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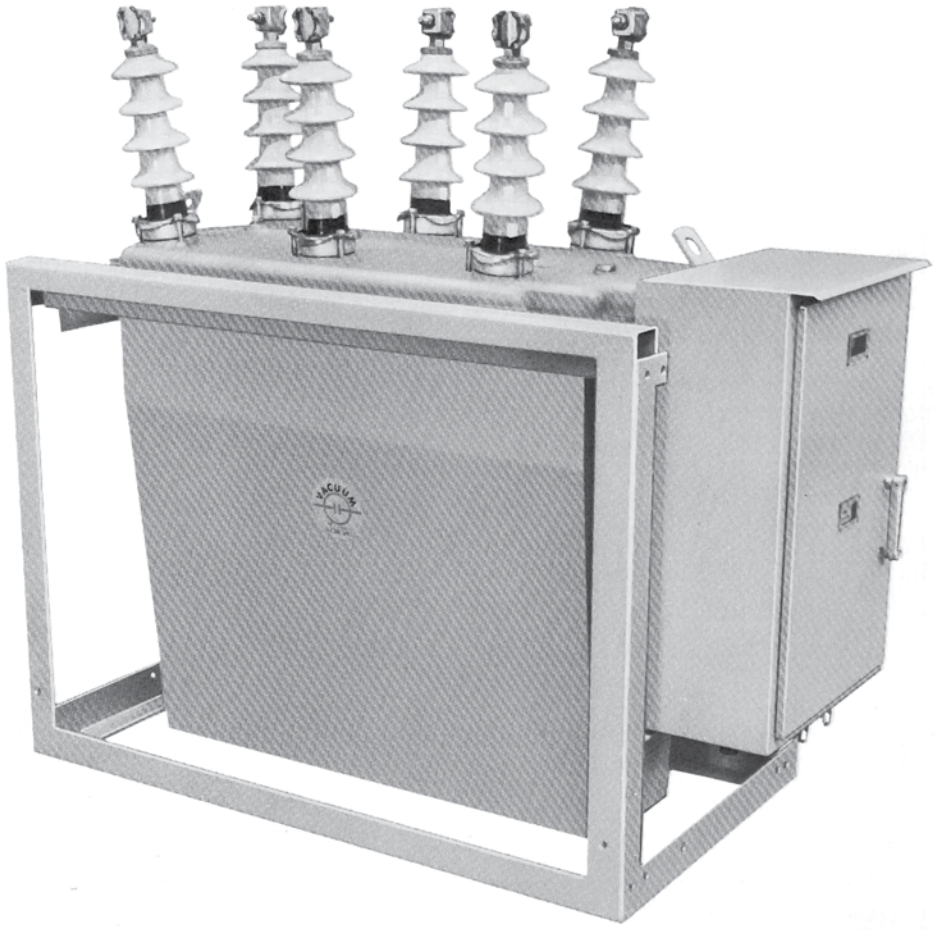
Type VSO maintenance instructions



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Safety for life

Eaton meets or exceeds all applicable industry standards relating to product safety in its Cooper Power™ series products. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Eaton employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment, and support our "Safety For Life" mission.

Safety information

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it.

A competent technician has these qualifications:

- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as arc flash clothing, safety glasses, face shield, hard hat, rubber gloves, clampstick, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statements:

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

Safety instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

DANGER

Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment. G103.3

WARNING

Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage. G101.0

WARNING

This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage. G102.1

WARNING

Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage. G122.3

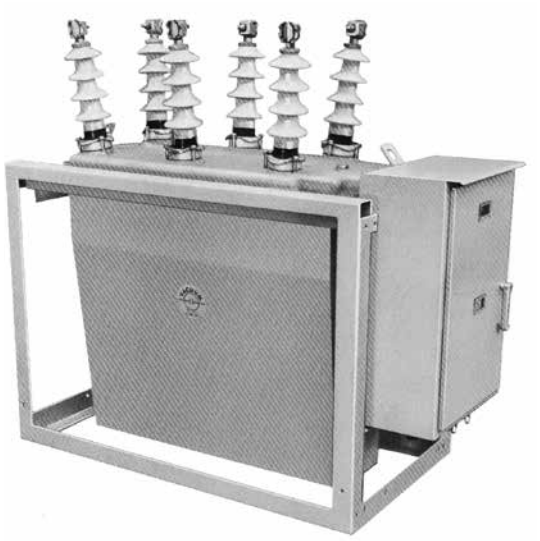


Figure 1. Type VSO 34.5-kV vacuum recloser with integral mounting frame

⚠ CAUTION

Radiation. At voltages up to the specified test voltages, the radiation emitted by the vacuum interrupter is negligible. However, above these voltages, radiation injurious to personnel can be emitted. See *Service Information MN280062EN, Vacuum Interrupter Withstand Test Voltage Ratings Information* for further information. G109.3

⚠ WARNING

Do not operate this equipment if energized parts are not immersed in dielectric fluid. Operation when parts are not properly immersed in dielectric fluid may result in internal flashovers that will damage the equipment and can cause death or severe personal injury. G104.4

Introduction

Service Information MN280066EN covers the maintenance instructions for the type VSO electronically controlled, three-phase, vacuum recloser. The manual includes a general description of the recloser and its operation, and instructions for periodic inspection, testing and shop repairs. Keyed service parts exploded-view drawings of the unit, along with ordering information are included at the back of the manual.

Description and operation

The type VSO recloser is an electronically controlled, three-phase fault interrupting device that utilizes vacuum interruption, oil insulation and an integral mounting frame. The recloser head is mounted to the upper side members of the box-shaped frame, and entire underhead portion of the recloser and the tank are suspended from the head. The operating mechanism is housed in a separate cabinet mounted at one end of the frame. All linkage between the operating mechanism and the head mechanism is at the level of the head casting and thus is above the top of the tank.

Current interruption takes place in the three vacuum interrupter assemblies which are suspended from the recloser head by insulating supports. A moving contact in each interrupter assembly is driven by the operating mechanism of the recloser through a one-inch stroke to close or open the circuit.

Two sets of springs provide the operating forces required to drive the vacuum interrupter contacts to their open and closed positions. The opening springs are located in the head mechanism; closing springs are in the operating mechanism.

The closing springs are charged by the operation of either a 120- or 24-Vac motor and gear train. They are released when a 24-Volt closing signal from the electronic recloser control energizes the closing solenoid in the recloser's operating mechanism. Release of the closing springs causes the operating mechanism to close the vacuum interrupter contacts and simultaneously charge the contact opening springs. Operation of the mechanism causes the 24-Volt closing signal from the electronic control to be interrupted. Immediately following the release of the closing springs, the motor runs to recharge the closing springs in preparation for the next closing operation. Limit switches interrupt the supply to the motor when closing springs are fully charged. Spring charging time is 40 cycles.

Having been charged by release of the closing springs, the opening springs are released by a 24-Volt trip signal from the electronic control; Release of the opening springs causes the vacuum interrupter contacts to open simultaneously on all three phases. Once released, the opening springs remain discharged until the next closing operation. However, since the opening springs are charged during a closing operation, the energy required for an opening operation is always stored in the mechanism whenever the vacuum contacts are closed.

The 24-Volt closing and opening signals from the electronic control are powered by the control battery. A charging system in the control maintains the required battery charge.

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

Power to operate the 120- or 240-Vac spring-charging motor must be supplied to the operating mechanism cabinet. An undervoltage relay in the operator cabinet opens a contact in the motor circuit if the 120-Volt motor supply voltage falls below 72 Volts or the 240-Volt motor supply voltage falls below 165 Volts.

If the 120- or 240-Vac supply voltage is lost, but the control battery is charged, the recloser can still perform a limited number of trip and close operations. If power loss occurs while the recloser contacts are closed, and the motor has run to recharge the closing springs, the capability exists to trip, close, and trip again; if power loss occurs while the main contacts are open, and closing springs are charged, the capability exists to close and trip once.

A totally manual closing operation can be accomplished even during loss of motor power and with the closing springs discharged. A hand crank can be applied to the motor to charge the closing springs. once charged, the closing springs can be released either from inside or from below the operator mechanism cabinet. As with electrical operations, the opening springs are charged by release of the closing springs, so even a manually closed unit has energy stored for a trip operation.

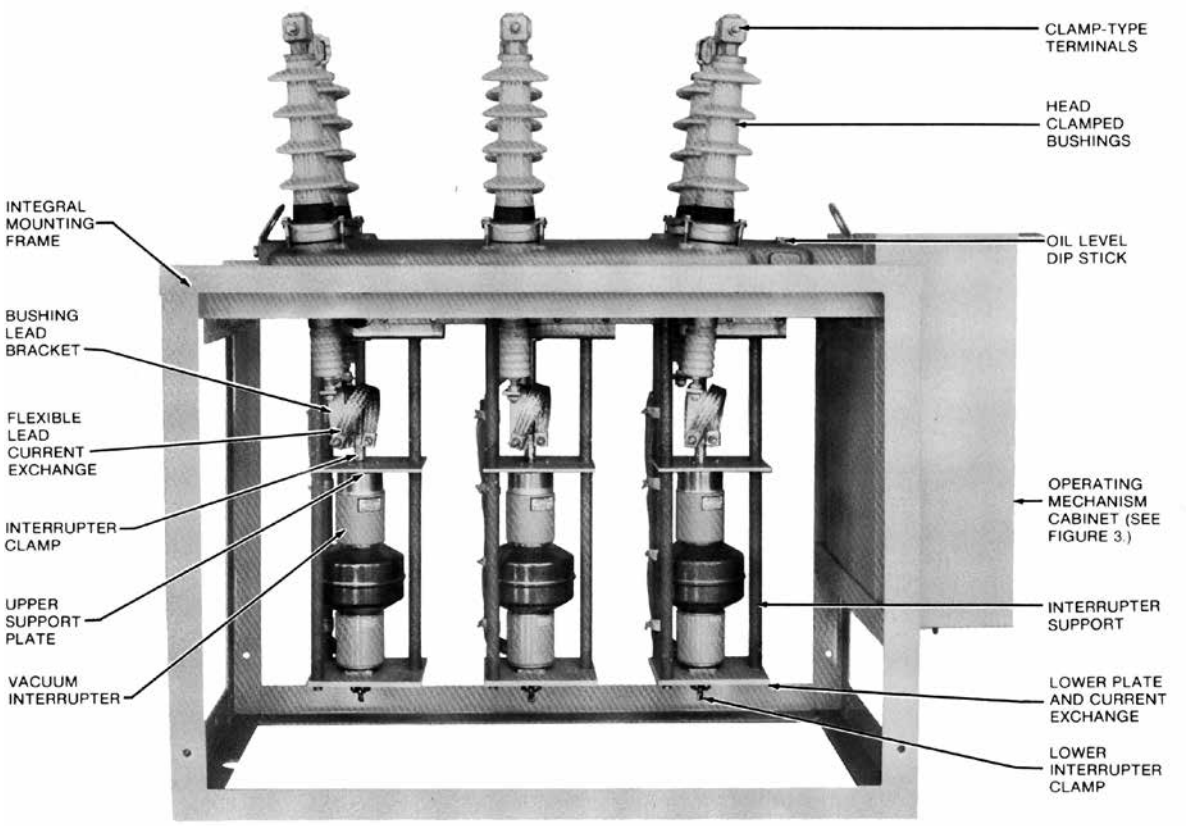


Figure 2. Untanked type VSO recloser

Major parts and assemblies of the VSO recloser are shown in Figures 2 and 3. Being aware of the location of these components and their part in the operation of the recloser will give a quicker and clearer understanding of the recloser maintenance and repair procedures that follow.

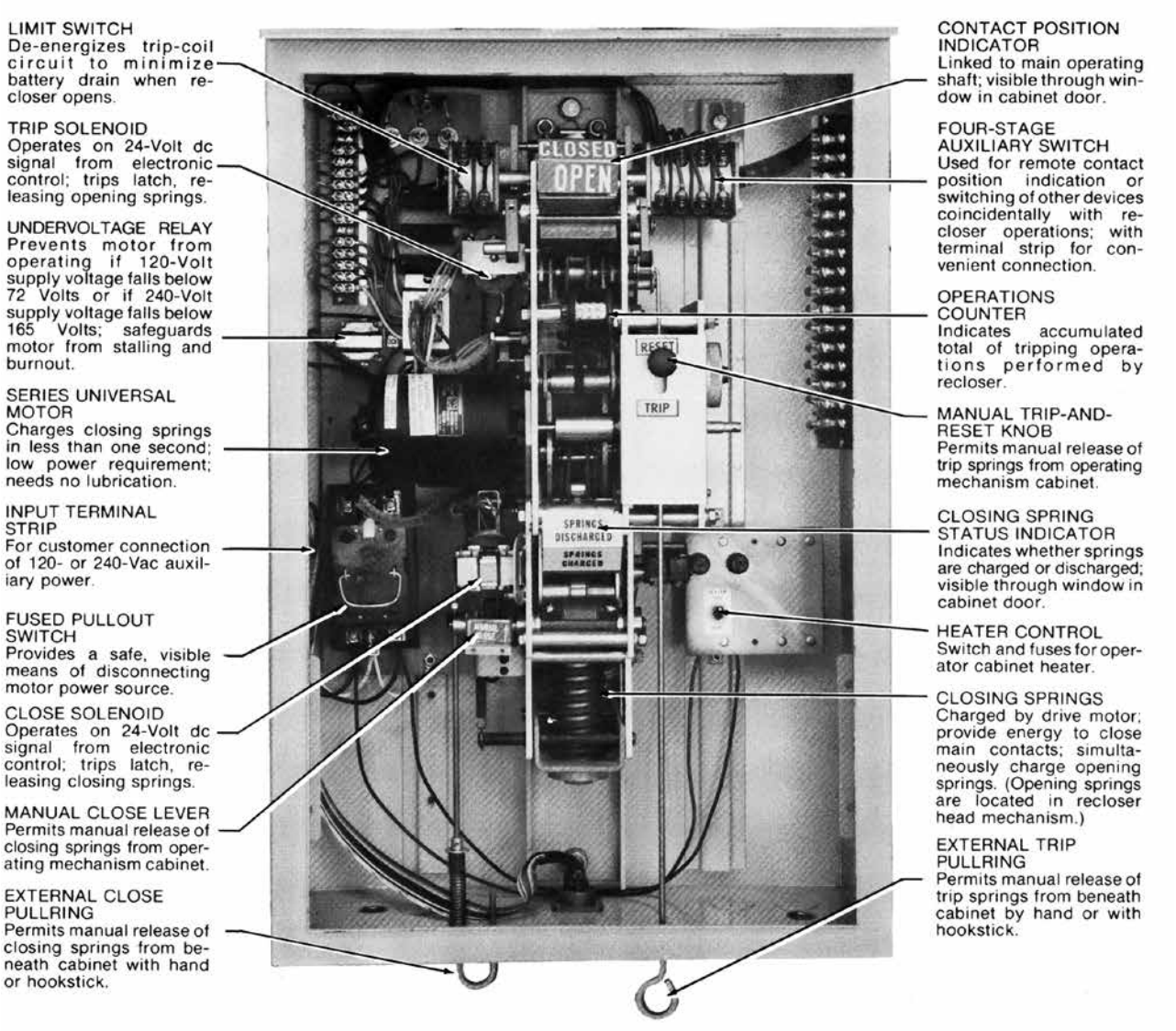


Figure 3. Operating mechanism used on type VSO recloser

Specifications and ratings

The recloser will interrupt fault currents only when applied within its specified ratings. Consult the following ratings and compare to system characteristics at point of application prior to installation.

Table 1. Voltage ratings

Nominal system voltage (kV rms)	34.5
Rated maximum voltage (kV rms)	38
Rated impulse withstand voltage (BIL) (kV crest)	150
60-Hz withstand voltage (kV rms) Dry, one minute	70
Wet, 10 seconds	60
Maximum ratio influence voltage @ 23 kV (μ V)	100

Table 2. Continous current rating

Maximum continous current (amps)	560*

*If the recloser includes an 800-amp accessory (KVS055VA or KVS055VB), this rating is increase to 800 amps.

Table 3. Interrupting current ratings

Minimun-trip current (AMPS)	Interrupting Current (RMS symmetrical amps)	
	Phase	Ground
25	_	3000*
35	_	4200*
50	_	6000*
70	_	8400*
100	3000*	12000
120	3600*	12000
140	4200*	12000
170	5100*	12000
200	6000*	12000
240	7200*	12000
280	8400*	12000
340	10200*	12000
400	12000	12000
480	12000	12000
560	12000	12000
600	12000	_
680	12000	_
800	12000	_
960	12000	_
1120	12000	_
1600	12000	_

*If the Type ME recloser control includes the appropriate KA1021ME protective accessory, this rating is increased to 12000 amps.

Table 4. Duty cycle

% Of interrupting rating	X/R Ratio	No. of operations
15-20	4	88
45-55	8	112
90-100	15	32
TOTAL		282

Table 5. Spring-charging motor

Nominal operating voltage (Vac)	120	240
Voltage range (Vac)	90-127	160-257
Inrush current (rms amps)	18	13
Steady-state current (amps)	9	8
Motor running time (cycles)	40	40

Table 6. Auxiliary switch interrupting ratings (AMPS) (10 amp cont. Rating)

Volts	Inductive (AC)	Non inductive (AC)	Inductive (DC)	Non inductive (DC)
24	-	-	15.0	20.0
48	-	-	7.5	10.0
120	60	80	-	-
125	-	-	1.5	2.0
240	30	60	-	-
250	-	-	0.45	0.5

Table 7. Trip and close solenoids

Nominal operating voltage (Vdc)	24
Approximate peak current, 1-1/2 cycles (amps)	5.65

Table 8. Operating specifications

Contact closing time*(cycles)	0.75
Contact opening time**(cycles)	0.5
Mechanical life (no-load operations)	2500

* Time from initial contact motion to contact make.
**Time from contact break to end of contact motion.

Table 9. Recloser control data

Minimum phase-trip settings (amps)	100, 120, 140, 170, 200, 240, 280, 340, 400, 480, 560, 600, 680,. 800, 960, 1120, 1600
Minimum ground-trip settings (amps)	25, 35, 50, 70,100, 120, 140, 170, 200, 240, 280, 340, 400, 480, 560,
Time-current characteristics (phase- and ground-trip)	Any two of available curves (See *R280-91-27*) in a sequence consisting of fast, slow, or fast followed by slow.
Number of fast phase-trip operations	0, 1, 2, 3, or 4
Number of fast ground-trip operations	0, 1, 2, 3, or 4
Number of operations to lockout	1, 2, 3, or 4
Reclosing intervals: limit of three, or one less than number of operations to lockout (seconds)	1/2 second (one only), 1, 2 5, 7,10, 15, 30, 45, and 60
Resetting time (seconds)	10, 15, 20, 30, 45, 60, 90, 120, or 180

Maintenance

Frequency of maintenance

Because reclosers are applied under widely varying operating and climatic conditions, maintenance intervals are best determined by the user, based on actual operating experience. To assure proper and trouble-free operation, reclosers must be maintained when they have operated the equivalent of a rated duty cycle and before the dielectric strength of the insulating oil has deteriorated below prescribed levels. In the absence of specific operating experience the following procedures are recommended:

- When the type VSO recloser is oper- ated under usual service conditions as defined in ANSI (American National Standards Institute) C37.60, "Standard Requirements for overhead, Pad Mounted, Dry Vault and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems", it is recommended that the following maintenance procedures be performed at the completion of an equivalent duty cycle.

Note: ANSI C37.61, "Guide for the Application, Operation and Maintenance of Automatic Circuit Reclosers", gives a procedure for converting the rated standard duty cycle into an equivalent duty cycle based on the actual operating duty of the recloser.

- However, if the recloser has not completed an equivalent duty cycle within THREE YEARS, it is recommended that an external inspection, an oil check and dielectric withstand test be made at that time. (See Steps 1, 2, 3, 4, 5, 8, and 13 of "Periodic Maintenance Inspection".)

Periodic maintenance inspection

Each maintenance inspection at the completion of an equivalent duty cycle should include at least the following:

1. Bypass and remove the recloser from service:
   a. Disconnect the control cable from the recloser.
   b. De-energize the auxiliary power source to the operator mechamsm.
2. Visually inspect external components:
   a. Check for broken or cracked bushings; replace as necessary. (See "Shop Maintenance Instructions—Bushings" for procedure.)
   b. Check for paint scratches and other mechanical damage; touchup to inhibit corrosion.
3. Visually inspect the operator mechanism:
   a. Check interior of the operator mechanism cabinet for accumulation of dust and dirt; clean as necessary.
   b. Check door gasket for effectiveness of seal.

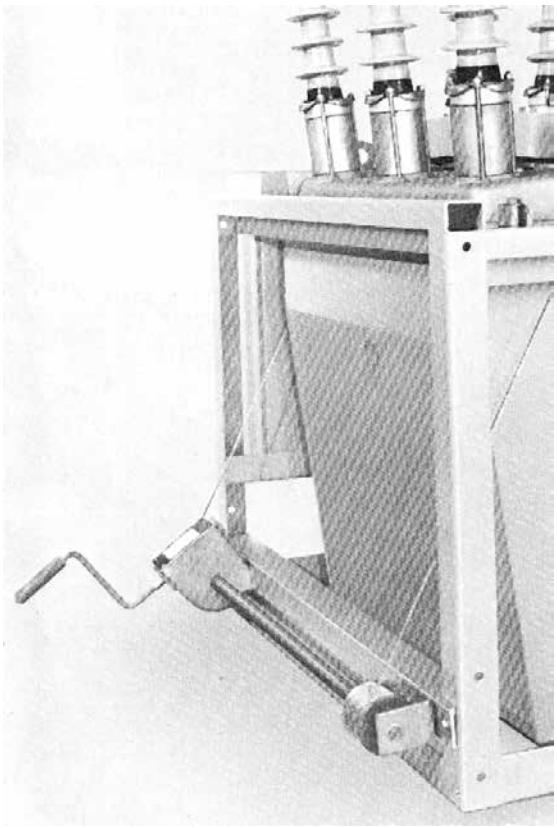


Figure 4. Tank-lifting windlass accessory

   c. Visually inspect all components for worn or broken parts and corrosion; replace as necessary.
   d. Check for broken or loose wiring terminations at the various components and terminal boards of the mechanism.
   e. Check the motor brushes for excessive wear and burning; replace as needed.

⚠ CAUTION

Do not use excessive force when replacing brush holder caps; excessive tightening may crack the caps.

   f. Note counter reading and enter in the record log in the control.
4. Close and trip the recloser manually several times to check the mechanical operation. (See"Manual operation—To Close the Recloser" for manual operating instructions.)
5. Perform a dielectric withstand test check the insulation level of the recloser and the vacuum integrity of the interrupters. (See "Insulation Level Withstand Tests" for procedure.)

6. Lower the tank to expose the internal components:
   a. Attach the sheaves of the tank lifting windlass mechanism (Figure 4) to the recloser tank and take up the slack.

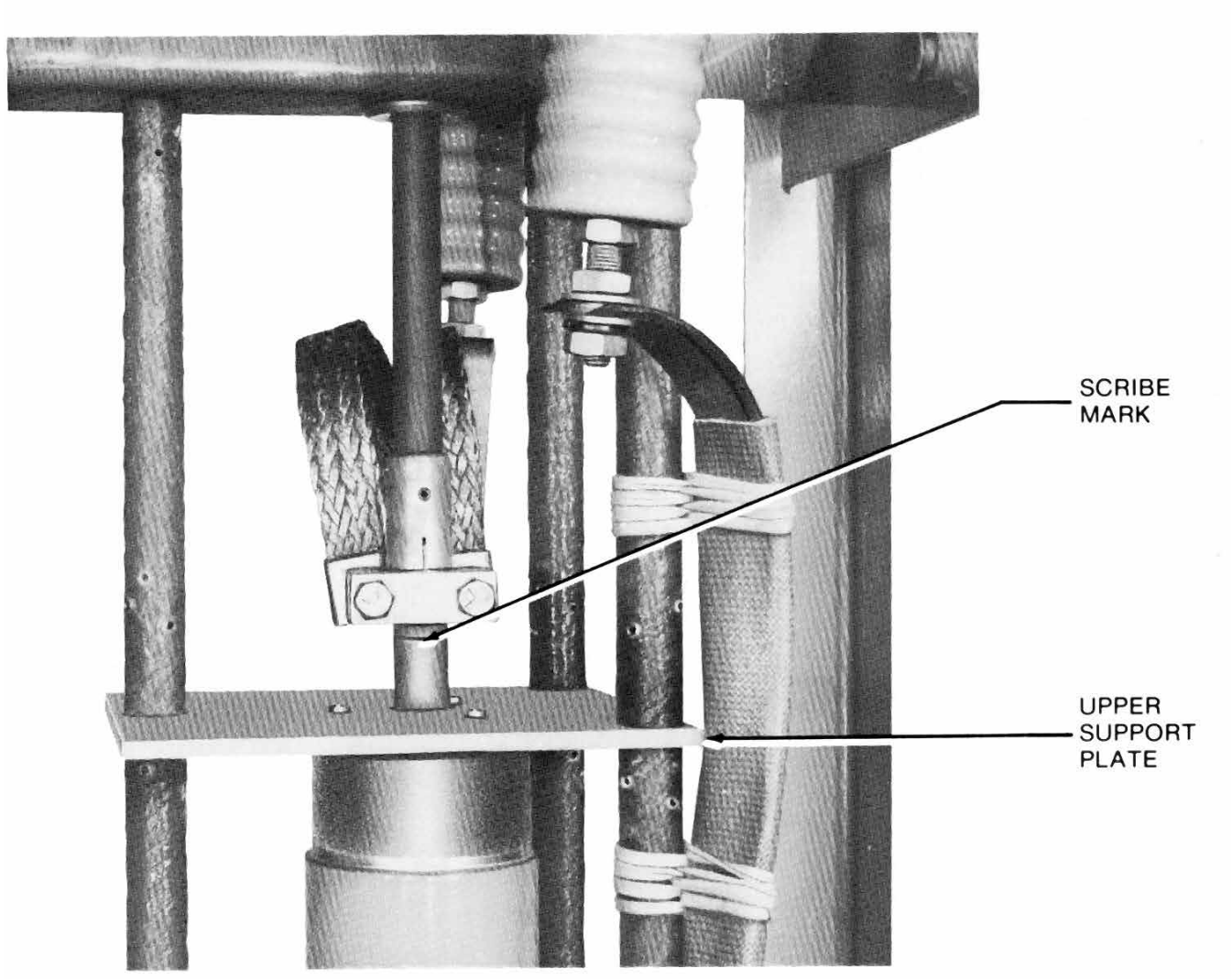


Figure 5. Location of scribe mark on movable contact rod of vacuum interrupter

   b. Remove the twelve head bolts that attach the tank to the head casting and carefully lower the tank.

7. Check the contact erosion of the vacuum interrupters:
   a. Locate the scribe mark on the moving contact rod at the top of the interrupter. (See Figure 5.)
   b. If the scribe mark falls below the top of the upper support plate when the interrupter is closed, the interrupter has reached the end of its useful life and must be replaced. (See "Vacuum Interrupters" for replacement procedure.)

8. Check the dielectric strength of the insulating oil:
   a. An oil 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 and/or other contaminants. Replace the oil if necessary.

9. If oil must be replaced:
   a. Drain and thoroughly clean the tank.
   b. Flush the internal mechanism with clean transformer oil.
   c. Fill the tank with new, clean oil up to 2-1/4 inches below the top surface of the tank flange. Tank capacity is approximately 65 gallons. (See "Oil Condition" section.)

10. Clean and examine the head gasket. Replace if it is cracked, cut, or otherwise damaged, or if it has been permanently deformed.

11. Clean the head gasket seating surfaces and retank the recloser.
12. Replace the head bolts and torque to 35-55 ft-lbs. Apply clamping force gradually and equally, in rotation, to each bolt to achieve an evenly distributed gasket sealing pressure.
13. Check the oil level through the oil sight gage in the side of the tank (See Figure 6):
    a. The oil level surface line should be above the sight gage window.
    b. If the oil surface line is visible in the window add oil through the dipstick port (Figure 7) and adjust the level to the upper line on the dipstick.
14. Repeat the high-voltage dielectric withstand test to make sure the dielectric clearances within the tank have not been compromised.
15. Check the electrical operation of the recloser:
    a. Reinstall the fused pullout switch to energize the motor circuit.

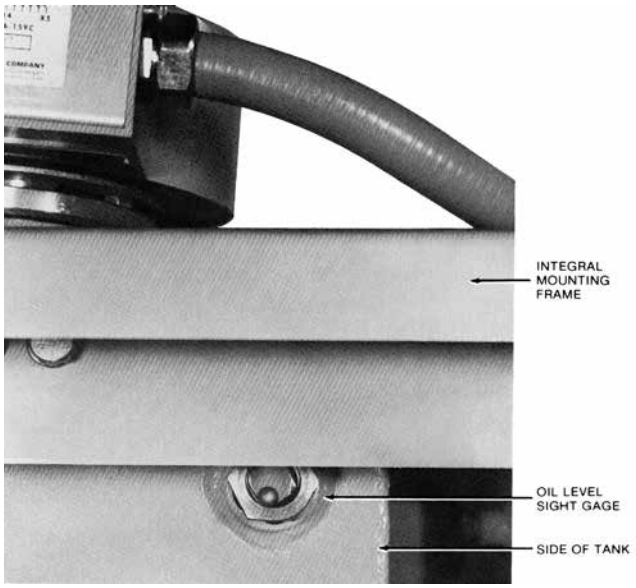


Figure 6. Oil sight gage in side of tank

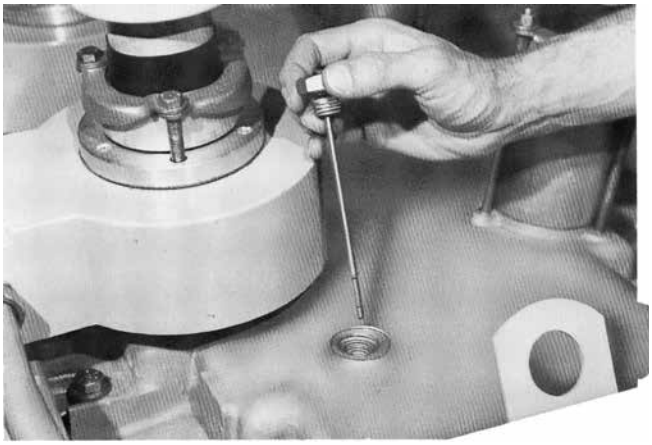


Figure 7. Checking oil level of recloser with dipstick

- If this recloser has been manually tripped while the motor circuit was de-energized (SPRINGS DISCHARGED), the motor will run to charge the closing springs (SPRINGS CHARGED).

    b. Momentarily apply 24-Vdc to terminals A (+) and E (-) of the control terminal board, mounted vertically along the left edge of the panel board.
    - The recloser will close, and the motor will run to recharge the closing springs for the next closing operation.

    c. Momentarily apply 24-Vdc to terminals A (+) and C (-) of the control terminal board.
    - The recloser will trip open.

    d. Electrically open and close the recloser several times to check its operation; leave in the open position.

16. Check the operation of the recloser with its electronic control:

⚠ CAUTION

For most recloser applications the electronic recloser is equipped with an MDL-3/8A fuse in the closing circuit. However because of the higher current drain of the type VSO closing circuit, the electronic control must be equipped with an MDL-2.5A fuse (See Figure 8).

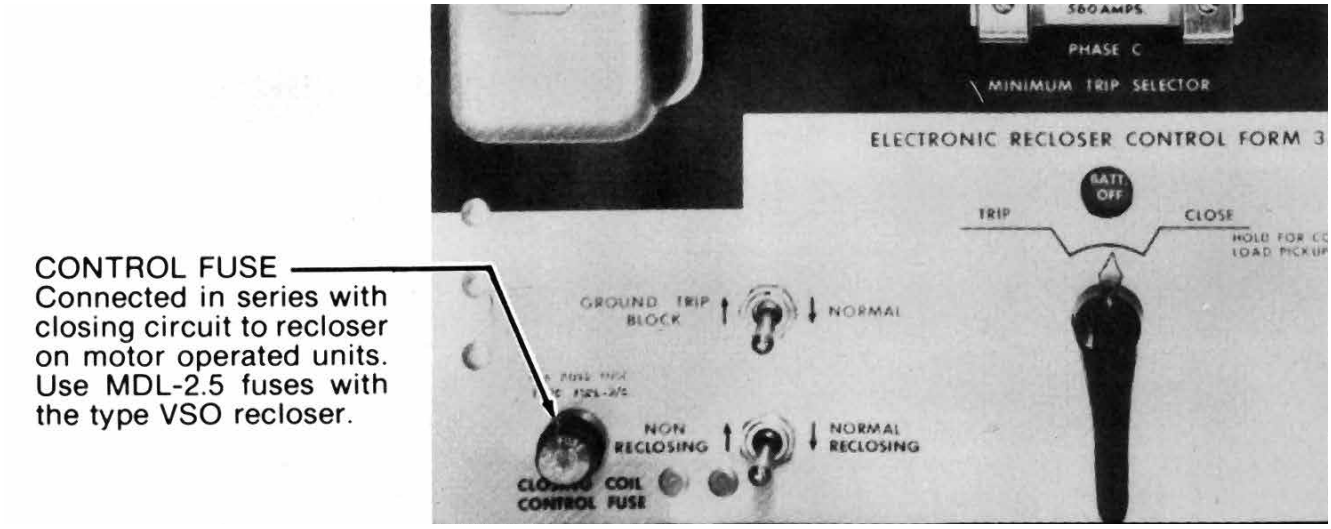


Figure 8. Closing-coil control fuse on electric control panel

a. Make sure the electronic control is in the lockout position by operating the Manual Control switch to TRIP; verify with the LOCKOUT TEST switch.

b. Reconnect the electronic control cable to the recloser.

c. Close and trip the recloser several times by operating the MANUAL CLOSE switch on the front panel of the electronic control.

Note: Service and maintenance instructions for the electronic control are provided in separate manuals, S280-75-1 and S280-75-2.

17. Check the appropriate sections of the "Type VSO Installation Instructions", MN280065EN, for proper procedures for returning the recloser to service.

Manual operation

The recloser can be manually closed and tripped with a set of operating levers on the operator mechanism inside the cabinet (Figure 9) or a set of pullrings located externally on the underside of the cabinet (Figure 10).

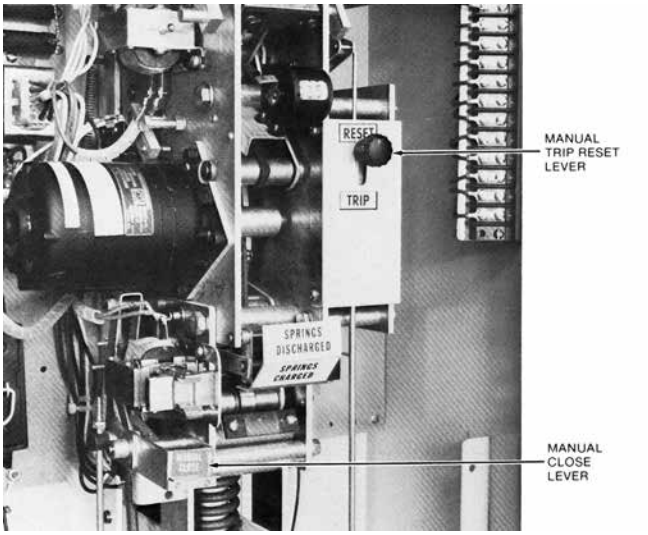


Figure 9. Operating levers inside operator mechanism cabinet

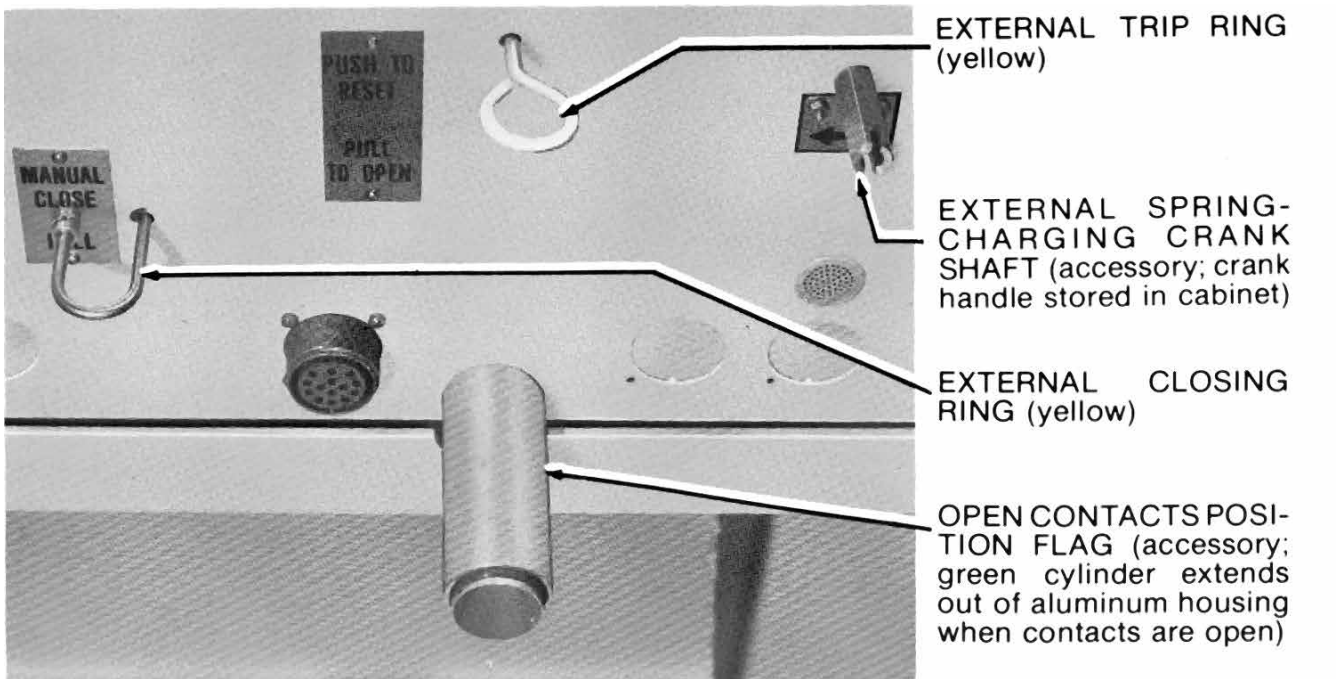


Figure 10. Underside of operating cabinet

To close the recloser

Proceed as follows:

1. Apply rated voltage to the input terminal block on the side of the operator cabinet.

Note: If closing springs are discharged, the motor will operate immediately to charge the springs.

2. When closing spring status indicator reads SPRINGS CHARGED, lift up the MANUAL CLOSE lever on the operating mechanism, or pull the external MANUAL CLOSE punting to release the charged springs and close the recloser.

Note: Immediately upon closing, the motor will operate to again charge the closing springs.

3. If motor operating power is not available the closing springs may be charged by manually cranking the motor until the closing springs status indicator reads SPRINGS CHARGED:

    a. Insert the shaft of the manual crank (stored on the inside of the cabinet door) through the hole in the right side of the cabinet and onto the shaft protruding from the mechanism (Figure 11).

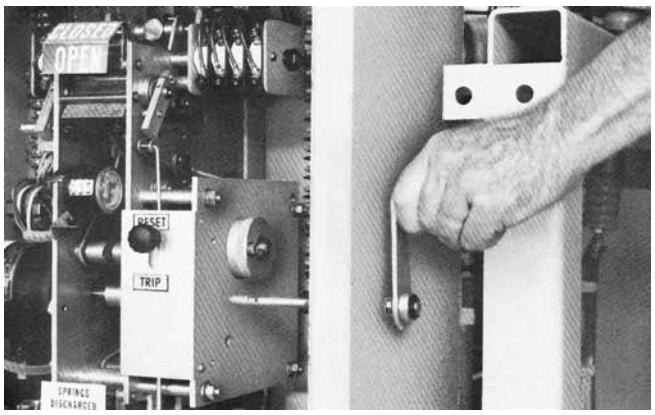


Figure 11. Manually charging closing springs

    b. Crank the motor in a **COUNTERCLOCKWISE** direction until the spring status indicator reads SPRINGS CHARGED. Approximately 95-100 revolutions are required to ful- ly charge the closing springs.

    c. If the recloser is equipped with the external spring charging accessory, the cranking drive shaft extends out of the bottom of the cabinet. To operate the recloser insert the accessory crank (stored on the inside of the cabinet door) into the drive shaft extension (Figure 12) and crank approximately 95-100 times in the direction of the arrow (clockwise) until the spring status indicator reads SPRINGS CHARGED.

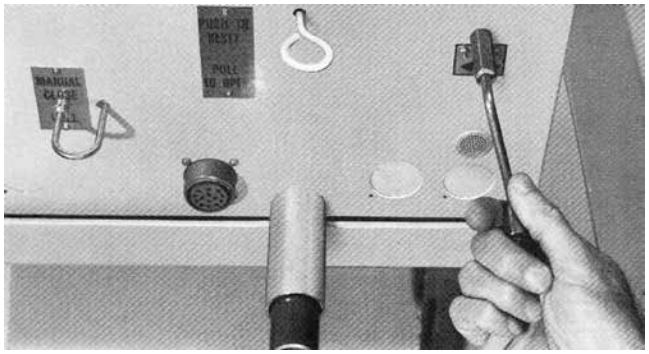


Figure 12. Manually charging closing springs with external accessory

To open the recloser

To release the opening spring either pull down theTRIP RESET knob on the front of the operator mechanism or the PULL To OPEN punting under the cabinet. Make sure knob or pullring is returned to the RESET position after the unit has tripped.

Insulatlon level withstand tests

High potential withstand tests provide information on the dielectric condition of the recloser and the vacuum integrity of the interrupters. Testing is performed at 52.2 kV rms (75% of the rated low frequency withstand voltage of the VSO recloser).

⚠ CAUTION

Radiation. At voltages up to the specified test voltages, the radiation emitted by the vacuum interrupter is negligible. However, above these voltages, radiation injurious to personnel can be emitted. *See Service Information MN280062EN, Vacuum Interrupter Withstand Test Voltage Ratings Information for further information.* **G109.3**

Test 1: Proceed as follows:

1. Manually close main contacts of recloser.
2. Ground recloser tank and head.
3. Connect all three bushings on one side of the recloser together.
4. Apply proper test voltage to the connected bushings.
5. The recloser should withstand the test voltage for 60 seconds.

Test 2: Proceed as follows:

1. Manually close main contacts of the recloser.
2. Ground recloser tank and head.
3. Ground the outer two bushings.
4. Apply proper test voltage to the center bushing.
5. The recloser should withstand the test voltage for 60 seconds.

Test 3: Proceed as follows:

1. Open main contacts of recloser.
2. Ground recloser tank and head.
3. Connect and ground all three bushings on one side of the recloser.
4. Connect the other three bushings together.
5. Apply proper test voltage to the ungrounded bushings.
6. The recloser should withstand the test voltage for 60 seconds.
7. Reverse the ground and test connections and apply test voltage to the ungrounded bushings for 60 seconds.
8. The recloser should withstand the test voltage for 60 seconds.

Test results: These high potential.

withstand tests provide information on the dielectric condition of the recloser and the vacuum integrity of the interrupters.

1. If the recloser passes the closed contacts tests (Tests 1 and 2) but fails the open-contacts test (Test 3) a deteriorated vacuum in one or more of the interrupters is most likely the cause. Retest each vacuum interrupter individually to determine the failed phase or phases, and replace the interrupter(s). Retest to confirm the repair.
2. If the recloser fails the closed-contacts tests (Tests 1 and 2) the cause is likely to be a diminished electrical clearance or a failed insulation. After correcting the problem, retest to confirm the repair.

Oil condition

Oil provides the internal insulation barrier between phases and from phase to ground, and must be replaced before it deteriorates below a safe dielectric level. Replace the oil if its dielectric strength falls below 22 kV.

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

Used oil must be treated before reusing. Filtering may remove absorbed and free water and other contaminants to raise the dielectric strength to acceptable levels. However, filtering does not always remove water-absorbing contaminants and the dielectric strength may fall rapidly

after being returned to service. Therefore the recloser should be filled with new oil, or oil that has been restored to like-new condition. Oil used in these reclosers conforms to ASTM Standard D3487, Type 1. Its property limits are shown in Reference Data R280-90-1, "Oil Specifications and Tests".

Shop maintenance instructions

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

Bushings

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

The bushings of the type VSO recloser are oil-filled. The special fixtures and procedures required to assemble and fill these bushings is beyond the scope of normal shop maintenance repair. Therefore, if a type VSO bushing is damaged, the entire bushing assembly must be replaced. Refer to Figure 13 and proceed as follows:

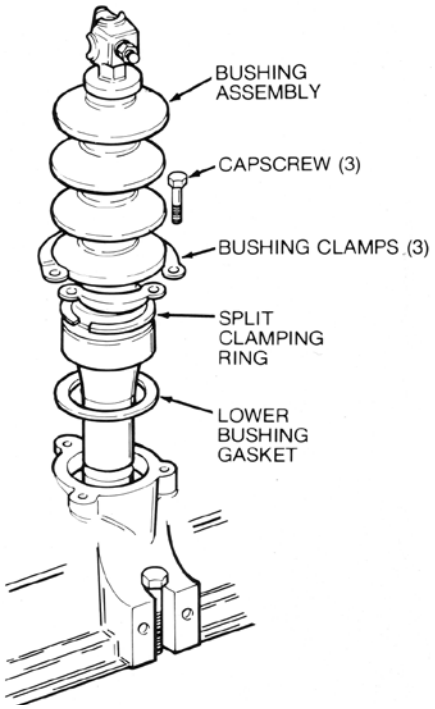


Figure 13. Removing type VSO bushing

1. Disconnect the bushing lead bracket from the bottom end of the bushing rod.
2. Remove the three hex head capscrews and bushing clamps that secure the bushing to the head casting and lift out the complete bushing assembly.
3. Remove and discard the lower bushing gasket.
4. Twist off the split aluminum ring from the old bushing and install on the new bushing assembly if it is still in good condition; replace with new ring if damaged.

Note: The clamping ring cushions and distributes the pressure between the porcelain and the clamps. DO NOT OMIT.

5. Install the new bushing assembly into the head using a new lower bushing gasket. Position the bushing with the stud-end of the terminal pointing outward.
6. Position the clamping ring with the split centered between two clampling bolts.
7. Reassemble the bushing to the head casting.
8. Tighten the clamping bolts evenly, a little at a time, to a torque of 10-15 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 lead bracket to the bushing rod.

Vacuum Interrupters

Vacuum interrupters must be replaced when:

- They lose their vacuum as evidenced by a failure during the low-frequency dielectric withstand test across the open contacts; or
- The interrupter contacts have eroded beyond their useful life as evidenced by the position of the scribe mark on the moving contact rod.

To replace an interrupter refer to Figure 14, and proceed as follows:

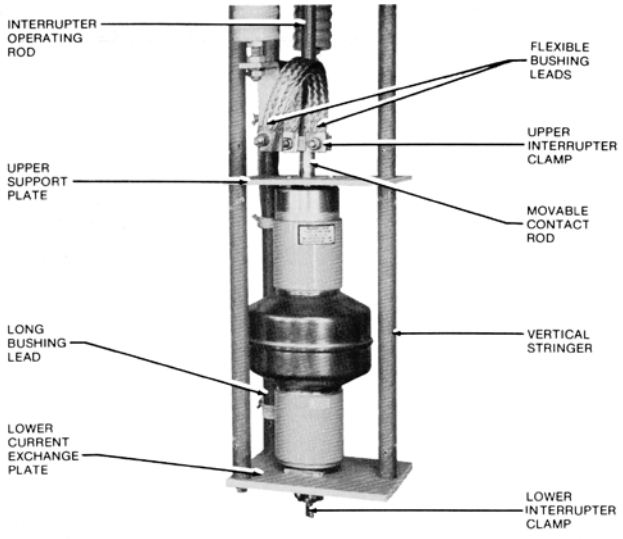


Figure 14. Vacuum interrupter assembly

1. Make sure the recloser contacts are open; the contact position indicator reads OPEN and the closing spring status indicator reads SPRINGS DISCHARGED.
2. Disconnect the flexible leads from the upper interrupter clamp by removing the attaching nut, lockwasher, and plain washer.
3. Loosen and remove the upper interrupter clamp. As the clamp is loosened, atmospheric pressure on the bellows will cause the contact rod to move down into the interrupter. This action can be verified by observing the scribe mark on the contact rod. It will move downward to just above (or below) the top surface of the upper support plate.

Note: If the contact rod does not move the interrupter may have lost its vacuum or the contact rod may be sticking in the clamping fingers at the end of the contact operating rod. Use a screwdriver to gently spread the clamping fingers to free the rod.

4. Disconnect the long bushing lead from the lower current exchange assembly.
5. Loosen and remove the lower interrupter clamp.
6. Remove the hardware attaching the lower current exchange plate to the three vertical stringers and drop the plate and vacuum interrupter from the recloser.
7. Install the stationary contact rod of the new interrupter into the lower current exchange plate. Attach the plate to the vertical stringers, making sure the three studs on the top of the interrupter seat into the three holes in the upper support plate and the upper (moving) contact rod is positioned in the clamping fingers of the operating rod.

⚠ CAUTION

Equipment damage. Do not twist or apply radial pressure to the vacuum interrupter movable contact rod. Excessive twisting or pressure on the contact rod will damage the interrupter bellows, which can cause equipment failure. T211.0

8. Manually slow-close the recloser, using the following procedure;
   a. Place the Trip Reset knob on the operating mechanism to RESET.
   b. Insert the manual operating handle through the hole in the side of the operating mechanism cabinet (Figure 11). Crank the motor counterclockwise until the trip latch is engaged above the roller link assembly (Figure 15).

Note: Do not crank further once the trip latch engages the roller.

   c. Remove the crank.

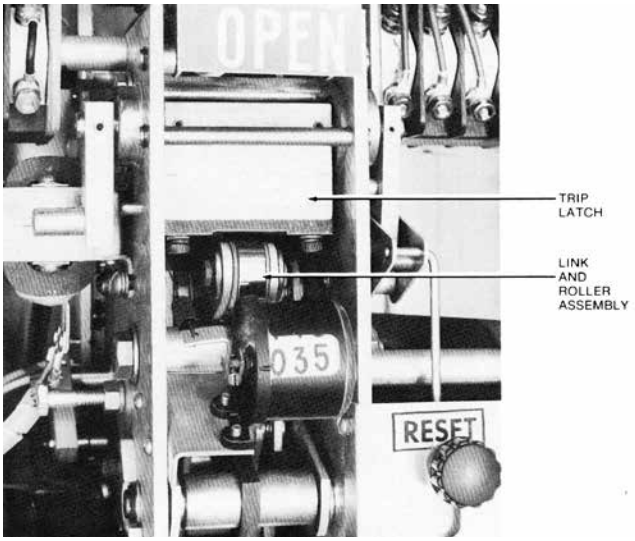


Figure 15. Trip latch engaged for manual "Slow-Close" operation

   d. Using an open end wrench carefully remove the hex head screw from the clutch assembly to release the clutch.

⚠ CAUTION

Keep fingers away from the clutch assembly as it will "kick-back" when released.

   e. When the clutch is released the charged closing springs will cause the mechanism to unwind (operate in the opposite direction) and settle the recloser into the closed position.
   f. Manually turn the main gear assembly an additional revolution counterclockwise (Figure 16) to make sure all cams are set.
   g. Using a pry bar on the interrupter mechanism move the operating linkage forward to latch the recloser in the fully closed position (Figure 17).
   h. Make sure to re-engage the clutch by reinstalling the hexhead screw and lockwasher removed in Step d.

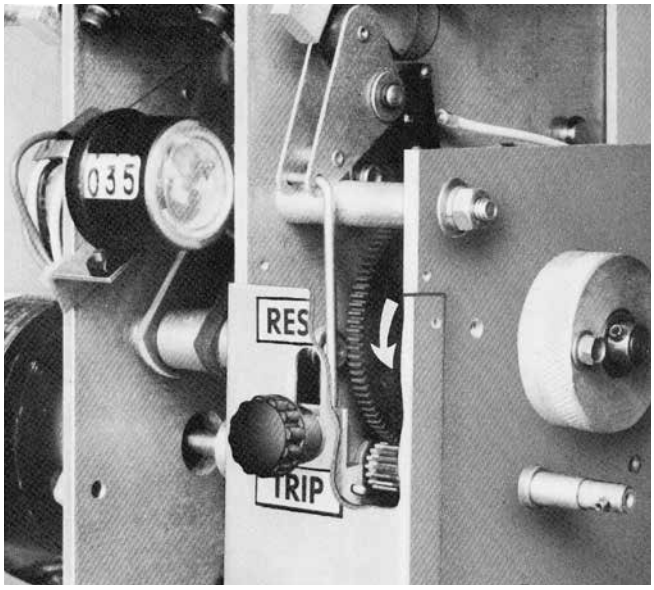


Figure 16. Main gear assembly location.

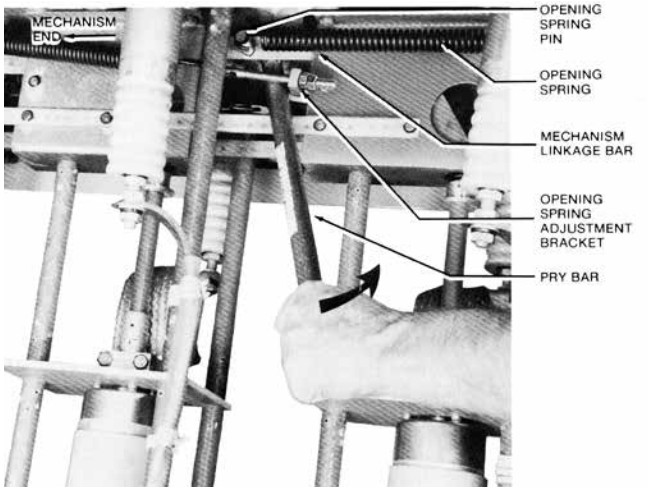


Figure 17. Pry bar is used to latch recloser in the fully closed position

9. Position the upper and lower clamps just below the slight shoulder on the clamping fingers of the current exchanges so that the clamping force will be applied to the center of each finger and the gaps between the clamp halves are approximately equal. (See Figures 18 and 19.)
10. Tighten the upper clamp to a torque of 20 ft-lbs.
11. Tighten the lower clamp to a torque of 75 in-lbs.
12. With the recloser still in the close position scribe a line on the upper interrupter contact rod, 1/8 inch above the top of the upper support plate as a reference point for determining contact wear.
13. Reconnect the flexible leads to the upper interrupter clamp.

    Manually trip and close the recloser several times to check that the moving interrupter rod travels the prescribed one inch.
14. Reconnect the long bushing lead to the lower current exchange assem bly.

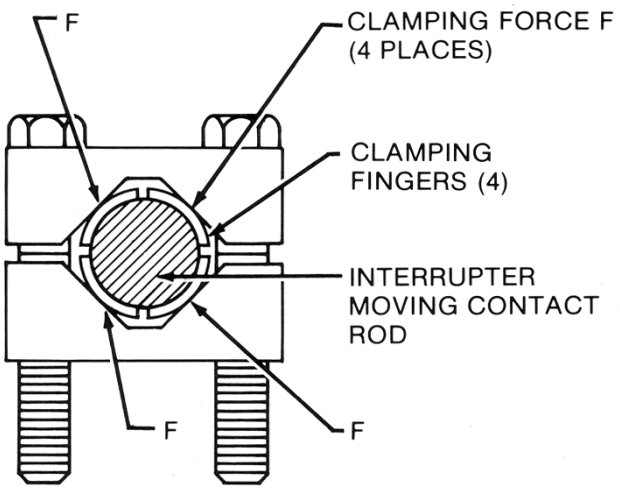


Figure 18. Upper interrupter clamp

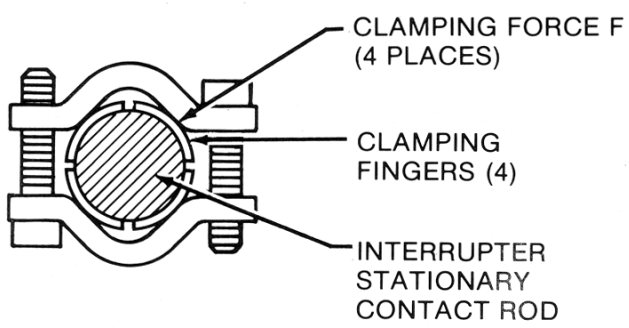


Figure 19. Lower interrupter clamp

Operating mechanism

The spring operated mechanism uses solenoids to release charged opening and closing springs. The closing springs are charged by a motor-gear reduction drive The closing operation charges the opening springs.

The upper portion of the operating mechanism in the operator cabinet incorporates the tripping mechanism which includes the trip solenoid, mechanical linkages and associated switches. The lower portion of the mechanism incorporates the closing mechanism which includes the close solenoid, motor, gear reduction drive, clutch, closing springs, mechanical linkages and associated switches. The four opening springs and the linkages to operate the interrupters are located under the head of the recloser.

The major components of the operating mechanism are easily accessible without the need to remove the

mechanism. However, if necessary, the complete operating mechanism in the operating cabinet can be removed as a unit. The following procedure can be used:

1. Make sure the recloser is open and the closing springs are discharged.
2. Loosen the two attaching screws to remove the auxiliary switch from the mechanism frame.
3. Remove the link pin attaching the mechanism to the interrupter linkage operating bar (Figure 20).

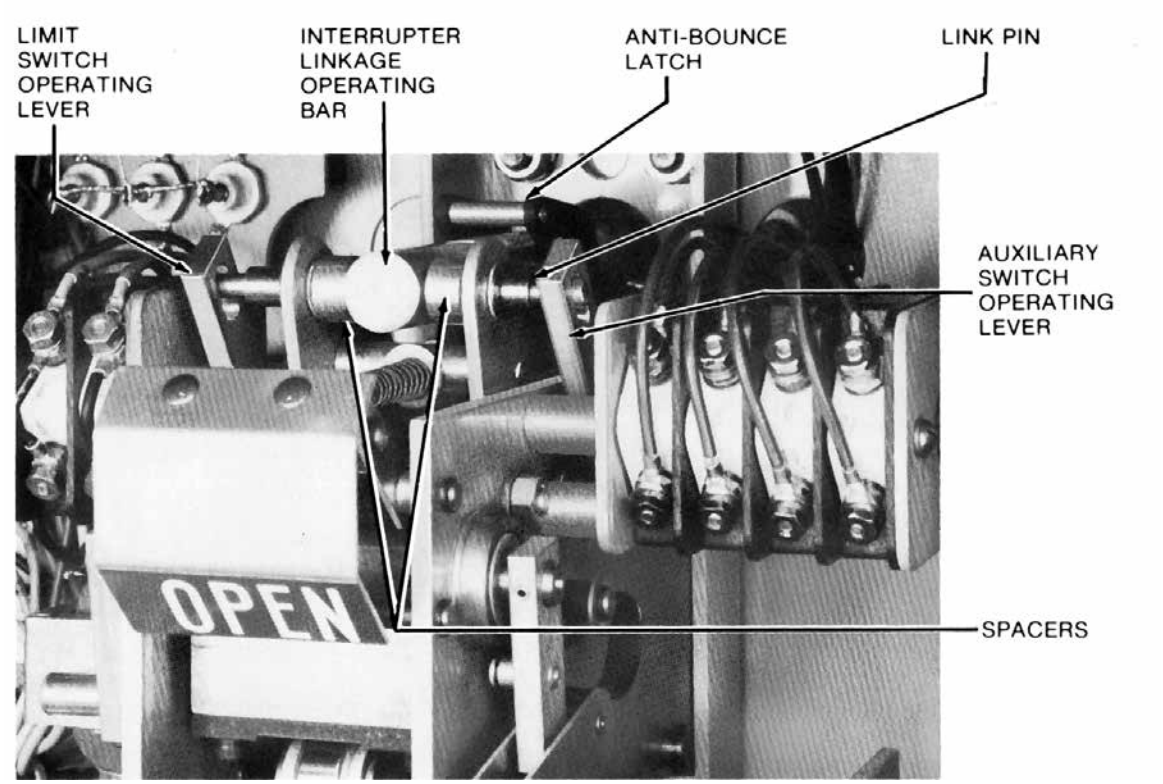


Figure 20. Location of link pin

4. Turn the bar clockwise 90 degrees to disengage the roll pin from the anti-bounce latch.
5. Unplug the wiring harness from the panel board on the back of the cabinet.
6. Remove the trip reset knob and the front plate to disconnect the external trip punting from the threaded pin on the trip link (Figure 21).
7. Disconnect the external quick-close pull hook by removing the attaching stop nut (Figure 22).
8. Remove the two 3/8 inch hex nuts and lockwashers from the top of the mechanism channel.
9. Remove the 1/2 inch hex nut lockwasher attaching the bottom of the channel to the cabinet.
10. Finally, remove the 7/16 inch hex head bolt and lockwasher attaching the top of the mechanism channel.

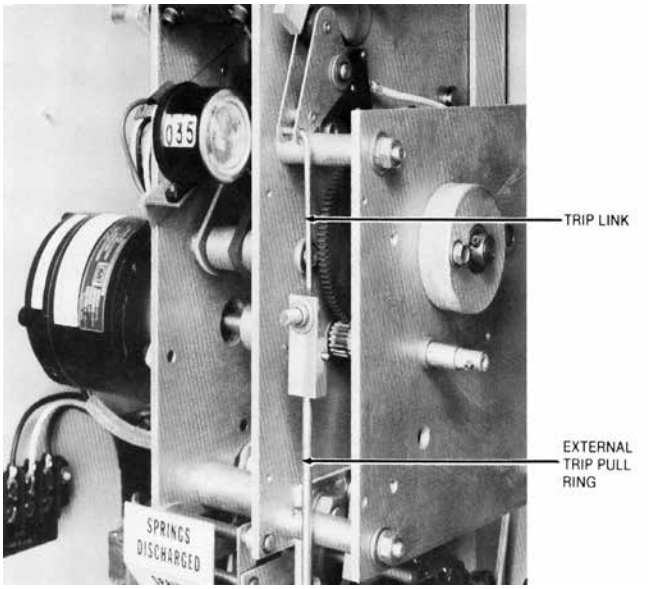


Figure 21. Attachment of external trip lullring

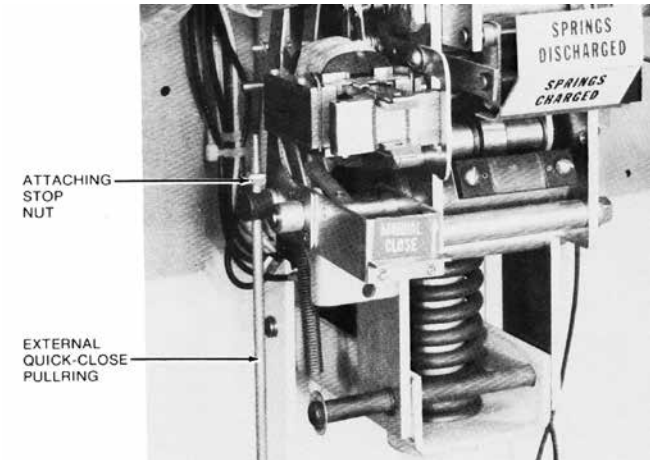


Figure 22. Attachment of external quick-close lullring

11. Maneuver the complete mechanism unit out of the cabinet.

Reinstall the mechanism in the reverse order of disassembly.

Motor

A universal series-type motor is used to charge the closing springs. The motor is energized from either a 240- or 120-Vac auxiliary power source through a fused pullout switch. The motor has permanently lubricated, sealed ball-bearings that require no service. Periodically check the motor brushes for wear or burning and replace as needed.

Note: Brush replacement kits are available for both the 24-Vac and 12-Vac motors. The kit consists of two brushes and two brush caps.

⚠ CAUTION

This type of motor should NEVER be energized while disconnected from the gear reduction unit. Operating while unloaded will result in an uncontrolled speed and possible damage to the motor.

Gear reduction unit

The pinion gear at the opposite end of the motor shaft coupling engages a gear reduction train consisting of a first and second intermediate gear and the main gear. All gears are permanently lubricated to provide maintenance-free operation and prevent corrosion. Oil-impregnated bronze bearings provide long wear life. Inspect all gear teeth and bearings carefully and disassemble the unit only if replacement is necessary.

Electrical components

Electrical circuit components of the operating mechanism require no maintenance and should provide trouble-free operation. If control circuit malfunction is indicated, check out the circuitry in the following order:

1. Substitute another electronic control known to be in working order. Follow the procedures in the electronic control service manual to test and repair the control.
2. Check the control cable for breaks or shorts.
3. Check the circuit components in the operating mechanism.

Control cable check

With the cable removed at the control, use an ohmmeter to check the continuity of each circuit through the connection at the operator cabinet up to the control terminal block. The connector pin sockets and the control terminal block are lettered correspondingly. Remove and replace each conductor at the control terminal block while checking. A zero reading will indicate continuity, an infinite reading indicates an open circuit. Continuity between terminals and unlike pin socket indicates a shorted circuit. Replace if cable is damaged.

Control circuit components

A schematic diagram of recloser circuits is shown in Figure 23. The operating sequence of the various circuit components is diagrammed in Figure 24. See Figures 25 and 26 for connection diagrams and wiring tables.

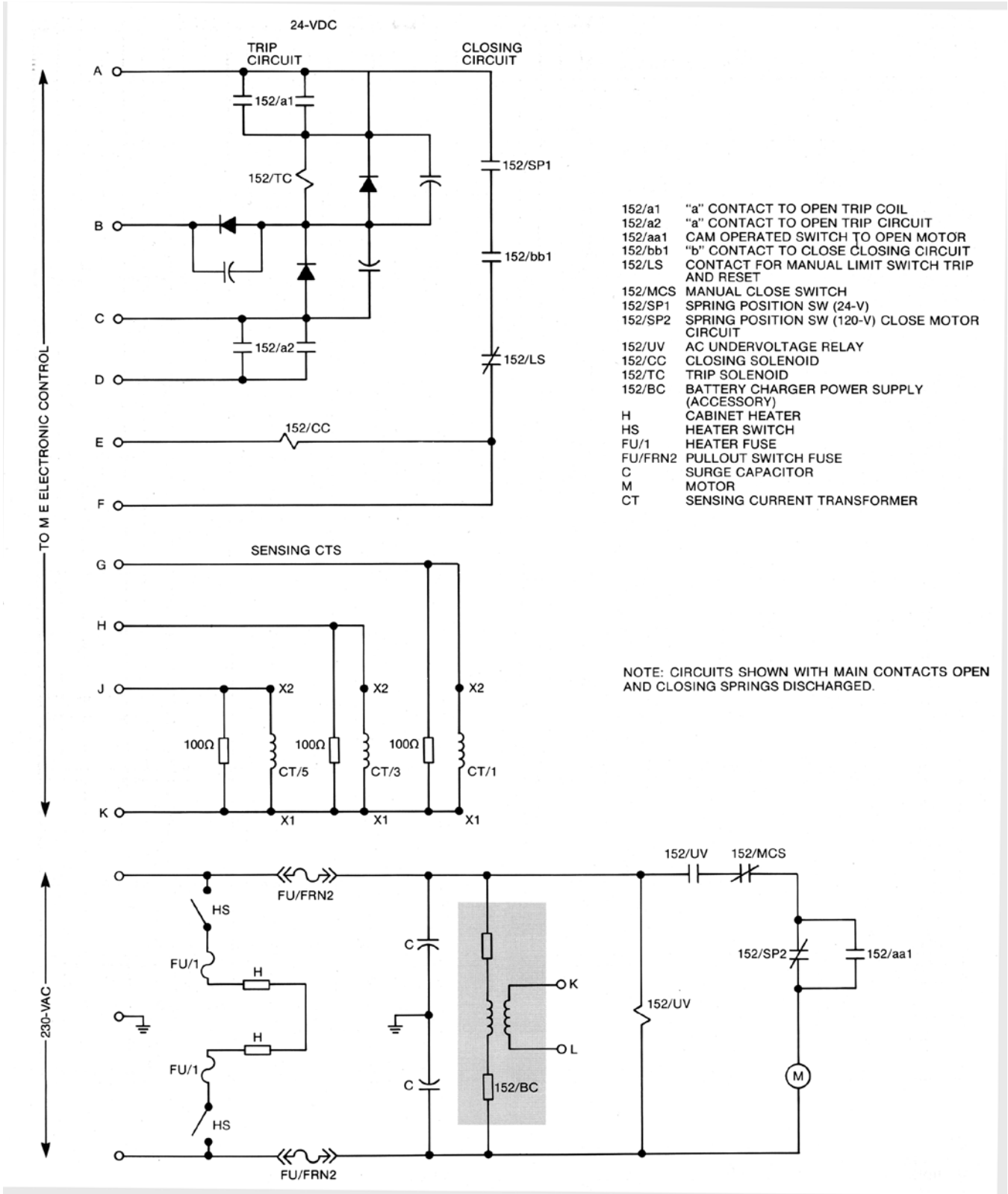
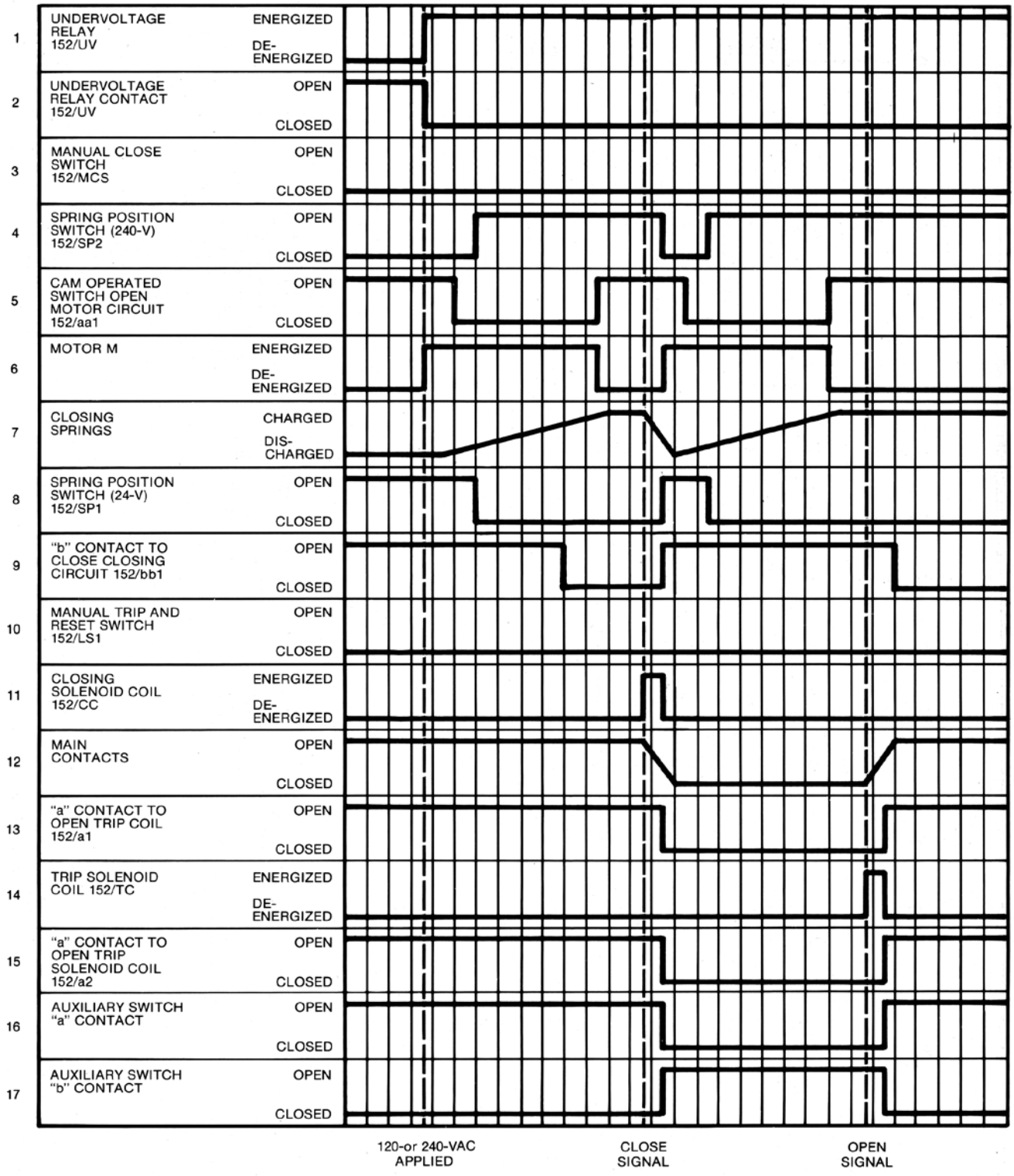
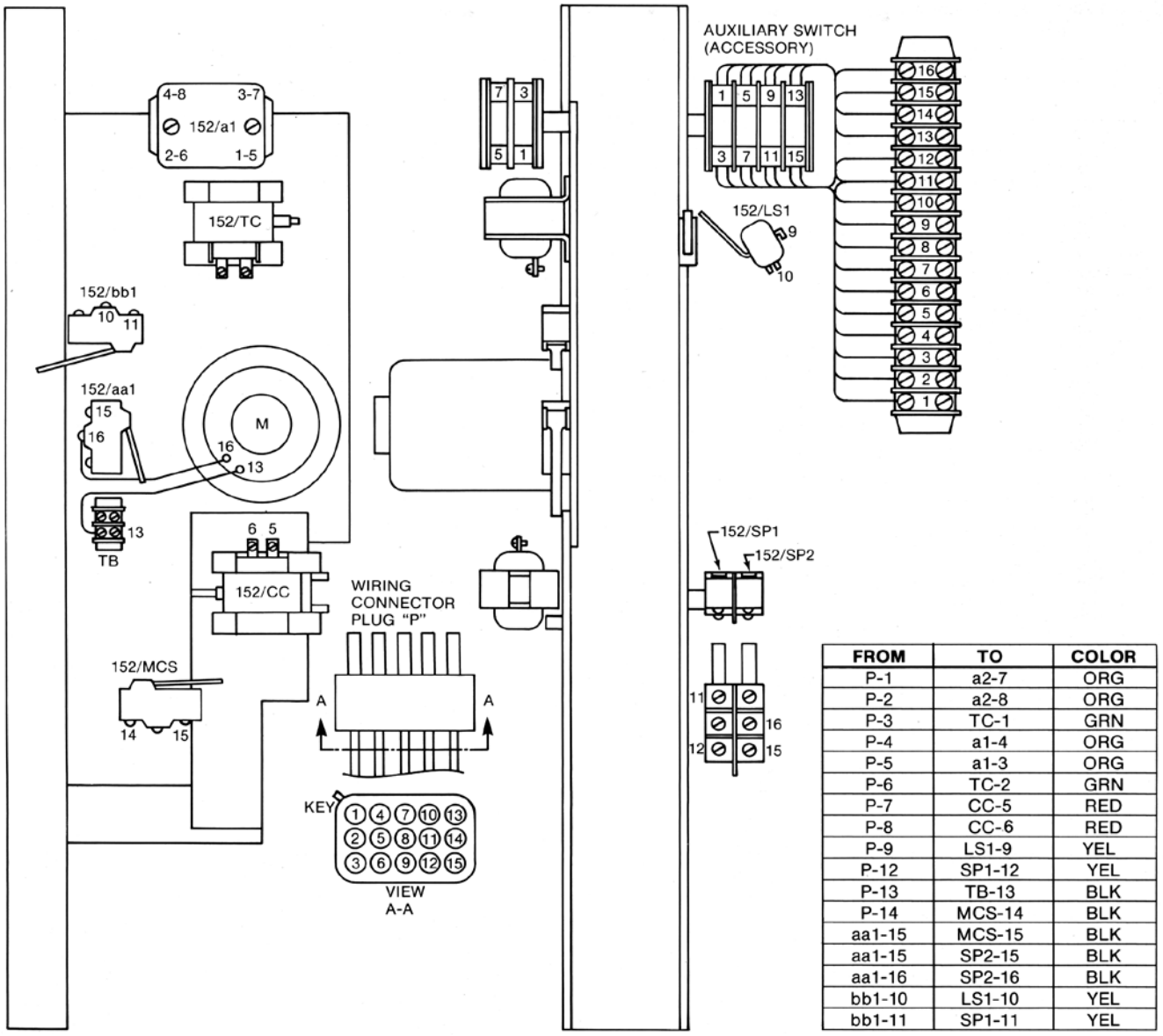


Figure 23. Schematic diagram of recloser circuits



NOTES:
1. UNIT IN "OPEN" POSITION WITH CLOSING SPRINGS DISCHARGED WHEN AUXILIARY POWER IS INITIALLY APPLIED. (MANUAL CLOSE OR TRIP PULL-RINGS ARE NOT OPERATED).
2. DRAWING SHOWS OPERATIONAL SEQUENCE ONLY; DOES NOT HAVE A SCALED TIME BASE.

Figure 24. Sequential operation of control circuit components in VSO recloser



FROM	TO	COLOR
P-1	a2-7	ORG
P-2	a2-8	ORG
P-3	TC-1	GRN
P-4	a1-4	ORG
P-5	a1-3	ORG
P-6	TC-2	GRN
P-7	CC-5	RED
P-8	CC-6	RED
P-9	LS1-9	YEL
P-12	SP1-12	YEL
P-13	TB-13	BLK
P-14	MCS-14	BLK
aa1-15	MCS-15	BLK
aa1-15	SP2-15	BLK
aa1-16	SP2-16	BLK
bb1-10	LS1-10	YEL
bb1-11	SP1-11	YEL

Figure 25. Location and connection table of control components on operating mechanism

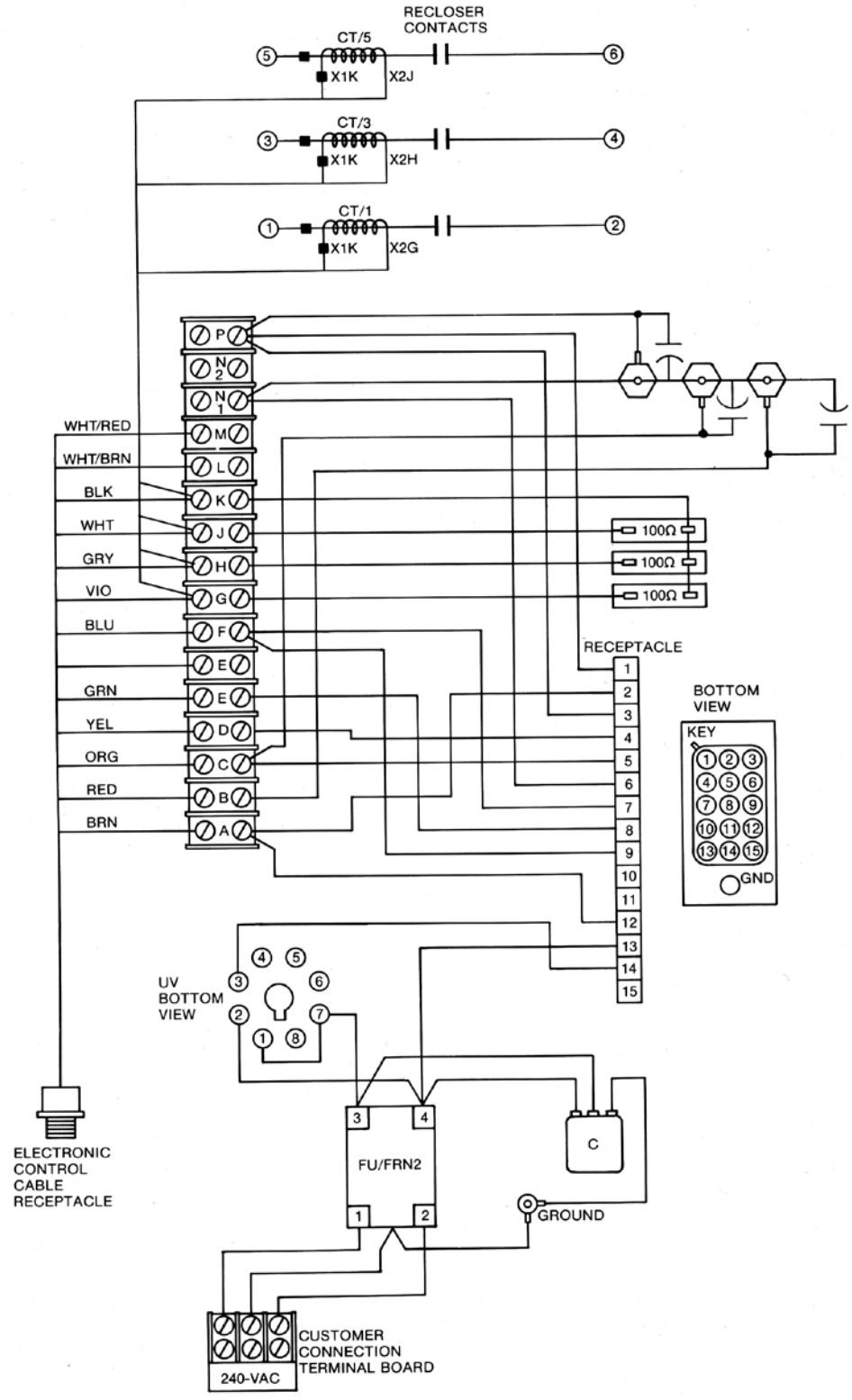


Figure 26. Connection diagram for other control components

Sensing current transformer tests

The sensing transformers can be tested using the circuits shown in Figure 27. Connect all three phases of the recloser in series across a 100 ampere ac test supply and close the recloser with the manual closing crank.

Ratio test for sensing-current transformers

Refer to Figure 27, "Ratio Test Circuit (A)".

1. Energize 100 ampere test source.
2. Check current through control cable receptacle sockets K-G (Phase A), K-H (Phase B) and K-J (Phase C). For each sensing bushing CT checked, the milliammeter should indicate 100 milliamperes (mA) plus or minus ten percent.

⚠ WARNING

Hazardous voltage. When checking the CT output of one phase, the output from the other two phases must be shorted. If the test circuit is energized while there is no load connected to the CT secondaries, dangerous voltages will be generated. Contact with high voltage can cause severe personal injury or death. T206.1

3. A 100 mA reading verifies the 1000:1 ratio of each current transformer. Be sure to allow for tolerances of metering equipment. De-energize test source and proceed with polarity test.

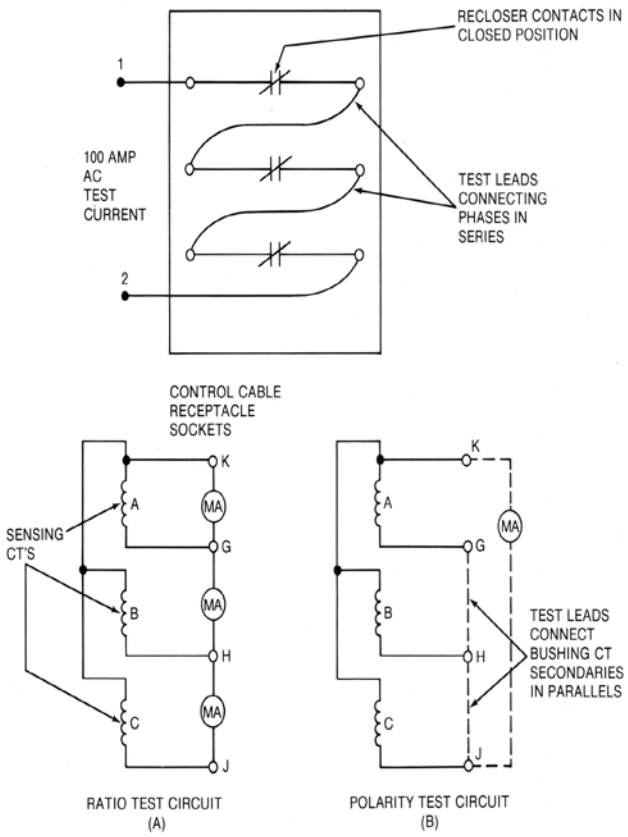
Polarity test

Refer to Figure 27, Polarity Test Circuit (B).

1. Connect sockets G. H and J of the control cable receptacle in series with jumper leads as indicated in Figure 27. The jumper leads connect the secondaries of the current transformers in parallel so that total output current, measured at points K and J. should be 300 mA.
2. Energize the 100 ampere test source. A 300 mA reading indicates correct polarity for all three sensing transformers. If the meter across K and J reads only 100 mA, the polarity of one of the transformers is reversed. Check for uniform location of the polarity marks on all three transformers. reposition as necessary.
3. De-energize ac test current and remove jumperwires from receptacle sockets.

Sensing-current transformer replacement

1. Remove the recloser bushing. Label the leads of the sensing current transformer that are to be replaced. Preferably use labeling in accordance with the connection diagram to aid in tracing leads later. The X1 leads are white and the X2 leads are black.
2. Cut the leads on the transformer side of the original splice to disconnect the current transformer.



NOTE: Ratio and polarity test circuits shown are the effective circuits that contribute to the testing. Components not having an effect on the current flow are not shown. Dotted lines in the polarity test circuits are test leads.

Figure 27. Test circuit for checking bushing current transformers

3. Remove capscrews and hex nuts that secure the current transformers to the recloser head. The sensing CT can now be dropped out with mounting and spacing plates.
4. Replace the CT's by reversing the above procedure. Be sure to reuse all spacers provided. All sensing CT's are marked with a black spot to indicate polarity.
5. Replacement of the CT's should be with polarity markings up toward the head casting. Replacement transformers are equipped with generous leads, which can be trimmed as required. When splicing connections, refer to previous labeling to assure proper leads are connected before soldering. Wrap all splices with electrical tape.
6. Perform the ratio and polarity tests after replacement of any sensing CT to make sure they are properly installed.

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 Eaton Cooper Power series reclosers that may not be readily locally available.

To assure correct receipt of any part order, always include recloser type and serial number. Because of Eaton's 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.

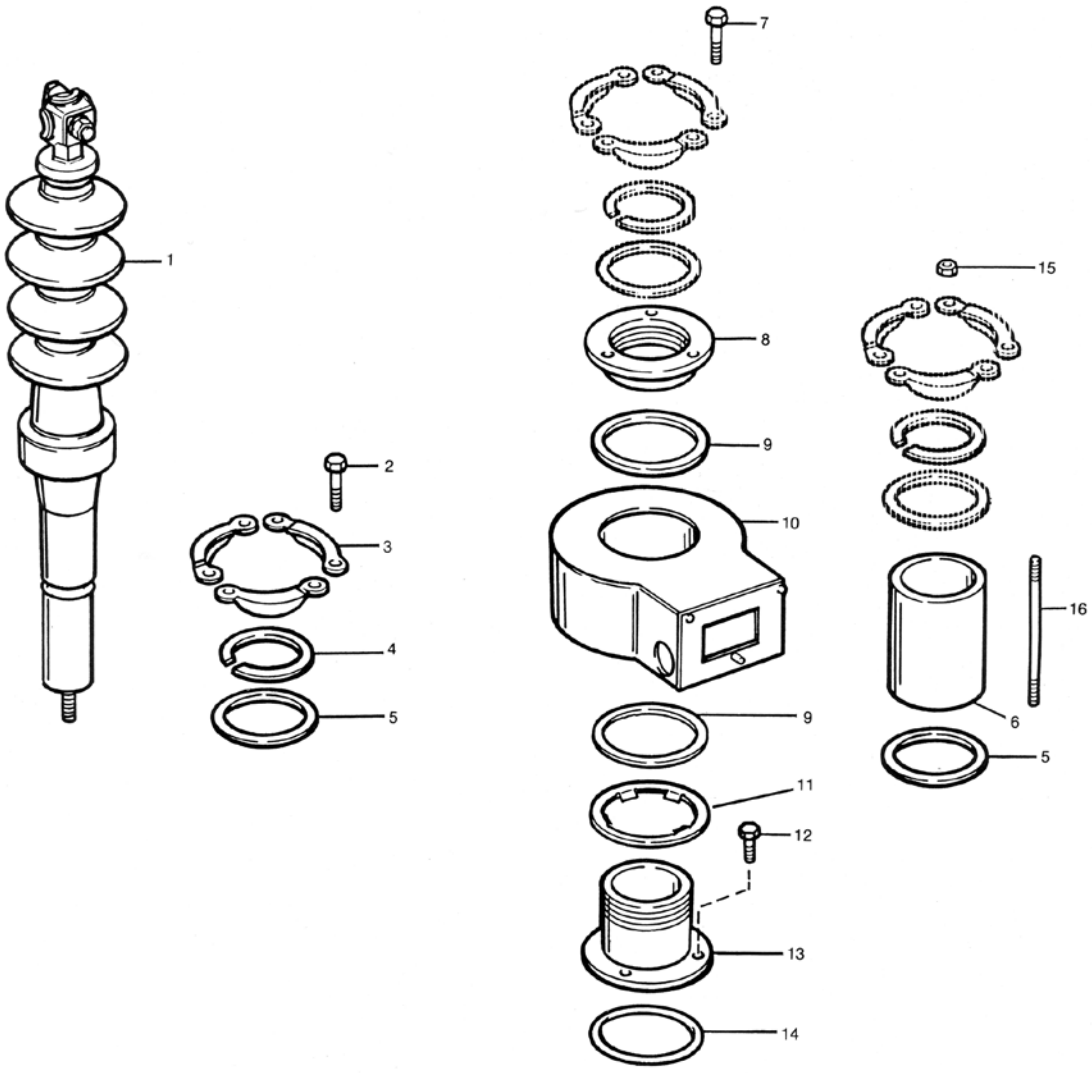


Figure 28. Bushing parts group

Bushing parts group (Figure 28)

Item no.	Description	Catalog number	Qty. per assy.
1	Bushing assembly standard bushing standard bushing with BCT	KA56RV3	6
2	Capscrew, hex hd, 3/8-16 x.	KA56RV4	6
	2-1/4, stl	K7301011272250	18
3	Bushing clamp	KP1109R	18
4	Clamping ring	KP1111R	6
5	Lower bushing gasket	KA1193R	6
The following parts are applicable to the bushing current transformer accessory.			
6	Bushing spacer	KP275W1	1
7	Capscrew, hex hd, 3/8-16 x 1-7/8, stl.	K7301011571870	3
8	Transformer clamping flange	KP170W1	1
9	Flange gasket	KP2090A73	2
10	Replacement current transformer		
	600:5 multi-ratio	KA159W1 S	1
	1200:5 multi-ratio	KA132W	1
11	CT washer, used with plastic housing CT's	KP312W	1
12	Capscrew, hex hd, 3/8-16 x 1 stl.	K7301011371000	3
13	Transformer clamping sleeve	KP169W1	1
14	O-ring gasket, used with transformer clamping sleeve that has machined groove. Old style clamping sleeve, without groove, use KP2090A66.	KP2000A64	1
15	Hex nut, 3/8-16, stl.	K8802011160370	3
16	Stud	KP3149A40	1

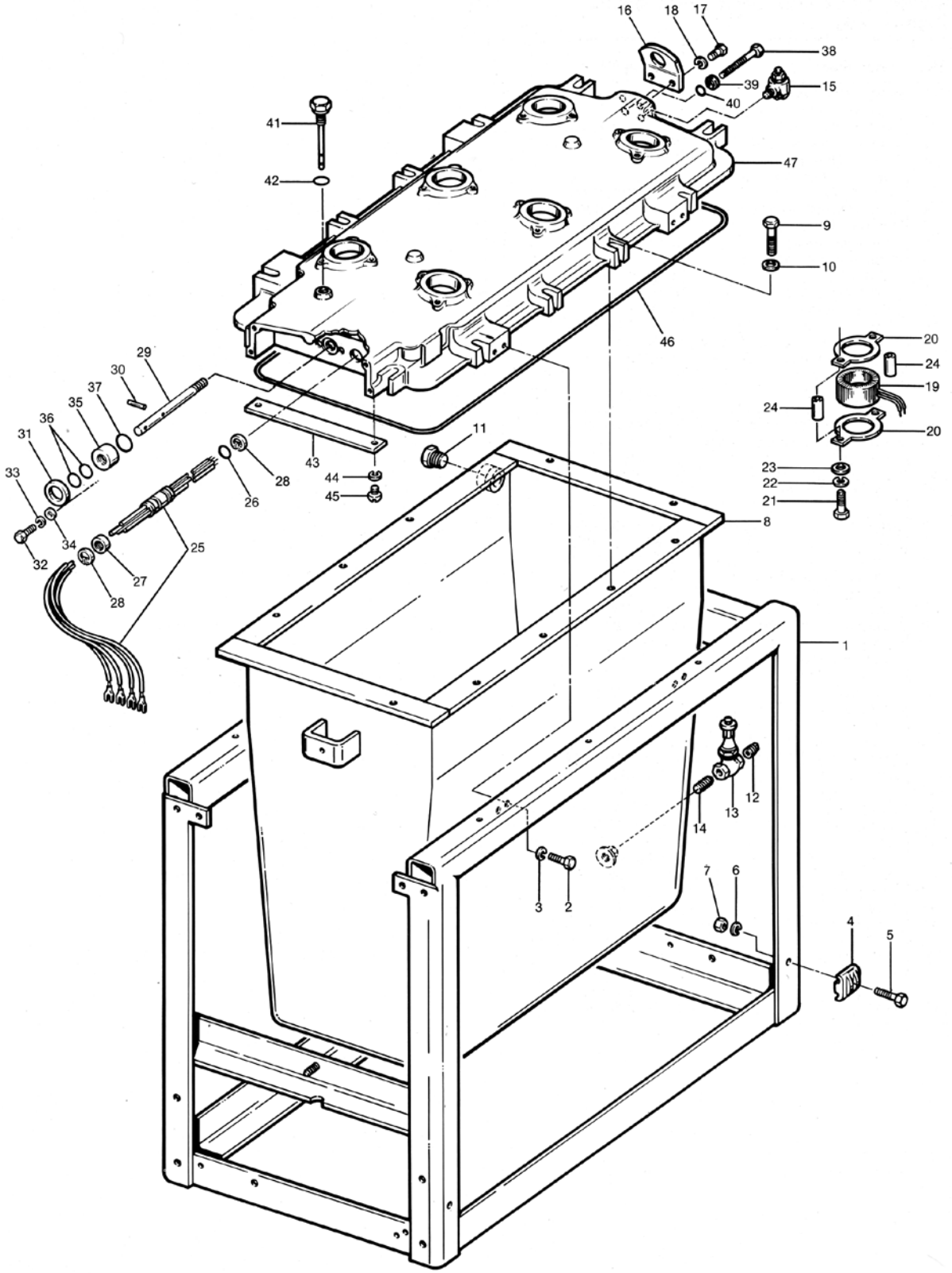


Figure 29. Frame, tank and head parts group

Frame, tank and head parts group (Figure 29)

Item no.	Description	Catalog no.	Qty.
1	Frame assembly	KVS0102VA	1
2	Capscrew, hex hd, 1/2-13 x1-1/4, stl	K7301011501250	8
3	Split lockwasher, med, 1/2, sst	K900815050000A	8
4	Ground clamp	KP1596R	2
5	Capscrew, hex hd, 1/2-13 x1-1/2, stl	K7301011501500	2
6	Split lockwasher, med, 1/2, sst	K900815050000A	2
7	Hex nut, 1/2-13, stl	K8810011130500	12
8	Tank assembly	KVSO101VA	1
9	Capscrew, hex hd, 1/2-13 x2-3/4, stl	K7301011502750	12
10	Plain washer, stl	KP2028A23	12
11	Oil sight gage	KA161W	1
12	Pipe plug, 1/2"	KP2007A3	1
13	Oil sampling and drain valve	KP2038A1	1
14	Close pipe nipple, 1/2x1-1/8	KP2039A1	1
15	Ground connector	KA393A1	
16	Lifting lug	KVSO1013V1	1
17	Capscrew, 1/2-13x1, stl	K7301011501000	2
18	Split lockwasher, med, 1/2, sst	K900815050000A	2
19	Sensing current transformer coil	KA43GV	
20	Coil retainer	KP145RE	6
21	Capscrew, hex hd, 1/4-20 x2-1/4, stl	K7301011252250	6
22	Lockwasher, med, 1/4, stl	K900801025000Z	6
23	Plain washer, No. 18S, brass	K900525025056A	6
24	Spacer	KP3009A88	6
25	Connector, feed thru	KA156CE	1
26	O-ring gasket	KP20000A10	1
27	Spacer	KP3023A5	1
28	External retaining ring	KP2013A22	2
29	Interrupter mechanism operating rod	KP1073VS3	1
30	Roll pin, 1/4x1-1/4, stl	K970801250125A	1
31	Retainer	KVSO1042V1	1
32	Capscrew, hex hd, 1/4-20 x5/8, stl	K7301011250620	2
33	Split lockwasher, med, 1/4, sst	K900815025000A	2
34	Plain washer, 1/4, brass	K900525028075A	2
35	Seal retainer	KVSO104V1	1
36	O-ring seal	KP2000A11	2
37	O-ring gasket	KA2000-13	1
38	Spring retainer bolt	KP1015VS1	1
39	Spacer	KP3013A46	1
40	O-ring gasket	KP2000A4	1
41	Oil dipstick	KA106TSC	1
42	O-ring gasket	KP2000A9	1
43	Cover	KVSO1008V1	1
44	Machine screw, rd hd, 10-24 x1/2, sst	K721515110050A	2
45	Split lockwasher, med, No. 10, sst	K900815010000A	2
46	Head Gasket	KP2103A15	2
47	Head	KVSO1039V1	1

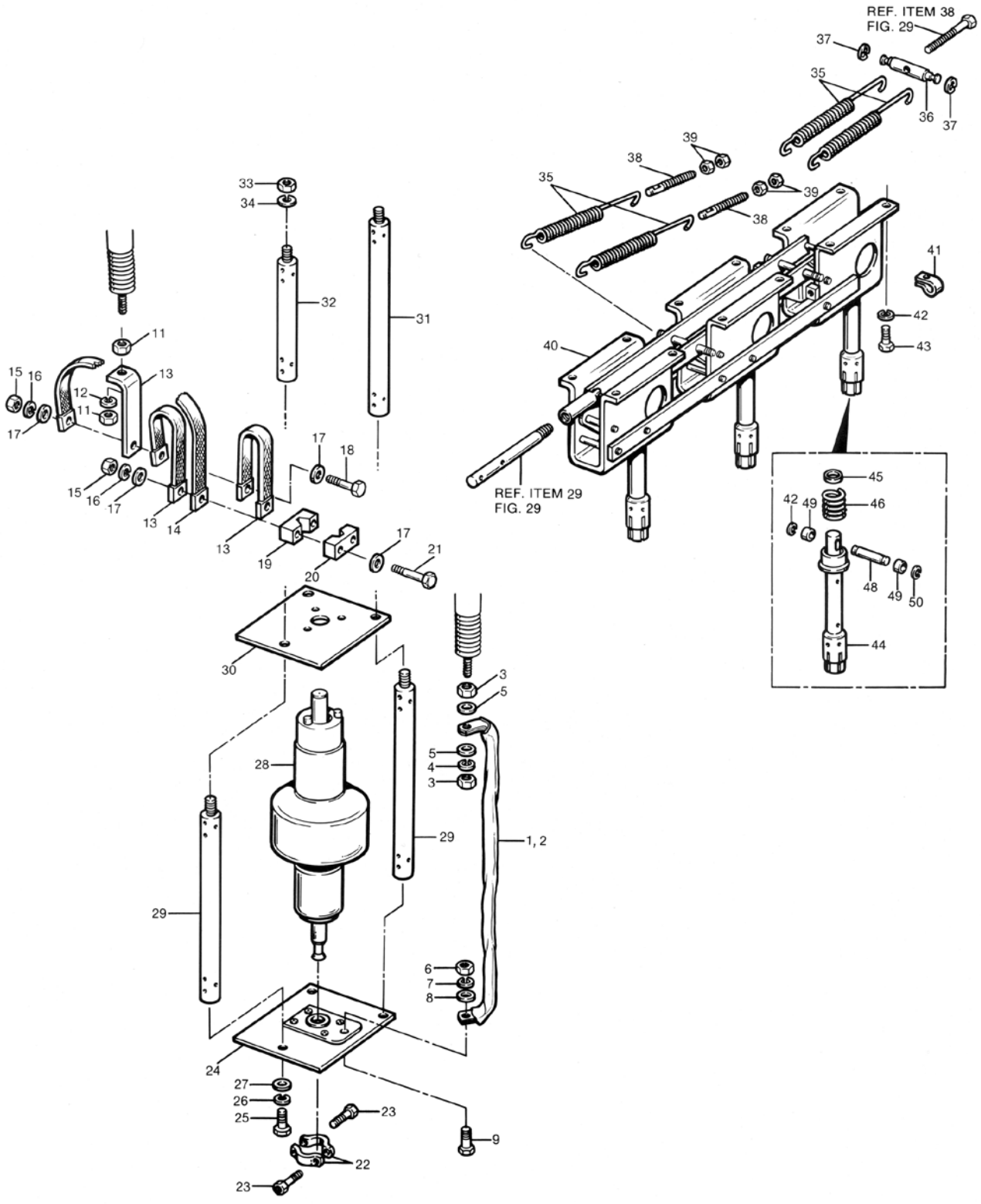


Figure 30. Interrupter mechanism parts group

Interrupter mechanism parts group (Figure 30)

Item No.	Description	Catalog No.	Qty
1	Long bushing lead (6 per phase)	KP3250A25	18
2	Sleeving	KP2104A30	3
3	Jam nut, 1/2-20, brass	K880725320050H	6
4	Split lockwasher, med, 1/2, bronze	K900830050000A	3
5	Plain washer	KP2028A3	6
6	Hex nut, 3/8-16, sst	K880215116037A	3
7	Split lockwasher, med, 3/8, stl	K900801037000Z	3
8	Plain washer, No. 24S, brass	K900525039087H	3
9	Capscrew, 3/8-16x1, sst	K730115137100A	3
10	Lead bracket	KVSO1029V1	3
11	Jam nut, 1/2-20, brass	K880725320050H	6
12	Split lockwasher, med, 1/2, bronze	K900830050000A	3
13	Braided lead, 10" long	KVSO115VB	6
14	Braided lead, 11" long	KVSO115VC	3
15	Hex nut, 3/8-16, sst	K880215116037A	3
16	Split lockwasher, med, 3/8, stl	K900801037000Z	3
17	Plain washer, No. 24S, brass	K900525039087H	6
18	Capscrew, hex hd, 3/8-16 x1-3/4, sst	K730115137175A	3
19	Interrupter clamp (threaded)	KVSO1033V2	3
20	Interrupter clamp (plain)	KVSO1033V1	3
21	Capscrew, hex hd, special	KVSO1047A	6
22	Lower interrupter clamp	KP1036VS	6
23	Capscrew, skt hd, 1/4-20 x1, stl	KP1036A10	6
24	Lower plate and current exchange	KVSO114VA	3
25	Capscrew, hex hd, 3/8-16 x1-1/4, stl	K730101137125Y	9
26	Split lockwasher, mea, 3/8, stl	K900801037000Z	9
27	Plain washer, 3/8 SAE, stl	K900201037000Z	9
28	Vacuum interrupter	KPV3BA	3
29	Lower stringer	KVSO120VB	9
30	Upper support plate	KVSO1017V1	3
31	Upper stringer, long	KVSO120VC	6
32	Upper stringer, short	KVSO120VA	3
33	Hex nut, 3/8-16, sst	K880215116037A	3
34	Split lockwasher, 3/8, stl	K900801037000Z	3
35	Opening spring	KVSO1044V1	4
36	Spring retainer	KP1078VS	1
37	Retaining ring, Type C 3/8 stl (WA518),	K970901375000M	2
38	Adjustment rod	KVSO1028V1	2
39	Hex nut, 3/8-16, sst	K880215116037A	4
40	Interrupter mechanism assembly, includes items 44 thru 49	KVSO112VA	1
41	Cable clip	KP2006A12	3
42	Capscrew, hex hd, 5/16-18 x3/4, stl	K730101131075Y	12
43	Split lockwasher, med, 5/16, stl THE FOLLOWING PARTS ARE INCLUDED IN ITEM 40 BUT MAY BE ORDERED SEPARATELY	K900801031000Z	12
44	Contact operating rod	KVSO1111A	3
45	Spacer	KP3019A2	3
46	Spring	KP100L	3
47	Retaining ring, Type C, 1/4, stl (WA514)	K970901250000M	6
48	Groove pin	KP3124A72	3
49	Spacer	KP3007A157	6

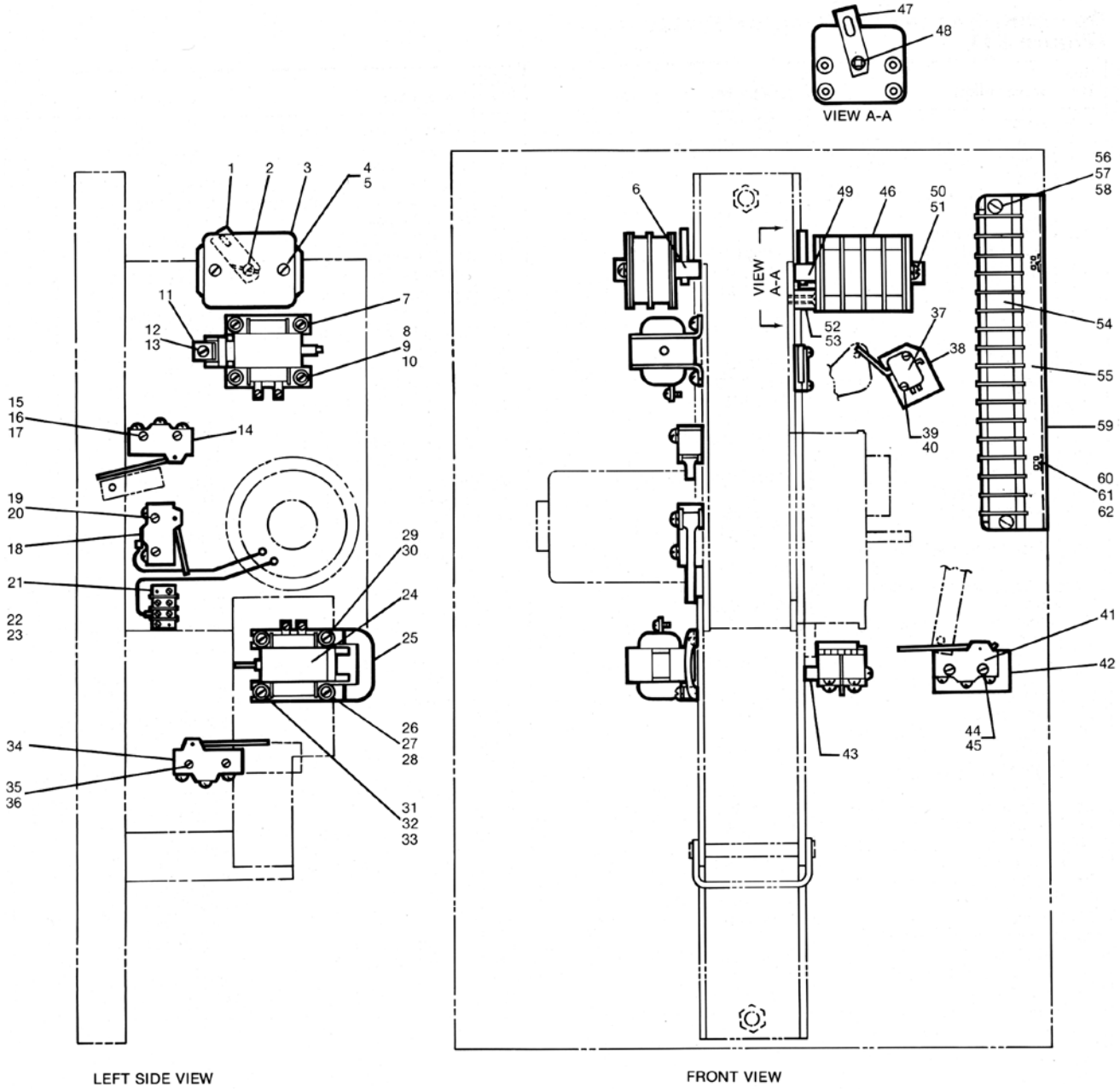


Figure 31. Operating mechanism electrical parts group

Operating mechanism electrical parts group (Figure 31)

Item no.	Description	Catalog no.	Qty.
1	Lever	KVSO1035V1	1
2	Roll pin, 3/32x3/4 19, stl	K970801043075M	1
3	Switch, 2 DPST 152/a1 152/a2		
4	Machine screw, rd hd, 10-24 x2-3/4, stl	K721501110275Z	2
5	Split lockwasher, med, No. 10, stl	K900801010000Z	2
6	Spacer	KP3009A167	2
7	Trip solenoid 152/TC	KA1055M1	1
8	Machine screw, rd hd, 10-24 x5/16, stl	K721501110031Z	4
9	Split lockwasher, med, No. 10, stl	K900801010000Z	4
10	Plain washer, No. 10S, brass	K900525020043A	4
11	Solenoid stop	KP1092CE	1
12	Machine screw, rd hd, 10-24 x5/16, stl	K721501110031Z	1
13	Split lockwasher, med, No. 10, stl	K900801010000Z	1
14	Closing circuit switch 152/bb1	KA1230VS	1
15	Spacer	KP3006A56	2
16	Machine screw, rd hd, 6-32 x1, stl	K721501106100Z	2
17	Split lockwasher, med, No. 6, stl	K900801006000Z	2
18	Motor circuit switch 152/aa1	KA1230VS	1
19	Machine screw, rd hd, 6-32 x7/8, stl	K721501106087Z	2
20	Split lockwasher, med, No. 6, stl	K900801006000Z	2
21	Terminal strip	KP2101A1	1
22	Machine screw, rd hd, 6-32 x1/2, stl	K721501106050Z	2
23	Split lockwasher, med, No. 6, stl	K900801006000Z	2
24	Closing solenoid 152/CC	KA169VSM1	1
25	Solenoid stop	KP1163VSM	1
26	Machine screw, rd hd, 10-24 x3/4, stl	K721501110075Z	1
27	Split lockwasher, med, No. 10, stl	K900801010000Z	1
28	Spacer	KP3006A1	1
29	Machine screw, rd hd, 10-24 x3/8, stl	K721501110037Z	1
30	Split lockwasher, med, No. 10, stl	K900801010000Z	1
31	Machine screw, rd hd, 10-24 x5/16, stl	K721501110031Z	2
32	Split lockwasher, med, No. 10, stl	K900810010000Z	2
33	Plain washer, No. 10S, brass	K900525020043Z	2
34	Manual close switch 152/MCS	KA1230VS1	1
35	Machine screw, rd hd, 6-32x7/8, stl	K721501106087Z	2
36	Split lockwasher, med, No. 6, stl	K900801006000Z	2
37	Manual limit switch 152/LS1	KA201CE	1
38	Insulating barrier	KP1244VSM	1
39	Machine screw, rd hd, 4-40x1/2, stl	K721501104050Z	2
40	Split lockwasher, med, No. 4, stl	K900801004000Z	2
41	Spring position switch 152/SP1 152/SP2	KA1230VS1	2
42	Insulating barrier	KNC1070S	1
43	Spacer	KP3007A32	2
44	Machine screw, rd, hd 6-32x2, stl	K721201106200Z	2
45	Split lockwasher, med, No. 6, stl	K900801006000Z	2
46	Auxiliary switch, 4 No – 4 NC	KA612R44	1
47	Lever	KVSo1036V1	1
48	Roll pin, 3/32x3/4, stl	K970801093075M	1
49	Spacer	KP3009A90	2
50	Machine screw, rd hd, 10-24 x3-3/4, stl	K721501110375Z	2
51	Split lockwasher, med, No. 10, stl	K900801010000Z	2
52	Spacer	KP 1020VS	2
53	Machine screw, fit hd, 10-24 x7/8, stl	K721601110082Z	2
54	Terminal strip	KP2101A18	1
55	Marker strip	KP2101A218	1
56	Machine screw, rd hd, 10-24 x5/7, stl	K721501110062Z	2
57	Split lockwasher, med, No. 10, stl	K900801010000Z	2
58	Hex nut, 10-24, stl	K881001124010Z	2
59	Bracket	KP1099VSM	1
60	Hex nut, 8-32, stl	K881001132008Z	2
61	Split lockwasher, med, No. 8, stl	K900801008000Z	2
62	Plain washer, No. 8 SAE, stl	K900201008000Z	2

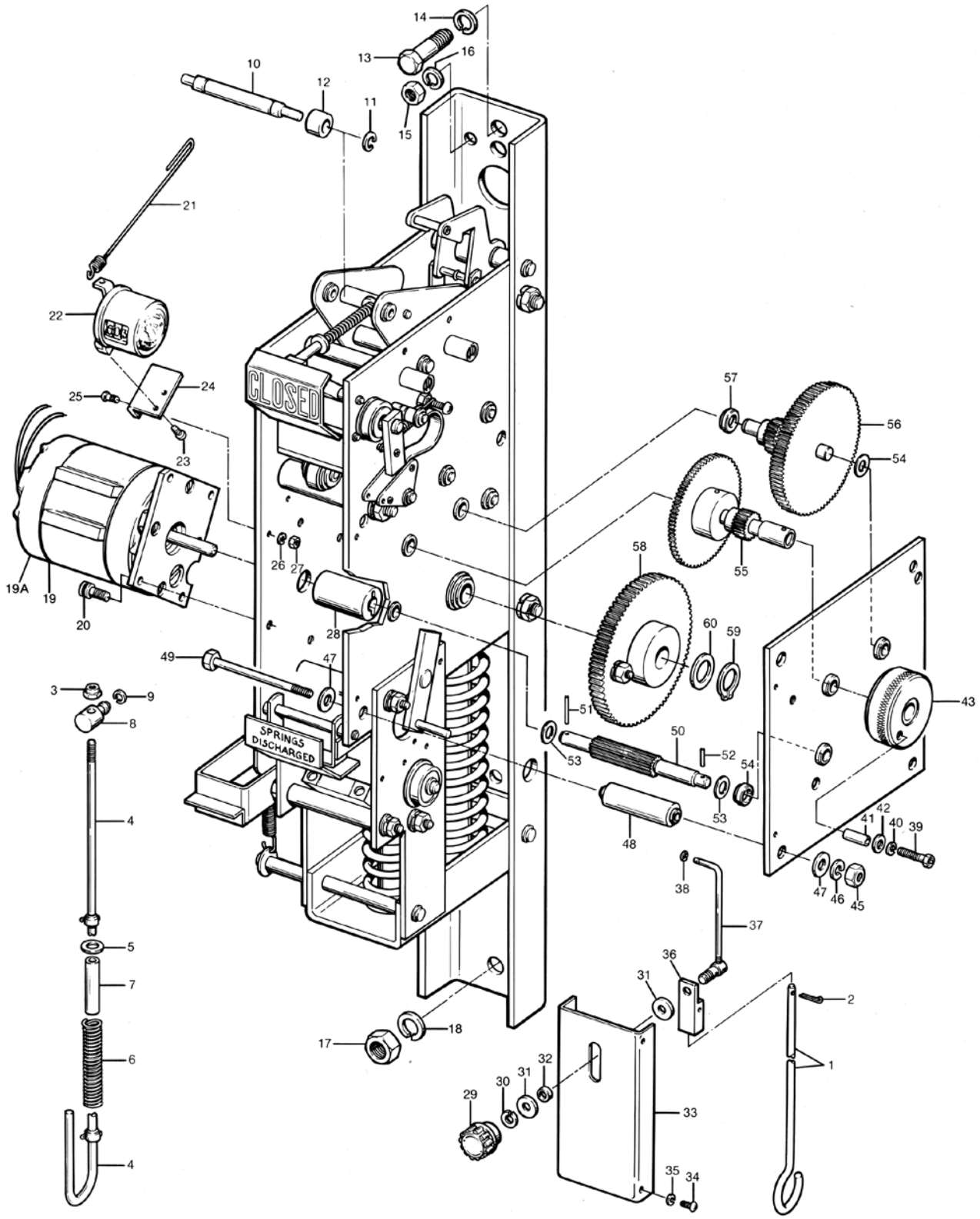


Figure 32. Operating mechanism mechanical parts group

Operating mechanism electrical parts group (Figure 32)

Item no.	Description	Catalog no.	Qty.
1	External trip pullring	KP1240VSM2	1
2	Cotter pin, 1/16x1, brass	K97052506210A	1
3	Elastic stop nut, 10-24	KP2020A13	1
4	External quick-close pull hook	KA186VSM3	1
5	Plain washer, special	KP2028A53	1
6	Spring	KP157VR	1
7	Spacer	KP3007A18	1
8	Operating link	KP724D	1
9	Retaining ring, Type C, 1/4, stl, (WA514)	K970901250000M	1
10	Pin	KP12O5VSM	1
11	Retaining ring, Type C, 3/8, stl, (WA518)	K970901375000M	1
12	Spacer	KP3011A54	2
13	Capscrew, hex hd, 7/16-14 x1-1/4, stl	K730101143125Y	1
14	Split lockwasher, med, 7/16, stl	K900801043000Z	1
15	Hex nut, 3/8-16, set	K880215116037A	2
16	Split lockwasher, med, 3/8, stl	K900801037000Z	2
17	Hex nut, 1/2-13, stl	K8810011130500	1
18	Split lockwasher, med, 1/2, set	K900815050000A	1
19	Motor and adapter plate assy, 240-Vac	KA248VSM	1
19A	Brush replacement kit (consists of 2 brushes and 2 brush caps) For 240-Vac motor For 120-Vac motor	 KA1294VSM900S KA210VSM900S	 1 1
20	Machine screw, skt hd, 1/4-20x3/8 stl	KP2036A29	4
21	Counter spring	KP1191VSM	1
22	Counter assembly	KA28C09	1
23	Self-tapping screw, Type F. 6-32x3/8, set	K7515106037A	1
24	Counter bracket	KP1190VSM	1
25	Machine screw, rd hd, 6-32 x2-1/2, stl	K721501106050Z	2
26	Split lockwasher, med, No. 6, stl	K900801006000Z	2
27	Hex nut, 6-32, stl	K8810011320062	2
28	Coupling	KP1278VSM	1
29	Reset knob	KP2069A6	1
30	Split lockwasher, 1/4, stl	K900801025000Z	1
31	Plain washer, No. 14S, brass	K900525026056A	2
32	Spacer	KP3007A75	1
33	Front plate	KP1165VSM	1
34	Machine screw, rd hd, 6-32 x5/16, stl	K721501106031Z	4
35	Split lockwasher, med, No. 6, stl	K900801006000Z	4
36	Pull link	KP1241VSM	1
37	Rod and pin assembly	KA143VSM	1
38	Retaining ring, Type E, 1/4, stl	K971001125000Z	1
39	Machine screw, hex hd, 10-24x1, stl.	K722401110100Z	1
40	Split lockwasher, med, No. 10, stl	K900801010000Z	1
41	Spacer	KP3005A9	1
42	Plain washer, No. 10S, brass	K900525020043A	1
43	Clutch assembly	KA185VSM	1
44	Plate assembly	KA119VS1	1
45	Hex nut, 1/4-20, stl	K8802011200250	4
46	Split lockwasher, med, 1/4, stl	K900801025000Z	4
47	Plain washer, 1/4 SAE, stl	K900201025000Z	8
48	Spacer	KP3105A29	4
49	Capscrew, hex hd, 1/4-20 x3, stl	K7301011253000	4
50	Pinion	KP1059VS	1
51	Roll pin, 0.156x3/4, stl	K970801156075C	1
52	Roll pin, 0.125x1/2, stl	K970801125050C	1
53	Plain washer	KP2028A67	3
54	Spacer	KP3010A14	1
55	Gear assembly, 1st intermediate	KA165VSM	1
56	Gear assembly, 2nd intermediate	KA166VSM	1
57	Spacer	KP3011A112	1
58	Gear assembly, main	KA164VSM	1
59	Retaining ring	KP2013A32	1
60	Washer	KP2028A17	1

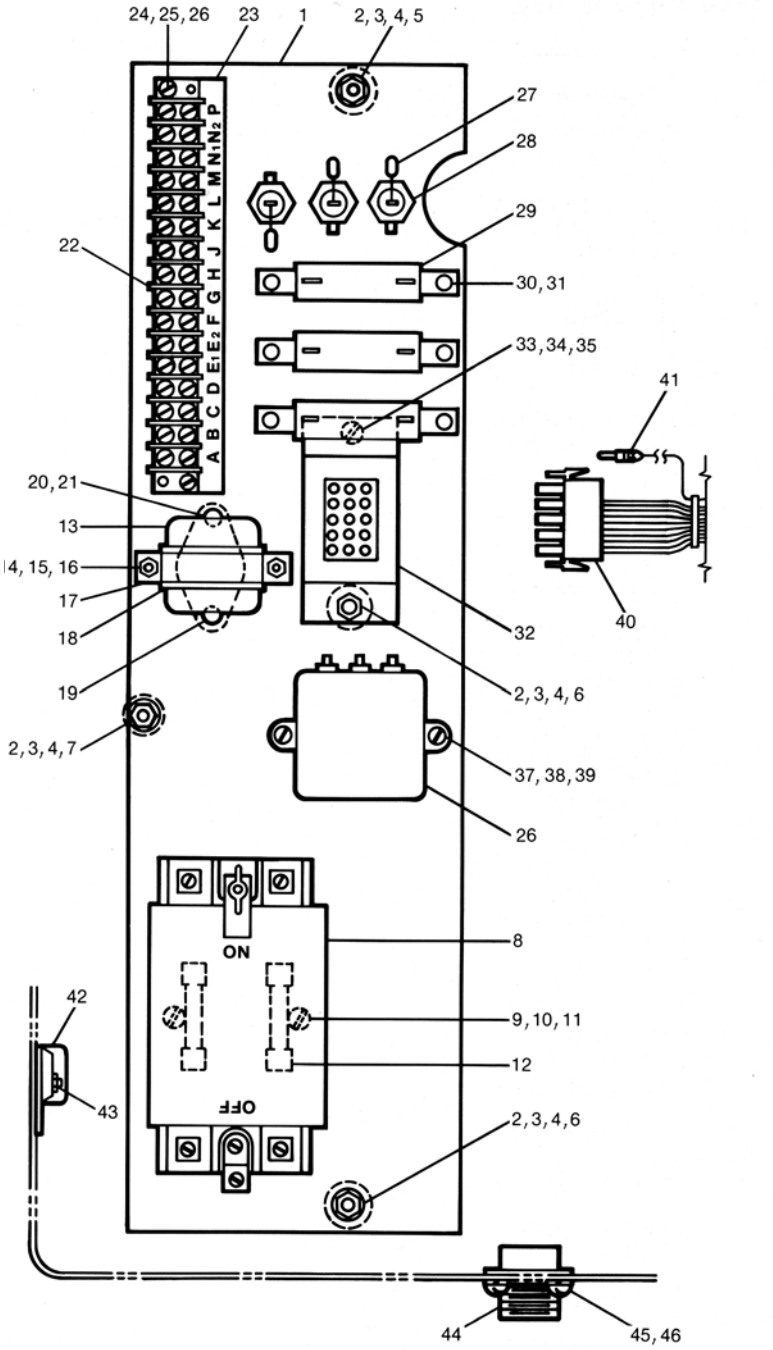


Figure 33. Panel board and wiring parts group

Operating mechanism electrical parts group (Figure 33)

Item no.	Description	Catalog no.	Qty.
1	Panel board assembly	KA192KSM3	1
2	Hex nut, 10-24, brass	K88102S125010A	4
3	Split lockwasher, med, No. 10, bronze	K900830010000A	4
4	Plain washer, No. 10S, brass	K900525020043A	4
5	Spacer	KP3006A32	1
6	Spacer	KP3013A23	2
7	Spacer	KP3010A4	1
8	Fuse cutout	KA965M1	1
9	Machine screw, rd hd, 10-24x1, stl	K7215011101002	2
10	Lockwasher, ext tooth, No. 10, stl	K901101010000Z	2
11	Hex nut, 10-24, stl	K8810011240102	2
12	Fuse, Type FRNR2, 2A, 250-Vac	KA2075A22	4
13	Undervoltage relay, 230-Vac	KA941M1	1
14	Hex nut, 6-32, stl	K8810011320062	2
15	Lockwasher, ext tooth, No. 6, stl	K901101006000Z	2
16	Machine screw, rd hd, 6-32 x7/16, stl	K721501106043Z	2
17	Bracket	KP1326M	1
18	Pad	KP1362M	1
19	Tube socket, 8 pin	KP1112ME	1
20	Rivet, 0.146x9/32, stl	K930801014028Z	2
21	Plain washer, No. 6S, brass	K900525015031A	2
22	Terminal block	KP2101A56	1
23	Market strip	KP2076A51	1
24	Machine screw, rd hd 6-32 x5/8, stl	K721501106062Z	2
25	Lockwasher, ext tooth, No. 6, stl	K901101006000Z	2
26	Hex nut, 6-32, stl	K8810011320062	2
27	Capacitor, 0.10 mfd ± 10% 200-wVdc	KP4002A123	3
28	Silicone diode	KP401149	3
29	Resistor, wirewound, 100Ω ±5%, 2.5 W.	KP4022A31	3
30	Rivet, 0.146x9/32, stl	K930801014028Z	2
31	Plain washer, No. 6S, brass	K900525014031A	2
32	Bracket and socket assembly	KA189VSM2	1
33	Machine screw, rd hd, 10-24 x3/8, stl	K7215011100372	1
34	Lockwasher, ext tooth, No. 10, stl	K901101010000Z	1
35	Hex nut, 10-24, stl	K8810011240102	1
36	Capacitor, 0.5-0.5 mfd, 1000-wVdc	K999904310208A	1
37	Machine screw, rd hd, 8-32 x3/8, stl	K7215011080372	2
38	Lockwasher, ext tooth, No. 8, stl	K901101008000Z	2
39	Hex nut, 8-32, stl	K8810011320082	2
40	Plug, 15 circuit	K999904250413A	1
41	Plug pin	K999904240415A	12
42	Terminal block, input	KP2101A27	1
43	Hex nut, 8-32, stl	K8810011320082	2
44	Cable receptacle	KP2056A5	1
45	Self-tapping screw, Type F, 6-32x3/8 stl	K7515011060372	4
46	Split lockwasher, med, No. 6	K900801006000Z	4

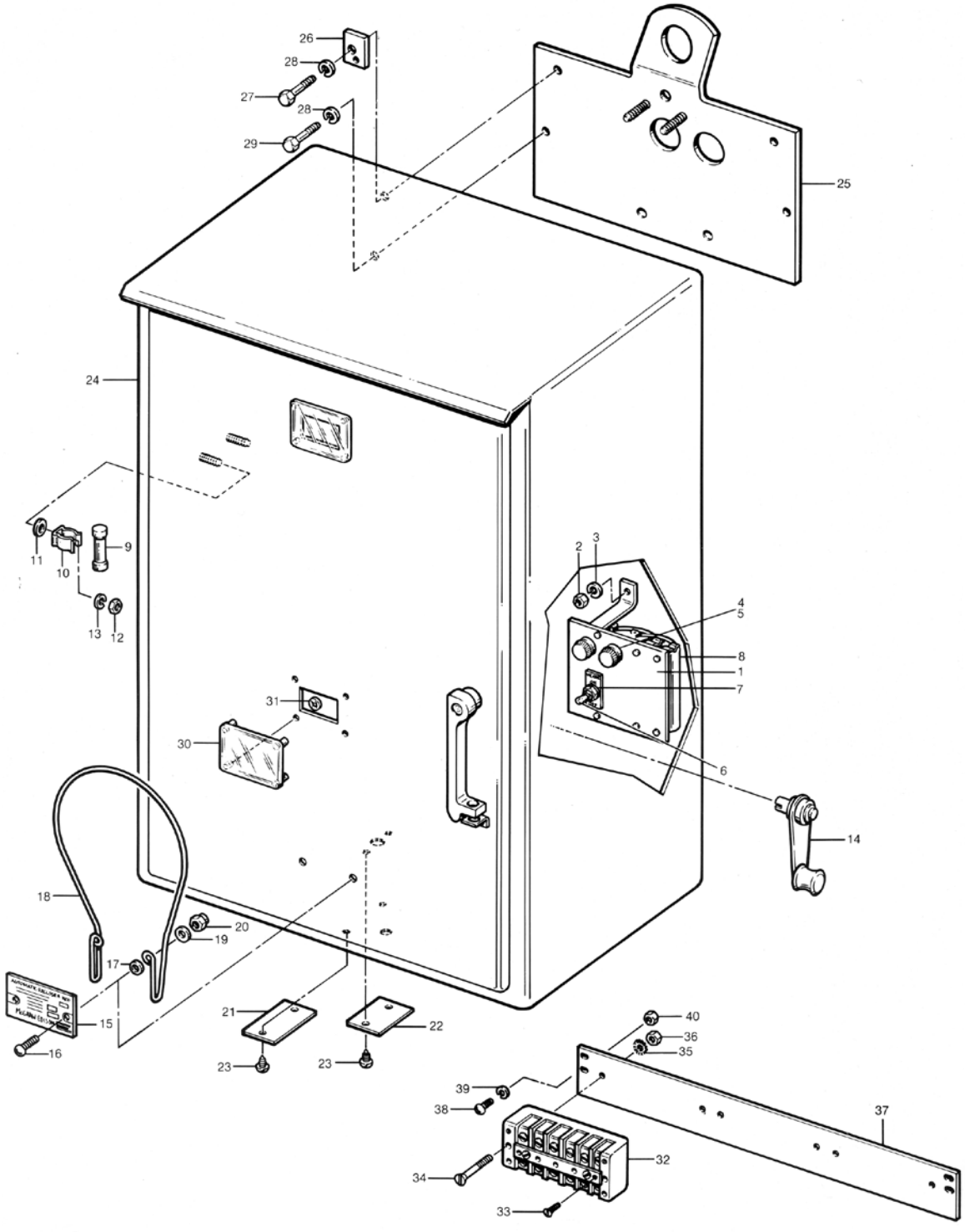


Figure 34. Mechanism cabinet parts group

Mechanism cabinet parts group (Figure 34)

Item no.	Description	Catalog no.	Qty.
1	Heater assembly, complete, includes items 4 thru 8	KVSO125VA	1
2	Hex nut, 8-32, stl	K881001132008Z	2
3	Split lockwasher, med, No. 8, stl	K900801008000Z	2
4	Fuse holder	KP2074A1	2
5	Fuse, Type AGC, 2A-250-V	KP2075A2	2
6	Toggle switch, DPST	K999904250091A	1
7	Washer, special	K999904250380A	1
8	Resistor, wirewound, 500 ohms, 50W	K999904310084A	2
9	Spare fuse, Type FRNR2, 2A-250W	KP2075A22	2
10	Fuse clip	KP1091A	2
11	Spacer	KP3011A132	2
12	Hex nut, No. 8, stl	K881001132008Z	2
13	Split lockwasher, med, No. 8, stl	K900801008000Z	2
14	Crank	KA134VSM1	1
15	Nameplate	KSVO1043V1	1
16	Machine screw, 6-32x3/8, sst	K721515106037A	2
17	Fibre washer	KP2090A39	2
18	Records holder	KP1215VSM	1
19	Plain washer, No. 6, stl	K900201006000Z	2
20	Elastic stop nut	KP2020A6	2
21	Manual trip instruction plate	KP1242VSM	1
22	Manual quick-close instruction plate	KP1176VSM	1
23	Self-tapping screw, rd hd, Type Z, No. 4x3/16, sst	K801515004018A	4
24	Cabinet assembly (includes items 30-31)	KA154VS4	1
25	Lifting plate assembly	KVSO103VA	1
26	Support plate	KVSO1034V1	2
27	Capscrew, hex hd, 5/16 x1-1/2, stl	K730101131150Y	2
28	Split Lockwasher, med, 5/16, stl	K900801031000Z	4
29	Capscrew, hex hd, 5/16x1, stl	K730101131100Y	2
30	Window	KP1240M	2
31	Speed nut THE FOLLOWING PARTS ARE APPLICABLE TO THE BCT ACCESSORY	KP2005A1	8
32	Terminal block	KP2101A53	3
33	Machine screw, rd hd, 8-32 x1/2, brass	K721525108050A	3
34	Machine screw, rd hd, 10-24 x1-1/8, stl	K721501110106Z	6
35	Lockwasher, ext tooth, No. 10, stl	K901101010000Z	6
36	Hex nut, 10-24, stl	K881001124010Z	6
37	Panel	KP1098VSM	1
38	Machine screw, rd hd, 1/4-20 x1/2, stl	K721501125050Z	2
39	Split lockwasher, med, 1/4, stl	K900801025000Z	2
40	Hex nut, 1/4-20, stl	K881001120025Z	2

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