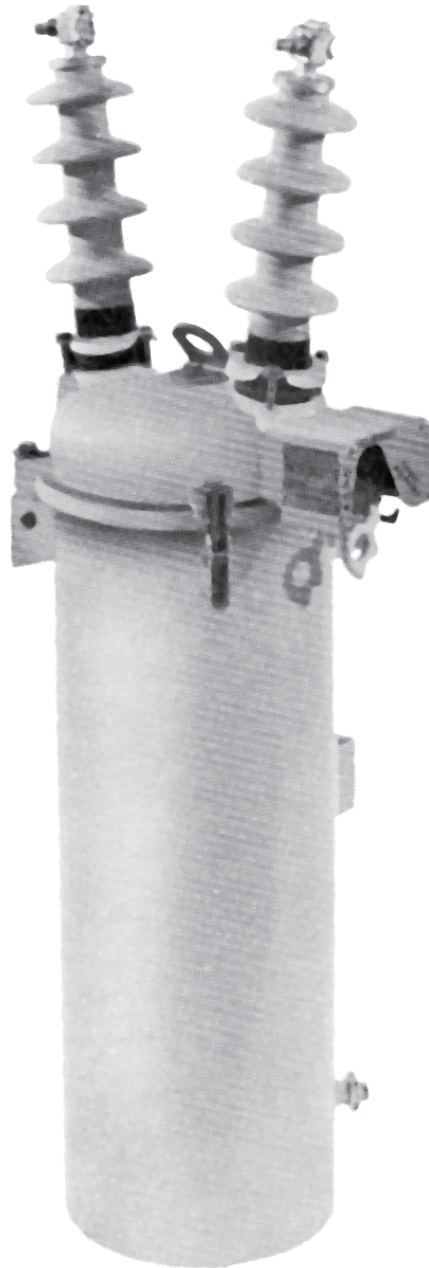


Type 4E maintenance instructions



EATON

Powering Business Worldwide

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Safety for life



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

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

Safety information

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

A competent technician has these qualifications:

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

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

Hazard Statement Definitions

This manual may contain four types of hazard statements:

DANGER

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

WARNING

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

CAUTION

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

CAUTION

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

Safety instructions

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

DANGER

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

G103.3

WARNING

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

G101.0

WARNING

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

G102.1

WARNING

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

G122.3

Introduction

Service Information *MN280057EN* covers the maintenance instructions for the Type 4E hydraulically controlled, single-phase, oil-interrupting recloser. The manual includes a general description of the recloser and its operating principles and instructions for periodic inspection, testing, and shop repairs. Service parts lists keyed to exploded-view drawings of the unit, along with ordering information, are included in the manual.

Description

Eaton's Cooper Power series Type 4E hydraulically controlled, oil-interrupting recloser (Figure 1) is a self-contained device that senses and interrupts fault currents on a single phase of a distribution line. The recloser automatically recloses and, if the fault is temporary, restores service. If the fault is permanent, the recloser locks open after one, two, three or four operations, depending upon its setting. Automatic resetting of this device enables it to distinguish between permanent and temporary faults. Thus, if a fault is temporary, the recloser resets and is then ready for a complete sequence should another fault occur.

Operating sequences of the recloser can be all fast, all delayed, or a combination of fast followed by delayed operations. Furthermore, any one of three delay curves can be used to assure coordination with other reclosers or protective devices. On coordinated systems, fast recloser operations are used to clear temporary fault currents before branch-line fuses are damaged. Subsequent delayed openings allow time for fault currents to be cleared by branch-line fuses. Outages caused by permanent faults are thereby confined to shorter sections of line.

Tripping is initiated by a series-connected coil. Current-carrying and interrupting capacities vary with the operating coil's rating, which is selected to meet circuit requirements. A non-reclosing feature (Figure 2), standard on all Eaton's Cooper Power series reclosers, is set with a hookstick-operated lever for one operation to lockout without removing the recloser from service.

Major parts and assemblies of Type 4E reclosers are identified in Figures 3 and 4.

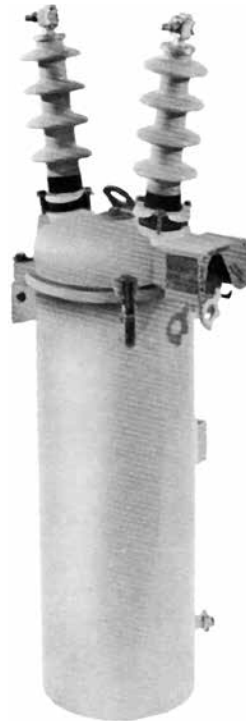


Figure 1. Type 4E single-phase, hydraulically controlled oil circuit recloser

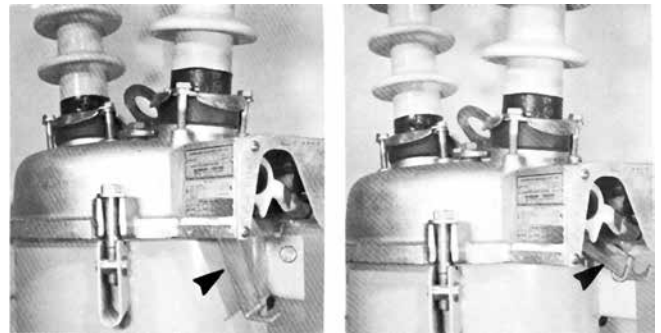


Figure 2. The non-reclosing feature is set with a handle under the sleet hood (see arrow). When the handle is down (left), the recloser will trip on overcurrent and lock out without reclosing. When the handle is up (right), the recloser will operate according to its internally set program

These instructions do not claim to cover all details or variations in the equipment, procedure, or process described, nor to provide direction for meeting every possible contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, contact your Eaton representative.

Type 4E maintenance instructions

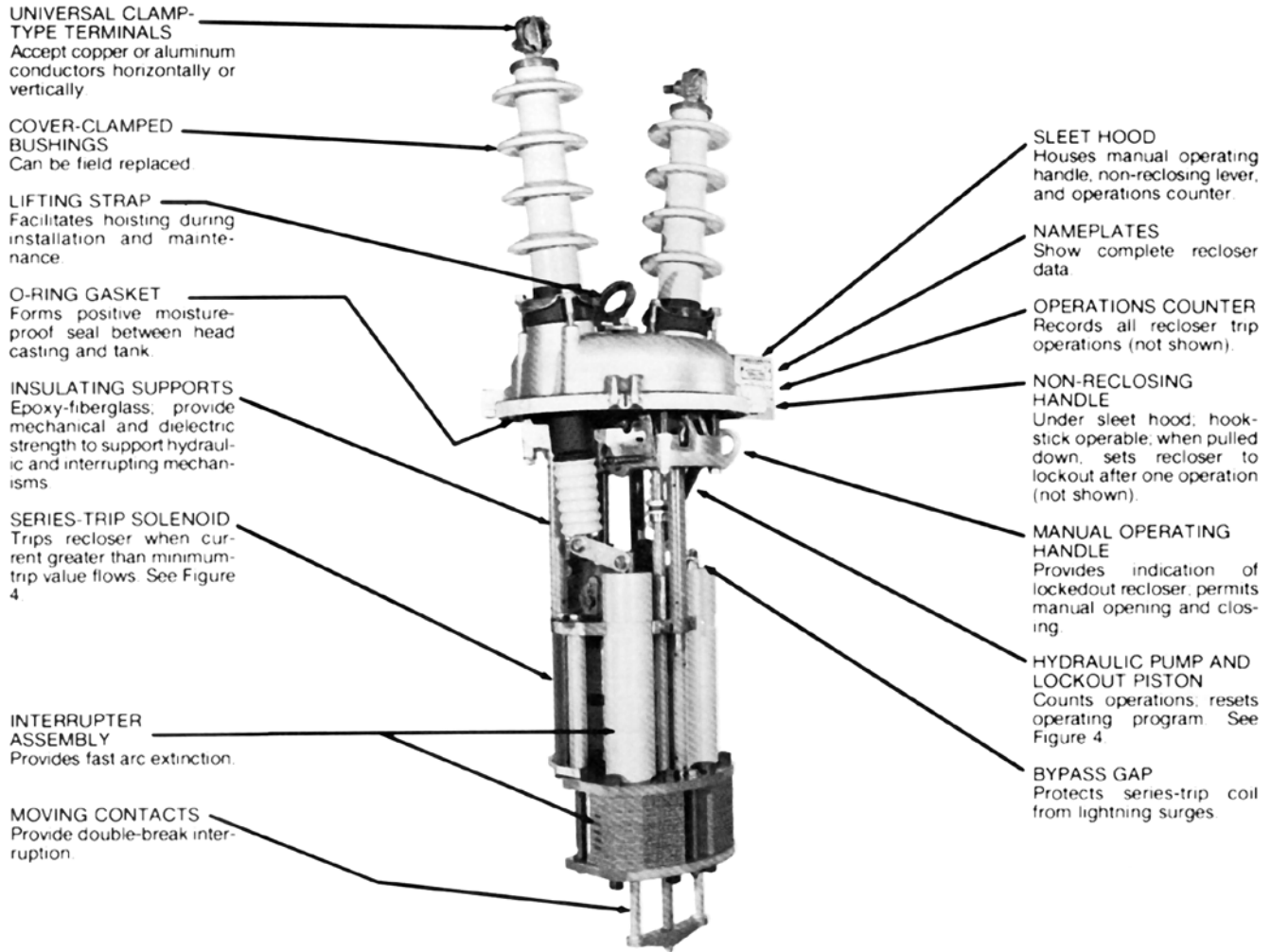


Figure 3. Untanked view of type 4E recloser

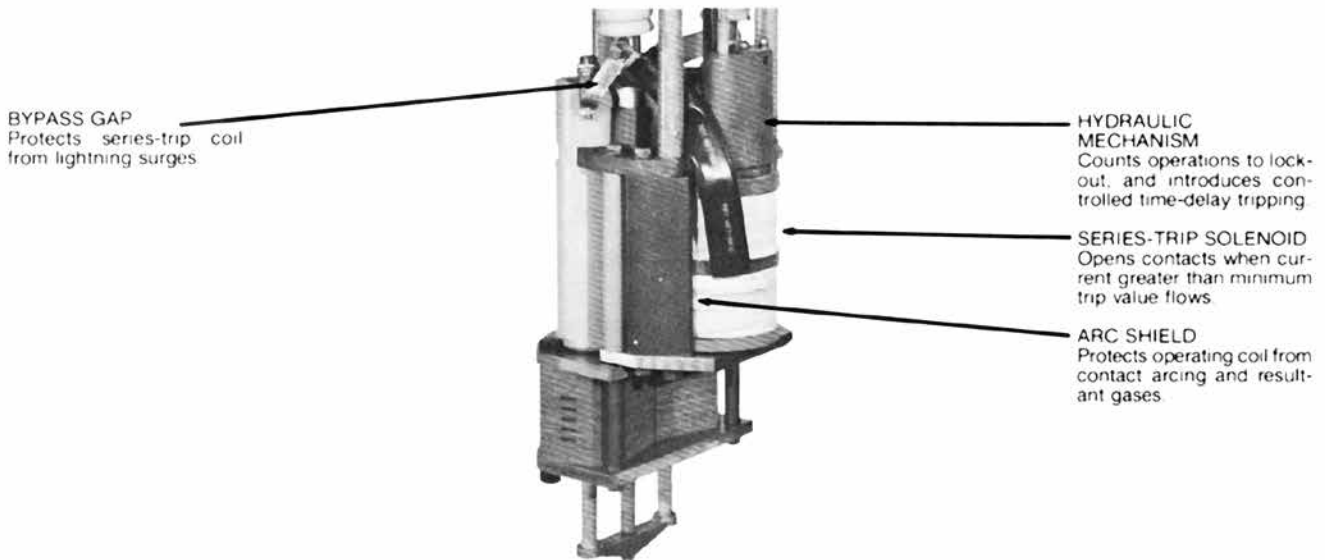


Figure 4. Hydraulic mechanism and series-trip solenoid

Specifications and ratings

Table 1. Specifications

Nominal operating voltage (rms kV)	24.9
Maximum design voltage (rms kV)	27
Impulse withstand (BIL), 1.2 X 50µsec wave (crest kV)	150
60-Hz withstanding (rms kV)	
Dry, one minute	60
Wet, ten seconds	50
Reclosing time (see)	1.8
Bushing creepage distance (in.)	17

Table 2. Interrupting ratings

Trip-coil continuous current (amps)	Minimum-trip current (amps)	Interrupting current (rms sym amps)
50	100	3000
70	140	4000
100	200	4000
140	280	4000
200	400	4000
280	560	4000

Table 3. Duty cycles

% Interrupting rating	Maximum circuit X/R ratio	Number unit operations	Total unit operations
15-20	3	32	64
45-55	6	20	
90-100	13	12	

General maintenance information

Type 4E reclosers are usually applied to increase service continuity, reduce operating costs, and increase revenue. The 4Es high load and interrupting ratings make it suitable for use in important substations. The Type 4E can perform at peak efficiency and provide reliable circuit protection if adequate maintenance is performed. Maintenance is relatively easy and inexpensive when compared with the savings achieved by the use of reclosers.

Oil condition

Oil provides the internal insulation barrier 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 using, 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 recloser should be filled with new oil, or oil that has been restored to like-new condition. Oil used in these reclosers conforms to ASTM Standard D3487, Type 1; its property limits are shown in *Reference Data TD280022EN Oil Specifications and Tests*.

Maintenance intervals

Frequency of maintenance depends upon local climatic conditions and the interrupting duty imposed on the recloser. Eaton recommends the unit be completely inspected, cleaned, and filled with new oil at least once each year. If the Type 4E operates through a duty cycle in less than one year, periodic maintenance should be performed then. The NEMA standard duty cycle for reclosers is listed in Table 3.

Oil dielectric strength

Although the Type 4E can go through the complete duty cycle without requiring an oil change, more frequent oil changes will be required if the majority of fault currents are near the maximum interrupting rating. Oil that has become contaminated with carbon and sludge, or has a dielectric strength of 22 kV or lower, should be replaced. Use only oil that meets the requirements for Eaton's Cooper Power series switchgear. Refer to *Reference Data TD280022EN*.

Periodic inspection and maintenance

Each periodic check should include at least the following steps:

1. **Bypass and remove recloser from service.**
Replace with a temporary fuse or spare recloser.
2. **Inspect external components.**
 - A. Check for broken bushings, paint scratches, or other mechanical damage.
 - B. The counter reading should be noted and entered in the recloser record.
 - C. Move the manual operating lever up and down to see if the counter is functioning properly. Leave the recloser in the open position.

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3. Remove mechanism from tank.

Loosen four bolts that secure the tank to the head casting, and loosen the gasket seal between tank and head casting. The gasket seal can be broken by carefully prying apart the head and tank. Hoist the mechanism out of the tank; allow oil to drain.

4. Clean all internal components.

- Remove all traces of carbon by wiping with a clean, lint-free cloth.
- Flush mechanism with clean, dry transformer oil.

CAUTION

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

5. Inspect moving contacts

Arcing tips of the moving contacts can experience a limited erosion before replacement is necessary. Contacts should be replaced before erosion of the load-current-transfer surfaces impairs their effectiveness.

If moving contacts appear to have further useful life, inspection of the arc interrupter chamber and stationary contacts can be omitted. These components are designed to last at least as long as the moving contacts.

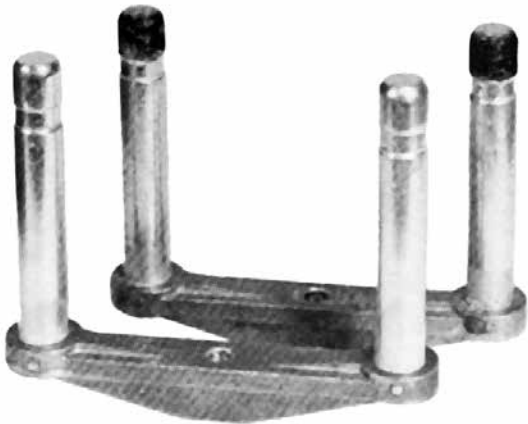


Figure 5. Moving contact assembly Background: After severe duty. Foreground: New

6. Inspect interrupter and exhaust port.

Each time fault current is interrupted by the recloser, the ten interrupter exhaust ports will experience some slight erosion. Exhaust port size on a new interrupter is 1/8-in. x 5/8-in. If significant erosion has occurred, the interrupter assembly (KA130E4) should be replaced. If moving and stationary contacts are being replaced, replacement of the interrupter stack is strongly recommended. See the "Arc-Interrupting Assembly" section of this manual for disassembly instructions.

7. Inspect stationary contacts.

If replacement of moving contacts or interrupter plate assembly is indicated, stationary contacts should also be replaced. order one each of KA101E4-1 and KA101E4-2.

If moving contacts have been removed from the end of the contact rod, a check of stationary contact erosion can be performed as follows:

- Close recloser with yellow handle.
- Insert moving contacts (by hand) into interrupter, up to their closed position.
- If resistance to insertion in stationary contacts is felt, the stationary contacts are likely to have further useful life.

If the interrupter plate assembly is removed, the stationary contacts will be exposed and erosion can be observed directly.

See the "Arc-interrupting Assembly" section of this manual for disassembly instructions.

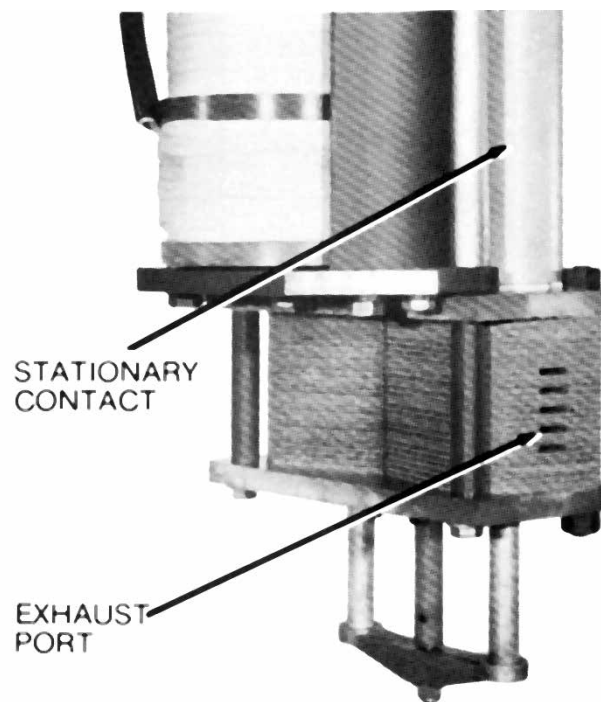


Figure 6. Inspecting interrupter and exhaust ports

8. Check the dielectric strength of the insulating oil.

- The dielectric strength should not be less than 22 kV when tested with a 0.1-in. gap in accordance with methods specified in ASTM D117.
- Low dielectric strength usually indicates the presence of water or carbon deposits.

9. Remove old oil.

If oil must be replaced, drain the tank and clean out all sludge or carbon deposits.

10. Inspect bank liers.

Note that two liners are employed. The inner liner is fibrous and readily absorbs any moisture present. Soft or spongy areas indicate water has been absorbed.

Replace the liner if these areas are present. The outer liner need not be replaced unless it is cracked.

Rinse the tank with clean oil, and wipe out all carbon traces with a clean, lint-free cloth.

11. Fill tank with oil.

Use only new transformer oil with dielectric strength of at least 30 kV as measured across a standard 0.1-in. gap in accordance with methods illustrated in ASTM Publication D117.

Fill the tank to the correct level with oil (9.5 gallons), indicated by a line on the fiber liner.

12. Check head gasket.

Clean and examine the head gasket. Replace if it is cracked, checked, cut, or otherwise damaged, or if it has been permanently deformed.

13. Replace cover and mechanism in tank.

- A. Wipe clean the O-ring type gasket, the gasket recess in the recloser cover, and the tank gasket seat.
- B. Position the four head bolts and tighten alternately (torque head bolts to 11—16 ft-lb). The cover can be rotated in steps of 90 degrees with respect to the tank and its mountings.

Operate the unit manually about eight times to be sure no air remains in the hydraulic mechanism.

14. Test mechanical operation.

An easy, effective test can be performed as follows:

- A. Move the operating lever to the CLOSED position and wait at least 4 minutes.
- B. Move the operating lever to the OPEN position and listen for opening of the main contacts. Then quickly move the lever back to the CLOSED position.
- C. Continue opening and closing the recloser manually until lockout is achieved. This can be determined by listening for unlatching of the lockout mechanism and also by noting that the recloser mechanism will not latch when the lever is moved to the CLOSED position.

Note: This test can be used to determine the number of operations to lockout. The number of fast and delayed operations can be noted also. Fast operations can be identified because the main contacts will open almost instantaneously when the operating lever is moved to the OPEN position. When delayed operations occur, a short time elapses between operation of the lever and opening of the contacts.

15. Direct-current testing.

Use the following to prove the recloser is in good operating condition, direct-current testing can be performed as follows:

- A. Move the operating lever to the CLOSED position and wait 4 minutes.
- B. Connect a storage battery across recloser terminals. Count the operations to lockout. If the correct number of operations did not occur, wait

5 minutes and repeat the test. Air in the hydraulic system can cause incorrect operation. Refer to Tables 4 and 5 for the number of 6-or 12- volt batteries to use for testing Type 4E reclosers.

Table 4. 6-Volt battery requirements for tripping

Recloser rating (amps)	Batteries* required	Cable size (AWG)
50	2 in series	
70	2	
100	2	Short lengths of no. 6 or larger
140	2	
200	2	
280	2	

*Fully charges and in good condition.

Table 5. 12-Volt battery requirements for tripping

Recloser rating (amps)	Batteries* required (Paralleled)	Cable size (AWG)
50	4	
70	4	
100	4	Short lengths of no. 6 or larger
140	4	
200	4	
280	4	

*Fully charges and in good condition.

Shop maintenance

When shop maintenance or repairs are to be performed, remove the four bolts that secure the tank and head casting. Trip the recloser and lift the mechanism out of the oil and allow to drain. Operations described in this section should be performed in the cleanest conditions possible.

Note: Maintenance work—except for bushing replacement—will be simplified if the work bench (table or stand) is arranged so the mechanism can be inverted (bushings down). Many of the following figures show the recloser in this inverted position.

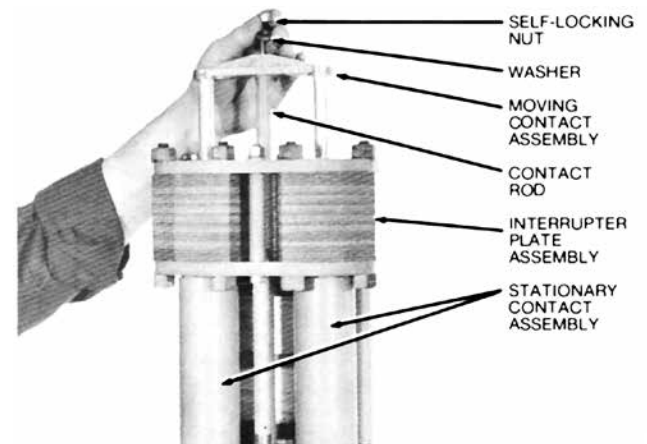


Figure 7. Removing contact yoke assembly

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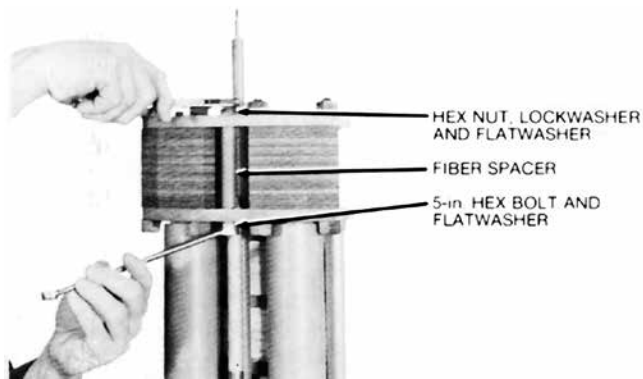


Figure 8. Removing 5-in. hex bolt from between interrupter stacks

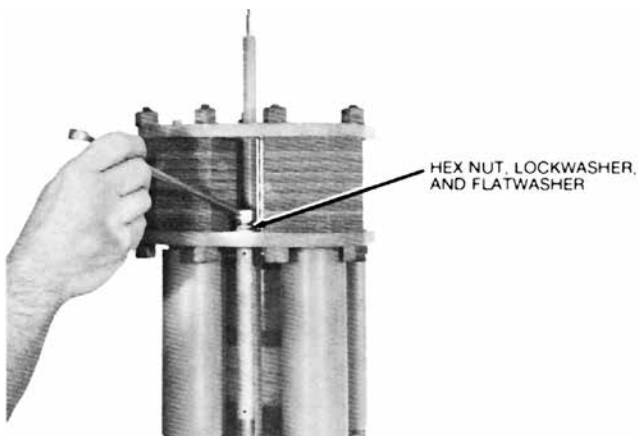


Figure 9. Removing hex nut and washers from center stringer

Arc-Interrupting assembly

When erosion has spread close to the loadcurrent transfer surfaces of the moving contacts, the entire arc-interrupting assembly should be dismantled and inspected. New parts should be installed as necessary. Best results will be obtained if the entire assembly—consisting of moving contacts, interrupting plate assembly, and stationary contacts—is replaced as a unit.

Follow these procedures to perform this work:

1. Remove self-locking nut and washer from end of contact rod (Figure 7) and lift off the moving contacts.
2. Remove the interrupter plate assembly as follows:
 - A. Remove the 5-in. hex bolt, flatwasher, fiber spacer, flatwasher, lockwasher, and hex nut located between the two interrupter stacks (Figure 8).
 - B. Remove the hex nut, lockwasher, and flatwasher from the end of the center stringer (Figure 9).
 - C. Remove the two 5-1/2-in. hex bolts, lockwashers, flatwashers, and spacers from the bottom of the interrupter plate assembly (Figure 10).
 - D. Remove the interrupter plate assembly from the stationary contact housing (Figure 11).

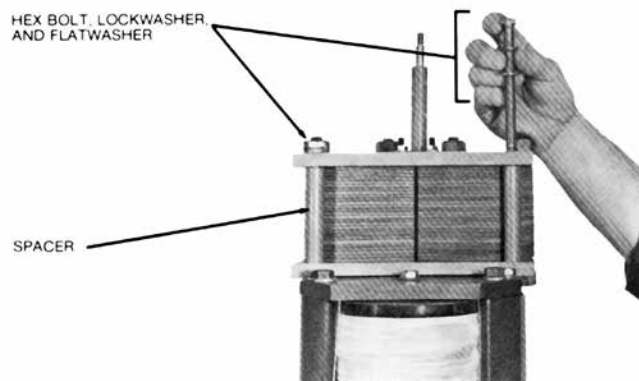


Figure 10. Removing 5-1/2-in. hex bolts, washers, and spacers from interrupter plate assembly

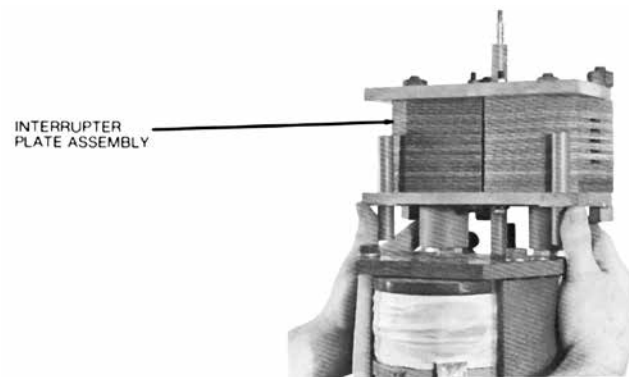


Figure 11. Removing interrupter plate assembly

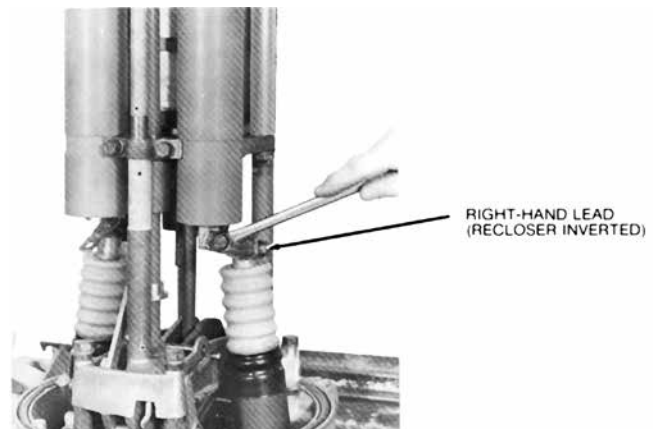


Figure 12. Removing lead from right-hand contact assembly

3. Remove the stationary contact tube assemblies as follows:
 - A. Disconnect the lead from the vertical terminal on the right-hand contact assembly by removing the hex bolt, lockwasher, and flatwasher (Figure 12).
 - B. Disconnect the coil lead and coil gap strap from the horizontal terminal on the left-hand contact assembly by removing the hex bolt, lockwasher, and flatwasher (Figure 13).

- C. Remove the two hex bolts, lockwashers, and flatwashers that secure the two contact wedges to the solenoid frame (Figure 14).

Note: Before removing the two stationary contact assemblies, note that the position of the right-hand contact assembly has the flat side, on its upper terminal, facing outward (Figure 14).

- D. Grasp both contact tubes near their free ends and pull apart enough to release the tubes from the solenoid frame (Figure 15).
4. If further maintenance is to be performed, do not reassemble the stationary contact assembly, interrupter plate assembly, or moving contact assembly. When reassembling, reverse the procedures listed in the preceding steps 1 through 3.

CAUTION

When reassembling the moving contact assembly on units below serial numbers 6680, tighten the self-locking nut and washer so as to leave a 1/16-in. clearance between the shoulder of the contact rod and the moving contact yoke, when the recloser is in the closed position.

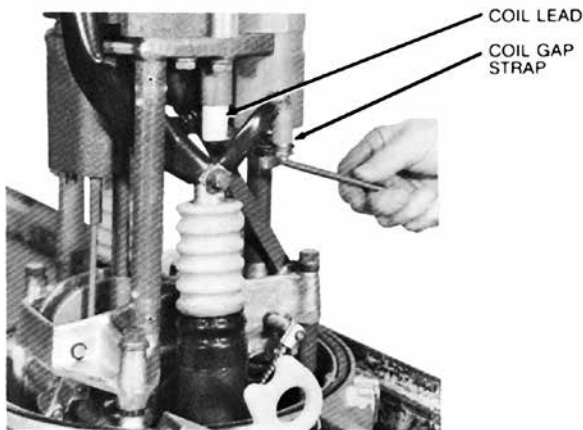


Figure 13. Removing lead from left-hand contact assembly

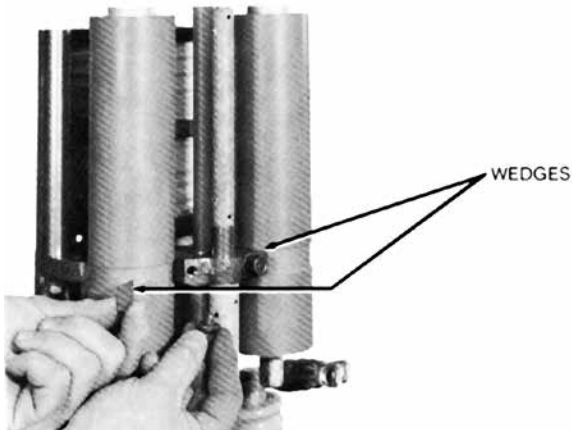


Figure 14. Removing contact tube wedges

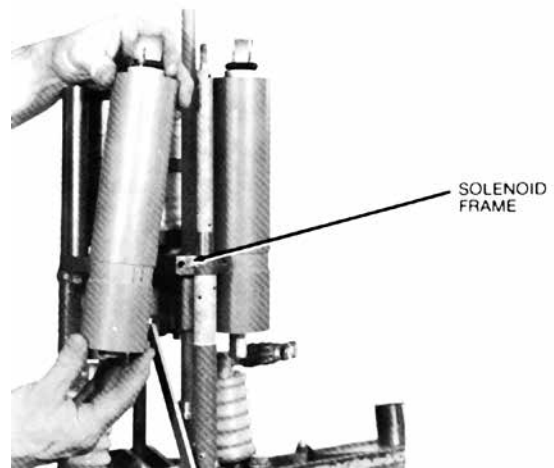


Figure 15. Removing contact tubes

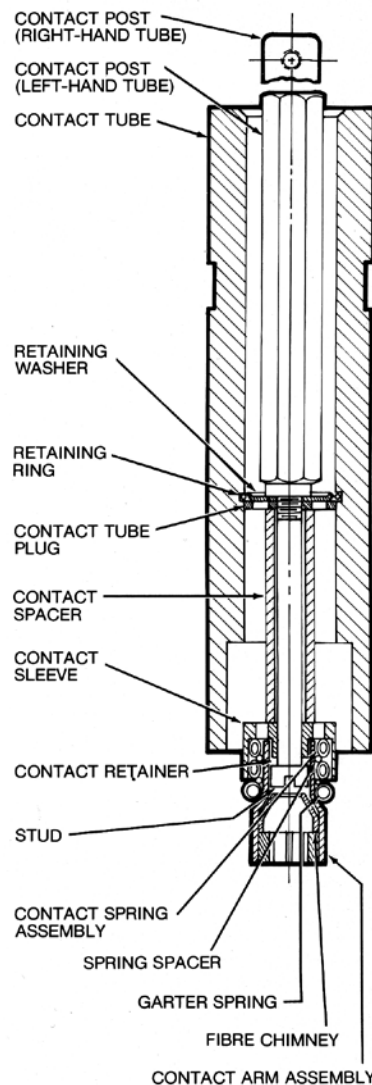


Figure 16. Cross-sectional view of contact tube

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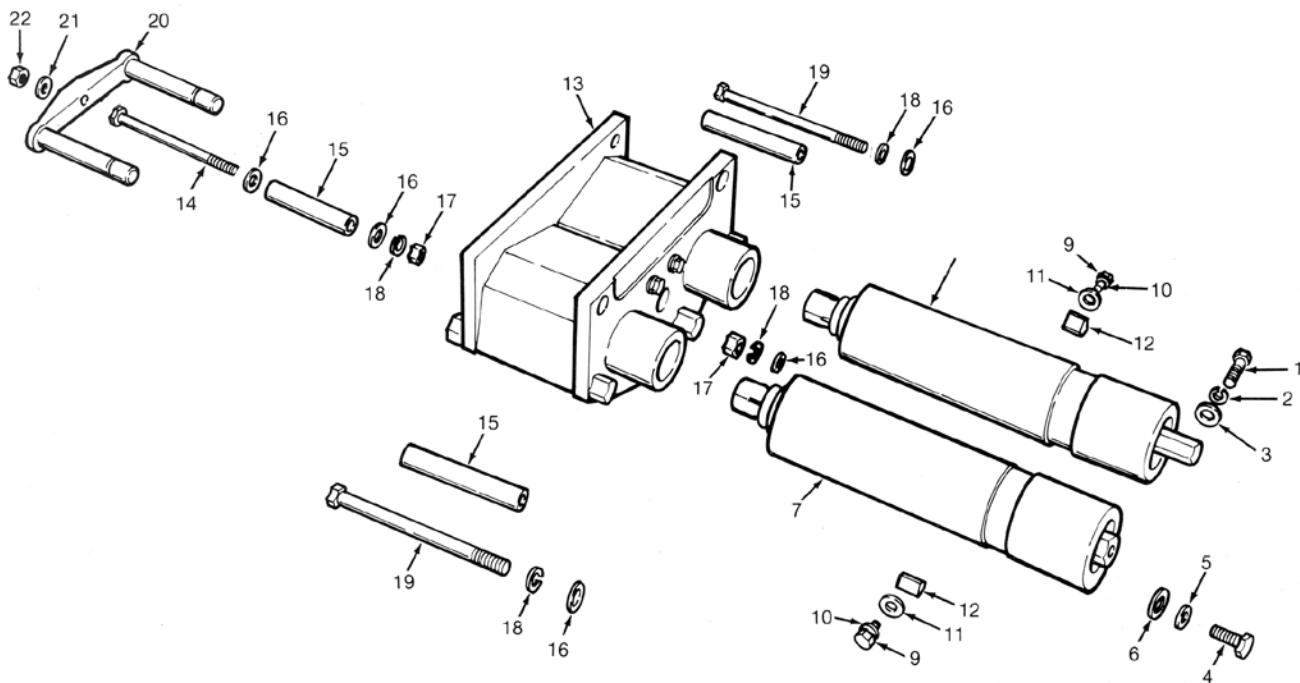


Figure 17. Arc-interrupting assembly parts. See table 6 for parts identification

Table 6. Parts list for arc-interrupting assembly (See Figure 17)

Item no.	Catalog no.	Description	No. used per recloser
1	K730125131100A	5/16-in.—18 UNC—2Ax1-in. brass capscrew	1
2	K900830031000A	5/16-in. bronze lockwasher	1
3	K9000525033075A	5/16-in. brass flat washer	1
4	K730125337100A	3/8-in.x240 NF—2Ax1-in. brass capscrew	1
5	K900830037000A	3/8-in. bronze lockwasher	1
6	K900525039087A	3/8-in. brass flatwasher	1
7	KA101E4-1	Stationary contact assembly-left hand	1
8	KA101E4-2	Stationary contact assembly-right hand	1
9	K730101131050A	5/16-in.—18NC—x1/2-in. steel hex screw	2
10	K900801031000A	5/16-in. steel lockwasher	2
11	K900201031000A	5/16-in. steel flatwasher	2
12	KP44L	Contact wedge	2
13	KA130E4	Interrupter assembly	1
14	K730101137500A	3/8-in.—16 UNC—2Ax5-in. steel capscrew	1
15	KA3011-77	Spacer	3
16	K900201037000A	3/8-in. steel flatwasher	5
17	K880133116037A	3/8-in.—16 UNC—2B steel hex nut	2
18	K900801037000A	3/8-in. steel lockwasher	4
19	K730101137550A	3/8-in.—16 UNC—2Ax5-1/2-in. steel capscrew	2
20	KA112E4	Moving contact assembly	1
21	KP3013A86	Spacer	1
22	KP2020A9	Self locking nut	1

Series-trip solenoid disassembly

If the series-trip coil has been damaged in any way or if the recloser is to be changed to a new rating, the series-trip coil can be replaced. New coils, gaskets, and data plates are shipped in sealed boxes.

Coils should not be exposed to air any longer than necessary because moisture from the air may be absorbed. When a good coil is replaced, it should be stored in the same container in which the new one was shipped.

Observe the following procedure for disassembly of a series-trip solenoid:

1. If the arc-interrupting assembly has not been removed previously, observe procedure outlined in the "Arc-Interrupting Assembly" section.
2. Disconnect coil leads. The short coil lead is disconnected while removing the arc interrupting assemblies. The long coil lead and bypass gap are disconnected from the bushing by removing the capscrew, lockwasher, and flatwasher (Figure 18).
3. Using a 3/4-in. box wrench, remove the four hex nuts and lockwashers that secure the solenoid bridge plate (Figure 18). Lift this plate off as shown in Figure 19. Note that a cushion washer is attached to the plate.
4. Remove the two rectangular dielectric shields inserted between the solenoid frame shoe and the series-trip coil (Figure 20). If necessary, remove the two dielectric shield tubes from the solenoid frame rod supports (Figure 20).
5. Lift off the lower gasket, coil and upper gasket.

Series-trip solenoid reassembly

If further maintenance is to be performed, do not reassemble the solenoid yet. When the solenoid is to be reassembled, reverse the procedures listed in the "Series-Trip Solenoid Disassembly" section of this manual.

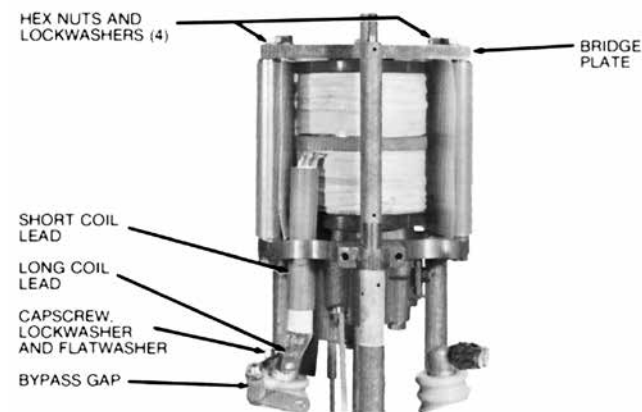


Figure 18. Removing coil leads

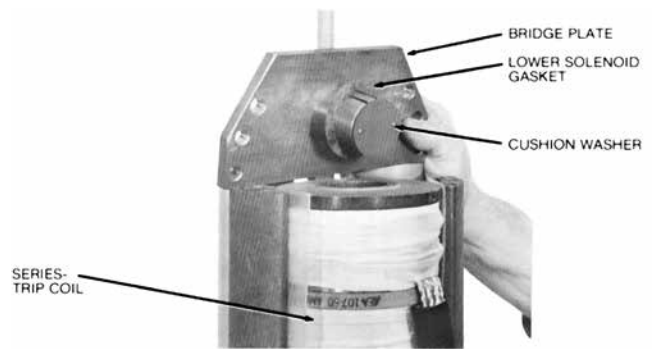


Figure 19. Removing the bridge plate

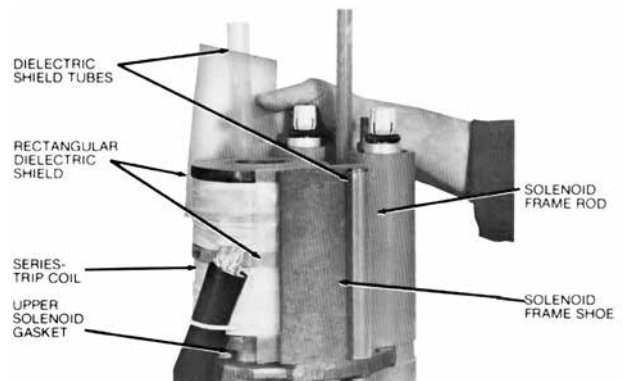


Figure 20. Removing the dielectric shields

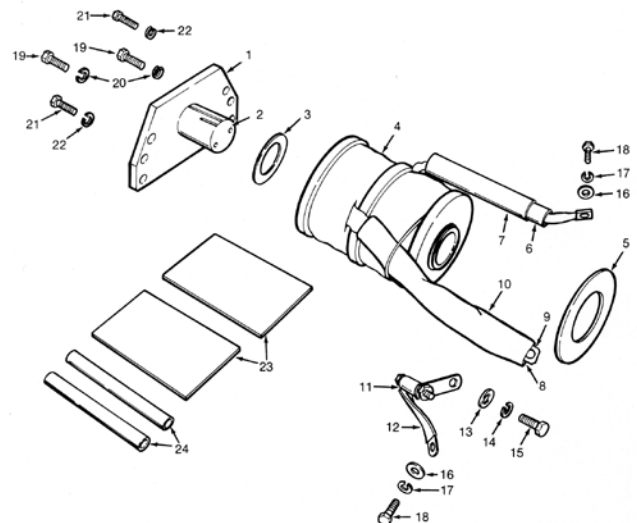


Figure 21. Series-trip solenoid assembly parts. See Table 7 for parts identification

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Table 7. Parts list for series-trip solenoid assembly (Figure 21)

Item no.	Catalog no.	Description	No. used per recloser
1	KP1016E3	Bridge Plate	1
2	KA122E4	Plunger Stop assembly	1
3	KP2090A28	Solenoid gasket, lower	1
4	KA700E4	Coil Assembly (Show coil rating by suffix. Example: KA700E4100 = 100 amp coil)	1
5	KP2090A6	Solenoid gasket, upper	1
6	KP2104A21	Glass sleeve, short lead (inner)	1
7	KP3017A49	Sleeve, short lead (outer)	1
8	KP2104A23	Glass sleeve, long lead (inner)	1
9	KP2106A51	Sleeve, long lead (middle)	1
10	KP2106A52	Sleeve, long lead (outer)	1
11	KA1 20E4	Coil gap assembly	1
12	KP2106A58	Sleeve	1
13	K900525039087A	3/8-in. brass flatwasher	1
14	K900830037000A	3/8-in. bronze lockwasher	1
15	K700133337087A	3/8-in.—24 UNF-2x7/8-in. bronze hex screw	1
16	K900525033075A	5/16-in. brass flatwasher	2
17	K900830031000A	5/16-in. bronze lockwasher	2
18	K730125131100A	5/16-in.—18 UNC—2Ax1-in. brass capscrew	2
19	K730101143125A	7/16-in.—14 UNC—2Ax1-1/4-in. steel capscrew	2
20	K900801043000A	7/16-in. steel lockwasher	2
21	K730101137125A	3/8-in.—16 UNC—2Ax1-1/4-in. steel capscrew	2
22	K900801037000A	3/8-in. steel lockwasher	2
23	KA1013E4	Rectangular dielectric shield	2

Hydraulic mechanism

This mechanism should require no maintenance, but components may be changed to provide different operation sequences. Furthermore, removal of this mechanism may be required to gain access to the head operating mechanism.

Note: The bushings must be removed to simplify the removal of the hydraulic mechanism. Refer to the "Bushings Disassembly" section of this manual.

To **disassemble** the hydraulic mechanism, observe the following steps:

1. Remove the two hex bolts, lockwashers and flatwashers from the bottom of the head mechanism to release the two rear stringers (Figure 22).
2. Remove the upper half of the front stringer by unscrewing it from the lower half of the front stringer (Figure 22).
3. Grasp the solenoid plunger and pump piston link with one hand and carefully lift off the frame with the other hand as illustrated in Figure 23. If desired, the lower half of the front stringer can now be unscrewed from the head mechanism.
4. If necessary the frame shoes and rod supports can be removed from the hydraulic mechanism by removing the hex bolts and lockwashers (Figure 24).
5. With a 1/2-in. wrench, remove the capscrew that secures the operation selector plate, orifice plate, and gasket. See Figure 25.

6. Using a 5/8-in. wrench, remove the control valve assembly. Tip the frame so the valve element falls out.
7. If equipped with the KA127L3 solenoid frame assembly, remove the slide valve chamber plug and gasket by means of a 5/8-in. wrench. Parts removed in steps 5, 6 and 7 are shown in Figure 26.

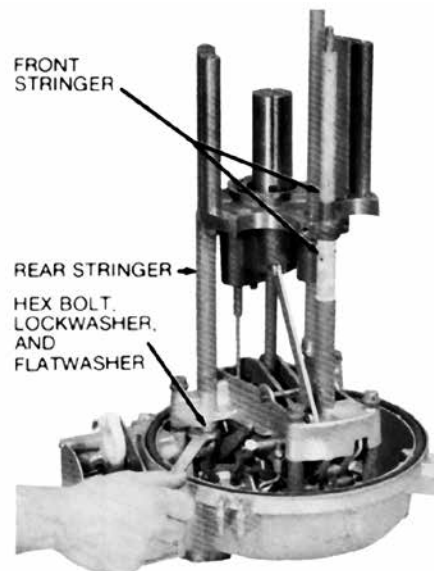


Figure 22. Removing stringers from the head and hydraulic mechanism

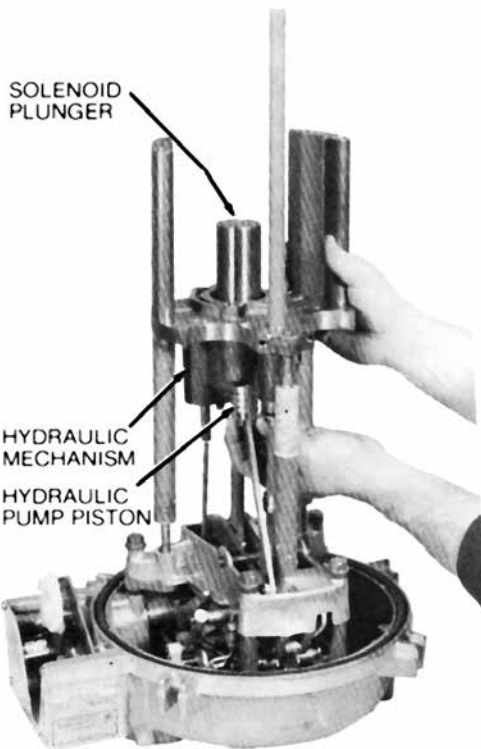


Figure 23. Removing the hydraulic mechanism

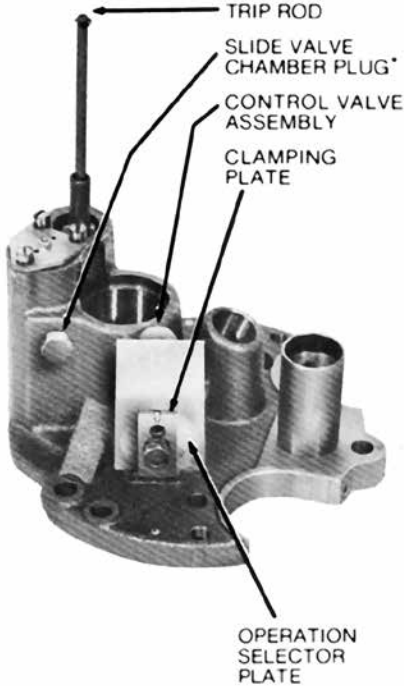


Figure 25. View of hydraulic mechanism
*Used only on solenoid frame assembly KA127L3

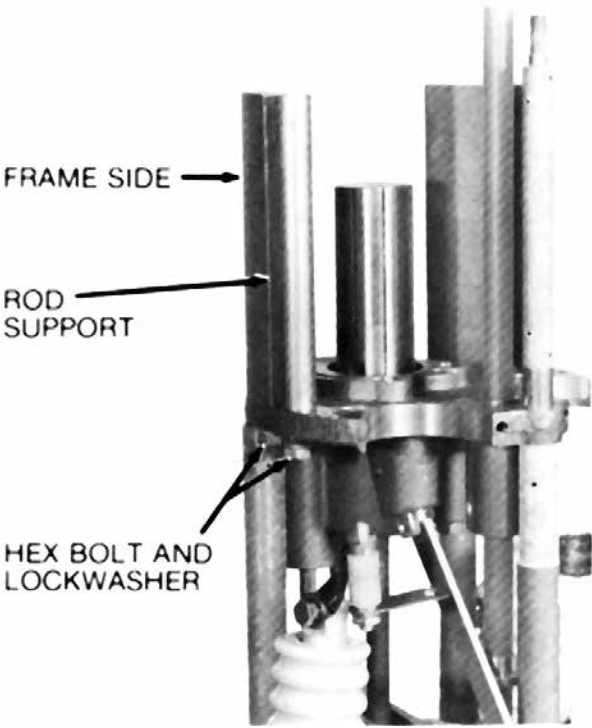


Figure 24. Removing frame shoes and rod supports

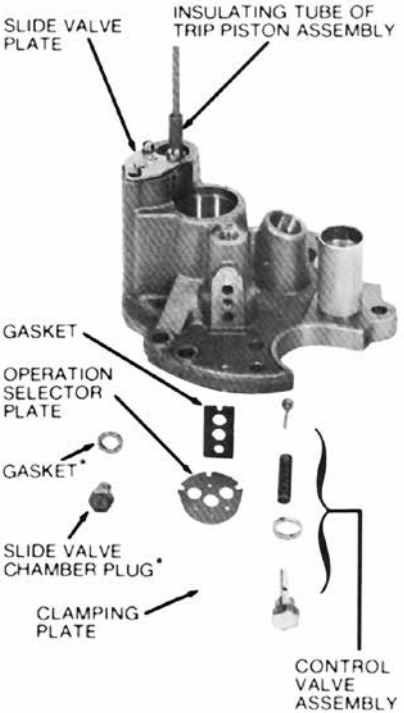


Figure 26. Hydraulic mechanism partially assembled
*Used only on solenoid frame assembly KA127L3

Type 4E maintenance instructions

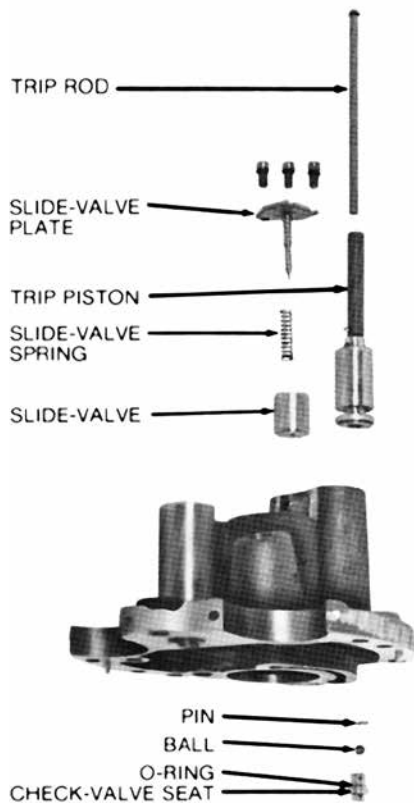


Figure 27. Removing slide valve, check valve and trip valve

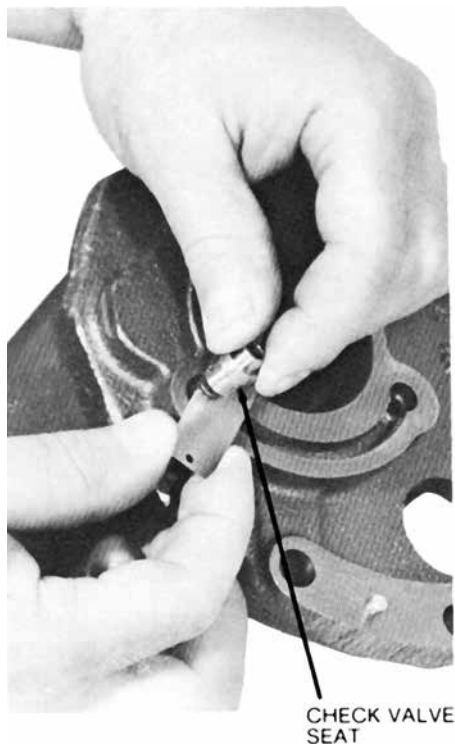


Figure 28. Removing check valve seat

8. Remove the slide valve plate and gasket by releasing three screws. Tip the frame so the valve will slide out (Figure 27).
9. With a wire hook, pull the ball check valve seat out enough to expose the spring (but not more than 1-in.) and insert a thin plate as demonstrated in Figure 28. Then push the pin out to release the spring. A steel ball will be released. Lift out the trip piston. Figure 27 shows parts removed in steps 8 and 9.
10. The pump piston can be removed if necessary by turning the outershell off the piston body. Then push out the pin that connects the body to the insulated link. See Figure 29.

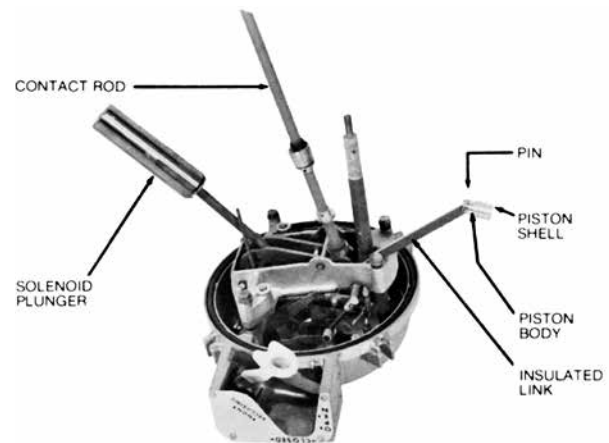


Figure 29. Removing pump piston

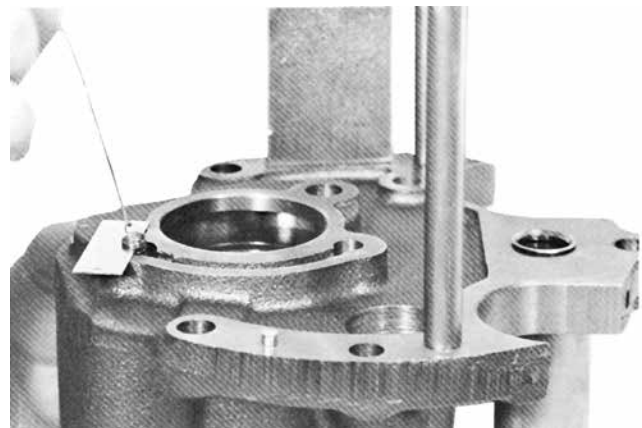


Figure 30. Pulling out trip piston spring

If further maintenance is to be performed, do not replace the hydraulic mechanism yet. When ready for **reassembly**, reverse the preceding disassembly instructions while observing the following steps:

1. Refer to Table 9 for components to be used for a particular operating sequence.

2. Insert the trip piston in its cylinder. Pull the spring out as shown in Figure 30 and insert a thin plate to hold it. Secure the ball, check valve seat, and o-ring gasket to the spring by inserting the pin, but be sure the small steel ball is also retained by the pin.
3. Replace the slide valve, slide-valve spring, and slide-valve plate and gasket assembly. Next (if equipped with the KA127L3 solenoid frame assembly), replace the slide-valve chamber plug and the operation selector assembly. Use a new gasket KA2011A1 with the slide-valve chamber plug.
4. Pin the pump piston body to the insulated link and screw on the outer shell. When sequence adjustments have been made according to the "Sequence Adjustment" section of this manual, stake the shell to the body by means of a small prick punch.

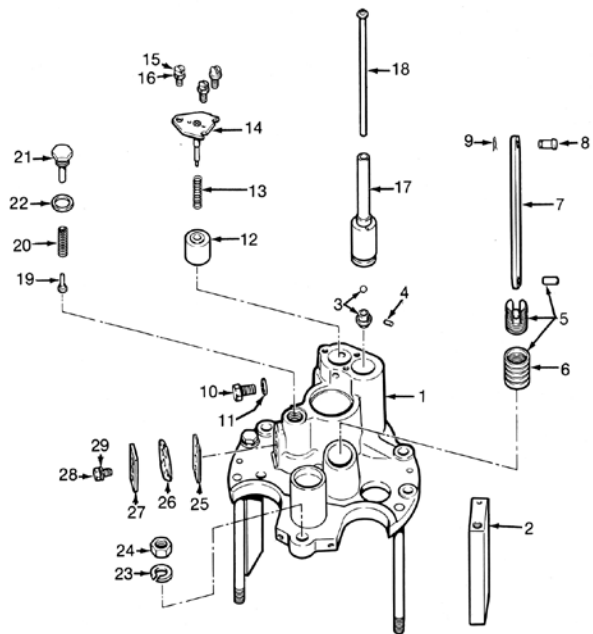


Figure 31. Hydraulic mechanism parts. See Table 8 for parts identification

Table 8. Parts list for hydraulic mechanism (see Figure 31)

Item no.	Catalog no.	Description	No. used per recloser
1	KA109E4	Solenoid frame assembly	1
2	KP1057E4-2	Frame shoe	2
3	KP155H2	Ball check valve seat and 1/4-in. steel ball	1
4	KP3051A3	Pin	1
5	KA25H	Pump piston assembly	1
6	KP151H	Pump piston shell only	1
7	KP112L	Pump piston link	1
8	KP85L	Pivot pin - includes item 9	1
9	KP2018A2	Spring clip, No.1137, 0.035-in.	1
10	KP123L	Slide valve chamber plug C*	1
11	KA2011A1	Type A gasket— 1/2-in.x11/16-in.x5/64-in.	1
12	KA10545LL	Slide valve	1
		Slide valve } See Tables 9 and 10	1
13	KP213L	Slide valve spring	1
14	KA64L	Slide valve stop assembly	2
15	K721801125050A	Steel round-head screw— 1/4-in.—20NC2x1/2-in.	3
16	K900801037000M	Lockwasher - 1/4-i n.	3
17	KA94L4	Piston and rod guide assembly	} See Table 9
	KA94L5	Piston and rod guide assembly	
	KA94L6	Piston and rod guide assembly	
	KA94L7	Piston and rod guide assembly	
18	KP108L900	Trip rod	} See Table 9
	KP197L900	Trip rod	

Type 4E maintenance instructions

Table 8. Parts list for hydraulic mechanism (see Figure 31) (continued)

Item no.	Catalog no.	Description	No. used per recloser
19	KP193L	Control valve	1
20	KP113L	Control valve spring	1
21	KP118L	Control valve stop screw	1
22	KP3013A12	Spacer	1
23	K900801 043000A	Steel lockwasher—7/16-in.x 0.156-in.x 0.109-in.	1
24	K880201114043A	Hex head steel nut—7/16-in.—14NC2	1
25	KP222L	Operations selector gasket	1
26	KP123L	Selector plate, standard	1
27	KP223L	Clamping plate	1
28	K730101131050A	Steel hex capscrew—5/16-in.—18NC2x1/2-in.	1
29	K900801031000D	Lockwasher—5/16-in.x0.125-in.x0.78-in.	1

*Used only on solenoid frame assembly KA127L3

Table 9. Part numbers used for various operating sequences

Curve	Timing	Trip piston	Trip rod	Slide valve	Sprag, slide valve	Stop slide valve	Spacer
A	3 fast	KA94L5	KP108L900	KP104L	KP21 3L	KA64L	KP233L
A	4 fast	*	*	*	*	*	**
B	4 delayed***	*	*	KA155L	*	KP105L & KP106L	**
B	3 delayed***	*	*	*	*	*	KP233L
B	2 delayed	*	*	KP104L	*	KA64L	KP332H
B	3 fast, 1 delayed	KA94L7	*	*	*	*	**
B	2 fast, 2 delayed	KA94L5	*	*	*	*	**
B	2 fast, 1 delayed	KA94L4	*	*	*	*	**
B	1 fast, 3 delayed	KA94L6	KP197L900	*	*	*	**
B	1 fast, 2 delayed	KA94L5	KP108L900	*	*	*	KP233L
B	1 fast, 1 delayed	KA94L4	*	*	*	*	*
C	4 delayed***	KA94L5	*	KA155L	*	KP105L & KP106L	**
C	3 delayed***	*	*	*	*	*	KP233L
C	2 delayed	*	*	KP104L	*	KA64L	KP332H
C	2 fast, 2 delayed	*	*	*	*	*	**
C	2 fast, 1 delayed	KA94L4	*	*	*	*	**
C	1 fast, 3 delayed	KA94L6	KP197L900	*	*	*	**
C	1 fast, 2 delayed	KA94L5	KP108L900	*	*	*	KP233L
C	1 fast, 1 delayed	KA94L4	*	*	*	*	*
D	4 delayed***	KA94L5	*	KA155L	*	KP105L & KP106L	**
D	3 delayed***	*	*	*	*	*	KP233L
D	2 delayed	*	*	KP104L	*	KA64L	KP332H
D	2 fast, 2 delayed	*	*	KP104L	*	*	**
D	2 fast, 1 delayed	KA94U	*	*	*	*	**
D	1 fast, 3 delayed	KA94L6	KP197L900	*	*	*	**
D	1 fast, 2 delayed	KA94L5	KP108L900	*	*	*	KP233L
D	1 fast, 1 delayed	KA94L4	*	*	*	*	*

*Same catalog no. as above.

**Not used in this sequence.

***Slide-valve spring omitted. All others use KP213zL slide-valve spring.

Note: In order to have all fast-trip operations, a solenoid frame assembly must be ordered.

Changing time-current settings

Time-current curves for the Type 4E recloser indicate minimum-trip and the interrupting capacity range plotted to an average clearing time for each opening of the recloser contacts. Recloser curves are labeled to represent their relative speed of opening with A being fast, B delayed, C extra delayed, and D steep delayed. To provide all operations on the A curve, a special solenoid frame assembly must be ordered (KA127L3). To select operations on the B, C, or D curves, merely loosen the capscrew and clamping plate and re-index the orifice selector plate to the desired delayed curve.

Changing operating sequence

Specified combinations of hydraulic parts as listed in Table 9 permit the recloser to operate along one curve (single timing) or with a combination of two curves (dual timing). When set for dual timing the recloser operates first on a fast curve and then on a slower curve. After a selected number of operations, the recloser locks out. Figures 32 to 35 illustrate the location of the various parts used for changing the operating sequence to lockout.

Sequence adjustments

After any change or servicing of the hydraulic mechanism, make sure to remove any air that may have been entrapped, by operating the yellow control handle manually seven or eight times. All changes should also be verified with the testing procedures that are explained in the "Periodic Inspection and Maintenance" section of this manual. It may also be necessary to adjust the hydraulic pump piston shell to enable pumping action to lockout in the following manner:

1. Lower the unit into the oil enough to cover the hydraulic system. Operate the recloser manually several times to dispel any air in the hydraulic system.
2. Close the recloser, wait 4 minutes, and rapidly trip and close the recloser three times. Then observe the position of the trip rod. This rod should just be touching the adjustable lockout level in the head mechanism.
3. If the trip rod is not correctly positioned, turn the pump piston shell to cause it to pump more or less oil as required. Turning the shell off the body tends to increase travel of the trip rod, whereas turning the shell into the body decreases trip-rod travel.

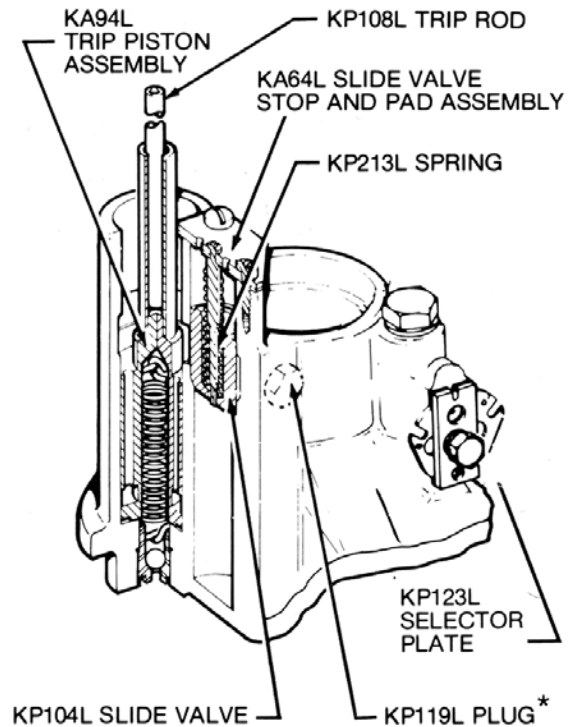


Figure 32. Parts for most commonly used sequence, two fast and two delayed
*On units with KA127L3 solenoid frame

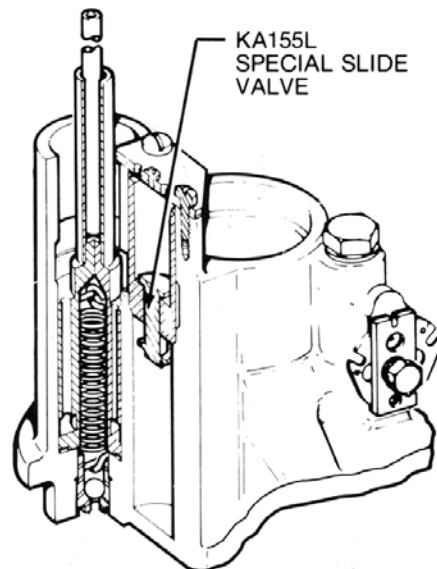


Figure 33. Installation of special slide valve used for delayed-only operations. No slide-valve spring is used

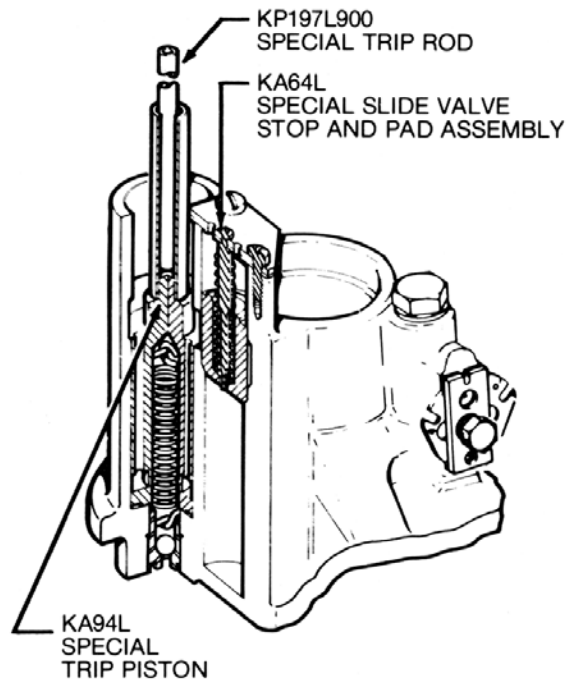


Figure 34. Special parts used for one fast and three delayed sequence

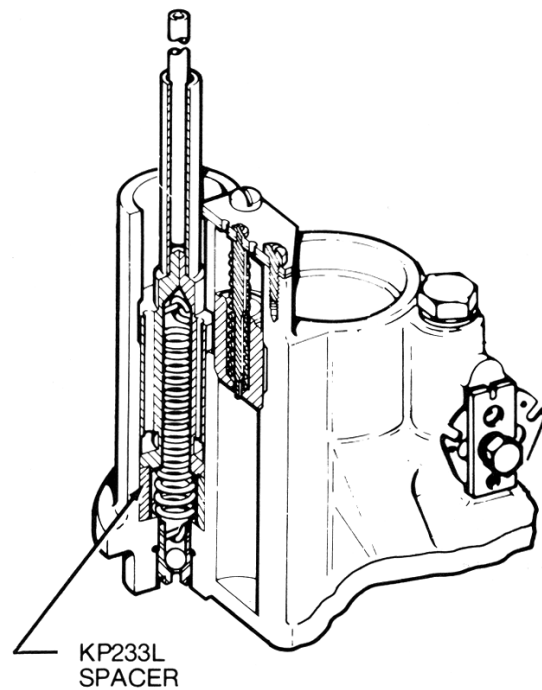


Figure 35. Location of spacer under trip piston

Bushings

Maintenance of bushings is ordinarily limited to an occasional cleaning. If, however, a bushing is cracked or chipped, replace as follows:

Note: The recloser must be untanked to replace the bushings.

Disassembly

1. If not done previously, remove the lead straps from bottom of each bushing by removing nut, lockwasher, and flatwasher.
2. Remove the three bolts that secure the bushing clamps and lift the bushings out of the head casting (Figure 36).

If further maintenance is to be performed, do not replace the bushings yet.

Reassembly

1. Position the new bushing gaskets on the head mechanism.
2. Place the bushing clamping gaskets around the bushings.
3. Carefully insert bushings into head casting so that the flat part of the lower terminal faces away from the center of the recloser mechanism.
4. Replace the bushing clamps and bolt into place. Torque clamp bolts to 6—10 ft-lbs.
5. Secure the lead straps to the bushings by reinstalling the flatwasher, lockwasher and nut.

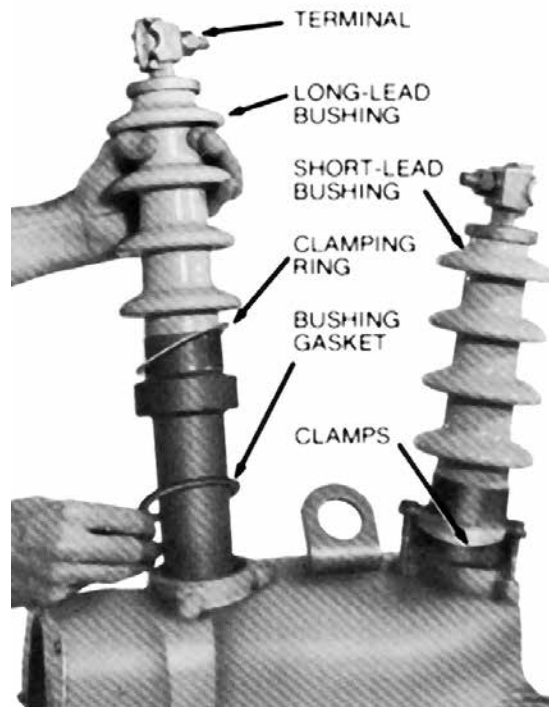


Figure 36. Lifting a bushing assembly

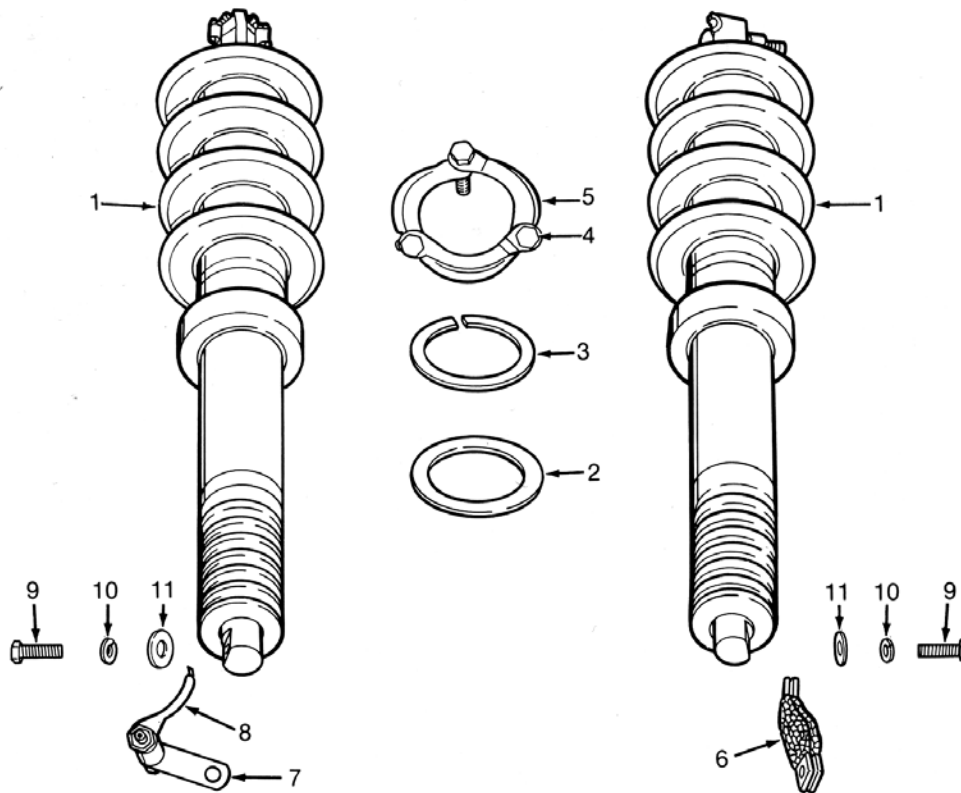


Figure 37. Bushing parts. See Table 10 for parts identification

Table 10. Parts list for bushings (See Figure 37)

Item no.	Catalog no.	Description	No. used per recloser
1	KA160E3	Bushing assembly	2
2	KP2090A29	Bushing gasket, lower	2
3	KP121L	Bushing clamping gasket	2
4	K730115157200A	Stainless steel hex capscrew-3/8-in.— 16NC2x2-in.	6
5	KP41L	Galvanized bushing clamp segment	6
6	KA147E4	Lead, short	1
7	KA120E4	Coil gap assembly	1
8	KP2106-58	Tubing sleeve for coil gap lead	1
9	K730125131100A	5/16-in.—8 UNC—2Ax1-in. brass capscrew	2
10	K900830031000A	5/16-in. bronze lockwasher	2
11	K900525033075A	5/16-in. brass flatwasher	2

Head mechanism

Disassembly of the head mechanism should rarely be required. Should this be necessary for any reason, observe the following steps:

1. Move operating lever to the OPEN position.
2. Figure 38 shows a head assembly as it appears after the arc-interrupting structure, series-trip solenoid, hydraulic mechanism, insulating stringers and bushings have been removed. Remove self-locking nut and

four hex cap screws with lockwashers indicated in Figure 38. Note the use of the flatwasher under the capscrew nearest the operating lever. Also note the use of two small spacers at the back of the head mechanism and the use of two small and two large spacers at the front of the head mechanism (Figure 38).

3. If desired, remove the pump piston by removing the spring clip and pivot pin (Figure 38).

Type 4E maintenance instructions

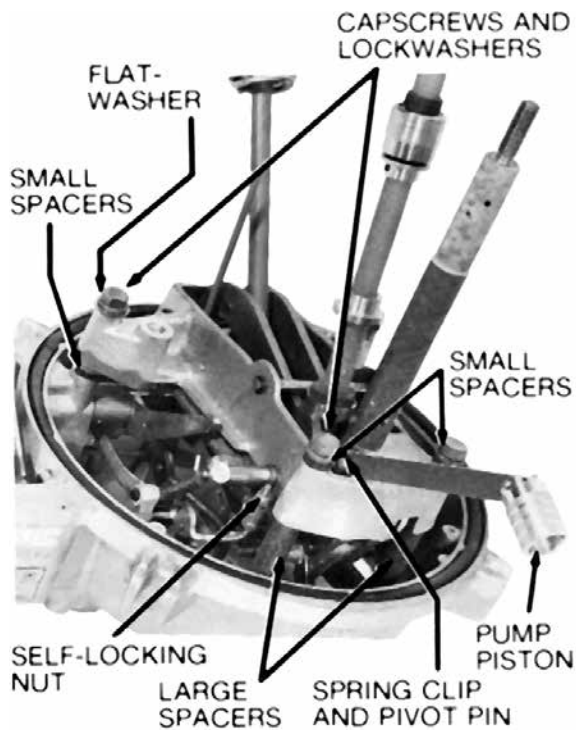


Figure 38. Removing head operating mechanism

4. Disconnect the lockout lever assembly link by removing the spring clip and pivot pin. Note the flatwasher used between the two links (Figure 39).
5. Lift the operating mechanism assembly to expose the lockout cam-link assembly pivot point. Remove the C-ring and pivot pin that connects the head mechanism to the lockout cam assembly. Lift out the entire mechanism.
6. Remove the C-ring (Figure 40) and pull pivot pin that secures the solenoid plunger to the operating mechanism. Then pull off the spring clip and remove the pivot pin that secures the contact rod. The trip rod is removed by removing the E-ring on the head casting side of the rod (Figure 25).
7. Figures 41a and 41b show the head assembly as it appears after the operating mechanism has been removed. Unhook the lockout spring and operating lever spring.

Note: In mid 1984 the counter torsion spring configuration changed. Figure 41a shows the old style, Figure 41b shows the new style. New torsion spring parts are interchangeable with old design.

8. Remove the sleet hood cover and counter. Then drive out the rollpin (not shown) in the lockout lever.

9. Pull the operating lever and remove the manual trip lever. Then lift out the lockout cam and link assembly, and lockout lever. See Figure 42.

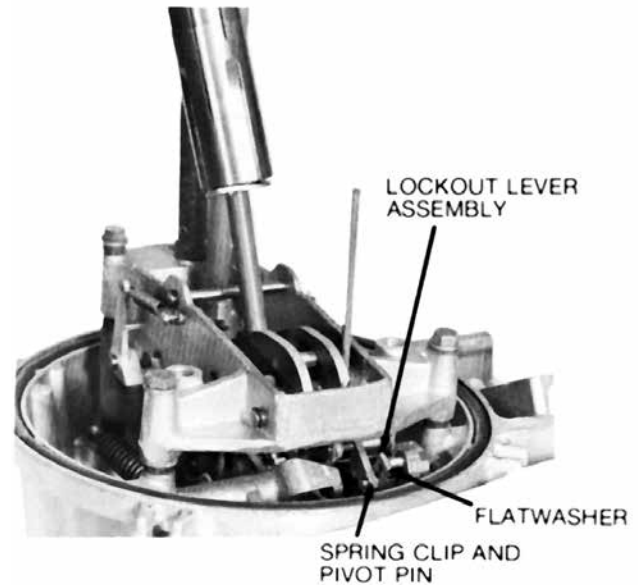


Figure 39. Disconnecting lockout lever assembly link

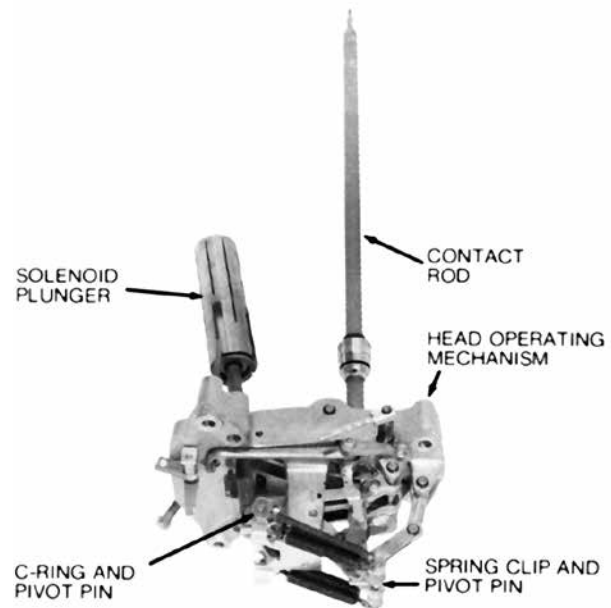


Figure 40. Removing solenoid plunger and contact rod

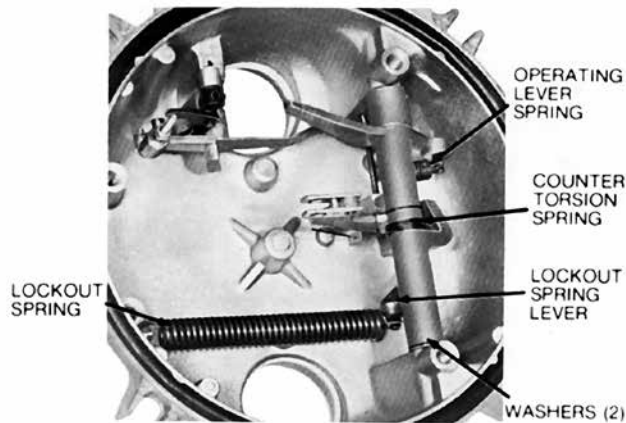


Figure 41a. View of head mechanism

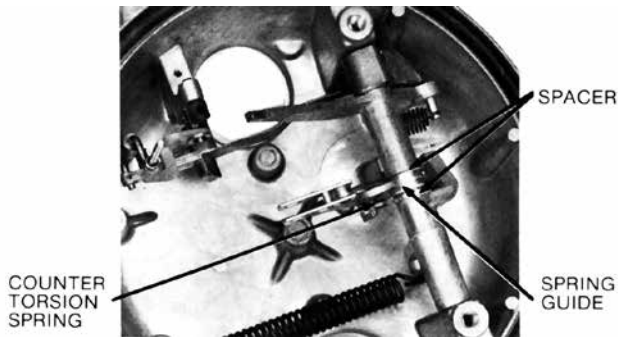


Figure 41b. View of head mechanism

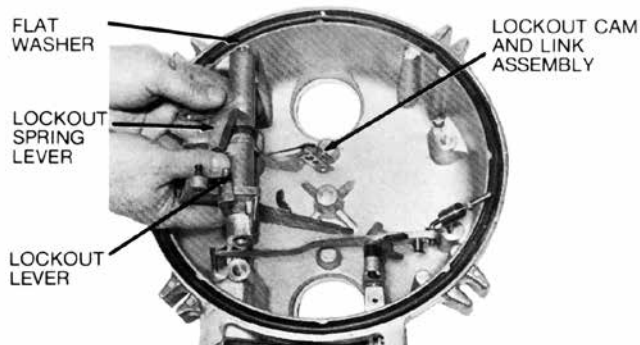


Figure 42. Head mechanism parts being removed

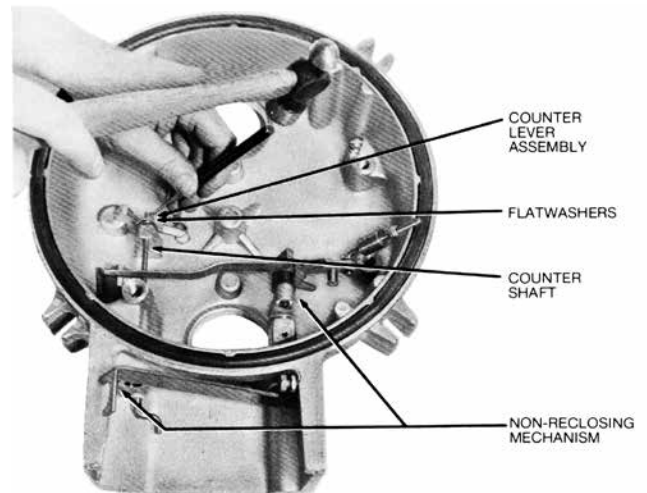


Figure 43. Head mechanism parts being removed

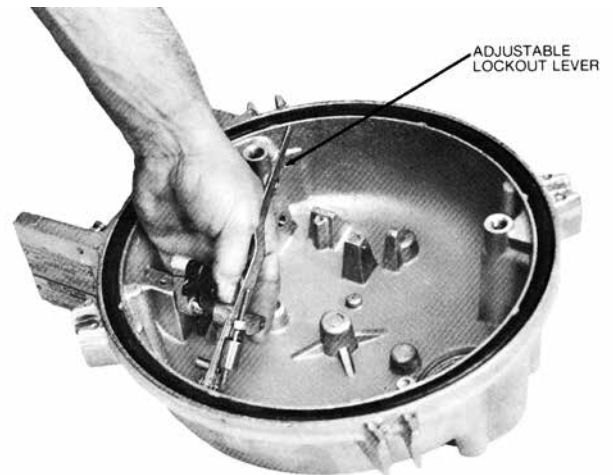


Figure 44. Lifting out adjustable lockout lever

10. Drive out the rollpin that secures the counter lever assembly to the counter shaft as illustrated in Figure 43. Pull out the shaft. Note the flatwasher that separates the counter lever assembly and the post in the head casting.
11. Slip off the adjustable lockout lever (Figure 44).

All major components have been removed at this point, with the exception of the nonreclosing accessory. Description of removal of this device is omitted because such procedure should never be necessary.

Type 4E maintenance instructions

Reassembly of the head mechanism can in general be accomplished by reversing the preceding disassembly procedure. Some helpful precautions are noted below.

1. Install counter parts first.
2. Next, position adjustable lockout lever (Figure 44).
3. Slide lockout spring lever, counter spring, lockout cam and link assembly, and lockout lever onto their shaft. Note that the hollow shaft end must point toward the sleet hood. Position this assembly. Be sure to include the flatwasher on the end of the shaft. See Figure 45.
4. Now position the manual trip lever and insert the operating lever. Pin the lockout lever to the operating lever.
5. Connect the solenoid plunger and contact rod to the operating mechanism. Bolt the operating mechanism in the position shown in Figure 38.
6. Connect the adjustable lockout lever to the operating mechanism by replacing the self-locking nut removed in the "Head Mechanism" section, step 2.
7. Check the adjustment of the lockout mechanism as follows:
 - A. Grasp the insulating tube portion of the trip piston assembly (Figure 27), and lift it until the trip piston contacts the slide valve stop. Make a light scribe mark on the insulating tube 1/4-in. above the slide valve stop.
 - B. Release the trip piston tube and move the operating lever to the CLOSED position.
 - C. Hold the operating lever with one hand to prevent the recloser from opening out of oil. Then slowly raise the insulating tube of the trip piston assembly. Recloser should trip just as the light mark made in step A moves even with the top of the slide valve stop.
 - D. If tripping does not occur as described in step C, adjust selflocking nuts shown in Figure 46 to achieve correct operation. Note that the mechanism cannot operate properly if the nuts are tight against the operating mechanism lever. Always back off either nut one-half turn before testing.

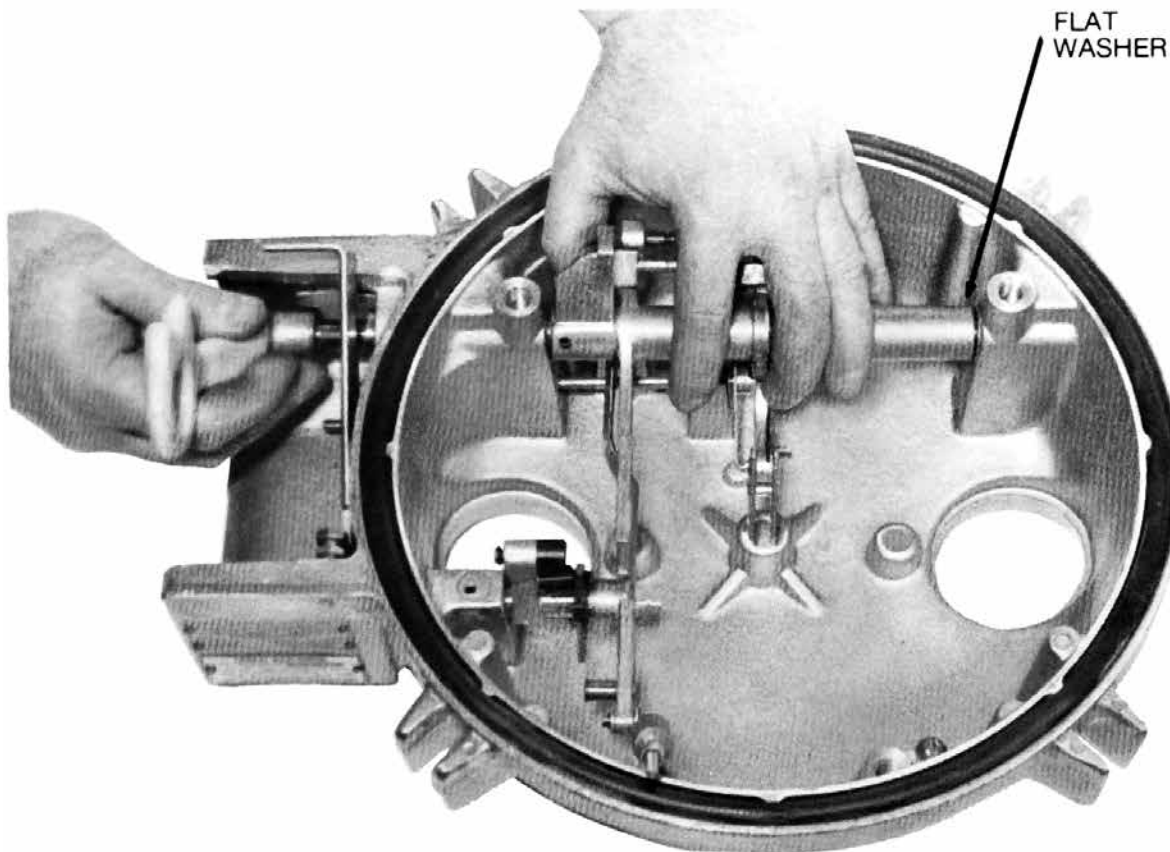


Figure 45. Reassembling head mechanism

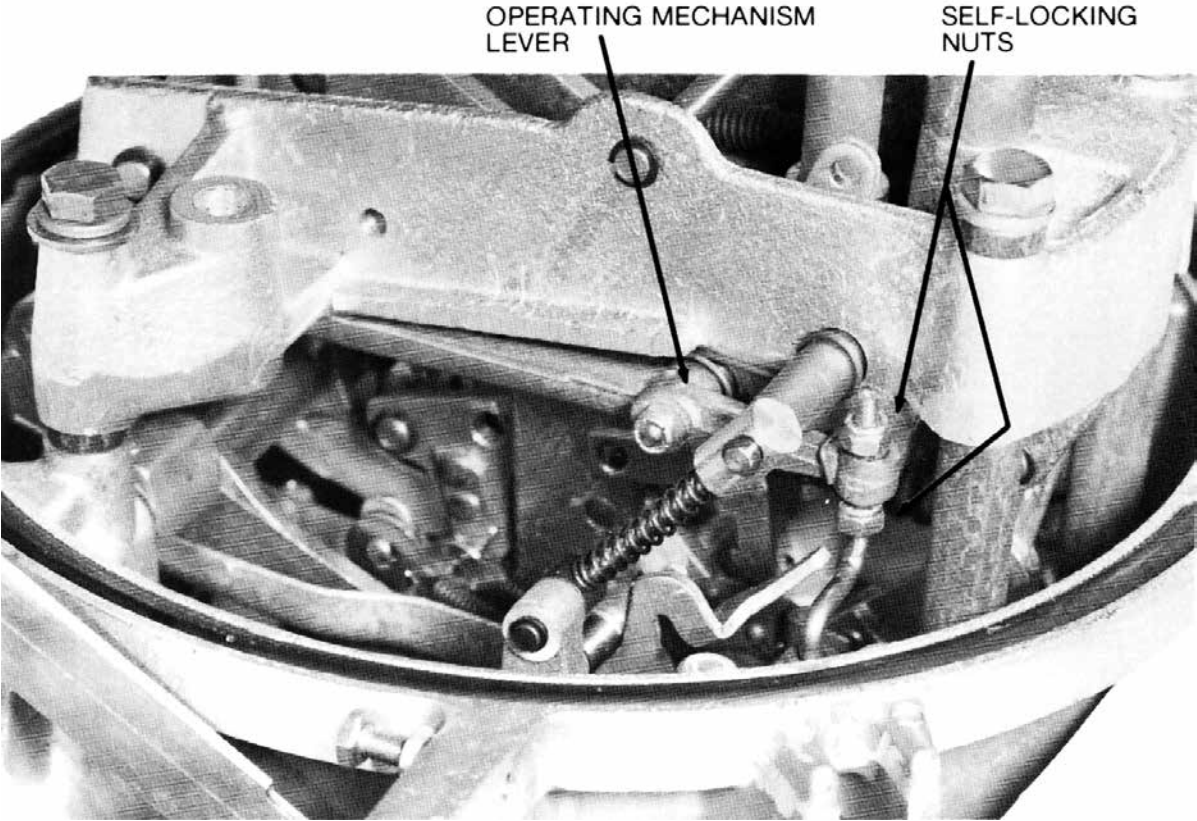


Figure 46. Adjustable lockout lever setting

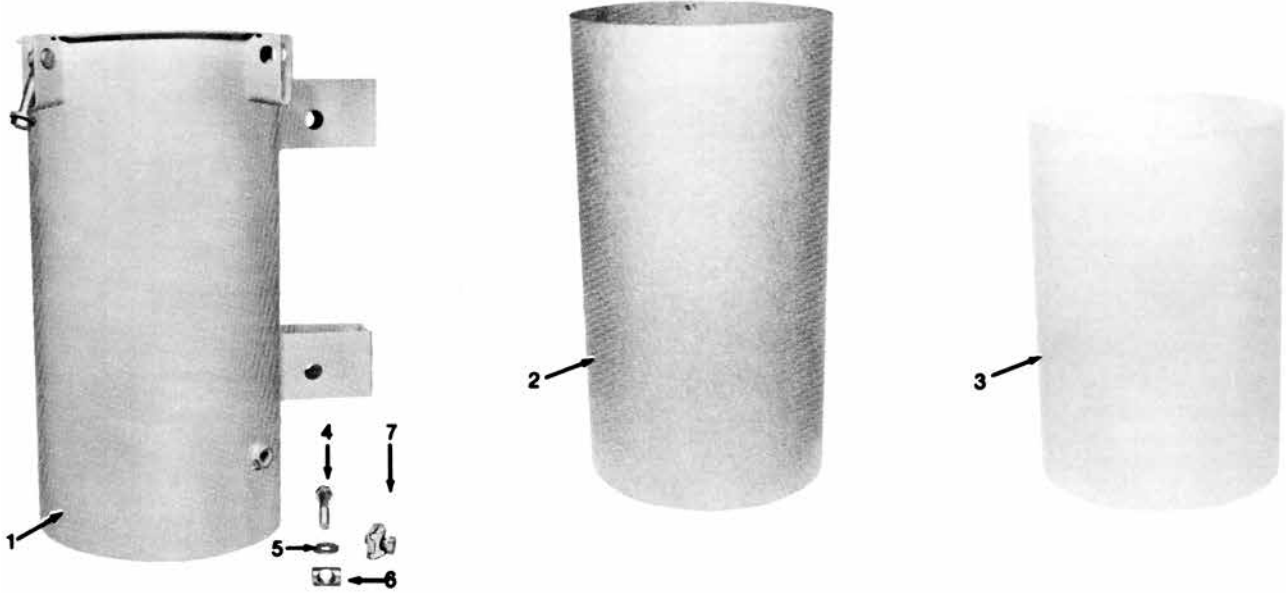


Figure 47. Parts for tank and liner. See Table 11 for parts identification

Type 4E maintenance instructions

Table 11. Parts list for tank and liner (See Figure 47)

Item no.	Catalog no.	Description	No. used per recloser
1	KA145L3	Tank assembly	1
2	KP1082E4	Tank wall insulation	1
3	KP1083E4	Liner	1
4	K730101150350Q	Electro zinc-plated steel hex cap screw— 1/2 in.—13NC2 X 3-1/4 in.	4
5	KP2028A23	Galvanized steel washer—17/32- X 1-1/8- X 1/8 in.	4
6	KP86L	Galvanized combination steel nut and pin	4
7	KA227H	Ground clamp	2

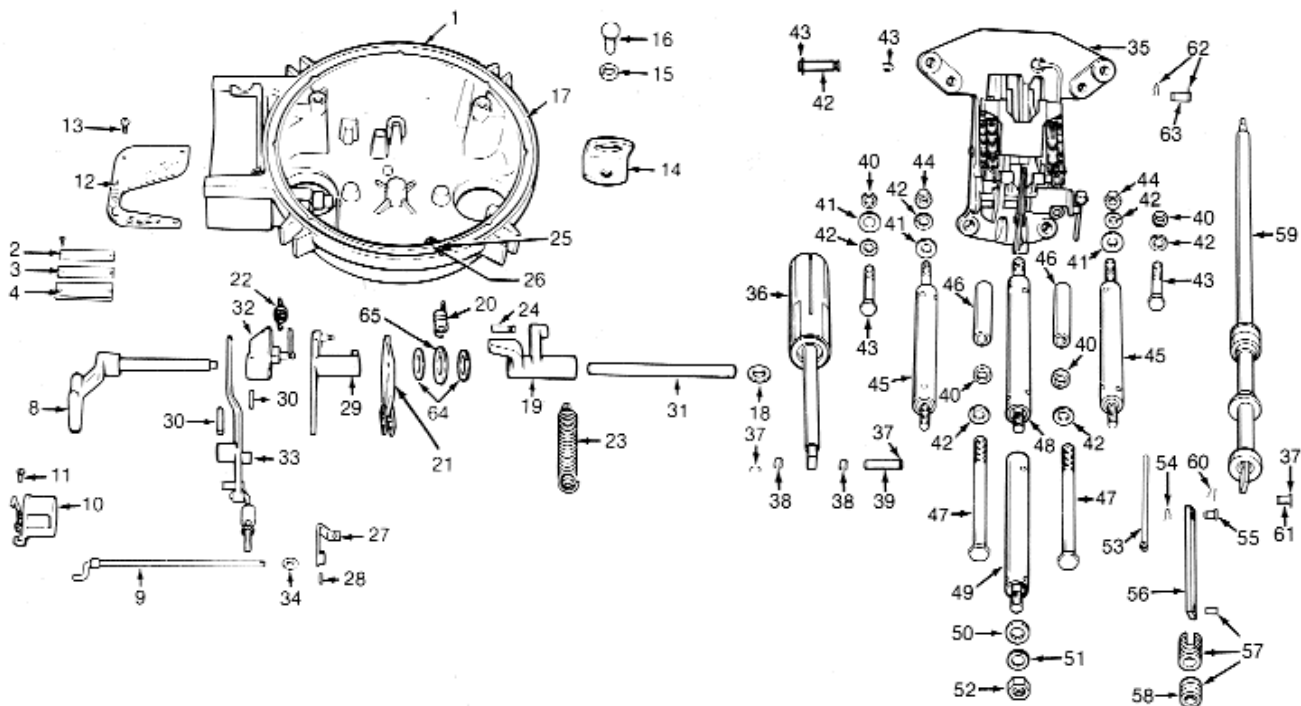


Figure 48. Parts for head assembly. See Table 12 for parts identification

Table 12. Parts List for Head Assembly (See Figure 48)

Item no.	Catalog no.	Description	No. used
1	KP344L2	Head Casting	1
2	KA1063E4	Name plate and mounting screws	1
3	KP2119A12	Coil data plate, add continuous rating and screws	1
4	KP1371R	Operating data plate, add sequence and screws	1
5	KP3106A12	Bushing in cover, counter shaft*	1
6	KP269L	Bushing*in cover, operating handle	1
7	K97090150000A	Open-type retaining ring*	1
8	KA144E4	Operating lever, includes shaft assembly	1
9	KP258L	Counter shaft assembly	1
10	KA28C01	Counter kit	1
11	K751501106062A	Round-head self-tapping screw No. 4x5/16-i n.	2
12	KP292L	Sleet hood cover plate	1
13	K781515112050A	Steel round-head phillips self tapping screw-No. 12x1/2-in.	4
14	KP456H1	Lifting lug	1
15	K900801050000W	Lockwasher	1
16	K730101150100Q	Standard hex capscrew 1/2-in.—13 UNC2x1-in.	1
17	KA2103-4	O-ring head gasket	1
18	K900101051087C	Flatwasher-zinc p lated .515-in. x 7/8-in.	1
19	KP14L	Lockout spring lever	1
20	KP385L	Counter spring	1
21	KA125E4	Lockout cam and link assembly	1
22	KP27H	Operating lever spring	1
23	KP1062E4	Lockout spring	1
24	KP73L	Lockout spring anchor pin	1
25	K721501125062C	Zinc plated round head screw 1/4-in.—20 UNCA2Ax5/8-in.	1
26	K881001120025C	Zinc plated hex nut-1/4-in.— 20 UNC2B	1
27	KA118L	Counter lever assembly	1
28	KP2001A2	Stainless steel groove pin 3/32-in. x 1/2-in., Type 2	1
29	KA17L	Lockout lever assembly	1
30	KP2001A13	Stainless steel groove pin 1/8-in. x 1-1/4-in., Type 1	2
31	KP77L	Operating shaft	1
32	KA143E4	Manual trip lever assembly, part of item 8 (KA144E4)	1
33	KA137E4-2	Trip lever assembly	1
34	KP3006A7	Spacer, counter shaft	1
35	KA113E4-1	Operating mechanism assembly standard	1
	KA113E4-2	Operating mechanism assembly one shot	1
36	KA1 21 E4	Solenoid plunger assembly	1

Item no.	Catalog no.	Description	No. used
37	K970901312000M	Retaining ring	2
38	KP3007A10	Spacer	2
39	KP3125A4	Pivot pin	2
40	KP3012A11	Spacer	4
41	K900201043000A	7/16-in. steel flatwasher (See Figure 38)	3
42	K900801043000A	7/16-in. steel lockwasher	6
43	K7301 01143225A	7/16-in.—1 4 NC2x2- 1 /4-in. steel hex capscrew	2
44	K880201114043A	7/16-in.—14 NC2 steel hex nut	2
45	KA111 E4	Insulating stringer-1 piece	2
46	KP3012A12	Spacer	2
47	K730101143600A	7/16-in.—14 UNC-2Ax6-in. steel hex screw	2
48	KA110E4	Insulating stringer-2 piece	1
49	KA103E4	Insulating stringer-2 piece	1
50	K900201037000A	3/8-in. steel flatwasher	1
51	K900801037000A	3/8-in. steel lockwasher	1
52	K880133116037A	3/8-in.—16 UNC-2B steel hex nut	1
53	KP108L900	Trip rod (See Table 8, item 18)	1
	KP197L900	Trip rod (See Table 8, item 18)	1
54	KP2018A3	Spring clip No. 1137 (0.035-in.)	1
55	KP85L	Pivot pin-includes item 54	1
56	KP112L	Pump piston link	1
57	KA25H	Pump piston assembly	1
58	KP151H	Pump piston shell only	1
59	KA106E4	Contact rod assembly	1
60	KP2018A1	Spring clip No. 1090 (0.041-in.)	1
61	KP3125A1	Groove pin	1
62	KP2018A1	Spring clip	2
63	KA80L	Pivot pin	1
64	KP3017A60	Spacer	2
65	KP386L	Spring Guide	1



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