Sectionalizers

COOPER Power Systems

Service Information

Type GW Maintenance Instructions

S270-20-5

Serial No. 2415 and above

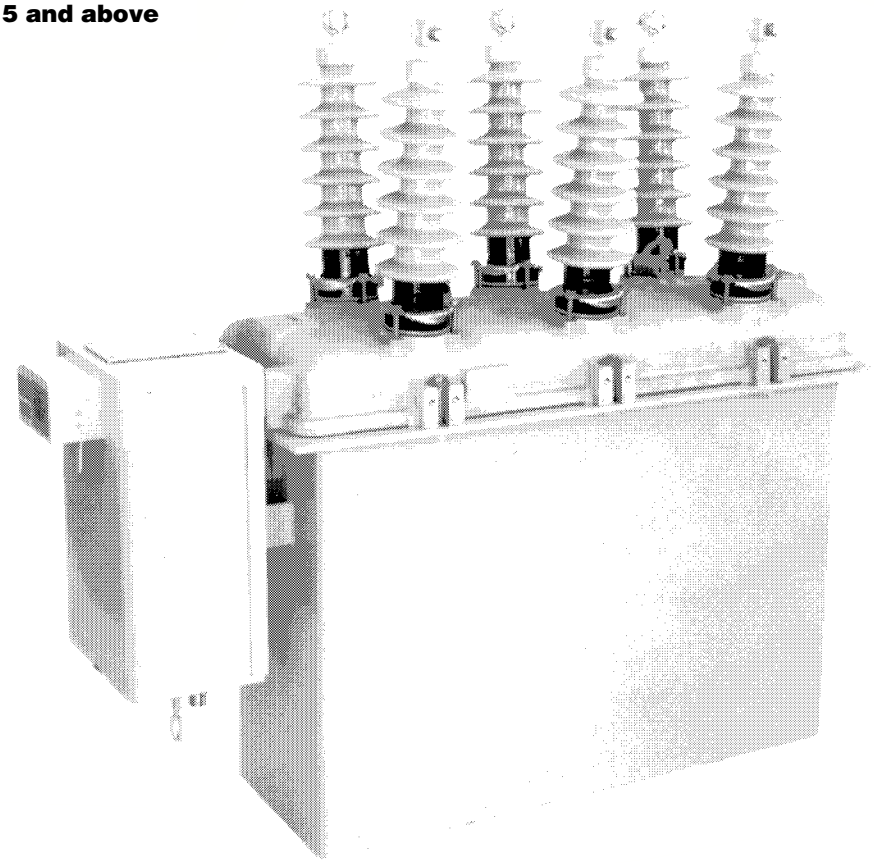

Figure 1.
Type GW sectionalizer.

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CONTENTS

SAFETY FOR LIFE

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

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

SAFETY INFORMATION

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

A competent technician has these qualifications:

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

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

Hazard Statement Definitions

This manual may contain four types of hazard statements:

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

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

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

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

Safety Instructions

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

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

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

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

WARNING: Power distribution equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install, or maintain power distribution equipment can result in death, severe personal injury, and equipment damage. G122.2

INTRODUCTION

Service Information S270-20-5 covers maintenance instructions for the Type GW 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

Operating Data

Phase-minimum-actuating current (amps)	16, 24, 40, 56, 80,112,160 224, 256, 296, 320, 448, 640, 768, 896
Ground-minimum-actuating current (amps)	3.5, 7, 16, 20, 28, 40, 56, 80, 112,160, 224, 320, 384 448, BLOCK
Number of counts to open	1, 2, 3
Count reset (seconds)	15, 30, 60, 120, 180
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

Basic Sectionalizer Ratings

Nominal voltage (kv)	34.5
Rated maximum voltage (kv)	38
Impulse withstand 1.2 x 50 microsecond wave (BIL) (kv)	150
60 hertz withstand	
Dry, 1 minute (kv)	70
Wet, 10 seconds (kv)	60
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.)	23-1/2

DESCRIPTION OF OPEATION

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.

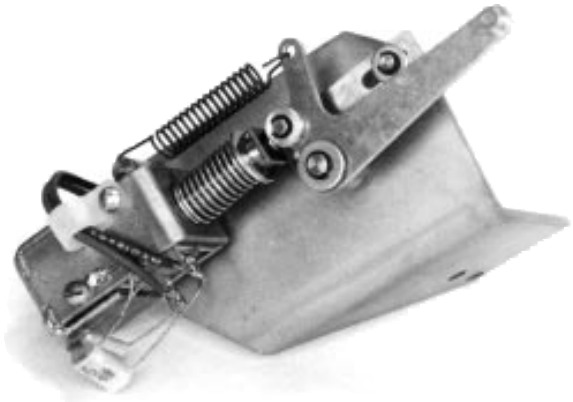

Figure 2. 87908KMA
Bi-stable actuator.

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.

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

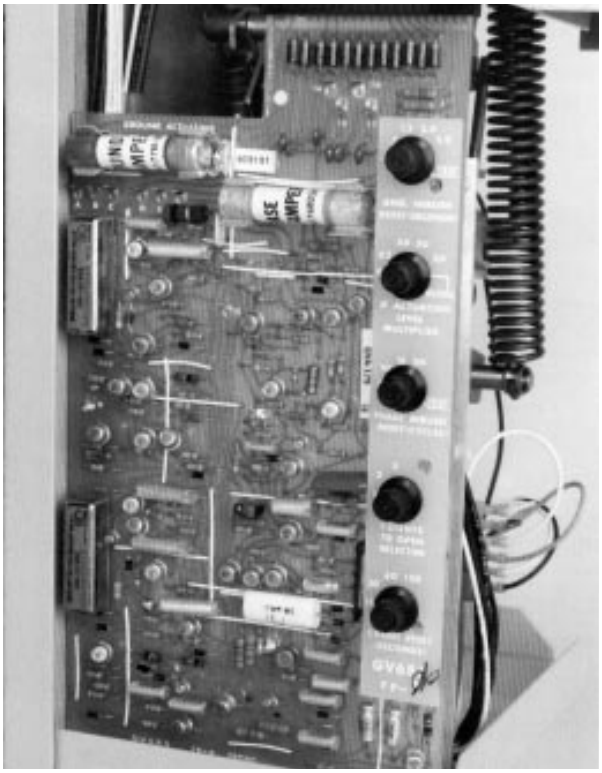

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Figure 5.
Typical connection diagram for three-wire control.

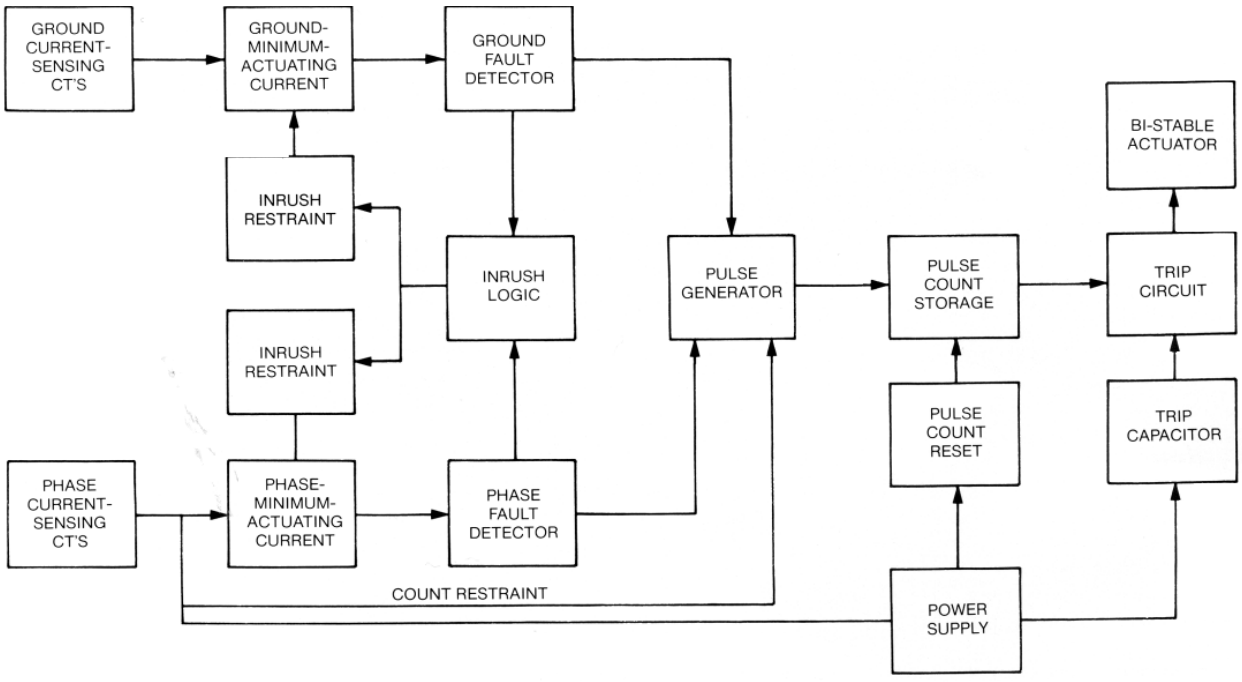


Figure 4.
Functional bolck diagram for sectionalizers.

The control is also equipped with an inrush-current restraint feature which distinguishes between inrush current and fault current bye 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 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.

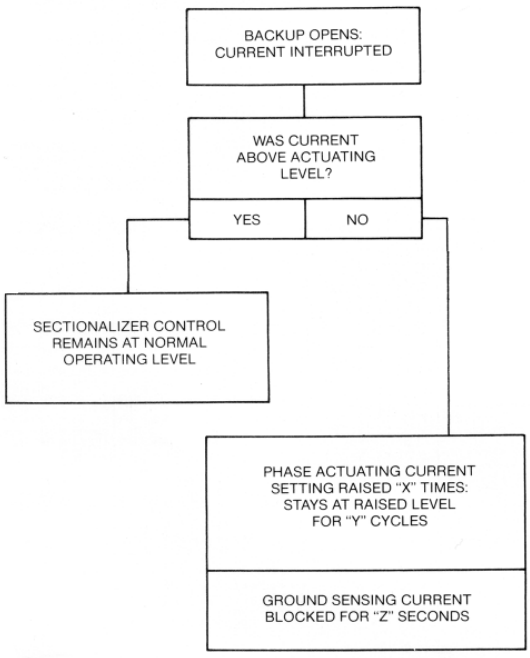


Figure 5.
Logic diagram for inrush-current restraint feature (both phase and ground currents).

ACTUATOR MECHANISM OPERTION

All three sets of moving contacts are linked to a common shaft. To describe the mechanical operation of the GW 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 opening springs are relaxed

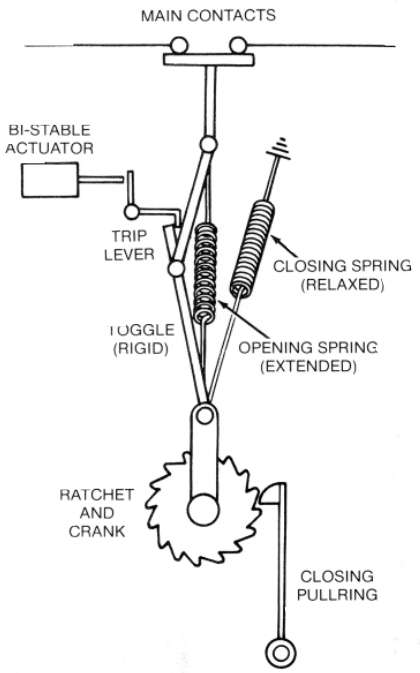


Figure 6.
Schematic diagram of actuator mechanism with contacts closed.

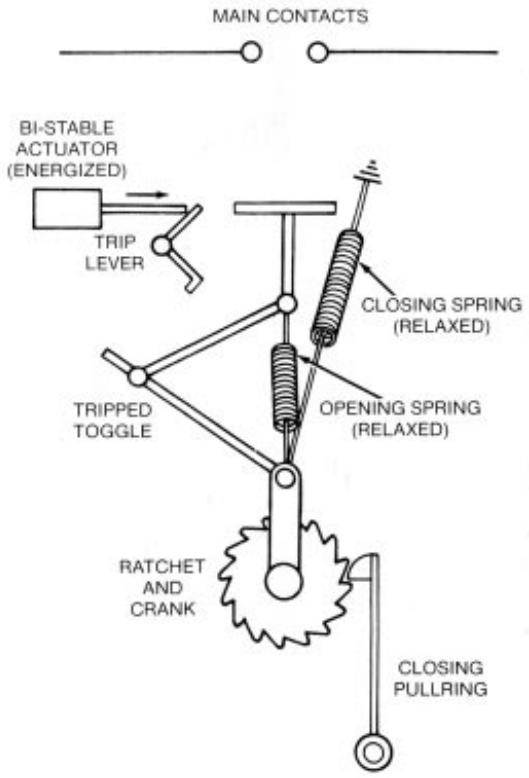


Figure 7.
Schematic diagram of trip operation.

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 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.

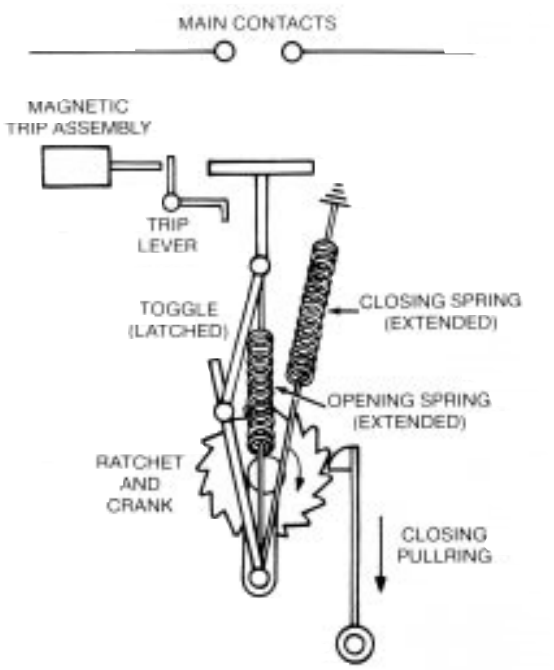


Figure 8.
Schematic diagram of closing operation.

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 regualr routine inspection and repair, can effect 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. Close and 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 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 35 55 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 52.5 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 600:5 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.

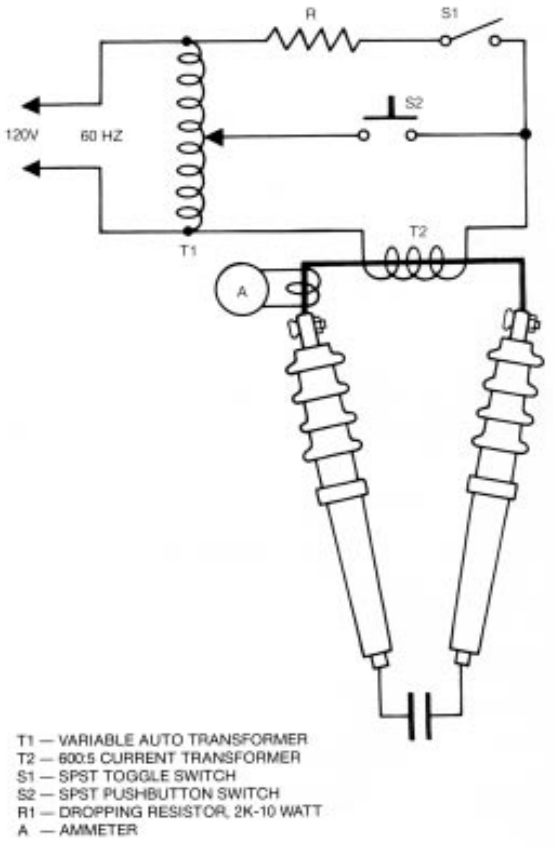


Figure 9.
Test circuit schematic.

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
768	691	845
896	806	986

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.

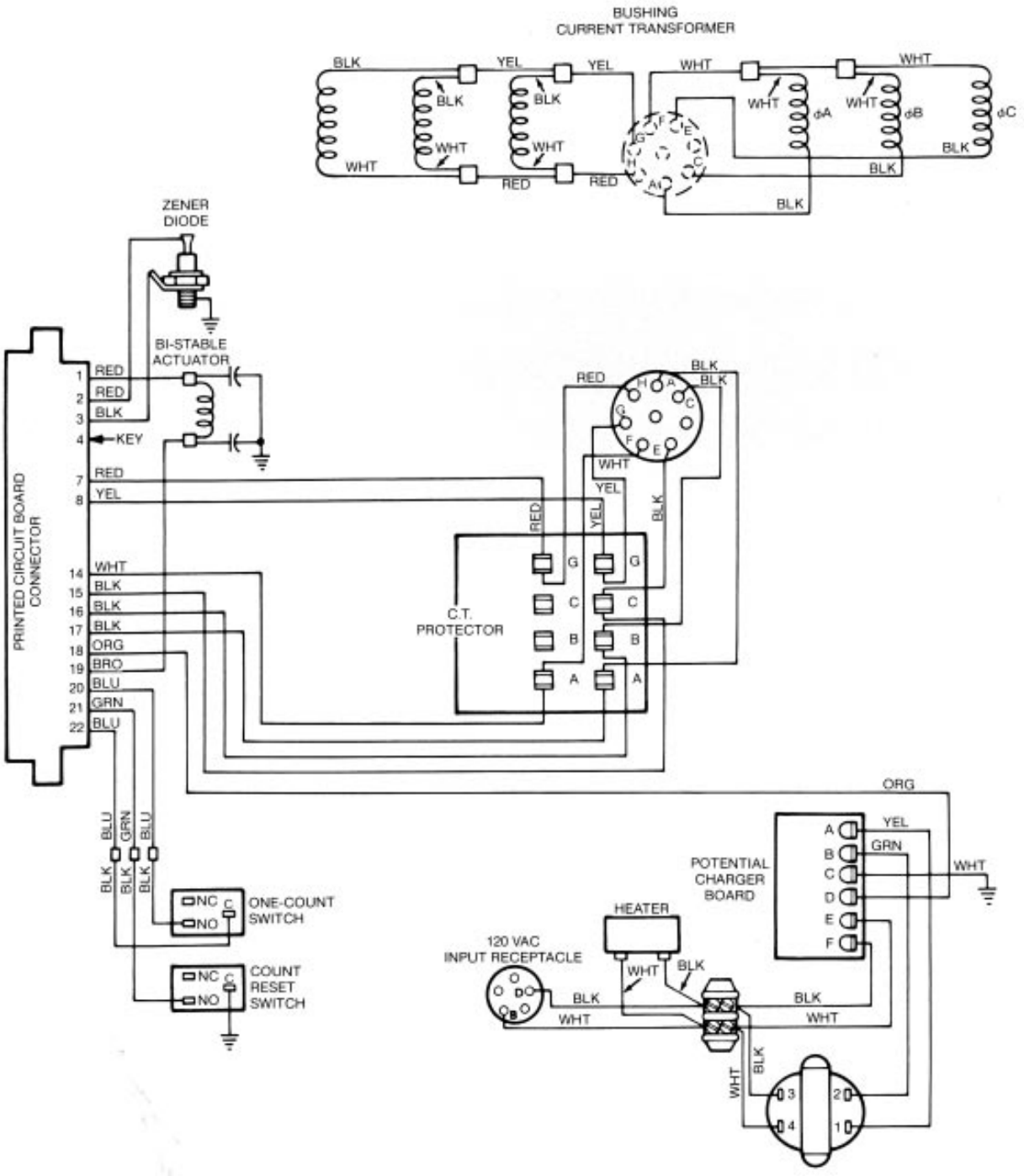
Post-Test Procedures

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.



GVA202C (R5)

Figure 10.
Type GW sectionalizer interconnection diagram.

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 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.

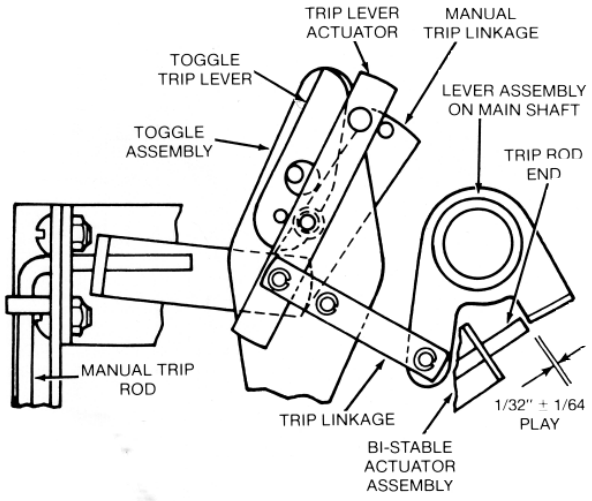


Figure 11.
Manual and electrical trip linkage.

SHOP MAINTENANCE PROCEDURES

The operations described in this section should be performed under the cleanest conditions possible. The repair work, except for bushing replacement, will be simplified if the work bench is arranged so the mechanism/head assembly can be inverted (bushings down). No special tools are required for any of the repair procedures.

Bushings

Bushing maintenance generally consists of a thorough cleaning and a careful examination for chips, cracks or other mechanical damage during the periodic maintenance inspection. Bushings must be replaced whenever damage is discovered. Refer to Figure 12 and proceed as follows:

1. Remove head-clamp bolts and untank sectionalizer.
2. Remove nut, lockwasher, and flatwasher holding the lower end of bushing rod to contact housing bracket.
3. Remove the three hex head capscrews and clamps that secure the bushing to the head and lift out.
4. Remove and discard the lower bushing gasket.
5. Twist off the split aluminum clamping ring from the old bushing and install on the new bushing, if it is in good condition—replace if damaged.
NOTE: The clamping ring cushions and distributes the pressure between the ceramic and the clamps. DO NOT OMIT.
6. Install new bushing into head, use a new lower bushing gasket.
7. Position 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 bushing to head casting. Tighten bolts evenly, a little at a time, to a torque of 10-15 ft-lbs.
NOTE: Clamping forces must be applied gradually and equally in rotation to each bolt. This results in an evenly distributed gasket sealing pressure.
10. Reconnect lead to contact housing bracket.

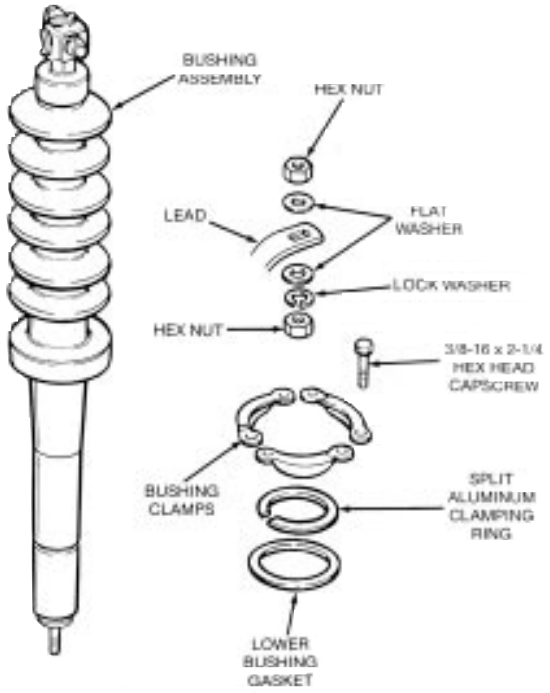


Figure 12.
Removing bushing.

Contacts

Open sectionalizer contacts and remove head mechanism from tank. Operate sectionalizer manually several times, while observing the contacts, to make sure contacts mate properly; leave in open position.

The contacts used in the Type GW sectionalizer are self-cleaning through the wiping action of the contacts. When erosion has spread to the load-current transfer surfaces of the moving contacts the entire contact assembly must be replaced. Use the following procedure for contact inspection and replacement, as required.

CONTACT INSPECTION

The movable contact yoke assembly must be removed for contact inspection, refer to Figure 13.

1. Remove stop nut and washer.
2. Carefully drive out roll pin.
3. Note arrangement of flat washers above and below the movable contact yoke, they must be replaced in the exact same order.

Figure 13. 88918KMA
Contact arrangement.

4. Remove contact yoke assembly and inspect (Figure 14).
   - Arcing tips of the moving contacts can experience considerable erosion before replacement is necessary. Slight pitting and discoloration can be dressed with crocus cloth.
   - If one-half or more of the contact load surface is worn away the complete contact assembly (movable and stationary contacts) must be replaced. Refer to Stationary Contact Assembly section of these instructions for stationary contact replacement instructions.
5. Install washers, as removed, and movable contact yoke assembly.
6. Install elastic stop nut and carefully tighten, do not over tighten.

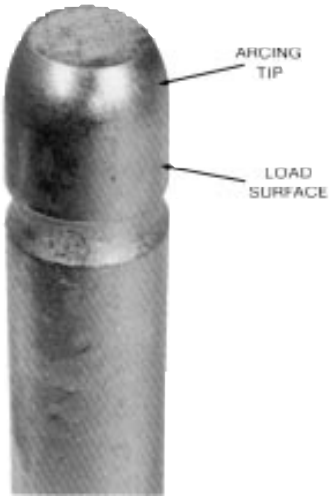


Figure 14. 88919KMA
Movable contact.

STATIONARY CONTACT ASSEMBLY

To replace the stationary contact assembly:

1. Remove movable contact yoke assembly, refer to Contact Inspection section of these instructions for removal procedure.
2. Remove the lower bushing nuts securing stationary contact assembly to bushing assemblies (Figure 13).
3. Lift contact assembly off bushings.
4. Operate actuator mechanism until it is in the switch-closed position.
5. Place the new stationary contact assembly on the upper bushing washers. Loosely install lower flat washer, lockwasher and lower bushing nuts.
6. Install the new movable contact yoke assembly, refer to Contact Inspection section for installation procedure.
7. Adjust upper bushing nuts to provide 1/32" (.8 mm) clearance between moving contact assembly and contact tubes, refer to Figure 15.

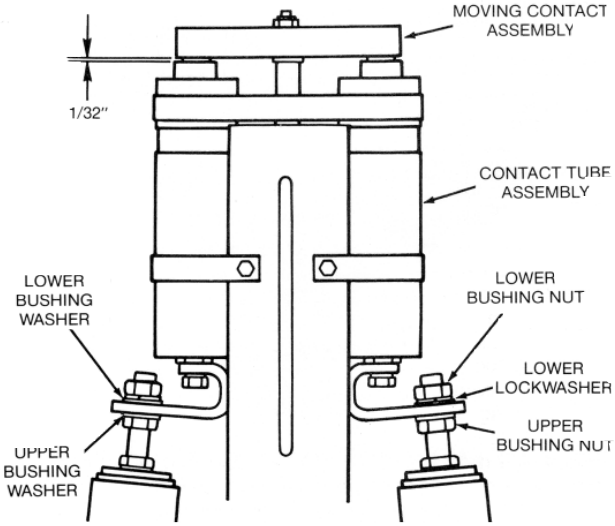


Figure 15.
Moving contact clearance.

8. Square contact housing with head casting bottom as shown in Figure 16.
9. Recheck moving contact assembly for proper clearance (refer to Figure 15).
10. Tighten lower bushing nuts to secure stationary contact assembly.
11. Refer to Contact Alignment section of these instructions for proper adjustment of contacts.

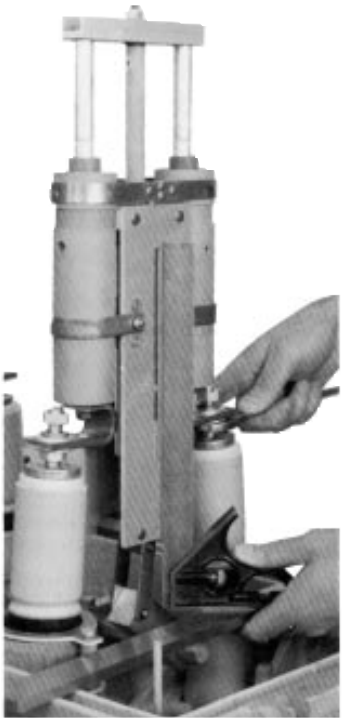


Figure 16. 88920KMA
Squaring contact housing.

CONTACT ROD

To replace the contact rod:

1. With the switch mechanism removed from the tank, remove moving contact assembly, refer to Contact Inspection section for removal instructions.
2. Remove lower bushing nuts, lockwasher and flat washer securing stationary contact assembly, Figure 13.
3. Lift contact assembly off bushings.
4. Remove C-ring and pin securing contact rod to shaft lever (Figure 17).
5. Attach new contact rod to shaft lever with pin and C-ring removed (Figure 17).
6. Place contact assembly over contact rod and onto upper bushing washers. Loosely install lower flat washer, lockwasher and jam nut.
7. Install movable contact yoke assembly, refer to Contact Inspection section for installation instructions.
8. Adjust upper bushing nuts to provide 1/32" (.8 mm) clearance between moving contact assembly and contact tubes, refer to Figure 15.
9. Square contact housing with head casting bottom as shown in Figure 16.

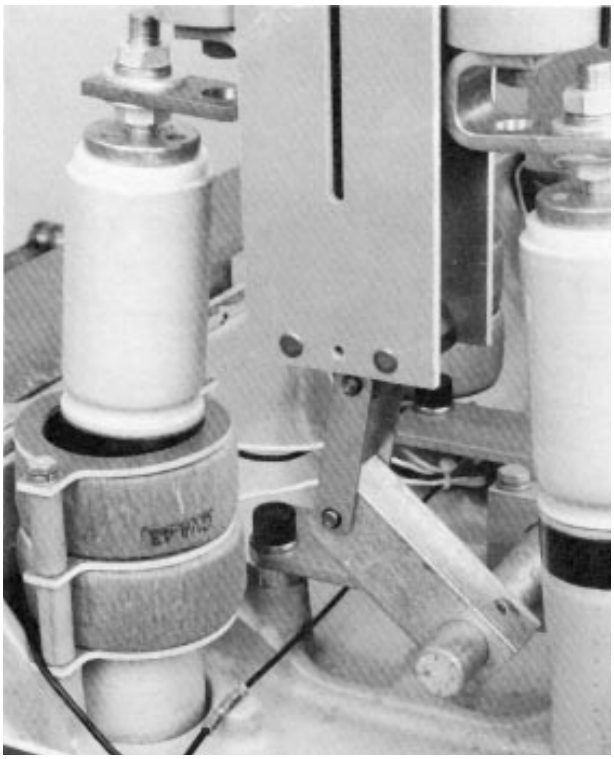


Figure 17. 88921KMA
Contact rod linkage.

10. Recheck contact assembly for proper clearance (refer to Figure 15).
11. Tighten lower bushing nuts to secure stationary contact assembly.
12. Refer to Contact Alignment section of these instructions for proper adjustment of contacts.

CONTACT ALIGNMENT

1. Make sure the clearance between the moving contact assembly and the stationary contact tubes is 1/32 in. with the contacts full closed (Figure 15).
   A. To obtain the 1/32 in. clearance, adjust the stationary contact assembly at the upper bushing nuts.
2. With the contacts fully open, check to make sure that the contact rod piston does not bottom in the stationary contact assembly dashpot.
   A. To prevent bottoming, set the stop bolt, inside the operating housing, (Figure 18) so that the slotted side plates of

Figure 18. 889228MA
Setting stop bolt.

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 19.

(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.

3. Retank the sectionalizer.

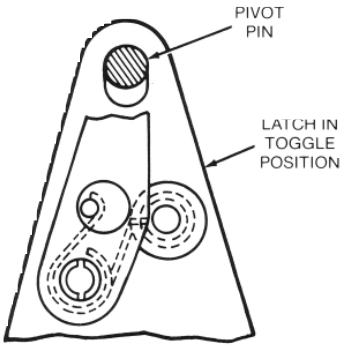


Figure 19.
Proper stop bolt adjustment.

Current Transformers

Type GW sectionalizers are equipped with six 1000:1 current sensing transformers. Two are installed over the shank of each source side 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:

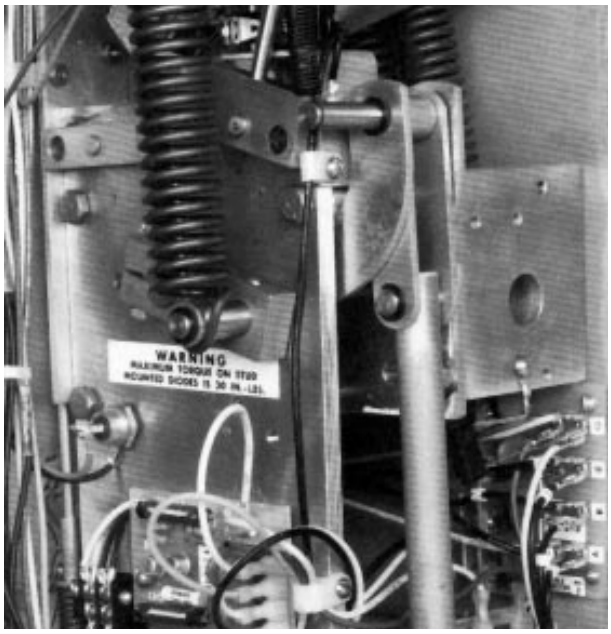


Figure 20.
CT protection board.

87910KMA

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 sectionalizer.

2. Connect a 100 ampere ac 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 black lead and white CT lead.

4. Energize 100 ampere source and observe the millammeter. The meter should record 100 ma ±10%. Deenergize source and reconnect 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 source and reconnect leads.

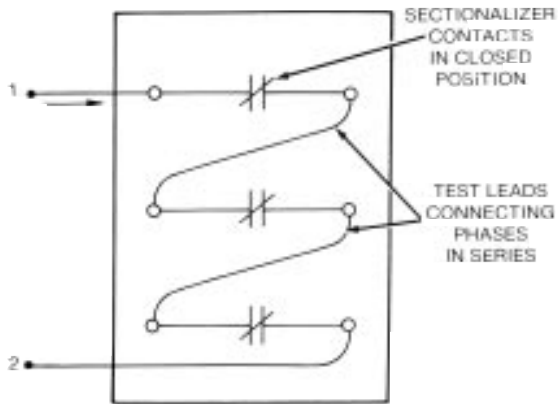


Figure 21.
Test circuit for checking bushing current transformers.

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. Unplug wire harness from control printed circuit board assembly.
2. Slowly increase the voltage on the variable transformer while observing the voltage between the 1000:1 CT leads.
3. 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.
4. Disconnect input power and reconnect to test phase B, phase C and ground.
5. Reconnect wire harness onto control printed circuit board assembly.

SERVICE PARTS LIST

When ordering service parts, always include the sectionalizer type and serial number. Because of McGraw-Edison's 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.

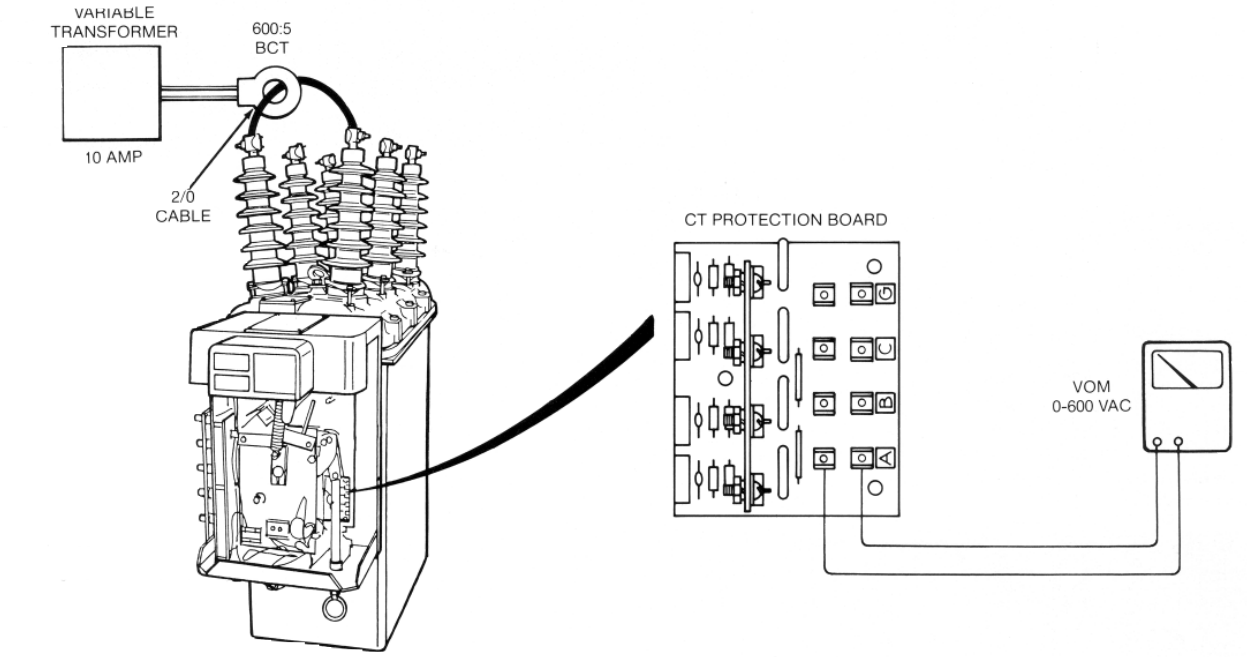


Figure 22.
Testing CT protection circuit.

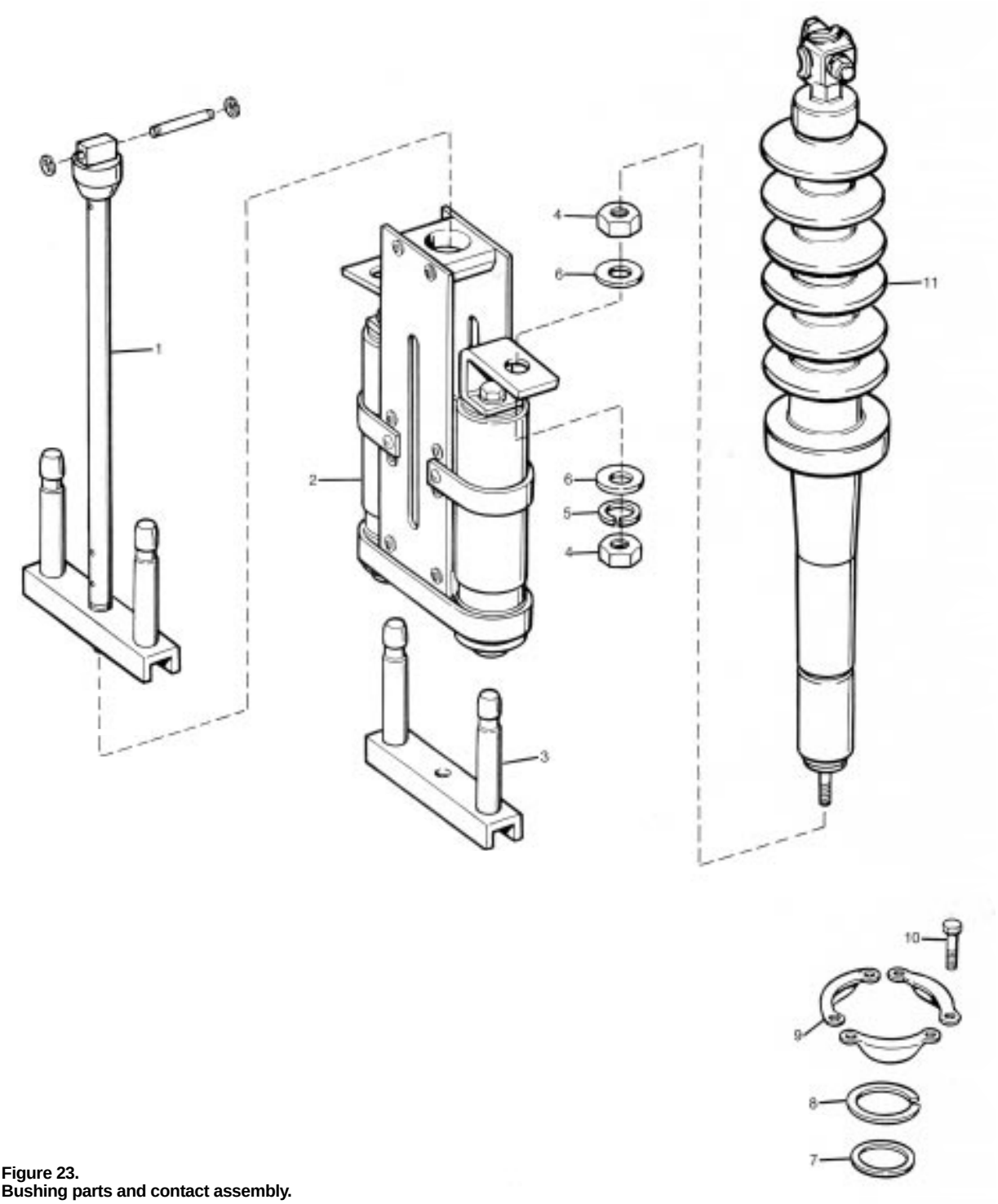


Figure 23.
Bushing parts and contact assembly.

Bushings and Contacts (Figure 23)

Item No.	Description	Catalog Number	Qty per Assy.
1	Contact rod assembly (includes item 3)	KA104GW	3
2	Stationary contact assembly	KA107GW	3
3	Movable contact assembly	KA102GW1	3
4	Jam nut, hex, 1/2-20, brass	K880625120050H	12
5	Split lockwasher, 1/2, med bronze	K900830050000A	6
6	Washer, 9/16, brass	K900225056125H	12

Item No.	Description	Catabg Number	Qty. per Assy.
7	Gasket	KP11 93RA	6
8	Clamping ring	KP1111R	6
9	Bushing clamp	KP1109R900	18
10	Capscrew, hex hd, 3/8-16 x 2-1/4, stl	K730101137225Q	18
11	Bushing assembly		
	Standard bushing	KA56RV1	6
	Standard bushing with BCT	KA56RV2	6

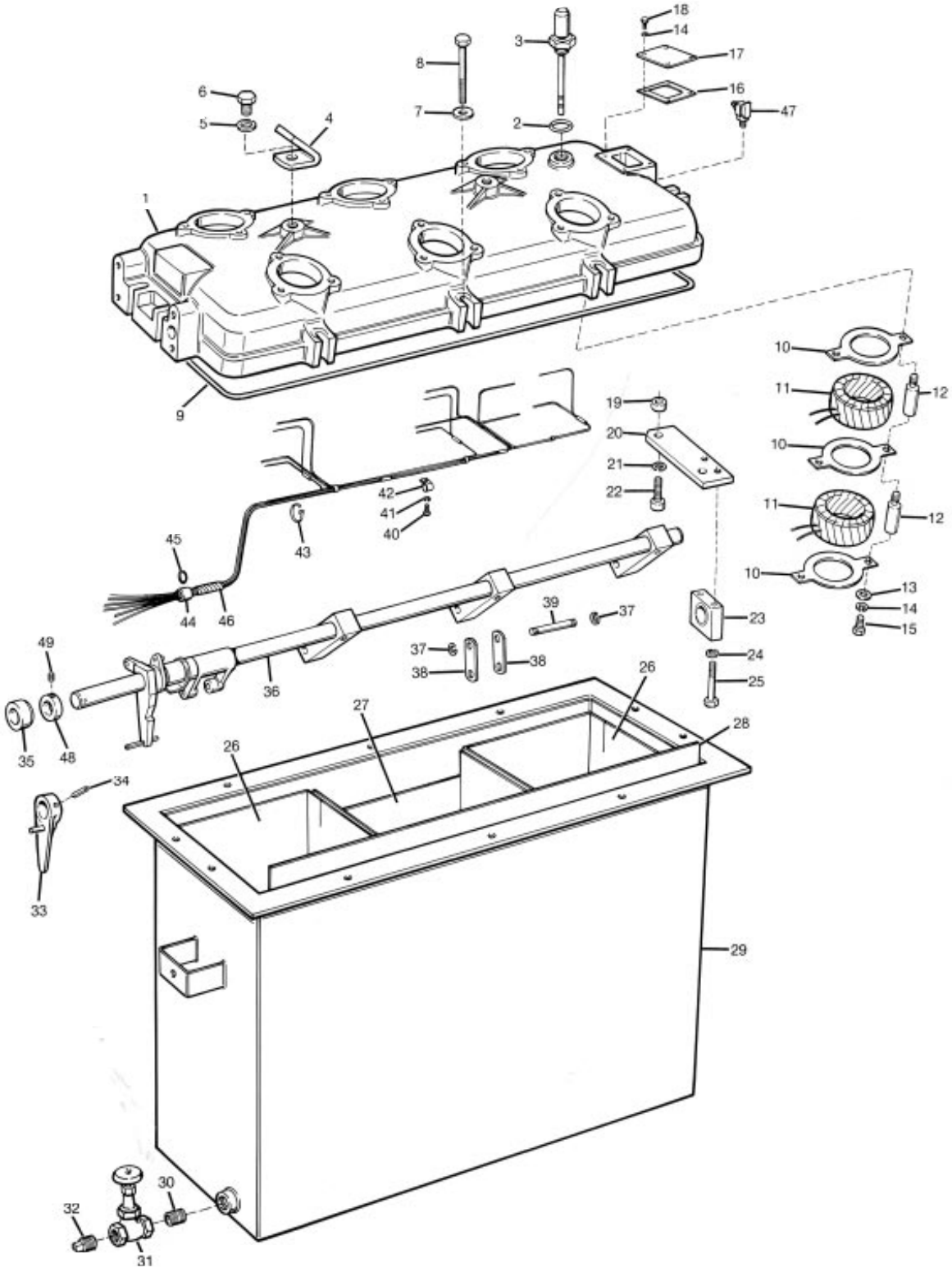


Figure 24.
Head and tank assemblies.

Head and Tank Assemblies (Figure 24)

Item No.	Description	Catalog Number	Qty per Assy.
1	Head assembly	KP504GW2	1
2	O-ring	KP2000A9	1
3	Plug and gauge assembly	KA118GW	1
4	Lifting lug	KP456H2	2
5	Lockwasher, med, 5/8, stl	K900801062000Z	2
6	Capscrew, hex head, 5/8-11 x 1-1/2, stl	K730101162150Q	2
7	Washer	KP2028A23	10
8	Capscrew, hex head, 1/2-13 x 3-1 /4, stl	K732401150325Q	10
9	Gasket	KP2103A8	1
10	Support	KP145RE	9
11	Current transformer assembly	KA43GV	6
12	Spacer	KP3009A88	12
13	Washer, #14, brass	K900525026056A	6
14	Lockwasher, 1/4, med, stl	K900801025000Z	10
15	Capscrew, hex head, 1/4 20 x 4, stl	K730101125400Y	6
16	Gasket	KP611R	1
17	Cover plate	KP609R	1
18	Capscrew, hex head, 1/4-20 x 5/8, stl	K730101125062Z	4
19	Spacer	KP3017A18	6
20	Bearing plate	KP502GW	1
21	Lockwasher, 1/2, med, stl	K900801050000Z	6
22	Capscrew, socket head, 1/2-13 x 1-1/2, stl	KP2036A11	6
23	Bearing	KP88VR	3
24	Lockwasher, 5/16, med, stl	K900801031000Z	6
25	Capscrew, hex head, 5/16-13 x 2, stl	K730101131200Y	6
26	Tank liner	KP52SGW	2
27	Tank liner	KP524GW	1
28	Tank liner support	KP22SW	2
29	Tank assembly	KA18GW	1
30	Pipe nipple	KP2039A1	1
31	Valve	KP2038A1	1
32	Pipe plug	KP2007A3	1
33	Position indicator assembly	KA19VR	1
34	Roll pin, 3/16 x 1-1/8	K970801188113Z	1
35	Bushing	KP3106A9	1
36	Lever and shaft assembly (includes items 32 and 33)	KA103GW	1
37	Retaining ring, WA514, 1/4, stl	K97091250000A	12
38	Link	KP510GW	6
39	Pin	KP3124A69	6
40	Machine screw, rd hd, #8-32 x 3/8, stl	K721501108037Z	3
41	Lockwasher, #8, med, stl	K900801008000Z	3
42	Cable clamp	KP2006A1	2
	Cable clamp	KP2006A8	1
43	Wire retainer	K994904170003A	3
44	Connector assembly	KA201GV	1
45	O-ring	KP2000A6	1
46	Spirap, 1-1/2”	KP2072A1	1
47	Ground connector	KP392RA	1
48	Collar	KP138VLM	1
49	Screw, hex set, 1 /4-20 x 3/8	K762315125037A	1

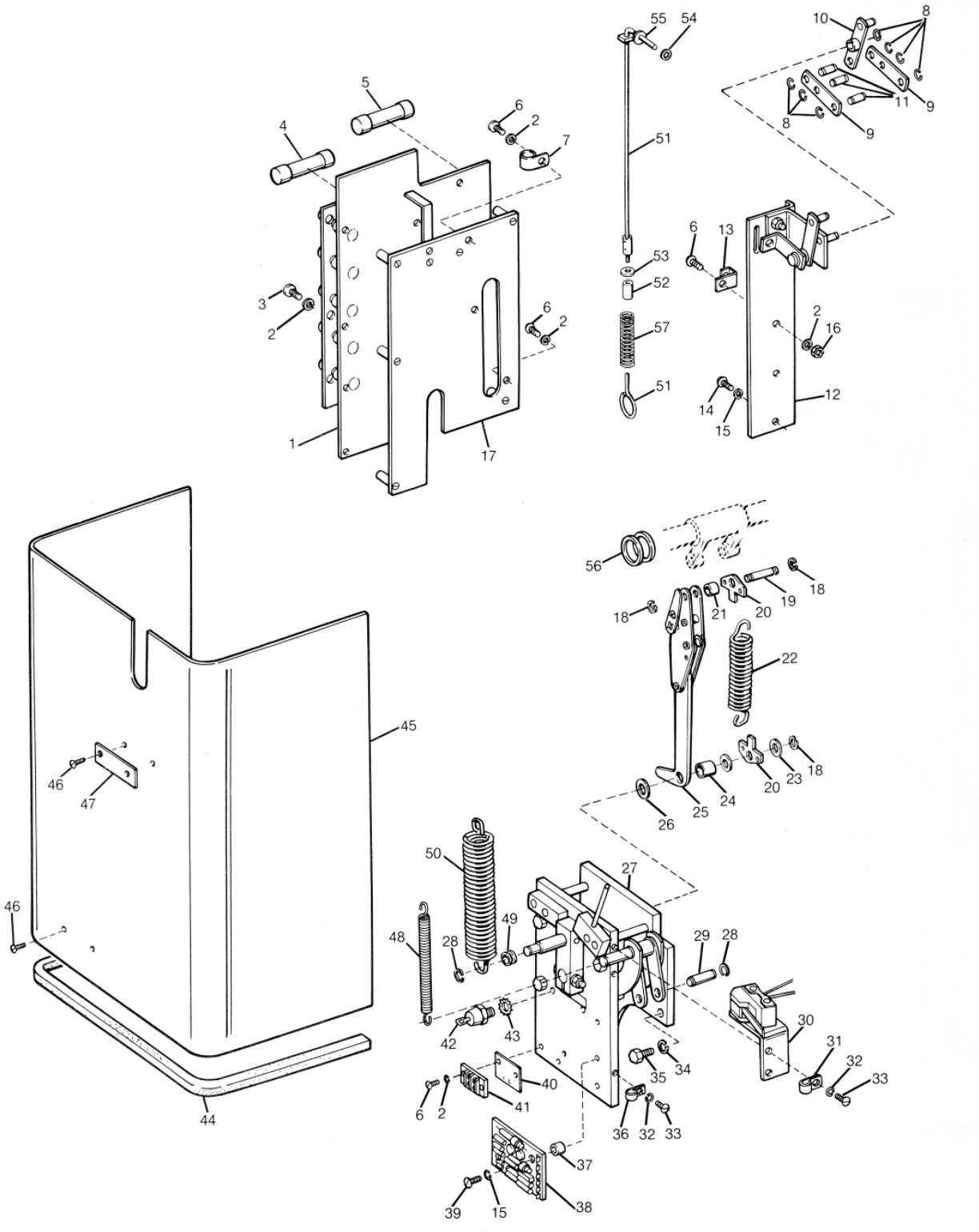


Figure 25a.
Operating mechanism.

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 x 3/8, stl	K7215011008038Z	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, stl	K7215011006050Z	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	1
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, #200, brass	K900225020000A	1
24	Spacer	KP3011 A6	1
25	Toggle assembly	KA11VR1	1
26	Washer, 1/2, brass	K900225050000A	1

Item No.	Description	Catalog Number	Qty 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, ;d 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	KP2101A2O1	1
41	Terminal strip	KP2101A1	1
42	Zener diode	KP4012A39	1
43	Lockwasher, external tooth, 1/4	K901132025000A	1
44	Gasket	KP2084A1	1
4S	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	KP3007A18	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

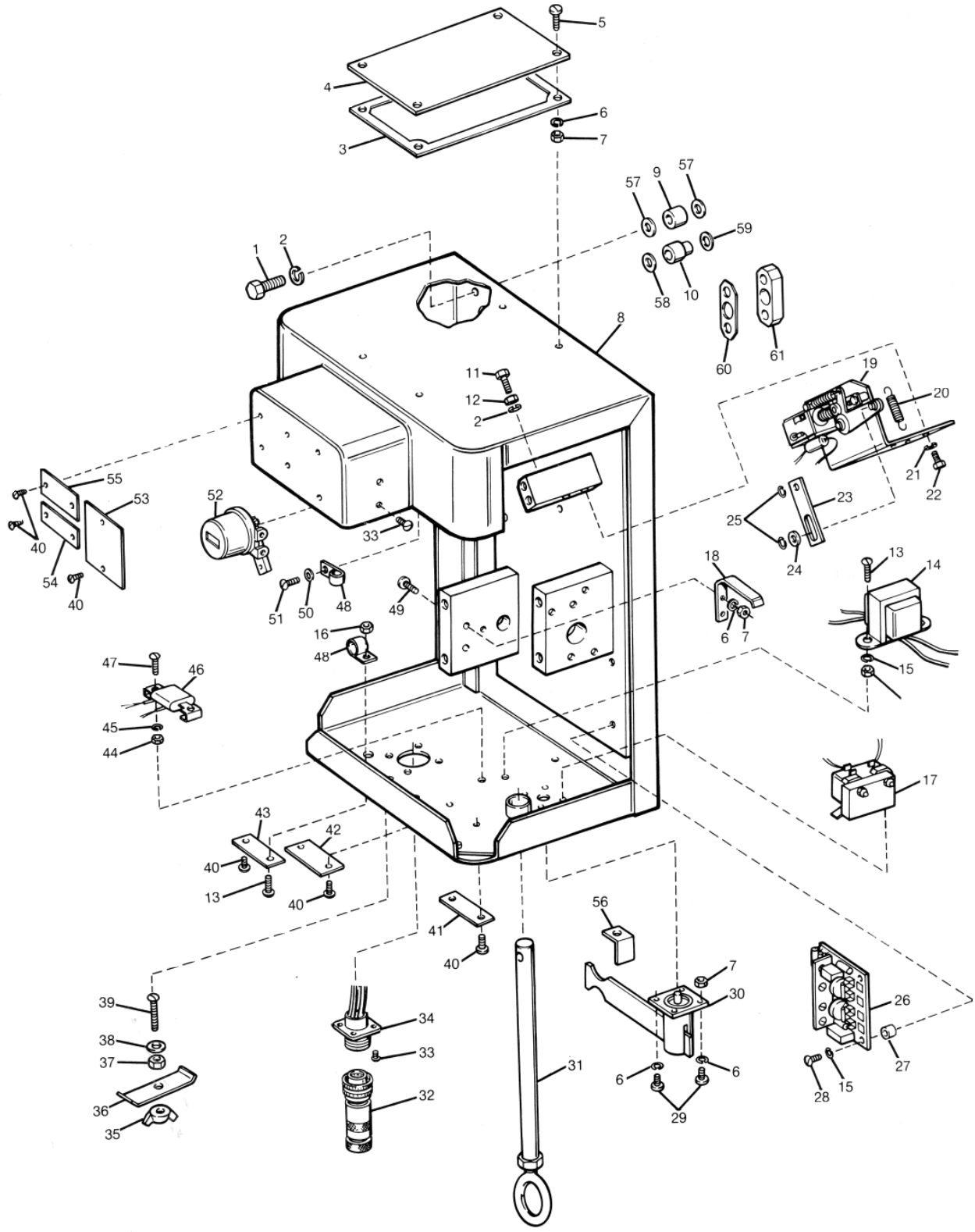


Figure 25b.
Operating Mechanism.

Operating Mechanism (Figure 25b)

Item No.	Description	Catalog Number	Qty per Assy.
1	Capscrew, hex head, 3/8-16 x 2, stl	K732401138200Q	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	K72151531OO75A	4
6	Split lockwasher, #10, med, stl	K900701010000Z	8
7	Hex nut, #10-32, stl	K880101332010Z	8
8	Mechanism housing assembly	KA230VR5	1
9	Spacer	KP3015A25	2
10	Bushing	KP3046A6	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 Micro-switch only	KA195GV KP172E1	1 1
18	Spring	KP72VR	1
19	Magnetic trip assembly	KA179GV	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
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	KA48GR	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, mea, #8, stl	K900801008000Z	2
46	Heater assembly	KA188GV1	1
47	Machine screw, rd head, #8-32 x 3/4, stl	K721501108075Z	2
48	Cable clip	KP2006A1	1
49	Machine screw, rd head, #10-32 x7/8,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	KA28CO3S	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
57	Gasket	KP2090A54	4
58	Gasket	KP2090A53	1
59	Gasket	KP2090AS2	1
60	Gasket	KP521GW	2
61	Spacer	KP520GW1	1

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