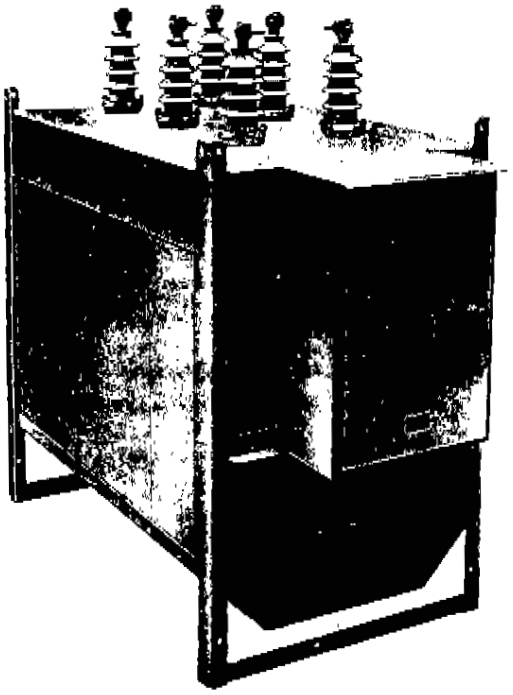
Reclosers

Type VSML
Maintenance Instructions



RADIATION WARNING

Before performing electrical tests on Type VSML reclosers refer to Service Information S280-90-1.

Figure 1
McGraw-Edison Type VSML electronically controlled vacuum recloser.

CONTENTS

INTRODUCTION

Service Information S280-45-3 covers the maintenance instructions for the Type VSML electronically controlled three-phase, vacuum recloser. The manual includes a general description of the recloser and its operating principles and instructions for periodic inspection, testing and shop repairs. Service parts lists keyed to exploded view drawings of the unit along with ordering information are included at the back of the manual.

DESCRIPTION

The Type VSML recloser is a three-phase, electronically controlled fault interrupting device that features vacuum interruption and air insulation. Current interruption takes place in vacuum interrupter assemblies suspended from the recloser cover by insulating supports (Figure 2). A moving contact in each interrupter assembly is driven by the operating mechanism of the recloser (Figure 3) to open and reclose the circuit and clear the arc within one-half cycle while utilizing a stroke of only one-half inch.

Recloser tripping and closing are initiated by signals from the electronic control. When fault currents in excess of the minimum trip value are detected in one or more phases, a 24-volt signal from the electronic control activates a solenoid in the operating mechanism of the recloser to trip the opening springs and open the interrupter contacts.

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At the programmed reclosing time, a 24-volt closing signal from the electronic control actuates the operating motor. The motor drives a cam to release preloaded closing springs which close the main contacts and charge the opening springs. The motor continues to run after the contacts are closed to preload the closing springs for the next operation.

An external 230 vac auxiliary power source supplies power for the motor operator and also charges the battery in the electronic control. The battery, in turn, supplies the 24-volt d-c tripping and closing signal power. An undervoltage relay opens a contact in the closing circuit if the 230 vac motor supply power is lost. This prevents draining the control battery because of a continuous closing signal when there is no closing power. Tripping is accomplished with stored-spring energy released by a 24-volt signal from the electronic control and will occur even though the 230 vac supply is lost.

Major parts and assemblies are identified in Figures 2 and 3.

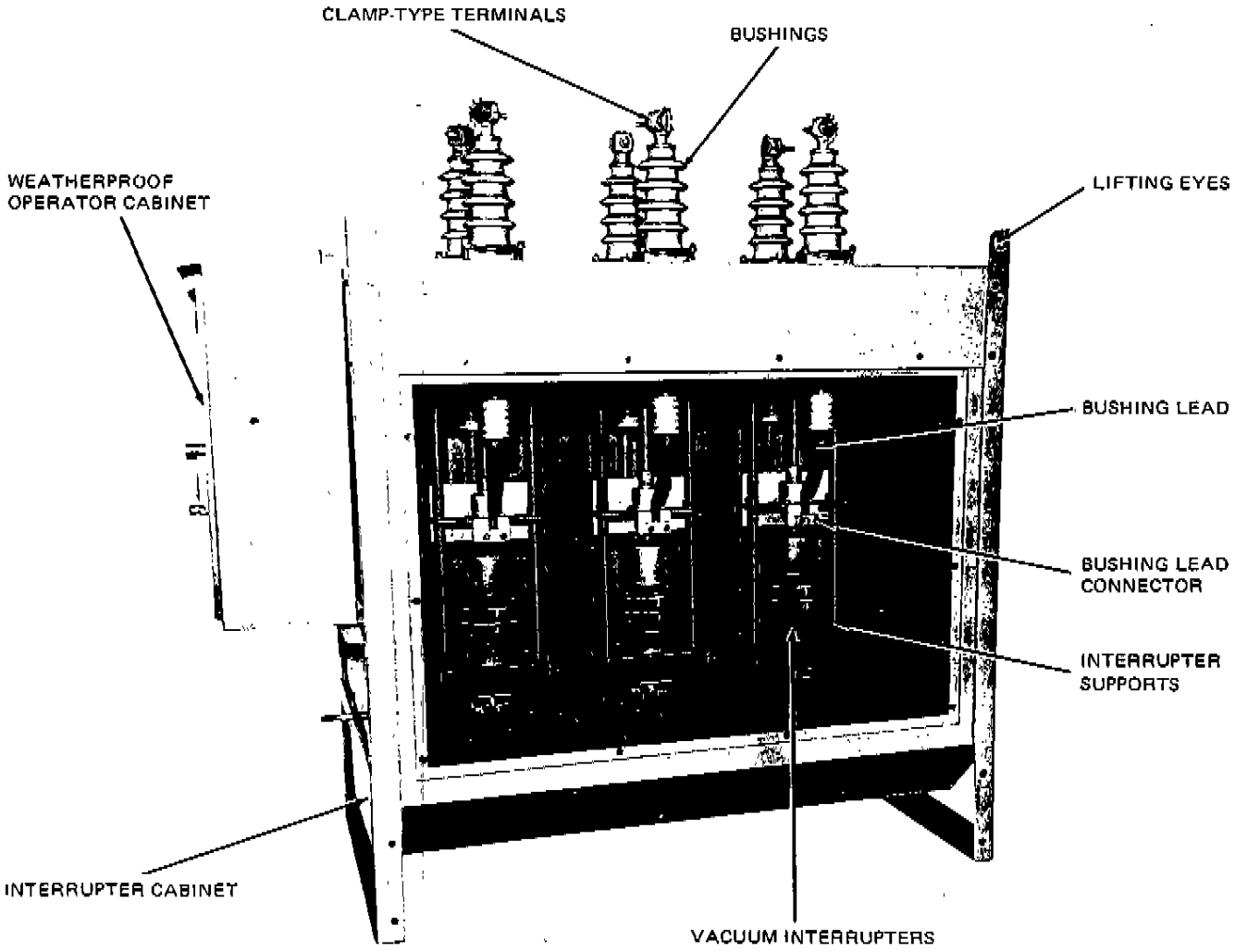
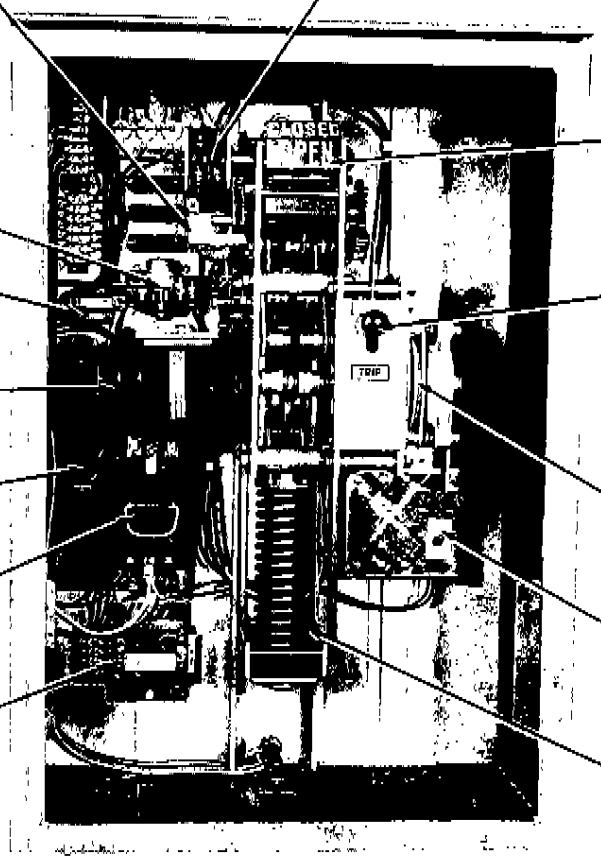


Figure 2
Type VSML vacuum recloser with inspection cover removed.



TRIP SOLENOID ASSEMBLY $\frac{152}{TC}$
operates with 24-volt d-c signal from electronic control.

LIMIT SWITCH $\frac{152}{a1}$ & $\frac{152}{a2}$
deenergizes trip coil and trip circuit.

CONTACTOR $\frac{152}{X}$
closes motor circuit.

UNDER-VOLTAGE RELAY $\frac{152}{UV}$
prevents draining battery in control if 230 vac is lost.

SERIES UNIVERSAL MOTOR (M)
has low power requirement, needs no lubrication.

RECTIFIER (R)
supplies d-c power for brake.

FUSED PULLOUT SWITCH $\frac{FU}{20}$
provides a safe, visible means of disconnecting motor power source.

BATTERY CHARGER $\frac{152}{BC}$
connected to 230-volt a-c source through fused pullout switch and to electronic control battery.

CONTACT POSITION INDICATOR
linked to main operating shaft visible through window in operator cabinet.

MANUAL TRIP AND RESET KNOB
permits manual tripping without control when knob is pushed to trip. Also operates limit switch $\frac{152}{LS}$ which opens close circuit to disable electrical closing.

BRAKE(B)
is solenoid operated, energized by dc from rectified 230-volt source.

HEATER CONTROL
switch and fuses for heaters in operator cabinet and in interrupter enclosure.

CLOSING SPRINGS
charged by drive motor.

Figure 3
Components of operating mechanism.

SPECIFICATIONS

RECLOSER ELECTRICAL RATINGS

Nominal system voltage (kv rms)	14.4
Rated maximum voltage (kv rms)	15.5
Rated Impulse withstand voltage (BIL) (kv crest)	110
60-hertz insulating level withstand (kv rms)	
Dry, one minute	50
Wet, ten seconds	45
Continuous current (amps)	560

INTERRUPTING RATINGS

Minimum Trip (amps)	Interrupting Capacity (amps)
100	3000*
140	4200*
200	6000*
280	8400*
400	12000*
560	16000
800	16000
1120	16000

*Protective accessory on the control extends the interrupting capacity of the recloser to its maximum rated value.

DUTY CYCLE

Percent of Interrupting Rating	X/R Ratio	No. of Operations
15-20	4	112
45-55	8	80
90-100	16	40
	Total Operations	232

CLOSING MOTOR

Operating voltage, vac	230
Voltage range, vac	190-250
Inrush current, amps	15
Steady-state current, amps	8
Motor start to contact make (cycles)	10.5

TRIP SOLENOID

Operating voltage, vdc	24
Peak current, amps	5.65 (1½ cycles)

PERIODIC FIELD INSPECTION AND MAINTENANCE

The frequency of maintenance depends upon local climatic conditions and the severity of the operating service imposed on the recloser. McGraw-Edison recommends that, initially, a maintenance check be made after one year of service or during the customer's normal substation maintenance interval whichever occurs first. A study of maintenance records for similar equipment and the results of this initial inspection can then be used to establish realistic maintenance interval requirements. The latest issue of American National Standards, ANSI C37.61 proposes methods for this evaluation.

Because there is no oil that requires changing, the maintenance check of this recloser is confined to a general cleaning and inspection for accidental or environmental damage. Each periodic maintenance check should include at least the following steps:

1. By-pass and trip the recloser to remove it from service.
   - A. Disconnect the control cable from the electronic control.
   - B. Be sure to deenergize the 230 vac auxiliary power source to the operator cabinet.
2. Inspect external components.
   - A. Check for broken or cracked bushings.
   - B. Check for paint scratches, corrosion, and mechanical damage.
3. Inspect the operator mechanism.
   - A. Check interior of the operator mechanism cabinet for accumulation of dust and dirt; clean as necessary. Check door gasket for effectiveness of gasket seal.
   - B. Visually inspect all components for worn or broken parts and corrosion.
   - C. Check for broken or loose wiring terminations at the various electrical components of the mechanism.
   - D. With a screwdriver check the tightness of brush-holder caps on the motor housing.

> **CAUTION**
>
> Hand-tightening is sufficient; excessive tightening may cause the brush-holder cap to crack.

4. Close and trip the recloser manually several times to check the mechanical operation.
   - A. Insert the manual closing crank (stored on the inside of the operator cabinet door) through the hole in the right-hand side of the cabinet (closed with a plug) and into the hole in the brake housing (Figure 4).
   - B. Make sure the Reset-Trip knob is up in the RESET position.
   - C. Release the brake by holding the brake handle to the right and crank the motor in a counterclockwise direction until the recloser closes. Approximately 10-12 revolutions of the crank are required to release the precharged closing springs and close the vacuum interrupters.
   - D. Move the Reset-Trip knob down to TRIP. The recloser will open and the contact position indicator will read OPEN.

     NOTE: Subsequent manual operations will require approximately 135-140 revolutions of the crank to charge the closing springs and ready the operating mechanism for a closing operation.
   - E. Repeat the mechanical operation several times.

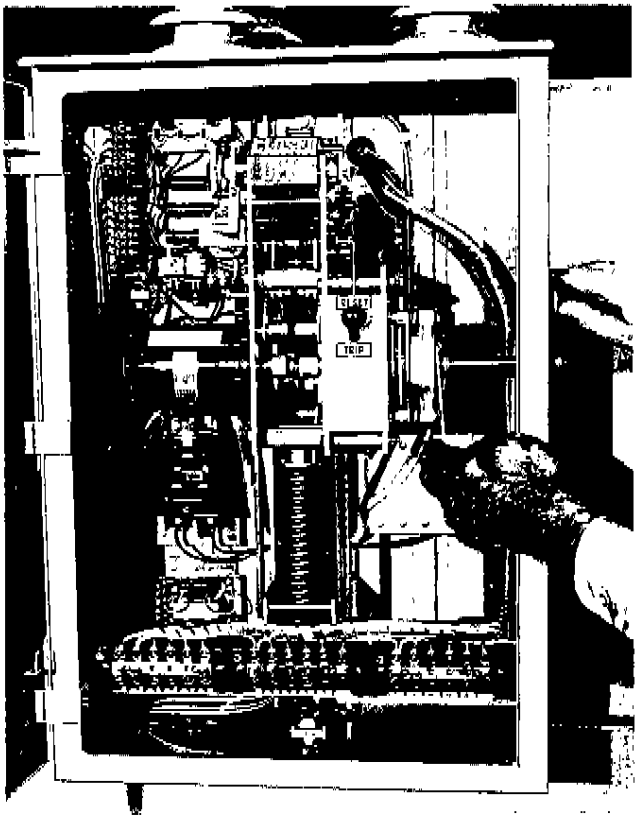


Figure 4
Manually closing Type VSML recloser.

5. Visually inspect the interior of the interrupter housing.
   - A. Remove one of the side inspection panels to gain access to the interior of the housing.
   - B. Check interior of housing for dirt and dust and clean as required.
6. Check the mechanical integrity of all primary connectors and current exchanges of the interrupter assemblies. Retighten or replace as necessary.
7. Check the contact erosion of the vacuum interrupters.
   - A. Manually close the reclose (see step 4).
   - B. Check the position of the scribed mark on the moving contact rod of the interrupter (Figure 5).

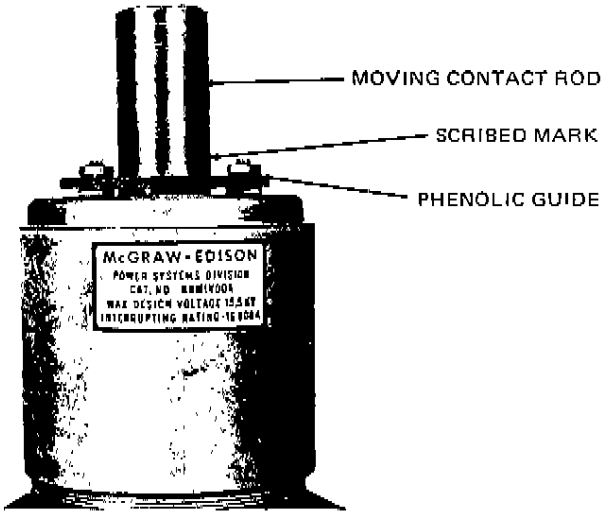


Figure 5
Scribed mark on movable contact rod.

C. If the scribed mark falls below the top of the phenolic guide when the interrupter is closed, the contacts have completed their useful life and the interrupter should be replaced.

8. Check the vacuum integrity of the interrupters.

A. With the recloser in the OPEN position, perform a hi-pot test across the bushings of each open phase at 37.5 kv rms, 60 hz or 50 kv dc.

B. The interrupter should withstand the specified test voltage for one minute and should not load down the test source.

CAUTION

At voltages up to 37.5 kv rms and 50 kv dc the radiation emitted by the vacuum interrupter is negligible. However, above these specified test voltages radiation injurious to personnel may be emitted. See Radiation Warning in Service Information Bulletin S280-90-1 for further details.

IMPORTANT--BE AWARE

After having been energized, the metallic envelope (located between the two ceramic insulators) may retain a small electric charge for some time. The magnitude of the charge is not harmful.

If the envelope is touched before the charge is drained off, a shock may be felt that is similar to the static discharge experienced in a dry, carpeted room.

9. Check the cabinet heaters.

A. Visually inspect the heater resistors in both the operator cabinet and the interrupter housing; check all connections for tightness.

B. Remove and visually check the heater fuses; if necessary, replace with Bussmann Fuse, Type AGC, 250 volt, 1 ampere fuses.

C. Remove the fused pullout switch to disconnect the motor circuit and apply 230 vac auxiliary power to the input terminals to energize the heater circuit.

D. Check the electrical operation of the heater switch and the heaters.

10. Check the electrical operation of the recloser.

A. Reinstall the fused pullout-switch to energize the motor circuit.

NOTE: If the recloser has been manually tripped while the motor circuit was deenergized, the motor will run to charge the closing springs.

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.

NOTE: The motor will continue to run to recharge the closing springs for the next closing operation and automatically stop.

C. Momentarily apply 24 vdc to terminals A(+) and C(–) of the control terminal board; the recloser will open.

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

11. Check the operation of the recloser with its electronic control.

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 by operating the Manual Control switch of the electronic control.

NOTE: Service instructions for the electronic control are provided in a separate manual which includes: control inspection, operational checks, battery charging, and testing.

12. Check the appropriate section in the Installation Manual, S280-45-1, before returning the recloser to service.

SERVICE INSTRUCTIONS

The extent of repairs will determine whether the recloser must be returned to the shop or can be left by-passed on the line. Bushing and vacuum interrupter replacement, and minor repairs may be performed in the field. However, it is recommended that the recloser be returned to the shop if more extensive testing or repairs are required.

If the electronic control requires service, it can be easily replaced with a spare unit and returned to the shop for repairs.

Following replacement of any major mechanical or electrical circuit components, the recloser should be checked out for proper operation both mechanically (manual closing and tripping) and electrically (with electronic control) before returning to service.

BUSHING REPLACEMENT

Bushing maintenance is generally limited to a thorough cleaning and a check for cracks or punctures during the regular maintenance inspection. Cracked or broken bushings must be replaced. To replace a bushing:

1. Disconnect the lead of the damaged bushing at the interrupter assembly.
2. Remove the bushing clamps, secured to the studs in the cover with three hex nuts.
3. Lift off the bushing assembly and remove and discard the lower bushing gasket.
4. Twist off the aluminum clamping ring from the old porcelain. If the ring is in good condition, install it on the new porcelain; if the ring is damaged, a new clamping ring must be installed.

   NOTE: The clamping ring cushions the pressure between the bushing and the bushing clamps and should not be omitted.
5. Unscrew the bushing terminal assembly and remove and discard the upper bushing gasket.
6. Examine the polyethylene insulation on the bushing lead for cuts, nicks and resulting tracking; replace the lead if damage is detected.
7. Install the bushing lead into the new porcelain and replace the bushing terminal using a new upper bushing gasket. Assemble with 35 foot-pounds of torque.

   NOTE: Apply a very small amount of petrolatum jelly to the inside face of the terminal before reassembly. It is sufficient to cover the knurled surface only.
8. Install the bushing assembly into the recloser cover using a new lower bushing gasket. Orient the bushing so that the lower end of the bushing lead is positioned for clamping to the interrupter assembly.
9. Position the aluminum clamping ring with the split positioned between two clamping bolts.
10. Replace the bushing clamps and tighten the clamping nuts gradually and equally in rotation to 12-15 foot-pounds of torque. This results in evenly distributed gasket sealing pressure.

VACUUM INTERRUPTER REPLACEMENT

Interrupters that lose their vacuum integrity (fail the high-pot test) or reach the limit of contact erosion (scribed mark on rod is below the top of the phenolic guide) must be replaced. The following is the recommended procedure for replacing vacuum interrupters on the Type VSML recloser:

1. Make sure the recloser is open. (Trip-Reset knob in TRIP position.)
2. Loosen and remove the upper interrupter clamps (Figure 6). As the clamps are loosened, the contact rod will move downward due to atmospheric pressure acting on the bellows. This action can be verified by observing the movement of the scribed mark as the clamp is loosened.

   NOTE: If the contact rod does not move, use a screwdriver to gently spread apart the clamping fingers at the end of the operating rod assembly to free it.

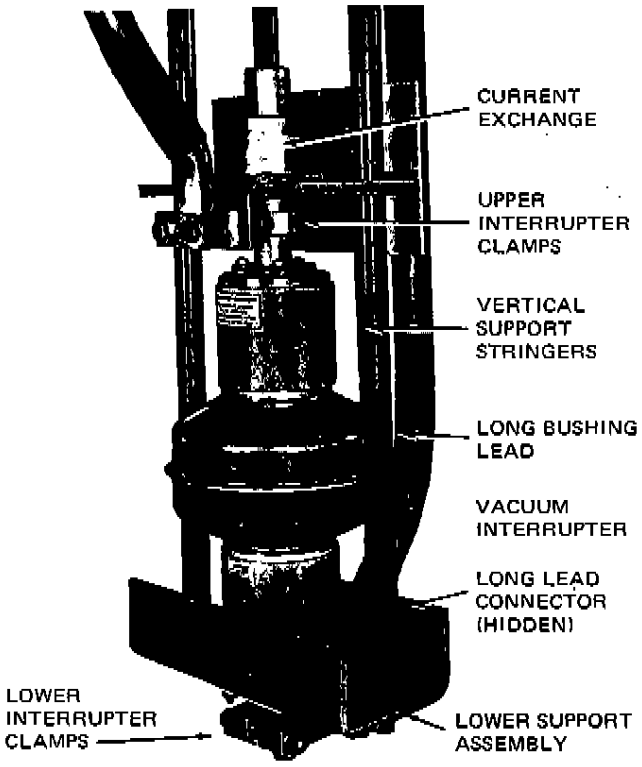


Figure 6
Vacuum interrupter assemblies.

CAUTION

It is important that the movable contact rod of the vacuum interrupter is free before proceeding. Do not twist or pull the vacuum interrupter to free the movable rod end during removal of the interrupter.

3. Disconnect the long bushing rod from the lower support and connector assembly by loosening the bushing-rod clamp and attaching hardware.
4. Loosen and remove the lower interrupter clamps.
5. Remove the two nuts, lockwashers and flatwashers that attach the lower contact support plate to the vertical support stringers, and remove the lower support assembly and vacuum interrupter.
6. Install the new vacuum interrupter into the clamping fingers of the contact operating rod and into the lower contact support assembly and attach the assembly to the vertical support stringers with the two flatwashers, lockwashers and hex nuts.

7. Manually slow-close the recloser using the following procedure:

   A. Place Trip-Reset knob on operating mechanism to RESET.

   B. Insert manual operating handle through side of operating mechanism cabinet into hole in brake assembly (Figure 4).

   C. Release the brake by holding the brake release handle to the right and crank the motor counter-clockwise until the trip latch is engaged above the link and roller assembly (Figure 7).

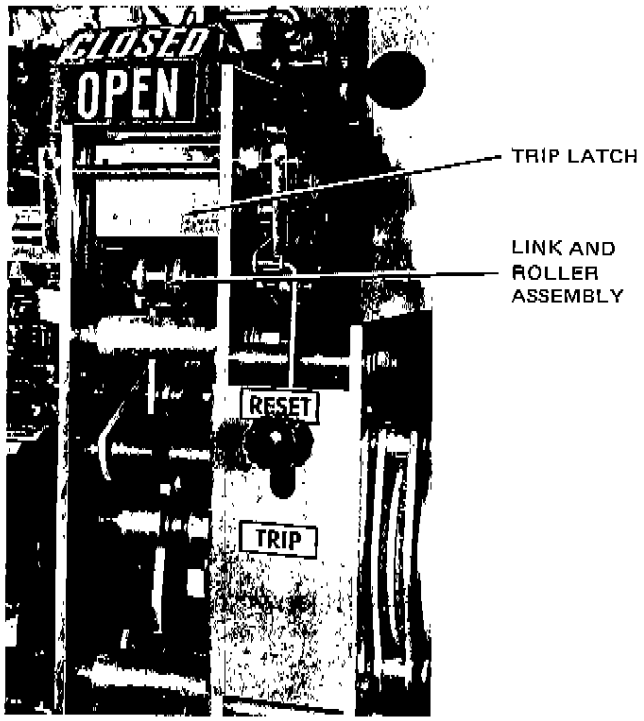


Figure 7
Trip latch engaged for manual "slow-close" operation.

   D. Engage the brake and remove the manual crank.

   E. Release the brake by moving the brake release lever to the right. The charged closing springs will cause the operating mechanism to "unwind" (operate in the opposite direction) and slowly settle the recloser into the closed position.

8. Install the upper and lower interrupter clamps. Position the clamps to the shoulder on the finger-type current exchange connectors and orient the upper clamp members so the gap between them (on one side) is above one of the three hex nuts on the interrupter (Figure 8).

   NOTE: Clamps must be tight to prevent the interrupter contact rods from slipping in their current exchange connectors. Coat the threads of the clamps and the attaching screws with Loctite Anti-Seize Compound No. 6770, or equivalent and torque the upper clamps to 12 foot-pounds minimum, and the lower clamps to 18 foot-pounds minimum.

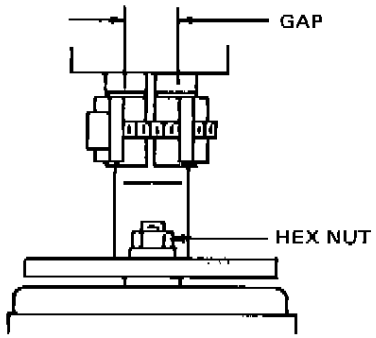


Figure 8
Position upper clamp so that gap between clamping members is directly above one of three hex nuts on interrupter.

9. Reconnect the long bushing lead to the lower contact and support assembly.

10. Trip and quick-close the recloser several times with the manual operating handle to check interrupter operation.

    NOTE: Contact movement can be verified by observing the movement of the scribed mark on the moving contact rod. When the recloser is open, the scribe mark will be 5/8 to 3/4 inch above the top of the phenolic guide disc; on closing, the mark will travel downward 1 1/2 inch.

OPERATING MECHANISM

The motor-spring operated mechanism employs a trip solenoid for opening and a motor-drive for closing. The upper portion of the operating mechanism in the operator cabinet incorporates the tripping mechanism which includes the trip solenoid, mechanical linkages and associated limit switches. The lower portion of the operating mechanism incorporates the closing mechanism which includes the motor, reduction gear box, brake, closing springs, mechanical linkages and associated switches. The opening springs and linkages to operate the vacuum interrupters are located in the interrupter housing.

Opening Spring Removal

With the contacts open the opening springs are relaxed. These springs can be removed by loosening the spring retainer bolt which extends through the back of the interrupter housing for easy access.

These springs pull on the contact operating bar assembly to separate the vacuum interrupter contacts with a high impact force when the contact bar is released by the operating mechanism. When the contacts open fully, a latch riding on the operating bar assembly engages a pin to prevent the bar from bouncing back. When the opening springs are removed, the contact operating bar can be pushed forward to disengage the bounce latch and the bar can be disconnected from the operating mechanism by removing the connecting pin.

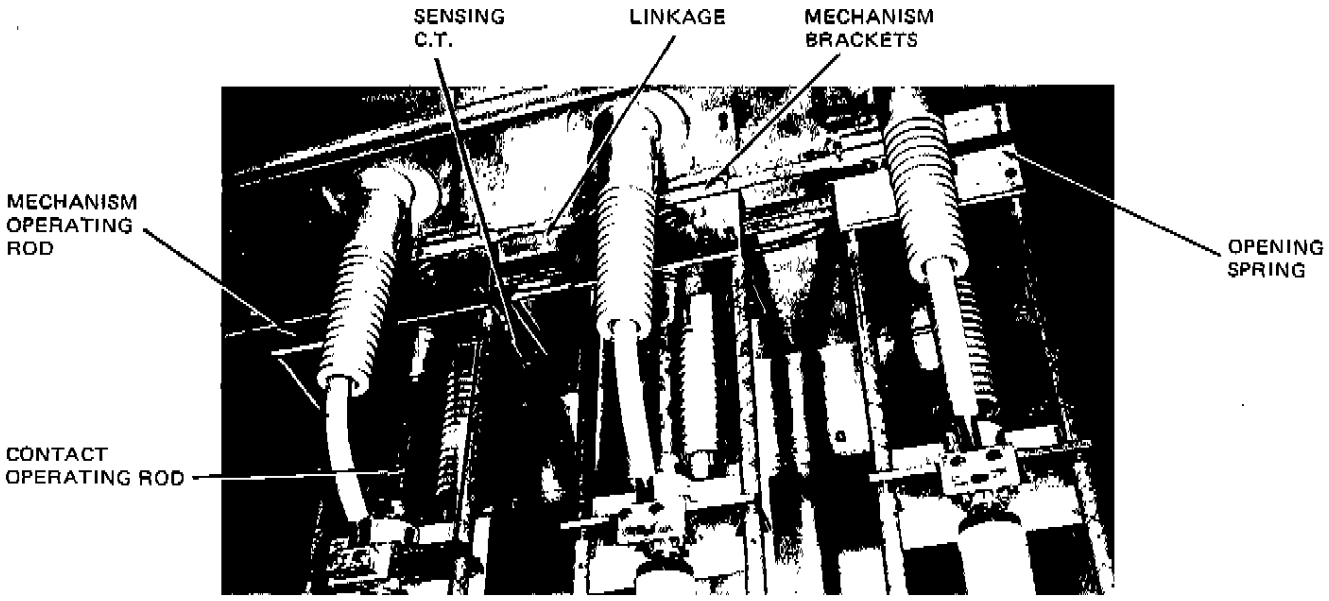


Figure 9
Interrupter operating mechanism in recloser cover.

Interrupter Linkages

The interrupter operating linkage and contact operating rod assemblies are supported by a box-like bracket fastened to studs in the recloser cover. If necessary, the interrupter operating linkages can be disassembled by removing the C-rings at the end of the link pins. Refer to the exploded parts view for disassembly and assembly.

Operating Mechanism

The complete operating mechanism in the operating cabinet can be removed as a unit by removing the 1/2-inch nuts securing the top and bottom of the back channel to the cabinet. Before removal it will also be necessary to detach the motor leads to the fused pullout switch, the brake leads to the selenium rectifier, trip coil connections and various limit switch leads. Tag the leads as they are removed for ease of replacement.

Motor Removal

A universal series-type motor is used to charge the closing springs and initiate the closing action. The motor is energized from a 230 vac auxiliary power source through a fused pullout switch. The motor has permanently lubricated, sealed ball-bearings and normally requires no service.

If motor is to be replaced, remove the four socket head capscrews that attach the motor to the mechanism and uncouple the motor shaft at first roll pin under the spring-loaded roll pin retainer.

CAUTION

This type of motor should never be energized while removed from the gear box assembly. Operating while unloaded will result in an uncontrolled speed and possible damage to the motor.

Brake Inspection

A solenoid-type brake (d.c.-energized for chatter-free operation) is released electrically whenever the motor circuit is energized. Two spring-loaded stationary outer discs acting on the rotating center disc provide double-braking action for long trouble-free operation. If any brake slippage is evident, check the tightness of the three capscrews which load the springs and compress the brake assembly; retighten as necessary. If the screws are tight, replace the entire brake assembly. A brake replacement kit is listed in the service parts section.

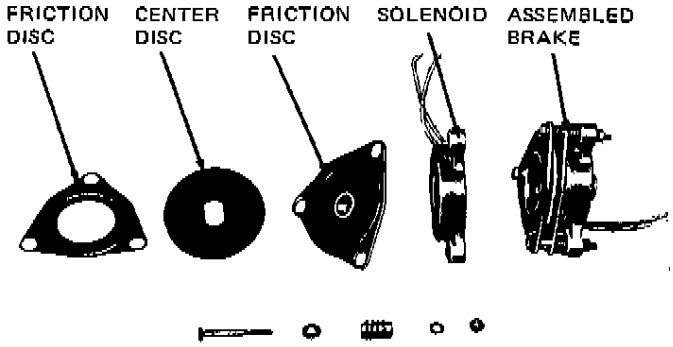


Figure 10
Disassembled solenoid brake assembly.

Gear Reduction Unit

The pinion gear at the opposite end of the motor shaft coupling is engaged to a gear reduction arrangement. All gears are permanently lubricated to provide maintenance-free operation and prevent corrosion. The pinion gear bearings are of oil-impregnated bronze and have long wear life. Inspect all gear teeth and bearings carefully and disassemble the unit only if replacement is necessary. When replacement of any bushings is necessary, it is recom-

mended that a complete new gear cover plate be ordered. A complete new set of bearings will result in quieter operation and a longer trouble-free service life.

TERMINAL PANEL AND CIRCUIT CONNECTIONS

Electrical circuit components of the operating mechanism require no maintenance and should provide trouble-free operation. If control circuit failure is indicated, check out this 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 out the control cable for breaks or shorts.
3. Test the circuit components in the operating mechanism.

Control Cable Check

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

Control Circuit Components

A schematic diagram of recloser circuits is shown in Figure 11. Figure 12 shows the recloser connection diagram. All the components are located in the operator cabinet except the internal bushing current transformers which are in the recloser cover assembly. Figure 13 shows the approximate location of circuit components in the Type VSML recloser.

With the recloser contacts open and the recloser's motor source deenergized, make the continuity checks as shown in Table 1.

Check the motor and brake circuit with recloser contacts open and the heater switch in OFF. An ohmmeter connected at the fused pullout switch terminals should read approximately 1.2 K ohms to indicate continuity. Also check for grounds.

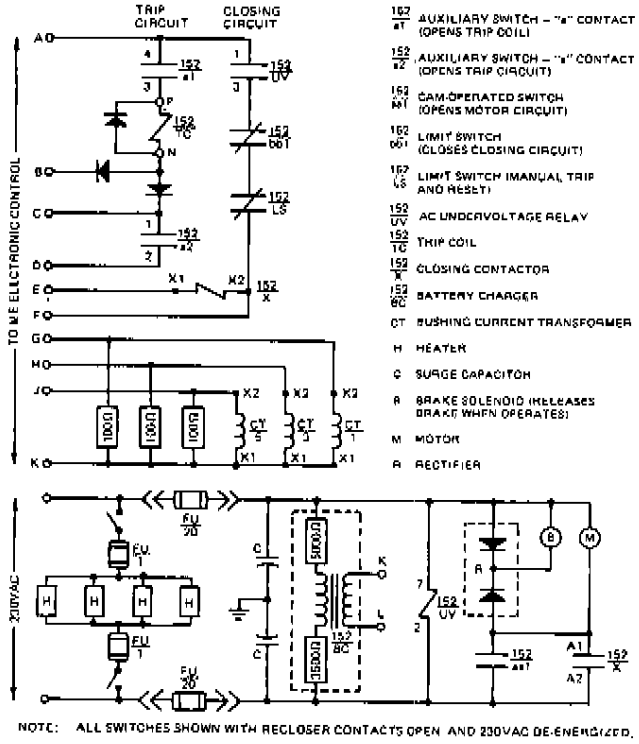


Figure 11
Schematic diagram of recloser circuits.

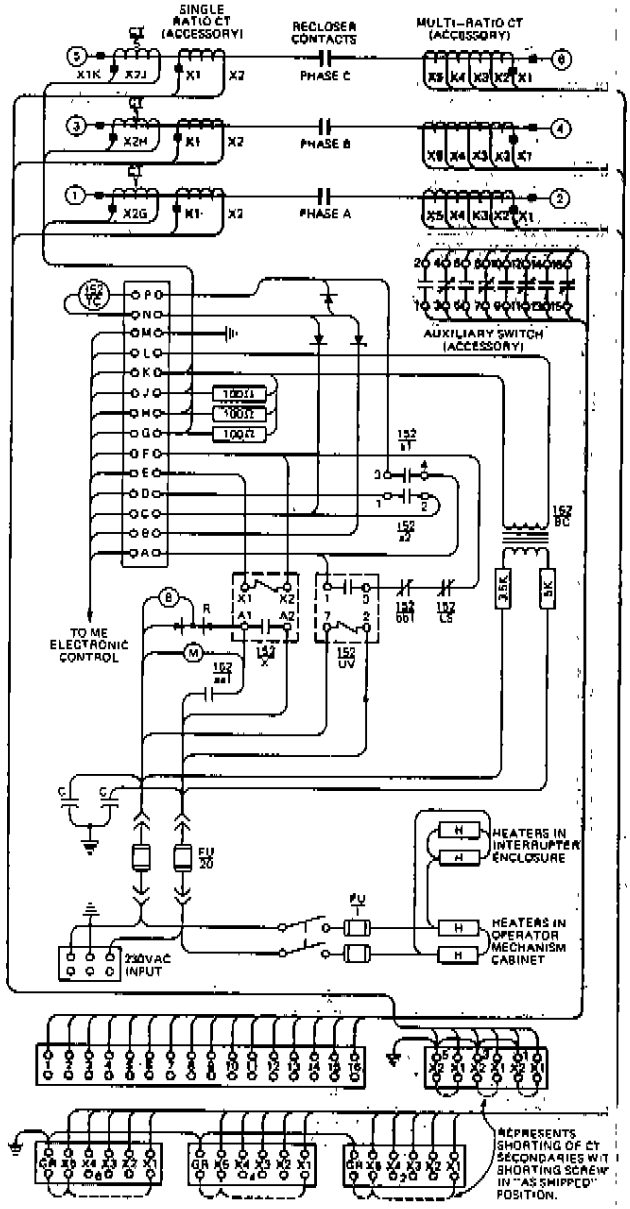


Figure 12
Recloser connection diagram. (Shaded areas are accessories.)

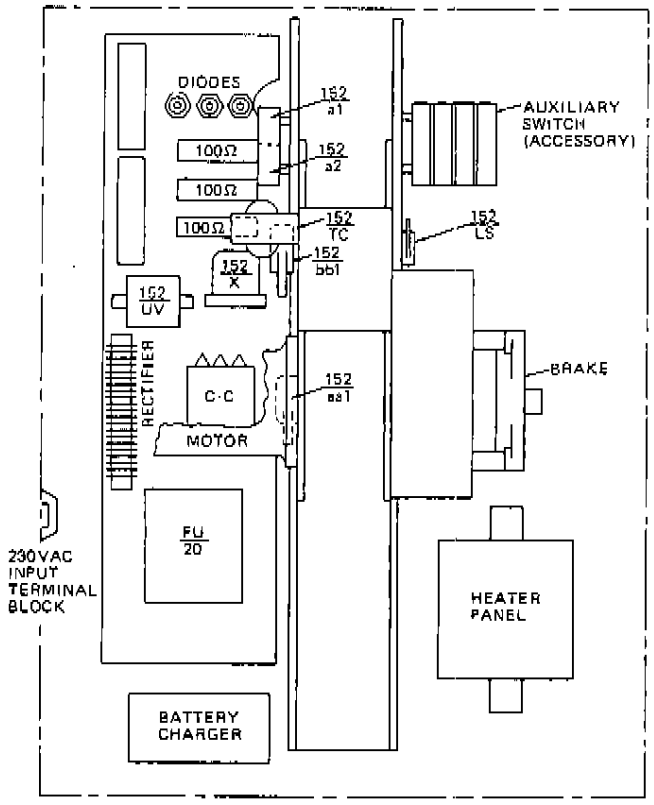


Figure 13
Approximate location of circuit components Type VSML recloser.

Bushing Current Transformer Tests

The sensing transformers can be tested using the circuits shown in Figure 14. Connect all three phases of the recloser in series across a 100 ampere a-c test supply and close the recloser with the manual closing crank.

Ratio Test for Sensing-Current Transformers

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 plus or minus ten percent.

CAUTION

When checking the CT output of one phase, be sure that the CT's on the other two phases are shorted—or use three milliammeters to load all three phases at one time.

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

Table 1

Continuity Checks at Control Cable Receptacle Pins (With Control Cable Disconnected)

Ohmmeter Probes	To Check	Value — Ohms	
		Contacts Open	Contacts Closed
A to B	Trip solenoid	Infinite	A+ 1.0 → 3000* B+ Infinite
A to F with 240 volts applied	Closing circuit	Zero	Infinite
A to F No voltage		Infinite	Infinite
C to D	Limit switch	Infinite	Zero
E to F	Closing contactor	82	82
K to J	Bushing current-transformer	1K	1K
K to H	Bushing current transformer	1K	1K
K to G	Bushing current transformer	1K	1K

*Resistance of the trip solenoid above is approximately 1.0 ohms. Measurement from A to B includes forward resistance of a diode in the A-B circuit. When checked with an ohmmeter, this diode can have a large resistance, which will vary depending upon the ohmmeter scale used.

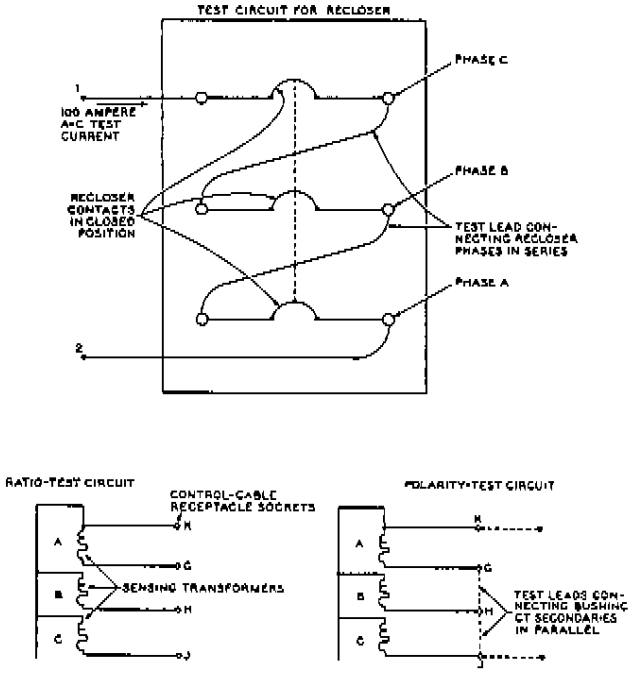


Figure 14
Test circuit for checking bushing current transformers. Ratio and polarity test-circuits shown are the effective circuits that contribute to the testing. Components not having an effect on the current flow are not shown. Dotted lines in the polarity-test circuit are test leads.

Polarity Test

1. Connect sockets G, H and J of the control-cable receptacle in series with jumper leads as indicated in Figure 14. The jumper leads connect the secondaries of the current transformers in parallel so that total output current, measured at points K an J, should be 300 ma.
2. Energize 100-ampere source. Check for 300-ma readings at sockets K and J. Results should indicate all three-bushing-current transformers have the same polarity with the 300-ma reading, or replacement is necessary.
3. Deenergize a-c test current and remove jumper wires from receptacle sockets.

SENSING-CURRENT TRANSFORMER REPLACEMENT

1. Remove the recloser bushing. Label the leads of the bushing current transformer that are to be replaced. Preferably use labeling in accordance with the connection diagram to aid in tracing leads later. X1 leads from the BCT's are white and the X2 leads are black.
2. Plastic covered metal connectors are used to connect wires from terminal strips to transformer leads. These are not reusable and when cutting transformer leads they can be left in place while cutting leads closer to the transformer.
3. Remove capscrews and hexnuts that secure the current transformers to the cover. Bushing CT can now be dropped out with mounting and spacing plates.
4. Replace BCT's by reversing the above procedure. Be sure to reuse all spacers provided. All BCT's are marked with a black spot to indicate polarity.
5. Replacement of BCT's should be with polarity marking up toward the cover. 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.

SERVICE PARTS LISTING

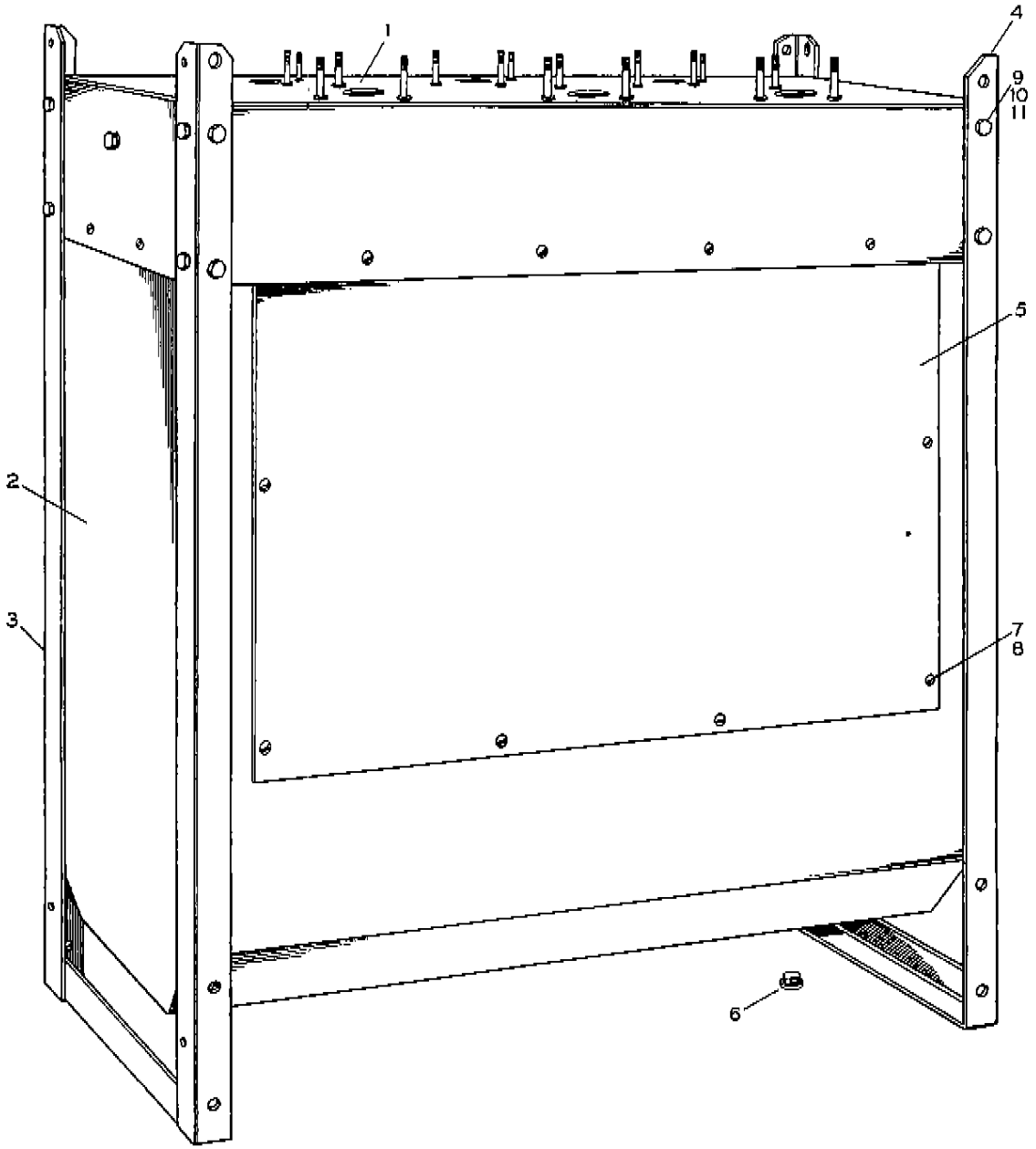
Service parts listed and illustrated include only those parts usually furnished with a standard unit. Major parts that have been especially ordered for a specific application are available upon request by submitting a full description of the part with the recloser type and serial number.

Because of the ease, faster receipt and greater economy of local acquisition, the wiring, wire-end terminals and connectors have not been included in this parts listing. All hardware parts dimensions have been carefully checked so they may also be obtained locally.

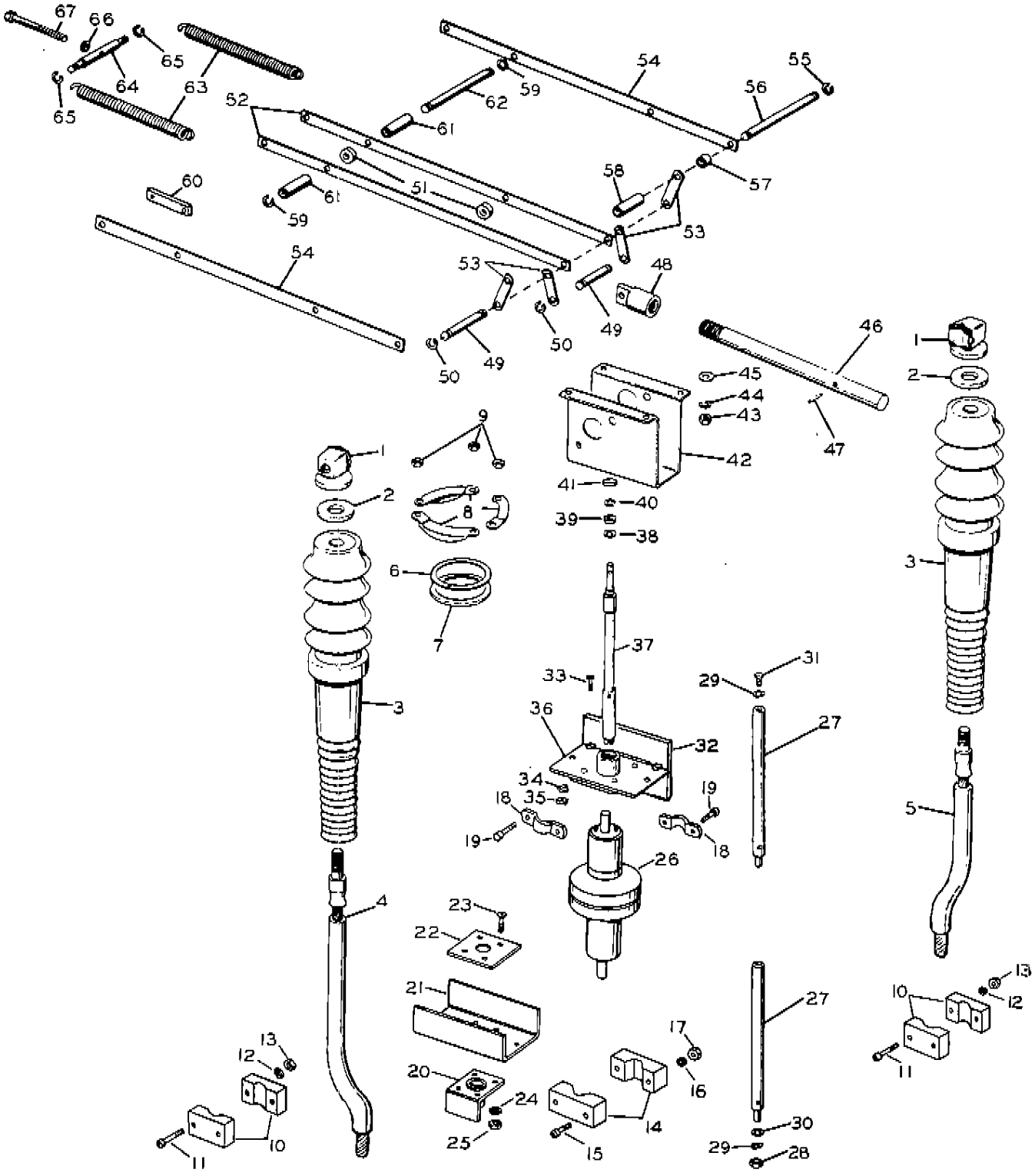
To assure correct receipt of any parts ordered always include switchgear type and serial number. Because of McGraw-Edison's continuous improvement policy, there will be cases where parts ordered may not be exactly the same as parts furnished; however, they will be completely interchangeable without any rework of the recloser. All parts have the same warranty as any whole item of switchgear; i.e. against defects in material or workmanship within one year from date of shipment.

INTERRUPTER CABINET PARTS GROUP

Item No.	Description	Catalog Number	Qty.
1	Interrupter cabinet cover	KA105VSML	1
2	Enclosure	KA106VSML	1
3	Rear cover support	KA107VSML	1
4	Cover and operating cabinet support	KA108VSML	1
5	Side panel	KA109VSML	2
6	Ventilating screen plug	KP698ME	2
7	Speednut	KP2005A4	30
8	Screw, self-tapping, Type Z, No. 14 x 5/8-in, sst	KP19	28
9	Capscrew, hex hd, 3/8-16 x 1, stl	KP778	16
10	Nut, hex, 3/8-16, stl	KP276	46
11	Lockwasher, med, 3/8, stl	KP1108	34



BUSHING AND INTERRUPTING MECHANISM PARTS GROUPS

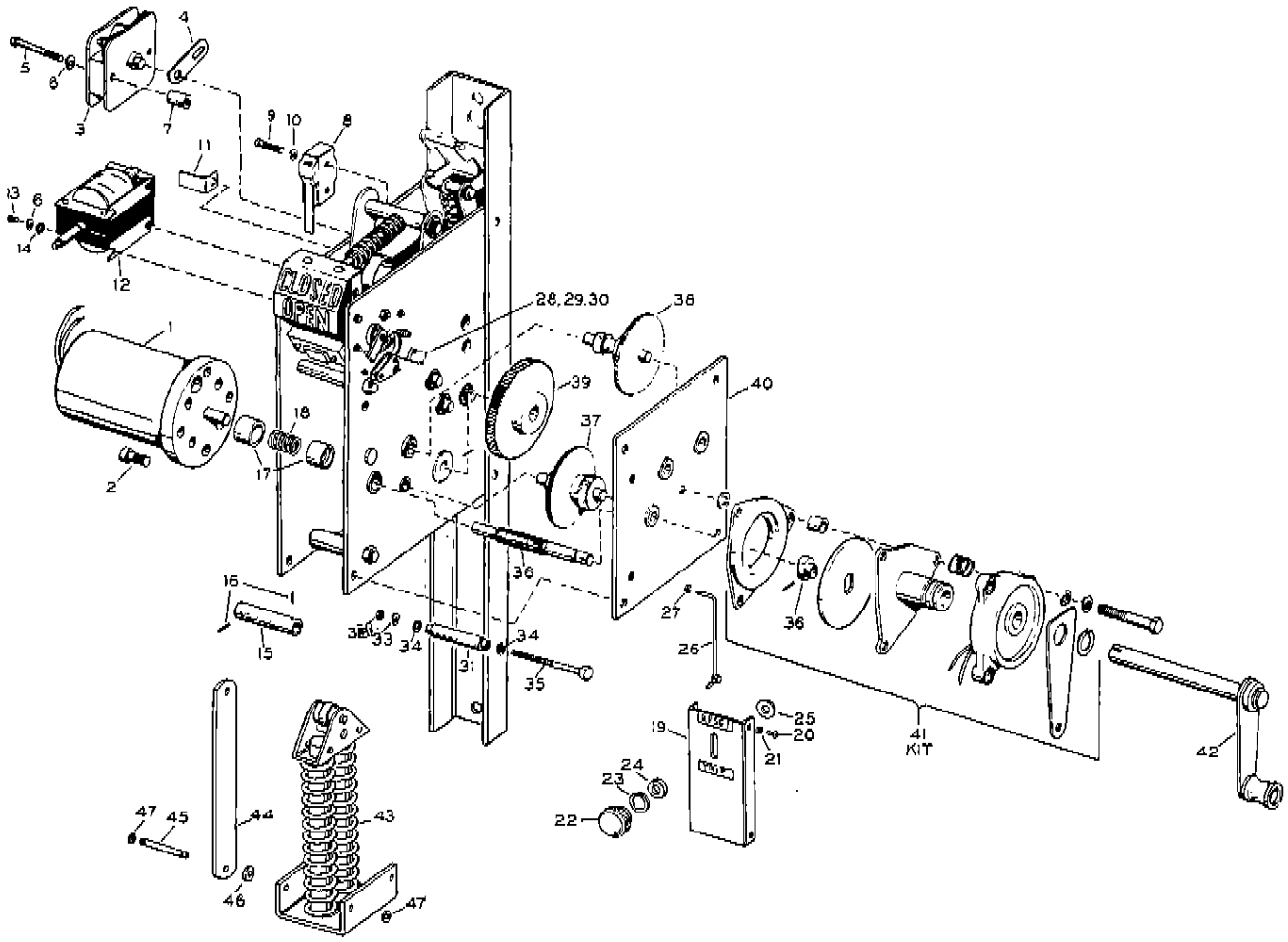


BUSHING AND INTERRUPTING MECHANISM PARTS GROUPS

Item No.	Description	Catalog Number	Qty.
—	Bushing assembly, long lead (Includes items 1 thru 4)	KA700VS4	3
—	Bushing assembly, short lead (Includes items 1, 2, 3, 5)	KA700VS3	3
1	Bushing terminal assembly	KA17W1	6
2	Upper bushing gasket	KP2090A57	6
3	Ceramic bushing	KP1039VS	6
4	Bushing rod, long	KA167VS4	3
5	Bushing rod, short	KA167VS3	3
6	Bushing clamping ring	KP1066VS	6
7	Lower bushing gasket	KP2090A9	6
8	Bushing clamp	KP1065VS	18
9	Hex nut, 3/8-16, stl	KP1215	18
10	Bushing rod clamp	KP1136VS1	12
11	Capscrew, 3/8-16 x 1-3/4, bronze	KP1075	12
12	Lockwasher, med, 3/8, sil bronze	KP326	12
13	Hex nut, 3/8-16, sil bronze	KP277	12
14	Lower interrupter clamp	KP1004VSM	6
15	Capscrew, hex hd, 3/8-16 x 3, stl	KP1369	6
16	Lockwasher, med, 3/8, stl	KP1145	6
17	Hex nut, 3/8-16, stl	KP1215	6
18	Upper bushing clamp	KP10003VSM	6
19	Capscrew, hex hd, 5/16-18 x 1, stl	KP1368	6
20	Transfer bracket and bushing assembly	KA100VSML	3
21	Support	KP1021VSM	3
22	Plate	KP1009VSM	3
23	Machine screw, flt hd, 1/4-20 x 1-1/8	KP1147	12
24	Lockwasher, med, 1/4, stl	KP837	12
25	Hex nut, 1/4-20 stl	KP1222	12
26	Vacuum interrupter	KRM1VB	3
27	Stringer assembly	KA118VSM	12
28	Hex nut, 3/8-16, stl	KP1245	6
29	Lockwasher, med, 3/8, stl	KP1145	12
30	Flat washer, 3/8 SAE, stl	KP1146	6
31	Capscrew, hex hd, 3/8-16 x 3/4, stl	KP1384	6

Item No.	Description	Catalog Number	Qty
32	Barrier and clip assembly	KA121VSM	3
33	Machine screw, 8-32 x 5/8, stl	KP1170	6
34	Lockwasher, med, No. 8, stl	KP1118	6
35	Hex nut, No. 8, stl	KP1200	6
36	Current exchange and support assembly	KA103VSM6	3
37	Transfer rod and stop assembly	KA117VSM	3
38	Special washer	KP2028A30	3
39	Washer	KP2090A17	3
40	Bushing	KP1075VS	3
41	Retaining ring	KP2013A22	3
42	Bracket	KP1046VSM	3
43	Spacer	KP3013A27	12
44	Lockwasher, med, 1/4, stl	KP837	12
45	Hex nut, 1/4-20, stl	KP872	12
46	Operating rod	KP1073VS2	3
47	Roll pin, 1/4 x 1-1/4 stl	KP527	3
48	Sleeve connector	KP1072VS	3
49	Groove pin	KP3126A11	3
50	Retaining ring, Type C, WA518	KP79	6
51	Spacer	KP3011A53	2
52	Link	KP1020VSM2	2
53	Link assembly	KA122VSA	12
54	Link	KP1020VSM1	2
55	Retaining ring, Type C, WA518	KP79	6
56	Groove pin	KP3126A17	3
57	Spacer	KP3011A49	6
58	Spacer	KP3011A50	3
59	Retaining ring, Type C, WA518	KP79	2
60	Link	KP1016VSM1	2
61	Spacer	KP3009A92	2
62	Groove pin	KP3126A17	1
63	Opening spring	KP1094VS	2
64	Spring retainer	KP1078A	1
65	Retaining ring, Type C, WA518	KP79	2
66	Flat washer, 3/8 SAE, stl	KP1112	1
67	Spring retainer bolt	KP1015VS	1

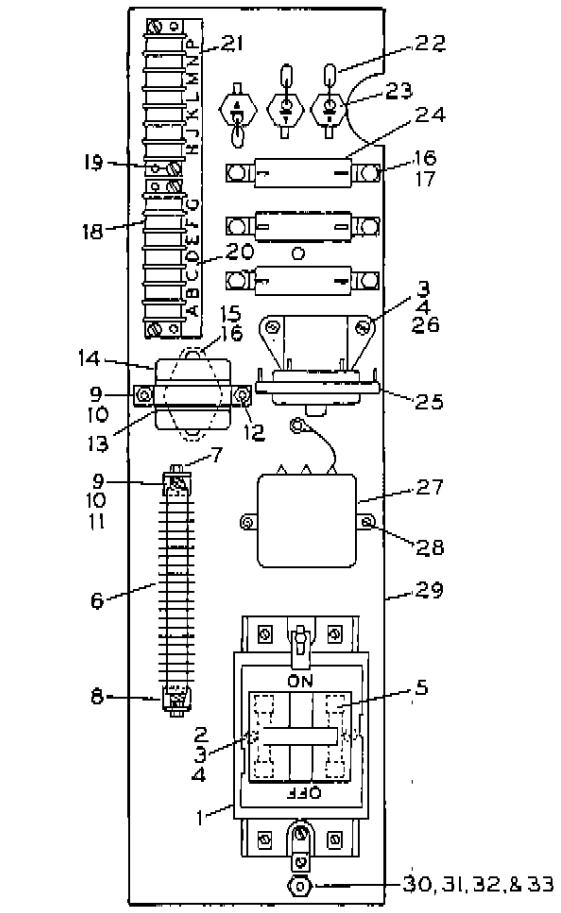
OPERATING MECHANISM PARTS GROUP

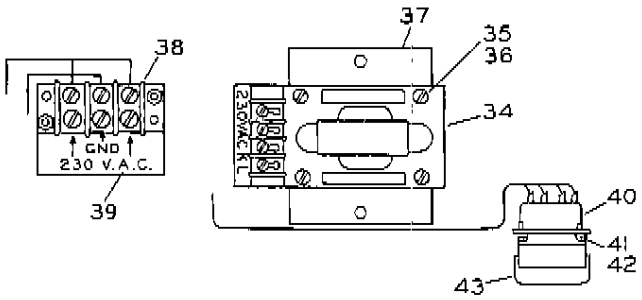


Item No.	Description	Catalog Number	Qty.
1	Motor	KP1006VS	1
2	Capscrew, socket hd, 1/4-20 x 5/8, stl	KP2036A5	4
3	Auxiliary switch	KA612R24	1
4	Lever	KP1029VS	1
5	Machine screw, rd hd, 10-24 x 2-1/2, stl	KP1197	2
6	Lockwasher, med, No. 10, stl	KP825	7
7	Spacer	KP3009A40	2
8	Micro-switch, Type A No. BA-2RVT	KP1230VSI	2
9	Machine screw, rd hd, 6-32 x 7/8, stl	KP1031	4
10	Lockwasher, med, No. 6, stl	KP1129	4
11	Bracket	KP1092CE	1
12	Solenoid assembly	KA1055M1	1
13	Machine screw, 10-24 x 5/16, stl	KP1151	5
14	Flatwasher, No. 10S, brass	KP840	5
15	Coupling	KP1021VS	1
16	Roll pin 5/32 x 3/4, stl	KP503	2
17	Roll pin retainer	KP1248CE	2
18	Spring	KP210L	1
19	Bracket	KP1034VSM	1
20	Machine screw 6-32 x 5/16, stl	KP1153	4
21	Lockwasher, med. No. 6, stl	KP1129	4
22	Knob	KP2069A6	1
23	Lockwasher, med, 1/4, stl	KP837	1

Item No.	Description	Catalog Number	Qty.
24	Spacer	KP3007A75	1
25	Flat washer, No. 14S, brass	KP1509	1
26	Rod and pin assembly	KA143VSM	1
27	Retaining ring XSO-209	KP1092	1
28	Limit switch	KP1092CE	1
29	Machine screw, rd hd, 4-40 x 1/2	KP1420	2
30	Lockwasher, med, No. 4, stl	KP1122	2
31	Spacer	KP3105A15	4
32	Hex nut, 1/4-20, stl	KP1213	4
33	Lockwasher, med, 1/4, stl	KP837	4
34	Flat washer, 1/4 SAE, stl	KP1113	8
35	Capscrew, hex hd, 1/4-20 x 2-3/4, stl	KP1370	4
36	Pinion assembly	KA128VS	1
37	Gear assembly	KA127VSM	1
38	Gear assembly	KA128VSM	1
39	Main gear	KP1244M	1
40	Plate assembly	KA115VSM	1
41	Brake assembly repair kit, complete	KA701VS	1
42	Manual closing crank	KA134VSM	1
43	Closing spring assembly	KA107VSM	1
44	Strap	KP1036VSM	2
45	Groove pin	KP3126A28	3
46	Spacer	KP3011A70	1
47	Retaining ring	KP2013A26	6

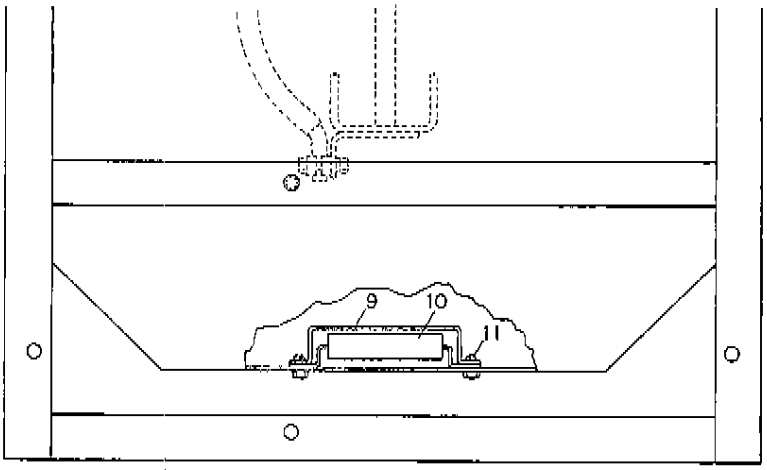
TERMINAL PAENL PARTS GROUP

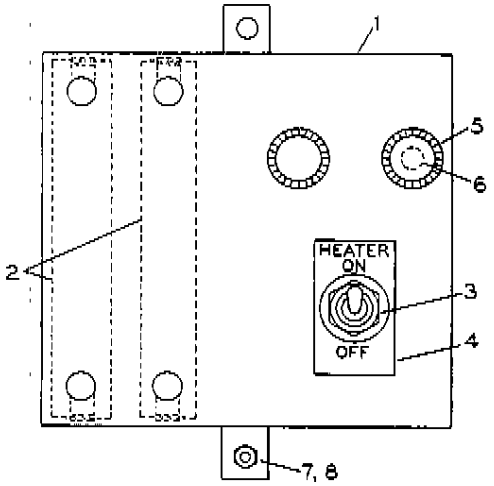




Item No.	Description	Catalog Number	Qty.
1	Fuse cutout	KP965M1	1
2	Machine screw, rd hd, 10-24 x 1, stl	KP1037	2
3	Lockwasher, med, No. 10, stl	KP825	4
4	Hex nut, 10-24, stl	KP864	4
5	Fuse, Bussmann, Type NON20	KP2075A6	2
6	Selenium rectifier, single-phase bridge, International Resistor Co. No. A7B19DBLD		1
7	Hex nut, 8-32, stl	KP1200	6
8	Bracket	KP1270M	2
9	Machine screw, rd hd, 6-32 x 7/16, stl	KP1155	4
10	Lockwasher, external tooth, No. 6, stl	KP845	12
11	Hex nut, 6-32, stl	KP863	12
12	Bracket	KP1326M	1
13	Pad	KP1362M	1
14	Relay	KP941M1	1
15	Tube socket, 8-pin, Amphenol 77M1P8M		1
16	Rivet, 0.146 x 9/32, stl	KP254	8
17	Flat washer, No. 6S, brass	KP992	8
18	Terminal board	KP2101A9	2
19	Machine screw, rd hd, 6-32 x 5/8, stl	KP697	6
20	Marker strip, A thru G	KP2076A45	1
21	Marker strip, H thru P	KP2076A46	1
22	Capacitor assembly	KA158CE	3
23	Silicon diode	KP4011A9	3
24	Resistor, 100 ohms	KP4022A31	3
25	Contactor, 24 vdc, Cutler-Hammer Cat. No. 6041H201 (152/X)		1
26	Machine screw, rd hd, 10-24 x 3/8, stl	KP698	2
27	Capacitor assembly	KA964M2	1
28	Machine screw, rd hd, 8-32 x 3/8, stl	KP1194	2
29	Panel board	KP1077VS	1
30	Hex nut, 10-24, brass	KP593	3
31	Lockwasher, med No. 10, bronze	KP351	3
32	Flat washer, No. 10S, brass	KP840	3
33	Spacer	KP3013A23	3
34	Potential battery charger	KA175VS2	1
35	Machine screw, rd hd, 8-32 x 7/8, stl	KP1434	4
36	Spacer	KP3006A40	4
37	Plate	KP1059VSM	1
38	Terminal block	KP2101A27	1
39	Label	KP1144VSM	1
40	Control cable assembly	KA106VS	1
41	Machine screw, rd hd, No. 6-32 x 3/8, stl	KP694	4
42	Lockwasher, med, No. 6, stl	KP1129	4
43	Caplug	KP2073A14	1

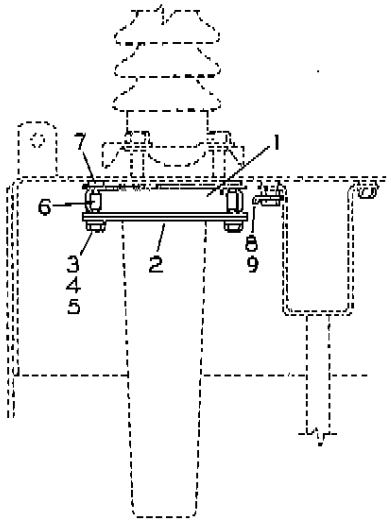
HEATER PARTS GROUP





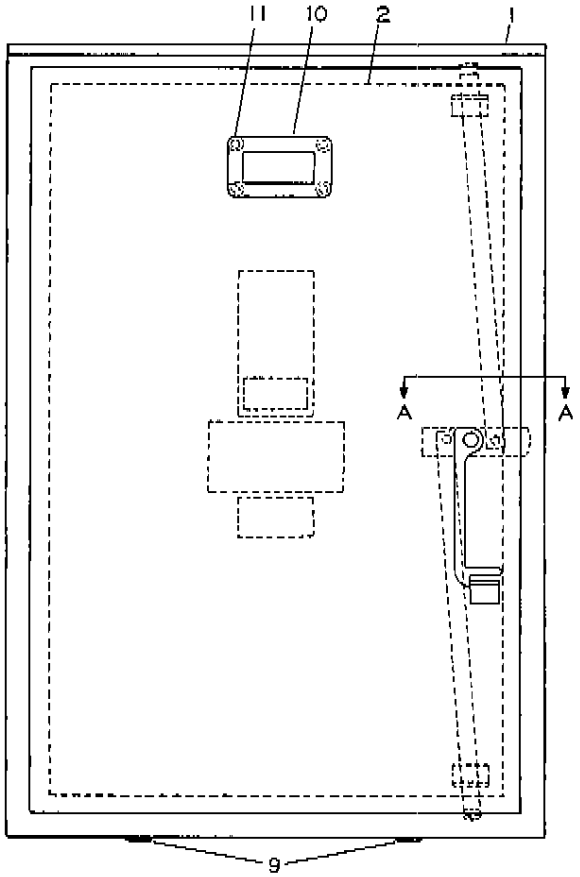
Item No.	Description	Catalog Number	Qty.
1	Heater assembly for operator cabinet (Includes items 2 thru 6)	KA157VS	1
2	Resistor, 500 ohm, 50 watt, IRC	–	2
3	Toggle switch, DPST, Cutler-Hammer Cat. No. 7561-K4	–	1
4	Decal	KP207VR	1
5	Fuse holder	KP2074A1	2
6	Fuse, Type AGC, 1A-250V	KP2075A3	2
7	Hex nut, 8-32, stl	KP1200	6
8	Lockwasher, med, No. 8, stl	KP800	6
9	Heater guard	KP1173CE	2
10	Resistor, 1000 ohms	KP287VR	2
11	Machine screw, rd hd, 8-32 x 7/16, stl	KP1417	4

CURRENT TRANSFORMER PARTS GROUP

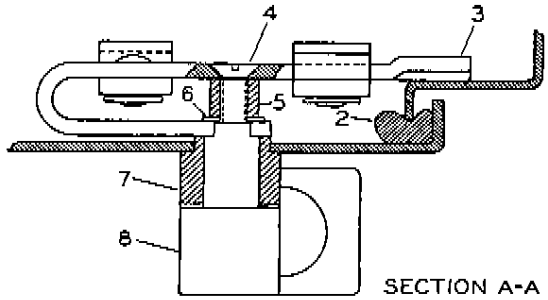


Item No.	Description	Catalog Number	Qty.
1	Sensing current transformer	KA1012M1	3
2	Plate	KP1163M	9
3	Capscrew, hex hd, 1/4-20 x 3/4, stl	KP1077	12
4	Lockwasher, med, 1/4, stl	KP837	12
5	Flat washer, 1/4 SAE, stl	KP1115	12
6	Threaded spacer	KP1067VS	12
7	Spacer	KP3013A27	12
8	Wire clip	KP2006A12	3
9	Hex nut, 1/4-20, stl	KP872	3

OPERATOR CABINET PARTS GROUP

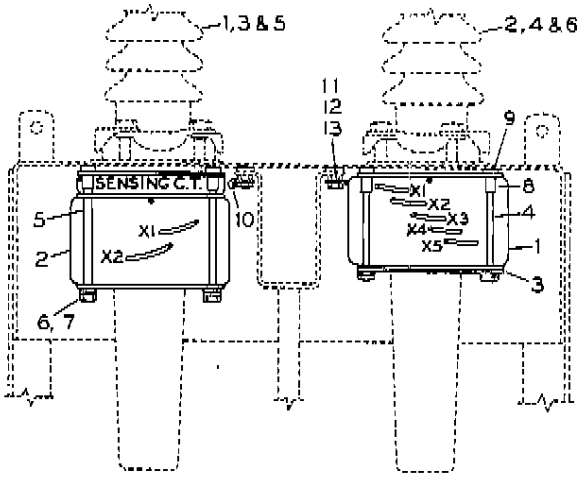


Item No.	Description	Catalog Number	Qty.
	Cabinet assembly, complete (Includes items 1 thru 11)	KA154VS	1
1	Cabinet only	KA133VSM	1
2	Gasket	KP2084A7	1
3	Latch assembly	KA152VS	1
4	Machine screw, flt hd, 10-24 x 3/4, stl	KP1433	1
5	Spacer	KP3006A32	1
6	Flat washer, No. 10SAE, stl	KP1115	1
7	Bushing	KP3041A5	1
8	Handle assembly	KA153VS	1
9	Ventilating screen plug	KP698ME	2
10	Window	KP1240M	1
11	Speed nut	KP2005A1	4



SECTION A-A

ACCESSORY CURRENT TRANSFORMER PARTS GROUP



Item No.	Description	Catalog Number	Qty.
1	Multi-ratio current transformer, 600:5	KA1013M1	3
	Multi-ratio current transformer, 1200:5	KA1013M2	3
2	Single-ratio current transformer, 600:5	KA1014M1	3
	Single-ratio current transformer, 1200:5	KA1014M2	3
3	Plate	KA1163M	12
4	Threaded stud	KP3149A5	12
5	Threaded stud	KP3149A9	12
6	Elastic stop nut	KP2020A3	24
7	Flat washer, 1/4 SAE, stl	KP1115	24
8	Threaded spacer	KP1067VS	12
9	Spacer	KP3013A27	12
10	Wire clip	KP3013A13	3
11	Wire clip	KP3013A16	3
12	Nut, hex hd, 1/4-20, stl	KP872	6
13	Terminal block	KP2101A53	1, 3 or 4
14	Machine screw, 10-24 x 1-1/8, stl	KP696	2, 6 or 8
15	Lockwasher, external tooth, No. 10, stl	KP846	2, 6 or 8
16	Hex nut, 10-24, stl	KP864	2, 6 or 8
17	Machine screw, 8-32 x 1/2 brass	KP461	1, 3 or 4
18	Marker strip	KP2076A23	1
19	Marker strip	KP2076A24	1
20	Marker strip	KP2076A25	1
21	Marker strip	KP2076A27	1
22	Panel	KP1098VSM	1 or 2
23	Machine screw, rd hd, 1/4-20 x 1/2, stl	KP1040	2 or 4
24	Lockwasher, med 1/4, stl	KP837	2 or 4
25	Hex nut, 1/4-20, stl	KP872	2 or 4
26	Decal	KP1250CE	1