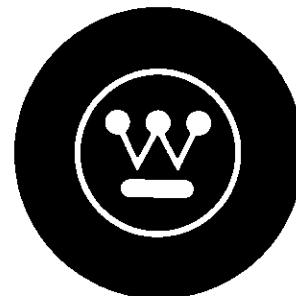


**Instructions for Porcel-line<sup>TM</sup>**  
**Type DHP**  
**Magnetic Air**  
**Circuit Breakers**



**Westinghouse Electric Corporation**

Switchgear Division, East Pittsburgh, PA 15112

I.B. 32-253-4A Effective September, 1978

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# **CAUTION**

**The circuit breakers described in this book have been designed and tested to operate within their nameplate ratings. Operation outside of these ratings may cause them to fail, resulting in bodily injury and property damage.**

## PURPOSE

This instruction book is expressly intended to cover the installation, operation and maintenance of Type DHP Magnetic Air Circuit Breakers.

For application information, consult your nearest Westinghouse sales office, see Westinghouse Application Data 32-262, or appropriate ANSI Standards.

## SAFETY

All Safety Codes, Safety Standards and/or Regulations as they may be applied to this type of equipment must be strictly adhered to.

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*All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.*

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## INTRODUCTION

These instructions cover Westinghouse Type DHP Magnetic De-ion® Air Circuit Breakers. They are the removable interrupting elements for use in horizontal drawout Porcel-line® Metal-Clad Switchgear to provide reliable control and protection for medium voltage electrical equipment and circuits. DHP Breakers are designed for ease of handling, reliable performance and ease of maintenance. Like ratings are interchangeable with each other.

The DHP Breaker operates on the magnetic De-ion principal of interruption wherein the arc is elongated, cooled, restricted and de-ionized by the interaction of the arc and the transverse magnetic field produced by the arc current.

DHP Breakers are available for application at voltages from 2.3 kV to 15.0 kV; with continuous currents of 1200, 2000 and 3000 amps; and with interrupting capabilities up to 48000 amps. Refer to the breaker nameplate for the complete rating information for any given breaker. DHP Breakers conform to NEMA, ANSI and IEEE standards.

**TYPE DHP BREAKERS ARE PROTECTIVE DEVICES. AS SUCH, THEY ARE MAXIMUM RATED DEVICES. THEREFORE, THEY SHOULD NOT UNDER ANY CIRCUMSTANCES BE APPLIED OUTSIDE THEIR NAMEPLATE RATINGS.**

The available DHP Breakers and their rated performance capabilities are given in the Rating Table below.

Table 1 – Type DHP Breaker Rating Table

Identification			Rated Values								Related Required Capabilities										
Circuit Breaker Type	Nominal Voltage Class	Nominal 3-Phase MVA Class	Voltage		Insulation Level		Current		Rated Interrupting Time	Rated Permissible Tripping Delay	Rated Max. Voltage Divided By K	Current Values									
	kV Class	MVA Class	Rated Maximum Voltage	Rated Voltage Range Factor	Rated Withstand Test Voltage	Rated Continuous Current at 60 Hz	Rated Short Circuit Current (at rated Max. kV)	K Times Rated Short-Circuit Current KI				3 Sec. Short-Time Current Capability	Closing and Latching Capability								
E	K	Low Frequency	Impulse	I	Y	E/K	K Times Rated Short-Circuit Current KI	1.6 K Times Rated Short-Circuit Current													
DHP Air Circuit Breaker																					
50 DHP 75		4.16	75	4.76	1.36	19	60	1200	8.8	5	2	3.5	12	12	19						
50 DHP 250			250		1.24			1200	29				36	36	58						
H 50 DHP 250 <sup>Ⓢ</sup>								350								1.19	2000	41	49	49	78
50 DHP 350																	3000				
75 DHP 500		7.2	500	8.25	1.25	36	95	1200	33	5	2	6.6	41	41	66						
150 DHP 500		13.8	500	15	1.30	36	95	1200	18	5	2	11.5	23	23	37						
H 150 DHP 500 <sup>Ⓢ</sup>								750							2000	28	36	36	58 <sup>Ⓢ</sup>		
150 DHP 750C			1000						3000				48	48	77 <sup>Ⓢ</sup>						
H 150 DHP 750C <sup>Ⓢ</sup>									37												
150 DHP 1000			48					48	77												

<sup>Ⓢ</sup> Non-Standard Breaker with High Momentary Rating available for Special Applications.

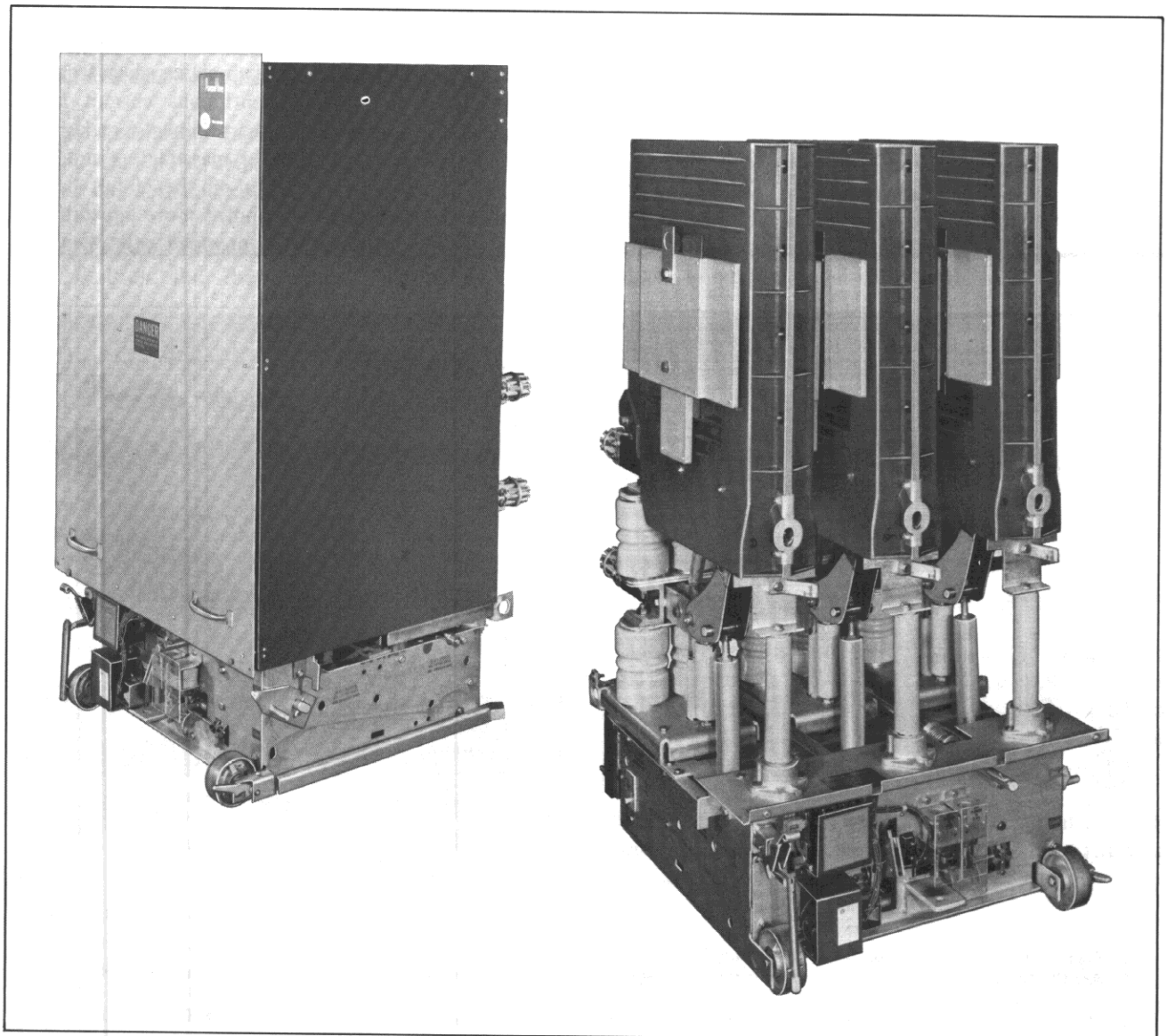
## GENERAL DESCRIPTION

Westinghouse Type DHP Circuit Breakers are horizontal drawout magnetic air circuit breakers. They are designed for use in Metal-Clad Switchgear assemblies having maximum voltages of 4.76 kV, 8.25 kV and 15.0 kV. They are equipped with spring stored energy closing mechanisms. All primary insulation to ground is porcelain. All type DHP circuit breakers have many common features, but they will vary in size and detail depending on the specific breaker type number and ratings. Fig. 1 shows two views of a 150DHP500 breaker.

Each circuit breaker consists of a basic breaker assembly, three interrupter assemblies (arc chutes), and a barrier assembly. Various accessories are also provided as required.

### Basic Breaker Assembly

The basic breaker assembly includes a chassis, a control panel, an operating mechanism, a puffer assembly, a levering-in device, various interlocks, and three porcelain



**Fig. 1** 150DHP500, 1200 Amperes with and without Barrier (392990 and 391370)



insulated pole unit assemblies. This entire assembly is mounted on wheels for ease of handling.

On the front of the breaker are the control items needed for proper operation of the circuit breaker. They are: tripping magnet, tripping trigger, closing spring release magnet, spring release trigger, latch checking switch, auxiliary switches, control relay, motor cut-off switch, and operation counter.

### Arc Chutes

Each arc chute contains arc runners, ceramic interrupter stacks, ceramic arc shields, blowout coils, various baffles and deflectors, and a magnet structure all assembled in an insulating arc chute jacket. The arc chutes mount on top of the pole units.

### Barrier Assembly

The barrier assembly consists of a grounded steel front panel and several insulating side sheets to shield the pole units and arc chutes from each other and ground. The barrier assembly is secured to the breaker chassis when mounted. It is arranged in such a way that it cannot

readily be removed when breaker is in its metal-clad housing.

### Accessories

Accessories provided for each circuit breaker installation usually include a handling dolly, a maintenance lever, a levering-in device crank, and, depending on breaker rating, an arc chute lifter.

Since the major components and the accessories depend on the particular type and rating of circuit breaker, packing lists provided with each shipment and more detailed sections of this instruction book should be referred to for special information. Any questions about the circuit breakers may be referred to the nearest Westinghouse Electric Corp. Sales Office. When making inquiries about type DHP circuit breakers always provide the specific type number, continuous current rating, mechanism type, applicable order numbers, breaker shop orders or style numbers, date of manufacture and other pertinent information as shown on the circuit breaker nameplate. Inquiries can be handled more expeditiously when complete information is provided with the initial inquiry.

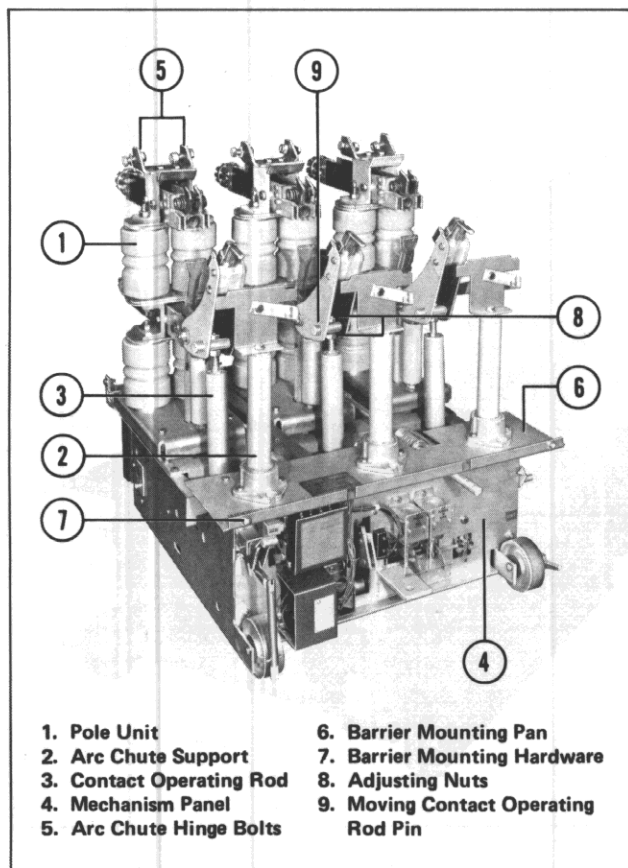


Fig. 2 Front View of 15.0 kV Breaker (391357)

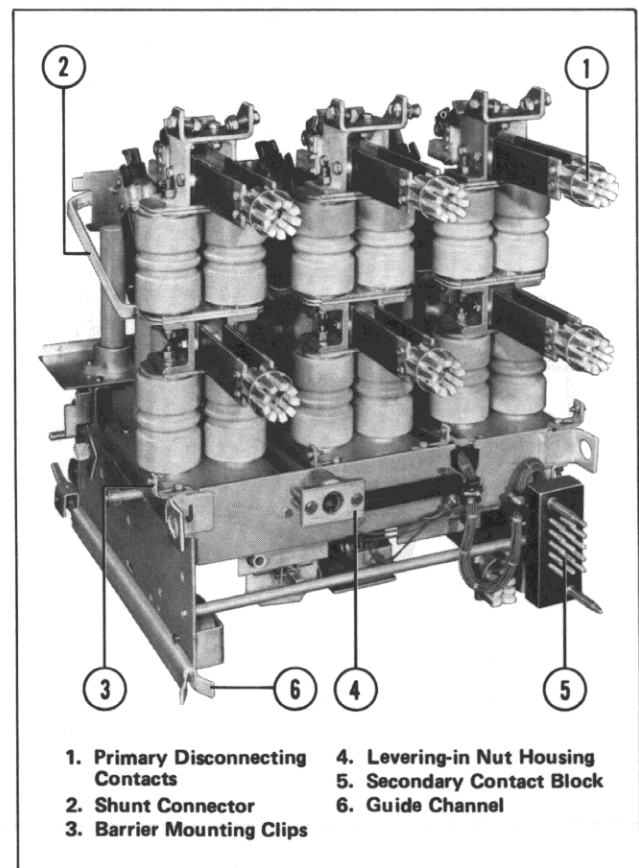


Fig. 3 Rear View of 15.0 kV Breaker (391356)

## SAFETY FEATURES

Type DHP Breakers are manufactured with several built-in interlocks and safety features to provide safe and proper operating sequences. **UNDER NO CIRCUMSTANCES SHOULD THEY BE MADE INOPERATIVE.**

1. Interphase Barrier is bolted to breaker at the rear so barrier can only be removed from a breaker that is out of its cell. On some ratings, the barrier must be lifted over the arc chutes. This cannot be done when the breaker is in the housing.
2. The Maintenance Handle (hand closing lever) is constructed so that it cannot be used to close the breaker when the breaker is in the housing.
3. The Levering-in Device is interlocked so that the breaker cannot be levered either in or out when the breaker contacts are closed.
4. The Breaker Mechanism is held trip-free between the Test Position and the Engaged Position to prevent

accidental closing while the breaker is in an intermediate position.

5. Floor Trippers are provided to trip the breaker and discharge the closing spring when the breaker is inserted into or removed from the housing.
6. A Closed Breaker Interlock is provided to prevent releasing the closing spring if the breaker is closed.
7. Each breaker has a Coding Plate attached to the left side. This plate in conjunction with a co-operating plate in each housing acts as an interference interlock so that only suitably rated circuit breakers can be inserted.
8. A Rail Latch is provided to hold the breaker in the Test Position and to prevent damage to the levering-in screw in the housing.
9. Positive Mechanical Indicators show whether the breaker is open or closed, and whether the closing spring is charged or discharged.

## SAFE PRACTICES

Type DHP circuit breakers are complex high voltage electrical devices containing high speed, high energy, operating mechanisms. They are designed to operate within the current and voltage limitations on the breaker nameplate. Do not apply these breakers to systems with currents and/or voltages exceeding these limits.

**1. Because of the nature of this type of equipment, only qualified electrical workers who, by reason of training and experience with high voltage circuits and equipment, are familiar with the work to be performed and the hazards involved should work on this equipment.**

**2. The breakers are equipped with various interlocks. DO NOT MAKE ANY OF THE INTERLOCKS INOPERATIVE.**

**3. Read these instructions carefully before attempting any assembly, operation, or maintenance of the circuit breaker.**

**4. Only Qualified Persons as defined in the National Electric Safety Code should be permitted to assemble, operate or maintain these breakers.**

**5. For maximum safety, assemble the arc chutes and barrier on the breaker before inserting it into an energized cell.**

**6. Never insert a breaker without arc chutes and barrier into an energized metal-clad cell beyond the test position.**

**7. If it is necessary to put a breaker without arc chutes and barrier in the test position in an energized cell, put a padlock through the hole in the levering-in shaft to prevent putting the levering-in crank on the levering-in shaft.**

**8. Always be sure that the shunt straps (front arc horn connectors) ARE IN PLACE AND BOLTED TIGHT as soon as the arc chutes are mounted on the breaker.**

**9. Do not attempt to lift the breaker with arc chutes and/or barrier in place with an overhead lifting device. Roll the breaker on its wheels. Use the turning dolly.**

**10. Never attempt to close the breaker by hand on a live circuit. The maintenance closing handle is made so that it**

cannot be used when the breaker is in cell. Do not remove interference bar from handle.

11. Keep fingers from top or sides of barrier when moving breaker in or out of cell.

12. When mounting barrier be sure to fasten securely all hardware; front, rear and sides.

13. When operating breaker without arc chutes and barriers, keep hands, arms, head and tools out of area where contacts travel. Severe injury could result from being struck by the moving contacts either on opening or closing.

14. Never leave breaker in an intermediate position in a cell. Always have the breaker either in the test/disconnect or connected position.

15. Be sure breaker is open and closing spring is discharged before attempting any maintenance.

16. Be sure breaker is open and closing spring is discharged after completing any maintenance.

17. Do not attempt to close breaker with maintenance closing handle when closing spring is charged.

18. Always remove the maintenance closing handle immediately after using it to close the breaker.

19. There are several interlocks on the breaker. They are for personnel and/or equipment protection. **UNDER NO CIRCUMSTANCES SHOULD THEY BE MADE INOPERATIVE.**

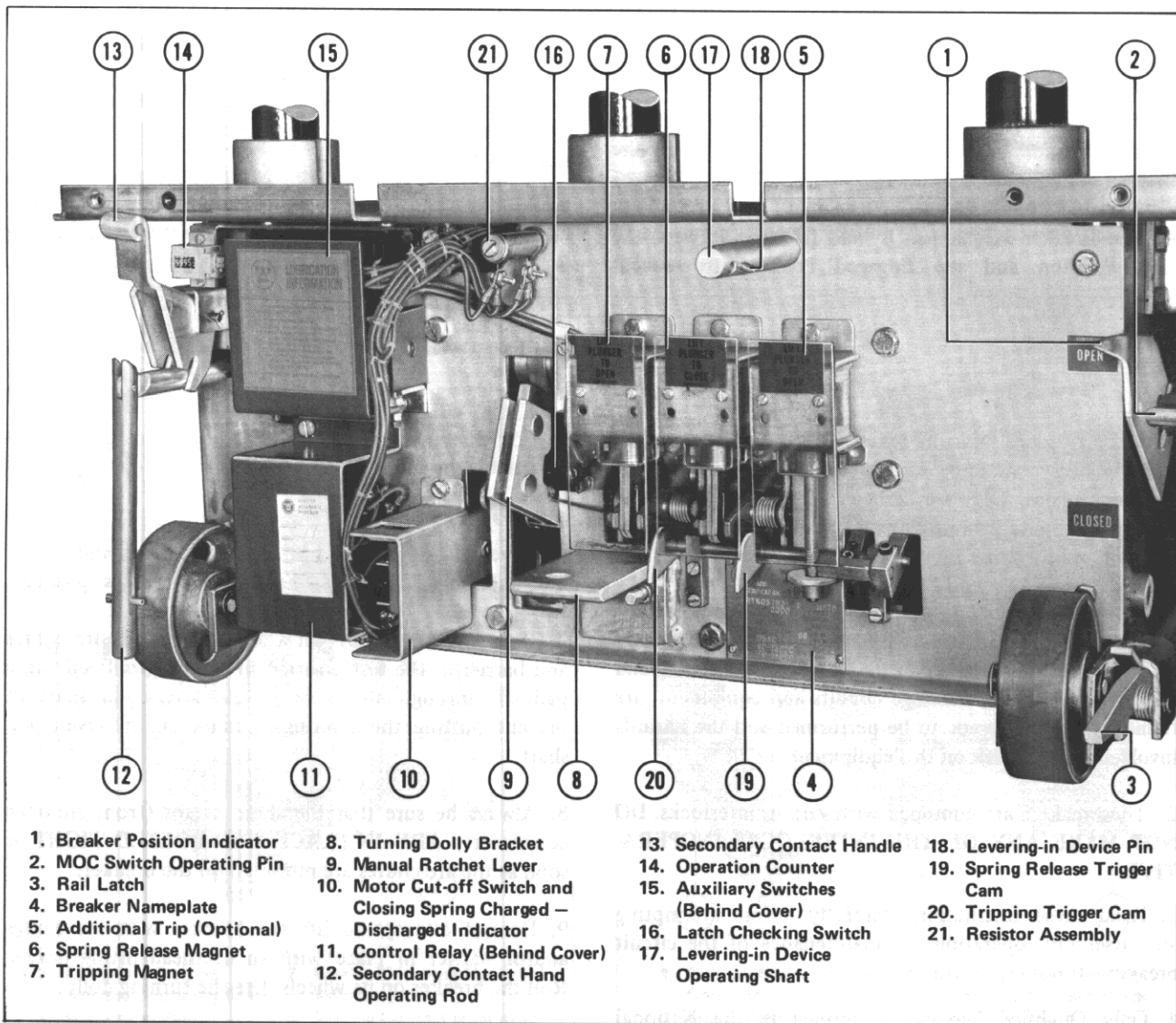


Fig. 4 Mechanism Panel

## RECEIVING, HANDLING AND STORING

Type DHP Breakers are shipped in packages designed to provide maximum protection to the equipment during shipment and storage and at the same time to provide convenient handling. The 50DHP75 and 50DHP250 breakers are shipped in a single crate containing the breaker, three individually boxed arc chutes and the interphase barrier. The 50DHP350 is shipped in 2 crates. One is a crate containing the breaker and the three packaged arc chutes. The other crate contains the barrier. The 75DHP500 and 150DHP500 breakers are shipped in 2 crates the same as the 50DHP350. The larger 150DHP750C and 150DHP1000 breakers are shipped in three packages; the breaker and barrier in separate crates and the three individually packaged arc chutes on a pallet. The size and weight of the individual packages is included in the section on handling.

### RECEIVING

Upon receipt of the equipment, inspect the crates for any signs of damage or rough handling. Open the crates carefully to avoid any damage to the contents. A nail puller is recommended for this rather than a crow bar.

When opening the crates, be careful that any loose items or hardware are not discarded with the packing material. Check the contents of each package against the packing list.

Examine the breaker, arc chutes and barrier for any signs of shipping damage. File claims immediately with the carrier if damage or loss is detected and notify the nearest Westinghouse Sales Office.

### HANDLING

Type DHP circuit breaker shipping containers are designed to be handled either by use of a rope sling and an overhead lifting device or by fork lift truck. If containers must be skidded for any distance it is preferable to use roller conveyors or individual pipe rollers.

Once the breakers have been inspected for shipping damage, it is best to return them to their original shipping crates until they are ready to be installed in the Metal-Clad Switchgear.

After the breakers have been removed from the shipping crates, they should be handled carefully until assembled and installed in the Metal-Clad Switchgear. Roll them on their wheels using the handling dolly for maneuvering. If this is not practical, the basic breaker assembly may be lifted by attaching hooks in the four holes in the chassis that are marked "Lift Here". Fig. 5. When lifting this way spreaders should be used to keep from distorting or damaging the pole units.

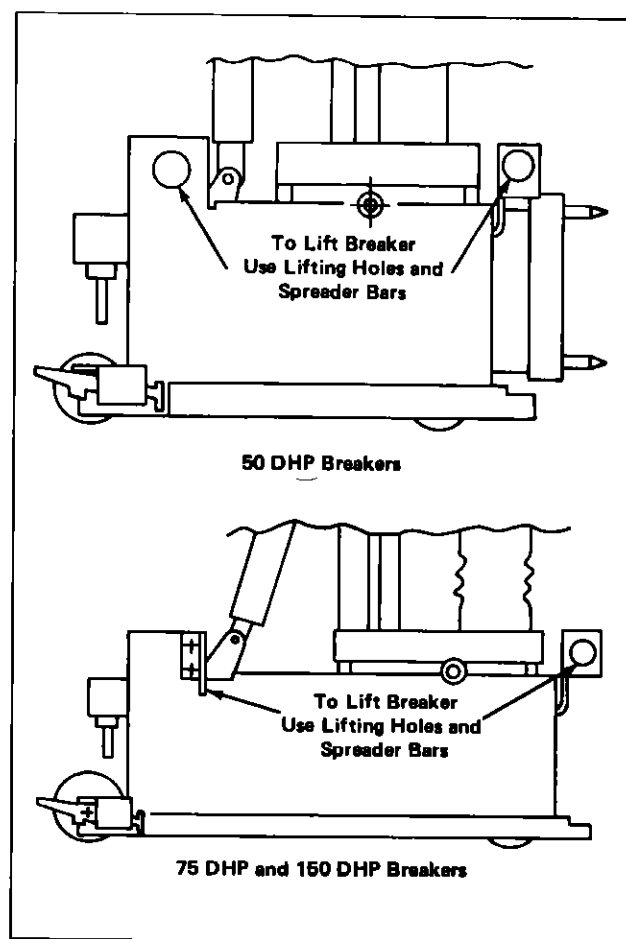


Fig. 5 Breaker Handling

The arc chutes should preferably be handled in their individual cardboard shipping cartons until it is time to mount them on the circuit breaker. Care should be taken in handling them so as not to crack or break the internal ceramic parts.

Once the arc chutes have been removed from their shipping cartons, care should be taken not to damage the front arc horn which may protrude from the bottom. If the arc chutes must be placed on the floor they should be laid on their side or placed on spacers to protect the extended front arc horn. Fig. 6.

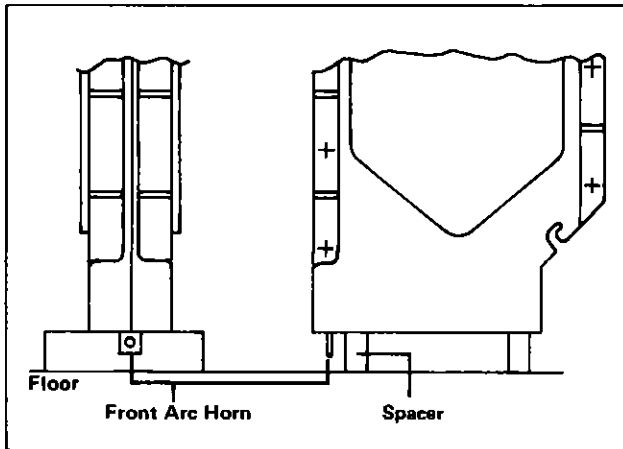


Fig. 6 Arc Chute on Floor

The 50DHP75 arc chute can be handled by one person. The 50DHP250 arc chute should be lifted by two people. The other arc chutes are provided with lifting lugs so that an overhead lifting device can be used to mount them on the breaker.

Barrier assemblies once removed from their shipping crates may be handled by hand. Because of their bulk it

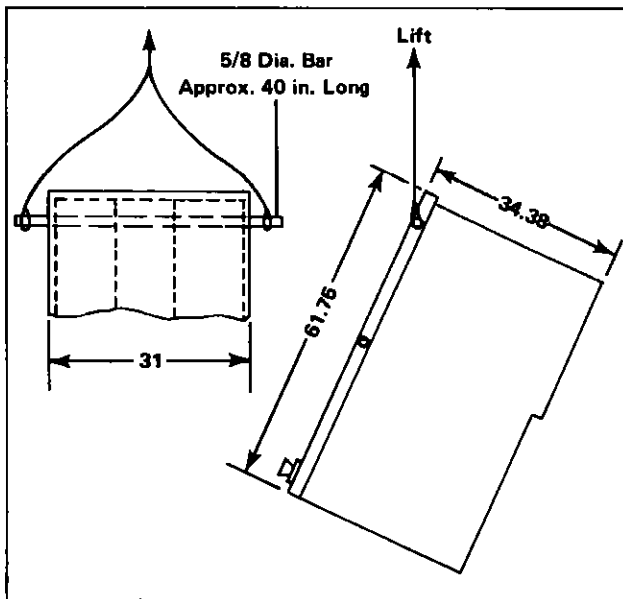


Fig. 7 Lifting 150DHP750C and 150DHP1000 Barrier

will generally require two persons to handle them. When lifting 150DHP750C and 150DHP1000 barriers on and off the breaker, it is easier because of the lifting height required to use an overhead lifting device. Holes are provided in the barrier steel to facilitate this type of handling. See Fig. 7.

Table 2 gives the approximate size and shipping weight for normal domestic packaging. Unusual shipping requirements will usually result in larger and heavier packages.

Breaker	Amps	No. of Pkg.	Breaker 3 Arc Chutes Barrier	Breaker 3 Arc Chutes	Breaker	3 Arc Chutes	Barrier
50DHP75	1200	1	50X26X40 640				
50DHP250	1200	1	50X27X45 850				
	2000	1	50X27X45 885				
50DHP350	1200	2		65X26X43 1140			50X32X32 140
	2000	2		65X26X43 1200			50X32X32 140
	3000	2		65X32X42 1500			58X26X31 200
75DHP500	1200	2		66X32X42 1600			50X32X32 140
	2000	2		66X32X42 1650			50X32X32 140
	3000	2		66X32X42 1750			50X32X32 140
150DHP500	1200	2		66X32X42 1600			50X32X32 140
	2000	2		66X32X42 1650			50X32X32 140
	3000	2		66X32X42 1750			50X32X32 140
150DHP750C	1200	3		50X32X40 940	33X30X50 1375		70X38X42 320
	2000	3		50X32X40 1010	33X30X50 1375		70X38X42 320
	3000	3		50X32X40 1110	33X30X50 1375		70X38X42 320
150DHP1000	1200	3		50X32X40 940	33X30X50 1495		70X38X42 350
	2000	3		50X32X40 1010	33X30X50 1495		70X38X42 350
	3000	3		50X32X40 1110	33X30X50 1495		70X38X42 350

Table 3 gives the approximate weights of the various breakers, arc chutes, barriers and complete breakers.

Breaker Type	Ampere Rating	Breaker	Weight in Pounds		Complete Breaker
			Single Arc Chute	Barrier Assembly	
50DHP75	1200	340	35	40	485
50DHP250	1200	340	100	50	690
	2000	375	100	50	725
50DHP350	1200	400	210	50	1080
	2000	450	210	50	1130
	3000	650	210	100	1380
75DHP500	1200	550	250	100	1400
	2000	600	250	100	1450
	3000	700	250	100	1550
150DHP500	1200	550	250	100	1400
	2000	600	250	100	1450
	3000	700	250	100	1550
150DHP750C	1200	750	425	165	2190
	2000	820	425	165	2260
	3000	920	425	165	2360
150DHP1000	1200	750	465	190	2335
	2000	820	465	190	2405
	3000	920	465	190	2505

## STORING

If the circuit breakers are to be placed in storage, maximum protection can be attained by returning the breaker, arc chutes and barrier to their original shipping containers after checking to be sure they are free from shipping damage.

Outdoor storage except for limited intervals is not recommended. If unavoidable, the outdoor location even though used for a short time must be well drained and a temporary shelter from sun, wind, rain and snow must be provided. Containers should be arranged to permit free circulation of air on all sides and temporary heaters should be used to minimize condensation. Moisture can cause rusting of metal parts and deterioration of high voltage insulation. A heat level of approximately 400 watts for each 100 cubic feet of volume is recommended

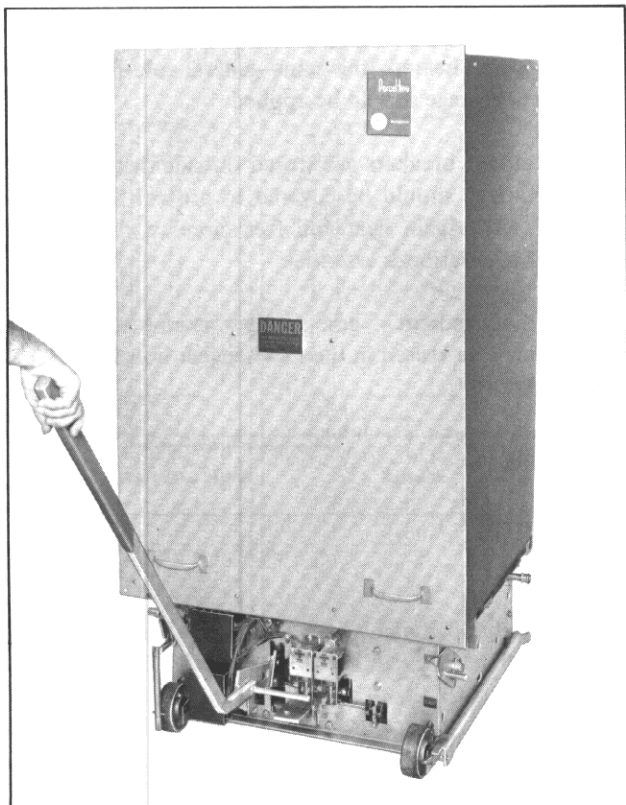
with the heaters distributed uniformly throughout the structure near the floor. If the circuit breakers are stacked for storage, the stacks should be limited to two high.

Indoor storage should be in a building with sufficient heat and circulation to prevent condensation. If the building is not heated, the same general rule for heat as for outdoor storage should be applied.

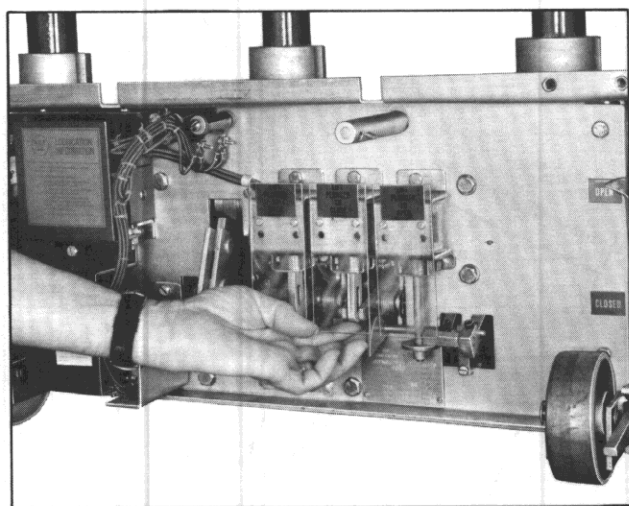
When circuit breakers are stored outside their shipping containers they should be covered to protect them from dust and dirt. Again heat and free circulation of air to prevent condensation is essential.

When convenient, completely assembled circuit breakers may be stored in their switchgear housings in the test position.

## DESCRIPTION AND OPERATION



**Fig. 8** *Charging Closing Spring by Hand (388811)*



**Fig. 9** *Releasing Closing Spring by Hand to Close Breaker (393526)*

DHP breakers are equipped with spring stored energy mechanisms. Normal operation is to charge the closing

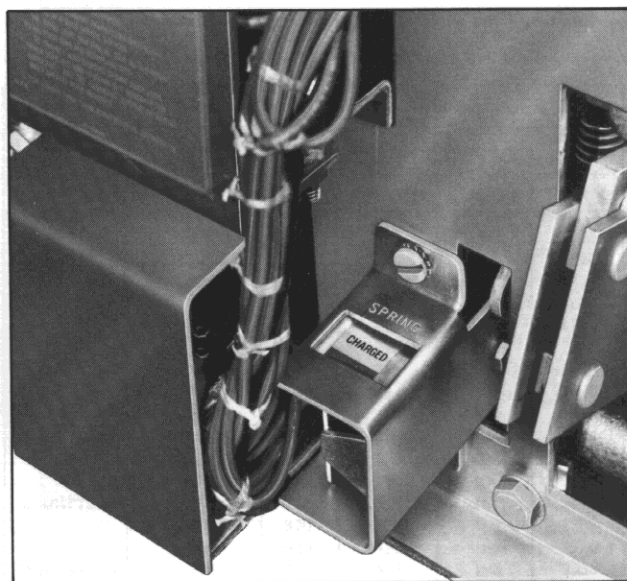
spring electrically by means of the spring charging motor and then to close the breaker electrically by energizing the spring release coil. Tripping is accomplished by energizing the trip coil. For maintenance purposes the closing spring can be charged manually and the breaker can be closed and tripped by lifting the spring release trigger and then the tripping trigger by hand.

The closing spring can be charged by hand, Fig. 8, and released by hand, Fig. 9 to close the breaker when control power is not available.

**CAUTION:** WHEN CONTROL POWER IS NOT AVAILABLE FOR CLOSING, IT MAY ALSO NOT BE AVAILABLE FOR TRIPPING. AN EVALUATION OF THE HAZARDS RELATED TO LACK OF TRIPPING POWER MUST BE MADE BY THE OPERATOR BEFORE CLOSING A CIRCUIT BREAKER UNDER THESE CONDITIONS. (PROTECTIVE RELAYS MAY OPERATE TO ENERGIZE THE TRIP CIRCUIT, BUT BREAKER WILL NOT TRIP DUE TO LACK OF TRIPPING POWER.)

### MANUAL SPRING CHARGING

On all DHP breakers a manual ratcheting lever projects through a slot in the mechanism panel just to the left of the coil marked "Lift to Trip", Fig. 4. A maintenance handle is provided to fit into the slot in the ratchet lever.



**Fig. 10** *Spring Charge Indicator (391329)*



A few downward strokes charge the closing spring. When charging is complete, the closing crank goes over center with an audible "click". When the spring is fully charged an indicator, Fig. 10, to the left of the manual ratchet lever changes position to show "SPRING CHARGED". Remove the maintenance handle after charging the closing spring.

### MANUAL CLOSING

After the closing spring has been charged either electrically or manually, the breaker may be closed manually by lifting the spring release plunger behind the plastic guard marked "Lift to Close". Fig. 9.

**CAUTION: KEEP HANDS, ARMS, HEAD AND TOOLS OUT OF AREA WHERE CONTACTS TRAVEL TO AVOID INJURY.**

### MANUAL TRIPPING

After the circuit breaker has been closed either electrically or manually, it may be tripped manually by lifting the tripping trigger plunger behind the plastic guard marked "Lift to Trip". Fig. 11.

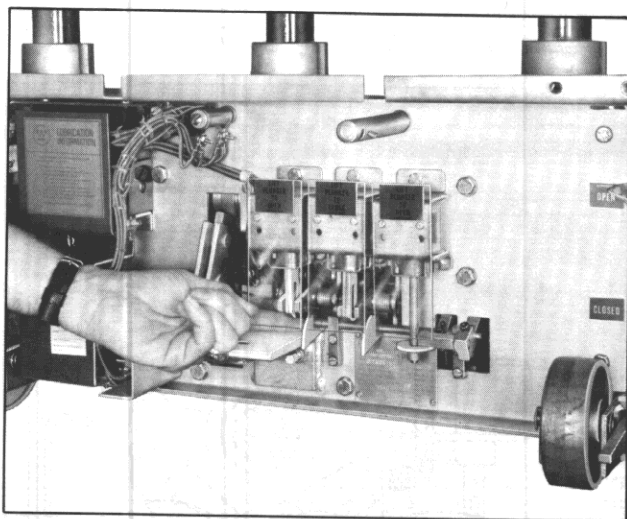


Fig. 11 Tripping Breaker by Hand (393524)

**CAUTION: KEEP HANDS, ARMS, HEAD AND TOOLS OUT OF AREA WHERE CONTACTS TRAVEL TO AVOID INJURY.**

### MAINTENANCE CLOSING

**CAUTION: DISCONNECT OR DE-ENERGIZE ELECTRICAL CONTROL POWER BEFORE ATTEMPTING**

**ANY MAINTENANCE CLOSING OPERATIONS. DISCHARGE CLOSING SPRINGS BY MANUALLY CLOSING AND TRIPPING THE BREAKER BEFORE ATTEMPTING ANY MAINTENANCE CLOSING OPERATION.**

On all DHP breakers the main shaft extends through the right hand side sheet of the breaker chassis. The maintenance handle fits on the end of the shaft for slow closing the breaker, Fig. 12. This operation is solely for inspecting and adjusting the contacts or other working parts of the breaker when slow motion is required. The handle should be operated with a slow downward motion to bring the moving contacts up into engagement with the stationary contacts. To close the contacts, move the handle down until an audible "click" is heard indicating that the tripping trigger has fallen into position. **BE SURE THE MAINTENANCE HANDLE IS SECURELY SEATED ON THE PROJECTING MAIN SHAFT END BEFORE APPLYING CLOSING PRESSURE.**

**CAUTION: REMOVE MAINTENANCE HANDLE FROM MAIN SHAFT IMMEDIATELY AFTER CLOSING THE BREAKER AND BEFORE ANY ADDITIONAL OPERATIONS ARE PERFORMED.**

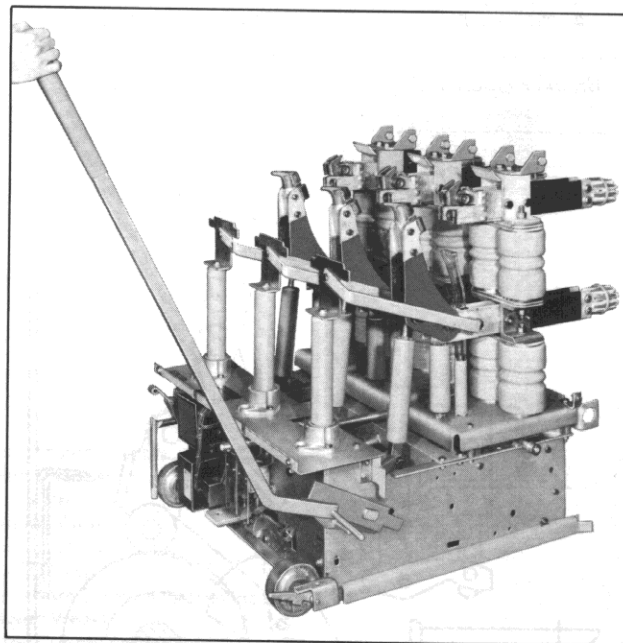
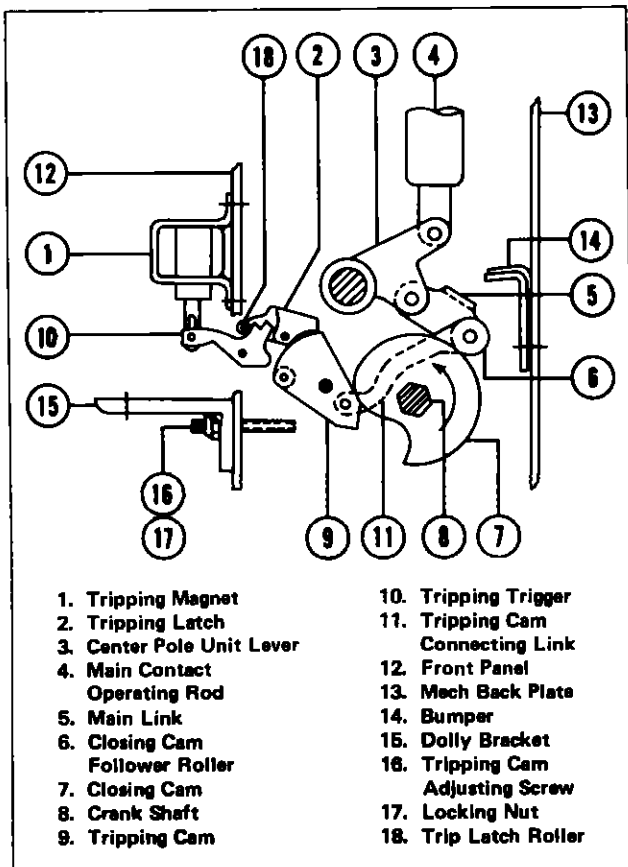


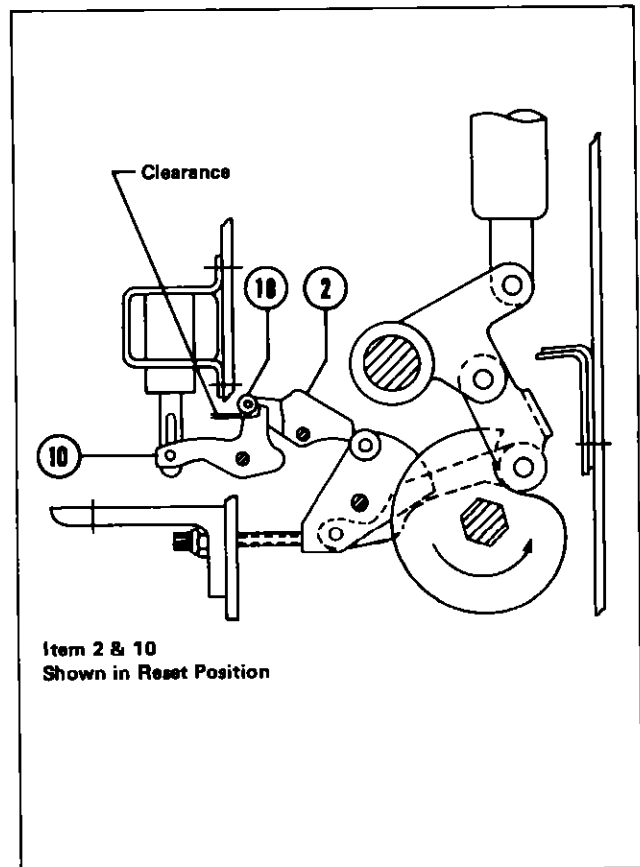
Fig. 12 Closing Breaker with Maintenance Handle (391368)

The maintenance handle is made so that it cannot engage the main shaft of the breaker when the breaker is in the housing. This prevents any attempt to close the breaker on a live circuit by manual closing. Do not defeat this safety feature.

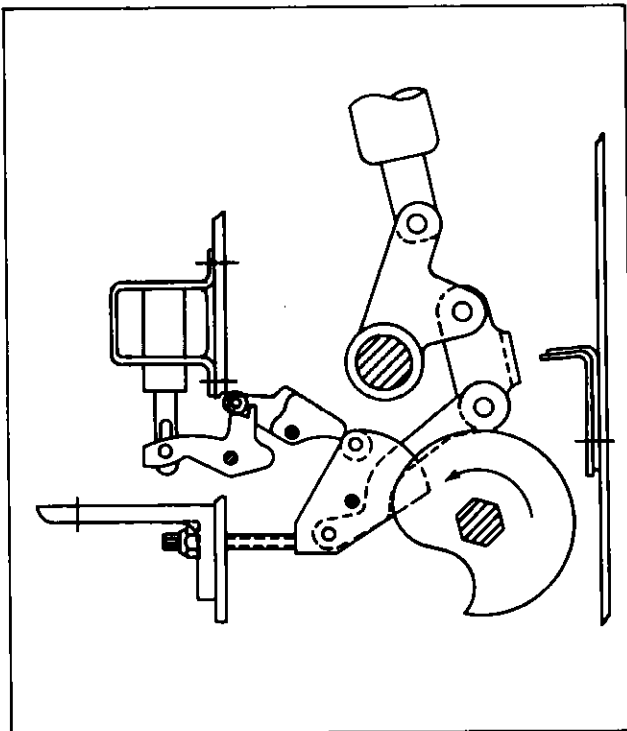




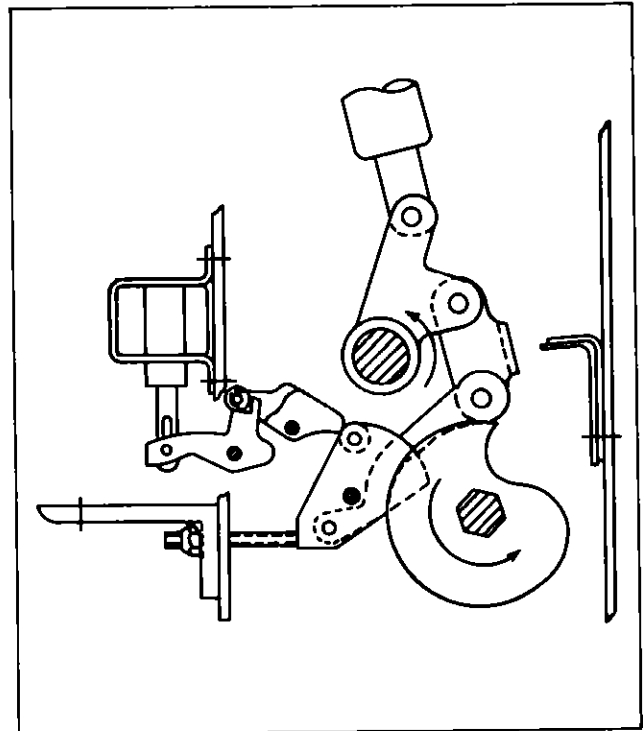
a. Breaker Open and Closing Spring Not Charged



b. Breaker Open and Closing Spring Charged



c. Breaker Closed and Closing Spring Not Charged



d. Breaker Closed and Closing Spring Charged

Fig. 13 The Four Positions of the Closing Cam and Trip Linkage

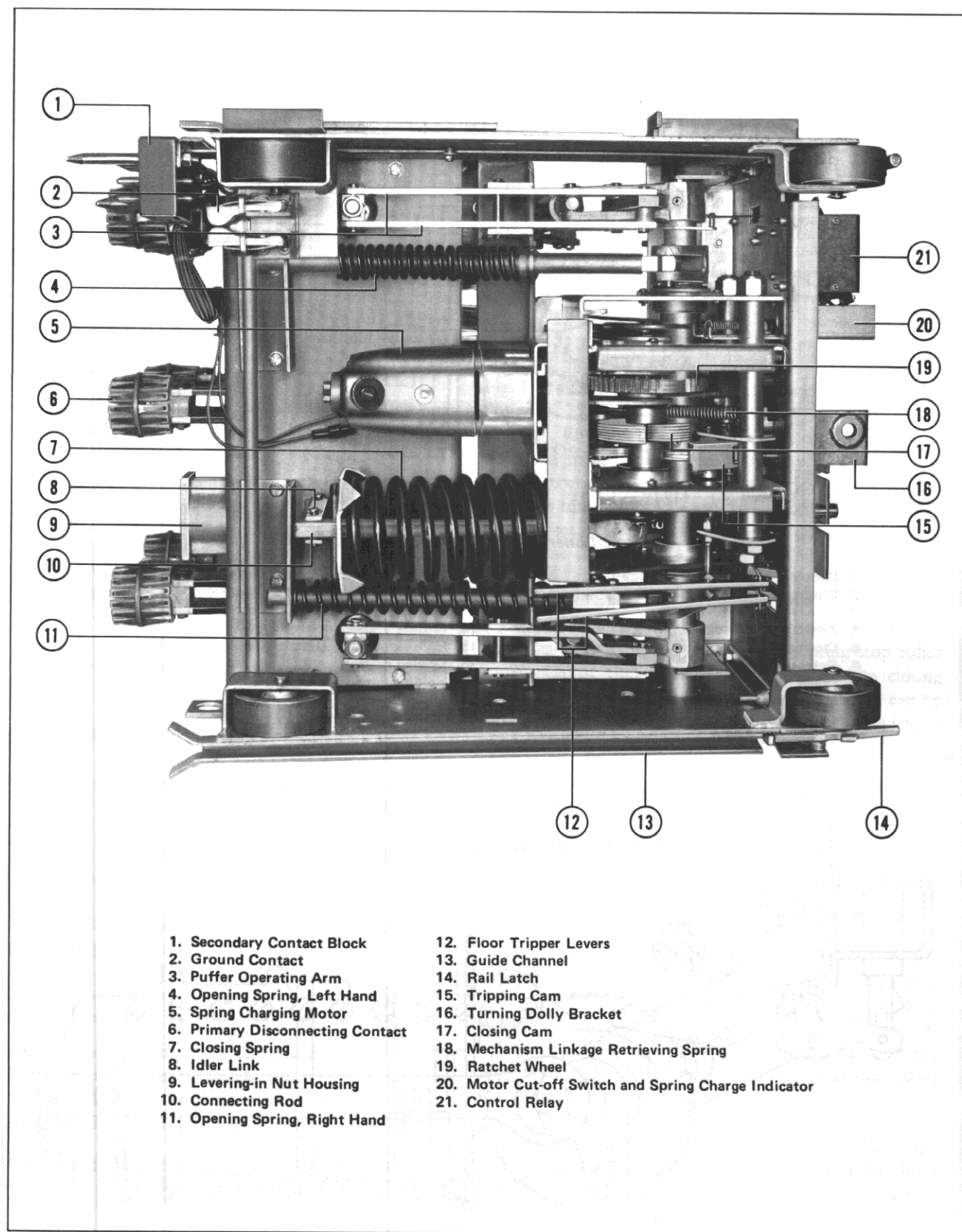


Fig. 14 Underside of 15.0 kV Breaker (393522)

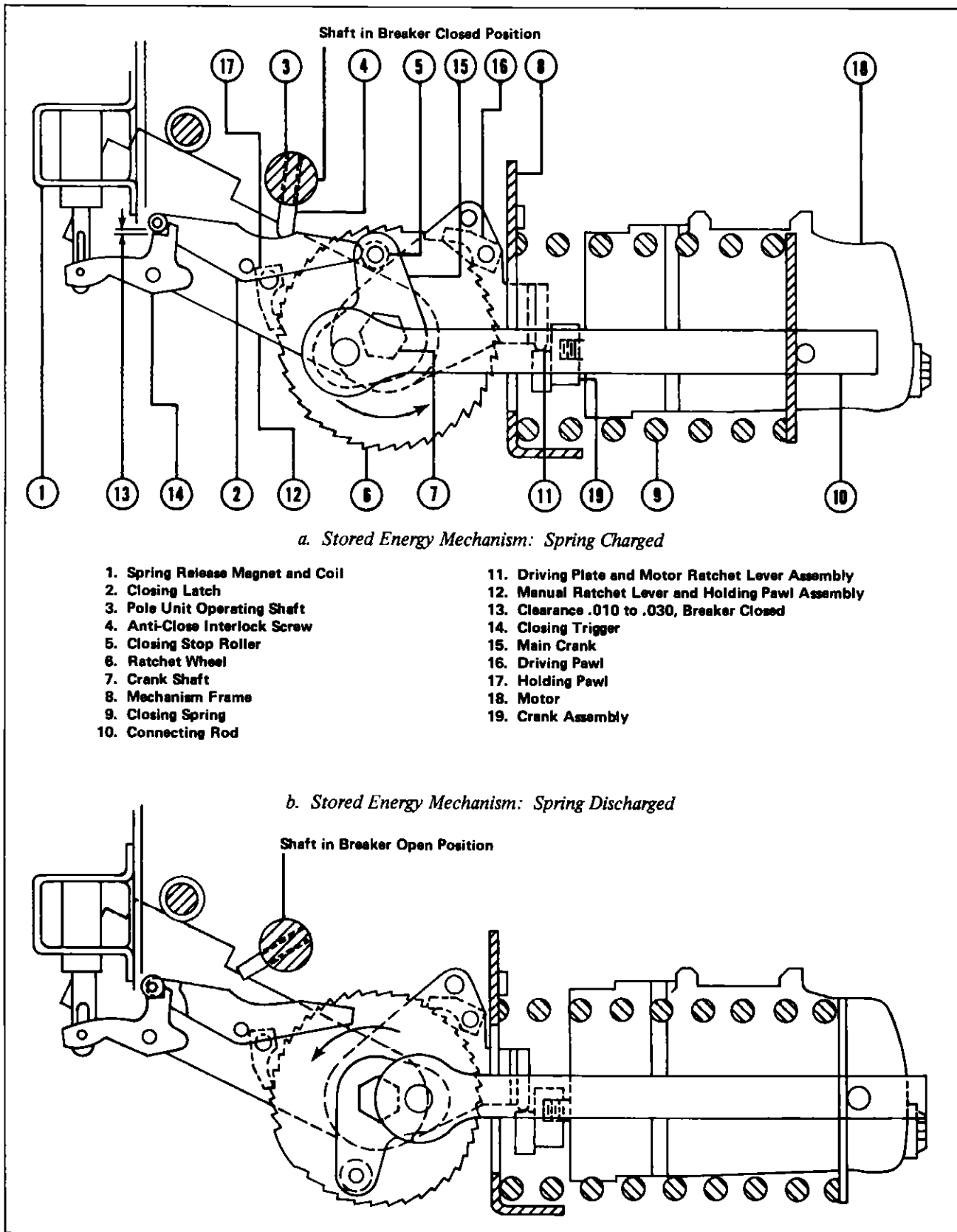


Fig. 15 Schematic Views of Spring Charging Parts

**CAUTION: DO NOT ATTEMPT TO CLOSE THE BREAKER WITH THE MAINTENANCE HANDLE AGAINST A LIVE CIRCUIT. PROPER CLOSING SPEED CANNOT BE OBTAINED USING THE MAINTENANCE HANDLE.**

## ELECTRICAL CLOSING AND TRIPPING

DHP breaker control is so arranged that the spring charging motor will be energized as soon as control power is applied to the breaker. The motor will charge the closing spring in approximately 5 seconds. When the closing spring is fully charged, the motor will be cut off. The breaker may then be closed through the control circuitry.

Immediately following the discharging of the closing spring, the spring charging motor will be reenergized to recharge the closing spring.

After the breaker has been closed, it may be electrically tripped.

**CAUTION: WITH CIRCUIT BREAKERS HAVING INDEPENDENT CLOSING AND TRIPPING CONTROL POWER CIRCUITS, THE TRIPPING POWER SHOULD ALWAYS BE ENERGIZED AND VERIFIED BEFORE THE CLOSING POWER IS APPLIED.**

## STORED ENERGY MECHANISM

The spring stored energy mechanism performs two functions:

1. It stores closing energy by compressing, or charging, the closing spring.
2. It applies the released energy to close the breaker and simultaneously charge the opening springs.

The mechanism may rest in any one of the four positions shown in Fig. 13, as follows:

- a. Breaker open, closing spring discharged.
- b. Breaker open, closing spring charged.
- c. Breaker closed, closing spring discharged.
- d. Breaker closed, closing spring charged.

Fig. 14 shows the under side of a stored energy mechanism in a 15.0 kV breaker.

Fig. 15 shows schematic views of the spring charging parts of a stored energy mechanism.

The major component of the mechanism is a crankshaft assembly, Fig. 88, which consists of a hex shaft to which is attached the main crank, the ratchet wheel and the closing cam.

The ratchet wheel is actuated by a ratcheting mechanism driven by an electric motor. As the ratchet wheel rotates, the main crank and closing cam rotate with it.

The main crank has a connecting rod connected to it which is coupled to the closing spring. As the crank is rotated, the closing spring is compressed.

Fig. 15a and 15b are schematic views of the spring charging portions of the stored energy mechanism. Fig. 15a shows the spring charged, breaker closed position. Fig. 15b shows the spring discharged, breaker open position. Rotation of the motor crank causes the driving plate and motor ratchet lever assembly to oscillate. The driving pawl, being part of the ratchet lever assembly also oscillates rotating the ratchet wheel counter-clockwise. As the ratchet wheel rotates the main crank also rotates pulling the connecting rod with it to compress the closing spring.

When the closing spring is completely compressed, the main crank goes over center and the closing stop roller comes against the closing latch. Fig. 15a. The closing spring is now held in the compressed position. It can be released to close the breaker by raising the closing trigger either electrically or manually.

Lifting the closing trigger frees the closing latch which rotates counter-clockwise releasing the closing stop roller on the main crank. The force of the closing spring rotates the main crank and crankshaft. The closing cam, being attached to the crankshaft, also rotates causing the breaker to close.

Fig. 13 shows the 4 positions of the closing cam and tripping linkage. Note that in 13a, in which the breaker is open and the closing spring is not charged, the tripping trigger is in the tripped or unlatched position. As the closing spring is charged, the tripping trigger snaps into the fully reset or latched position as in 13b near the end of the spring charging operation.

In Fig. 13c the linkage is shown with the breaker in the closed position and before the closing 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 Fig. 15. Rotation of the closing cam pushes the cam roller upward so as to rotate the main

shaft of the breaker and close the contacts. This is possible because the restraining links between the closing cam roller and the tripping cam prevent the closing cam roller from moving off the cam 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. Fig. 13d shows the breaker in the closed position after the closing 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 Fig. 15.

Lifting the tripping trigger either by hand or by the tripping magnet releases the tripping latch, tripping cam and closing-cam follower roller. The linkage collapses and the breaker opens. The linkage then assumes the position shown in Fig. 13b.

## MECHANISM PANEL

The mechanism panel, Fig. 4, is located on the front of the breaker chassis. Mounted on it are the closing spring release magnet and the tripping magnet for closing and opening the breaker electrically. Also mounted on the mechanism panel are the auxiliary switch, operation counter, control relay, motor cutoff switch, closing spring charge indicator, latch check switch, breaker position indicator, and breaker nameplate. Cams and linkages for the floor tripper assembly are also supported on the mechanism panel. When supplied, undervoltage and transformer trip devices are also mounted on the mechanism panel.

## POLE UNITS

The pole units as shown in Figs. 16 and 17 are for the 15.0 kV and 4.76 kV breakers respectively. Each pole unit is made up of a pole unit base, porcelain insulators and aluminum extrusions bolted together to support the breaker studs, the moving contact assembly, the stationary contacts, and the arc chute hinge assembly.

The breaker studs are multiple rectangular bars. The rectangular bars may be aluminum or copper.

On the disconnecting end of the breaker, a round stud adapter is bolted securely to the rectangular stud conductors. This adapts the rectangular studs to the round primary disconnecting finger clusters.

## CONTACTS

DHP breaker contact assemblies are wedge-finger types with contact wipe. The moving contact wedges penetrate the space between cooperating pairs of stationary mounted fingers which are deflected as the breaker is closed. Typical contact assemblies are shown on Fig. 16 and 17. Each pole unit includes one arcing contact assembly and two parallel main contact assemblies.

The stationary main current carrying contacts are bolted to the top stud conductors of the pole unit immediately below the arcing contacts. They are fabricated from a high strength silver plated copper alloy with anti-weld main current carrying inserts.

On the 1200 ampere breaker, there are a total of 4 stationary contact members, each slotted part way, making a total of 8 contact fingers per pole.

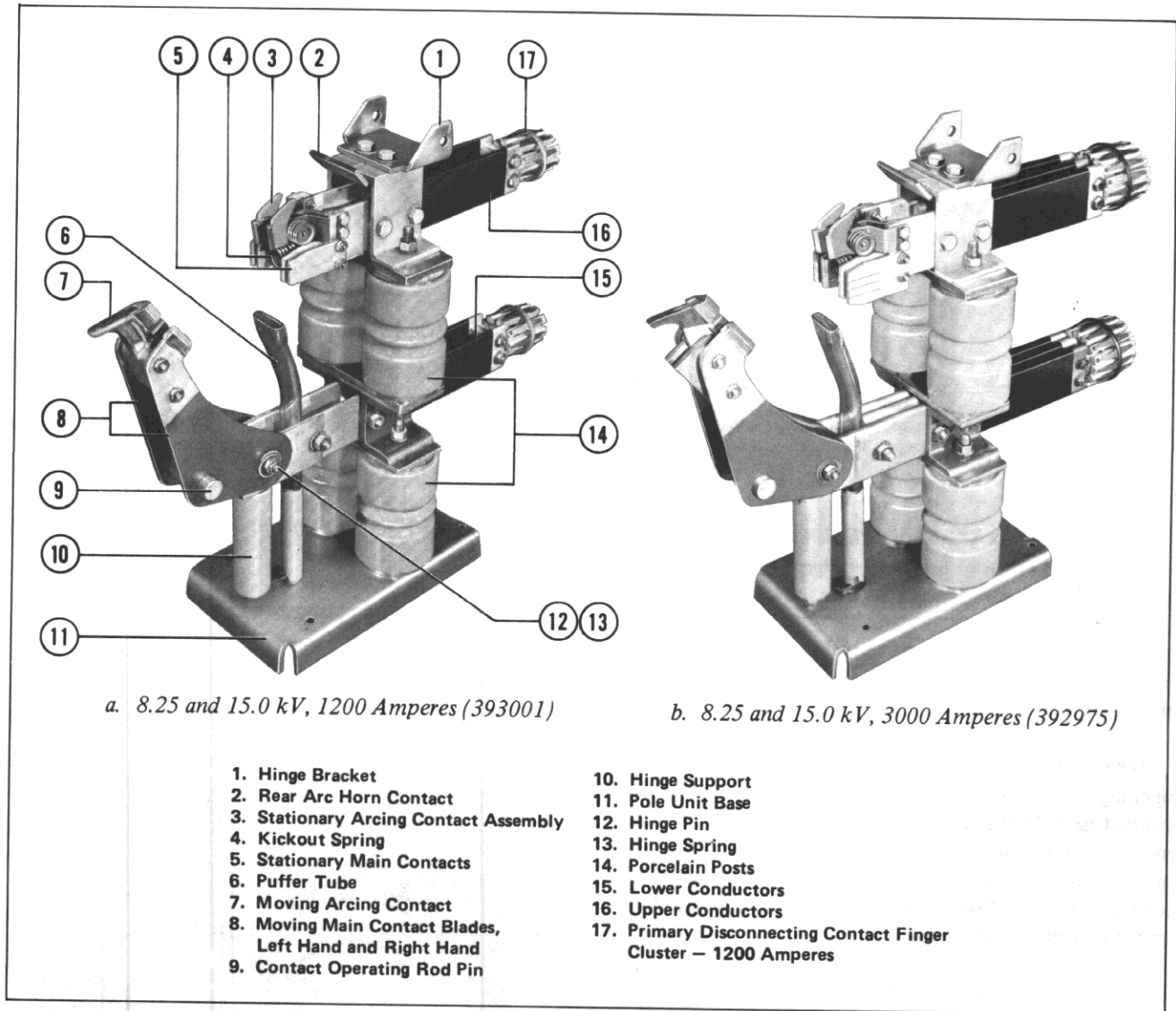
On the 2000 ampere breaker, the stationary main contacts are similar to the 1200 amp contacts but are somewhat wider and have 2 slots in each member, making a total of 12 contact fingers per pole.

The main stationary contacts on the 3000 ampere breaker are similar to the 2000 amp contacts but are thicker and have 3 slots in each giving a total of 16 contact fingers per pole.

The moving main current carrying contact members are anti-weld wedges fastened to the moving blades of the pole unit. These blades vary in length and thickness depending on breaker rating. The contact members however are similar for all ratings.

The stationary arcing contact members are secured to the top stud conductor assembly of the pole unit above the main contact members. They are fabricated from the same high strength copper alloy as the stationary main contact members but are heavier and shaped differently. Their mounting is such as to permit them to rock or pivot as they are deflected. They are also backed up by compression springs to provide and maintain suitable contact pressure. Each contact member includes an anti-weld contact insert suitable for carrying arcing current. Stationary arcing contact members are practically the same for all ratings of DHP breakers.

The moving arcing contact member consists of an anti-weld wedge suitable for carrying arcing current. This wedge is fastened to a moving member which is a part of the moving blade assembly. Moving blade assemblies vary depending on breaker rating but all moving arcing contact wedges are the same for all ratings.



**Fig. 16 Pole Unit Assemblies**

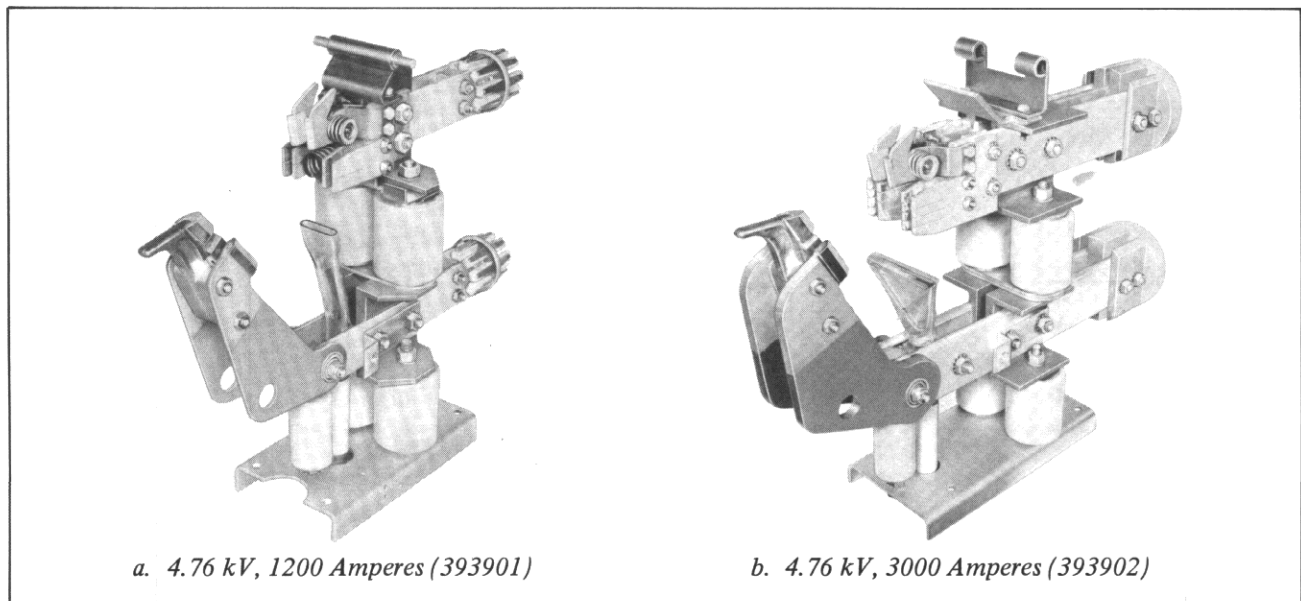
In operation, the arcing contacts engage first on closing and break last on opening. For best performance it is important that the cooperating pairs of stationary fingers deflect approximately equal amounts to each side of the entering wedge.

### ARC CHUTES

Figures 46, 69, and 78 illustrate the general appearances of Type 50DHP250, 150DHP500 and 150DHP750C arc chutes respectively.

Functionally all type DHP arc chutes are the same. Their sizes are dependent on the ratings of the circuit breakers with which they are applied.

Fig. 18 is a schematic representation of a typical Westinghouse type DHP center coil arc chute on a 4.76 kV pole unit. A laminated magnetic core passes transversely through the center of the arc chute. Magnetic poles, bolted to each end of this core, extend along the outsides of the arc chute enclosure. Two blowout coils, connected in series, are wrapped around the magnetic core, one near each end. The outer terminal of each coil is bolted to one of two center arc horns so that a conducting circuit from one center arc horn to the other is provided through the series connected blowout coils. Two main interrupting stacks, each comprised of multiple ceramic plates, are located at each end of the center arc horn, coils and core assembly. Front and rear arc horns are situated at the ends of the arc chute adjacent to the outer ends of the main stacks. The front arc horn is connected via a shunt strap

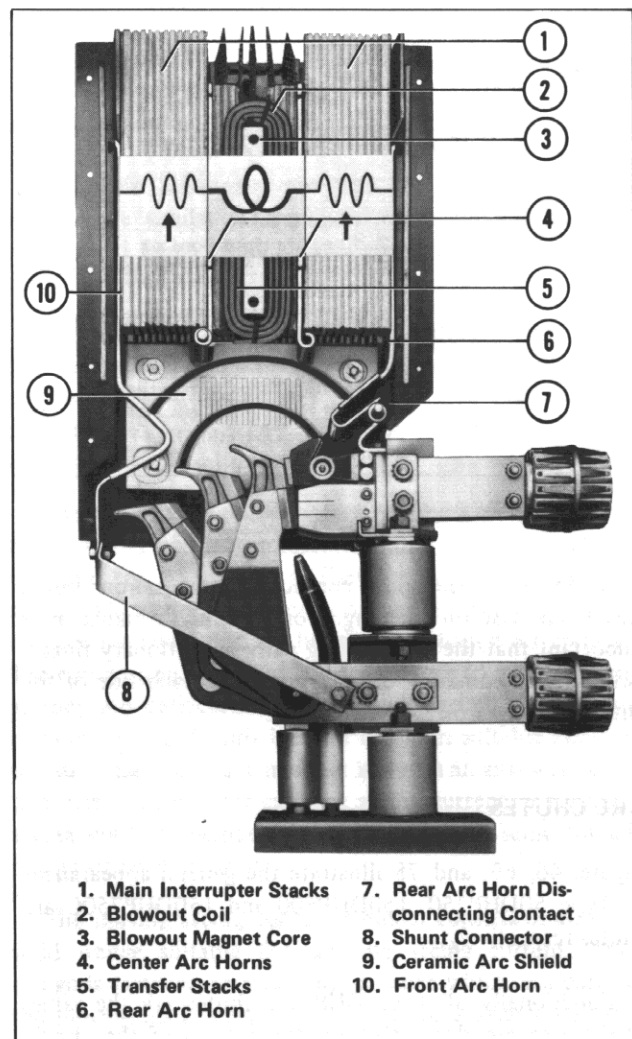


**Fig. 17 Pole Unit Assemblies**

to the lower stud of the circuit breaker pole unit. The rear arc horn engages the upper stud of the pole unit above the stationary contact assembly.

When the contacts of the breaker first part during an opening operation an arc is drawn across the arcing contact gap. As this gap increases the arc is elongated and moves upward due to thermal and magnetic effects. The arc terminals move quickly transferring from the arcing contacts to the front and rear arc horns and climb upward within the arc chute.

A short central segment of the arc impinges on the two center arc horns and the two transfer stacks so that momentarily this segment of the arc is in parallel with the series blowout coils. The transfer stacks act to extinguish this segment of arc thus breaking up the arc into two major sections coupled together at the middle through the blowout coils. With arc current now flowing through the blowout coils a strong transverse magnetic field is produced between the pole faces of the blowout magnet. The interaction between arc current and the transverse field produces an upward thrust on the two arc sections forcing each into its adjacent main stack. Within the main stacks offset slots in each of the ceramic plates are arranged to direct the upward moving arc into a tortuous zig-zag path. Each arc section is thus elongated and cooled as it is brought into intimate contact with the surfaces of the heat absorbing ceramic plates. As the alternating arc current approaches a natural zero the rate at which the arc path is being cooled exceeds the rate at which heat is being generated by the arc. Effectively a rapid deionization of the arc path takes place. At current zero the arc is



**Fig. 18 4.76 kV Pole Unit with Arc Chute**

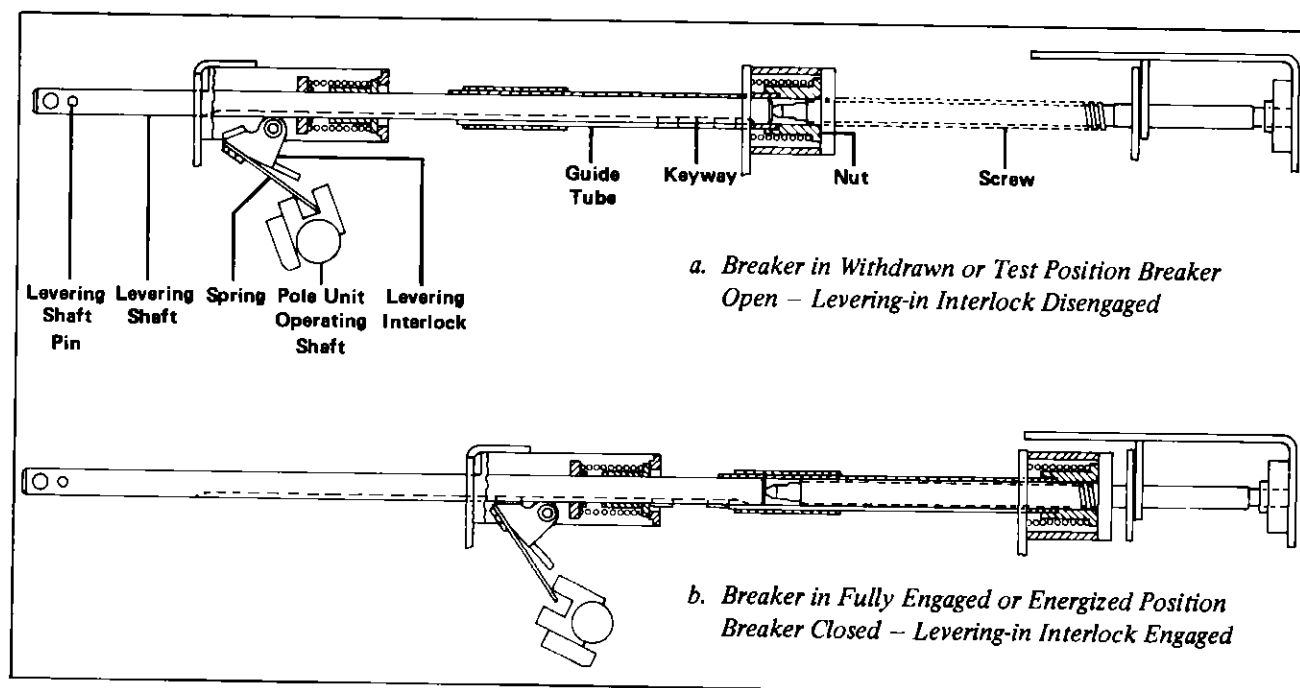


Fig. 19 Schematic of Levering-in Device and Interlock

naturally extinguished and cannot be re-established since it no longer has a conducting path.

On all ratings above the 50DHP75, 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 within the arc chute. Fig. 92 is an inside view of a typical DHP arc chute and shows the ceramic arc shields.

### INTERPHASE BARRIERS

The interphase barrier is an assembly of insulating sheets, channels and angles all mounted on a steel front plate. Figs. 1 and 3 show typical barrier assemblies.

The insulating sheets, channels and angles are so arranged that when the interphase barrier assembly is mounted on the circuit breaker over the arc chutes and pole units, it provides phase to phase and phase to ground insulation and separation of hot conducting gasses during interruption.

The steel front plate provides a grounded metal barrier between the breaker live parts and operating personnel.

Although functionally the same, the interphase barrier assemblies are different for each breaker rating.

### LEVERING-IN DEVICE

The purpose of the levering-in device is to move the circuit breaker between the disconnected or test position and the connected or engaged position in the cell.

Figs. 19a and 19b show the two extreme positions of the levering-in device. The main parts of the device are:

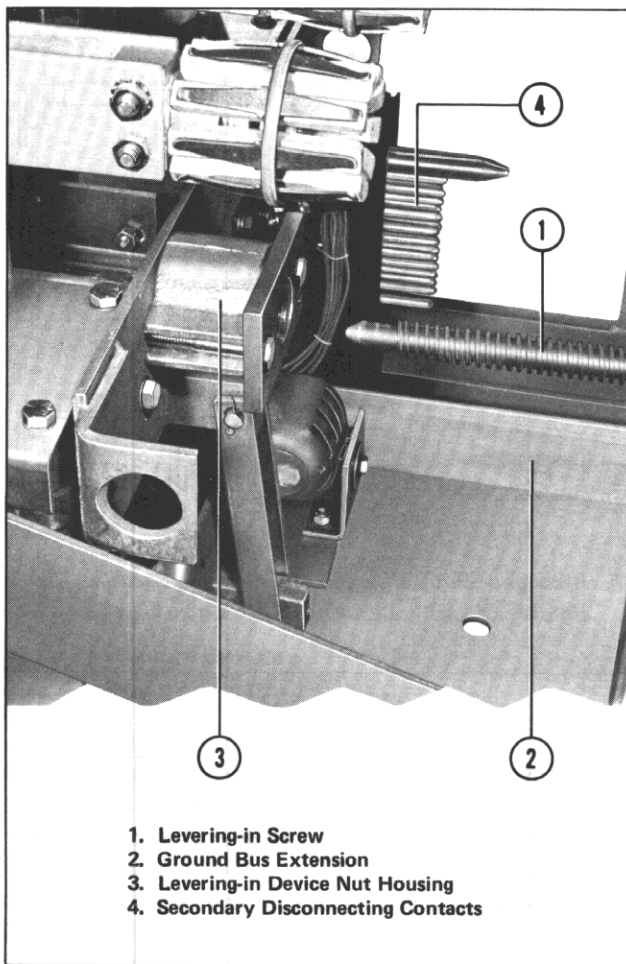
1. The levering nut.
2. The guide tube.
3. The levering-in shaft.
4. The levering-in interlock.

These components are installed as part of the breaker chassis assembly. The levering nut is fastened securely to the guide tube and is loosely retained in a housing fastened to the extreme rear of the chassis as shown in Fig. 20.

The operation consists of engaging the rotatable levering nut on the circuit breaker with the levering screw mounted on the rear wall of the cell. By traversing the levering nut along the levering screw, the breaker is moved between test and connected positions within the switch-gear housing.

The guide tube is slotted lengthwise for a distance about equal to the travel distance of the breaker. The levering-in shaft has two rectangular hardened keys





**Fig. 20** Breaker in Housing – Levering-in Nut and Screw Disengaged (393344-5A)

welded to it which slide in the guide tube slot. Thus, as the levering-in shaft is rotated, the guide tube and nut are also rotated.

As the breaker is levered in by clockwise rotation, the keys on the levering-in shaft move toward the end of the guide tube slot. As the rear key comes out of the slot, the levering-in 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.

At the end of the travel, the nut will disengage from the screw and spin free. The levering-in interlock is described in the Interlock Section of this book.

## PUFFER

The puffer is located in the breaker chassis just below the pole units. It is arranged to supply a jet or puff of air through an insulating tube and nozzle to each of the three contact assemblies each time the breaker is opened. On low current interruptions, the magnetic blowout force of small arcs is very weak. The jet of air from the puffer facilitates the movement of the low current arc upward into the arc chute where it is quickly interrupted.

In addition to acting as a puffer, the puffer casting serves as a tie member for the chassis side sheets, the mounting surface for the pole units, the breaker open position stop and a dash pot.

An oblong cavity in the underside of the casting serves as the puffer and dashpot cylinder. A piston is linked to the mechanism so as to move upward in the puffer cavity as the breaker opens. The cylinder has three openings which allow air to exhaust into the puffer tubes which direct the air over the breaker contacts.

As the breaker nears the end of the opening stroke, the puffer piston moves past the three puffer openings trapping and compressing the remaining air in the puffer cylinder causing it to act as a dashpot. The final stopping position for the breaker is reached when the puffer piston comes to rest against the closed end of the puffer cylinder.

## SHUTTER ROLLER

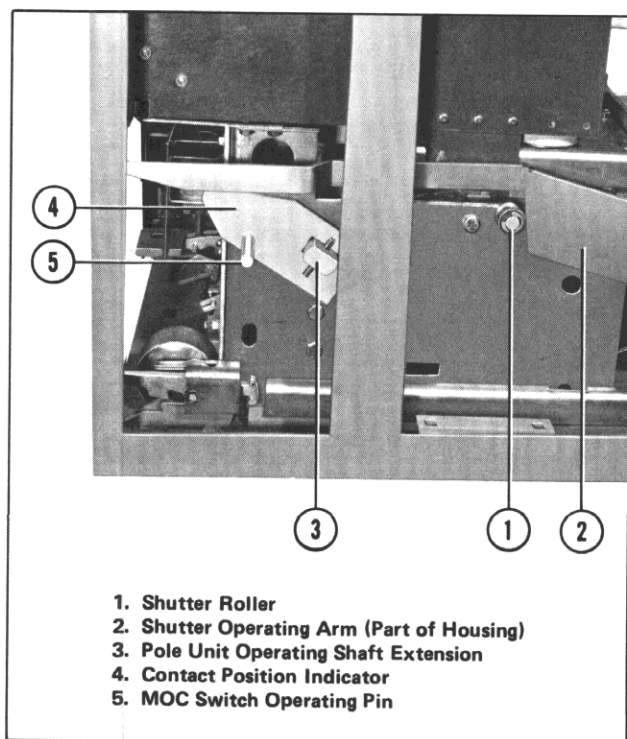
The shutter roller is located on the right side of the breaker chassis. Fig. 21. Its function is to engage the shutter operating cam in the cell to raise the shutter over the stationary disconnecting contacts as the breaker is levered from the test position to the engaged position in the cell.

## GUIDE CHANNEL AND RAIL LATCH

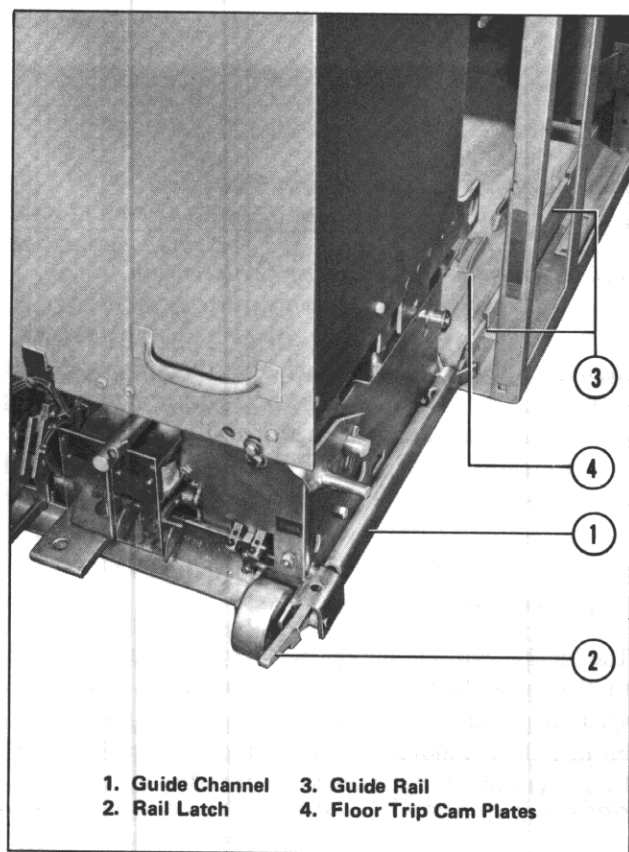
The guide channel is an inverted U-shaped channel welded along the bottom edge of the right hand chassis side sheet. The guide channel cooperates with the guide rail welded to the floor of the metal-clad cell. The two pieces acting together position the breaker laterally in the cell. Fig. 22.

The rail latch is located directly in front of the guide channel. Its purpose is two fold.

1. The rail latch stops the breaker in the cell just before the levering screw and nut engage.



**Fig. 21 Side View – Breaker in Housing (393303)**



**Fig. 22 Breaker Guide and Rail Latch (393301)**

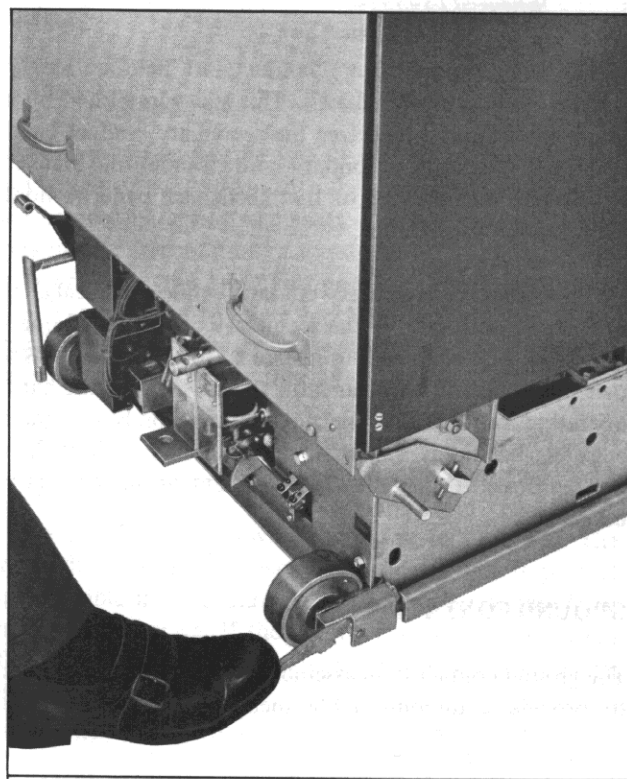
2. The rail latch holds the breaker in the disconnected or test position.

The rail latch has two catching dogs, one on each side of the pivot, which engage notches in the cell 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 impede further movement. This latch prevents damage to the levering-in nut and screw.

When it is desired to lever the breaker into the engaged position from the test position, the rail latch is pressed down (it can conveniently be done with the foot, see Fig. 23) and the breaker is pushed into the cell approximately 1/4 inch so that the levering device nut and screw can be engaged.

When the breaker is levered out of the cell and the levering nut and screw have become disengaged, the breaker should be pulled out of the cell approximately 1/4 inch more to engage the rail latch, thus locking the breaker in the test position.

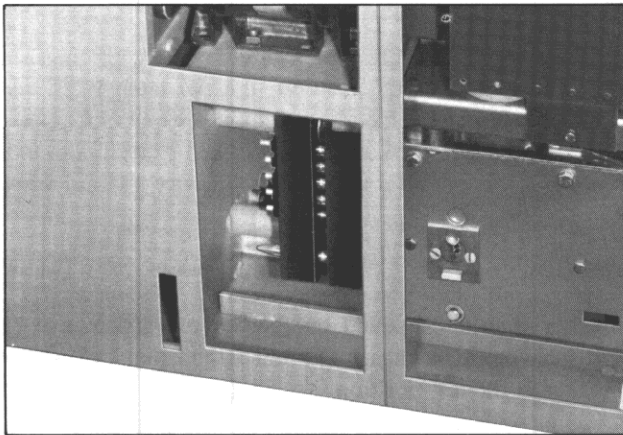
The rail latch must be released to withdraw the breaker from the test position in the cell.



**Fig. 23 Releasing Rail Latch (388824)**

## SECONDARY CONTACTS

The breaker control wiring is arranged for drawout disconnecting by means of a 15 point male plug arranged to connect to a female receptacle mounted in the rear of the cell. See Fig. 24. The secondary contact plug is mounted on a moveable bracket on the left side of the breaker chassis. This permits it to be extended to the rear while the breaker is in the test position to make contact with the stationary receptacle in the cell so that the control circuits are completed.



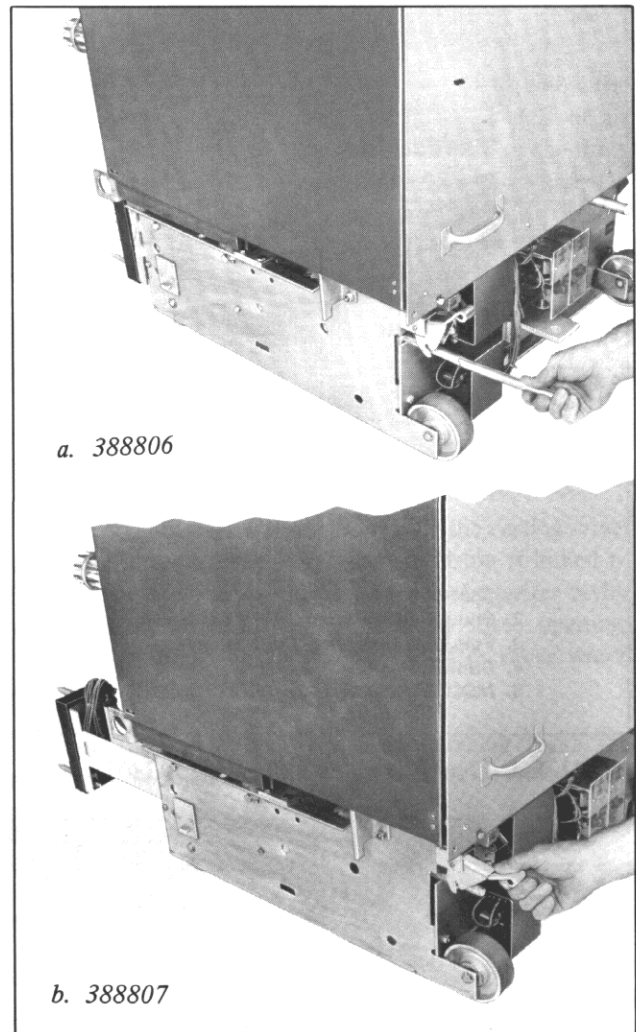
**Fig. 24 Breaker in Cell – Secondary Contacts Engaged (393314)**

Normally the secondary contacts are held stationary relative to the breaker chassis. This is accomplished by a notch in the bar connecting the secondary contact hand operating rod to the secondary contact mounting bracket which acts on the edge of the mechanism panel to hold the assembly in position.

To engage the secondary contacts while the breaker is in the test position, lift the secondary contact hand operating rod, Fig. 4, enough to release it from the mechanism panel and push to the rear until the cross-pin in the hand operating rod goes into the slots in the secondary contact engaging handle as shown in Fig. 25. The handle is then pressed down to make final engagement of the secondary contacts.

## GROUND CONTACT

The ground contact is an assembly of spring loaded fingers to provide a disconnectable means for grounding the breaker chassis after it has been inserted into a switchgear cell. Fig. 26. The ground contact is located on the underside of the chassis next to the left hand rear wheel of the breaker. An extension of the switchgear ground bus is



**Fig. 25 Operation of Secondary Contacts with Breaker in Test Position**

secured to the cell floor in such a position to engage the ground contact when the breaker is pushed into the test position and to remain engaged in all positions of the circuit breaker from the test position to and including the engaged position.

## BREAKER POSITION INDICATOR AND MOC SWITCH OPERATING PIN

The breaker position indicator is a lever assembly secured to the main shaft of the breaker operating mechanism where it projects through the right hand side sheet of the breaker chassis. Movement of this lever is directly related to movement of the breaker mechanism and contacts. OPEN and CLOSED nameplates on the right side of the mechanism panel are located to indicate respective positions of the breaker contacts in relation to the position of this lever. Fig. 4.

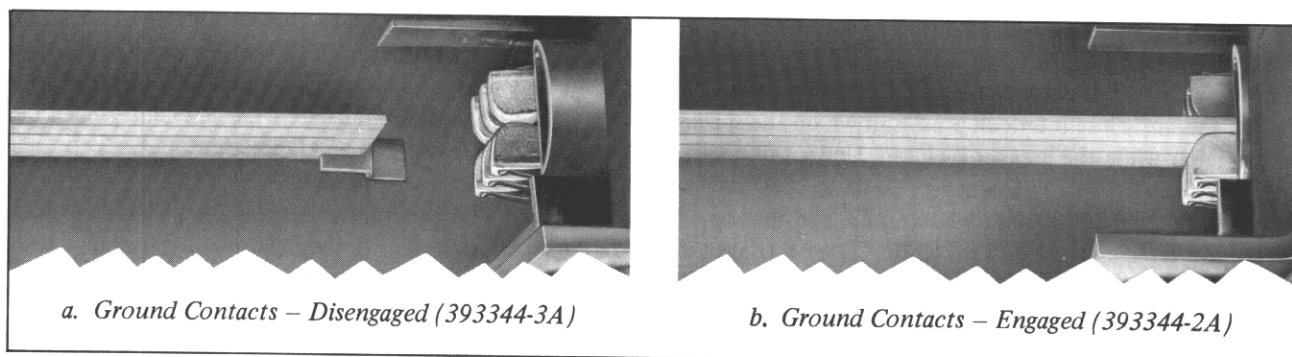


Fig. 26 Breaker in Cell

A heavy pin welded to the breaker position indicator lever projects to the right of the breaker chassis. Fig. 4. As the breaker is inserted into the cell this pin engages a channel member of the Mechanism Operated Cell Switch (MOC Switch) mechanism located in the switchgear cell. Thus the MOC switch is operated by the pin each time that the breaker is operated and the contacts of the MOC Switch can be correlated with breaker contact position in the same manner as the auxiliary switches mounted on the breaker. (Note that the MOC Switch operating pin is furnished on all breakers. MOC switches are provided in the cell only when specified on the switchgear order.)

## INTERLOCKS

All DHP breakers are equipped with several interlocks. These interlocks permit proper breaker operation and prevent improper breaker operation.

**CAUTION: CONDITIONS HAZARDOUS TO PERSONNEL, EQUIPMENT, AND PROPERTY CAN BE CREATED SHOULD ANY OF THE INTERLOCKS BE BY-PASSED OR MADE INOPERATIVE.**

1. **Breaker-Cell Coding Plates** — This is a combination of a notched plate in the cell and interference bars on the breaker so that only appropriately rated breakers can be put into the cell. Fig. 27.

2. **Levering-in Interlock** — The levering-in interlock is designed to prevent moving the breaker into or out of the energized position if the breaker contacts are closed. It consists of a movable key, mounted securely on the rear of the mechanism 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 main shaft. When the breaker is CLOSED, a force is applied through a flat spring to the key causing it to enter the keyway on the levering-in shaft. The

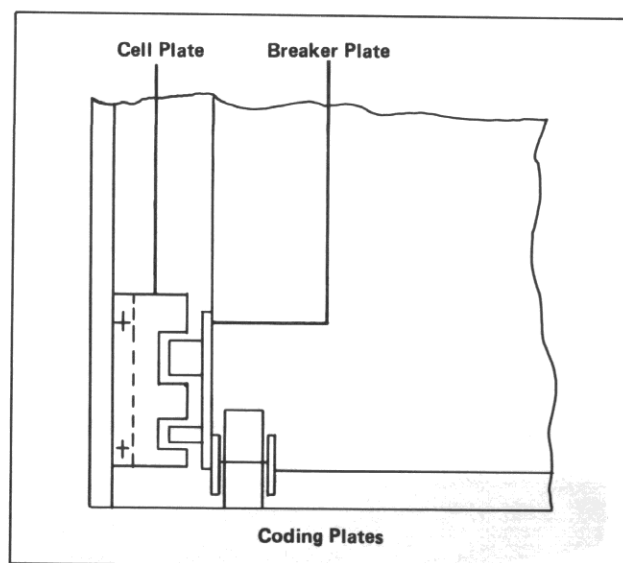


Fig. 27 Coding Plates

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. This prevents further rotation of the levering-in shaft thus blocking the levering of the breaker. Opening the breaker removes the key from the levering-in shaft keyway. Fig. 19.

If excessive force is applied to the levering-in shaft while the interlock key is engaged, the levering-in shaft pin, Fig. 19, located where the levering-in crank is attached, will break allowing the crank to turn free. The strength of this pin has been purposely selected to protect unaccessible internal parts of the interlock assembly from mechanical damage. If the pin is broken it is an indication that the breaker should be opened before further levering is attempted.

**CAUTION: THE INTERLOCK COULD BE DAMAGED IF LEVERING-IN PINS STRONGER THAN THOSE SUPPLIED ON ORIGINAL EQUIPMENT ARE USED, USE ONLY PIN STYLE NO. 103A133H07.**



3. **Anti-Close Interlock** — The anti-close interlock is provided to prevent releasing the closing spring to close the breaker when the breaker is already closed. As shown in Fig. 15 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 .030 inches between the front spring release latch roller and the top of the spring release trigger. If the spring release trigger is lifted while the breaker is closed, it will simply rotate past the front spring release latch roller without releasing the main latch to discharge the closing spring. The trigger will reset when released.

4. **Floor Tripping and Closing Spring Release Interlocks** — The floor tripping and closing spring release interlocks operate to trip the breaker and discharge the closing spring when the breaker is inserted into the cell to the test position or removed from the cell. Cam plates on the cell floor Fig. 22 lift trip levers on the underside of the breaker, Fig. 28, to trip the breaker and/or discharge the closing spring.

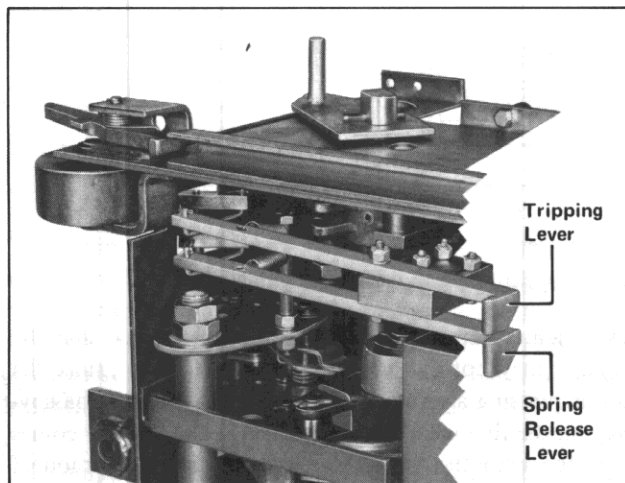


Fig. 28 Floor Tripping and Closing Spring Release Levers (Floor Trippers) (393900)

The floor tripping interlock also operates to hold the breaker trip-free while it is travelling between the test and connected positions. This is to prevent accidental closing of the breaker in an intermediate position. An extension of the cam plate mentioned above lifts the tripping lever and holds it up between the test and engaged position. The floor tripping and closing spring release interlock levers on the underside of the breaker are coupled to cams located on the front panel of the breaker which operate to engage the breaker tripping and close release triggers as described under *Manual Closing* and *Manual Tripping*.

5. **Rail Latch** — The main function of the rail latch, Fig. 23, is to prevent damage to the levering-in screw and nut. It also functions to latch the breaker in the test position. Operation of the rail latch has previously been described under Description and Operation.

6. **Barrier** — The interphase barriers on all DHP breakers are constructed so that if they are properly installed they cannot readily be removed when the breaker is in the cell.

7. **Maintenance Handle** — The maintenance handle Figs. 8 and 12, has an interference bar welded to it to prevent using the handle when the breaker is in the cell. **DO NOT REMOVE THIS INTERFERENCE BAR.**

## CONTROL SCHEMES

Basically all DHP stored energy operated breakers operate the same. There may be different control voltages and there may be one or more tripping elements to open the breaker but the principal mode of operation for all DHP breakers is as follows:

As soon as the secondary contacts make up the spring charging motor will start to charge the closing spring provided control power is available. When the spring is completely charged the motor cut-off switch will turn the motor off. The breaker can be closed by closing the control switch to energize the spring release solenoid on the breaker mechanism panel. This releases the closing spring to close the breaker. When the breaker closes, the motor will immediately recharge the closing spring.

The breaker can be tripped open by energizing the tripping solenoid by means of the control switch or by the action of protective relays. This releases the trip latch allowing the opening springs to cause the circuit breaker to open. Figs. 29a and 29b are typical d-c control schemes. Fig. 30 is a typical a-c control scheme.

## UNDERVOLTAGE TRIP ATTACHMENT

The undervoltage trip shown in Fig. 31 is an electro-mechanical device that trips the circuit breaker when the voltage on its coil falls to between 30 and 60 per cent of normal.

In operation, the moving core is held magnetically against the stationary core and a spring. The moving core is linked to a roller lever which restrains the tripping lever of this assembly.

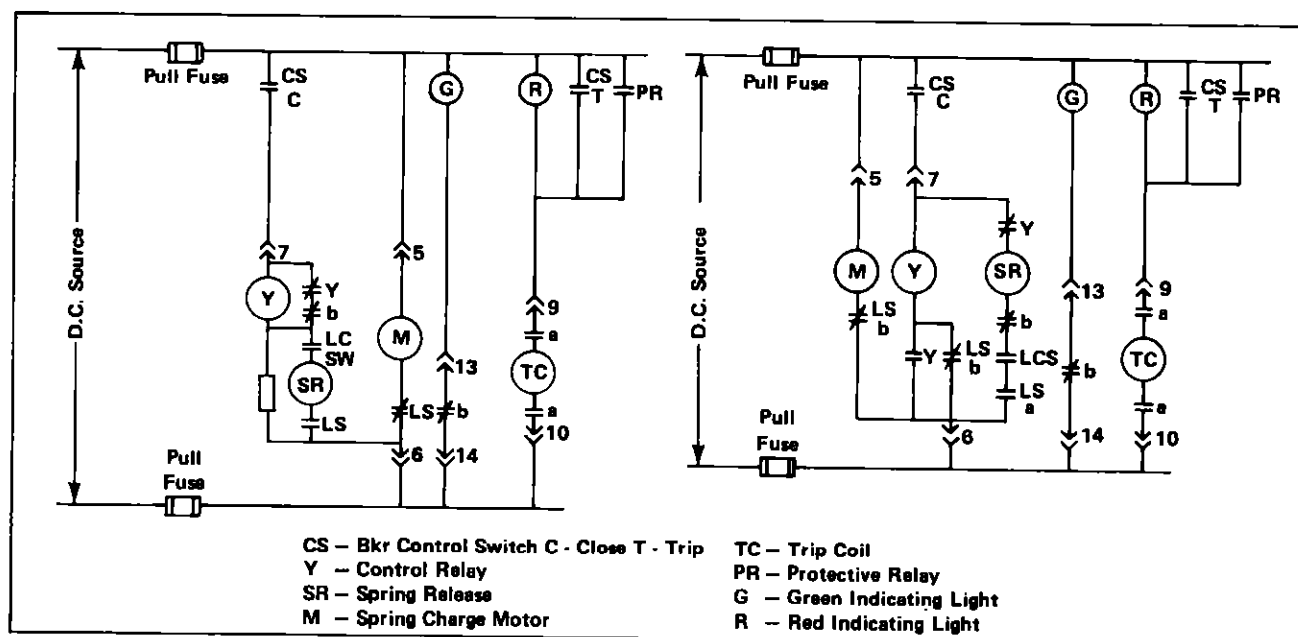


Fig. 29 D-C Control Schemes – Typical

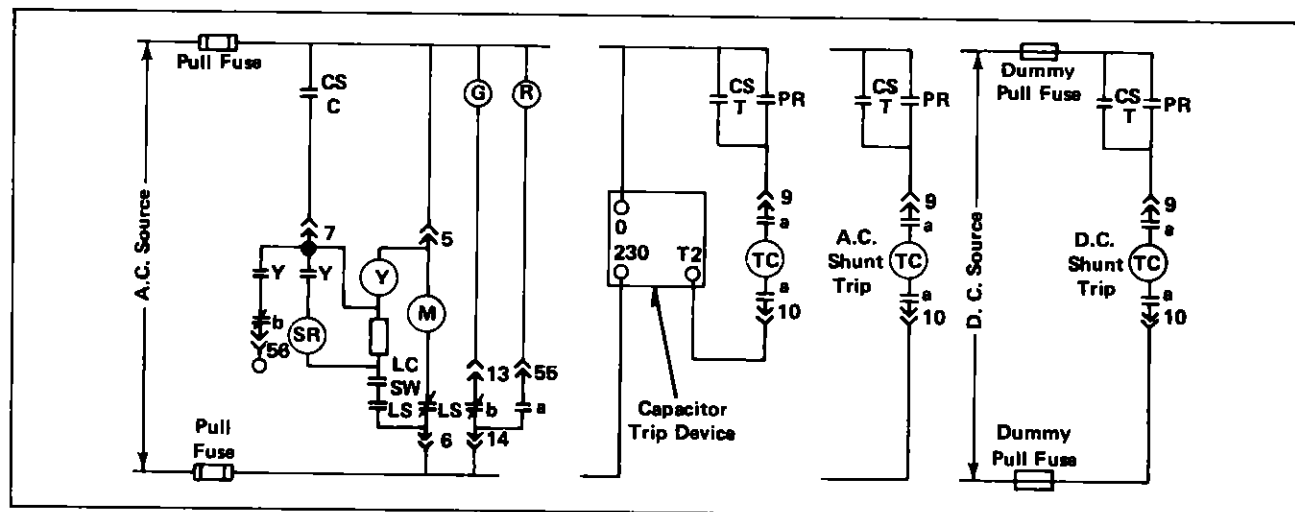


Fig. 30 A-C Control Schemes – Typical

When the coil voltage is reduced sufficiently, the roller lever spring overcomes the magnetic attraction between the two cores. The moving core travels downward and rotates the roller lever counterclockwise so that the roller moves to release the tripping lever. A torsion spring around the pivot pin of the tripping lever then rotates it counterclockwise causing a linkage on the under side of this lever to trip the breaker.

As the breaker opens, a pin on the center pole reset lever strikes the undervoltage reset lever and rotates it counterclockwise against the tripping lever and roller lever. The roller lever and tripping lever are rotated clockwise and the moving core re-engages the stationary core.

As the breaker closes, the center pole reset lever moves away from the undervoltage reset lever. The tripping lever acted upon by its torsion spring moves counterclockwise against the roller on the roller lever.

The undervoltage is now completely reset and in a position to trip the breaker if the undervoltage coil voltage drops 30 to 60 percent of normal.

**CAUTION: SPECIAL CARE SHOULD BE TAKEN WHEN WORKING ON A BREAKER WITH AN UNDERVOLTAGE ATTACHMENT. THE BREAKER WILL TRIP AS SOON AS THE CONTROL SOURCE IS DE-ENERGIZED. WITH THE UNDERVOLTAGE DE-**

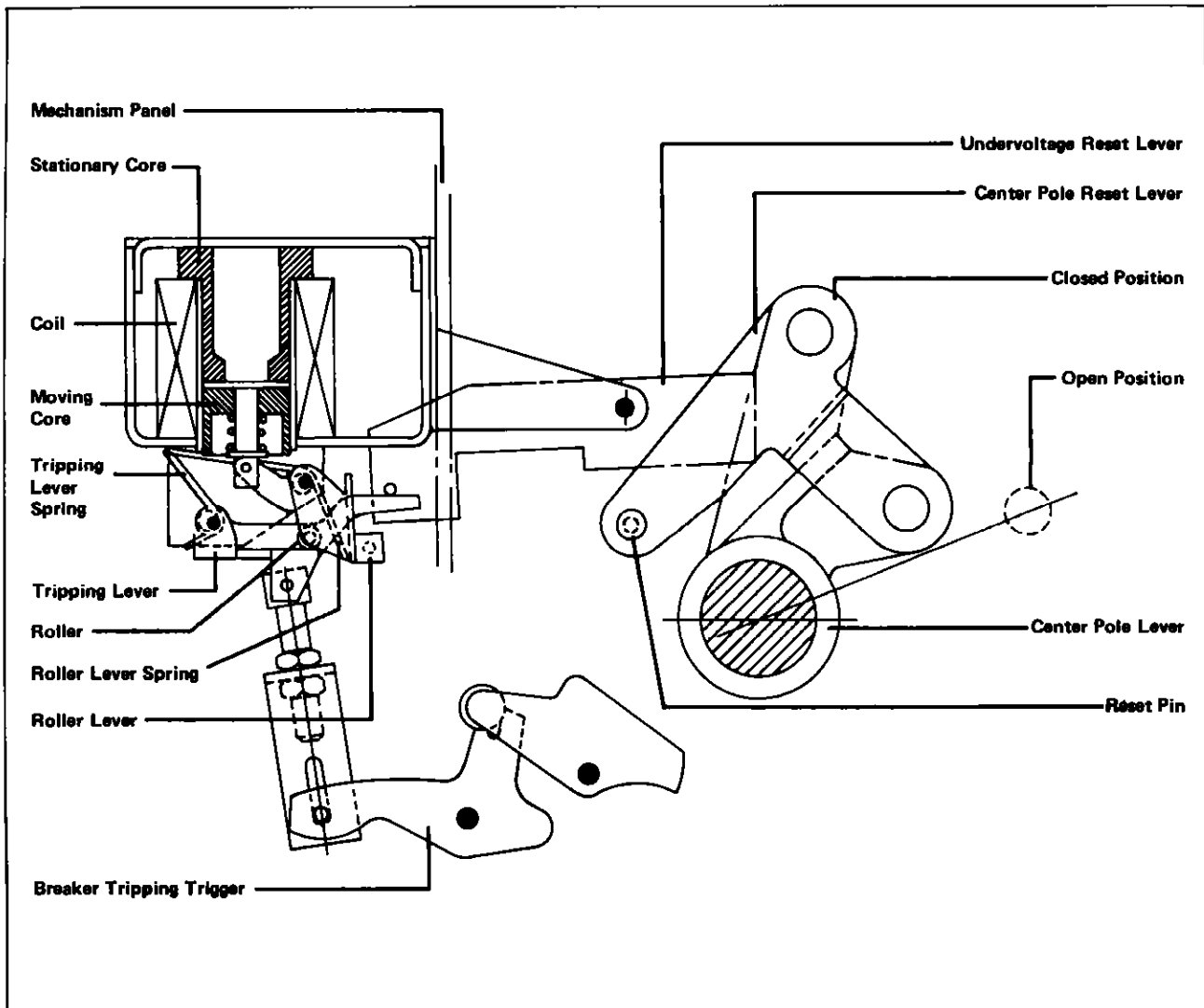


Fig. 31 Undervoltage Trip Attachment

**ENERGIZED, THE BREAKER MAY BE CLOSED WITH THE MAINTENANCE HANDLE TO CHECK THE CONTACTS BUT THE BREAKER CANNOT BE LATCHED CLOSED.**

#### ACCESSORIES

Several maintenance items are supplied with each order of metal-clad switchgear. They are shipped with the switchgear order, not with the breakers. Those directly associated with the breaker are:

1. **Maintenance Handle** — Used to close the breaker contacts during maintenance only. Also used to manually charge the breaker closing spring.

**CAUTION: DO NOT ATTEMPT TO CLOSE THE BREAKER WITH THE MAINTENANCE HANDLE WHEN THE BREAKER IS IN THE HOUSING.**

2. **Turning Dolly** — Used to maneuver the breaker when out of the cell and to assist in lining the breaker up before putting it into the cell.

**CAUTION: DO NOT USE THE TURNING DOLLY TO MOVE THE BREAKER IN OR OUT OF THE CELL.**

3. **Arc Chute Lifter** — Used to tilt the arc chutes during maintenance so that arc chutes and contacts may be examined. Not furnished with 50DHP75 and 50DHP250 breakers.

4. **Levering-in Crank** — Used to move the breaker between the Test Position and the Connected Position.

5. **50DHP350 Arc Chute Hanger** — Used when lifting the arc chutes on and off the breaker.

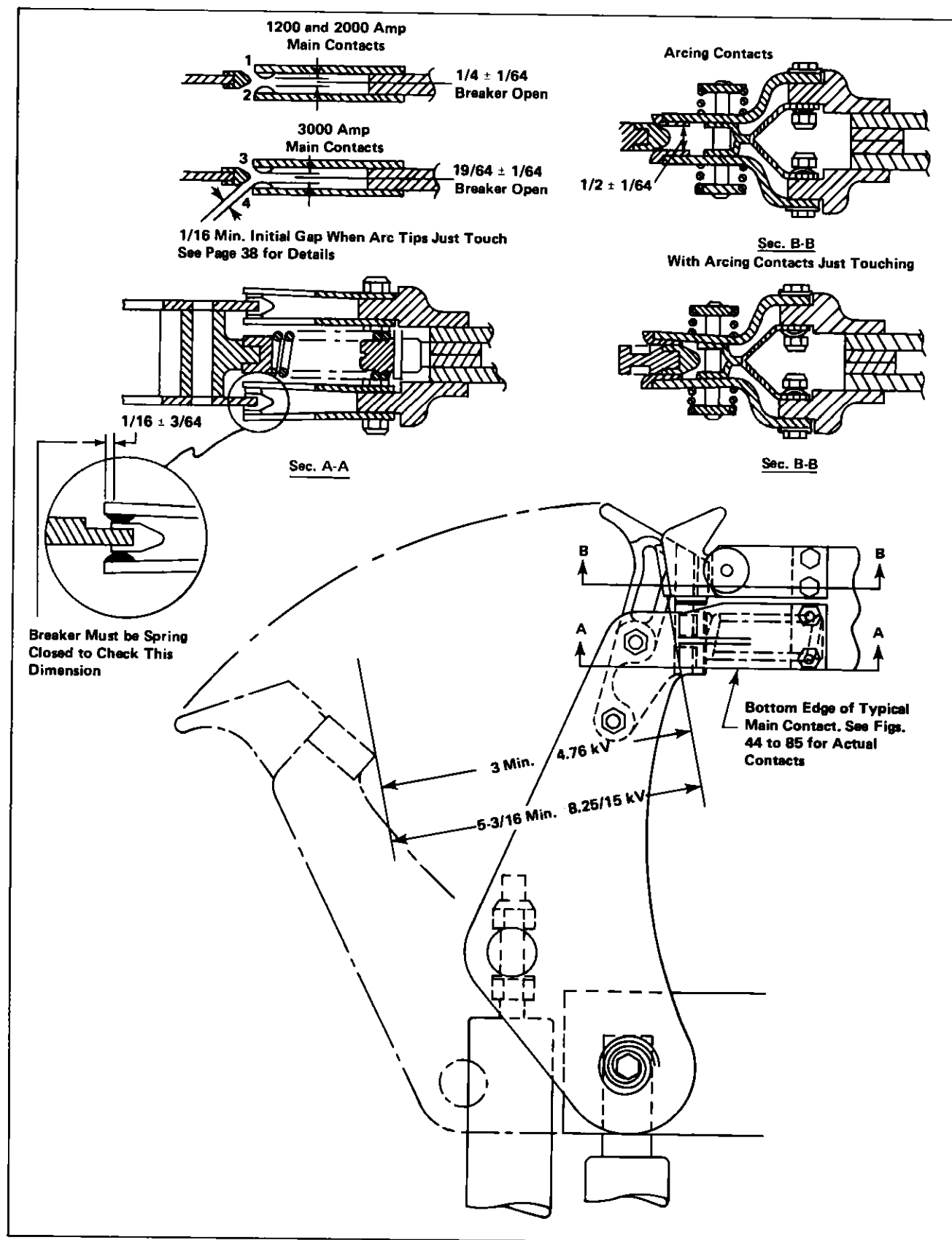


Fig. 32 Contact Adjustments



## INITIAL INSPECTION AND OPERATION

Before attempting to put the breaker in service it should carefully be checked and operated manually. The breakers were adjusted, inspected and tested at the factory before they were shipped and should require no readjusting before they are put in service. Do not change any adjustments, assemblies or parts unless they are obviously damaged or incorrectly adjusted. However, handling and transportation conditions could cause some damage or loss of adjustment. If some part is obviously out of adjustment refer to the Adjustment section of this instruction book for the correct settings.

The following sequence for inspection and operation should be followed.

1. Examine breaker for loose or obviously damaged parts.
2. Operate breaker manually.

**NOTE: STORED ENERGY BREAKERS ARE SHIPPED WITH THE CLOSING SPRING DISCHARGED. DO NOT CHARGE CLOSING SPRING AT THIS TIME.**

a) Put the rectangular cutout in the maintenance closing lever over the flats on the breaker main shaft which extends thru the right side of the breaker chassis. See Fig. 12. Slowly push down on the lever to bring the moving contacts close to the stationary contacts. The effort required to move the contacts will increase as the moving contacts approach the stationary contacts because the closing operation is compressing the breaker opening springs. **DO NOT ENGAGE MOVING AND STATIONARY CONTACTS.**

Move the contacts back and forth in this manner several times.

b) Check contact alignment — Push down on maintenance closing lever until arcing contacts just touch. When the first moving arcing contact touches its cooperating stationary arcing contacts, the other two arcing contacts should be within 1/8 inch of touching. The moving arcing contacts should be approximately centered between the two stationary arcing contacts.

c) Close breaker manually — Push down on maintenance closing lever until the contacts close and the trip mechanism latches. There will be a positive metallic click when the latch makes up. The force required on the lever will

increase significantly as the contacts make up. **REMOVE THE MAINTENANCE CLOSING HANDLE IMMEDIATELY.**

d) Trip breaker manually — Place finger under trip magnet plunger marked "Lift to Trip" and lift. See Fig. 11. This releases the tripping latch and the breaker opens.

**CAUTION: KEEP HEAD AND HANDS FROM PATH OF MOVING CONTACTS DURING TRIPPING TO AVOID INJURY.**

e) Manually charge closing spring — Place the end of the maintenance closing lever in the slot in the manual ratchet lever. This lever projects through a slot in the front of the mechanism panel just to the left of the "Lift to Trip" magnet. See Fig. 4. Charge spring with several downward movements of the lever until the lever suddenly turns freely and a positive metallic "click" is heard. See Fig. 8. **DO NOT ATTEMPT TO RATCHET ANY FURTHER.** Remove lever.

f) Release closing spring to close breaker manually — Place finger under close-release magnet plunger marked "Lift to Close" and lift. See Fig. 9. This releases the closing latch and closes the breaker.

**CAUTION: KEEP HEAD AND HANDS FROM PATH OF MOVING CONTACTS DURING CLOSING TO AVOID INJURY.**

g) Check contact penetration — With contacts closed by means of the closing spring, check for proper main contact penetration. See section on Adjustments and Fig. 32.

**NOTE: BREAKER MUST BE CLOSED WITH THE CLOSING SPRING TO PROPERLY CHECK CONTACT PENETRATION. CONTACT FRICTION MAY CAUSE APPARENT INCORRECT CONTACT PENETRATION IF CONTACTS ARE CLOSED WITH THE MAINTENANCE CLOSING LEVER.**

h) Trip breaker — Repeat procedure of Step d.

3. Operate breaker electrically.

After going through the above 8 steps, the breaker may now be operated electrically.

A test cabinet or a test jumper is the preferred method for electrically operating the breaker out of the cell for inspection and maintenance.

- a) Connect the female plug from the test cabinet or test jumper to the secondary contact plug on the rear of the breaker.
- b) If the test jumper is used, plug the male end of the jumper into an energized secondary contact block in a convenient cell.
- c) The spring charging motor will immediately start to charge the closing spring as soon as the secondary contacts are engaged. As soon as the closing spring is completely charged, the motor will automatically be turned off.

d) Close the breaker — If a test cabinet is being used, the control switch or pushbutton switch is used to close the breaker. If the test cable is used, the control switch on the cell door is used to close the breaker.

e) As soon as the breaker closes the motor will immediately recharge the closing spring.

f) Trip breaker using control switch or pushbutton switch.

g) Disconnect secondary contacts from test cabinet or test cable.

h) Close and trip the breaker manually by lifting the "Lift to Close" and "Lift to Trip" magnet plungers in that order. All springs are now completely discharged.

## INSTALLATION

### 1. Position Breaker

Move breaker, arc chutes and barrier to a convenient location as close to the metal-clad cell it is to be used in as is convenient and remove from shipping crates if this has not already been done. See section on Handling.

**BE SURE BREAKER IS OPEN AND CLOSING SPRING IS DISCHARGED BEFORE STARTING TO ASSEMBLE ARC CHUTES AND BARRIER.**

### 2. Mount Arc Chutes on Breaker

Generally the procedure is the same for mounting all arc chutes. However, because of the size and weight differences, hinge arrangement differences, and support and shunt strap differences, the detailed instructions for mounting arc chutes given in the Data Sheets for the various breakers should be consulted.

### 3. Connect Shunt Strap

**CONNECT SHUNT STRAP FROM LOWER CONTACT TO FRONT ARC CHUTE CONNECTION. BE SURE CONNECTION IS TIGHT AT BOTH ENDS OF SHUNT. FAILURE TO FIRMLY TIGHTEN EITHER OF THESE CONNECTIONS COULD CAUSE EXCESSIVE HEATING OR SEVERE ARCING DURING CIRCUIT INTERRUPTION EITHER OF WHICH COULD CAUSE FAILURE OF THE BREAKER.**

### 4. Mount Barrier

Barrier assemblies for DHP breakers are similar for all sizes and ratings. The following procedure is applicable to all ratings. Detail differences which primarily have to do with attaching the side sheets to the breaker chassis are given on the specific Breaker Data Sheets.

a. Place barrier assembly on breaker. Be sure that the barrier is seated as far down and as far back on the breaker chassis as possible. The steel panel should be in front of the lip on the barrier mounting pan, Fig. 2. The front part of the insulating sub-assembly should rest on top of the pan.

b. The barrier insulating side sheets should be to the outside of the vertical leg of the barrier mounting clips, Fig. 3.

c. Fasten the steel panel to the barrier mounting pan using the hardware provided. The square slots in the panel permit some shifting side-to-side to permit centering the barrier on the breaker as well as adjusting the barrier vertical alignment.

d. Fasten barrier sheets to the barrier clips using the hardware provided. When installing the bolts in the outer brackets, the bolt heads should always be on the outside of the insulating sheets. The barrier clips have horizontal and vertical slots permitting side-to-side and up and down

adjustment. In addition, the barrier sheets have slots for front-to-back adjustment. The brackets should be set to bias the side sheets slightly inward, approximately 1/8 inch.

e. The installation of a barrier is not a precise operation. However, reasonable care is required to insure that the barrier is centered on the circuit breaker and aligned side-to-side, front-to-back and vertically. Once the barrier is aligned, all the bolts should be tightened to maintain the alignment. A final adjustment to line up the barrier with the cell opening may be necessary just prior to inserting the breaker into the cell.

##### 5. Position Breaker in Front of Cell.

**DO NOT ATTEMPT TO LIFT BREAKER ONCE ARC CHUTES AND BARRIERS ARE MOUNTED.**

For general movements of breaker where corners must be turned and for positioning in front of the cell, use the turning dolly. Place vertical pin of dolly in hole in handling bracket at bottom and center of mechanism panel by tilting dolly handle sharply toward breaker. Push dolly handle down until front wheels of breaker lift off floor. Breaker can now be steered by horizontal movement of dolly handle. See Fig. 33.

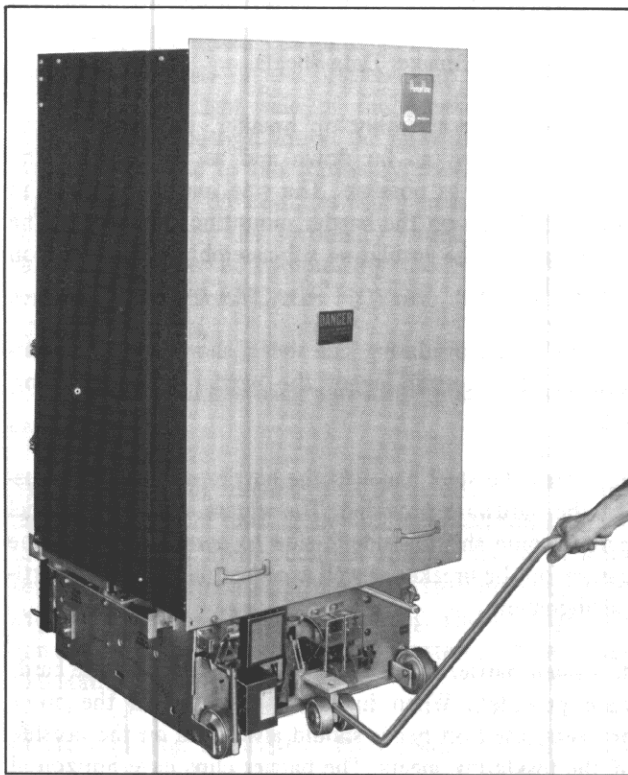


Fig. 33 Using Turning Dolly (391371)

**USE HANDLE ON FRONT STEEL PANEL OF BARRIER ASSEMBLY TO PULL OR PUSH BREAKER STRAIGHT FORWARD OR BACKWARD ONLY. KEEP HANDS OFF TOP EDGE OF FRONT BARRIER IN MOVING BREAKER.**

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

Check secondary contacts to see that none are bent out of alignment.

Make sure that the cell is clean and clear of anything that might interfere with breaker travel.

Levering screw in cell should be clean and free from dirt or grit. There is sufficient grease packed in the levering-in nut on the breaker to lubricate the screw.

##### 6. Push Breaker into Test Position in Cell

Line up guide channel on right hand side of breaker near floor with guide rail on right hand side of cell floor.

Remove handling dolly once breaker is aligned with guide on cell floor.

**DO NOT START BREAKER INTO CELL WITH TURNING DOLLY. THIS COULD CAUSE FAILURE OF MOC SWITCH PIN TO ENGAGE PANTOGRAPH IN CELL AND DAMAGE LEVERING-IN SCREW.**

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

**KEEP HANDS OFF TOP EDGE OF FRONT STEEL BARRIER WHEN PUSHING BREAKER INTO CELL.**

The breaker is now in the TEST POSITION.

**NOTE: THE BREAKER MAY OPEN AND ITS CLOSING SPRING MAY BE DISCHARGED WHILE IT IS PUSHED INTO THE CELL, DEPENDING ON WHETHER THE BREAKER WAS LEFT CLOSED OR OPEN, OR WHETHER THE CLOSING SPRING WAS LEFT CHARGED OR DISCHARGED WHILE THE BREAKER WAS STANDING OUTSIDE THE HOUSING.**

##### 7. Engage Secondary Contacts

Lift the handle on left hand 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 the handle will engage the two slots in the lever which is pivoted immediately above the handle.

Push down on the curved end of the lever as far as it will go.

**NOTE: AS SOON AS THE SECONDARY CONTACTS MAKE UP THE MOTOR WILL CHARGE THE CLOSING SPRING IF THE CONTROL CIRCUIT IS ENERGIZED.**

#### 8. Operate the Breaker in Test Position

The breaker may now be electrically closed and tripped by using the control switch on the cell door.

The control of the breaker is arranged so that the closing spring will recharge immediately after each closing operation.

#### 9. Trip Breaker Open

#### 10. Lever Breaker into Cell

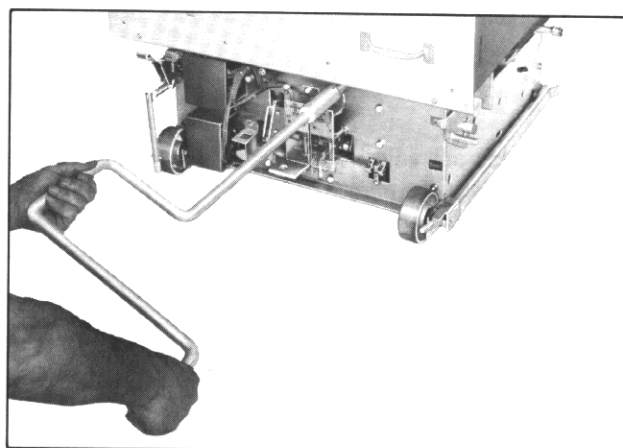
**CAUTION: THE POLE UNIT PARTS ARE ALIVE AT FULL CIRCUIT VOLTAGE WHEN THE BREAKER IS IN THE FULLY ENGAGED POSITION. BEFORE MOVING THE BREAKER INTO THAT POSITION, MAKE SURE ARC CHUTES HAVE BEEN PROPERLY INSTALLED AND THAT MAIN BARRIER ASSEMBLY HAS BEEN PROPERLY FASTENED IN PLACE. FAILURE TO DO THIS MAY CAUSE SERIOUS DAMAGE OR INJURY.**

Mechanical interlock prevents levering breaker into or out of the cell if breaker is closed. If excessive force is applied to the levering-in mechanism while the breaker is closed, the 3/16 pin that the levering-in crank engages will shear.

Press down on rail latch on right side of breaker, see Fig. 23. Push breaker toward rear of cell as far as it will go, about 1/4 inch.

Be sure breaker is pushed in until it stops. This should require only a few pounds of push. It brings the levering nut on the breaker up to the screw in the cell.

Engage crank on levering shaft, push moderately toward rear of cell and turn crank clockwise. Breaker will move slowly toward rear of cell. After breaker starts to move it is not necessary to push.



**Fig. 34 Using Levering-in Crank (388826)**

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

This is the **OPERATE** or **ENGAGED POSITION**.

Breaker may now be closed and tripped electrically using the control switch on the cell door.

#### 11. Trip Breaker Open

Mechanical interlock prevents levering breaker into or out of the cell if breaker is closed.

#### 12. Remove Breaker from Operate Position.

Engage crank on levering device shaft and turn counter-clockwise until crank rotates freely.

Pull breaker toward front of cell until rail latch engages slot in rail. Breaker is then secured in **TEST POSITION**.

#### 13. Remove Breaker from Cell

Press down on rail latch to free breaker from rail.

Pull breaker out of cell using handle on front of barrier.

**NOTE: THE BREAKER MAY OPEN AND ITS CLOSING SPRING MAY BE DISCHARGED AS IT IS WITHDRAWN FROM THE CELL DEPENDING ON WHETHER BREAKER WAS LEFT CLOSED OR OPEN, OR WHETHER SPRING WAS LEFT CHARGED OR DISCHARGED WHILE STANDING IN THE TEST POSITION.**

## ADJUSTMENTS

DHP Breakers are adjusted, inspected and tested at the factory and should give many years of troublefree service. However, with time and operations some wear will naturally occur and some readjustment will be necessary from time to time.

The following paragraphs give the proper settings and the method of adjusting to attain them.

### MECHANISM

The basic spring stored energy mechanism requires no adjusting. There are no adjustments.

### TRIPPING LATCH CLEARANCE

There should be just enough clearance between the tripping trigger and the tripping latch roller, Fig. 13, to allow the trigger to move under the roller without touching the roller when the breaker is open and the spring is charged. Just a few thousandths of an inch is sufficient.

With the breaker out of the cell remove the transparent plastic cover (Lift Plunger to Trip) from in front of the tripping trigger and proceed as follows:

1. Charge the closing spring.
2. Loosen locking nut, Item 17, Fig. 13.
3. Turn the tripping cam adjusting screw, Item 16, Fig. 13, clockwise until the trip latch roller, Item 18, Fig. 13, positively touches the latch surface of the tripping trigger, Item 10, Fig. 13. Do not overtighten. A nominal pressure is all that is required.
4. Raise the tripping trigger approximately one inch and release it. It will remain up approximately as shown in Fig. 13a.
5. Back the trip cam adjusting screw "OUT" VERY SLOWLY until the trip latch roller and tripping latch just reset. Then back the adjusting screw out an additional one quarter turn. There will be a small but noticeable clearance between the roller and the latch surface.
6. Tighten the locking nut.

### HOLDING PAWL ADJUSTMENT

If the motor runs but the closing spring does not charge, the holding pawl can be repositioned relative to the ratchet wheel by loosening the set screw that holds the pawl adjusting collar and moving it left or right so that the manual ratchet lever and holding pawl assembly stops on a different surface, Fig. 35. Three possible adjustment surfaces are provided.

### ANTI-CLOSE INTERLOCK ADJUSTMENT

With the breaker closed and the spring charged, there should be a clearance of 0.010 to 0.030-inch between the closing trigger and the closing latch roller, Fig. 15a. If it is ever necessary to readjust this clearance, the following procedure should be followed:

**CAUTION: THIS PROCEDURE REQUIRES WORK ON A CLOSED, SPRING CHARGED BREAKER. EXTREME CAUTION MUST BE EXERCISED TO STAY CLEAR OF THE PATH OF THE MOVING CONTACTS AND TO AVOID ACCIDENTAL OPERATION OF THE CLOSING AND TRIPPING TRIGGERS.**

1. Remove breaker from cell.
2. Remove barrier and arch chutes.
3. Remove barrier mounting pan, Fig. 2.
4. With propane torch apply heat to pole unit operating shaft, Item 3, Fig. 15a, and anti-close interlock screw to soften anaerobic adhesive holding screw in place.
5. Remove screw and clean.
6. Charge spring, close breaker, recharge spring.
7. Apply fresh anaerobic adhesive to screw and put back in shaft.
8. Run screw down till it bears on the closing latch.
9. Slowly run screw down farther to obtain the required 0.010 to 0.030 inches clearance between the roller and closing trigger.
10. Trip breaker, close breaker, trip breaker.
11. Reassemble breaker.

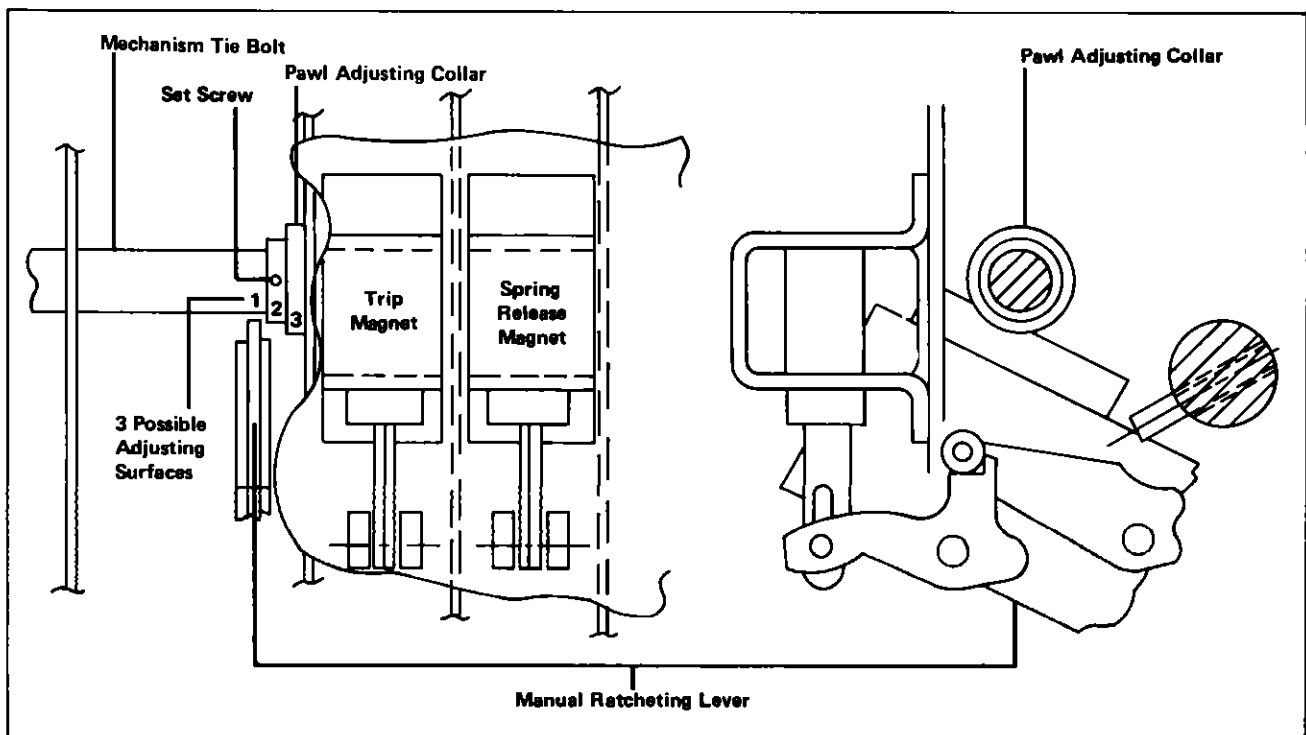


Fig. 35 Holding Pawl Adjustment

### LATCH CHECK SWITCH ADJUSTMENT

Refer to Fig. 4. The latch check switch is a snap action 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. As used in the control scheme, the latch check switch will not allow the spring release coil circuit to be completed until the tripping trigger has reset.

The 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 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.

### CONTACT ADJUSTMENT

**NOTE: THE CLOSING SPRING MUST BE DISCHARGED BEFORE ATTEMPTING TO CLOSE THE BREAKER WITH THE MAINTENANCE CLOSING HANDLE. THE BREAKER CANNOT BE CLOSED MANUALLY WITH THE SPRING CHARGED. IF IT IS TRIED, THE TRIPPING LINKAGE MAY BE DAMAGED.**

With the circuit breaker barrier removed, the arc chutes may be tilted back one at a time to provide access to contact assemblies for inspection and for minor adjustment and maintenance procedures. Refer to Descriptive Section, Pages 42 through 57 for instructions and precautions when tilting arc chutes for specific types of DHP breakers. Where more extensive maintenance and adjustment including replacement of contacts is anticipated, remove arc chutes completely for maximum accessibility to contacts.

Proper contact settings will be obtained more quickly if inspection, adjustment, and checking procedures are followed in ordered sequences as indicated in the following sections.

### CONTACT GAP ADJUSTMENTS

An initial inspection should be made to determine the physical condition of the contacts. This is to be followed by an inspection to identify where adjustments may be required. The adjustments are then made followed by a re-check to determine if the adjustments have produced proper contact settings. The arcing contact assembly should be inspected and adjusted first. When the arcing contacts have been properly set, the main contacts can then be inspected and adjusted. When the settings of all contact assemblies on a single pole have been completed proceed to the next pole unit.

During the initial inspection, if any contact insert is cracked or missing, the damaged contact member should be replaced at once. For other types of damage refer to the section on Contact Maintenance (Pages 37 and 38) for appropriate action.

Having established that contacts are in good condition, measure the gap between stationary contacts. The nominal gap dimensions with appropriate tolerances are shown in Fig. 32. Note the conditions found for later evaluation.

Using the maintenance closing handle, slowly close the circuit breaker manually. At the point where the moving contact first touches the stationary contacts visually check and note how well the contacts are centered. If the moving contact is badly misaligned with the stationary contact gap, make an adjustment as described below to center the contact gap with respect to the moving contact.

As the moving contact penetrates the stationary contact gap visually check whether or not the stationary contacts are deflected outward approximately equal amounts and again note the conditions found. After these observations are made open the breaker.

**CAUTION: REMOVE THE MAINTENANCE CLOSING HANDLE BEFORE TRIPPING A LATCHED BREAKER.**

For the contacts to be suitably aligned, the moving contact should be visually centered with respect to the stationary contact gap and both stationary contacts should touch the sloped sides of the moving contact at approximately the same time. As stationary contacts are deflected outward a visual comparison should indicate that both contacts deflect approximately equal amounts. Experience has shown that precise dimensions are not required for evaluating these conditions. Stationary contact gaps however must be adjusted within the dimensional tolerances shown in Fig. 32 to assure suitable contact pressure.

The method for adjustment involves the bending of each stationary contact to the left or the right as required for centering. Careful blows with a soft mallet may be used to bend the stationary contacts. For the stationary arcing contacts which are spring mounted, a back-up bar may be required when striking the contact to provide the necessary bending effort. For stationary arcing contacts of the type shown in Figs. 80 and 86 no stress should be applied to the riveted extension fastened to the upper side of the contact. For multiple fingered stationary main contacts all fingers on the same side of the assembly must be bent uniformly.

Following adjustment, repeat the steps of the inspection procedure to check whether additional adjustments may be required. When the arcing contacts have been set,

repeat similar inspect-adjust-recheck procedures on each of the remaining contact assemblies of the same pole unit before proceeding to the next pole unit. Note that three different stationary contact gap dimensions are indicated in Fig. 32. Be sure to use each in its proper place.

### CONTACT PENETRATION ADJUSTMENT

This adjustment is concerned with the depth of penetration of the moving main contact into the gap between stationary contacts. Although the adjustment is made by changing the effective length of the individual pole unit operating rods the final determination of the proper setting is based on dynamically closing all three poles at the same time.

Contact gap adjustments including centering alignment on all three poles as described in the previous section are required to be made prior to starting the Contact Penetration Adjustment procedure. In making Contact Penetration Adjustments start with the center pole first; then similarly adjust each of the outer poles.

### CONTACT PENETRATION – MAJOR ADJUSTMENT

This procedure is normally required if any operating rod has been disconnected. Both nuts at the top end of each pole unit operating rod are positioned to loosely couple the rods to their respective blade assemblies so that no contact penetration is made initially when the breaker is closed. (Refer Fig. 2, items 3, 8, 9).

With the maintenance closing handle slowly operate the breaker to the "latched-closed" position and remove the handle.

**CAUTION: WHEN THE CIRCUIT BREAKER IS LATCHED CLOSED THE TRIPPING SPRINGS ARE CHARGED. ACCIDENTAL OPERATION OF THE TRIP TRIGGER WILL CAUSE THE BREAKER TO OPEN UN-**

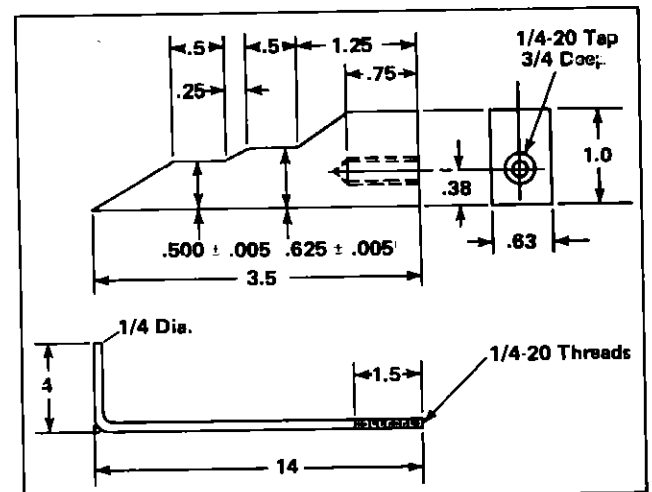


Fig. 36 Floor Tripper Adjusting Tool

## EXPECTEDLY AND CAN CAUSE PERSONAL INJURY OR DAMAGE.

Starting with the center pole, advance the lower operating rod nut until the moving main contacts engage their respective stationary contact pairs. The nominal penetration is checked on both main contact assemblies. ( $1/16 \pm 3/64$  inches as shown in Fig. 32). Then hand tighten the top adjusting nut on the operating rod. Repeat this procedure on each of the outer poles. When completed on all three poles these settings will serve as initial Contact Penetration Adjustments. Trip the circuit breaker and proceed with further adjustments in accordance with the section on Contact Penetration – Minor Adjustment.

### CONTACT PENETRATION – MINOR ADJUSTMENT

This procedure is applicable when a circuit breaker requires minimal adjustment or when a preliminary setting has been made as described in the preceding section on Major Adjustment.

Close and trip the circuit breaker dynamically several times. With the breaker in the “latched-closed” position check the contact penetration on each main contact assembly to determine whether or not it is within  $1/16 \pm 3/64$  inches as shown in Fig. 32. Make minor readjustments by moving the adjusting nuts up or down as required. When each readjustment has been completed hold the bottom adjusting nut and wrench tighten the top nut to secure the adjusted setting. After all three poles have been readjusted and secured, trip and close the breaker dynamically several times. Then recheck the several penetration settings. Main contact penetrations will differ slightly between poles as well as between main contacts on the same pole. These differences are acceptable if the penetration of each main contact assembly is set within  $1/16 \pm 3/64$  inches as shown in Fig. 32.

### HINGE

The hinge contact is set at the factory and will require no adjustment unless the main contacts are changed. See section on Maintenance.

### FLOOR TRIPPER ADJUSTMENT

The floor trippers Fig. 28, are set at the factory and unless the breaker is rolled over an obstruction on the floor that bends the actuators, they should not require adjusting.

If, however, the floor trippers should require readjusting, a checking tool similar to that shown in Fig. 36 should be made and the following procedure followed.

1. Set the breaker on a smooth flat surface preferably off the floor at a convenient height. Remove barrier and arc chutes before the breaker is lifted off the floor.
2. Manually charge the closing spring.

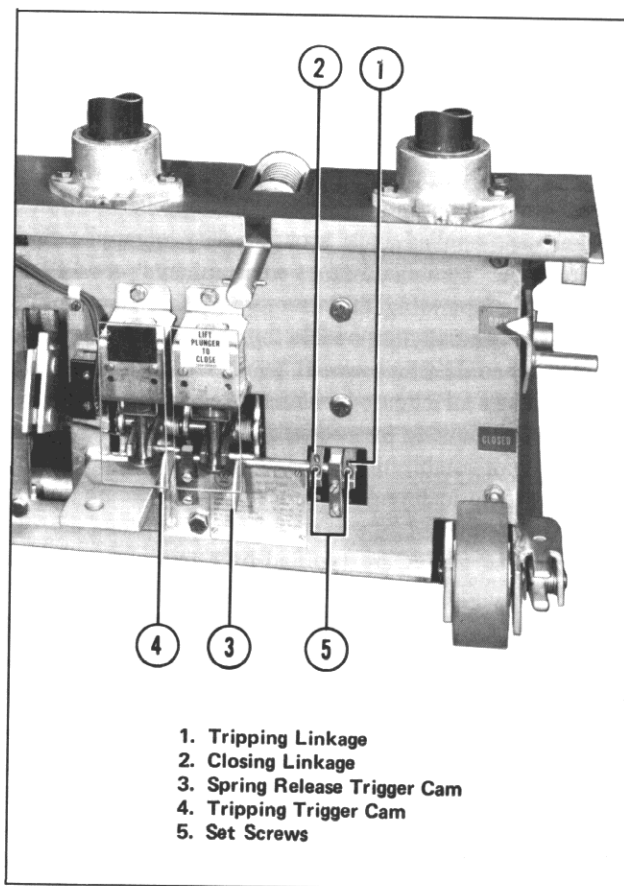


Fig. 37 Floor Tripper Adjustments

3. Slide adjusting tool under spring release lever, Fig. 28, and slowly push forward until lever end is resting on  $1/2$  inch high surface. Breaker should not close.
4. Continue sliding tool forward until lever end is resting on  $5/8$  inch high surface. Breaker should be closed.
5. If breaker closes on  $1/2$  inch high surface or does not close on  $5/8$  inch high surface, reposition spring release trigger cam, Item 3, Fig. 37, by loosening the set screw, Item 5, Fig. 37, and moving the cam up or down as required.
6. Be sure to tighten set screw after adjusting.
7. Slide tool under breaker tripping lever, Fig. 28, and proceed as in 3, 4, 5, and 6 above to reset the breaker tripping lever.
8. Breaker should neither close nor trip when  $1/2$  inch high surface is under the lever ends.
9. Breaker must close or trip when  $5/8$  inch high surface is under the bar.
10. Be sure closing spring is discharged and breaker is tripped open after completing adjustments.
11. Set breaker back on floor and remount arc chutes and barriers.



## MAINTENANCE

Type DHP circuit breakers are designed to have a long "in service" life with a minimum of maintenance when operating duty is fairly ordinary or average. Because these breakers are applied in a broad variety of applications under unique combinations of environmental conditions, each having operating duty requirements that can vary widely, it is virtually impossible to outline a specific maintenance schedule which would be universally appropriate for all ratings of circuit breakers in all types of applications. The following instructions are provided as general guidelines for establishing inspection schedules and for selecting specific maintenance procedures which are recommended to be used when particular conditions are observed. These guides are typified by a minimum number of rigid requirements to permit persons familiar with circuit breaker operation and maintenance a maximum amount of flexibility in developing a maintenance program consistent with good operating practices.

### INSPECTION/MAINTENANCE PROGRAMS

In order to obtain the most effective use of this type of maintenance instructions it is important for the user to establish an inspection program that will permit him to routinely examine each circuit breaker after regularly scheduled intervals of operation as well as at discrete times when conditions requiring particular maintenance procedures may be observed. Various suggestions are noted below to be used in setting up suitable inspection/maintenance programs.

### INSPECTION/MAINTENANCE RECORDS

As a part of an ongoing inspection/maintenance program some form of recordkeeping is suggested. Records may consist of a simple diary whose primary purpose is to document that an established inspection/maintenance schedule is actually being followed. However, more completely detailed records will facilitate evaluation of a breaker's condition or its changing condition. Such records may include formal check lists, detailed descriptions of conditions found, notes on operating duty, tests performed, maintenance procedures undertaken, etc. Whether simple records or more complete records are kept is for the user to decide. Records can be very helpful in determining both the types and extent of maintenance which may be required and in determining whether inspections should be scheduled more or less frequently.

### INSPECTION SCHEDULES

The schedule for routinely inspecting circuit breakers will depend on three inter-related factors.

1. Time since the last inspection.
2. Number of load switching operations since the last inspection.
3. Number of short circuit switching operations since the last inspection.

Whichever of these three factors comes up first is the factor which determines when an inspection should be made.

The routine inspection interval should be based either on Time or on the Number of Anticipated Load Current Switching Operations whichever comes first. Superimposed on this routine inspection schedule is the requirement that the breaker must be inspected after an accumulation of a number of short current switching operations if this occurs before the Time or Load Switching Operations interval is completed.

### ROUTINE INSPECTION INTERVAL BASED ON TIME

An initial inspection at the end of the first year in service is suggested because it provides an opportunity to evaluate conditions at an early point in the life of a circuit breaker. Based on conditions found, realistic decisions can be made concerning the length of time for succeeding inspection intervals. This first interval of one year is not considered a rigid requirement.

No breaker should be left in service longer than three years without being inspected even if it has accumulated very few operations. This is to be considered as a rigid requirement.

### ROUTINE INSPECTION INTERVAL BASED ON LOAD SWITCHING

The maximum number of load switching operations between scheduled inspections should not exceed the "Maxi-

imum Number of Operations Between Servicing" as shown in the following chart.

Operations – Continuous Current Rating Basis							
Circuit Breaker Type	Continuous Current Rating Amperes	Number of Operations					
		Max. No. Operations Between Servicing	No Load Mechanical Duty	Full Load	Inrush	Full Load	Inrush
				Fault Operation		Nonfault Duty	
All DHP Air Circuit Breakers Ratings Except 50DHP350 and 150DHP1000	1200	2000	10,000	1000	750	5000	3000
	2000	2000	10,000	1000	750	3000	2000
50DHP350, 150DHP1000 and All 3000A Ratings	1200 2000 3000	1000	5,000	500	400	2500	1500

The chart lists recommended numbers of load switching operations. The different columns apply depending on whether the load switching duty includes inrush currents or not and whether it includes fault current switching or not.

#### INSPECTION INTERVAL BASED ON SHORT CIRCUIT SWITCHING

Since the short circuit switching requirements for circuit breakers may vary widely from one installation to another both in the number of short circuits which are switched and in the magnitude of the short circuit current to be interrupted, it is necessary to establish practical guidelines on which to determine how frequently a circuit breaker requires inspection to be certain that necessary maintenance is performed to keep the breaker in good operating condition.

Circuit breakers described in this instruction book have been required to demonstrate that each rating can endure an accumulation of short circuit interruptions totaling at least 400% of its respective maximum rated short circuit interrupting capability without maintenance being performed. By relating the actual short circuit interruptions performed by a circuit breaker in the field to the capability demonstrated in design tests, a practical basis for scheduling inspections and maintenance can be established. A key term which will be used here is the "most likely" short circuit which can occur. While recognizing that a circuit breaker is applied on the basis that it has the capability of interrupting the largest short circuit which can occur at its location in an electrical system experience indicates that the probability is quite small that the largest possible fault will occur during the operating life of any given circuit breaker. Experience also shows that many circuit breakers are applied where lower level short circuits will probably occur during the life of the circuit breaker with some degree of regularity or predictability. By selecting inspection/maintenance intervals which are

related to the possible occurrence of "most likely" short circuits and allowing for the contingency that a maximum system short circuit can occur at any time during the interval, a practical inspection/maintenance guide can be established.

The following chart lists the level of the "most likely" fault as a percentage "P" of the maximum short circuit interrupting rating of the breaker. Each percentage "P" is coupled with an interval number "N" which is a suggested number of "most likely" short circuit interruptions which the circuit breaker may be permitted to accumulate within an established maintenance interval before it is removed from service for inspection and possible maintenance.

Suggested Inspection/Maintenance Interval	
"Most Likely" Short Circuit (P)	Accumulated Short Circuit Interruptions (N)
Greater than 50%*	1*
50%	2
40%	3
35%	4
28.5%	6
24.5%	8
20% and less	12

\*NOTE: For a short circuit interruption at P greater than 50%, it is strongly recommended that inspection of the circuit breaker always be made immediately after a single interruption.

During the inspection following the accumulation of "N" interruptions attention should be directed to the condition of arc chutes and of contact assemblies. Insulating members as well as general physical and mechanical condition should also be checked. (Refer to appropriate maintenance instructions in this instruction book for guidance.) Several operations using control power are also advisable for checking mechanism operation. Whether maintenance is required or not or whether maintenance procedures can be delayed until the next scheduled routine inspection/maintenance date is a decision which must be made in each case on the basis of the conditions found and operating experience.

When a circuit breaker has accumulated 'a total of "N" short circuit interruptions or less at percentage "P" in any inspection interval and after the circuit breaker has been inspected and maintained when necessary, the circuit breaker may be returned to service to begin a new inspection interval and a new accumulation of "N" "most likely" short circuit interruptions. Care should be exercised to keep the selected "P" and "N" characteristic for each circuit breaker up-to-date with system growth.

The maintenance interval chart is a suggested guide which has been developed on the basis of the demonstrated endurance capability of the circuit breakers. The number of operations given in the chart was conservatively chosen to reduce the level of periodic maintenance and to give a longer life before major maintenance is required.

Assuming that circuit breakers are applied under usual service conditions, where they are inspected on a regular basis and properly maintained when required, it is reasonable to anticipate that most circuit breakers applied where short circuit switching duties are moderate to light will be able to accumulate during normal operating life up to 24 short circuit interruptions at  $P = 40\%$  or up to 100 short circuit interruptions at  $P = 20\%$  before major maintenance such as replacement of contacts is required. These operating life figures are engineering estimates whose only purpose is to guide users in setting up realistic inspection/maintenance programs.

### SERVICE CONDITIONS

The time or number of operations indicated above are based on the usual service conditions of ambient temperatures in the range from plus  $40^{\circ}\text{C}$  to minus  $30^{\circ}\text{C}$ , altitudes below 3300 feet (1000 meters), and relatively clean and dry conditions.

Unusual service conditions such as exposure to damaging fumes and vapors, excessive or abrasive dust, explosive mixtures of dust or gases, steam, salt spray, and excessive moisture will usually reduce the time or number of switching operations between scheduled inspections. When unusual conditions prevail information may be referred to the nearest Westinghouse Sales Office for special inspection/maintenance recommendations.

The foregoing three inspection schedules cannot be discretely applied. Depending on the particular application, one of the three operating conditions will predominate. Whichever cycle is completed first, time in service, number of load current switching operations, or short circuit switching operations, will determine the completion of an inspection/maintenance interval and it will be necessary to remove the breaker from service for inspection and necessary maintenance as soon as practical.

### ROUTINE INSPECTION

The maximum time between routine inspections as dictated by either time in service, load current switching operations, or short circuit switching should not be exceeded. Maintenance should include removal of the circuit

breaker from its switchgear housing, an inspection to determine the condition of the circuit breaker, and cleaning to remove dust, dirt or other contaminants. Servicing may also include exercising operations of the circuit breaker, testing, adjusting, lubrication, tightening and other maintenance procedures as recommended in this instruction book.

### MECHANICAL OPERATION

Mechanically the circuit breaker should be quick, snappy and positive in operation. There should be no signs of sluggishness or hesitation. Should there be sluggishness indicated during an inspection, remove the barrier, and operate the circuit breaker slowly with the maintenance operating handle in order to identify the source of difficulty. Refer to the section on Mechanism Maintenance Procedures for corrective actions to be taken. After maintenance has been performed, a few exercising operations using control power are advisable. Any excess lubricant should be wiped off to prevent the accumulation of dust and dirt on and near moving parts.

### LOW LEVEL LOAD CURRENT SWITCHING DUTY

When circuit breakers are applied in circuits having a very low incidence of short circuit switching duty but where numerous interruptions at 100 amps or less are included there may be a tendency for soot and metal spray to accumulate in the arc chutes. The ceramic arc shields in the lower part of the arc chute, particularly the surfaces adjacent to the contact assemblies, are more susceptible to this condition and the user's inspection/maintenance instructions should recognize this. These deposits can be electrically conducting and should be removed if detected. The maintenance procedure recommended is described under Arc Chutes.

### MODERATE TO HIGH LEVEL SWITCHING DUTY

Circuit breakers applied where currents 1000 amperes and larger are regularly switched seldom develop potentially harmful deposits within the arc chutes since the larger currents interrupted have abraded effects which leave the arc chute ceramic surfaces electrically clean. Instead there will be a tendency for the ceramic surfaces, particularly the edges of ceramic interrupter plates, to become glazed and for the slots to erode. The amount of glazing and erosion will vary with the magnitude of current and the number of operations. Glazing may be barely noticeable unless medium to high levels of short circuit current are interrupted or numerous low to moderate short circuit interruptions are accumulated. Arc chute maintenance procedures discuss glazing in more detail. Attention

should also be directed to the condition of the contacts for this type of duty.

## CAPACITOR SWITCHING

Capacitor switching applications produce inrush currents and interrupting currents which have characteristics similar to those encountered in fault switching duty. Since conditions may vary widely depending on bank size, number of banks and system characteristics it is difficult to set realistic maintenance guidelines. Therefore, as a general guide for capacitor switching, it is suggested that an initial inspection/maintenance interval be established on the basis of 500 capacitor switching operations or one year whichever occurs first. Intervals beyond the initial inspection may then be determined based on the conditions observed and the level of maintenance required at the first inspection date. As an engineering estimate, major maintenance, such as contact replacement, may be anticipated after a total accumulation of 2500 to 5000 capacitor switching operations depending on circuit breaker rating and the characteristics of the capacitor circuit being switched. The circuit breakers in capacitor bank feeder circuits are the ones normally considered in capacitor switching evaluations. It should not be overlooked in setting up inspection/maintenance schedules that under identifiable operating conditions incoming line or source breakers and bus tie breakers may also be subjected to a limited number of capacitor switching operations.

## TOTAL BREAKER LIFE

While operating duties are important considerations in establishing an inspection/maintenance program, it is equally important to consider factors which relate to the total life of a circuit breaker. Although it is usual to think in terms of years in service, breaker life in terms of total accumulated operations is a more definitive parameter. A breaker which has passed the mid-point of its operational life may reasonably require more frequent inspection and different levels of maintenance than a newer breaker. Elements such as the wear on mechanical parts, erosion of contacts, glazing of arc chute ceramics are more apt to occur in the later life of the breaker. As illustrated by the chart "Operations - Continuous Current Rating Basis", a breaker will have a longer mechanical life span than an electrical life span. Time allowed for maintenance may have to be extended to permit part replacements and more extensive maintenance procedures during later life. An inspection/maintenance program will take these life factors into account. Where the selection of an initial inspection interval is often arbitrarily and conservatively established primarily due to a lack of operating experience, later life inspection/maintenance scheduling can be more

realistically determined based on the experience which has accumulated. It is at this point where the advantages of well kept inspection/maintenance records will become manifest.

## CHANGING DUTY CONSIDERATIONS

A further consideration in an on-going inspection/maintenance program can be generally categorized as "changing duty". For some applications changes may occur to increase breaker load current. For other applications changes may include more frequent switching or exposure to more short circuit switching operations. Dirt and dust may accumulate faster or may change in content. Damaging fumes or vapors may become more significant in their effects on breaker condition. The effect of these and other similar types of changes can be detected in an on-going inspection program and inspection/maintenance schedules originally developed may have to be modified from time to time as a result.

## INSPECTION/MAINTENANCE PROGRAM REVIEWS

In order to keep an ongoing inspection/maintenance program up to date so that it reflects the experience accumulated it is suggested that such programs be reviewed on a periodic basis through the life of the circuit breaker. The first review should be made following the initial inspection after a breaker is placed in service. Subsequent reviews will depend on the type of application. For breakers which accumulate operations slowly (100 or less per year) subsequent reviews are suggested at seven to ten year intervals. For breakers which accumulate operations more rapidly, reviews are suggested after approximately 25%, 50%, 75% and 100% of the number of operations shown in the chart "Operations - Continuous Current Rating Basis" under No Load Mechanical Duty have been accumulated.

## MAINTENANCE PROCEDURES

Following are recommendations for the maintenance of particular breaker components. These include Contacts, Arc Chutes, Mechanisms and Spring Charging Motors. In addition guides for Lubrication and Insulation Maintenance are provided.

## CONTACTS

In normal operation the arc will make terminal marks all over the contacts and to a lesser extent on nearby metal parts. High current arcs will erode arc contact material more rapidly, but high current arcs move upward very quickly off the contacts. Low current arcs move very

slowly and their terminals may hop around the contacts for several cycles. Hence a breaker which has had many operations at low currents may be expected to have numerous small burn spots and pock marks all over the metal parts supporting the arcing contacts. When inspecting arcing contacts the important thing to look for in addition to adjustment is the extent of the erosion of the contact material. When the thickness of the arcing contact tip has decreased to  $1/16$  inch at the first point of contact, the contacts should be replaced.

On high fault current operations there may be occasional slight burning on the main contacts. Also after many operations, the main contacts will sometimes become roughened. A fine flat file should be used lightly on the main contact tips removing only enough material to take off the high spots. A moderate amount of pitting on the main contact surfaces will not appreciably impair their current carrying ability because of the high contact pressure.

After the contacts have been worn and dressed off as above, or replaced, contact adjustment should be checked. Refer to the section on contact adjustment.

The burning away of the arc tips causes a change in the arc tip adjustment and the relation of arc tips to main contacts. Refer to Fig. 32.

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

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

Referring to Fig. 32, the  $1/16$  initial gaps shown at points 1, 2, 3 and 4 will gradually decrease as the arcing tips burn away. When these gaps have decreased to approximately  $1/32$  inch, the contacts should be readjusted. If the gaps cannot be readjusted to at least  $1/16$  inch, consideration should be given to replacing the arcing contacts.

To correct both gaps described 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 less than  $1/2$  inch  $\pm 1/64$ .

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

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

The main current carrying contact deterioration is primarily 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 the fingers with a mallet, as with the arcing contacts.

Contact separation for 1200 and 2000 amp main contacts is  $1/4 \pm 1/64$  inch; for 3000 amp contacts, the separation is  $19/64 \pm 1/64$  inch.

The main contact fingers should be replaced when the thickness of the contact insert has been reduced to about  $1/32$  inch. The moving main contacts should be replaced when the thickness of the tip at the first point of contact has decreased to about  $1/32$  inch.

If it is necessary to replace a moving main contact, the entire moving contact arm must be replaced. The hinge is properly adjusted when the nuts on the hinge pin are tightened solid and then one nut is backed off  $1/2$  turn.

Do not disassemble the pole unit. Special fixtures are required to properly assemble and align all of the parts. Only the parts indicated in the pole unit parts list on page 58 and 59 are available as replacement parts.

## ARC CHUTE

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 taken 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.

**NOTE: FOR INSPECTION AND MAINTENANCE, THE ARC CHUTES MAY BE TILTED BACK AS IN FIGS. 49, 72 AND 78. DO NOT TILT MORE THAN ONE ARC CHUTE AT A TIME AS THIS MAY CAUSE THE BREAKER TO TIP OVER. TILT ARC CHUTES ONLY WITHIN LIMITS PROVIDED BY USING ARC CHUTE LIFTER TYPICALLY SHOWN IN FIGS. 72 AND 78.**

On general inspections, blow out the arc chutes with dry compressed air by directing the steam upward from the contact area and out through each of the slots be-

tween 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, the ceramic stack should be replaced.

#### 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 dry clean cloths. Third very tightly adhering deposits from the arc gases may appear 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. Next best is a flexible disc on an electric drill with medium grain aluminum oxide paper.

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 Hz for one minute between the front and rear arc horns. Also the dirty surface of the ceramic near the contacts should withstand approximately 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.

#### 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 at or referred to the extreme tip of the moving arcing contact.

#### MINIMUM CLOSING SPEED

Minimum closing speed is based on the average slope of the time-travel curve in the 17 millisecond interval preceding arcing contact touch (1 cycle on 60 Hz base).

4.76 kV Breakers 6.5 ft/sec

8.25 and 15.0 kV Breakers:

40,000 Amp Momentary 7.5 ft/sec

60,000-70,000 Amp Momentary 9 ft/sec

80,000 Amp Momentary 10.5 ft/sec

## MINIMUM CONTACT SEPARATION

The contacts should travel the following distance during the 17 millisecond interval after arcing contact separation (1 cycle on 60 Hz base).

4.76 kV Breakers — 1-3/4 inches

8.25 and 15.0 kV Breakers — 2-1/2 inches

## MECHANISM

Close the breaker by spring power and open by normal tripping action. Try charging the closing 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 free as the click is heard.

In these operations, closing and opening should be snappy, without hesitation or sluggishness.

In addition to the above operational check, the following points should be checked:

1. With the breaker open and the closing spring charged, check for clearance between the tripping trigger and tripping latch roller. Refer to Fig. 13b. The trigger should not touch the roller. If adjustment is necessary see section on Adjustments.
2. With breaker closed and closing spring charged, check for clearance between the closing trigger and the closing latch roller. Refer to Fig. 15a. If adjustment is necessary see section on Adjustments.
3. Lubricate the mechanism sparingly as described under Lubrication.

## INSULATION

All insulation to ground on DHP breakers is porcelain. All other insulation not directly stressed to ground, such as barriers, arc chutes, and shields is glass reinforced plastic.

Insulation maintenance consists primarily of keeping the insulating surfaces clean. This can be done by wiping off the insulation each time the breaker is removed from the cell.

In case there is any tightly adhering dirt that will not come off by wiping, it can be removed with a mild solvent or water. **THIS DOES NOT APPLY TO THE INTERIOR OF THE CHUTES.** Be sure to dry the insulation completely after this type of cleaning.

## LUBRICATION

### Mechanism

The most reliable performance on the stored energy mechanism can be obtained by lubrication. All parts which require it are lubricated with a molybdenum disulphide grease, Westinghouse M. No. 53701QB, when assembled. Some items should be lubricated at regular maintenance intervals. Other parts normally should require lubrication only after long periods of time.

After each interval of 2000 Operations, the following items should be lubricated with light machine oil applied sparingly:

1. Front and rear tripping latch rollers and pivot pin.
2. Tripping trigger pivot pin.
3. Spring release latch roller and pivot pin.
4. Spring release trigger and pivot pin.
5. Tripping cam pivot pin and restraining link pin.

### Roller Bearings

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

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

If it is necessary to disassemble the mechanism, the bearings and related parts should be thoroughly cleaned of old grease in a good grease solvent. **DO NOT USE 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 No. 53701QB.

### Main Contacts

Do not use a molybdenum disulphide grease on the contacts. Use only a graphite grease.

When the breaker pole units are assembled, a graphite grease, Westinghouse No. 53701AN, is used between the contact fingers and the stud, at the moving contact hinge points, and an extremely light coat is put on the main and arcing contacts. Unless the contacts are replaced, it should not be necessary to relubricate either the hinge or the bolted arcing and main contact connections.

At normal maintenance intervals, a light application of graphite grease No. 53701AN to the contact surfaces will be beneficial to the contacts. This should consist of apply-

ing a small amount of the lubricant to the contact surfaces, rubbing it in and then wiping off any excess with a soft cloth.

### Secondary Contacts

Use only a very light coating of petrolatum.

### Drawout Disconnect Contact Fingers

Use only a very light coating of petrolatum.

### SPRING CHARGING MOTOR

To remove the spring charging motor proceed as follows:

1. Discharge all springs.
  2. Remove arc chutes, barrier and support pan.
  3. Place breaker on bench at convenient working height.
  4. Disconnect motor leads.
  5. Remove four nuts holding motor assembly to mechanism. **DO NOT REMOVE THE BOLTS FROM THE MECHANISM BACK PLATE.**
  6. Remove motor assembly.
  7. Remove motor crank, Fig. 90, by striking sharp blow with soft mallet. Threads are right hand.
  8. Remove motor from mounting bracket.
  9. Install new motor in reverse order. **BE SURE MOTOR CRANK ROLLER IS UNDER DRIVING PLATE.**
- Item 11, Fig. 15a.

10. Remove tool and spring.
11. Reassemble in reverse order.

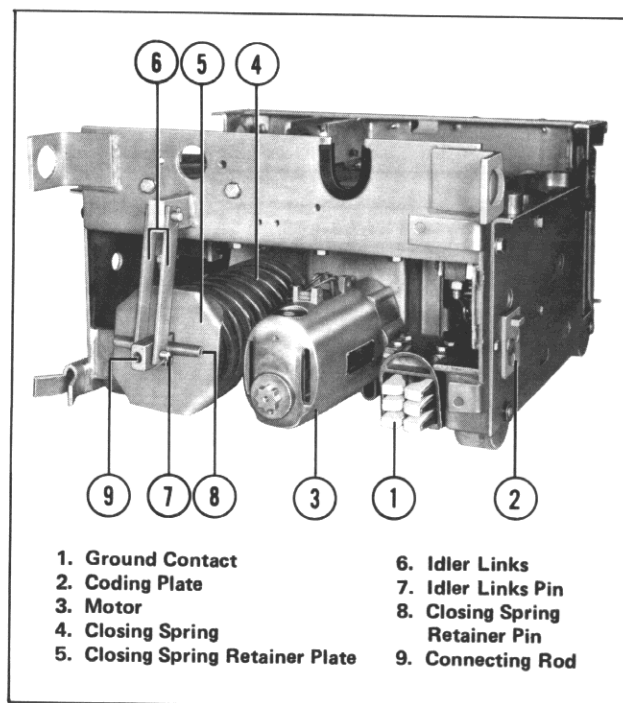


Fig. 38 4.76 kV Chassis - Rear View C

### REMOVAL OF CLOSING SPRING

Under normal conditions it should be necessary to change the closing spring during the useful life of the mechanism. If the spring does have to be changed, a Closing Spring Removal Tool 592C864 G01 is available from Westinghouse.

To change the closing spring, refer to Figs. 38 and 39 and proceed as follows:

1. Close and trip breaker manually to be sure all springs are discharged.
2. Remove barrier and arc chutes.
3. Assemble nut, thrust bearing, thrust washer, collar and tube on stud. Items 9, 8, 7, 6, 5 and 10 Fig. 39.
4. Screw stud, Item 10, into end of connecting rod, Item 1, as far as it will go.
5. Hold stud firmly and remove idler links and pin. Items 6 and 7, Fig. 38.

**NOTE: SPRING WILL MOVE EITHER UP OR DOWN WHEN IDLER LINKS ARE REMOVED.**

6. Position the tube, Item 5, so that the slots straddle pin 4 thru the connecting rod 1.
7. Tighten nut 9 so that spring retainer 2 is moved away from pin 4.
8. Drive pin 4 out of hole in connecting rod 1.
9. Hold end of stud 10 with a wrench to keep it from turning and unscrew nut 9 until closing spring 3 is completely free of tension. Travel will be from 5 to 6.5 inches depending on breaker rating.

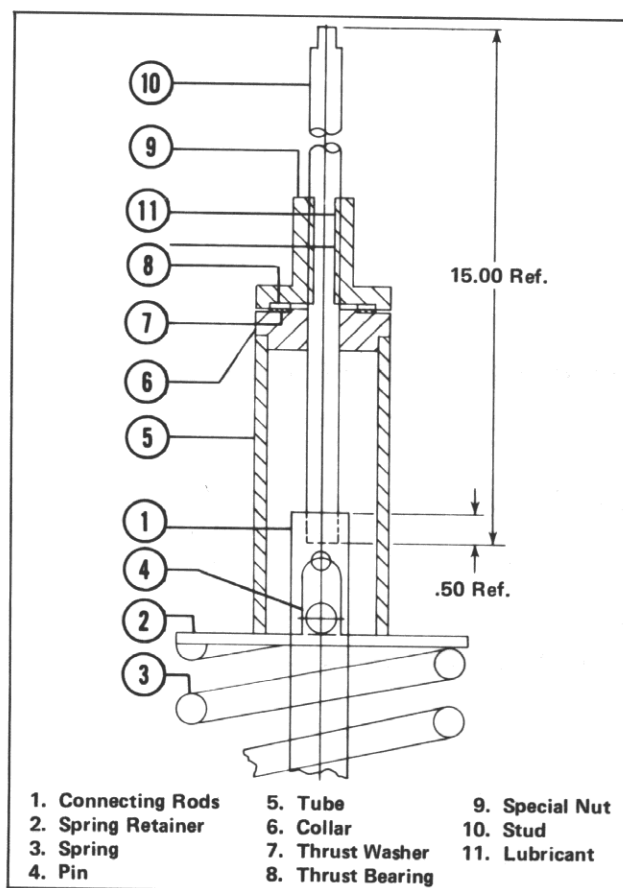


Fig. 39 Closing Spring Removal Tool



## 50DHP75 - 1200 AMPERE

## Shipping

1 Package . . . . . 50 x 26 x 40 inches

## Weights

Breaker . . . . . 340 lbs.  
 One Arc Chute . . . . . 35 lbs.  
 Barrier . . . . . 40 lbs.  
 Complete Breaker . . . . . 485 lbs.

## MOUNTING ARC CHUTE (FIG. 40)

Because of their lightweight, the arc chutes can easily be set in place over the hinge pins on the breaker. Be sure hinge pin is all the way in the slots in the arc chute before tilting the chute forward.

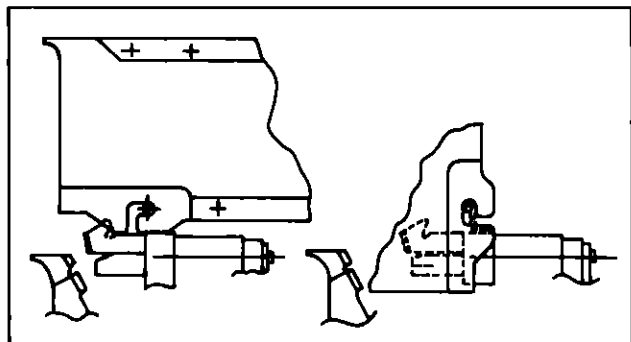


Fig. 40 Mount Arc Chute

## CONNECT SHUNT STRAP (FIG. 41)

CONNECT SHUNT STRAP FROM LOWER CONTACT TO FRONT ARC CHUTE CONNECTION. BE SURE CONNECTION IS TIGHT AT BOTH ENDS OF SHUNT. FAILURE TO FIRMLY TIGHTEN EITHER OF THESE CONNECTIONS COULD CAUSE EXCESSIVE HEATING OR SEVERE ARCING DURING CIRCUIT INTERRUPTION EITHER OF WHICH COULD CAUSE FAILURE OF THE BREAKER.

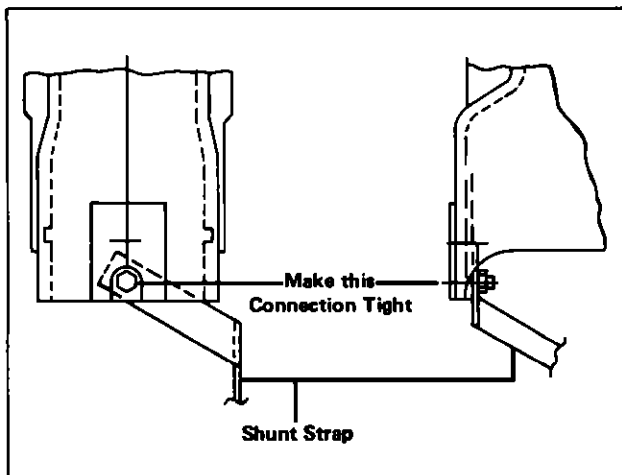


Fig. 41 Connect Shunt Strap

## BARRIER (FIG. 41)

Barrier consists of a steel front sheet with an insulating shield behind it and two insulating sheets that go on either side of the center pole when mounted on the breaker. Attachment is by bolting the front sheet to the support pan and by bolting the two insulating tabs extending from the bottom rear of the barrier sheets to angle brackets at the rear of the pole units.

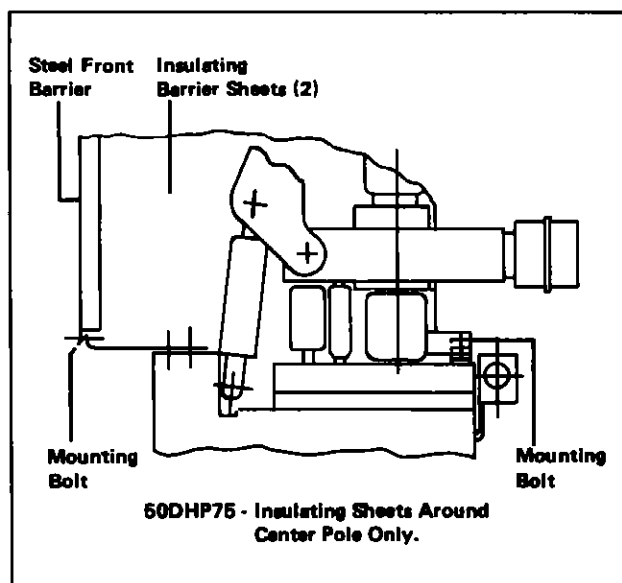
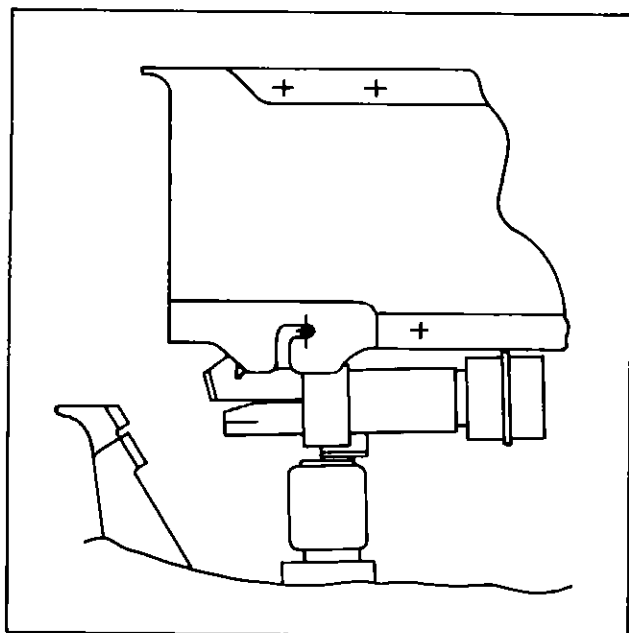


Fig. 42 Barrier Mounting

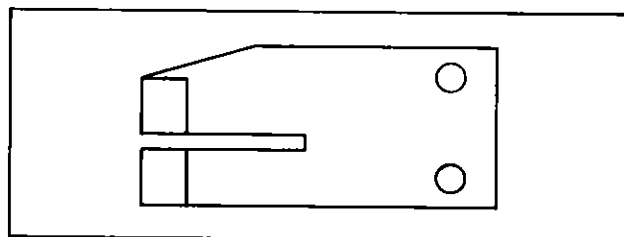
**TILT BACK ARC CHUTE (FIG. 43)**

Remove front shunt strap connection and tilt arc chute back against top stud.

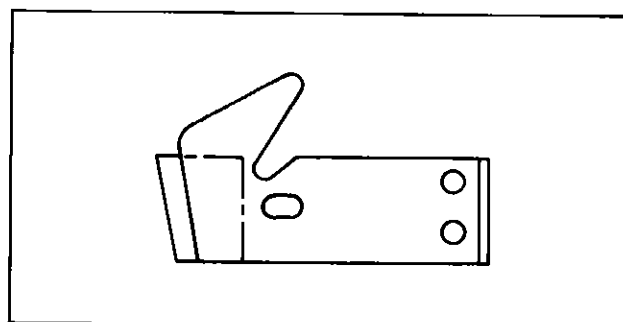
**CAUTION:** TILT BACK ONLY ONE ARC CHUTE AT A TIME. MORE THAN ONE TILTED BACK COULD CAUSE BREAKER TO TIP OVER.



**Fig. 43** *Tilt Arc Chute*



**Fig. 44** *Stationary Main Contacts*



**Fig. 45** *Stationary Arcing Contacts*

## 50DHP250 — 1200 and 2000 AMPERE

**Shipping**

1 Package . . . . . 50 x 27 x 45 inches

**Weights**

Breaker . . . . . 340 lbs.  
 One Arc Chute . . . . . 100 lbs.  
 Barrier . . . . . 50 lbs.  
 Complete Breaker . . . . . 690 or 725 lbs.

**MOUNTING ARC CHUTE (FIG. 46)**

Because of their lightweight, the arc chutes can easily be set in place over the hinge pins on the breaker. Be sure hinge pin is all the way in the slots in the arc chute before tilting the chute forward.

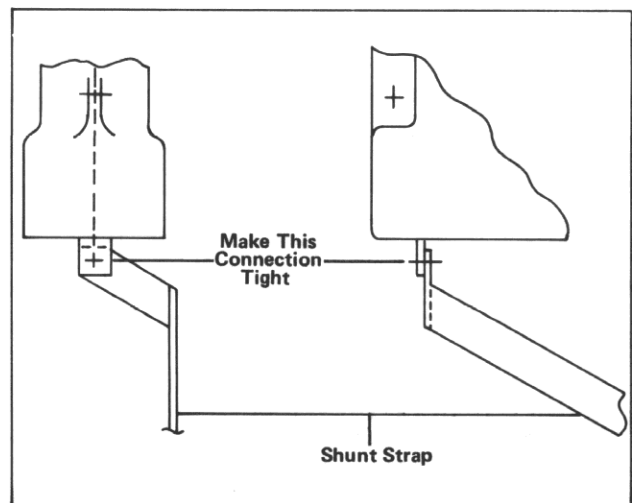


**Fig. 46** *Mount Arc Chute*

**CONNECT SHUNT STRAP (FIG. 47)**

**CONNECT SHUNT STRAP FROM LOWER CONTACT TO FRONT ARC CHUTE CONNECTION. BE SURE CONNECTION IS TIGHT AT BOTH ENDS OF SHUNT.**

**FAILURE TO FIRMLY TIGHTEN EITHER OF THESE CONNECTIONS COULD CAUSE EXCESSIVE HEATING OR SEVERE ARCING DURING CIRCUIT INTERRUPTION EITHER OF WHICH COULD CAUSE FAILURE OF THE BREAKER.**



**Fig. 47** *Connect Shunt Strap*

**BARRIER (FIG. 48)**

Barrier consists of a steel front sheet with an insulating shield behind it and four insulating sheets that go around the three arc chutes and pole units. The steel front sheet has a notch in the bottom edge which fits into a clip on the support pan. Attachment is by bolting the front sheet to the support pan, bolting the two center insulating sheets to the clips behind the pole units, and by bolting the two outside insulating sheets to the sides of the breaker. See Installation Section, this Instruction Book for method of aligning the barrier.

**TILT BACK ARC CHUTE (FIG. 49)**

Remove front shunt strap connection and tilt arc chute back against top stud.

**CAUTION: TILT BACK ONLY ONE ARC CHUTE AT A TIME, MORE THAN ONE TILTED BACK COULD CAUSE BREAKER TO TIP OVER.**

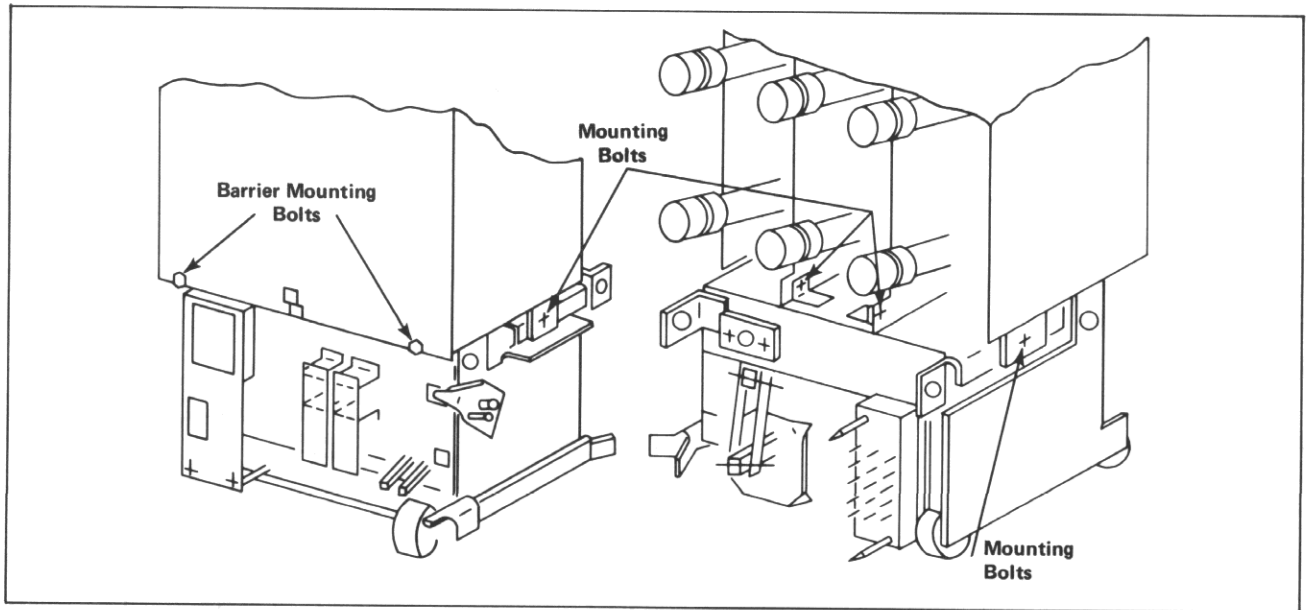


Fig. 48 *Barrier Mounting*

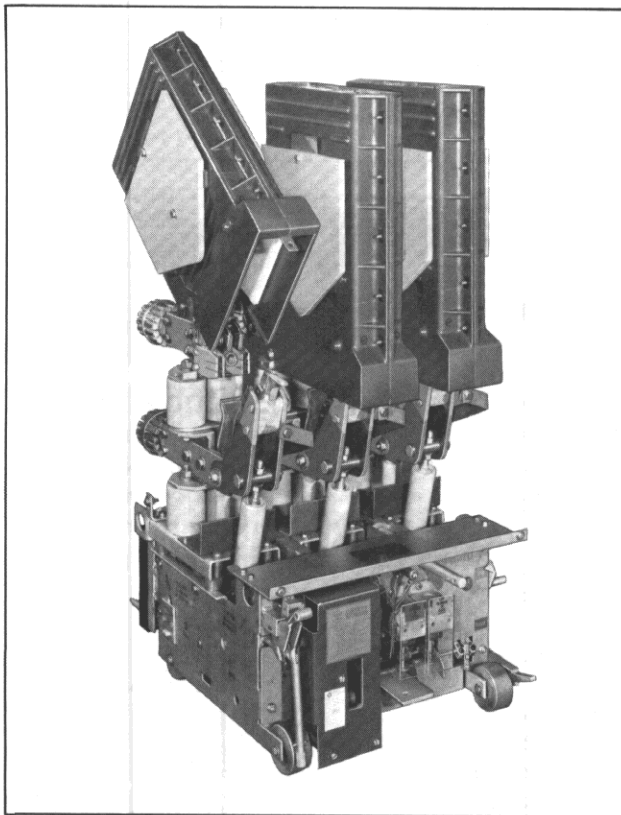


Fig. 49 *Tilt Arc Chute*

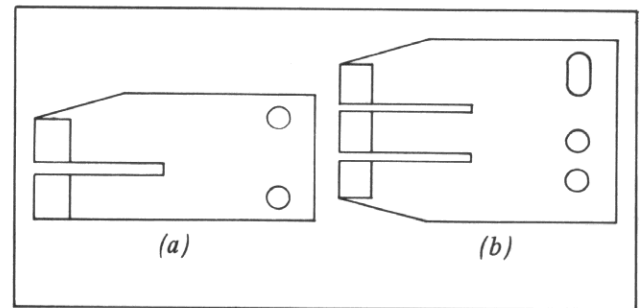


Fig. 50 *Stationary Main Contacts*

a. 1200 Amp

b. 2000 Amp and 1200 Amp High Momentary

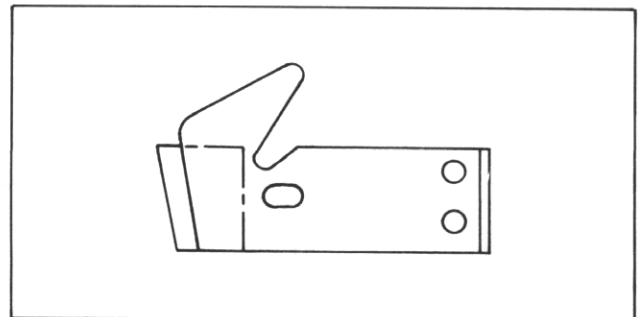


Fig. 51 *Stationary Arcing Contacts*

## 50DHP350 – 1200 AND 2000 AMPERE

### Shipping

#### 2 Packages:

Breaker plus 3 Arc Chutes . . . . .	65 x 26 x 43 inches
Barrier . . . . .	50 x 32 x 32 inches

### Weights

Breaker . . . . .	400 or 450 lbs.
One arc chute . . . . .	210 lbs.
Barrier . . . . .	50 lbs.
Complete breaker . . . . .	1080 or 1130 lbs.

### MOUNTING ARC CHUTE (FIG. 52 AND 53)

An overhead lifting device is required to lift the arc chutes into place on the breaker. Because of the close spacing between the arc chutes, an arc chute hanger to attach to the arc chute lifting lugs is provided as an accessory, Fig. 52.

Remove all three hinge pins.  
Remove shunt connector hardware.  
Mount the center arc chute first.

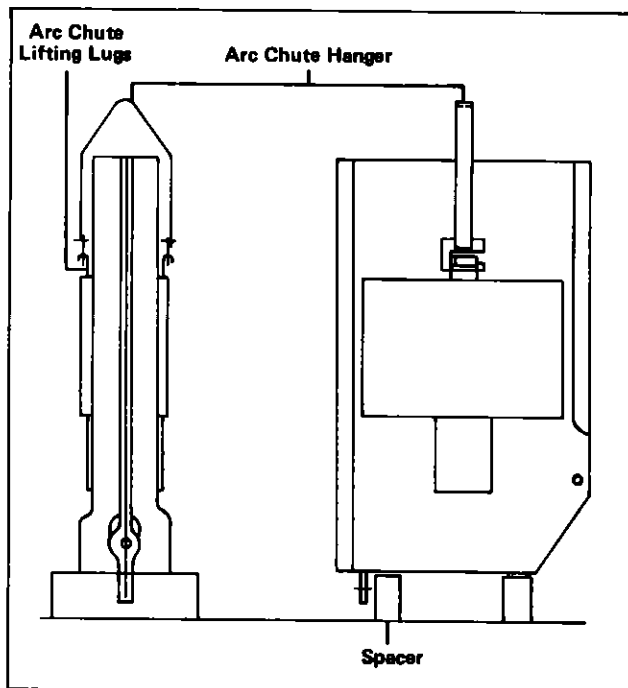


Fig. 52 Lift Arc Chute

Lift arc chute above breaker and slowly lower into position so that the front is on the arc chute support and the hinge holes are lined up with the hinge bracket on the pole unit.

Insert hinge pin and replace retainer rings, Fig. 53.

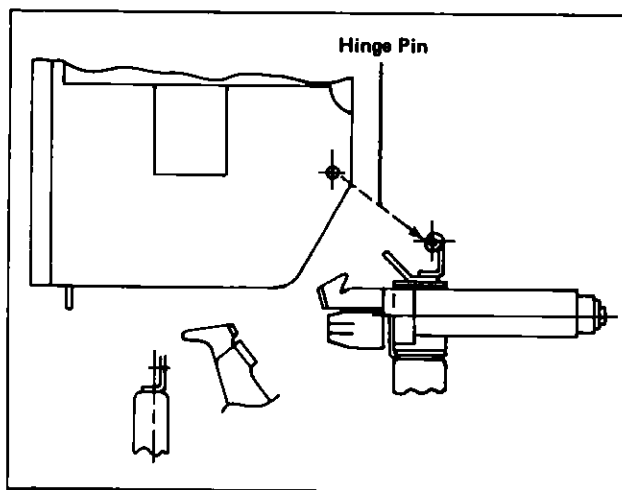


Fig. 53 Mount Arc Chute

### CONNECT SHUNT STRAP (FIG. 54)

CONNECT SHUNT STRAP FROM LOWER CONTACT TO FRONT ARC CHUTE CONNECTION. BE SURE CONNECTION IS TIGHT AT BOTH ENDS OF SHUNT. FAILURE TO FIRMLY TIGHTEN EITHER OF THESE CONNECTIONS COULD CAUSE EXCESSIVE HEATING OR SEVERE ARCING DURING CIRCUIT INTERRUPTION EITHER OF WHICH COULD CAUSE FAILURE OF THE BREAKER.

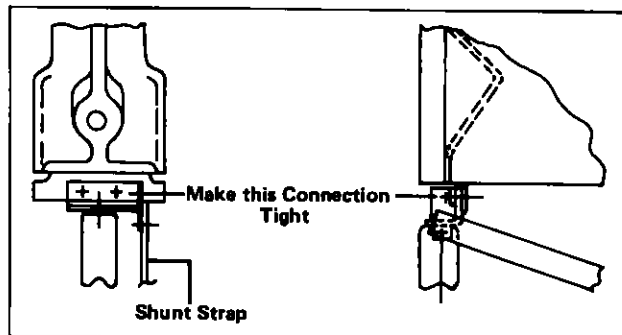


Fig. 54 Connect Shunt Strap

## BARRIER (FIG. 55)

Barrier consists of a steel front sheet with an insulating shield behind it and four insulating sheets that go around the three arc chutes and pole units. There are insulating deflectors on top of the barrier above the arc chutes. The steel front sheet has a notch in the bottom edge which fits

into a clip on the support pan. Attachment is by bolting the front sheet to the support pan, bolting the two center insulating sheets to the clips behind the pole units, and by bolting the two outside sheets to the sides of the breaker. See Installation Section, this Instruction Book for method of aligning the barrier.

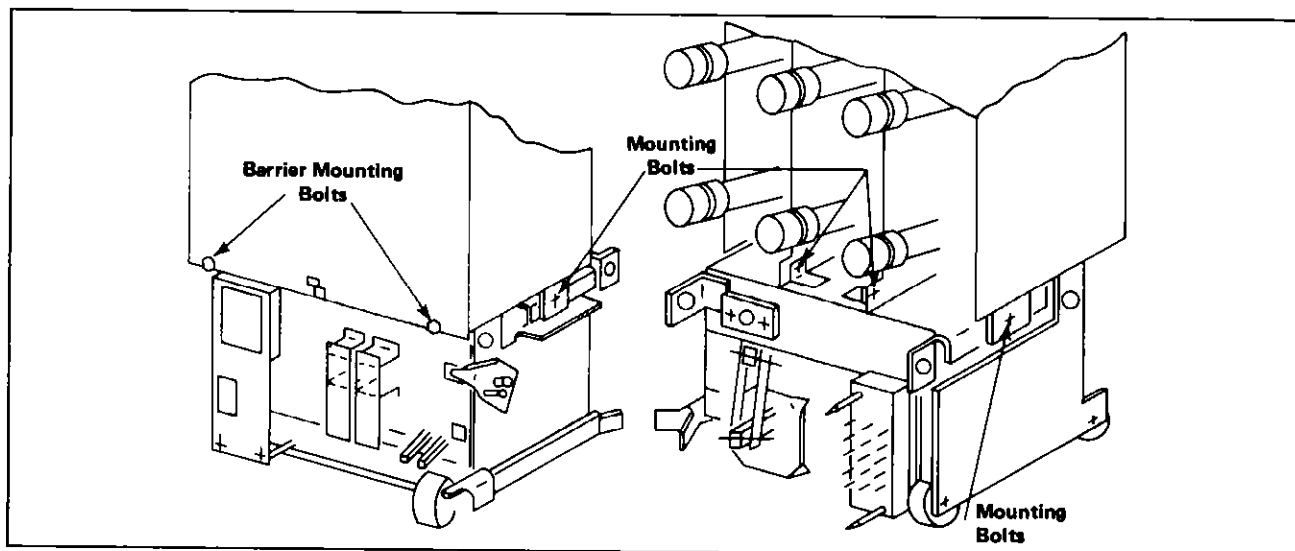


Fig. 55 Barrier Mounting

## TILT ARC CHUTE (FIG. 56)

Remove bolt from front of arc horn.

Attach arc chute lifter by placing end of rod in hole in front of arc chute.

Lift arc chute up and position end of prop in hole in casting at base of chute support post.

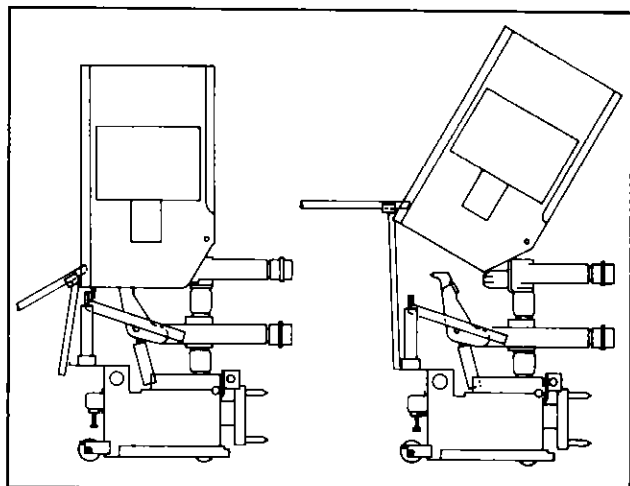


Fig. 56 Tilt Arc Chute

**CAUTION: TILT ONLY ONE ARC CHUTE AT A TIME. MORE THAN ONE ARC CHUTE TILTED COULD CAUSE BREAKER TO TIP OVER.**

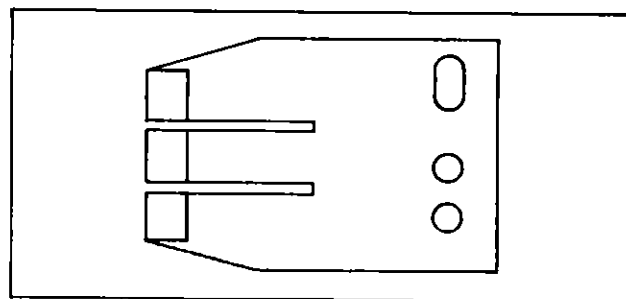


Fig. 57 Stationary Main Contacts

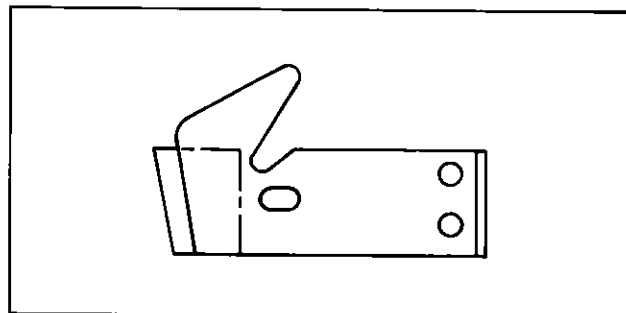


Fig. 58 Stationary Arcing Contacts

## 50DHP350 — 3000 AMPS

**Shipping**

## 2 Packages:

Breaker plus 3 Arc Chutes . . . . . 65 x 32 x 42 inches  
 Barrier . . . . . 58 x 26 x 31 inches

**Weights**

Breaker . . . . . 650 lbs.  
 One Arc Chute. . . . . 210 lbs.  
 Barrier . . . . . 100 lbs.  
 Complete Breaker. . . . . 1380 lbs.

**MOUNTING ARC CHUTE (FIG. 59)**

Mount the arc chutes exactly as was described for the 50DHP350 — 1200 and 2000 ampere breakers Page 42.

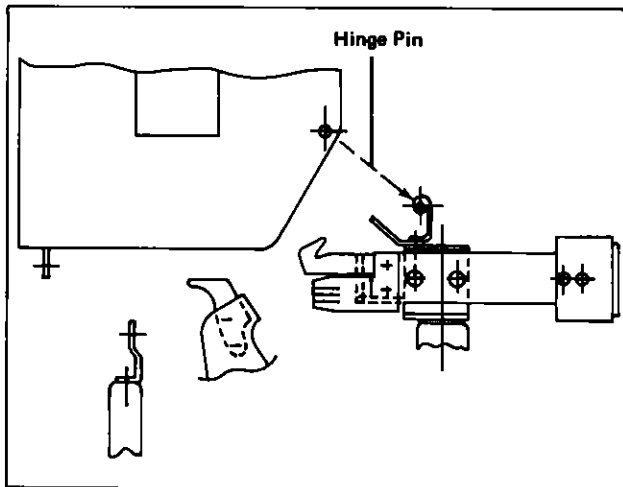


Fig. 59 Mount Arc Chute

**CONNECT SHUNT STRAP (FIG. 60)**

CONNECT SHUNT STRAP FROM LOWER CONTACT TO FRONT ARC CHUTE CONNECTION. BE SURE CONNECTION IS TIGHT AT BOTH ENDS OF SHUNT. FAILURE TO FIRMLY TIGHTEN EITHER OF THESE CONNECTIONS COULD CAUSE EXCESSIVE HEATING OR SEVERE ARCING DURING CIRCUIT INTERRUPTION EITHER OF WHICH COULD CAUSE FAILURE OF THE BREAKER.

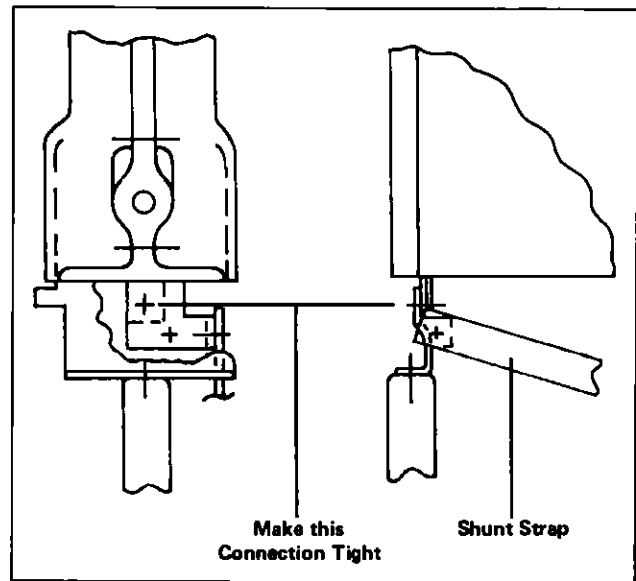


Fig. 60 Connect Shunt Strap

**BARRIER (FIG. 61)**

Barrier consists of a steel front sheet with an insulating shield behind it and four insulating sheets that go around the three arc chutes and pole units. There are insulating deflectors on top of the barrier above the arc chutes. The steel front sheet has a notch in the bottom edge which fits into a clip on the support pan. Attachment is by bolting the front sheet to the support pan and bolting the four side sheets to clips behind the pole units. See Installation Section, this Instruction Book for method of aligning the barrier.

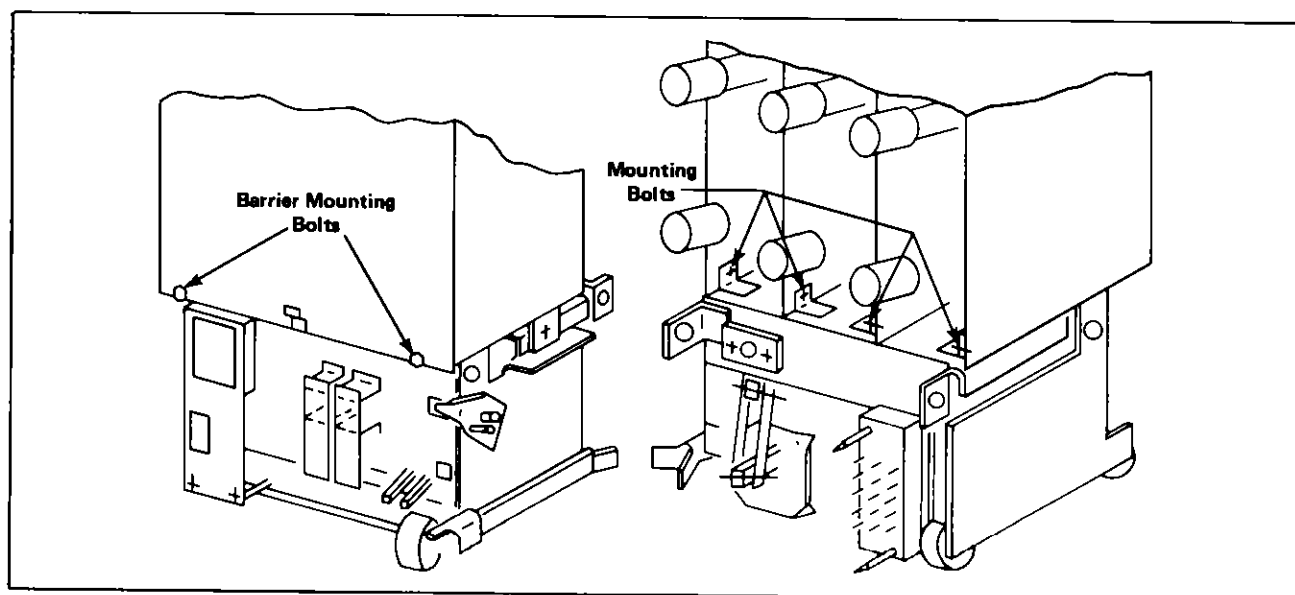


Fig. 61 Barrier Mounting

#### TILT ARC CHUTE (FIG. 56)

Remove bolt from front of arc horn.

Attach arc chute lifter by placing end of rod in hole in front of arc chute and positioning retainer.

Lift arc chute up and position end of prop in hole in casting at base of chute support post. See Fig. 56.

**CAUTION: TILT ONLY ONE ARC CHUTE AT A TIME. MORE THAN ONE TILTED COULD CAUSE THE BREAKER TO TIP OVER.**

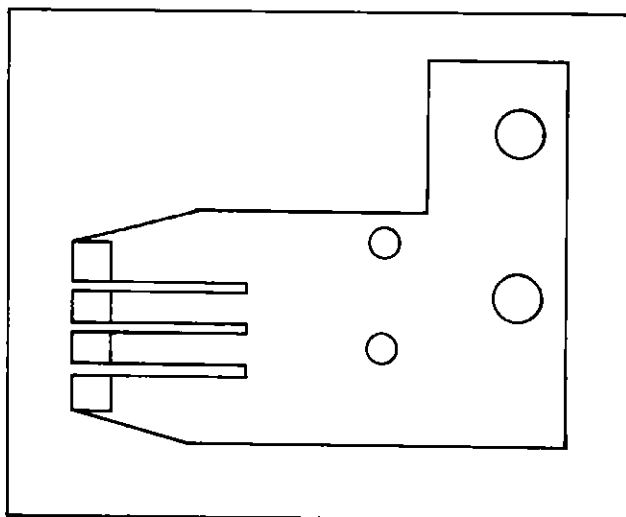


Fig. 62 Stationary Main Contacts

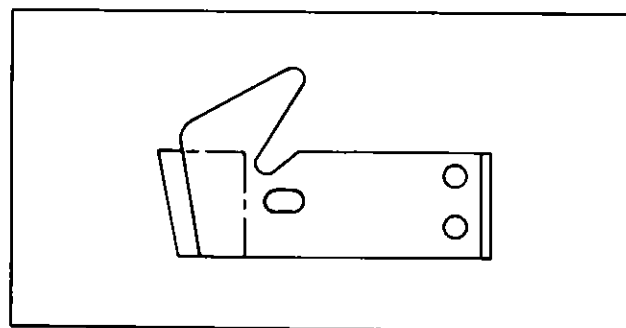


Fig. 63 Stationary Arcing Contacts



## 75DHP500 – 1200, 2000, 3000 AMPS

## Shipping

2 Packages . . . . . 66 x 32 x 42 inches  
 50 x 32 x 32 inches

## Weights

Amps.	Breaker	One Arc Chute	Barrier	Complete Breaker
1200	550	250	100	1400
2000	600	250	100	1450
3000	700	250	100	1550

## MOUNTING ARC CHUTES (FIG. 64)

The arc chutes must be held in position while the 0.50 diameter bolts that serve as the hinge pin are assembled. Because of its weight, 250 pounds, the arc chute should be suspended from a crane or chain hoist. The center arc chute should be installed first. The 0.50 diameter bolts should be snug but not tight enough to interfere with raising the arc chute with the arc chute lifter.

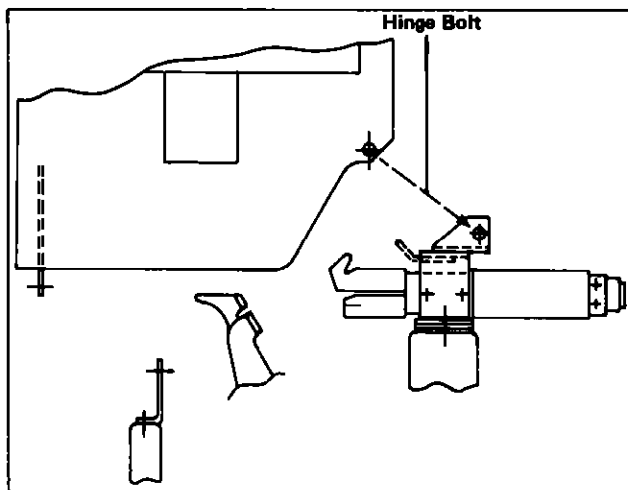


Fig. 64 Mount Arc Chute

## CONNECT SHUNT STRAP (FIG. 65)

CONNECT SHUNT STRAP FROM LOWER CONTACT TO FRONT ARC CHUTE CONNECTION. BE SURE

CONNECTION IS TIGHT AT BOTH ENDS OF SHUNT. FAILURE TO FIRMLY TIGHTEN EITHER OF THESE CONNECTIONS COULD CAUSE EXCESSIVE HEATING OR SEVERE ARCING DURING CIRCUIT INTERRUPTION EITHER OF WHICH COULD CAUSE FAILURE OF THE BREAKER.

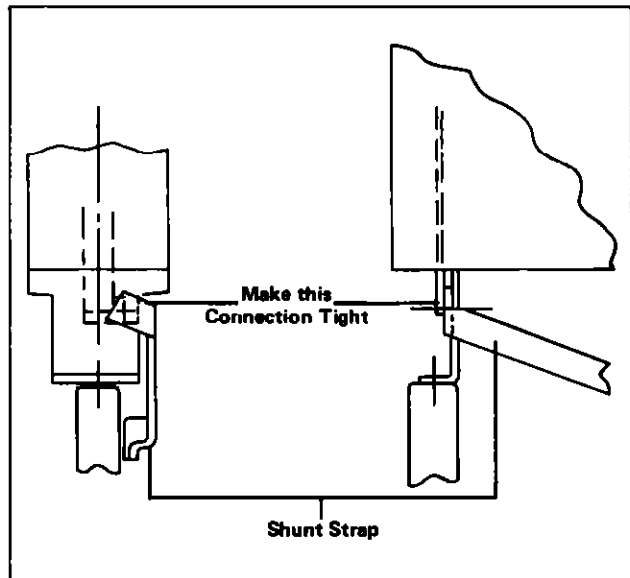


Fig. 65 Connect Shunt Strap

## BARRIER (FIG. 66)

Barrier consists of a steel front sheet with an insulating shield behind it and four insulating sheets that go around the three arc chutes and pole units. There are insulating deflectors on top and on the back of the assembly. The back deflectors are long enough to extend down below the top of the arc chute. The barrier must be lifted to place it on or remove it from the breaker. Attachment is by bolting the front sheet to the support pan and bolting the four side sheets to clips behind the pole units. See Installation Section, this Instruction Book for method of aligning the barrier.

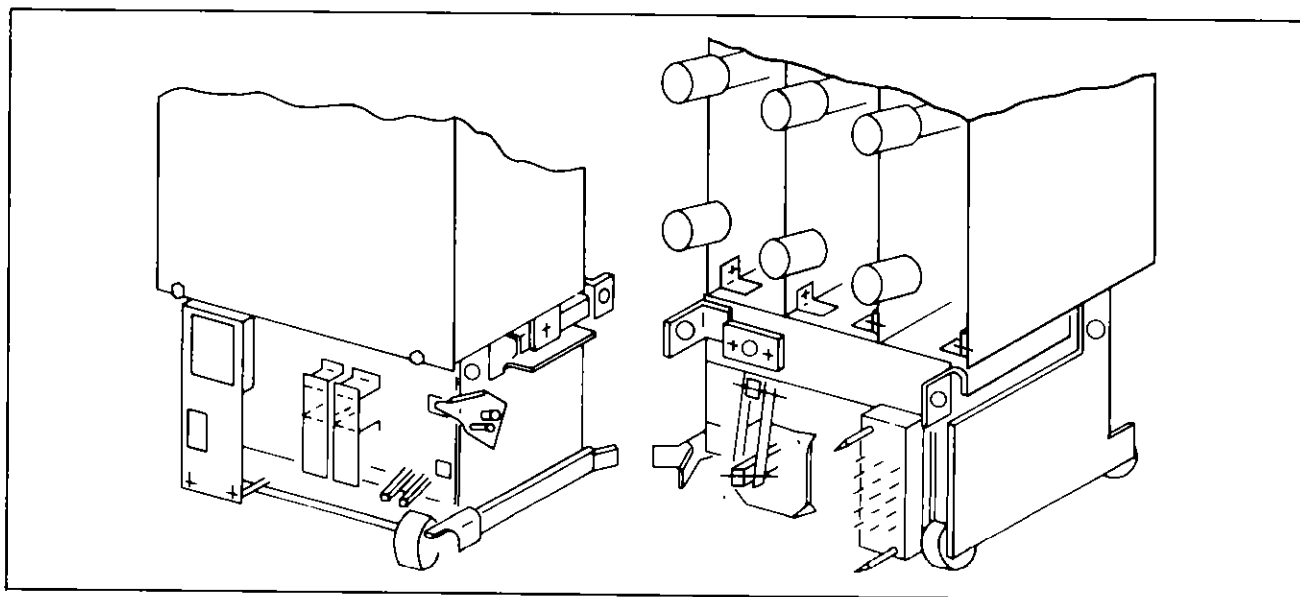


Fig. 66 Barrier Mounting

### TILT ARC CHUTE (FIG. 72)

Remove bolt from front of arc horn.

Attach arc chute lifter by placing end of rod in hole in front of arc chute.

Lift chute up and position end of prop in hole in casting at base of chute support post.

**CAUTION: TILT ONLY ONE ARC CHUTE AT A TIME. MORE THAN ONE ARC CHUTE TILTED COULD CAUSE BREAKER TO TIP OVER.**

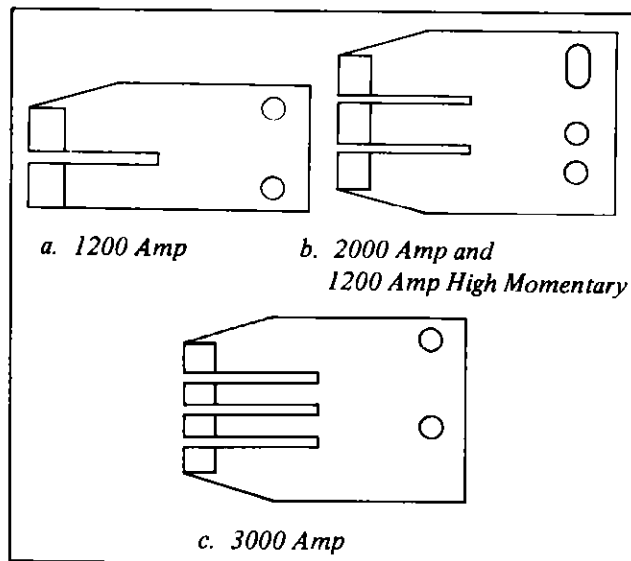


Fig. 67 Stationary Main Contacts

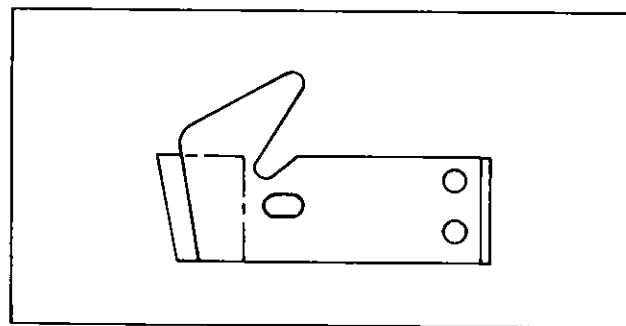


Fig. 68 Stationary Arcing Contacts

# 150DHP500 – 1200, 2000, 3000 AMPS

## Shipping

2 Packages . . . . . 66 x 32 x 42 inches  
50 x 32 x 32 inches

## Weights

Amps.	Breaker	One Arc Chute	Barrier	Complete Breaker
1200	550	250	100	1400
2000	600	250	100	1450
3000	700	250	100	1550

## MOUNTING ARC CHUTES (FIG. 69)

The arc chutes must be held in position while the 0.50 diameter bolts that serve as the hinge pin are assembled. Because of its weight, 250 pounds, the arc chutes should be suspended from a crane or chain hoist. The center arc chute should be installed first. The 0.50 diameter bolts should be snug but not tight enough to interfere with raising the arc chute with the arc chute lifter.

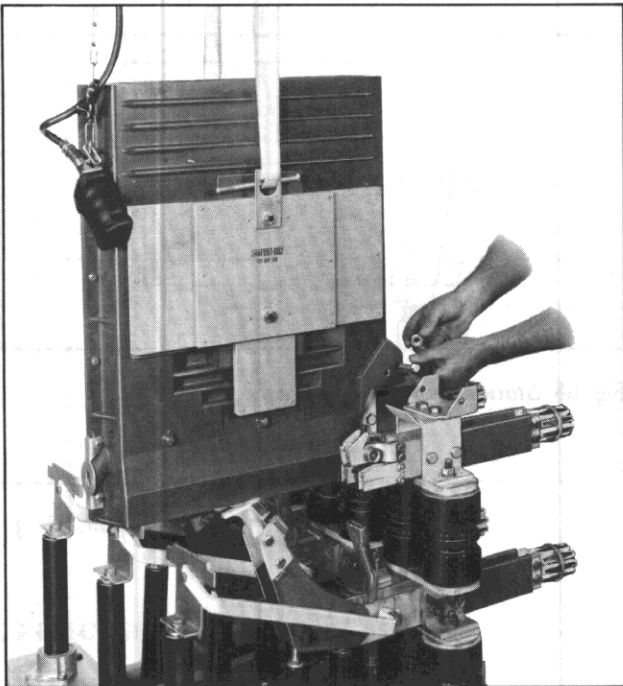


Fig. 69 Mount Arc Chute

## CONNECT SHUNT STRAP (FIG. 70)

CONNECT SHUNT STRAP FROM LOWER CONTACT TO FRONT ARC CHUTE CONNECTION. BE SURE CONNECTION IS TIGHT AT BOTH ENDS OF SHUNT. FAILURE TO FIRMLY TIGHTEN EITHER OF THESE CONNECTIONS COULD CAUSE EXCESSIVE HEATING OR SEVERE ARCING DURING CIRCUIT INTERRUPTION EITHER OF WHICH COULD CAUSE FAILURE OF THE BREAKER.

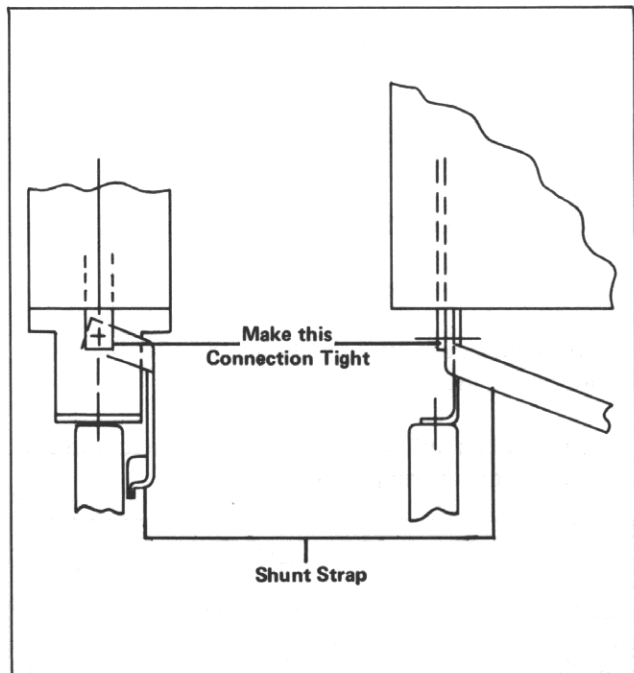


Fig. 70 Connect Shunt Strap

## BARRIER (FIG. 71)

Barrier consists of a steel front sheet with an insulation shield behind it and four insulating sheets that go around the three arc chutes and pole units. There are insulating deflectors on top and on the back of the assembly. The back deflectors are long enough to extend down below the top of the arc chute. The barrier must be lifted to place it on or remove it from the breaker. Attachment is by bolting the front sheet to the support pan and bolting the four side sheets to clips behind the pole units. See Installation Section, this Instruction Book for method of aligning the barrier.

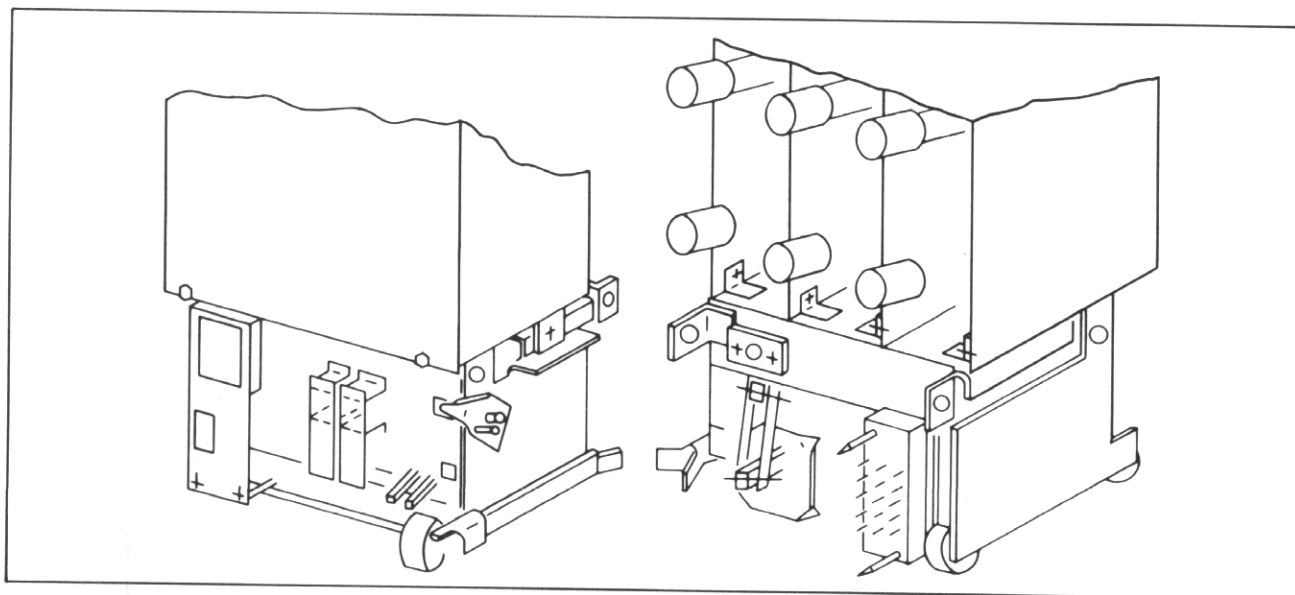


Fig. 71 Barrier Mounting

### TILT ARC CHUTE (FIG. 72)

Remove bolt from front of arc horn.

Attach arc chute lifter by placing end of rod in hole in front of arc chute.

Lift chute up and position end of prop in hole in casting at base of chute support post.

**CAUTION: TILT ONLY ONE ARC CHUTE AT A TIME. MORE THAN ONE ARC CHUTE TILTED COULD CAUSE BREAKER TO TIP OVER.**

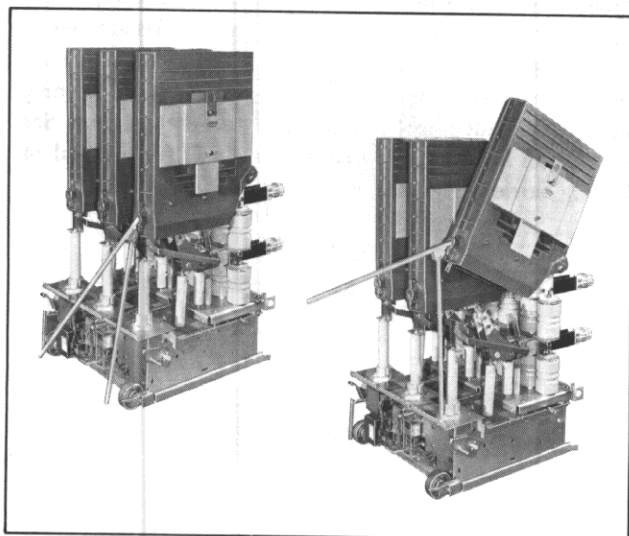


Fig. 72 Tilt Arc Chute

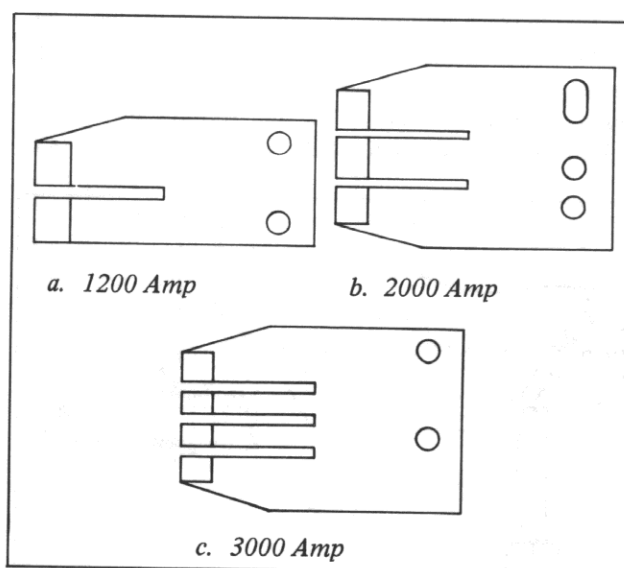


Fig. 73 Stationary Main Contacts

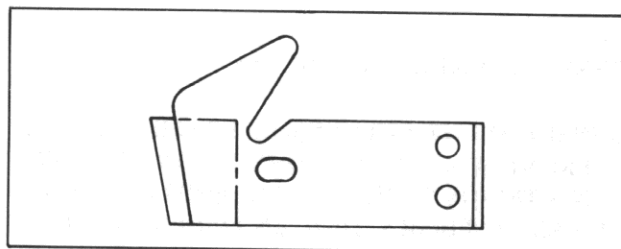


Fig. 74 Stationary Arcing Contacts

## 150DHP750C – 1200, 2000, 3000 AMPS

## Shipping

3 Packages . . . . . 50 x 32 x 40 inches  
 33 x 30 x 50 inches  
 70 x 38 x 42 inches

## Weights

Amps.	Breaker	One Arc Chute	Barrier	Complete Breaker
1200	750	425	165	2190
2000	820	425	165	2260
3000	920	425	165	2360

## MOUNTING ARC CHUTES (FIG. 75)

The arc chute is secured at the rear with 0.5 inch diameter pin held in place with two "E" rings. This is the hinge pin. At the front the arc chute is secured with two 0.375 inch diameter studs. A one inch hex bar is provided in the center of the arc chutes near the top for lifting. For convenience the center arc chute should be mounted first.

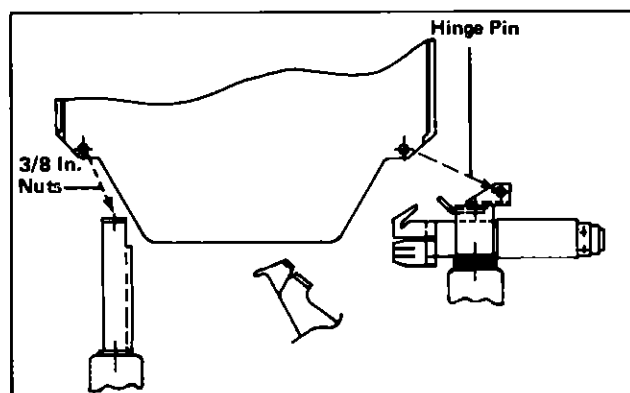


Fig. 75 Mount Arc Chutes

## CONNECT SHUNT STRAP (FIG. 76)

CONNECT SHUNT STRAP FROM LOWER CONTACT TO FRONT ARC CHUTE CONNECTION. BE SURE CONNECTION IS TIGHT AT BOTH ENDS OF SHUNT. FAILURE TO FIRMLY TIGHTEN EITHER OF THESE CONNECTIONS COULD CAUSE EXCESSIVE HEAT-

ING OR SEVERE ARCING DURING CIRCUIT INTERRUPTION EITHER OF WHICH COULD CAUSE FAILURE OF THE BREAKER.

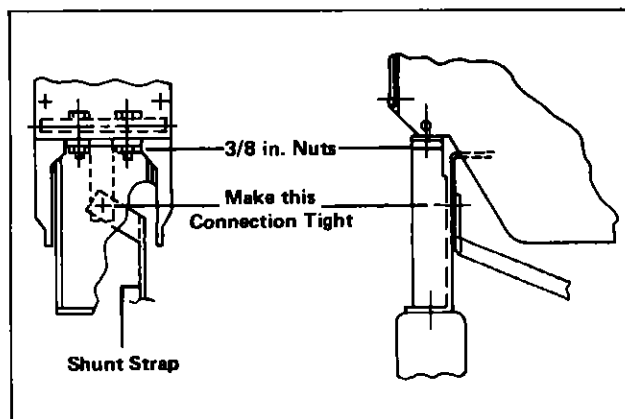


Fig. 76 Connect Shunt Strap

## BARRIER (FIG. 77)

Barrier consists of a steel front sheet with an insulating shield behind it and four insulating sheets that go around the three arc chutes and pole units. There are insulating deflectors on the top and on the back of the assembly. The back deflector is long enough to extend down below the top of the arc chute. The barrier must be lifted high enough for the rear deflector to clear the arc chute when installing or removing it from the breaker. See Fig. 7 for the preferred method of lifting the barrier. Attachment is by bolting the front sheet to the support pan, bolting the four side sheets to clip behind the pole unit, and fastening the two outside sheets to the sides of the breaker. See Installation Section, this Instruction Book for method of aligning barrier.

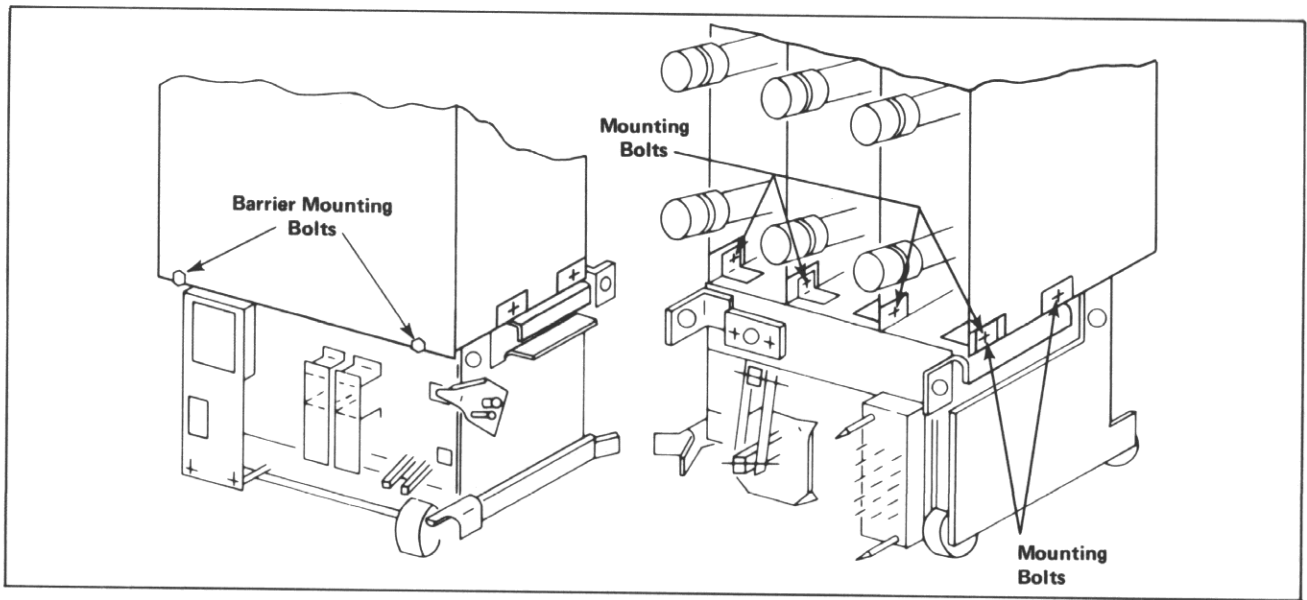


Fig. 77 Barrier Mounting

#### TILT ARC CHUTE (FIG. 78)

Remove front shunt connection bolt.

Remove nuts from studs thru arc chute support.

Attach arc chute lifter by placing flat end with four teardrop shaped holes over for special bolts on front of arc chute.

Lift chute up and position end of prop in hole in support pan.

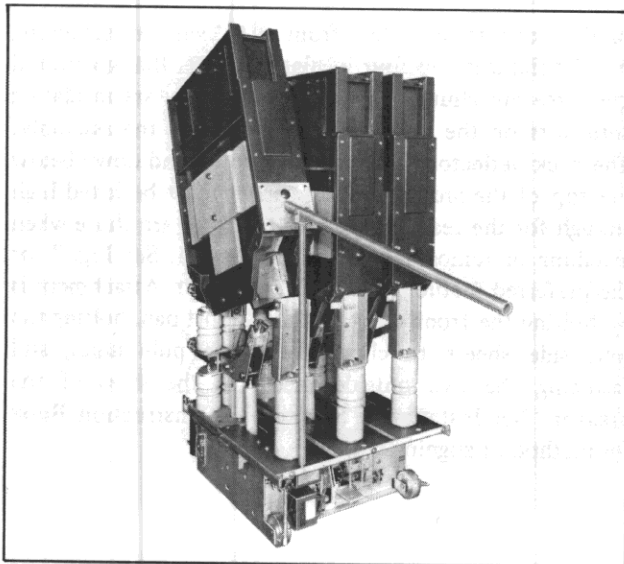


Fig. 78 Tilt Arc Chute

**CAUTION: TILT ONLY ONE ARC CHUTE AT A TIME. MORE THAN ONE CHUTE TILTED COULD CAUSE BREAKER TO TIP OVER.**

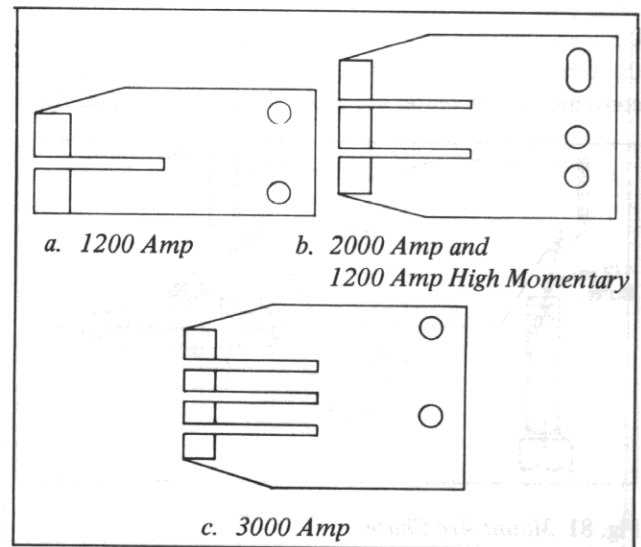


Fig. 79 Stationary Main Contacts

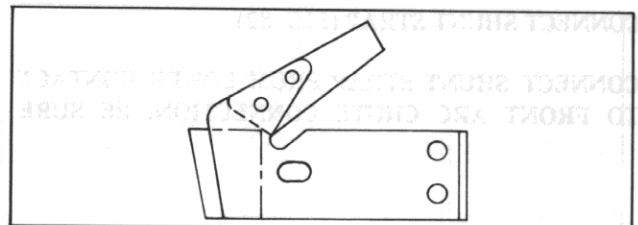


Fig. 80 Stationary Arcing Contacts

## 150DHP1000 – 1200, 2000, 3000 AMPS

## Shipping

3 Packages . . . . .	50 x 32 x 40 inches
	33 x 30 x 50 inches
	70 x 38 x 42 inches

## Weights

Amps.	Breaker	One Arc Chute	Barrier	Complete Breaker
1200	750	465	190	2335
2000	820	465	190	2405
3000	920	465	190	2505

## MOUNTING ARC CHUTES (FIG. 81)

The arc chute is secured at the rear with a 0.5 inch diameter pin held in place with two "E" rings. This is the hinge pin. At the front the arc chute is secured with two 0.5 inch diameter bolts. A one inch hex bar is provided in the center of the arc chutes near the top for lifting. For convenience the center arc chute should be mounted first.

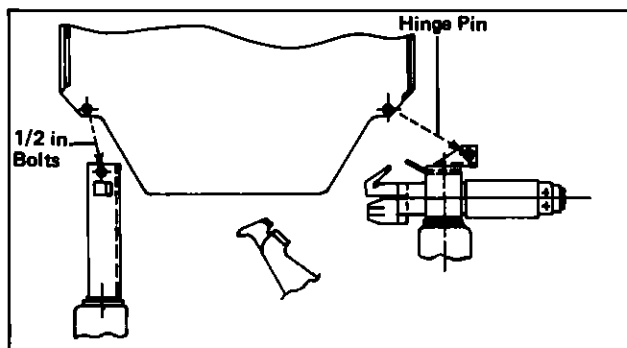


Fig. 81 Mount Arc Chute

## CONNECT SHUNT STRAP (FIG. 82)

CONNECT SHUNT STRAP FROM LOWER CONTACT TO FRONT ARC CHUTE CONNECTION. BE SURE

CONNECTION IS TIGHT AT BOTH ENDS OF SHUNT. FAILURE TO FIRMLY TIGHTEN EITHER OF THESE CONNECTIONS COULD CAUSE EXCESSIVE HEATING OR SEVERE ARCING DURING CIRCUIT INTERRUPTION EITHER OF WHICH COULD CAUSE FAILURE OF THE BREAKER.

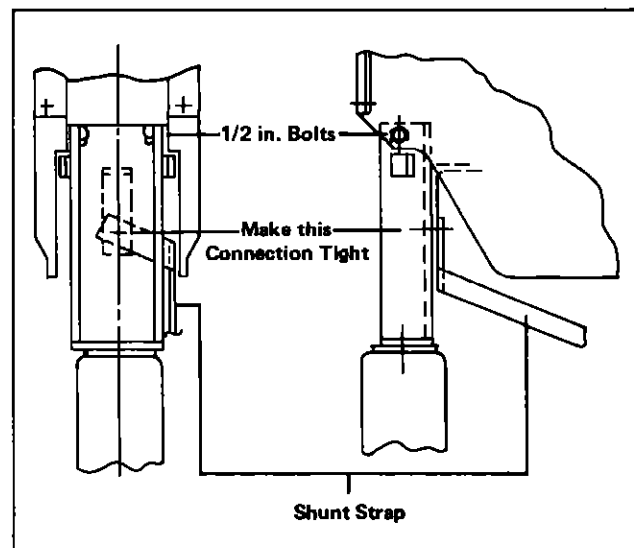


Fig. 82 Connect Shunt Strap

## BARRIER (FIG. 83)

Barrier consists of a steel front sheet with an insulating shield behind it and four insulating sheets that go around the three arc chutes and pole units. There are insulating deflectors on the top and on the back of the assembly. The back deflector is long enough to extend down below the top of the arc chute. The barrier must be lifted high enough for the rear deflector to clear the arc chute when installing or removing it from the breaker. See Fig. 7 for the preferred method of lifting the barrier. Attachment is by bolting the front sheet to the support pan, bolting the four side sheets to clips behind the pole units, and fastening the two outside sheets to the sides of the breaker. See Installation Section, this Instruction Book for method of aligning barrier.

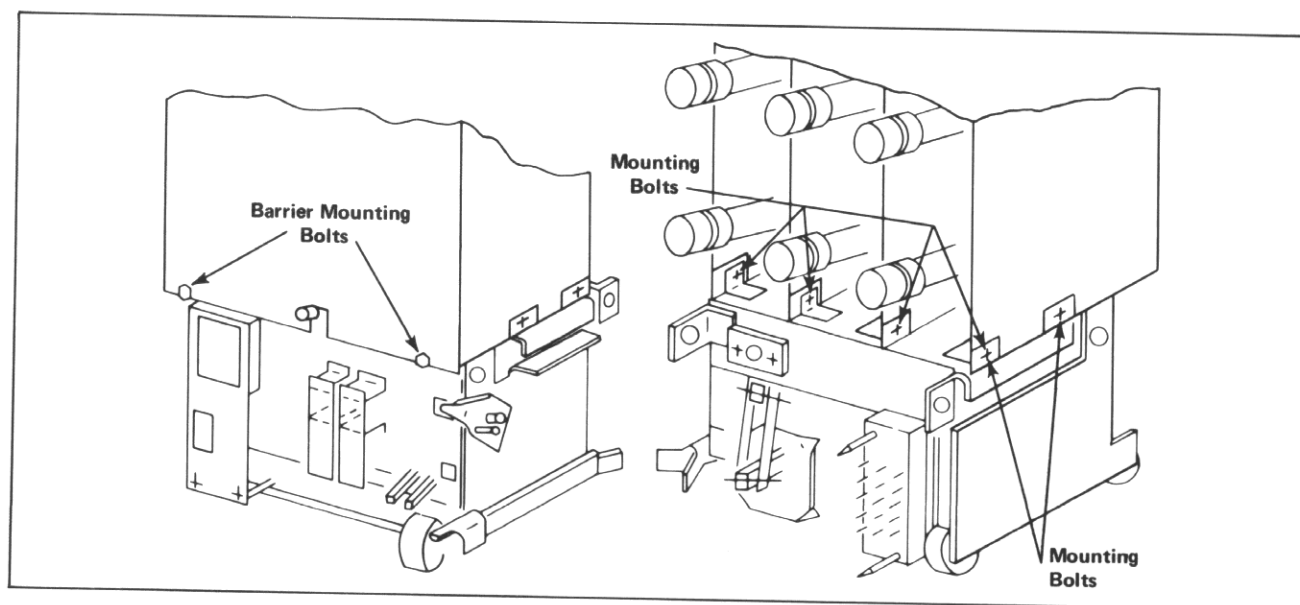


Fig. 83 Barrier Mounting

#### TILT ARC CHUTE (FIG. 84)

Remove front shunt connection bolt.

Remove nuts from studs thru arc chute support.

Attach arc chute lifter by placing flat end with four teardrop shaped holes over for special bolts on front of arc chute.

Lift chute up and position end of prop in hole in support pan.

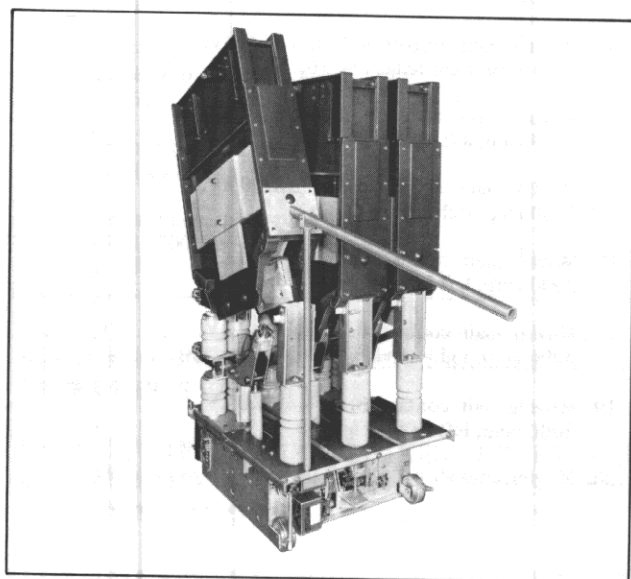


Fig. 84 Tilt Arc Chute

**CAUTION: TILT ONLY ONE ARC CHUTE AT A TIME. MORE THAN ONE CHUTE TILTED COULD CAUSE BREAKER TO TIP OVER.**

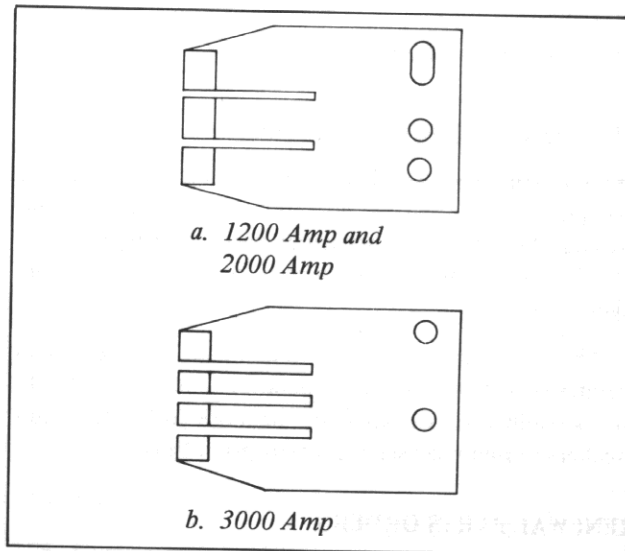


Fig. 85 Stationary Main Contacts

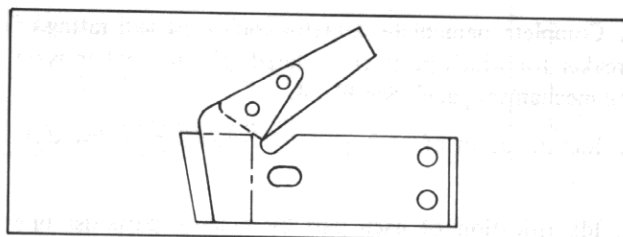


Fig. 86 Stationary Arcing Contacts



## RENEWAL PARTS

### PARTS IDENTIFICATION

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

Lists of renewal parts applicable to all Type DHP Circuit Breakers are provided at the end of this instruction book. These lists contain the items which are most likely to require replacement under normal operating conditions. The items and assemblies listed are identified by parts list line number, part name and reference figures in this book. The identification of parts using the lists contained in this book cannot be completed without all of the information contained on the breaker nameplate which is located on the front of the breaker mechanism panel.

Renewal parts lists are usually prepared for each circuit breaker order. These lists, when available, contain the descriptions and figure references as described above along with the style numbers of the parts for the breaker supplied. When available, these lists are the preferred source for renewal parts information.

### RECOMMENDED STOCK OF RENEWAL PARTS

The renewal parts lists that follow include with each line the quantity required per component assembly or circuit breaker. Quantities of particular parts are suggested for stocking depending on the number of circuit breakers installed.

When service continuity requirements interfere with maintenance scheduling consideration should be given to the possibility of stocking one or more complete circuit breakers to minimize service interruption time.

### RENEWAL PARTS ORDERS

When ordering renewal parts, the following information must be provided to expedite processing the order:

1. Complete nameplate data for each type and rating of breaker for which parts are ordered. The nameplate is on the mechanism panel. See Fig. 4.
2. Identification of each part by renewal parts list style number.
3. Identification of each part by renewal parts list line number from this book.

Pole Unit Parts*	Reqd. No. for One Pole Unit
1. Stationary arcing contact assembly, Fig. 93, Item 1.	# 1
2. Stationary arcing contact assembly, 150DHP750C, 150DHP1000, Fig. 93, Item 2.	# 1
3. Moving arcing contact, 1200 and 2000 amp, Fig. 93, Item 4.	# 1
4. Moving arcing contact, 3000 amp, Fig. 93, Item 5.	# 1
5. Stationary main contacts, 1200 amp, Fig. 16a, Item 5.	# 1 Set
6. Stationary main contacts, 2000 amp.	# 1 Set
7. Stationary main contacts, 3000 amp, Fig. 16b.	# 1 Set
8. Moving main contact, 4.76 kV, 1200 amp, right hand, Fig. 17a.	1
9. Moving main contact, 4.76 kV, 1200 amp, left hand, Fig. 17a.	1
10. Moving main contact, 4.76 kV, 2000 amp, right hand.	1
11. Moving main contact, 4.76 kV, 2000 amp, left hand.	1
12. Moving main contact, 4.76 kV, 3000 amp, right hand, Fig. 17b.	1
13. Moving main contact, 4.76 kV, 3000 amp, left hand, Fig. 17b.	1
14. Moving main contact, 8.25 and 15.0 kV, 1200 amp, right hand Fig. 16a.	1
15. Moving main contact, 8.25 and 15.0 kV, 1200 amp, left hand, Fig. 16a.	1
16. Moving main contact, 8.25 and 15.0 kV, 2000 amp, right hand.	1
17. Moving main contact, 8.25 and 15.0 kV, 2000 amp, left hand.	1
18. Moving main contact, 8.25 and 15.0 kV, 3000 amp, right hand, Fig. 16b.	1
19. Moving main contact, 8.25 and 15.0 kV, 3000 amp, left hand, Fig. 16b.	1
20. Moving contact pad, Fig. 93, Item 6.	# 1
21. Moving contact hinge pin, 1200 amp, Fig. 16a, Item 12.	1
22. Moving contact hinge pin, 2000 amp.	1

Pole Unit Parts*	Reqd. No. for One Pole Unit
23. Moving contact hinge pin, 3000 amp, Fig. 16b.	1
24. Moving contact hinge springs, Fig. 16a Item 13.	2
25. Moving contact lift rod, 4.76 kV.	1
26. Moving contact lift rod, 50DHP350.	1
27. Moving contact lift rod, 8.25 and 15.0 kV, Fig. 2, Item 3.	1
28. Puffer tube assembly, 4.76 kV, Fig. 17a.	1
29. Puffer tube assembly, 50DHP350, Fig. 17b.	1
30. Puffer tube assembly, 8.25 and 15.0 kV, Fig. 16a, Item 6.	1
31. Kick out spring, Fig. 16a, Item 4.	1
32. Disconnecting contact finger cluster, 1200 amp. (9 fingers) Fig. 16a, Item 17.	2
33. Disconnecting contact finger cluster, 2000 and 3000 amp, (15 fingers) Fig. 16b.	2
34. Disconnecting contact finger cluster, 3000 amp, 50DHP350, (26 fingers).	2
35. Complete pole unit less lift rod and disconnecting contact finger clusters, typical 1200 amp, 4.76 kV, Fig. 17a.	1
36. Complete pole unit as in Item 35 except typical 2000 amp, 4.76 kV.	1
37. Complete pole unit as in Item 35 except 3000 amp, 50DHP350, Fig. 17b.	1
38. Complete pole unit as in Item 35 except typical 1200 amp, 8.25 and 15.0 kV, Fig. 16a.	1
39. Complete pole unit as in 35 except typical 2000 amp, 8.25 and 15.0 kV.	1
40. Complete pole unit as in 35 except typical 3000 amp, 8.25 and 15.0 kV, Fig. 16b.	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.**

\*Since pole units require critical assembly at the factory, these are the only pole unit renewal parts available.

Chassis Parts	Reqd. No. per Breaker
51. Auxiliary switch, upper, Fig. 4	1
52. Auxiliary switch, lower, Fig. 4	1
53. Latch check switch, Fig. 4	1
54. Motor cut-off switch, Fig. 4	1
55. Control relay, "Y" Fig. 4 (specify voltage)	# 1
56. Trip coil, Fig. 4 48 v.d.c. 125 v.d.c. 250 v.d.c. Capacitor	# 1
57. Spring release coil, Fig. 4 48 v.d.c. 125 v.d.c. 250 v.d.c. 115 v.a.c., 60 Hz 230 v.a.c., 60 Hz	# 1
58. Spring charging motor, Fig. 14 48 v.d.c. 125 v.a.c. or d.c. 230 v.a.c. or d.c.	1
59. Ground contact cluster, Fig. 14	1
60. Resistor assembly, Fig. 4, Specify "Y" relay voltage	1

**NOTE: SAME AS FOR POLE UNIT PARTS.**

Arc Chute Parts	Reqd. No. for One Arc Chute
71. Main interrupter stacks, Fig. 92	2
72. Transfer stacks, 50DHP75	1
73. Transfer stacks, Fig. 92	2
74. Front arc horn, Fig. 92	1
75. Rear arc horn, Fig. 92	1
76. Transfer arc horns, Fig. 92	2
77. Arc shield L.H., Fig. 92	1
78. Arc shield R.H., Fig. 92	1

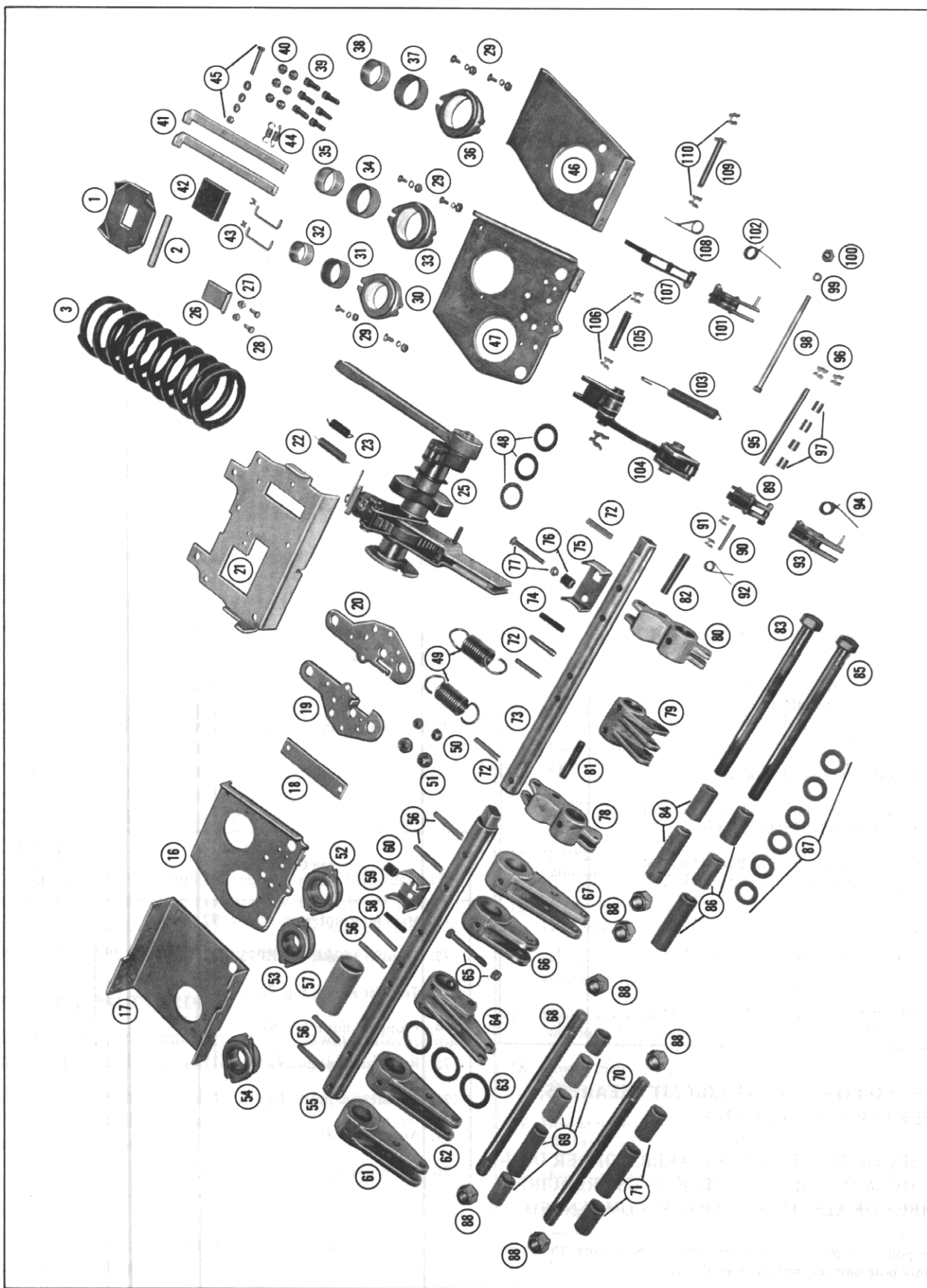
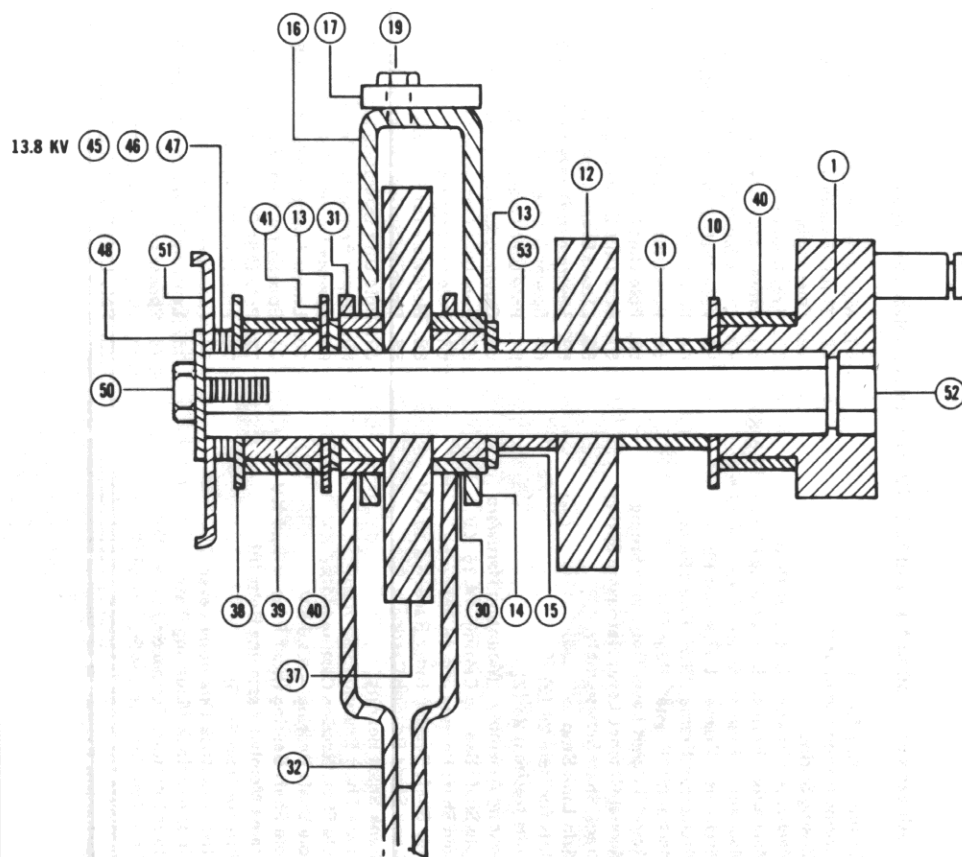
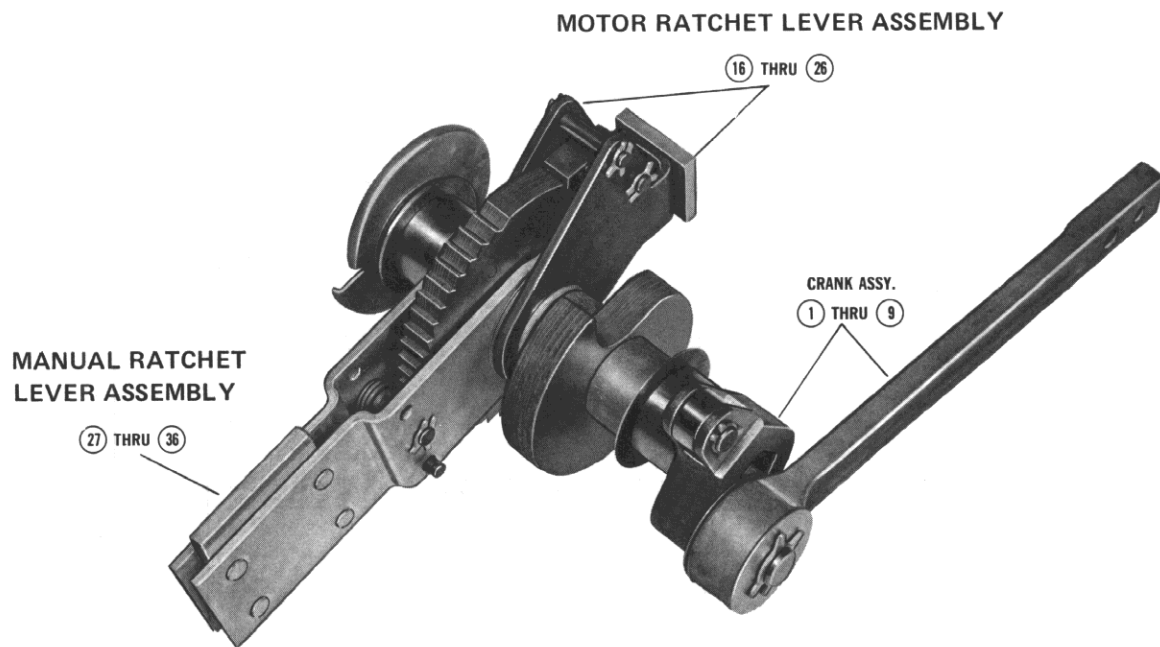


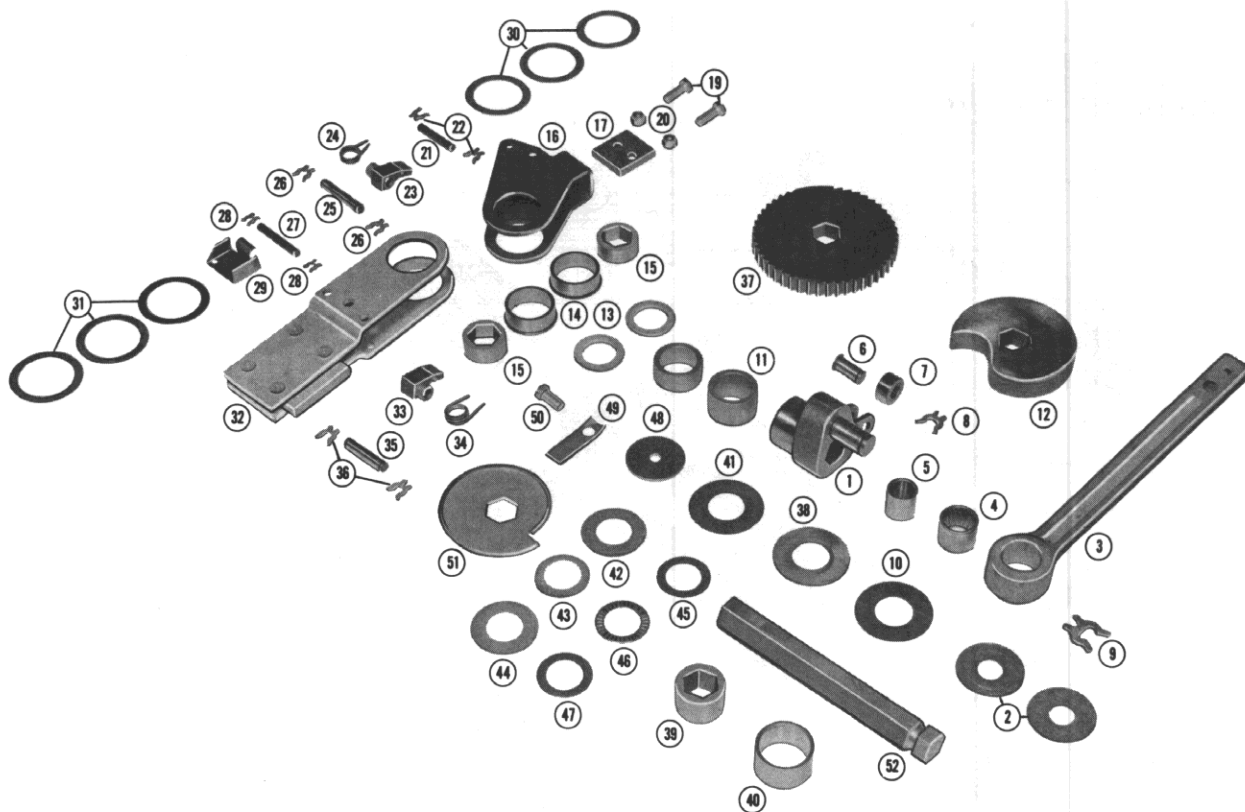
Fig. 87 Parts for Stored Energy Mechanisms

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

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



**Fig. 88** *Stored Energy Mechanism: Crank Shaft Subassembly*

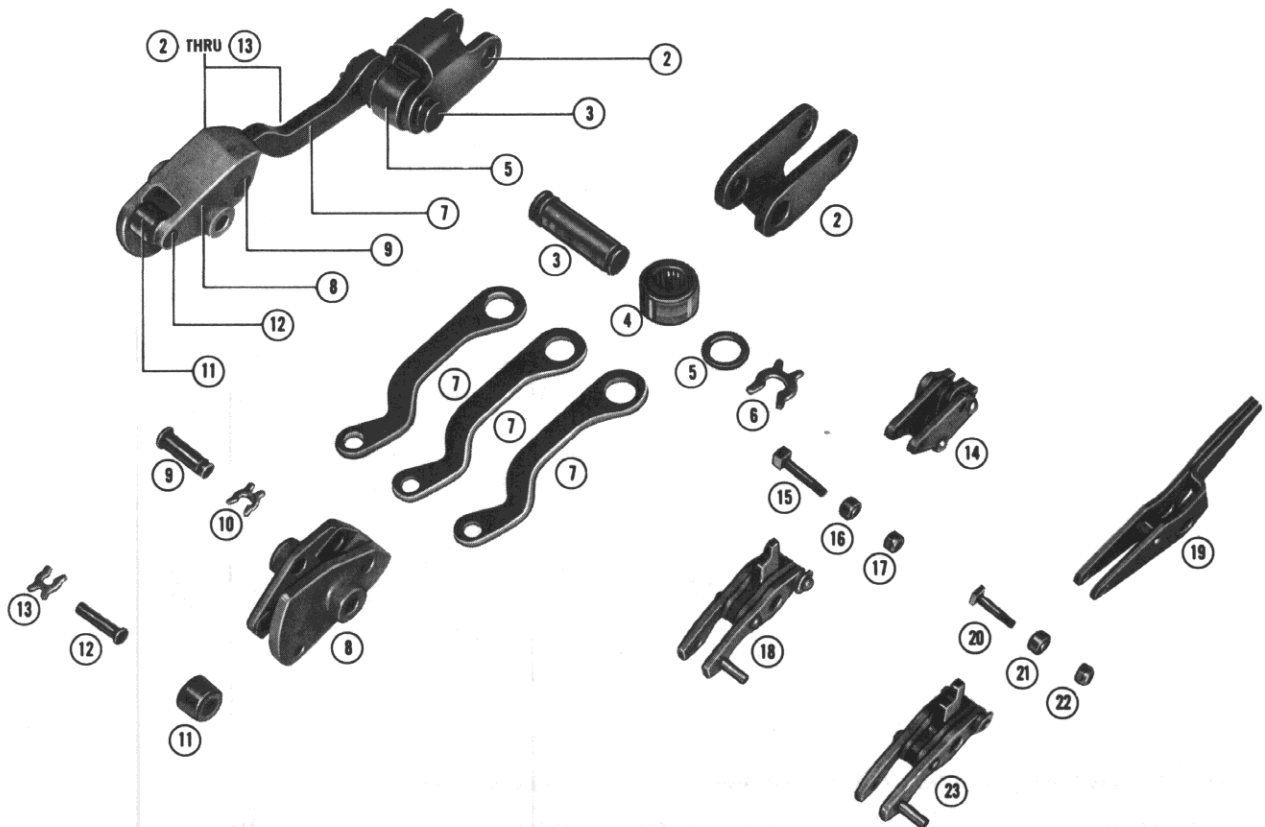


Note: All Parts Common to 4.76, 8.25 and 15 kV Mechanisms Unless Otherwise Noted.

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

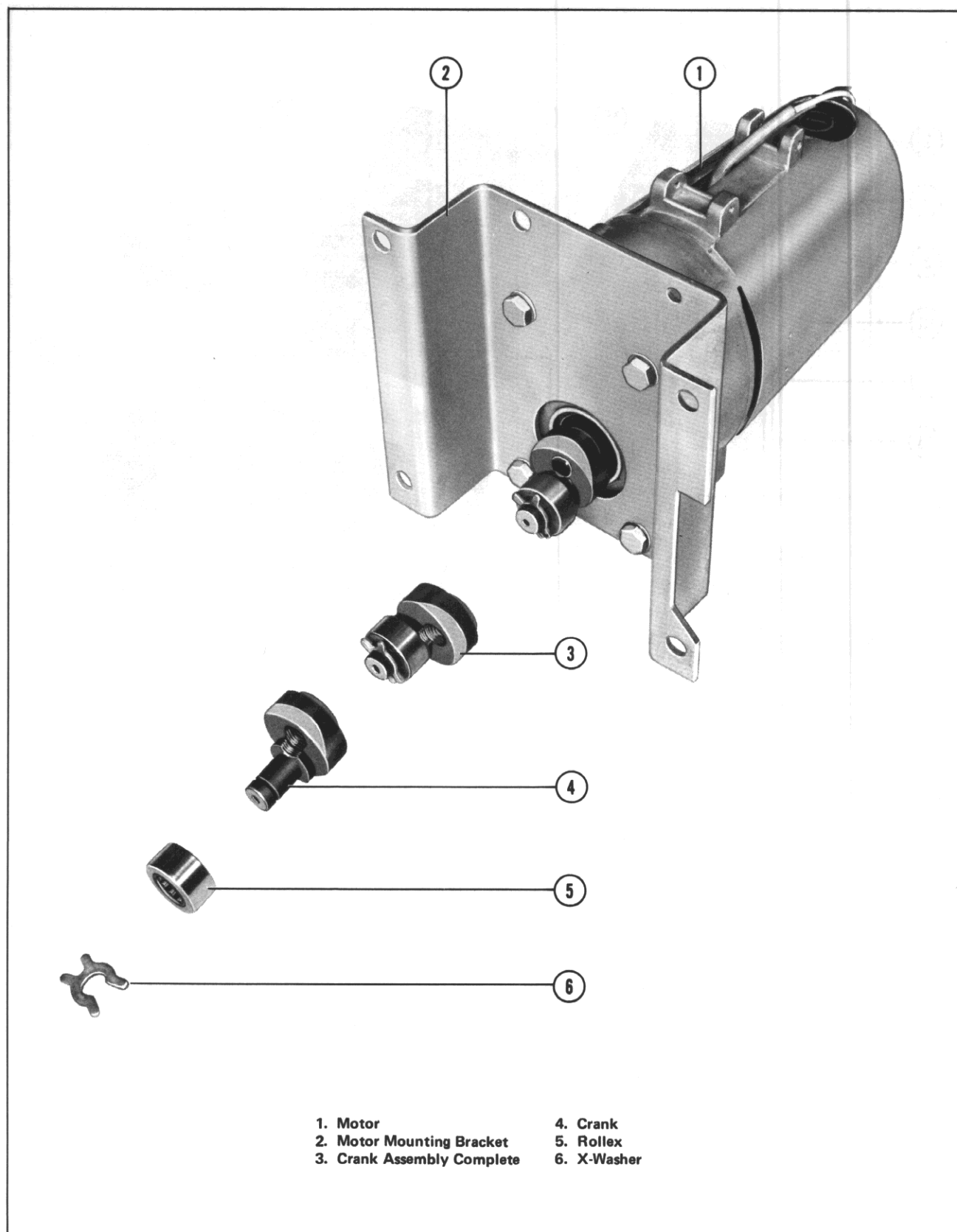
Fig. 89 Stored Energy Mechanism: Parts for Crank Shaft Subassembly

## CLOSE AND TRIP LINKAGE



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

Fig. 90 Stored Energy Mechanism: Parts for Close and Trip Linkage Subassembly



**Fig. 91** *Spring Charging Motor Assembly*



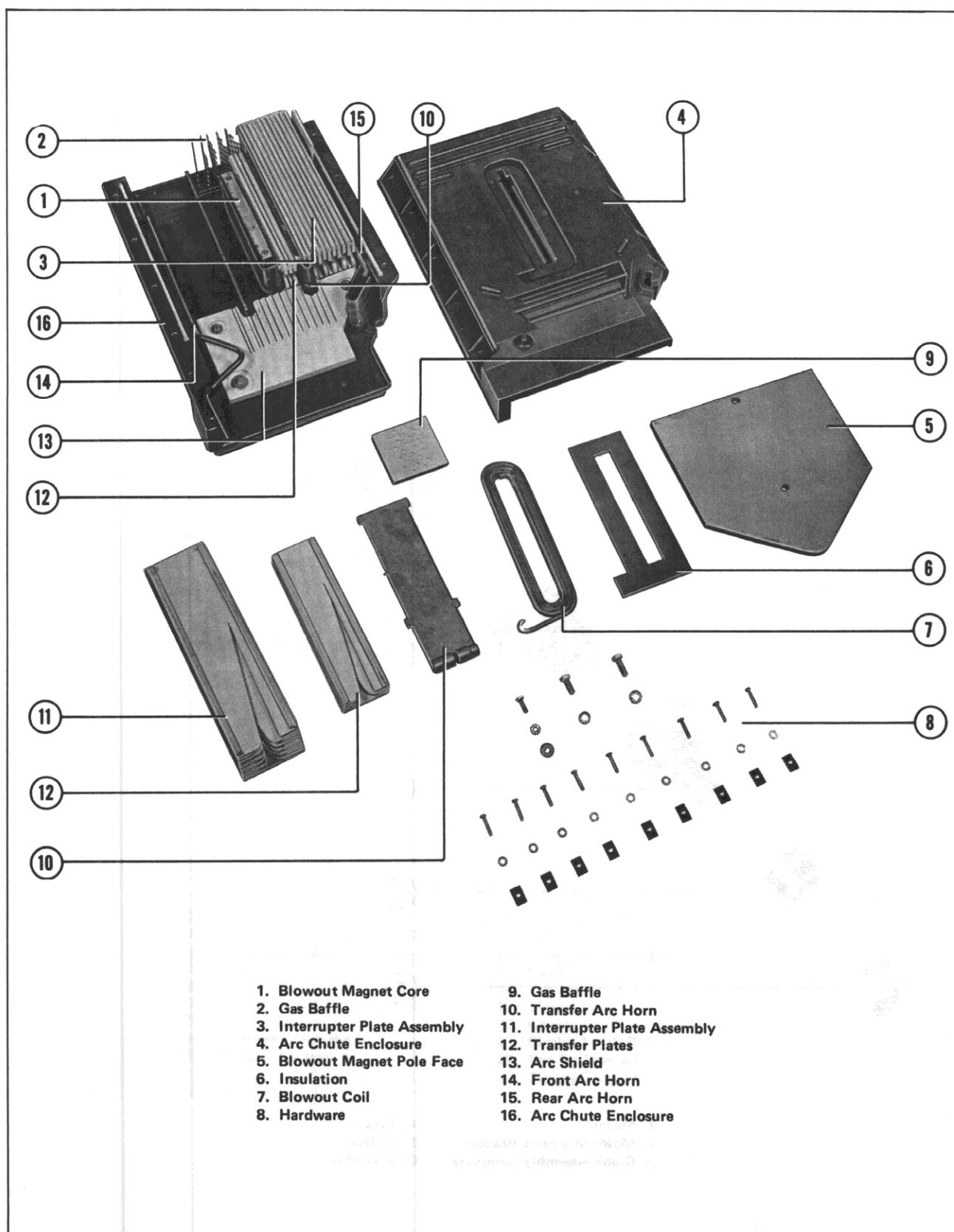


Fig. 92 Partially Assembled View and Details of 50-DH-P250 Arc Chute

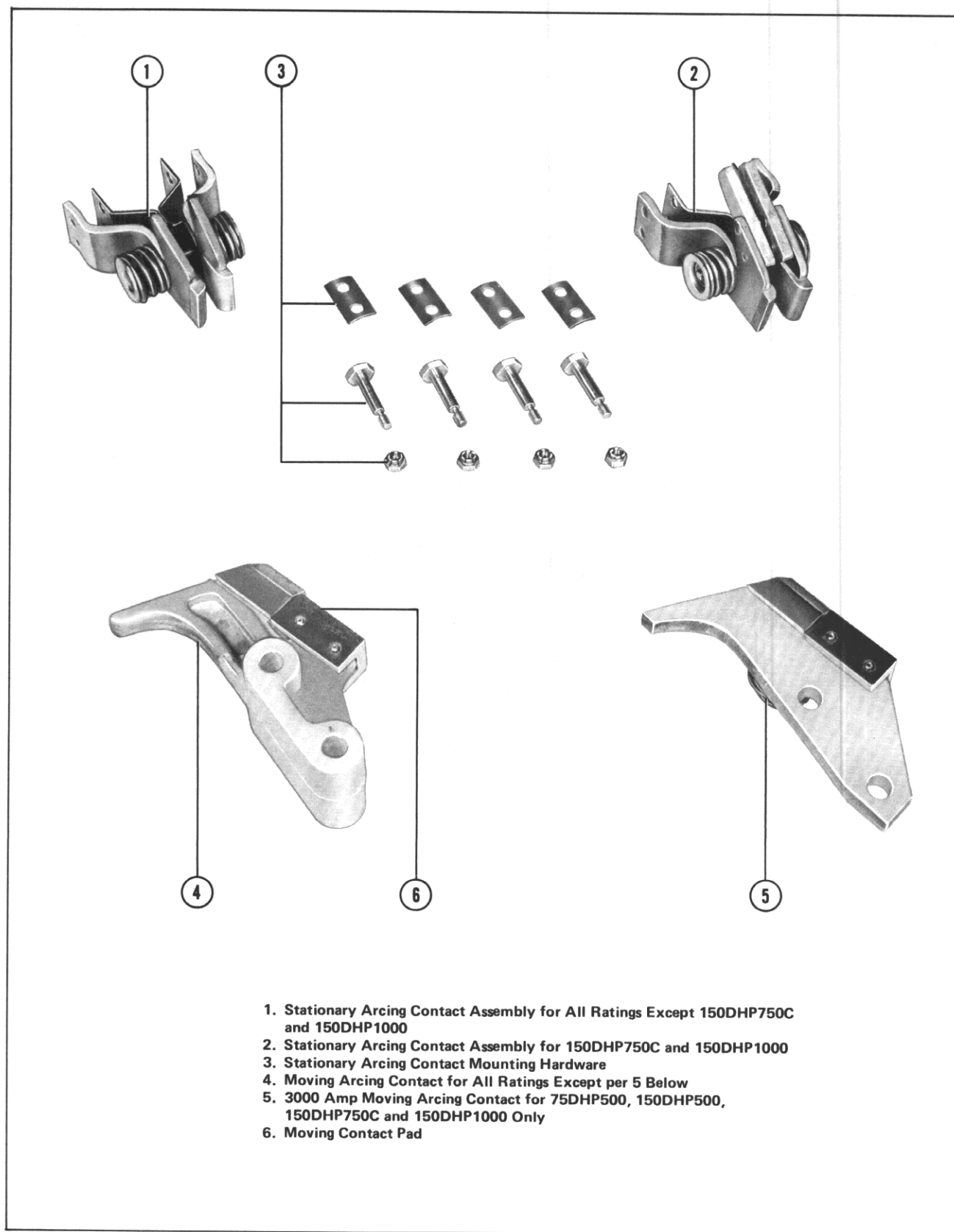


Fig. 93 Arcing Contact Assemblies

