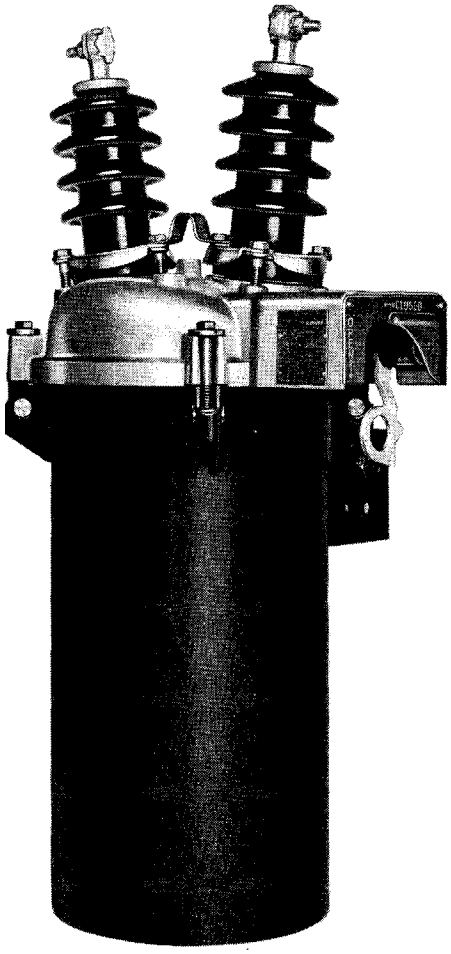
Type H single-phase recloser maintenance instructions

14.4 kv • 5 thru 50 Amperes

Applicable to serial numbers beginning with 100974 through 246403.



Powering Business Worldwide

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Contents

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. G122.2

Product information

Introduction

Service Information MN280035EN provides maintenance instructions for Eaton's Cooper Power™ series Type H single-phase recloser.

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 provide directions 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, please contact your Eaton representative.

Acceptance and initial inspection

Each recloser is in good condition at the factory and when accepted by the carrier for shipment.

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

Handling and storage

Use care during handling and storage of the recloser to minimize the possibility of damage. If the recloser is to be stored for any length of time prior to installation, provide a clean, dry storage area.

Quality standards

ISO 9001 Certified Quality Management System

⚠ WARNING

Do not operate this equipment if energized parts are not immersed in dielectric fluid. Operation when parts are not properly immersed in dielectric fluid may result in internal flashovers that will damage the equipment and can cause death or severe personal injury. G104.4

Description

A Type H recloser is a self-contained device that senses and interrupts single-phase fault currents on a distribution circuit. The recloser automatically closes to restore service if the fault is temporary and then resets for another series of operations. If the fault is permanent, the recloser locks open after two, three or four operations, depending upon its setting.

Operating sequences of the reloser can be all fast, all delayed, or a combination of fast and delayed. When a combination sequence is used, fast operations always precede delayed operations. On coordinated systems, fast recloser operations are used to clear temporary faults before branch-line fuses are damaged. Subsequent time-delay openings allow fault currents to flow long enough to be cleared by branch-line fuses. Thus, outages caused by permanent faults are confined to shorter sections of line.

Type H reclosers are widely applied to increase service continuity, reduce operating costs and increase revenue. They can perform at peak efficiency, providing reliable circuit protection, if adequate maintenance is performed. Maintenance is relatively easy and inexpensive.

Arc interruption inherently results in the reduction of some oil, which is a complex hydrocarbon, into various chemical compounds, free carbon and gases. Addition of these chemical compounds to the oil has several adverse effects :

1. Oil dielectric strength is reduced.
2. Water-absorbing particles are formed.
3. Under extreme conditions, recloser timing may be erratic.

For these reasons, oil must be replaced periodically.

Filtering of oil may remove absorbed and free water in addition to some other contaminants. The dielectric strength sometimes can be raised to acceptable levels by this method. Filtering, however, does not always remove water-absorbing contaminants and the oil's dielectric strength may fall rapidly after being returned to service.

Therefore, a recloser undergoing periodic maintenance should be filled with new oil or oil that has been restored to like new condition.

Frequency of maintenance depends upon local climatic conditions and the interrupting duty imposed upon the equipment. Eaton recommends units be completely inspected and cleaned at least once each year. Oil should be replaced under any of the following conditions:

1. When contaminated with sludge or carbon.
2. When dielectric strength has decreased to 18 kv or lower.
3. When the equivalent of a duty cycle has been completed.

The NEMA® standard duty cycle for distribution class reclosers is as follows:

Table 1. NEMA® Standard Duty Cycle for Distribution Class Reclosers

Percent of Rated Interrupting Current	No. of Operations	Circuit X/R Value
15 - 20	40	2
45 - 55	40	4
90 - 100	20	8
	total 100	

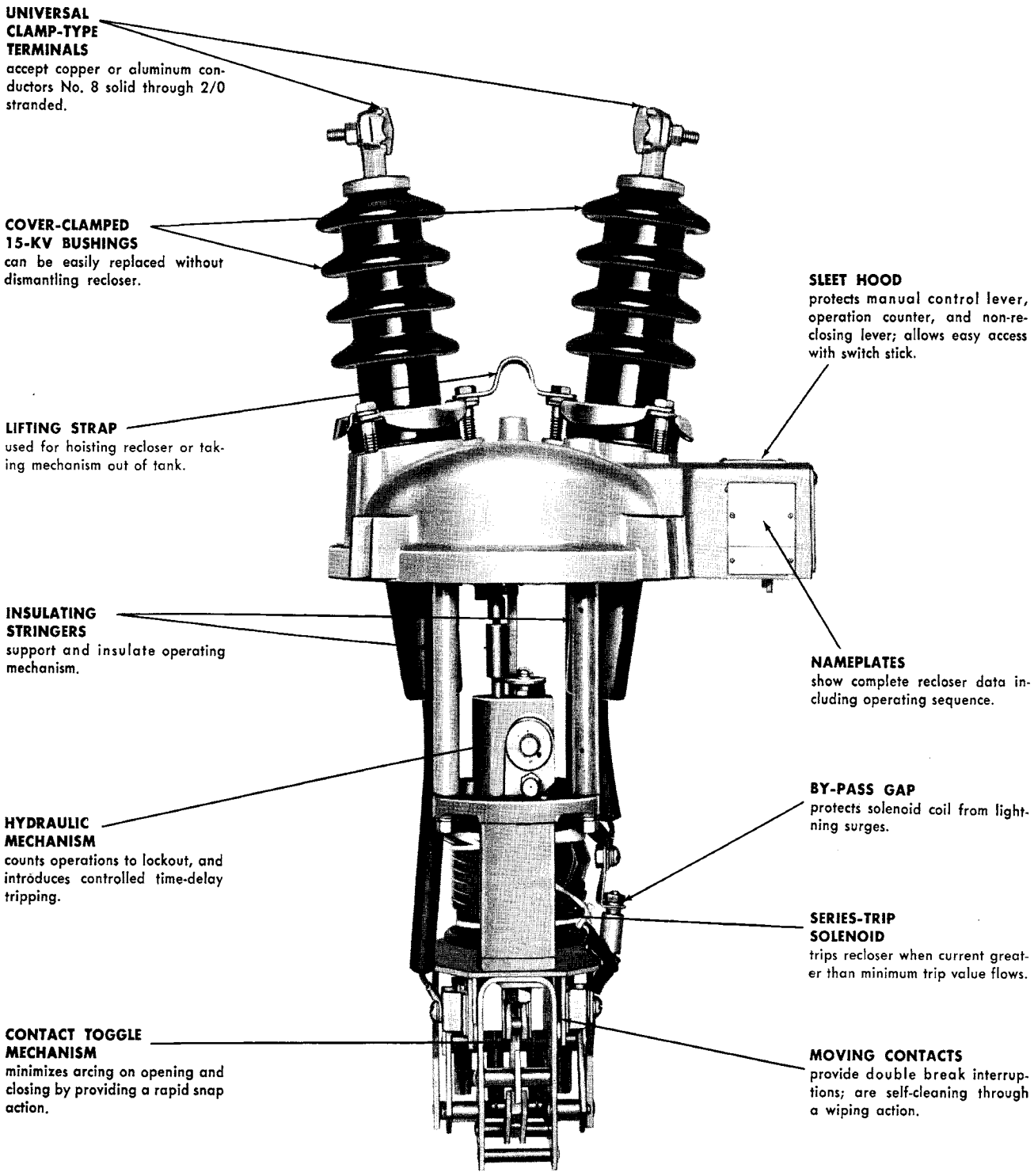

Figure 1. Recloser description.

Periodic inspection and maintenance

Each periodic check should include at least the following steps: (Detailed disassembly instructions are given under **General repairs and maintenance**.)

1. Remove recloser from service and replace with a spare or a fuse.
2. Inspect external components. Check for broken bushings, paint scratches, or other mechanical damage. Note counter reading and enter in the recloser record. Move manual control lever up and down to see if counter is functioning properly and leave in tripped position.
3. Loosen bolts that secure head casting and remove mechanism from tank. If tank and head do not separate readily, break gasket seal by prying them apart. Allow oil to drain off mechanism. Repair work will be simplified if the work bench is arranged so the mechanism can be placed in an inverted position.
4. Inspect contacts and interrupting structure. Replace moving and stationary contacts if they are severely eroded.
5. Clean all internal components. Remove all carbon traces by wiping with a clean, lint-free cloth. Pay particular attention to insulating members. Flush the mechanism with clean, dry transformer oil.

⚠ 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

6. Examine head gasket. Replace 0-ring gasket if it has taken a permanent set. Always replace flat CORPRENE gasket, furnished on older reclosers.
7. Inspect tank liners. Soft or spongy areas indicate water has been absorbed. Replace liners if these areas are present. Remove any carbon or sludge from tank.
8. Fill the tank with oil. An orange line inside tank shows proper oil height with mechanism removed. Capacity is approximately four gallons. Use only new transformer oil which possesses the following properties:

Table 2. Transformer Oil Properties

Characteristic	Acceptable Value
Color: nearly colorless by Union colorimeter by ASTM colorimeter	 2.0 max. 1.0 max.
Reaction	Neutral
Neutralization number	0.03 mg KOH/g max.
Free sulfur	none
Steam emulsion number	25 seconds max.
Flash point	145°C min. (293°F)
Fire point	160°C min. (320 °F)
Pour point	-45.6°C max. (-50 °F)
Viscosity: at 37.8°C (100°F) Saybolt Universal at 0°C (32°F) Saybolt Universal	 62 sec. max. 320 sec. max.
Specific gravity: at 29.9°C (86.0°F)	0.895 max
Coefficient of expansion: at 0°C (32°M) at 100°C (212°F)	 0.000725 0.000755
Interfacial tension	40 dynes/cm min.
Dielectric constant	2.2
Dielectric strength	26,000 volts min.
Weight per gallon	7.5 lbs.

9. Replace mechanism in tank. Reposition head bolts and tighten evenly. Operate the recloser manually about eight times to expel all .air from the hydraulic system.
10. Check for proper operation. Allow a few minutes for trip piston to fully reset after expelling air. Manually open and close contacts by means of the manual control lever until recloser locks open. The number of contact openings should correspond with number of operations indicated on recloser nameplate. When lockout is reached, unlatching of the lockout mechanism can be heard and, for a short period of time, the manual control lever cannot be latched in the closed position.

    Fast and delayed operations can also be checked. During a fast operation the contacts will snap open shortly after the manual control lever is pulled down. For delayed operations there will be a longer interval after the lever is pulled down before the contacts snap open. The number of fast and delayed operations should agree with the nameplate data.
11. Direct current testing can also be employed to verify its electrical as well as its hydraulic operation. For this test, connect a number of six-volt storage batteries in series in accordance with the following table. For a series connection, each battery is connected from positive (+) to negative (–).

Table 3. Series Connections

Coil Rating Amperes	No. of 6-Volt Batteries (Series)	Cable Size AWG
5	6	Short Lengths of No. 6 to 250 MCM
10	3	
15	2	
25	2	
35	2	
50	2	

A. Push yellow control lever up to the CLOSED position and wait about three minutes for the trip piston to fully settle.

B. Momentarily connect bushing terminals to the series output of the batteries for each tripping operation. Count the operations to lockout. If correct number of operations did not occur wait five minutes and repeat test. Air in the hydraulic system can often cause incorrect operation.

General repairs and maintenance

Operations described in this section should be performed under the cleanest conditions possible. Move manual control lever to OPEN position and remove the recloser mechanism from the tank as described in **Periodic inspection and maintenance** section.

Arc-interrupting structure

Fault current is interrupted in minimum time by the arc-interrupting structure. Circuit opening is provided by a double, spring-loaded, moving contact assembly.

Inspect contact assembly and be sure contacts completely close.

1. If contacts are rough and carbonized, they should be cleaned as follows:

   A. Disconnect two leads from the arc-interrupting structure.

   B. Remove the two screws from arc shield and swing shield upward. See Figure 3.

   C. Take off both arc deflectors as shown in Figure 2.

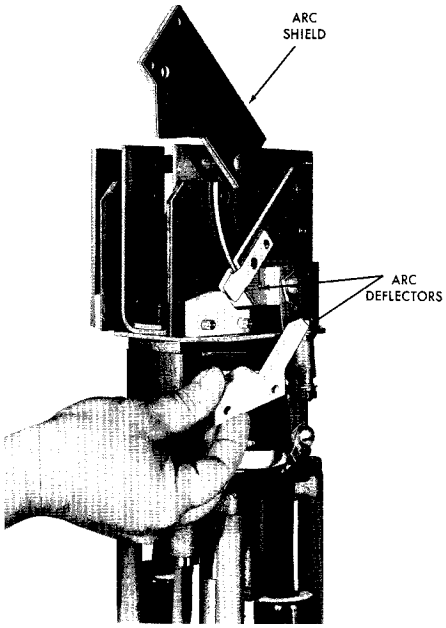

Figure 2. Removing arc deflectors

D. Lift movable contact and clean both contacts with crocus cloth. See Figure 3.

E. Reassemble arc-interrupting structure by reversing above procedure.

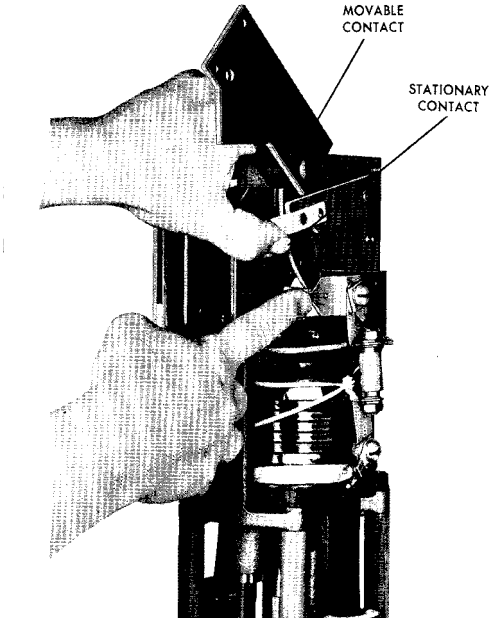

Figure 3. Reassembling arc-interrupting structure

F. Clean other set of contacts in same manner.

2. If contacts are badly burned or do not close completely, the arc-interrupting structure should be replaced as follows:

   A. Disconnect two leads from the arc-interrupting structure.

   B. Remove the two hex nuts and washers that hold the interrupting structure in place.

   C. Lift off interrupting structure. Note proper orientation of interrupting structure with respect to pump piston.

   D. Install new unit in same position by reversing above procedure. Be sure interrupting structure is oriented as shown in Figure 3.

If further maintenance is to be performed at this time, do not reinstall the arc-interrupting structure.

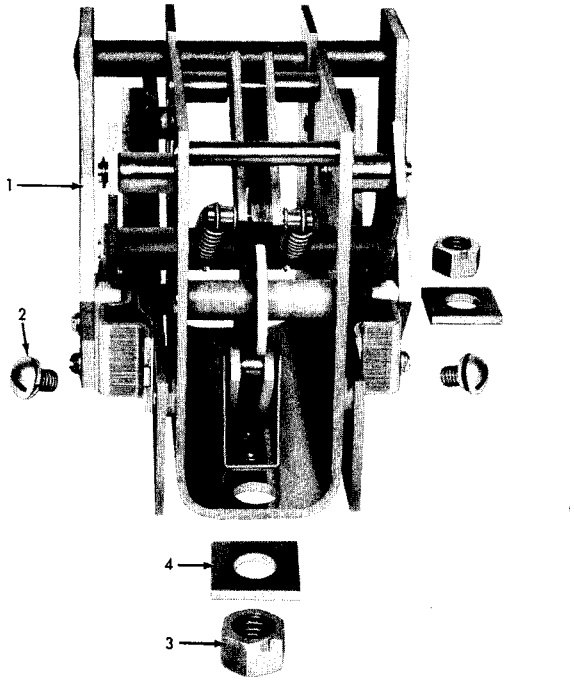

Figure 4. Arc-interrupting structure

Table 4. Parts List Arc-Interrupting Structure

Item No.	Description	Catalog No. (all serial numbers)	No. Used Per Recloser
1	Arc-interrupting structure	KA732H	1
2	Preassembled brz lack washer and rd hd scr 5/16"-18 x 1/2"	KP103	2
3	Lock nut 1/2"	KP284	2
4	Fiber mounting washer	KP282H	2

Solenoid coil

Electrical operation is accomplished by the series-trip solenoid whose coil is connected in series with the line and protected by an air bypass gap. When fault current approaches twice normal line current, the increased magnetic field pulls a plunger down into the coil. As the plunger moves downward, it trips open the recloser contacts.

Type H reclosers are constructed so that solenoid coils of different ampere ratings are interchangeable.

IMPORTANT

Maximum thermal rating of H reclosers is 50 amperes; therefore, do not install coils rated 70- or 100-amperes.

Change coils in the following way:

1. Remove arc-interrupting structure as described in **Arc-interrupting structure** section.
2. Mark bridge plate and solenoid frame with chalk or file to identify the correct orientation of the parts with respect to one another. No dowel pins were used between bridge plate and solenoid frame from serial nos. 169460 thru 178980.
3. Lift off coil shield, bridge, and lower solenoid gasket as shown in Figure 5.

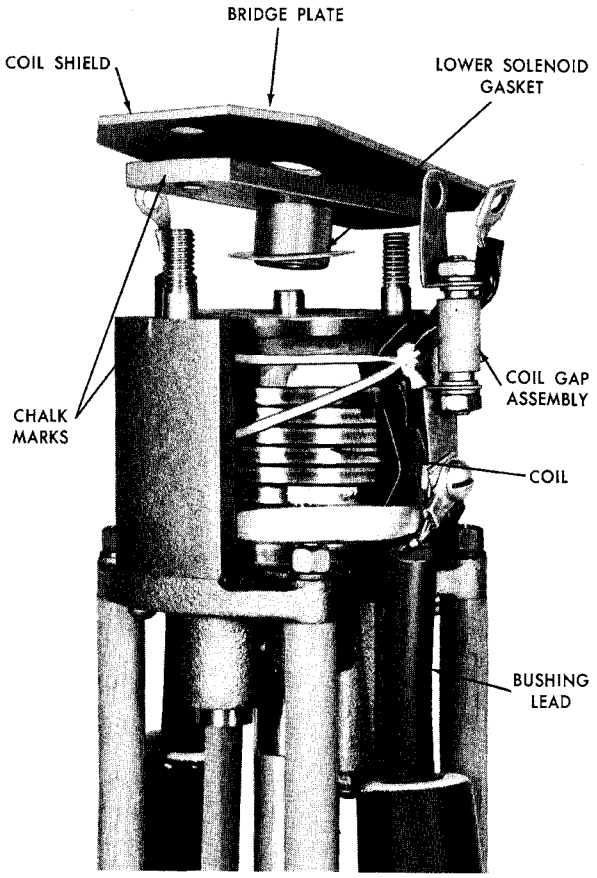

Figure 5. Changing coils

4. Disconnect bushing lead and coil gap assembly identified in Figure 5.
5. Remove solenoid coil.
6. Remove upper solenoid gasket and impact washer as shown in Figure 6. Whenever the coil is removed, upper and lower solenoid gaskets must be replaced to maintain proper timing characteristics.
7. Figure 7 illustrates the manner in which various sizes of solenoid coils are identified. A new coil data plate for mounting on the recloser sleet hood is included with each coil order.

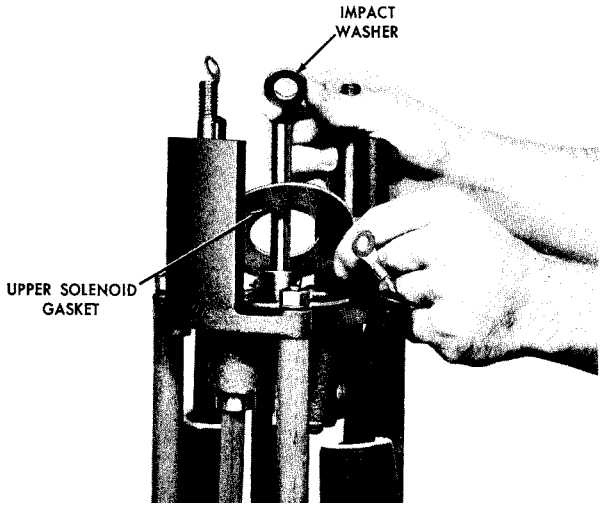

Figure 6. Removing upper solenoid gasket

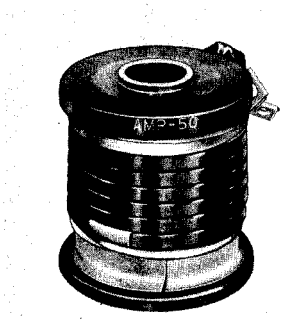

Figure 7. Identifying solenoid coils

8. Replace solenoid coil with one of desired rating by reversing above procedure. Be certain that coil leads are on the same side as manual control lever and that the bridge plate and solenoid frame are properly oriented. If bridge plate was not marked prior to disassembly, mount it first in one position and then the other. Correct orientation will be the position in which the plunger operates the easiest.

If further maintenance is to be performed at this time, do not reinstall solenoid coil.

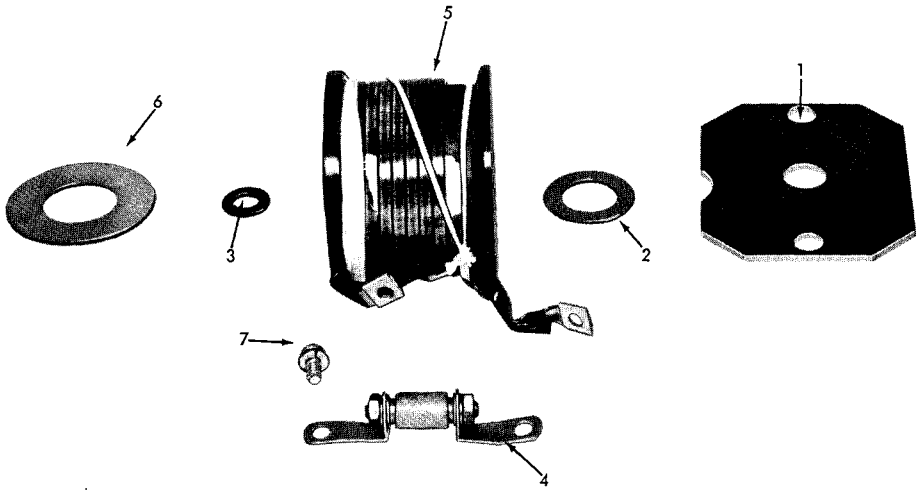

Figure 8. Solenoid coil

Table 5. Parts List Solenoid Coil

Item No.	Description	Catalog No. (all serial numbers)	No. Used Per Recloser
1	Coil shield	KP92H	1
2	Lower solenoid gasket	KPI0JH	1
3	Impact washer	KPJ7H	1
4	Coil gap assem.	KAI00H	1
5	Solenoid coil, specify amperes	KA24H	1
6	Upper solenoid gasket	KP2090A23	1
7	Preassembled brz lock washer and rd hd scr 5/16" - 18 x 1/2"	KPI0J	2

Solenoid frame and hydraulic mechanism

Insulating oil of the recloser is used by the hydraulic mechanism to provide time-controlled tripping and to count operations to lockout. Components function as follows for a normal sequence of two fast and two delayed operations.

First operation – As the plunger is drawn down by the solenoid coil, the lower end trips the contact assembly to open the contacts. At the same time, the plunger displaces oil which raises the slide valve and escapes through a port above the trip piston, Figure 9. Also, the pump piston, connected to the plunger by a lever arrangement, moves downward and forces a charge of oil under the trip piston. Quantity of oil in the charge is regulated by position of pump piston's shell. This charge displaces the trip piston a measured amount and is retained in the trip piston cylinder by a ball check valve.

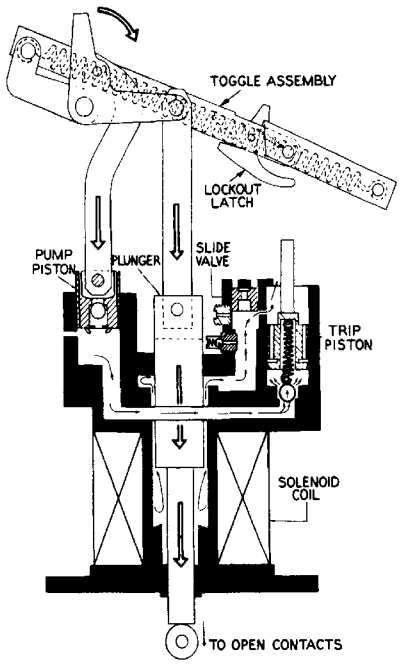

Figure 9. Magnetic force of coil pulls plunger down.

Opening of the contacts breaks the circuit and de-energizes the solenoid coil. Contact operating springs force the plunger back to its normal position. As the plunger moves upward, Figure 10, oil in the slide valve cylinder returns to the plunger cylinder. The slide valve moves down and blocks the escape port to the trip piston cylinder. Thereafter, oil flows slowly through the small port in the slide valve. This slow flow retards the plunger's return to its normal position and causes the closing of the contacts to be delayed about one second.

Second operation – If fault still exists after contacts close, the recloser cycles again. The second operation is similar to the first operation, except trip piston is moved higher in its cylinder where it blocks the escape port from the slide valve cylinder.

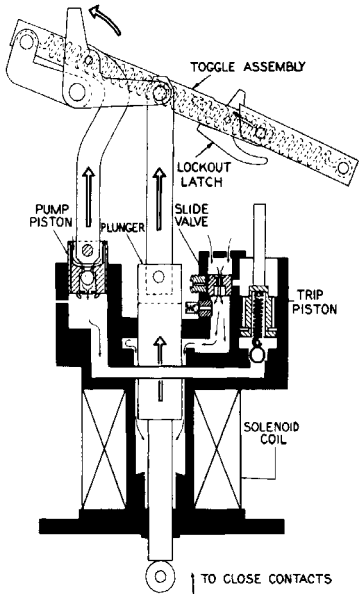

Figure 10. Plunger returns to normal position.

Third operation – During this operation, Figure 11, the plunger's movement down into coil is impeded by oil. Oil displaced by plunger raises slide valve but can no longer flow through escape port because trip piston is covering it. Therefore, the oil must flow around plunger or through timing orifice in slide valve cylinder. If the fault current is high, enough pressure will be developed in the slide valve cylinder to open the spring-loaded control valve. This provides an additional outlet for the oil. Thus, release of oil in the plunger cylinder is governed by (1) leakage, (2) timing orifice size, and (3) the control valve.

As plunger moves downward, the pump piston forces the third charge of oil under trip piston, raising it still higher in its cylinder.

Fourth operation – If fault still persists after first three operations, the recloser opens again. Fourth operation is a delayed operation similar to the third. However, the fourth charge of oil forces trip piston the remaining distance required to strike the lockout latch, Figure 12. This latch releases the toggle assembly and the contacts are held open until recloser is reset manually. During lockout the trip piston, aided by its spring, settles to the bottom of its cylinder and recloser is ready to perform four operations as soon as contacts are closed.

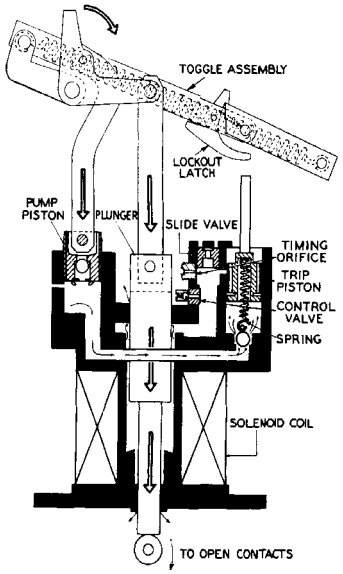

Figure 11. Plunger force pulls plunger down for third operation which is retarded by blocked escape port.

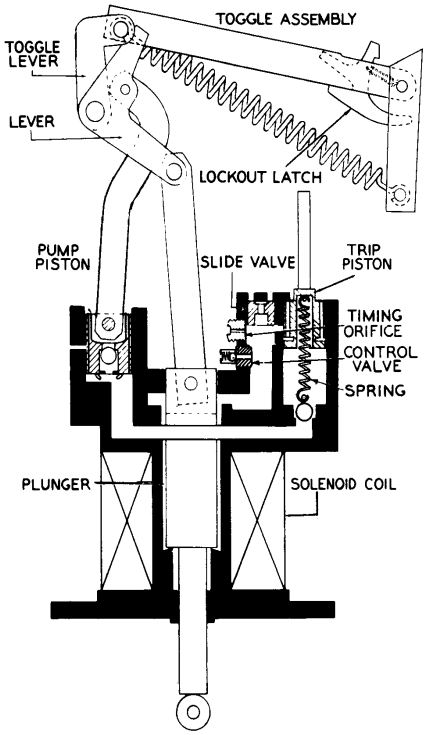

Figure 12. Fourth operation causes lockout as trip piston strikes lockout latch.

If a temporary fault clears before lockout, all mechanical operations cease after the contacts have closed. The trip piston settles to the bottom of its cylinder and recloser is ready to perform four operations when another fault occurs. Settling of the trip, piston enables recloser to "forget" that a temporary fault occurred.

Normally, no maintenance will be required on the pump piston assembly, slide valve, trip piston assembly, or trip piston ball check valve. The following procedure may be used to remove these parts for inspection, replacement, or to change the operating sequence.

1. Remove solenoid coil as described in **Solenoid frame and hydraulic mechanism** section.
2. Remove four hex head nuts and lock washers from support stringers.
3. Lift complete solenoid frame and mechanism off support stringers. However, raise the frame slowly because the plunger and pump piston will be withdrawn from their cylinders. Be careful to keep them from falling and being damaged. Figure 13 illustrates a convenient method of removing the solenoid frame.

Note: One stringer has been removed for clarity.

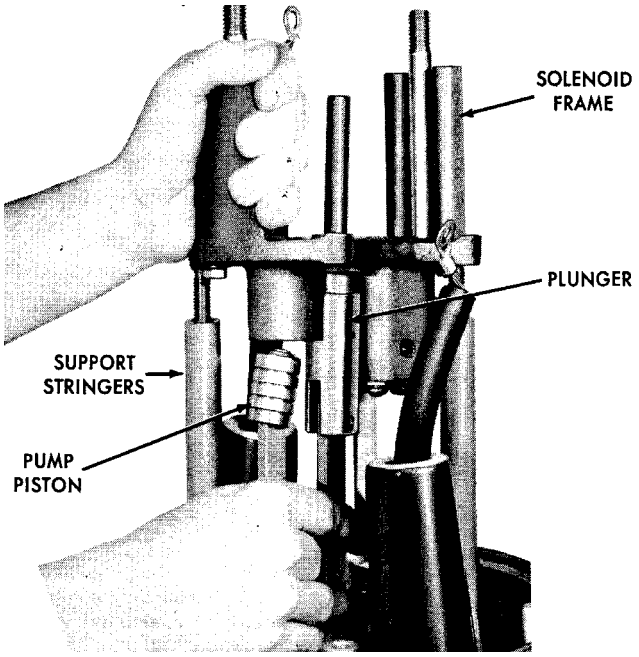

Figure 13. Removing solenoid frame

4. Disassemble slide valve by removing the two screws and lock washers, slide valve stop, and fiber plate as illustrated in Figure 14. Tip up frame and remove slide valve.

Note: Bottom of slide valve is ground to match seat, and top of slide valve has a recess.

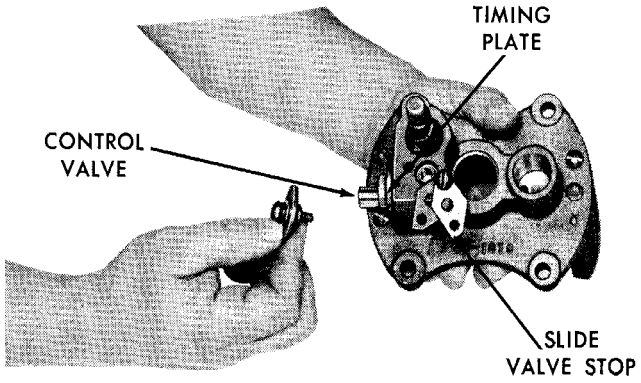

Figure 14. Disassembling the slide valve

5. Unscrew from frame, timing plate secured with capscrew or orifice plug and control valve assembly, identified in Figure 14.
6. To remove the trip piston assembly, pull check valve ball seat out from underside of solenoid frame and unhook the" spring which is part of the trip piston assembly as follows:

   A. Using a wire hook, raise check valve ball seat to expose spring. Insert a thin plate through the spring so spring tension on pin in ball seat will be released. See Figure 15.

   B. Push ball seat pin out to disengage spring. See Figure 16.

Note: Steel ball inside ball seat is free to drop out. Handle carefully to prevent nicking.

   C. Withdraw thin plate from spring and remove trip piston.

7. Clean all parts of the hydraulic mechanism and solenoid frame carefully before reassembly.

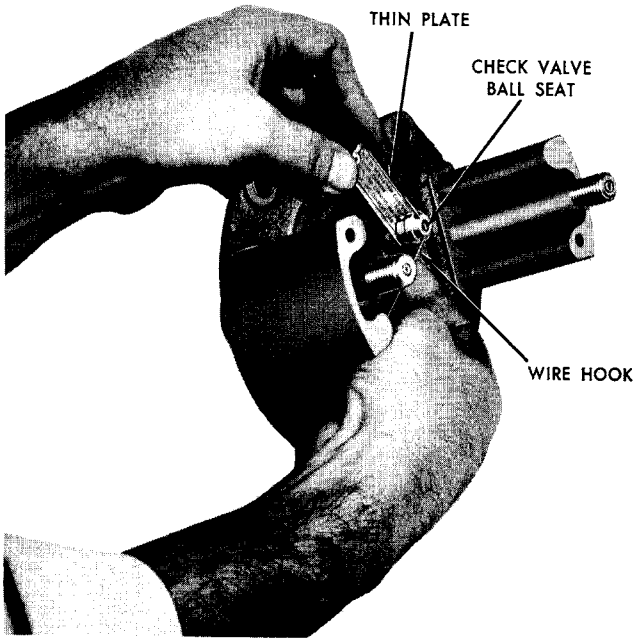

Figure 15. Removing trip piston assembly (a)

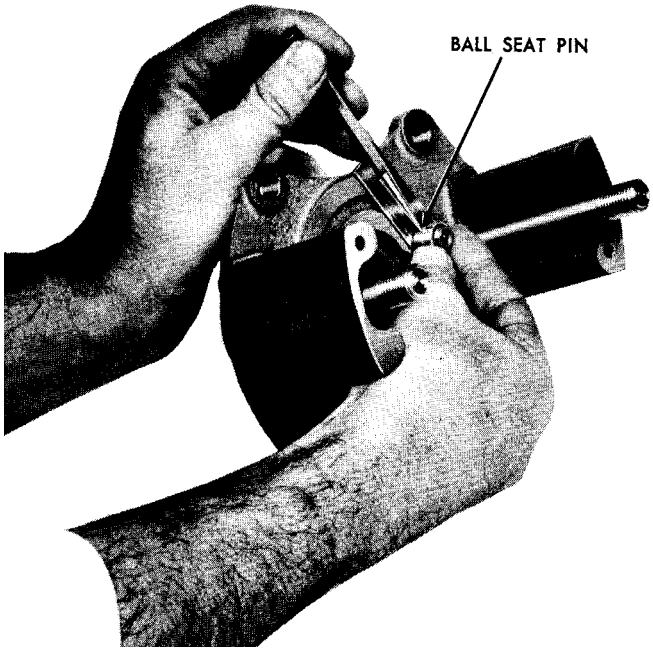

Figure 16. Removing trip piston assembly (b)

Changing operating characteristics

Type H reclosers with serial numbers prior to 169460 require an exchange of parts as listed in Table 6 to obtain desired operating characteristics. Reclosers with subsequent serial numbers can be simply adjusted to provide the characteristics required for desired operation. To make the adjustments on these later reclosers, refer to Figure 17. Provision is made for selection of an A characteristic with no intentional time delay, a retarded B characteristic and an extra retarded C characteristic.

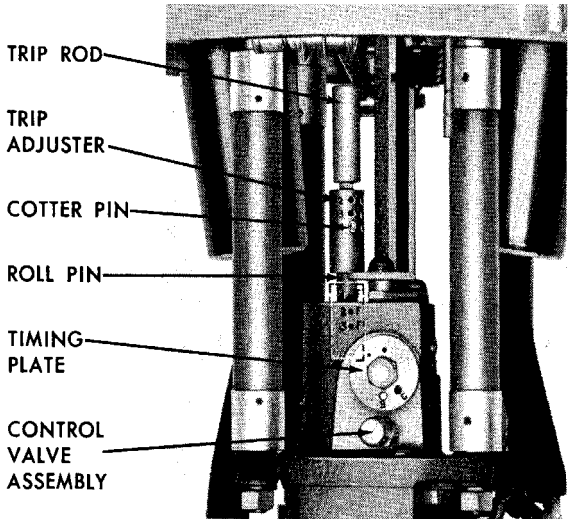

Figure 17. Adjusting the recloser

Choice of the B or C characteristic is made by positioning the timing plate. A timing plate and gasket replacement will permit four operations of the A characteristic. Choice of one operation to lockout is made by pulling down the non-reclosing handle, an accessory located under the sleethood.

Two, three or four operations to lockout are selected by repositioning the cotter pin and trip rod on the trip adjuster.

Selection of the number of fast operations is made by properly locating the roll pin at the bottom of the trip adjuster. The trip adjuster should be backed by a solid metal object when the roll pin is being driven out.

To obtain a sequence of retarded only, or extra-retarded, only characteristics, unscrew timing plate capscrew and replace timing plate in groove-pin to a B or C position. B position provides retarded operations, and C position will give extra-retarded operations. Remove old slide valve and replace with new slide valve that includes a special timing orifice, and add spacer. Change lockout setting to number of retarded operations desired. Whenever all retarded or extra-retarded operations are wanted, the bottom sequence selector should be set for 3F or three fast operations with proper placement of roll pin.

Table 6. Exchange of Hydraulic Mechanism Components for Changing Operating Sequence Below Serial no. 169460

NO. OF OPERATIONS			TRIP PISTON AND ROD ASSEMBLY			SLIDE VALVE	SLIDE VALVE STOP	FIBER PLATE	TIMING ORIFICE	TRIP PISTON LIFT
Fast (Curve A)	Retarded (Curve B)	Extra Retarded (Curve C)	Serial No. H48803 and Below	Serial No. H48804 thru H58254	Serial No. H58255 and Above	All Serial Numbers Below 169460				
4			KA58H	KA89H11	KA89H12	KP41H	KP117H	KP32H	omit	omit
	4		KA58H	KA89H11	KA89H12	KP233H	KP117H	KP32H	omit	omit
		4	KA58H	KA89H11	KA89H12	KP41H	KP117H	KP32H	KP186H	KP162H
2	2		KA58H*	KA89H11	KA89H12	KP41H	KP117H	KP32H	KP186H	omit
2		2	KA58H*	KA89H11	KA89H12	KP41H	KP117H	KP32H	KP228H	omit
1	3		KA183H†	KA184H	KA115H	KP41H	KP264H	KP265H	KP186H	KP254H
1		3	KA183H†	KA184H	KA115H	KP41H	KP264H	KP265H	KP228H	KP254H
1	2		KA58H	KA89H11	KA89H12	KP41H	KP117H	KP32H	KP186H	KP216H
1		2	KA58H	KA89H11	KA89H12	KP41H	KP117H	KP32H	KP228H	KP216H

* If original toggle has been replaced with a KA803H11 toggle, use trip piston and rod assembly KA112H.
† Original toggle must be replaced with a KA803H11 toggle.

Solenoid frame reassembly

1. Insert trip piston in its cylinder.
2. Pull down spring using a wire hook and insert thin plate to hold spring, as shown in Figure 18.
3. Put ball in check valve and pin check valve assembly to spring.
4. Remove thin plate and seat check valve assembly in frame.
5. Insert slide valve, and spring if provided, in its cylinder.
6. Reinstall fiber plate, slide valve stop, and screws and lock washers. When no indexing marks are present, be sure holes in fiber plate and slide valve stop are aligned and centered over slide valve cylinder.

Note: Slide valve stop also serves as trip piston stop.

7. Replace timing orifice plug or timing plate and control valve assembly.
8. Mark data plate with correct information if the operation sequence has been changed.

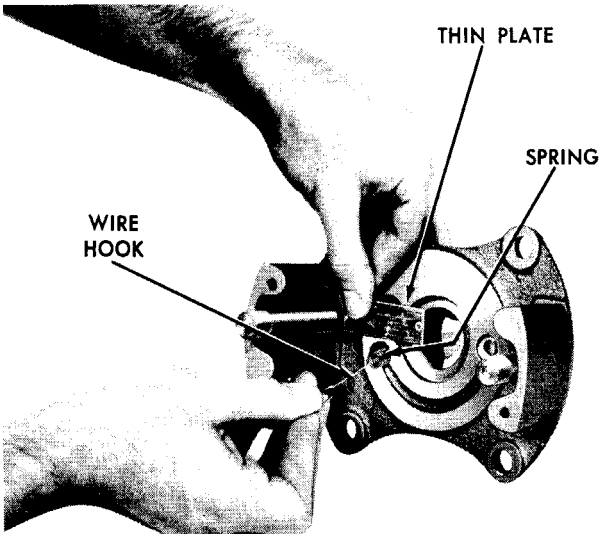

Figure 18. Reassembling the solenoid frame

Test check valve in base of pump piston. Hold piston upside down and fill it with de-greasing fluid or transformer oil. If the valve does not hold, clean it thoroughly in de-greasing fluid and repeat test. If the valve still does not hold, replace the entire pump piston assembly as follows:

1. Unscrew pump piston shell far enough to expose steel pin.
2. Push out steel pin as shown in Figure 19.
3. Remove piston from link assembly.
4. Install new piston by reversing above procedure.

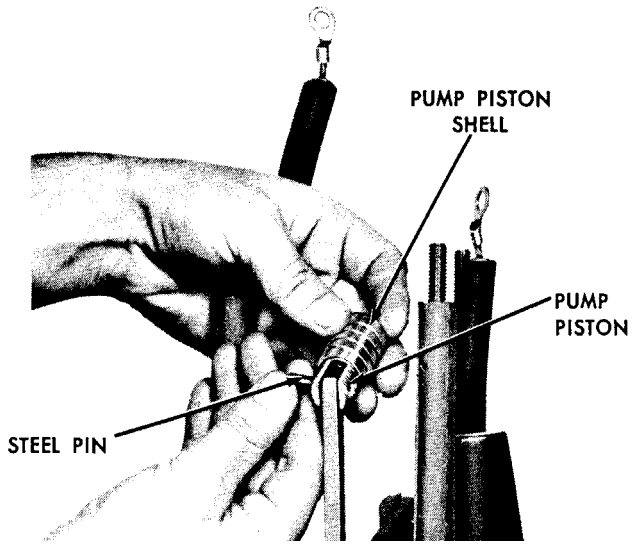

Figure 19. Pushing out steel pin

5. Position pump piston shell as described below.

If further maintenance is to be performed at this time, do not reinstall the solenoid frame mechanism.

After replacing pump piston or performing a change of sequence, adjustment of pump piston shell may be necessary to provide the correct number of operations to lockout. Turning pump piston shell clockwise increases effective length of piston. This causes the port, Figure 20, to be covered earlier in the downward stroke. The quantity of oil escaping through this port is reduced; therefore, the amount of oil pumped to trip piston is increased. Turning pump piston shell counterclockwise causes the port to remain open during a greater part of stroke. More oil escapes through the port and less oil is pumped under the trip piston.

Proper position of pump piston shell is determined as follows:

1. Attach solenoid frame to support stringers. Make sure the plunger and pump pistons are inserted in their respective cylinders.
2. Install solenoid coil assembly as described in **Solenoid frame and hydraulic mechanism** section.
3. Lower the mechanism into oil until pump and trip pistons are completely covered.

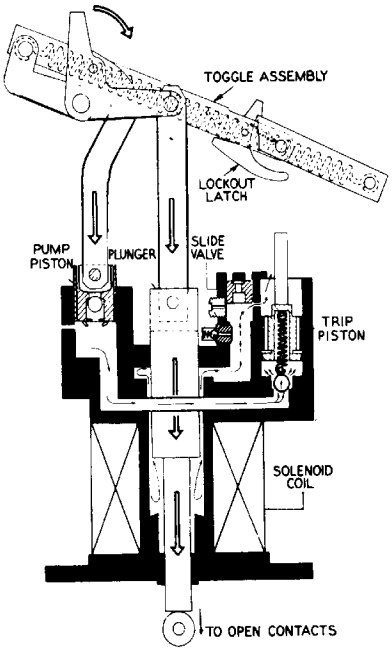

Figure 20. Positioning pump piston.

4. Operate recloser manually. Close and trip mechanism by means of the manual operating lever a few times to remove any entrapped air in the hydraulic system. Return operating handle to CLOSED position. Allow trip piston to fully reset.
5. Manually open and close recloser three times if it is set for four operations to lockout. Observe trip rod. End of the trip rod should just touch lockout latch.
6. If trip rod is not in proper position, remove solenoid frame from stringers. Unscrew pump piston shell from pump piston and smooth out punched indentation. This procedure is necessary to allow finger-trip positioning of the shell. Replace the shell on piston and repeat steps 1 through 5.
7. Turn pump piston shell clockwise to increase travel of trip rod. To decrease trip rod travel, turn pump piston shell counterclockwise. See Figure 21. Adjust in one-half turn increments and repeat step 5.
8. When adjustment is completed, set pump piston shell with a small punch.

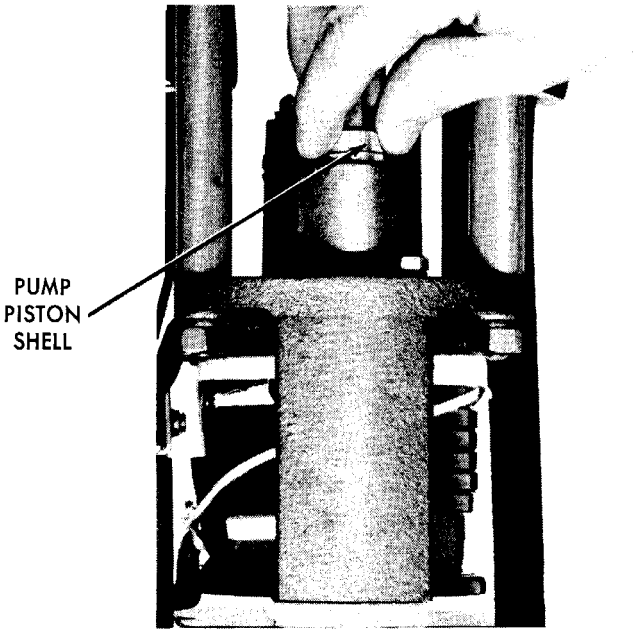

Figure 21. Increasing travel of trip rod

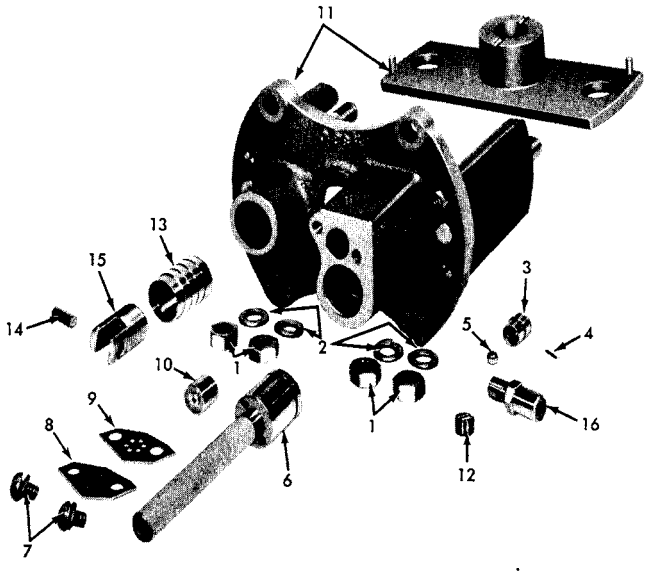

Figure 22A. Parts view for serial numbers up to 169459.

Table 7. Parts List Solenoid Frame and Hydraulic Mechanism Serial Numbers up to 169459

Item No.	Description	Catalog No.		No. Used per Recloser
1	Semi-finished stl hex nut 3/8"-16UNC2	KP276		4
2	Stl Kantlink lock washer 3/8" x .141" x .094"	KP556		4
3	Check valve ball seat	KP155H		1
4	Check valve ball seat pin	KP3051A1		1
5	Stl ball grade No.3-1/4"dia	KP362		1
6	Trip piston and rod assy	KA58H	See Table 6	1
		KA112H		
		KA183H		
		KA89H11		
		KA184H		
		KA89H12		
		KA115H		
7	Preassembled stl lock washer and mach scr 1/4" - 20UNC2 x 3/8"	KP108		2
8	Slide valve stop (top plate)	KP117H	See Table 6	1
		KP264H		
9	Fiber plate	KP32H	See Table 6	1
		KP265H		
10	Slide valve	KP41H	See Table 6	1
		KP233H		
11	Solenoid frame assy and bridge plate	KA723H11*		1
		KA723H12†		
		KA723H13‡		
		KA723H14§		
12	Timing orifice plug	KP186H	See Table 6	1
		KP228H		
13	Pump piston shell	KP151H		1
14	Stl straight pin	KP3055A1		
15	Pump piston assy	KA725H		
16	Control valve assy	KA155H*		
17	Trip piston lift (not shown)	KP162H	See Table 6	1
		KP216H		

* For reclosers serial number 48803 and below equipped with original toggle and trip lever assembly.
† For reclosers serial number 48003 and below equipped with replacement toggle and trip lever assembly KA803H11, item 8, page 19.
‡ For reclosers serial number 48004 through 58254 (equipped with original toggle and trip lever assembly.
§ For reclosers serial number 48004 through 58255 equipped with replacement toggle and trip lever assembly KA803H12, item 8, page 19 and all reclosers serial number 58255 and above.
# For reclosers serial number 100975 and above only.

Table 8. Parts List Solenoid Frame and Hydraulic Mechanism for Serial Numbers 169460 and Above

Item No.	Description	Catalog No.	No. Used Per Recloser
1	Solenoid frame subassembly	KA206H	1
2	Trip piston assembly	KA17H4	1
3a	Slide valve, fast, fast and retarded operation	KA16H4	1
3b	Slide valve, retarded, extra-retarded only	KA49H	1
4	Control valve assembly	KA211H	1
5	Washer	KP108H4	1
6	Spacer	KP3009A9	1
7	Stop, slide valve	KP110H4	1
8	Gasket	KP111H4	1
9	Spring	KP177H4	1
10	Gasket, interchangeable with item 12	KP113H4	1
11	Plate, timing, interchangeable with item 13	KP112H4-1	1
12	Gasket, for all fast operations only	KP202H4	1
13	Plate, timing, for all fast operations only	KP201H4	1
14	Stop, slide valve, use only with item 3b	KP3010A8	1
15	Pin	KP3051A1	1
16	Ball seat	KP155H	1
17	Trip rod	KP434H	1
18	Adjuster, trip	KP105H4	1
19	5/16-18 UNC x 1/2 lg stl P.A. lockwasher and hex hd capscrew (Parkerized)	KP2001A3	1
20	Std groov-pin	KP2001A3	1
21	1/4-20 NC-2 x 3/4 lg rd hd mach screw, stl.		1
22	1/4-20 NC-2 x 1/2 lg rd hd mach screw, stl		1
23	1/4 med lockwasher, steel		2
24	1/16 x 7/8 lg cotter pin, stl		1
25	1/16 x 3/8 lg roll pin		1
26	Ball, stainless steel	KP2025A2	1

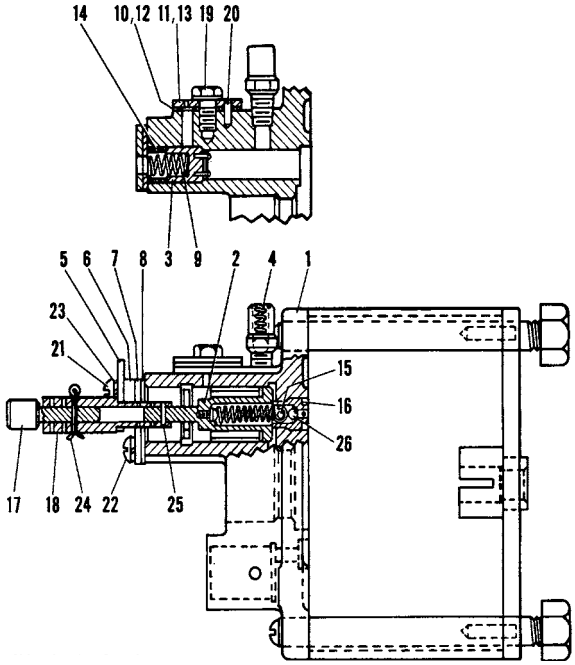

Figure 22B. Parts view for serial numbers 169460 and above.

Insulating support stringers

Replace defective members as follows:

1. Remove solenoid frame assembly as described in **Solenoid frame and hydraulic mechanism** section.
2. Use a cloth wrapping as shown in Figure 23 to protect stringers from being marred, and loosen them with pliers.

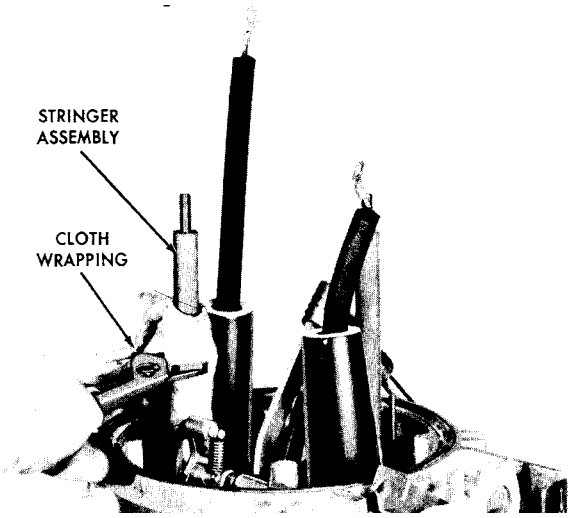

Figure 23. Insulating support stringers

3. Unscrew from head casting.

4. Replace in reverse order.

If further maintenance is to be performed at this time, do not reinstall insulating stringers.

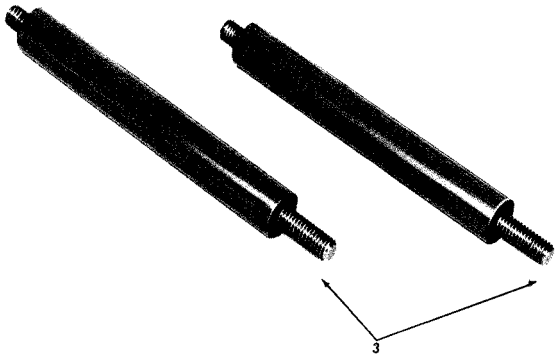

Figure 24. Insulating support stringer replacement kits.

Table 9. Parts List Insulating Support Stringer Replacement kits

		Catalog No.			
Item No.	Description	Serial No. 48803 and Below	Serial No. 48004 Thru 100973	Serial No. 100974 and Above	No. of Kits* Per Recloser
1 (not shown)	Short stringer assembly	KA17H11	KA17H12		1
2 (not shown)	Long stringer assembly	KA22H11	KA22H12		1
3	Stringer assembly			KA17H12	2

* Each kit contains two insulating support stringers.

Bushing replacement

Maintenance of bushings is generally limited to an occasional cleaning. However, if a bushing should become cracked or broken, replace as follows:

1. Untank recloser and disconnect lead if not previously done.

   A. Disconnect long lead (on side opposite manual control lever) from arc-interrupting structure as described in **Arc-interrupting structure** section**.**

   B. Disconnect short lead (on same side as manual control lever) from solenoid coil as described in **Solenoid coil** section.

2. Remove bushing assembly, consisting of bushing, lead, and terminal, from head.

   A. Serial No. 100974 and higher. Remove three hex-head cap screws and bushing clamps.

   B. Serial No. 100973 and lower. Remove three hex-head cap screws that secure bushing flange to head. If recloser is equipped with a lifting strap, loosen cap screw that secures strap to second bushing.

3. Lift bushing assembly up through head casting.

4. Bushing assembly can be completely replaced, or a new bushing only may be installed. If new bushing is to be installed, unscrew bushing terminal and draw lead out lower end of bushing. Insert lead in new bushing and draw up until locking key is seated. Replace bushing terminal, using a new gasket between terminal and bushing. Twist clamping ring to remove it from old bushing and install on new bushing. This ring cushions the pressure between bushing and bushing clamps and should not be omitted.

4A. Bushings may be replaced without untanking recloser. Unscrew bushing terminal and remove terminal gasket. Disconnect bushing from the head as described in step 2 above. Lift bushing up through head casting. Install new bushing by reversing this procedure. Replace both terminal gasket and lower bushing gasket. When new bushing is slid down over lead, the lead may drop down to a point where the threads do not protrude above bushing. This can be prevented by tying a string onto the lead and threading string through bushing. After bushing is positioned, use string to pull up lead until locking key is seated.

5. Replace bushing assembly, using a new gasket between bushing and head casting. When securing bushing clamps, tighten the three bolts evenly, a little at a time. Torque should not exceed 10 foot-pounds.

If further maintenance is to be performed at this time, do not reinstall bushing assemblies.

Leaded-flange bushings are no longer manufactured. When replacement of a leaded-flange bushing is necessary, order a clamp-type bushing kit, shown in Figure 25.

Note: Clamp-type bushings have the same over-all height as leaded-flange bushings; therefore, old leads and terminals can be re-used.

If new leads and terminals are desired when replacing leaded-flange bushings, order clamp-type bushing assembly kits, shown in Figure 26.

When one bushing is to be changed, improved appearance of recloser will result if both bushings are replaced. The leaded-flange bushing that is still serviceable can be saved for future installation on a similar recloser.

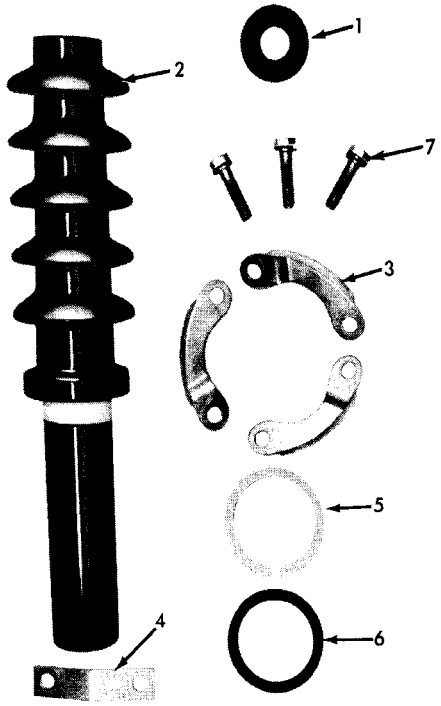

Figure 25. Bushing replacement kit

Table 10. Parts List Bushing Replacement Kit

Item No.	Description	Catalog No. Serial No. 100973 and Below	Quantity Per Kit
	Complete replacement kit, includes items 1 through 7	KA749H	
1	Upper terminal gasket	KP440H	1
2	Bushing	KP419H	1
3	Bushing clamp	KP420H	3
4	Lift strap	KP421H	1
5	Bushing clamping ring	KP425H	1
6	Lower gasket	KP426H	1
7	Sstl hex hd mach bolt 5/16"-18UNC2 x 1-3/8"	KP416	3

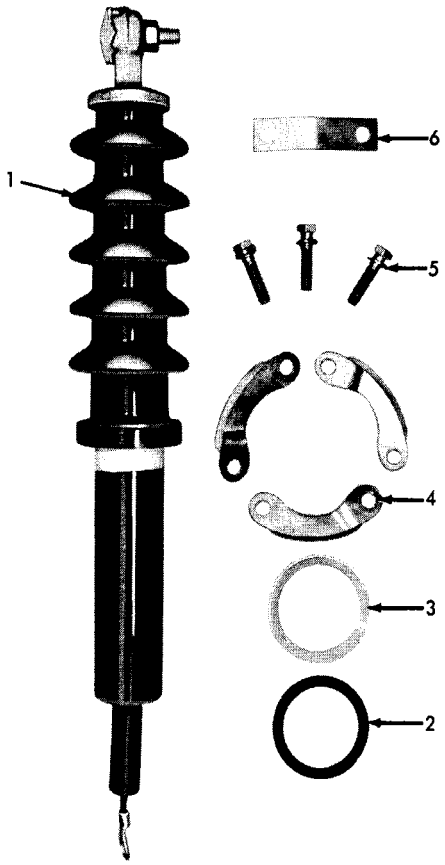

Figure 26. Bushing assembly replacement kit

Table 11. Parts List Bushing Assembly Replacement Kit

Item No.	Description	Catalog No. Serial No. 48803 and Below	Catalog No. Serial No. 48044 Thru 100973	Quantity Per Kit
	Complete short lead replacement kit, includes items 1 through 6	KA753H11	KA753H12	
	Complete long lead replacement kit, includes items 1 through 6	KA754H11	KA754H12	
1	Bushing assembly Short lead Long lead	 KA234H11 KA234H12	 KA234H13 KA234H14	1
2	Lower gasket	KP426H	KP426H	1
3	Bushing clamping ring	KP425H	KP425H	1
4	Bushing clamp	KP420H	KP420H	3
5	Sstl hex hd mach bolt 5/16"-18UNC2 x 1-3/8"	KP416	KP416	3
6	Lift strap	KP421H	KP421H	1

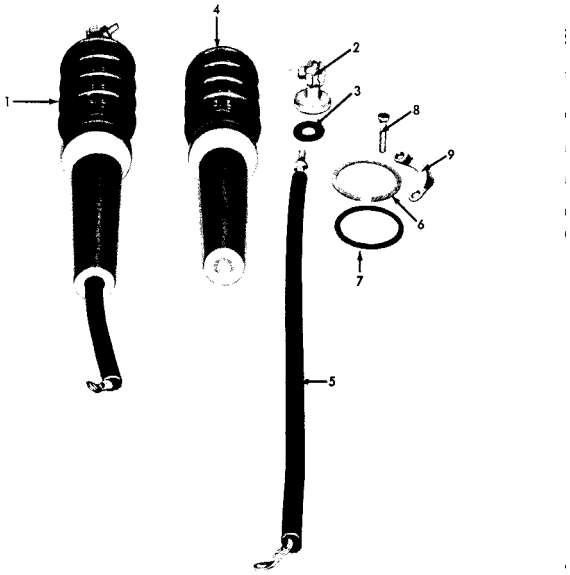

Figure 27. Bushings.

Table 12. Parts List Bushings

Item No.	Description	Catalog No. Serial No. 48803 and Below	Catalog No. Serial No. 48004 Thru 100973	Catalog No. Serial No. 100974 and Above	No. Used Per Recloser
1	Bushing assembly Short lead Long lead	 KA753H KA754H	 KA753H1 KA754H1	 KA107H KA108H	 1 1
2	Bushing terminal assembly	KA82H	KA82H	KA82H	2
3	Upper terminal gasket	KP440H	KP440H	KP440H	2
4	Bushing	KP419H	KP419H	KP328H	2
5	Lead assembly Short Long	 KA5H11 KA6H11	 KA5H12 KA6H12	 KA109H KA110H	 1 1
6	Bushing clamping ring	KP425H	KP425H	KP335H	2
7	Lower gasket	KP426H KP3H*	KP426H KP3H*	KP335H	2
8	Sstl hex hd mach bolt 5/16"-18UNC2 x 1-3/8"	KP416	KP416		6
	Sstl cap scr 5/16"-18UNC2 x 3/4"	KP175*	KP175*		6
	Sstl hex hd mach bolt 3/8"-16UNC2 x 1-5/8"			KP414	6
9	Bushing clamp	KP420H	KP420H	KP41L	6
10	Lift strap	KP421H KP109H*	KP421H KP109H*		1 1

*Required for original leaded-flange bushings.

Head assembly

Normally, no maintenance will be required on the head assembly. If the head mechanism is to be disassembled, the following procedure may be used:

1. Remove insulating stringers as described in **Insulating support stringers** section.
2. Remove bushing assemblies as described in **Bushing replacement** section.
3. Remove plunger and link assembly, and reset lever by withdrawing manual control lever shaft:

   A. Make sure manual control lever is in a CLOSED position.

Note: If furnished, non-reclosing lever should be in up position.

   B. Remove cover plate by unscrewing two round-head self-tapping screws. See Figure 28.

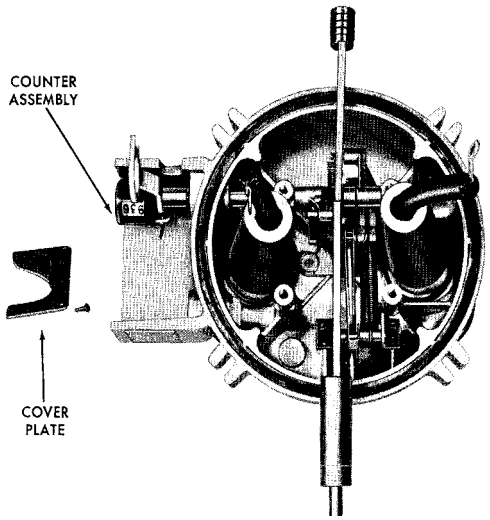

Figure 28. Removing cover plate.

   C. Remove counter assembly by unscrewing two round-head mounting screws.

   D. Insert short pencil under lockout latch, as shown in Figure 29. *This precaution is necessary to insure against accidental tripping of the mechanism.*

   E. Unhook manual control lever spring shown in Figure 29.

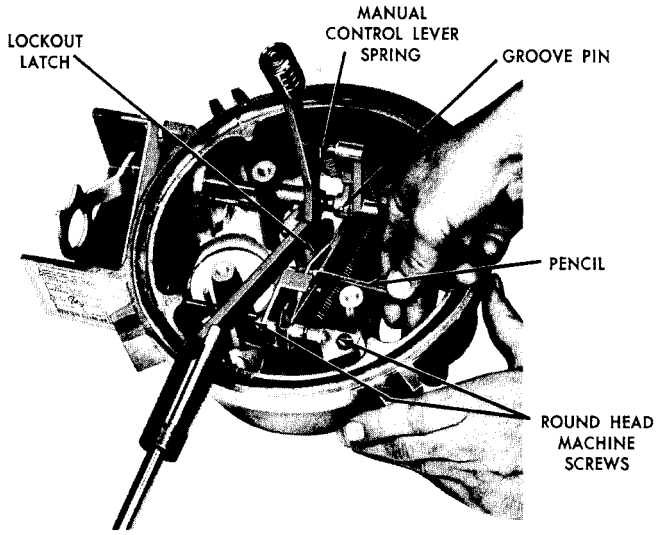

Figure 29. Unhooking manual control lever spring

F. Using a drift punch, drive out groove pin. See Figure 30.

Note: All groove pins are tapered and must be driven out from small end.

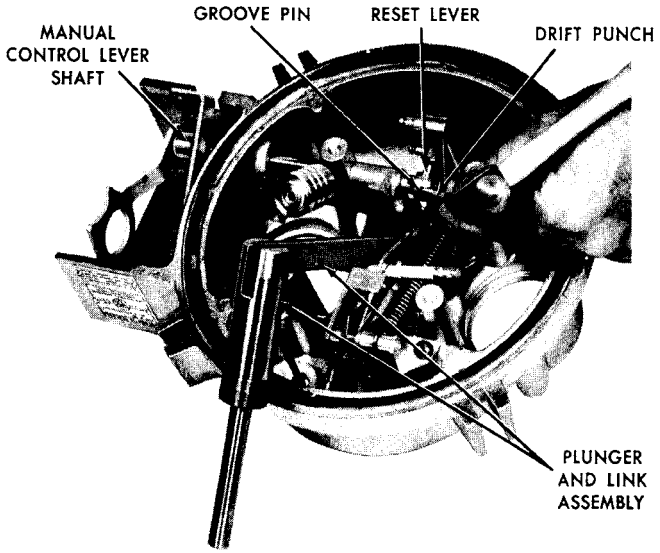

Figure 30. Driving out groove pin

G. Withdraw manual control lever shaft and remove plunger and link assembly, and reset lever.

Note: If required, counter shaft can now be removed. Drive out groove pin with a drift punch and withdraw shaft.

4. Remove toggle and trip lever assembly by unscrewing the two round-head machine screws (refer to Figure 29).

Note: If furnished, unhook the non-reclosing lever spring shown in Figure 31.

Clean and inspect all parts. Replace defective parts and reassemble head mechanism:

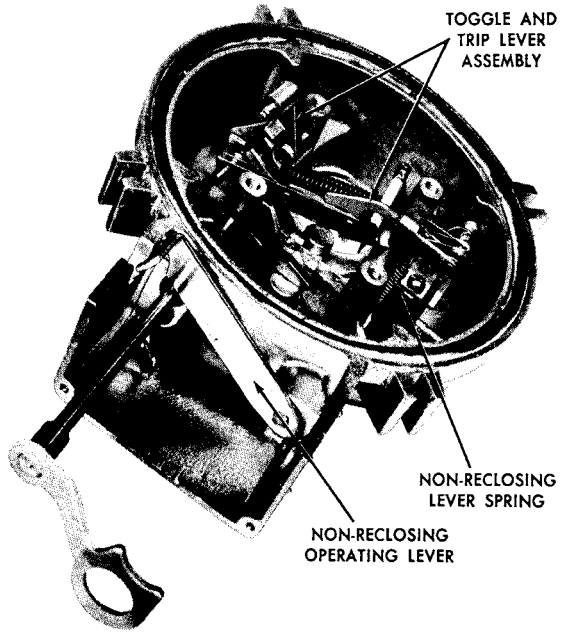

Figure 31. Unhooking non-reclosing lever spring

1. Replace toggle and trip lever assembly and secure with the two round-head machine screws.

Note:

A. If furnished, reinstall the non-reclosing lever spring.

B. Where applicable, replace counter shaft. Drive groove pin through shaft and counter lever, with counter lever positioned so bend is away from sleet hood.

2. Position the reset lever as shown in Figure 32.
3. Position the plunger and link assembly as shown in Figure 32.

Note: Trip arm of link assembly is pointed straight down.

4. Insert manual control lever shaft. Make sure shaft goes through the plunger and link assembly, reset lever, and toggle and trip lever assembly.
5. Install manual control lever spring.
6. Drive in groove pin.

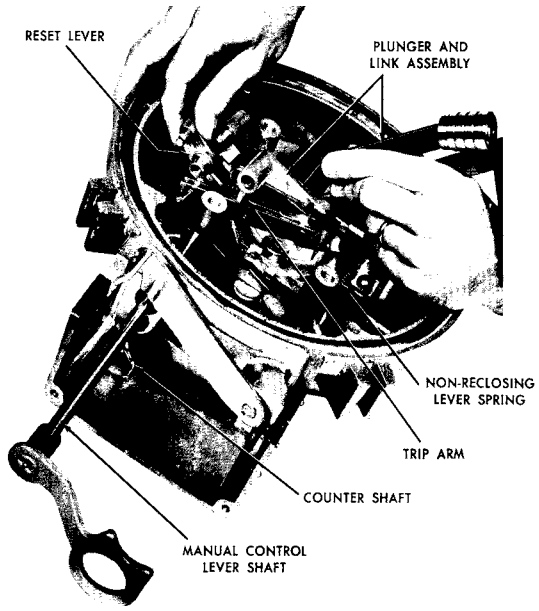

Figure 32. Head assembly

7. Install counter assembly by replacing two round-head mounting screws.

Note: Counter arm goes under counter shaft lever.

8. Replace cover plate using two self-tapping screws.
9. Remove short pencil from under lockout latch.

Each circuit interruption is recorded by the automatic counter. When the counter shaft fails to raise the counter arm enough to register an operation, adjust as follows:

1. Remove counter assembly as described under step 3c, in **Head assembly** section.
2. Loosen screw holding counter arm in place.
3. Move counter arm downward.
4. Securely tighten screw.
5. Install counter assembly as described under step 7, **Head assembly** section.
6. Check to see that counter is functioning properly by manually operating recloser.

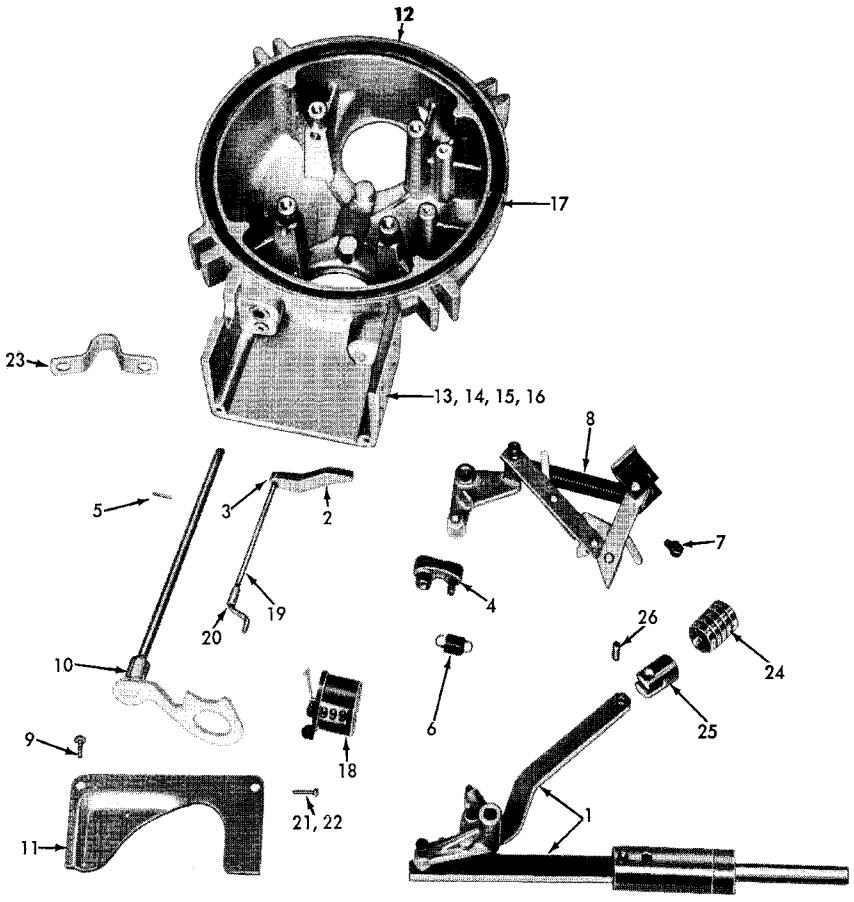

Figure 33. Head assembly parts

Table 13. Parts List Head Assembly

Item No.	Description	Catalog No. Serial No. 48803 and Below	Catalog No. Serial No. 48004 Thru 100973	Catalog No. Serial No. 100974 and Above	No. Used Per Recloser
1	Plunger and link assembly	KA63H11	KA63H12	KA63H12	1
2	Counter lever	KP18H	KP18H	KA186H*	1
3	Type 1 sstl groove pin 3/32" x 1/2"	KP126	KP126	KP126	1
4	Reset lever	KA11H	KA11H	KA11H	1
5	Type 1 sstl groove pin 1/8" x 5/8"	KP125	KP125	KP125	1
6	Manual control lever spring	KP27H	KP27H	KP27H	1
7	Stl rd hd mach scr 1/4"-20NC2 x 1/2"	KP104	KP104	KP104	2
8	Toggle and trip lever assembly Accommodates non-reclosing accessory Does not accommodate non-reclosing accessory	 KA803H11	 KA803H12† KA803H13‡	KA119H KA803H13	1
9	Sstl self-tapping rd hd scr No. 12 x 1/2"	KP52	KP52	KP52	2
10	Manual control lever and shaft assembly	KA10H	KA10H	KA121H	1
11	Cover plate	KP25H	KP25H	KP308H	1
12	Head gasket	KP22H	KP22H	KP342H	1
13	Coil data plate (state amp size)	KP23H	KP23H	KP23H	1
14	Nameplate	KP24H	KP24H	KP24H	1
15 (not shown)	Operating data plate Operating sequence–blank Operating sequence 2A2B	 KP164H11 KP164H12	 KP164H11 KP164H12	 KP164H11 KP164H12	
16	Sstl self-tapping rd hd scr No. 2 x 1/4"	KP69	KP69	KP69	6
17	Head casting	KA79H	KA79H	KA708H KA700H4#	1

Table 13. Parts List Head Assembly

Item No.	Description	Catalog No. Serial No. 48803 and Below	Catalog No. Serial No. 48004 Thru 100973	Catalog No. Serial No. 100974 and Above	No. Used Per Recloser
18	Counter and bracket assembly	KA704H	KA704H	KA701H	1
19	Counter shaft	KA15H	KA15H	KA186H*	1
20	Spacer			KP376H	1
21	Cad plated stl rd hd mach scr No. 6-32NC2 x 1/2"			KP471	1
22	Cad plated stl lock washer No. 6 x .047" x .031" Plug and gage assembly Plug and gage assembly O-ring gasket Preassembled electro zn plated stl lifting eye and Palnut 3/8"-16UNC2			KP332 KP106H√ KP902√ KP322H√	2 1 1 1
23	Lifting strap			KP439H	1
24	Piston shell	KP151H	KP151H	KP151H	1
25	Piston assem	KA725H	KA725H	KA725H	1
26	Pin, piston	KP3055A1	KP3055A1	KP3055A1	1

* Counter lever and counter shaft sold as complete assembly.
† For reclosers serial number 48004 through 57255.
‡ For reclosers serial number 58256 and above.
# For reclosers serial number. 142625 and above .
√ For reclosers serial number 100974 through 170842.

Tank and liner

Tank and liner should be replaced under conditions described on page 4.

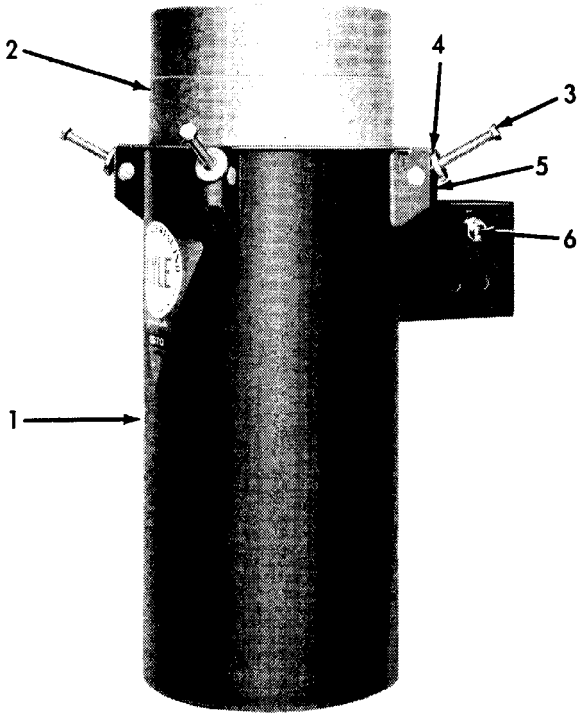

Figure 34. Tank and liner

Table 14. Parts List Tank and Liner

Item No.	Description	Catalog No.		No. Used Per Recloser
		Serial No. 100973 and Below	Serial No. 100974 and Above	
1	Tank assem	KA37H	KA172H	1
2	Tank wall liner	KA748H	KA741H	2
3	Electro zn plated st hex hd cap scrs 3/8"-16UNC2 x 3"		KP176	4
4	Washer		KP375H	4
5	Combination nut and pin		KP3061A3	4
6	Ground connector	DK1B2	DK1B2	1

Suggested list of spare parts

Eaton suggests the following parts be kept on hand to expedite any routine maintenance program.

1. Bushing assembly
2. Lower bushing gasket
3. Bushing terminal gasket
4. Contact assembly
5. Upper solenoid gasket
6. Lower solenoid gasket
7. Impact washer
8. Tank liners

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