Instructions for Porcel-line Type DH-P Circuit Breakers

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Switchgear Division, East Pittsburgh, Pa. 15112
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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On stored energy mechanisms, the breaker may close and open as it is withdrawn, depending on whether breaker was left closed or open, or whether spring was left charged or discharged while standing in the test position.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. 5a).

(a) Place end of combination spring charge/maintenance handle into the slot in the manual ratchet lever. This lever projects through a slot in the front chassis panel just to the left of the coil marked "Lift to Trip".

(b) Charge spring with several downward movements of handle until the handle 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):

Charge closing spring per paragraph 1 or 5 above. 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:

NOTE

When the breaker is beyond the test position in the cell, it is not possible to insert the slot in the maintenance handle over the flats on the R.H. end of the main shaft. This feature prevents any attempt to close the breaker on a live circuit by maintenance hand closing. Do not attempt to defeat its purpose.

CAUTION

Always be sure to remove maintenance closing handle before opening breaker by means of the tripping trigger. The handle is not trip free in this mode of operation and will move upward fast if left on the shaft while the breaker is tripped.

(a) The breaker should be closed with maintenance handle only when the closing spring is discharged. The flat end of the main shaft projects through the R.H. side of the breaker chassis for this purpose.

(b) To close: place the slot in the closing handle over the flats on the main shaft and push downward until breaker latches closed. Remove handle from shaft.

(c) To open breaker contacts slowly with the breaker in the closed position, place maintenance closing handle on main shaft and press down with a force about equal to that required to close the breaker. Hold in this position and lift the 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. 9a.

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 shows 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. 22. 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 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.

This is done by the floor interlock and one of the automatic tripping levers pointed out in Figs. 6 and 9a. 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 connected or test position, the mechanism will cause 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.

As the breaker is withdrawn from the test position, two 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. The handle 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. The rail latch prevents accidental damage to the cell levering-in device screw or the nut on the breaker. Without this rail latch, the screw and possibly the 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. The rail latch holds the breaker in the test position.

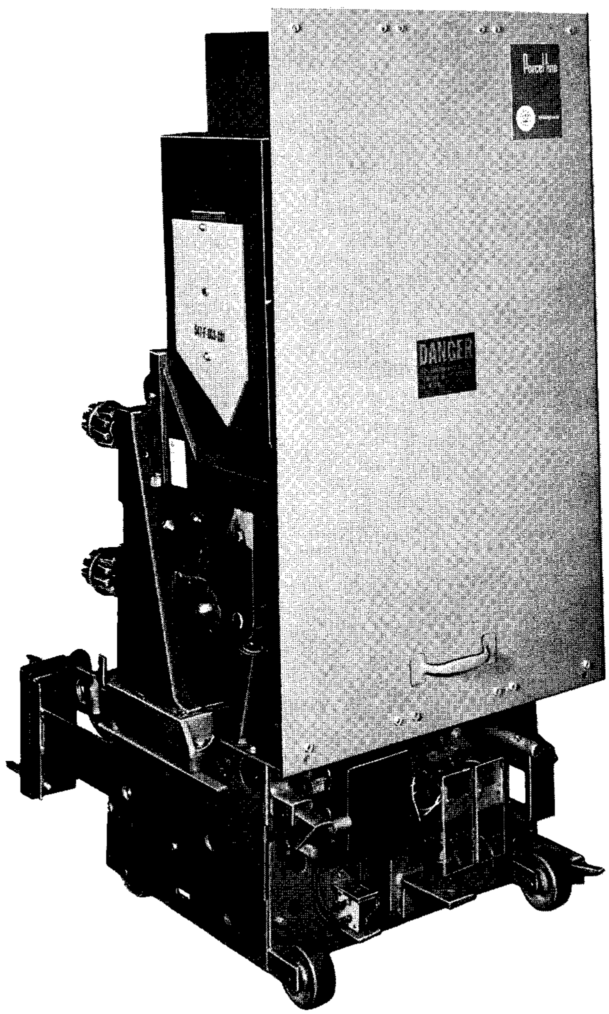


Fig. 1a.

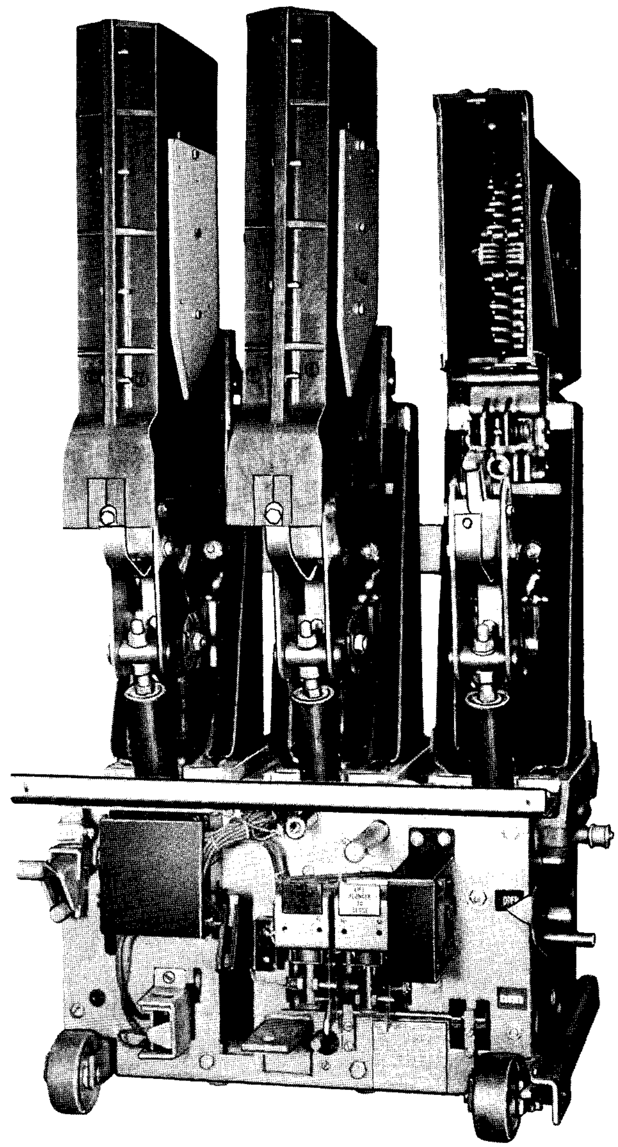


Fig. 1b.

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

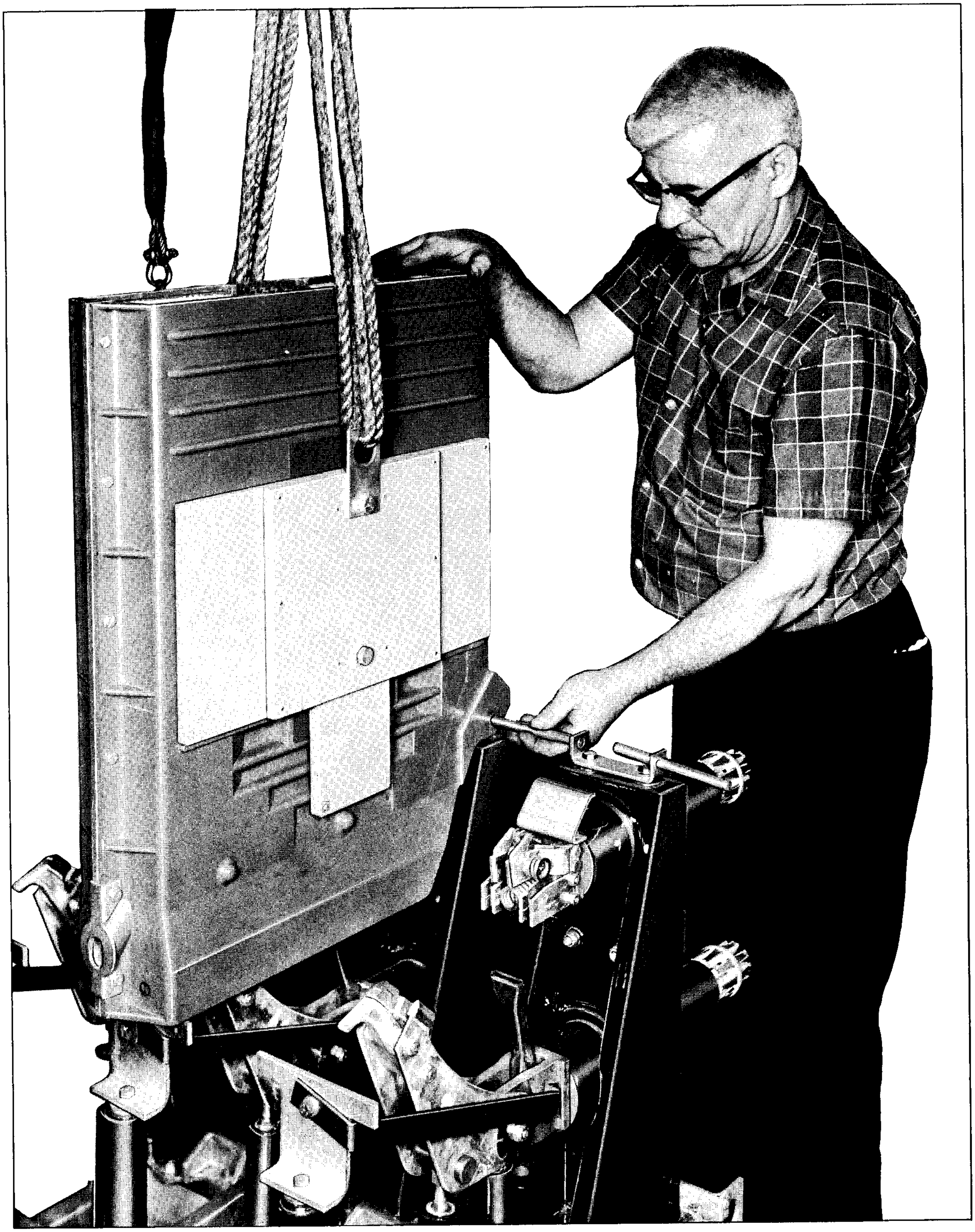


Fig. 2b. Installing Arc Chute of Type 150-DH-P500 Breaker

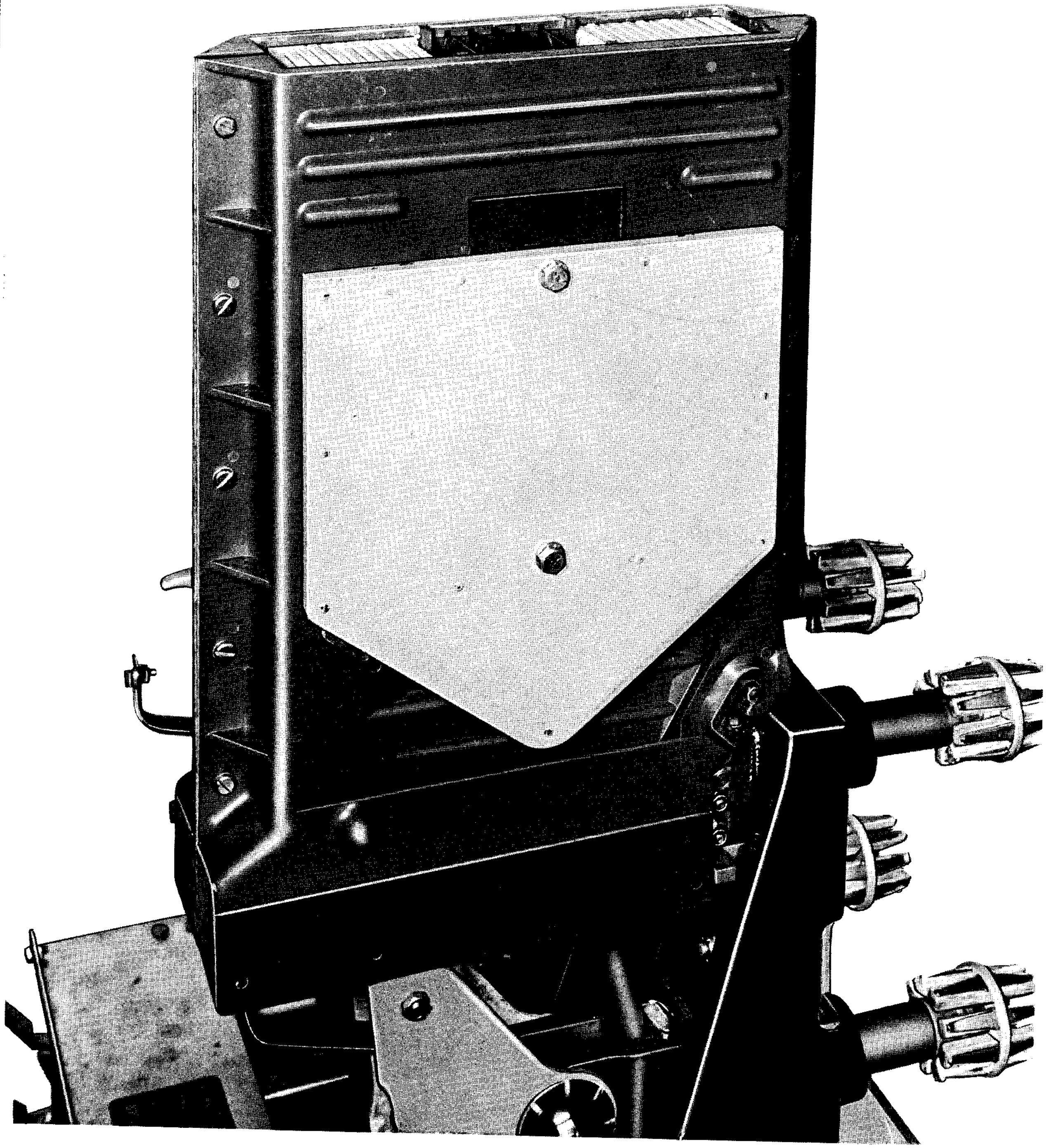


Fig. 2c. Arc Chute of Type 50-DH-P250 in Place on Breaker

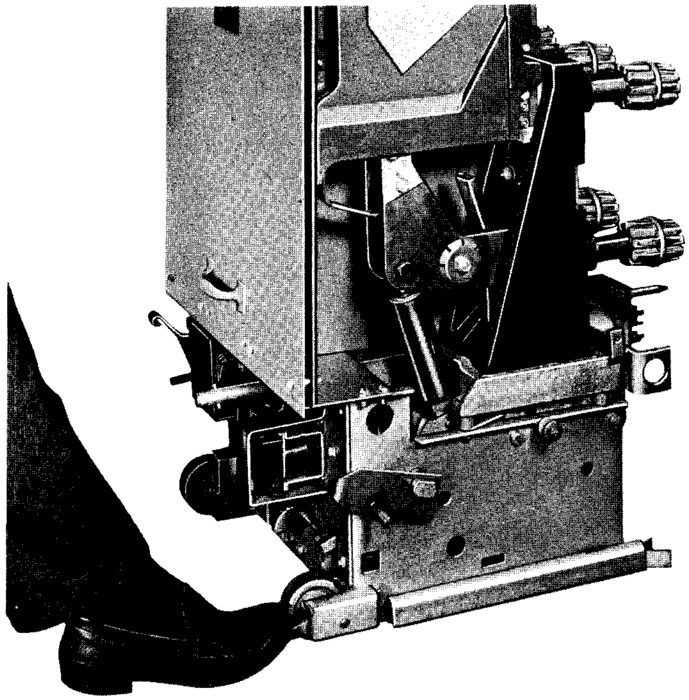


Fig. 3. Releasing Rail Latch

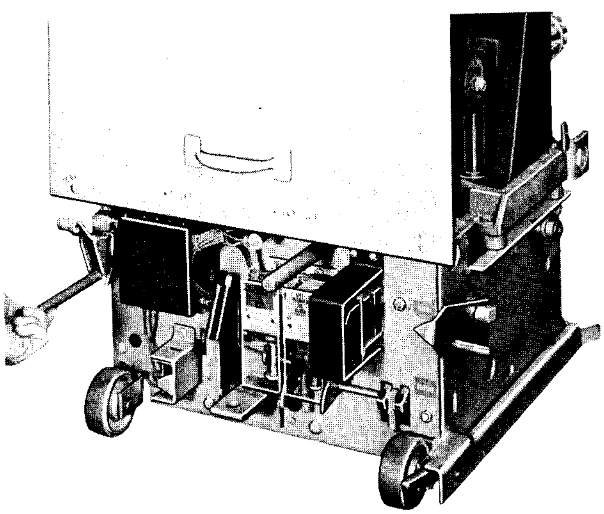


Fig. 4a.

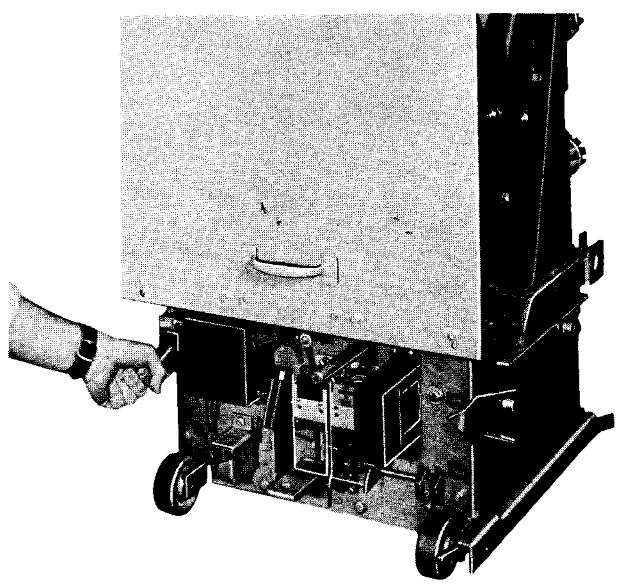


Fig. 4b.

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

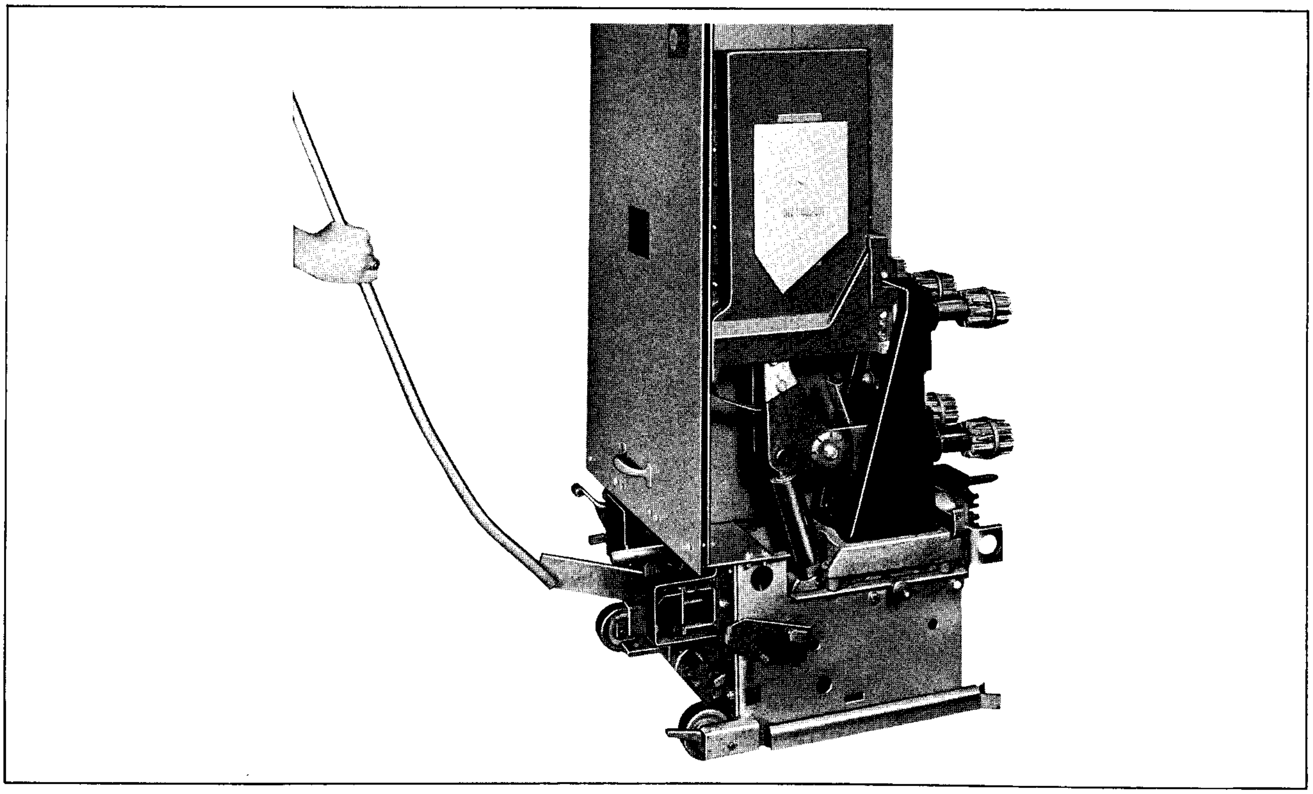


Fig. 5a. Charging Closing Spring by Hand

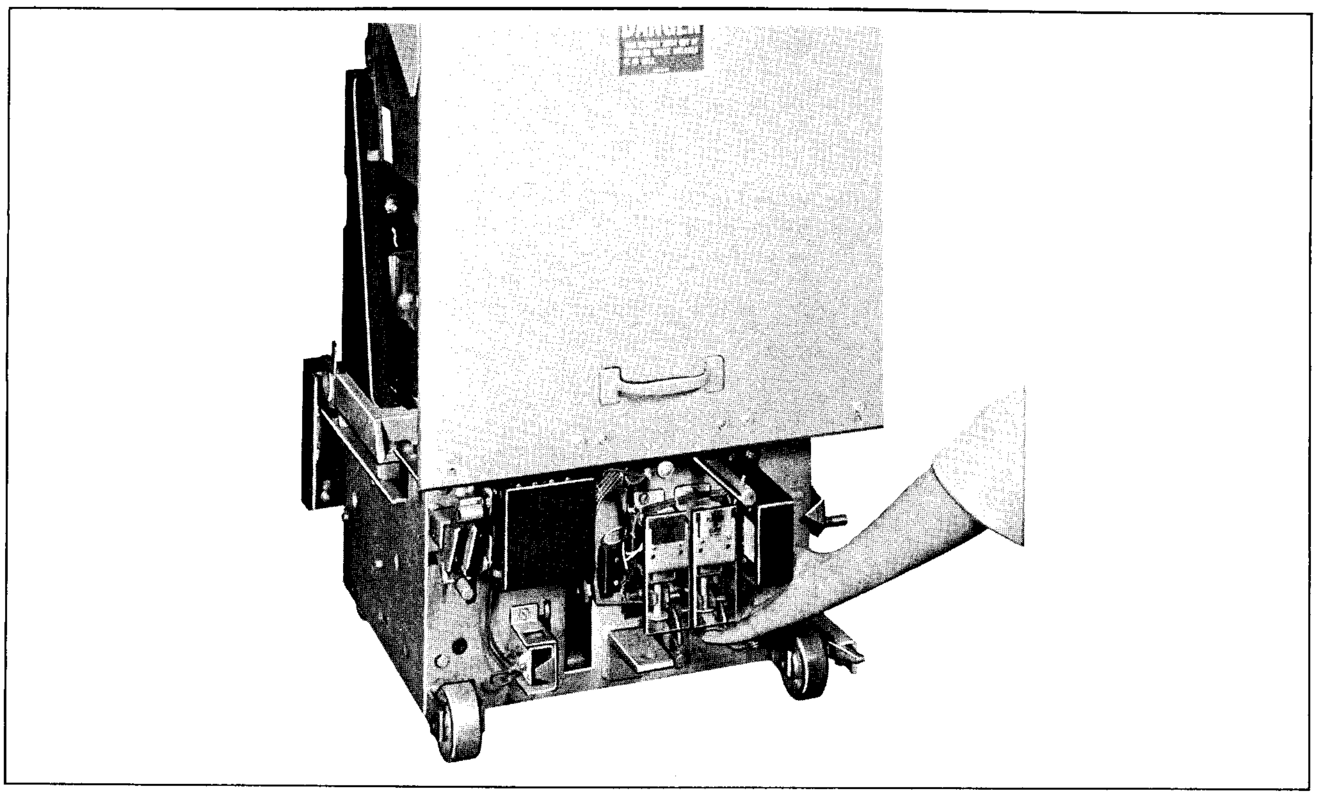
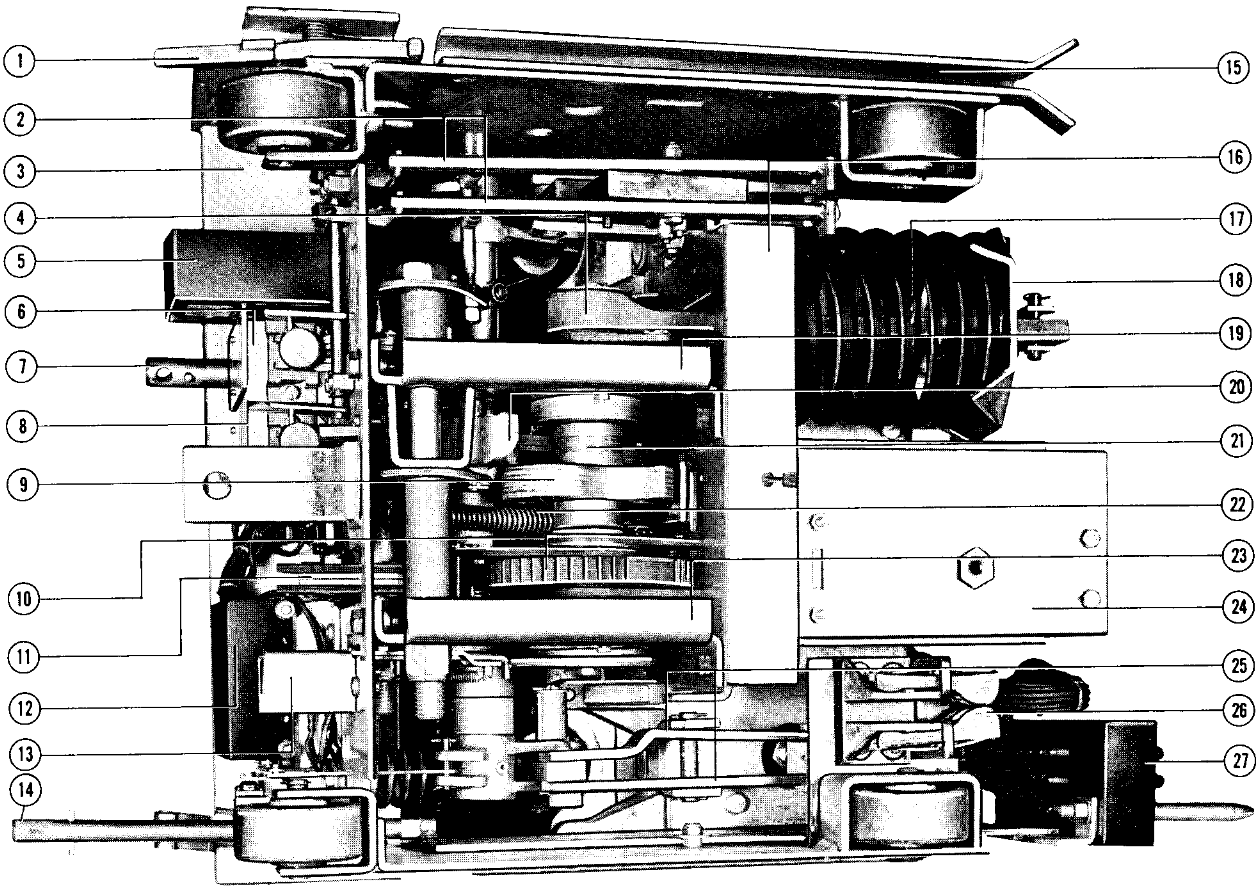
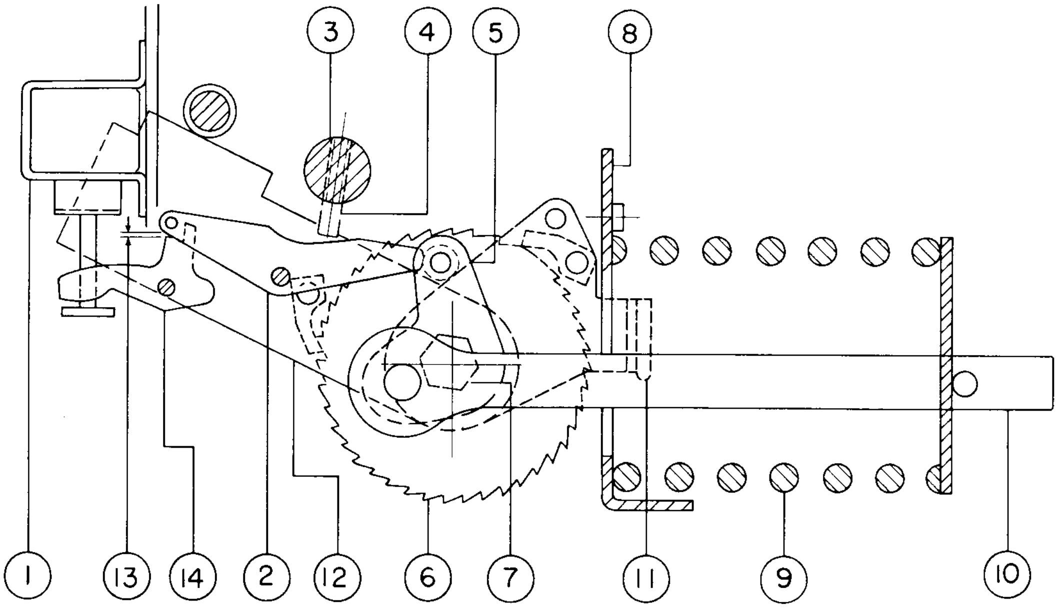


Fig. 5b. Spring Closing Breaker by Hand Release, 4.16 KV Breaker



1. Rail Latch
2. Floor Interlock Levers
3. Barrier Mounting Plate
4. Connecting Rod
5. Control Relay "Y"
6. Spring Release Magnet
7. Levering Device: Operating Shaft
8. Trip Magnet
9. Closing Cam
10. Ratchet Wheel
11. Manual Ratchet Lever
12. Auxiliary Switches
13. Motor Cut-Off Switch: Operating Linkage
14. Secondary Contact Hand Operating Rod
15. Guide
16. Mechanism Frame: Rear Plate
17. Closing Spring
18. Closing Spring Retainer Plate
19. Mechanism Frame: R.H. Side Plate
20. Tripping Cam
21. Crank Shaft
22. Main Link Retrieving Spring
23. Mechanism Frame: L.H. Side Plate
24. Spring-Charge Motor Mounting Bracket
25. Puffer Operating Arm
26. Ground Contact
27. Secondary Contact Block

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



1. Spring Release Magnet and Coil "SR"
2. Closing Latch
3. Pole Unit Operating Shaft
4. Closed Breaker Interlock Screw
5. Closing Stop Roller
6. Ratchet Wheel
7. Crank Shaft
8. Mechanism Frame
9. Closing Spring
10. Connecting Rod
11. Driving Plate and Motor Ratchet Lever Assembly
12. Manual Ratchet Lever and Holding Pawl Assembly
13. Clearance .010 to .030, Breaker Closed
14. Closing Trigger

Fig. 7a. Stored Energy Mechanism: Spring Charged

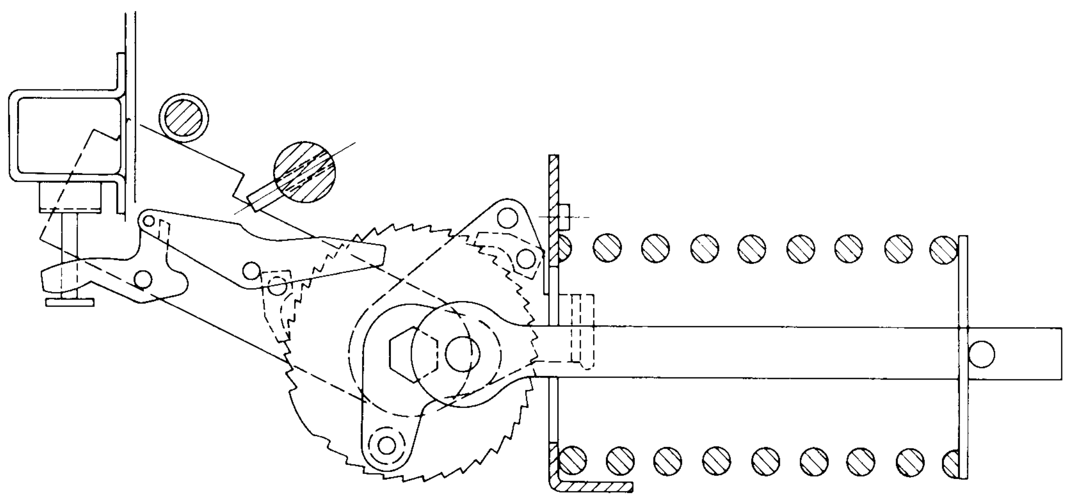


Fig. 7b. Stored Energy Mechanism: Spring Discharged

Fig. 7. Schematic Views of Stored Energy Mechanism: Spring Charging and Close Latch Parts

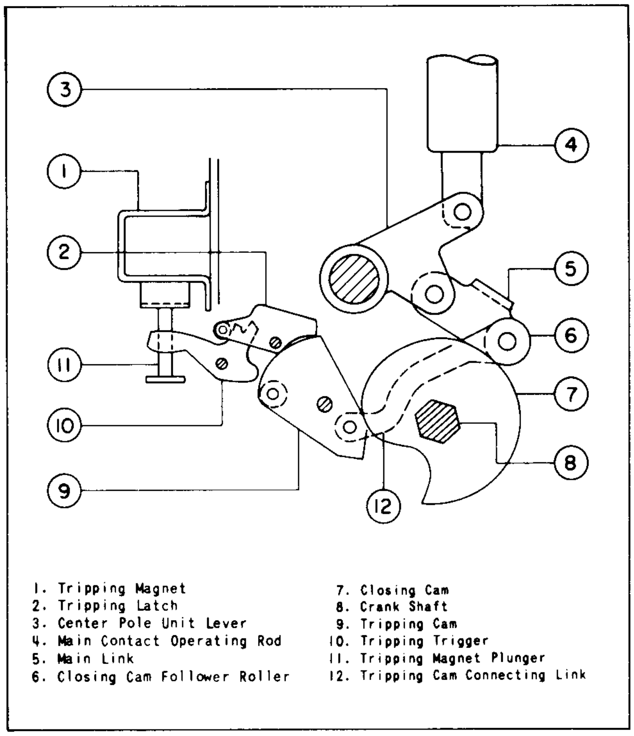


Fig. 8a. Breaker Open and Spring not Charged

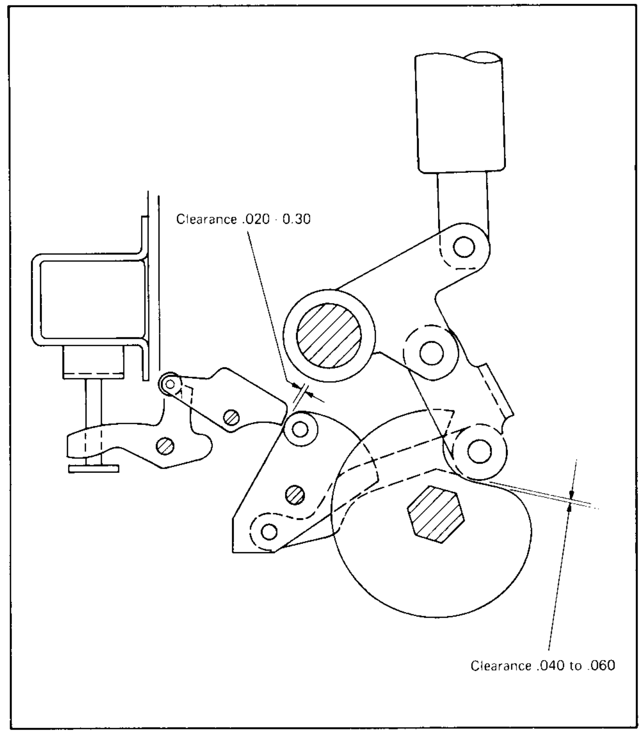


Fig. 8b. Breaker Open and Spring Charged

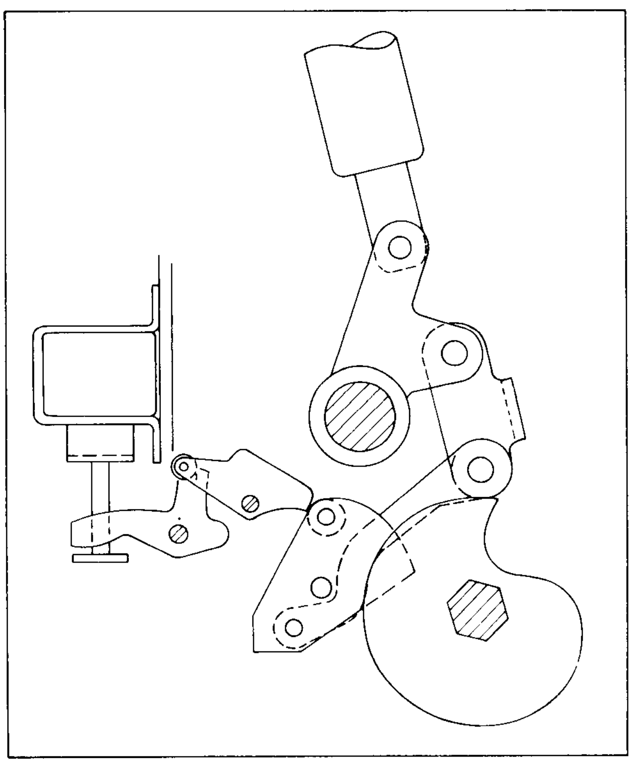


Fig. 8c. Breaker Closed and Spring Charged

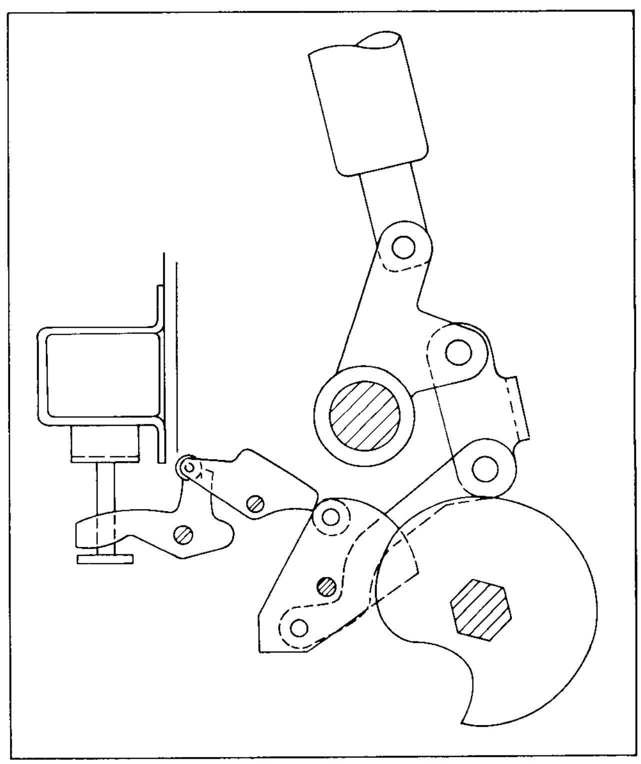


Fig. 8d. Breaker Closed and Spring not Charged

Fig. 8. The Four Positions of the Closing Cam and Tripping Linkage

1. Rail Latch
2. MOC Switch Operating Pin
3. Opening Spring
4. Floor Interlock and Automatic Tripping Lever
5. Closing Coil "CC"
6. Movable Core
7. Ground Contact
8. Puffer Operating Arm
9. Closing Coil Cut-Off Relay, "X"
10. Closing Coil Cut-Off Relay Operator
11. Auxiliary Switch
12. Tripping Latch and Cam Clearance Adjusting Screw
13. Trip Magnet "TC"
14. Closing Latch
15. Movable Core and Retrieving Spring Pin
16. Retrieving Spring

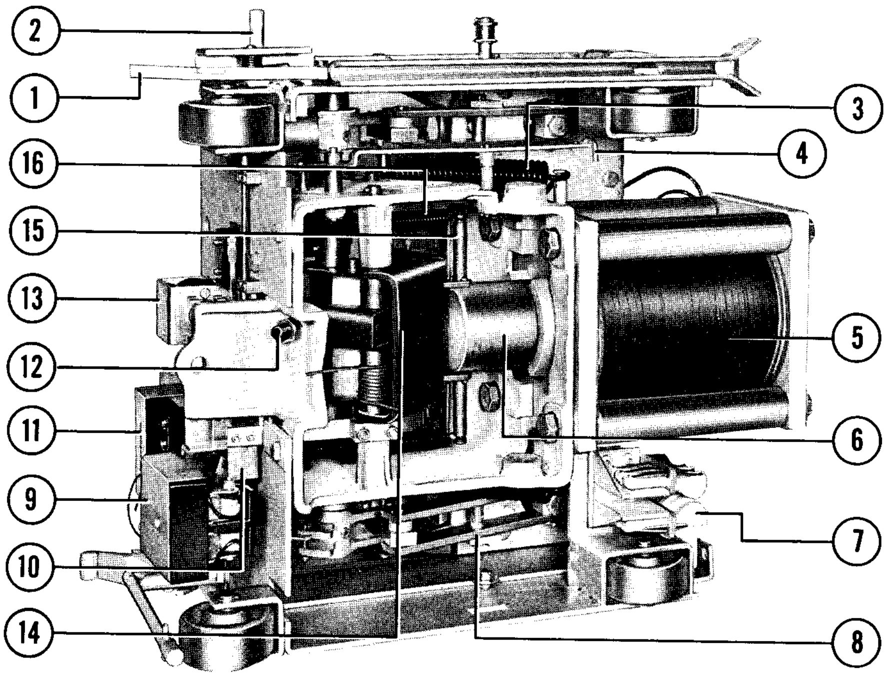


Fig. 9a. Bottom View of a 4.16 KV Breaker with Solenoid Mechanism

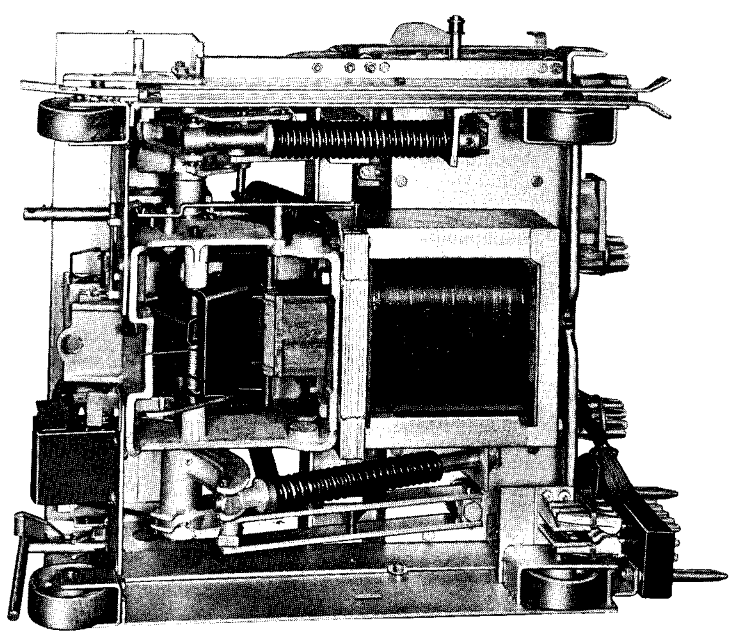


Fig. 9b. Bottom View of a 13.8 KV Breaker with Solenoid Mechanism

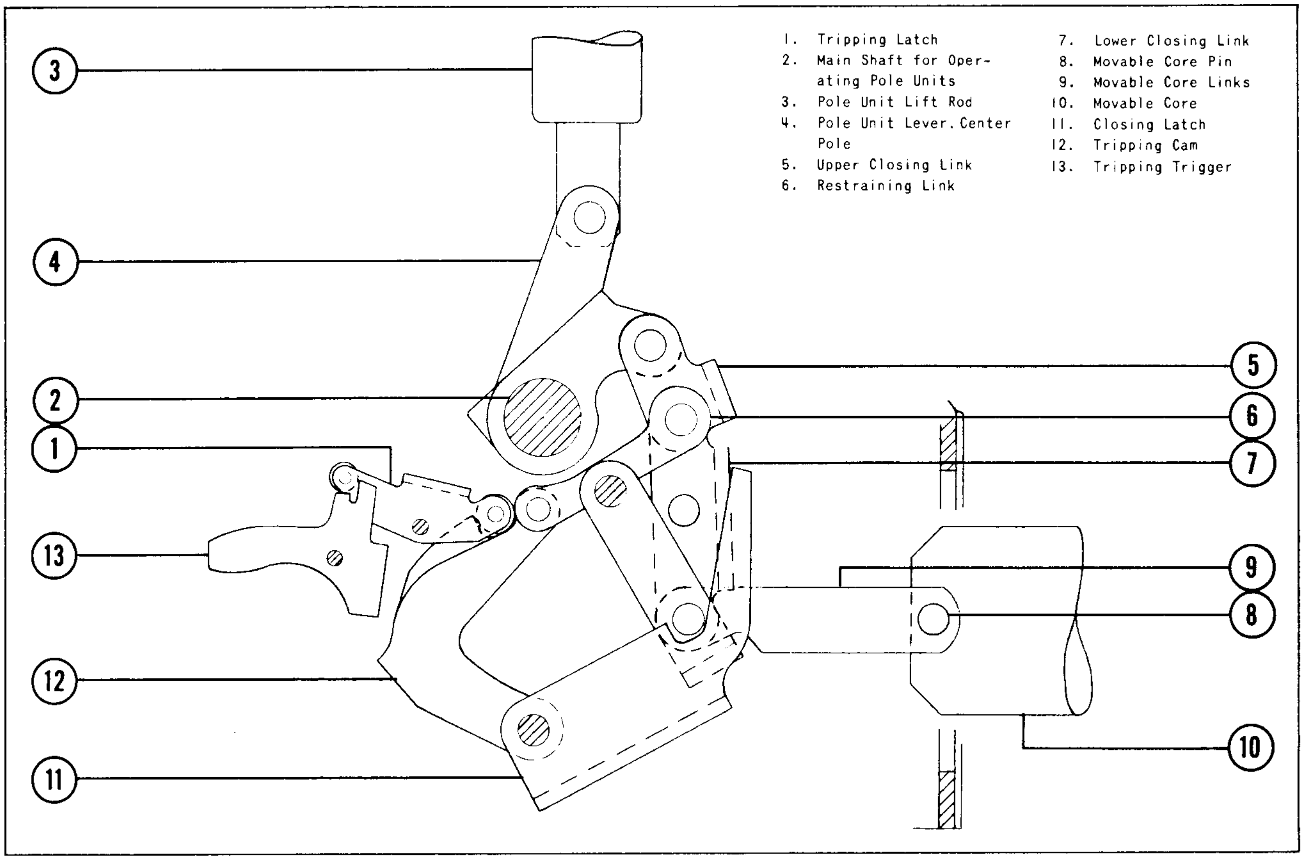


Fig. 10a. Closed and Latched

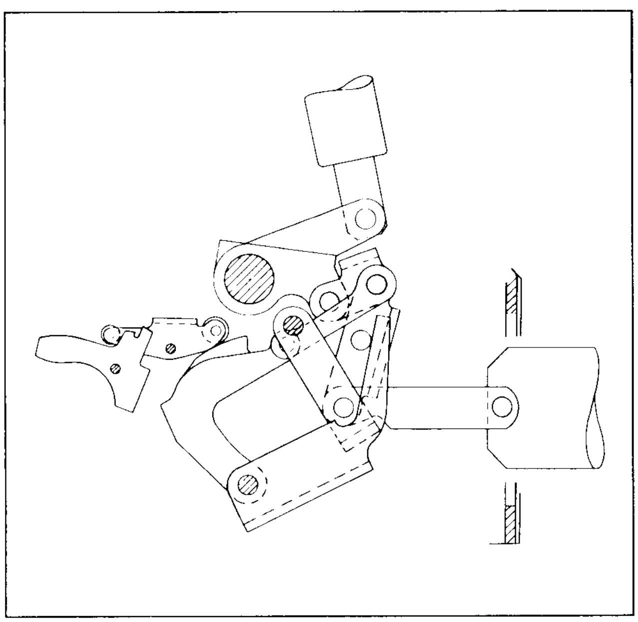


Fig. 10b. Tripped Free

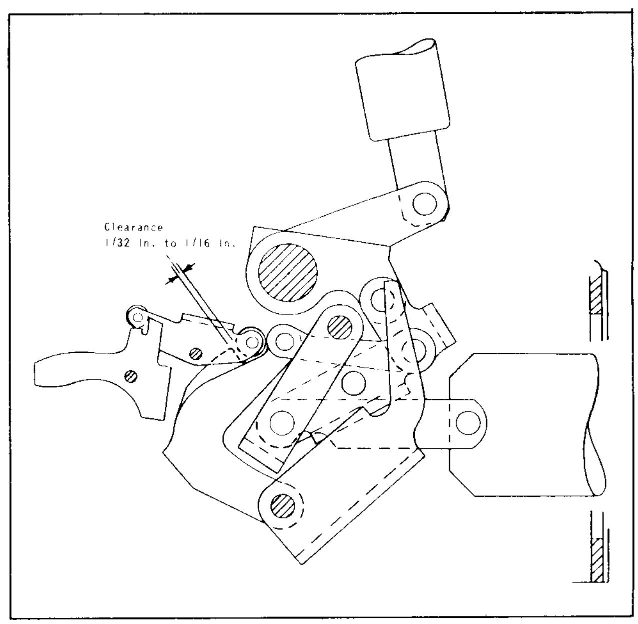
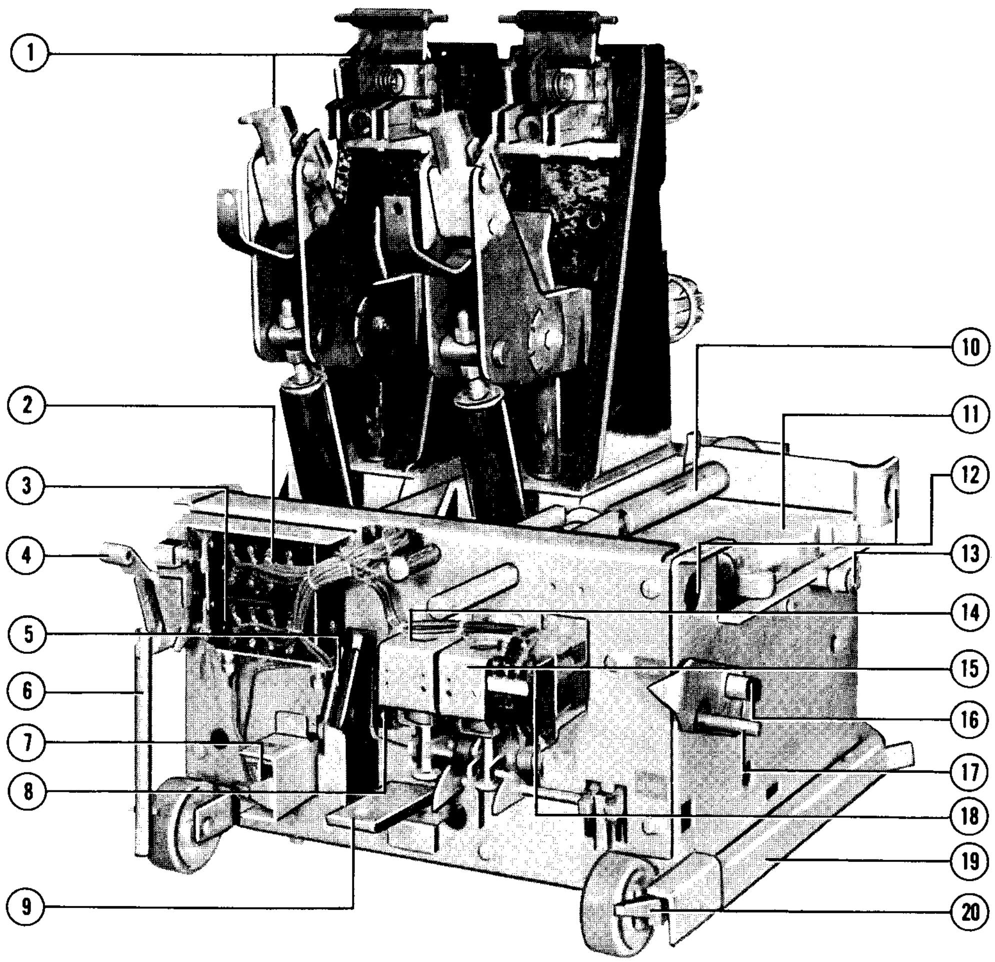


Fig. 10c. Open and Reset, Ready to Close

Fig. 10. Schematic Drawings showing Positions of Solenoid Mechanism Linkage



1. Pole Units and Contact Assembly
2. Auxiliary Switch: Upper a and b Contacts
3. Auxiliary Switch: Lower a and b Contacts
4. Secondary Contact Levering Handle
5. Manual Ratchet Lever for Charging Closing Spring by Hand
6. Secondary Contact Hand Operating Rod
7. Motor Limit Switch "LS"
8. Latch Check Switch "LC"
9. Handling Dolly Bracket
10. Levering Device
11. Puffer Casting
12. Lifting Holes
13. Shutter Operating Roller
14. Tripping Magnet and Coil, "TC"
15. Spring Release Magnet and Coil, "SR"
16. Flat End of Shaft for Maintenance Hand Closing
17. MOC Switch Operating Pin and Indicator Bracket
18. Control Relay, "Y"
19. Rail Guide
20. Rail Latch

Fig. 11. 4.16 KV Breaker with Stored Energy Mechanism: R.H. Pole Unit Assembly Removed

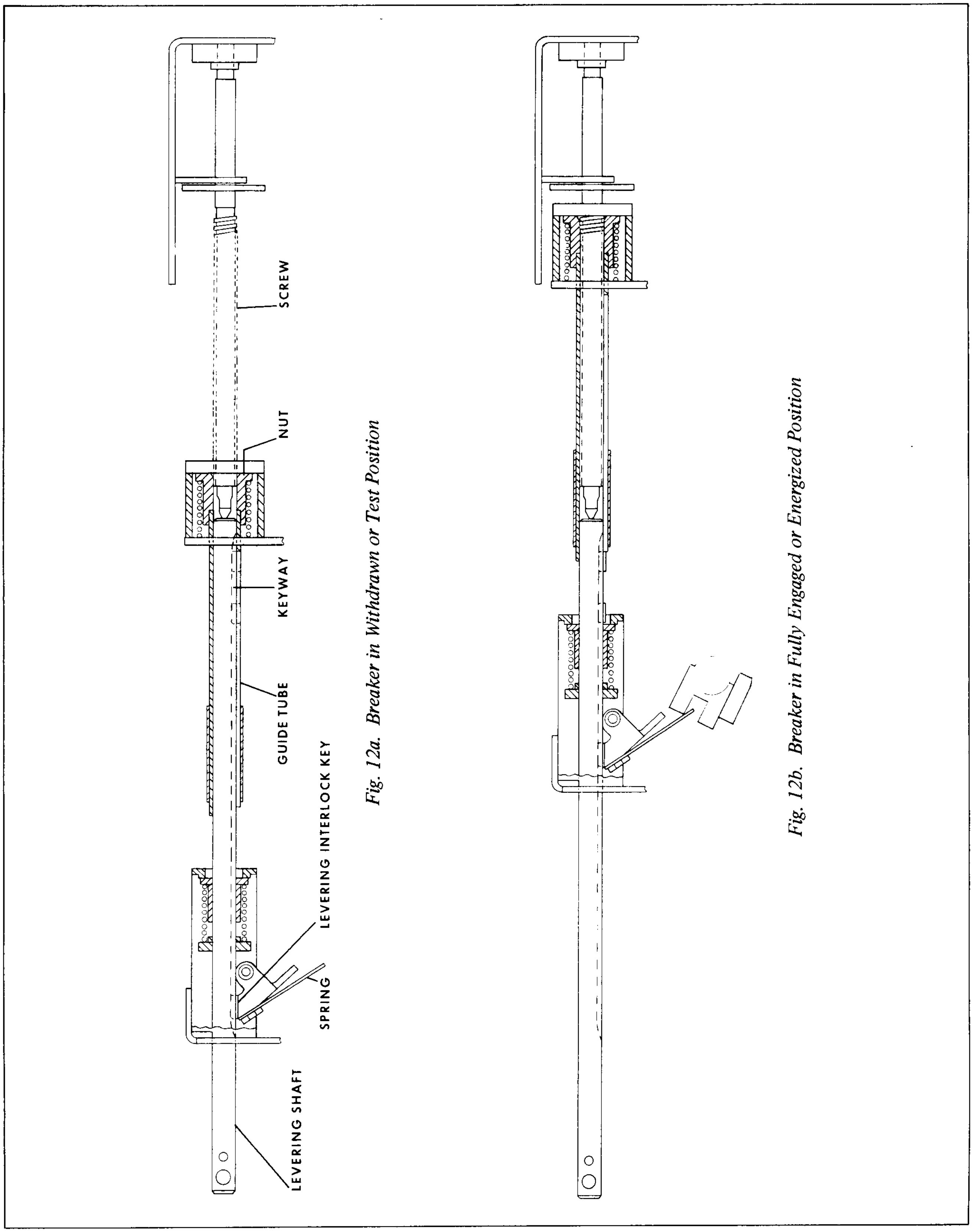
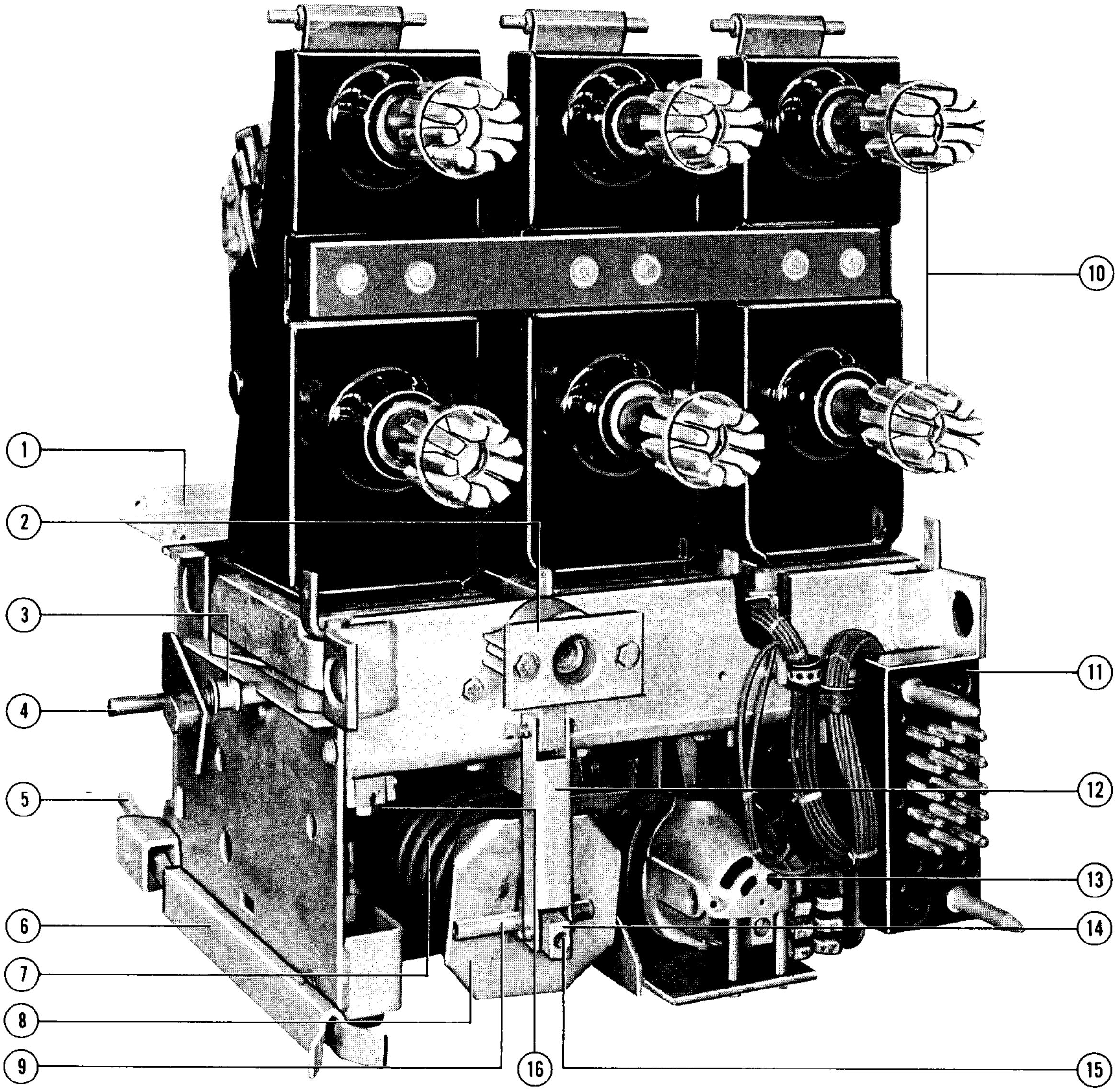


Fig. 12a. Breaker in Withdrawn or Test Position

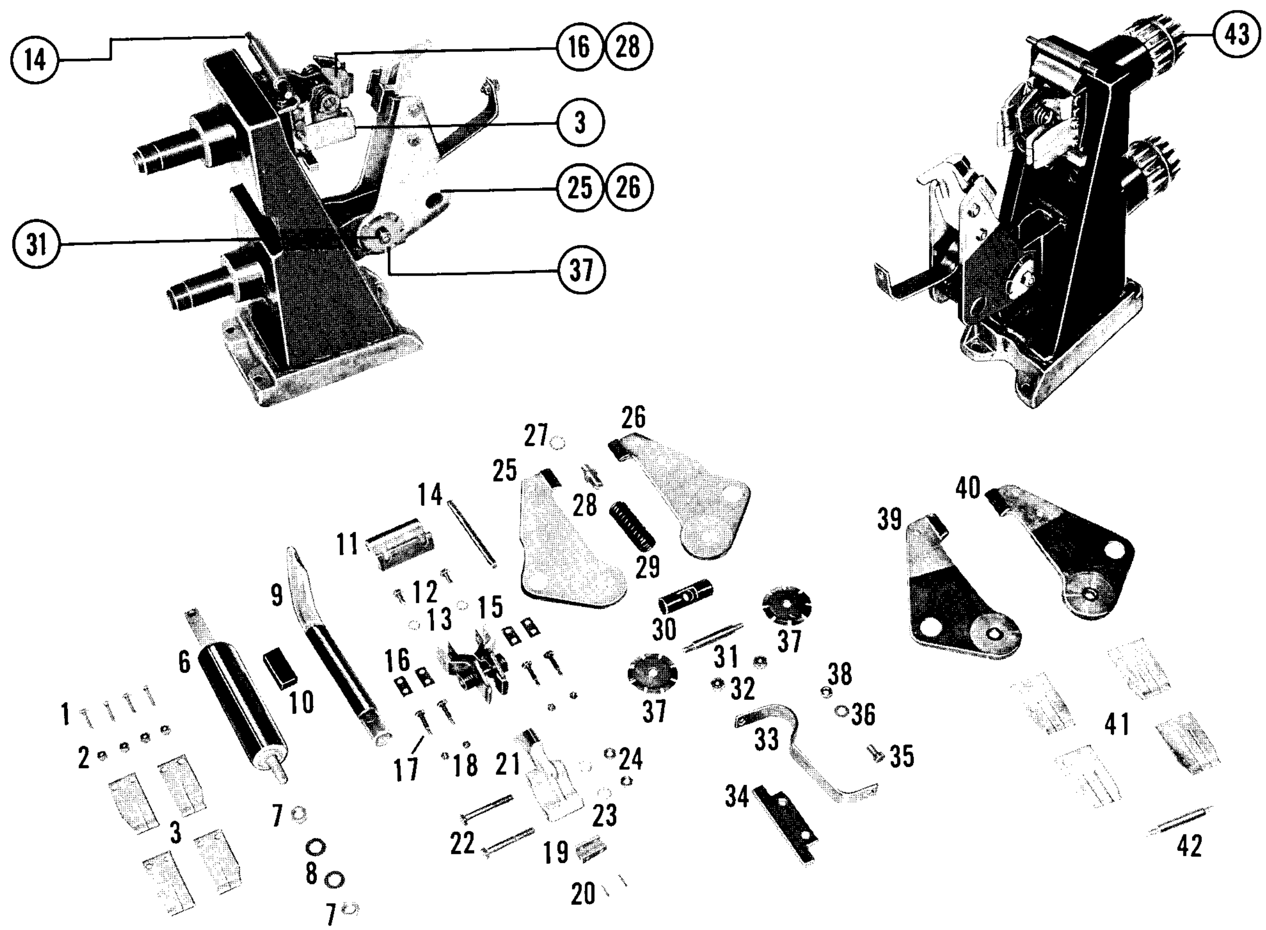
Fig. 12b. Breaker in Fully Engaged or Energized Position

Fig. 12. Schematic Drawings of Levering Device



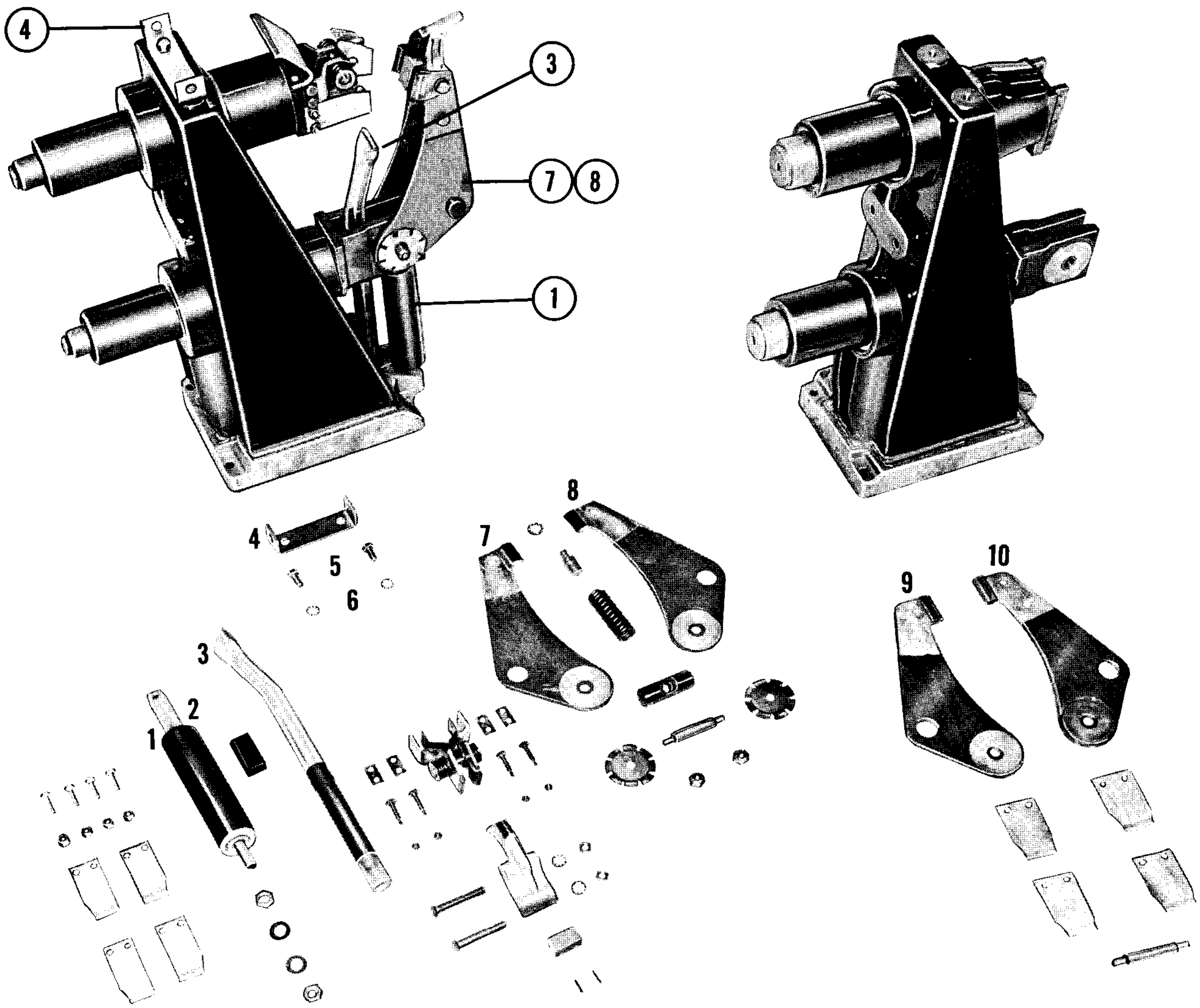
1. Barrier Mounting Plate
2. Levering Device Nut
3. Shutter Operating Roller
4. MOC Switch Operating Pin and Indicator Bracket
5. Rail Latch
6. Rail Guide
7. Closing Spring
8. Closing Spring Retainer Plate
9. Closing Spring Retainer Pin
10. Disconnecting Finger Clusters, 1200 Amp
11. Secondary Contact Block
12. Closing Spring Idler Link
13. Spring Charge Motor
14. Connecting Rod
15. .50-13 Tapped Hole
16. Puffer Piston Adjustment

Fig. 13. Rear View of 4.16 KV Breaker



1. Main Contact Mounting Bolts
2. Main Contact Mounting Nuts
3. Main Contact Fingers, 1200 Amp
6. Movable Contact Lift Rod
7. Movable Contact Adjusting Nuts
8. Movable Contact Adjusting Nuts Lockwashers
9. Puffer Tube
10. Puffer Tube Retainer
11. Arc Chute Hinge Bracket
12. Arc Chute Hinge Bracket Bolts
13. Arc Chute Hinge Bracket Bolt Lockwashers
14. Arc Chute Hinge Pin
15. Stationary Arcing Contact Assembly
16. Arcing Contact Leaf Springs
17. Arcing Contact Mounting Bolts
18. Arcing Contact Mounting Bolt Nuts
19. Movable Contact Pad
20. Movable Contact Pad Retainer Pins
21. Movable Arcing Contact
22. Movable Arcing Contact Mounting Bolts
23. Movable Arcing Contact Mounting Bolt Lockwashers
24. Movable Arcing Contact Mounting Bolt Nuts
25. Movable Main Contact Blade L.H. 1200 Amp
26. Movable Main Contact Blade R.H. 1200 Amp
27. Kick Out Spring Retainer Lockwasher
28. Kick Out Spring Retainer
29. Kick Out Spring
30. Movable Contact Lift Rod Pin
31. Movable Contact Hinge Pin
32. Movable Contact Hinge Pin Nuts
33. Arc Chute Shunt Strap
34. Arc Chute Operating Position Stop
35. Arc Chute Shunt Strap Bolt
36. Arc Chute Shunt Strap Bolt Lockwasher
37. Movable Contact Hinge Spring Washers
38. Arc Chute Shunt Strap Nut
39. Movable Main Contact Blade L.H., 2000 Amp
40. Movable Main Contact Blade R.H., 2000 Amp
41. Stationary Contact Fingers, 2000 Amp
42. Movable Contact Hinge Pin, 2000 Amp
43. Disconnecting Contact Finger Cluster 2000 Amp

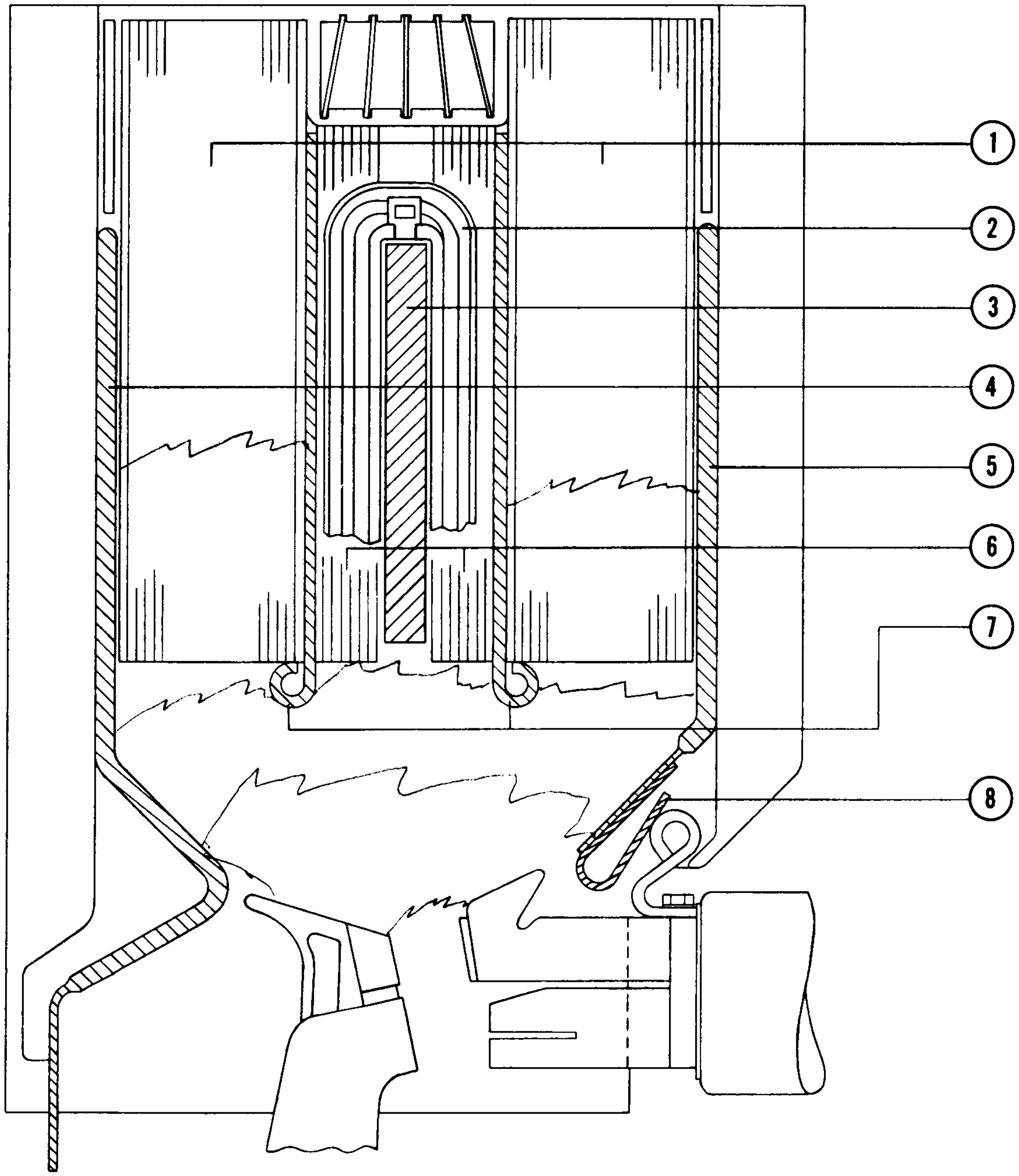
Fig. 14. Pole Units and Details for 1200 and 2000 Ampere, 4.16 KV Breakers



Note: Parts without Numbers are the same as on the 4.16 KV Breaker.

1. Lower Contact Brace
2. Movable Contact Lift Rod
3. Puffer Tube
4. Arc Chute Hinge Pin Bracket
5. Arc Chute Hinge Pin Bracket Bolts
6. Arc Chute Hinge Pin Bracket Bolts Lockwasher
7. Movable Contact Arm L.H. 1200 Amp
8. Movable Contact Arm R.H. 1200 Amp
9. Movable Contact Arm L.H. 2000 Amp
10. Movable Contact Arm R.H. 2000 Amp

Fig. 15. Pole Units and Details for 1200 and 2000 Ampere, 13.8 KV Breakers



1. Main Interrupter Stacks
2. Blowout Coils
3. Blowout Magnet Core
4. Front Arc Horn
5. Rear Arc Horn
6. Transfer Stacks
7. Center Arc Horns
8. Rear Arc Horn Disconnecting Contact

Fig. 16. Schematic Drawing of Center Coil Type of Arc Chute as used on the DH-P Line of Breakers

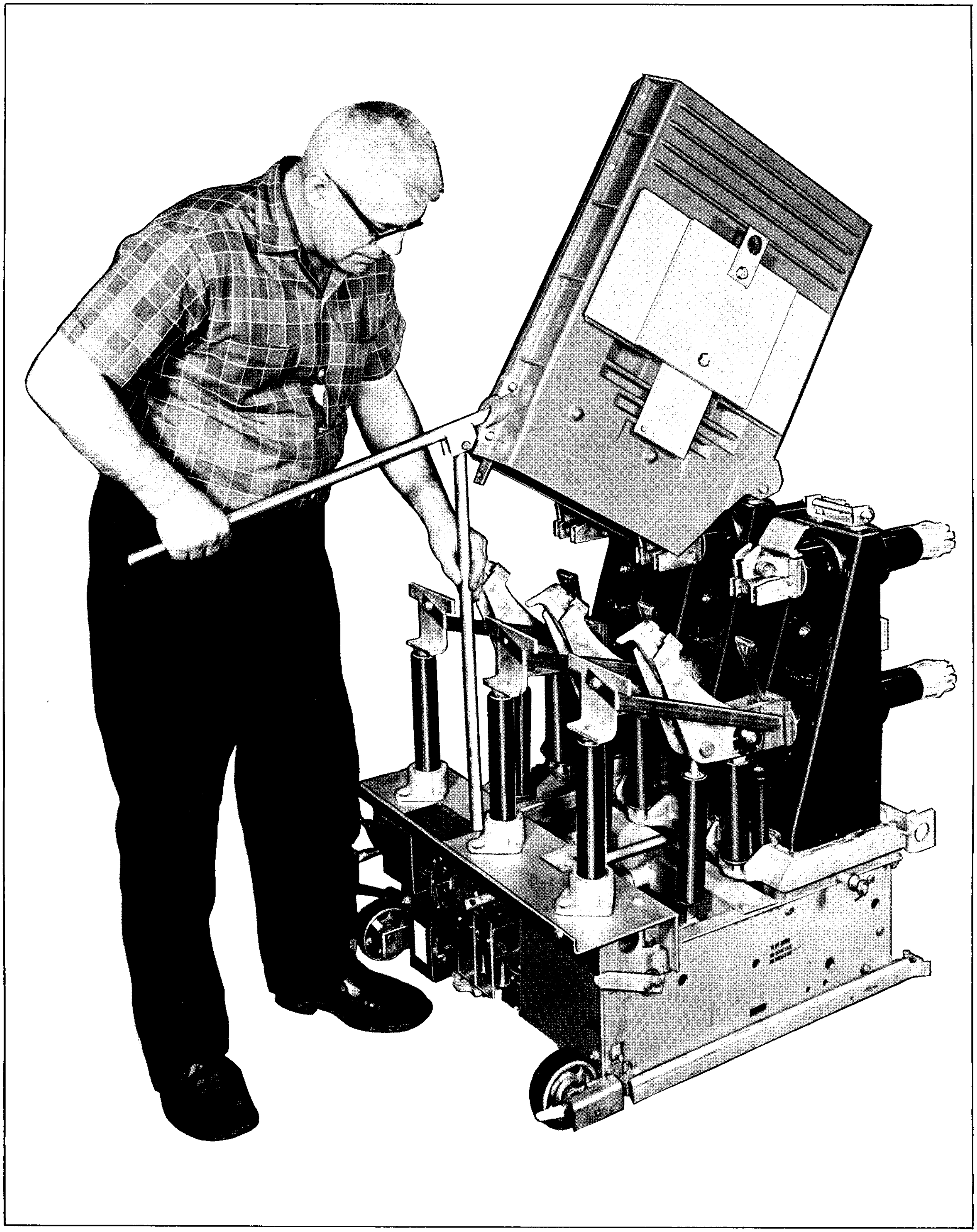


Fig. 19. Lifting the Arc Chute of 13.8 KV Breaker with Arc Chute Lifter

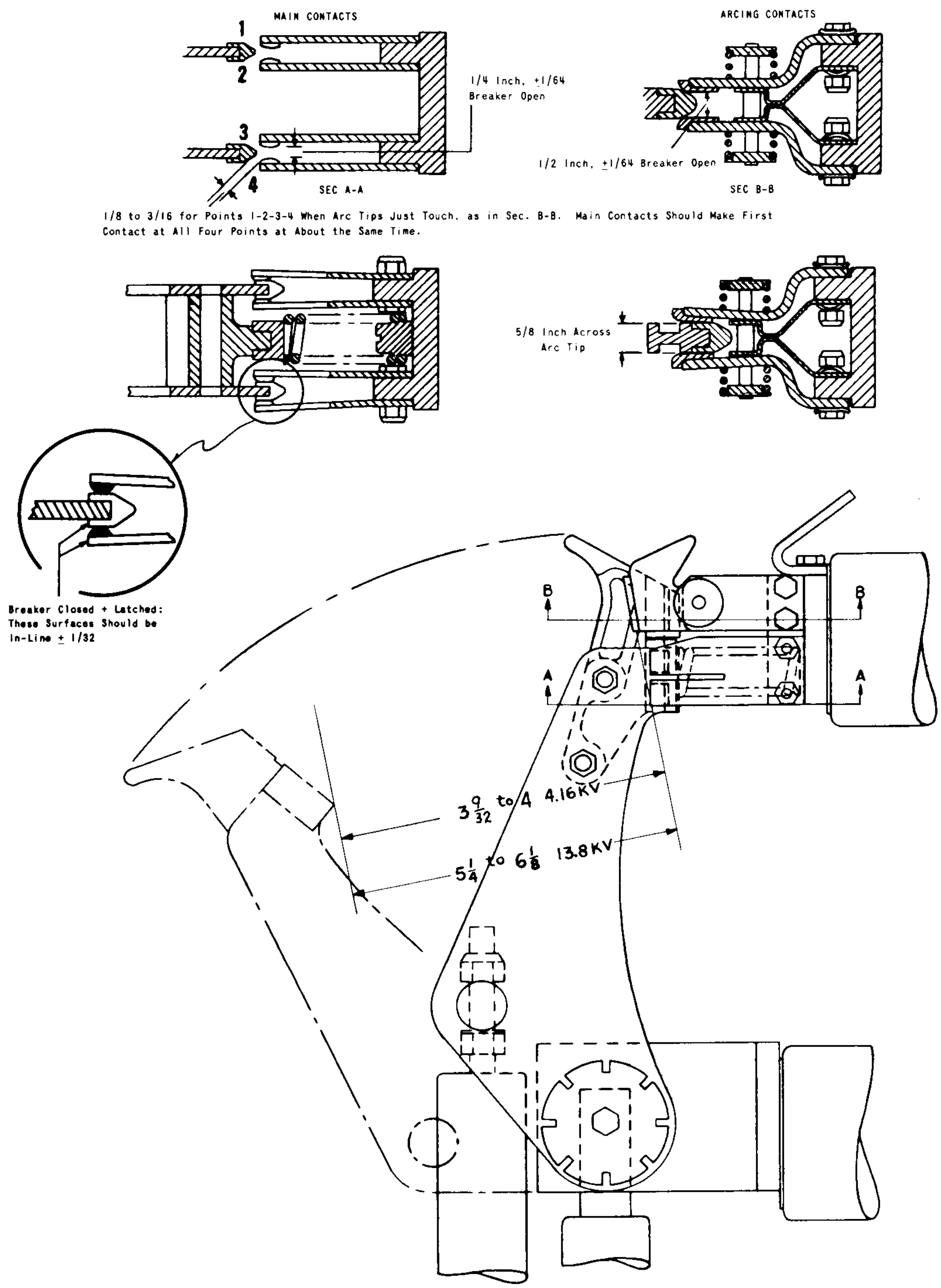


Fig. 20. Drawing of Contacts showing Settings and Movements

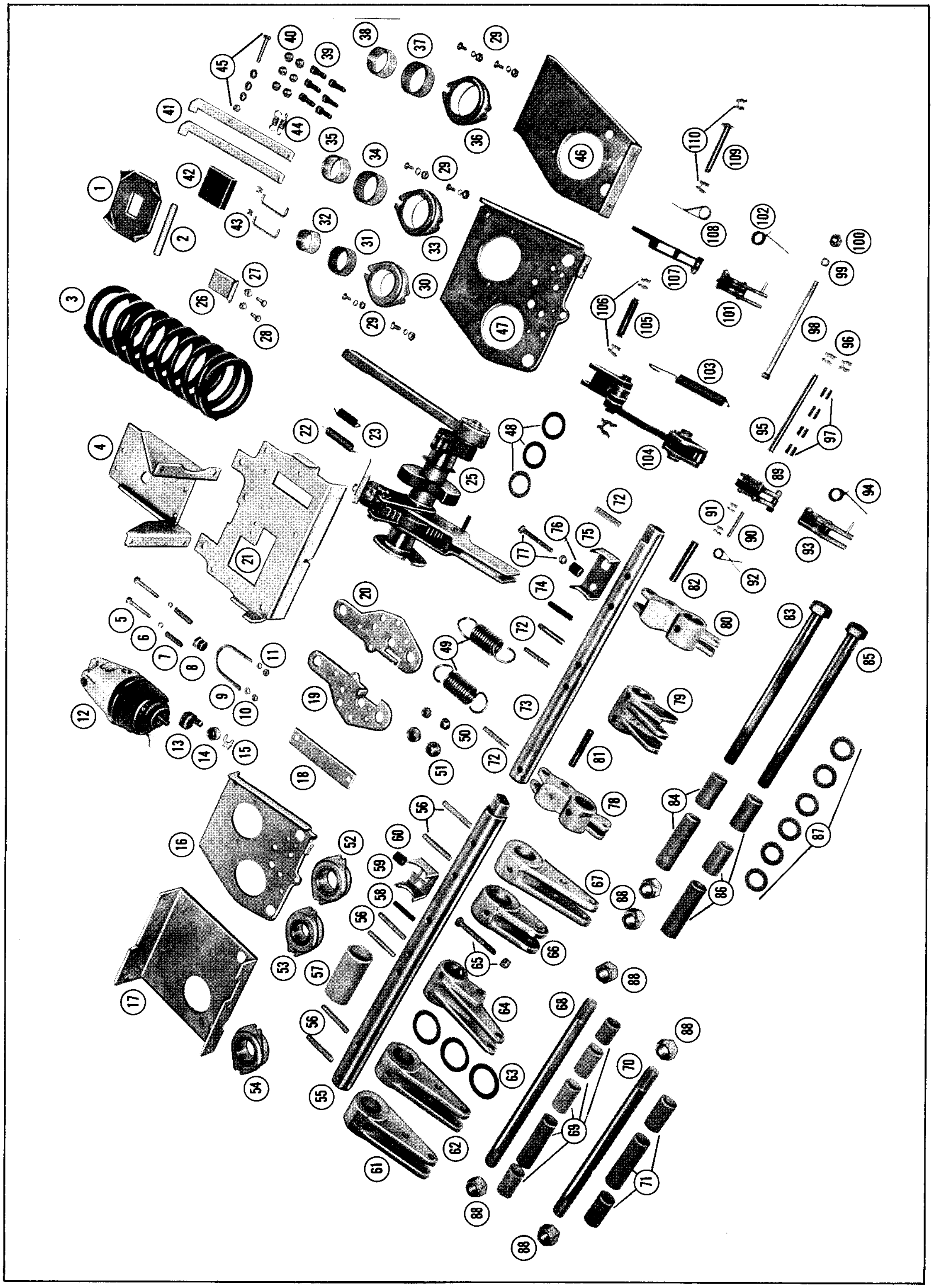


Fig. 21. Parts for Stored Energy Mechanisms

Note: All parts common to 4.16 and 13.8 KV mechanisms unless otherwise noted.

1. Closing Spring Retainer
2. Closing Spring Retainer Pin
3. Closing Spring
4. Mechanism Frame: Motor Mounting Bracket
5. Rear Motor Mounting Bolts (2)
6. Washers for Item 5 (2)
7. Spacers for Item 5 (2)
8. Pipe Plug
9. U-Bolt
10. Washers for Item 9 (2)
11. Nuts for Item 9 (2)
12. Spring Charge Motor
13. Driving Eccentric
14. Driving Roller
15. X-Washer for Item 13
16. Mechanism Frame: L.H. Side Plate
17. Mechanism Frame: L.H. Bearing Plate - 13.8 KV
18. Mechanism Frame: Spacer Plate - 4.16 KV
19. Mechanism Frame: L.H. Front Plate
20. Mechanism Frame: R.H. Front Plate
21. Mechanism Frame: Rear Plate
22. Motor Ratchet Lever Retrieving Spring
23. Manual Ratchet Lever Retrieving Spring
24.
25. Crank Shaft Sub-Assembly
26. Main Link Stop
27. Nuts for Item 26 (2)
28. Bolts for Item 26 (2)
29. Bearing Assembly: Mounting Hardware
30. Pole Shaft Bearing Casting - 4.16 KV
31. Pole Shaft Bearing - 4.16 KV
32. Pole Shaft Bearing Inner Race - 4.16 KV
33. Crank Shaft Bearing Casting
34. Crank Shaft Bearing
35. Crank Shaft Bearing Inner Race
36. Pole Shaft Bearing Casting - 13.8 KV
37. Pole Shaft Bearing - 13.8 KV
38. Pole Shaft Bearing Inner Race - 13.8 KV
39. Frame Member Fastening Bolts (6)
40. Nuts for Item 39 (6)
41. Floor Interlock Operating Lever (2)
42. Floor Interlock Mounting Plate
43. Floor Interlock Connecting Link (2)
44. Floor Interlock Retrieving Spring (2)
45. Hardware for Floor Interlock
46. Mechanism Frame: R.H. Bearing Plate - 13.8 KV
47. Mechanism Frame: R.H. Side Plate
48. Thrust Bearing and Hardened Races - 13.8 KV
49. Opening Springs - 4.16 KV
50. Trip Latch Bearings (2)
51. Close Latch Bearings (2)
52. Crank Shaft Bearing Assembly
53. Pole Shaft Bearing Assembly - 4.16 KV
54. Pole Shaft Bearing Assembly - 13.8 KV
55. Pole Unit Operating Shaft - 13.8 KV
56. Pole Unit Operating Lever: Retainer Pins (6) - 13.8 KV
57. Pole Unit Operating Shaft Spacer - 13.8 KV
58. Closed Breaker Interlock Adjusting Screw - 13.8 KV
59. Levering in Device Interlock Bracket - 13.8 KV
60. Spacer for Item 59
61. Pole Unit Operating Lever: L.H. - 13.8 KV
62. Opening Spring Lever: L.H. - 13.8 KV
63. Pole Unit Operating Shaft Spacer Washers
64. Pole Unit Operating Lever: Center - 13.8 KV
65. Hardware for Item 59
66. Opening Spring Lever: R.H. - 13.8 KV
67. Pole Unit Operating Lever: R.H. - 13.8 KV
68. Upper Frame Tie Bolt - 13.8 KV
69. Spacers for Item 68
70. Lower Frame Tie Bolt - 13.8 KV
71. Spacers for Item 70
72. Pole Unit Operating Lever: Retainer Pins - 4.16 KV
73. Pole Unit Operating Shaft - 4.16 KV
74. Closed Breaker Interlock Adjusting Screw - 4.16 KV
75. Levering in Device Interlock Bracket - 4.16 KV
76. Spacer for Item 75
77. Hardware for Item 75
78. Pole Unit Operating Lever: L.H. - 4.16 KV
79. Pole Unit Operating Lever: Center - 4.16 KV
80. Pole Unit Operating Lever: R.H. - 4.16 KV
81. Opening Spring Pin: L.H. - 4.16 KV
82. Opening Spring Pin: R.H. - 4.16 KV
83. Upper Frame Tie Bolt - 4.16 KV
84. Spacers for Item 83
85. Lower Frame Tie Bolt - 4.16 KV
86. Spacers for Item 85
87. Spacer Washers for Items 83 and 85
88. Nuts for Frame Tie Bolts
89. Tripping Latch
90. Tripping Latch Pivot Pin
91. X-Washers for Item 90
92. Tripping Latch Spring
93. Tripping Trigger
94. Tripping Trigger Spring
95. Trigger Pivot Pin
96. X-Washers for Item 95
97. Spacers for Item 95
98. Latch and Trigger Spring Stop Pin
99. Spacer for Item 98
100. Nut for Item 98
101. Closing Trigger
102. Closing Trigger Spring
103. Main Link Retrieving Spring
104. Close and Trip Linkage Sub-Assembly
105. Main Link Connecting Pin
106. X-Washers for Item 105
107. Closing Latch
108. Closing Latch Spring
109. Closing Latch Pivot Pin
110. X-Washers for Item 109

Fig. 21. Parts for Stored Energy Mechanisms

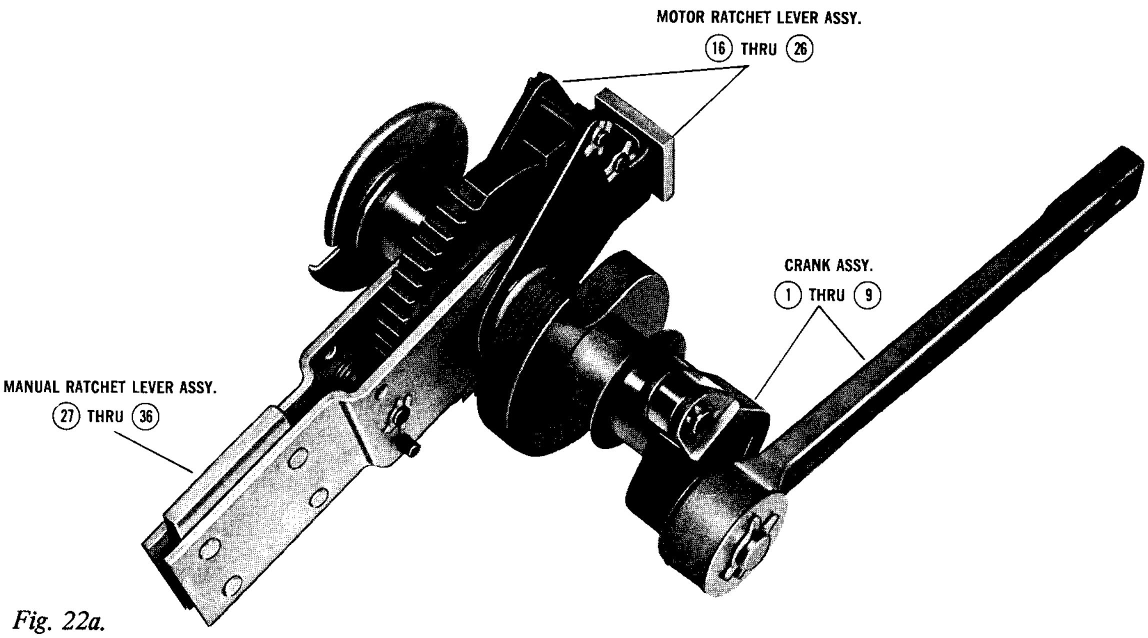


Fig. 22a.

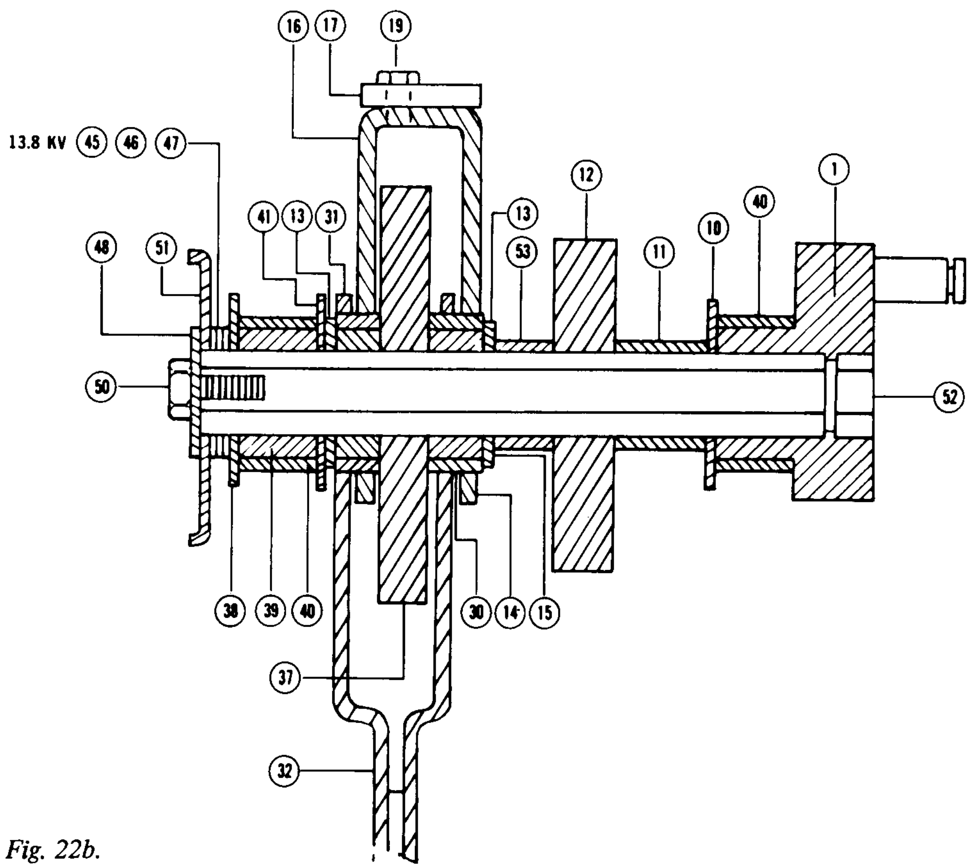
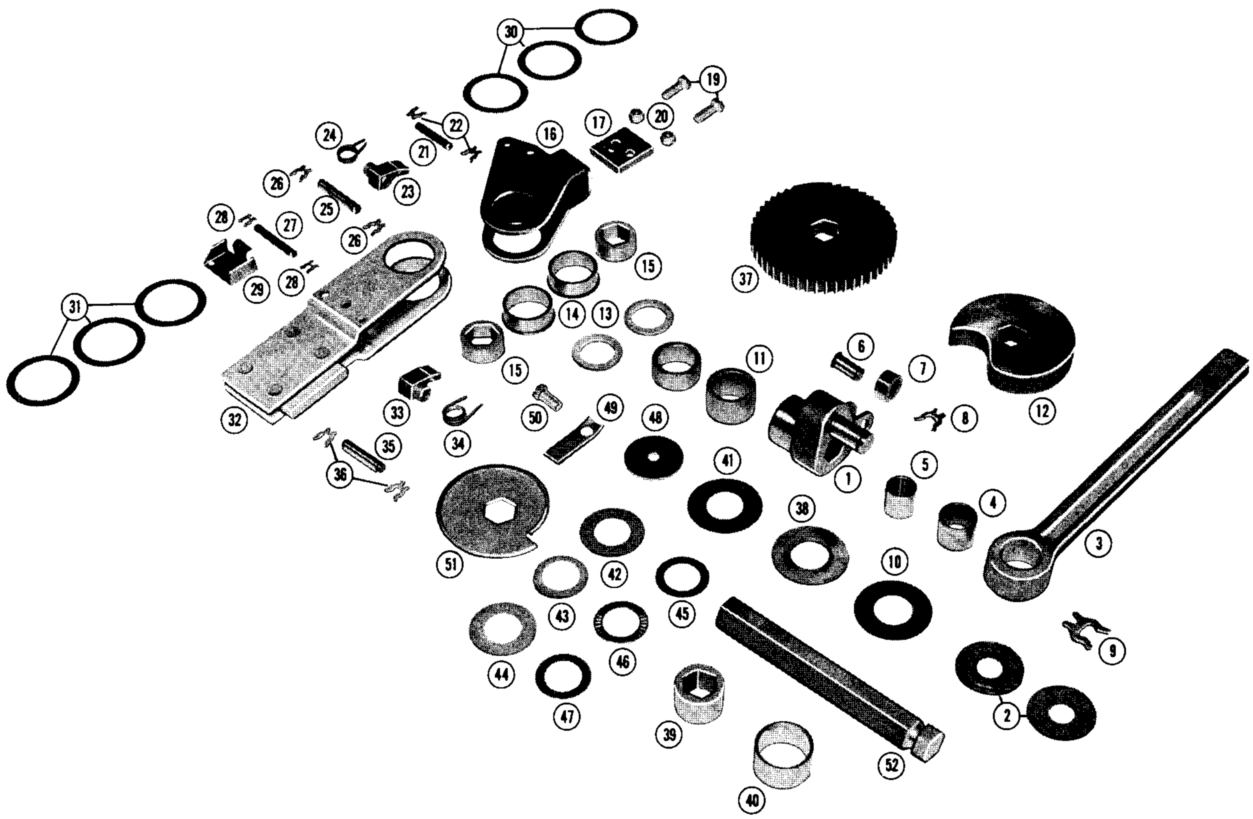


Fig. 22b.

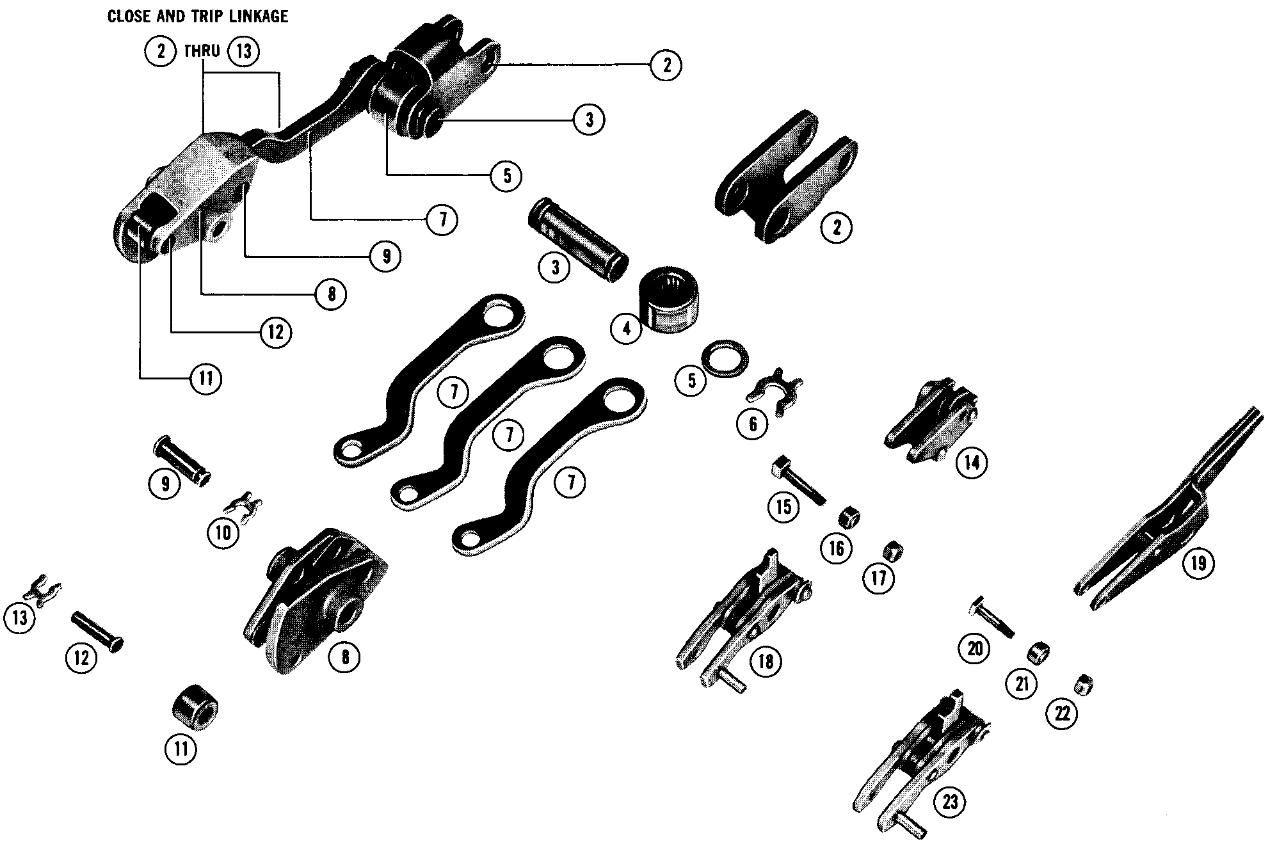
Fig. 22. Stored Energy Mechanism: Crank Shaft Sub-Assembly



Note: All Parts Common to 13.8 & 4.16 KV Mechanisms Unless Otherwise Noted.

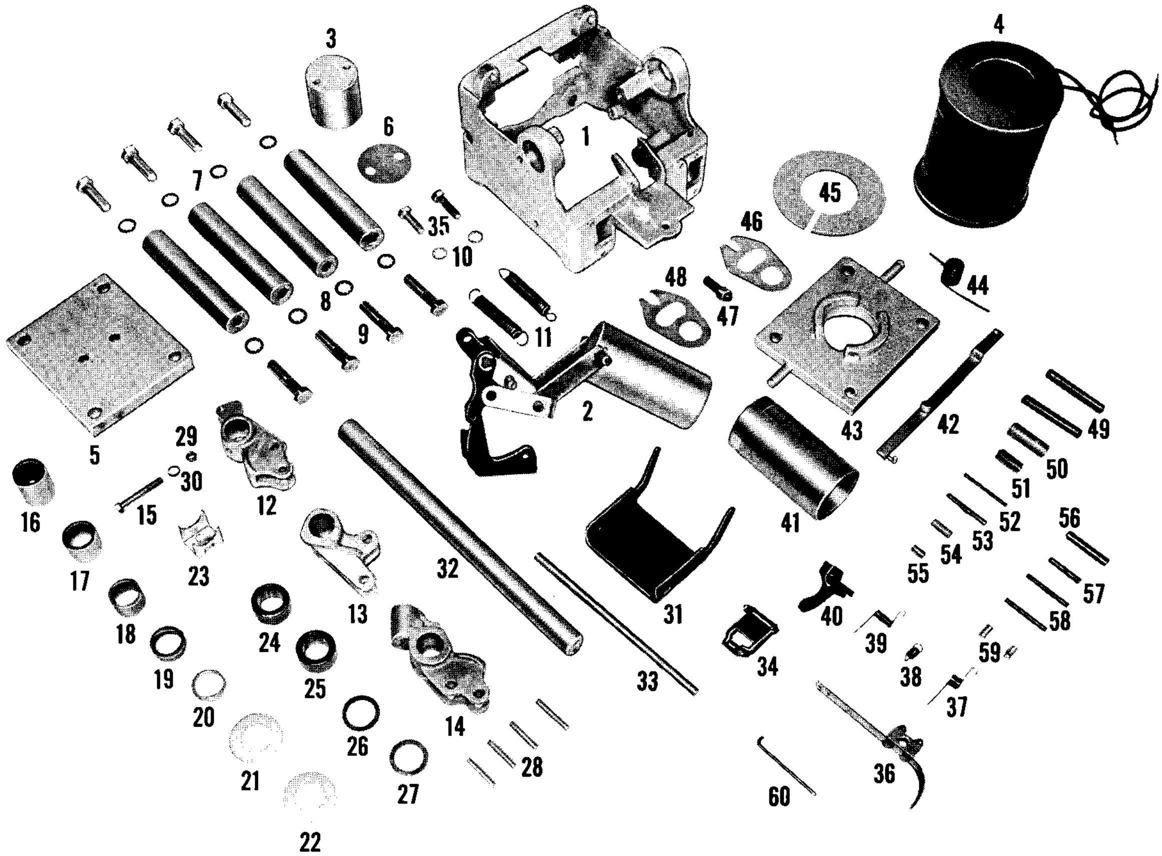
1. Main Crank
2. Wide Washer for Item 1
3. Connecting Rod
4. Connecting Rod Bearing
5. Connecting Rod Bearing Inner Race
6. Closing Stop Roller Pin
7. Closing Stop Roller
8. X-Washer for Item 6
9. X-Washer for Item 1
10. Hardened Washer
11. Spacer
12. Closing Cam
13. Spacer Washers
14. Ratchet Lever Bearings
15. Ratchet Lever Bearing Insert
16. Motor Ratchet Lever
17. Driver Plate
18.
19. Driver Plate Mounting Bolts
20. Nuts for Item 19
21. Driving Pawl Stop Pin
22. X-Washers for Item 21
23. Driving Pawl
24. Driving Pawl Spring
25. Driving Pawl Pivot Pin
26. X-Washers for Item 25
27. Holding Pawl Stop Pin
28. X-Washers for Item 27
29. Manual Ratchet Lever Spring Retainer
30. Spacer Washers
31. Spacer Washers
32. Manual Ratchet Lever
33. Holding Pawl
34. Holding Pawl Spring
35. Holding Pawl Pivot Pin
36. X-Washers for Item 35
37. Ratchet Wheel
38. Washer
39. Crank Shaft Bearing Insert
40. Crank Shaft Bearing Inner Race
41. Hardened Washer
42. Spacer Washer - 4.16 KV
43. Spacer Washer - 4.16 KV
44. Spacer Washer - 4.16 KV
45. Thrust Bearing Race - 13.8 KV
46. Thrust Bearing - 13.8 KV
47. Thrust Bearing Race - 13.8 KV
48. End Washer
49. Locking Clip
50. Limit Switch Cam Retainer Bolt
51. Limit Switch Cam
52. Crank Shaft

Fig. 22c. Stored Energy Mechanism: Parts for Crank Shaft Sub-Assembly



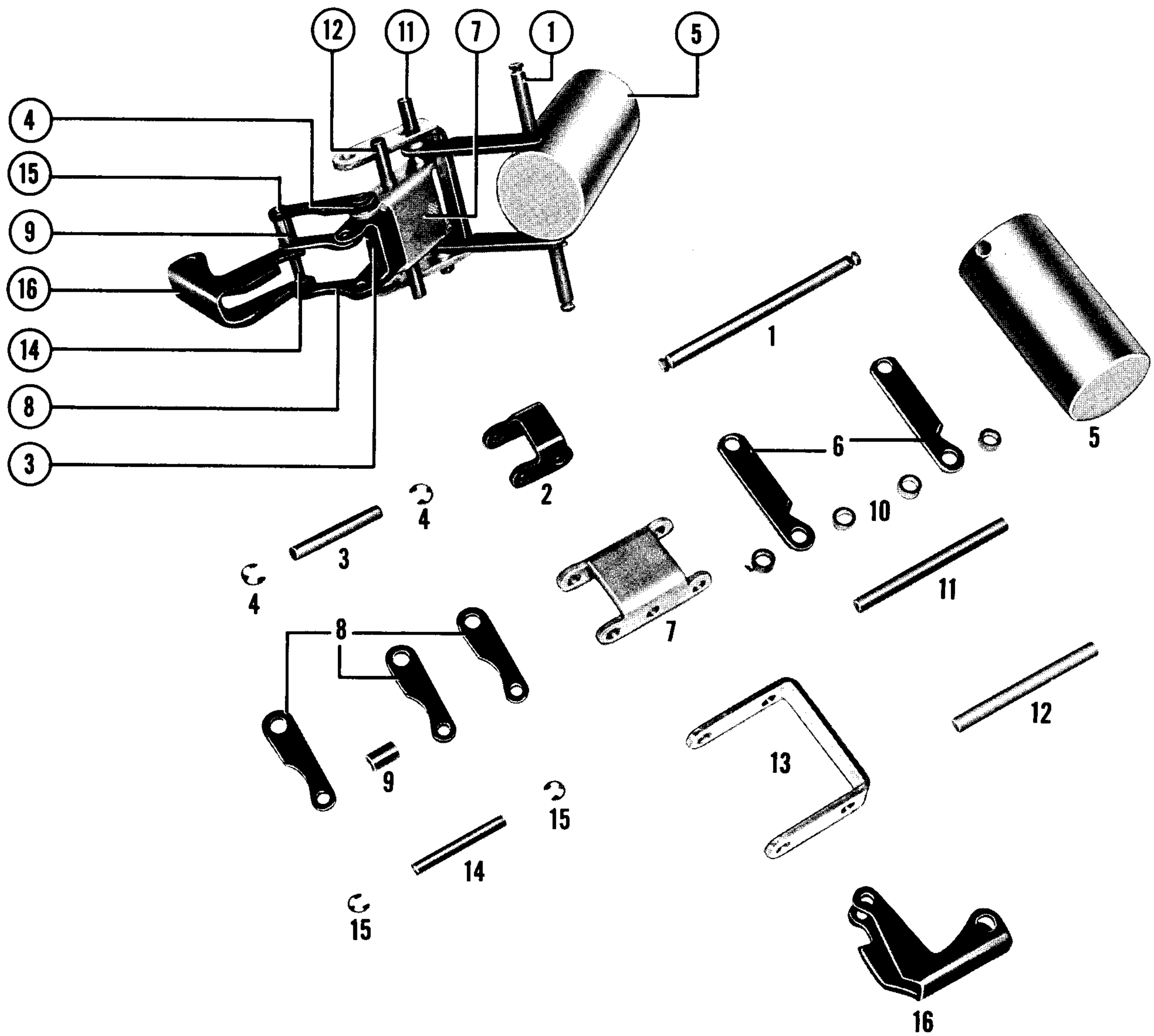
1. Close and Trip Linkage Sub-Assembly
2. Main Closing Link
3. Closing Cam Follower Roller Pin
4. Closing Cam Follower Roller
5. Spacer Washer for Item 3
6. X-Washer for Item 3
7. Tripping Cam Connecting Link
8. Tripping Cam
9. Connecting Link Pin
10. X-Washer for Item 9
11. Tripping Cam Roller
12. Tripping Cam Roller Pin
13. X-Washer for Item 12
14. Tripping Latch
15. Tripping Latch Roller Pin
16. Tripping Latch Roller
17. Nut for Item 15
18. Tripping Trigger
19. Closing Latch
20. Closing Latch Roller Pin
21. Closing Latch Roller
22. Nut for Item 20
23. Closing Trigger

Fig. 23. Stored Energy Mechanism: Parts for Close and Trip Linkage Sub-Assembly



1. Mechanism Frame
2. Movable Core, Close Latch and Link Sub-Assembly
3. Stationary Core
4. Closing Coil
5. Closing Magnet Rear End Plate
6. Anti-Freeze Washer
7. Rear End Plate Bolt Lock Washers
8. Magnetic Tie Rod Front Bolt Lock Washers
9. Magnetic Tie Rod Front Bolts
10. Stationary Core Bolt Lock Washers
11. Movable Core Retrieving Springs
12. Pole Unit Operating Lever, L.H.
13. Pole Unit Operating Lever, Center
14. Pole Unit Operating Lever, R.H.
15. Bolt for Item 23
16. Spacer for Item 32
17. Spacer for Item 32
19. Spacer for Item 32
20. Spacer for Item 32
21. Washer for Item 32
22. Washer for Item 32
23. Breaker Interlock Operator
24-25. Bearings for Main Shaft, Item 32
26-27. Washers for Main Shaft Bearings, Items 24-25
28. Pole Unit Lever Retainer Pins
29. Nut for Item 15
30. Lock Washer for Item 15
31. Closing Latch
32. Main Shaft
33. Closing Latch Pin
34. Tripping Latch
35. Stationary Core Bolts
36. Relay Cut-Off Lever
37. Tripping Trigger Spring
38. Floor Interlock Tripping Lever Spring
39. Tripping Latch Spring
40. Tripping Trigger
41. Closing Movable Core Guide Tube
42. Floor Interlock Tripping Lever
43. Closing Magnet Front End Plate
44. Closing Latch Spring
45. Closing Coil Washer
46-48. Closing Link Guides
47. Tripping Latch and Cam Clearance Adjusting Screw, See Fig. 9a
49. Guide Link Pins, See Fig. 27
50. Spacer for Item 53
51. Spacer for Item 52
52. Floor Interlock Tripping Lever Pivot Pin
53. Floor Interlock Tripping Lever Stop Pin
54. Tripping Latch Spacer
55. Tripping Trigger Spring Spacer
56. Center Pole Toggle Lever Pin
57. Floor Interlock, Tripping Lever Spring Pin
58. Trigger and Tripping Latch Pins
59. Retrieving Spring Stationary Support
60. Automatic Trip Operating Rod

Fig. 24. Parts for Solenoid Mechanism, 4.16 KV



1. Movable Core Pin
2. Upper Closing Link
3. Restraining Link and Tripping Cam Pin
4. Retainers for Item 3 ("E" Rings)
5. Movable Core
6. Movable Core Links
7. Lower Closing Link
8. Restraining Links
9. Spacer for Item 8
10. Lower Closing, Movable Core and Guide Link Spacers
11. Lower Closing, Movable Core and Guide Link Pin
12. Closing Latch Release Pin
13. Guide Link
14. Restraining Link and Tripping Cam Pin
15. Retainers for Item 14
16. Tripping Cam

Fig. 25. Solenoid Mechanism, 4.16 KV

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 Fig. 11, 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, 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 both the 4.16 and 13.8 KV breakers the manual ratchet lever projects through a slot in the front chassis panel just to the left of the coil marked "Lift to Trip". A manual spring charge/maintenance handle is provided to fit into the slot in the ratchet lever. 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 plastic guard marked "Lift to Close".

MAINTENANCE CLOSING AND OPENING

On both the 4.16 and 13.8 KV breakers the main shaft extends through the R.H. side sheet of the breaker chassis. A manual spring charge/maintenance handle is provided to fit on the end of the shaft for the purpose of hand closing and opening the breaker. This operation is solely for the purpose of inspecting and adjusting the contacts or other working parts of the breaker when slow motion may be required.

When the breaker has been levered beyond the test position in the cell it is not possible to insert the slot in the maintenance handle onto the end of the main shaft. This feature prevents any attempt to close the breaker on a live circuit by hand closing. Do not attempt to defeat its purpose.

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 SHAFT BEFORE TRIPPING THE BREAKER.

For further operating details, see BASIC OPERATING INSTRUCTIONS.

POLE UNITS

The pole Units, as shown in Figs. 14 and 15 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. 13.

CONTACTS

Figures 14 and 15 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 from high strength copper alloy, silver plated, and with anti-weld main current carrying inserts. The copper alloy contacts act as their own spring and no other spring is required. On the 1200 ampere breaker, there are a total of 4 contact members, each slotted part way, making a total of 8 contact points.

On 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 are also made of copper alloy, but are of heavier construction. For this reason, the stationary arcing contact are not tightly bolted to the contact block, but can pivot slightly. They are backed by compression springs to provide proper contact pressure. A stop is provided 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 and 150-DH-P500 arc chutes respectively. Figure 16 shows a schematic drawing of a typical arc chute of the Westinghouse center coil type. The blowout coils are located on the laminated magnet core in the center of the arc chute. Magnetic pole faces, bolted to each end of the core, extend along the outside of the arc chute enclosure. The coil terminals are connected to the two center arc horns. The main stacks are placed on each side of the coil and center arc horn assembly. The main stacks are made up of groups of zircon ceramic plates spaced apart and cemented together to form a unit assembly. Front and rear arc horns are located at the ends of the internal assembly and are connected to the lower and upper main studs of the breaker.

When interrupting current, the arc is started at the arcing contacts and moves upward due to the iron of the blowout magnet, and the heat of the arc. It quickly touches the center arc horns so that the central part of the arc is in parallel with the blowout coils. The transfer plates quickly extinguish this part of the arc, causing the total current to flow through the blowout coils. The magnetic field over the main stacks is consequently greatly intensified. This drives the arc into the main stacks, the plates of which have tapered and alternately offset slots. The arc is forced into a zig-zag shape and consequently forced into large areas of contact with the relatively cool surfaces of the zircon plates. This quickly makes the arc space substantially non-conducting at the next zero point of current and the arc is put out. This is known as deionization, as the conducting ions in the arc space are removed by the cooling action of the zircon plates and the turbulance of the high speed air movement due to the high speed of the arc.

On all ratings above the 50-DH-P75, zircon ceramic arc shields are located below the main stacks and blowout coil assembly on the inner walls of the arc chute enclosure to protect the walls from the burning action of the arc as it is drawn on the arcing contacts. Figure 17 shows insides of a 50-DH-P250 arc chute, which is typical. As shown in Fig. 18, in the 50-DH-P75 arc chute, the arc shield part is molded integrally with the arc chute enclosure. A special Westinghouse molding compound permits this.

MAINTENANCE GUIDE -- INSPECTION, ADJUSTMENTS AND GENERAL MAINTENANCE

General

This class of power circuit breaker is a protective device to prevent damage to more expensive apparatus and to maintain continuity of electric power service. To maintain greatest reliability they should be inspected and given all indicated maintenance on a regular schedule. The type DH-P circuit breakers are designed to comply with standards, one requirement of which is that the breaker be capable of performing 1000 to 5000 switching operations at up to rated continuous current before any parts renewal may be required, based on maintenance every 2000 operations. If the breaker opens a fault before the specified number of switching operations is complete, additional maintenance or parts replacement may be necessary, depending on its condition at the time.

Actual inspection and maintenance will depend upon individual application conditions. Some atmospheric conditions such as extremes of dust and moisture or corrosive gases might indicate inspection and maintenance at more frequent intervals than 2000 operations. Very clean and dry conditions combined with low switching duty will justify longer times between inspection and maintenance operations. In respect to general maintenance requirements, the DH-P line is about the same as the Westinghouse Type DH suffix E line for a given set of conditions. With experience, each user can set an inspection and maintenance schedule which is most economical for the particualr case.

These breakers are adjusted, inspected and tested at the factory in line with high standards of quality control and reliability. They should not require readjustments before placing in service. Do not change any adjustments, assemblies or parts unless there has been an obvious damage or incorrect adjustment. However, handling and transportation conditions could cause loss of adjustment or damage.

Therefore, some inspection should be done on the breaker immediately after unpacking. The 4.16 KV breaker is packed all in one crate. The arc chutes, in 3 cartons, and the main barrier assembly are inside the crate with the breaker.

The 13.8 KV breakers are packed in 3 crates, the basic breaker unit in one crate, 3 arc chutes in one crate and the barrier assembly in another crate.

These packing methods permit easy inspection before final assembly of arc chutes and barriers on the breakers.

CONTACTS SETTINGS

NOTE

On breakers with stored energy mechanisms, before trying to close the breaker with the maintenance closing handle, make sure that the closing spring is discharged. It can not be closed this way with the spring charged. If it is tried, the tripping linkage may be damaged. Breaker should be open and spring discharged as it is unpacked.

Figure 1b shows a 4.16 KV breaker arc chute tilted back for getting to the contacts. This is done directly by hand, after disconnecting the shunt connection. Figure 19 shows the method of lifting the 13.8 KV arc chute with the accessory arc chute lifter.

With the maintenance closing handle, close the breaker contacts slowly. The movable arcing contact and two main contacts should enter the stationary fingers centrally between pairs of fingers. Movement outward of the stationary fingers on each side of the movable member as the movable contact enters should be about equal. Complete the closing of the breaker until it is latched closed.

In this overall operation refer to Fig. 20 for required deflections, overlap and tolerances in the contact system.

Adjustment for contact overlap is by change in the effective length of the lift rod. To increase overlap, increase effective length of lift rod by adjusting the nuts at the top end of the rod. To decrease overlap, decrease effective length of lift rod.

On the rare possibility that some of the main stationary fingers may be slightly out of alignment with the movable member beyond the tolerances in Fig. 20, they may be set by careful blows with a soft mallet.

Slight misalignment of the arcing contacts may be remedied in a similar manner. If there is much misalignment or damage to any of the contacts, they should be replaced.

The movable contact is hinged to the lower contact block by a stud and spring washers. The blades should fit snugly against the block and it should not be possible to rattle the blades against the block by sidewise hand effort.

To Adjust the Hinge:

1. Disconnect the lift rod.
2. Tighten hinge nut until movable contact arms will stand at about 45° 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. 20:

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. 20, 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 vaults. 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 interferring 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. 8b, the clearance between the roller on the tripping cam and the vertical surface of the tripping latch should be .020 to .030 in. If there is no clearance at all, the tripping latch cannot drop into place and the tripping trigger cannot reset to the untripped position. Therefore, the breaker will

not close. This clearance can be checked from the top of the breaker with the barrier mounting plate removed.

The clearance can be adjusted by the trip cam adjusting screw which projects through the front chassis panel; directly under the tripping coil (Fig. 6). With the spring charged and the breaker open, remove the locking clip and turn the adjusting screw until hand tight, then back out 1/2 turn. Hold screw and replace locking clip.

2. Referring to Fig. 8b, the clearance between the closing cam and the main roller should be .040 to .060 in. with the breaker open and the spring charged. This clearance can be checked from the rear of the breaker. Adjustment is by means of the puffer piston connecting bolts.

With the breaker open, the puffer piston should be at the top limit of its travel. Adjust the bolts to the proper clearance of the roller. Turning counterclockwise 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. 20. If there are no signs of shipping damage or of anything interferring 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. 11. 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.

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. 20.

MINIMUM CLOSING SPEED

4.16 KV Breakers 7 ft/sec

13.8 KV Breakers:
40,000 Amp Momentary 9 ft/sec
60,000-70,000 Amp Momentary 10 ft/sec
80,000 Amp Momentary 11 ft/sec

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	inches, min.
13.8 KV Breakers	2-3/4	inches, 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 chute are not much affected by humidity but the ceramic material especially will absorb liquid water. Hence these words of caution.

NOTE

For inspection and maintenance, the arc chutes may be tilted back on their hinge points; however, do not tilt more than one arc chute at a time as this causes the breaker to become top heavy. On 13.8 Kv breakers, tilt arc chutes only within limits provided by using arc chute lifter shown in Fig. 19.

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. 53701GC 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. 55213AG. 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 throughly 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. 55213AG 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. 53701GC.

STORED ENERGY MECHANISM REMOVING AND 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 become necessary due to some unusual condition, proceed as follows:

1. Turn breaker on its R.H. side as viewed from the front of the cell. Use wood blocks under the R.H. pole unit to hold it near level on the floor.

2. Remove 2 bolts and the pipe plug located on the underside of the motor mounting plate. Loosen nuts on U-bolt also on underside of mounting plate. (See Fig. 6).

3. Withdraw motor from breaker.

4. 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. 13. 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.

No.	Part	Required Number for one Pole Unit.
1.	Stationary arcing contact assembly, Fig. 14, item 15	1#
2.	Movable arcing contact, Fig. 14, item 21	1#
3.	Stationary main contacts, 1200 amp., Fig. 14, item 3	1 set#
4.	Stationary main contacts, 2000 amp., Fig. 14, item 41	1 set#
5.	Movable main contact, 4.16 KV, 1200 amp., R.H., Fig. 14, item 26	1
6.	Movable main contact, 4.16 KV, 1200 amp., L.H., Fig. 14, item 25	1
7.	Movable main contact, 4.16 KV, 2000 amp., R.H., Fig. 14, item 40	1
8.	Movable main contact, 4.16 KV, 2000 amp., L.H., Fig. 14, item 39	1
9.	Movable main contact, 13.8 KV, 1200 amp., R.H., Fig. 15, item 8	1
10.	Movable main contact, 13.8 KV, 1200 amp., L.H., Fig. 15, item 7	1
11.	Movable main contact, 13.8 KV, 2000 amp., R.H., Fig. 15, item 10	1
12.	Movable main contact, 13.8 KV, 2000 amp., L.H., Fig. 15, item 9	1
13.	Movable contact pad, Fig. 14, item 20	1#
14.	Movable contact hinge pin, 1200 amp., Fig. 14, item 31	1
15.	Movable contact hinge pin, 2000 amp., Fig. 14, item 42	1
16.	Movable contact hinge spring washers, Fig. 14, item 37	1
17.	Movable contact lift rod, Fig. 14, item 6	1
18.	Puffer tube assembly 4.16 KV, Fig. 14, item 9	1
19.	Puffer tube assembly 13.8 KV, Fig. 15, item 3	1
20.	Kick out spring, Fig. 14, item 29	1
21.	Disconnecting contact finger cluster, 1200 amp., Fig. 13, indicated	2
22.	Disconnecting contact finger cluster, 2000 amp., Fig. 14, item 43	2
23.	Complete pole unit less lift rod and disconnecting finger contact clusters, 1200 amp., 4.16 KV, Fig. 14	1
24.	Complete pole unit as specified in item 23 except, 2000 amp., 4.16 KV., Fig. 14	1
25.	Complete pole unit as specified in item 23 except, 1200 amp., 13.8 KV, Fig. 15	1
26.	Complete pole unit as specified in item 23 except, 2000 amp., 13.8 KV, Fig. 15	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. 11, indicated	1
2. Auxiliary switch, lower, Fig. 11, indicated	1
3. Latch check switch, Fig. 11, indicated	1
4. Motor limit switch, Fig. 11, indicated	1
5. Control relay, "Y", Fig. 11, indicated	1#
6. Trip coil, 24 v.d.c., Fig. 11, indicated 48 v.d.c. 125 v.d.c. 250 v.d.c. 230 v.a.c., 60 cycle	1#
7. Spring release coil, 24 v.d.c., Fig. 11, indicated 48 v.d.c. 125 v.d.c. 250 v.d.c. 230 v.a.c., 60 cycle	1#
8. Spring charging motor 48 v.a.c. or d.c., Fig. 13, indicated 125 v.a.c. or d.c. 230 v.a.c. or d.c.	1
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. 9a, indicated 125 v.d.c. 250 v.d.c.	1
4. Trip coil, same as for stored energy mech.	1#
5. Closing coil, 4.16 KV, 48 v.d.c., Fig. 9a, indicated 125 v.d.c. 250 v.d.c.	1#
7. Closing coil, 13.8 KV, 48 v.d.c., Fig. 9b, indicated 125 v.d.c. 250 v.d.c.	1#
8. Ground contact, same as for stored energy mech.	1

Note:
Same as for pole unit parts.

Table of Approximate Weights

Breaker Type	Ampere Rating	Weight in Pounds			
		Breaker	Single Arc Chute	Barrier Assembly	Complete Breaker
50-DH-P75	1200	425	35	40	575
50-DH-P250	1200	425	100	50	775
50-DH-P250	2000	450	100	50	800
50-DH-P350	1200	450	125	50	875
50-DH-P350	2000	475	125	50	900
50-DH-P350	3000	625	250	100	1475
75-DH-P500	1200	575	250	100	1425
75-DH-P500	2000	600	250	100	1450
150-DH-P500	1200	575	250	100	1425
150-DH-P500	2000	600	250	100	1450
150-DH-P750	1200	575	300	100	1575
150-DH-P750	2000	600	300	100	1600

Rating Table

Air Circuit Breaker Type	3-Phase Inter-rupting Rating mva	Voltage Ratings			Current Ratings in Amperes		Interrupting Rating in Amperes	
		Rated kv	Max. Design kv	Min. kv for Rated Int. mva	Contin-uous 60 cy	Short Time Momen-tary	At Rated Voltage	Max. Amperes
50-DH-P75	75	4.16	4.76	3.5	1200	20,000	10,400	12,500
50-DH-P250	250	4.16	4.76	3.85	1200	60,000	35,000	37,500
50-DH-P250	250	4.16	4.76	3.85	2000	60,000	35,000	37,500
50-DH-P350	350	4.16	4.76	4.0	1200	80,000	48,600	50,000
50-DH-P350	350	4.16	4.76	4.0	2000	80,000	48,600	50,000
50-DH-P350	350	4.16	4.76	4.0	3000	80,000	48,600	50,000
75-DH-P500	500	7.2	8.25	6.6	1200	70,000	40,000	44,000
75-DH-P500	500	7.2	8.25	6.6	2000	70,000	40,000	44,000
150-DH-P500	500	13.8	15.0	11.5	1200	40,000	21,000	25,000
150-DH-P500	500	13.8	15.0	11.5	2000	40,000	21,000	25,000
150-DH-P500	500	13.8	15.0	11.5	1200	60,000	21,000	25,000
150-DH-P500	500	13.8	15.0	11.5	2000	60,000	21,000	25,000
150-DH-P750	750	13.8	15.0	11.5	1200	60,000	31,000	37,500
150-DH-P750	750	13.8	15.0	11.5	2000	60,000	31,000	37,500
150-DH-P750	750	13.8	15.0	11.5	1200	80,000	31,000	37,500
150-DH-P750	750	13.8	15.0	11.5	2000	80,000	31,000	37,500

Memorandum