Sectionalizers

COOPER
Cooper Power Systems

Type GV Maintenance Instructions

S270-20-2
Service Information

(Serial No. 1302 and above)

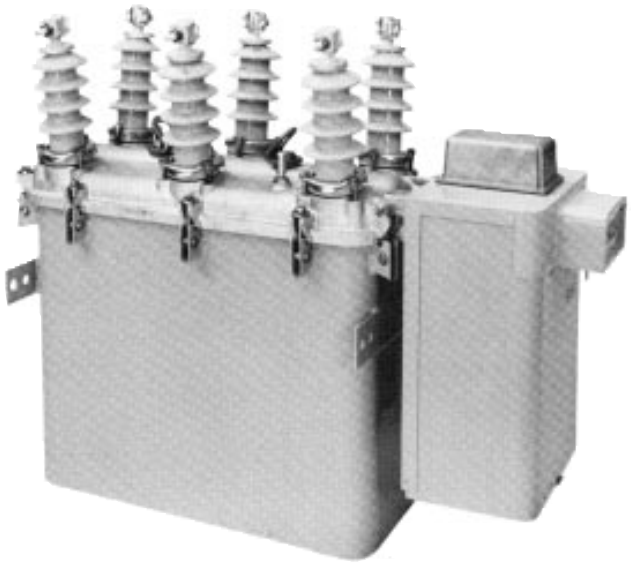


Figure 1.
Type GV sectionalizer.

87909KMA

CONTENTS

INTRODUCTION

Service Information S270-20-2 covers maintenance instructions for the Type GV electronically controlled three-phase sectionalizer. It covers—in separate sections—a general description of the unit, a detailed description of operation (both electronic and mechanical), instructions for periodic inspection and maintenance, testing and troubleshooting, and shop repairs. In addition, service parts lists keyed to exploded-view drawings of the various sectionalizer parts groups are included in the back of this manual.

DESCRIPTION AND OPERATION

General

The sectionalizer is a self-contained, circuit-opening device used in conjunction with source-side protective devices, such as reclosers or reclosing circuit-breakers, to automatically isolate faulted sections of electrical distribution systems. The sectionalizer senses current flow above a preset level, and when the source-side protective device opens to deenergize the circuit, the sectionalizer counts the overcurrent interruption. Depending upon the coordination scheme, the sectionalizer will open during the first, second, or third open interval of the fault interrupting device to isolate permanent faults and confine outages to smaller sections of line.

The sectionalizer does not interrupt fault current but can be closed into a faulted line. It opens during the open interval of the backup device. For this reason, it must always be used in series with a fault-interrupting, backup protective reclosing device. Also, it will forget counts that do not reach the counts-to-open setting within the selected reset time due to clearing of temporary faults.

When properly applied, the sectionalizer will respond to downline fault currents that are interrupted by its backup device. However, as with any other protective device, system conditions may produce unexpected and unwanted sectionalizer operation. Overcurrents interrupted by a downline device is one cause for these occurrences, inrush current is another. Count restraint and inrush current restraint features are built into the sectionalizer control to block the sectionalizer's response to these system conditions.

A minimum of one-half amp of load current flowing through any phase of the sectionalizer will block the generation of a count pulse. This "count-restraint" feature prevents the sectionalizer from counting overcurrents interrupted by downline devices.

The sectionalizers are also equipped with an inrush-current restraint feature which distinguishes between inrush currents and fault currents. If it is determined that the overcurrent through the sectionalizer is inrush current, the phase actuating current level of the sectionalizer is raised by a multiple (X) for a time (Y) after circuit energization. At the same time, ground overcurrent protection is blocked entirely for a time (Z).

RATINGS

Basic Sectionalizer Ratings

Nominal voltage (kv)	14.4
Rated maximum voltage (kv)	15.5
Impulse withstand 1.2 x 50 microsecond wave (BIL) (kv)	110
60 hertz withstand	
Dry, 1 minute (kv)	50
Wet, 10 seconds (kv)	45
Continuous current rating (amps)	400
Rated symmetrical interrupting current (amps rms)	880
Rated making current, asymmetrical (amps rms)	15000
Short-time ratings (amps rms)	
10-seconds symmetrical	3500
1-second symmetrical	10000
Momentary maximum, asymmetrical (amps rms)	1500
Creepage distance, standard bushing (in.)	11

Operating Data

Phase-minimum-actuating current (amps)	16, 24, 40, 56, 80,112,160 224, 256, 296, 320, 448, 640,
Ground-minimum-actuating current (amps)	3.5, 7, 16, 20, 28, 40, 56, 80, 112,160, 224, 320, BLOCK
Number of counts to open	1, 2, 3
Count reset (seconds)	15, 30, 60, 120,
Phase actuating level multiplier (inrush restraint)	X1, X2, X4, X6, X8, BLOCK
Phase inrush reset (cycles)	5,10,15, 20
Ground inrush reset (seconds)	0.3, 0.7, 1.5, 3.0, 5.0

DESCRIPTION OF OPERATION

All three sets of moving contacts are linked with bellcranks to a common torque shaft connected to the electronically controlled operating mechanism. The mechanism can also be operated manually. Manual controls consist of the yellow pullring for tripping and the red pullring for closing.

For automatic tripping, a bi-stable actuator trip mechanism is operated from the electronic sensing-and-counting system. Bistable actuation is provided by a permanent magnet-and-coil assembly mounted on a springloaded frame and linkage (Figure 2). When the sectionalizer is closed, the armature below the trip rod is held against the core by the magnetic force produced by the permanent magnet. In this state, a compressed spring is trying to pull the trip shaft away from the core. During the tripping operation, a silicon-controlled rectifier connects charged capacitors across the coil of the magnetic tripping assembly. The counterflux produced by the discharge of the capacitors is sufficient to allow the spring to override the magnetic force and operate the tripping circuit.

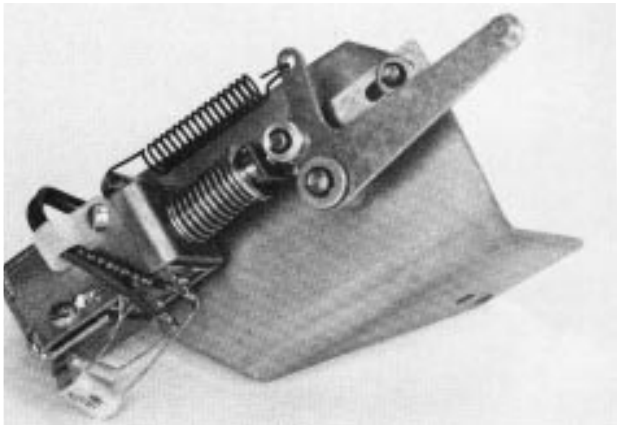
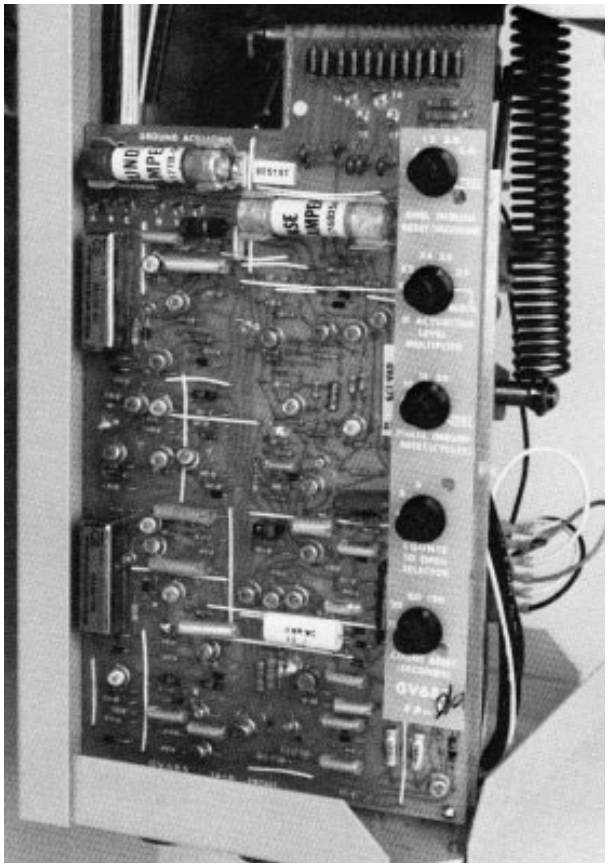


Figure 2. 87908KMA
Bi-stable actuator.

ELECTRONIC CONTROL CIRCUIT

The printed circuit board in the operator cabinet mounts the electronic components of the control circuit (Figure 3). A functional block diagram of the electronic circuitry is shown in Figure4.



87905KMA

Figure 3.
Control printed circuit board.

Current flowing through the sectionalizer is sensed by the bushing-current transformers. Three transformers connected in a wye configuration sense phase currents. Another three bushing-current transformers connected in parallel sense the ground (earth) or zero-sequence current. These signals are rectified and are adjusted to the desired minimum-actuating current level by the selection of the proper plug-in resistors.

To generate and register a count pulse, a current above the preset-minimum-actuating level must be flowing through the sectionalizer (downline fault) and this overcurrent must drop to zero (fault interrupted by the backup protective device). The pulse counter provides storage for up to three pulses. Depending upon the counts-to-open setting, the tripping circuit will turn on after one, two, or three count pulses have been registered. When turned on, the tripping circuit completes the discharge path for the trip-energy-storage capacitors through the coil of the bi-stable actuator which, in turn, trips the sectionalizer mechanism to open the sectionalizer contacts.

The pulse count reset will erase any stored pulse counts whenever load current through the sectionalizer flows without interruption for longer than the reset time programmed.

A count-restraint feature is built into the control of Type GV sectionalizer to prevent the sectionalizer from counting fault currents interrupted by a downline protective device. The current restraint will block the generation of acount pulse as long as at least one-half amp of load current is flowing through the sectionalizer after the disappearance of fault current.

The control is also equipped with an inrush-current restraint feature which distinguishes between inrush current and fault current by a logic circuit functionally diagrammed in Figure 5. If an overcurrent is present through the sectionalizer when the backup protective device opens (current is interrupted), the overcurrent present upon reclosing is assumed to be fault current and the sectionalizer control operates in the normal manner as previously described. If, however, there is no overcurrent detected by the sectionalizer when the current is interrupted, the overcurrent present upon reclosing is assumed to be inrush current. To prevent the sectionalizer from counting this inrush current, the fault level detector circuit is modified to raise the

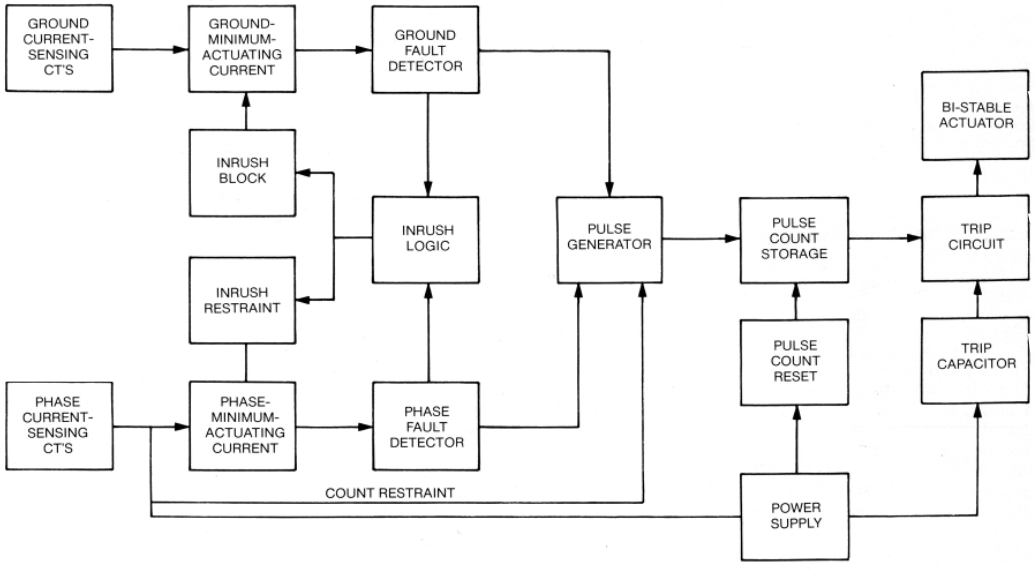


Figure 4.
Functional bolck diagram for sectionalizers.

phase actuating level by a multiple of 2X, 4X, 6X, or 8X the normal setting (or current detection can be blocked entirely) for a time (Y) of 5,10, 15, or 20 cycles after current flow through the sectionalizer is restored. Upon expiration of this time, the sectionalizer control returns to normal operating settings. At the same time, ground overcurrent detection is blocked entirely for a period (Z) of 0.3, 0.7, 1.5, 3, or 5 *seconds* after current flow through the sectionalizer is restored.

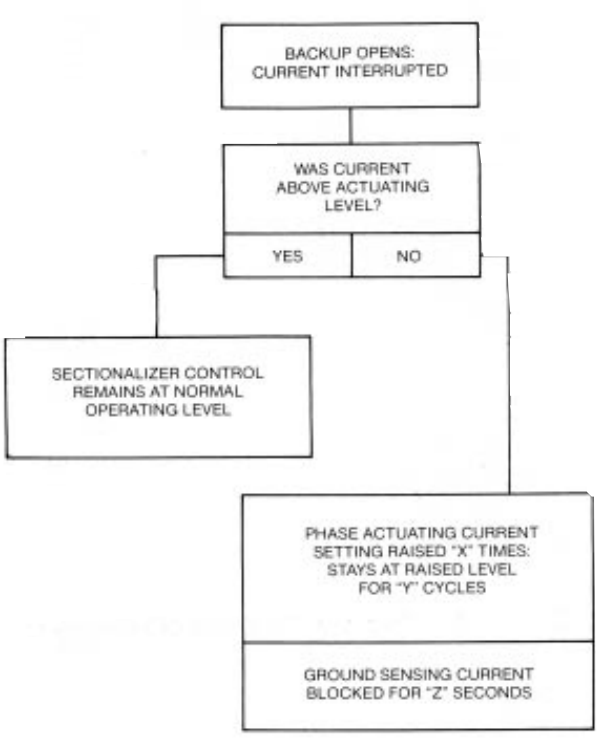


Figure 5.
Logic diagram for inrush-current restraint feature (both phase and ground currents).

ACTUATOR MECHANISM OPERATION

All three sets of moving contacts are linked to a common shaft. To describe the mechanical operation of the GV sectionalizer, a single set of contacts connected to a simplified straight-line motion linkage is shown diagrammatically:

With the contacts closed, Figure 6, the opening spring is held extended by the latched toggle mechanism. The trip signal from the electronic control actuates the bi-stable actuator assembly which acts upon the trip lever to break the toggle latch. This action collapses the toggle to open the contacts and place the mechanism in the condition shown in Figure 7. Both the closing and the opening springs are relaxed and the contacts remain open until closed manually. The opening motion of the main torque shaft also resets the bi-stable actuator assembly. Operating the closing pullring rotates the ratchet-and-crank assembly

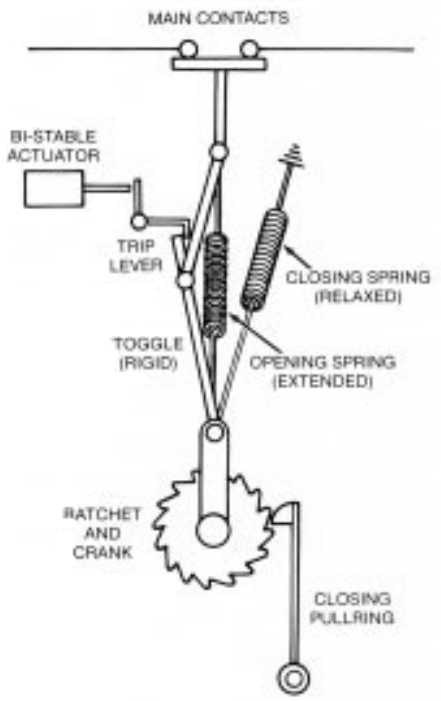


Figure 6.
Schematic diagram of actuator mechanism with contacts closed.

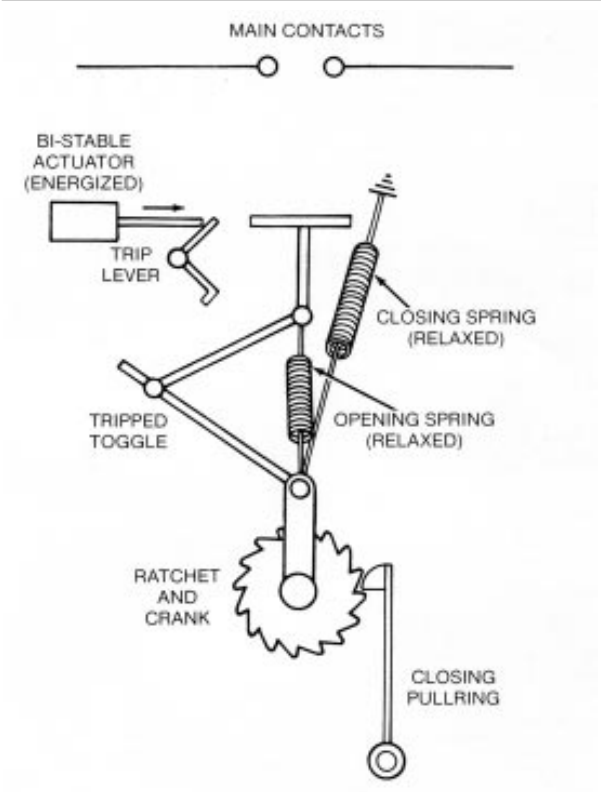


Figure 7.
Schematic diagram of trip operation.

clockwise to extend both springs as shown in Figure 8. The motion of the crank arm also extends the toggle members until they latch. A few more degrees of ratchet travel will overtoggle the crank arm and cause the extended closing spring to pull the mechanism through the remainder of its travel to close the contacts. The latched toggle and extended opening springs are carried along with the contacts into the original closed position shown in Figure 6. The mechanism is now set for another trip operation.

The contacts can be tripped open manually with another pullring located underneath the operator mechanism housing. The manual trip pullring acts on the trip lever to break the latch and collapse the toggle.

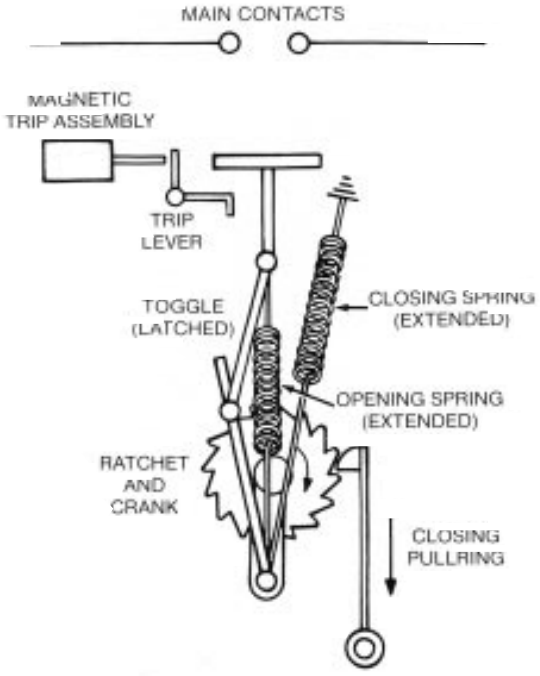


Figure 8.
Schematic diagram of closing operation.

MAINTENANCE

Frequency of Maintenance

Because sectionalizers are applied underwidely varying operating and climatic conditions, maintenance intervals are best determined by the user based on actual operating experience. However, to assure proper operation sectionalizers must be routinely maintained; sectionalizers should be externally inspected, the oil level should be checked and the dielectric strength of the oil should be measured on a yearly basis. (See steps 1, 2, 8 and 10 of "Periodic Inspection and Maintenance" below.) Each periodic check should include at least the following steps:

WARNING: Continuous use of a sectionalizer, without regular routine inspection and repair, can affect reliability. This could lead to equipment failure and possible injury.

1. Bypass and remove the sectionalizer from service.
2. Inspect external components.
   A. Check for broken or cracked bushings, paint scratches, and other mechanical damage.
   B. Note the counter reading and enter the reading in the record log.
   C. Closeand trip the sectionalizer manually several times to check the manual operators. Leave the sectionalizer in the tripped position.
3. Loosen the bolts that secure the head casting and remove the mechanism from the tank. (If tank and head do not separate readily, break the gasket seal by prying them apart.)
   A. Allow the oil to drain off mechanism.
4. Inspect contacts for erosion. Refer to Contact Inspection procedure, within this manual, for inspection instructions.
   A. Slight pitting and discoloration can be dressed with crocus cloth.
   B. Replace moving and stationary contacts if they are severely eroded.
5. Clean all internal components.
   A. Remove all carbon traces by wiping with a clean, lint-free cloth.
   B. Flush the internal mechanism with clean, dry transformer oil.

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

6. Replace head gasket. Use Pliobond to retain new gasket.
7. Inspect tank liners.
   A. Soft or spongy areas indicate that water has been absorbed. Replace liners if this condition exists.
8. Check the dielectric strength of the insulating oil.
   A. The dielectric strength should not be less than 22 kv.
   B. Low dielectric strength usually indicates the presence of water. There are gasket seals between each bushing and the head. Check the seals carefully for deterioration or entrance of moisture.

   NOTE: The unit employs a vented oil-level gage and filler plug. Make sure vent is free and clear to allow unit to breathe with changes in atmospheric conditions. Normal breathing will prevent a seal from breaking which can instigate a path for moisture to enter the tank.

9. Inspect circuit components attached to the recloser head and operating mechanism.
   A. Check condition of wiring to terminal strips, make sure all connections are tight.
   B. Check condition of bushing current transformers and associated wiring.
   C. Check condition of microswitches and wiring.
10. If oil must be replaced.
   A. Drain tank and clean out all sludge and carbon deposits.
   B. Fill tank with clean insulating oil to 7/8 in. from top of tank, with mechanism removed. Capacity is approximately 42 gallons. See oil Condition following.
11. Replace mechanism into tank.
   A. Install head bolts and tighten evenly to 12-15 ft-lbs torque.
12. Manually close and trip the unit several times to **check for** proper operation of the mechanism.
13. Perform an insulation withstand test (see page 7 for procedure).

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 use 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 sectionalizer should be filled with new oil, or oil that has been restored to like-new condition. Oil supplied in sectionalizers conforms to ASTM Standard D3487, Type I; its property limits are shown in Reference Data R280-90-1, "Oil Specifications and Tests."

Insulation Level Withstand Tests

High-potential withstand tests provide information on the dielectric condition of the sectionalizer. Testing is performed at 75% of the rated low-frequency withstand voltage 37.5 kv test voltage.

TEST 1: Proceed as follows:

1. Manually close main contacts.
2. Ground sectionalizer tank and head.
3. Connect all three source-side bushings (1, 3, 5) together.
4. Apply proper test voltage to source-side bushings.
5. The sectionalizer should withstand the test voltage for 60 seconds.

TEST 2: Proceed as follows:

1. Manually close main contacts.
2. Ground sectionalizer tank and head.
3. Ground Phase A (bushing 2) and Phase C (bushing 6).
4. Apply proper test voltage to Phase B (bushing 3).

TEST 3. Proceed as follows:

1. Open main contacts of sectionalizer.
2. Ground sectionalizer tank and head.
3. Connect and ground all three load-side bushings (2, 4, 6).
4. Connect all three source-side bushings (1, 3, 5).
5. Apply proper test voltage to source-side bushings.
6. The sectionalizer should withstand the test voltage for 60 seconds.
7. Reverse the connections: ground source-side bushings (1, 3, 5); apply test voltage to load-side bushings (2, 4, 6) for 60 seconds.
8. The sectionalizer should withstand the test voltage for 60 seconds.

TEST RESULTS: These high potential withstand tests provide information on the dielectric condition of the sectionalizer and the integrity of the contacts.

A. If the sectionalizer passes the closed-contacts tests (Tests 1 and 2) but fails the open-contacts test (Test 3) a deterioration of one or more of the contact assemblies is likely to be the cause. Check each contact assembly individually to determine the failed phase or phases, and replace. Retest to confirm repair.

B. If the sectionalizer fails the closed-contacts tests (Test 1 and 2) the cause is likely to be a diminished electrical clearance, low oil dielectric strength or failed insulation. After correcting the problem, retest to confirm repair.

TEST PROCEDURES AND TROUBLESHOOTING

The following test procedures are recommended to check the operating condition and to determine possible trouble areas in a malfunctioning unit:

Test Circuit and Equipment

A suggested test circuit is shown in Figure 9. In this test setup the test current is obtained by back-feeding a 500:5 amp current transformer (located in the primary loop of one phase of the sectionalizer) from an adjustable 120 vac source. The ammeter scales should be selected to accommodate the appropriate range of test currents.

IMPORTANT: Before performing any of the test procedures that follow, make sure the 120 vac power to the heater and voltage charging board is disconnected to disable the voltage restraint feature. The sectionalizer will not count as long as the voltage restraint feature (part of the voltage charging board) is energized.

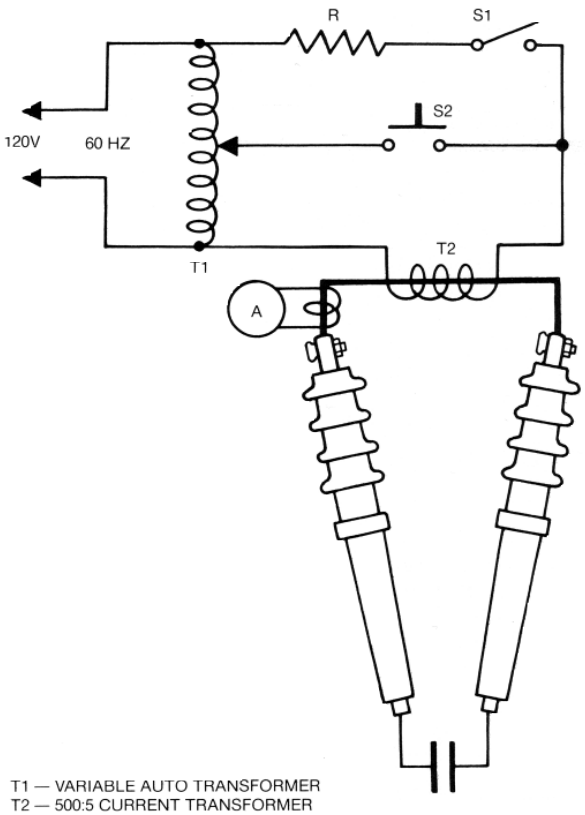


Figure 9.
Test circuit schematic.

Test Procedures

MINIMUM ACTUATING CURRENT

The minimum actuating current can be verified by testing at the ±ten percent values of the phase and ground actuating current ratings. For example, the minimum actuating resistor rated at 80 amps is tested at 72 amps (no-count) and 88 amps (count registered).

PHASE MINIMUM ACTUATING CURRENT

When checking the phase minimum actuating current, the ground fault sensing portion of the sectionalizer must be disabled. Testing an individual phase without disabling the ground sensing circuits will cause a false count. The following procedure can be used:

1. Jumper the ground actuating current resistor with a short lead to disable the ground sensing circuit.

2. Program sectionalizer for one count-to-open by setting the COUNTS TO OPEN SELECTOR switch to "1".
3. Close sectionalizer by operating the close pullring the required number of times.
4. With the test circuit connected to phase A of the sectionalizer and S1 open, hold S2 closed and slowly raise the test current from zero to the appropriate value shown in Column A of Table 1.
5. Release S2 to simulate a backup opening. The sectionalizer should not open.
6. Close S2 and adjust the test current to the appropriate value shown in Column B of Table 1.
7. Release S2 to simulate a backup opening. The sectionalizer should count the overcurrent interruption and open.
8. Repeat steps 3 through 7 for phases B and C.
9. Remove the jumper from across the ground actuating current resistor upon completion of this portion of the test.

GROUND MINIMUM ACTUATING CURRENT

To prevent the possibility of a false count, the phase sensing portion of the sectionalizer control circuit should be disabled when the ground minimum actuating current is being checked. The following procedure can be used:

1. Jumper the phase actuating current resistor with a short lead to disable the phase sensing circuit.
2. Check that sectionalizer control is set for one count-to-open.
3. Close sectionalizer by operating close pullring the require number of times.
4. With the test circuit connected to phase A of the sectionalizer and S1 open, hold S2 closed and slowly raise the test current from zero to the appropriate value shown in Column A of Table 1.
5. Release S2 to simulate a backup opening The sectionalizer should not open.
6. Close S2 and adjust the test current to the appropriate value shown in Column B of Table 1.
7. Release S2 to simulate a backup opening. The sectionalizer should count the overcurrent interruption and open.
8. Repeat steps 3 through 7 for B and C phases.
9. Remove the jumper from across the phase actuating current resistor.

COUNT RESTRAINT

The count restraint feature prevents erroneous counts of overcurrents interrupted by downline protective devices by blocking the counting operation as long as a minimum of one-half amp of uninterrupted line current flows through the sectionalizer. The operation of the count restraint can be verified by super imposing an interruptable overcurrent on a constant minimum line current. The sectionalizer will not count or open on the interruption of the overcurrent as long as the minimum line current is not interrupted. To check the ground restraint feature, proceed as follows:

1. Jumper the ground actuating current resistor with a short lead to disable the ground sensing circuit.
2. Check that sectionalizer is set for one count-to-open.
3. Close sectionalizer by operating close pullring the required number of times.
4. With the test circuit connected to phase A of the sectionalizer and S1 closed (to simulate a constant load current of approximately six amps), hold S2 closed and raise the test current to slightly above the appropriate value shown in Column B of Table 1.
5. Release S2 to simulate a downline device clearing the overcurrent. The sectionalizer should not open verifying the operation of the count restraint feature.
6. Open S1 and again close and release S2 to simulate a backup device clearing the fault. This time the sectionalizer should count the overcurrent interruption and open.

Table 1
Test Circuit Operating Limits for Actuating Current Settings

Actuating Current Setting (amps)	Column A Sectionalizer Must Not Count Below (amps)	Column B Sectionalizer Must Count At (amps)
3.5	3	4
7	6.3	7.7
16	14.4	17.6
20	18	22
24	21.6	26.4
28	25.2	30.8
40	36	44
56	50.4	61.6
80	72	88
112	101	124
160	144	176
224	201	247
256	230	282
296	266	326
320	288	352
384	345	422
448	403	493
640	576	704

VOLTAGE RESTRAINT

When energized at 120 vac, the voltage charging board provides fast charging times for the trip energy storage capacitors. It also acts as a voltage restraint; the sectionalizer will not count an overcurrent interruption of the backup protective device unless the voltage at the control is also interrupted. To check the voltage restraint feature, proceed as follows:

1. Jumper the ground actuating resistor with a short lead to disable the ground sensing circuit.
2. Program sectionalizer for one count-to-open.
3. Close sectionalizer by operating close pullring the required number of times.
4. Connect 120 vac across pins B and D of the 120 vac input receptacle.
5. With the test circuit connected to phase A of the sectionalizer and S1 open, close S2 and raise the current to slightly above the appropriate value shown in Column B of Table 1.
6. Release S2 to simulate a downline device clearing the overcurrent. The sectionalizer *should not* open.
7. Disconnect the 120 vac from the input receptacle.
8. Again close and release S2. The sectionalizer should open.

NUMBER OF COUNTS-TO-OPEN

The number of counts-to-open can be verified by interrupting an overcurrent through the sectionalizer for a preset number of times. For example, with the control set for three counts, the sectionalizer will open upon the third overcurrent interruption. Proceed as follows:

1. Jumper the ground actuating current resistor with a short lead.
2. Program sectionalizer for three counts-to-open by setting the COUNTS-TO-OPEN SELECTOR switch to "3".
3. Close sectionalizer by operating the close pullring the required number of times.
4. With the test circuit connected to phase A of the sectionalizer and S1 open, close S2 and raise the test current to slightly above the appropriate value shown in Column B of Table 1.
5. Open and close S2 a number of times. The sectionalizer should open upon the third opening of S2.
6. To verify the two-counts-to-open setting, set the COUNTS-TO-OPEN SELECTOR switch to "2" and repeat steps 3 through 5. The sectionalizer should open upon the second opening of S2.

COUNT RESET

The count reset feature resets the sectionalizer count to zero whenever current below the actuating level flows through the sectionalizer for longer than the programmed reset time without

interruption. The reset time settings have a tolerance of ± 10 percent. It can be verified by interrupting an overcurrent flow through the sectionalizer one time less than the counts-to-open setting, then allowing load current to flow for periods just under and just over the reset setting. The sectionalizer should open if the overcurrent for the final count is interrupted within the reset time period (reset has not activated). The sectionalizer should not open if the over current for the final count is interrupted after the reset time period (count has reset to zero). The following procedure may be used to verify the count reset.

1. Jumper the ground actuating current resistor with a short lead to disable ground sensing circuit.
2. Program sectionalizer control for 2 COUNTS-TO-OPEN and set the COUNT RESET SELECTOR to 15 seconds.
3. Close sectionalizer by operating close pullring the required number of times.
4. With test circuit connected to phase A of the sectionalizer and S1 open, close S2 and raise the test current to slightly above the appropriate value shown in Column B of Table 1.
5. Release S2 to simulate a backup protective device clearing the overcurrent. The sectionalizer will register a count.
6. Close S1 for 13.5 seconds.
7. Momentarily close and then release switch S2. The sectionalizer should open, verifying that the count reset has not been activated.
8. Reclose sectionalizer and then close and release S2 once to register one overcurrent interruption count.
9. Close S1 for slightly more than 22 seconds.
10. Momentarily close and release switch S2. The sectionalizer should not open verifying that the count reset has been activated and the first count has been erased.
11. Again close and release S2. The sectionalizer should open.

INRUSH-CURRENT RESTRAINT

The inrush-current restraint feature distinguishes between fault currents and inrush currents. For fault current interruptions, the sectionalizer counts and opens normally. For an inrush-current condition, the phase minimum actuating current is raised by a preset multiple for a preset time and ground fault detection is blocked for a preset time to prevent counting the inrush current. The operation of the inrush-current restraint can be verified by simulating a fault condition (the overcurrent is preceded by an overcurrent interruption) and an inrush condition (the overcurrent is preceded by a load current interruption). The following procedure may be used to verify the inrush current restraint feature.

1. Jumper the ground actuating current resistor with a short lead to disable the ground sensing circuit.
2. Set the COUNTS-TO-OPEN SELECTOR switch to “1” and the PHASE ACTUATING LEVEL MULTIPLIER switch to X2.
3. Set the GND INRUSH RESET and the PHASE INRUSH RESET switches to TEST.
   NOTE: In the TEST position, the inrush restraint is blocked from resetting once it is activated.
4. Close sectionalizer by operating close pullring the required number of times.
5. With test circuit connected to phase A of the sectionalizer and S1 open, hold S2 closed and raise the test current to slightly below the appropriate value shown in Column A of Table 1.
6. Release S2 to simulate a backup opening with only load current flowing through the sectionalizer when current was interrupted. The sectionalizer should not open.
7. Close S2 and adjust the test current to just below twice the appropriate value shown in Column A of Table 1 to simulate an inrush condition.
8. Release S2. The sectionalizer should not open, verifying that the inrush restraint feature has been activated.
9. Reset inrush restraint as follows:
   A. Return the GND INRUSH RESET and the PHASE INRUSH RESET switches to some finite values.
   B. Hold S2 closed longer than the greater of the two settings to reset the inrush restraint feature.
   C. Return both GND INRUSH RESET and PHASE INRUSH RESET switches to TEST.
10. Again hold S2 closed and raise the test current to slightly below the appropriate value shown in Column A of Table 1.
11. Release S2 to simulate a backup opening with only load current flowing through the sectionalizer when current was interrupted.
12. Close S2 and adjust the test current to slightly twice the value shown in Column B of Table 1.
13. Release S2. The sectionalizer should trip verifying the 2X phase actuating level multiplier setting.
14. Manually close the sectionalizer and repeat step 9 to reset the inrush restraint feature.
15. Close S2 and raise the test current to slightly above the appropriate value shown in Column B of Table 1.
16. Release S2 to simulate a backup opening with fault current flowing through the sectionalizer when current was interrupted. The sectionalizer should open.
17. Close the sectionalizer.
18. Repeat step 15 to simulate a fault condition.
19. ReleaseS2.The sectionalizer should open verifying that the inrush restraint feature has not been activated.

Post-Test Procedures

After testing has been completed, make sure the control settings are programmed to the operating parameters as originally specified.

TROUBLESHOOTING

Sectionalizer troubleshooting is the process of evaluating problems that are encountered and determining the cause. The following procedure is recommended.

1. Check for loose or broken connections and wiring. Figure 10 shows the interconnection between the various electrical components of the sectionalizer.
2. Check the toggle and associated linkage and springs for mechanical binding by closing the sectionalizer and tripping it manually several times.
3. Perform the applicable electrical test described in the Test Procedures section of these instructions. If the sectionalizer does not trip under test either the control or the bi-stable actuator assembly may be malfunctioning.

A. Check the bi-stable actuator assembly to see if it has—or has not—released.

NOTE: There should be approximately 1/32-in. play between the end of the trip rod and the lever assembly on the main shaft (Figure 13).

(1) If the bi-stable actuator assembly actuated the toggle assembly should be released. If the malfunction is the result of mechanical binding of the toggle orthe associated linkages check the engagement surface of the toggle to make sure there are no rough spots or burrs. Repair as required.

(2) If the bi-stable actuator assembly did not actuate, check the d-c resistance of the trip coil:

With the red and the brown leads removed from the control circuit board the resistance should measure approximately 6.5 ohms.

If the bi-stable actuator assembly is damaged or inoperative it must be replaced. Make sure there is approximately 1/32-in. play between the end of the

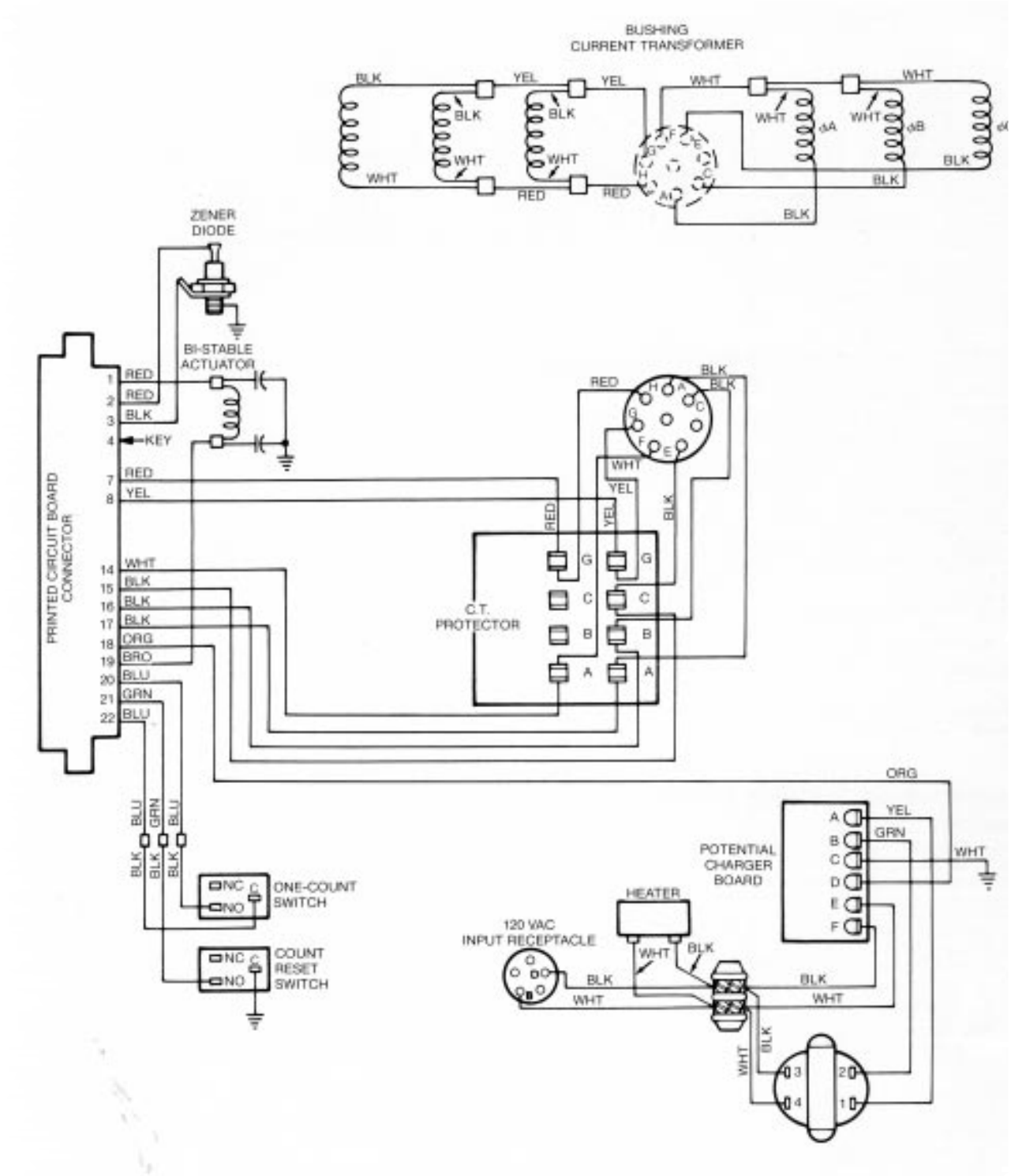


Figure 10.
Type GV sectionalizer interconnection diagram.

trip rod and the lever assembly on the main shaft (Figure 11) when the new bi-stable actuator is installed.

(3) If the bi-stable actuator assembly appears to be operative, check the Zener diode, mounted above the voltage charging circuit board. If the Zener diode is damaged replace it.

NOTE: The dc voltage across the zener diode will be approximately 18 Vdc, with any load current over 10 amps flowing through the sectionalizer.

B. If all components check out satisfactorily, the problem is in the control printed circuit board assembly, replace the board and retest.

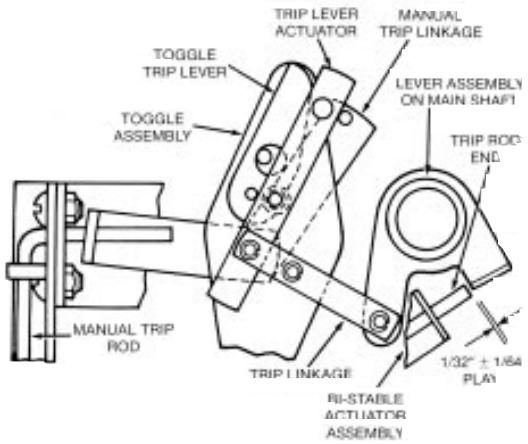


Figure 11.
Manual and electrical trip linkage.

SHOP MAINTENANCE PROCEDURES

Bushings

Bushing maintenance is generally limited to a thorough cleaning during the regular maintenance inspection; however, if a bushing is cracked or broken, it must be replaced. To replace a bushing:

1. Loosen head-clamp bolts and untank sectionalizer.

2. Remove nut, lockwasher, and flatwasher holding the lower end of bushing rod to the contact housing bracket.

NOTE: If more than one bushing is damaged, replace only one bushing at a time so thatthe relative position of the contact housing will not be disturbed. If the contact housing position is changed, the contacts must be readjusted as described in the Contacts section of these instructions.

3. Remove the three hex head capscrews and clamps that secure the bushing to the head and lift out complete bushing assembly.

4. Remove and discard the lower gasket.

5. Depending upon the extend of damage, the complete bushing assembly can be replaced or new ceramic only can be installed. If new ceramic only is to be installed, refer to Figure 12 and proceed as follows:

A. Unscrew the bushing terminal and withdraw the rod from the bottom of the bushing ceramic; discard the terminal gasket.

B. Insert the rod assembly all the way into the new ceramic, making sure the roll pin is seated in the locking groove in the top of the bushing.

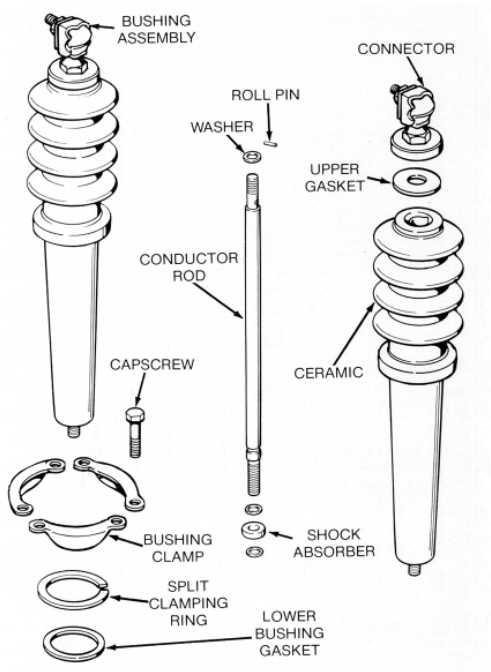


Figure 12.
Bushing parts.

C. Assemble the terminal to the bushing rod using a new terminal gasket; tighten to 35 ft-lbs. of torque.

NOTE: Apply a very small amount of petroleum jelly to the knurled surface of the inside face of the terminal before assembly to the bushing rod.

6. Twist off the split aluminum clamping ring from the old bushing and install on the new bushing if it is in good condition; replace the ring if damaged.

NOTE: The clamping ring cushions and distributes the pressure between the ceramic and the clamps. DO NOT OMIT.

7. Install the bushing assembly (new or reworked) into the head using a new lower bushing gasket. Position the bushing with the stud end of the terminal pointing outward.

8. Position the clamping ring with the split centered between two clamping bolts.

9. Reassemble the bushing to the head casting. Tighten the bolts evenly, a little at a time, to 6-10 ft-lbs torque.

NOTE: Clamping forces must be applied gradually and equally in rotation to each bolt. This results in an evenly distributed gasket sealing pressure.

10. Reconnect the bushing rod to the contact housing bracket.

Contacts

MOVING AND STATIONARY CoNTACTS

Type GV sectionalizers have an open-type contact arrangement with separate load and arcing contacts (Figure 13). To check the contacts:

1. Manually trip the sectionalizer and remove the mechanism from the tank.
2. Inspect the moving and the stationary contacts.
   A. If the contacts are rough or carbonized, clean them with crocus cloth.

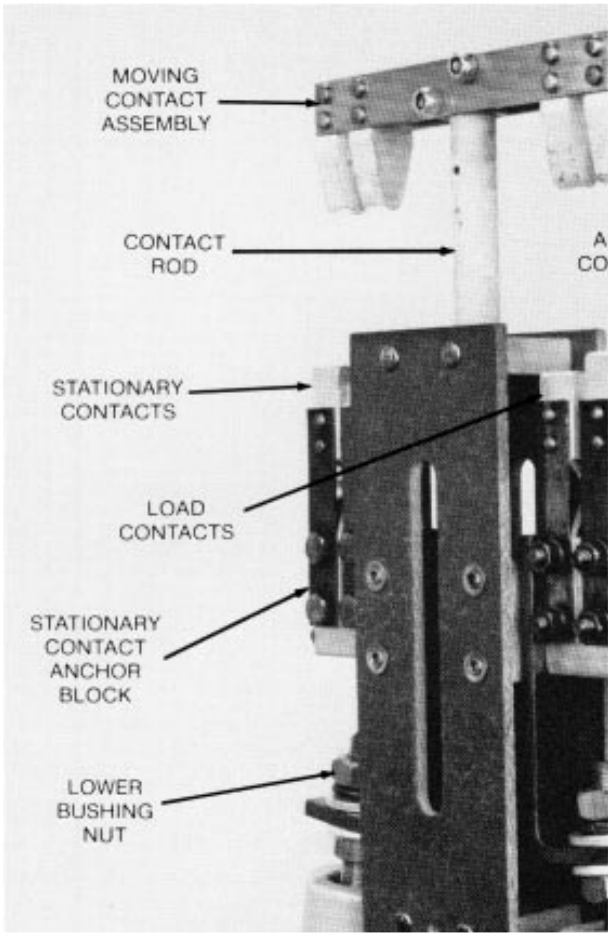


Figure 13. 57907KMA
Contact arrangement.

B. If the contacts are badly burned or do not close completely, replace them.

To replace the moving and stationary contacts, refer to Figure 13 and proceed as follows:

1. Remove the two screws securing the moving contact assembly to the contact rod.
2. Remove the hardware securing the stationary contacts to the anchor block and remove the stationary contacts.
3. Install the new moving and stationary contacts.
A. Align the arms of the stationary contacts parallel to the anchor block sides before tightening the arms.
4. Refer to the Contact Alignment section of these instructions for the proper adjustment of contacts.

CONTACT HOUSING

To replace the contact housing:

1. With the switch mechanism removed from the tank, remove the C-ring and pin securing the contact rod link to the shaft lever (Figure 14).
2. Remove the lower bushing nuts securing the contact housing to the bushing assemblies (Figure 13).
3. Lift the contact housing off the bushing assemblies.
4. Operate the actuator mechanism until it is in the switch-closed position.
5. Place the new contact housing on the upper bushing washers.

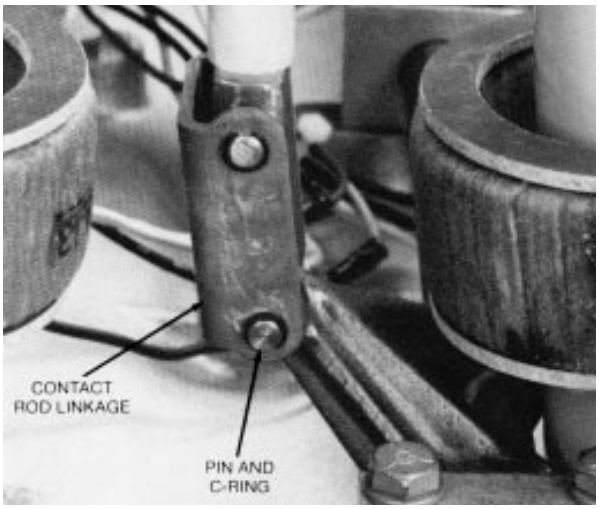


Figure 14. 87906KMA
Contact rod linkage.

6. Secure the link to the shaft assembly with the pin, but do not replace the C-ring.
7. Adjust the upper bushing nuts until the contact rod provides a 1/32- to 1/16-in. clearance between the moving contact assembly and the contact housing, making sure the contact housing is level.
8. Square the contact housing with the head casting bottom as shown in Figure 15.
9. Recheck the contact anchor for proper clearance.
10. Tighten the lower bushing nuts to secure the contact housing.
11. Attach the C-ring to the link pin.
12. Refer to Contact Alignment section of these instructions for the proper adjustment of contacts.

CONTACT ROD

To replace the contact rod:

1. With the switch mechanism removed from the tank, remove the C-ring and pin securing the contact rod link to the shaft lever.
2. Remove the lower bushing nuts securing the contact housing to the bushing assemblies.
3. Lift the contact housing off the bushing assemblies (Figure 14).
4. Drive out the roll pin at the bottom end to detach the rod spacer.
5. Pull the contact rod out through the dashpot.
6. Insert the new contact rod through the dashpot.
7. Attach the rod spacer and roll pin at the bottom end.
8. Operate the actuator mechanism until it is in the switch closed position.
9. Place the contact housing on the upper bushing washers.
10. Secure the link to the shaft assembly with the pin, but do not replace the C-ring.
11. Adjust the upper bushing nuts until the contact rod provides a 1/32- to 1/16-in. clearance between the moving contact assembly and the contact housing, making sure the contact housing is level.
12. Square the contact housing with the head casting bottom as shown in Figure 15.
13. Recheck the contact anchor for proper clearance.

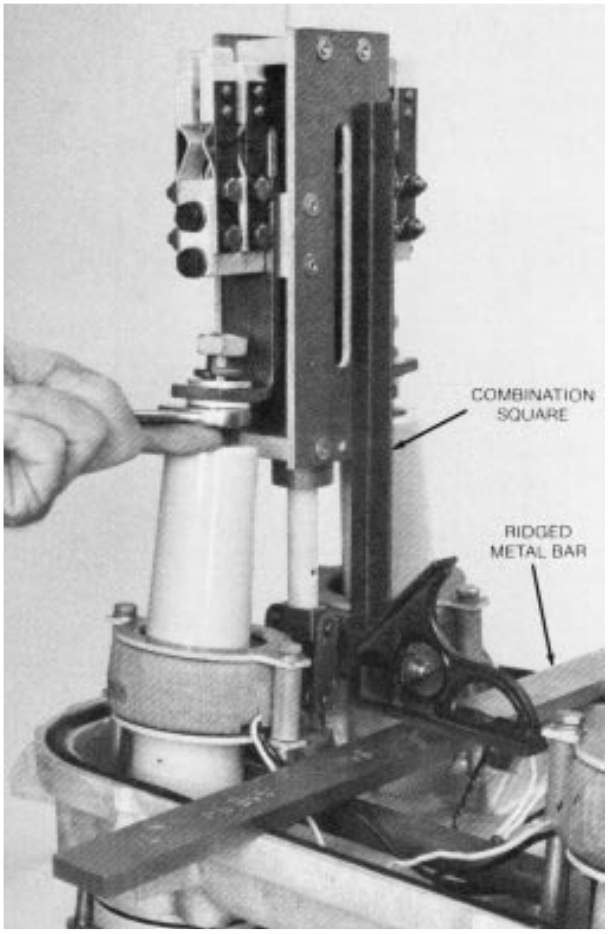


Figure 15. 87911KMA
Square contact housing.

14. Tighten the lower bushing nuts to secure the contact housing.
15. Attach the C-ring to the link pin.
16. Refer to Contact Alignment section of these instructions for the proper adjustment of contacts.

CONTACT ALIGNMENT

1. Check contact stroke.
   NOTE: The contact rod of each assembly has a 3-in. stroke which must be maintained and checked when replacing contacts.
   A. With the switch mechanism removed from the tank and with the contacts in the closed position, measure from the top of the contact rod piston down to the support housing as shown in Figure 16.
   B. If this measurement is not 3 in., adjust the lower bushing nuts holding the contact structure, making sure the contact structure is centered and vertical.

2. Make sure the clearance between the movable contact rod and the lower surface of the rod bearing block is 1/32- to 1/16-in. with the contacts full closed.
   A. To obtain the 1/32- to 1/16-in. clearance, adjust the contact housing structure at the lower bushing nuts.

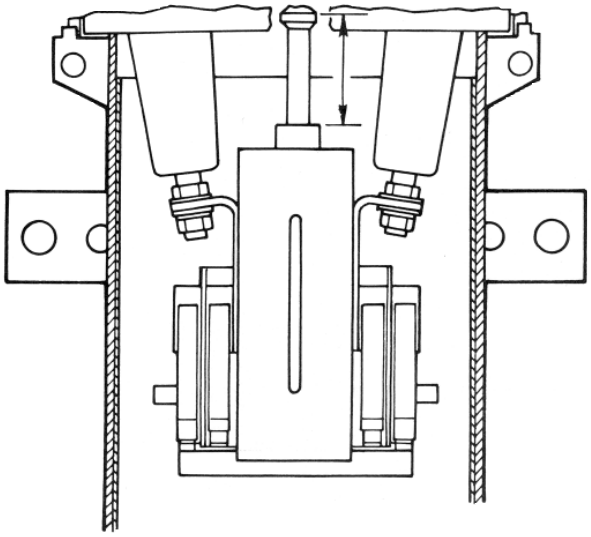


Figure 16.
Contact rod stroke measurement.

3. With the contacts fully closed, check to make sure that the contact rod piston does not bottom in the contact housing dashpot.
   A. To prevent this bottoming, set the stop bolt inside the operating housing (Figure 17) so that the slotted side plates of the latch assembly at the upper pivot bear snugly against the pivot pin when the latch is in the toggle position as shown in Figure 18.
      (1) Check this by manually winding the actuator mechanism.
         a. The pivot pin should touch the end of the slot just as the latch assembly reaches the toggle position.

4. Check contact force.
   NOTE: Contact force must be checked when a contact is replaced.

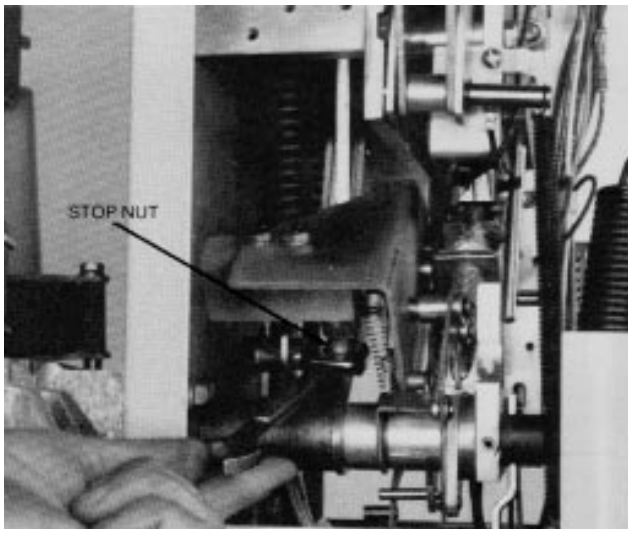


Figure 17. 87913KMA
Setting stop bolt.

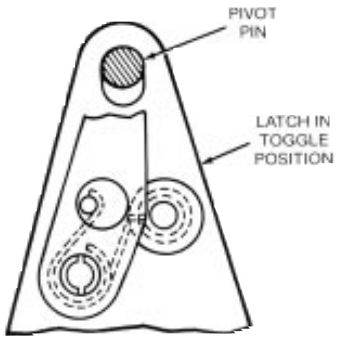


Figure 18. 88920KMA
Proper stop bolt. adjustment.

A. Using a pressure gage as shown in Figure 19, check the contact pressure.
   (1) The correct amount of force to separate a stationary contact from its moving contact is 7.5 lb. ± 0.5 lb.
   (2) Adjust the pressure toward the high side.
   NOTE: The separating force on a set of new contacts is generally greater than 7.5 Ib.; therefore, the adjustment of new contacts will be in the direction of reducing contact pressure.

CAUTION: To assure that the acring contacts make befoe the load contacts, pressure on the arcing contacts must be equal to — or exceed — the pressure on the load contacts.

B. To adjust the contact pressure, insert a screwdriver between the stationary and the moving contact tips.
   (1) Pry in the direction to move the stationary contact away from the moving contact tip.

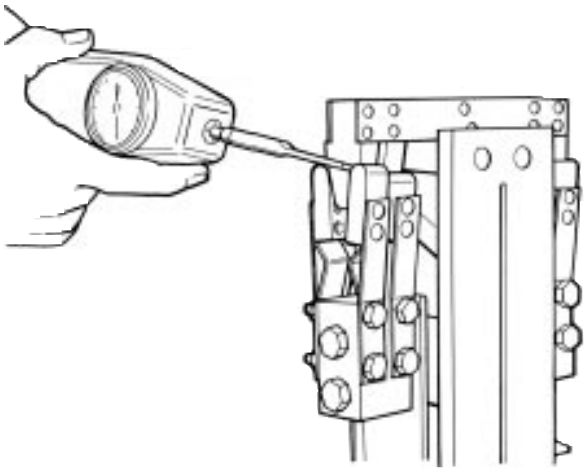


Figure 19.
Measuring fixed contact holding force.

   NOTE: A "feel" for applying the proper leverage is easily determined after the first trial. Make small changes in pressure until experience has been gained.
   (2) Equalize—as closely as possible—the pressure on each side of the set of contacts.
   NOTE: To help determine when the applied force causes contact separation, an electrical continuity check can be used. The faces of all contacts except the faces of the set being adjusted are isolated with strips of thin insulating material.

C. Operate the sectionalizer a few times to make sure all alignments have been properly secured.

5. Retank the sectionalizer.

Current Transformers

Type GV sectionalizers are equipped with six 1000:1 current sensing transformers. one is installed over the shank of each bushing, underneath the head casting. The leads from the current transformers are routed to a through connector and then into the mechanism housing to the CT protection board, see Figure 20. To test the current transformers proceed as follows:

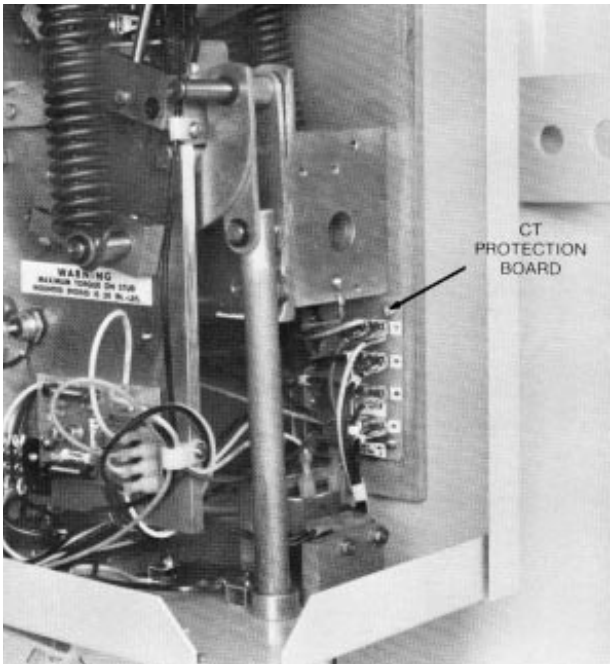


Figure 20. 87910KMA
CT protection board.

CONTINUITY CHECK

1. Disconnect white CT lead from phase A connector on CT protection board. Measure resistance between white lead and phase A, B, and C leads (connected to CT protection board). Approximately 11.4 ohms should be measured. Replace white lead.

2. Disconnect yellow and red CT leads, from ground connectors on CT protection board. Measure resistance between leads. Approximately 3.8 ohms should be measured. Replace leads.

RATIO TEST FOR SENSING CT's

1. Connect all three phases of the sectionalizer in series, as shown in Figure 21, and close the sectionalizer.
2. Connect a 100 ampere a-c test circuit to test points 1 and 2, do not energize.
3. Remove the black CT lead from phase A on the CT protection board. Insert a 0-500 milliammeter between the black lead and the white CT lead.
4. Energize the 100 ampere source and observe the millammeter. The meter should record 100 ma ±10%. Deenergize the 100 ampere source and reconnect the lead.
NOTE: Be sure to allow for the tolerances of meter being used. The resistance of certain type of meters is not negligible. Use as high a scale (lower resistance) as is accurately readable.
5. Repeat test on phases B and C.
6. Remove red and yellow ground CT leads from CT protection board. Insert a 0-500 millammeter between red and yellow leads.
7. Energize 100 ampere source and observe millammeter. The meter should record 300 ma ±10%. Deenergize 100 ampere source and reconnect leads.

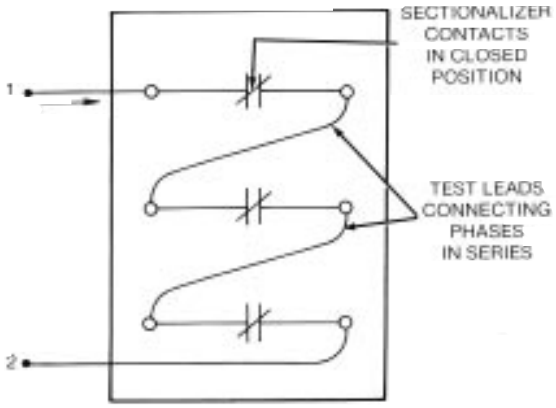


Figure 21.
Test circuit for checking bushing current transformers.

POLARITY TEST FOR SENSING CT's

1. With phases still connected in series, from previous test, remove three black leads from phase connectors on CT protection board. Temporarily connect black leads together. Insert a 0-500 millammeter between black leads and white phase CT lead.
2. Energize 100 ampere source and observe millammeter. The meter should record 300 ma ±10%. Deenergize 100 ampere source and reconnect leads.
A. All three transformers should have the same polarity; the output should measure 300 ma.
B. If one transformer has its polarity opposite of the remaining two the output will measure 100 ma.

CT Protection Board

The CT protection board provides automatic protection for the bushing mounted CTs. The protection board is located on the right side of the mechanism frame, within the mechanism housing. The following test can be used to determine if the protection board is working properly.

Assemble and connect the equipment as shown in Figure 22, which shows the test voltage being applied to phase A.

1. Slowly increase the voltage on the variable transforme rwhile observing the voltage between the 1000:1 CT leads.
2. At approximately 115 volts, the voltage should drop off even though the voltage from the variable transformer is increased. If the voltage does not drop off, the CT protection board is damaged and must be replaced. 3. Disconnect input power and reconnect to test phase B, phase C and ground.

SERVICE PARTS LIST

When ordering service parts, always include the sectionalizer type and serial number. Because of Cooper Power Systems continuous-improvement policy, there will be cases in which parts ordered may not be the same as the parts furnished; however, they will be interchangeable. All parts have the same warranty as any whole item of switchgear; i.e., against defects in material or workmanship within one year from the date of shipment.

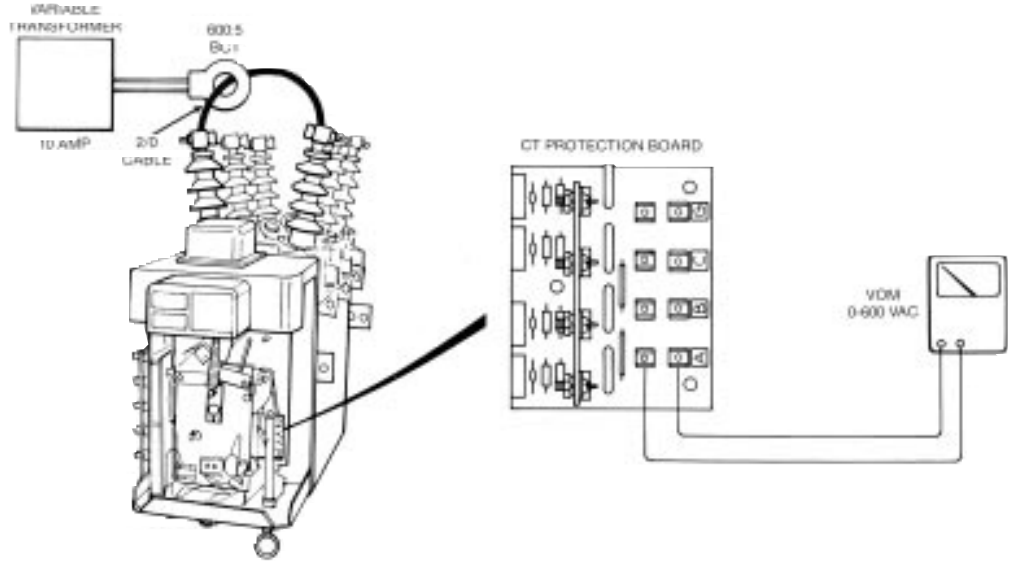


Figure 20.
CT protection board.

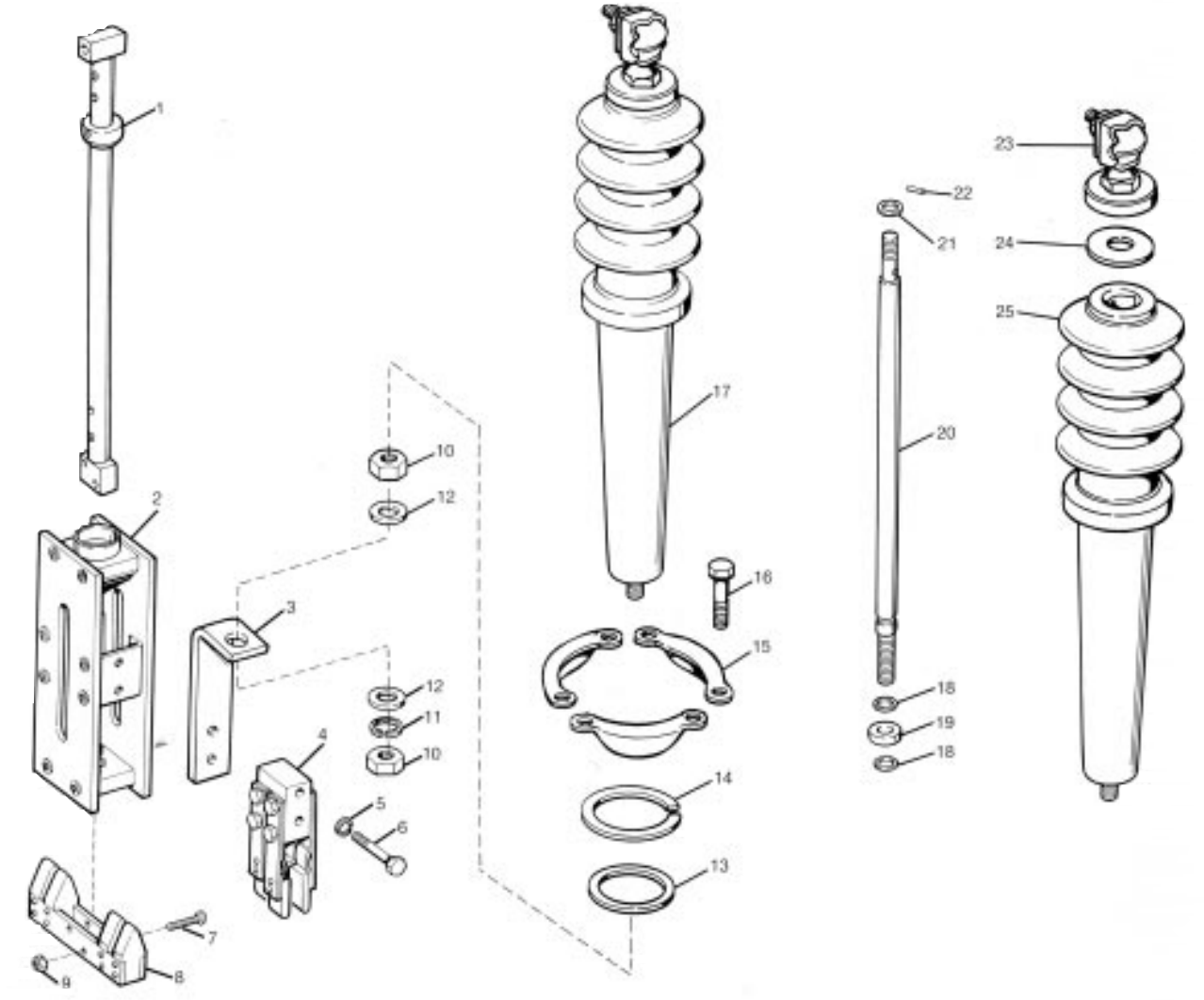


Figure 23.
Bushing parts and contact assembly.

Bushings and Contacts (Figure 23)

Item No.	Description	Catalog Number	Qty per Assy.
1	Contact rod assembly	KA149GV	3
2	Contact support assembly	KA211VR	3
3	Bracket	KP673GV	6
4	Stationary contact assembly	KA209VR	6
5	Split lockwasher, 5/16, med, stl	K900801031000A	12
6	Capscrew, hex hd, 5/16-18 x 2-1/4, stl	K732401131225A	12
7	Machine screw, rd hd, #10-32 x 1, stl	K7215001110100A	6
8	Movable contact assembly	KA201VR	3
9	Elastic stop nut, #10-32	KP2020A1	6
10	Jam nut, hex, 5/8-18, light, brass	K880625118063A	12
11	Split lockwasher, 5/8, med bronze	K900830063000A	12
12	Washer	KP2028A45	24
13	Gasket	KP2090A29	6
14	Clamping ring	KP121L	6

Item No.	Description	Catalog Number	Qty per Assy.
15	Bushing clamp	KP41L	18
16	Capscrew, hex hd, 3/8-16 x 1-3/4, stl	K732401138175Q	18
17	Bushing assembly		
	13-inch standard creepage	KA160E9	6
	17-inch extra-creepage	KA160E11	6
18	Retaining ring, type X50-227	K970901625000M	12
19	Washer	KP2090A2	6
20	Bushing rod	KP504GV	6
21	Washer	KP2028A40	6
22	Roll pin, 1/8 x 15/16	K970801125093C	6
23	Terminal assembly	KP143LA	6
24	Upper bushing gasket	KP2090A57	6
25	Bushing ceramic		
	13-inch standard creepage	KP670GV2	6
	17-inch extra-creepage	KP654GV2	6

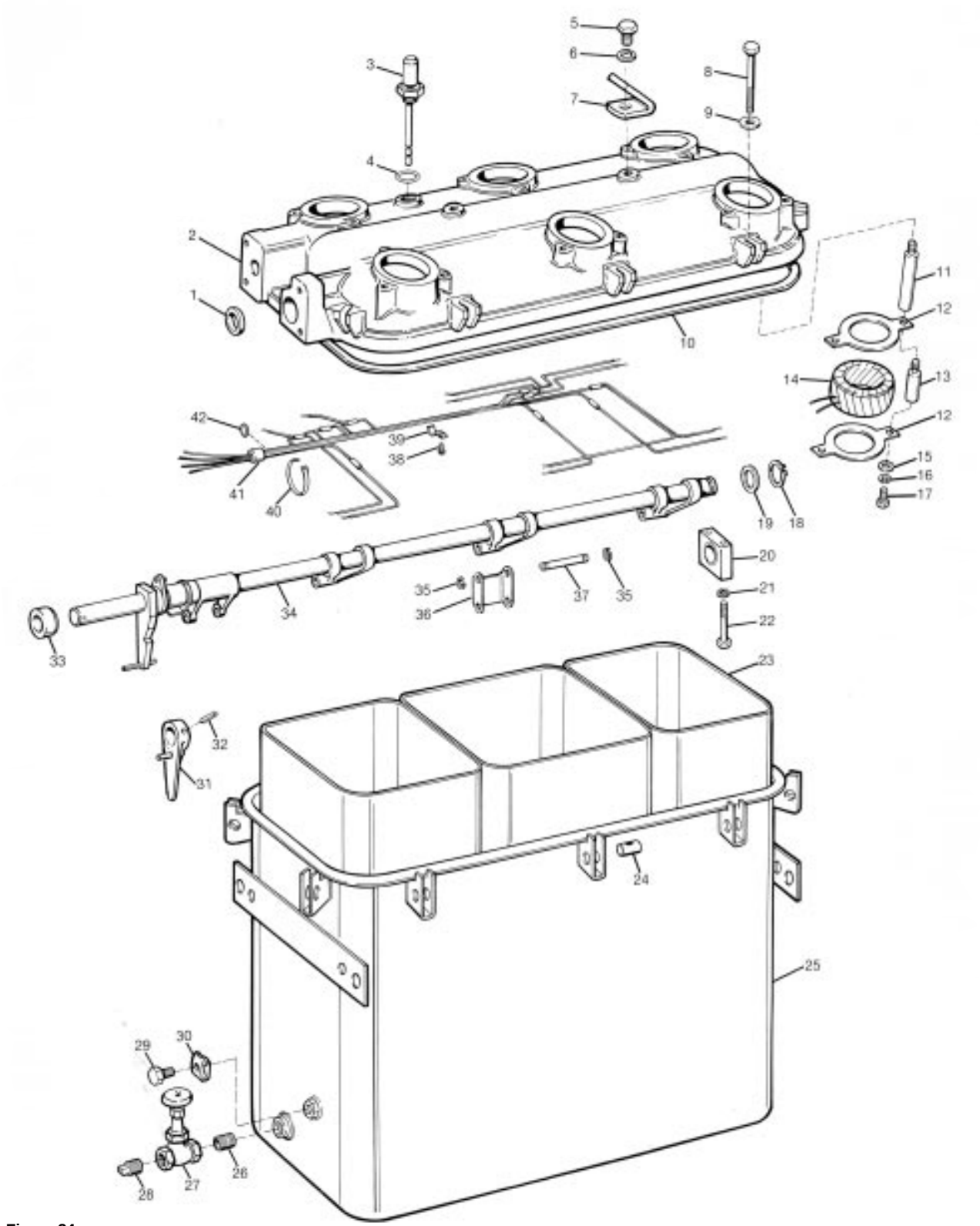


Figure 24.
Head and tank assemblies.

Head and Tank Assemblies (Figure 24)

Item No.	Description	Catalog Number	Qty per Assy.
1	Oil seal	KP259VR	1
2	Head assembly	KP1VR3	1
3	Plug and gage assembly	KA213VR	1
4	O-ring	KP2000A6	1
5	Capscrew, hex head, 1/2-13 x 1, stl	K732401150100Q	2
6	Split lockwasher, med, 1/2, stl	K900801050000Z	2
7	Lifting lug	KP456H1	2
8	Capscrew, hex head, 3/8-16 x 3, stl	K732401138300Q	10
9	Washer	KP2028A33	10
10	Gasket	KP2103A6	1
11	Spacer	KP671GV	12
12	Support	KP145RE	12
13	Spacer	KP3009A88	12
14	Current transformer assembly	KA43GV	6
15	Washer	KP2028A46	AR
16	Split lockwasher, med, 1/4, stl	K900801025000Z	12
17	Capscrew, hex head, 1/4-20 x 2-1/4, stl	K732401125225Y	12
18	Retaining ring	KP2013A1	1
19	Washer	KP2028A46	AR
20	Bearing	KP88VR	3
21	Split lockwasher med, 5/16, stl	K900801031000Z	6
22	Capscrew, hex head, 5/16-18 x 2, stl	K732401131200Y	6

Item No.	Description	Catalog Number	Qty per Assy.
23	Tank liner assembly	KP1193H2	3
24	Nut and pin combination	KP3061A3	10
25	Tank assembly	KA3VCR	1
26	Pipe nipple	KP2039A1	1
27	Valve	KP2038A1	1
28	Pipe plug	KP2007A3	1
29	Capscrew, hex head, 1/2-13 x 1, stl	K732401150100Q	1
30	Ground terminal		
	Parallel ground clamp assembly	KA227H	
	Ground connector assembly	KA226H	
31	Position indicator assembly	KA19VR	1
32	Rollpin,3/16x1-1/4	K970801188125Z	2
33	Bearing	KP70VR	1
34	Levers and shaft assembly, includes items 31 and 32	KA14GV	1
35	Retaining ring, WA514, 1/4, stl	K970901250000A	12
36	Link	KP17VR	3
37	Pin	KP3124A18	6
38	Machine screw, rd head, 1/4-20 x 3/8, stl	K721501125038Z	1
39	Cable clip	KP2006A12	1
40	Wire retainer	K994904170003A	1
41	Connector assembly	KA16GW	1
42	O-ring	KP2000A6	1

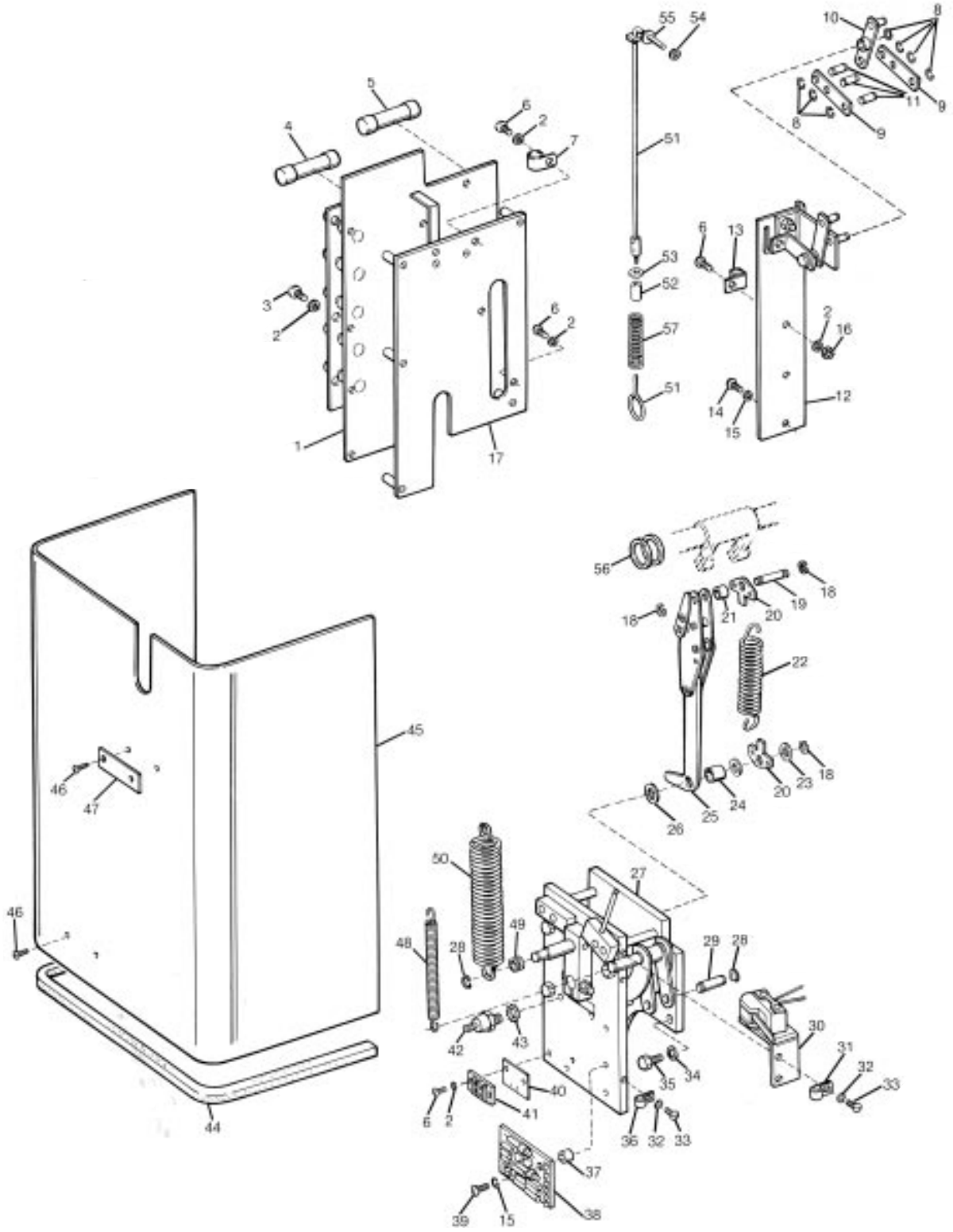


Figure 25a.
Operating mechanism.

Operating Mechanism (Figure 25a)

Item No.	Description	Catalog Number	Qty per Assy.
1	Control printed circuit board assembly	KA175GV	1
2	Split lockwasher, #6, med, stl	K900801008000Z	10
3	Machine screw, rd head, #6-32 x3/8,stl	K72150110080382	6
4	Phase trip resistor assembly *Complete part number with value: 16, 24, 40, 56, 80, 112, 160, 224, 256, 296, 320, 448, or 640.	KA176GV_*	1
5	Ground trip resistor assembly *Complete part number with value:3.5,7,16,20, 28, 40, 56, 80, 112, 160, 224, 320, or BLO (block).	KA177GV_*	1
6	Machine screw, rd head, #6-32 x 1/2, sH	K72150110060502	5
7	Cable clip	KP2006A1	1
8	Retaining ring, #WA510, 3/16	K970915188000A	7
9	Link arm	KP645GV	2
10	Trip arm assembly	KA122GV	1
11	Pin	KP3123A31	3
12	Manual trip linkage assembly	KA126GV	1
13	Bracket	KP688GV	1
14	Machine screw, rd head, #10-32 x 3/4, st stl	K721515310075A	2
15	Split lockwasher, #10, med, stl	K900801010000Z	4
16	Hex nut, #6-32, stl	K880101132006Z	1
17	Mounting plate assembly	KA178GV	I
18	Retaining ring, #WA516, 5/16, stl	K970901312000M	3
19	Pin	KP3125A7	1
20	Link	KP31VR	2
21	Spacer	KP3010A7	1
22	Opening spring	KP35VR	2
23	Washer, #20, brass	K900225020000A	1
24	Spacer	KP3011A6	1
25	Toggle assembly	KA11 VR1	1
26	Washer, 1/2, brass	K900225050000A	1

Item No.	Description	Catalog Number	at per Assy.
27	Ratchet mechanism assembly	KA19GV	1
28	Retaining ring, #WA518, 3/8, stl	K9709011375000M	3
29	Pin	KP3126A2	1
30	Memory dumping switch assembly	KA196GV	1
	Micro-switch only	KP172E1	1
31	Cable clip	KP2006A8	1
32	Split lockwasher, #8, med, stl	K900801008000Z	2
33	Machine screw, rd head, #8-32 x 3/8, stl	K721501108038Z	2
34	Split lockwasher, 5/16, med, stl	K900801025000Z	2
35	Capscrew, hex head, 5/16-18 x 3/4 stl	K732401131075Q	2
36	Cable clip	KP2006A4	1
37	Spacer	KP3007A71	2
38	Voltage charging board assembly	KA174GV1	1
39	Machine screw, rd head, #10-32 x 5/8, stl	K721501310068Z	2
40	Terminal strip marker	KP2101A201	1
41	Terminal strip	KP2101A1	1
42	Zener diode	KP4012A39	1
43	Lockwasher, external tooth, 1/4	K901132025000A	1
44	Gasket	KP2084A1	1
45	Cover	KP129VR	1
46	Self tapping screw, #2 x 3/16, st stl	K741515106019Z	4
47	Nameplate	KP730R	1
48	Spring	KP537GV	1
49	Sleeve	KP280VR	1
50	Closing spring	KP533GW	1
51	Manual trip rod assembly	KA65VR	1
52	Spacer	KP3007A1 8	1
53	Washer, flat, 1/4, stl	K900201025000Z	1
54	Speed nut	KP2005A1	1
55	Washer, plain, #10, brass	K900525010000A	1
56	Spacer	KP2028A46	2
57	Spring	KP157VR	1

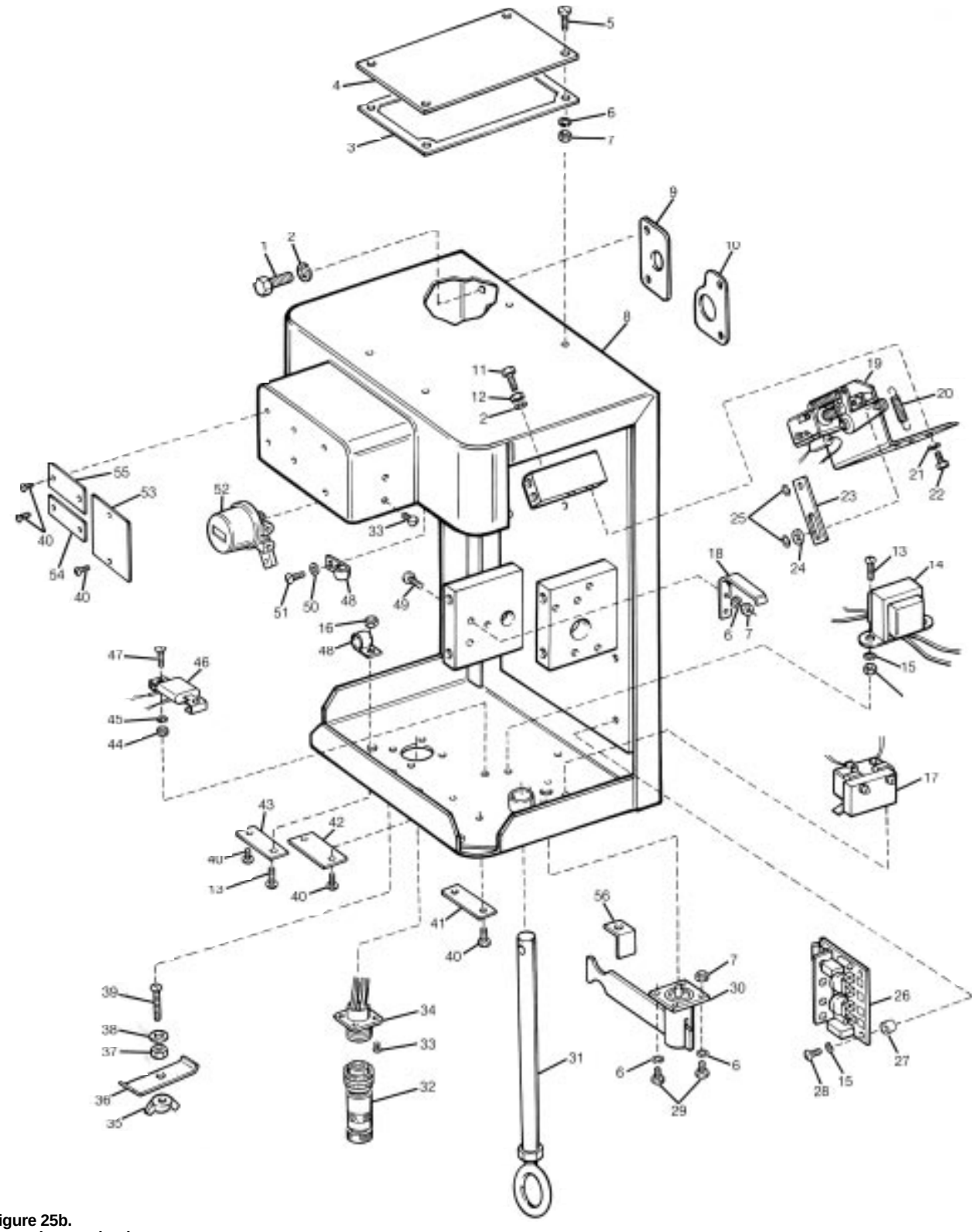


Figure 25b.
Operating mechanism.

Operating Mechanism (Figure 25b)

Item No.	Description	Catalog Number	Qty. per Assy.
1	Capscrew, hex head, 3/8-16 x 1, stl	K732401138100Q	4
2	Split lockwasher, 3/8, med, stl	K900801038000Z	5
3	Gasket	KP649R	1
4	Cover	KP158VR	1
5	Machine screw, rd head, #10-32 x 3/4, st stl	K721515310075A	4
6	Split lockwasher, #10, med, stl	K900701010000Z	8
7	Hex nut, #10-32, stl	K880101332010Z	8
8	Mechanism housing assembly	KA230VR6	1
9	Gasket	KP675GV	1
10	Gasket	KP77VR	1
11	Capscrew, hex head, 3/8-16 x 1-1/2, stl	K732401138150Q	1
12	Jam nut, hex, 3/8-16, stl	K880601116038Q	1
13	Machine screw, rd head, #6-32 x 1/2, stl	K721501106050Z	3
14	Transformer assembly	KA189GV	1
15	Split lockwasher, #6, med	K900801006000Z	6
16	Hex nut, #6-32, stl	K880101132006Z	6
17	One shoot switch assembly	KA195GV	1
	Micro-switch only	KP172E1	1
18	Spring	KP72VR	1
19	Magnetic trip assembly	KA179GV	1
	Bi-stable actuator assembly only	KA180GV	1
20	Spring	KCE1093X	1
21	Split lockwasher, med 1/4, stl	K900801025000Z	2
22	Capscrew, hex head, 1/4-20 x 1/2, stl	K732401125050Q	2
23	Link	KP692GV	1
24	Washer, flat, 1/4, stl	K900201025000Z	1
25	Retaining ring, WA514, 1/4, stl	K970901250000M	2
26	CT protection board assembly	KA200GV	1
27	Spacer	KP3004A60	2
28	Machine screw, rd head, #6-32 x 7/16, stl	K721501106044Z	2

Item No.	Description	Catalog Number	Qty. per Assy.
29	Machine screw, rd head, #10-32 x 1/2, stl	K721501310050Z	4
30	One shot handle assembly	KA38GV	1
31	Operating rod assembly	KA35GV	1
32	Plug assembly	KA48NR	1
33	Self tapping screw, #6 x 3/8, st stl	K741515106038A	6
34	Receptacle assembly	KA194GV	1
35	Wing nut, 5/16-18, stl	K881201118031Z	1
36	Latch	KP268VR	1
37	Hex nut, 5/16-18, stl	K880101118031Z	1
38	Washer, flat, 5/16, stl	K900201031000Z	1
39	Machine screw, rd head, 5/16 18 x 1-1/4, stl	K721501131125Z	1
40	Self tapping screw, #2 x 3/16, st stl	K741515106019Z	11
41	Nameplate (pull to close)	KP563GV	1
42	Nameplate (one-shot)	KP548GV	1
43	Nameplate (manual trip)	KP245VR	1
44	Hex nut, #8-32, stl	K880101132008Z	2
45	Split lockwasher, med, #8, stl	K900801008000Z	2
46	Heater assembly	KA188GV1	1
47	Machine screw, rd head, #8-32 x3/4,stl	K721501108075Z	2
48	Cable clip	KP2006A1	1
49	Machine screw, rd head, #10-32 x 7/8, stl	K721501110088Z	2
50	Washer, plain, #6, brass	K900225006000A	1
51	Machine screw, rd head, #6-32 x 3/8, stl	K721501106038Z	1
52	Counter assembly	KA28CO3	1
53	Nameplate (current ratings)	KP549GW	1
54	Nameplate (closed)	KP729R	1
55	Nameplate (serial number)	KP547GV	1
56	One shot handle stop	KP558GV	1

Cooper Power Systems

Quality from
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P.O. Box 1640, Waukesha, WI 53187