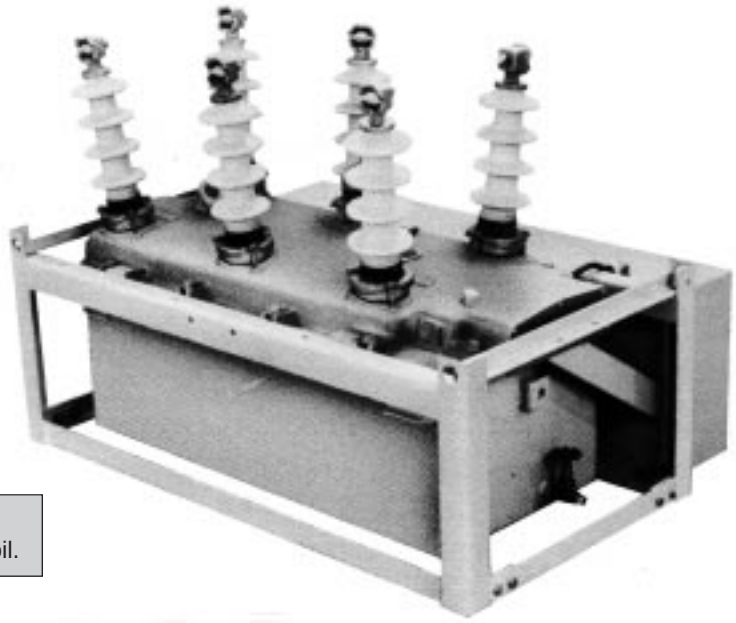
# Oil-and Vacuum-Break Switches

COOPER Power Systems

Service Information

## Type F; Three-Phase; Vacuum Load Break Switch Maintenance Instructions

S260-50-2



**WARNING**
Do not energize this equipment out of oil.

**Figure 1.**
**Type F vacuum load break switch.**

83392KMA

## CONTENTS



## INTRODUCTION

*Service Information S260-50-2* provides maintenance instructions for Type F three-phase, vacuum load break switches. Included is a general description of the switch and control, and their operation. A service parts list, keyed to exploded-view drawings of the switch is included at the back of the manual.

## DESCRIPTION

The Type F switch operates on distribution systems through 38 kV with continuous loads up to 600 amps. Oil-insulated vacuum interrupters provide minimum size and maintenance, making it ideally suited for pole-mounted applications. An integral stored-energy operator allows the switch to operate even if power is lost, and a fault-sensing and indicating accessory can provide indication of faults to the supervisory control.

Then when commanded, the interrupter contacts can be remote-electrically tripped or closed. Since all moving parts are completely enclosed, installation location and switch application is seldom a problem.

A complete F switch package consists of the switch which interrupts the circuit, a switch control which provides on-site-ground level and remote operation of the switch and indication of faults to the supervisory control (when equipped with the fault indicating accessory), and an interconnecting control cable set.

### F Switch

The Type F load break switch stored-energy operator provides switching response when commanded even if operating power to the switch is lost. Energy for multiple opening/closing operations is stored in a spring mechanism, permitting a number of switching operations before recharging is needed. This feature enhances switch application on systems employing supervisory controls, on systems using remote switching, or on systems where source position may reverse. Operations available after loss of motor power are O-C-O-C-O (starting in closed position) and C-O-C-O (starting in open position).

The release of the charged opening/closing spring provides the force required to open or close the three sets of vacuum interrupter contacts. A motor-operated mechanism—powered from an external 120-Vac supply—recharges the spring immediately after an opening or closing action. If power to the motor is lost, recharging can be done manually by using the pullring on the underside of the switch housing or by waiting until power is restored. The switch cabinet—housing the operator springs, spring charging motor, auxiliary switch, etc.—is protected against temperature and humidity by a 30 watt heater.

Interruption takes place within vacuum interrupters. The horizontal mounting configuration of the vacuum interrupters within the F switch tank also provides a compact package that is easily handled and installed.

The Type F switch can be operated from the bottom of the switch housing. A pullring to charge the operating spring, a pullring to open/close the vacuum contacts (with indicator flags indicating if contacts are OPEN or CLOSED), and a disabling handle that locks the interrupter contacts in the open position are provided. These controls can be operated by hand or hookstick to manually initiate an operating sequence.

### F Switch Control

The cable-connected Type F switch control provides on-site-ground level and remote operation (with or without the fault-indicator accessory). This control is mounted in a cabinet and provides commands to the switch to electrically open or close the interrupter contacts. A sealed, nickel-cadmium 24-volt battery supplies the power to the F switch trip/close coil—releasing the charged springs which open/close the interrupter contacts. A 120-Vac potential charger built into the control circuitry provides a constant trickle charge to the battery. In addition, a standard 25-watt thermostatically controlled heater provides thermal protection and humidity control (turning on at temperatures below 85° F and turning off at temperatures above 100°F). The heater is energized from the 120-Vac auxiliary power input. Indicator lights are provided to check contact position. For safety, the remote control ON-OFF switch can block automated-supervisory control commands.

In addition, terminals are provided for battery testing. For remote contact indication, a two-stage auxiliary switch (two A and two B contacts) is provided. Customer connections are made to the auxiliary switch contact terminals in the switch control which is cable-connected to the Type F switch.

## DUTY CYCLE

| | |
|---|---|
| Electrical | 2500 Operations at 600 Amps |
| Mechanical | 2500 Operations |

## TESTING

Procedures for testing the Type F switch are included in the Installation Manual S280-50-1.

## MAINTENANCE

### Frequency of Maintenance

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

- When Type F switches are operated under usual service conditions as defined in ANSI (American National Standards Institute) C37.60, “Standard Requirements for Automatic Circuit Reclosers for Alternating Current Systems,” it is recommended that the following maintenance procedures be performed at the completion of an equivalent duty cycle.
- However, if the switch has not completed an equivalent duty cycle within *three* years, it is recommended that an external inspection, oil-level check, and a check of the dielectric strength of the oil be made at that time. (See steps 1, 2, and 8 of “Maintenance Procedure” below.)

The bellows used on interrupter moving contact rods have a mechanical life expectancy of 7000 operations. Interrupters must be replaced when 7000 operations have been accumulated.

**CAUTION**
After 7000 operations bellows may develop leaks due to mechanical wear. If a leak develops the interrupter may be unable to clear load current.

### Periodic Maintenance Inspection

Each periodic maintenance inspection done at the completion of an equivalent duty cycle, should include:

1. Bypass and remove the switch from service.
2. Inspect external components.
   A. Check for broken or cracked bushings. Replace as necessary.
   B. Check for scratched paint, repaint as needed.
   C. Note counter reading and enter in the record log.
3. Perform an insulation level withstand test (see page 3 for procedure).
4. Raise head mechanism assembly from tank to expose internal components.
5. Clean all internal components.

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

**6.** Check the contact erosion of the vacuum interrupters.
A. Locate the scribe mark on the moving contact rod.
B. If the scribe falls below the edge of the phenolic guide when the interrupter is closed, the interrupter has reached the end of its useful life and must be replaced.
**7.** Check circuit components attached to the switch head, frame and operating mechanism.
A. Check condition of wiring to terminal strips and make sure all connections are tight.
B. Check condition of all microswitches and trip solenoid.
C. Check condition of the bushing current transformers and the associated wiring.
D. Check the control cable receptacles.
**8.** Check the dielectric strength of the insulating oil.
A. An oil sample taken near the bottom of the tank should have a dielectric strength of not less than 22 kv rms.
B. Low dielectric strength indicates the presence of water or other pollutants. Replace oil as necessary.
**9.** If oil must be replaced:
A. Drain the tank and clean.
B. Fill with new, clean, insulating oil up to the oil level mark on tank. Tank capacity is approximately 35 U.S. gallons. See Oil Condition section below.
**10.** Replace head gasket.
**11.** Clean the head gasket seat and retank the switch. Replace the head bolts and tighten to 35-55 ft-lbs. torque. Apply clamping force gradually and equally, in rotation, to each bolt to achieve an evenly distributed gasket sealing pressure.
**12.** Check the oil level with the dipstick in the head and adjust level to the upper line on dipstick.
**13.** Repeat the high voltage dielectric withstand test (Step 3) to make sure the dielectric clearances within the tank have not been compromised.

## 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 switch should be filled with new oil, or oil that has been restored to like-new condition. Oil used in switches 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 switch. Testing is performed at 75% of the rated low-frequency withstand voltage.

| Switch Type | BIL (Kv) | Test Voltage (Kv) |
|---|---|---|
| 15 Kv | 110 | 37.5 |
| 27 Kv | 125 | 45 |
| 29 Kv | 125 | 45 |
| 38 Kv | 150 | 52.5 |

TEST 1: Proceed as follows:
**1.** Manually close switch.
**2.** Ground 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 switch should withstand the test voltage for 60 seconds.
TEST 2: Proceed as follows:
**1.** Manually close switch.
**2.** Ground tank and head.
**3.** Ground Phase A (bushing 2) and Phase C (bushing 6).
**4.** Apply proper test voltage to Phase B (bushing 3).
**5.** The switch should withstand the test voltage for 60 seconds.
TEST 3: Proceed as follows:
**1.** Manually open switch.
**2.** Ground 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 switch 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 switch should withstand the test voltage for 60 seconds. TEST RESULTS: These high potential withstand tests provide information on the dielectric condition of the switch and the integrity of the interrupters.
A. If the switch passes the closed-contacts test (Tests 1 and 2) but fails the open-contacts test (Test 3) a deterioration of one or more of the interrupters is likely to be the cause. Check each interrupter individually to determine the failed phase or phases, and replace the interrupter(s). Retest to confirm the repair.
B. If the switch fails the closed-contacts tests (Test 1 and 2) the cause is likely to be a diminished electrical clearances, low oil dielectric strength or failed insulation. After correcting the problem, retest to confirm the repair.

# SHOP MAINTENANCE 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.

### 15 Kv BUSHINGS

A damaged bushing can be replaced with the switch either tanked or untanked, depending upon the circumstance of the damage.

If the bushing porcelain is damaged during handling or installation of a switch, and it is obvious that no other damage was done, the damaged porcelain can be replaced without untanking the unit.

If a bushing was damaged while the switch was in service or storage, the switch must be untanked and inspected to ensure that no water or other contamination has entered the tank. The dielectric strength of the oil must be checked. And the bushing lead must be checked for damage (either mechanical or electrical flashover).

### REPLACING THE BUSHING PORCELAIN WITH THE SWITCH TANKED

Refer to Figure 2 and proceed as follows:
**1.** Unscrew the bushing terminal and discard gasket.
**2.** Remove three hex head capscrews and clamps. Carefully lift out old porcelain.
**3.** Remove and discard lower gasket.
**4.** Twist off the split aluminum clamping ring from the old porcelain. If it is in good condition, it can be reused on the new porcelain; replace if damaged.

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

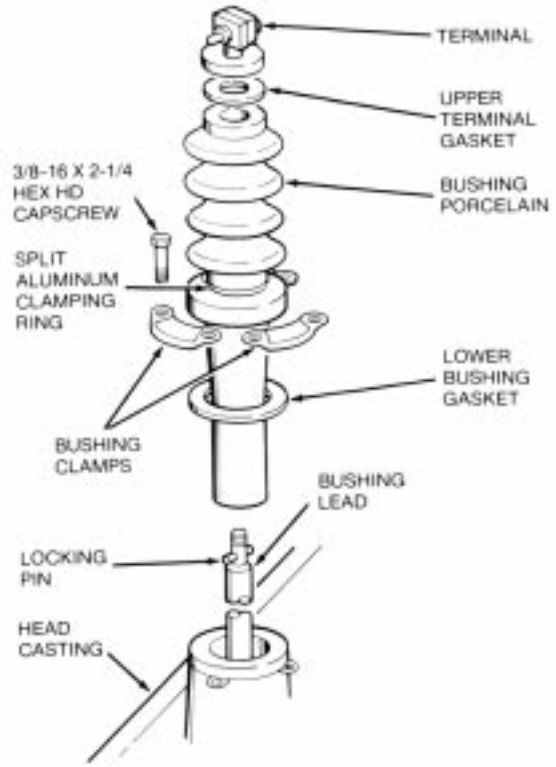



**Figure 2.**
**Removing bushing.**

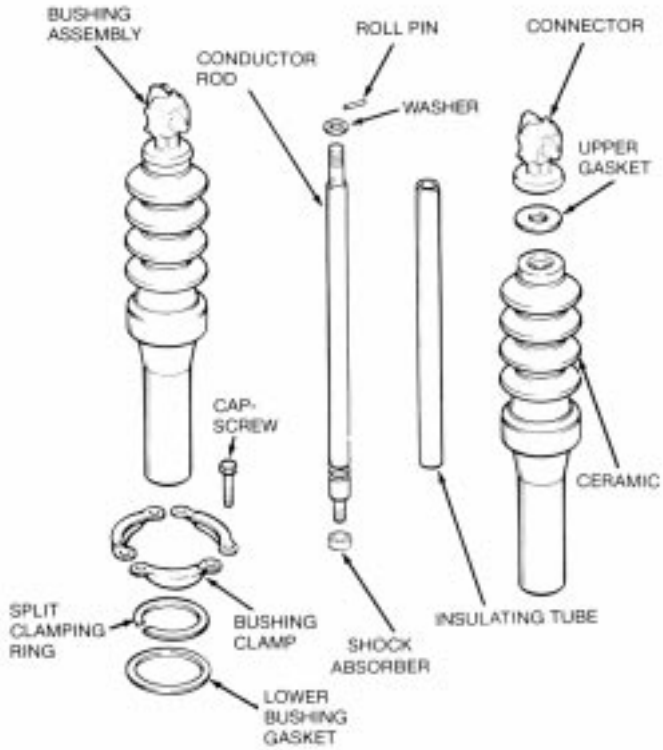



**Figure 3.**
**Bushing parts.**

**5.** Using a new lower gasket, install new porcelain over the bushing rod and into head. Make sure roll pin on end of rod is seated into locking groove at top of porcelain.
**6.** Position clamping ring with split centered between two clamping screws.
**7.** Position clamps around bushing; apply anti-seize to threads of capscrews and loosely install. Tighten capscrews evenly, a little at a time, to 10-15 ft-lbs. torque.

NOTE: Clamping force must be applied gradually and equally in rotation to each screw. This provides an evenly distributed gasket sealing pressure.

**8.** Install a new terminal gasket. Apply a very small amount of petroleum jelly to the knurled surface on the inside face of the terminal. Thread terminal onto bushing rod and tighten to 35 ft-lbs. torque.

**REPLACING THE BUSHING WITH THE SWITCH UNTANKED**

Refer to Figure 3 and proceed as follows:

**1.** Disconnect bushing lead from bushing rod.
**2.** Remove three hex head capscrews and clamps. Carefully lift out bushing assembly.
**3.** Remove and discard lower gasket.
**4.** The bushing can be replaced as an assembly or a new porcelain only can be installed, depending upon the extent of damage. If a new porcelain is to be installed, proceed as follows:
   A. Unscrew bushing terminal and discard gasket. Withdraw rod from the bottom of the porcelain.
   B. Insert rod assembly up through the new porcelain, make sure roll pin is seated in locking groove at top of porcelain.
   C. Install a new terminal gasket. Apply a very small amount of petroleum jelly to the knurled surface on the inside face of the terminal. Thread terminal onto bushing rod and tighten to 35 ft-lbs. torque.
**4.** Twist the split aluminum clamping ring off the old porcelain, if it is in good condition.
**5.** Install the used, or new, clamping ring onto new bushing assembly.

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

**6.** Install the new or reworked bushing assembly, with a new lower gasket, into the head. Position bushing so stud end of terminal is pointing outward.
**7.** Position clamping ring with split centered between two clamping screws.
**8.** Position clamps around bushing, apply anti-seize to threads of capscrews and loosely install. Tighten capscrews evenly, a little at a time, to 10-15 ft-lbs. torque.

NOTE: Clamping force must be applied gradually and equally in rotation to each screw. This provides an evenly distributed gasket sealing pressure.

**9.** Reconnect lead to bushing rod.

**27/38 Kv BUSHINGS**

The 27/38 Kv bushings are oil-filled. Special fixtures and procedures are required to assemble these bushings making field repair beyond the scope of normal shop maintenance. If these bushings are damaged, they must be replaced as a complete unit. Refer to Figure 4 and proceed as follows:

**1.** Disconnect the bushing lead from the bushing rod.
**2.** Remove three hex head capscrews and clamps. Carefully lift out bushing assembly.
**3.** Remove and discard lower gasket.
**4.** Twist the split aluminum clamping ring off the old bushing assembly, if it is good condition.
**5.** Install the used, or new, clamping ring onto new bushing assembly.

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

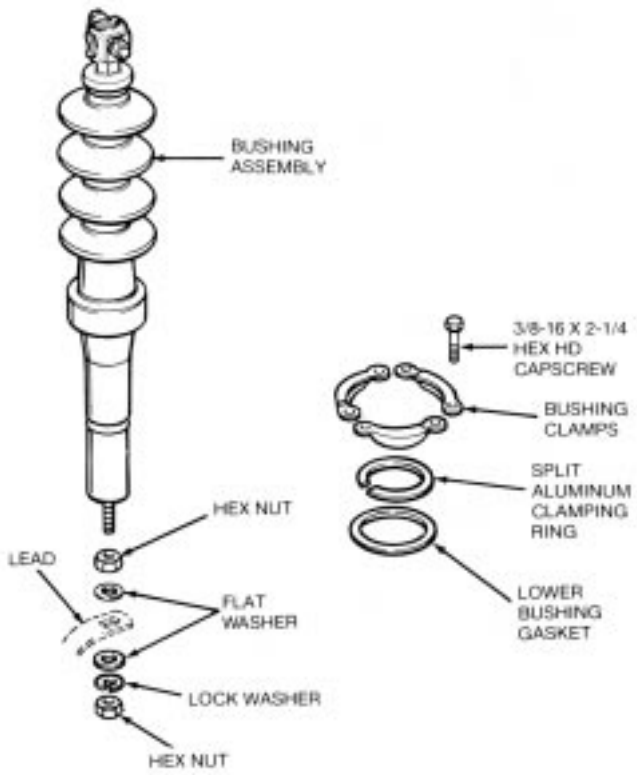



**Figure 4.**
**Removing bushing.**

6. Install new bushing assembly, with a new lower gasket, into the head. Position bushing so stud end of terminal is pointing outward.
7. Position clamping ring with split centered between two clamping bolts.
8. Position clamps around bushing, apply anti-seize to threads of capscrews and loosely install. Tighten capscrews evenly, a little at a time, to 10-15 ft-lbs. torque.

   NOTE: Clamping force must be applied gradually and equally in rotation to each screw. This provides an evenly distributed gasket sealing pressure.
9. Reconnect lead to bushing rod.

## SWITCH OPERATION

Since the F switch is designed with an integral stored-energy operator, the switch can operate up to five times while 120 Vac power is lost. Operations available after loss of power are O-C-O-C-O (starting in closed position) and C-O-C-O (starting in open position). But even when the stored-energy operator is discharged, all switch operations can be manually controlled—by hand or hookstick—from the bottom of the switch housing (see Figure 5).

The **Pull To Charge Spring Pullring** allows the integral stored-energy operator to be manually charged. Simply continue pulling down (approximately 32 times if spring is fully discharged) on this pullring until it disengages—indicating a fully charged stored energy operator.

The **Pull To Operate Pullring** allows the switch to be opened or closed manually. If the interrupter contacts are closed, simply pulling down on this pullring will open the switch. If the interrupter contacts are open, pulling down on the pullring will close the switch.

**The Switch Position Indicator Window** displays the position of the switch's interrupter contacts—open or closed. This indicator displays the correct switch contact position, whether the operation is commanded from the switch, the control, or the supervisory control.

The **To Disable Closing Lever** prevents the switch from being closed during service or testing. The lever is kept in the "NORMAL" position for general switch operation. To prevent switch closing, simply rotate the lever 180° to the "DISABLE" position. The lever can be padlocked in this position.

The **Operation Counter** records the total number of times the switch opened. This provides an accurate record of switch operation.

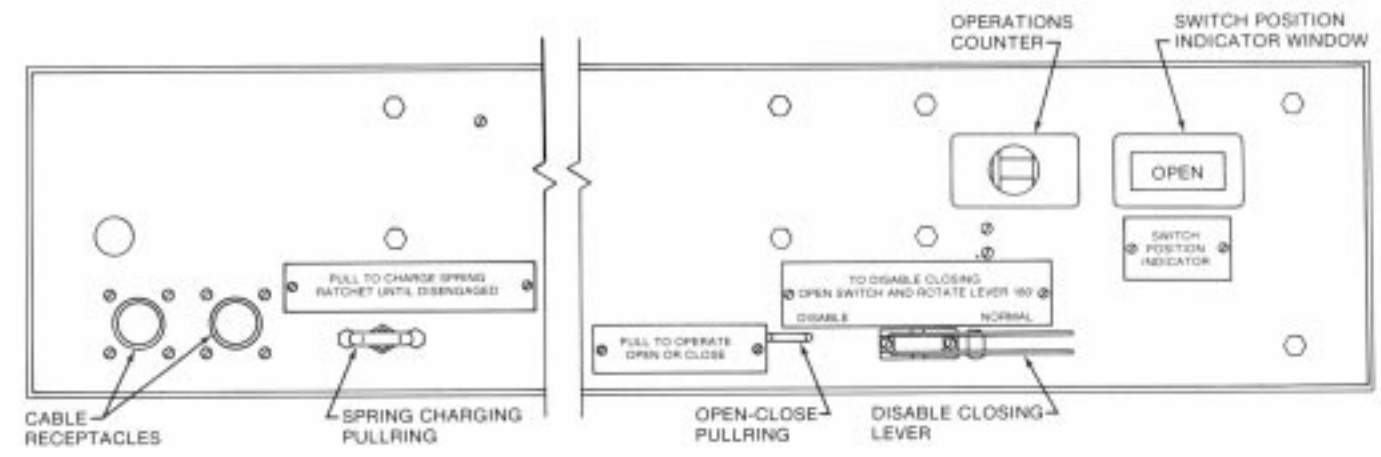
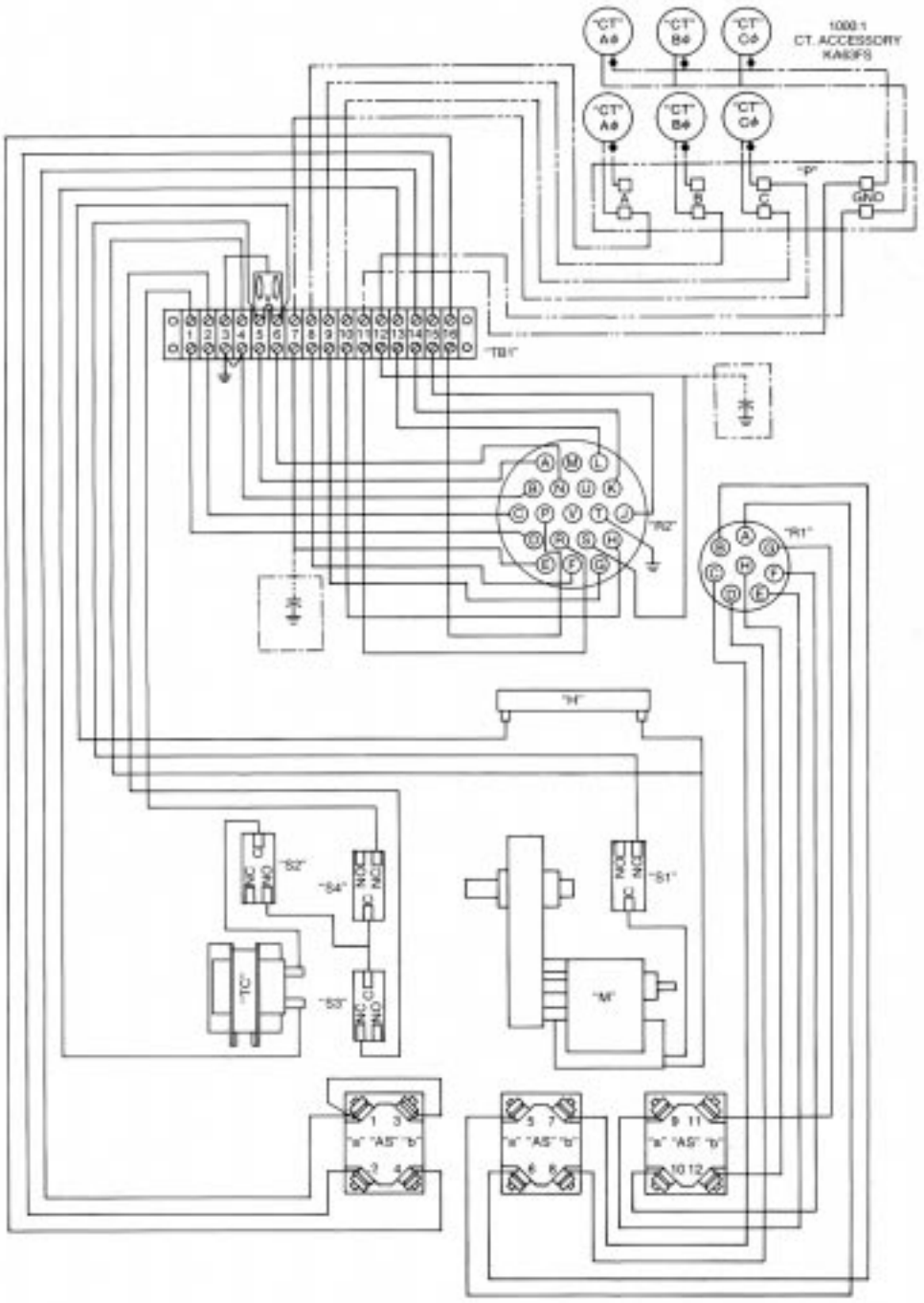


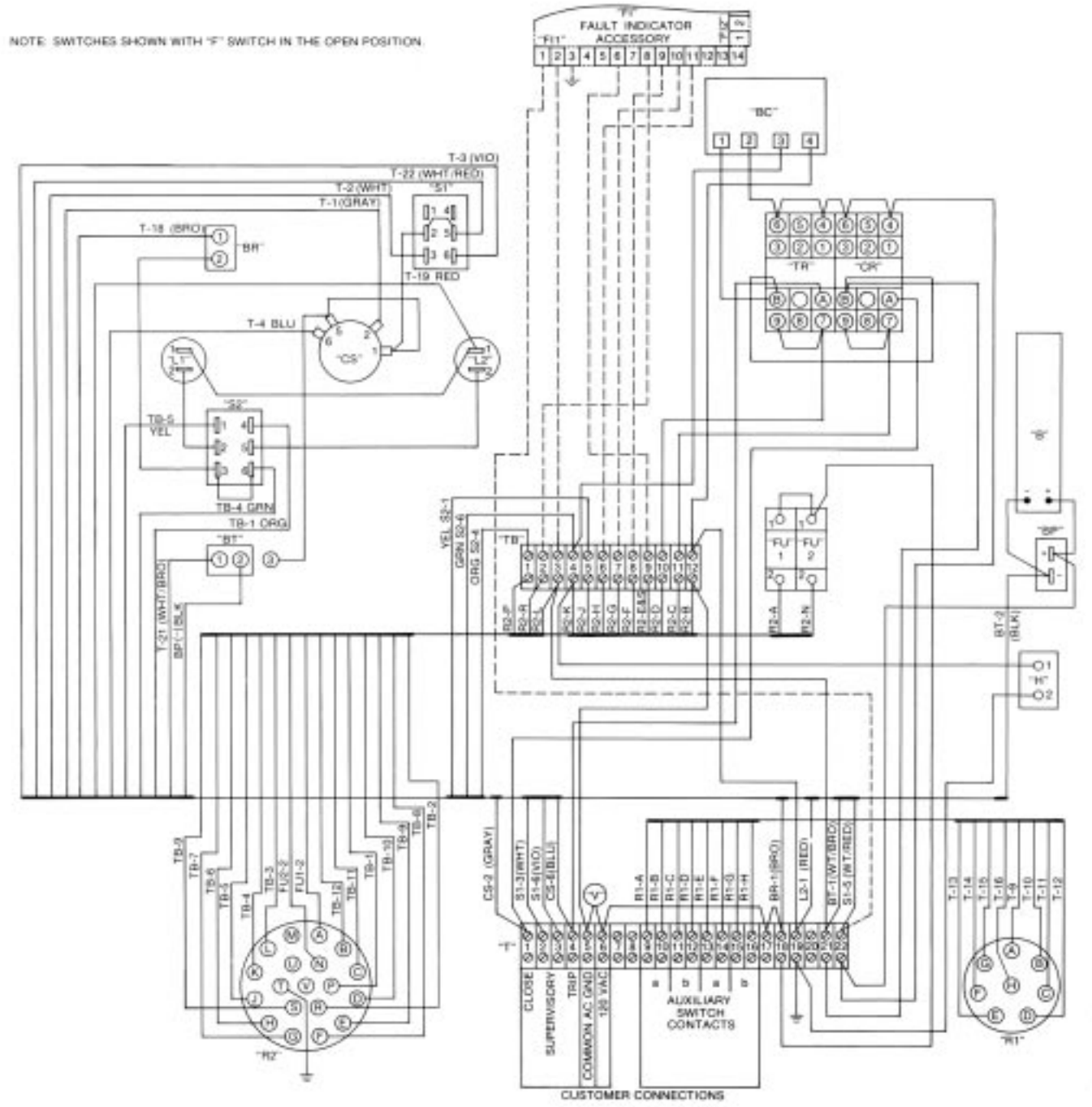

**Figure 5.**
**Type F switch operation.**




| SYM. | DESCRIPTION |
|---|---|
| TB1 | TERMINAL BLOCK — 16 POSITION |
| CT | CURRENT TRANSFORMER |
| P | C. T. PROTECTOR |
| V | VARISTOR ASSEMBLY |
| R1 | RECEPTACLE — 8 PINS |
| R2 | RECEPTACLE — 19 PINS |
| H | HEATER — 500 OHMS |
| M | MOTOR — 115 VAC |
| TC | TRIP/CLOSE COIL — 24 VDC STANDARD |

| SYM. | DESCRIPTION |
|---|---|
| S1 | LIMIT SWITCH—OPENS MOTOR CIRCUIT ONLY WHEN SPRING IS FULLY CHARGED |
| S2 | CUTOUT SWITCH—WITH UNIT IN THE OPEN POSITION SWITCH WILL OPEN IF MAIN SPRING DOES NOT HAVE ENOUGH ENERGY TO CLOSE & REOPEN UNIT |
| S3 | CLOSE CIRCUIT SWITCH—CLOSED WHEN UNIT IS OPEN & OPEN WHEN UNIT IS CLOSED |
| S4 | TRIP CIRCUIT SWITCH—OPEN WHEN UNIT IS OPEN & CLOSED WHEN UNIT IS CLOSED |
| AS | AUXILIARY SWITCH — 3 STAGE |

**Figure 6.**
**Type F switch interconnection diagram.**

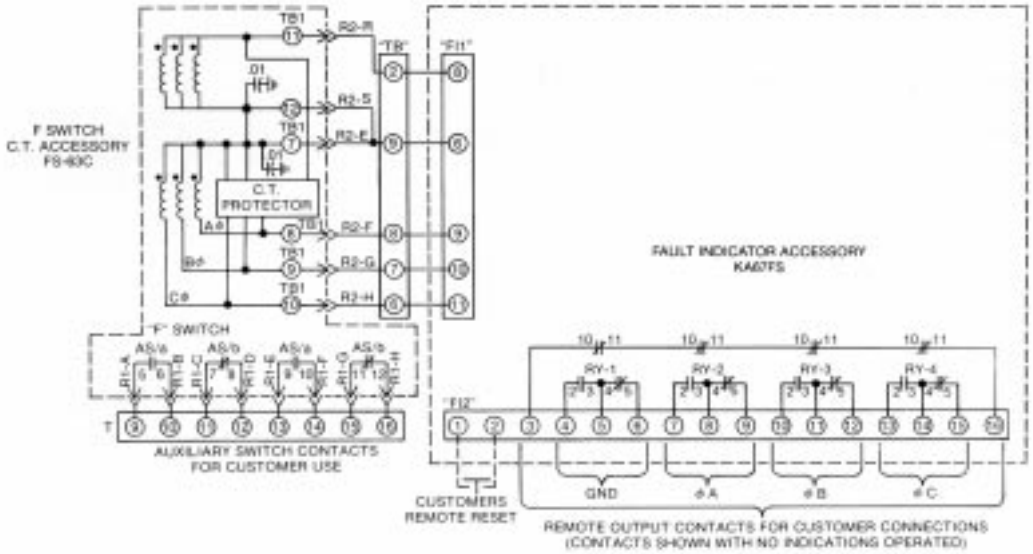


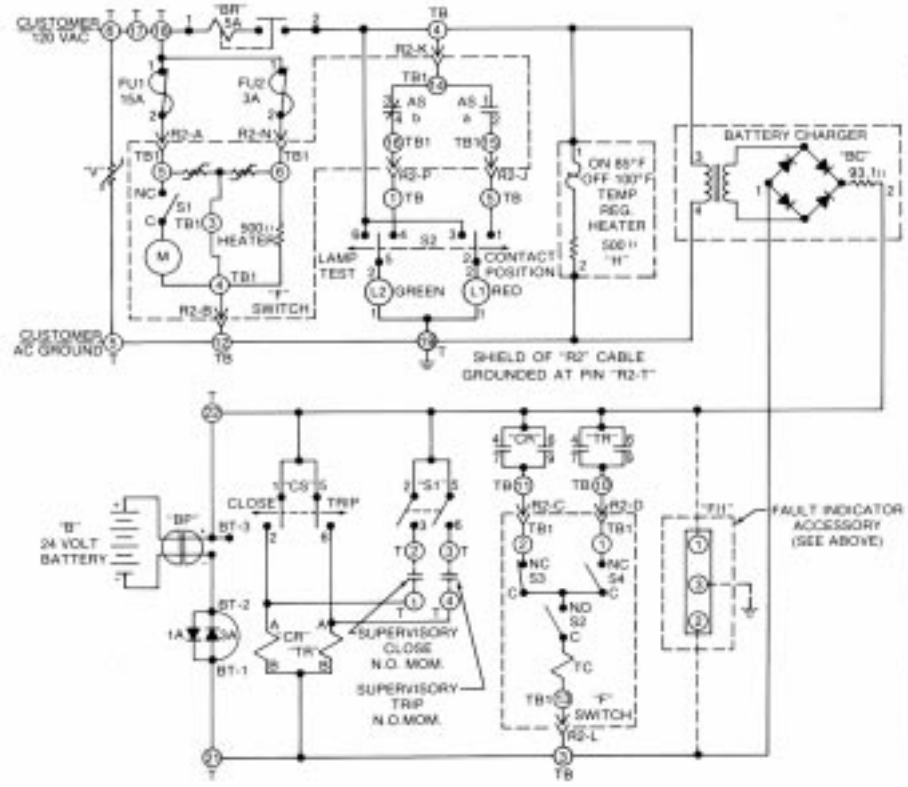

"F" CONTROL

| SYM. | DESCRIPTION |
|---|---|
| T | TERMINAL BLOCK — 22 POS. |
| TB | TERMINAL BLOCK — 12 POS. |
| R1 | AUX. SW. RECEPTACLE — 8 PIN |
| R2 | CONTROL RECEPTACLE — 19 PIN |
| FU1 | MOTOR FUSE SWITCH (15A) |
| FU2 | HEATER FUSE SWITCH (3A) |
| B | BATTERY -24 VDC |
| BP | BATTERY PLUG |
| BC | BATTERY CHARGER |
| H | HEATER |
| CR | CLOSE RELAY |

| SYM | DESCRIPTION |
|---|---|
| TR | TRIP RELAY |
| V | VARISTOR |
| CS | CONTROL SWITCH |
| BR | 120 VAC CKT. BREAKER — 5 AMP |
| S1 | SWITCH (REMOTE CONTROL ON-OFF) |
| S2 | SWITCH (LIGHT TEST & CONTACT POSITION) |
| L1 | LIGHT (RED) |
| L2 | LIGHT (GREEN) |
| BT | BATTERY TEST TERMINALS |
| FI | FAULT INDICATOR ACCESSORY |

**Figure 7.**
**Type F switch control interconnection system.**




"F" CONTROL

| SYM. | DESCRIPTION |
|---|---|
| T | TERMINAL BLOCK — 22 POS. |
| TB | TERMINAL BLOCK — 12 POS. |
| R1 | AUX. SW. RECEPTACLE — 8 PIN |
| R2 | CONTROL RECEPTACLE — 19 PIN |
| FU1 | MOTOR FUSE SWITCH (15A) |
| FU2 | HEATER FUSE SWITCH (3A) |
| B | BATTERY -24 VDC |
| BP | BATTERY PLUG |
| BC | BATTERY CHARGER |
| H | HEATER |
| CR | CLOSE RELAY |
| TR | TRIP RELAY |
| V | VARISTOR |
| CS | CONTROL SWITCH |
| BR | 120 VAC CKT. BREAKER — 5 AMP |
| S1 | SWITCH (REMOTE CONTROL ON-OFF) |
| S2 | SWITCH (LIGHT TEST & CONTACT POSITION) |
| L1 | LIGHT (RED) |
| L2 | LIGHT (GREEN) |
| BT | BATTERY TEST TERMINALS |
| FI | FAULT INDICATOR ACCESSORY |

"F" SWITCH

| SYM. | DESCRIPTION |
|---|---|
| TB1 | TERMINAL BLOCK — 16 POS. |
| M | MOTOR — 120 VAC |
| TC | TRIP COIL — 24 VDC |
| AS | AUXILIARY SWITCH |
| S1 | LIMIT SWITCH — OPENS MOTOR CIRCUIT WHEN SPRING IS FULLY CHARGED. |
| S2 | CUTOUT SWITCH — WILL BE OPEN IF SPRING DOES NOT HAVE ENOUGH ENERGY TO CLOSE UNIT. |
| S3 | CLOSE CIRCUIT SWITCH — CLOSED WHEN UNIT IS OPEN & OPEN WHEN UNIT IS CLOSED. |
| S4 | TRIP CIRCUIT SWITCH — OPEN WHEN UNIT IS OPEN & CLOSED WHEN UNIT IS CLOSED. |

**Figure 8.**
**Type F switch schematic diagram.**

## SERVICE PARTS LIST

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

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

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

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

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

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

### Type F Switch Control Parts

| Catalog No. | Description |
|---|---|
| KA175FS | Varistor assembly |
| KA544ME1 | Heater assembly |
| KP2155A1 | Relay socket |
| KA83GV | Battery charger assembly |
| KP1100ME | Fuse block single section |
| KP1110ME | Fuse block end closure unit |
| KA460ME | 24V battery (Gould) |
| KP2075A13 | 15 Amp fuse, Ban fibre tube |
| KP2075A12 | 3 Amp fuse, Ban fibre tube |
| KP2153A1 | Relay, open relay and close relay |
| KP2156A1 | Relay and socket bail |
| KP191FS | Receptacle, (R2) |
| KP192FS | Receptacle, (R1) |
| KP92GV | Battery connector |
| KA1139ME | Selector switch assembly, (CS) |
| KP2069A8 | Pointer knob |
| K999904310308A | Pilot lamp, red, (L1) |
| K999904310309A | Pilot lamp, green, (L2) |
| K999904310310A | Light bulb, for use in (L1) and (L2) |
| KP2124A7 | Toggle switch, (S2) |
| KP2124A10 | Toggle switch, (S1) |
| K999904310246A | 5 Amp thermal circuit breaker |
| KA894ME | Link assembly, used with battery test terminal |
| KP2081A2 | Terminal, black, dual |
| KP2081A3 | Terminal, red, single |
| KA145GV | Battery test circuit board assembly |

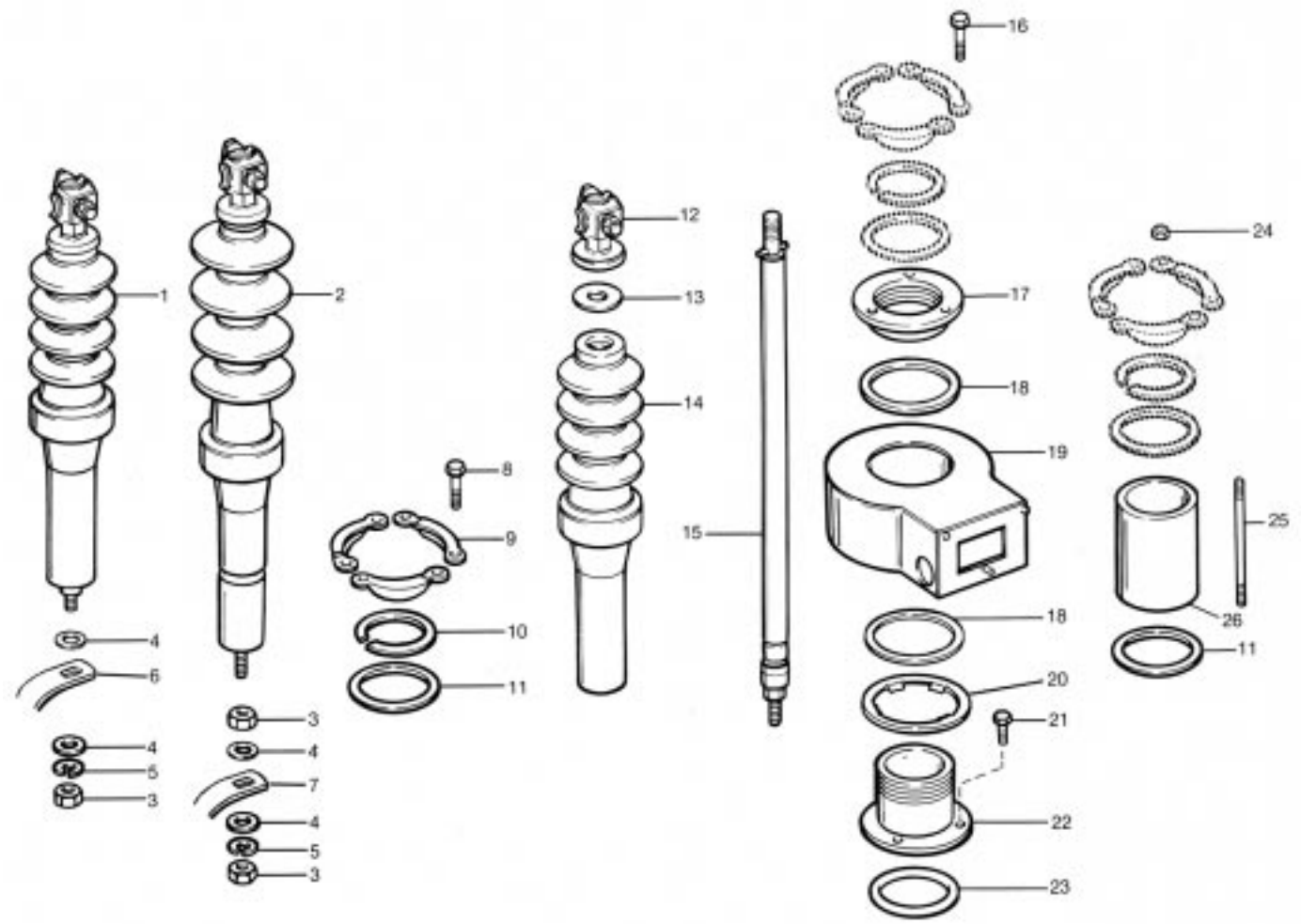



**Figure 9.**
**Bushing parts.**

## Bushing Parts (Figure 9)

| Item No. | Description | Catalog Number | Quan. Req'd. |
|---|---|---|---|
| 1 | Bushing assembly, 15 Kv (consists of items 12 through 15) | | |
| | 13-inch standard creepage | KA717R25 | 6 |
| | 13-inch standard creepage with BCT accy. | KA717R26 | 6 |
| | 17-inch extra-creepage | KA717R27 | 6 |
| | 17-inch extra-creepage with BCT accy. | KA717R28 | 6 |
| 2 | Bushing assembly 27 Kv through 38 Kv | | |
| | Standard | KA56RV3 | 6 |
| | Standard bushing with BCT accy. | KA56RV4 | 6 |
| 3 | Nut, 1/2-20 UNF, hex jam, brass | K8807253200050K | AR |
| 4 | Washer, flat | KP2028A3 | AR |
| 5 | Lockwasher, 1/2, med, brz | K900830050000A | AR |
| 6 | Lead, used with 15 Kv bushings (6 used, 4-3/16 long) | KP3256A4 | 36 |
| 7 | Lead, used with 27-38 Kv bushings | | |
| | (6 used, 4-3/16 long) | KP3256A4 | 18 |
| | (6 used, 3-3/16 long) | KP3256A2 | 18 |
| 8 | Screw, 3/8-16 UNC x 2-1/4, hex hd, stl. | K730101137225Q | 18 |
| 9 | Bushing clamp | KP1109R | 18 |
| 10 | Clamping ring | KP1111R | 6 |
| 11 | Lower bushing gasket | KA1193R | 6 |
| 12 | Terminal assembly | KA17W901 | 1 |
| 13 | Upper bushing gasket | KP2090A57 | 1 |
| 14 | Bushing ceramic, 15 Kv | | |
| | 13-inch standard creepage | KP1110R | 1 |
| | 13-inch standard creepage with BCT accy. | KP171W | 1 |
| | 17-inch extra-creepage | KP1578R | 1 |
| | 17-inch extra-creepage with BCT accy. | KP186W | 1 |
| 15 | Bushing rod assembly, 15 Kv | | |
| | Standard and extra-creepage | KA716R20 | 1 |
| | Standard and extra-creepage with BCTaccy. | KA716R21 | 1 |
| The following parts are applicable to the bushing current transformer accessory. | | | |
| 16 | Capscrew, hex hd, 3/8-16 x 1-7/8, stl. | K730101157187Q | 3 |
| 17 | Transformer clamping flange | KP170W1 | 1 |
| 18 | Flange gasket | KP2090A73 | 2 |
| 19 | Replacement current transformer | | |
| | 600:5 multi-ratio | KA159W1S | 1 |
| | 1200:5 multi-ratio | KA132W | 1 |
| 20 | CT washer, used with plastic housing CT's | KP312W | 1 |
| 21 | Capscrew, hex hd 3/8-16 x 1 stl. | K730101137100Q | 3 |
| 22 | Transformer clamping sleeve | KP169W1 | 1 |
| 23 | O-ring gasket, used with transformer clamping sleeve that has machined groove. Old style clamping sleeve, without groove, use KP2090A66. | KP2000A64 | 1 |
| 24 | Hex nut, 3/8-16, stl. | K880201116037Q | 3 |
| 25 | Stud | KP3149A40 | 1 |
| 26 | Bushing spacer | KP275W1 | 1 |

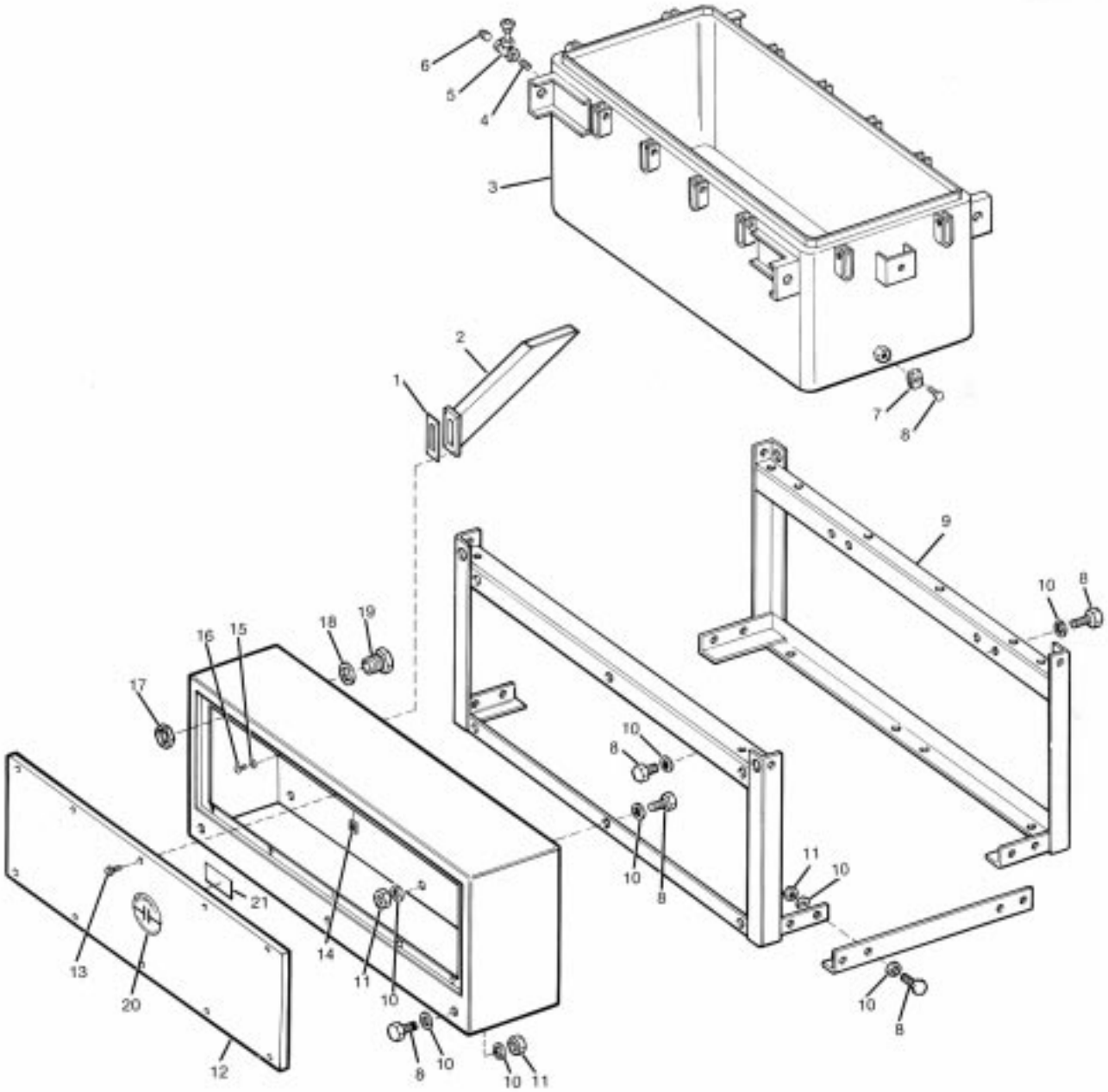



**Figure 10.**
**Frame and tank parts.**

## Tank and Frame Assembly (Figure 10)

| Item No. | Description | Catalog Number | Qty. Per Assy. |
|---|---|---|---|
| 1 | Gasket | KP1202FS | 1 |
| 2 | Guard assembly | KA217FS | 1 |
| 3 | Tank | KP155TSC2 | 1 |
| 4 | Nipple | KP2039A1 | 1 |
| 5 | Valve | KP2038A1 | 1 |
| 6 | Plug | KP2007A3 | 1 |
| 7 | Ground clamp | KA227H | 1 |
| 8 | Screw, 1/2-13UNC x 1, hex hd., stl. | K730101150100Q | 26 |
| 9 | Flame assembly | KA235FS | 1 |
| 10 | Lockwasher, 1/2, internal tooth | K901001050000Z | 24 |
| 11 | Nut, 1/2-13UNC, hex, stl. | K880201113050Q | 8 |
| 12 | Cover | KP206FS | 1 |

| Item No. | Description | Catalog Number | Qty. Per Assy. |
|---|---|---|---|
| 13 | Screw, #14 x 3/4, self tapping, pan hd., st. stl. | K801715014075A | 10 |
| 14 | Speed nut | KP2005A11 | 10 |
| 15 | Lockwasher, #6, external tooth, brz. | K901132006000A | 4 |
| 16 | Screw, #6-32 x 3/8, rd hd., st. stl. | K721515106037A | 4 |
| 17 | Nut | KP2009A4 | 1 |
| 18 | Seal | KP2141A3 | 1 |
| 19 | Plug | KP2007A13 | 1 |
| 20 | Decal, vacuum warning | KP1041V4H | 2 |
| 21 | Decal, warning | KP1015VSR | 1 |

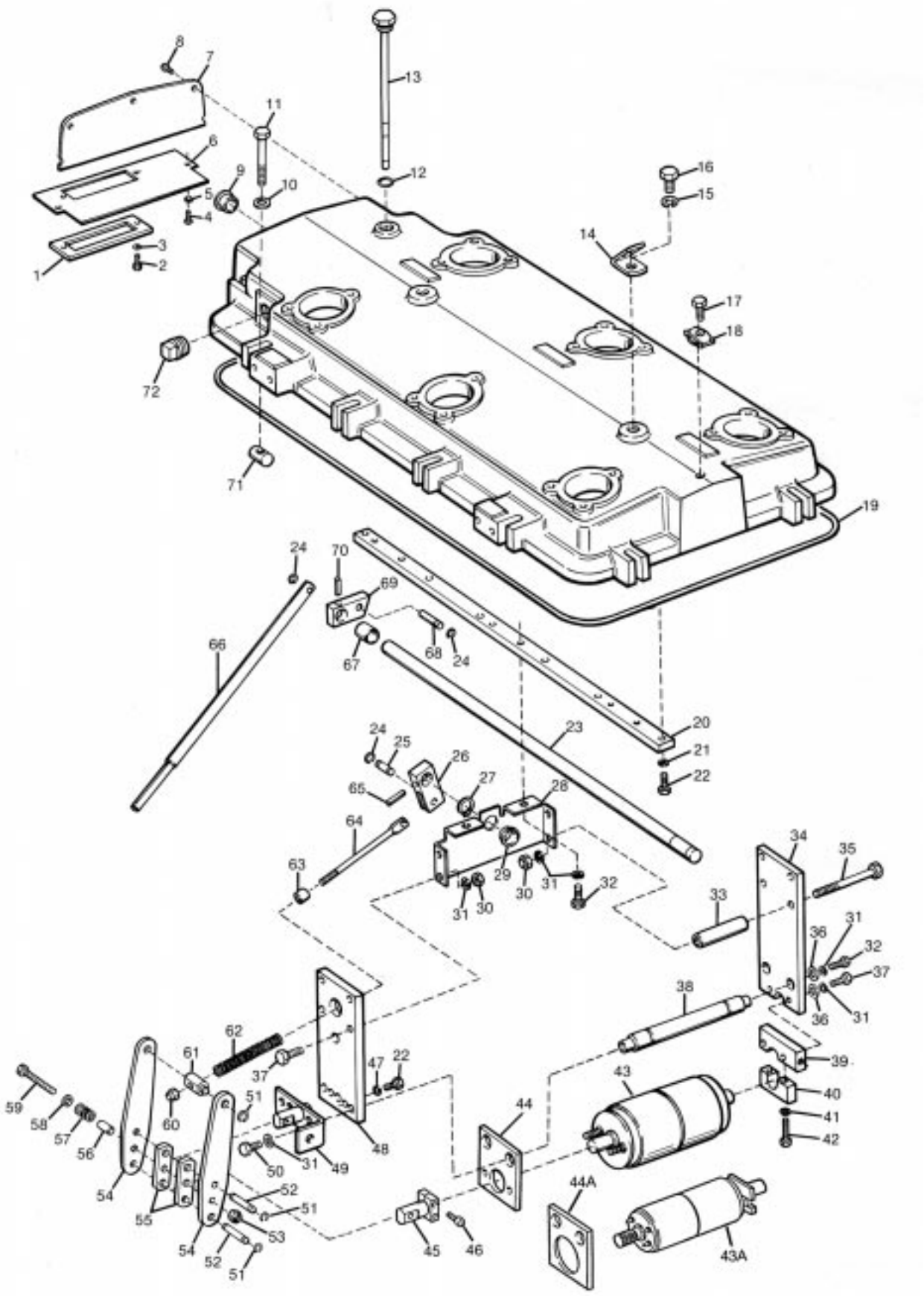



**Figure 11.**
**Head assembly.**

## Head Assembly (Figure 11)

| Item No. | Description | Catalog Number | Qty. Per Assy. |
|---|---|---|---|
| 1 | Plate | KP1259FS | 1 |
| 2 | Screw, #8-32UNC x 1/2, hex hd., st. stl. | K722415108050A | 2 |
| 3 | Lockwasher, #8, internal tooth, st. stl. | K901015008000A | 2 |
| 4 | Screw, #10-24UNC x 1/2 rd hd., st. stl. | K721515110050A | 2 |
| 5 | Lockwasher, #10, med, st. stl. | K900815010000A | 2 |
| 6 | Bottom plate | KP1201FS | 1 |
| 7 | Cover | KP1228FS | 1 |
| 8 | Screw, #12 x 1/2, self tapping, rd hd., st. stl. | K781515112050A | 5 |
| 9 | Bushing | KP3046A29 | 1 |
| 10 | Washer | KP2028A23 | 12 |
| 11 | Screw, 1/2-13UNC x 3-1/2, hex hd., stl. | K730101150350Q | 12 |
| 12 | O-ring | KP2000A9 | 1 |
| 13 | Dipstick | KA106TSC | 1 |
| 14 | Lifting lug | KP456H2 | 2 |
| 15 | Lockwasher, 5/8, med., stl. | K900801062000Z | 2 |
| 16 | Screw, 5/8-11UNC x 1-1/2, hex hd., stl. | K730101162150Q | 2 |
| 17 | Screw, 1/2-13UNC x 1-1/4, hex hd., stl. | K730101150125Q | 1 |
| 18 | Ground clamp | KA227H | 1 |
| 19 | Gasket | KP2103A15 | 1 |
| 20 | Mounting bar | KP1188FS | 2 |
| 21 | Lockwasher, 5/16, med., stl. | K900801031000Z | 12 |
| 22 | Screw, 5/16-18UNC x 1, hex hd., stl. | K730101131100Q | 18 |
| 23 | Shaft | KP1186FS | 1 |
| 24 | Retaining ring, C-type, WA514 | K970901250000M | 8 |
| 25 | Pin | KP3124A77 | 3 |
| 26 | Lever | KP1168FS | 3 |
| 27 | Retaining ring | KP2013A33 | 6 |
| 28 | Bracket | KP1167FS | 6 |
| 29 | Bushing | KP548RC2 | 6 |
| 30 | Nut, 3/8-16UNC, hex, stl. | K880201116037Q | 24 |
| 31 | Lockwasher, 3/8, med. stl. | K900801037000Z | 54 |
| 32 | Screw, 3/8-16UNC x 3/4, hex hd., stl. | K730101137075Q | 18 |
| 33 | Spacer | KP3013A90 | 12 |
| 34 | Plate | KP1183FS | 3 |
| 35 | Screw, 3/8-16UNC x 3-1/2, hex hd., stl. | K730101137350Q | 12 |
| 36 | Washer, 3/8 stl. | K900201037000Z | 12 |
| 37 | Screw, 3/8-16UNC x 1-1/4, hex hd., stl. | K730101137125Q | 18 |

| Item No. | Description | Catalog Number | Qty. Per Assy. |
|---|---|---|---|
| 38 | Stringer assembly | KA208FS | 6 |
| 39 | Clamp | KP1175FS | 3 |
| 40 | Clamp bar | KP1176FS | 3 |
| 41 | Lockwasher, 5/16, med., stl. | K900801031000Z | 6 |
| 42 | Screw, 5/16-18UNC x 1-3/8, hex hd., stl. | K730101131137Q | 6 |
| *43 | Vacuum interrupter | KA225VS-2 | 3 |
| *43A | Vacuum interrupter | | |
| | 15.5 Kv | KA234FS-1 | 3 |
| | 27-29.2 Kv | KA234FS-2 | 3 |
| | 38 Kv | KA234FS-3 | 3 |
| 44 | Brace | KP1272FS | 3 |
| 44A | Brace | KP1180FS | 3 |
| 45 | Clamp | KP1227FS | 3 |
| 46 | Capscrew socket head | KP2036A31 | 6 |
| 47 | Washer, 5/16, internal tooth, brz. | K901032031000A | 6 |
| 48 | Plate | KP1182FS | 3 |
| 49 | Current exchange assembly | KA210FS | 3 |
| 50 | Screw, 3/8-16UNC x 1, hex hd., stl. | K730101137100Q | 6 |
| 51 | Retaining ring, C-type, WA516 | K970901312000M | 19 |
| 52 | Pin | KP3125A37 | 6 |
| 53 | Nut, elastic stop | KP2020A3 | 3 |
| 54 | Link | KP1171FS | 6 |
| 55 | Link | KP1172FS | 6 |
| 56 | Spacer | KP3007A145 | 1 |
| 57 | Spring | KP123RC1 | 3 |
| 58 | Washer, #14, brass | K900525026056A | 3 |
| 59 | Screw, 1/4-20UNC x 3, hex hd., stl. | K730101125300Q | 3 |
| 60 | Nut, elastic stop | KP2020A10 | 3 |
| 61 | Pin | KP1170FS | 3 |
| 62 | Spring | KP1177FS | 3 |
| 63 | Spacer | KP3011A139 | 3 |
| 64 | Rod | KP1169FS | 3 |
| 65 | Roll pin, 7/32 x 1-1/4 | K970801218125C | 3 |
| 66 | Rod | KP1200FS | 1 |
| 67 | Spacer | KP3017A56 | 2 |
| 68 | Pin | KP3124A77 | 1 |
| 69 | Lever | KP1187FS | 1 |
| 70 | Roll pin, 1/4 x 1-114 | K970801250125C | 1 |
| 71 | Nut pin | KP86L | 12 |
| 72 | Plug, 1/2 | KP2007A3 | 1 |

*Replace interrupters with same type, as was removed, or premature failure will result.

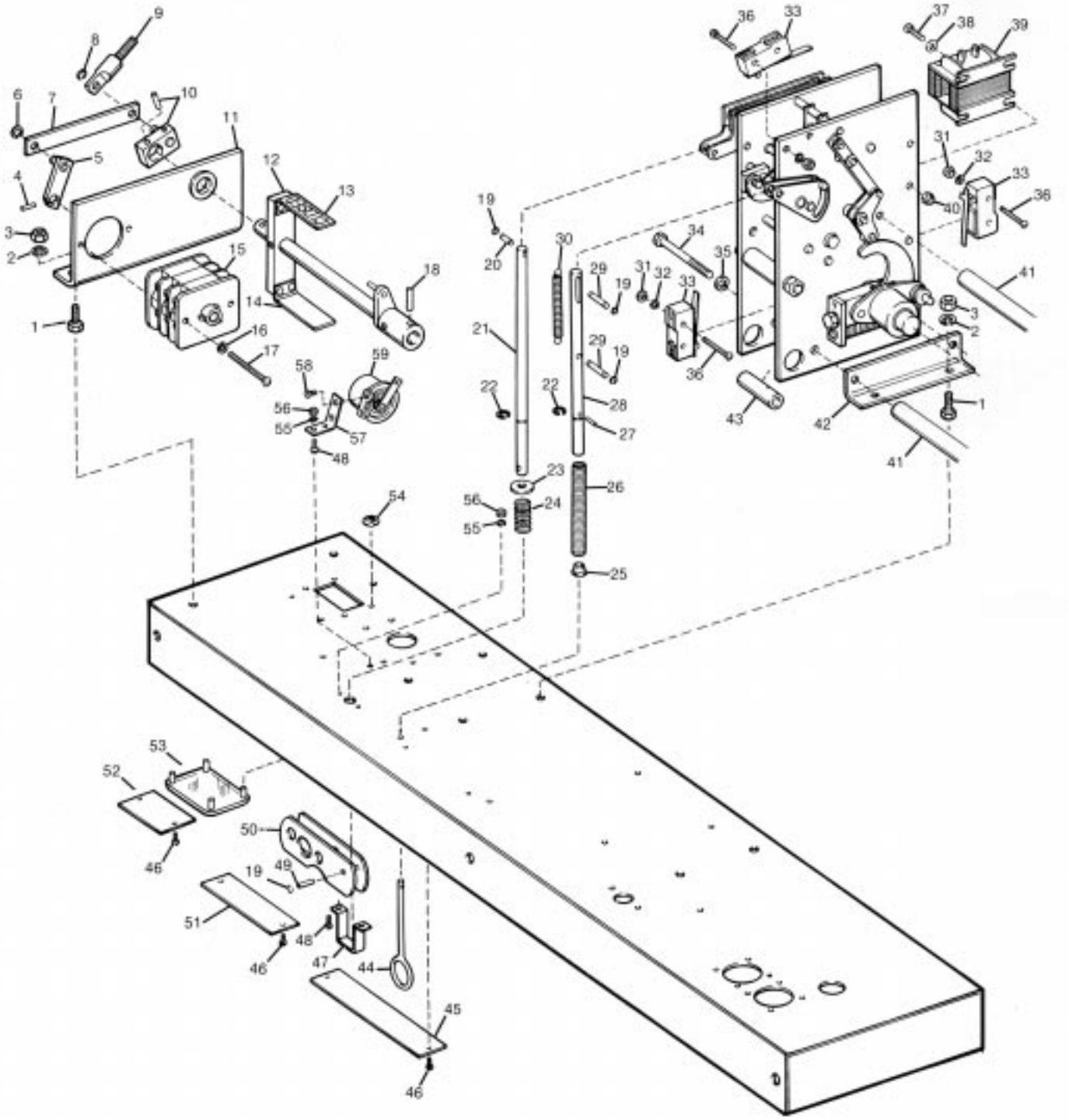



**Figure 12.**
**Mechanism assembly, view 1.**

## Mechanism Assembly (View 1) (Figure 12)

| Item No. | Description | Catalog Number | Qty. Per Assy. |
|---|---|---|---|
| 1 | Screw, 3/8-16UNC x 3/4, hex hd., stl. | K730101137075Q | 6 |
| 2 | Lockwasher, 3/8, med., stl. | K900801037000Z | 6 |
| 3 | Nut, 3/8-16UNC, hex, stl. | K880201116037Q | 6 |
| 4 | Pin | KP3200A37 | 1 |
| 5 | Lever | KP1210FS | 1 |
| 6 | Retaining ring, C-type, WA514 | K970901250000M | 1 |
| 7 | Link | KP1209FS | 1 |
| 8 | Retaining ring, C-type, WA516 | K970901312000M | 1 |
| 9 | Connecting rod end | KP216FS | 1 |
| 10 | Lever and pin assembly | KP219FS | 1 |
| 11 | Bracket assembly | KP221FS | 1 |
| 12 | Shaft assembly, includes item 10 | KP214FS | 1 |
| 13 | Decal, closed | KP1164KM | 1 |
| 14 | Decal, open | KP1165KM | 1 |
| 15 | Auxiliary switch (AS) | KP612R33 | 1 |
| 16 | Lockwasher, #10, med., st. stl. | K900815010000A | 2 |
| 17 | Screw, #10-24UNC x 2-1/2, rd hd., st. stl. | K721515110250A | 2 |
| 18 | Roll pin, 7/32 x 1, st. | K970801218100A | 1 |
| 19 | Retaining ring, C-type, WA510 | K970901188000M | 8 |
| 20 | Pin | KP3123A55 | 1 |
| 21 | Rod | KA1143FS | 1 |
| 22 | Retaining ring, C-type, WA518 | K970901375000M | 2 |
| 23 | Washer, flat, 3/8, stl. | K900201037000Z | 1 |
| 24 | Spring | KP139NL-V1 | 1 |
| 25 | Bushing | KP3034A30 | 1 |
| 26 | Spring | KP157VR | 1 |
| 27 | Roll pin, 1/16 x 3/8, stl. | K970801062037C | 1 |
| 28 | Rod | KP1021FS | 1 |
| 29 | Pin | KP3123A36 | 2 |
| 30 | Spring | KA141GN-E1 | 2 |
| 31 | Nut, hex, #6-32UNC, st. stl. | K881015132006A | 6 |

| Item No. | Description | Catalog Number | Qty. Per Assy. |
|---|---|---|---|
| 32 | Lockwasher, #6, med., st. stl. | K900815006000A | 6 |
| 33 | Microswitch (S2, S3, S4) | KP2181A4 | 3 |
| 34 | Screw, hex hd., 5/16-18UNC x 3-1/2, stl. | K730101131350Q | 3 |
| 35 | Lockwasher, 5/16, med., stl. | K900801031000Z | 3 |
| 36 | Screw, #6-32UNC x 1-1/8 rd hd., st. stl. | K721515106112A | 6 |
| 37 | Screw, #10-24UNC x 5/8, rd hd., st. stl. | K721515110062A | 3 |
| 38 | Washer, flat, #10, med., stl. | K900201010000Z | 3 |
| 39 | Solenoid coil (TC) | KP1259M1 | 1 |
| 40 | Nut, elastic stop | KP2020A13 | 3 |
| 41 | Spacer | KP1065FS | 3 |
| 42 | Bracket | KP1064FS | 2 |
| 43 | Spacer | KP3011A131 | 3 |
| 44 | Manual trip ring | KP113FS | 1 |
| 45 | Instruction plate | KP1100FS | 1 |
| 46 | Screw, #4 x 3/16, self tapping, rd hd., st. stl. | K801515004018A | 6 |
| 47 | Guide bracket | KP1144FS | 1 |
| 48 | Screw, #8-32UNC x 1/2, rd hd., st. stl. | K721515108050A | 4 |
| 49 | Pin | KP3123A52 | 1 |
| 50 | Handle assembly | KA180FS | 1 |
| 51 | Instruction plate | KP1216FS | 1 |
| 52 | Name plate | KP1098FS | 1 |
| 53 | Window | KP1240M | 2 |
| 54 | Nut, push-on | KP2005A1 | 8 |
| 55 | Lockwasher, #8, med., st. stl. | K900815008000A | 6 |
| 56 | Nut, hex, #8-32UNC, st. stl. | K881015132008A | 6 |
| 57 | Bracket | KP1219FS | 1 |
| 58 | Screw, #6-32UNC x 3/8, self tapping, rd hd., st. stl. | K751515106037A | 2 |
| 59 | Counter assembly | KA28C08 | 1 |

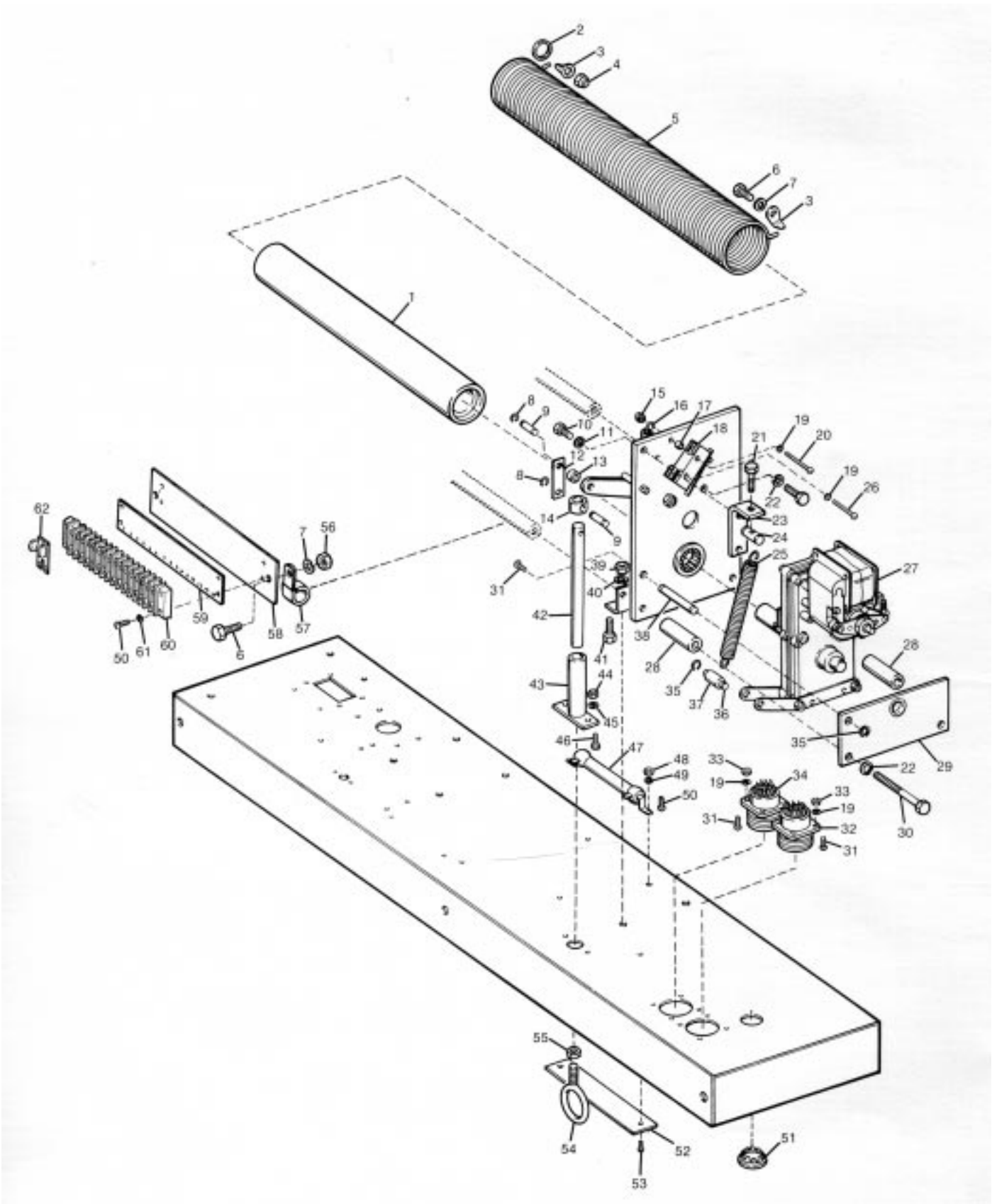



**Figure 13.**
**Mechanism assembly, view 2.**

## Mechanism Assembly (View 2) (Figure 13)

| Item No. | Description | Catalog Number | Qty. Per Assy. |
|---|---|---|---|
| 1 | Guide | KP1066FS | 1 |
| 2 | Spacer | KP3017A44 | 1 |
| 3 | Clip | KP1088FS | 2 |
| 4 | Nut, elastic stop | KP2020A7 | 1 |
| 5 | Spring | KP1138FS | 1 |
| 6 | Screw, 5/16-18UNC x 3/4, hex hd., stl. | K730101131075Q | 3 |
| 7 | Lockwasher, 5/16, med., stl. | K900801031000Z | 3 |
| 8 | Retaining ring, C-type, WA514 | K970901250000M | 4 |
| 9 | Pin | KP3124A59 | 2 |
| 10 | Screw, 1/4-20UNC x 1/2 hex hd., stl. | K730101125050Q | 1 |
| 11 | Lockwasher, 1/2, med., st. | K900801025000Z | 1 |
| 12 | Link | KP1011FS | 2 |
| 13 | Spacer | KP3007A12 | 2 |
| 14 | Stop | KP1018FS | 1 |
| 15 | Nut, elastic stop | KP2020A6 | 1 |
| 16 | Spring | KP1066VWS | 1 |
| 17 | Spacer | KP3004A60 | 2 |
| 18 | Microswitch (S1) | KP2181A4 | 1 |
| 19 | Lockwasher, #6, med., st. stl. | K900815006000A | 10 |
| 20 | Screw, #6-32UNC x 1-3/4 rd hd., st. stl. | K721515106175A | 1 |
| 21 | Screw, 1/4-20UNC x 1 hex hd., st. | K730101125100Q | 1 |
| 22 | Lockwasher, 5/16, med., st. | K900801031000Z | 3 |
| 23 | Bracket | KP1089FS | 1 |
| 24 | Pin | KP1090FS | 1 |
| 25 | Spring | KP1139FS | 2 |
| 26 | Screw, #6-32UNC x 1-1/8 rd hd., st. stl. | K721515106112A | 1 |
| 27 | Motor assembly (M) | KA136FS | 1 |
| 28 | Spacer | KP3011A128 | 2 |
| 29 | End plate assembly | KA116FS | 1 |
| 30 | Screw, 5/16-18UNC x 3 hex hd., st. | K730101131300Q | 2 |
| 31 | Screw, #6-32UNC x 1/2 rd hd., st. stl. | K721515106050A | 9 |
| 32 | Receptacle, 19 pin (R2) | KP231FS | 1 |
| 33 | Nut, #6-32UNC, hex, st. stl. | K881015132006A | 8 |
| 34 | Receptacle, 8 pin (R1) | KP232FS | 1 |
| 35 | Retaining ring, C-type, WA516 | K970901312000M | 4 |
| 36 | Pin | KP3125A35 | 1 |
| 37 | Spacer | KP3009A185 | 1 |
| 38 | Pin | KP1002FS | 1 |
| 39 | Nut, 3/8-16UNC, hex, stl. | K880201116037Q | 2 |
| 40 | Lockwasher, 3/8, med., stl. | K900801037000Z | 2 |
| 41 | Screw, 3/8-16UNC x 3/4, hex hd., stl. | K730101137075Q | 2 |
| 42 | Rod | KP1214FS | 1 |
| 43 | Guide | KP222FS | 1 |
| 44 | Nut, 1/4-20UNC hex,stl. | K880201120025Q | 2 |
| 45 | Lockwasher, 1/4, med. stl. | K900801025000Z | 2 |
| 46 | Screw, 1/4-20UNC x 5/8, hex hd., stl. | K730101125062Q | 2 |
| 47 | Heater (H) | K999904310084A | 1 |
| 48 | Nut, #8-32, hex, st. stl. | K881015132008A | 2 |
| 49 | Lockwasher, #8 med., st. stl. | K900815008000A | 2 |
| 50 | Screw, #8-32 x 1/2, rd hd., st. stl. | K721515108050A | 6 |
| 51 | Plug | KP2041A16 | 1 |
| 52 | Instruction plate | KP1099FS | 1 |
| 53 | Screw, #4 x 3/16, self tapping, rd hd., st. stl. | K801515004018A | 2 |
| 54 | Eye bolt | KP322H2 | 1 |
| 55 | Nut, 3/8-16UNC | K881101116037W | 1 |
| 56 | Nut, 5/16-18UNC, hex, stl. | K880201118031Q | 2 |
| 57 | Clip | KP2006A13 | 2 |
| 58 | Panel | KP1208FS | 1 |
| 59 | Marker strip | KP2101A221 | 1 |
| 60 | Terminal strip (TB) | KP2101A21 | 1 |
| 61 | Lockwasher, #8, internal tooth, brz. | K901032008000A | 4 |
| 62 | Varistor assembly (V) | KA1138ME | 1 |

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