



SERVICE DATA OIL CIRCUIT RECLOSERS • THREE-PHASE

Types ME, MLE, MVE

APPARATUS
SERVICE MANUAL
281-40SB-1

Page 1
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MAINTENANCE MANUAL

INTRODUCTION

For maintenance directions, this manual is divided into a descriptive section to acquaint personnel with major parts and assemblies, a periodic field inspection and maintenance section, shop maintenance instructions and testing.

This manual particularly covers the recloser and the operating mechanisms and includes replacement procedures for their mechanical and electrical components. Maintenance of the electronic control is described separately in the "Electronic Control Service Manual".

Procedures for changing operation and timing characteristics are given in the control installation manual. Thus, for complete servicing instructions, please refer to the control service manual and the control installation manual as well as this manual.

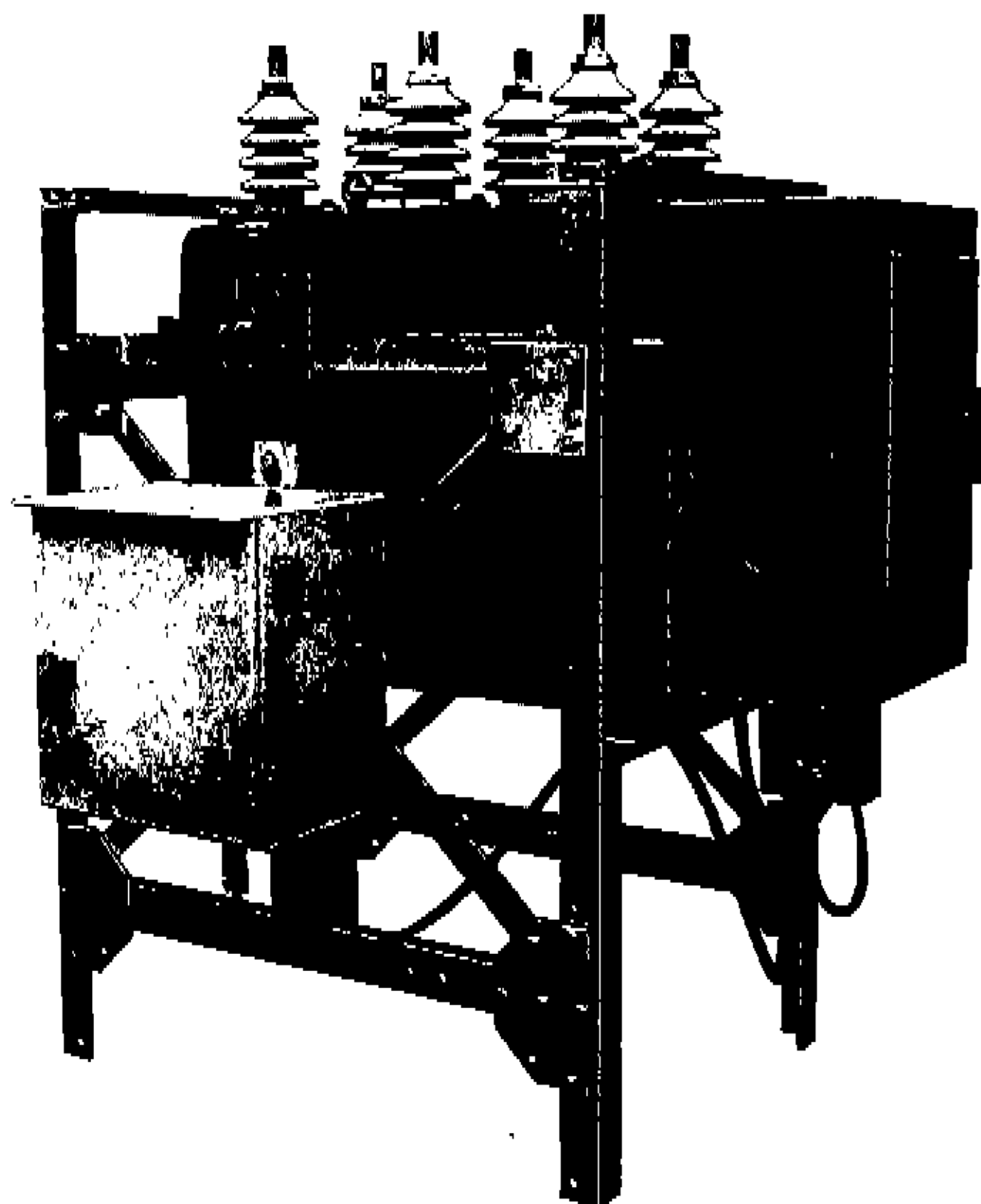


FIGURE 1
Type MVE recloser with hoist assembly

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Description

The versatility of the basic Type ME recloser is shown by its many and varied applications. Basically the Type ME is a circuit interrupting device with an operating mechanism and an electronic control having a continuous current rating of 1120 amperes at 14.4 kv.

Substitute circuit breaker relay connections for the electronic control and the Types M, ML, or MV can become an inexpensive change-out for an old circuit-breaker. The electronic control can also be replaced with a series solenoid and a rectifier arrangement on Types MS and MVS to operate as a non-reclosing series trip breaker, especially desirable to protect underground cable that is tapped to an overhead circuit.

As a recloser Types ME, MLE, MVE perform similarly to other reclosers in that they trip and automatically reclose. If a fault is temporary, reclosing restores normal service. If the fault is permanent, the recloser senses this and performs a preset number of operations and locks open. All three phases open and lock out simultaneously.

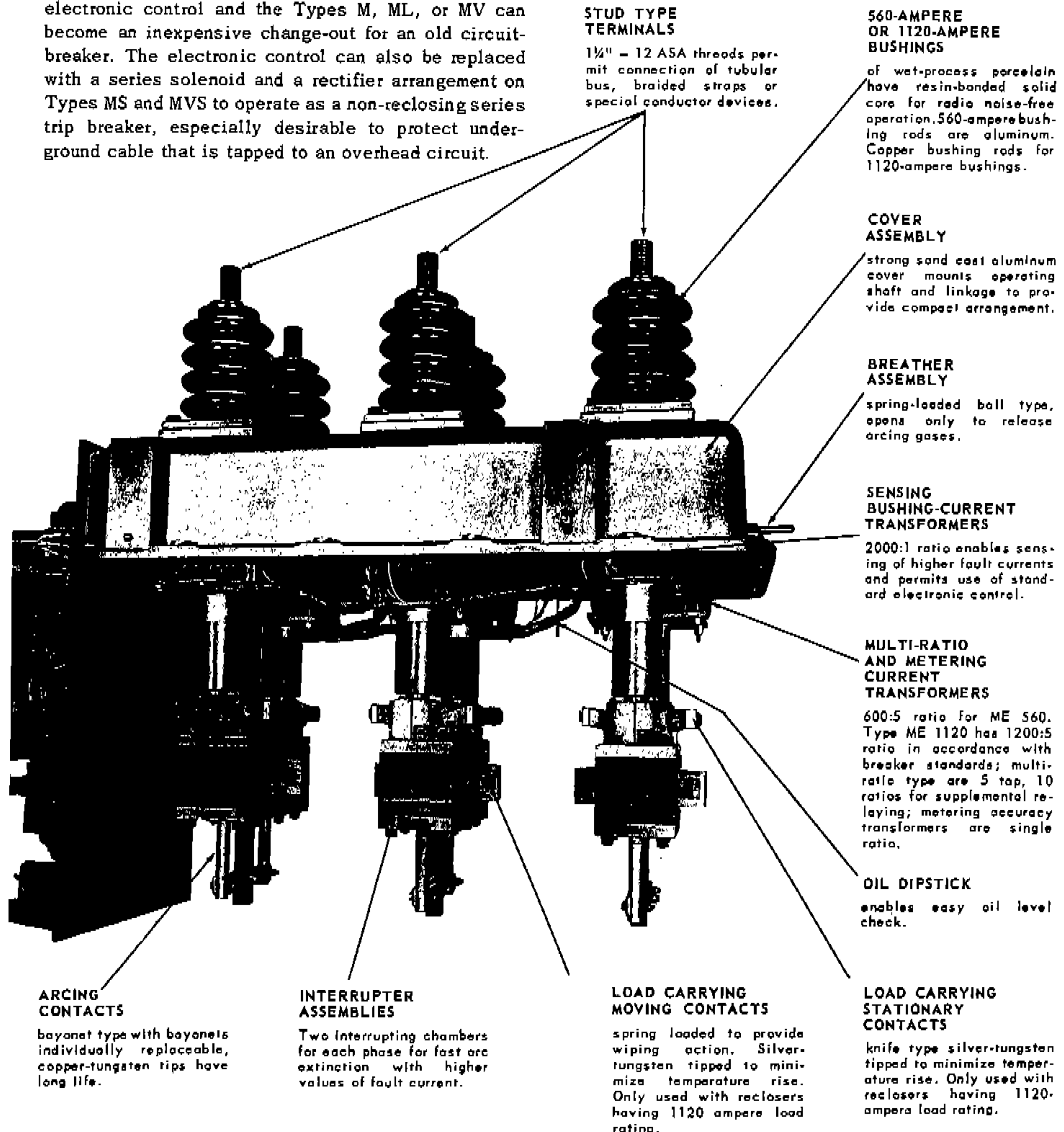


FIGURE 2
Untanked recloser

Arcs are extinguished in the rugged arc-interrupter assemblies. The moving contacts are tripped by a powerful spring in the operating mechanism that is charged by a universal motor.

Motor operation is from a separate auxiliary source; usually 230-volt ac. The motor drive is transmitted through a gear reduction unit to a cam and rod which engage the trip mechanism. The trip mechanism is

attached to the operating shaft extending through the cover of the recloser. Internally, the recloser operating shaft is linked to the contact rods, externally a semaphore marked "OPEN" and "CLOSE" indicates contact position. A manual close crank used on the motor shaft when the brake is manually released enables manual opening and closing of the contacts with the recloser de-energized and motor voltage off.

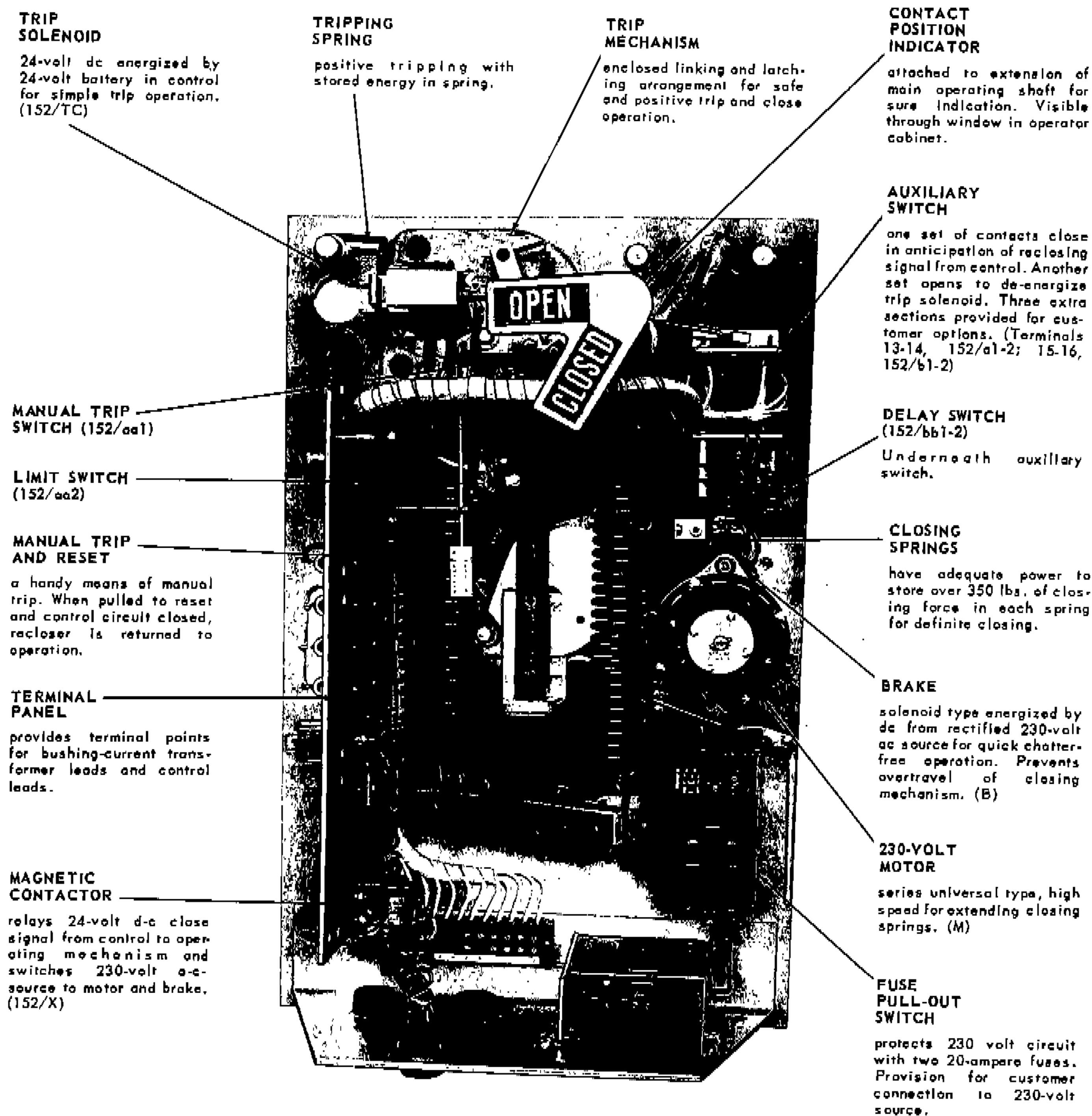


FIGURE 3
Operating mechanism, Type ME

RECEPTACLE

for internal bushing current transformer leads and connection to terminal blocks.

TERMINAL BLOCKS

prewired for customer's connection to bushing current transformers.

POWER RELAYS

provide control of recloser tripping and closing operations.

FUSE PULLOUT SWITCHES

separated for safe simple connection of opening and closing power.

TRIPPING SOLENOID

triggers tripping mechanism on signal from tripping relay.

OPERATIONS COUNTER

behind operating shaft to record tripping operations.

MANUAL RECLOSE

toggle switch at operating mechanism permits local reclosing for remote controlled reclosers.

UNIVERSAL MOTOR

high speed for extending closing springs.

HEATER

is optional for use in highly humid atmosphere to prevent condensation.

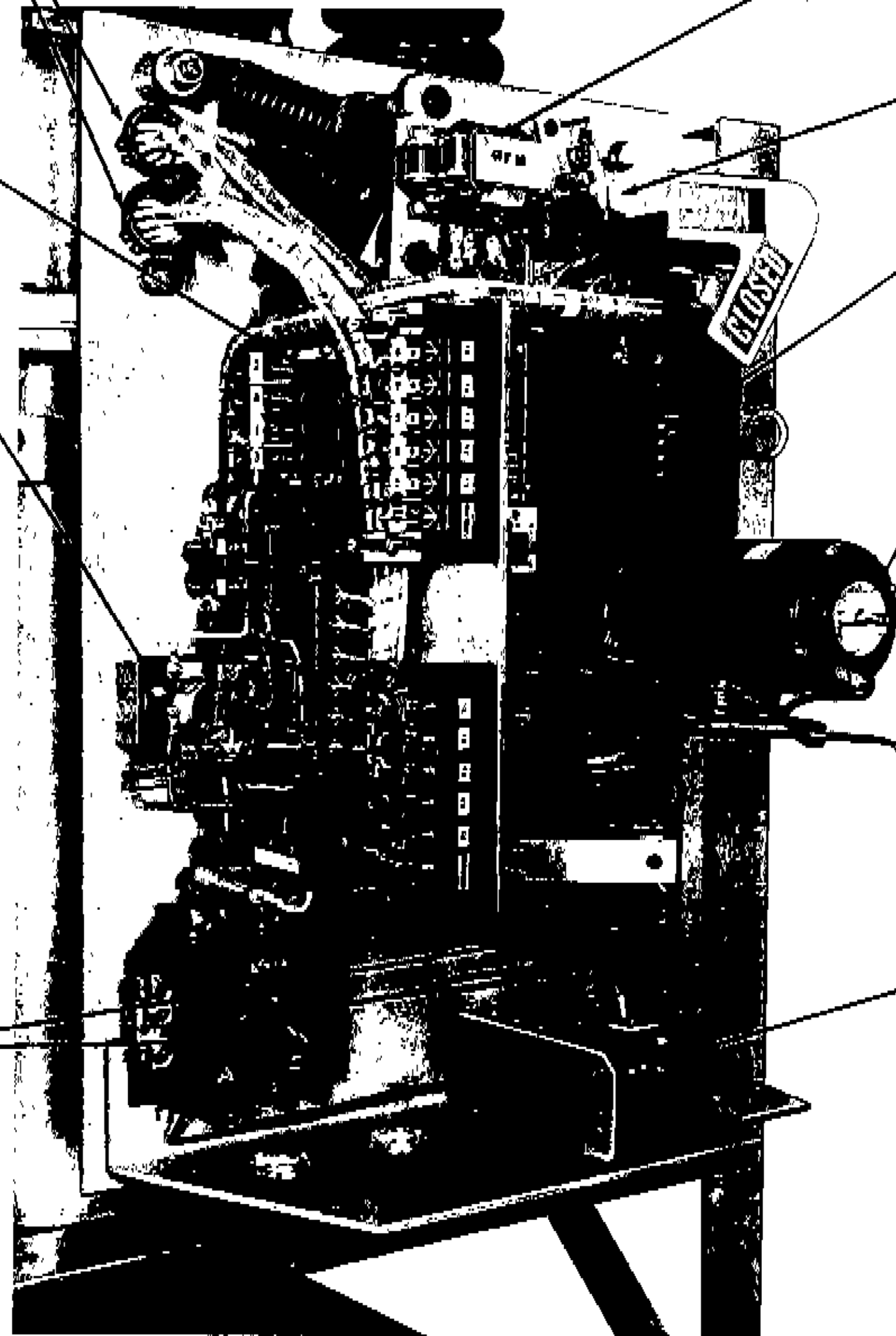


FIGURE 4

Operating mechanism for relay controlled operation

GENERAL MAINTENANCE INFORMATION

This equipment can perform at peak efficiency only if it is maintained in good condition. While maintenance is relatively easy and inexpensive, it is important.

Frequency of maintenance depends upon local climatic conditions and the interrupting duty imposed on the recloser. M-E recommends the unit be inspected completely, cleaned and filled with new oil at least once each year. If this apparatus operates through a duty cycle in less than one year, periodic maintenance should be performed then.

Duty cycles for reclosing duty are listed below. When the unit is not used for reclosing it is quite possible that the number of operations in a duty cycle may not be ever approached, which would infer that no maintenance is ever necessary. This is true except for the need to change oil and an occasional clean-up.

Duty Cycle Table

Type	No. of Operations	Percent of Interrupting Rating	X/R Ratio of Test Circuit
ME, MLE, 16,000 amperes at 14.4 kv	24	15 to 20	5
	20	45 to 55	12
	8	90 to 100	25
Total	52		
MVE 8,000 amperes at 24.9 kv	28	15 to 20	4
	20	45 to 55	8
	10	90 to 100	15
Total	58		

Characteristics of Oil for M-E Switchgear

- Color: nearly colorless
 - ASTM colorimeter 1.0 max.
 - Union colorimeter 2.0 max.
- Reaction neutral
- Neutralization number 0.03 mg KOH/g max.
- Free sulfur none
 - corrosive sulfur 3.0 max.
- Steam emulsion number 25 seconds max.
- Flash point 145°C min.
(293°F)
- Fire point 160°C min.
(320°F)
- Pour point -45.6°C max.
-50°F
- Viscosity:
 - at 37.8° (100°F)
 - Saybolt Universal 62 seconds max.
 - at 0°C (32°F)
 - Saybolt Universal 320 seconds max.

- Specific gravity:
 - at 29.9°C (86.0°F) 895 g/cc max.
 - Specific heat 0.488 approx.

- Co-efficient of expansion:
 - at 0°C (32°F) 0.000725
 - at 100°C (212°F) 0.000755
- Interfacial tension 40 dynes/cm min.
- Dielectric constant 2.2
- Dielectric strength 26,000 volts min.
- Weight per gallon 7.5 lbs.

Solid Insulation

The contact rod assembly and the arc interrupting structure members also constitute major insulation in the recloser. Although less susceptible to deterioration than insulating oil, this solid insulation is weakened by continuous exposure in contaminated oil and may ultimately fail dielectrically. It is recommended that a device such as M-E's TE tester be used to check the solid insulation each time shop maintenance is performed. If any parts making up this solid insulation test out marginal, they should be replaced.

PERIODIC FIELD INSPECTION AND MAINTENANCE

The following field inspection and maintenance procedures can be performed on a recloser without removing it from the mounting frame. Use the following steps for equipment that is performing reclosing duty:

1. BYPASS, TRIP AND DE-ENERGIZE THE RECLOSER

Disconnect the control cable from the recloser operating cabinet. Be sure to switch off the auxiliary source used to energize the motor in the operator cabinet.

2. INSPECT EXTERNAL COMPONENTS

Check for cracked bushings, paint scratches or other mechanical damage.

3. LOWER TANK TO EXPOSE INTERNAL COMPONENTS

Turn hoist mechanism to take up slack. Then remove the cover bolts to free the tank from the cover assembly.

4. INSPECT ARCING CONTACTS

Arcing tips of the bayonet contacts can experience considerable erosion before replacement is

necessary. However, the contacts should be replaced before their effectiveness is impaired by erosion of contact surfaces.

Figure 5 shows a set of moving contacts after they have experienced severe interrupting duty, and a new set for comparison. The used contacts shown have reached the condition where they should be replaced. When the moving contacts are replaced the stationary contacts will also require replacement.



FIGURE 6

Stationary arcing contacts; left new, right, after one full duty cycle

5. INSPECT TANK LINERS

Any soft or spongy areas in the liners indicate moisture has been absorbed. These areas are most likely to occur near the bottom of the tank. Replace any liners that appear to have absorbed moisture. Figure 7 shows the liners installed.

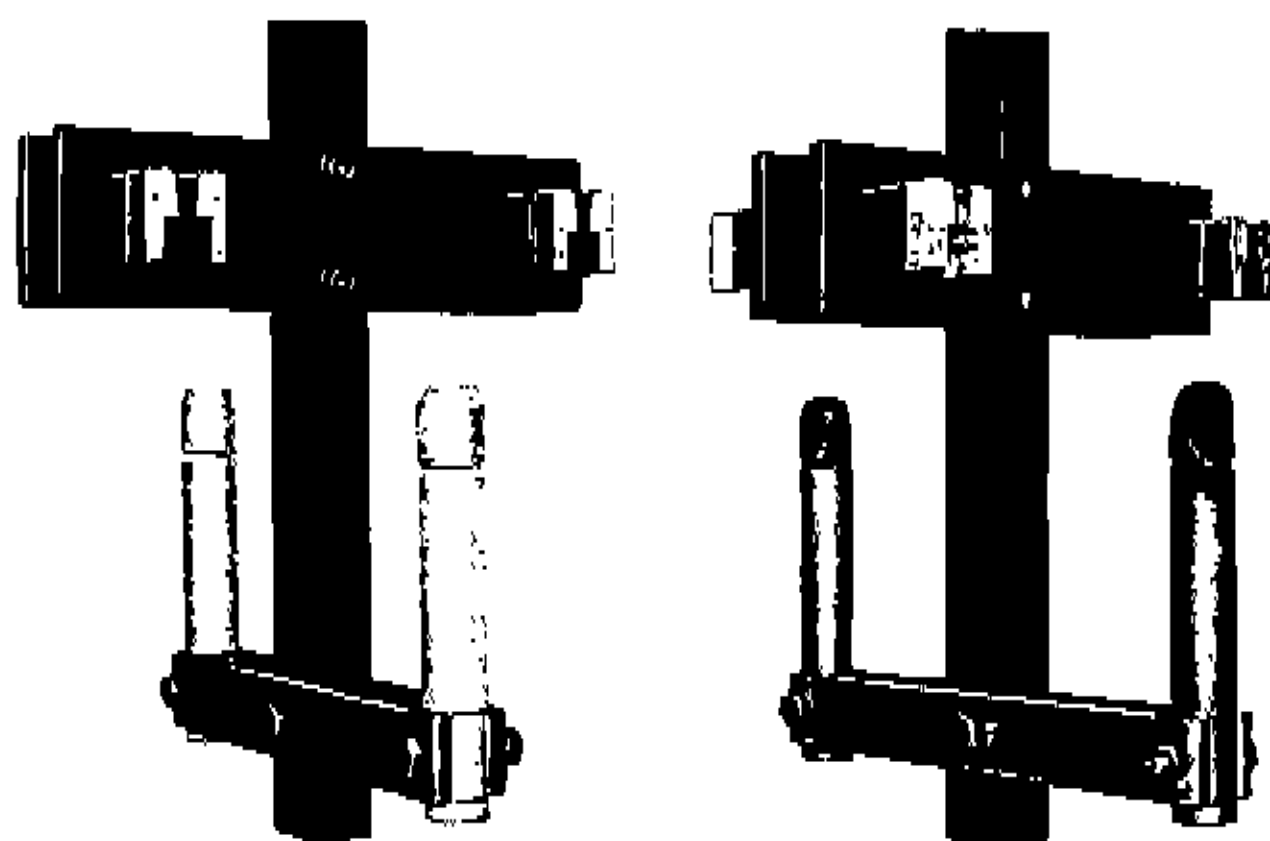


FIGURE 5

Moving contact set; left new, right, after one full duty cycle

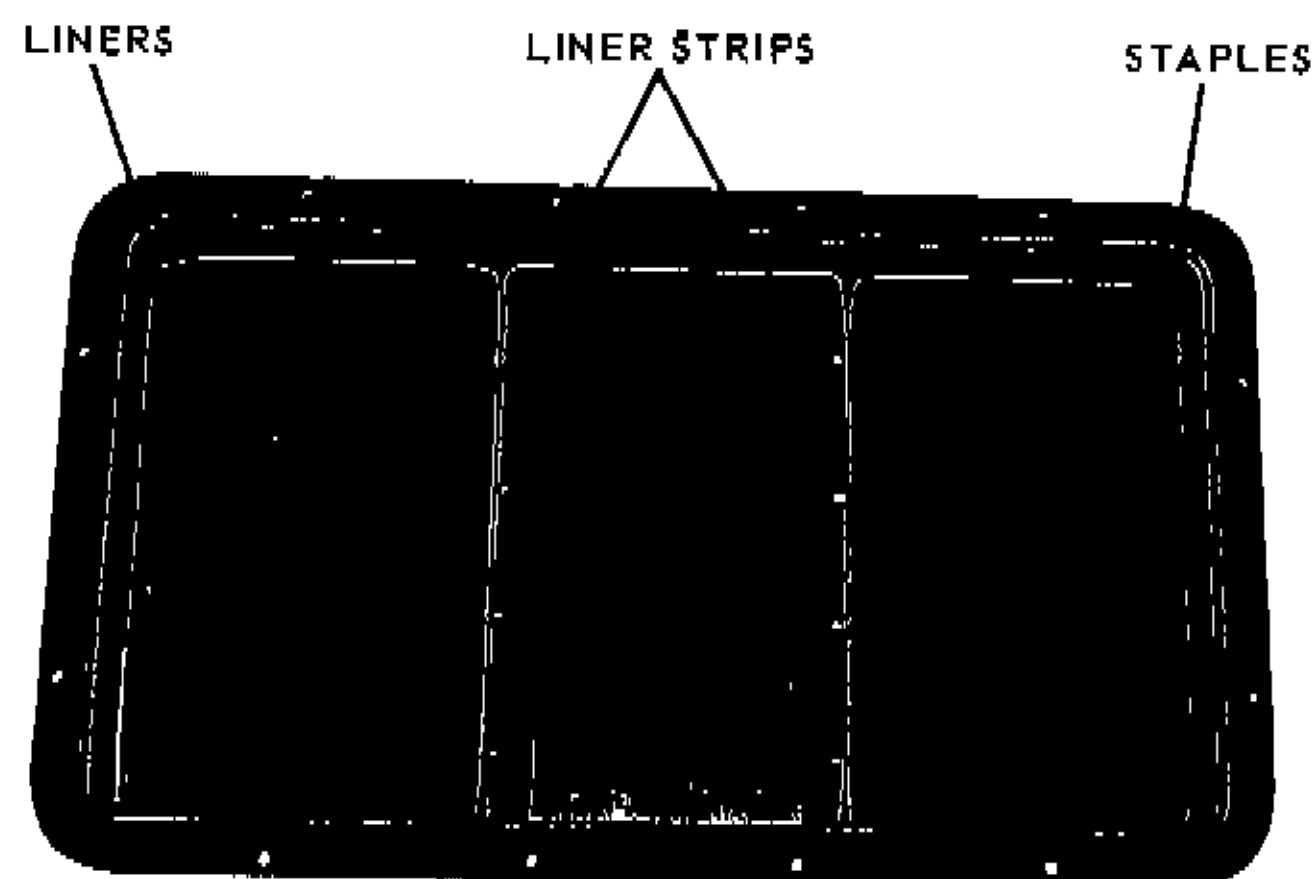


FIGURE 7

Tank with new liners and liner-strip installed

The recloser tank has three compartments; one for each interrupting assembly, and three compartment liners are used with each tank. New liners are furnished unstapled and should be stapled as indicated in illustration. The center liner is attached to the outer liners with an additional liner strip which is fastened with rivets and push-on fasteners.

If interrupting duty is severe, the tank liners may be eroded near the exhaust ports of the arc interrupting structures. Replace any liners that show appreciable erosion.

6. FILL TANK WITH OIL

Use only new clean transformer oil as previously specified. Approximately 46½ gallons fill the tank when the cover and interrupting mechanism are removed.

7. REPLACE TANK

Clean the cover mating flange and the tank gasket seat before hoisting tank to its mounting position. Make sure the cabinet back plate engages lug on tank. Secure cover to tank with ten 1½" head bolts. Two additional 7½" bolts secure the cover to the tank from the top of the cover, passing through a pipe-type spacer in the cover to tapped holes in the tank mating flange.

8. INSPECT OPERATOR MECHANISM

The separate operator mechanism and wire terminations from recloser to control are enclosed in a lockable cabinet assembly. This cabinet assembly may be completely removed to give all-around access for inspection and service. The cabinet fits over the inner housing assembly and is held in place with a single eye-bolt and wing nut located inside the door at the bottom of the operator cabinet. Upon removal of the wing nut, the cabinet may be lifted off. Check all components of the operating mechanism assembly. Be sure all wiring to the terminal strips is secure at each terminal. Also, check leads at auxiliary switch, trip solenoid, and the d-c relay behind the terminal panel. See Figures 3 and 4.

9. CONNECT CONTROL CABLE TO RECEPTACLE ON OPERATOR CABINET

Place recloser in service according to procedures outlined in the installation manual.

10. INSPECT ELECTRONIC CONTROL

See control service manual.

11. CHECK BUSHINGS FOR LEAKAGE

This direction is most important for reclosers with serial numbers prior to ME-145. Since then the original cork gasket which had a tendency to take a set has been replaced with a resilient neoprene-asbestos gasket.

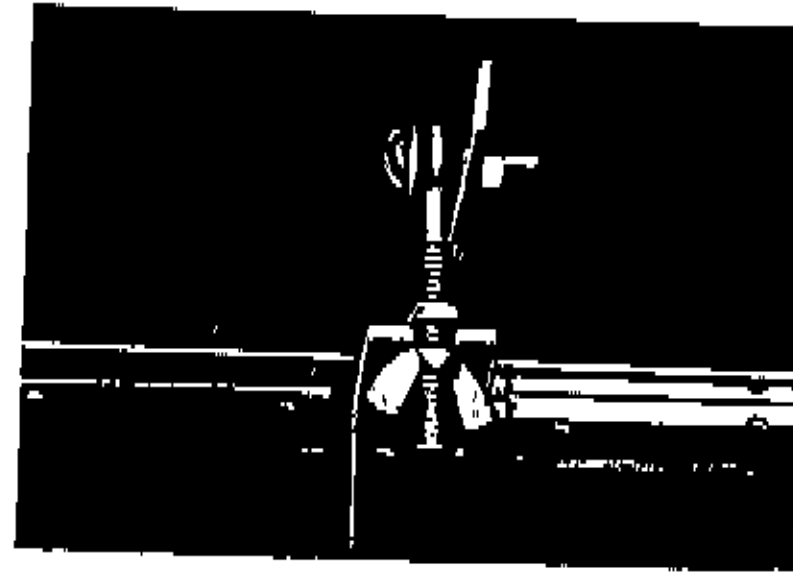


FIGURE 8

Location of wingnut for removing cabinet

If leakage is detected make sure the bushing porcelain bottom is concentric with the counter-bore in the mounting flange. If not, loosen set screw 1 shown in Figure 9. Then loosen top flange slightly. Tap porcelain bottom with wood block so porcelain will be concentric. Retighten top flange to 110 ft. lbs. and turn in setscrew.

To refill with oil, use oil filler screw marked number 2 on Figure 9. To refill a Type 3 bushing; set screw (1) should be backed off and the top terminal removed while holding down the porcelain to maintain a seal at lower end. The oil level should be approximately ¾ of an inch below top edge of porcelain; refill if necessary. The top terminal is then to be turned back on until surfaces meet, concentricity of porcelain to counter-bore checked and the top terminal torqued to 110 ft. lbs. minimum. The set screw (1) is then retightened.

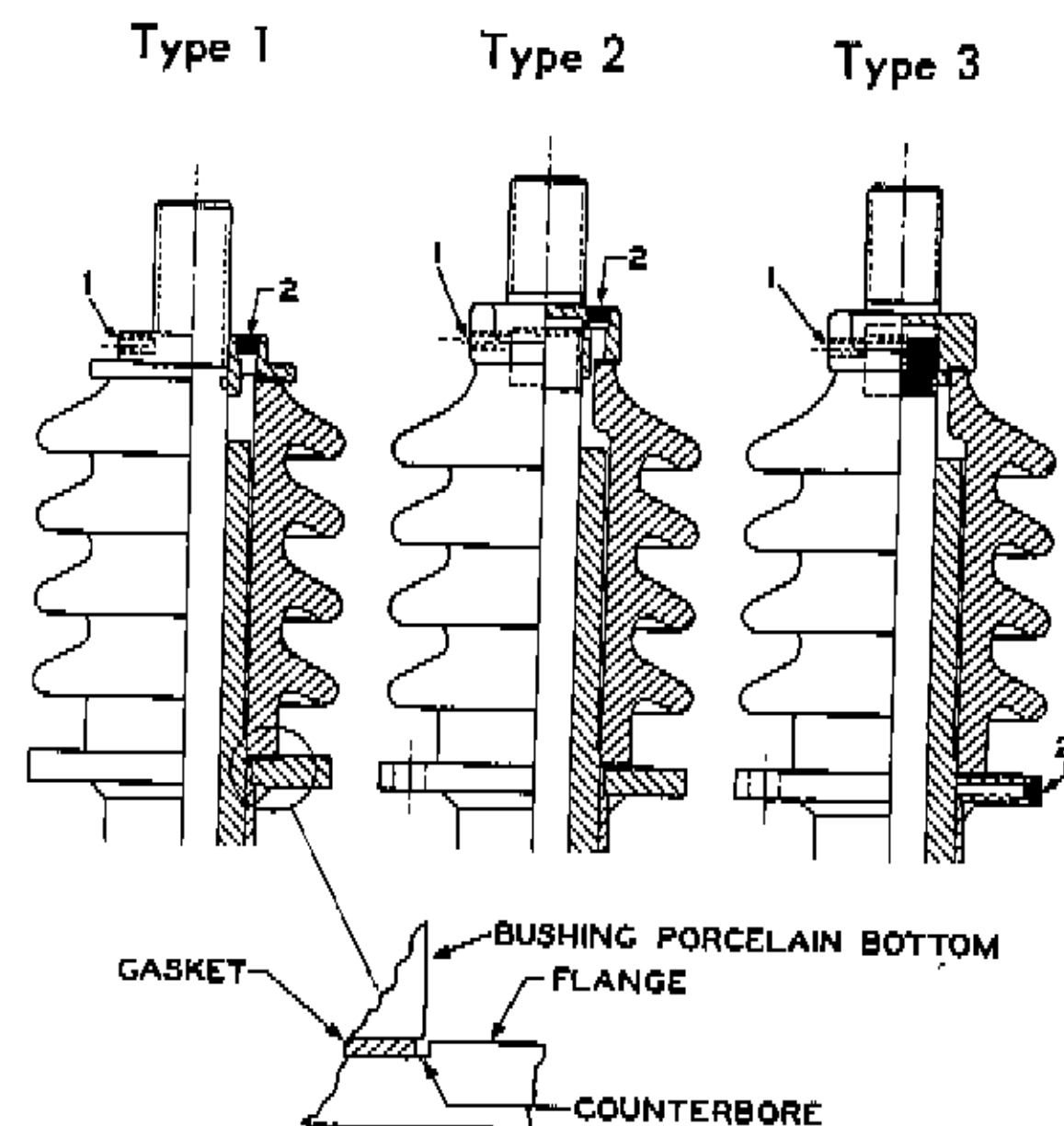


FIGURE 9

Bushing oil seals used prior to serial ME-145

SHOP MAINTENANCE

When shop maintenance or repairs are to be performed on the recloser, remove the bolts that secure the head-casting to the tank. Use the tank hoist assembly to lower the tank to ground after which it may be removed to provide complete access to the recloser mechanism. Any service or repair to the operator mechanism must be preceded by the removal of the operating cabinet assembly, as described in "Periodic Field Inspection and Maintenance" section.

Arc Interrupting Assembly Removal

After the recloser has operated through a complete duty cycle, the arc interrupter assemblies should be completely dismantled and any worn parts replaced.

The interrupter assembly can be dismantled without removing the interrupter casting from the bushings in the following manner:

1. With the recloser untanked and the contacts tripped, remove the four stationary load contacts from the interrupter casting assembly, each of which are fastened with two brass capscrews and lockwashers.
2. To assure rigidity of adjustment of the interrupter casting on the bushing, it is recommended that a guide bar of $\frac{3}{8}$ inch stock and about $\frac{3}{4}$ inch wide be used as illustrated. The bar should have $\frac{3}{8}$ inch holes to mate with the tapped holes in the interrupter casting.

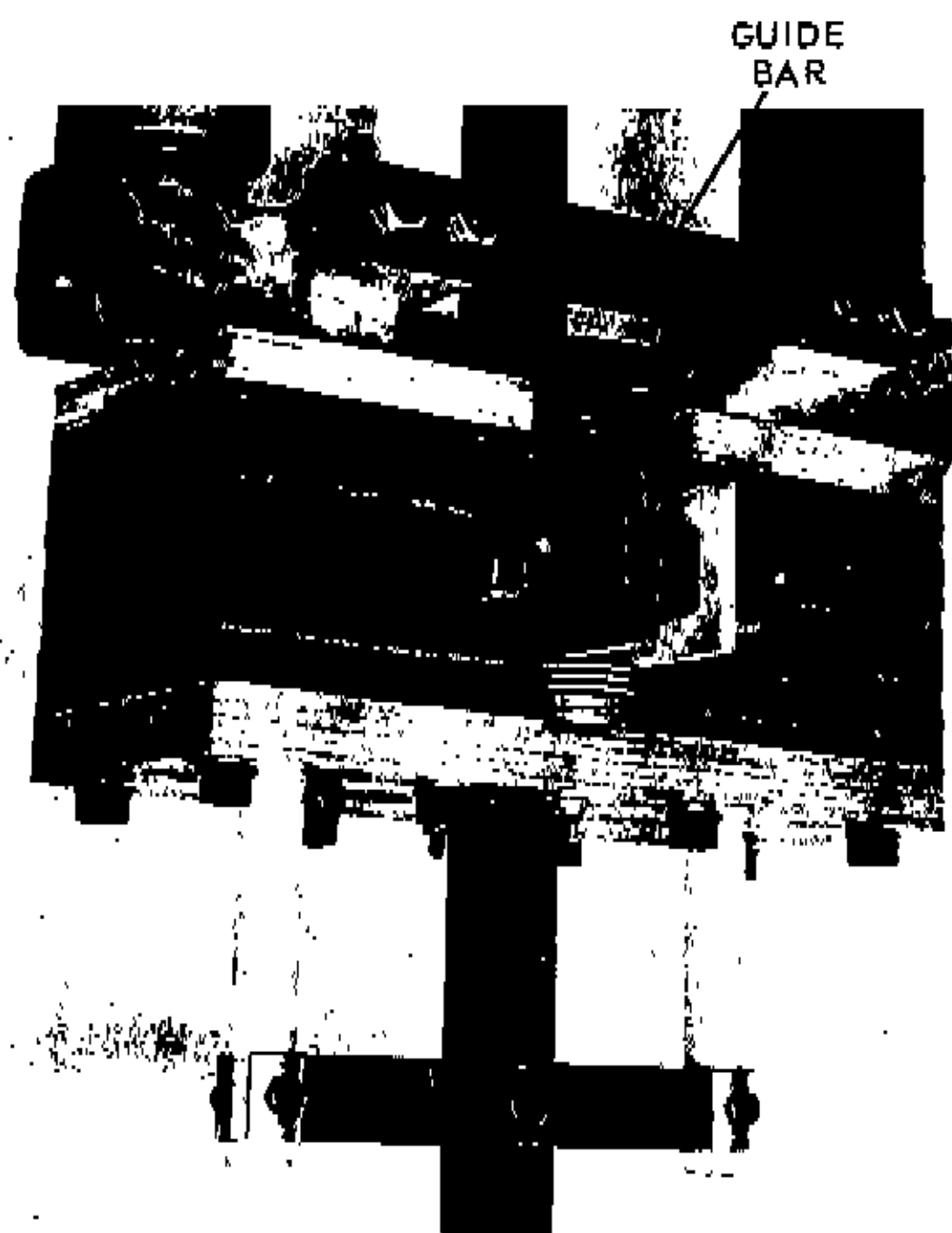


FIGURE 10
Guide bar attached to interrupter casting following removal of stationary load contacts

3. Then remove cotter pin and contact rod pin where the contact rod is connected to the bell-crank lever on the operating shaft.
4. Alternately unfasten the top three $\frac{3}{8}$ inch nuts and lockwashers on each interrupter casting.
5. The interrupting chamber assemblies may then be dropped down off the interrupter casting with the contact rod assembly.



FIGURE 11
Contact rod pinned to operating shaft on Type MVE

Stationary Arcing Contacts

The stationary arcing contact assemblies are retained on the interrupting castings with the removal of the interrupting chambers. To remove stationary arcing contact:

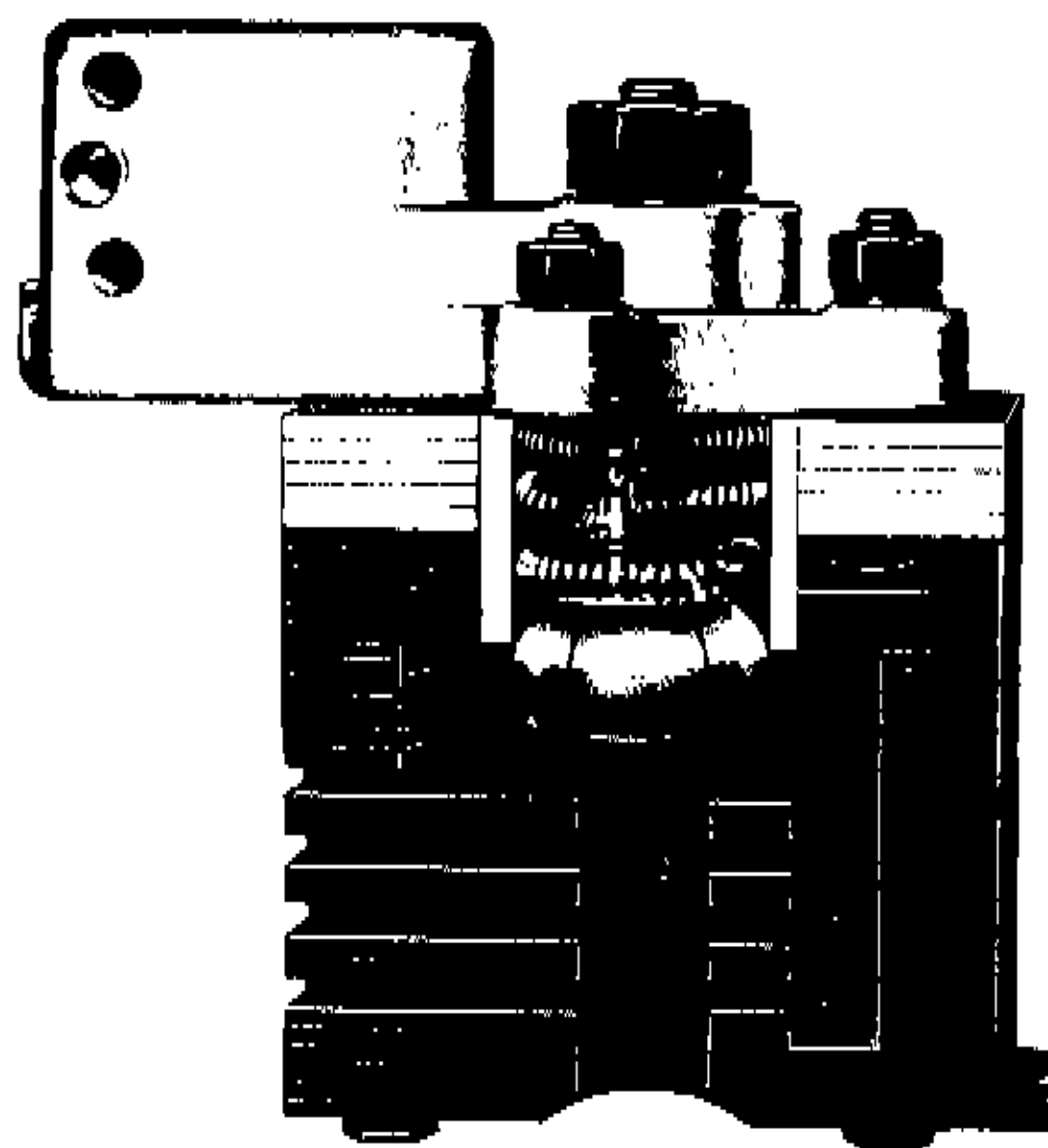


FIGURE 12
Cross-section of interrupting structure

1. With an adjustable wrench, hold the $\frac{1}{2}$ inch brass terminal nut of the contact stud on the interrupter casting.
2. Use a wide screwdriver in the slotted contact stud located inside the contact assembly and remove terminal nut and lockwasher.
3. Pull and twist the contact segments to remove the contact assembly. Twisting out of the contact assembly can only be done in the direction that it was originally assembled because of the spring setting on the interrupter casting.



FIGURE 13
Stationary contact assembly

To reassemble stationary contacts, arrange the six segments so they are hooked to the slotted head of the contact stud. Use a rubber band to hold them in place while installing springs. Slip the steel spring on, then a spacer ring; follow with one-copper-alloy spring, a spacer ring, and the second copper-alloy spring.

NOTE: Installation of the spacer rings over the contact segments can be simplified by the use of a tapered wooden sleeve, easily made in any woodworking shop. Turn and drill a piece as displayed in illustration. Slip the sleeve over the end of the heavy screw and roll the spacer rings in place over the contact segments.



FIGURE 14
Sleeve for assembling
stationary contact springs

Interrupting Chamber Assembly

Bench disassembly of the interrupting chamber assemblies begins with the removal of the eight plain washers, lockwashers and nuts on the stud-type stringers. Then:

1. Pull off the fiber plates, marking each with a colored pencil to insure proper order of reassembly if they are re-usable upon further inspection.
2. Examine the fiber plate interrupting chambers during removal. Plate erosion due to repeatedly high arc interruptions should not extend to provide less than one inch of existing stock at any extension of its diameter.
3. Three of the plates in each interrupting chamber assembly have a slot out on one end to form exhaust ports. Each arc interruption causes some erosion of these slots which will result in longer arcs being drawn.

If less than a quarter-inch fiber stock remains toward the stringer holes, these fiber plates should be replaced. With the nominal cost of these fiber plates, maintenance personnel should not be hesitant about plate replacement when extent of erosion becomes questionable. Recommended method of replacement is with a complete new stack of plates.

It should be remembered that the high fault current interruptions that are encountered by these interrupting chambers will decrease the recloser's duty cycle if doubtful replacement practices are used.

Refer to the interrupter cutaway and to the exploded views listed in the parts list for order of interrupting chamber assembly. Using a complete new stack of plates prevents any error in stacking order.

Load Carrying Contacts

The stationary load carrying contacts on the interrupter assembly and the moving contacts on the contact rod are used with the Type ME 1120-ampere recloser only. The moving contacts on the contact rod are spring-loaded and held in place with a capscrew and an elastic stop nut. Although it may never be necessary, removal of the capscrew, spacers, washers, spring and nut permits these moving contacts to be pulled out and replaced.

SHOP MAINTENANCE – CONT'D.

Adjusting Recloser Contacts

Recloser contacts must be adjusted after each reassembly. They may also be checked by using the following adjustment instructions with the recloser untanked.

Untank the recloser by removing cover bolts and lowering tank with hoist assembly. When lowering tank, note that the bottom of the motor and mechanism panel has been engaged in a lug on the tank assembly. When the tank is lowered for testing, secure the backplate support across the frame to brace the bottom of the panel to counteract any rebound action of the heavy closing springs. This support must be removed to lower or raise the tank. Then, to check operation of contacts:

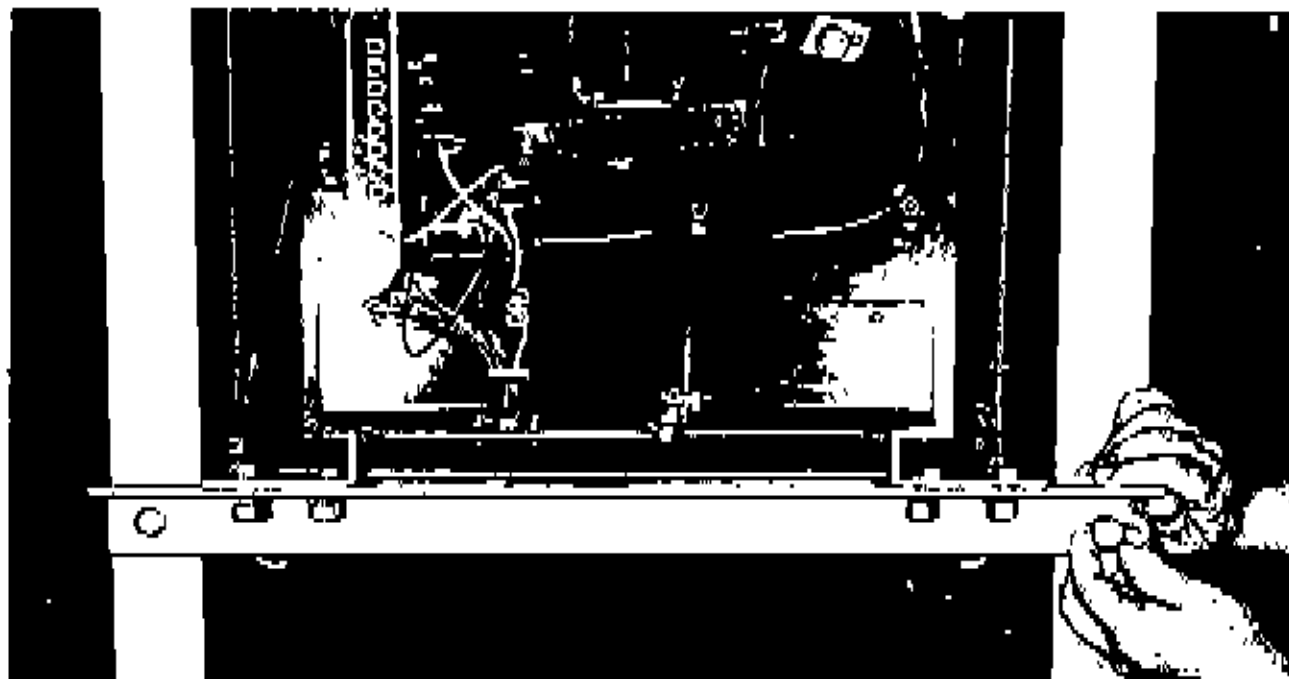


FIGURE 15
Securing backplate support

1. Use the crank clipped in the cabinet assembly to engage motor shaft for manual closing of the recloser.
2. Extend closing springs by pushing in brake rod and turning motor clockwise with the crank. Turn motor shaft until the main latch drops into place. Do not allow the cam follower to drop off.
3. Reverse rotation of motor with crank allowing the actuating rod to close the contacts slowly. This allows the observation of contact movement during the closing operation. Check for binding or misalignment of the arcing and main load carrying contacts.
4. With contacts open, close contacts by cranking motor shaft clockwise, allowing springs to close contacts by running off cover.

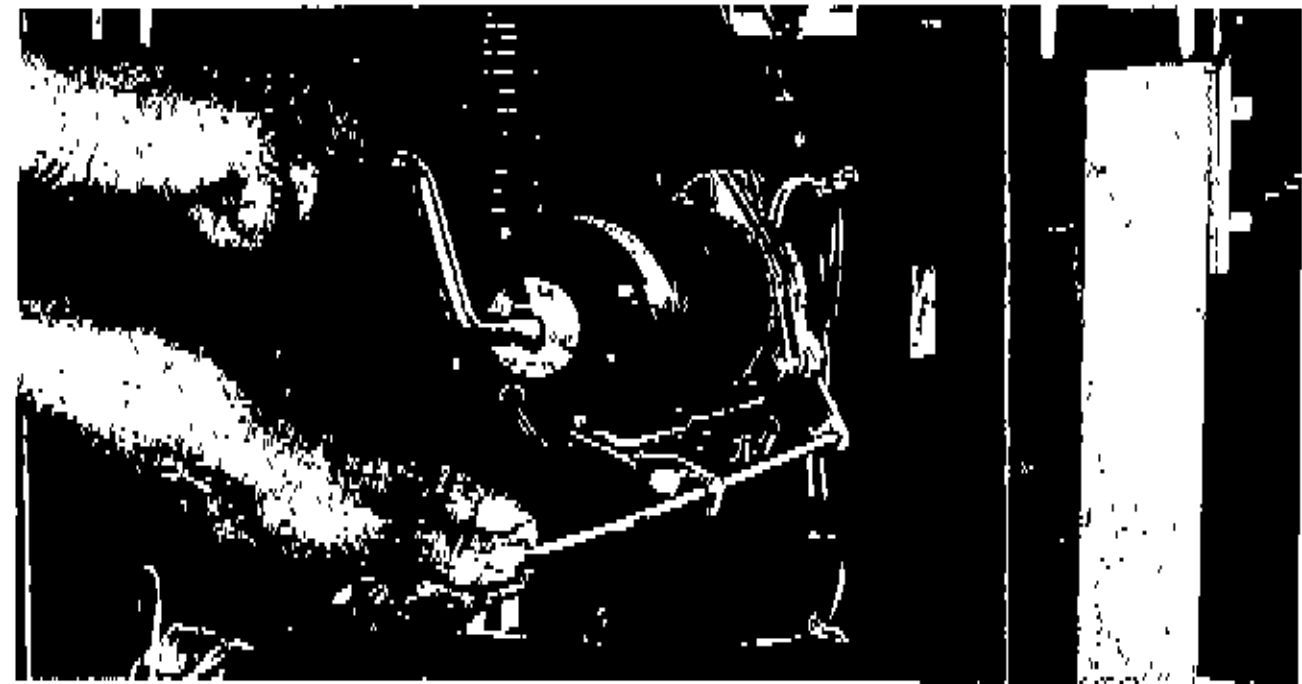


FIGURE 16
Manual closing of recloser

With contacts closed, check clearance between the bayonet yoke and the bottom of the interrupter base plate. This dimension should be a minimum of $\frac{1}{32}$ " and a maximum of $\frac{1}{16}$ ". If these dimensions are exceeded, the interrupter assembly should be readjusted on the bushing assembly in the following manner:

- a. Loosen clamping bolts at interrupter casting and bushings.
- b. Tighten jackscrew until interrupting casting slides freely on bushing stud.
- c. Insert shim (max. $\frac{1}{16}$ ", min. $\frac{1}{32}$ ", .045" preferred) between bayonet yoke arm and underside of interrupter base plate. Use rubber-covered mallet to adjust interrupter assembly for clearance by tapping on the interrupter casting.

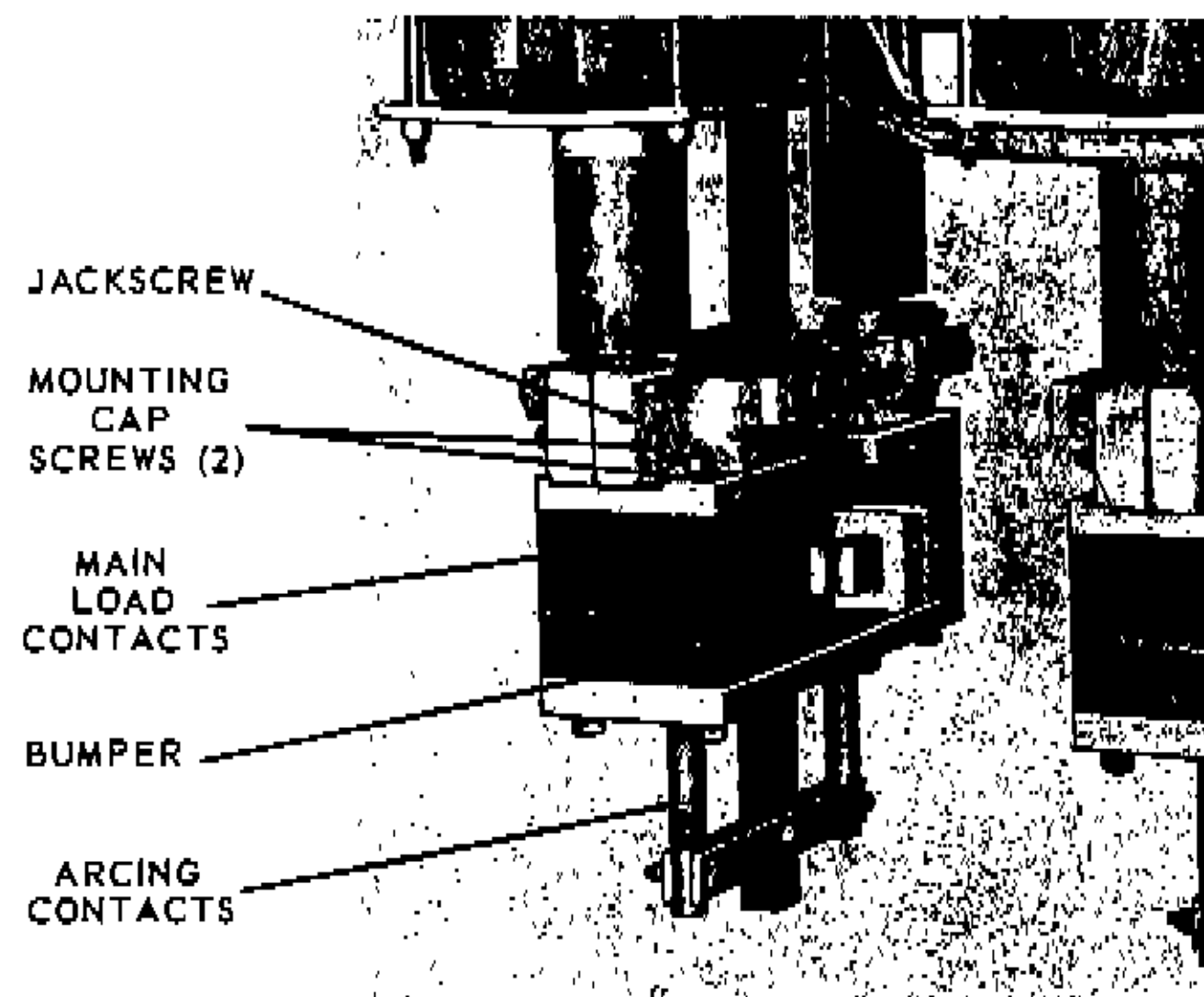


FIGURE 17
Interrupter adjusting points. Main load current carrying contacts are not used on Type MLE and MVE reclosers

- d. Loosen center socket head jackscrew on stationary load contact assembly and tighten upper and lower socket head capscrews. Then retighten center jackscrew. At this adjustment the overlap of the main load contacts should be $\frac{5}{16}$ " for the Type ME 1120-ampere recloser.
- e. Follow above closing adjustment with an opening adjustment by fully opening contacts. Contacts may be manually tripped by pushing up on manual trip and reset rod.
- f. Note position of bumper plates or main load moving contacts against bumper assemblies attached to the base plate of each interrupter. Bumper assembly should just touch bottom of main load contact yoke or the bumper plate yoke when recloser is tripped. The bumper assemblies absorb opening shocks of the contact or bumper plate yoke, as well as permitting the contact rod to travel its full stroke.
- g. Change height of both bumper assemblies in each interrupter, if necessary, by removing capscrew and adding or removing bumper discs. Both bumpers in each interrupter should have the same height.

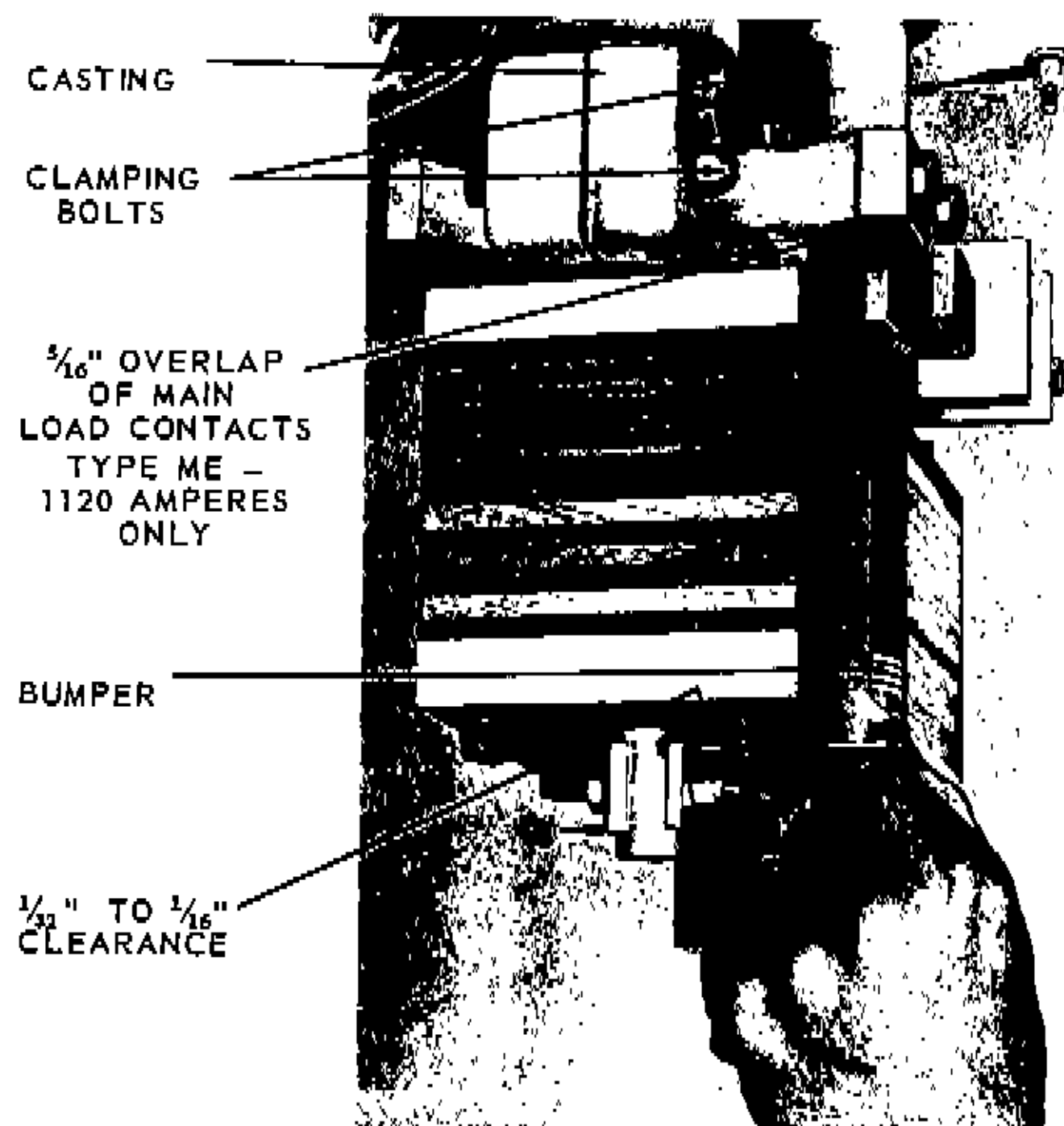


FIGURE 18
Adjusting interrupter assemblies

Bushing Replacement

Maintenance of bushings is generally limited to an occasional cleaning with a check for cracks or punctures. Because the bushings support the interrupter assemblies, the tank must be lowered prior to removal and replacement. When both bushings of one phase are to be substituted, replace one bushing at a time to provide support for the interrupter assembly by the opposite bushings. Then:

1. Loosen setscrews at side of stationary load contact assembly that are used to align the interrupter assembly with the bushing. See Figure 17.
2. Remove the socket head capscrews that pass through the stationary load contact assembly that clamps the bottom of the bushing.
3. Take off capscrews and lockwashers securing the bushing mounting flange to the cover and the bushing can be pulled out of the cover. Bushing weight is about 25 lbs.
4. Before replacing new bushing, use a new neoprene gasket at mounting flange.
5. Insert new bushing through the cover and fit bushing shank into interrupter casting.
6. Replace the mounting flange capscrews at cover tightening the four bolts evenly.
7. Before fastening the interrupters to the bushings, use the adjusting and aligning instructions previously described in the paragraph "Adjusting Recloser Contacts."
8. Repeat with same instructions for opposite bushing if needed.

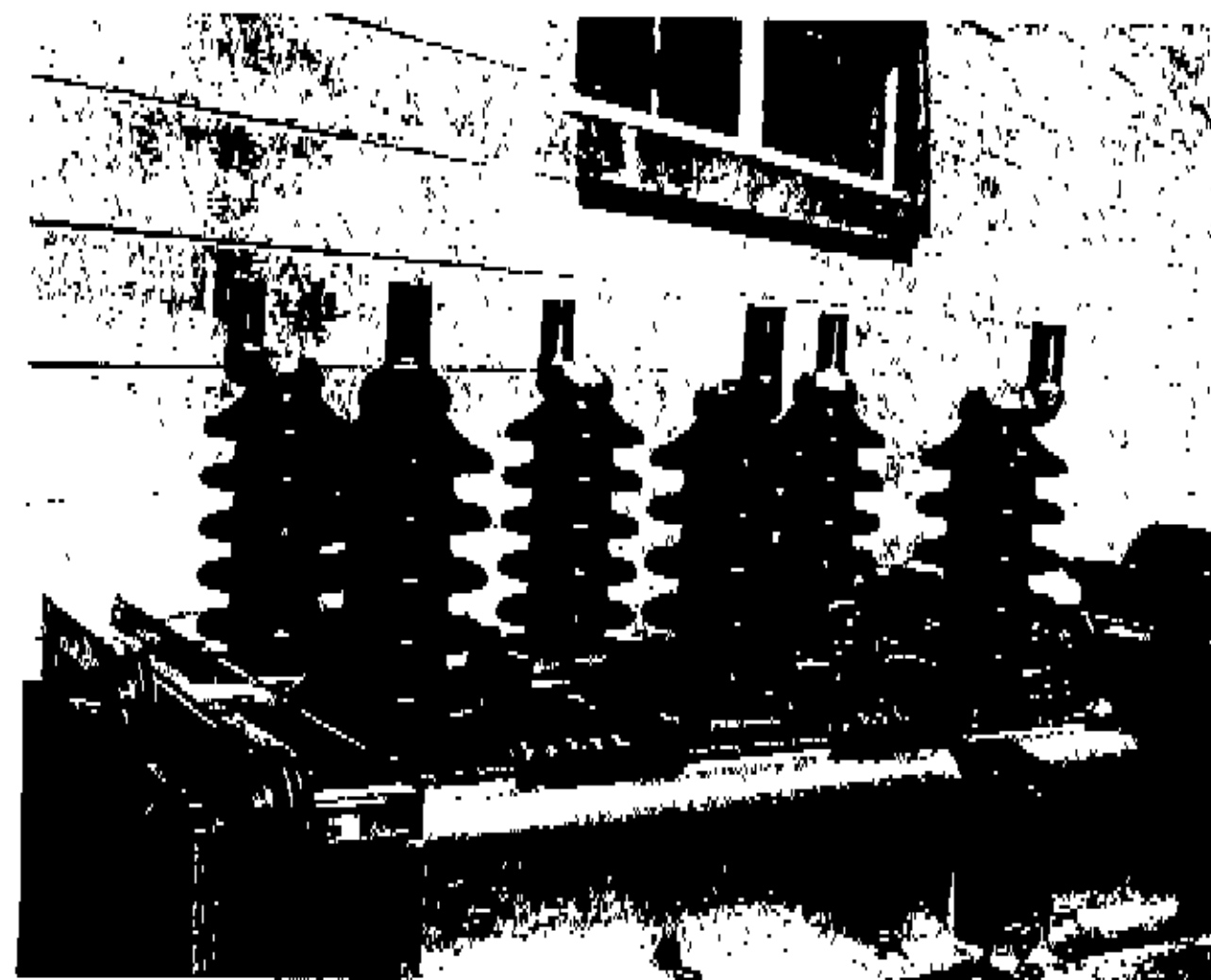


FIGURE 19
Offset bushing terminal positions on 24.9 kv reclosers

SHOP MAINTENANCE – CONT'D.

Recloser Cover Assembly

Located in the recloser cover are the sensing type bushing current transformers, the battery charging current transformer, (multi-ratio and metering current transformers when required) and the operating shaft. The operating shaft assembly is bearing-mounted in the recloser cover. Three needle bearings on the shaft are enclosed in the three bearing holders that are attached to the cover. Each of these bearing holders is fastened to the cover with a 3½-inch capscrew and one sensing current transformer stud and nut. A fourth shaft bearing is installed in the plate and receptacle support assembly attached to the cylinder head cover.

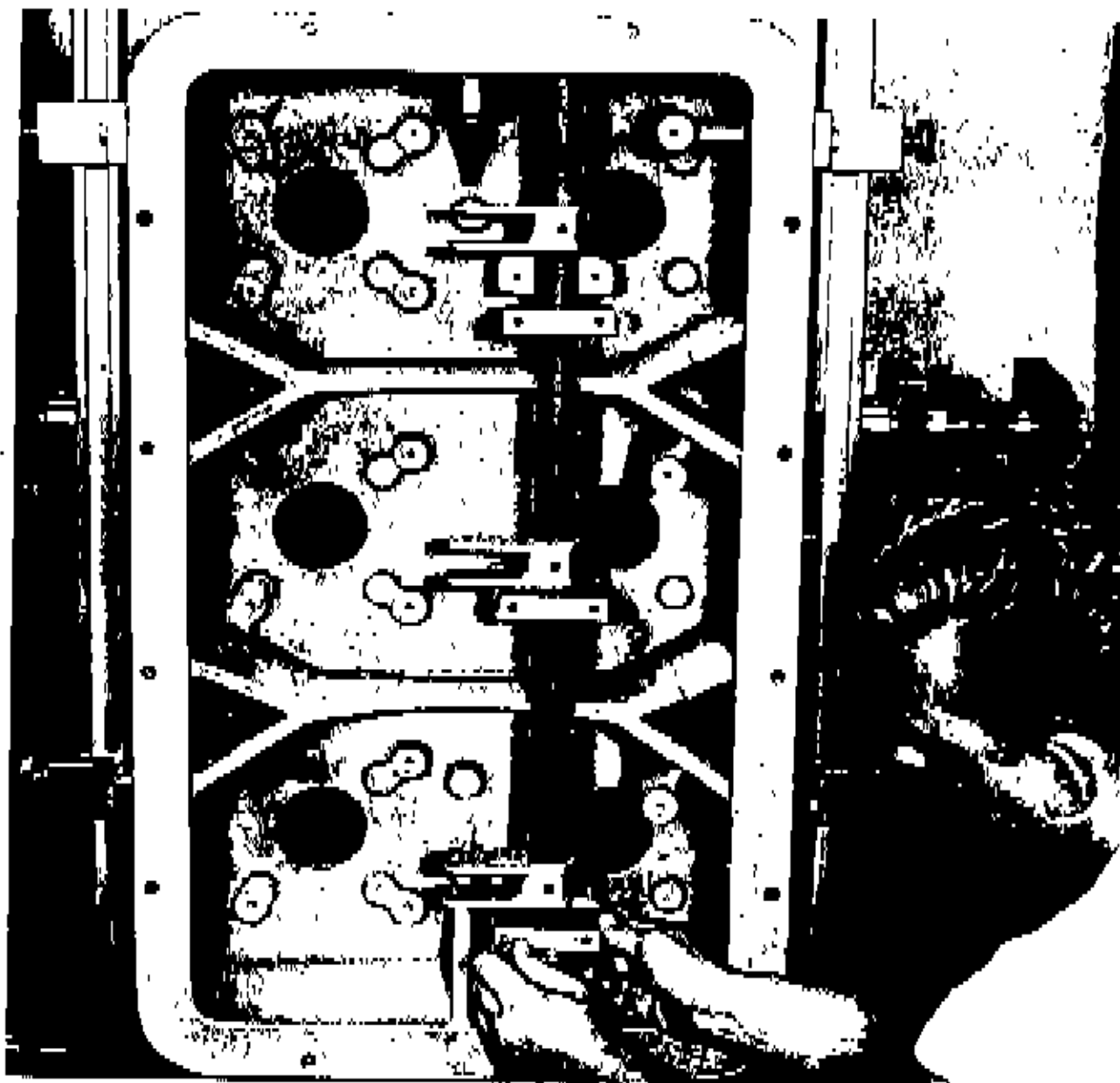


FIGURE 20

Replacing main bearings in cover assembly

Bellcranks, to operate the contact rods, are held on the operating shaft with roll pins. The contact rods are pinned to the bellcrank. It is unlikely that any of these operating shaft parts will require any service except for an occasional tightening and check of fastening parts.

At the factory the operating shaft is installed as a complete assembly with the front bellcrank and contact position indicator removed. This front bellcrank that connects the trip mechanism link and the auxiliary switch is pinned to the operating shaft after the shaft has been inserted in the cover and front plate assembly and is then fastened with the main bearing holders. The contact position indicator is pinned to the end of the shaft. Follow this same procedure if it is ever required to remove or replace the operating shaft assembly or any of its components.

OPERATOR MECHANISM

All moving parts in the operator mechanism have been permanently pre-lubricated. Repair services can be performed on individual components of the operator mechanism without disturbing the setting of allied parts. General repair and replacement services, while seldom necessary, are easily accomplished with the removal of the operator cabinet assembly as described in the "Periodic Field Inspection and Maintenance" section.

Further accessibility is also available, if required, with the removal of the closing springs, the trip mechanism assembly, and the gear box and motor assembly.

CLOSING SPRINGS

About a 760-pound pull is required to fully extend the closing springs, and in relaxed position closing spring force is about 400 pounds, so no attempt should be made to unhook the closing springs off of the spring yoke. Rather, note the top portion of each spring is threaded on a spring plug. Loosening the ¼ inch hexhead bolt that secures this spring plug will enable an easy unhook of the spring. Then to remove the spring, continue turning the spring plug off the bolt, leaving the bolt in place. When replacing the spring, turn the plug with spring onto the bolt while it remains in place because there is not enough clearance to remove one of the bolts under the operating shaft.

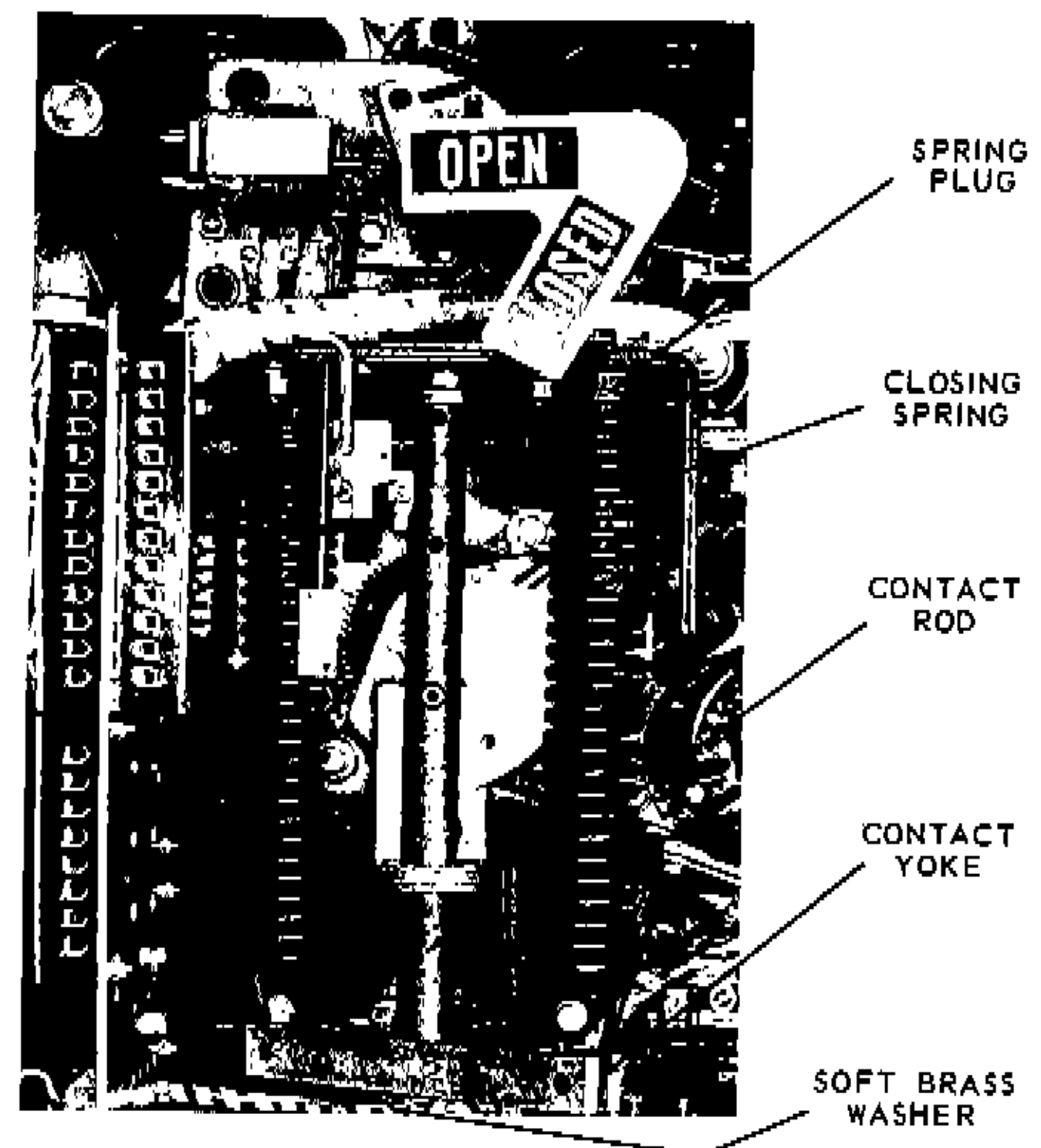


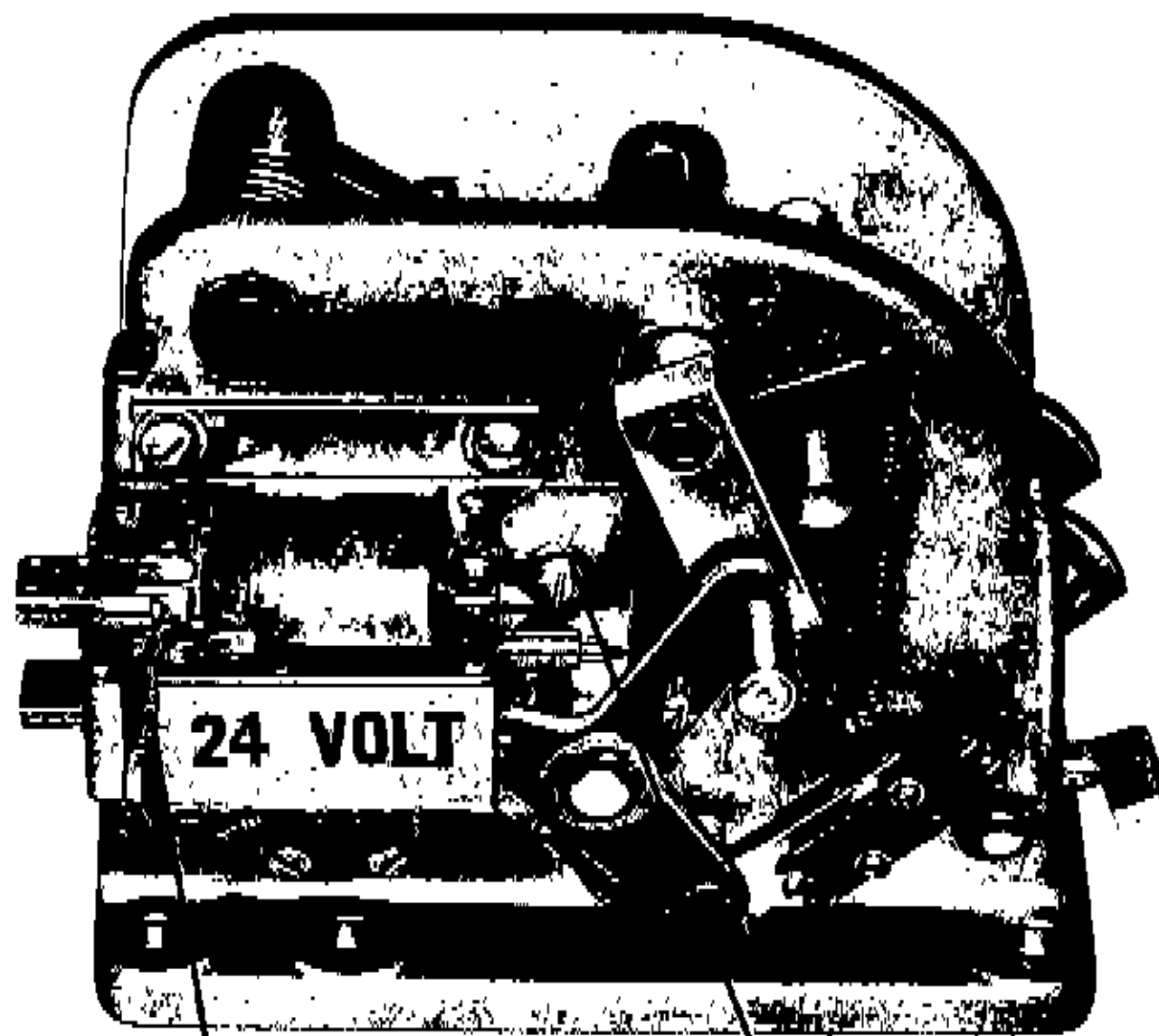
FIGURE 21

Closing springs and spring plugs

TRIP MECHANISM

The levers in the trip mechanism and the frame are of lightweight aluminum and all latches are steel so that the need for replacement is unlikely. Thru shafts in the trip mechanism assembly revolve in needle bearings that are press-fitted in the frame. Torsion springs in the assembly are used to return all levers to their original positions. Some of those components including the trip solenoid can be replaced, if necessary, without removing the trip mechanism assembly.

The trip solenoid is mounted directly on the trip mechanism and over an adjustable stop bracket, which limits the travel of the solenoid plunger. If the trip solenoid is ever replaced, the gap of the solenoid plunger stroke should be set to 1/4 of an inch. First loosen the adjustable stop bracket, which is secured with a round head machine screw. Then separate the solenoid 1/4 of an inch and secure this dimension with the bracket screw while the adjustable stop bracket is in contact with the outside of the solenoid plunger.



PLUNGER GAP 1/4 INCH STOP BRACKET SCREW

FIGURE 22
Solenoid plunger stroke gap

Use the following procedure if necessary to remove the trip mechanism assembly:

1. With the recloser tripped, remove tripping spring between bellcrank on operating shaft extension and the spring anchor on the back plate assembly.
2. Disconnect lead wires at the trip solenoid.
3. Remove retaining ring and pin on the trip mechanism linkage connected to bellcrank on the operating shaft extension.

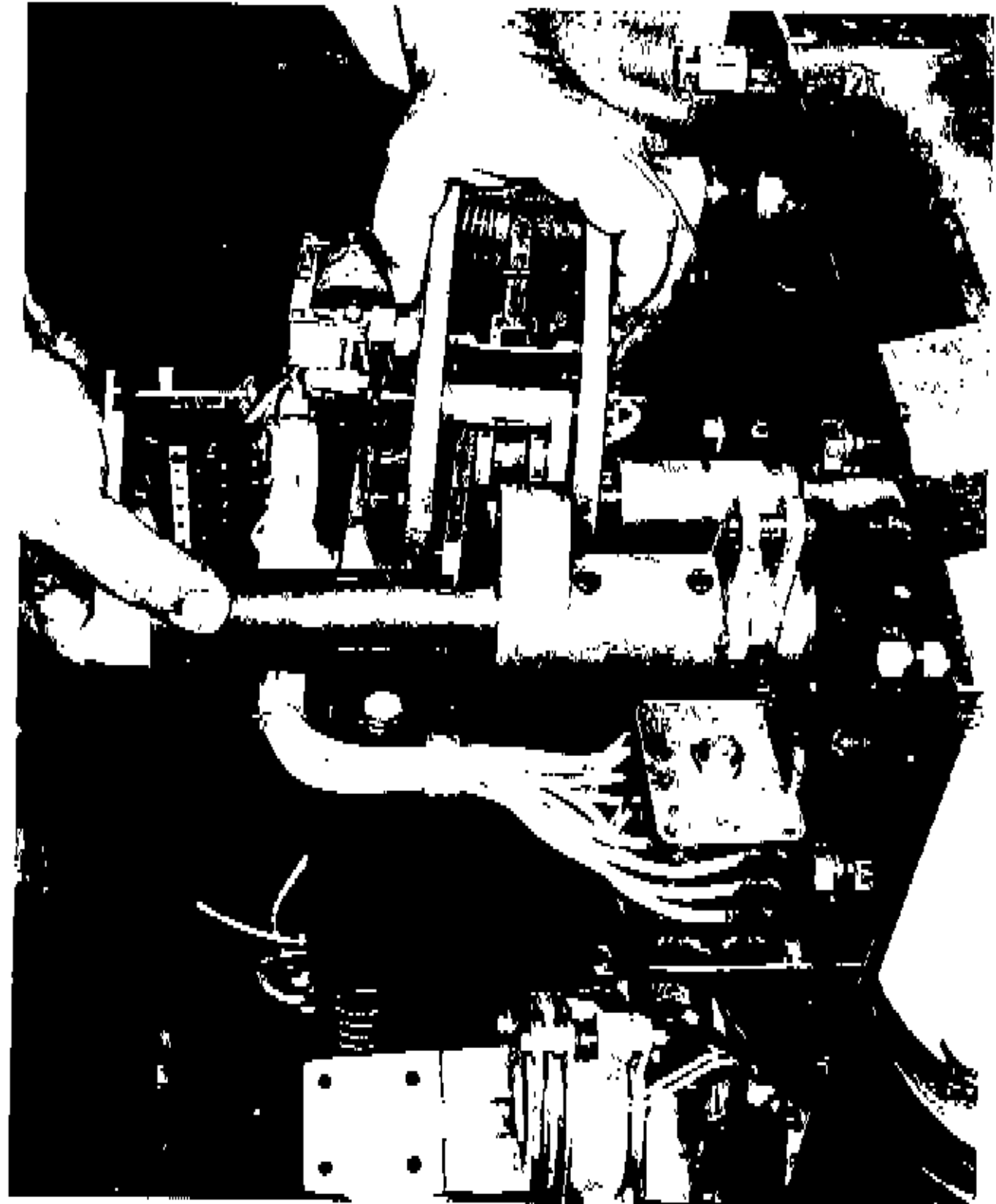


FIGURE 23
Removing trip mechanism assembly

4. Take out the four mounting capscrews that fasten the trip mechanism assembly to the top of the housing with a 3/8-inch socket.
5. With the trip spring removed, the operating shaft extension can be readily moved to provide the small clearance the trip mechanism needs to be removed as illustrated.

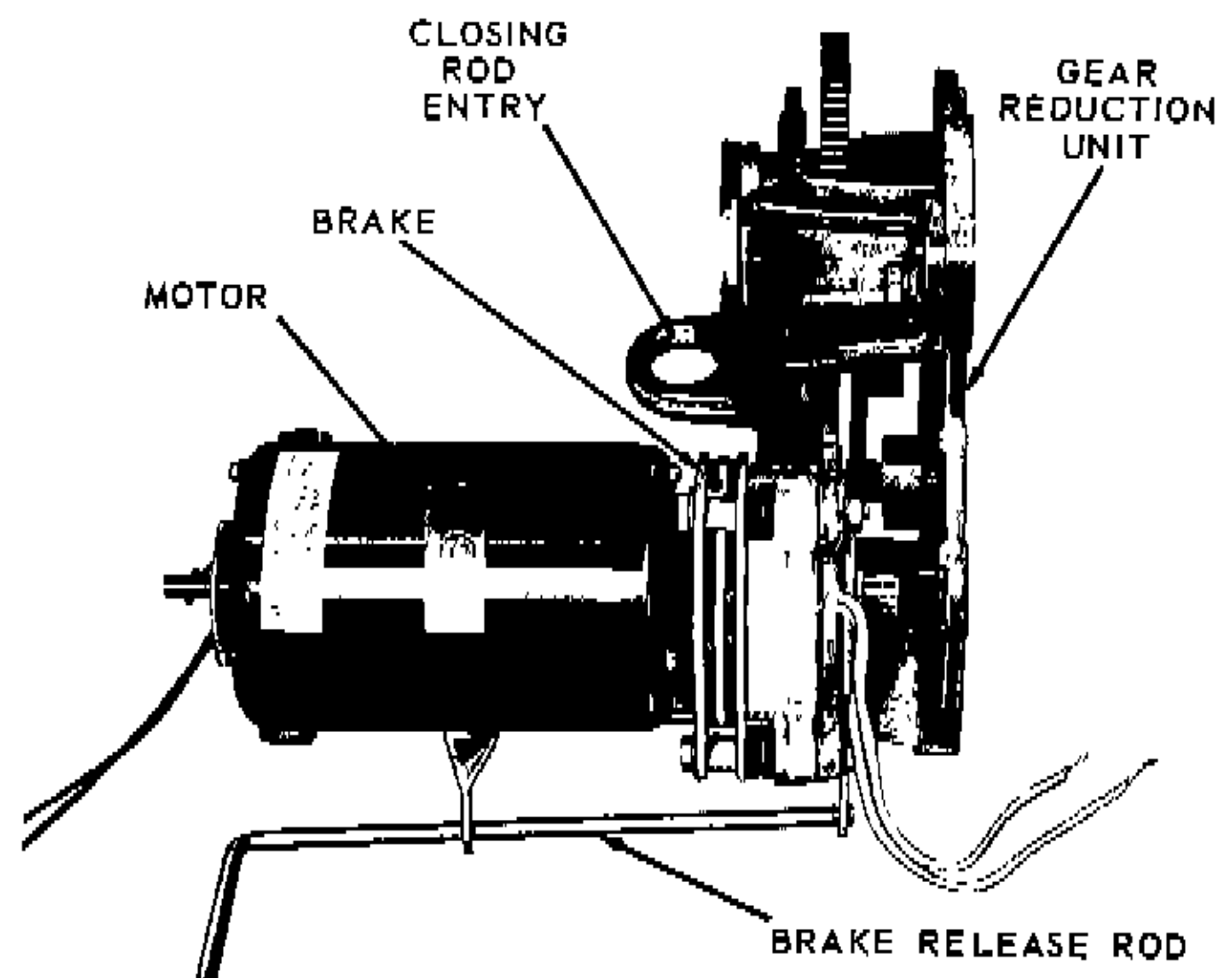


FIGURE 24
Motor and gearbox assembly removed

SHOP MAINTENANCE – CONT'D.

MOTOR AND GEAR BOX ASSEMBLY

The motor and gear box assembly function is to extend the closing springs and includes a motor, brake and the gear box assembly. A closing rod is inserted and attached to the gear box assembly. All of these components can be removed together after the closing springs have been removed; or the components can be removed separately. Three $\frac{3}{4}$ inch hexhead capscrews fasten the motor and gear box assembly to the plate and receptacle assembly. Remove the leads from the brake and motor before pulling out the complete motor and gear box assembly.

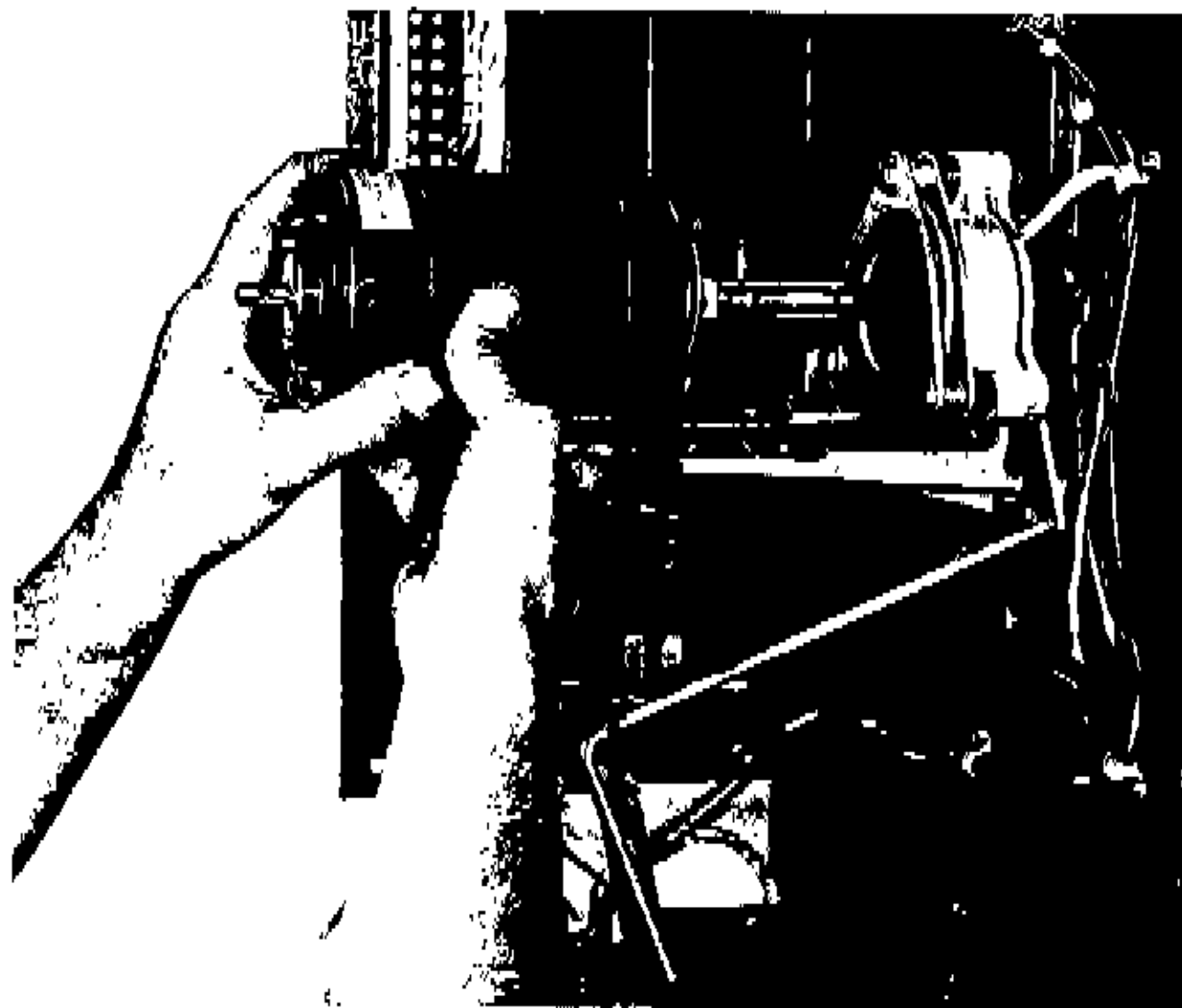


FIGURE 25
Removing motor from assembled gearbox

MOTOR REMOVAL

The universal series type motor is connected to an auxiliary source through a fuse pullout switch which must be opened prior to performing any services. This high speed motor with its fast acceleration should never be energized while removed from the gear box assembly. Operation while unloaded will result in an uncontrolled speed and possible damage to the motor. The motor is permanently lubricated with grease-sealed ball bearings and normally requires no service. The motor can be simply removed to gain access to the brake by detaching the four capscrews that secure it and the brake release rod support to the gear box housing. The motor may then be pulled out directly after wires are disconnected. When replacing the motor through the brake assembly, the pinned motor bushing on the motor shaft must pass through the brake plate and disc assembly and the pinion gear must fully engage with its adjoining drive gear.

BRAKE INSPECTION

The solenoid type brake is also connected to the 230-volt ac source through a selenium type rectifier on the terminal panel. Thus it is actuated by direct current to provide chatter-free operation. When the motor source is disconnected, the solenoid brake is energized against spring pressure so that the single disc provides a double-brake action against both the inner and the outer plate and disc assemblies. This simple brake action enables long, trouble-free operation. Should there be any evidence of over-travel due to a lessening of brake action first examine the tightness of the three spring-loaded capscrews that compress the brake assembly, and tighten if necessary. If these are already tight remove the motor and disassemble the brake to inspect the discs. The friction discs bonded to the inner and outer brake plates had an original dimension of $\frac{1}{8}$ inch thickness. The center brake disc also had the same thickness. If wear has passed the $\frac{3}{32}$ inch dimension of both plate and disc assemblies, as well as the center disc, complete replacement of these parts will be required.

The brake release rod, which is manually pushed in to release the brake for manual cranking of the motor, should never be propped to "brake off" position.

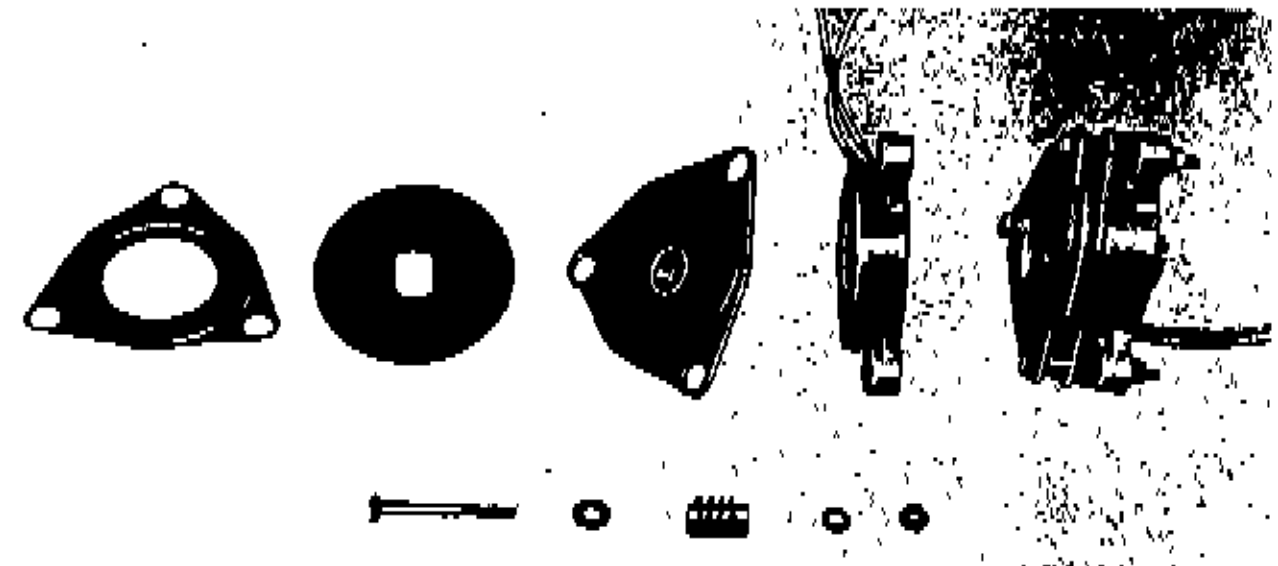


FIGURE 26
Brake assembly

CLOSING ROD AND SPRING YOKE

The closing rod and cam, which mechanically extend the closing springs, unlike the motor and brake, cannot be detached without removal of the complete motor and gear box assembly. With this assembly removed, first drive out the roll pin on the closing rod that fixes the cam follower thread setting. The bearing type cam follower may now be unscrewed off the closing rod, permitting the rod to be separated from the gear box assembly.

The spring yoke is fastened to the closing rod with a two-inch long capscrew and a special $1\frac{1}{2}$ inch soft brass flat washer. This flat washer is bent over the spring yoke and over one of the nearest flats of the tightened capscrew to hold the fastened spring yoke perpendicular to the closing springs. Thus if the spring

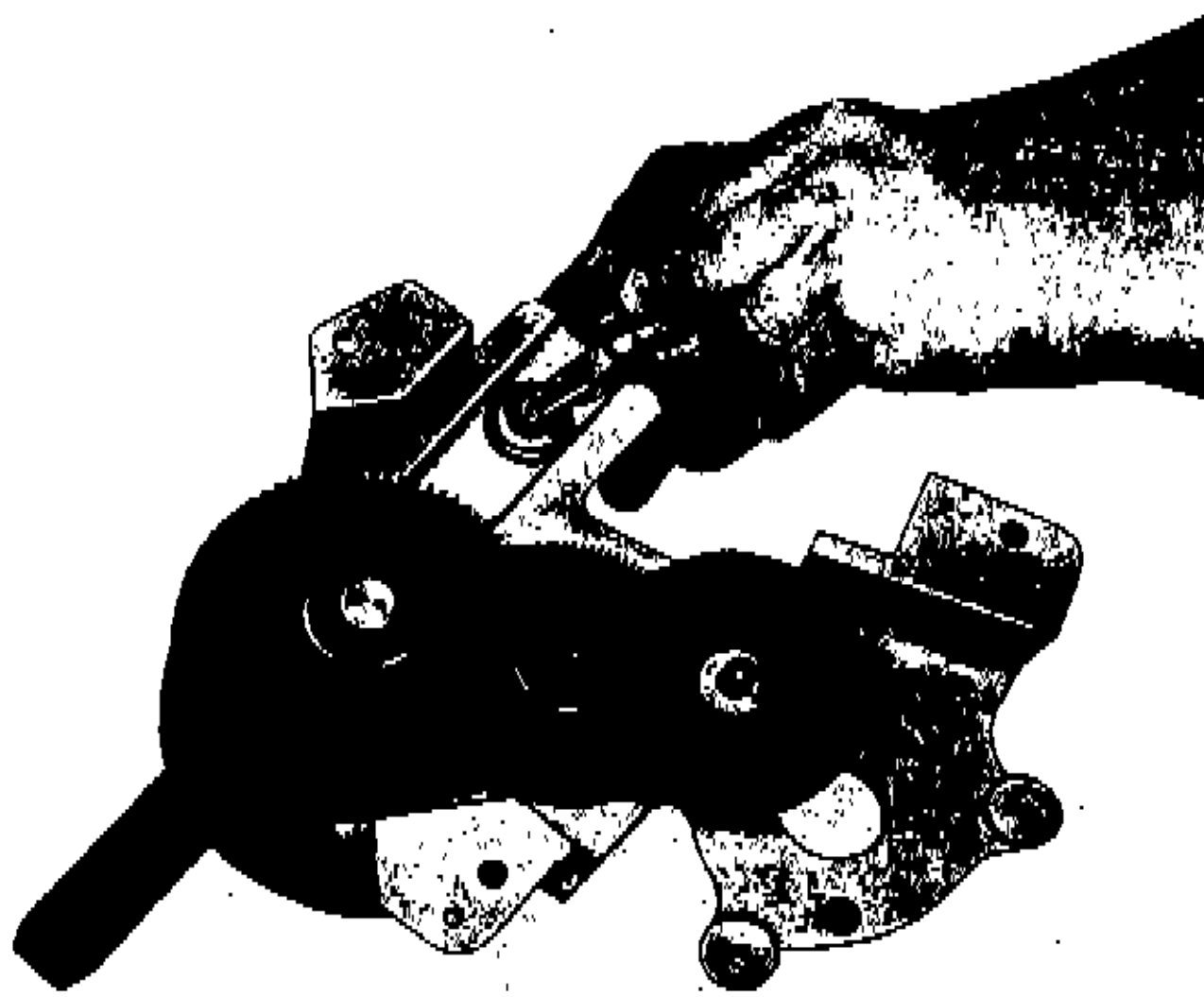


FIGURE 27
Removing closing rod

yoke is ever replaced, it should not be fully tightened at the securing capscrew until the springs have been hooked onto the yoke pins. First leave a clearance of about $\frac{1}{64}$ of an inch to permit bending the soft brass over the spring yoke face, then tighten. The other side of the flat washer is then bent over the nearest flat of the fastening capscrew to hold it in place. See Figure 21.

GEAR BOX ASSEMBLY

The pinion gear at the end of the motor shaft is engaged to a gear reduction arrangement in the gear box assembly. Gear ratio is 288:1. All gears are permanently lubricated with a bonded coating of molybdenum disulphide. To completely disassemble the motor and gear box assembly:

1. Remove the motor according to previous instructions.
2. Separate the back plate of the gear box housing by removing the three fastening capscrews and punching out the two aligning dowel pins.
3. Pull out the motor-driven spur gear and pinion.
4. The middle spur gear and pinion assembly can then be removed by taking off the "C" ring that retains the shaft on the front plate of the gear housing.
5. The third spur gear is held in place on the cam shaft by the adjoining sleeve, which is pinned through the cam shaft. Drive out the sleeve pin to separate the spur gear and spacer from the cam shaft.

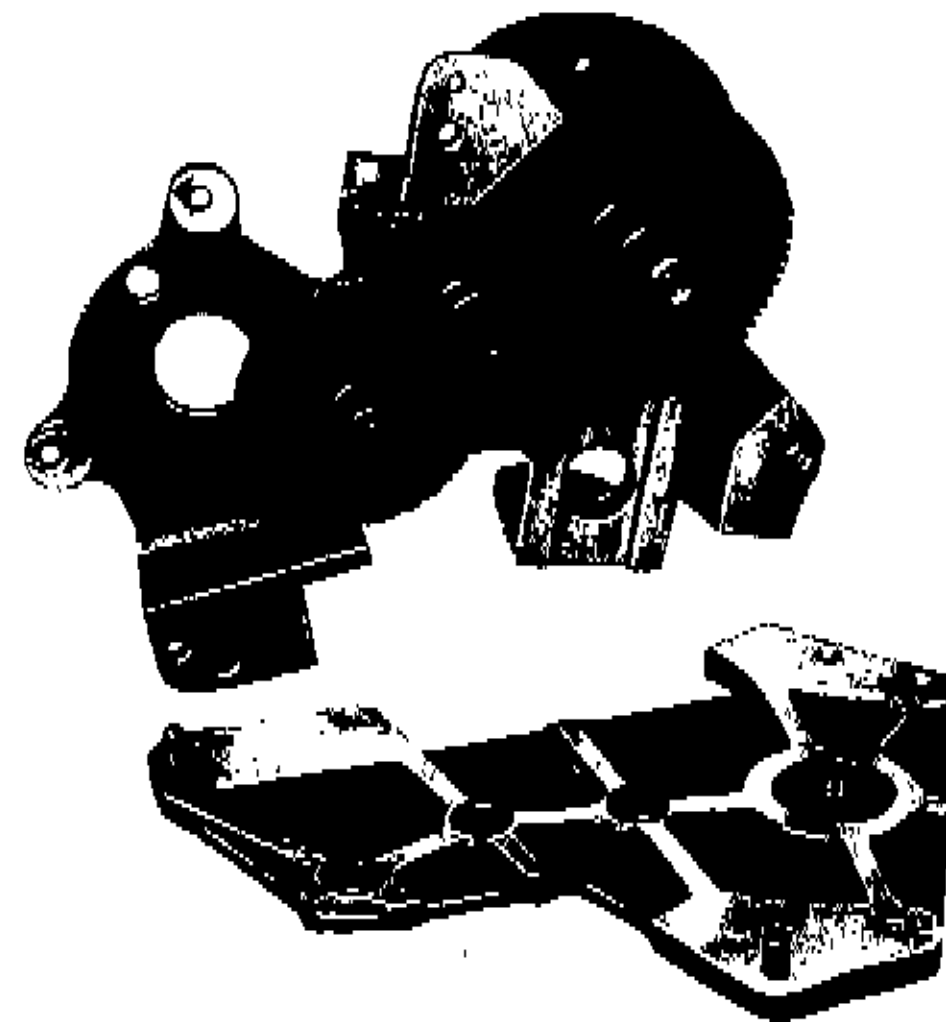


FIGURE 28
Disassembled gearbox

Reassemble the gear train in reverse order of disassembly beginning with the pinning of the spur gear to the cam shaft. Before attaching back plate of the housing, note condition of the bushing and bearings that are press-fitted in the back plate and the front gear housing.

TERMINAL PANEL AND CIRCUIT CONNECTIONS

Electrical connections, from the sensing bushing current transformers located in the recloser cover assembly, can be traced on marked terminal boards (on the terminal panel) that are wired to the receptacle assembly. The receptacle assembly, in turn, provides the recloser connection to the control. For reclosers equipped with bushing current multi-ratio and current metering transformers, the connections are terminated on marked terminal blocks furnished on the terminal panel in the operating mechanism.

The four-stage auxiliary switch linked to the operating shaft uses only one stage for standard recloser operations. The other three stages are available for various accessory functions and are also pre-wired to a terminal block in back by the terminal panel. Outside leads to the bushing CT and auxiliary switch terminal blocks can enter through the holes provided at the bottom of the operator mechanism plate. One of these holes is also used for the entrance of the auxiliary power circuit.

SHOP MAINTENANCE - CONT'D.

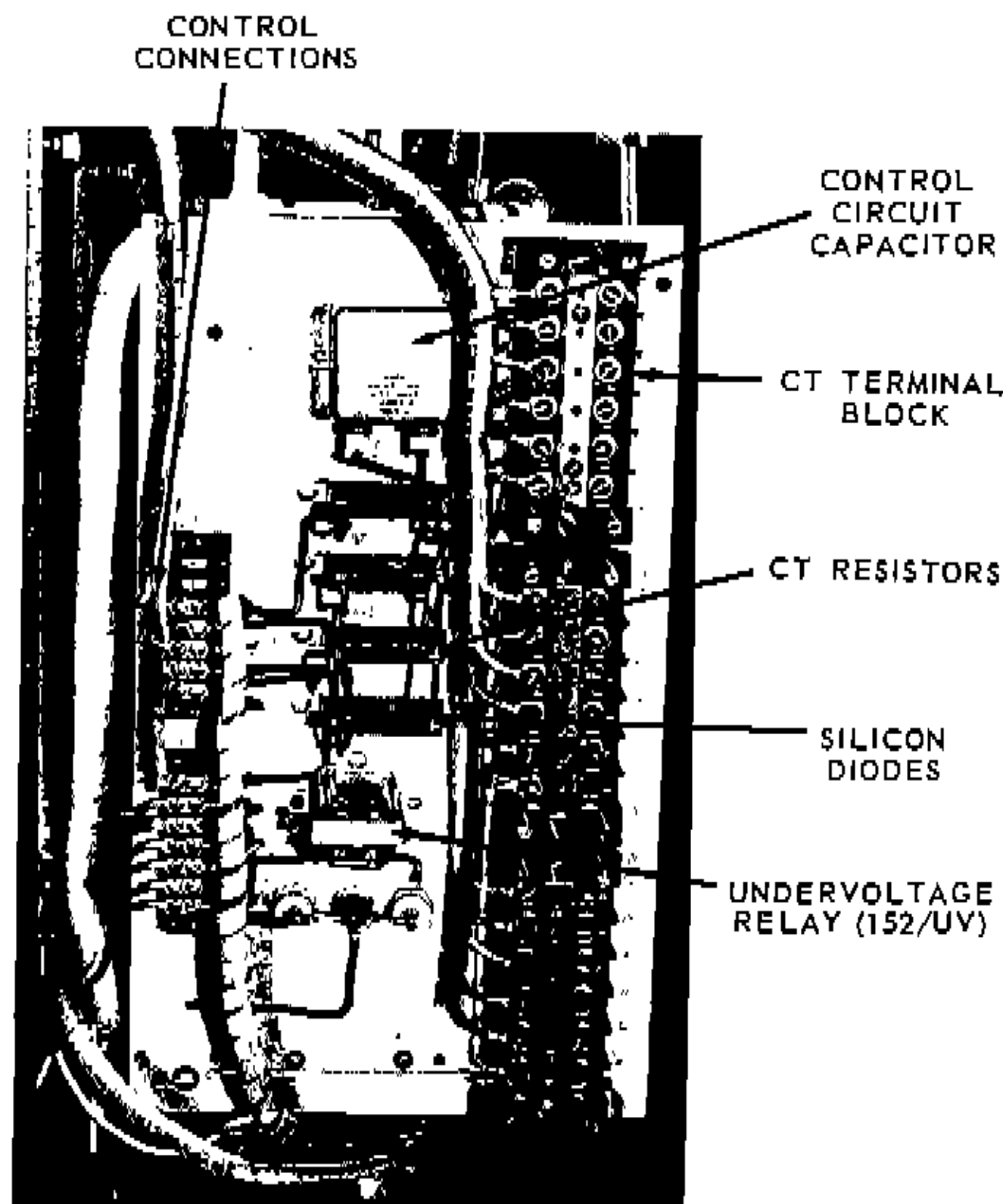


FIGURE 29
Terminal panel

CAUTION: The bushing CT terminal strips are shipped with shorting bars across their terminals. Shorting wires must not be removed until actual metering and relaying connections are made to prevent damage to the bushing current transformers in the event the recloser is energized.

Circuit components in the operating mechanism require no maintenance and should provide trouble-free operation. If control circuit failure is indicated check out this circuitry in the following order:

1. Check out the control cable for continuity between pins.
2. Test the circuit components in the operating mechanism.
3. Follow procedures listed in the control service manual numbered 281-27SB to service the electronic control.

CONTROL CABLE CHECK

Remove the recloser from service if not already disconnected. Then detach the control cable from the receptacle underneath the operator mechanism and from the underside of the electronic control housing. Using a volt-ohmmeter, check the cable for continuity between cable pins and pin sockets. Pins and pin sockets are identified on each cable end. A zero reading indicates continuity; an infinite reading indicates an open circuit. If an open circuit is discovered the cable should be replaced. Continuity between unlike pins or sockets will indicate a short circuit. Pins and sockets of the control cable designated N and P are not used.

CIRCUIT COMPONENT CHECK

Two major circuits are included in the operating mechanism cabinet and they should be checked separately. After checking continuity in the control cable, continue with a check of the control circuitry at the terminal strips located on the terminal panel. The auxiliary source motor and brake circuitry can be checked separately.

CONTROL CIRCUIT COMPONENTS

Refer to the connection diagram in the installation manual or in separate connection diagrams for connections of circuit components. All of these components are located in the operating mechanism except the internal bushing current transformers, which are in the recloser cover assembly. All current transformers' secondary leads are brought out of the recloser head through a special epoxy-sealed connector. This sealing prevents the entrance of moisture into the recloser and the emission of oil into the operator. Bringing the leads out to terminal strips facilitates the checking of all circuit components.

With the control cable attached to the receptacle in the operator cabinet, with recloser contacts open, and the recloser's motor source and line source de-energized make the following tests of control circuit components with a volt-ohmmeter.

1. All measurements are made from the pin sockets of the control cable receptacle that has been detached from the control.
2. Connect ohmmeter probes to pin sockets at control cable to check the circuit components listed in following table. Readings with 15 percent plus or minus are sufficient to indicate components are A-O.K. (Ohmmeter to have 1.5 volt battery and set on a 1000:1 multiplier.)

CONTINUITY CHECKS AT CONTROL CABLE RECEPTACLE PINS

Ohmmeter Probes	To Check	Value - Ohms	
		Contacts Open	Contacts Closed
A to C	Trip solenoid circuit	Infinite	A+ 1.5K to 3.0K B+ Infinite
B to C	Diodes	Infinite	Infinite
A to B	Trip solenoid circuit	Infinite	A+ 1.5K to 3.0K B+ Infinite
A to F with voltage on *	Closing circuit	Zero	Infinite
A to F no voltage	Closing circuit	Infinite	Infinite
C to D	Auxiliary switch	Infinite	Zero
E to F	Closing contactor	93	93
K to J	Bushing current transformer (6)	10-12	10-12
K to H	Bushing current transformer (4)	10-12	10-12
K to G	Bushing current transformer (2)	10-12	10-12
K to L	Battery-charging bushing current transformer (4)	1K	1K

* With 240 volts applied to UV relay.

MOTOR AND BRAKE CIRCUIT CONTINUITY

Check motor and brake circuit with the closing springs in collapsed position and if a heater is used in the cabinet the heater switch must be in off position. With closing rod up apply ohmmeter probes at the fuse pull out switch terminals. Reading should be about five ohms to indicate continuity. Also check the grounding.

BUSHING CURRENT TRANSFORMER TESTS

For units that are electronically controlled the sensing transformers and battery-charging transformer can be tested using the circuits shown in Figure 30. An a-c ammeter with a 0-500 milliamperere range is the only equipment necessary. Assemble test circuit as indicated in Figure 30 at the top. Connect the phases in series and close the recloser contacts manually by releasing brake and cranking the motor shaft.

CAUTION: Always disconnect control cable from control and open 230-volt a-c source at fuse, pullout switch before manually closing the contacts to provide safety to equipment and personnel. Connect a 100-ampere a-c test-current supply to the bushing terminals at points 1 and 2.

RATIO TEST FOR SENSING-CURRENT TRANSFORMERS

1. Energize 100-ampere test source.
2. Check current through control-cable receptacle sockets K-G (Phase A), K-H (Phase B) and K-J (Phase C). For each sensing bushing CT checked, the milliammeter should indicate 50 milliamperes plus or minus 10 percent.
3. A 50-ma reading verifies the 2000:1 ratio of each current transformer. Be sure to allow for tolerances of metering equipment. De-energize test source and proceed with polarity test.

POLARITY TEST FOR SENSING-CURRENT TRANSFORMERS

1. Connect sockets G, H and J of the control-cable receptacle in series with jumper leads as indicated in Figure 30. The jumper leads connect the secondaries of the current transformers in parallel so that total output current, measured at points K and J, should be 150 ma.
2. Energize a-c test source. Check for 150-ma readings at sockets K and J. Results should indicate all three bushing-current transformers have the same polarity with the 150-ma reading or replacement is necessary.
3. De-energize a-c test current and remove jumper wires from receptacle sockets.

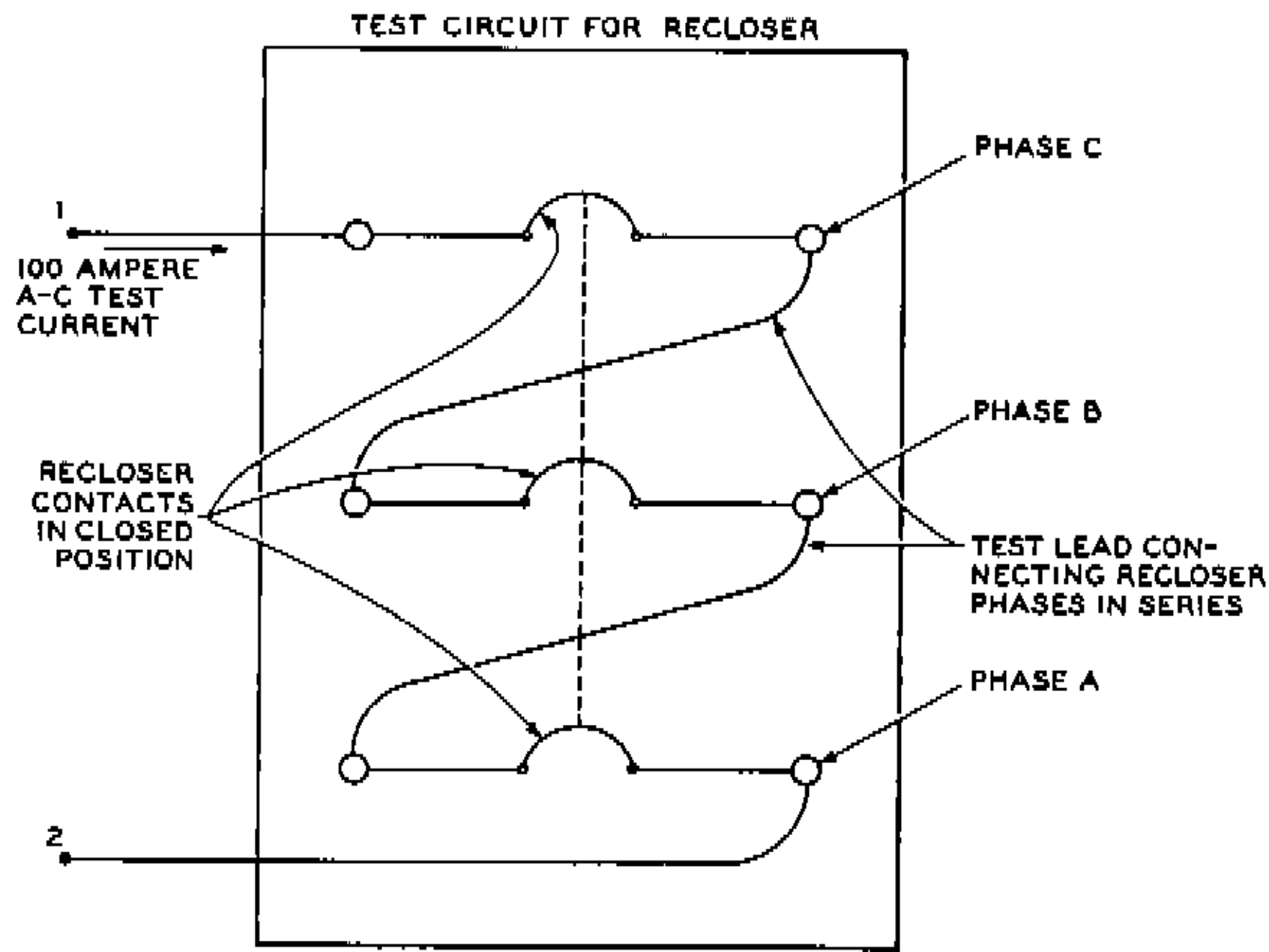
OUTPUT TEST FOR BATTERY-CHARGING TRANSFORMER

1. Energize 100-ampere a-c test source.
2. Measure current at sockets K and M of receptacle. Value should be about 65 milliamperes.
3. Readings outside this range indicate insufficient or excessive current to maintain the control battery at optimum voltage level. This transformer has a 1000:1 ratio.

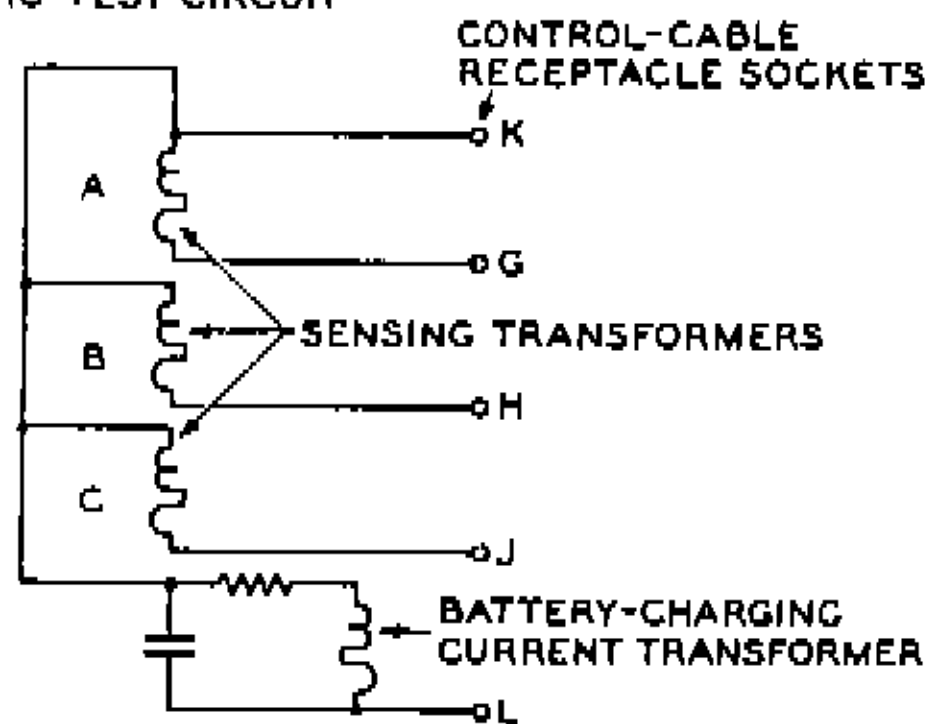
SENSING-CURRENT TRANSFORMER REPLACEMENT

1. Untank the recloser and remove bushings. Label the leads of the bushing current transformer that is to be replaced. Preferably use labeling in accordance with the connection diagram to aid in tracing leads later. X1 leads from the BCT's are white and X2 leads are black and white.
2. Plastic covered metal connectors are used to connect wires from terminal strips to transformer leads. Usually these are not reusable and when cutting transformer leads they can be left in place while cutting leads closer to the transformer.

SHOP MAINTENANCE – CONT'D.



RATIO-TEST CIRCUIT



POLARITY-TEST CIRCUIT

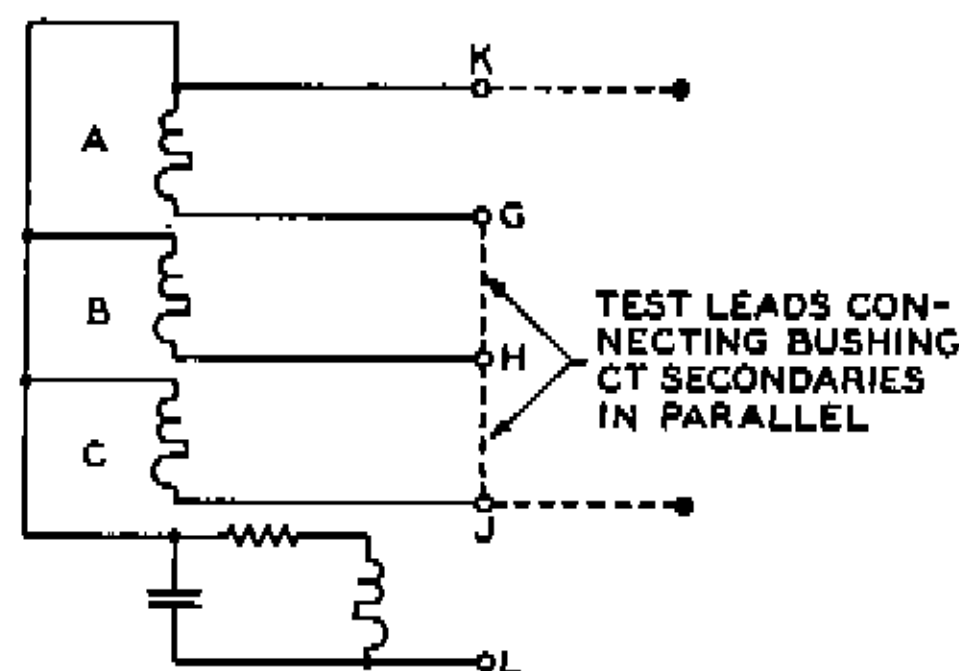


FIGURE 30

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

3. Remove capscrews and hexnuts that secure the current transformers to the cover. Bushing CT can now be dropped out with mounting and spacing plates.
4. Replace BCT's by reversing the above procedure. Be sure to reuse all spacers provided. All BCT's are marked with a black spot to indicate polarity.

Replacement of BCT's should be with polarity markings up toward the cover. Replacement transformers are equipped with generous leads, which can be trimmed as required. When splicing connections, refer to previous labeling to assure proper leads are connected before soldering. Wrap all splices with electrical tape.

TERMINAL PANEL ASSEMBLY

Control circuit components located on the terminal panel assembly (Figure 29) include a 0.2 mfg capacitor, resistors, undervoltage relays, stud-mounted silicon diodes, and a closing contactor at the back of the panel. The closing contactor is also a component of the motor and brake circuit, which includes the selenium rectifier. Because of the improbability of exchange, the resistors are riveted to the panel and its leads as well as the capacitor leads are soldered. If ever replacing these circuit components, be sure to label all leads before melting solder joints.

AUXILIARY SWITCH

The four section auxiliary switch is mounted in the operator cabinet directly on the back plate and is linked to the operating shaft. (Figure 31) The bottom section of the auxiliary switch is used for control functions and the three other top sections are prewired to a terminal strip on the back of the terminal panel.

Each section has two sets of contacts, either of which can be reset and are controlled by the cam setting in each section. These cams are installed at the factory to operate with the contact positions on the table below.

An advanced auxiliary switch design used on present reclosers has single lobe cams permitting a greater variety of switch positions. The initial cam setting for this switch (Figure 32) is also in accordance with the table below.

To change any cam position follow these steps:

1. Bypass, trip and de-energize the recloser if it is in service.
2. Remove the auxiliary switch by unlinking the switch arm and unfastening the two machine screws that attach the switch bracket to the back plate. Tag all wiring before removal.
3. Detach switch sections by punching out the pin securing switch arm and removing the two securing nuts and lockwashers.
4. Starting with the top switch section, lift the cams off the operating shaft, reposition cams to obtain desired setting.

CAUTION: Do not disturb the cam settings in the bottom section of the switch. These are connected to perform control and recloser operations. The bottom cam section must be positioned as illustrated in Figures 31 or 32.

5. Reassembly switch. Return it to its original mounting position and reconnect linkage and wiring. Before returning recloser to operation it is suggested that the auxiliary switch position be checked with continuity test indicated below.

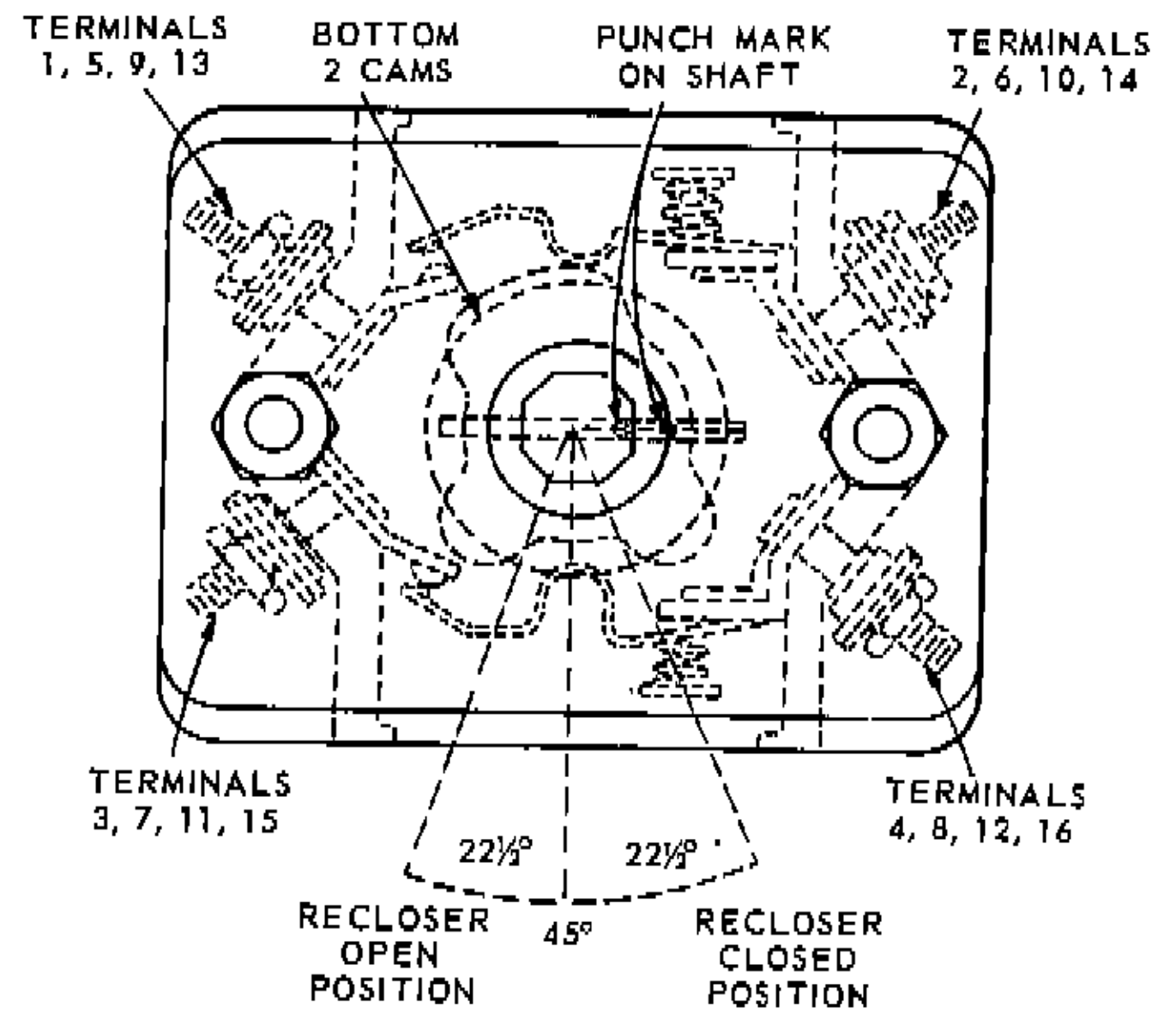


FIGURE 31
Auxiliary switch cam position on reclosers preceding serial numbers ME-255, MLE-125, MVE-115. For bottom section only.

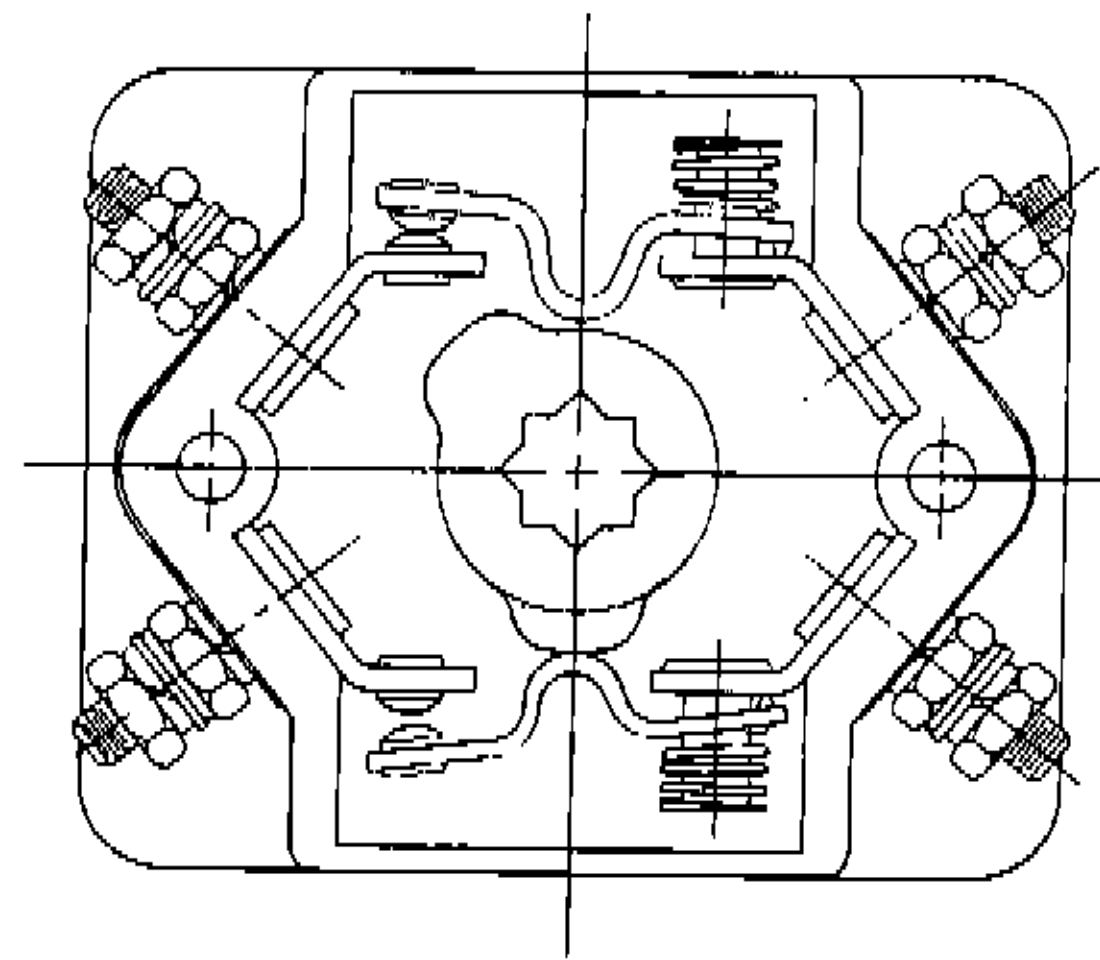


FIGURE 32
Auxiliary switch cam position on reclosers after serial numbers ME-255, MLE-125, MVE-115. For bottom section only.

TABLE
MAIN RECLOSER AND SWITCH CONTACT POSITIONS

Main Recloser Contact Position	Auxiliary Switch Contact Position							
	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16
Open	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed

SHOP MAINTENANCE - CONT'D.

AUXILIARY SWITCH CONTINUITY

To establish proper auxiliary switch operation that will be coincidental with the operation of the recloser's main contacts the following continuity check should be employed using an ordinary volt-ohmmeter.

1. Manually trip the de-energized recloser so that colored contact position indicator indicates "OPEN".
2. Apply ohmmeter probes to each set of marked switch section terminals.
3. Refer to Table of Main Recloser and Switch Contact Positions. Those contact sets marked "CLOSED" in the table should provide a zero reading with the position indicator showing "OPEN". The opened switch contacts will give an infinite reading.
4. Use the same table and repeat the readings with the main recloser contacts in "CLOSED" position.

RECLOSER TESTING

Following replacement of any major mechanical or electrical circuit components, the recloser should be tested together with the control, if provided. Electronic control testing is described in the Control Service Manual 281-27SB-1. First test should insure correct operation of the operating mechanism before proceeding to a recloser and control test. If the control is not furnished with the recloser, check out the auxiliary relays used in accordance with the relay supplier's instructions. Test of recloser and electronic control is described in Type ME, Control Installation Manual. See figure 33 for circuit connections in operating mechanism cabinet.

SERVICE PARTS LISTING

To help you find a service part by a general location this parts listing has been divided into various parts groups that are cross-referenced to exploded parts views.

To save time and parts ordering writing, an indentation system is used in these parts groups. All indented parts in a group are components or subassemblies of the previously described and not indented assembly. When ordering an assembly it is not necessary to order these subsequently indented component parts. Also, component parts can be ordered separately without referring to the assembly.

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

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

IMPORTANT

To assure correct receipt of any parts order always include switchgear type number and serial number. With McGraw-Edison's continuous improvement policy there will be some cases where parts ordered may not be exactly the same as the parts furnished.

However, all parts ordered, including those of an advanced design, have the same warranty as any whole item of switchgear, i.e., against defects in material or workmanship within a period of one year from date of shipment.

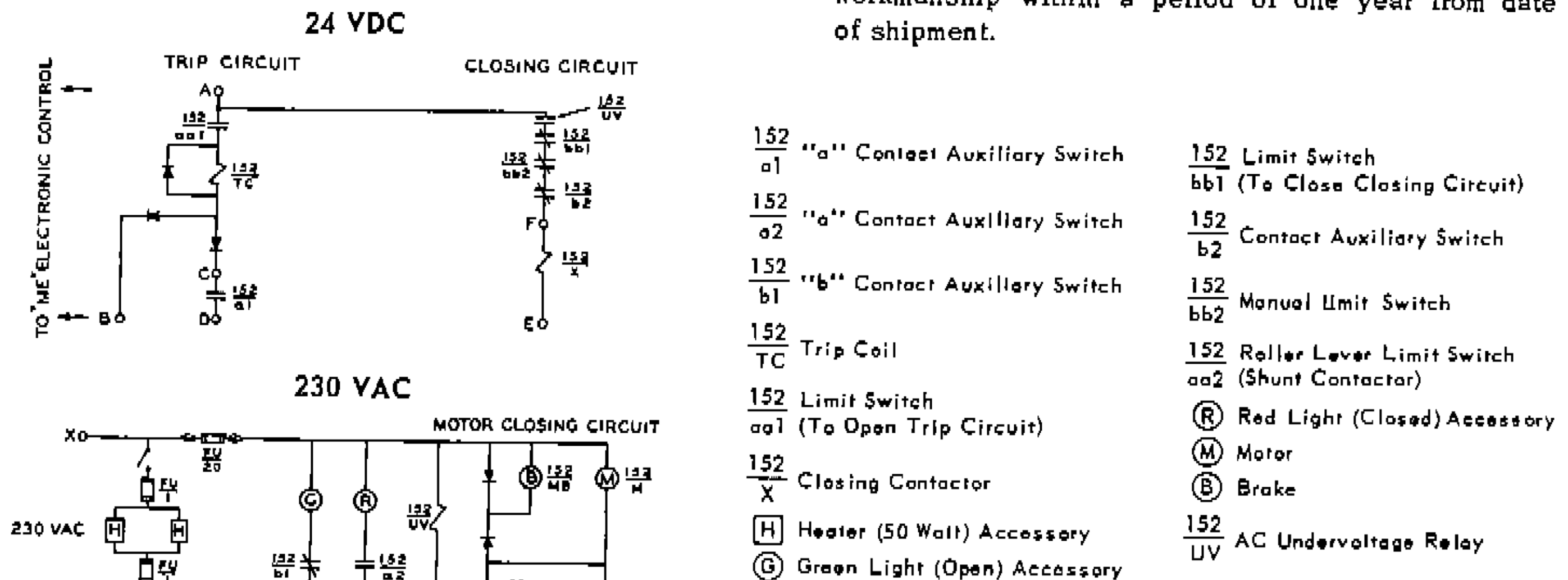
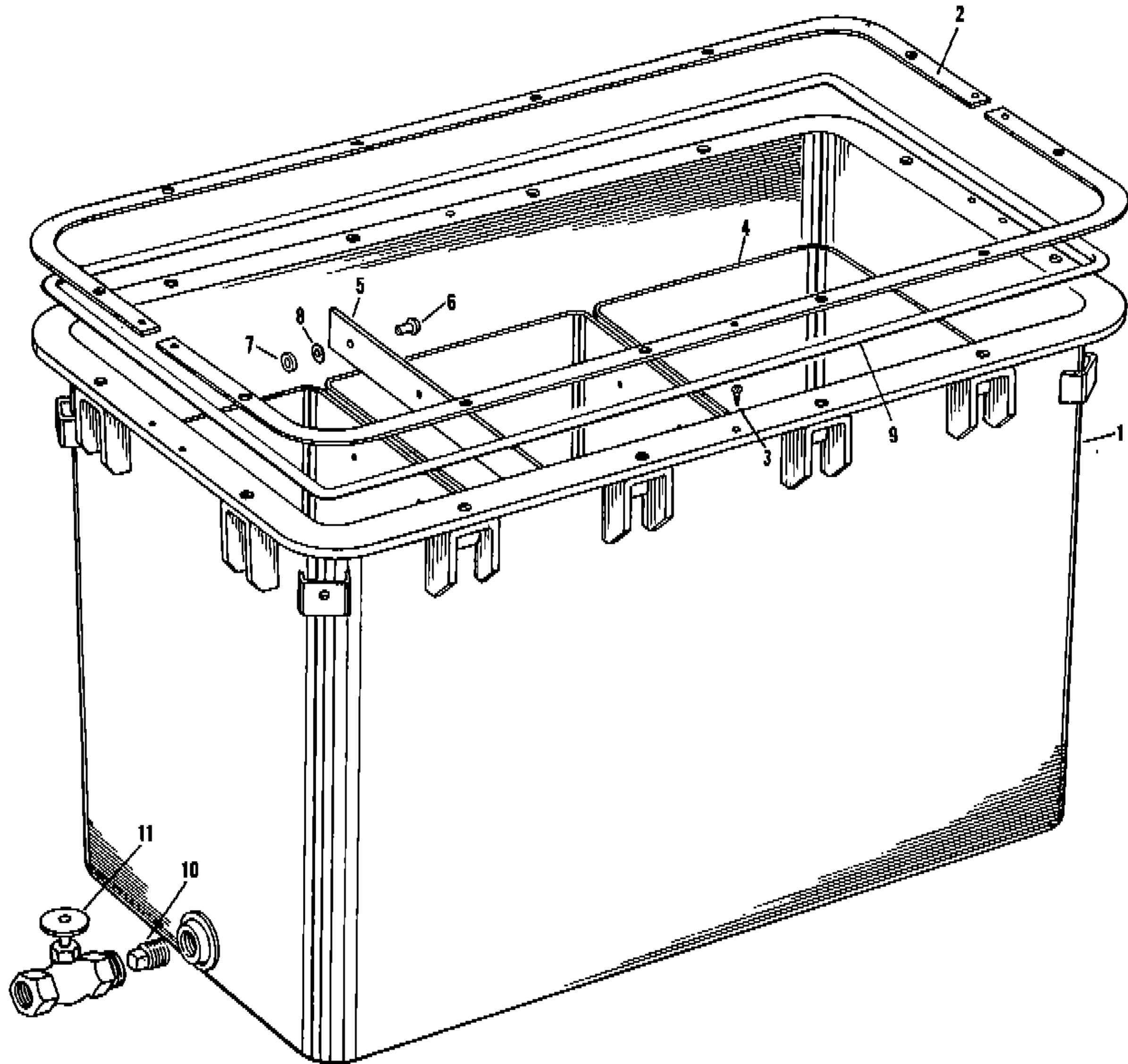
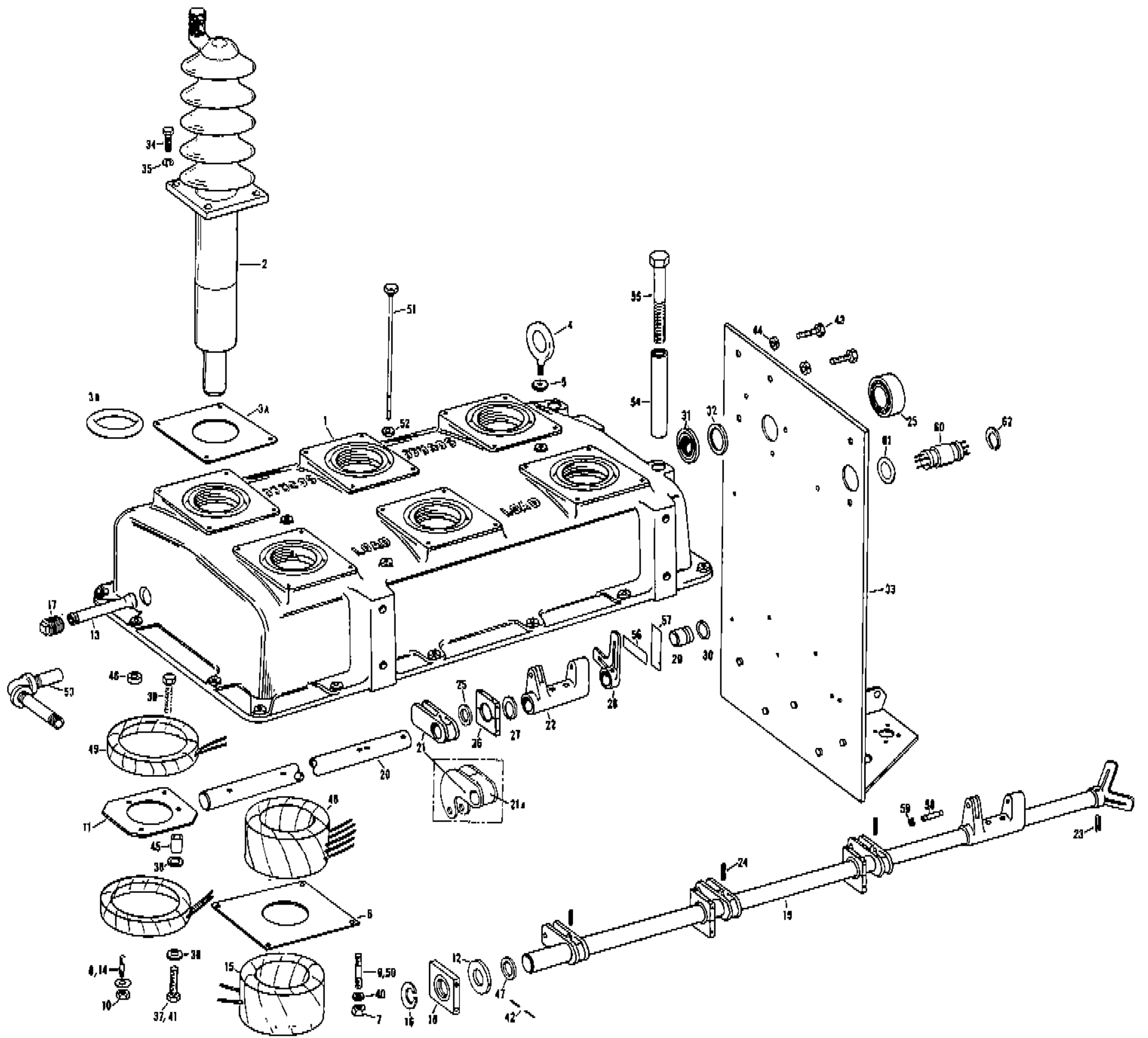


FIGURE 33
Control circuitry schematic



PARTS LIST - TANK AND LINER PARTS GROUP

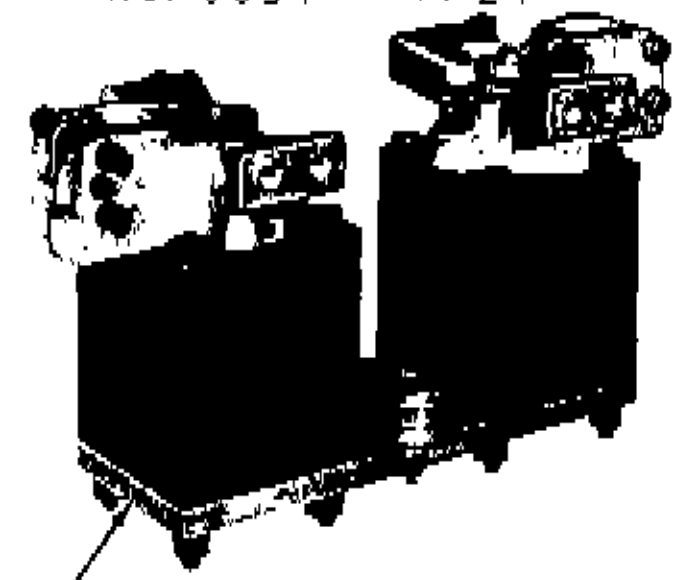
Item	Catalog Number	Description	Quantity
1-4	KA1016M	Tank and retainer assembly	1
1	KA1101M	Tank	1
2	KP1103M	Retainer, gasket	2
3	KP23	Drive screw, #2 x 1/4", type U	6
4	KA1010M	Tank liner assembly	3
5	KP1104M2	Tank liner strip, center well	2
6	KP251	Rivet, 3/4" x 9/16", steel, semi-tub liner retaining	8
7	KP2013A17	Retainer, push on, center liner retaining	8
8	KP818	Washer, #14L, brass, center well liner.	16
9	KP1272M	Gasket, tank top to cover	1
10	KP2007A3	Plug, oil drain, brass	1
11	KA809R	Gate valve, 1/2" - 100 lb., brass, optional, includes 1/2" nipple	1



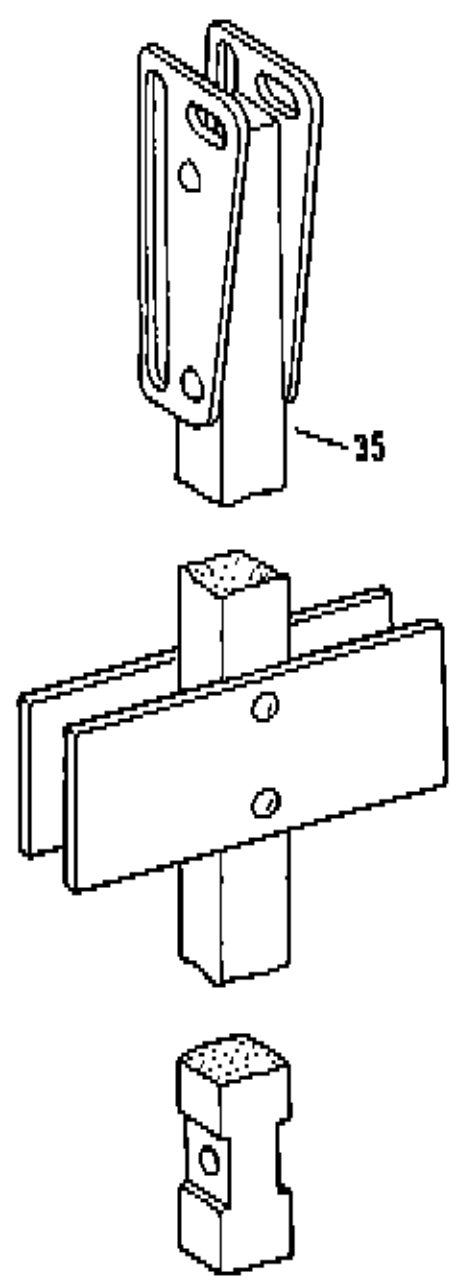
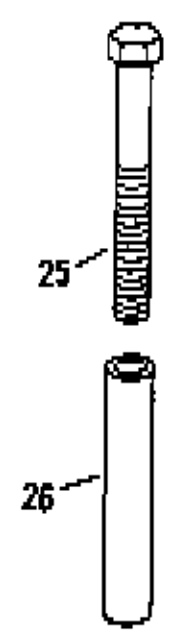
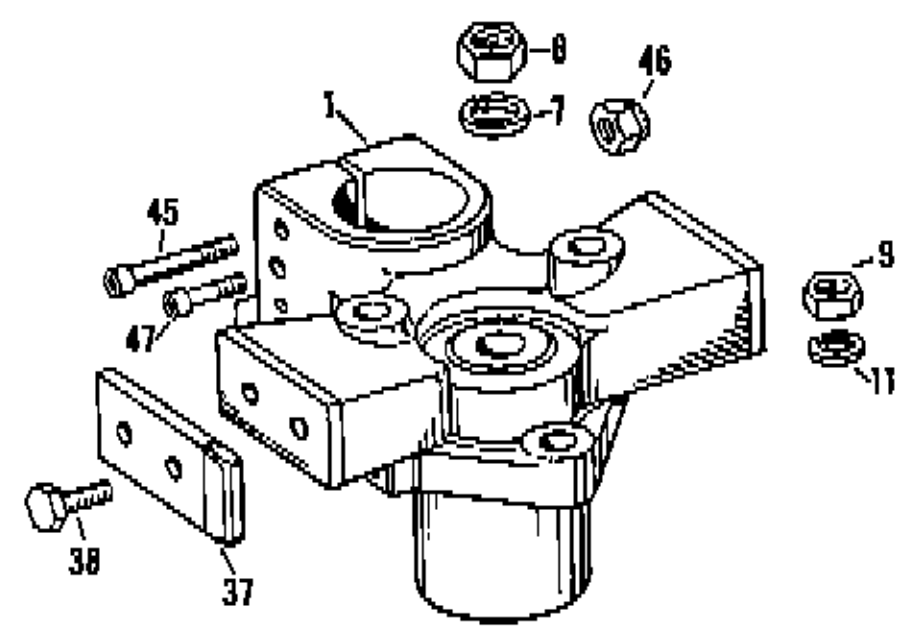
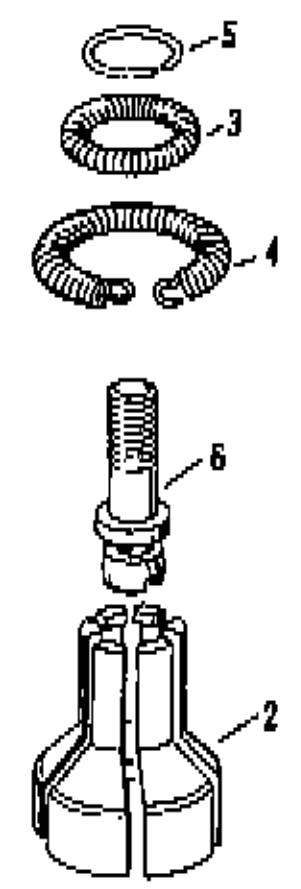
PARTS LIST - COVER ASSEMBLY PARTS GROUP

Item	Catalog Number	Description	Quantity
1	KP1100M1	Cover, casting w/1 BCT connector bore	1
	KP1100M2	Cover, casting, w/2 BCT connector bores	1
2	KA1099M1	Bushing, 1120 ampere, 110 kv BIL	6
	KA1099M2	Bushing, 560 ampere, 110 kv BIL	6
	KA1099M3	Bushing, 1120 ampere, 125 kv BIL	6
	KA1099M4	Bushing, 560 ampere, 125 kv BIL	6
	KA105MV1	Bushing, 560 ampere, center phase, 25 kv	2
	KA105MV2	Bushing, 560 ampere, A and C phase, 25 kv	4
3a	KP1131M	Gasket, bushing	6
3b	KP2000A21	Gasket, bushing	2
4	KP1104R	Eyebolt	2
5	KP2064A7	Palnut, eyebolt retaining	2
6	KP1163M	Spacer plate, current transformer	9-12
7	KP2020A7	Elastic stop nut, spacer plate retaining	3-15
8	KP3149A13	Stud, short, coil	0-12
9	KP3149A14	Stud, long, coil	0-12
10	KP2020A3	Elastic stop nut, sensing transformer retaining	6
11	KP1105M	Spacer plate, sensing transformer	7
12	KP1139M	Collar, operating shaft, breather end	1
13	KP1140M	Pipe, breather	1
14	KP3149A12	Stud, short, sensing transformer A and C phase	1
15	KA1014M1	Metering current transformer, 600:5	3-6
	KA1014M2	Metering current transformer, 1200:5	3-6
16	KP2019A6	Retaining ring, Waldes Truarc #5000-175	1
17	KP1141M	Plug, breather pipe, threaded both ends, for shipping only	1
18	KP1138M	Main bearing holder, breather end	1
19	KA1021M	Shaft and lever assembly, cover, 15 kv	1
	KA103MV	Shaft and lever assembly, cover, 24.9 kv	1
20	KP1135M	Shaft, operating	1
21	KP1134M	Lever, contact rod, 15 kv, KA103MV assembly	3
21A	KP1004MV	Lever, contact rod, 24.9 kv, KA103MV assembly	3
22	KP1137M	Bell crank, operating shaft	1
23	KP535	Roll pin, 3/16" x 1 3/4", contact position indicator	1
24	KP536	Roll pin, 3/8" x 2", bell crank and lever	5
25		Ball bearing, shaft, Fafnir B-542	2
26	KP1138M	Main bearing holder, shaft assembly	2
27	KP2019A6	Retaining ring ball bearing, Waldes Truarc #5000-175	2
28	KP1179M	Contact position indicator	1
29	KP1136M	Plug, shaft, at bellcrank	1
30	KP2000A9	"O" ring, shaft plug	1
31	KP1157M	"U" cup packing, shaft at washer	1

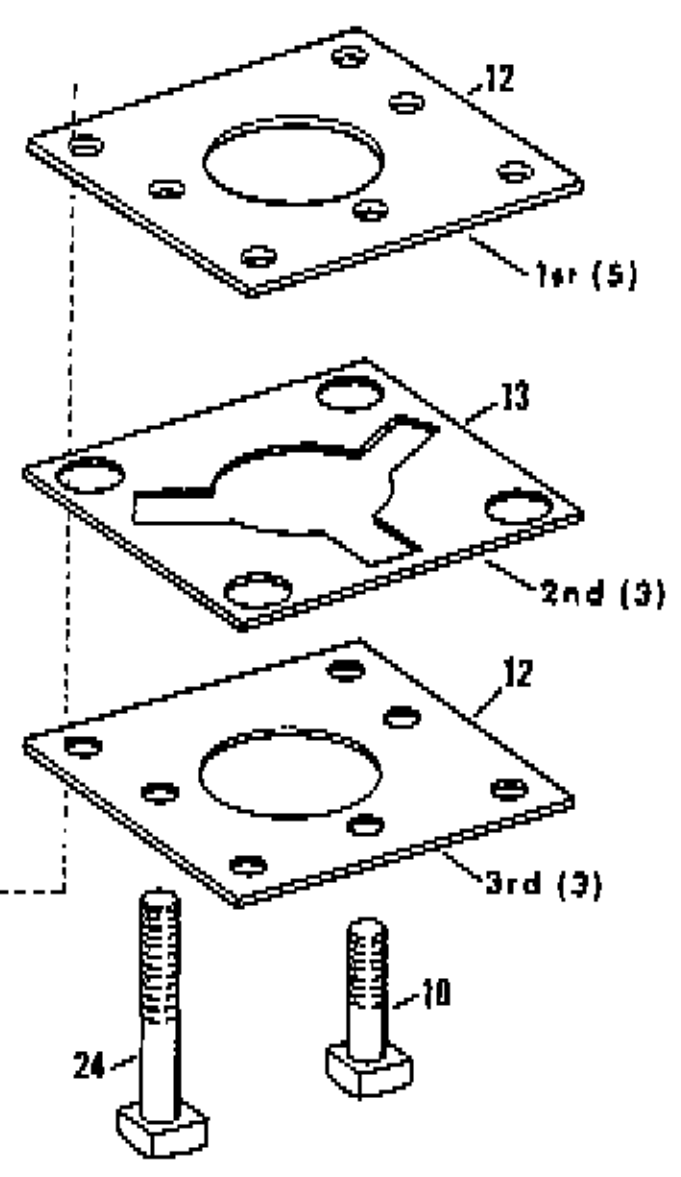
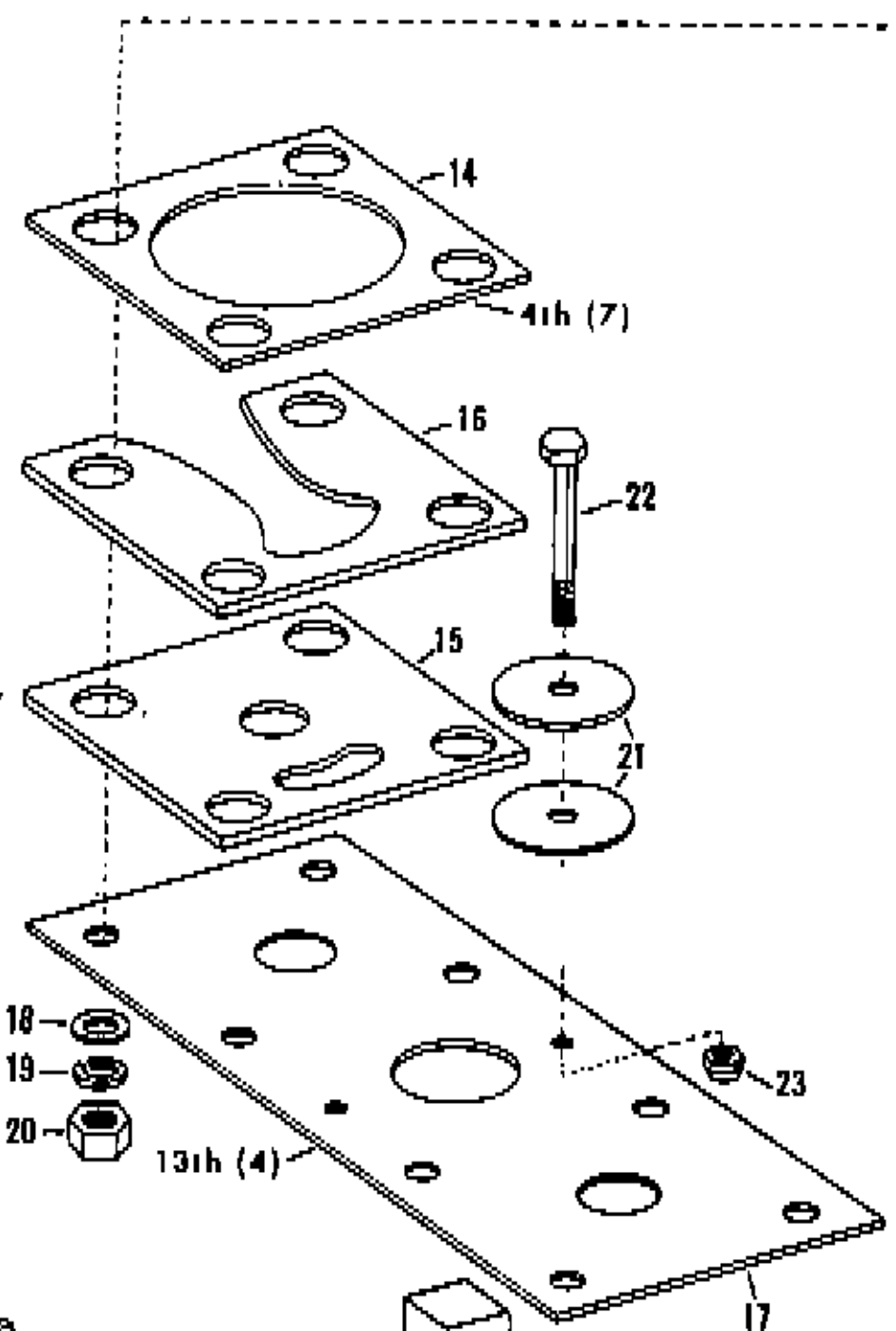
Item	Catalog Number	Description	Quantity
32	KP1122M	Washer, aluminum, shaft to plate	1
33	KA1045M	Plate and receptacle support assembly	1
34	KP787	Hex bolt, 1/2" - 13NC-2 x 1 1/2", bushing retaining	24
35	KP2028A23	Flat washer, 1/2", medium, bushing retaining	24
36	KP843	Washer #20L, BCT retaining	6-30
37	KP788	Capscrew, 3/4" - 20UNC - 2 x 2", A and C phase sensing transformer retaining, brass	4
38	KP339	Washer, #14S, brass, sensing transformer retaining	12
39	KP789	Capscrew, 5/16" - 18UNC - 2 x 3 1/2", B phase sensing transformer retaining	4
40	KP833	Lock washer, 5/16", Med., sensing transformer retaining	6
41	KP790	Capscrew, 5/16" - 18UNC - 2 x 2 1/4", A and C phase sensing transformer retaining	2
42	KP401	Setscrew, hex socket, 3/4" - 28UNF - 2", collar	2
43	KP787	Hex bolt, 1/2" - 13UNC - 2 x 1 1/2", plate and support	4
44	KP817	Lockwasher, 1/2" med. plate and receptacle assembly	4
45	KP3011A19	Spacer, sensing transformer retaining, B phase	12
46	KP3015A8	Spacer, sensing transformer retaining	3
47		Ball bearing, shaft, breather end, Fafnir B-542	1
48	KA1013M2	Multi-Ratio current transformer, 1200:5 amp	3-6
	KA1013M1	Multi-Ratio current transformer, 600:5 amp	3-6
49	KA1012M2	Sensing current transformer for electronic control, 2000:1	3
	KA1012M1	Current transformer for battery charging, 1000:1	1
50	KP3149A11	Stud, sensing transformer, B phase	1
51	KA1024M	Plug and dipstick assembly	1
52	KP2000A6	"O" ring, dipstick	1
53	KA975M	Breather assembly	1
54	KP3182A2	Spacer, iron pipe, cover to tank, actuator end	2
55	KP784	Capscrew, 1/2" - 13UNC - 2 x 7 1/2", cover to tank, actuator end	2
56	KP1165M	Decal, open, contact indicator	1
57	KP1164M	Decal, closed, contact indicator	1
58	KP3126A5	Pin, bellcrank	1
59	KP79	"C" ring, WA-518, rod and bellcrank pin	2
60	KA1081M1	Receptacle, 5 pin, BCT's to cabinet terminal bd.	1-2
	KA1081M2	Receptacle, 9 pin	1-2
	KA1081M3	Receptacle, 24 pin	1-2
	KA1081M4	Receptacle, 20 pin	1-2
	KA1081M5	Receptacle, 15 pin	1-2
61	KP2000A13	"O" ring, BCT connector	1-2
62	KP2013A20	Retaining ring, BCT connector	1-2



1-26
also
43-47

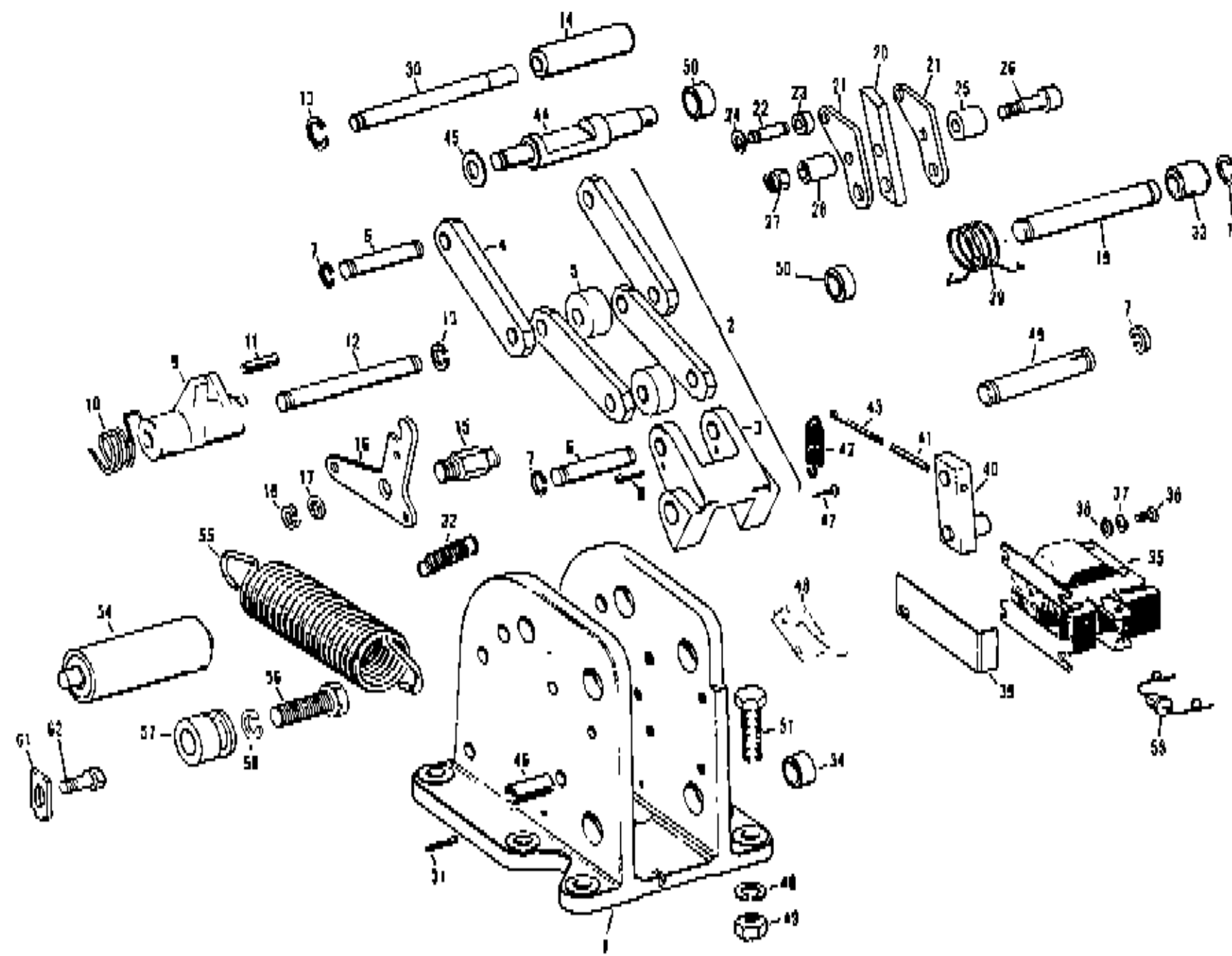


- 5rh (2)
- 7rh (2)
- 9rh (2)
- 11rh (2)
- 6rh (2)
- 8rh (2)
- 10rh (2)
- 12rh (2)



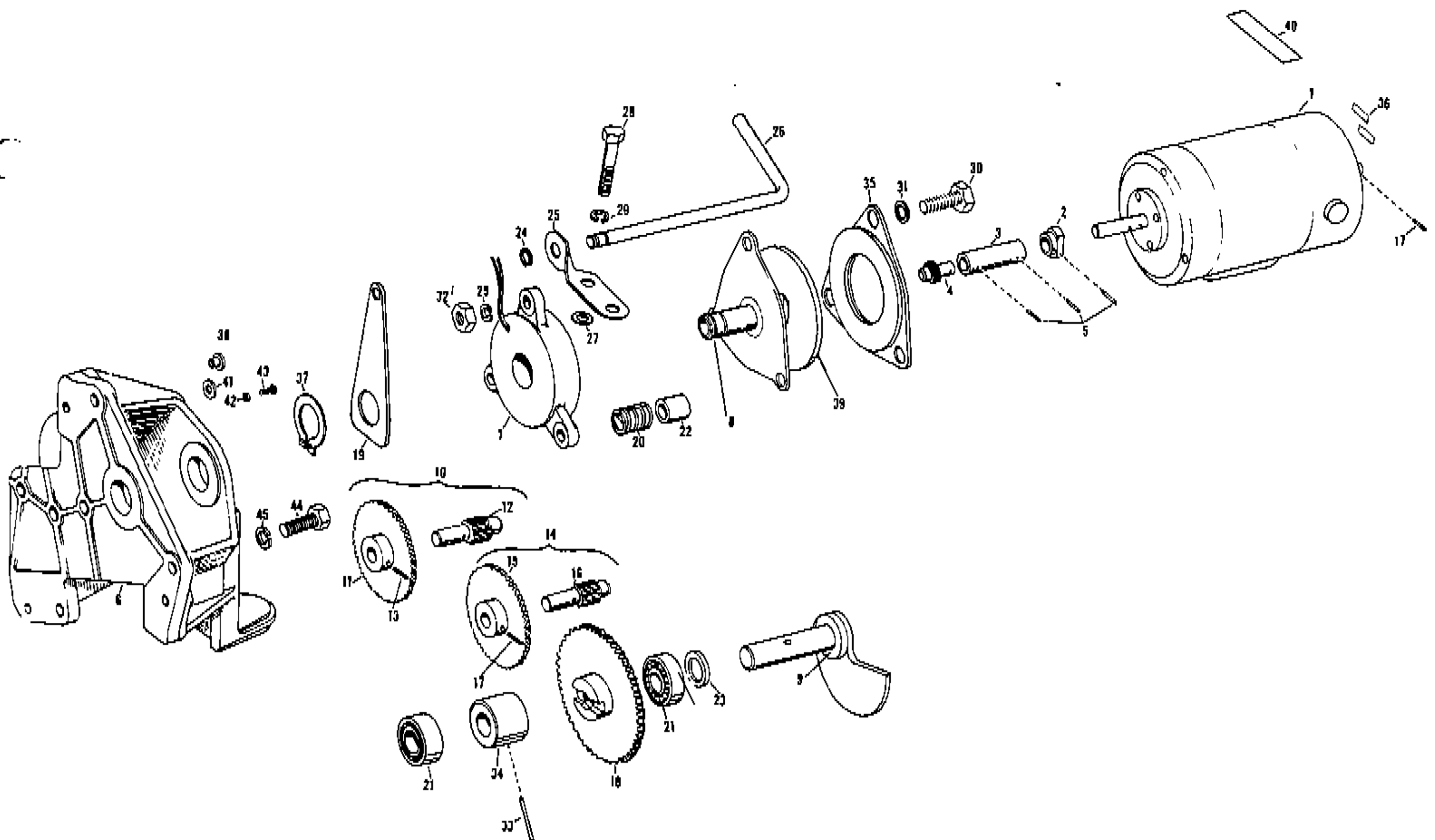
**PARTS LIST -
INTERRUPTER AND CONTACT
ASSEMBLY PARTS GROUP**

Item	Catalog Number	Description	Quantity	Item	Catalog Number	Description	Quantity
1-26	KA704M1	Interrupter and stationary contact kit, includes KA1002M interrupter assembly KP1121M bumper disc and hardware marked (*), Type ME		24	KP795	Machine bolt, interrupter retaining, 3/8" - 16UNC - 2 x 3", sq. head	12
	KA1002M	Interrupter assembly, 15 kv, 1120 ampere	3	25	KP796	Capscrew, 3/8" - 16UNC - 2 x 5 1/2", hex hd., thru stack	24
1-26	KA704M2	Interrupter and stationary contact kit, includes KA1086M1 interrupter assembly, KP1121M bumper disc and hardware marked (*), Type MLE		26	KP3008A23	Spacer, thru stack cap screw	24
	KA1086M1	Interrupter assembly, 15 kv, 560 ampere	3	27-33	KA1022M	Moving contact assembly, 15 kv, 1120 ampere, also includes selection of either item 34, 35 or 36	3
1-26	KA704M3	Interrupter and stationary contact kit, includes KA1086M2 interrupter assembly, KP1121M bumper disc and hardware marked (*), Type MVE		27	KA1028M	Contacts, load	12
	KA1086M2	Interrupter assembly, 24.9 kv, 560 ampere	3	28	KP797	Cap screw, 3/4" - 28UNF 2 x 3/4", load contact	6
1	KP1303M	Interrupter casting, 15 kv, 560 and 24.9 kv 560 ampere reclosers	6	29	KP1129M	Block, spacer	6
	KP1108M	Interrupter casting, 15 kv, 1120 ampere	6	30		Spring, Danly Die #9-1004-21	6
2	KA68W	Contact fingers	36	30A	KP3007A60	Spacer, inside spring	6
3	KP117W	Spring, contact pressure	12	31	KP343	Flat washer, 1/4", steel	12
4	KP1267M	Spring, garter	6	32	KP2020A9	Nut, elastic stop	6
5	KP121W	Spacer, spring	12	33	KP1286M	Spacer	12
6	KP1130W	Stud, contact fingers	6	34	KA1023M	Rod and holder, 15 kv, 1200 amp reclosers	3
7	KP542	Lockwasher, 3/8", bronze	6	35	KA106MV	Rod and Guide, 24.9 kv, 560 amp reclosers	3
8	KP291	Jam Nut, 1/2" - 20UNF - 2B, brass	6	36	KA5ML	Rod and plate, 15 kv, 560 amp reclosers	3
9	KP276	Hex nut, 3/8" - 16UNC - 2 top stack bolt	6	37	KA1029M	Load contacts, stationary, 15 kv, 1200 amp	6
10	KP793	Bolt, 3/8" - 16UNC - 2 x 1 1/4", sq. hd. top stack	6	38	KP729	Capscrew, 3/8" - 24UNF x 7/8", hex hd., stationary load contact	24
11	KP556	Lock washer, 3/4", steel, top stack bolt	6	39	KP1118M	Yoke, interrupting contact	6
12	KP1291M	Plate, top and intermediate	48	40	KA1027M1	Post, interrupting contact, 15 kv reclosers	6
13	KP1292M	Plate, with bolt head grooves	18		KA1027M2	Post, interrupting contact, 24.9 kv reclosers	6
14	KP1293M	Plate, 2 3/4" approx. center hole diameter	42	41	KP782	Capscrew, 3/8" - 24UNF - 2 x 1 1/2", yoke to holder	3
15	KP1294M	Plate, with crescent shaped opening	18	42	KP783	Capscrew, 1/4" - 28UNF - 2 x 1 1/2", yoke to contact	6
16	KP1295M	Plate, keyhole opening	48	43	*KP2020A8	Stop nut, 3/8" - 24", yoke to holder	3
17	KP1296M	Plate, base	12	44	*KP2020A9	Stop nut, 1/2" - 28", yoke to contact	6
18	KP543	Washer, 3/8"	48	45	*KP2036A7	Capscrew, socket head, interrupter to bushing	12
19	KP556	Lockwasher, 3/8", steel	42	46	*KP2020A4	Stop nut, socket head cap screw	12
20	KP276	Hex nut, 3/8" - 16UNC - 2 steel	42	47	*KP2036A8	Capscrew, socket head, interrupter to bushing	6
21	*KP1121M	Bumper disc, aluminum	90-96	48	KP1133M1	Pin, contact rod, 15 kv reclosers	3
22	KP794	Capscrew, 3/4" - 20UNC - 2 x 2", hex hd. bumper retaining	6		KP1133M2	Pin, contact rod, 24.9 kv reclosers	3
23	KP2020A3	Elastic stop nut, bumper retaining	6	49	KP431	Cotter pin, 3/32" x 3/4", contact rod pin	3
				50	KP79	Retaining ring, WA518, contact rod pin	3



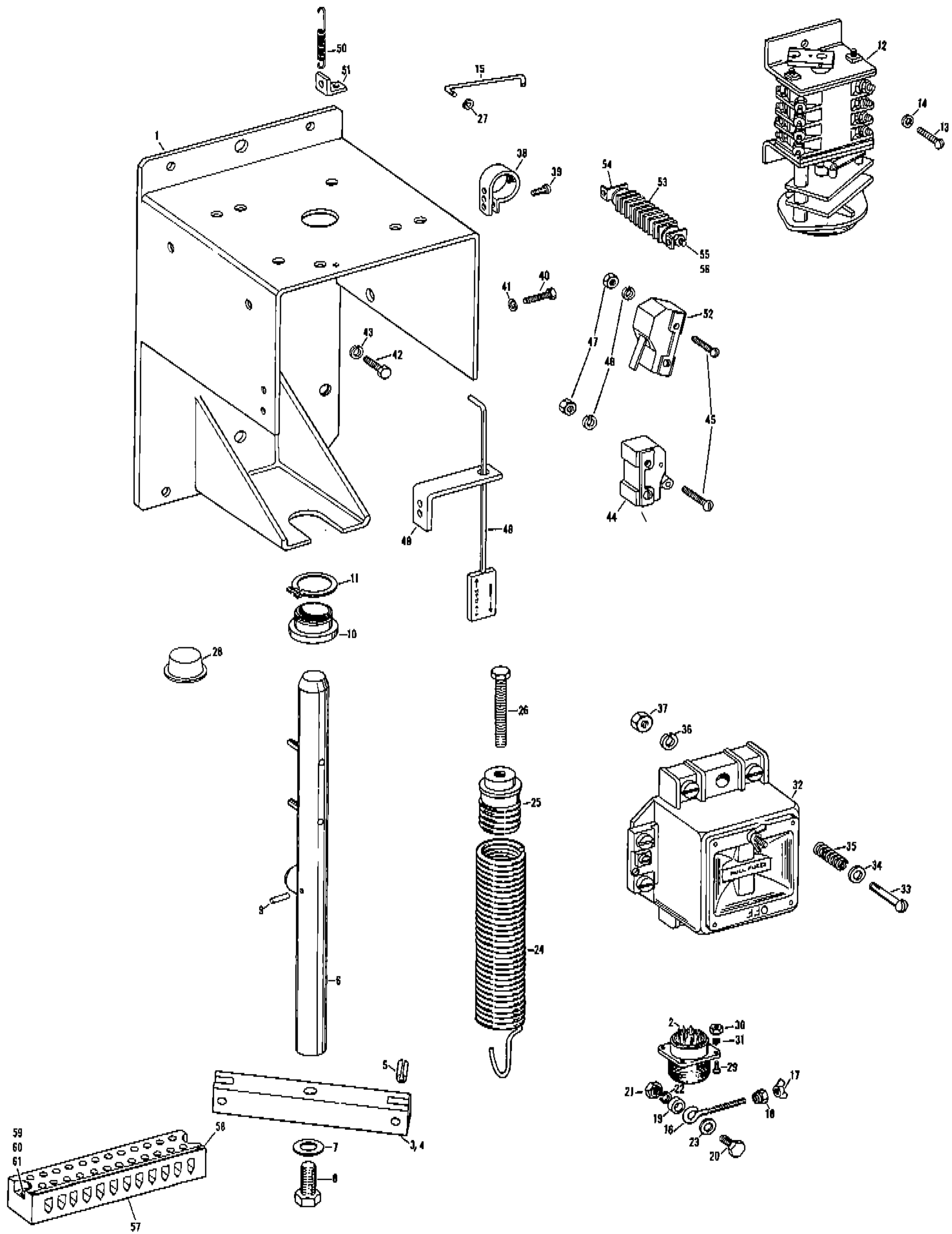
PARTS LIST – TRIPPING MECHANISM PARTS GROUP

Item	Catalog Number	Description	Quantity	Item	Catalog Number	Description	Quantity
1-46	KA1003M	Tripping mechanism assembly	1	35	KA1055M	Tripping solenoid, 24 vdc (152/TC)	1
1	KP1149M	Frame, tripping mechanism	1	36	KP694	Machine screw, #10-32 UNF x 3/8", solenoid	5
2	KA1004M	Link assembly	1	37	KP838	Lock washer, #10 med., solenoid retaining	5
3	KP1150M	Lever, twin	1	38	KP839	Washer, #10S, plain, solenoid retaining	5
4	KP1154M	Link	4	39	KP1168M	Bracket, trip solenoid to frame	1
5	KP3017A3	Spacer	2	40	KA1043M	Lever assembly, trip solenoid	1
6	KP3126A8	Pin	2	41	KP538	Roll pin, 1/8" x 1 1/2", lever assembly	1
7	KP79	Retaining ring, "C" type, WA518	5	42	KP1313M	Spring	1
8	KP315	Cotter pin, 3/32" x 1/2"	2	43	KP317	Cotter pin, 1/16" x 1 3/4", brass	1
9	KP1152M	Prop latch	1	44	KP1155M	Latch, shaft	1
10	KP1146M	Spring torsion	1	45	KP2028A2	Washer, nickel-plated, latch shaft	2
11	KP537	Roll pin, 3/32" x 3/8"	2	46	KP373	Roll pin, 3/16" x 3/8"	1
12	KP3126A7	Shaft	1	47	KP26	Drive screw, #6 - 32 x 3/8" self tapping rd. hd.	1
13	KP79	Retaining ring, "C" type, WA518	6	48	KP1290M	Switch, spdt., with extension (152/bb2)	1
14	KP3011A18	Spacer	1	49	KP3128A19	Pin, link assembly	1
15	KP1223M	Hex pin	1	50		Needle bearing, Torrington B66	1
16	KA1079M	Latch and spacer assembly	1	51	KP791	Capscrew, 3/8" - 16UNC - 2 x 1 1/2", frame mtg.	4
17	KP986	Lockwasher, 3/8" external tooth	1	52	KP834	Lockwasher, 3/8", med., frame mtg.	4
18	KP79	Retaining ring, "C" type, WA518	1	53	KP294	Nut, 3/8" - 16UNC - 2, frame mtg.	4
19	KP3128A1	Shaft	2	54	KP1025M	Stop, bell crank	1
20-28	KA980M	Lever latch assembly includes items 20 to 28	1	55	KP1283M	Spring, contact opening	1
20	KP1361M	Latch	1	56	KP792	Capscrew, 1/2" - 13UNC - 2 x 2 1/2", spring anchor	1
21	KP1360M	Lever	2	57	KP1284M	Spacer, spring anchor capscrew	1
22	KP3123A21	Groove pin, 3/16", double	1	58	KP817	Lockwasher, 1/2", spring anchor capscrew	1
23	KP3008A18	Spacer, 3/16" disc, round	1	59	KA986M	Diode assembly, used with 48 and 125 vac solenoids	1
24	KP72	Retaining ring, WA510	2	60	KP3014A5	Spacer	2
25	KP1358M	Stop	1	61	KP1386M	Key	1
26	KP2036A13	Capscrew, 1/4-20UNC - 3A x 1 1/2", socket hd.	1	62	KP698	Machine screw #10-24 UNC - 2 x 3/8", hex hd. socket, stl., zinc-plated	1
27	KP2020A3	Stop nut	1				
28	KP3007A80	Spacer	1				
29	KP1359M	Spring, torsion	1				
30	KP1268M	Shaft	1				
31	KP316	Cotter pin, 3/32" x 3/4", steel, zinc pltd.	2				
32	KP1145M	Spring	2				
33		Needle bearing, Torrington B86	3				
34		Needle bearing, Torrington B88	2				



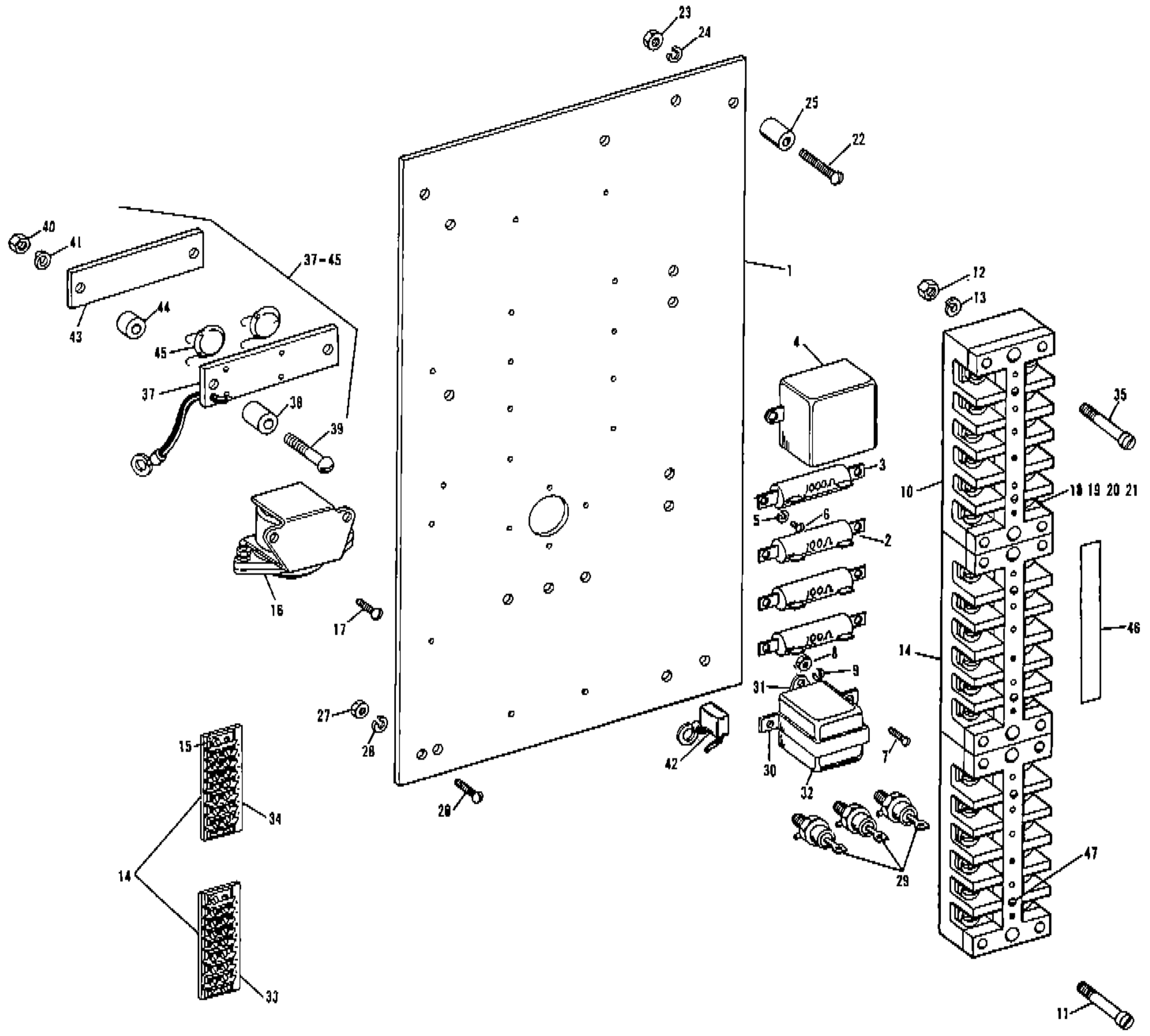
PARTS LIST – MOTOR AND GEAR BOX PARTS GROUP

Item	Catalog Number	Description	Quantity	Item	Catalog Number	Description	Quantity
1-43	KA1063M	Motor and gear box assembly	1	26	KP1232M	Rod, manual brake	1
1-5	KA1056M	Motor assembly	1	27	KP335	3/16" washer, brass, AN-960-B416, rod support, inner	2
1	KP1257M	Motor	1	28	KP772	Capscrew, 1/4" – 20UNC – 2 x 3/4", hex hd.	4
2	KP1253M	Bushing	1	29	KP836	Lockwasher, 1/4" med.	7
3	KP3011A22	Spacer	1	30	KP798	Capscrew, 1/4" – 20UNC – 2 x 2 1/4" brake	3
4	KP1245M	Pinion	1	31	KP848	Washer, 1/4" SAE, steel, brake	3
5	KP519	Roll pin, 1/8" x 5/8"	4	32	KP855	Nut, 1/4" – 20UNC – 2 steel, brake	3
6	KA1050M	Gear box subassembly	1	33	KP527	Roll pin, 1/2" x 1 1/4", sleeve	1
7	KA1061M	Solenoid braking assembly	1	34	KP1166M	Sleeve	1
8	KA1085M	Sleeve and plate assembly	1	35	KA1065M	Plate and disc assembly, outer	1
9	KA1059M	Cam and shaft assembly	1	36	KP1214M	Decal, pull fuse warning, cut in two	1
10	KA1057M	Pinion and gear assembly	1	37	KP2013A19	Retaining ring, brake sleeve	1
11	KP58VR	Gear, spur type	1	38	KP285VR	Bearing, gear housing	5
12	KP1245M	Pinion	1	39	KP1247M	Disc, motor braking	1
13	KP520	Roll pin, 1/8" x 1 1/4"	1	40	KP1252M	Decal, motor	1
14	KA1058M	Pinion and gear assembly	1	41	KP2028A13	Flat washer, middle pinion and gear	3
15	KP58VR	Gear, spur type	1	42	KP335	Flat washer, no. 105, brass, cam and shaft	2
16	KP1246M	Pinion	1	43	KP1022	Machine screw no. 8 – 32UNC – 2 x 3/8", rd. hd.	2
17	KP520	Roll pin, 1/8" x 1 1/4"	1	44	KP799	Capscrew, 3/8" – 16UNC – 2 x 3/4", gear box mtg.	3
18	KP1244M	Gear, spur type	1	45	KP834	Lockwasher, 3/8" med., gear box mtg.	3
19	KP1255M	Lever, brake release	1				
20	KP1227M	Spring, brake	3				
21	KP2026A1	Bearing	2				
22	KP3009A65	Spacer, plate and disc assemblies	3				
23	KP3015A9	Spacer, spur gear to gear box	1				
24	KP75	Retaining ring, WA514, brake rod	2				
25	KP1233M	Support, manual brake rod	1				



PARTS LIST -
OPERATING MECHANISM PARTS GROUP

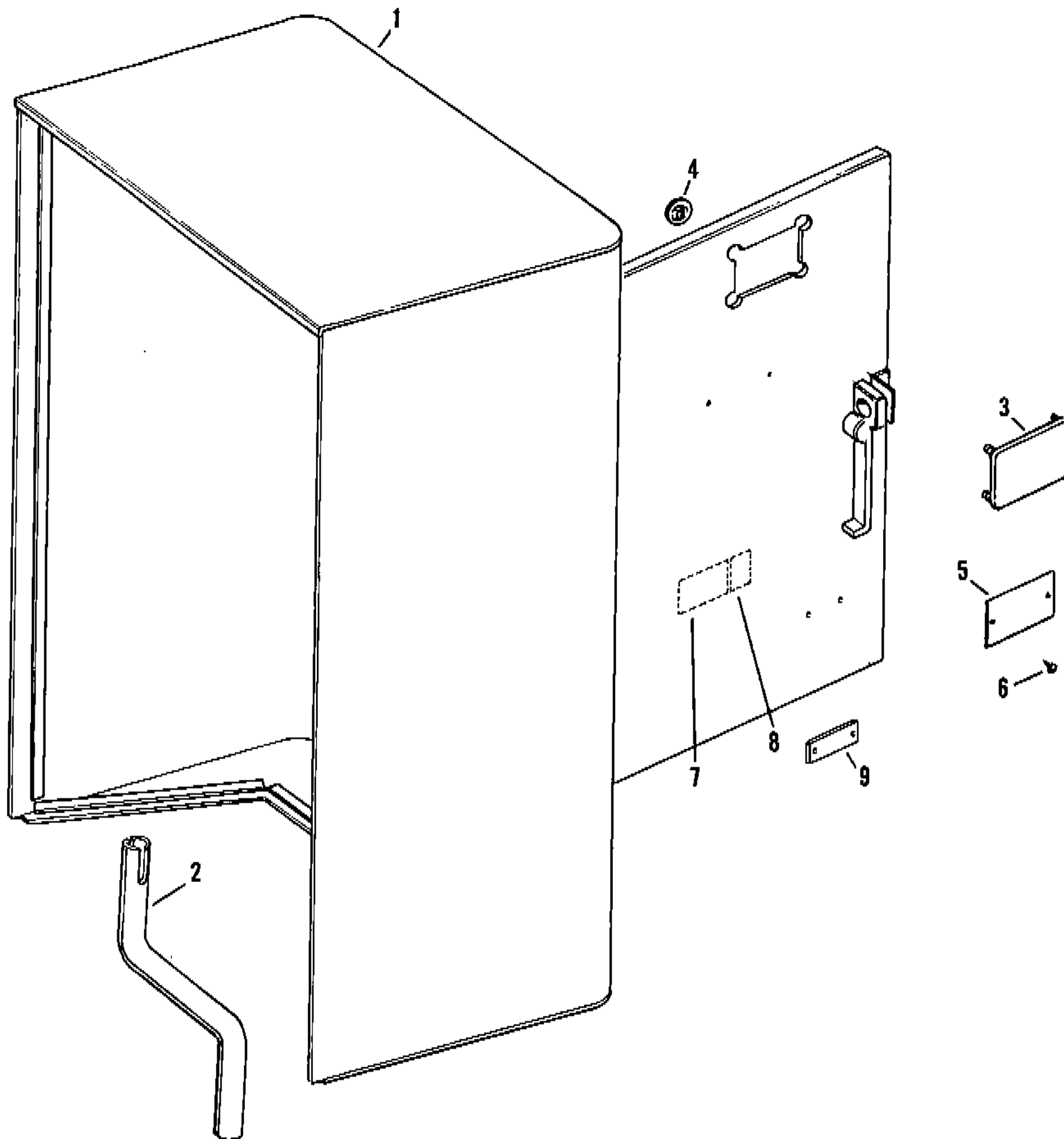
Item	Catalog Number	Description	Quantity	Item	Catalog Number	Description	Quantity
1	KA1011M	Housing assembly, within cabinet	1	32	KA1040M	Fuse pull-out switch, 230 volt	1
2	KA1046M	Receptacle assembly	1	33	KP1025	Machine screw, #10-24UNC - 2" x 1 1/8", switch mtg.	2
3	KA1052M	Spring yoke assembly	1	34	KP839	Washer, #10S, steel, switch mtg.	2
4	KP1243M	Spring yoke	1	35	KP630R2	Spring, switch mtg.	2
5	KP374	Roll pin, 3/8" x 1"	2	36	KP838	Lockwasher, #10, med.	8
6	KA1053M	Closing rod assembly	1	37	KP859	Nut, #10 - 24, UNC - 2", switch mtg.	2
7	KP2028A24	Washer, 1/2" rod to yoke	1	38	KP2006A3	Cable clip	2
8	KP1051	Capscrew, 1/2" - 13UNC - 2" x 2", hex, rod to yoke	1	39	KP1026	Machine screw, #10 - 24UNC - 2" x 1/4"	6
9	KP375	Roll pin, 3/32" x 1", closing rod	1	40	KP766	Capscrew, 5/16" - 18UNC - 2" x 3/4", hsg. to gear box	1
10	KP1258M	Bearing, brass, rod and housing	1	41	KP833	Lockwasher, 5/16", hsg. to gear box	1
11	KP2013A12	Retaining ring, rod and housing bearing	1	42	KP196	Capscrew, 3/8" - 24UNF - 2" x 3/8", hsg. to backplate	4
12	KA969M	Switch and arm assembly; (152/a1 and 152/b1)	1	43	KP834	Lockwasher, 3/8" medium	11
13	KP1023	Machine screw, 3/4" - 20UNC - 2" x 3/8", switch mtg.	2	44		Limit switch, Unimax 0158, with rollerleaf (152/aa2)	1
14	KP849	Lockwasher, 1/4", internal tooth, switch mtg.	2	45	KP1027	Machine screw, #6 - 32UNC - 2" x 1", microswitch	4
15	KP1176M	Link, auxiliary switch	2	46	KP1101	Lockwasher, #6, med.	4
16	KP962	Eyebolt, #4 Std. x 2 5/8"	1	47	KP867	Nut, #6 - 32UNC - 2, microswitch	2
17	KP865	Wingnut, 1/4" - 20UNC - 2", eyebolt	1	48	KA1078M	Manual trip and reset rod	1
18	KP2020A3	Elastic stop nut, 1/4" - 20UNC - 2	1	49	KP107GN3	Bracket, reset rod	1
19	KP3007A12	Spacer, eyebolt	1	50	KP141R2	Spring, reset rod return	1
20	KP1052	Capscrew, 1/4" - 20UNC - 2" x 1", eyebolt	1	51	KP1287M	Bracket, reset rod spring	1
21	KP855	Nut, 1/4" - 20UNC - 2", eyebolt screws	1	52		Limit switch, type A, cat. #BA-2RVT, (152/aa1)	1
22	KP836	Lockwasher, 1/4", eyebolt screw	1	53		Selenium rectifier, IRC single-phase bridge type, J116B04	1
23	KP848	Flatwasher, 1/4" SAE, eyebolt	1	54	KP1270M	Bracket, rectifier mtg.	2
24	KP1158M	Closing spring	2	55	KP597	Nut, #8 - 32NC - 2, bracket to rectifier	2
25	KP1262M	Plug, closing spring, top	2	56	KP847	Lockwasher #8, external tooth, bracket to rectifier	2
26	KP1239M	Bolt, closing spring	2	57	KP109S	Terminal block, 12 terminals	1
27	KP76	Retaining ring, WA510, switch arm link	2	58	KP2076A7	Marker strip, 1-12	1
28	KP2073A12	Cap plug, bottom, entrance for customer leads	2	59	KP1165	Machine screw, #10-24 x 1 1/4 - 2	2
29	KP1024	Machine screw, #4 - 40UNC - 2" x 3/8", receptacle retaining	4	60	KP846	Lockwasher #10, int. tooth, stl. and zinc-plated	2
30	KP866	Nut, #4 - 40UNC - 2, receptacle	4	61	KP839	Washer, #10S, stl. zinc-plated	6
31	KP1100	Lockwasher, #4, receptacle	4				



PARTS LIST -
TERMINAL PANEL PARTS GROUP

Item	Catalog Number	Description	Quantity	Item	Catalog Number	Description	Quantity
	KA1082M1	Terminal panel assembly, standard unit	1	23	KP855	Nut, 1/4" - 20UNC - 2, hex panel mtg. top	2
1	KP1342M	Terminal Panel	1	24	KP836	Lockwasher, 1/4", panel mtg., top	2
2	KP4022A31	Power resistor, 100 ohm, 25 watt	3	25	KA3009A66	Spacer, panel mtg., top	2
3	KP4022A36	Power resistor, 1000 ohm, 25 watt	1	26	KP699	Machine screw, 1/4" - 20UNC - 2 x 3/8" rd. hd., panel bottom	2
4		Capacitor, 0.2 mfd., 2500 vdcw	1	27	KP855	Nut, 1/4" - 20UNC - 2, hex, panel mtg., bottom	2
5	KP992	Washer, #6S, brass, resistor and capacitor mtg.	12	28	KP836	Lockwasher, 1/4", panel mtg., bottom	2
6	KP252	Rivet, .146 x 3/32", semi-tubular, resistor and capacitor mtg.	12	29	KP4011A9	Silicon diode, stud mounted	3
7	KP695	Machine screw #6 - 32XC - 2 x 3/8", relay mtg.	2	30		Relay, undervoltage, 230 vac, dpdt, KRP11A, 152/UV	1
8	KP863	Nut, #6 - 32NC - 2, hex, relay mtg.	8	31		Tube socket, 8 prong, undervoltage relay	1
9	KP845	Lockwasher, #6, external teeth, mtg.	6	32	KA979M	Bracket, undervoltage relay	1
10		Terminal block, Penn-Union #6006-SC, 6 terminals	*	33		Marker strip, A to G, control terminals	1
11	KP696	Machine screw, #10 - 24NC - 2 x 1 1/8" rd. hd.	*	34		Marker strip, H to P, control terminals	1
12	KP864	Nut, #10 - 24NC - 2, hex., block mtg.	*	35	KP1164	Machine screw, #10 - 24NC - 2 x 1 3/8", block mtg.	*
13	KP846	Lockwasher, #10, ext. teeth, block mtg.	*	37-45	KA977M1	Surge protective kit	1
14		Terminal board, 7 terminals, control, Cinch-Jones #7-140	2	37	KA978M	Capacitor assembly	1
15	KP697	Machine screw, #6 - 32NC - 2 x 5/8", rd. hd. control terminal board	4	38	KP3006A23	Spacer	2
16		Magnetic contactor, d-c, 24 volt, Cutler Hammer 6041-H201, 152/X	1	39	KP1027	Machine screw, #6 - 32UNC - 2 x 1, steel irridite	2
17	KP698	Machine screw, #10 - 24NC - 2 x 3/8", rd. hd., contactor	2	40	KP863	Nut, #6 - 32UNC - 2, hex. zn. irridite	2
18	KP2076A20	Marker strip, Y1 to Y5, ground	1	41	KP845	Lockwasher, #6, external tooth	2
19	KP2076A19	Marker strip, X1 to X5, ground	1	42	KA158CE	Capacitor assembly, on diodes	3
20	KP2076A21	Marker strip, G, H, J, K, M, ground	1	43	KP1363M	Support, capacitor	1
21	KP2076A10	Marker strip, Y1-Y2, sections 1, 3, 5	1	44	KP3006A38	Spacer	2
22	KP480	Machine screw, 1/4" - 20UNC 20UNC - 2 x 1 1/4", rd. hd., panel top	2	45	KP4003A5	Capacitor, .1 mfd	2
				46		Metal cal, A, B, C	*
				47	KP461	Machine screw, #8 - 32UNC - 2 x 1/2 rd. hd. for shorting CT's	*

* As Required



PARTS LIST - OPERATING CABINET ASSEMBLY

Item	Catalog Number	Description	Quantity
1	KA1049M	Cabinet assembly	1
2	KP1234M	Crank, motor	1
3	KP1240M	Window	1
4	KP2005A1	Speed nut, push on	4
5	KP1238M	Nameplate	1
6	KP69	Drive screw, #2 x 3/16", type Z, self-tapping	4
7	KP1327M	Decal	1
8	KP1328M	Decal	1
9	KP110GS	Serial No. plate	1