Type L recloser maintenance instructions

Powering Business Worldwide

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Contents

Safety for life

Eaton's Cooper Power series products meet or exceed all applicable industry standards relating to product safety. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all 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 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. G103.2

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 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 distribution and transmission equipment can result in death, severe personal injury, and equipment damage. G122.3

Product information

Introduction

Service Information MN280053EN covers the maintenance instructions for the Type L single-phase, hydraulically controlled recloser. The manual includes a general description of the Type L recloser and its operating principles. It includes instructions for its periodic inspection, testing, and shop repairs. Also are included are service-parts lists, keyed to exploded-view drawings, and ordering instructions.

⚠ READ THIS MANUAL FIRST

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing or operating this equipment.

Additional information

These instructions cannot cover all details or variations in the equipment, procedures, or process described, nor can they provide directions for meeting every possible contingency during installation, operation, or maintenance. For additional information, contact your Eaton representative.

Acceptance and initial inspection

This product is completely assembled, tested, and inspected at the factory. It is carefully calibrated, adjusted and in good condition when accepted by the carrier for shipment.

Upon receipt, inspect the carton for signs of damage. Unpack the control and inspect it thoroughly for damage incurred during shipment. If damage is discovered, file a claim with the carrier immediately.

Handling and storage

Be careful during handling and storage of the recloser to minimize the possibility of damage. If storing the recloser for any length of time prior to installation, provide a clean, dry storage area.

Standards

Type L reclosers are designed and tested in accordance with IEEE Std C37.60™-2003, IEEE Std C37.61™ and IEEE Std C37.85™ standards.

Quality standards

ISO 9001 Certified Quality Management System

Introduction

The Type L hydraulically controlled oil interrupting recloser is a self-contained device that senses and interrupts fault currents on a single-phase distribution line. Current interruption takes place through an operating mechanism suspended in an oil-filled tank.

A series connected coil initiates tripping. Current carrying and interrupting capacities vary with the operating coil's rating, which is selected to meet circuit requirements.

When the recloser senses a fault current, it automatically opens, and if the fault is temporary, it automatically restores service. During a temporary fault, the recloser operating mechanism will reset at the rate of approximately 60 seconds per accumulated trip operation(s). Once reset, the recloser is ready for another complete operating sequence should another fault occur.

If the fault is permanent, the recloser automatically locks open after one, two, three or four operations, depending on the selected setting. The automatic reclosing of this device enables it to distinguish between permanent and temporary faults.

Recloser operating sequences can be all fast, all delayed, or a combination of fast followed by delayed operations. Any one of several standard delay curves can be used to assure coordination with other reclosers or protective devices. Fast operations clear temporary faults before branch-line fuses are damaged, while delayed operations provide time for faults to be cleared by branch-line fuses. This ability to coordinate with branch-line protective equipment ensures that outages will be confined to the shortest section of line possible.

Perform maintenance only after removing recloser from service and placing it in a suitable work environment.

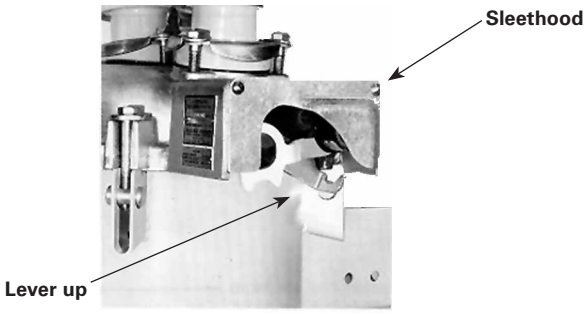


Figure 1. Non-reclose lever in operating position

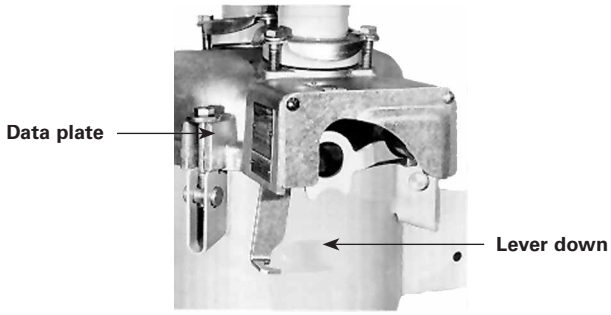


Figure 2. Non-reclose lever in trip position

⚠ 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

Non-reclosing feature

The non-reclosing feature, standard on all Eaton's Cooper Power series reclosers, is set with a hookstick-operated lever. The feature provides a convenient means to set the recloser for one operation to lockout, without removing the recloser from service. (Figures 1 and 2)

Manual operating lever

⚠ WARNING

Hazardous voltage. This device is not a substitute for a visible disconnect. Follow all locally approved safety practices. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G112.1

The manual operating lever, which is yellow (Figure 3) permits the manual opening and closing of an energized recloser. It is not to be used as a substitute for a visible disconnect during line work. Pulling the lever down trips and locks open the main contacts of the recloser. Lifting up the lever closes the main contacts. The lever is operated with a hotstick. (Figures 3 and 4)

IMPORTANT

The manual operating lever is trip-free. If the recloser is closed against a fault, it will continue to trip and reclose until the lever is allowed to drop to the open position.

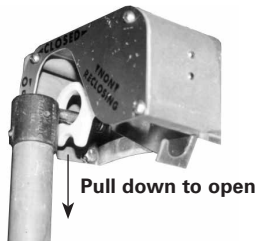


Figure 3. Pull manual operating lever down to open

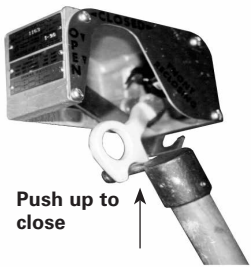


Figure 4. Pull manual operating lever up to close

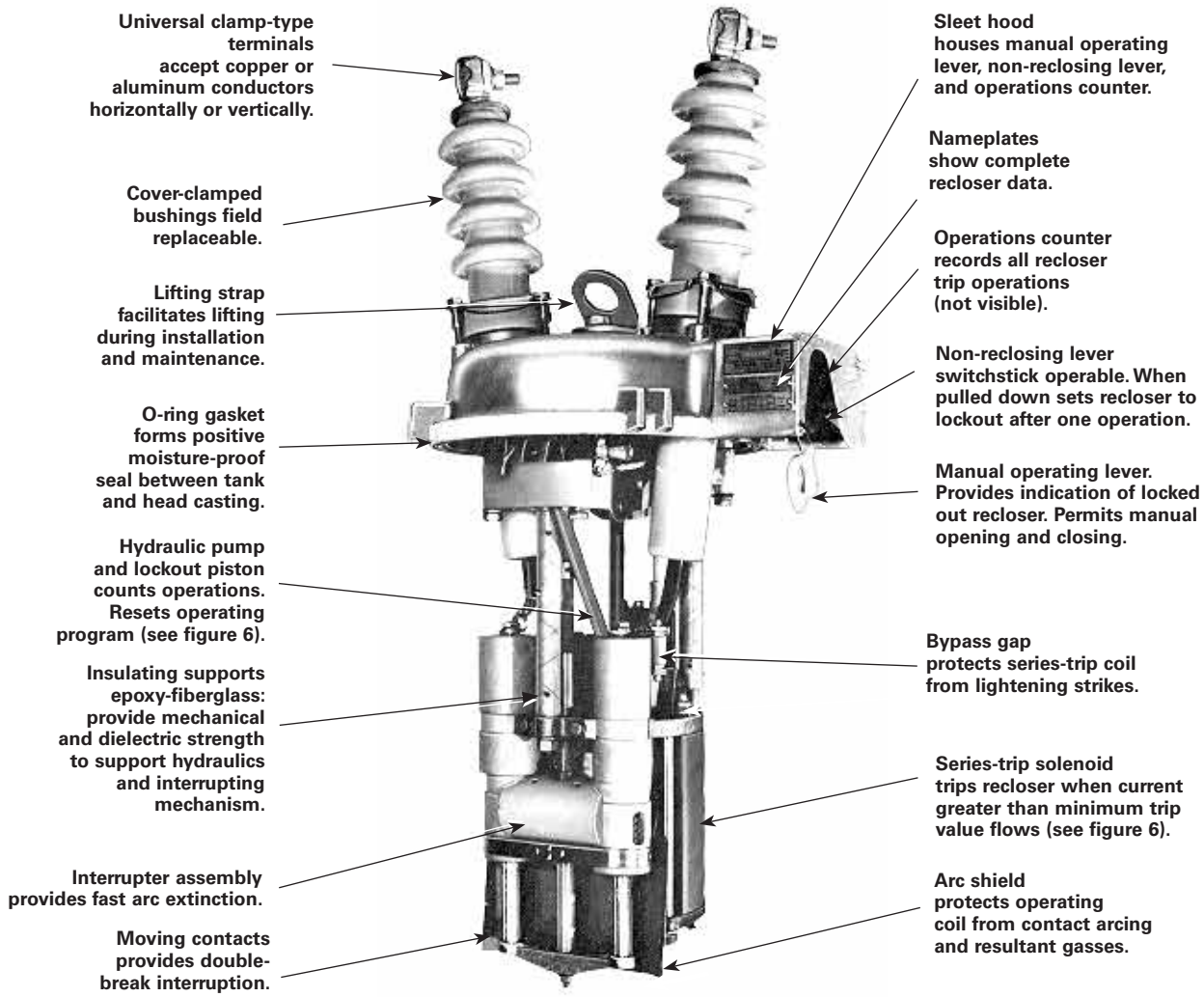


Figure 5. Untanked view of Type L recloser

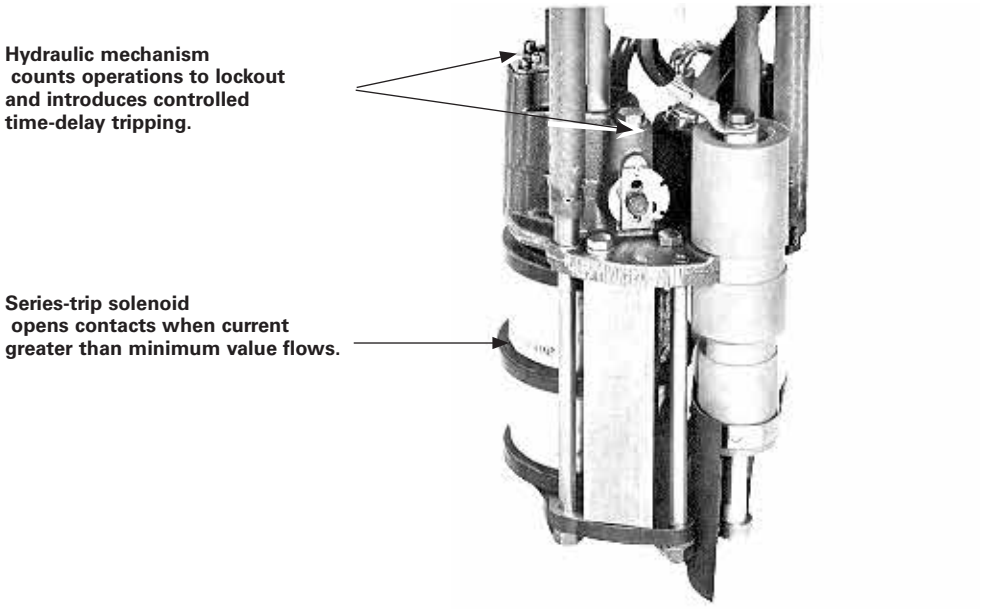


Figure 6. Hydraulic mechanism and series-trip solenoid

Maintenance

Specifications and ratings

Table 1. Specifications

Normal Operating Voltage (rms kV)	2.4 - 14.4
Maximum Design Voltage (rms kV)	15.5
Impulse Withstand (BIL) 1.2 X 50 usec wave (crest kV)	110
60 Hz withstanding (rms kV) Dry, one minute	50
Wet, ten seconds	40
Reclosing time (seconds)	2
Bushing Creepage Distance (inches)	11-3/4

Table 2. Interrupting ratings

Trip-coil continuous current (amps)	Minimum trip current (amps)	Interrupting cuirrent (rms symmetrical amps) @4.8 kV	@8.32 kV	@14.4 kV
25	50	1,500	1,500	1,500
35	70	2,100	2,100	2,100
50	100	3,000	3,000	3,000
70	140	4,200	4,200	4,200
100	200	6,000	5,000	4,000
140	280	6,000	5,000	4,000
200	400	6,000	5,000	4,000
280	560	6,000	5,000	4,000

Table 3. Duty cycles

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

General maintenance

Type L reclosers normally are applied to improve service continuity, reduce operating costs and increase revenue. This recloser's high load and interrupting ratings make it suitable for use in important substations. When adequately maintained, the Type L recloser is capable of performing at peak efficiency and providing reliable circuit protection. Maintaining the recloser is relatively easy and inexpensive, especially when compared to the savings achieved through its use.

Maintenance intervals

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

- When Type L reclosers are operated under usual service conditions as defined in IEEE Std C37.60™-2003, "Standard Requirements for Automatic Circuit Reclosers for Alternating Current Systems," it is recommended that the following maintenance procedures be performed at the completion of an equivalent duty cycle.
- However, if the recloser has not completed an equivalent duty cycle within three years, it is recommended that a Periodic Maintenance Inspection be performed at that time.

Oil condition

Oil provides the internal insulation barrier between phases and from phase to ground. It must be replaced before it deteriorates below a safe dielectric level. Replace the oil if its dielectric strength falls below 22 kV.

Always filter new oil before using, even though it may be 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.

Oil dielectric strength

Although the Type L recloser 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 Oil Specifications and Tests.*

Used oil must be treated before reusing. Filtering may remove absorbed and free water and other contaminants, raising 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 I; its property limits are shown in *Reference Data TD280022EN Oil Specifications and Tests.*

Periodic Inspection and maintenance

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

Each periodic check includes at least the following steps:

1. Bypass and remove recloser from service and replace with a temporary fuse or spare recloser.
2. Inspect external components.
   A. Check for broken bushings, paint scratches, or other mechanical damage.
   B. Enter the counter reading 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.
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.

CAUTION

Dielectric failure, equipment damage. Never use volatile solutions, detergents, or water-soluble cleaners when cleaning the interior of this equipment. These cleaners will contaminate the insulating oil, reducing its dielectric strength. Operation with contaminated insulating oil can result in internal flashovers that will cause equipment damage and possible personal injury. T201.2

   A. Remove all traces of carbon by wiping with a clean, lint free cloth. Flush the mechanism with clean, dry transformer oil.
   B. If additional cleaning action is necessary, a dielectric cleaner (Rochester Midland Biogenic Electrosafe, Dawg Positron, or similar) may be used to clean internal parts. Check with your local regulating authorities to determine which dielectric cleaners are permitted in your area. After the cleaner has evaporated, the mechanism must be thoroughly flushed or dipped in clean, dry transformer oil to remove all cleaner residue. Even dielectric cleaners with high dielectric strength leave a residue that will affect oil insulating properties if not removed.

5. Inspect moving contacts.

   Arcing tips of the moving contacts can experience a limited erosion before intervals replacement is necessary. (Figure 7) Replace contacts 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.

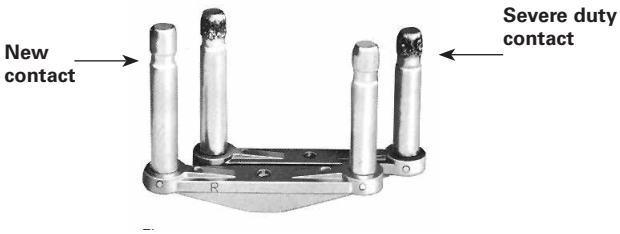


Figure 7. Comparing a new moving contact with a severe duty contact

6. Inspect exhaust chamber orifices.

   Each time fault or load current is interrupted by the Type L, the 12 holes in the exhaust port will experience some erosion. (Figure 8) If any hole becomes enlarged to 9/64 inches, or greater diameter, replace the exhaust structure. (A 9/64-inch. drill can be used as a gage.) See Arc-Interrupting Assembly section for disassembly instructions.

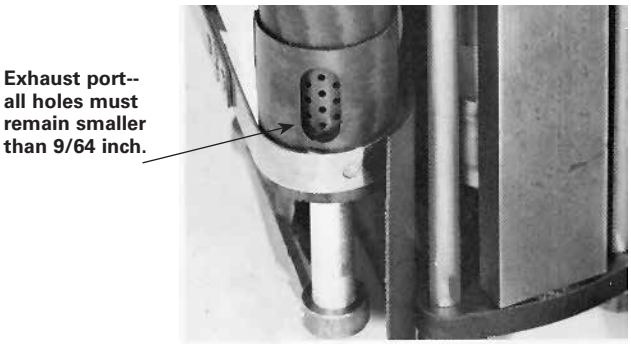


Figure 8. Exhaust Chamber Orifices

7. Inspect stationary contacts.

   If replacement of the exhaust structure or moving contacts is indicated, inspect stationary contacts.

   The two contact shoes of each stationary contact can be replaced without replacing fiber parts of the arc-interrupting structure. Best performance, however, will be achieved if complete stationary contact tube assemblies are replaced as a unit. See Step 5 in Arc-Interrupting Assembly section for disassembly instructions.

8. Check the dielectric strength of the insulating oil.

   The dielectric strength should not be less than 22 kV when tested with a 3 mm (0.1-inch). 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. Replace all external seals and gaskets.

    A. Remove and disassemble bushings, discarding old gaskets. Inspect bushing porcelain, rod and hardware for damage. Replace as required. After installing bushings, tighten the bushing clamp bolts to 6-10 ft lbs torque.

11. Inspect tank liners.

    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 such areas are present. The outer liner need not be replaced unless it is cracked or punctured.

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

12. Fill tank with oil.

    Use only new transformer oil with dielectric strength of at least 30 kV as measured across standard 3 mm (0.1-inch) gap in accordance with methods illustrated in ASTM Publication D117.

    The tank will hold 26.5 liters (7 U.S. gallons) of oil. A line on the fiber liner indicates the correct fill level.

13. Replace cover and mechanism in tank.

    A. Wipe clean the O-ring type gasket, the gasket in the recloser cover, and the tank gasket seat.

    B. Position the four head bolts and tighten alternately. Torque head bolts to 25-40 ft-lbs. The cover can be rotated in steps of 90 degrees with respect to the tank and its mountings.

Table 4. Six-volt battery requirements for tripping

Recloser rating (amperes)	Batteries required	Cable size (AWG)
In series		
25	2	
35	2	
50	2	
In parallel		Short lengths of No. 6 or larger
70	2	
100	2	
140	2	
200	2	
280	2	

Table 5. Twelve-volt battery requirements for tripping

Racloser rating (amperes)	Batteries required (parallel)	Cable size (AWG)
25	4	
35	4	
50	4	
70	4	Short lengths of No. 6 or larger
100	4	
140	4	
200	4	
280	4	

    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. Lockout can be determined by listening for unlatching of the lockout mechanism and by noting that the recloser mechanism will not latch when the lever is moved to the CLOSED position.

    This test can be used to determine the number of operations to lockout. The number of fast and delayed operations also can be noted.

    D. 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: To prove the recloser is in good operating condition, perform direct-current testing as follows:

    A. Move the operating lever to the CLOSED position and wait four minutes.

    B. Connect a storage battery across recloser terminals. Count the operations to lockout. If the correct number of operations did not occur, wait five 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 for testing Type L reclosers. (Batteries must be fully charged and in good condition.)

16. Perform a high-potential insulation withstand test, see page 24. Use a suitable tester to verify that the recloser is operating per data plate specifications, see page 23.

Shop maintenance

When performing shop maintenance or repairs, 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.

Arc-Interrupting assembly

When erosion has spread close to the load-current transfer surfaces of the moving contacts, dismantling and inspecting the entire arc-interrupting assembly is recommended. Install new parts as necessary. However, best results will be obtained if the entire assembly—consisting of moving contacts, stationary contacts, interrupter tubes and cross-blast tube—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 9). Then drive out the roll pin that aligns the moving contact yoke. Lift off the moving contacts.
2. For units with serial numbers below 134024, pull one retaining ring off the guide tube. (Figure 10) Slide this tube off the contact rod as illustrated in Figure 11. For units with serial numbers above 134024, proceed to Step 3.
3. Remove the bronze cap screw and lockwasher from the end of each contact tube; remove the leads to each contact tube. Then remove cap screws, lock washers, and flat washers to release contact tube wedges shown in Figure 12.
4. Grasp both contact tubes near the free ends and pull apart enough to cause the locking band (Figure 13) to be released. A fiber pin may drop free from each tube when the cross-blast tube is separated from the contact tubes. Lift off the locking band and cross-blast tube.
5. Figures 14 and 15 show cross-sectional views of stationary contact tube assemblies. To dismantle either tube, observe the following:
   A. With long-nose or needle-nose pliers, remove the snap ring located at one tube end and release the washer.
   B. Tap the tube to cause the fiber locking pin to slide out if it has not already done so. Now pull out the bayonet guide tube.
   C. Insert a 1/2- X 1/16-in. screwdriver through the stationary contacts to engage the contact stud slot. With a 3/4-in. box wrench, loosen the long hex terminal stud. Remove terminal stud, contact shoes, contact stud, and both retaining washers. Retaining ring need not be removed. Completely disassembled contact tubes are shown in the parts list (Figure 18 and Table 6).

Note: It is recommended that complete stationary contact tube assemblies be installed if any of the stationary contact components are found defective. New stationary contacts and slightly eroded fiber parts can be installed in the old tubes, but best results will be obtained if new tube assemblies are installed.

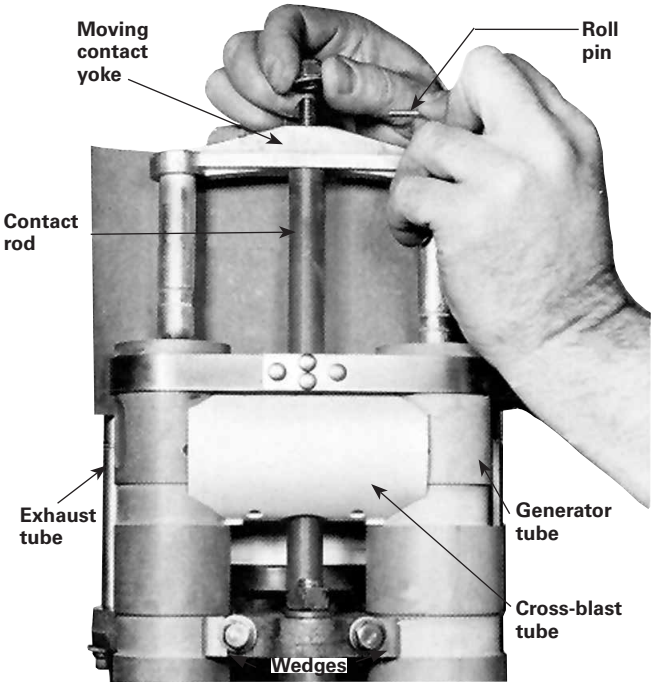


Figure 9. Removing contact yoke

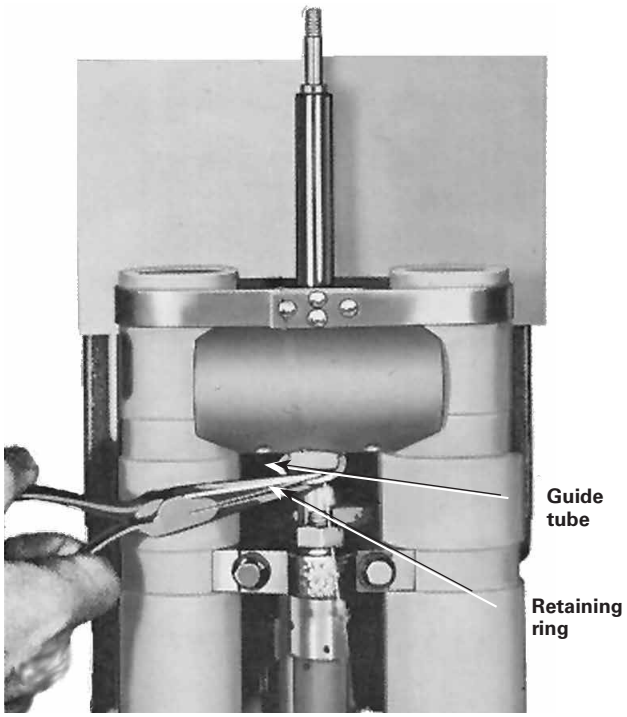


Figure 10. Releasing guide tube
(Units below serial number 134024)

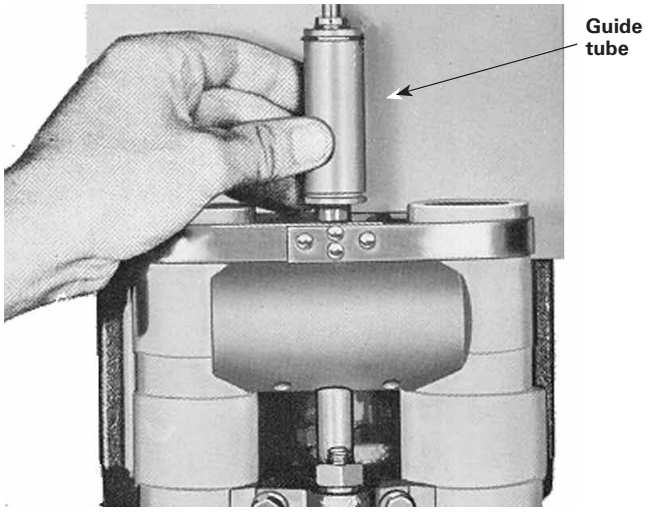


Figure 11. Removing guide tube
(Serial number 134024 and above).

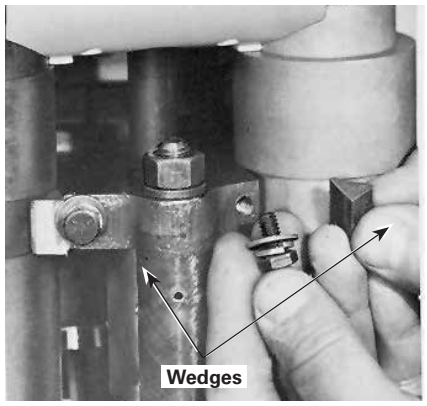


Figure 12. Removing contact-tube wedges

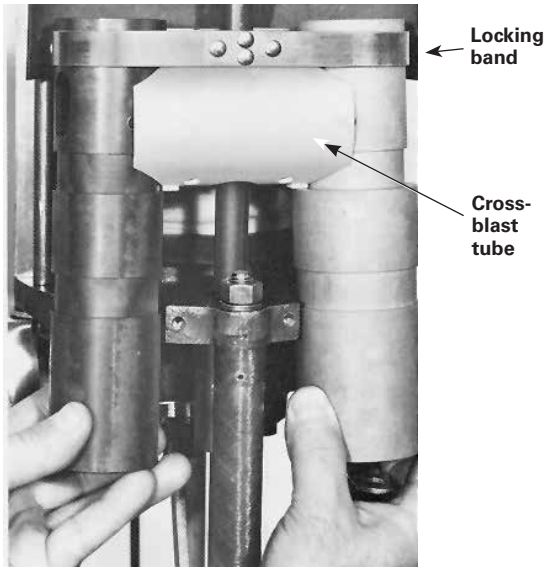


Figure 13. Separating contact tubes

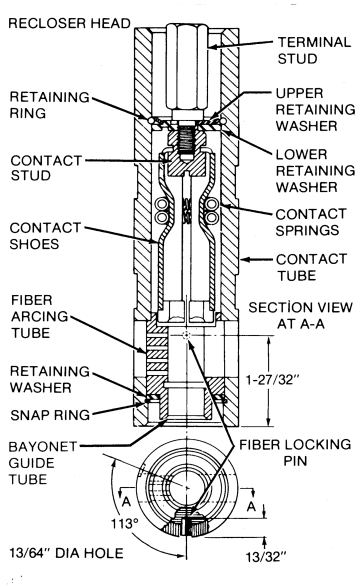


Figure 14. Cross-sectional view of exhaust tube

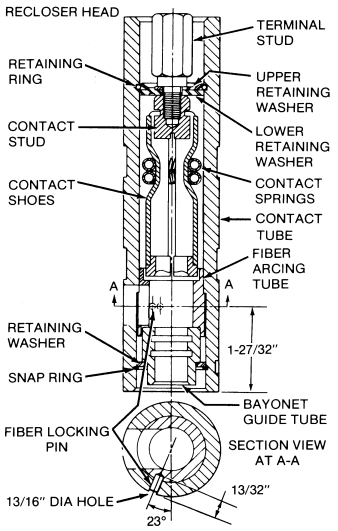


Figure 15. Cross-sectional view of generator tube

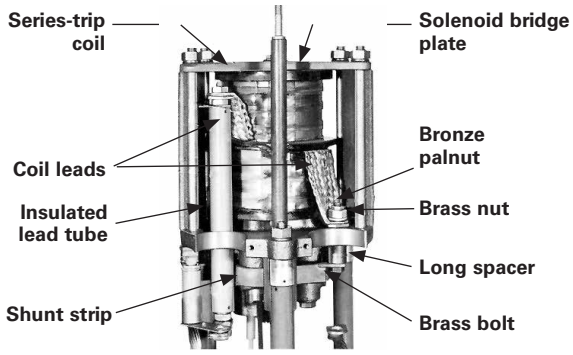


Figure 16. Series-trip on solenoids below serial number L42775

6. Reassemble contact tubes by reversing the procedure outlined in preceding paragraphs A, B, and C. If installing a new fiber arcing tube in an old contact tube, a hole must be drilled to accept the locking pin. Refer to Figures 14 and 15 for hole location and drill to a depth of 10 mm (13/32 in.) with a 5 mm (13/64 in.) bit.
7. If performing further maintenance, do not reassemble the arc interrupting assembly yet. When reassembly is to be performed, observe the following steps:
   A. Place the cross-blast tube between the contact tubes so that it seats in the lower tube slots. In addition, the cross-blast tube must be oriented so two small holes will be near the top and pointed away from the series-trip solenoid.
   B. With tubes slightly apart at the top, slip clamping band in place and match indents in the tubes to small projections on the band. Align the tubes so they are parallel.
   C. Position the contact tubes and cross-blast tube and secure by means of the clamping wedges. (Replace guide tube and retaining ring on units with serial numbers below 134024 and/or with original cross-blast tubes.) Make electrical connections to the tubes. The exhaust tube (vented) must be on the same side as the sleet hood.
   D. Replace moving contact assembly. Be sure the longer bayonet is positioned to go into the generator (unvented) tube.

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 moisture-resistant wrappings.

Coils must not remain exposed to the atmosphere any longer than necessary because moisture from the air may be absorbed. When a good coil is replaced, store it in the container used to ship the new one.

One end of the coil is attached directly to the solenoid frame. When a recloser is uprated to 280 amps, a shunt-strip kit must be installed to increase conductivity of the frame (Figure 16). Specify catalog no. KA100L for a kit that includes items 3, 4, 5, 6, 7, 8,10, and 11 shown in the parts list.

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

1. If the arc-interrupting assembly has not been removed previously, observe procedures outlined in the Arc-Interrupting Assembly section.
2. Disconnect coil leads. Figure 16 shows connections for coils with one short lead connected to an insulated lead tube. Coils with one long lead are directly connected to the contact tube and do not require this lead tube. See Figure 17 for arrangement of sleeved long lead used in place of insulated lead tube after serial no. L42755.

Table 6. Parts list for arc-interrupting assembly (See Figure 18)

Item no.	Catalog number	Description	No. required
1	K730133337075A	Bronze hex machine screw—3/8—24NF2 X 3/4 in.	2
2	K900830037000A	Bronze lockwasher—3/8X .114, x 0.94	2
3	KP60L	Terminal stud—exhaust tube	1
4	KP215L	Terminal stud—generator tube	1
5	KP170L	Upper retaining washer	2
6	KP168L	Wire retaining ring (not shown)	2
7	KP52L	Lower retaining washer and lock	1
8	KP3054A1	Fiber locking pin	2
9	KP62L	Fiber arcing tube—generator tube	1
10	KP51L	Fiber bayonet guide tube—generator tube	1
	KP2028A49	Bottom retaining washer	1
	KP2019A2	Retaining ring—No. 5000-145	2
	KA68L	Complete stationary contact tube assembly—generator above serial no. 3478, includes 1—10, 24, 25, 26	2
	KA33L	Complete stationary contact tube assembly—generator below serial no. 3478, includes 1—10,24, 25 26	1
11	KP58L	Generator tube only, below serial no. 3479	1
	KP232 L	Stationary contact housing, generator tube only above serial no. 3478	1
12	KP372L	Cross-blast tube	1
12a*	KA34L	Complete stationary contact tube assembly, exhaust, includes 1—6, 9, 10, 24, 25, 26, 27 Cross-blast tube (no longer available)	
13	KP57L	Exhaust tube only	1
14	KP44L	Contact tube wedge	2
15	KP343	Steel flat washer—1/4 in.	2
16	K831501125050A	Steel hex cap screw 1/4 in.—20NC2 X 1/2 in. and steel lockwasher—1/4 in.	2
17	K970901999000M	Open-type retaining ring XS0-238	2
18*	KP55L	Guide tube	1
19	KA32L	Moving contact assembly—above serial no. 9221	1
	KP12L	Moving contact assembly and contact rod. Must be ordered together below serial no. 9222	
20	K900201031000A	Flat washer—5/16- X 11/16- X 11/32 in.	1
21	KA2020A2	Self-locking nut—5/16 in.—24UNC2	1
22	K970801156075M	Rollpin—1 /8- X 13/16 in.	1
23	KA50L	Contact tube band assembly	1
24	KP59L	Silver-plated contact stud	2
25	KA29L	Silver-plated contact shoe	4
26	KP95L	Contact garter springs	4
27	KP216L	Fiber arcing tube, vented—exhaust tube	1

*Used on units below serial number 13024. Accepts KP372L for replacement

3. Using a 3/4-in. box wrench, remove four hexnuts that secure the solenoid bridge plate. Lift this plate off as shown in Figure 19. Note that a red cushion washer is attached to the plate.
4. Lift off the lower gasket, coil, and upper gasket. If recloser has an insulated lead tube, remove hexnut and lockwasher from one end to release two flat bars. Pull the tube out of the solenoid frame.
5. Remove the hex cap screw that secures the lockwasher, bushing lead, and bypass gap to the frame.

Note: On 280 A reclosers, a transfer-shunt rod also must be removed from the solenoid frame assembly, attached by two bronze 1-3/4-in. cap screws and two bronze flat washers. One solenoid frame shoe also will be released. (See Figure 20.)

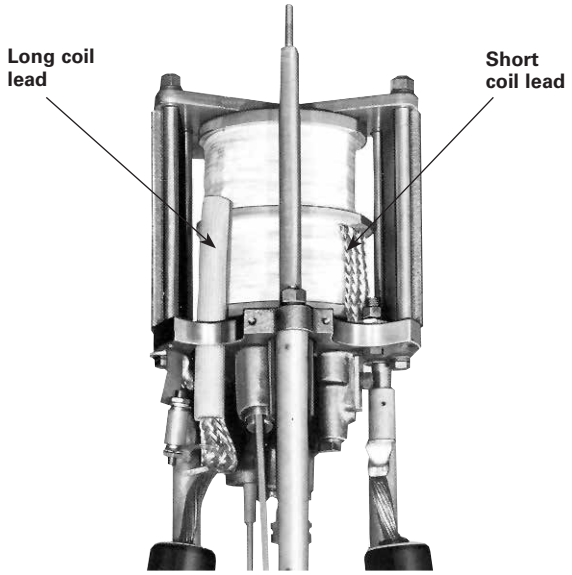


Figure 17. Series-trip coil for units with serial number L42775 and above

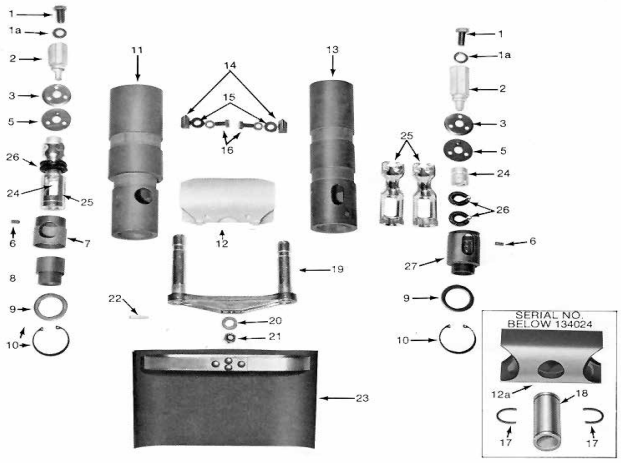


Figure 18. Arc-interrupting assembly parts identification

Series-trip solenoid reassembly

If further maintenance is to be performed, do not reassemble the solenoid yet. When the solenoid is to be reassembled, observe the following steps:

Units rated below 280 amperes

1. If old coil with two short leads is being reused, replace insulated lead tube and attach the two flat copper bars that connect to the one short coil lead. If new coil with one long lead is replacing the old coil with two short leads, the insulated lead tube and the copper bars may be discarded.
2. Position solenoid frame shoe. Place a lockwasher on the 3/8 X 1-1/4-in. steel cap screw and secure one bushing lead and the bypass gap to the solenoid frame. This cap screw threads into the solenoid frame shoe.
3. Place a new upper gasket on the flanged end of the trip coil. Reposition the coil and new lower gasket (serial no. above L81543); secure the bridge plate. Reconnect one coil end to the lead tube if coil has two short leads, or to contact tube if coil has a long lead.

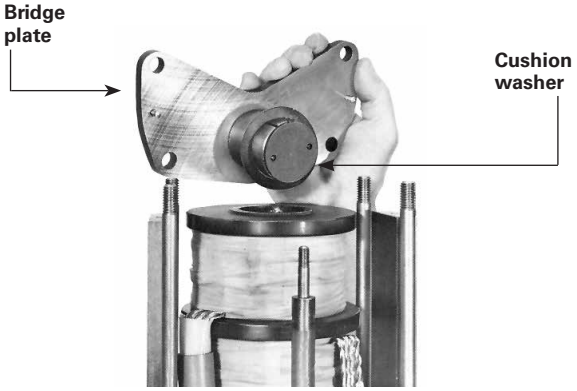


Figure 19. Bridge plate removal

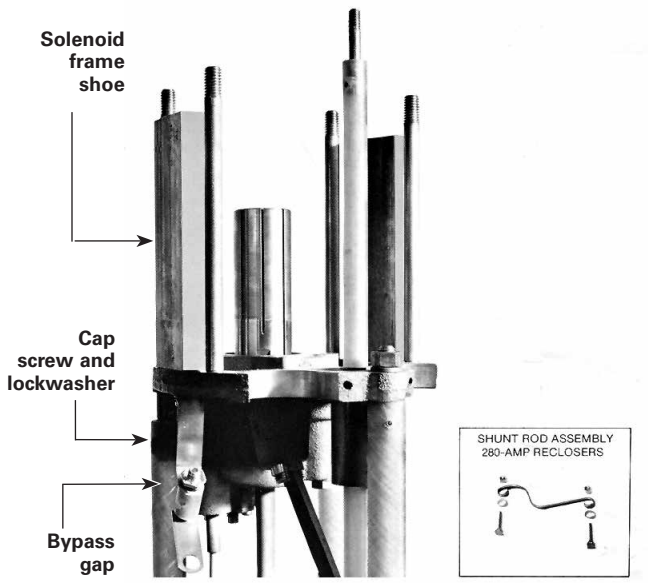


Figure 20. Releasing bushing lead and bypass gap

Table 7. Series trip solenoid assembly (Figures 18a and 18b)

Item No.	Catalog number	Description	No. required
1	KA60L-1	Coil bypass gap assembly	1
2	KA702L	Lead rod assembly	1
3	KP342 L	Frame shunt rod	1
4	KP3013A8	Spacer—5/8 in. long (serial no. below L42755)	1
5	KP3013A9	Spacer—7/8 in. long (serial no. below L42755)	1
6	K730101137125D	Steel hex cap screw—3/8-in.—16NC2 X 1-1/4 in. (for units under 280 amps only)	1
	KP763	Steel hex cap screw—3/8 in.—16UNC2A X 2 in. (for 280-amp units only)	1
7	K90080103700D	Steel Kantlink lockwasher—3/8- X 0.141- X .094 in.	1
8	K730101137150A	Steel hex cap screw—3/8-—16NC2 X 1-1/2 in. (for units under 280 amps only)	
	K730125137250A	Brass hex cap screw—3/8 in.—16UNC2A X 2-1/2 in. (for 280-amp units only)	
9	K900801037000D	Steel Kantlink lockwasher—3/8- X .141- X .094 in. (for units under 280 amps only)	2
10	K880233320050A	Steel hexnut—3/8 in.—16NC2 (for units under 280 amps only)	1
	K880125116037A	Brass regular hexnut—3/8 in.—16UNC2B (for 280-amp units only)	
11	K880133116037A	Bronze hex locknut—3/8 in. 16 UNC (for 280-amp units only) (not shown)	1
12	KP130L	Copper connecting links—3/4- X 2-3/8- X 1/8 in	2
13a	KP2090A6	Solenoid gasket, upper	1
13b	KP2090A28	Solenoid gasket, lower (serial number above L81543)	1
14	KA67L	Coil assembly (Show coil rating by suffix. Example: KA36L200 = 200-amp coil)*	1
15	KA85L	Plunger stop assembly	1
16	KP10L	Bridge plate	
17	KP3149A33	Solenoid tie bolt—short, below serial no. 31114	2
18	KP3149A26	Solenoid tie bolt—long (not shown)	2
19	KP31L	Tie bolt spacer nut and steel lockwasher—7/16- X .156- X 0.109 in. below serial no. 31114	2
	KP45L	Steel hexnut and steel lockwasher	4
20	K900830037000A	Bronze lockwasher—3/8- X 0.141- X 0.094 in.	2
21	K881025324037A	Brass hexnut—3/8 in.—24NF2	2
22	KA100L	Kit for field addition of frame shunt, includes items 3, 4, 5, 6, 7, 8, 10, and 11	1
23	KP2106A53	Sleeve, long coil lead (280A Outer)	1
24	KP3017A49	Sleeve, long coil lead (outer)	1
25	KP2104A4	Sleeve, long coil lead (inner)	1
26	K900830037000A	Bronze lockwasher, 3/8 in.	1
27	K700133337087A	Steel hex cap screw—3/8- X 16UNC2 X 7/8 in.	1
28	K880201116037A	Steel hexnut—3/8 in.—16NC2	2
29	K880233116037A	Bronze hexnut—3/8 in.—16UNC2	2
30	K900525039087A	Brass flat washer, 3/8 in	
31	K730133137175A	Bronze hex cap screw—3/8 in.—16UNC2A X 3/4 in	1

* When upgrading units below serial no 6995 to 200 or 280 A, in addition to the solenoid coil, the following parts need to be replaced:

1 Both bushing leads. Install one KA716R27 (Long lead) and one KA716R28 (short lead) See Bushings section.

2 Copper connecting link. (Item 12)

Type L reclosers below serial number 31114 used two short tie bolts (item17) with fastening hardware items 19 and 20. To eliminate the tie bolt spacer nuts, longer tie bolts are now used. These new tie bolts are threaded directly Into the short stringers and fastened with nuts and washers at the bridge plate When replacing either old stringer or tie bolt,specify Kit KA707L, which includes new stringer KA122L and new tie bolt KP314L.

4. Secure other coil end to the solenoid frame by means of the 3/8 X 1-1/2-in. steel hex cap screw. Note that a lockwasher is used under the nut and another under the head of the cap screw.

5. Replace arc-interrupting structure as described in the Arc-Interrupting Assembly section.

Units rated 280 amperes

1. If old coil with two short leads is being reused, replace insulated lead tube and attach the two flat copper bars that connect to the one short coil lead. If new coil with one long lead is replacing the old coil with two short leads, the insulated lead tube and the copper bars may be discarded.

2. Place shunt rod in approximate location. Note that this bar is bent in an S shape on one end to pass around the insulated coil lead. Then position the solenoid frame shoe.

3. With the 3/8 X 2-in. steel cap screw and lockwasher, secure shunt rod, short spacer, bushing lead, bypass gap, and solenoid frame shoe to the solenoid frame.

4. Place a new upper gasket on the flanged end of the trip coil. Reposition the coil and new lower gasket (serial no. above L81543); secure the bridge plate. Reconnect one coil end to the lead tube or directly to the contact tube if coil has a long lead.

5. Slip the long spacer between the free end of the shunt rod and the solenoid frame. Push the 3/8 X 2-1/2-in. brass cap screw through the shunt rod, solenoid frame, and other coil end. Add parts in order stated above and tighten the lockwasher, nut and palnut.

6. Replace arc-interrupting structure as described in the Arc-Interrupting Assembly section.

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. Observe the following steps:

1. On reclosers below serial no. 31114, remove the three hexnuts and lock washers (Figure 23) that secure the hydraulic frame to the insulating stringers. Note that two of these nuts are double length and are joined to long studs that secure the solenoid bridge plate.

Note: On reclosers after serial no. 31114, tie bolt spacer nuts are not used. Disassemble by removing one hexnut and lockwasher from the long insulating stringer at the hydraulic frame and remove tie bolts.

2. 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 24.
3. With a 1/2-in. wrench, remove the cap screw that secures the operation selector plate, orifice plate, and gasket. See Figure 25.
4. Using a 5/8-in. wrench, remove the control valve assembly. Tip the frame so the valve element falls out.

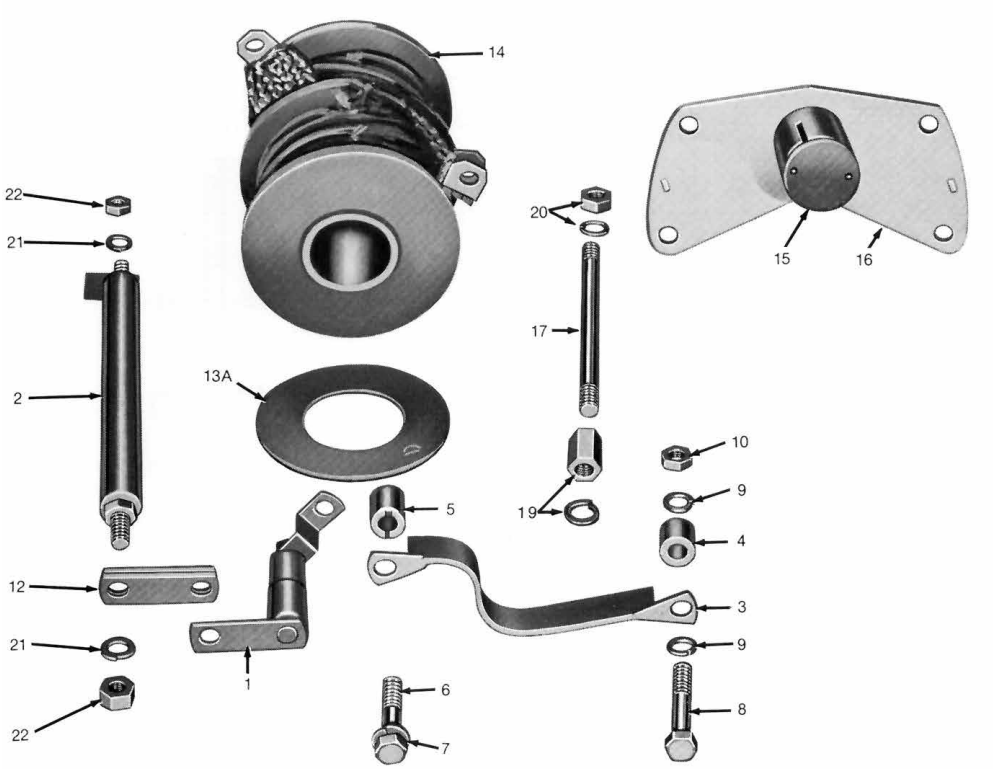


Figure 21. Coil assembly for units below serial number 42775

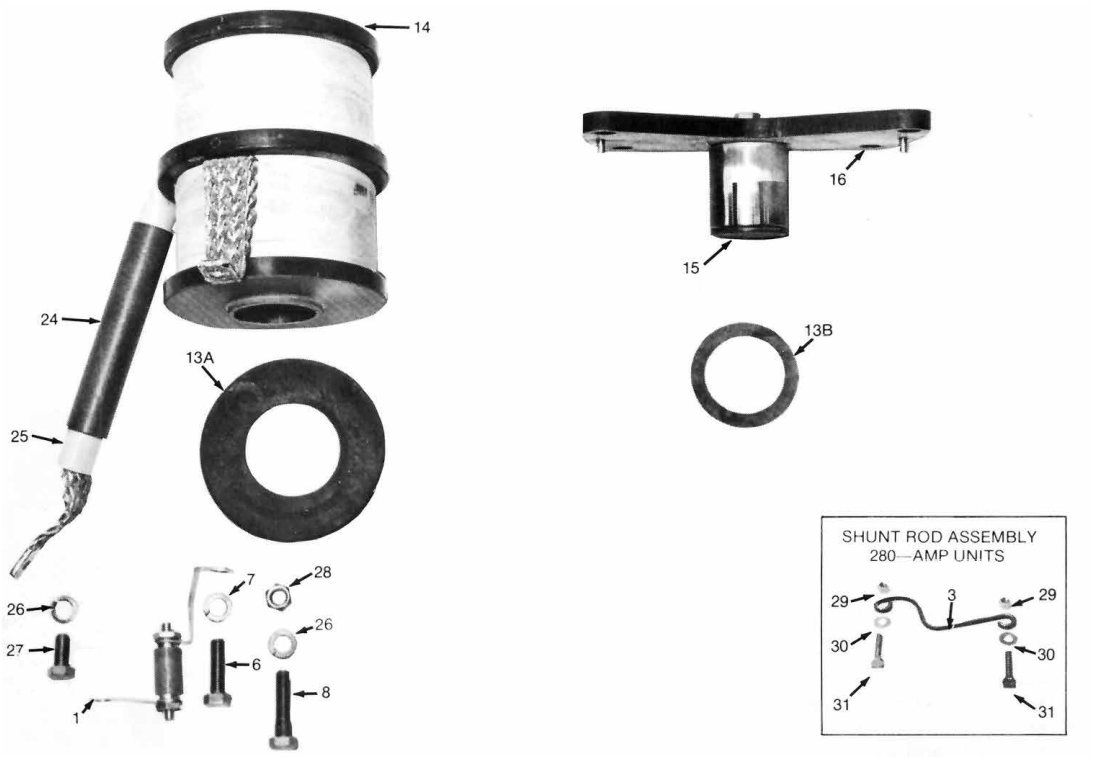


Figure 22. Coil assembly for units with serial number 42775 and above. See table 7 for parts identification

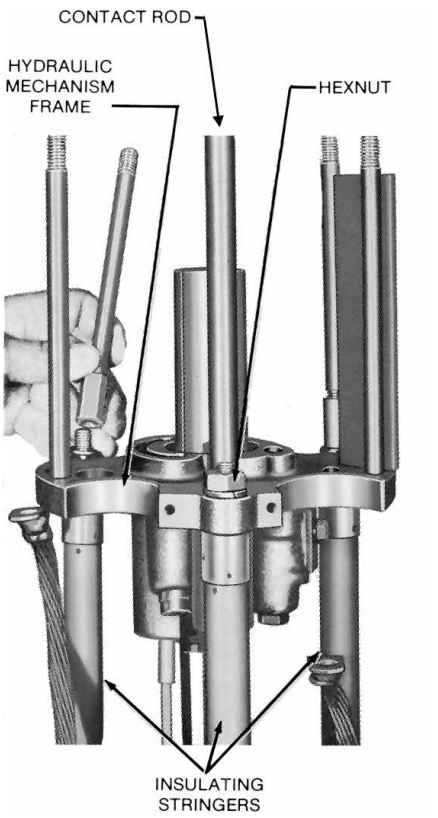


Figure 23. Hydraulic mechanism removal on units below serial number 31114

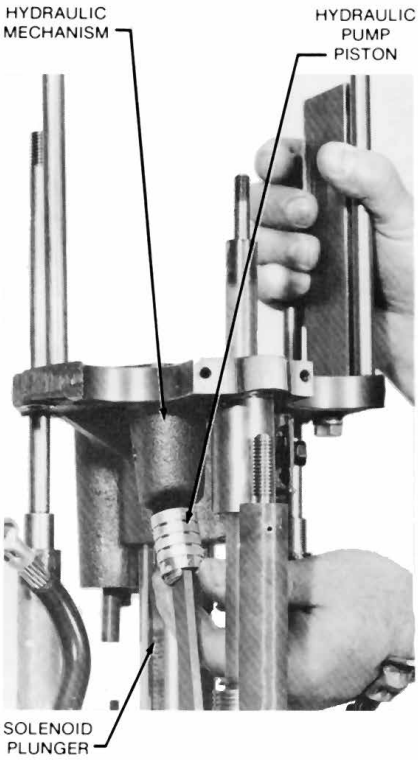
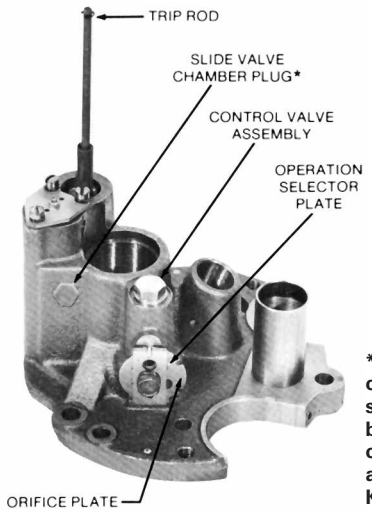
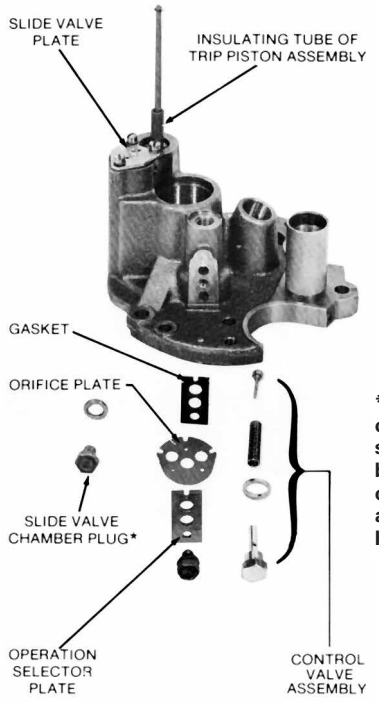


Figure 24. Lifting off hydraulic mechanism on units with serial number-31114 and above



***Used only on units with serial number below 97000 or solenoid assembly KA127L-3.**

Figure 25. View of hydraulic mechanism



***Used only on units with serial number below 97000 or solenoid assembly KA127L-3.**

Figure 26. Hydraulic mechanism partially assembled

5. Remove the slide valve chamber plug and gasket by means of a 5/8-in. wrench. Parts removed in steps 3, 4, and 5 are shown in Figure 26.
6. Remove the slide valve plate and gasket by releasing three screws. Tip the frame so the valve will slide out.
7. With the wire hook, pull the ball check valve seat out enough to expose the spring and insert a thin plate as demonstrated in Figure 27. Then push the pin out to release the spring. A steel ball will be released. Lift out the trip piston. Figure 28 shows parts removed in Steps 6 and 7.
8. If necessary, the pump piston can be removed by turning the outer shell off the piston body. Then push out the pin that connects the body to the insulated link. See Figure 29.

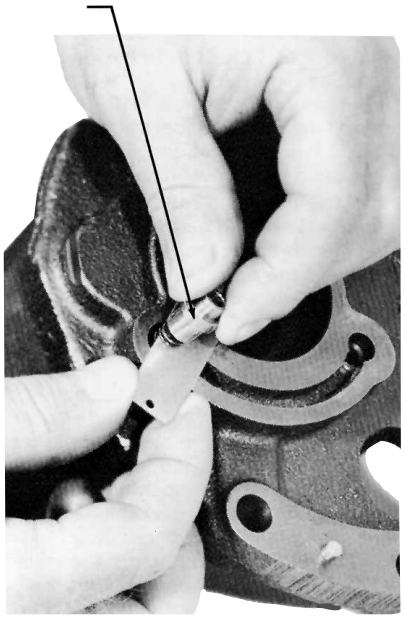


Figure 27. Removing check valve seat

If further maintenance is to be performed, do not replace the hydraulic mechanism yet. When ready for reassembly, observe the following steps:

1. Refer to Table 9 and Table 10 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 27 and insert a thin plate to hold it. Secure the ball check valve seat 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, 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, stake the shell to the body by means of a small prick punch.

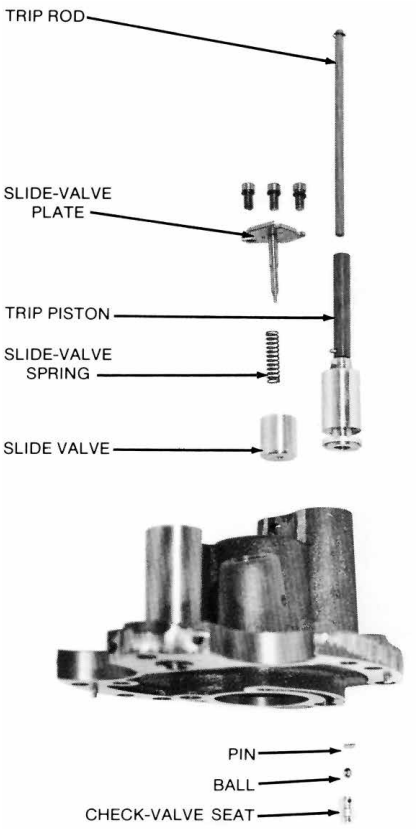


Figure 28. Slide valve, check valve and trip valve removed

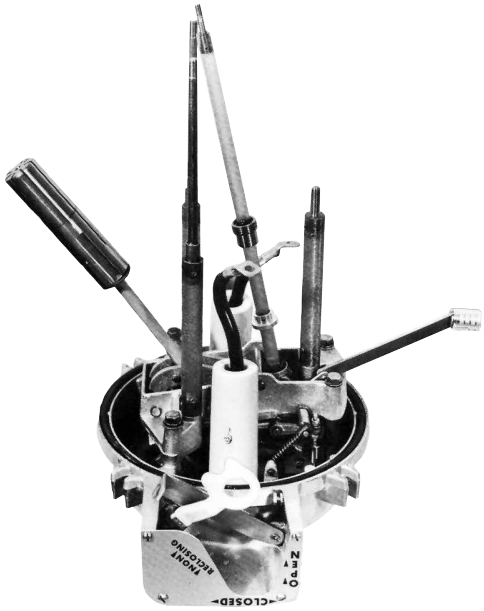


Figure 29. Removing stringers and pump piston

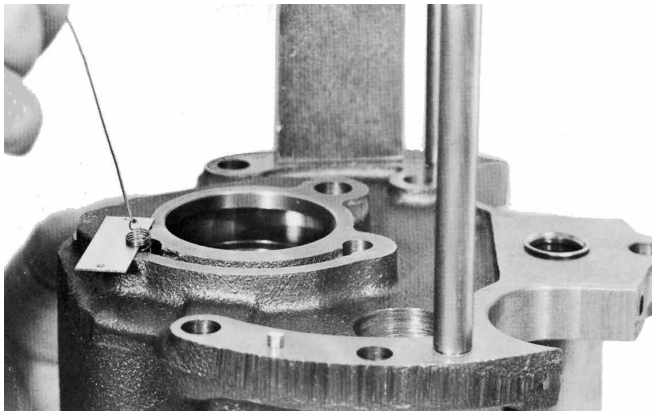


Figure 30. Removing trip-piston spring

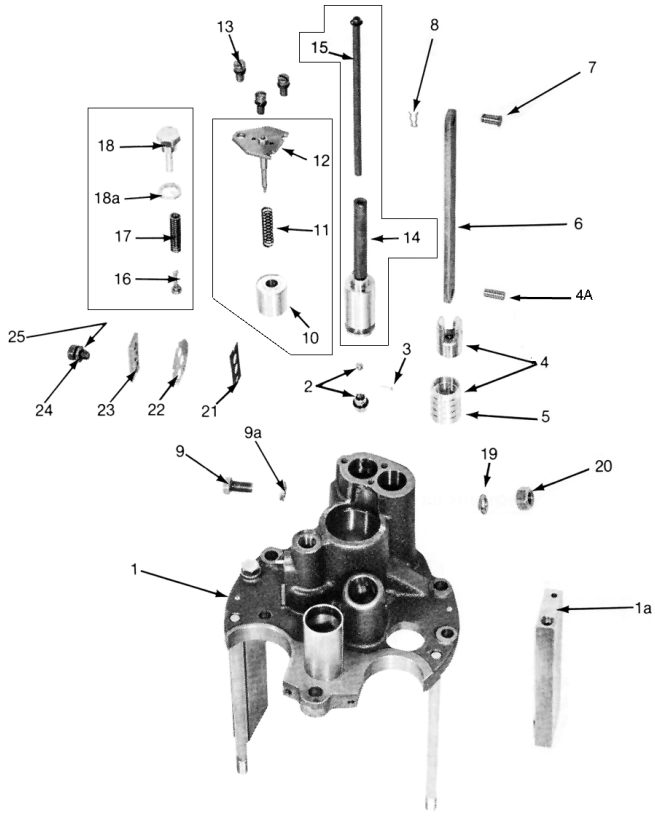


Figure 31. Parts for hydraulic mechanism on units below serial number 208750 See Table 8 for parts identification

Table 8. Parts list for hydraulic mechanism below 208750 (Shown in Figure 31.)

Item no.	Catalog number	Description	No. required
1	KA69L1	Solenoid frame assembly	1
1a	KP12L1	Frame shoe	2
2	KP155H	Ball check valve seat and 1/4-in.-steel ball	1
3	KP3051 A1	Pin	1
4	KA725H	Pump piston assembly	1
4a	KP3055A1	Pin--1/4 in. dia. 12L14-tellurium steel 10-12	1
5	KP151 H	Pump piston shell only	1
6	KP112L	Pump piston link	1
7	KP85L	Pivot pin	1
8	KP2018A2	Spring clip, No. 1137, 0.035 in.	1
9	KP119L	Slide valve chamber plug C	1
9a	KA2011 A1	Type A gasket—1/2- X 11/16- X 5/64 in.	1
10	KP104L	OBSOLETE †	1
	KA155L	OBSOLETE †	
11	KP213L	OBSOLETE †	1
12	KA64L	OBSOLETE †	1
13	K721801125050A	Steel round-head screw—1/4 in.—20NC2 X 1/2 in.	2
	K900801037000M	Lockwasher—1/4 in.	2
14	KA94L1	OBSOLETE † †	
	KA94L2	OBSOLETE † †	
	KA94L4	OBSOLETE † †	
	KA94L3	OBSOLETE † †	
15	KP108L900	OBSOLETE † †	
	KP197L900	OBSOLETE † †	
16	KP193L	OBSOLETE † † †	
17	KP113L	OBSOLETE † † †	
18	KP118L	OBSOLETE † † †	
18a	KP3013A12	OBSOLETE † † †	5
19	K900801043000A	OBSOLETE † † †	5
20	K880201114043A	Steel lockwasher—7/16- X 0.156- X 0.109 in.	1
21	KP222L	Hexhead steel nut—7/16 in.—14NC2	1
22	KP123L	Operations selector gasket	1
23	KP223L	Plate, selector, standard	1
24	K730101131050A	Steel hex cap screw—5/16 in.—18NC2 X 1/2 in.	1
25	K900801031000D	Lockwasher—5/16- X 0.125- X 0.78 in.	1

† REPLACED BY KITS: KA718L1 (Slide valve and slide valve stop replacement kit)

BELOW S/N 246536 KA718L2 (Slide valve replacement kit)
KA718L3 (Slide valve stop replacement kit)

† † REPLACED BY KITS KA715L1 (Curves 1F1D, 1F2D, 1F3D, 2F0D. 2F1D, 2F2D, 3F0D, OR 4F0D)
KA715L2 (Curves 2F0D, 2F1D, 2F2D. 3F1D, or 3F0D without special solenoid frame)
KA715L3 (Curves 0F2D, 0F3D OR 0F4D.)

† † † REPLACED BY KIT: KA716L7001 (Adjustable control valve kit)

Adjusting sequences and time current curves

Curve adjustment serial numbers 97000 to 208749

Hydraulic parts as listed in Tables 9, 10, and 11 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.

When replacing a new slide valve, KA155L—which is used for delayed operations—it may be necessary to remove any projection resulting from the tolerance provided for the depth of the slide-valve base. Any projection may be removed with a file so that the slide valve will fit flush to 0.008 in. above the slide valve base.

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. 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.

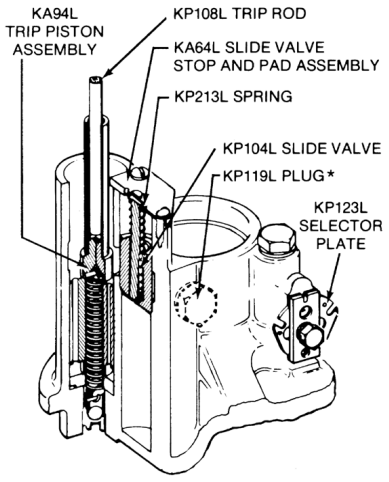


Figure 32. Parts most commonly used: Sequence two fast, two delayed

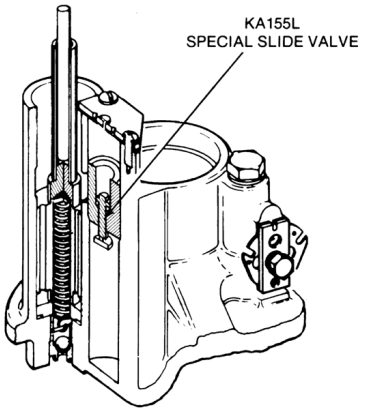


Figure 33. Installation of special slide valve used for delayed-only operations. No slide-spring is used

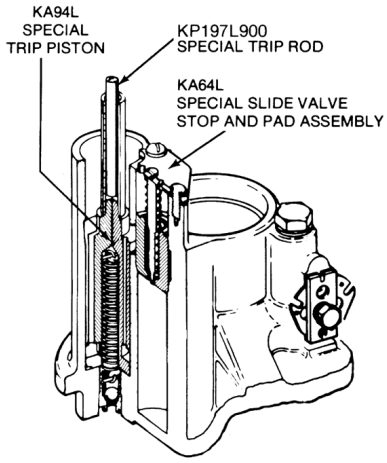


Figure 34. Special parts used: One fast and three delayed sequence

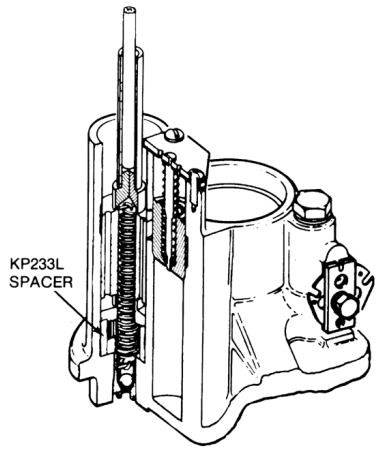


Figure 35. Location of spacer under trip piston

Curve adjustment serial numbers 208750 and above

Type L reclosers, with serial numbers 208750 and above, offer several sequence options, and adjustments depending on which option was originally ordered.

Each option allows the customer to vary the fast and delayed sequences of operation to lockout. Operating sequences can be all fast, all delayed, or a combination of both.

The Height, as defined by (H) on Figure 36, of the trip piston permits different timing sequences. Refer to Table 9, 10, and 11, to determine the correct parts used for desired timing sequence. These tables also identify additional service parts that may be present or required.

Indexing the adapter within the trip adjuster determines the total number of operations, while indexing the trip rod guide within the trip adjuster determines the number of fast operations.

Recloser operating sequences are used with standard delay curves to assure coordination with other reclosers or protective devices.

Table 9. Type L-- sequence selector options

Ordered option	Trip piston	Piston height (h)	Available sequences for ordered option
1	LA-23A-1	468 mm (1-27/32 in)	Sequences: 1F1D, 1F2D, 1F3D, 2F0D, 2F1D F2D, 3F0D or 4F0D. Cannot be used to select 3F1D sequence.
2	LA-23A-3	357 mm (1-13/32 in)	Sequences 2F0D, 2F1D, 2F2D, 3F1D: or 3F0D without special solenoid frame. Cannot be used to set 1F1D,1F2D, 1F3D sequence.
3	LA-23A-1	468 mm (1-27/32 in)	Sequences: 0F2D, 0F3D, or F4D sequence.

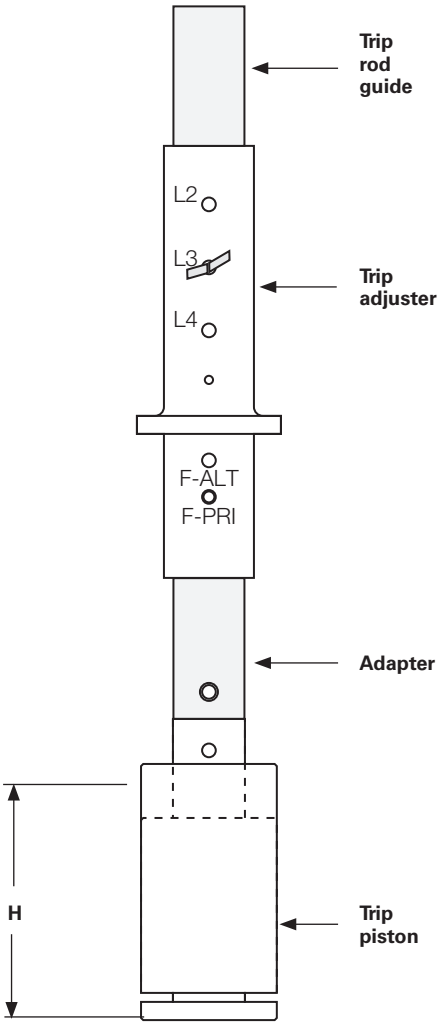


Figure 36. Sequence Selector Assembly

Table 10. Sequence selector parts identification

Item	Part number	Description	Option 1	Option 2	Option 3
1	L-3287A	Trip Rod	1	1	1
2	L-388A	Trip Rod Guide, 2-1/16" Long	1	1	1
3	L-389A	Trip Adjuster	1	1	1
4	L-390A	Adapter, 1-3/4" Long	1	1	1
5	L-391A	Trip Adjuster Stop (spacer)	1	1	1
6	L23A-1	Trip Piston Assembly	1	-	1
	L23A-3	Trip Piston Assembly	-	1	-
7	KA-2030-1	Lockwasher, High Collar	1	1	1
8	L-376A	Screw, Flange Head	1	1	1
9	9708-15-093050A	Roll Pin, 3/32 x 1/2" Long	1	1	1
10	9708-15-093062A	Roll Pin, 3/32 x 5/8" Long	1	1	1
11	9708-15-062062A	Roll Pin, 1/16 x 5/8" Long	1	1	1
12	9705-25-093100A	Cotter Pin, 3/32 x 1" Long	1	1	1
13	9710-01-187000A	Retaining Ring	1	1	1
14	LA155	Valve Assembly	-	-	1
15	L-106	Fiber Slide Valve Pad	-	-	1
16	L-105	Metal Slide Valve Stop	-	-	1

Note: Above part numbers are for identification purposes only. Individual parts cannot be purchased.

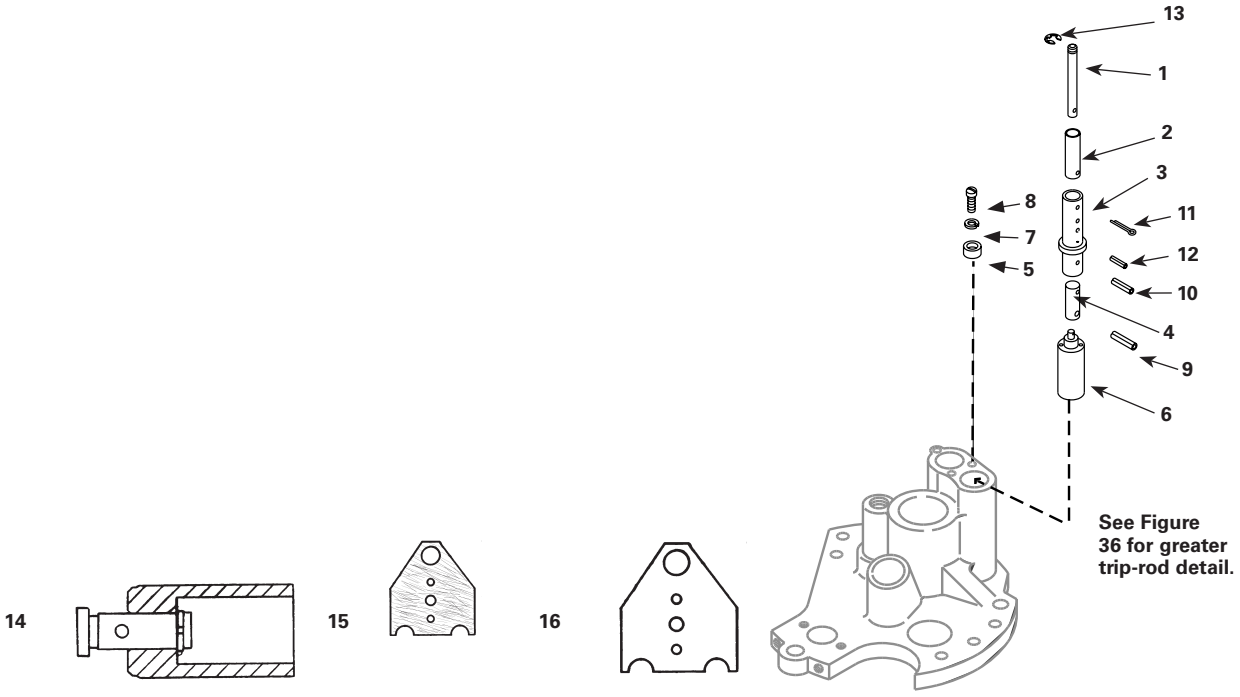


Figure 37. Sequence selector parts. See Table 10 for parts identification

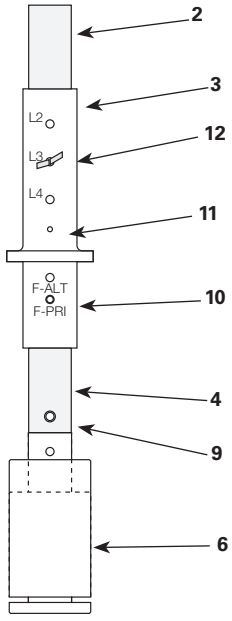


Figure 38. Larger view of trip rod assembly. See Table 10 for parts identification

Table 11. Lockout sequences (Refer to Figure 36)

Possible sequences	Option	Adjuster hole	Lockout hole
0F1D*	Use non-reclose handle.		
0F2D*	3	Either	L2
0F3D*	3	Either	L3
0F4D*	3	Either	L4
1F0D	Use non-reclose handle.		
1F1D	1	F-ALT	L2
1F2D	1	F-ALT	L3
1F3D	1	F-ALT	L4
2F0D	1	F-PRI	L2
2F0D	2	F-ALT	L2
2F1D	1	F-PRI	L3
2F1D	2	F-ALT	L4
2F2D	1	F-PRI	L4
2F2D	2	F-ALT	L4
3F0D*	1	Either	L3
3F0D	2	F-PRI	L3
3F1D	2	F-PRI	L4
4F0D*	1	Either	L4

Table 12. Sequence selection

Desired sequence	Option (see table 9)	Solenoid frame used	Slide valve stops	Slide valve
3F0D, 4F0D	1	X		
2F0D, 2F1D, 2F2D	1 or 2	X		
1F1D, 1F2D, 1F3D	1	X		
3F0D	2	Not		
3F1D	2	Required		
0F2D, 0F3D, 0F4D	3		X	X
1F0D	Timing Sequence can only be obtained using non-reclosing handle.			
0F1D	Timing sequence can only be obtained using non-reclose handle and the slide valve assembly/ slide valve stop for "all delay" sequence.			

Table 13. Parts for adjustable control valve

Item	Part number	Description	Quantity
1	LA178	Control Valve Outer Sleeve	1
2	KA3013-6	Brass Washer	1
3	LA113	Spring	1
4	L193	Control Valve Inner Sleeve/Stop Assembly	1

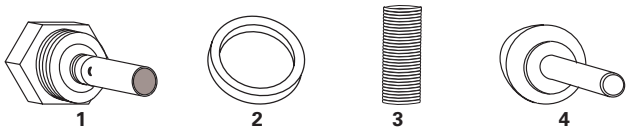


Figure 39. Individual control valve components. See Table 13 for parts identification

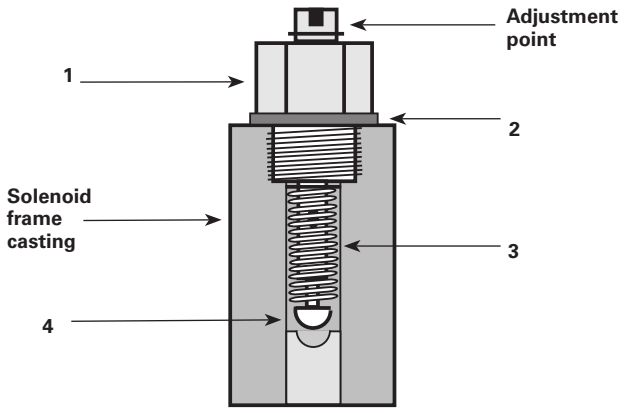


Figure 40. Adjustable control valve assembled into casting. See Table 13 for parts identification

Control valve for time current curve adjustment

Type L reclosers with serial number 208750 and above also have an adjustable control valve for B, C, and D time-current curves. (Figures 39 and 40) This valve allows for improved adjustment of the timing curve by permitting adjustment of the point at which the high-pressure control valve opens.

There are five maximum full turns (from all the way out, to all the way in) to set the B, C, and D TCCs on the adjustable time-current curve valves. Use a screwdriver for each time-current curve Adjustment. See Figure 40 to identify adjustment point.

B and D time current curve settings

1. Gently turn the adjustment screw clockwise unit it bottoms it out.
2. Gently turn the adjustment screw counterclockwise 2.5 turns to achieve the correct adjustment for the B and D adjustments.

C time current curve setting

1. Turn the adjustable spring retainer clockwise and gently bottom it out to achieve C curve settings.

Sequence adjustment (serial number 208750 and above)

When resetting sequencing, it is necessary to verify the operation of the recloser. The pump piston shell and the trip linkage can be initially set by operating the recloser mechanism out of oil. To verify the adjustments, use a suitable tester to apply the required test currents.

The fine-tuning procedure begins with adjustment of the pump piston shell, which produces the proper number of fast operations, and it concludes with adjustment of the trip linkage, which produces the proper number of operations to lockout. The pump piston and pump piston shell are threaded and turning or rotating the shell on or off the piston decreases or increases effective piston stroke.

Pump piston

Verify position of pump piston and pump piston shell.

Initially, it is necessary to verify the position of the pump piston shell on the pump piston. (Refer to Figure 41).

1. Turning (rotating) the pump piston shell off the piston increases the effective length of the piston, causing the ports in the cylinder wall to be covered earlier during the downward stroke of the pump. As a result, more oil will be pushed into the trip piston cylinder and the trip piston will raise higher in the cylinder, which reduces the number of fast operations.
2. Turning the pump piston shell onto the pump piston, decreases the effective length of the piston, causing the ports to remain open longer during the downward stroke of the pump. As a result, less oil will be pushed into trip piston cylinder and the trip piston will raise lower in the cylinder increasing the number of fast operations.

IMPORTANT

When possible, reuse the existing pump piston and piston shell but DO NOT DRILL OUT THE shell's STAKING AREA AND REUSE. If the old piston is not reuseable as is, order a new pump piston assembly, catalog number KA725H. The assembly includes pump piston, piston shell and link.

Adjust pump piston travel in housing.

1. With the recloser in the OPEN position, initially set the pump piston according to the following guide: (Figure 42.)
   A. When the recloser is adjusted for a "B" timing curve, the pump piston shell should cover approximately 25 percent of the pump cylinder port.
   B. When set for a "C" curve, the piston shell should cover approximately 50 percent of the port.
   C. When set for a "D" curve, the piston shell should cover approximately 37 percent of the port.
2. Before restaking the pump piston, first perform the trip point adjustment (next step).

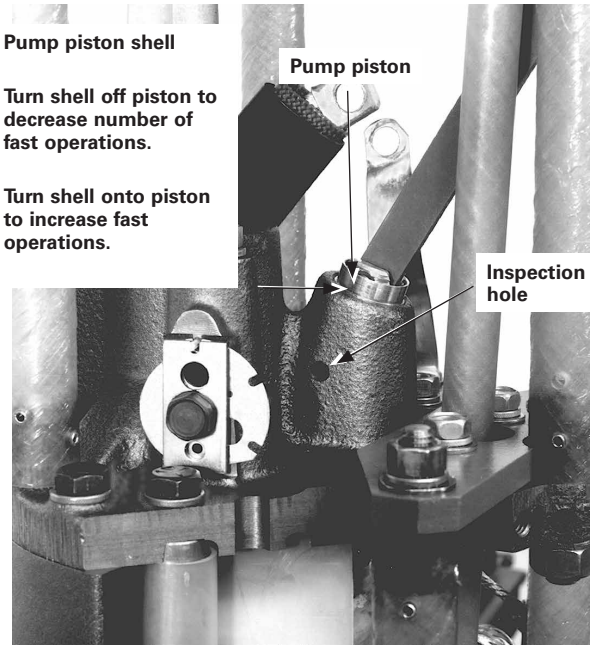


Figure 41. Location of inspection hole in casting

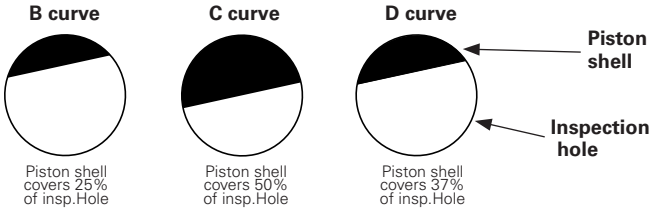


Figure 42. Pump piston shell adjustment

Trip linkage

After adjusting the pump piston for the correct number of fast operations, adjust the trip linkage so the recloser will operate the correct number of times to lockout. Initial adjustment is performed by operating the solenoid out of oil.

Note: With the solenoid assembly removed from the tank, the recloser should be prevented from fast open to prevent damage to the mechanism.

1. Firmly rest your thumb in the groove under the eyelet of the yellow manual operating handle to prevent fast opening when the latch releases.
   A. With your thumb in position, manually close the recloser.

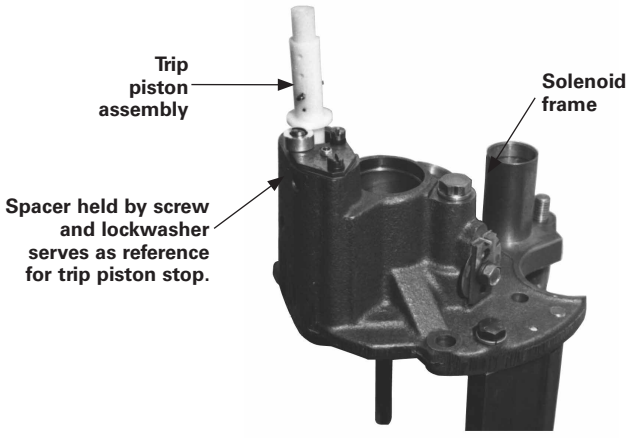


Figure 43. Trip piston stop

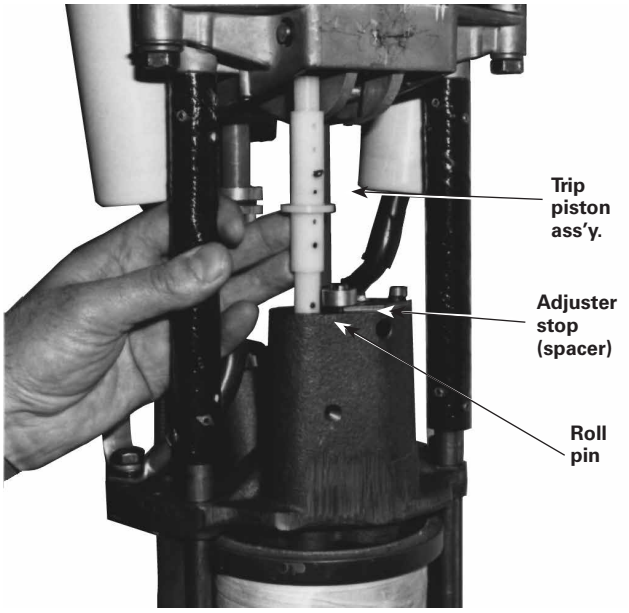


Figure 44. Trip Linkage Adjustment

2. Refer to Figures 43 and 44. Grasp trip piston assembly and lift until the recloser trips. Observe the roll pin that secures the trip piston to the trip piston adjuster assembly. Note the location of the roll pin relative to the trip adjuster stop (spacer) as shown in Figure 37.
   A. If sequence is set for 0, 2, or 3 fast operations, the recloser should trip to lockout when the roll pin is even with the bottom of the trip adjuster stop.
   B. If sequence is set for 1 fast operation, the recloser should trip to lockout when the roll pin is about even with the top of the trip adjuster stop.
   C. If the recloser trips too soon (roll pin below desired height), turn the self-locking nuts counterclockwise (downward, or off the recloser). Refer to Figures 41 and 44.
   D. If the recloser trips too late (roll pin above desired height), turn the self-locking nuts clockwise (toward the head casting).

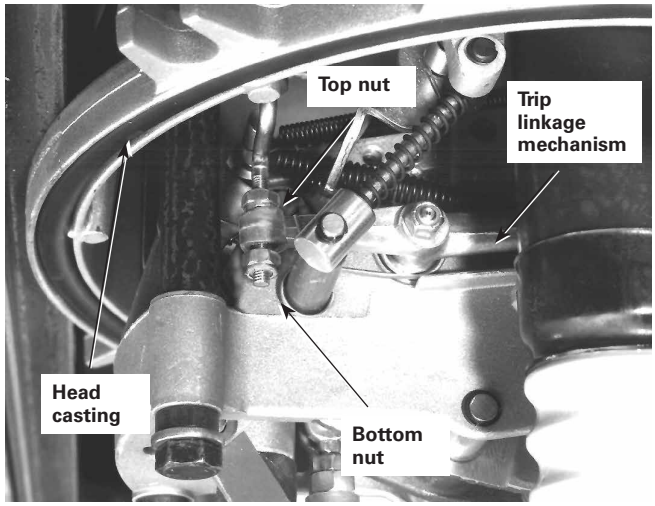


Figure 45. Trip point adjustment

Note: Be sure to maintain free play between the trip linkage mechanism and the two self-locking nuts. Loosen one nut one-half turn, to maintain proper free play, any time the assembly becomes tight. If free play is in question, make sure the adjustment is correct, tighten the bottom nut against the trip linkage mechanism, then back the nut off 1-1/2 turns.

3. After all adjustments are completed, stake the pump piston shell. (Figure 46)
4. Retank the recloser and test operation of the pump piston and trip point adjustment using a low voltage tester.

IMPORTANT

If the timing sequence has been changed, make sure a new data plate is attached to the recloser to identify the correct sequence of operation.

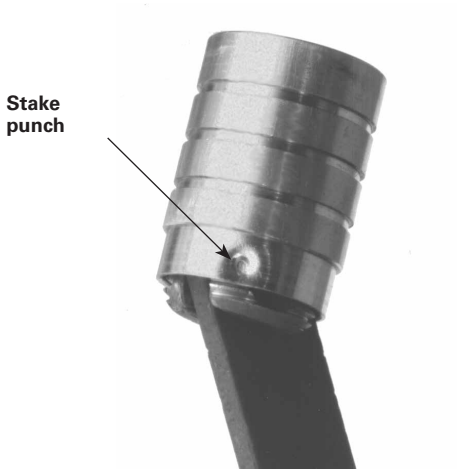


Figure 46. Staking pump piston shell

Testing

Pump piston

Adjustment of the pump piston shell must be done with a suitable tester. *Refer to Reference Data R280-90-2 Low Voltage A-C Testing of Hydraulic Reclosers* for additional information. Adjust the tester to provide a minimum of four-times the minimum trip current of the recloser being tested. Use the following procedure to test the piston shell adjustment:

Note: Test Type L reclosers as identified in *Reference Data R280-90-2.1.* Move the yellow manual operating handle to the CLOSED position and wait at least three minutes for the trip piston to fully reset.

1. Operate the tester (per manufacturer's directions) to apply the required current through the recloser. Note the sequence and number of operations.

Note: During fast operations, the recloser contact will open almost immediately after test current is applied. During delayed operations, a noticeable delay will be observed before the recloser operates. When lockout occurs the yellow manual operation handle will drop down. The trip times recorded for all fast operations should be almost identical.

2. The number of fast and delayed operations should match the data plate specifications. If the sequence does not match, check to see if the recloser is correctly configured. If the configuration is correct, the problem may be either a mis-adjusted pump piston or an oil leak.

Note: If the recloser operates too many, or too few, times to lockout it will be necessary to adjust the trip linkage to achieve the correct number of operations to lockout. It may be necessary to re-adjust the piston shell and trip linkage several times to obtain the proper sequence and time characteristics.

   A. Inspect the upper coil gasket and replace if damaged or worn. Repeat the test.

   B. If the recloser is performing too many fast operations, turn the piston shell counterclockwise slightly (off the pump piston) refer to Figure 41. Repeat the test.

   C. If the recloser is performing too few fast operations, turn the piston shell clockwise slightly (onto the pump piston) as shown in Figure 41. Repeat the test.

   D. Continue to test and adjust the pump piston shell until the proper number of fast trip operations are being performed.

Note: If the adjustment of the pump piston shell will not provide proper operation, the piston shell may be worn. Replace pump piston and pump piston shell assembly and repeat the test and adjustment procedure.

3. Stake the piston shell to prevent movement after the adjustment is correct. (See Figure 46.)

4. If the total number of operations is not correct, test the trip point adjustment.

Trip point

After the pump piston has been adjusted for the correct number of fast operations, the trip linkage must be adjusted so the recloser will operate the correct number of times to lockout.

1. Move the yellow manual operating handle to the closed position and wait at least three minutes for the trip piston to fully reset.

2. Operate the tester (per manufacturer's directions) to apply the required current through the recloser. Note the number of operations to lockout.

3. The number of operations should match the data plate specifications. If the number of operations does not match, check to see if the recloser is correctly configured. If configuration is correct, adjust the trip linkage (refer to Figures 43 through 45).

   A. If the recloser is performing too many operations, turn the self-locking nuts off the trip linkage (towards head casting) slightly. Repeat the test.

   B. If the recloser is performing too few operations, turn the self-locking nuts onto the trip linkage (away from head casting) slightly (onto the pump piston). Repeat the test.

4. Perform the Insulation Level Withstand Tests and the Contact Operation Test.

5. Return the recloser to operation after all the adjustments are correct. Time-current curves for the Type L 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, D steep delayed, E an intermediate delayed, and F a slightly less delayed curve than B curve.

To provide all operations on the A curve on units with serial numbers below 97000, remove the fast shot blocking plug KP119L; on units with serial numbers above 97000, a special solenoid frame assembly must be ordered (KA127L-3).

To select operations on the B, C, or D curves, merely loosen the cap screw and clamping plate and re-index the orifice selector plate to the desired delayed curve.

For all operations on the E curve, the KP123L selector plate is removed and a KP226L plate is inserted and indexed in its place.

F curve operation requires the removal of the fast shot blocking plug KP1 19L (serial no. below 97000) and the addition of a KA123L control valve. Selector plate setting for this F curve is indexed at B.

High-potential withstand test

High-potential withstand tests provide information on the dielectric condition of the recloser. Perform the high-potential withstand test in a test cage at 75 percent of the low-frequence-withstand voltage. Service Information MN280062EN or MN280051EN contain the dry, one-minute 60 Hz with standard voltage for each model of recloser.

⚠ WARNING

Hazardous voltage. The switchgear (apparatus and control) and high-voltage transformer must be in a test cage or similar protected area to prevent accidental contact with the high-voltage parts.

Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage. **T221.5**

Test the recloser at applicable voltage for 60 seconds in each of the following configurations

Closed contacts test

1. Close the switch contacts.
2. Ground the switch.
3. Apply proper test voltage to the bushing terminal. The switch should withstand the test voltage for 60 seconds.

Open contacts test

1. Open the switch contacts.
2. Ground the switch.
3. Ground the bushing on one side of the switch.
4. Apply proper test voltage to the ungrounded bushing. The switch should withstand the test voltage for 60 seconds.
5. Reverse the test and ground connections to the bushings.
6. Apply proper test voltage to the ungrounded bushing. The switch should withstand the voltage for 60 seconds.

Withstand test results

The high-potential withstand tests provide information on the dielectric condition of the switch.

If the switch passes the closed-contacts test and fails the open-contacts test, the cause is likely to be in the interrupter assembly. If the switch fails the closed contacts test, the cause is likely to be a diminished electrical clearance or failed insulation.

Contact operation test

The following test is intended to verify that the recloser contacts/mechanism are operating properly. With the recloser tanked:

1. Manually operate the recloser to lockout.
2. Slowly raise the operating handle to the closed position. Operate at a uniform rate which will allow the handle to swing through its complete arc in a period of approximately 5 to 15 seconds.
3. As soon as the contacts close, restrain the downward movement of the handle. Slowly allow the handle to return to the open position. This movement should take approximately 5 to 15 seconds and the contact must open.

Contacts must freely close and open while the mechanism is being slowly operated. If the contacts fail to freely open or close, inspect the recloser and repair or replace parts as required to achieve proper operation.

Bushings, head, and tank assemblies

Bushings

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

1. Porcelain only can be replaced without untanking the recloser. (See Figures 47 and 48.)
   A. Turn the bushing terminal counterclockwise to remove it. Lift off the terminal gasket.
   B. Remove three bolts that secure the bushing clamps and lift the porcelain out of the head casting.
   C. Position a new bushing gasket on the head mechanism. Slide new porcelain over the bushing lead and turn it so the terminal on the lead is seated properly.
   D. Remove the aluminum clamping gasket from the old bushing and put it on the new porcelain. Secure the bushing clamps. Torque the clamp bolts to 6-10 ft-lb. Add the terminal gasket and terminal.

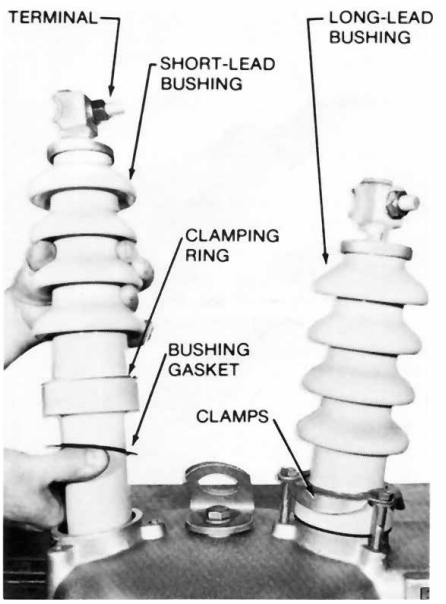


Figure 47. Lifting a bushing assembly

2. Replace entire bushing assemblies as follows:

   A. If bushing leads have not been disconnected, observe procedure in the Series-Trip Solenoid Disassembly section.

   B. Remove bushing clamps and lift out entire bushing as illustrated in Figure 47.

Note: The lead in one bushing is longer than the other. The long-lead bushing is installed on the side next to the sleet hood.

If further maintenance is to be performed, do not replace the bushings yet. When installing bushings, merely clamp them in place, but use a new gasket. Also, be sure to use the aluminum clamping ring between the clamps and the porcelain.

Tighten bushing clamp bolts to 6-10 ft-lbs. torque.

Table 14. Bushing parts list

Item no.	Catalog no.	Identification	No. used
1	KA717R34	Long-lead bushing assembly	1
	KA717R35	Short-lead bushing assembly	1
2	KA143L900	Terminal assembly	2
3	KP2090A57	Terminal gasket, upper	2
4	KA716R27	Long-lead assembly	1
	KA716R28	Short-lead assembly	1
5	KP1L	Bushing, porcelain only	2
6	KP121L	Bushing clamping gasket	2
7	KP2090A29	Bushing gasket, lower	2
8	KP763	Stainless steel hex cap screw 3/8 in. - 16C2 x 2in	6
9	KP41I	Galvanized bushing clamp segment	6

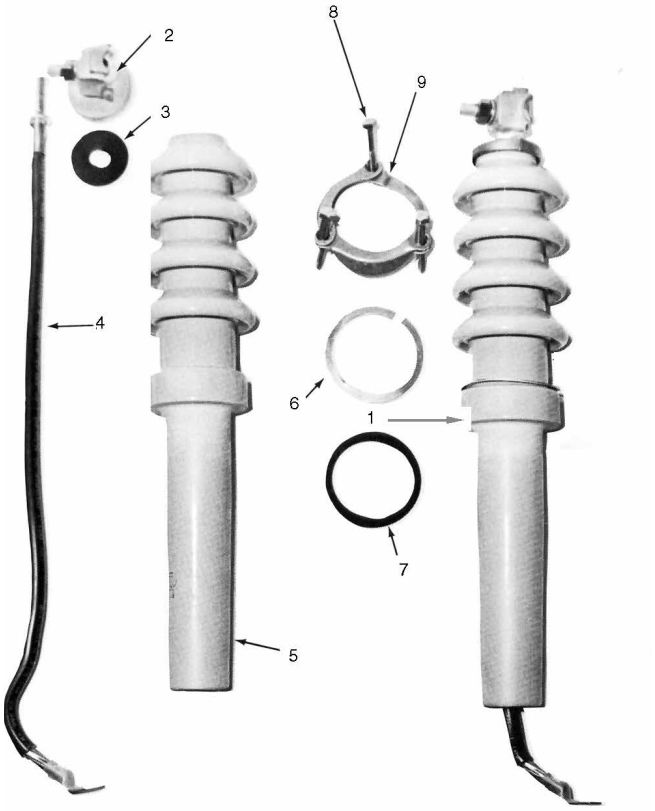


Figure 48. Bushing parts. See Table 14 for parts identification

Head mechanism

Disassembly of the head mechanism should rarely be required. Should removal be necessary, for any reason, follow these steps and refer to Figures 49 through 57.

1. Move operating lever to the OPEN position.
2. Figure 49 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 indicated in Figure 49. Note use of flat washer under cap screw nearest the operating lever. Also note that two pipe spacers will be released.
3. Lift the operating mechanism assembly to expose the pivot point. Remove the C ring and pull out the pin. Lift out the entire mechanism.
4. Remove C ring (Figure 50) and pull pin that secures the solenoid plunger to the operating mechanism. Then pull off spring clip and remove pin that secures the contact rod.
5. Figure 51 shows the head assembly as it appears after the operating mechanism has been removed. Unhook lockout spring and operating lever spring.

6. Remove sleet hood cover and counter. Then drive out pin (not shown) in the lockout lever.
7. Pull the operating lever and remove manual trip lever. Then lift out the lockout spring lever, lockout cam and link assembly, and lockout lever (Figure 52).
8. Drive out the rollpin that secures the counter lever assembly to the counter shaft (Figure 53). Pull out the shaft. Note the flat washer that separates the counter lever assembly and a post in the head casting.

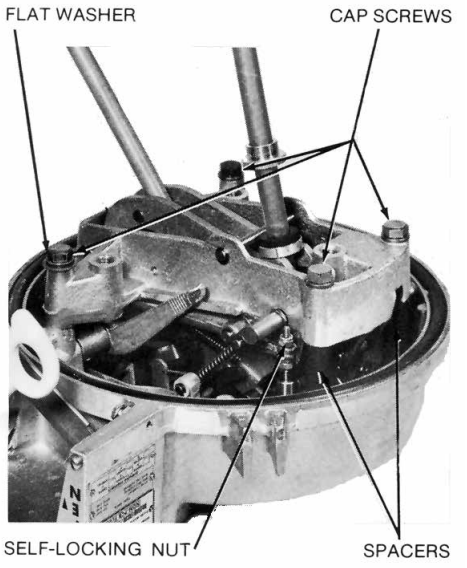


Figure 49. Head operating mechanism

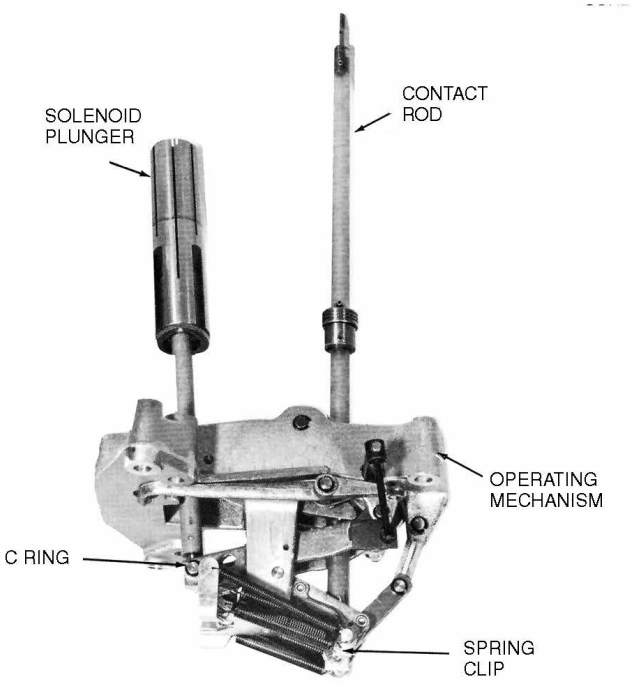


Figure 50. Releasing plunger and contact rod

9. Slip off the adjustable lockout lever (Figure 54).

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

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

Note: If the unit has a serial no. between 55469 to 78552, a Trip Lever Modification Kit (KA709L) must be ordered and installed during reassembly. See *Service Information* S280-15-4 for details.

1. Install counter parts first.
2. Position adjustable lockout lever (Figure 54).
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 flat washer on one end of the shaft. See Figure 55.
4. Position manual trip lever and insert operating lever. Pin the lockout lever to the operating lever.
5. Connect solenoid plunger and contact rod to the operating mechanism. Bolt operaring mechanism in the position shown in Figure 50.
6. Connect adjustable lockout lever to the operating mechanism by replacing the self locking nut removed in Step 2 of the head mechanism disassembly procedure.
7. Check adjustment of the lockout mechanism as follows:
   A. Grasp the insulating tube portion of the trip piston assembly (Figure 26), and lift it until the trip piston contacts the slide valve stop plate. Make a light scribe mark on the insulating tube 1/4 above the slide valve stop.
   B. Release the trip position 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 position assembly. Recloser should trip just as the 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 self-locking nuts shown in Figure 56 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.

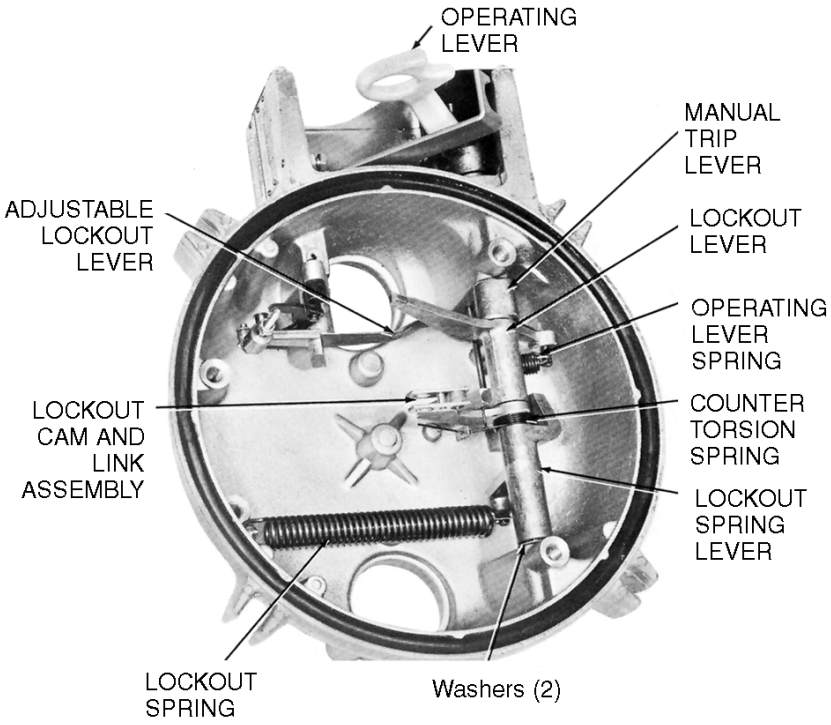


Figure 51. View of head mechanism

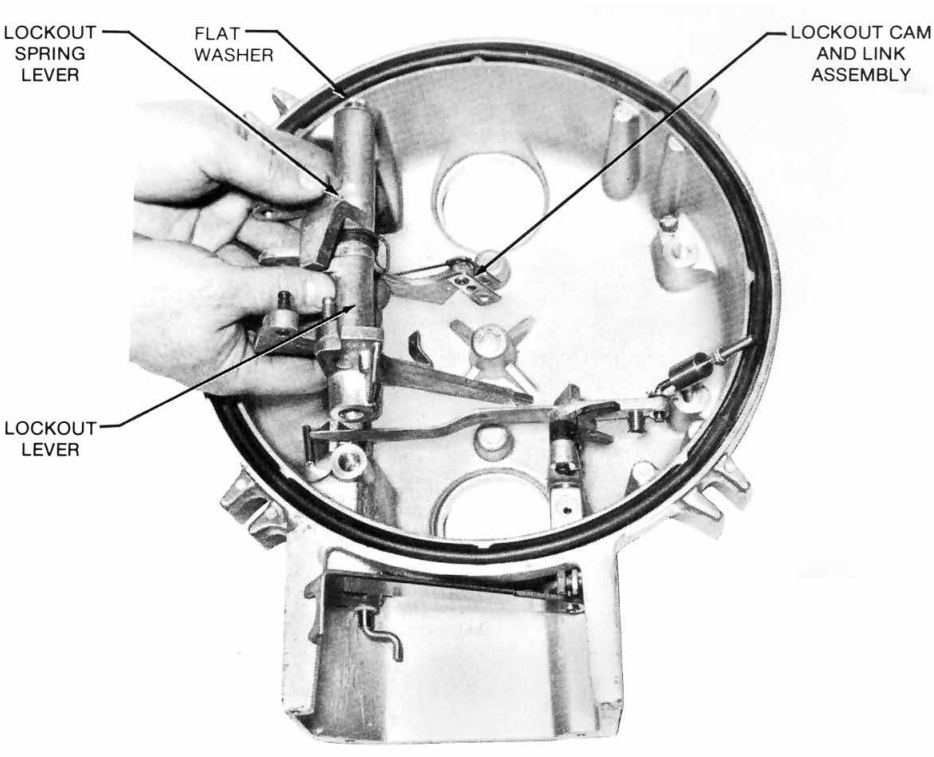


Figure 52. Removing parts from head mechanism

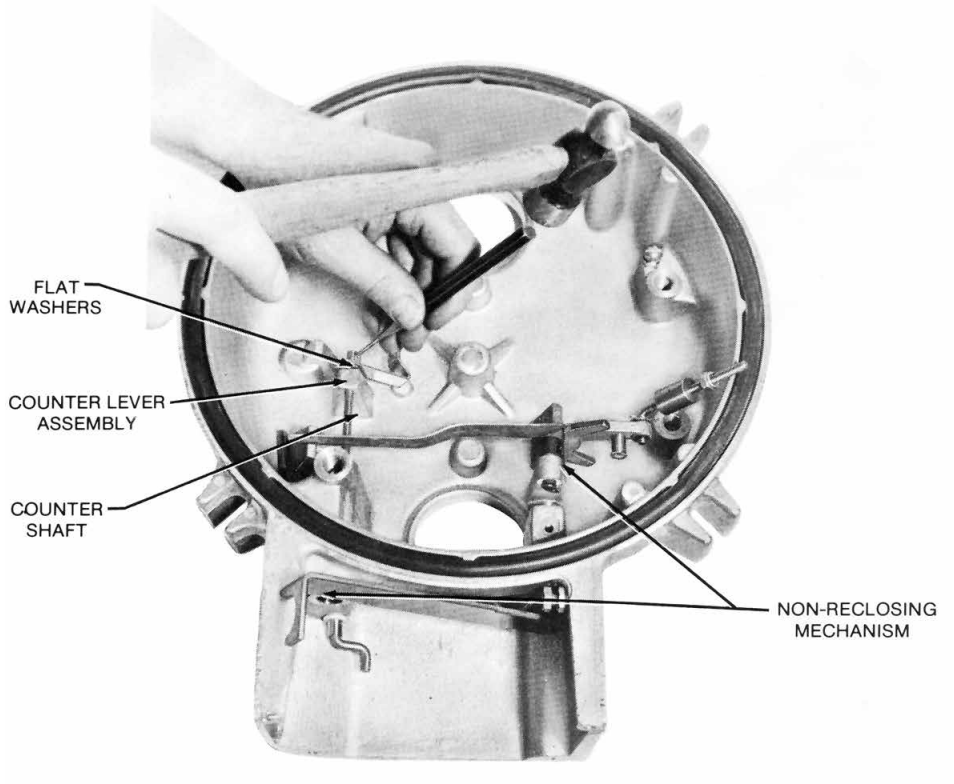


Figure 53. Driving out countershaft pins

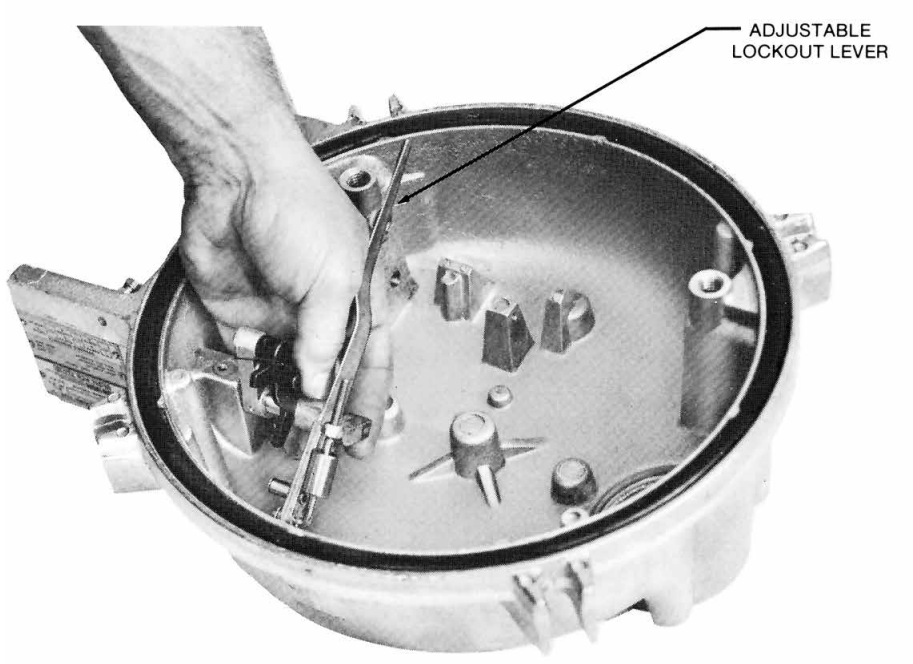


Figure 54. Lifting out adjustable trip lever

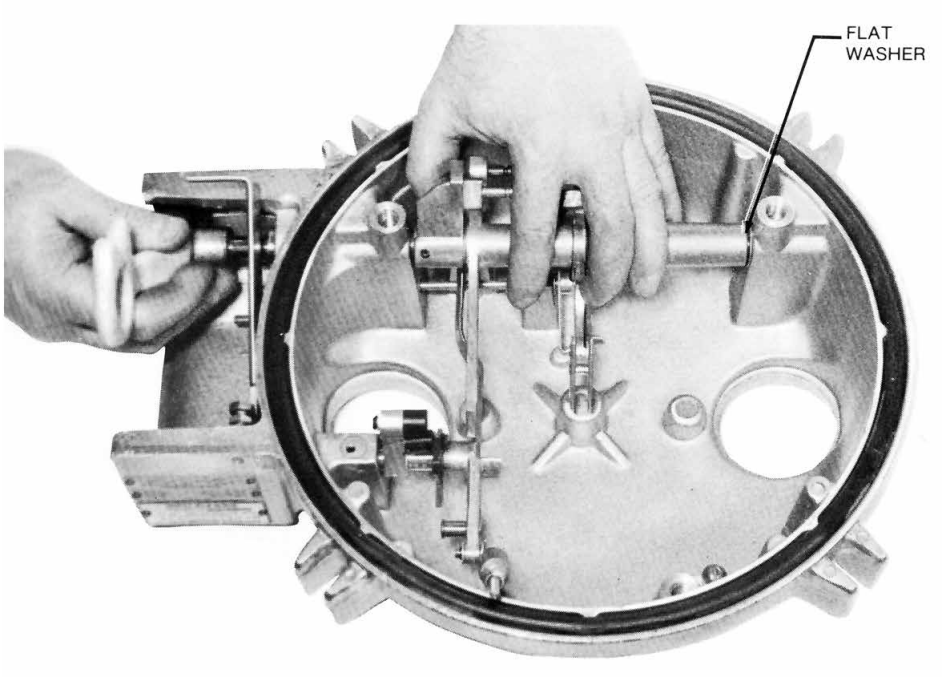


Figure 55. Reassembling head mechanism

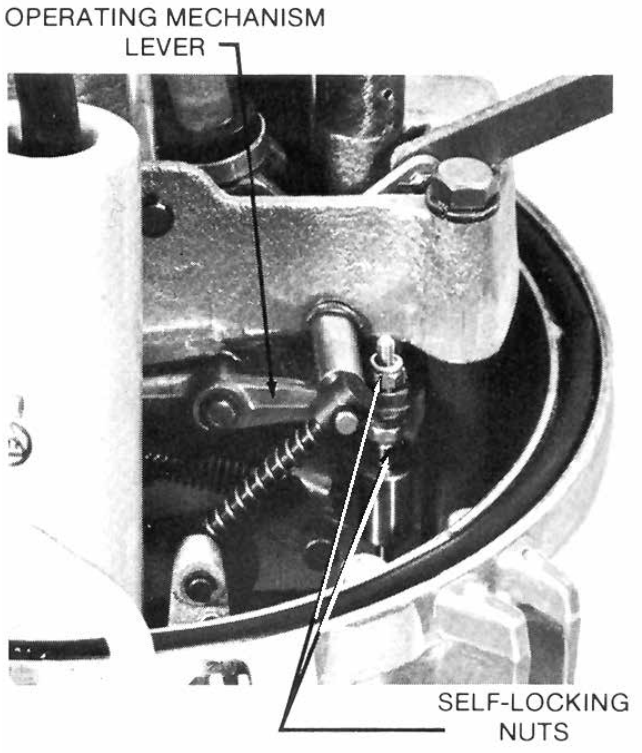


Figure 56. Adjustable lockout lever setting

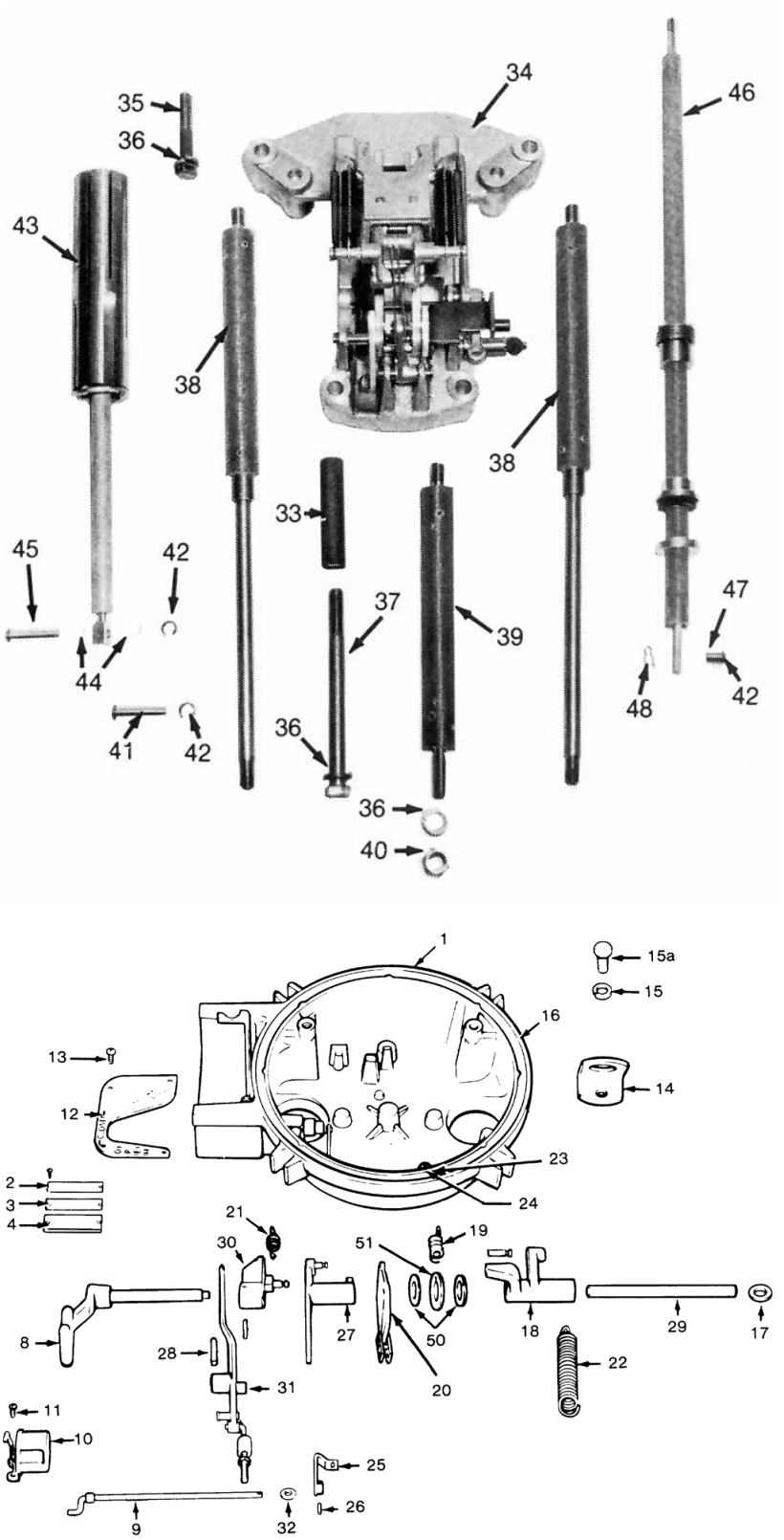


Figure 57. Parts for head assembly. See Table 15 for parts identification

Table 15. Parts list for head assembly

Item no.	Catalog number	Description	No. required
1	KA705L	Head casting—below serial no.12100	1
	KA706L 1	Head casting—serial no.12099 to 86200	1
	KA706L2	Head casting—above serial no.86200	1
2	KP181 L900	Name plate and mounting screws	1
3	KP2112A/KP2113A	Coil data plate, add continuous current rating	1
4	KP1371 R	Operating data plate, add sequence	1
5	KP348L	1 /2-in. groove pin; trip lever pivot*	1
6	KP3106A12	Bushing in cover, counter shaft*	1
6a	KP269L	Bushing in cover, operating handle*	1
7	K970901500000M	Open-type retaining ring, WA-522*	1
8	KA92 L	Operating lever includes shaft assembly—KA5L above serial no.12099	1
9	KA9L	Counter shaft assembly—below serial no.8750	1
	KA84L	Counter shaft assembly—serial no.8750 to 12099	
	KP258L	Counter shaft assembly— serial no.12100 and above	1
10	KA708L	Counter kit below serial no.37202	1
	KA28C01	Counter kit above serial no.37203 and above	1
11	K751501106062A	Round-head self-tapping screw—No.4 X 5/16 in.	2
12	KP117L	Sleet hood cover plate—below serial no.26081	1
	KP292L	Sleet hood cover plate—serial no.26082 and above	1
13	K801515012050A	Stainless-steel, round-head Phillips self-tapping screw—No.12 X 1 /2 in.	4
14	KP764H	lifting lug replacement kit	1
15a	K900801050000Z	Lockwasher	1
15b	K73010111501000	Standard hex cap screw—1/2 in.—13UNC2 X 1 in.	1
16	KP2090A7	Head gasket—below serial no.86200	1
	KA2103-4	O-ring head gasket—serial no.86200 and above	
17	K900101051087D	Flat washer—zinc plated	1
18	KP14L	Lockout spring lever	1
19	KP158L	Counter torsion spring	1
20	KA27 L	Lockout cam and link assembly	1
21	KP27H	Operating lever spring	1
22	KP99L	Lockout spring	1
23	K721501125062D	Zinc-plated steel, round-head screw—1 /4 in.—20UNC2A X 5/8 in.	1
24	K881001120025A	Zinc-plated steel hexnut—1/4 in.—20UNC-2B	1
25	KA8L	Counter lever assembly below serial no.26082	1
	KA118L	Counter lever assembly serial no.26082 and above	1
26	KP2001A23	Stainless steel groove pin—3/32 X 1/2 in., Type 2	1
27	KA17L	Lockout lever assembly	1
28	KP2001A14	Groove pin—1/8 X 1-1/4 in., Type 1	1
29	KP77 L	Operating shaft	1
30	KA5L	Manual trip lever assembly—part of item 8, KA92L	1
31	KA20L	Trip lever assembly	1
32	KP3006A7	Spacer, counter shaft	1
33	KP33L	Operating mechanism frame spacer	2
34	KA37L	Operating mechanism assembly	1
35	K730101143250A	Steel hex cap screw—7/16 in.—14NC2 X 2-1 /2 in	2
36	K900801043000A	Steel lockwasher—7/16 X 0.156 X .109 in.	9
37	K730101143550A	Steel hex cap screw—7/16 in.—14NC2 X 5-1 /2 in.	2
38	KP3149A33	Insulating stringer, long	2
39	KA10L	Insulating stringer, short—serial no.31114 and above; below serial no. 31114, see KA707L	1
	KA11L		

Table 15. Parts list for head assembly (continued)

Item no.	Catalog number	Description	No. required
40	K880201114043A	Steel hex nut—7/16 in.—14NC2	5
41	KP348L	Pivot pin	1
42	K970901312000M	Retaining ring, WA516	5
43	KA28L	Solenoid plunger assembly	1
44	KP3007A10	Spacer	2
45	KP3125A4	Pivot pin	1
46	KA117L	Contact rod assembly	1
47	KP3125A1	Pivot pin	1
48	KP2018A1	Spring clip, no.1090 narrow,0.041-in.-dia. wire	1
49	K900201043000A*	Standard light steel flat washer—7/16 X 59/64 X 0.080 in. (see Figure 34, page 17)	1
50	KP3017A60	Spacer	2
51	KP386L	Spring Guide	1

* Not Shown

Tank assembly

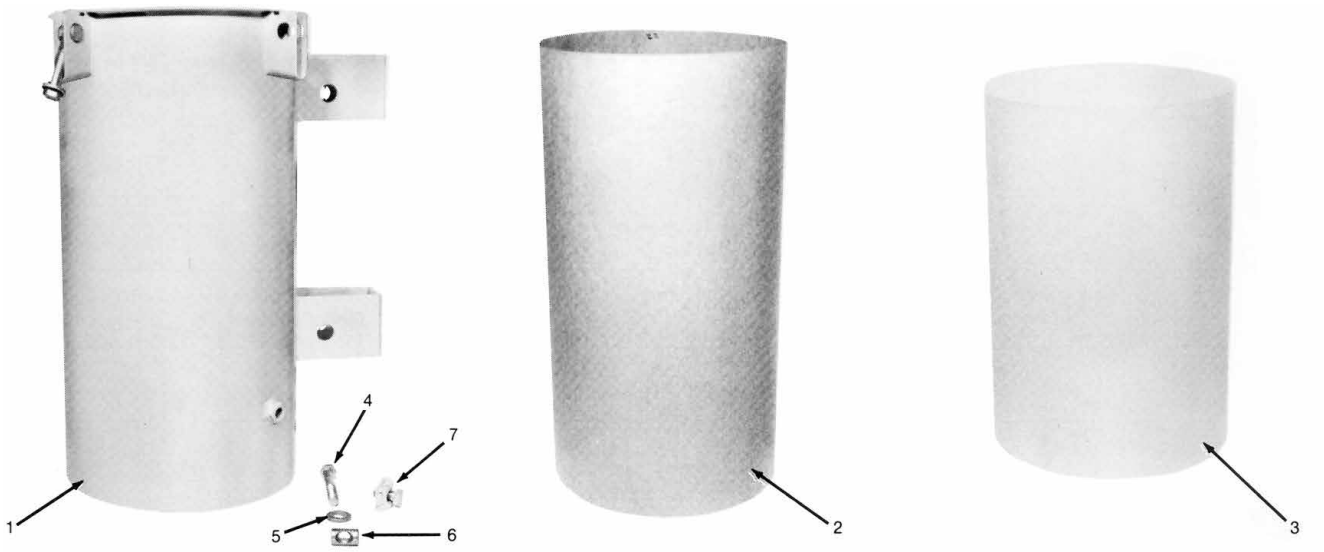


Figure 58. Tank and liner parts. See Table 16 for parts identification

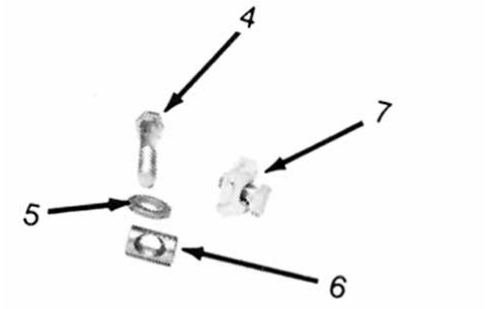


Figure 59. Enlarged view of small tank liner parts

Table 16. Tank and tank liner parts list

Item no.	Catalog no.	Description	Not used
1	KA4L*	Tank assembly (serial number below 86200)	1
	KA145L1	Tank assembly (serial number 86201 and above)	
2	KP191L	Tank liner	1
3	KP340L	Tank wall insulation	1
4	K7301011503500	Electyrozinc-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	KP307L	Galvanized combination steel nut and pin	4
7	KA227H	Ground clamp	2

*If this tank assembly must be replaced, order Kit KA706l-1, which includes KA145L-1 tank, KP207 head casting and KA2103A4 head gasket.

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