

**Instructions for Porceline  
Metal Clad Switchgear  
Type DH-P  
Circuit Breakers**



**Westinghouse Electric Corporation**

Assembled Switchgear & Devices, East Pittsburgh, Pa.  
I.B. 32-253-1 Effective May, 1964

## Table of Contents

Description	Page
Introduction . . . . .	6
General Description . . . . .	7
Receiving, Handling . . . . .	7
Storing . . . . .	8
Basic Operating Instructions . . . . .	8
To Lift Breaker . . . . .	8
To Install Arc Chutes, 4.16 KV Breakers . . . . .	8
To Install 13.8 KV Arc Chutes . . . . .	8
To Install Main Barrier . . . . .	8
To Roll Breaker Around Corners . . . . .	9
To Place Breaker in First Position in Cell . . . . .	9
To Place Breaker in Fully Energized Position . . . . .	9
To Withdraw Breaker from Energized Position to Test Position . . . . .	9
To Withdraw Breaker from Cell . . . . .	10
To Engage Secondary Contacts with Breaker in Test Position . . . . .	10
To Disengage . . . . .	10
Operation of Stored Energy Mechanism . . . . .	10
To Charge Closing Spring by Hand . . . . .	10
To Spring Close Breaker without Electric Power . . . . .	10
To Open Breaker by Hand . . . . .	11
To Close Breaker by Hand with Maintenance Closing Handle . . . . .	11
To Open Breaker Contacts Slowly . . . . .	11
How the Breaker Works . . . . .	11
Operating Mechanism, Stored Energy Type . . . . .	11
Anti-Close Interlock . . . . .	12
Operating Mechanism, D.C. Solenoid Type . . . . .	13
Chassis . . . . .	13
Levering Device and Breaker Interlock . . . . .	13
Floor Interlock and Operating Levers . . . . .	14
Automatic Floor Tripping and Closing Spring Release . . . . .	43
Secondary Contacts . . . . .	43
Rail Latch . . . . .	43
Puffer . . . . .	44
Mechanism Panel . . . . .	44
Closing Spring Hand Charge Device for Stored Energy Mechanism . . . . .	44
Maintenance Closing and Opening . . . . .	44
Pole Units . . . . .	45
Contacts . . . . .	45
Arc Chutes . . . . .	45

## Table of Contents - Continued

Description	Page
Maintenance Guide - Inspection, Adjustments and General Maintenance . . . . .	46
Contacts Settings . . . . .	47
Contact Replacement . . . . .	48
Stored Energy Mechanism . . . . .	48
Solenoid Mechanism, Inspection and Adjustment . . . . .	49
Mechanical Timing . . . . .	50
Arc Chute Inspection and Maintenance . . . . .	50
Broken or Cracked Ceramic Parts . . . . .	51
Erosion of Ceramics . . . . .	51
Dirt in Arc Chute . . . . .	51
Cleaning Arc Shields . . . . .	51
Lubrication . . . . .	51
At the 2000 Operation Maintenance Period . . . . .	52
4.16 KV and 13.8 KV Solenoid Mechanism . . . . .	52
Roller Bearings on all Mechanisms . . . . .	52
Stored Energy Mechanism . . . . .	52
Removing and Installing Spring Charge Motor . . . . .	52
Removal of Closing Spring . . . . .	53
Parts Identification . . . . .	53
Renewal Parts . . . . .	53, 54
Chassis Parts . . . . .	55
Stored Energy Mechanism - All Ratings . . . . .	55
Solenoid Mechanism . . . . .	55
Rating Table and Weights . . . . .	56

## List of Illustrations

Figure	Page
1a., 1b. General Arrangement of Type 50-DH-P75 Circuit Breaker . . . . .	15
2a. Installing Arc Chute of Type 50-DH-P75 Breaker . . . . .	16
2b. Installing Arc Chute of Type 150-DH-P500 Breaker . . . . .	17
2c. Arc Chute of Type 50-DH-P250 in Place on Breaker . . . . .	18
3. Releasing Rail Latch . . . . .	19
4a., 4b. Operation of Secondary Contacts with Breaker in Test Position . . . . .	19

## List of Illustrations - Continued

Figure	Page	
5a.	Charging Closing Spring by Hand, 4.16 KV Breaker . . . . .	19
5b.	Spring Closing Breaker by Hand Release, 4.16 KV Breaker . . . . .	20
6.	Bottom View of Stored Energy Mechanism in 4.16 KV Breaker . . . . .	21
7a., 7b.	Schematic Views of Stored Energy Mechanism Spring Charging Parts . . . . .	22
8a., b., c., d.	The Four of the Closing Cam and Tripping Linkage . . . . .	23
	(a) Breaker Open and Spring Not Charged . . . . .	23
	(b) Breaker Open and Spring Charged . . . . .	23
	(c) Breaker Closed and Spring Not Charged . . . . .	23
	(d) Breaker Closed and Spring Charged . . . . .	23
9a., b.	Bottom View of a 4.16 KV Breaker with Solenoid Mechanism . . . . .	24
10a., b., c.	Schematic Drawings Showing Positions of Solenoid Mechanism Linkage . . . . .	25
	(a) Closed and Latched . . . . .	25
	(b) Tripped Free . . . . .	25
	(c) Open and Reset, Ready to Close . . . . .	25
11a., b.	4.16 KV Breaker Chassis with Stored Energy Mechanism . . . . .	26, 27
12.	4.16 KV Breaker Chassis with Solenoid Mechanism . . . . .	27
13a., b.	Schematic Drawings of Levering Device . . . . .	28
	(a) Breaker in Withdrawn or Test Position . . . . .	28
	(b) Breaker in Fully Engaged or Energized Position . . . . .	28
14.	Rear View of 4.16 KV Breaker . . . . .	29
15.	Pole Units and Details for 1200 and 2000 Ampere, 4.16 KV Breakers . . . . .	30
16.	Pole Units and Details for 1200 and 2000 Ampere, 13.8 KV Breakers . . . . .	31
17.	Schematic Drawing of Center Coil Type of Arc Chute as used on the DH-P Line of Breakers . . . . .	32
18.	Partially Assembled View and Details of 50-DH-P250 Arc Chute . . . . .	33
19.	Arc Chute Details of 50-DH-P75 Breaker . . . . .	34
20.	Lifting the Arc Chute of 13.8 KV Breaker with Arc Chute Lifter . . . . .	35

## List of Illustrations - Continued

Figure		Page
21.	Drawing of Contacts Showing Settings and Movements . . . . .	36
22.	Parts for Stored Energy Mechanisms . . . . .	37, 38
23.	Stored Energy Mechanism Parts for Crank Shaft Subassembly . . . . .	39
24.	Stored Energy Mechanism Parts for Close and Trip Subassemblies . . . . .	40
25.	Parts for Solenoid Mechanism . . . . .	41
26.	Solenoid Mechanism . . . . .	42

## INTRODUCTION

These instructions cover the description, operation and maintenance of Westinghouse type DH-P Magnetic "De-Ion" Air Circuit breakers. These breakers are applied by Westinghouse as a rule only as part of Porcel-line Metal Clad Switchgear. The available ratings are shown in the Rating Table on page 56.

These instructions are written so as to be easy to read. In order to avoid trouble in handling, operation etc. PLEASE READ THE INSTRUCTIONS BEFORE ATTEMPTING ANY OF THESE OPERATIONS.

If the need to get into operation is especially urgent, the sections, "RECEIVING, HANDLING, STORING" and "BASIC OPERATING INSTRUCTIONS" can be read first and the remainder studied later.

## GENERAL DESCRIPTION

Following Westinghouse practice for 35 years in the development of magnetic air breakers, the DH-P line is designed for horizontal drawout construction. Figure 1 shows two views of a type 50-DH-P75 breaker. The arrangement chosen is for convenience of operation. Parts which must be reached and seen in the routine operation of the breaker are easily found.

The front of the breaker chassis carries all controls ordinarily needed, such as the tripping magnet or magnets, hand tripping trigger, closing spring release magnet and spring release hand trigger for the stored energy mechanism, auxiliary switches, secondary contact controls, levering device, etc.

The DH-P breakers are built with either a spring operated stored energy mechanism or a conventional d.c. solenoid type mechanism. Both are mechanically trip free. The mechanism is located in the chassis at the bottom of the breaker. The porcelain pole unit supports are mounted on the top of the chassis and there is no grounded metal higher than the base of the pole unit. The arc chutes are hinged to the top of the pole unit directly over the circuit breaker contacts. The barrier assembly provides gas isolation between pole units and to the cell wall where necessary. A grounded metal plate in front forms a shield from live parts.

## RECEIVING, HANDLING, STORING

The 4.16 KV type DH-P breakers are packed all in one crate but not completely assembled. The basic breaker unit, assembled complete except for arc chutes and main barrier, is in one section of the crate. The three arc chutes, each in a carton, and the main barrier are inside the same crate with the breaker.

The 13.8 KV breakers are packed in 3 separate crates for one complete breaker. The basic breaker unit without arc chutes or barrier, is in one crate, the 3 arc chutes are together in another crate and the barrier in another.

These packing methods make it easy for inspection before final assembly and placing in service. See "Maintenance Guide" - "Inspection, Adjustments and Maintenance".

First, inspect crates for any signs of damage or rough handling. You should use a nail puller to open the crates, as this is less likely to cause damage to the apparatus than crow bars, etc. There will usually be loose parts such as hardware packed in the crate or fastened to the larger parts. Be careful after removal of crate that none of these are overlooked.

In lifting the breaker off the base of the crate keep the arc chutes off because you might damage them. Use a spreader over the top of the breaker and attach at the holes on the breaker chassis marked "Lift Here". Do not lift breaker at any time with the arc chutes in place.

After the breaker is out of the crate, roll it on its own wheels only if the floor is smooth. In rolling it around corners, use the handling dolly. See "Basic Operating Instructions".

Handle all parts carefully but be especially careful with the arc chutes. Do not drop them or bump them hard either before or after removal from the box. They contain a porcelain-like material which breaks easier than metal or most plastics.

After unpacking, inspect immediately before further handling for any signs of damage. If any damage is found, file a claim at once with the Transportation Company and notify the nearest Westinghouse Electric Corporation Sales Office.

## STORING

It is best to examine the apparatus immediately after receiving for any signs of damage, to clarify damage claims. During storage, whether packed or unpacked, keep all parts in a clean dry place, warm enough and with enough clean air circulation to prevent condensation of moisture. This apparatus is insulated for high voltage and it must be protected from dirt and moisture at all times.

## BASIC OPERATING INSTRUCTIONS

READ CAREFULLY AND LOOK AT BREAKER BEFORE TRYING TO OPERATE.

1. To Lift Breaker:

### CAUTION:

Do not lift breaker with arc chutes in place, you might damage them.

Place crane hooks in holes in chassis marked "Lift Here". Be sure to use spreader bar over top of breaker to prevent damage to breaker parts.

2. To Install Arc Chutes, 4.16 KV Breakers:

Hold arc chute approximately in the tilted back position as shown in Fig. 2a. Place entrance of hinge pin slots over hinge pin. Let weight of chute down on to hinge pin and tilt forward. Hinge pin should go to end of slots in arc chutes. Tilt chute forward to normal operating position. Tilt back against stop for inspection. Take care not to drop or bump arc chute unnecessarily.

CONNECT SHUNT STRAP  
FROM LOWER CONTACT  
TO FRONT ARC CHUTE

CONNECTION. BE SURE  
CONNECTION IS TIGHT  
AT BOTH ENDS OF  
SHUNT. TO LEAVE CON-  
NECTION LOOSE WILL  
CAUSE DANGEROUS  
FIREWORKS.

3. To Install 13.8 KV Arc Chutes:

The 13.8 KV Arc Chute has a closed hinge pin hole. Therefore, the Arc Chute must be held in position while the hinge pin is inserted. Figure 2b shows the recommended method of installation. Because of its weight the Arc Chute should be suspended from a crane or chain block. Because of the length of the hinge pin and close spacing of the Arc Chutes, the center pole Arc Chute should be installed first. The hinge pin must be backed into an adjacent Arc Chute bracket and then pushed into the center pole, with the Arc Chute in position. Be sure to install the retainers on the hinge pin.

BE SURE TO CONNECT SHUNT STRAP  
FROM LOWER CONTACT TO FRONT ARC  
CHUTE CONNECTION. BE SURE CON-  
NECTION IS TIGHT AT BOTH ENDS OF  
SHUNT. TO LEAVE CONNECTION LOOSE  
WILL CAUSE DANGEROUS FIREWORKS.

4. To Install Main Barrier:

Place barrier assembly on breaker with steel panel at front and insulating sheets between poles of breaker. Place bolts in front to fasten front steel panel to front of breaker chassis and tighten securely. Bolt the tabs or lower rear corners of insulating barriers to steel brackets on rear of breaker chassis.

USE HANDLE ON FRONT  
STEEL PANEL OF BAR-  
RIER ASSEMBLY TO

PULL OR PUSH BREAKER STRAIGHT FORWARD OR BACKWARD. KEEP HANDS OFF TOP EDGE OF FRONT BARRIER IN MOVING BREAKER.

5. To Roll Breaker Around Corners:

For general movements of breaker where corners must be turned, use the handling dolly. Place vertical pin of dolly in hole in handling bracket at bottom and center of front chassis panel by tilting dolly handle sharply toward breaker. Turn dolly handle downward until front wheels of breaker lift off floor. Breaker can now be steered by horizontal movement of dolly handle.

6. To Place Breaker in First Position in Cell:

This is called the TEST POSITION.

**NOTE:**

This is a valuable piece of equipment. PLEASE HANDLE IT CAREFULLY. It will stand some abuse but, like any other similar equipment, it can be damaged by rough handling.

(a) Examine disconnecting finger clusters for any signs of damage. See that they are properly positioned and that the retaining bolts are all in place in the end of the breaker studs. Clean off any dirt, paper, etc. DO NOT APPLY GREASE.

(b) Make sure that the cell is clean and clear of anything that might interfere with breaker travel. Make sure levering screw in cell is clean and free from dirt or grit.

(c) Line up guide channel on R.H. side of breaker near floor, with guide rail on R.H. side of cell floor.

**NOTE:**

Keep hands off top edge of front steel barrier when pushing breaker into cell.

(d) Push breaker into cell until yellow rail latch at front of guide channel catches in notch in guide rail and stops further movement of breaker toward rear of cell.

7. To Place Breaker in Fully Energized Position:

**CAUTION:**

1. The pole unit parts are alive at full circuit voltage when the breaker is in the fully energized position. Before moving the breaker into that position, make sure arc chutes have been properly installed and that main barrier assembly has been properly fastened in place. Failure to do this may cause serious damage or injury.

2. Mechanical interlock prevents levering breaker in or out if breaker is in closed position. If such an attempt is made with enough force, 3/16 pin at front of levering shaft is designed to shear as a safety measure, to prevent damage to parts harder to get to.

(a) Press down on rail latch on breaker, see Fig. 3.

(b) Push breaker toward rear of cell as far as it will go, about 1/4 to 3/8 inch. Be sure it is pushed until it is stopped. This should require only a few pounds of push. It brings the levering nut on the breaker up to the screw in the cell.

(c) Engage crank on levering shaft, push moderately toward rear of cell and turn crank clockwise. Breaker should move slowly toward rear of cell. After

breaker starts to move it is not necessary to push.

(d) Continue cranking until crank turns freely and breaker stops moving. When breaker is fully engaged, front steel barrier should be about 1/4 inch or less from cell frame angles.

8. To Withdraw Breaker from Energized Position to Test Position:

**CAUTION:**

See Note Under (6).

(a) Engage crank on levering device shaft and turn counterclockwise until crank rotates freely.

(b) Pull breaker toward front of cell until rail latch engages slot in rail. Breaker is then secured in test position.

9. To Withdraw Breaker from Cell:

(a) Press down on rail latch to free breaker from rail.

(b) Pull breaker out of cell.

**NOTE:**

On stored energy mechanisms, the breaker may close and open as it is withdrawn, depending on whether breaker was left closed or open, or whether spring was left charged or discharged while standing in the test position. This is to discharge closing and opening springs as a safety measure.

10. To Engage Secondary Contacts with Breaker in Test Position (See Figs. 4a and 4b):

(a) Lift "T" handle on L.H. side at front of chassis to a horizontal position. Lift further to disengage notch in rod from top edge of panel and push toward rear of breaker. The small horizontal pin in "T" handle should engage the 2 slots in the

levering handle, which is pivoted immediately above the "T" handle.

(b) Push down on the curved end of the levering handle as far as it will go. This adds leverage for the necessary force for final full makeup of contacts.

To Disengage:

(a) Lift up on the levering handle for initial break of contacts.

(b) Pull "T" handle out as far as it will go and let it drop to the vertical position.

OPERATION OF STORED ENERGY MECHANISM

1. With breaker in cell and secondary contacts engaged, motor normally charges closing spring as soon as control voltage is applied to control circuit.

2. Normally spring is charged immediately after each closing operation.

3. Breaker is closed electrically by applying voltage to the spring release coil, marked "Lift to Close", through the control switch.

4. Breaker is tripped electrically by applying voltage to the trip coil, marked "Lift to Trip", through the control switch.

5. To Charge Closing Spring by Hand (See Fig. 5):

(a) Place special ratchet wrench on hexagonal end of crank shaft. On 5 KV breakers this projects from the R.H. side of breaker chassis. On 15 KV breakers this is inside the chassis panel opening, to the left of the maintenance closing handle socket.

(b) Charge spring with several downward movements of ratchet wrench until

wrench suddenly turns freely and a "click" is heard. Do not attempt to ratchet any further.

6. To Spring Close Breaker without Electric Power see Fig. 5b:

Place finger under plunger marked "Lift to Close" and push up. This releases closing latch and breaker closes.

7. To Open Breaker by Hand

Place finger under plunger marked "Lift to Trip" and push up.

8. To Close Breaker by Hand with Maintenance Closing Handle:

**CAUTION:**

Do not under any circumstances try to close the breaker on a live circuit by maintenance hand closing socket. When the breaker is beyond the test position in the cell, a flag covers the maintenance closing socket to prevent insertion of the handle. Don't force flag out of position and insert handle.

**CAUTION:** Always remove maintenance handle before opening the breaker by the tripping trigger. Handle is not trip free in this mode of operation and it will move upward fast if left in socket while breaker is tripped.

(a) The socket on the breaker for the maintenance closing handle is accessible through the opening in the chassis panel near the lower R.H. corner.

(b) Breaker should be closed with maintenance handle only when closing spring is discharged. Place handle in socket and push down until breaker latches closed.

**CAUTION:**

Be sure to remove Maintenance Closing Handle before tripping Breaker. Handle is not Trip Free in this Mode of Operation.

- (c) To Open Breaker Contacts Slowly:

With breaker in closed position place maintenance closing handle in socket and press down with a force about equal to that required to close the breaker. Hold in this position and lift "TRIP" plunger. Then let up slowly on handle and make desired observations.

#### OPERATION OF SOLENOID MECHANISM

The solenoid mechanism is operated in the same manner as the stored energy mechanism except that there is no closing spring. The solenoid magnet closes the breaker directly and is energized through the "X" relay, mounted on the mechanism front panel, as shown in Fig. 12.

Operation with maintenance handle is the same as for stored energy mechanism.

#### HOW THE BREAKER WORKS

Operating Mechanism, Stored Energy Type

The spring stored energy mechanism does two jobs:

1. It stores energy by compressing, or charging, a spring.
2. It applies the released energy to the breaker contact system to close the contacts and charge the opening springs.

Tripping is accomplished in a conventional manner.

The mechanism may rest in any one of 4 normal conditions as follows:

1. Spring not charged (or spring discharged) and breaker open.
2. Spring charged and breaker open.
3. Spring discharged and breaker closed.
4. Spring charged and breaker closed.

Figure 6 is a photograph of the lower side of a stored energy mechanism in a 4.16 KV breaker. The 13.8 KV model is similar but the breaker frame is larger. The major component is a single-throw crankshaft to which is attached a ratchet wheel for charging the spring and a cam for closing the breaker. Parts of the crankshaft and associated parts can be seen. The crankshaft sub-assembly and details are also shown in Fig. 23. On the crankshaft will be seen a connecting rod, which attaches to the spring to compress it, the ratchet wheel and the closing cam, both of which rotate together with the crankshaft.

Figures 7a and 7b are schematic views of a section of the mechanism as would be seen from the R.H. side of the breaker with the breaker in the normal position with respect to the cell. The driving pawl runs by continuous rotation of the driving motor until charging is complete, as is shown. The holding pawl holds the ratchet wheel during the back travel of driving pawl. The closing spring is held compressed by the spring release latch and in turn by the spring release trigger. It will be seen that rotation of the ratchet wheel is counterclockwise and that the connecting rod is slightly over horizontal dead center with the spring fully charged. It stops at that point because the ratchet roller bumps against the spring release latch. You can hear this at the end of the charging operation. When the spring release trigger, extending out from the mechanism panel, is released by lifting the arm either by hand or electrically, the ratched roller is freed and the crankshaft, ratchet wheel and cam rotate rapidly counterclockwise for about one-half turn as shown in Fig. 7b. This closes the breaker. The motor limit switch is closed by this operation and the spring is immediately charged again back to the position in Fig. 7a.

Figures 8a, -b, -c and -d show the 4 conditions of the closing cam and tripping linkage. Note that in 8a, in which the breaker is open and the spring not charged, the tripping trigger is in the tripped position. As the spring is charged, the tripping trigger snaps into the fully reset position as in 8b near the end of the spring charging operation.

In Fig. 8c the linkage is shown in the breaker closed position and before the spring has been recharged. Note that the closing cam has rotated about one-half turn, corresponding to the rotation of the crankshaft and ratchet wheel of Figs. 7a and 7b. Rotation of the closing cam pushes the cam roller so as to rotate the main shaft of the breaker and close the contacts. This is possible because the restraining links between the cam roller and the tripping cam prevent the roller from moving off to the right. The restraining links cause the tripping cam to push against the tripping latch, which pushes downward, on the left end, on top of the tripping trigger. Figure 8d shows the breaker in the closed position after the spring has been recharged. Note that the closing cam has rotated about one-half turn. The cam for this portion of the travel is cylindrical and causes no further movement of the closing cam follower roller. This rotation corresponds to the spring charging rotation of the ratchet wheel shown in Figs. 7a and 7b.

Lifting the tripping trigger arm either by hand or by the tripping magnet causes release of the tripping latch, tripping cam and closing-cam follower roller, which opens the breaker and the linkage moves to the position shown in Fig. 8b.

#### ANTI-CLOSE INTERLOCK

An anti-close interlock is provided to prevent attempted closing of the breaker after it has already been closed. If such an at-

tempt is made without the interlock the breaker will open and close as long as the spring release trigger is lifted.

As shown in Fig. 7a the anti-close interlock presses down on the spring release latch while the breaker is closed. Under this condition there should be a clearance of .010 to .060 inches between the front spring release latch roller and the top of the spring release trigger. If the spring release trigger is lifted as in an attempt at closing under this condition it will simply rise and no operation will occur, and it will reset when released.

#### OPERATING MECHANISM, D.C. SOLENOID TYPE

Figure 9a is a photograph of the bottom of a 4.16 KV breaker with a d.c. solenoid mechanism. Figure 9b shows the same view of a 13.8 KV solenoid operated breaker. With the exception of being especially compact these mechanisms are of conventional design. They consist essentially of d.c. magnets and mechanically trip free linkages, meaning that the breaker contacts are always tripped free of the closing core. Thus the breaker will always open even though the closing core may remain energized and in its closed position.

Figures 10a, b and c are schematic drawings of the solenoid mechanism linkage, which are basically the same for all breaker ratings. The dark circles are stationary pin centers with respect to the mechanism frame. Figure 10a shows the linkage in the normal closed and latched position. The closing core has moved to the right, to the limit of its travel, where it bumps into the stationary core. The core pulls the core links, which in turn swing the guide link about its stationary center. This gives a generally upward motion to the lower and upper closing links and in turn to the pole unit lever turning it to the breaker closed position.

These movements are made possible by virtue of the restraining link connecting the lower and upper closing links to the tripping cam. The tripping cam is held back by the tripping latch and tripping trigger. Lifting the tripping trigger allows the tripping latch to be pushed away by the tripping cam. The restraining link no longer restrains the closing links, which jack-knife out to the right, allowing the pole unit levers to rotate downward and open the breaker. The linkage is now in the position shown in Fig. 10b. It will be noted that the upper extension of the closing latch has been pushed to the right by the closing link pin. It thus no longer holds the closing core in position.

The retrieving spring then pulls the closing core to the left. Since the breaker is now open, this core movement resets the tripping cam, tripping latch and tripping trigger to the position shown in Fig. 10c. The mechanism is now ready to close again.

#### CHASSIS

Figure 11a is a photograph of a 4.16 KV breaker chassis with stored energy mechanism. Figure 11b shows the opposite side of a 13.8 KV chassis. The extensive use of the same parts in the two ratings is evident. Figure 12 shows the chassis of a 4.16 KV solenoid operated breaker. Major parts are named.

#### LEVERING DEVICE AND BREAKER INTERLOCK

Figures 13a and b show the two extreme positions of the levering device. The main parts of the device are:

1. The nut.
2. The guide tube.
3. The levering shaft.

These are a part of the chassis assembly. The nut is fastened securely to the guide tube and is housed in a casting fastened to the extreme rear of the chassis as shown in Fig. 14.

The basic operation is for the nut to turn onto the screw which is mounted on the rear wall of the cell. Since the nut is securely fastened to the chassis, it pulls the breaker into the final energized position.

The guide tube is slotted lengthwise for a distance about equal to the travel of the breaker. The levering shaft has 2 rectangular hardened keys welded to it which slide in the guide tube slot. Thus, as the levering shaft is rotated, the guide tube and nut are also rotated. As the nut consequently moves on the screw, BY CLOCKWISE ROTATION, the screw extends farther and farther toward the front of the breaker, pushing the levering shaft with it. Consequently the levering shaft stands still relative to the screw and other cell parts, including the door. Thus, the end of the levering shaft is always the same distance behind the door, whether the breaker is in the test or energized position, or in between.

As the breaker is continued to be levered in, the keys on the levering shaft move toward the end of the guide tube slot. As the rear key comes out of the slot, the levering shaft turns freely and the breaker moves no further. The end of the guide tube is shaped like a steep-pitch one-turn screw thread so that when the levering shaft is rotated counterclockwise, the rear key will catch and enter the slot, and rotate the guide tube and nut, and the breaker will be withdrawn.

The breaker interlock is designed to prevent moving the breaker into or out of the energized position if the breaker contacts are in the closed position. It consists essentially of a movable key, mounted

securely on the rear of the front panel, which can enter an elongated keyway in the front part of the levering-in shaft. The key is spring-operated by the closing and opening movement of the breaker contact linkage. When the breaker is in the CLOSED POSITION, a force is applied through a single-leaf spring to the key, to make it enter the keyway on the levering-in shaft. The levering-in shaft may be left in any position so that the keyway may not line up with the key. However, since the key is pressing against the shaft, it will snap into the keyway on the first rotation of the shaft as the keyway comes into line with the key.

Thus, the levering-in shaft cannot be rotated any further and no more movement of the breaker can occur as long as it is in the closed position.

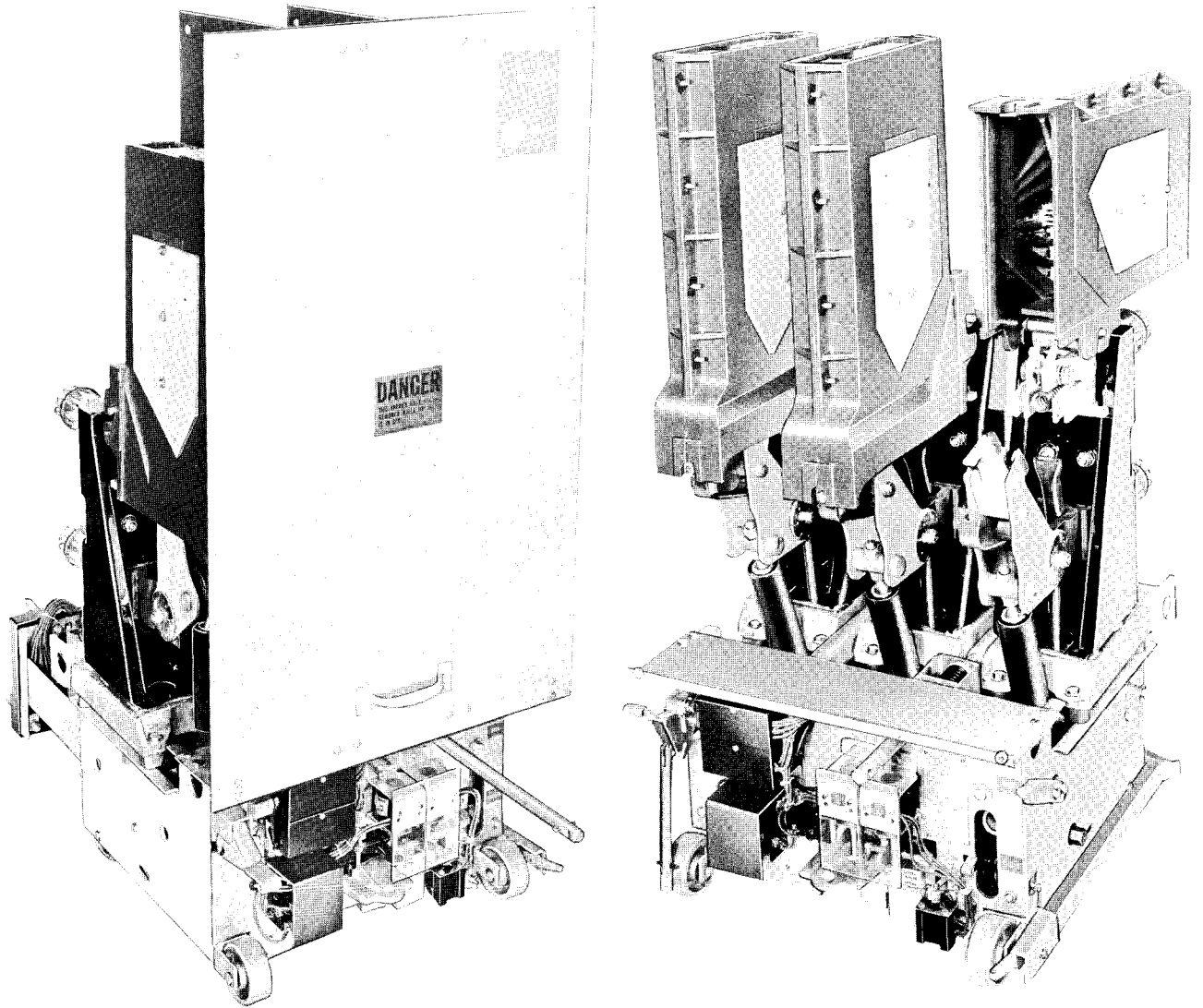
If you try to turn the levering-in shaft as hard as possible while the breaker is closed, the levering-in shaft pin, where the levering-in crank is attached, will be broken. This protects the internal parts of the interlock against mechanical damage and prevents unintentional withdrawing or insertion of the breaker while it is closed, which is very dangerous.

If the pin is broken it should become clear that the breaker must be opened before it is withdrawn and the broken pin must be replaced.

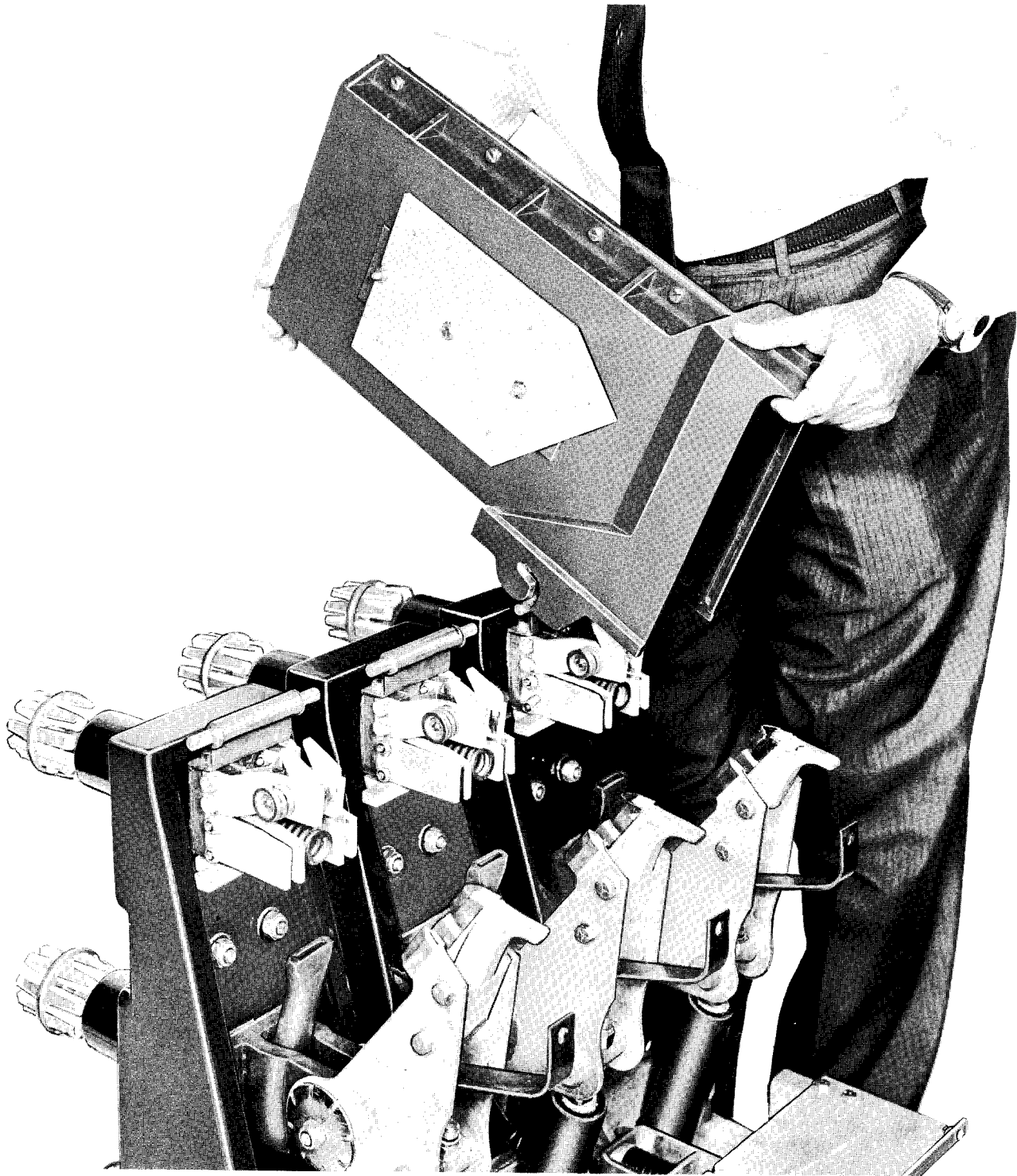
For further operating details, see BASIC OPERATING INSTRUCTIONS.

#### FLOOR INTERLOCK AND OPERATING LEVERS

Another job of the breaker interlocking system is to prevent closing of the breaker while the breaker is being levered into or out of the energized position.



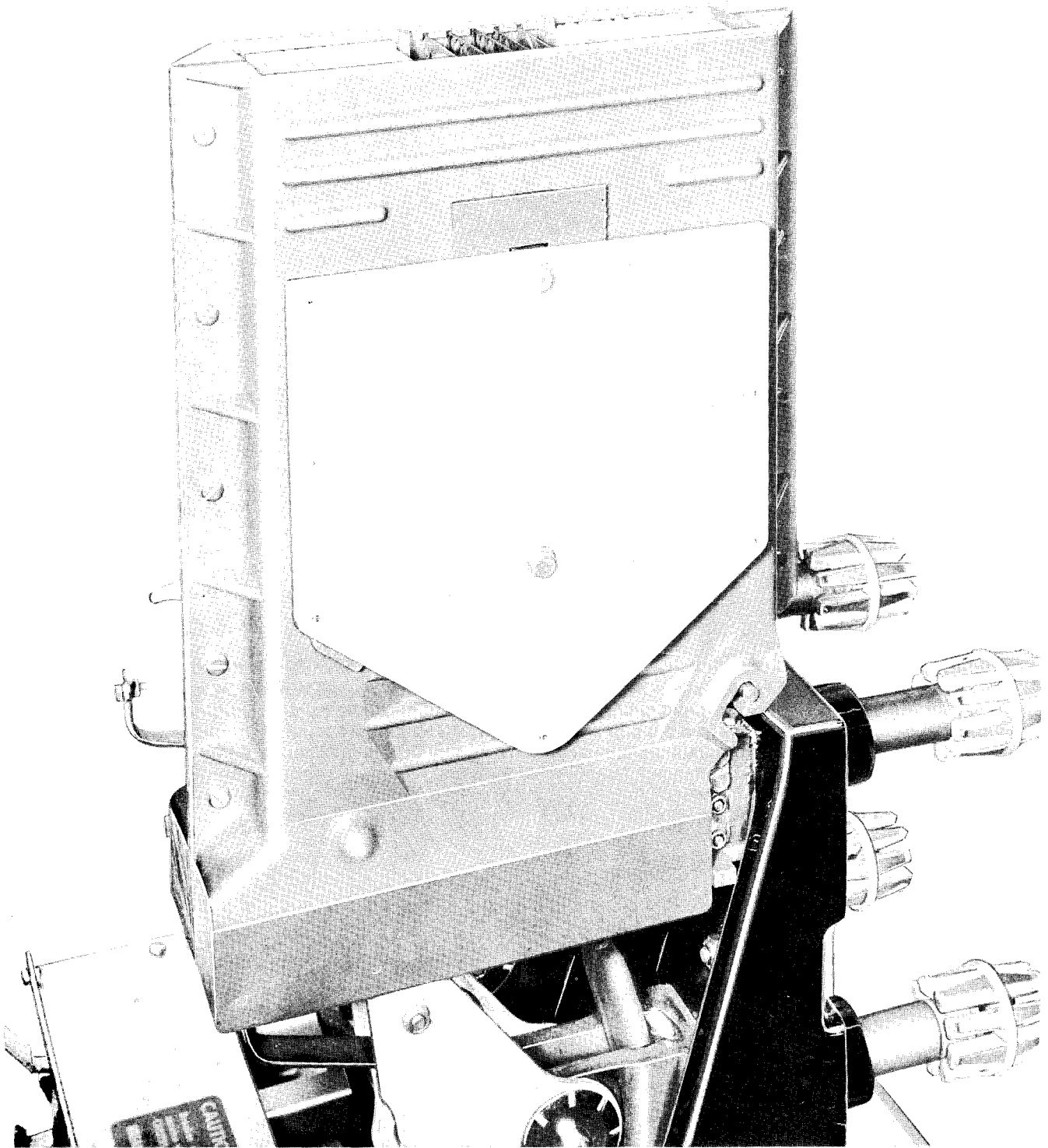
*Figs. 1a. & 1b. Views Showing General Arrangement of Type 50-DH-P75 Circuit Breaker*



*Fig. 2a. Installing Arc Chute of Type 50-DH-P75 Breaker*



*Fig. 2b. Installing Arc Chute of Type 150-DH-P500 Breaker*



*Fig. 2c. Arc Chute of Type 50-DH-P250 in Place on Breaker*

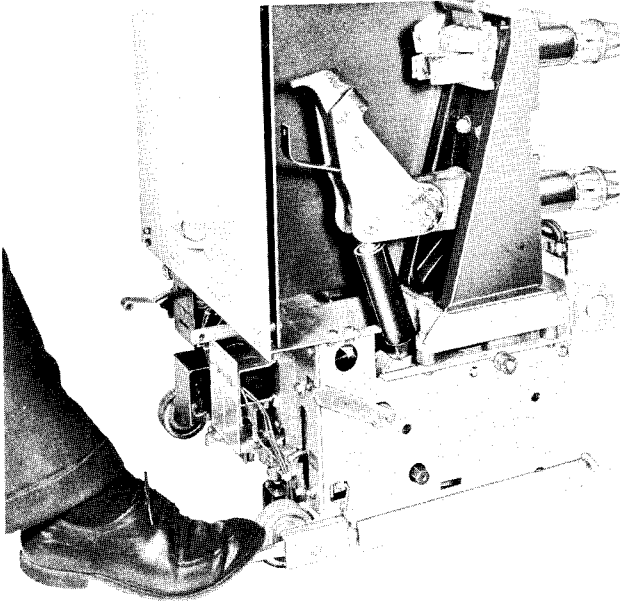


Fig. 3. Releasing Rail Latch

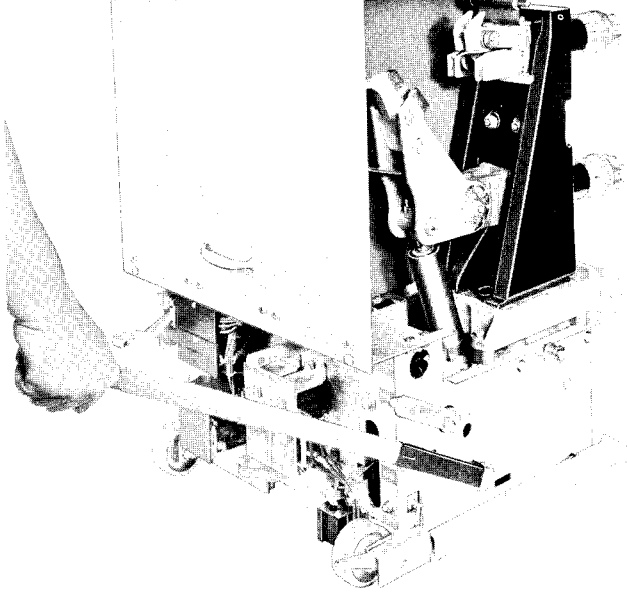
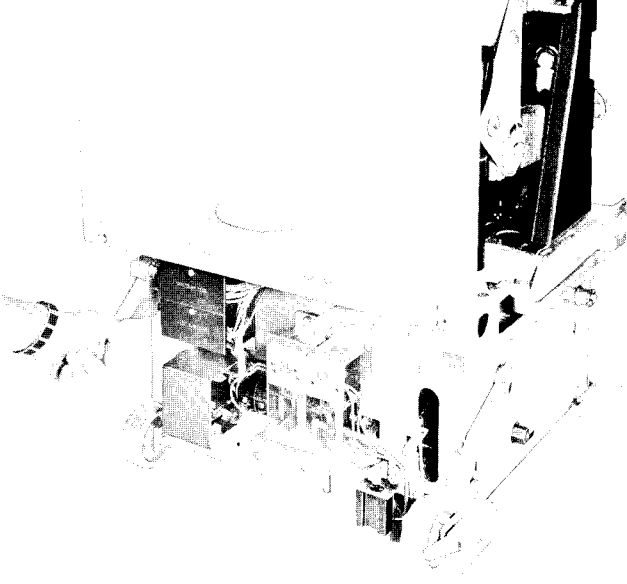
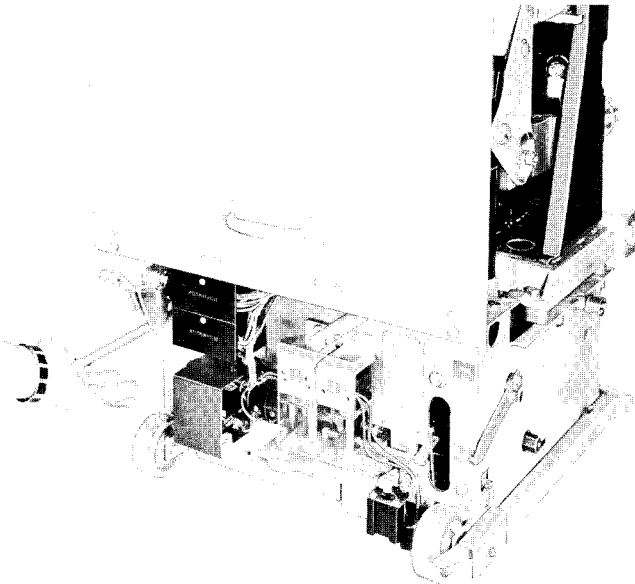
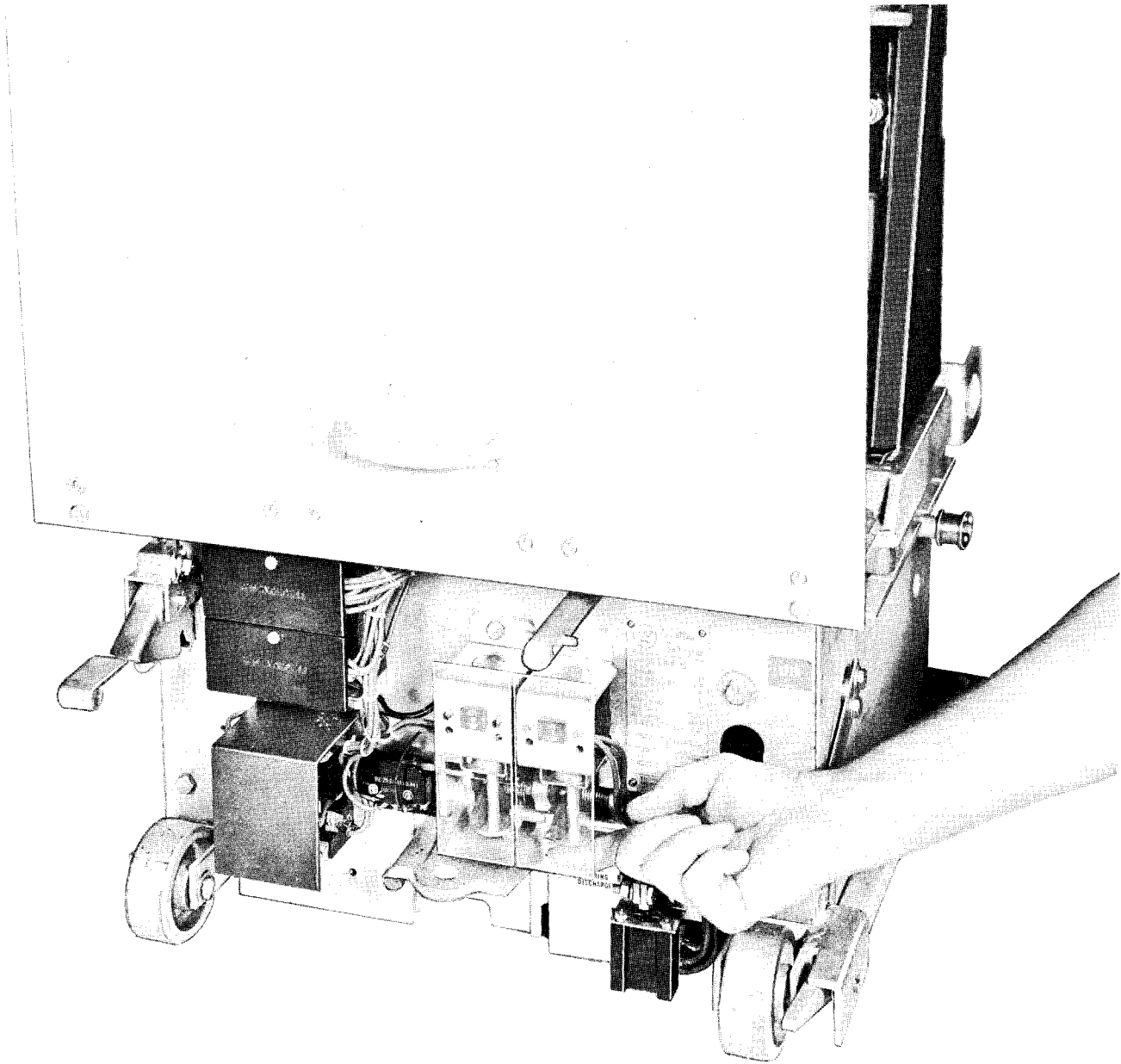


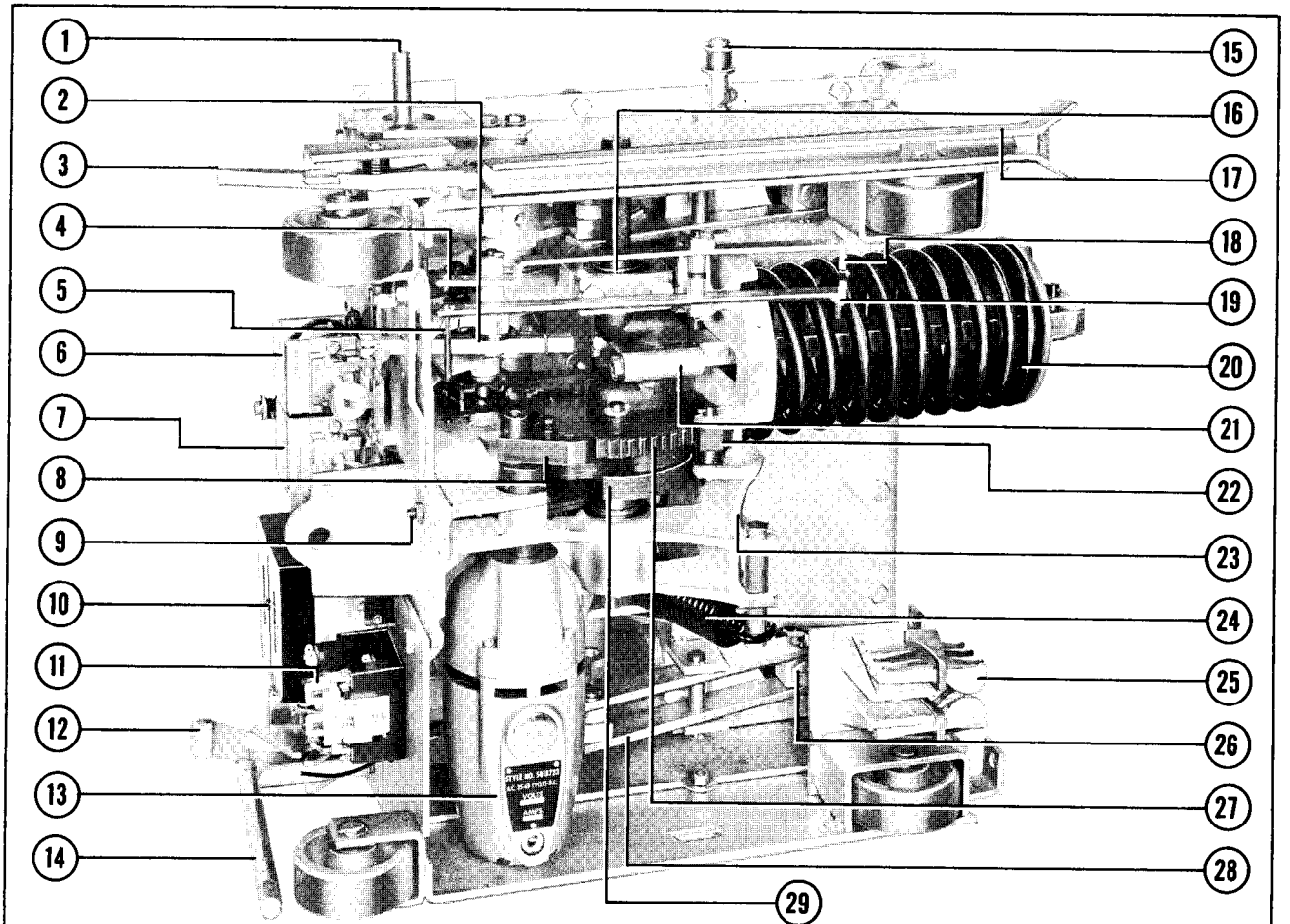
Fig. 5a. Charging Closing Spring by Hand, 4.15 KV Breaker



Figs. 4a.,4b. Operation of Secondary Contacts with Breaker in Test Position



*Fig. 5b. Spring Closing Breaker by Hand Release, 4.16 KV Breaker*



- |  |  |  |
|--|--|--|
| 1. MOC Switch Operating Pin                      | 10. Auxiliary Switches                         | 19. Automatic Floor Closing Spring Release Lever |
| 2. Motor Limit Switch Operating Arm              | 11. Control Relay, "Y"                         | 20. Closing Spring                               |
| 3. Rail Latch                                    | 12. Secondary Contact Levering Handle          | 21. Connecting Rod                               |
| 4. Floor Lever Trip Operating Rod                | 13. Spring Charging Motor                      | 22. Holding Pawl                                 |
| 5. Floor Lever Spring Release Operating Rod      | 14. Secondary Contact Hand Operating Rod       | 23. Mechanism Frame                              |
| 6. Spring Release Magnet                         | 15. Shutter Operating Roller                   | 24. Opening Spring                               |
| 7. Trip Magnet                                   | 16. Crank Shaft Washers                        | 25. Ground Contact                               |
| 8. Driving Pawl                                  | 17. Guide                                      | 26. Piston Adjustment                            |
| 9. Tripping Cam & Tripping Latch Adjusting Screw | 18. Floor Interlock & Automatic Tripping Lever | 27. Ratchet Wheel                                |
|  |  | 28. Puffer Operating Arm                         |
|  |  | 29. Closing Cam                                  |

Fig. 6. Bottom View of Stored Energy Mechanism in 4.16 KV Breaker

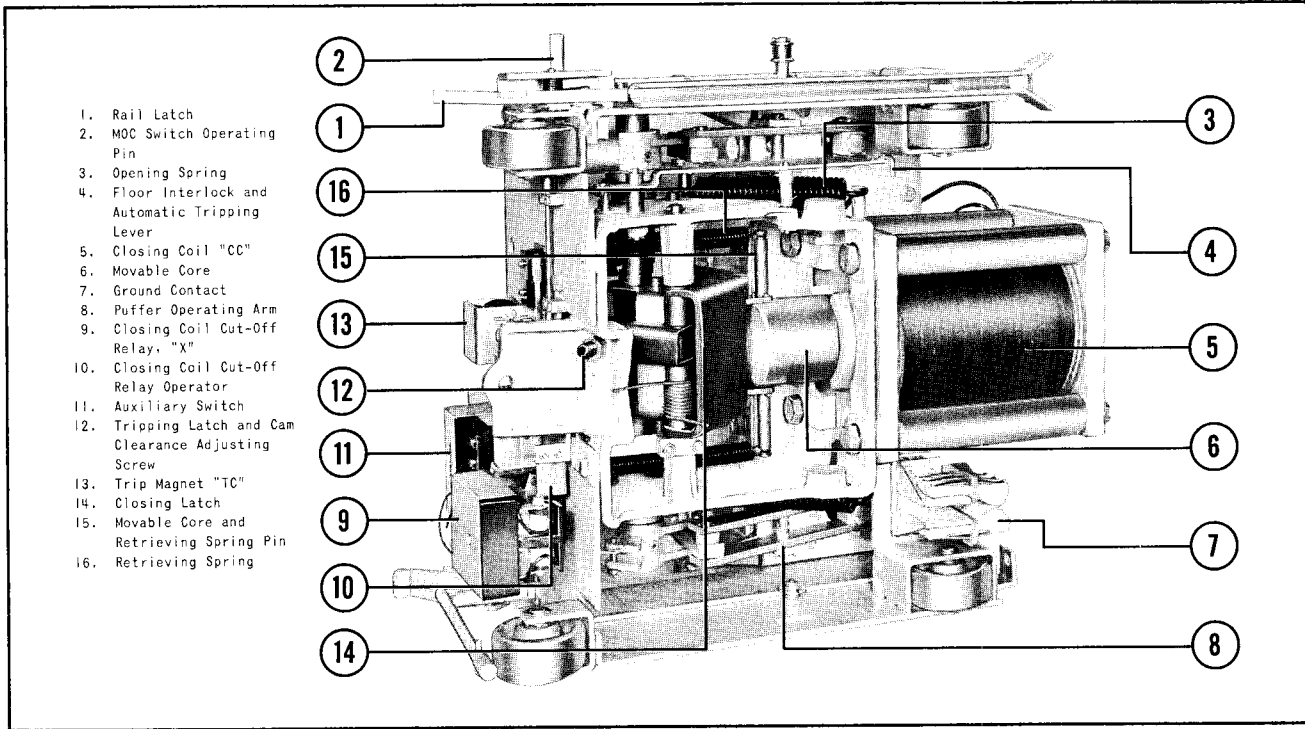


Fig. 9a. Bottom View of a 4.16 KV Breaker with Solenoid Mechanism

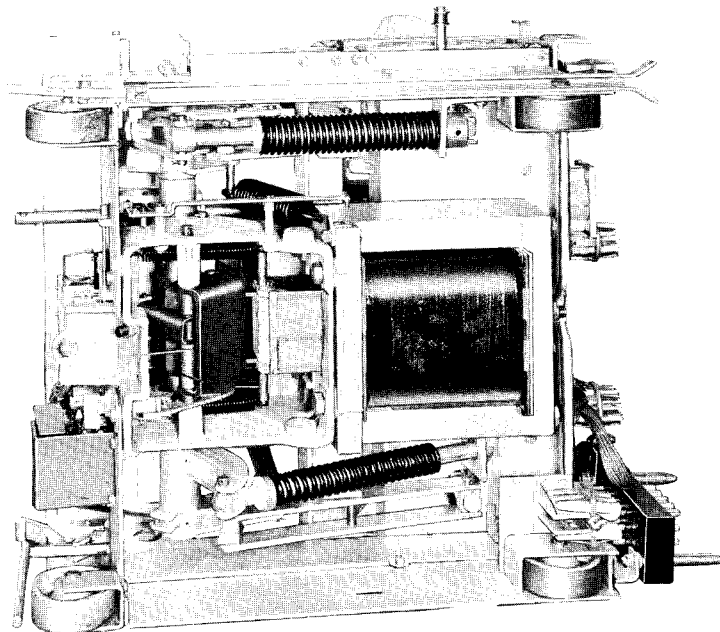
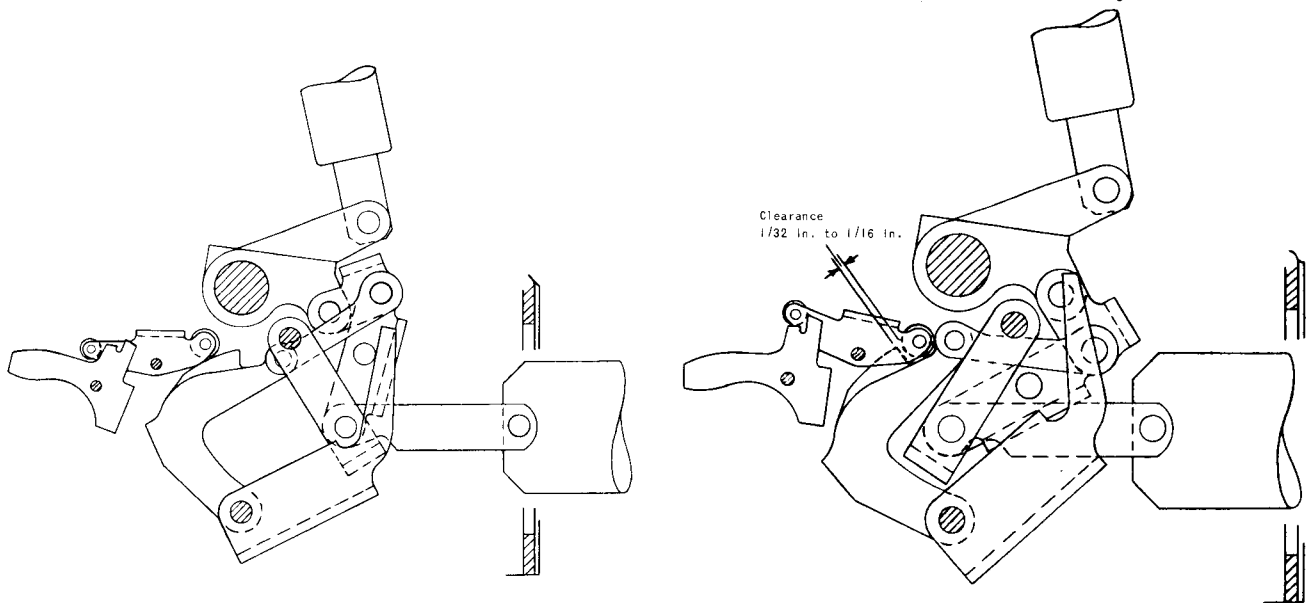
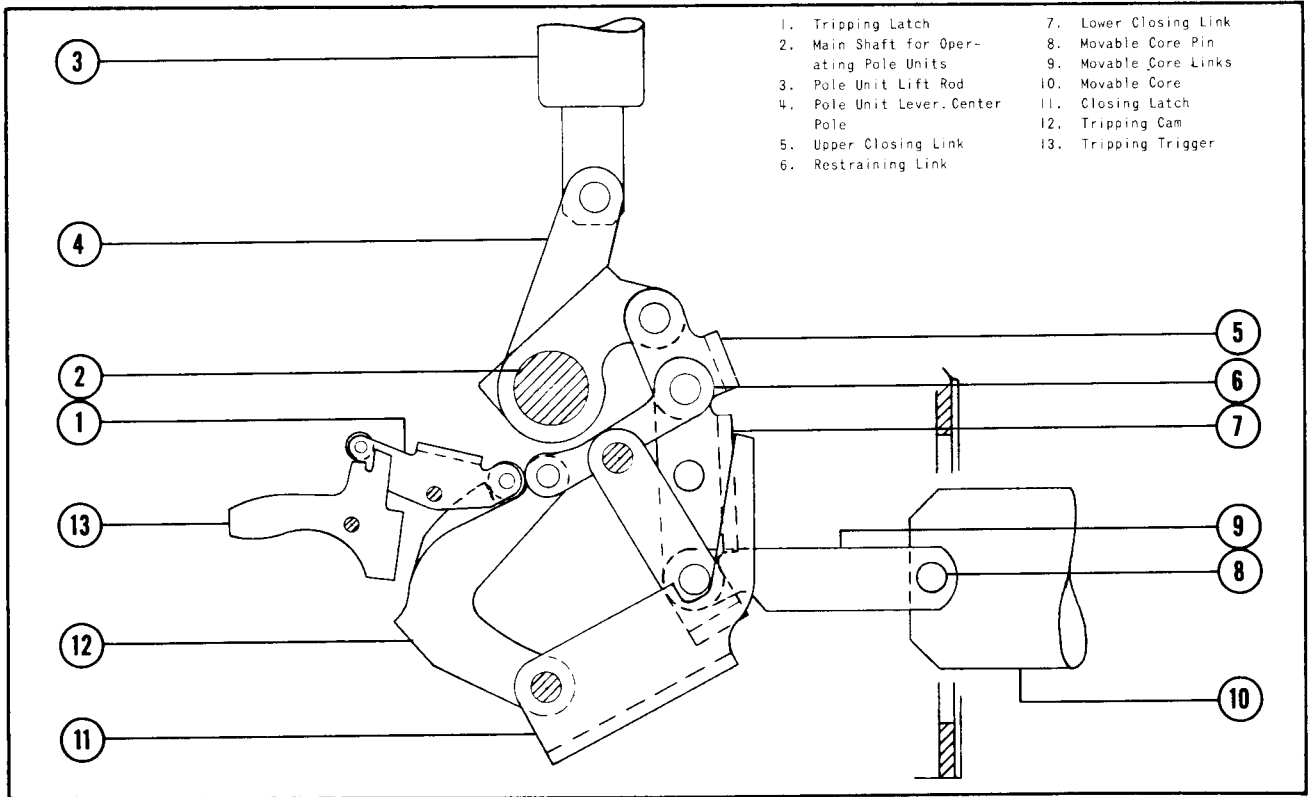


Fig. 9b. Bottom View of a 13.8 KV Breaker with Solenoid Mechanism



**Figs. 10a., b., c. Schematic Drawings showing Positions of Solenoid Mechanism Linkage**  
**(a) Closed and Latched.**  
**(b) Tripped Free.**  
**(c) Open and Reset, Ready to Close.**

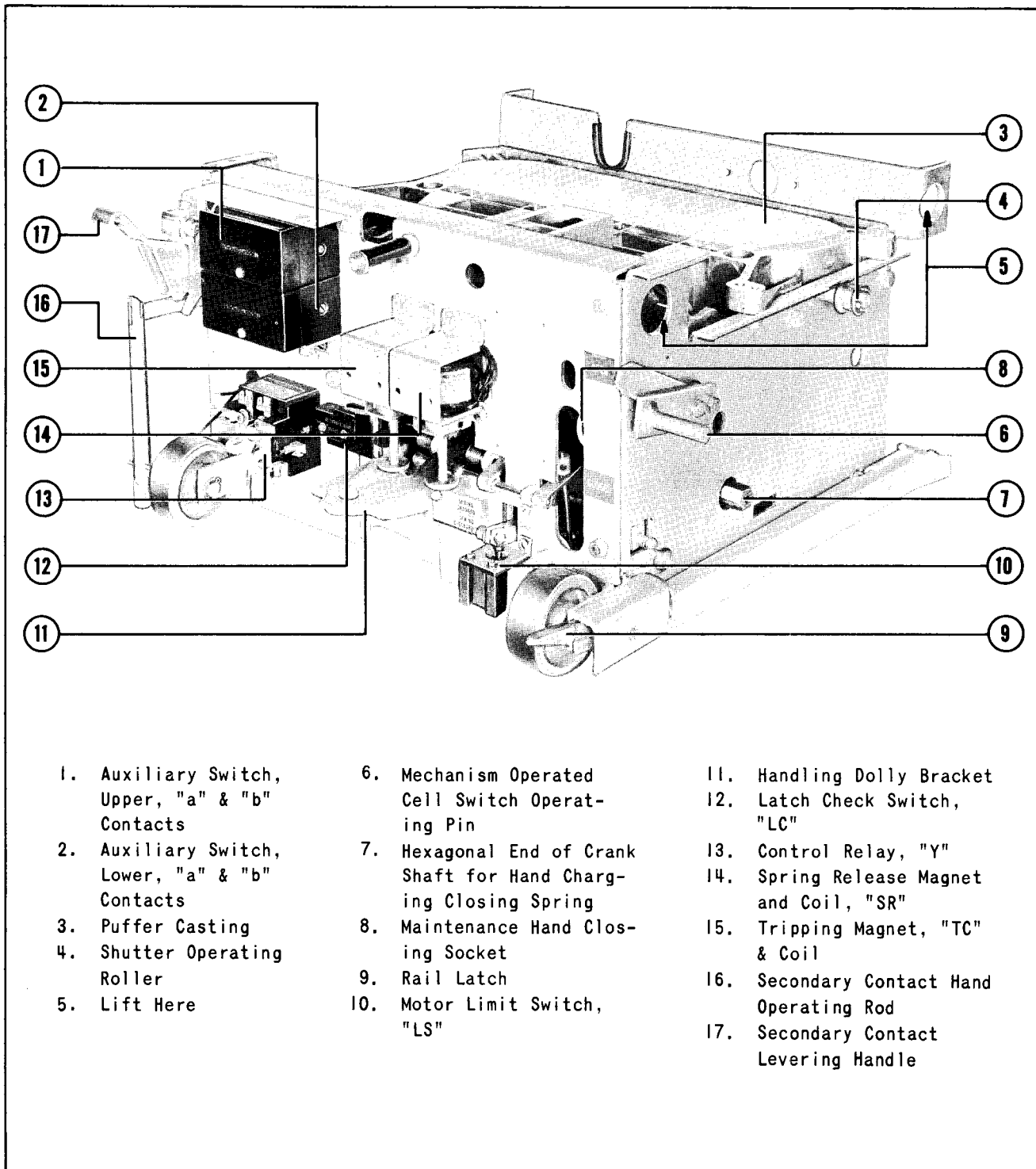


Fig. 11a. 4.16 KV Breaker Chassis with Stored Energy Mechanism

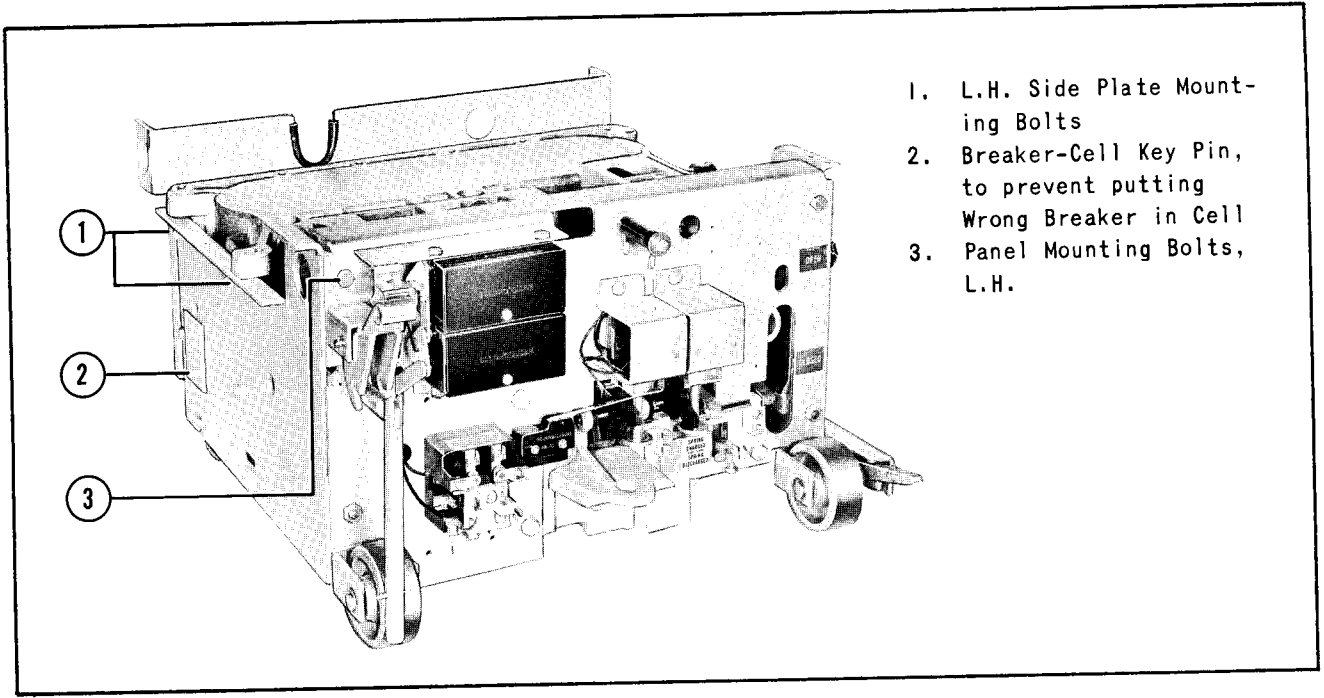


Fig. 11b. 4.16 KV Breaker Chassis with Stored Energy Mechanism

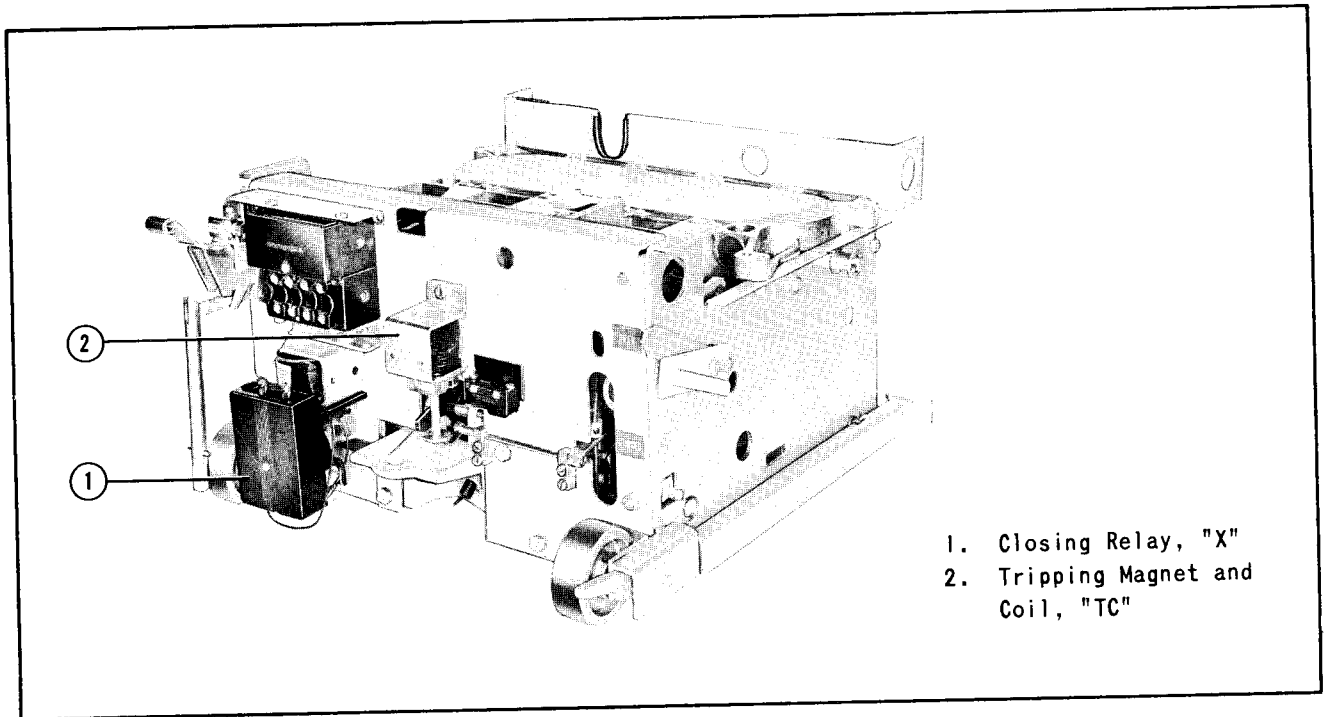


Fig. 12. 4.16 KV Breaker Chassis with Solenoid Mechanism

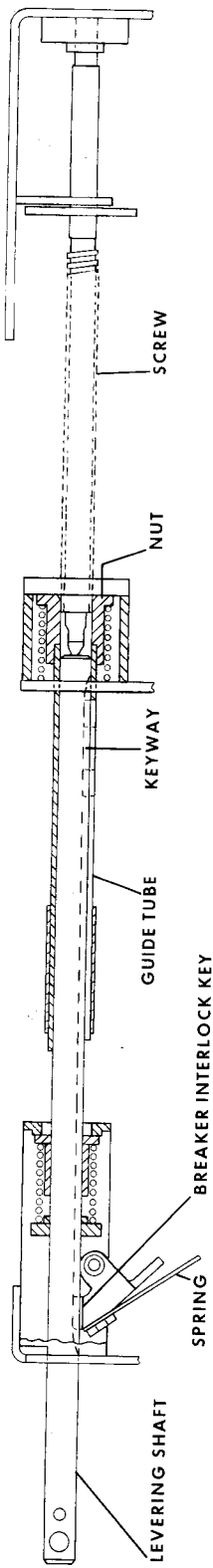


Fig. 13a.

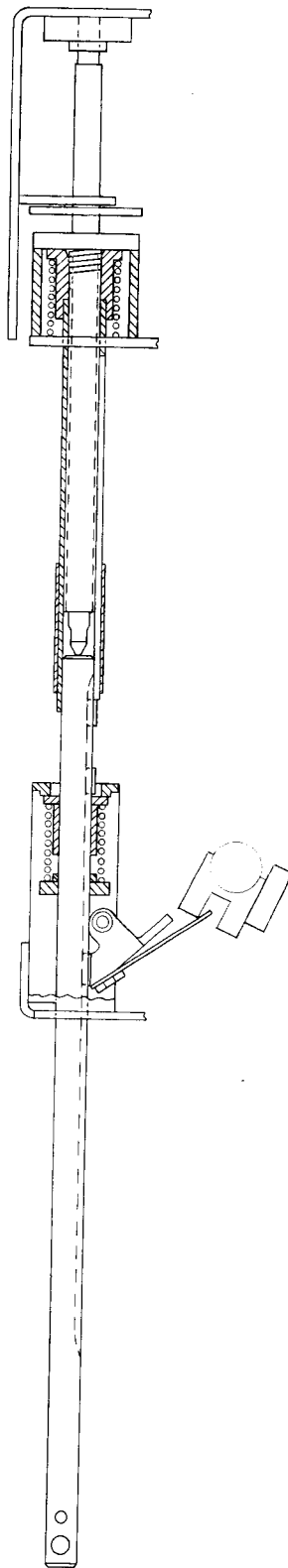


Fig. 13b.

Figs. 13a., b. Schematic Drawings of Levering Device  
(a) Breaker in withdrawn or Test Position.  
(b) Breaker in Fully Engaged or Energized Position.

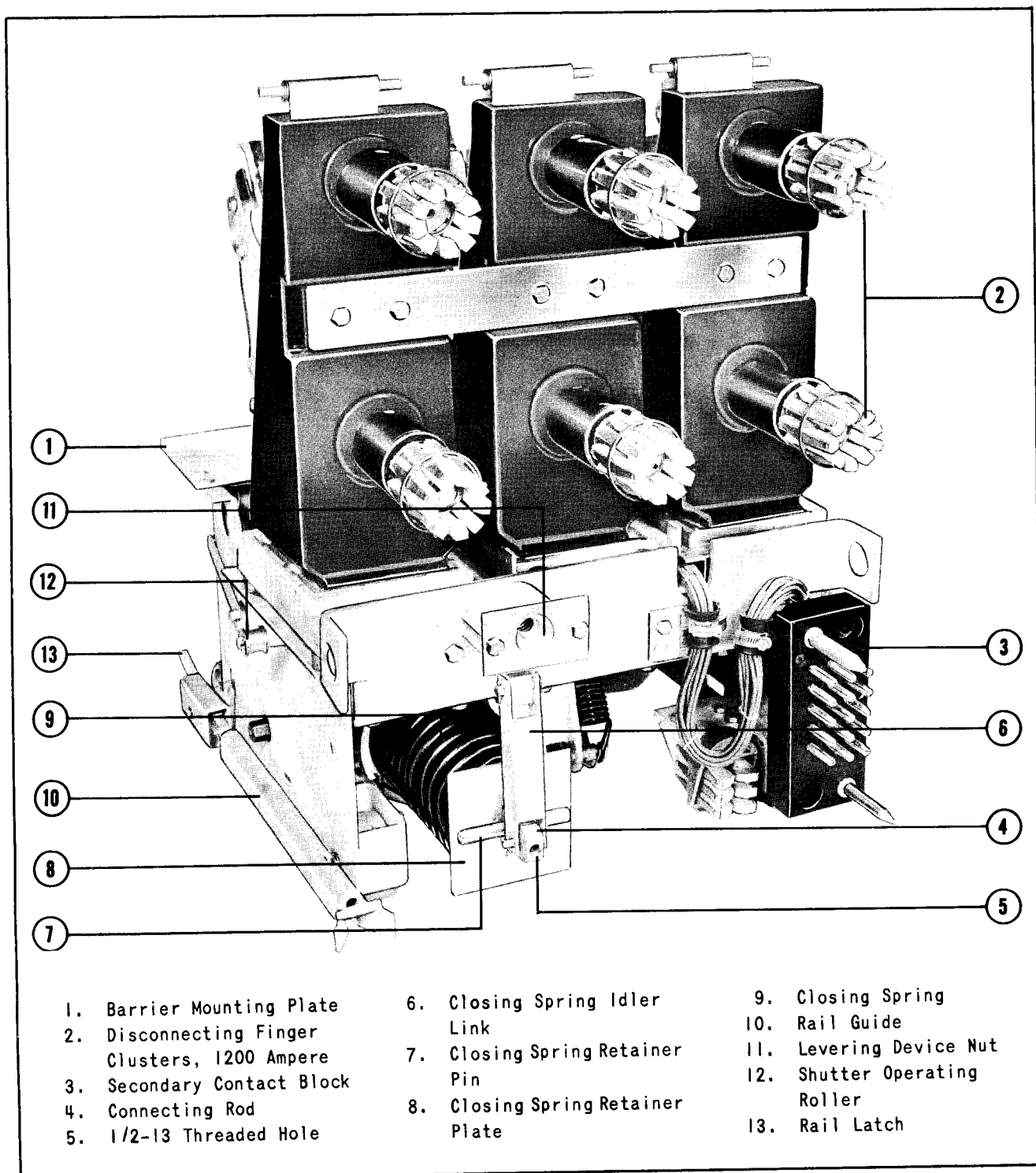
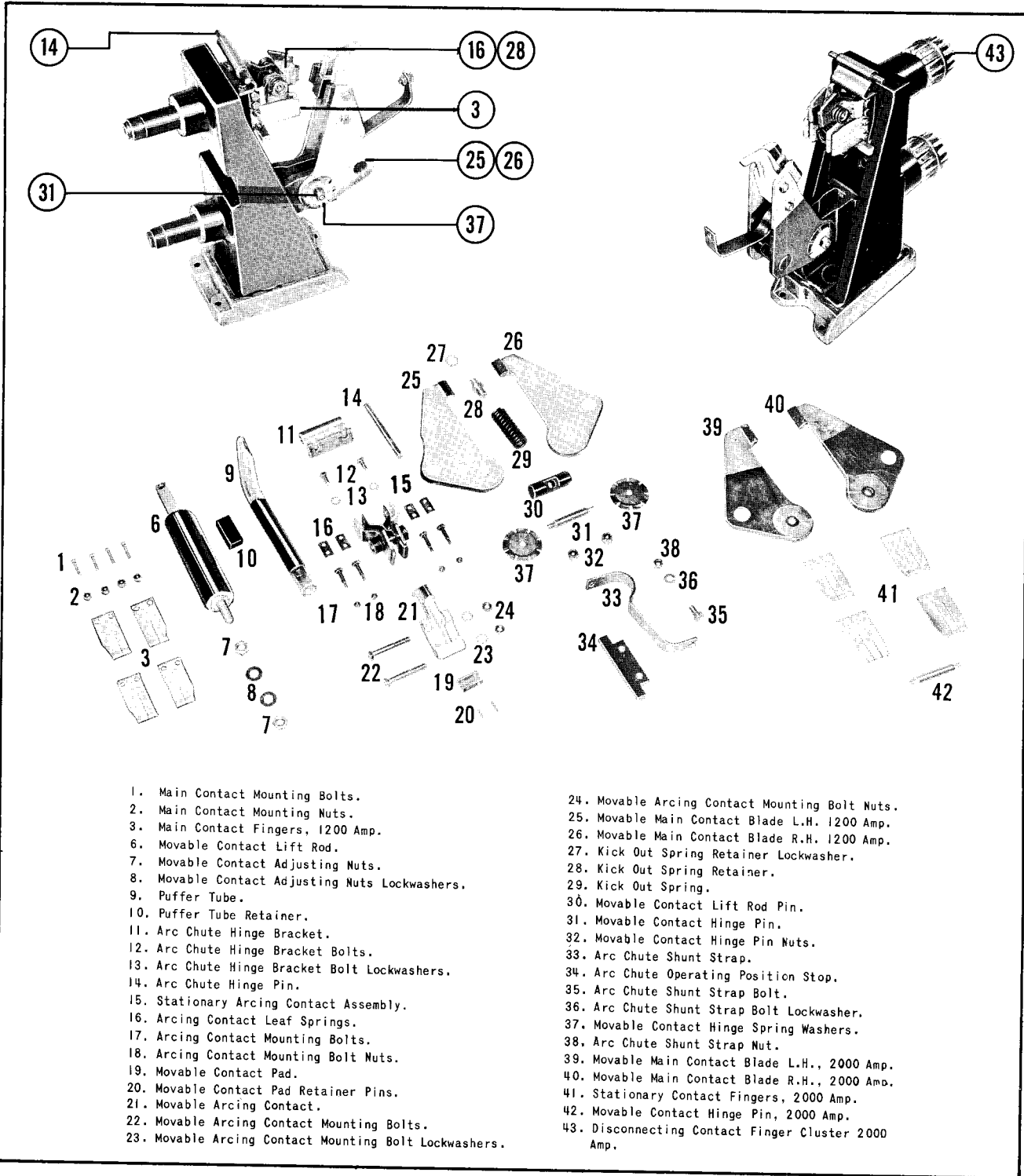


Fig. 14. Rear View of 4.16 KV Breaker



- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>1. Main Contact Mounting Bolts.</li> <li>2. Main Contact Mounting Nuts.</li> <li>3. Main Contact Fingers, 1200 Amp.</li> <li>6. Movable Contact Lift Rod.</li> <li>7. Movable Contact Adjusting Nuts.</li> <li>8. Movable Contact Adjusting Nuts Lockwashers.</li> <li>9. Puffer Tube.</li> <li>10. Puffer Tube Retainer.</li> <li>11. Arc Chute Hinge Bracket.</li> <li>12. Arc Chute Hinge Bracket Bolts.</li> <li>13. Arc Chute Hinge Bracket Bolt Lockwashers.</li> <li>14. Arc Chute Hinge Pin.</li> <li>15. Stationary Arcing Contact Assembly.</li> <li>16. Arcing Contact Leaf Springs.</li> <li>17. Arcing Contact Mounting Bolts.</li> <li>18. Arcing Contact Mounting Bolt Nuts.</li> <li>19. Movable Contact Pad.</li> <li>20. Movable Contact Pad Retainer Pins.</li> <li>21. Movable Arcing Contact.</li> <li>22. Movable Arcing Contact Mounting Bolts.</li> <li>23. Movable Arcing Contact Mounting Bolt Lockwashers.</li> </ul> | <ul style="list-style-type: none"> <li>24. Movable Arcing Contact Mounting Bolt Nuts.</li> <li>25. Movable Main Contact Blade L.H. 1200 Amp.</li> <li>26. Movable Main Contact Blade R.H. 1200 Amp.</li> <li>27. Kick Out Spring Retainer Lockwasher.</li> <li>28. Kick Out Spring Retainer.</li> <li>29. Kick Out Spring.</li> <li>30. Movable Contact Lift Rod Pin.</li> <li>31. Movable Contact Hinge Pin.</li> <li>32. Movable Contact Hinge Pin Nuts.</li> <li>33. Arc Chute Shunt Strap.</li> <li>34. Arc Chute Operating Position Stop.</li> <li>35. Arc Chute Shunt Strap Bolt.</li> <li>36. Arc Chute Shunt Strap Bolt Lockwasher.</li> <li>37. Movable Contact Hinge Spring Washers.</li> <li>38. Arc Chute Shunt Strap Nut.</li> <li>39. Movable Main Contact Blade L.H., 2000 Amp.</li> <li>40. Movable Main Contact Blade R.H., 2000 Amp.</li> <li>41. Stationary Contact Fingers, 2000 Amp.</li> <li>42. Movable Contact Hinge Pin, 2000 Amp.</li> <li>43. Disconnecting Contact Finger Cluster 2000 Amp.</li> </ul> |
|---|--|

Fig. 15. Pole Units and Details for 1200 and 2000 Ampere, 4.16 KV Breakers

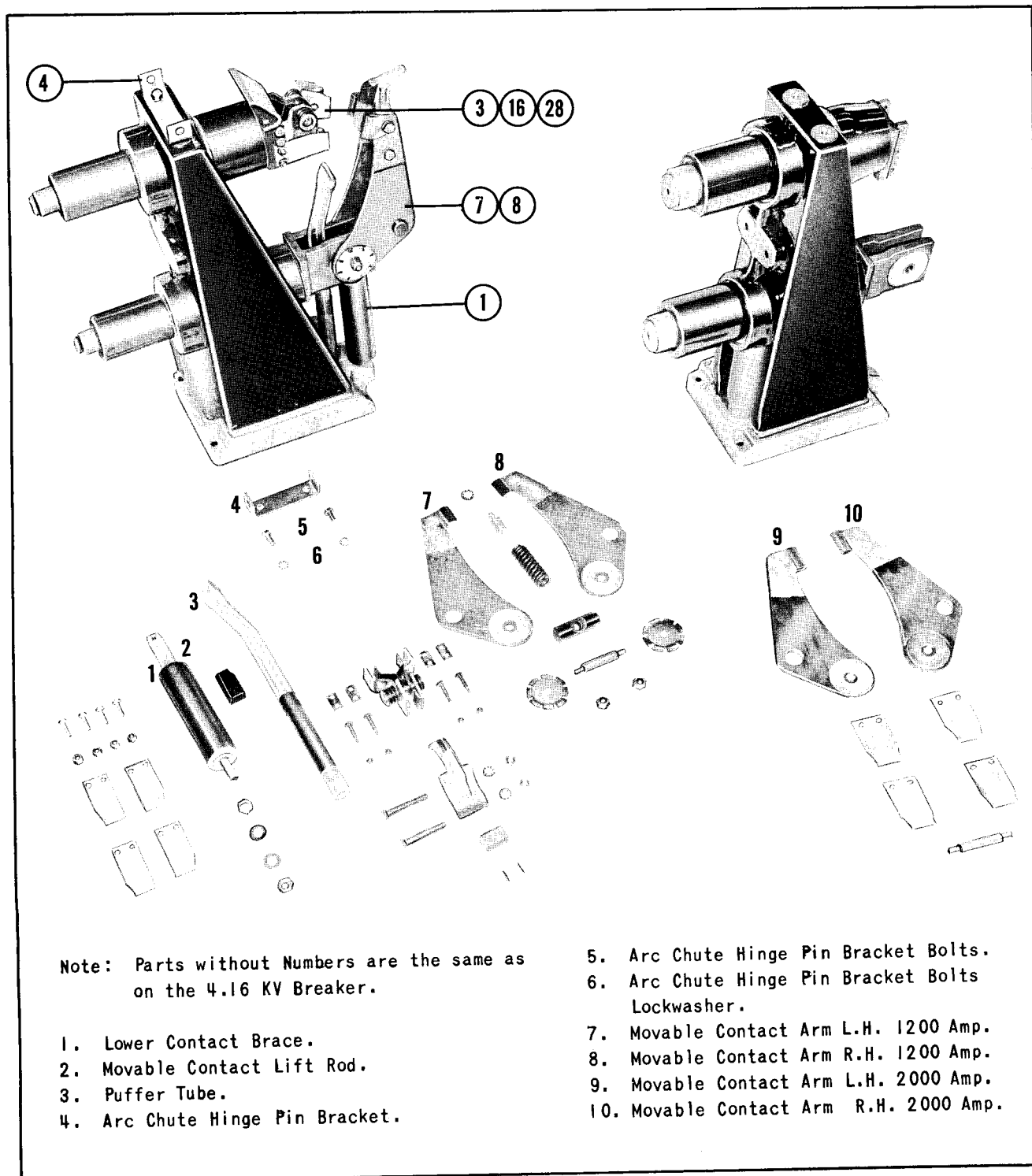


Fig. 16. Pole Units and Details for 1200 and 2000 Ampere, 13.8 KV Breakers

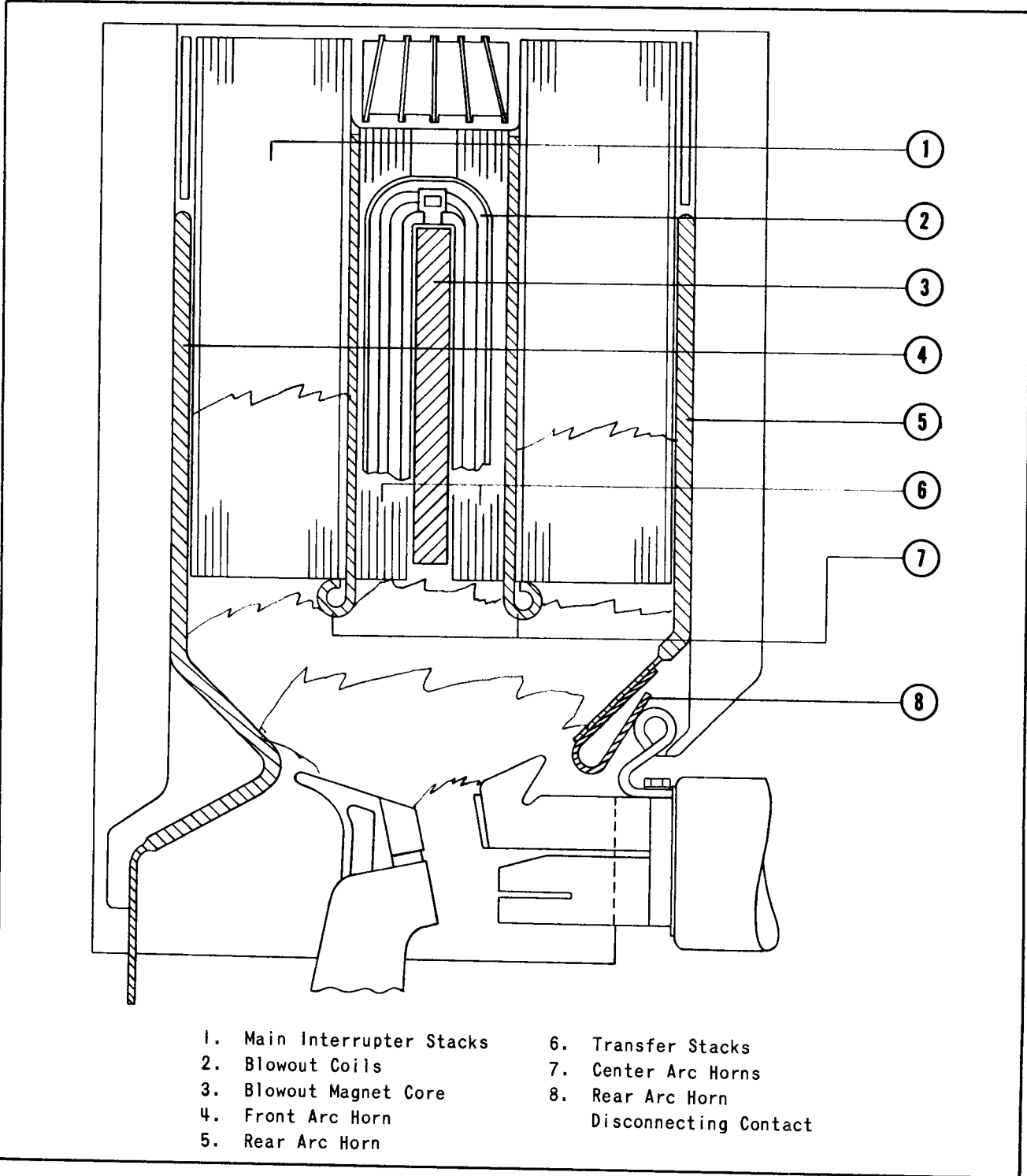


Fig. 17. Schematic Drawing of Center Coil Type of Arc Chute as used on the DH-P Line of Breakers.

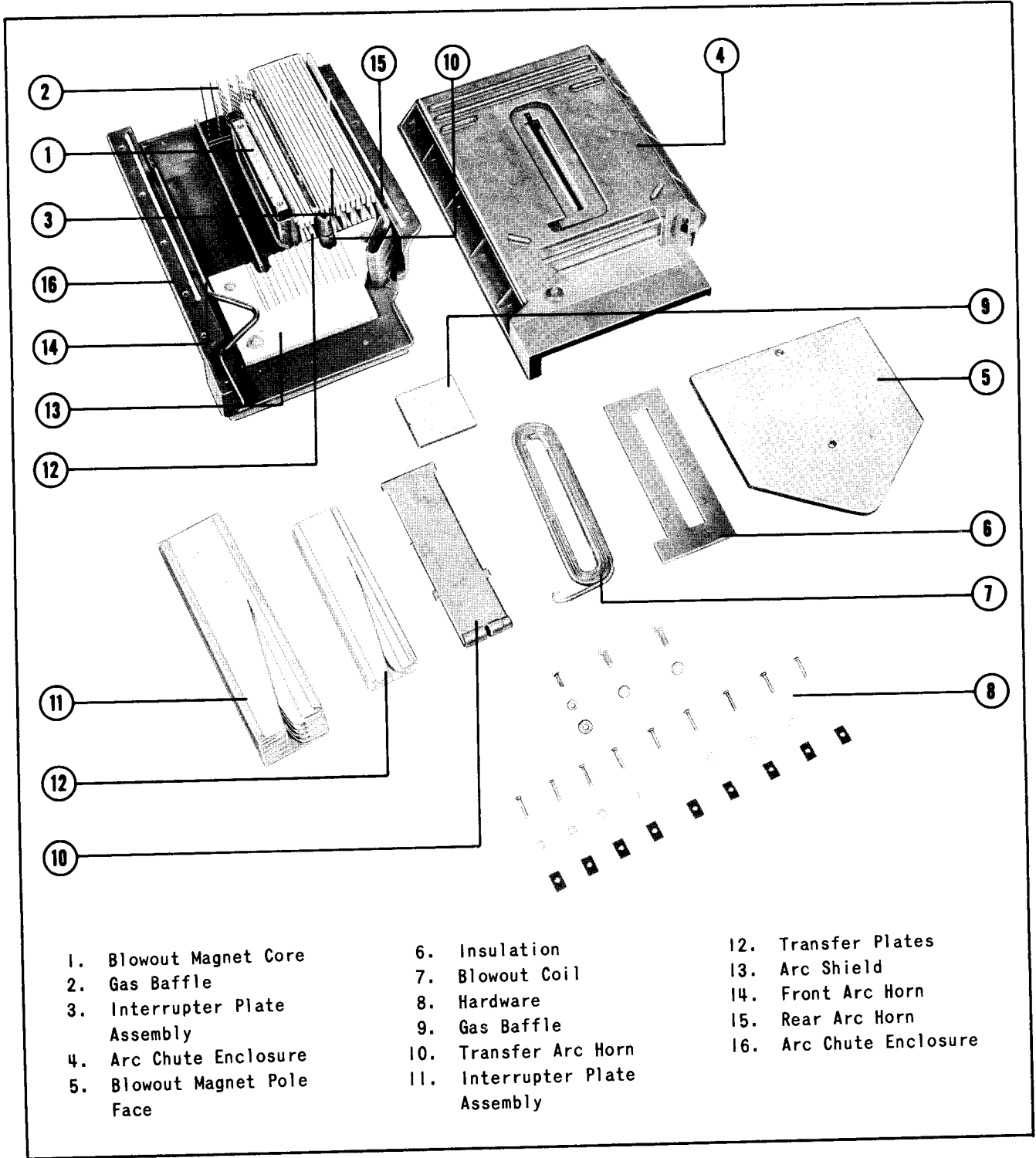
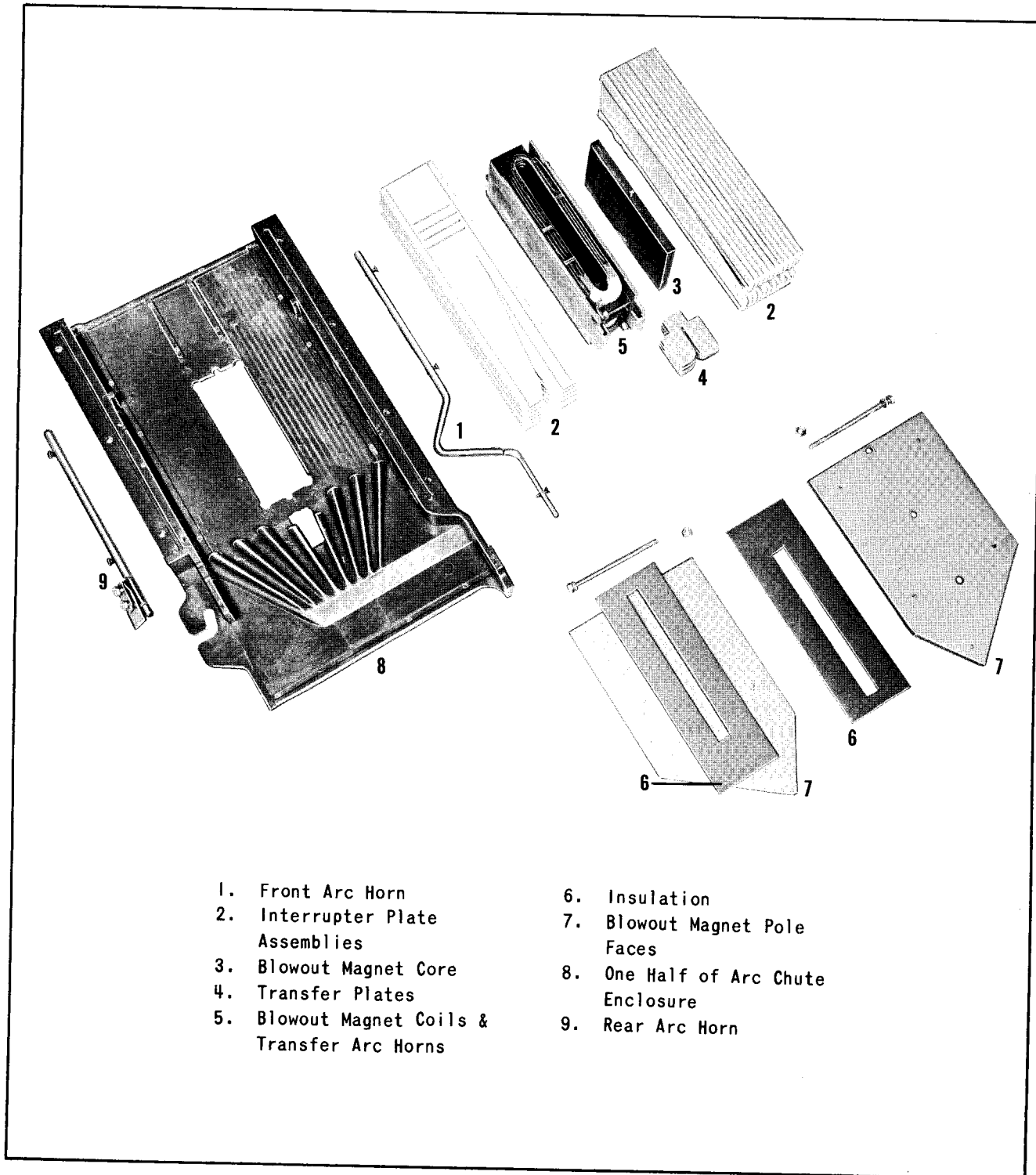
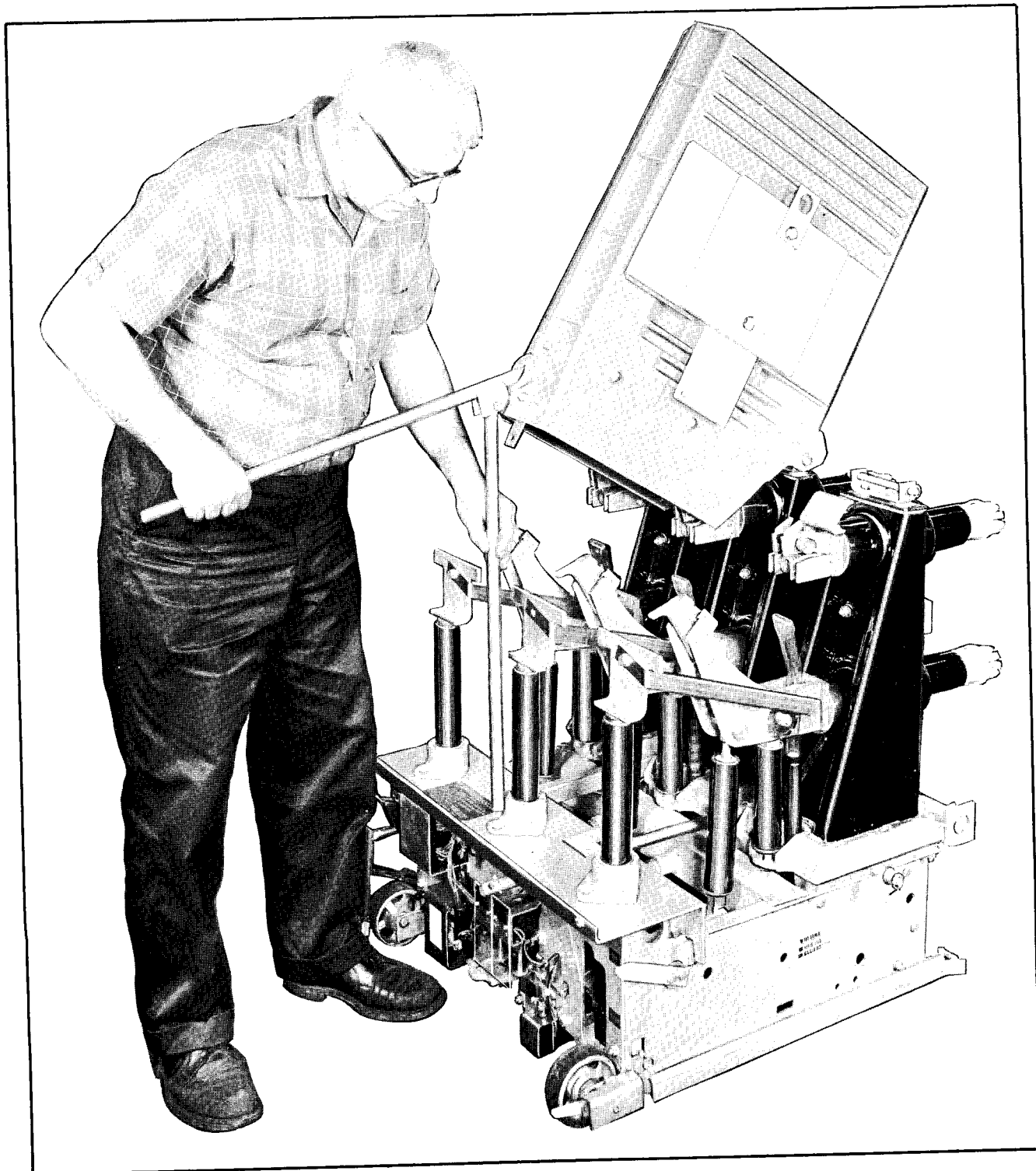


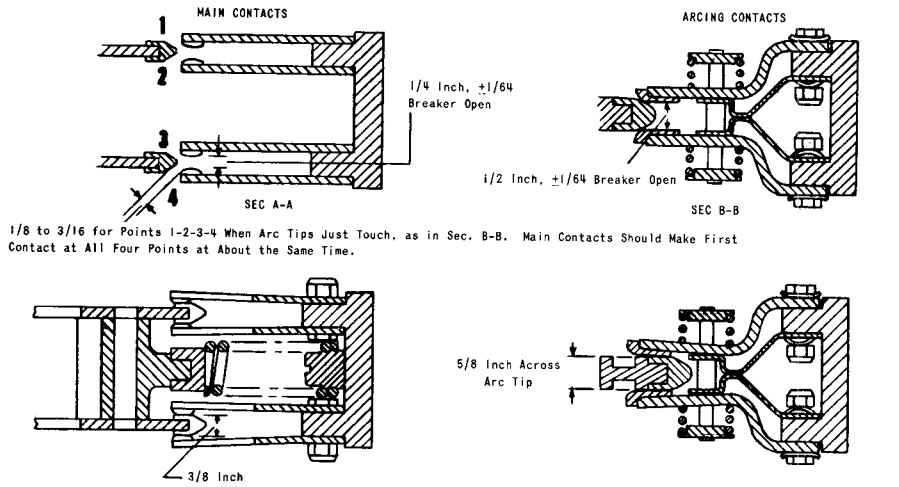
Fig. 18. Partially Assembled View and Details of 50-DH-P250 Arc Chute



*Fig. 19. Arc Chute Details of 50-DH-P75 Breaker*



*Fig. 20. Lifting the Arc Chute of 13.8 KV Breaker with Arc Chute Lifter*



$1/8$  to  $3/16$  for Points 1-2-3-4 When Arc Tips Just Touch, as in Sec. B-B. Main Contacts Should Make First Contact at All Four Points at About the Same Time.

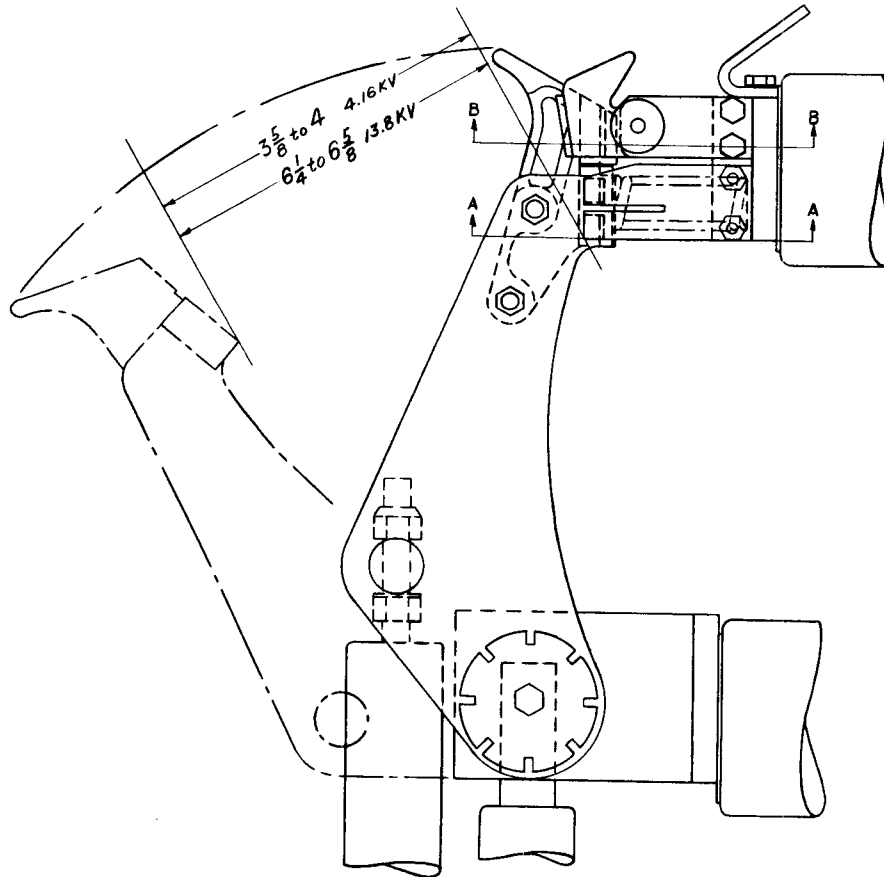
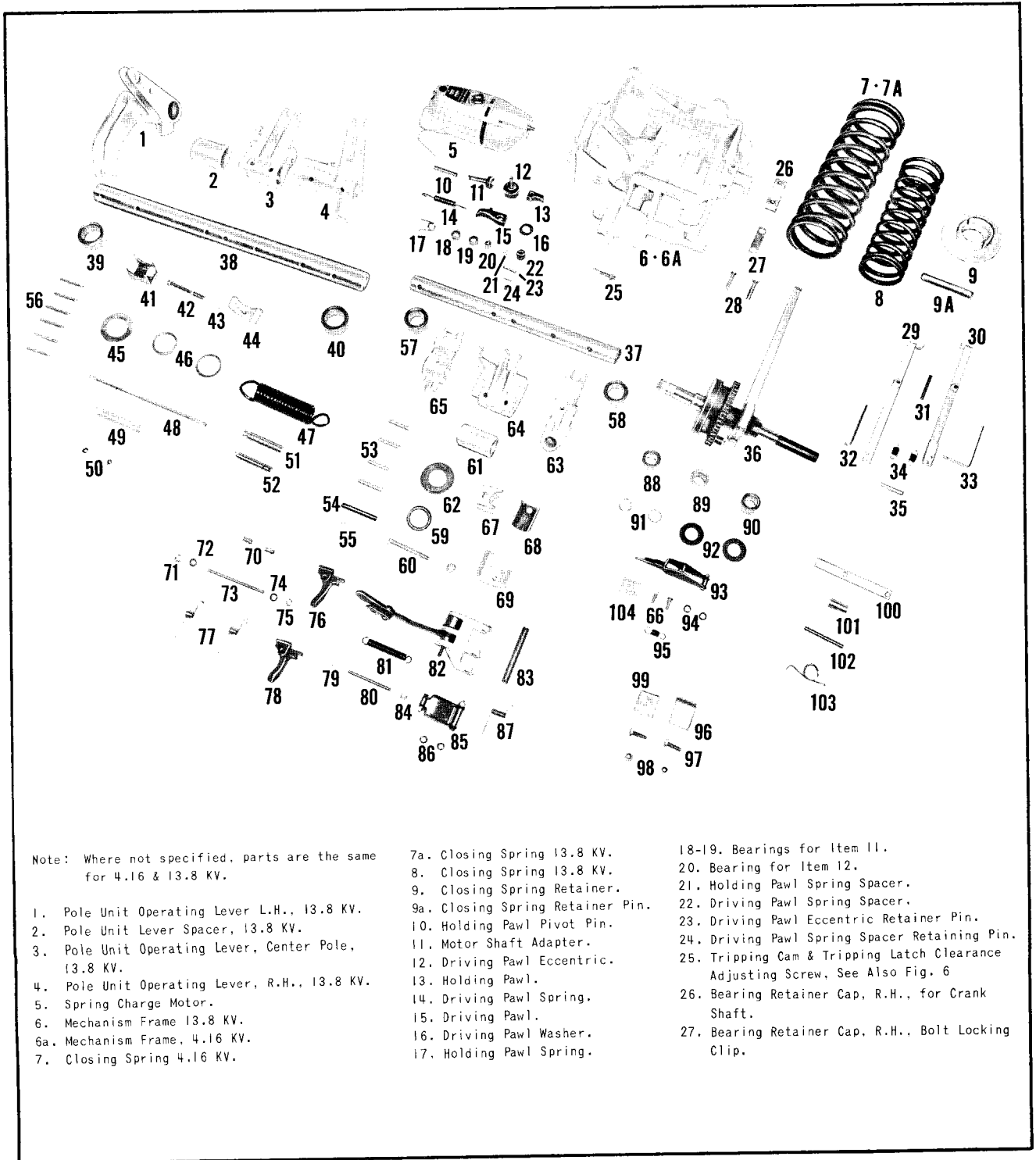


Fig. 21. Drawing of Contacts showing Settings and Movements



Note: Where not specified, parts are the same for 4.16 & 13.8 KV.

- 1. Pole Unit Operating Lever L.H., 13.8 KV.
- 2. Pole Unit Lever Spacer, 13.8 KV.
- 3. Pole Unit Operating Lever, Center Pole, 13.8 KV.
- 4. Pole Unit Operating Lever, R.H., 13.8 KV.
- 5. Spring Charge Motor.
- 6. Mechanism Frame 13.8 KV.
- 6a. Mechanism Frame. 4.16 KV.
- 7. Closing Spring 4.16 KV.

- 7a. Closing Spring 13.8 KV.
- 8. Closing Spring 13.8 KV.
- 9. Closing Spring Retainer.
- 9a. Closing Spring Retainer Pin.
- 10. Holding Pawl Pivot Pin.
- 11. Motor Shaft Adapter.
- 12. Driving Pawl Eccentric.
- 13. Holding Pawl.
- 14. Driving Pawl Spring.
- 15. Driving Pawl.
- 16. Driving Pawl Washer.
- 17. Holding Pawl Spring.

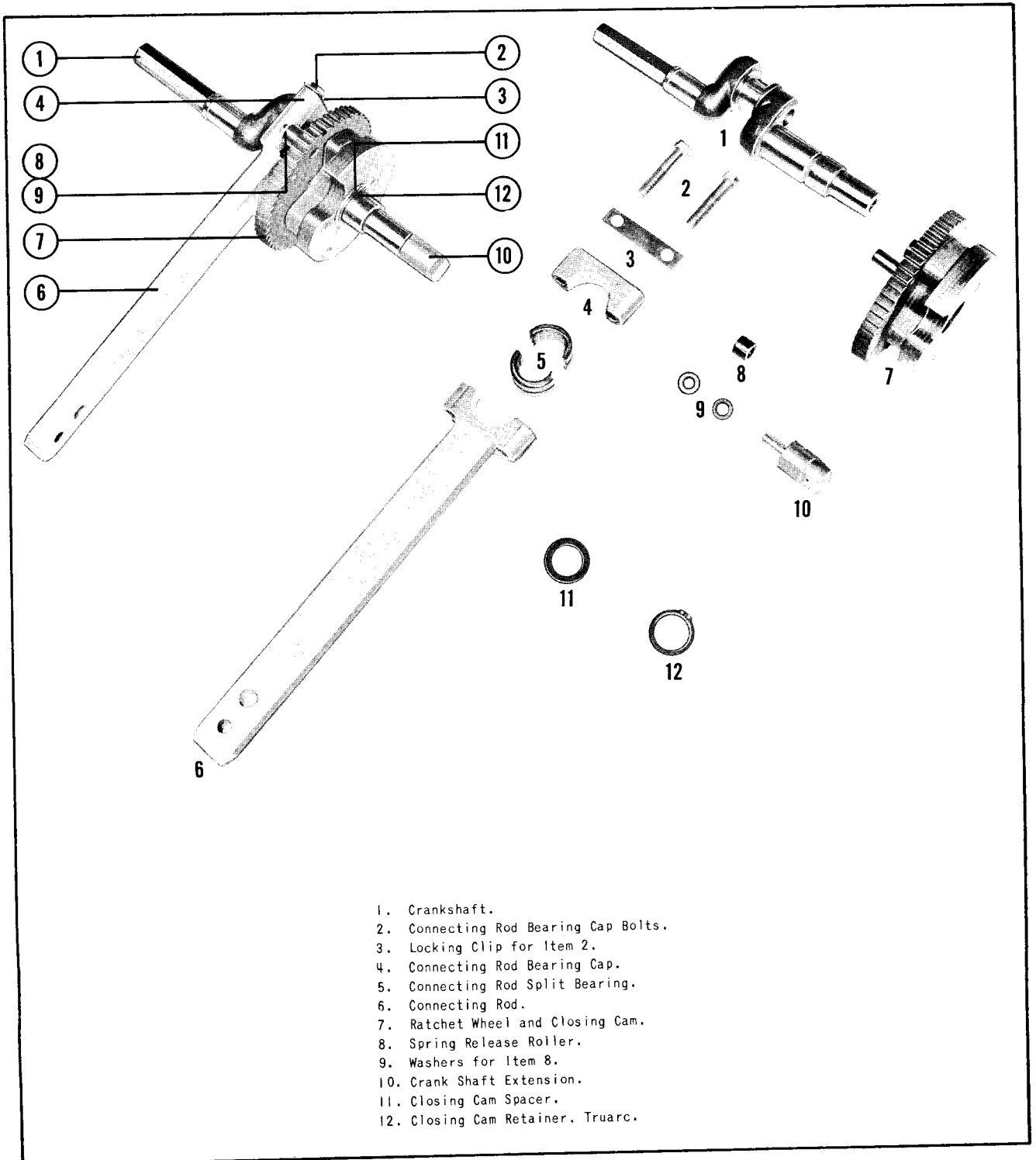
- 18-19. Bearings for Item 11.
- 20. Bearing for Item 12.
- 21. Holding Pawl Spring Spacer.
- 22. Driving Pawl Spring Spacer.
- 23. Driving Pawl Eccentric Retainer Pin.
- 24. Driving Pawl Spring Spacer Retaining Pin.
- 25. Tripping Cam & Tripping Latch Clearance Adjusting Screw, See Also Fig. 6
- 26. Bearing Retainer Cap, R.H., for Crank Shaft.
- 27. Bearing Retainer Cap, R.H., Bolt Locking Clip.

Fig. 22. Parts for Stored Energy Mechanisms

28. Bearing Cap, R.H., Retainer Bolts.
29. Automatic Floor Closing Spring Release Lever See Fig. 6.
30. Floor Interlock & Automatic Tripping Lever, See Fig. 6.
31. Pin for Items 29 & 30.
32. Floor Lever Spring Release Operating Rod, See Fig. 6.
33. Floor Lever Trip Operating Rod, See Fig. 6.
34. Springs for Items 29, 30.
35. Pin for Items 29, 30.
36. Crank Shaft Sub Assembly, See Fig. 23.
37. Pole Unit Operating Shaft, 4.16 KV.
38. Pole Unit Operating Shaft, 13.8 KV.
- 39-40. Bearings for Item 38.
- 41-67. Breaker Interlock Operator.
42. Bolt for Item 41.
43. Lockwasher for Item 42.
44. Anti-Close Interlock Cam.
45. Crank Shaft Washer, See Fig. 6, 13.8 KV.
46. Washers for Item 38.
47. Opening Spring, 13.8 KV.
48. Mechanism Frame Tie Rod.
49. Opening Spring & Mechanism Frame Tie Rod Pin.
50. Mechanism Frame Tie Rod Nuts.
51. Opening Spring Lower Pin.
52. Opening Spring, Upper Pin.
53. Pole Unit Lever Retainer Pins, 4.16 KV.
54. Tripping Cam and Restraining Link Pin.
55. Retainers (Truarc Rings) for Item 54.
56. Pole Unit Lever Retainer Pins, 13.8 KV.
- 57-58. Bearings for Item 37, 4.16 KV, See Fig. 6.
59. Washer for Crank Shaft R.H. End, 5.16 KV.
60. Bolt for Item 67, 4.16 KV.
61. Pole Unit, Lever Spacer.
62. Washer for Crank Shaft R.H. End 4.16 KV, See Fig. 6
63. Pole Unit Lever R.H. Pole.
64. Pole Unit Lever Center Pole.
65. Pole Unit Lever L.H. Pole.
66. Spring Release Latch Stop Bolts.
67. Anti-Close Interlock Operator.
68. Shim for Item 69.
69. Anti-Close Interlock Cam.
70. Tripping Trigger and Spring Release Trigger Pin Spacers.
- 71-75. Retainers (E Rings) for Item 73.
- 72-74. Washers for Item 73.
- 76-78. Tripping Trigger and Spring Release Trigger.
77. Springs for Items 76 & 78.
- 79-84. Spacers for Tripping Latch, Item 85.
80. Tripping Latch Pivot Pin.
81. Tripping Cam Spring.
82. Tripping Cam, Retainer Links and Roller Lever Sub-Assembly, See Fig. 24.
83. Closing Cam Follower Roller Pin.
85. Tripping Latch, See Fig. 24.
86. Washers for Item 80.
87. Tripping Latch Spring.
- 88-90. Crank Shaft Bearings.
89. Crank Shaft Spacer.
91. Crank Shaft Retainers (Truarc).
92. Crank Shaft Washers.
93. Spring-Release Latch, See Fig. 7.
94. Spring-Release Latch Stop Spacers, See Items 104,105.
95. Spring-Release Latch Spring.
96. Tripping Cam Follower Bumper.
97. Bolts for Item 96.
98. Nuts for Item 97.
99. Retainer Plate for Item 96.
100. Motor Limit Switch Operating Lever.
101. Spacer for Item 100.
102. Pin for Item 100.
103. Spring for Item 100.
104. Spring Release Latch Stop.

Fig. 22.

*Parts for Stored Energy Mechanisms*



*Fig. 23. Stored Energy Mechanism Parts for Crank Shaft Sub Assembly*

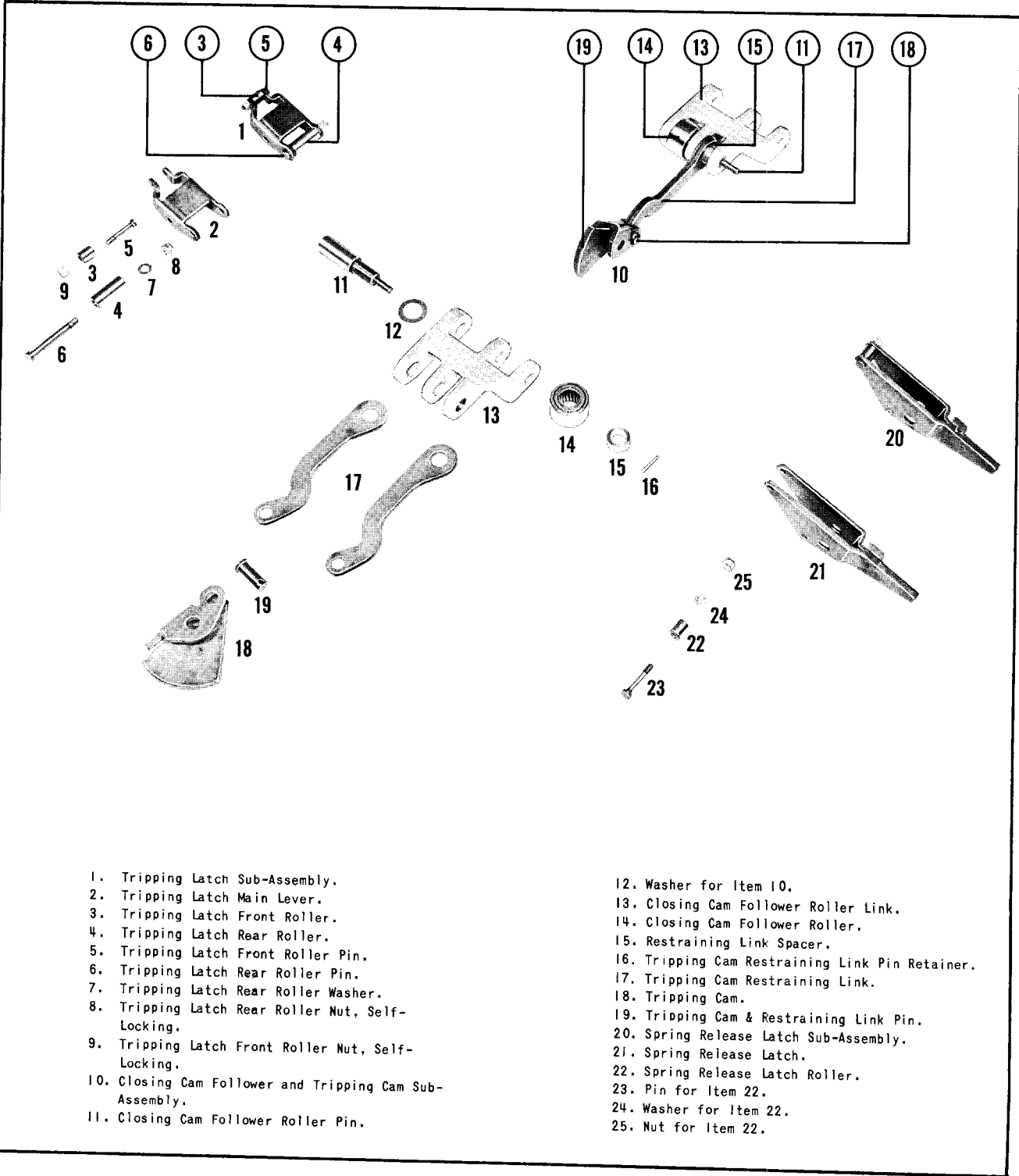
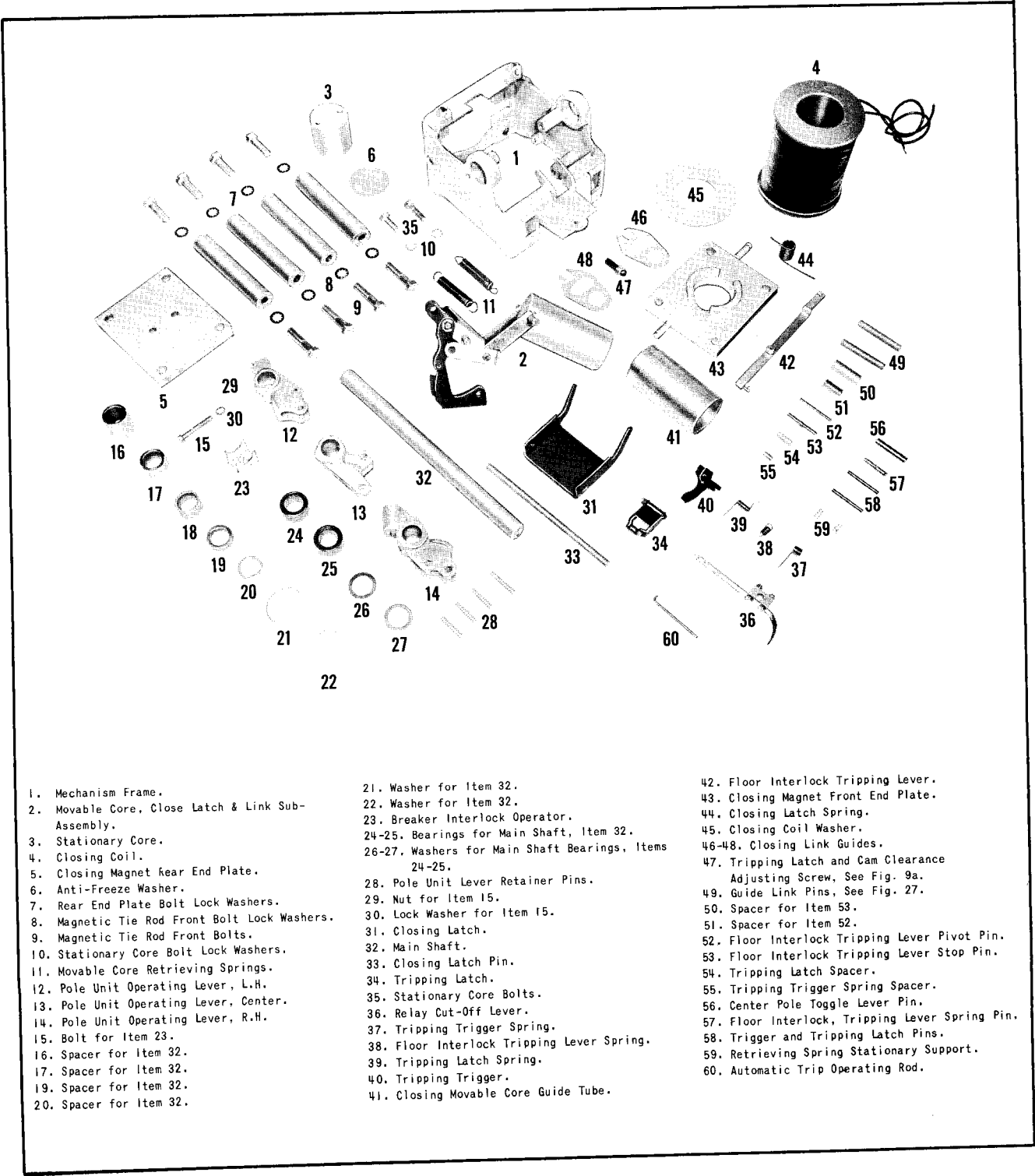


Fig. 24. Stored Energy Mechanism Parts for Close and Trip Sub Assemblies



- |   |  |   |
|---|--|---|
| <ul style="list-style-type: none"> <li>1. Mechanism Frame.</li> <li>2. Movable Core, Close Latch &amp; Link Sub-Assembly.</li> <li>3. Stationary Core.</li> <li>4. Closing Coil.</li> <li>5. Closing Magnet Rear End Plate.</li> <li>6. Anti-Freeze Washer.</li> <li>7. Rear End Plate Bolt Lock Washers.</li> <li>8. Magnetic Tie Rod Front Bolt Lock Washers.</li> <li>9. Magnetic Tie Rod Front Bolts.</li> <li>10. Stationary Core Bolt Lock Washers.</li> <li>11. Movable Core Retrieving Springs.</li> <li>12. Pole Unit Operating Lever, L.H.</li> <li>13. Pole Unit Operating Lever, Center.</li> <li>14. Pole Unit Operating Lever, R.H.</li> <li>15. Bolt for Item 23.</li> <li>16. Spacer for Item 32.</li> <li>17. Spacer for Item 32.</li> <li>19. Spacer for Item 32.</li> <li>20. Spacer for Item 32.</li> </ul> | <ul style="list-style-type: none"> <li>21. Washer for Item 32.</li> <li>22. Washer for Item 32.</li> <li>23. Breaker Interlock Operator.</li> <li>24-25. Bearings for Main Shaft, Item 32.</li> <li>26-27. Washers for Main Shaft Bearings, Items 24-25.</li> <li>28. Pole Unit Lever Retainer Pins.</li> <li>29. Nut for Item 15.</li> <li>30. Lock Washer for Item 15.</li> <li>31. Closing Latch.</li> <li>32. Main Shaft.</li> <li>33. Closing Latch Pin.</li> <li>34. Tripping Latch.</li> <li>35. Stationary Core Bolts.</li> <li>36. Relay Cut-Off Lever.</li> <li>37. Tripping Trigger Spring.</li> <li>38. Floor Interlock Tripping Lever Spring.</li> <li>39. Tripping Latch Spring.</li> <li>40. Tripping Trigger.</li> <li>41. Closing Movable Core Guide Tube.</li> </ul> | <ul style="list-style-type: none"> <li>42. Floor Interlock Tripping Lever.</li> <li>43. Closing Magnet Front End Plate.</li> <li>44. Closing Latch Spring.</li> <li>45. Closing Coil Washer.</li> <li>46-48. Closing Link Guides.</li> <li>47. Tripping Latch and Cam Clearance Adjusting Screw, See Fig. 9a.</li> <li>49. Guide Link Pins, See Fig. 27.</li> <li>50. Spacer for Item 52.</li> <li>51. Spacer for Item 52.</li> <li>52. Floor Interlock Tripping Lever Pivot Pin.</li> <li>53. Floor Interlock Tripping Lever Stop Pin.</li> <li>54. Tripping Latch Spacer.</li> <li>55. Tripping Trigger Spring Spacer.</li> <li>56. Center Pole Toggle Lever Pin.</li> <li>57. Floor Interlock, Tripping Lever Spring Pin.</li> <li>58. Trigger and Tripping Latch Pins.</li> <li>59. Retrieving Spring Stationary Support.</li> <li>60. Automatic Trip Operating Rod.</li> </ul> |
|---|--|---|

Fig. 25. Parts for Solenoid Mechanism, 4.16 KV

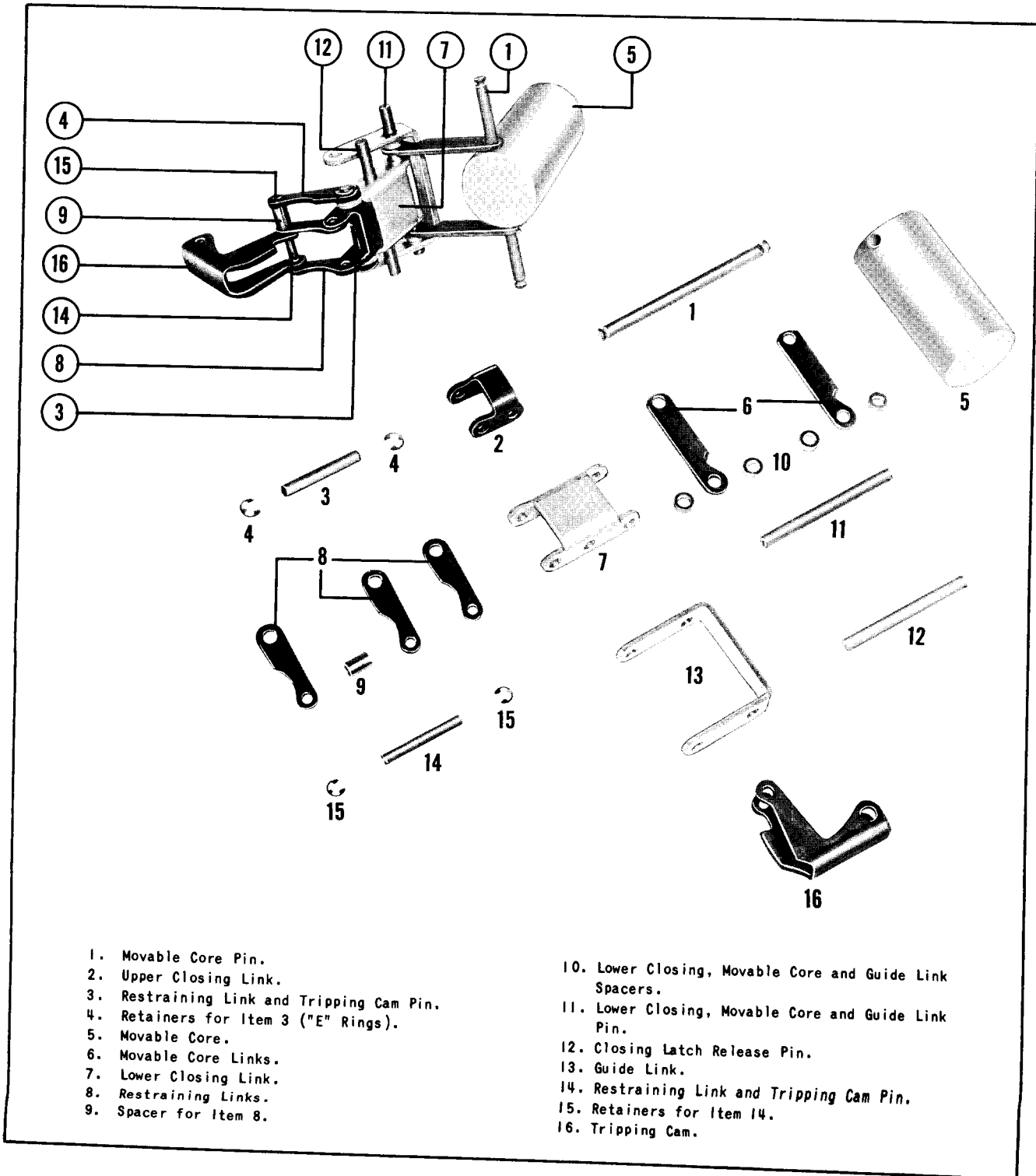


Fig. 26. Solenoid Mechanism, 4.16 KV

This is done by the floor interlock and automatic tripping levers pointed out in Figs. 6c and 9c. In operation, the rear end of this lever is pushed upward by a cell floor cam on the very first movement of the breaker from the test position toward the energized position, or from the energized position toward the test position.

The lifting of this lever, through its connected linkage, lifts the tripping trigger, and the floor cam holds it in this tripped position as long as the breaker is not at one of its limits of travel. If there is an attempt to close the breaker while it is not completely in the energized or test position, the mechanism will make a trip free operation and the breaker contacts will not close.

#### AUTOMATIC FLOOR TRIPPING AND CLOSING SPRING RELEASE

On breakers with stored energy mechanisms, the floor interlock and automatic tripping lever also acts to lift the tripping trigger as the breaker is withdrawn from the cell from the test position. This, together with the automatic floor closing spring release, acts to discharge the closing spring and open the breaker as it comes from the cell so that it is completely dead mechanically. The closing spring release trigger is lifted so that, if the closing spring is charged, it will discharge the spring by closing the breaker if it is open, or by a trip free operation. The floor tripping lever will then open the breaker if it is closed, as described above.

Thus, as the breaker is withdrawn from the test position, 2 mechanical noises may be heard, the closing of the breaker and the opening of the breaker.

#### SECONDARY CONTACTS

The 15 point secondary contact block is mounted on a slidable plate on the inside

of the left hand chassis side plate. This sliding plate is operated by a round folding rod with a "T" handle, extending from the L.H. upper corner of the mechanism panel. Above this rod is the secondary contact levering handle. The round rod is notched so as to normally be keyed to the mechanism panel. Thus, when the breaker is in the test position, the secondary contact block is normally disconnected and in the forward position against the rear of the chassis.

When you wish to operate the breaker electrically while it is in the test position the folding bar is lifted to the horizontal position enough to unhook it from the panel, and pushed to the rear until the cross-pin goes into the slots in the levering handle, as shown in Figs. 4a and b, which is then pressed down to make final engagement of the secondary contacts.

For further operating details see BASIC OPERATING INSTRUCTIONS.

#### RAIL LATCH

The purpose of the rail latch is as follows.

1. It prevents accidental damage to the cell levering - in device screw or the nut on the breaker. Without this rail latch, the screw and possibly nut would be damaged if the breaker were pushed into the cell so as to bump the nut hard against the end of the screw.
2. It holds the breaker in the test position.

The rail latch has two catching dogs, one on each side of the pivot, which can engage notches on the guide rail. A spring normally holds the front dog down against the rail so that as the breaker is pushed into the cell, the front dog will drop into the rear notch and prevent further movement. If an attempt is made to override the latch by pressing down on it as the breaker is rolled in, the rear dog will

catch in the front notch and prevent further movement.

When it is desired to lever the breaker into the energized position, the rail latch is pressed down (it can conveniently be done with the foot) and the breaker is pushed 1/4 to 3/8 inch so as to get the levering device nut against the screw.

When levering the breaker out, it should be pulled slightly forward after the nut has run off the screw, to engage the rail latch. The rail latch must be released to withdraw the breaker from the cell.

For further operating details, see BASIC OPERATING INSTRUCTIONS.

#### PUFFER

The purpose of the puffer is to speed up the interruption of currents below a few hundred amperes. As shown in Figs. 11 and 12, it is part of the main chassis casting, which also serves as a tie member for the chassis side sheets, the support for the pole units and an open position bumper.

An oval shaped cavity extending across the chassis serves as the puffer and bumper cylinder. A piston containing a plastic ring pushed outward by an expander is linked to the mechanism so as to move upward as the breaker opens. The cylinder has 3 openings which allow air to exhaust into the puffer tubes under the breaker contacts. The piston moves past the puffer openings for about 1/4 inch and compresses the trapped air. This acts as a shock absorber to reduce the mechanical shock of opening.

#### MECHANISM PANEL

The mechanism panel has mounted on it externally for easy reach, the tripping magnet or magnets, spring release magnet

for the stored energy mechanism and the accompanying hand operating triggers. Also are the auxiliary switches, the motor limit switch and spring charge indicator for the stored energy mechanism, the latch check switch, position indicator, operation counter, access window for the maintenance closing by hand, spring charging and under voltage and transformer trip devices, if any.

#### CLOSING SPRING HAND CHARGE DEVICE FOR STORED ENERGY MECHANISM

Breakers equipped with the stored energy mechanism can be closed safely without electric power. The closing spring can be charged by hand and released by hand to close the breaker. See Fig. 5a.

On the 4.16 KV breaker, the hexagonal end of the crank shaft extends slightly through the R.H. side sheet of the chassis. On the 13.8 KV breaker the hexagonal end of the crank shaft ends just to the left through the maintenance closing access window. A ratchet wrench is provided to fit on the end of the crank shaft. A few downward strokes charge the spring. When charging is complete the crank pin snaps over center with an audible "click". DO NOT ATTEMPT TO CHARGE ANY FURTHER.

The breaker may now be closed by lifting the spring release trigger plunger, behind the Plexiglass guard marked "Lift to Close".

#### MAINTENANCE CLOSING AND OPENING

A maintenance closing socket is located on the main pole unit operating shaft. A maintenance closing handle is provided which can be inserted into the socket through a window in the mechanism panel. This operation is solely for the purpose of inspecting and adjusting contacts or other working parts of the breaker, when slow motion may be required.

When the breaker has been levered beyond the test position, a flag covers the window to prevent insertion of the maintenance handle. Don't attempt to push the flag out of the way to insert the handle. **DON'T EVER ATTEMPT TO CLOSE THE BREAKER BY HAND AGAINST A LIVE CIRCUIT. PROPER CLOSING REQUIRES MORE SPEED AND POWER THAN CAN BE SUPPLIED BY HAND POWER.**

When the maintenance closing handle is used, the control circuit should be entirely disconnected to prevent accidental electrical operation at the same time.

**IF THE BREAKER IS CLOSED AND LATCHED WITH THE MAINTENANCE CLOSING HANDLE BE SURE TO REMOVE IT FROM THE SOCKET BEFORE TRIPPING THE BREAKER.**

For further operating details, see BASIC OPERATING INSTRUCTIONS.

## POLE UNITS

The pole units, as shown in Figs. 15 and 16 for 4.16 KV and 13.8 KV respectively, are complete sub assemblies. The porcelain supports contain the main studs and contact blocks permanently anchored in the porcelain. The porcelain supports are permanently anchored in the pole unit base casting. All other pole unit members are bolted or pinned on. These comprise the movable and stationary contacts, the contact lift rod, the disconnecting contacts and the arc chute hinge bracket.

The pole unit is fastened to the chassis by 4 bolts through the pole unit base casting. When the 3 poles are mounted on the breaker, they are tied together with a glass polyester brace as shown in Fig. 14.

## CONTACTS

Figures 15 and 16 show respectively 4.16 and 13.8 KV 1200 and 2000 ampere pole

units and all pole unit details, including contacts. They are of the general type known as wedge and fingers. The contact make and break details for 1200 amperes are the same for 4.16 KV and 13.8 KV breakers. Those for 2000 amperes are also the same for 4.16 kV and 13.8 KV breakers.

The stationary main current carrying contacts, shown below the arcing contacts, are made of zirconium copper, silver plated and with anti-weld main current carrying inserts. The zirconium copper acts as its own spring and no other spring is required. In the 1200 ampere breaker there are a total of 4 contact members, each slotted part way, making a total of 8 contact points.

In the 2000 ampere breaker the main contacts are similar but somewhat wider, and have 2 slots in each member, making a total of 12 points of contact.

The arcing contacts are the same for all ratings of breakers. They also are made of zirconium copper but of heavier material with silver-tungsten arc tips. For this reason they are not tightly bolted to the contact block but can pivot slightly, under spring pressure. They are backed up by compression springs. A stop is in the center to limit inward travel.

In operation, the arcing contacts make first on closing and break last on opening. For best performance it is important that the individual contact movement be about the same on each side of the entering wedge. These are set at the factory. Extensive closing and opening tests, interrupting both high and low currents, show that the contacts will maintain proper adjustment for long periods.

## ARC CHUTES

Figures 2a, 2b and 2c illustrate the general appearance of the 50-DH-P75, 50-DH-P250

### To Adjust the Hinge:

1. Disconnect the lift rod.
2. Tighten hinge nut until movable contact arms will stand at about  $45^\circ$  without falling.
3. Tighten hinge nut one more flat (1/6 turn).

### CONTACT REPLACEMENT

Switching operations, especially relay or fault openings of the breaker will cause contact deterioration. On the arc tips, part of the metal will be burned or vaporized on each circuit interruption. The higher the current interrupted, the faster will be the deterioration. For this reason there can be no definite rule for replacing contacts after a given number of fault openings or switching operations. In laboratory tests, as many as 15 openings, starting at 500 amperes and going by steps to 37,500 amperes have been made without contact replacement.

The burning away of the arc tips causes a change in the arc tip adjustment and in the relation of arc tips to main contacts. As shown in Fig. 21:

1. The distance between new arcing contact fingers with breaker open is normally  $1/2$  inch. With the breaker closed, it is  $5/8$  inch, making a nominal movement of  $1/16$  inch for each contact of a pole unit pair.

Burning action and mechanical wear will gradually decrease this movement from  $1/16$  inch to a smaller measurement. This movement should not be allowed to become less than  $1/32$  inch or arc tip pressure will get too low and excessive burning will occur on main contacts.

2. Referring again to Fig. 21, it will be seen that the gap between main contacts should be approximately  $3/16$  inch when the arc tips touch. As the arc tips burn away this gap will decrease. If it becomes too low, excessive burning will occur on main contacts. This gap should not be allowed to become less than  $3/32$  inch.

To correct both gaps in (1) and (2) above, bend arcing contacts inward by light blows with a mallet, not a metal hammer, and check by measurement. Distance between arcing contacts should not be made less than  $1/2$  inch  $\pm 1/64$ .

This mallet adjustment can be done several times before the arc tips should need to be replaced.

The arcing contact fingers and the movable contact casting should be replaced when the thickness of the silver tungsten tips on the fingers at the points of first contact has decreased to  $1/16$  inch.

The main current carrying contact deterioration will be mainly caused by mechanical wear. There may be a small amount of pitting caused by opening very heavy faults. Generally the main contacts will last several times as long as the arcing contacts.

Wear on the mains can be compensated for by bending with a mallet, as with the arcing contacts.

Replacement should be made when the thickness of the finger insert has been reduced to about  $1/32$  inch. Under ordinary distribution service conditions this should not be necessary for many years.

### STORED ENERGY MECHANISM

Close the breaker by spring power and open by normal tripping action. Try charging spring electrically and also by

hand. In either case, at the completion of the charging operation there should be an audible "click" as the crank arm goes over center. With electrical charging the motor should automatically cut off at the sound of the click. With hand charging, the handle will tend to run away from the hand for a short distance as the click is heard. No more force should be put on the ratchet handle after that point, as it simply puts a high load on the spring release latch and related parts.

In these operations, closing and opening should be snappy, without hesitation or sluggishness. Under normal circumstances, that is if there are no signs of shipping damage or of anything interfering with mechanical movement, this is a satisfactory check for closing and opening of a breaker before placing it in service.

With the breaker open and spring charged, as in Fig. 7b, there are two important points where there must be enough clearance for satisfactory operation.

1. Referring to Fig. 7b, the clearance between the rear roller of the tripping latch and the vertical surface of the tripping cam should be  $1/32$  to  $1/16$  inch. If there is no clearance at all, the tripping latch roller cannot drop into place and the tripping trigger can not reset to the untripped position. Therefore, the breaker will not close. This clearance can be adjusted by the screw on the front of the frame under the handling dolly tongue, as shown in Fig. 6. In order to see this clearance it is necessary to look from the bottom. To do this it is easiest to turn the breaker carefully over on its side, as shown in Fig. 6. First loosen the lock nut. Turn the screw with a screwdriver, clockwise to decrease clearance, hold and retighten the locknut.

2. The clearance between the closing cam follower roller and the closing cam,

looking at Fig. 7b, should be  $1/32$  to  $1/16$  inch. On the breaker, this can best be seen from the rear of the chassis. This clearance can be adjusted at the two operating rods of the puffer piston. When the breaker is fully open, the puffer piston should be at the top limit of its travel. With the piston held in this position, adjust piston operating rods to proper clearances of the roller. Lengthening rods increases clearance.

#### SOLENOID MECHANISM, INSPECTION AND ADJUSTMENT

Close and open the breaker several times electrically with normal control voltage. Operation should be snappy and without hesitation or sluggishness. Note whether or not contacts come to the proper position when closed, as shown in Fig. 21. If there are no signs of shipping damage or of anything interfering with mechanical movement, this is a satisfactory check for the closing and opening of the breaker before placing it in service.

As a further check on mechanism adjustment, refer to Fig. 10c. As indicated the clearance between the tripping latch rear roller and the tripping cam should be  $1/32$  to  $1/16$  inch. This is necessary for proper resetting. Referring to Fig. 9a this adjustment is made by turning the tripping cam and tripping latch adjusting screw. Counterclockwise turning increases clearance.

#### LATCH CHECK SWITCH ADJUSTMENT

Refer to Fig. 11a. The latch check switch is a Micro Switch which makes contact when the tripping trigger is in the fully reset position ready for the breaker to close. Where the tripping trigger is not reset, the latch check switch is open. When properly connected in the control circuit it will not allow the closing circuit to be energized until the mechanical resetting of the tripping trigger is complete.

The micro switch operating arm is of tough steel and is subject to only very light forces. It is set at the factory and should remain in adjustment unless tampered with. It is adjustable by bending the arm slightly. Correct adjustment is for the micro switch to make contact when the tripping trigger is  $1/8$  to  $3/16$  from its completely reset position, measured at the center of the trip plunger stem.

#### MOTOR LIMIT SWITCH ADJUSTMENT

Referring again to Fig. 11a the motor limit switch stops the motor of the stored energy mechanism after spring charging is complete. It is a single pole double throw switch, operated by a lever extending outward from behind the panel. Adjustment is by turning the hexagonal bolt located head-down at the front end of the operating lever.

With closing spring uncharged, screw the bolt until the lower contacts of the limit switch make. Continue turning downward to get about  $1/16$  inch overtravel on the switch. When the closing spring is charged, the clearance between the bolt head and switch push button should be  $1/32$  to  $1/16$  inch.

#### MECHANICAL TIMING

The mechanical operating speed of the breaker should be satisfactory as received. Some users include timing as part of inspection and maintenance. If or when a mechanical timing check is made, such as with a graphic timing recorder, the following values and limits should be obtained. Contact speed and separation should be measured or referred to the points of contact break shown in Fig. 21.

##### Closing

4.16 KV Breakers 7 to 9 ft. per sec., min.  
13.8 KV Breakers 8 to 10 ft. per sec., min.

#### NOTE:

Measure closing speed at maximum slope before contacts touch.

##### Opening

Inches traveled in first cycle after contact parting.

4.16 KV Breakers 1-3/4 to 2 in., min.  
13.8 KV Breakers 2-3/4 to 3 in., min.

#### ARC CHUTE INSPECTION AND MAINTENANCE

The insulation parts of the arc chute remain in the circuit across the contacts at all times. During the time that the contacts are open, these insulating parts are subjected to the full potential across the breaker. Ability to withstand this potential depends upon the care given the insulation.

Particular care should be made at all times to keep the arc chutes dry. The materials in the arc are not much affected by humidity but the ceramic material especially will absorb liquid water. Hence these words of caution.

On general inspections, blow-out the arc chutes with dry compressed air by directing the stream upward from the contact area and out through each of the slots between the arc splitter plates. Also direct the dry air stream thoroughly over the arc shields. These are the ceramic liners in the lower end of the chute where the arc is drawn.

The arc chutes should be inspected each time the contacts are inspected. Remove any residue, dirt, or arc products with a cloth or by a light sanding. Do not use a wire brush or emery cloth for this purpose because of the possibility of embedding conducting particles in the ceramic material.

When inspecting an arc chute, look for the following:

1. Broken or Cracked Ceramic Parts. Small pieces broken from the ceramics, or small cracks are not important. But large breaks and particularly cracks extending from the inverted V slot in the interrupter plates out to the edge of the plate or to the top may interfere with top performance of the interrupter. Hence if more than one or two broken or badly cracked plates are apparent, renewal of the ceramic stack is indicated.

2. Erosion of Ceramics. When an arc strikes a ceramic part in the arc chutes, the surface of the ceramic will be melted slightly. When solidified again, the surface will have a glazed whitish appearance. At low and medium current, this effect is very slight. However, large current arcs repeated many times may boil away appreciable amounts of the ceramic. When the width of the slot at its upper or narrow end (originally 1/16 inch) has been eroded to twice its original size, (about 1/8 inch), the ceramic stack assembly should be replaced.

3. Dirt in Arc Chute. In service the arc chute assembly will become dirty from three causes. First, dust deposited from the air which can readily be blown out of the chute with a dry compressed air stream. Second, loose soot deposited on the inside surfaces of the arc chute in the lower portions near the contacts which may be removed by wiping with cloths free of grease or metallic particles. Third, very tightly adhering deposits from the arc gases on the ceramic arc shields near the contacts. These deposits from the metal vapors boiled out of the contacts and arc horns, may accumulate to a harmful amount in breakers which receive many operations at low or medium interrupted currents.

4. Cleaning Arc Shields. Cleaning methods for the first two types of dirt are obvious as mentioned above. Particular attention should be paid to any dirt on the plastic surfaces below the ceramic arc shield. Wipe clean if possible. If wiping will not remove the dirt, clean with sand paper to remove all traces of carbon or metallic deposit. On breakers which receive thousands of operations at low and medium interrupted currents, tightly adhering dirt may accumulate on the ceramic arc shields sufficiently to impair proper interrupting performance. These arc shields are of a very hard material and a hard non-conducting abrasive is necessary for cleaning. The best and easiest way to clean them is by sand blasting, NOT SHOT BLASTING, if a sand blasting outfit is available. Next best is a flexible abrasive disc on an electric drill with medium grain aluminum oxide discs.

The ceramic arc shields may appear dirty and yet have sufficient dielectric strength. The following insulation test may be used as a guide in determining when this complete or major cleaning operation is required. The arc chutes should withstand 15 KV, 60 cycle for one minute between the front and rear arc horns. Also the dirty surface of the ceramic near the contacts should withstand in the order of 5 to 10 KV per inch when test prods are placed directly on the ceramic surface. When test voltage is applied, there should be no luminous display.

#### LUBRICATION

The most reliable performance on both the stored energy and solenoid mechanism can be obtained by lubrication. All parts which require it are lubricated with "molly" (molybdenum polysulphide) Westinghouse M. No. 8577-3 when assembled. You should lubricate some items at the regular maintenance period. Other parts normally should require lubrication only after long

periods, such as several years. Otherwise it should be done at any time the breaker appears slow or sluggish in opening or closing or where bearings may be clogged with dirt.

At the 2000 Operation Maintenance Period.

Lubricant: Light Machine oil or auto crank case oil.

4.16 KV and 13.8 KV Stored Energy Mechanism.

Points to lubricate, applied sparingly:  
Front and rear tripping latch rollers and pivot pin.

Tripping trigger pivot pin.

Spring release latch roller and pivot pin.

Spring release trigger and pivot pin.

Tripping cam pivot pin and restraining link pin.

4.16 KV and 13.8 KV Solenoid Mechanism.

Points to lubricate, applied sparingly:

Front and rear tripping latch rollers.

Tripping trigger pivot pin.

All pins in closing and tripping linkage.

Check the condition of the solenoid movable core. If surrounding conditions are very dirty, it may pick up dirt and become sluggish in resetting. An application of machine oil will usually free it for a large number of operations. Where the dirt condition persists it eventually will be necessary to remove the core, clean it and the inside of the guide tube or cavity with a rag and cleaner and relubricate with grease, Westinghouse M. No. 9921-4. A grease sold under the trade name "Molycote" may also be used.

Roller Bearings on all Mechanisms.

On the stored energy mechanisms there are roller bearings on the main pole unit shaft, crank shaft and connecting rod, and closing cam follower. On the solenoid mechanisms

there are roller bearings on the main pole unit shaft.

These bearings are packed at the factory with a top grade slow oxidizing grease which normally should be effective for some years. They should not be disturbed unless there is definite evidence of sluggishness, dirt or unless the parts are dismantled for some other reason.

If it does appear advisable, the bearings and related parts should be thoroughly cleaned of old grease in a good grease solvent such as kerosene or household dry cleaner, except carbon tetrachloride. They should then be washed in light machine oil until the cleaner is removed. After the oil has drained off they should be packed with grease, Westinghouse M. No. 9921-4 or "Molycote". If parts other than the above mentioned roller bearings are dismantled, they should be cleaned in the same way and relubricated with Westinghouse M. No. 8577-3.

#### STORED ENERGY MECHANISM, REMOVING & INSTALLING SPRING CHARGE MOTOR.

The spring charging motor can be expected to last under normal conditions for more than 10,000 closing operations without requiring removal or replacement. If or when it might be necessary due to some unusual condition, proceed as follows:

1. See Fig. 14. Remove barrier mounting plate.

2. Turn breaker so that it rests on its R. H. side as viewed from front of cell. Use wood blocks such as pieces of 2 x 4's under R. H. pole unit to hold it near level on floor.

3. See Fig. 11b. Remove panel mounting bolts, L. H.

4. Remove L.H. side plate mounting bolts. These fasten the side plate to end of puffer casting.

5. Remove the 4 bolts that hold motor to mechanism. These are vertical bolts and go into place from above when breaker is in the normal upright position. Two of the bolts can be removed from the normal top side with a socket wrench. The other two can be removed from the normal under side with an open end wrench or box spanner.

6. Lift left hand side plate up enough to lift motor away from its coupling and withdraw it from the breaker.

7. Install in reverse order.

#### Removal of Closing Spring

Under normal conditions it should not be necessary to remove the closing spring during the useful life of the mechanism. If it should be necessary due to accident or other unusual condition, proceed as follows:

1. See Fig. 14. Remove idler link and pin.

2. Use a fixture consisting of a notched piece of 1-1/2 inch pipe about 8 inches long, a piece of 1/2 inch rod threaded 1/2-13 about 14 inches long, a thick washer about 2 inches outside diameter with a clearance hole for the 1/2 inch rod and a 1/2-13 nut.

3. Place notched pipe with notch over closing spring retainer pin.

4. Screw threaded rod into hole in end of connecting rod.

5. Place washer over end of pipe.

6. Screw nut on outer end of rod and tighten against washer until retainer plate moves away and takes pressure off closing spring retainer pin.

7. Remove retainer pin by driving it out.

8. Unscrew nut until closing spring is completely freed.

9. Remove special fixture and spring.

10. Reassemble in reverse order.

#### PARTS IDENTIFICATION

Individual parts and sub assemblies for the circuit breakers are marked in the various figures in this section. Refer to list of illustrations for a figure that may show a part in question for a particular type or rating of circuit breaker.

#### Renewal Parts

List of renewal parts by name, recommended to be kept in stock, are included in this section and are referred to the figures showing them. When ordering renewal parts, always specify the part name and style number, if known, from the Renewal Parts Data, not included in this book. If the style number is not known, use the Figure number, name, and item number if given, together with the instruction book number, from this section of the instruction book. Also always supply the complete information from the nameplate on the front of the breaker chassis panel.

## RENEWAL PARTS

Parts Most Subject to Wear in Normal Operation.

Pole Unit Parts - 4.16 Kv and 13.8 Kv  
1200 and 2000 amp.

All parts not marked for a particular rating are common to all ratings.

	Required Number for one Pole Unit.
1. Stationary arcing contact assembly, Fig. 15, item 15.	1 #
2. Movable arcing contact, Fig. 15, item 21.	1 #
3. Stationary main contacts, 1200 amp., Fig. 15, item 3.	1 set #
4. Stationary main contacts, 2000 amp., Fig. 15, item 41.	1 set #
5. Movable main contact, 4.16 KV, 1200 amp., R.H., Fig. 15, item 26.	1
6. Movable main contact, 4.16 KV, 1200 amp., L.H., Fig. 15, item 25.	1
7. Movable main contact, 4.16 KV, 2000 amp., R.H., Fig. 15, item 40.	1
8. Movable main contact, 4.16 KV, 2000 amp., L.H., Fig. 15, item 39.	1
9. Movable main contact, 13.8 KV, 1200 amp., R.H., Fig. 16, item 8.	1
10. Movable main contact, 13.8 KV, 1200 amp., L.H., Fig. 16, item 7.	1
11. Movable main contact, 13.8 KV, 2000 amp., R.H., Fig. 16, item 10.	1
12. Movable main contact, 13.8 KV, 2000 amp., L.H., Fig. 16, item 9.	1
13. Movable contact pad, Fig. 15, item 20.	1 #
14. Movable contact hinge pin, 1200 amp., Fig. 15, item 31.	1
15. Movable contact hinge pin, 2000 amp., Fig. 15, item 42.	1
16. Movable contact hinge spring washers, Fig. 15, item 37.	1
17. Movable contact lift rod, Fig. 15, item 6.	1
18. Puffer tube assembly 4.16 KV, Fig. 15, item 9.	1
19. Puffer tube assembly 13.8 KV, Fig. 16, item 3.	1
20. Kick out spring, Fig. 15, item 29.	1
21. Disconnecting contact finger cluster, 1200 amp., Fig. 14, indicated.	2
22. Disconnecting contact finger cluster, 2000 amp., Fig. 15, item 43.	2
23. Complete pole unit less lift rod and disconnecting finger contact clusters, 1200 amp., 4.16 KV, Fig. 15.	1
24. Complete pole unit as specified in item 23 except, 2000 amp., 4.16 KV., Fig. 15.	1
25. Complete pole unit as specified in item 23 except, 1200 amp., 13.8 KV, Fig. 16.	1
26. Complete pole unit as specified in item 23 except, 2000 amp., 13.8 KV, Fig. 16.	1

## Note:

For one to five circuit breakers, order parts identified #.  
For six to ten circuit breakers, order double quantity identified #,  
plus required number of all other parts recommended.

## CHASSIS PARTS

## Stored Energy Mechanism - All Ratings

	Required Number per Breaker
1. Auxiliary switch, upper, Fig. 11a, indicated.	1
2. Auxiliary switch, lower, Fig. 11a, indicated.	1
3. Latch check switch, Fig. 11a, indicated.	1
4. Motor limit switch, Fig. 11a, indicated.	1
5. Control relay, "Y", Fig. 11a, indicated.	1#
6. Trip coil, 24 v.d.c., Fig. 11a, indicated.	1#
48 v.d.c.	
125 v.d.c.	
250 v.d.c.	
230 v.a.c., 60 cycle	
7. Spring release coil, 24 v.d.c., Fig. 11a, indicated.	1#
48 v.d.c.	
125 v.d.c.	
250 v.d.c.	
230 v.a.c., 60 cycle	
8. Spring charging motor 48 v.a.c. or d.c., Fig. 6, indicated.	1
125 v.a.c. or d.c.	
230 v.a.c. or d.c.	
9. Ground contact cluster, Fig. 6, indicated.	1

## Note:

Same as for pole unit parts.

## CHASSIS PARTS

## Solenoid Mechanism.

1. Auxiliary switches, same as for stored energy mech.	1 ea.
2. Latch check switch, same as for stored energy mech.	1
3. Control relay, "X" 48 v.d.c., Fig. 12, indicated	1
125 v.d.c.	
250 v.d.c.	
4. Trip coil, same as for stored energy mech.	1#
5. Closing coil, 4.16 KV, 48 v.d.c., Fig. 9a, indicated.	1#
125 v.d.c.	
250 v.d.c.	
7. Closing coil, 13.8 KV, 48 v.d.c., Fig. 9b, indicated.	1#
125 v.d.c.	
250 v.d.c.	
8. Ground contact, same as for stored energy mech.	1

## Note:

Same as for pole unit parts.

TABLE OF APPROXIMATE WEIGHTS (In Pounds)

Breaker Type	Ampere Rating	Breaker Without Chute & Barrier	Single Arc Chute	Barrier Assembly	Complete Breaker
50DH-P75	1200	425	35	37	567
50DH-P250	1200	425	87	50	737
50DH-P250	2000	442	87	50	754
150DH-P500	1200	580	240	104	1400
150DH-P750	1200	580	300	104	1580
150DH-P500	2000	600	240	104	1420
150DH-P750	2000	600	300	104	1600

RATING TABLE

Air Circuit Breaker Type	3-Phase Interrupting Rating Mva.	Voltage Ratings			Amperes Continuous 60 Cycles	Interrupting Ratings-Amperes	
		Rated Kv.	Max. Design Kv.	Min. Kv. for Rated Int. Mva.		At Rated Voltage	Max. Amperes
50DH-P75	75	4.16	4.76	3.5	1200	10,500	12,500
50DH-P250	250	4.16	4.76	3.85	1200	35,000	37,500
50DH-P250	250	4.16	4.76	3.85	2000	35,000	37,500
150DH-P500	500	13.8	15.	11.5	1200	21,000	25,000
150DH-P500	500	13.8	15.	11.5	2000	21,000	25,000
150DH-P750	750	13.8	15.	11.5	1200	31,000	37,500
150DH-P750	750	13.8	15.	11.5	2000	31,000	37,500