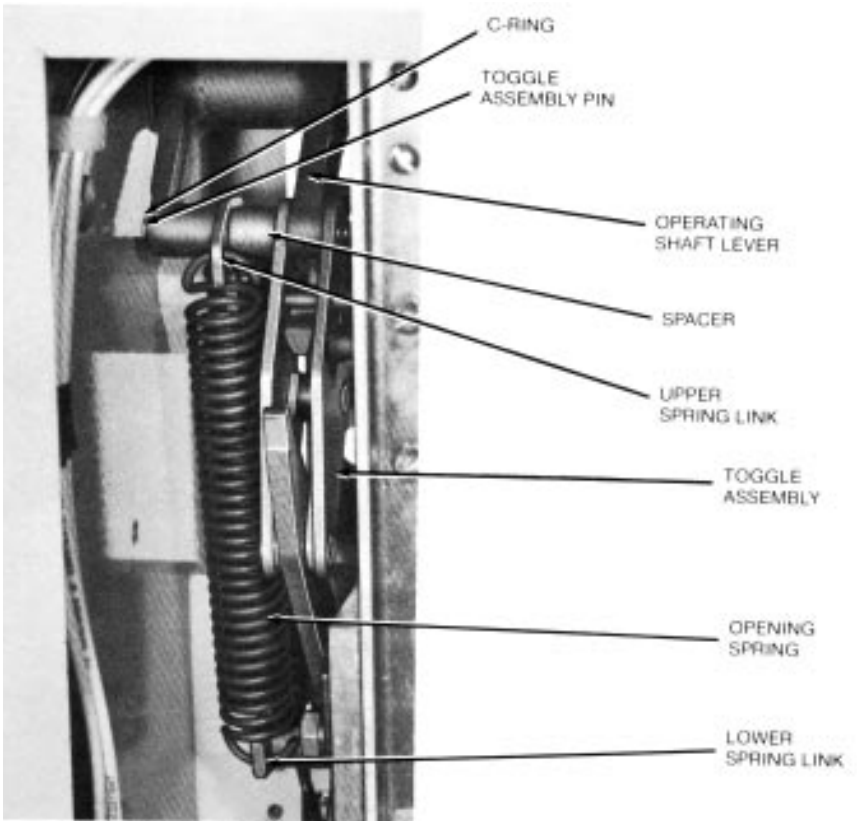

Figure 37.
Operating shaft lever attachement.

5. Remove hexhead screws that secure the speed reducer to the actuator housing.

6. Lift out the speed reducer with toggle assembly and opening springs attached as shown in Figure 38. Remove the springs from the lower spring link.

7. Remove the C ring to release the flat washer, lower spring link, spacer and toggle assembly from the toggle shaft. Remove C ring and closing spring bushing from the crank lever.

8. Replace spring link and spacer on toggle shaft of new speed reducerand secure with C ring. Attach opening springs to spring link.

CAUTION: Stop bolt, for operating shaft lever, is factory set and should never be readjusted.

9. Install new speed reducer in actuator housing. Moderately tighten hexhead screws. Be sure latch lever is positioned behind stop-lever roll pin as shown in Figure 36.

10. Lift trip lever and insert toggle pin to secure toggle, spacer, and upper spring link to shaft lever. Secure pin with C ring. Attach opening springs to upper spring link. Be sure toggle, spacer, and link are positioned as in Figure 37.

11. Attach mounting plate to speed reducer frame. Slip pull rod through mounting plate slot and secure with speed nut and washer.

12. Tighten hexhead screws that secure speed reducer to actuator housing.

13. Install closing spring bushing and secure with C ring.

14. Attach closing spring onto crank lever drive pin. Operate actuator mechanism manually with crank to close contacts. Open contacts with manual trip rod. Repeat operation of actuator mechanism electrically and check for proper operation.

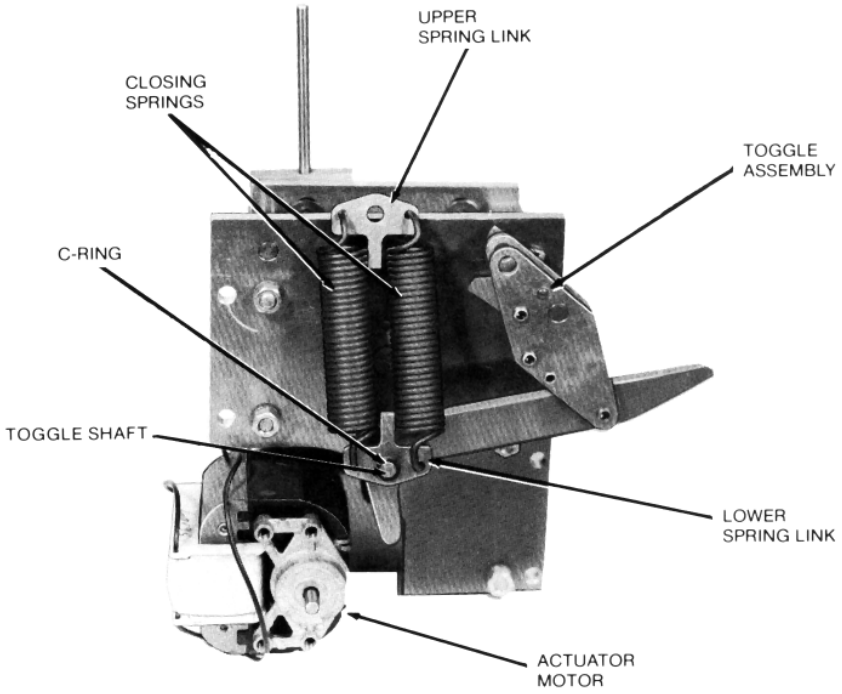

Figure 38.
Detached speed reducer.

SERVICE PARTS LIST

The service parts and hardware listed and illustrated include only those parts and assemblies usually furnished for repair or involved in the maintenance procedures described in this manual. Further breakdown of listed assemblies is not recommended.

Dimensions of all common hardware parts have been carefully checked so that they may be locally acquired. The suffix letter of the 14 character catalog number for common hardware parts codes the plating of the part:

A—No plating; raw material
H—Silver
M—Black oxide
Q—Cadmium + zinc + chromate
Y —Zinc + chromate
Z —Electro zinc + bronze irridite

A hardware kit, Catalog No. KA849R1, contains an assortment of roll pins, cotter pins, retaining rings, stop nuts, etc.— common hardware parts used in Cooper Power Systems switches that may not be readily locally available.

To assure correct receipt of any part order, always include switch type and serial number. Because of Cooper Power Systems continuous improvement policy, there may be instances where the parts furnished may not look exactly the same as the parts ordered. However, they will be completely interchangeable without any rework of the recloser.

All parts carry the same warranty as any whole item of switchgear, i.e. against defects in material or workmanship within a period of one year from date of shipment.

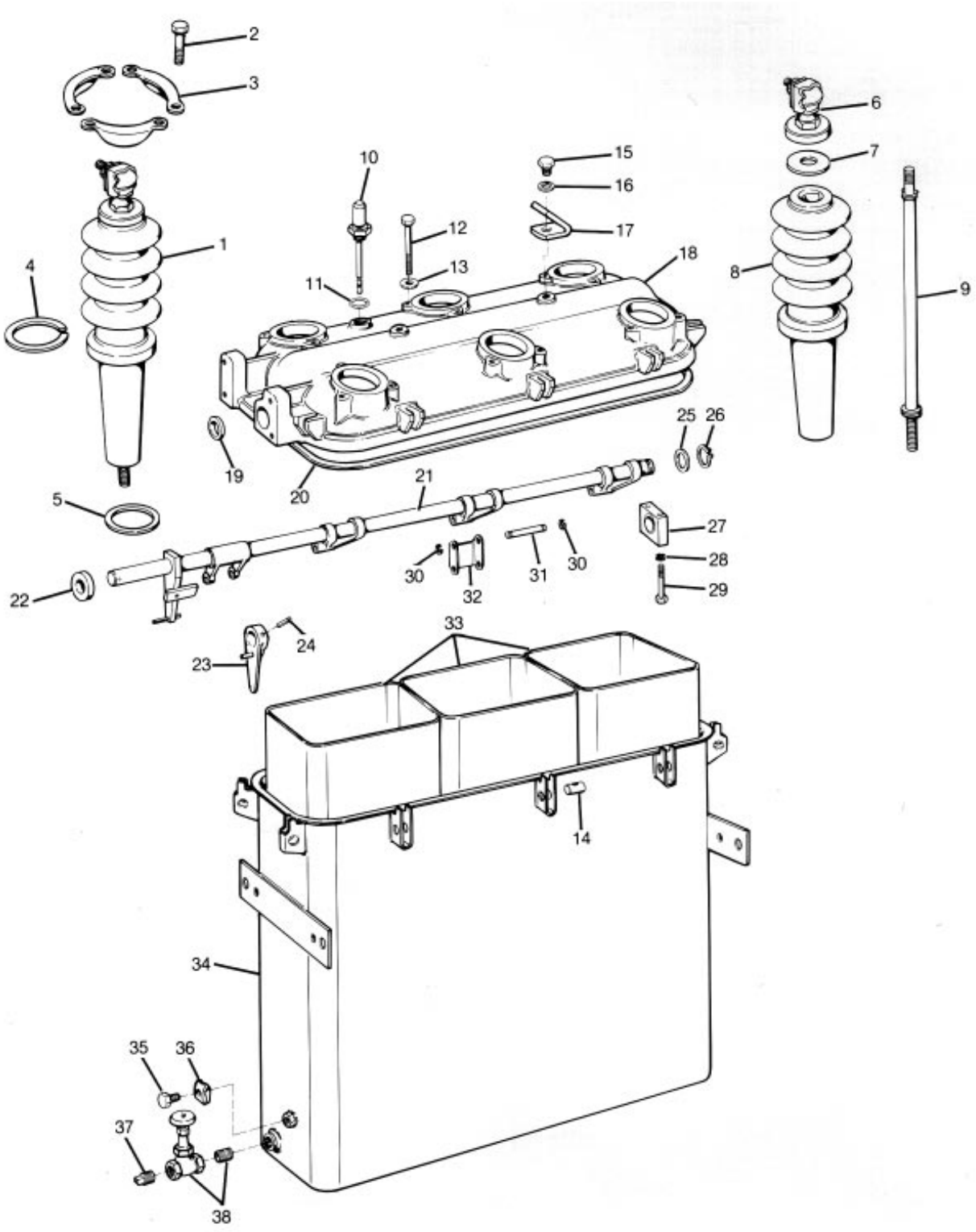

Figure 39.
Tank and head assembly parts.

Tank and Head Assembly Parts (Figure 39)

Item No.	Description	Catalog Number	Qty. Per Assy.
1	Bushing assembly, complete (includes items 6, 7, 8 and 9)		
	Standard creepage	KA160E7	6
	17-inch creepage	KA160E8	6
2	Capscrew, hex hd, 3/8-16 x 1-5/8, stl	K730101137162Q	18
3	Bushing clamp	KP41L	18
4	Clamping ring	KP121L	6
5	Lower bushing gasket	KP2020A29	6
6	Terminal	KA143L900	1
7	Terminal gasket	KP2090A57	1
8	Ceramic bushing		
	Standard creepage	KP130VR	1
	17-inch extra creepage	KP318VR	1
9	Bushing rod	KA160E907	1
10	Vented dipstick	KA213VR	1
11	O-ring gasket	KP2000A46	1
12	Capscrew, hex hd, 3/8-16 x 3, stl	K73101137300Q	10
13	Washer	KP2028A23	10
14	Combination nut and pin	KP3061A3	10
15	Capscrew, hex hd,1/2-13 x 1-1/4, stl	K730101150125Q	2
16	Split lockwasher, med,1/2, stl	K900801050000Z	2
17	Lifting lug	KP456H1	2

Item No.	Description	Catalog Number	Qty. Per Assy.
18	Head casting (includes operating shaft bushing)	KA701VR	1
19	Oil seal	KP259VR	1
20	Head gasket	KP2103A6	1
21	Shaft and levers assembly	KA23VR	1
22	Rubber seal	KP2090A44	1
23	Indicator	KA19VR	1
24	Roll pin, 3/16 x 1-1/8, stl	K970801187112M	1
25	Washer	KP164VR	1
26	External retaining ring	KP2013A1	1
27	Shaft bearing	KP88VR	1
28	Split lockwasher, med, 5/8, stl	K900801062000Q	6
29	Capscrew, hex hd, 5/8-18 x 2, stl	K730101162200Q	6
30	Retaining ring, Type C, 1/4 stl (WA514)	K970901250000M	6
31	Pin	KP3124A18	3
32	Contact operating link	KP17VR	3
33	Tank liner kit	KA761H3-2	1
34	Tank assembly	KA3VCR	1
35	Capscrew, hex hd, 1/2-13 x 1, stl	K730101150100Q	1
36	Parallel ground clamp	KA227H	1
37	Pipe plug 1/2, sq hd	KP2007A3	1
38	Oil sampling and drain valves	KA809R	1

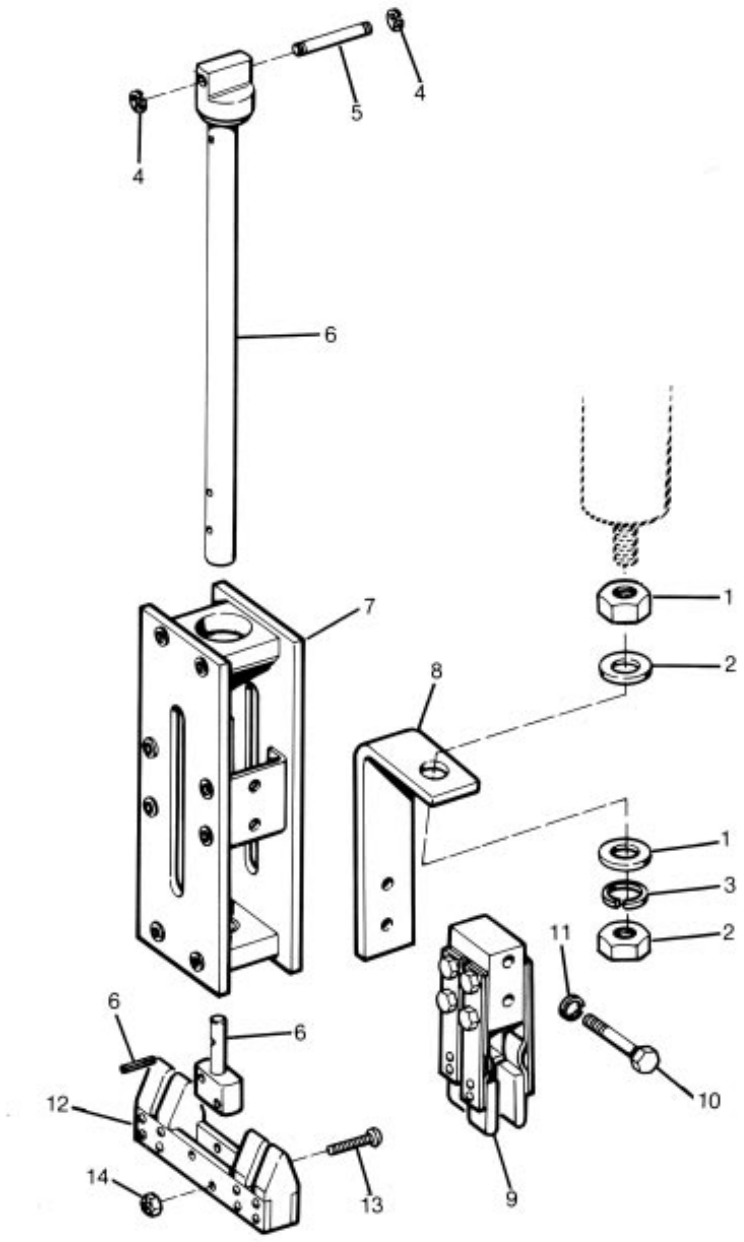

Figure 40.
Type VR contact assembly parts.

Type VR Contact Assembly Parts (Figure 40)

Item No.	Description	Catalog Number	Qty. Per Assy.
1	Hex jam nut, light, 5/8-18, brass	K880725318062A	4
2	Washer	KP2028A45	4
3	Split lockwasher, med, 5/8, bronze	K900830062000A	2
4	Retaining ring, Type C, 1/4, stl (WA514)	K970901250000M	2
5	Pin	KP31 24A18	1
6	Contact rod assembly	KA200VR	1
	Stationary contact assembly complete (includes items 7 through 11)	KA199VR1	1

Item No.	Description	Catalog Number	Qty. Per Assy.
7	Contact housing support assembly	KA211 VR1	1
8	Mounting bracket	KP134VR1	2
9	Stationary contact assembly	KA209VR	2
10	Capscrew, hex hd, 5/16-18 x 2-1/4, stl	K730101131225A	4
11	Split lockwasher, med, 5/8, stl	K900801062000A	4
12	Movable contact assembly	KA201VR	1
13	Machine screw, rd hd, 10-32 x 1, stl	K721501310100A	2

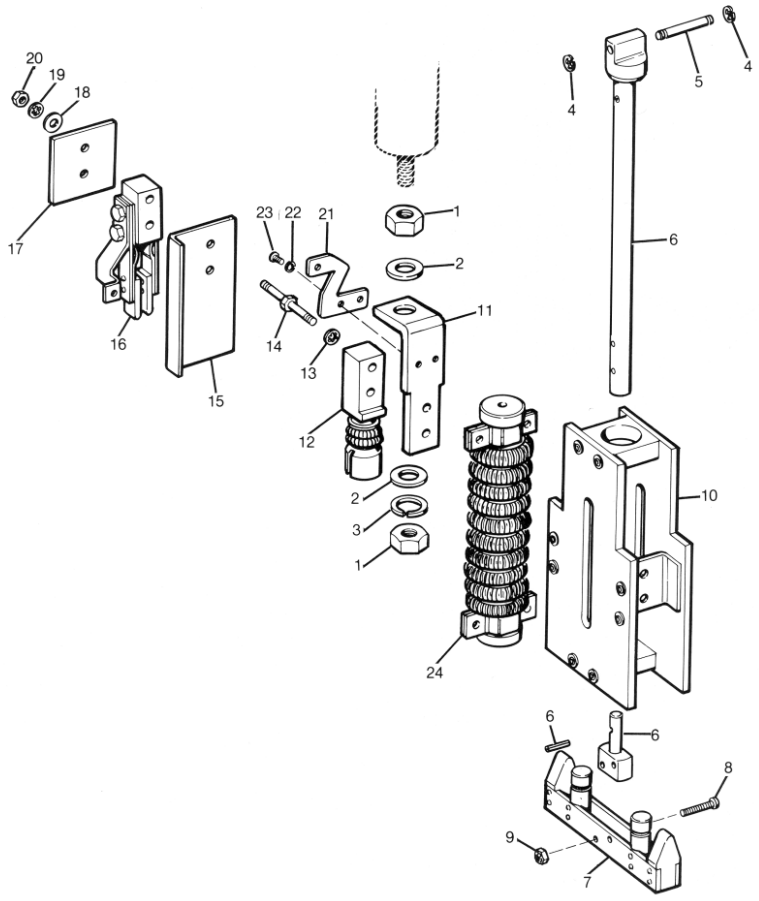

Figure 41.
Type VCR contact assembly parts.

Type VCR Contact Assembly (Figure 41)

Item No.	Description	Catalog Number	Qty. Per Assy.
1	Hex jam nut, light, 5/8-18 brass	K88072S318062A	4
2	Washer	KP2028A45	4
3	Split lockwasher	K9008300620000A	2
4	Retaining ring, Type C, 1/4, stl (WA514)	K970901250000M	2
5	Pin	KP3124A18	1
	Contact assembly, complete (includes items 6 through 24)	KA704VCR	1
6	Contact rod assembly	KA200VR	1
7	Movable contact assembly	KA36VCR	1
8	Machine screw, rd hd, 10-32 x 1, stl	K721501310100A	2
9	Elastic stop nut, 10-32	KP2020A1	2
	Stationary contact assembly complete (includes items 10 through 24)	KA30VCR	1
10	Contact support assembly	KA34VCR	1
11	Mounting bracket	KP134VR2	2
12	Stationary contact assembly, load	KA32VRC	2
13	Internal tooth lockwasher 5/16 sil brz	K901033031000A	4
14	Double-ended stud	KP138VCR	4
15	Plate, right hand	KP127VCR1	1
	Plate, left hand	KP127VCR2	1
16	Stationary contact assembly, arcing		
	Right hand	KA33VCR1	1
	Left hand	KA33VCR2	1
17	Plate	KP128VCR	2
18	Plain washer, 5/16, SAE, stl	K900201031000A	4
19	Internal tooth lockwasher, 5/16, sil brz	K901033031000A	4
20	Hex nut, 5/16-18, stl	K881001118031A	4
21	Resistor mounting bracket right hand	KP118VCR901	1
	Resistor mounting bracket, left hand	KP118VCR902	1
22	Split lockwasher, med, No. 8, stl	K900801008000A	4
23	Machine screw rd hd 8-32 x 7/16, stl	K721501108043A	4
24	Resistor, 3.2 ohms (Cutler Hammer G3AL320)	K999904250136A	2

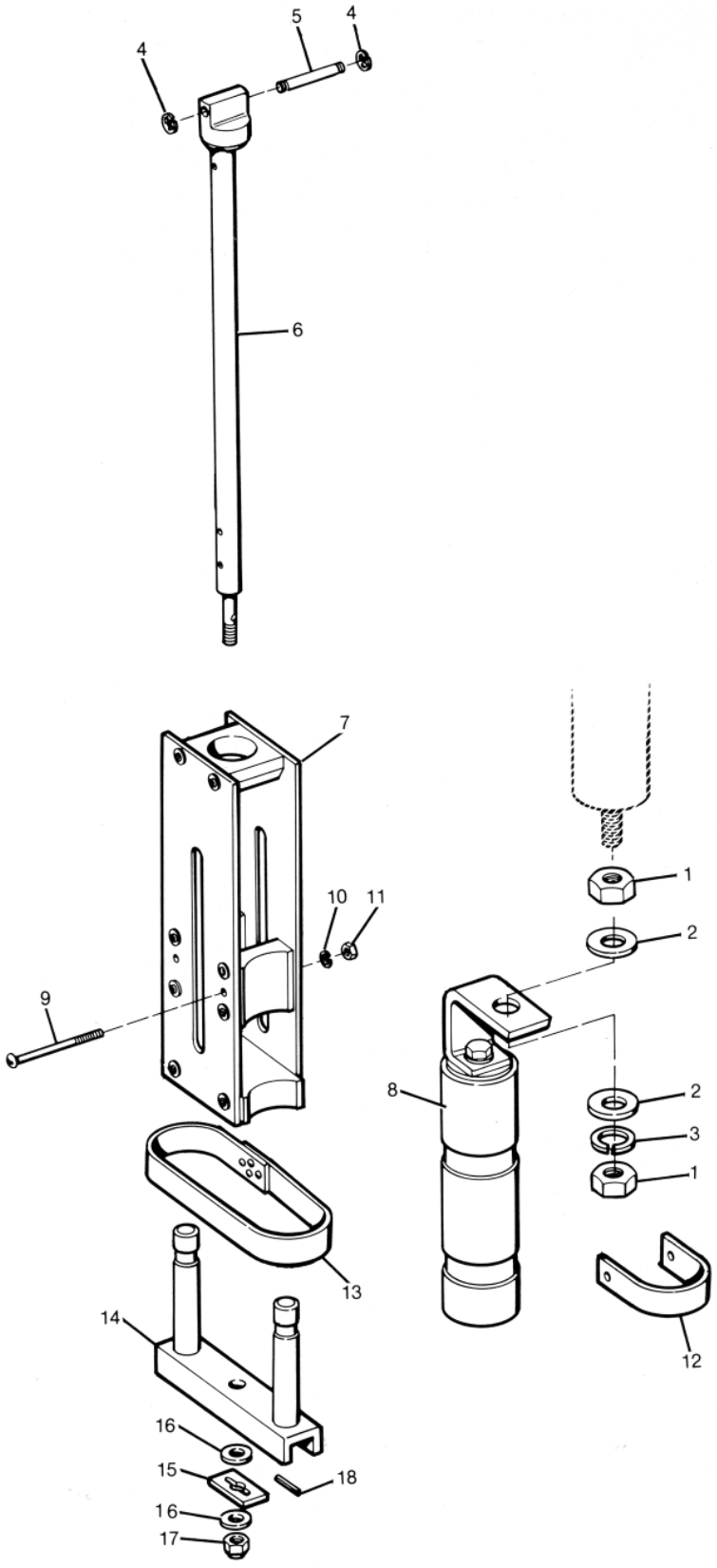

Figure 42.
Type VLR contact assembly parts.

Type VLR Contact Assembly (Figure 42)

Item No.	Description	Catalog Number	Qty Per Assy.
1	Hex jam nut, light, 5/8-18, brass	K880725318062A	4
2	Washer	KP2028A4S	4
3	Split lockwasher, med, 5/8 bronze	K900830062000A	2
4	Retaining ring, Type C 1/4 stl (WAS14)	K970901250000M	2
5	Pin	KP3124A18	1
6	Contact rod assembly	KA5VLR	1
	Stationary contact assembly complete (includes items 7 through 13)	KA4VLR1	1
7	Contact housing support	KA3VLR	1
8	Stationary contact housing assembly	KA7VLR 1	2

Item No.	Description	Catalog Number	Qty. Per Assy.
9	Machine screw, rd hd, 10-32 x 2-1/2, stl	K721501310250A	2
10	Split lockwasher, med No. 10, stl	K900801010000Z	2
11	Hex nut, 10-32, stl	K881001332010A	2
12	Tube strap	KP111 VLR	2
13	Contact tube band	KA98VR	1
14	Movable contact yoke assembly	KA16VLR	1
15	Spacer	KP1505R	1
16	Plain washer, 5/8 SAE, steel	K900201031000A	4
17	Stop nut	KP2020A4	1
18	Roll pin, 1/8 x 13/16	K970801125081M	1

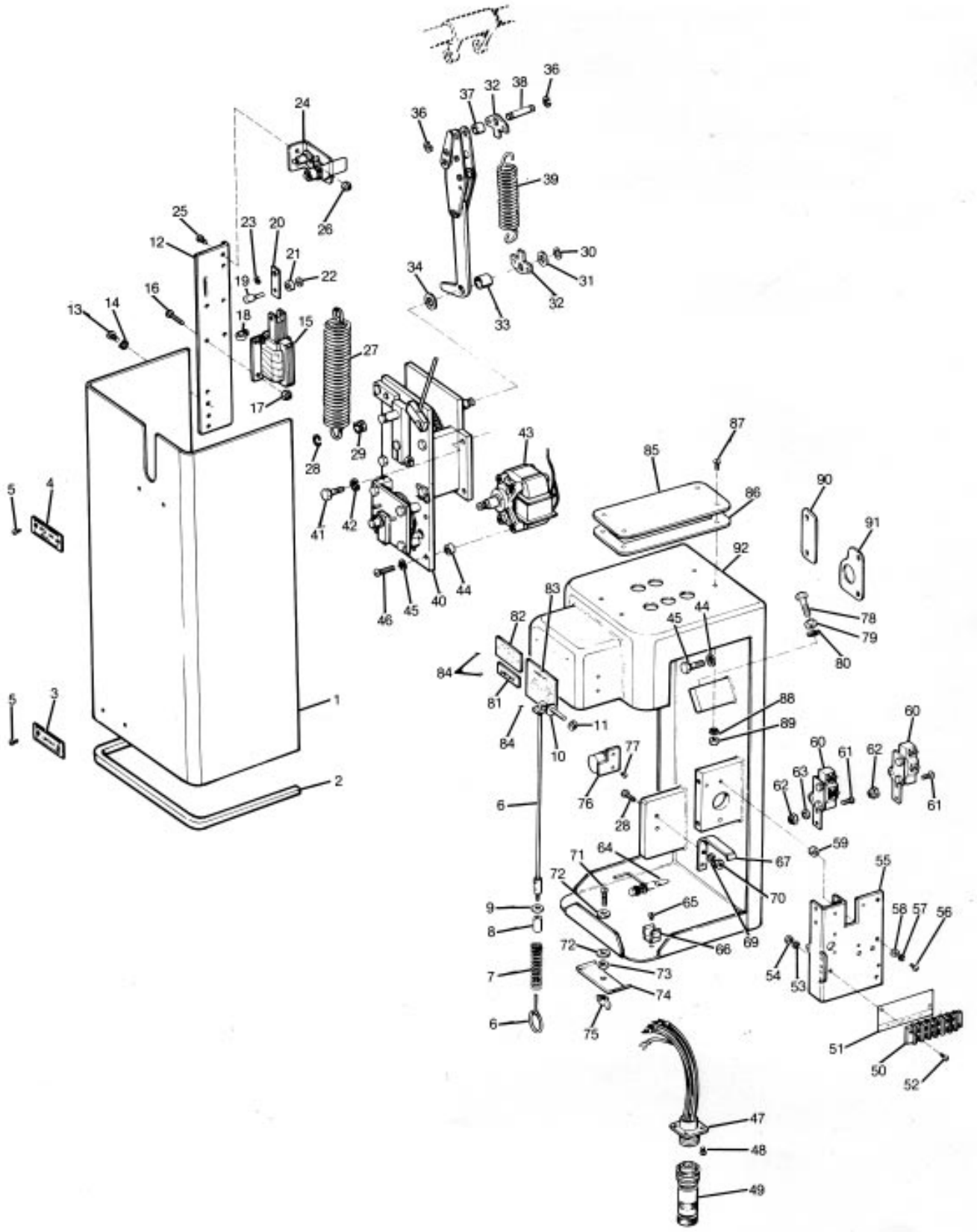

Figure 43.
Actuator mechanism parts.

Actuator Mechanism Parts (Figure 43)

Item No.	Description	Catalog Number	Qty. Per Assy.
1	Cover	KP129VR	1
2	Cover gasket	KP2084A1	1
3	Plate, MANUAL TRIP	KP245VR	1
4	Plate, OPEN	KP730R	1
5	Self-tap screw, rd hd, Type Z, No. 2 x 3/16, sst	K801515002018A	4
6	Manual trip assembly	KA65VR900	1
7	Spring	KP157VR	1
8	Spacer	KP3007A8	1
9	Plain washer, 1/4 AN, stl	K900201026050Z	1
10	Plain washer, No. 10S, brass	K900525020043A	1
11	Speed nut	KP2005A1	1
12	Mounting plate	KP87VR	1
13	Machine screw, rd hd, 10-32 x 3/4, sst	K721515310075A	2
14	Split lockwasher, med, No. 10, stl	K900801010000Z	2
15	Trip solenoid assembly		
	120 vac	KA185VR1	1
	125 vdc	KA185VR2	1
	48 vdc	KA185VR3	1
	24 vdc	KA185VR4	1
16	Machine screw, 10-32 x 1/2, stl	K72150130050Z	4
17	Elastic stop nut, 10-32	KP2020A1	4
18	Nylon wire clip	KP2006A1	1
19	Pin	KP314VR	1
20	Link	KP83VR	1
21	Spacer	KP3004A24	1
22	Plain washer, No. 6 SAE, stl	K900201006000Z	1
23	Retaining ring, Type C, 1/4, stl (WA514)	K970901250000M	1
24	Support and lever assembly	KA41VR	1
25	Machine screw, 10-32 x 1/2, stl	K721501310050Z	2
26	Elastic stop nut, 10-32	KP2020A1	2
27	Closing spring	KP533GW	1
28	Retaining ring, Type C, 3/8, stl (WA518)	K970901375000M	1
29	Sleeve	KP280VR	1
30	Retaining ring, Type C, 5/16, stl (WA516)	K970901312000M	1
31	Plain washer, No. 20S, brass	K900525312000A	1
32	Spring link	KP31VR	2
33	Spacer	KP3011A6	1
34	Plain washer, 1/2, brass	K900525056125A	1
35	Toggle assembly	KA11 VR1	1
36	Retaining ring Type C, 5/16, stl	K970901312000A	2
37	Spacer	KP3010A7	1
38	Pin	KP3125A7	1
39	Opening spring	KP35VR	2
40	Speed reducer (includes items 42 through 45)	KA32VR	1
41	Capscrew, hex hd, 5/16-18 x 3/4, stl	K731001131075Q	4
42	Split lockwasher, med, 5/16, stl	K900801031000Z	4
43	Motor assembly	KA225VR	1
44	Spacer	KP3009A159	3
45	Split lockwasher, med, 14, stl	K900801025000Z	3
46	Machine screw, rd hd, 1/4-28 x 1 -18, stl	K721501325112Q	3
47	Receptacle assembly	KA129VR	1
48	Self tap screw, rd hd, Type Z, No. 6 x 3/8, stl	K801515006037A	4

Item No.	Descrliption	Catalog Number	Qty. Per Assy.
49	Plug assembly	KA98NR	1
50	Terminal strip	KP2101A7	1
51	Marker	KP40VR	1
52	Machine screw, rd hd, 8-32 x 3/4, stl	K721501108075Z	2
53	Split lockwasher, med, No. 8, stl	K900801008000Z	2
54	Hex nut, 8-32, stl	K881001132008Z	2
55	Switch mounting panel	KP344VR	1
56	Machine screw, rd hd, 100-32 x 3/4, stl	K721501310075Z	3
57	Split lockwasher, med, No. 10, stl	K900801010000Z	3
58	Plain washer, No. 10, stl	K900201010000Z	3
59	Spacer	KP3007A37	3
60	Switch and latch assembly	KA182VR900	2
61	Machine screw, rd hd, 8-32 x 1/2, stl	K721501108050Z	4
62	Elastic stop nut, 8-32	KP2020A5	4
63	Spacer	KP3007A35	2
64	Crank assembly	KP141VR	1
65	Self-tap screw, pan hd,.10-32 x 1/8, sst	KP751717110037A	1
66	Mounting clip	KP1091ME	1
67	Latch-in spring	KP72VR	1
68	Machine screw, rd hd, 10-32 x 7/8, stl	K721501310087Z	2
69	Split lockwasher, med, No. 10 stl	K900201010000Z	2
70	Hex nut, 10-32, stl	K881001332010Z	2
71	Machine screw, rd hd, 5/16-18 x 1-1/4, brass	K721525131125A	1
72	Flat washer, 5/16 AN, stl	K900201032056Z	2
73	Hex nut, 5/16-28, stl	K880201118031Q	1
74	Latch	KP268VR	1
75	Wing nut	K881201118031Z	1
76	Counter assembly	KA28C03	1
77	Self-tap screw, rd hd, No. 6 x 3/8, sst	K801515006037A	2
78	Capscrew, hex hd, 3/8-16 x 1-1/2, stl	K730101137150Q	1
79	Hex nut, 3/8-16, stl	K880201116037Q	1
80	Split lockwaser, med, 3/8, stl	K900801037000Z	1
81	Plate, CLOSED	KP729R	1
82	Nameplate	KP131 VR	1
83	Control rating plate	KP289VR1	6
84	Self-tap screw, rd hd, Type Z, No. 2 x 3/16, stl	K801515002018A	6
85	Cover	KP158VR	1
86	Gasket	KP649VR	1
87	Machine screw, rd hd, 10-32 x 3/4, sst	K721515310075A	4
88	Split lockwasher, med, No. 10, stl	K900801010000Z	4
89	Hex nut, 10-32, stl	K880201332010Z	4
90	Gasket	KP78VR	1
91	Gasket	KP77VR	1
92	Mechanism housing	KA230VR1	1
93	Capscrew, hex hd, 3/8-16 x 1, stl	K730101137100Q	4
94	Split lockwasher, med, 3/8, stl	K900801037000Z	4

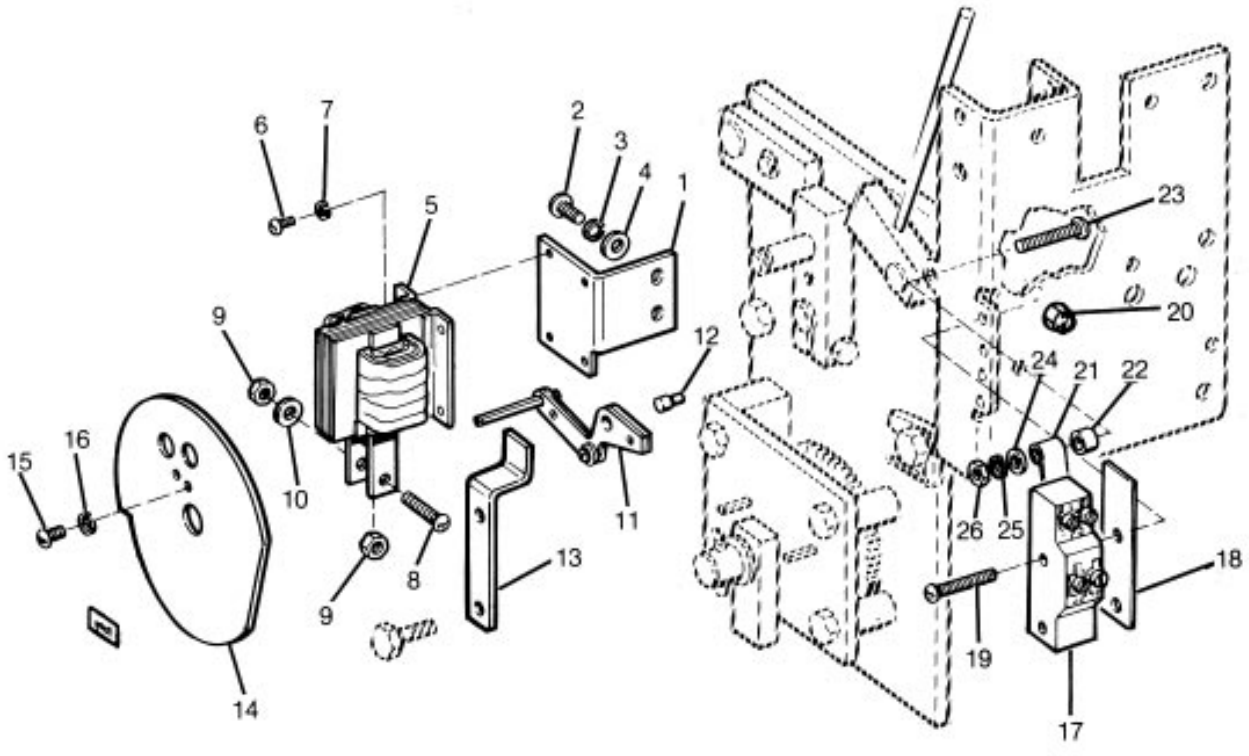

Figure 44.
Quick-close mechanism parts.

Type VR Contact Assembly Parts (Figure 40)

Item No.	Description	Catalog Number	Qty. Per Assy.
1	Bracket	KP188VR	1
2	Machine screw, rd hd, 10-32 x 3/4, stl	K721501310075Z	2
3	Split lockwasher, med, No. 10, stl	K900801010000Z	2
4	Plain washer, No. 10 SAE, brass	K900225010000Z	2
5	Solenoid assembly, 120 vac	KA185VR1	1
6	Machine screw. rd hd, 10-32 x 5/16, stl	K721501310031Z	2
7	Split lockwasher, med, No. 10, stl	K900801010000Z	2
8	Machine screw, rd hd, 8-32 x 1, stl	K721501108100Z	1
9	Hex nut, 8-32, stl	K881001132008Z	2
10	Plain washer, No. 8S, brass	K900525014031A	1
11	Latch assembly	KA72VR	1
12	Pin	KP185VR	1

Item No.	Description	Catalog Number	Qty. Per Assy.
13	Bracket	KP186VR	1
14	Cam	KP312VR	1
15	Machine screw, rd hd, 1/4-20 x 1 /2, stl	K721501125050Z	1
16	Split lockwasher, med, 1/4	K900801025000Z	1
17	Miniature switch	KP2181A13	1
18	Insulation	KNC1070A1	1
19	Machine screw, rd hd, 6-32 x 1, stl	K721501106100Z	2
20	Elastic stop nut, 6-32	KP2020A6	2
21	Latch assembly	KA204VR900	1
22	Spacer	KP3032A11	1
23	Machine screw, 6-32 x 1, brass	K721525106100A1	1
24	Plain washer, No. 6S, brass	K900525017037A	1
25	Split lockwasher, med, No. 6, sil brz	K900830006000A	1
26	Hex nut, 6-32 brass	K881025132006A	1

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