Instructions for Porcel-line™
Type DV-P
Circuit Breakers

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INTRODUCTION

These instructions cover the description, operation and maintenance of Westinghouse DV-P Vacuum Circuit Breakers. These breakers are applied by Westinghouse as a rule, only as part of Porcel-line (TM) Metal Clad Switchgear. DV-P Vacuum breakers are interchangeable with the DHP Magnetic De-ion® Air Circuit breakers where the rating and the application will permit. The DV-P line of breakers uses the basic 150 DHP 500 cell as its housing.

The available ratings of DV-P breakers are shown in the Table 2 Rating Table on page 15.

In order to avoid trouble in handling, operation, etc. PLEASE READ THE INSTRUCTIONS BEFORE ATTEMPTING ANY OF THESE OPERATIONS.

Note: **These breakers are designed to operate within the current and voltage limits specified on the breaker nameplate. In addition to these limits, one must follow the Application Guide Bulletin for Vacuum Breakers to avoid possible problems with over voltages on certain circuits.**

Caution: **If a breaker is used as a tie between two system voltages which are out of phase, do not leave an open breaker in the connected position in the cell for long periods of time. Such a condition may cause higher than rated voltage to appear between upper and lower studs.**

GENERAL DESCRIPTION

The DV-P line of circuit breakers is of horizontal drawout construction. This arrangement provides convenience of operation and safety. The current carrying conductors are well concealed when the breaker is properly installed.

All of the controls necessary for ordinary operation of the breakers are located on the front panel and are accessible at all times. The controls referred to are shown in Figure 1, and include the following; tripping coil or coils, hand tripping trigger, closing spring release coil and spring release hand trigger, auxiliary switches, secondary contact controls, and the levering device for the breaker. The electrical components and circuits necessary for the proper operation of the breaker are also located on the front panel. The components referred to include the following; control relay "Y", and its associated resistor, the motor limit switch and the latch check switch.

The DV-P breakers are built with a spring stored energy mechanism which is mechanically trip free. The mechanism is located in the chassis at the bottom of the breaker. The vacuum interrupters are mounted on the porcelain pole unit supports which are bolted to the top of the chassis. The circuit breaker contacts are completely enclosed within the vacuum interrupter and the arc is therefore always contained inside the interrupter and never contaminates the surrounding air with ionized gases or arc products. The interphase barrier assembly provides isolation between the phases and to the cell wall where necessary. A grounded metal plate on the front of the barrier assembly protects all personnel from live breaker parts when the breaker is in the fully connected position.

RECEIVING, HANDLING

The DV-P breakers are shipped from the factory completely assembled, with the main barrier assembly in place, and ready for service.

Before placing the breaker in service see Maintenance Guide – Inspection, Adjustment and Maintenance.

If it is necessary to lift the breaker, attach crane hooks in the notches on the breaker chassis. The hooks should be inside the barriers as shown in Figure 4. This will help to prevent damage to the barrier assembly.

The breaker may be rolled on its own wheels if the floor is reasonably smooth. In rolling it around corners, use the handling dolly. See Basic Operating Instructions.

Handle all parts carefully but be especially careful with the vacuum interrupters. The interrupters are encased in porcelain envelopes which are subject to breakage. Be especially careful when working near the interrupter bellows. The bellows must never be twisted as this decreases bellows' life and hence the useful life of the interrupters.

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

STORING

During storage, keep all parts in a clean dry place, warm enough and with enough clean air circulation to prevent condensation of moisture.

BASIC OPERATING INSTRUCTIONS

READ CAREFULLY AND EXAMINE THE BREAKER BEFORE ATTEMPTING THE FOLLOWING OPERATIONS:

To Lift Breaker

The breaker may be lifted with the barrier assembly on the breaker. If the barrier assembly is on the breaker, the crane hooks must be inside the barrier panels to prevent damage to the barrier. For an example of lifting the breaker see Figure 4.

To Remove or Tilt Main Barrier

It is not usually necessary to remove the barrier from the breaker. The barrier is installed at the factory and can be tilted back as shown in Figure 3 for accessibility to breaker parts during maintenance and inspection. It is recommended that the barrier not be removed unless absolutely necessary. In order to either tilt the barrier back or to remove the barrier from the breaker it is necessary that the breaker be removed completely from the cell. This is a safety feature intended for the protection of operating personnel. Do not attempt to circumvent this feature.

To tilt the barrier back after the breaker has been removed from the cell, remove the two screws located at the bottom edge of the front steel panel. The barrier assembly will now pivot on the lower rear brackets as shown in Figure 3. The barrier assembly may then be pivoted until the upper edge of the front panel comes to rest on the

floor behind the breaker. The barriers can be tilted best by first raising the barriers with the front panel handle to a semi-balanced position and then while holding the barriers in this position walk to the rear of the breaker to finish pivoting the barriers to the floor. To return the barriers to their original position repeat the steps in the reverse order. Be sure that the tab on the lower edge of the front panel engages the turned up edge on the front of the breaker. Be sure to insert the two screws in the bottom of the front panel and tighten them securely.

If during any maintenance work or inspection there is any chance that the breaker will be moved with the barrier tilted back be sure to return the barrier assembly to the installed position before moving the breaker. After the breaker has been moved tilt the barrier back again.

If it becomes necessary to remove the barrier from the breaker, first remove the two screws from the bottom of the front panel and the four screws which hold the barrier to the lower rear brackets. Once these six screws have been removed the barrier assembly can be lifted off of the breaker.

To install the barrier assembly place barrier assembly on breaker with steel panel at front of breaker and the insulation sheets between poles of breaker. Be sure that the tab located at the center bottom edge of the front steel panel engages the turned up edge on the front of the breaker. Place screws in front to fasten front steel panel to front of breaker chassis and tighten securely. Place the four bolts with spacers in the rear brackets as shown in figure.

CAUTION: **USE HANDLE ON FRONT STEEL PANEL OF BARRIER ASSEMBLY TO PULL OR PUSH BREAKER STRAIGHT FORWARD OR BACKWARD. THE SIX SCREWS WHICH FASTEN THE BARRIER TO THE BREAKER MUST BE SECURELY TIGHTENED BEFORE ATTEMPTING TO MOVE BREAKER BY MEANS OF THE HANDLE. FAILURE TO HAVE THE BARRIER SECURELY FASTENED MAY RESULT IN DAMAGE TO THE EQUIPMENT OR PERSONAL INJURY.**

To Roll Breaker Around Corners

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

To Place Breaker in First Position in Cell

This is called the TEST POSITION.

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

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

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

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

(d) 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.

To Place Breaker in Fully Energized Position

CAUTION: **The pole unit parts are alive at full circuit voltage when the breaker is in the fully energized position. BEFORE MOVING THE BREAKER INTO THAT POSITION, MAKE SURE 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 in or out of the cell if breaker is in closed position. If such an attempt is made with enough force, 3/16 pin at front of levering shaft is designed to shear as a safety measure, to prevent damage to parts harder to reach.

(a) Press down on rail latch on breaker, see Figure 8.

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

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

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

To Withdraw Breaker from Energized Position to Test Position

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

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

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

To Withdraw Breaker from Cell

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

(b) Pull breaker out of cell.

NOTE: **With the stored energy mechanism, the mechanism may open or trip free as it is withdrawn, depending on whether breaker was left closed or open, or whether spring was left charged or discharged while standing in the test position. This is to discharge closing and opening springs as a safety measure.**

To Engage Secondary Contacts with Breaker in Test Position (See Figures 9a and 9b)

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

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

To Disengage

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

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

OPERATION OF STORED ENERGY MECHANISM

With the breaker in the cell and secondary contacts engaged, the motor normally charges the closing spring as soon as control voltage is applied to control circuit. Normally the spring is charged immediately after each closing operation. The breaker is closed electrically by applying voltage to the spring release coil, marked "Lift to Close". The breaker is tripped electrically by applying voltage to the trip coil, marked "Lift to Trip".

To Charge Closing Spring by Hand (See Figure 5)

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

(b) Charge spring with several downward movements of handle until the handle suddenly turns freely and a "click" is heard. Any attempt to continue ratching will cause damage to the closing linkage.

To Spring Close Breaker without Electric Power (See Figure 7)

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

To Open Breaker by Hand

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

To Close Breaker by Hand with Maintenance Closing Handle (See Figure 6)

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

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

(a) The breaker should be closed with maintenance handle ONLY WHEN THE CLOSING SPRING IS DISCHARGED. The flat end of the main shaft projects through the R.H. side of the breaker chassis for this purpose.

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

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

HOW THE BREAKER WORKS

The spring stored energy mechanism does two jobs:

1. It stores energy by compressing, or charging a spring.

2. It applies the released energy to the breaker contact system to close the contacts and charge the opening springs.

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

1. Spring not charged (or spring discharged) and breaker open.

2. Spring charged and breaker open.

3. Spring discharged and breaker closed.

4. Spring charged and breaker closed.

Figure 10 shows the lower side of a stored energy mechanism in a breaker. The major component is a single-throw crankshaft to which is attached a ratchet wheel for charging the spring and a cam for closing the breaker. Parts of the crankshaft and associated parts can be seen. The crankshaft sub-assembly and details are also shown in Figure 19. On the crankshaft will be seen a connecting rod, which attaches to the spring to compress it, the ratchet and the closing cam, both of which rotate together with the crankshaft.

Figures 11a and 11b are schematic views of a section of the mechanism as would be seen from the right hand side of the breaker with the breaker in the normal position with respect to the cell. The driving pawl runs by continuous rotation of the driving motor until charging is complete as shown. The holding pawl holds the ratchet during the back travel of driving pawl. The closing spring is held compressed by the spring release latch and in turn by the closing trigger. It will be seen that rotation of the ratchet is counterclockwise and that the connecting rod is slightly over horizontal dead center with the spring fully charged. It stops at that point because the closing stop roller bumps against the spring release latch. You can hear this at the end of the charging operation. When the closing trigger, extending out from the mechanism panel is released by lifting by hand or electrically, the closing stop roller is freed and the crankshaft, ratchet and cam rotate rapidly counterclockwise for about one-half turn as shown in Figure 11b. This closes the breaker. The motor limit switch is closed by this operation and the spring is immediately charged again back to the position in Figure 11a.

Figures 12a, b, c and d show the 4 conditions of the closing cam and tripping linkage. Note that in 12a in which the breaker is open and the closing spring not charged, the tripping trigger is in the tripped position. As the spring is charged, the tripping trigger snaps into the fully reset position as in 12b near the end of the spring charging operation.

In Figure 12c the linkage is shown in the breaker 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 of Figures 11a and 11b. Rotation of the closing cam from position in 12b to 12c, pushes the cam roller so as to rotate the main shaft of the breaker and close the contacts. This is possible because the restraining link between the cam roller and the tripping cam prevent the roller from moving off to the right. The restraining link causes the tripping cam to push against the tripping latch, which pushes downward, on the left end, on top of the tripping trigger. Figure 12d 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 shown in Figures 11a and 11b.

Lifting the tripping trigger arm either by hand or by the tripping coil causes release of the tripping latch, tripping cam and restraining link, which opens the breaker and the linkage moves to the position shown in Figure 12b.

ANTI-CLOSE INTERLOCK

An anti-close interlock is provided to prevent release of a charged spring on a breaker that is already closed. If such an attempt is made without the interlock the closing cam will rotate causing an instantaneous open-close operation when the spring release trigger is lifted.

As shown in Figure 11a the closed breaker interlock screw 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 as in an attempt at closing under this condition, the trigger will simply rotate past the front spring release latch roller. No operation will occur. The trigger will reset when released.

LEVERING DEVICE AND BREAKER INTERLOCK

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

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

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

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

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

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

The levering interlock is designed to prevent moving the breaker into or out of the energized position if the breaker contacts are in the closed position. It consists essentially of a movable key, mounted securely on the rear of the front panel, which can enter an elongated keyway in the front part of the levering-in shaft. The key is spring-operated by the closing and opening movement of the breaker contact linkage. When the breaker is in the CLOSED POSITION, a force is applied through a single-leaf spring to the key, to make it enter the keyway on the levering-in shaft. The levering-in shaft may be left in any position so that the keyway may not line up with the key. However, since the key is pressing against the shaft, it will snap into the keyway on the first rotation of the shaft as the keyway comes into lines with the key.

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

Turning the levering-in shaft too hard will shear the levering-in shaft pin where the crank is attached. This protects the internal parts of the interlock against mechanical damage and prevents unintentional withdrawing or insertion of the breaker while it is closed.

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

For further operating details, see BASIC OPERATING INSTRUCTIONS.

FLOOR INTERLOCK AND OPERATING LEVERS

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

This is done by the floor interlock and one of the automatic tripping levers pointed out in Figure 10. In operation, the rear end of this lever is pushed upward by a cell floor cam on the very first movement of the breaker from the test position toward the energized position, or from the energized position toward the test position.

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

AUTOMATIC FLOOR TRIPPING AND CLOSING SPRING RELEASE

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

As the breaker is withdrawn from the test position, two mechanical noises may be heard, the trip free of the breaker and the opening of the breaker.

SECONDARY CONTACTS

The 15 point secondary contact block is mounted on a sliding plate on the inside of the left hand chassis side plate. This sliding plate is operated by a round folding rod with a "T" handle, extending from the L.H. upper corner of the mechanism panel. Above this rod is the secondary contact levering handle. The round rod is notched so as to normally be keyed to the mechanism panel. Thus, when the breaker is in the test position, the secondary contact block is normally disconnected and in the forward position against the rear of the chassis.

When you wish to operate the breaker electrically while it is in the test position the folding bar is lifted to the horizontal position enough to unhook it from the panel, and pushed to the rear until the cross-pin goes into the slots in the levering handle, as shown in Figures 9a and b. The handle is then pressed down to make final engagement of the secondary contacts.

For further operating details see BASIC OPERATING INSTRUCTIONS.

RAIL LATCH
(See Figure 8)

The purpose of the rail latch is as follows.

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

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

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

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

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

For further operating details, see BASIC OPERATING INSTRUCTIONS.

MECHANISM PANEL

Externally mounted on the mechanism panel for easy reach are the tripping coil, spring release coil and the accompanying hand operating triggers. Also mounted are the auxiliary switches, the motor limit switch and spring charge indicator, the latch check switch, breaker open-close indicator, operation counter, and under voltage and transformer trip devices, if any.

CLOSING SPRING HAND CHARGE DEVICE

Breakers can be closed safely without electric power. The closing spring can be charged by hand and released by hand to close the breaker. See Figures 5 and 7.

The manual ratchet lever projects through a slot in the front chassis panel just to the left of the coil marked "Lift to Open." A spring charge/maintenance handle is provided to fit into the slot in the ratchet lever. A few downward strokes charge the spring. When charging is complete, the crank snaps over center with an audible "click". Any attempt to continue ratcheting will cause damage to the closing linkage.

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

MAINTENANCE CLOSING AND OPENING

The main shaft extends through the R.H. side sheet of the breaker chassis. A spring charge/maintenance handle has a rectangular hole which fits on the end of the shaft for the purpose of hand closing and opening the breaker for Figure 6. This operation is solely for the purpose of adjusting the wear gap and contact stroke or other working parts of the breaker when slow motion may be required. The breaker can be closed with the maintenance handle only when the closing spring is discharged. Any attempt to hand close the breaker when the closing spring is charged may result in damage to the mechanism.

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

DON'T EVER ATTEMPT TO CLOSE THE BREAKER BY HAND AGAINST A LIVE CIRCUIT. PROPER CLOSING REQUIRES MORE SPEED AND POWER THAN CAN BE SUPPLIED BY HAND POWER.

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

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

For further operating details, see BASIC OPERATING INSTRUCTIONS.

POLE UNITS

The pole units shown in Figure 15 include all current carrying and current interrupting parts of the vacuum breaker. The parts in Figure 15 include the vacuum interrupter, the interrupter bottom support assembly, the clamping plates and the roller contacts which transfer current from the moving contact of the interrupter to the bottom support assembly. Three poles are mounted on the breaker as shown in Figure 14.

VACUUM INTERRUPTER

The vacuum interrupters used for the DV-P line of breakers are shown in Figure 18 along with the other pole unit parts. These interrupters (Figure 16) consist of two special contacts mounted on stems, a ceramic envelope with metal ends, and a bellows to allow movement of one contact while maintaining a vacuum inside the bottle. The stationary contact is rigidly fastened to the upper stem, which protrudes through the upper end plate of the interrupter and is fixed rigidly to it. The moving contact is fastened to the lower stem which is free to move through the bottom end plate. The movement of the bottom stem is limited by the bellows seal. These two contacts are used for both carrying continuous current and for interrupting fault current. The contacts are surrounded by a metal vapor shield which protects the ceramic envelope from the metal vapors formed during interruption. The interrupter is a self contained unit which is hermetically sealed to maintain the integrity of the vacuum.

NOTE: **The bellows is constructed of thin material so as to be flexible. Because this material is so thin the bellows must be handled with extreme care. The bellows have been well designed and with proper care will operate without failure over a long life. Any harsh treatment of the bellows will result in reduced life or failure. If air enters the interrupter it will not interrupt current. To prevent any abusive treatment to the bellows never pull or drive the moving stem more than the recommended 3/4 inch. In addition under absolutely no circumstances is the moving stem to be twisted or rotated even slightly.**

During an opening operation the mechanism pulls on the porcelain operating rod and causes the moving stem of the interrupter to move downward and a gap to open between the contacts. As the contacts part an arc is drawn between them. This arc is supported by metal vapor from the contacts and continues to current zero. The absence of gas in the interrupter permits rapid recovery of dielectric strength, and causes the arc to extinguish.

MAINTENANCE GUIDE – INSPECTION, ADJUSTMENTS AND GENERAL MAINTENANCE

General

This class of power circuit breaker is a protective device to prevent damage to more expensive apparatus and to maintain continuity of electric power service. To maintain greatest reliability the breaker should be inspected and given all indicated maintenance on a regular schedule. The Type DV-P circuit breakers are designed to comply with standards performing switching operations based on maintenance every 2000 operations.

Actual inspection and maintenance will depend upon individual application conditions. Some atmospheric conditions such as extremes of dust and moisture or corrosive

gases might indicate inspection and maintenance at more frequent intervals than 2000 operations. Very clean and dry conditions combined with low switching duty will justify longer times between inspection and maintenance operations. With experience, each user can set an inspection and maintenance schedule which is most economical for the particular case.

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

Therefore, some inspection should be done on the breaker immediately after receiving the breaker.

NOTE: **Before trying to close the breaker with the maintenance closing handle, make sure that the closing spring is discharged. It can not be closed this way with the spring charged. If it is tried, the tripping linkage may be damaged. Breaker should be open and spring discharged as it is received.**

Checking the Interrupter for Vacuum

The vacuum interrupters have been carefully inspected at the factory before being shipped to the customer. The integrity of the vacuum can be checked by opening the breaker and Hi Potting the open contacts of each phase, with 36 KV A.C. for one minute. If the interrupter does not flash over during the one minute interval it should function properly. (This voltage is higher than the value stated in standards for field testing 15 KV switchgear, but is necessary to check for vacuum.)

Applying a high voltage across an open gap in a vacuum makes x-ray emission possible. The level of x-ray emission from a vacuum breaker with proper contact spacing and with 36 KV across the open contacts is extremely small and well below the maximum level permitted by standards. However, there is always the possibility that the contacts are out of adjustment and therefore closer than they should be, or that the voltage across the contacts is greater than 36 KV. Therefore, it is advisable that all operating personnel stand behind the steel front barrier and remain further from the breaker than would otherwise be necessary for reasons of electrical safety during the Hi Pot test.

During the Hi Pot test the vapor shield inside the vacuum interrupter can acquire an electro static charge. This charge should be bled off immediately after the test by grounding the metal ring which circles the center of the ceramic envelope.

Checking Contact Wear Gaps

The contact stroke and wear gaps are factory set at .25" but should be checked every 2000 operations to see that they are not less than .04" and should be reset only in the event that a vacuum bottle is replaced. To check the wear gap the breaker must be outside the cell with the barriers tilted back and the breaker contacts closed. Figure 17 shows the gap being checked with a .25" thick rod. Figure 3 shows how the barrier tilts back to expose the interrupters and the mechanism for maintenance and inspection. The barriers are interlocked so they can only be tilted or removed when the breaker is out of the cell.

It is safe to operate this breaker with less than .25" wear gap. As the contacts in the vacuum bottle erode, the wear gap will diminish. WHEN THE WEAR GAP IS DOWN TO .04" THE VACUUM BOTTLE MUST BE REPLACED and the wear gaps set to .25" again. Under normal duty the vacuum bottles should last for many years. NEVER ALLOW THE GAP TO DISAPPEAR since there will be no force holding the contacts closed and no hammer action to open the contacts. On the other hand an excessively larger wear gap puts unwarranted stress on the mechanism. THE WEAR GAPS SHOULD NOT BE RESET after the breaker has been put in service. If this is done there will be no record or valid indication of contact life. When an interrupter is replaced and the gaps are set to .25", the contact travel will automatically be .65" to .69". As the gaps diminish due to contact wear, the travel will increase toward .75".

Vacuum Interrupter Replacement

The following procedure should be used to replace a vacuum bottle and set the wear gaps. See Figure 15.

a. Take breaker out of the cell.

b. Remove "X" washers from operating rod pin at the top of operating rods.

c. Using maintenance handle, slowly close breaker until the wear gap starts to appear. At the point just before the gap starts to appear, the pin should be easily removed from the operating rod.

d. Remove the 6" long bolt clamping the top conductors to the upper stud.

e. Remove the two nuts holding the top conductors to the insulators. Remove the upper nut on the front insulator strut.

f. Lift off the top conductor.

g. Remove mounting nuts that hold the bottle to the lower mounting assembly. DO NOT PULL UP ON THE BOTTLE TO REMOVE IT FROM THE MOUNTING PLATE. IT MUST BE PUSHED UP BY ITS STEM. This can be done easily by using a 4" long steel tube with an outer diameter of 1.250" and an inner diameter of 7/8 to 1". Place it over the stud and locknut on the bottom stem of the vacuum bottle. Push up on the tube to force the bottle free from its mounting. DO NOT PULL UP (OR TURN) THE BOTTLE UNDER ANY CIRCUMSTANCES.

This procedure will maintain compression on the roller contact assembly if the tube is not removed.

h. Mount the new bottle by placing its stud and locknut into the tube. Align the operating rod pin hole and mounting studs. Then press or lightly tap the bottle into place. DO NOT TURN THE BOTTLE ONCE THE ROLLERS MAKE CONTACT WITH BOTTLE STEM. Tap only on the upper stem.

i. Lubricate rollers lightly with specified compound 53701RK (Figure 15).

j. Slip top conductors on upper stem of bottle.

k. Align the finger cluster end of the top conductor assembly by measuring from adjacent stud centerlines. The distance from adjacent studs vertically and horizontally should be 10.00" ± .03.

Tighten the nuts holding the top conductor to the insulators while maintaining stud alignments.

l. Tighten the 6" long clamping bolt to 60 ft. lbs. Stud alignment must be set correctly before the clamping bolt is tightened as stud adjustment afterwards will put undue loads on the vacuum interrupter.

At this point set wear gaps as follows:

a. Loosen the bottom nut on the bottom of the operating rod. After the nut is loose turn the nut down an additional 1/2 inch.

b. Attach the operating rod to the vacuum interrupter with the pin and new "X" washers. The breaker can be partially closed with the maintenance handle so that the operating rod will reach the vacuum bottle to allow the pin to be inserted.

c. Slowly close the breaker with the maintenance handle while watching the wear gap. If the gap gets larger than .38" before the breaker latches close, do not continue closing with the handle, but reopen breaker and spin the upper nut on the end of the operating rod upward thereby shortening the operating rod. If no gap appears at all when the breaker is closed, the operating rods are too short and the upper nut should be turned down. Again slowly close the breaker with the maintenance handle until a gap of .31" appears when the breaker is closed. Then tighten the lower nut on the bottom of the operating rod. (See Figure 18). This results in a wear gap of about .25" when the locking washers are compressed. The lower nut should be very tight. The upper nut is not tightened.

Mechanism

Close the breaker by spring power and open by normal tripping action. Try charging the 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 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 "free wheel" for a short distance as the click is heard. No more force should be put on the ratchet handle after that point, as it simply puts a high load on the spring release latch and related parts.

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

To be sure that the breaker will close completely, charge the closing spring and close the breaker by lifting the closing trigger. If the motor does not begin to charge the spring, with the control voltage on, it could be that the crank shaft did not turn far enough to permit the motor cut off switch to make proper contact. This condition would exist if the breaker was not completely closed. Do not place a breaker in service that does not close properly.

Referring to Figure 12b, there should be .02 to .03 inch clearance between the tripping trigger and the tripping latch roller. If there is no clearance, the tripping latch cannot drop into place and the tripping trigger can not

reset to the untripped position. Therefore, the breaker will not close at all. The clearance can be adjusted by properly setting the trip cam adjusting screw on the front chassis panel under the handling dolly bracket (Figure 10). To set this adjusting screw, open the breaker and charge the closing spring. Loosen the locking nut on the adjusting screw and turn the screw in until it stops against the tripping cam. Then back the screw out until there is a .03 gap between the opening trigger and the tripping latch roller as shown in Figure 12b.

Latch Check Switch Adjustment

Refer to Figure 1. The latch check switch makes contact when the tripping trigger is in the fully reset position ready for the breaker to close. Where the tripping trigger is not reset, the latch check switch is open. When properly connected in the control circuit it will not allow the closing circuit to be energized until the mechanical resetting of the tripping trigger is complete.

The 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. The switch is properly adjusted if it makes contact when the tripping trigger is 1/8 to 3/16 from its completely reset position as measured at the center of the trip plunger stem.

Mechanical Timing

The mechanical operating speed of the breaker should be satisfactory as received. The breakers are checked at the factory for contact speed and contact bounce. These values do not change appreciably during the mechanical life of the breaker and are not considered as part of the regular inspection and maintenance program.

The timing of the vacuum breaker can be checked by using a potentiometer and an oscilloscope. The potentiometer must have 2 inches of linear travel. It is fastened between the frame of the breaker and the operating rod. The speed is then checked with an oscilloscope. The speeds should be in the following range: 2.5 ft/sec. to 3.5 ft/sec. closing, 6.0 ft/sec. to 7.5 ft/sec. opening.

Lubrication

The most reliable performance of the mechanism can be obtained by lubrication. All parts which require it are lubricated with "molly" (molybdenum polysulphide) Westinghouse M. No. 53701GC when assembled. You should lubricate some items at the regular maintenance period. Other parts normally should require lubrication only after long periods, such as several years. Otherwise, it should be done at any time the breaker appears slow or sluggish in opening or closing or where bearings may be clogged with dirt.

At the 2000 operation maintenance period lubricate the mechanism with light machine oil or auto crank case oil.

Points to lubricate, applied sparingly:

Front and rear tripping latch rollers and pivot pin.
Tripping trigger pivot pin.
Spring release latch roller and pivot pin.
Closing trigger and pivot pin.
Tripping cam pivot pin and restraining link pin.

There are roller bearings on the pole unit shaft, crank shaft and 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 some years. They should not be disturbed unless there is definite evidence of sluggishness, dirt or unless the parts are dismantled for some other reason.

If it does appear advisable, the bearings and related parts should be thoroughly cleaned of old grease in a good grease solvent such as kerosene or household dry cleaner (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 M. No. 55213AG or "Molycote." If parts other than the above mentioned roller bearings are dismantled, they should be cleaned in the same way and relubricated with Westinghouse M. No. 53701GC.

Removing and Installing Spring Charge Motor

The spring charging motor can be expected to last under normal conditions for the life of the breaker without requiring removal or replacement. If it does become necessary due to some unusual condition, proceed as follows:

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

2. Remove 2 bolts and the pipe plug located on the underside of the motor mounting plate. Loosen nuts on U-bolt also on underside of mounting plate. (See Figure 10).

3. Withdraw motor from breaker.

4. Install in reverse order.

Removal of Closing Spring

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

1. See Figure 14. Remove idler link and pin.
2. Use a fixture consisting of a notched piece of 1-1/2 inch pipe about 8 inches long, a piece of 1/2 diameter inch rod threaded 1/2-13 about 14 inches long, a thick washer about 2 inches outside diameter with a clearance hole for the 1/2 inch rod and a 1/2-13 nut.
3. Place notched pipe with notch over closing spring retainer pin.
4. Screw threaded rod into hole in end of connecting rod.
5. Place washer over end of pipe.
6. Screw nut on outer end of rod and tighten against washer until retainer plate moves away and takes pressure off closing spring retainer pin.
7. Remove retainer pin by driving it out.
8. Unscrew nut until closing spring is completely freed.
9. Remove special fixture and spring.
10. Reassemble in reverse order.

Cleaning Procedure for Porcelain Insulation

If the porcelain insulation or the ceramic surface of the vacuum interrupter requires cleaning it is suggested that the surface to be cleaned be wiped with a dry lint free cloth or a dry paper towel. This surface can be washed with distilled water but be sure that the surface is completely dry before placing the breaker in service. If a solvent is required to cut the dirt use Stoddards solvent Westinghouse 55812CA or commercial equivalent. Be sure the surface is completely dry before placing the breaker in service. Do not use any type of detergent to wash the surface of a porcelain insulator as detergents leave an electrical conducting residue as they dry.

PARTS IDENTIFICATION

Individual parts and subassemblies for the circuit breakers are marked in the various figures. Refer to list of illustrations for a figure that may show a part in question for a particular type or rating of circuit breaker. When ordering the renewal parts, always specify the part name and figure number together with the instruction book number. Also, always supply the complete information from the nameplate on the front of the breaker chassis panel.

EXTRA PARTS

The following list of parts are the ones most likely to be replaced in normal maintenance and it is suggested that they be kept on hand for each breaker installed.

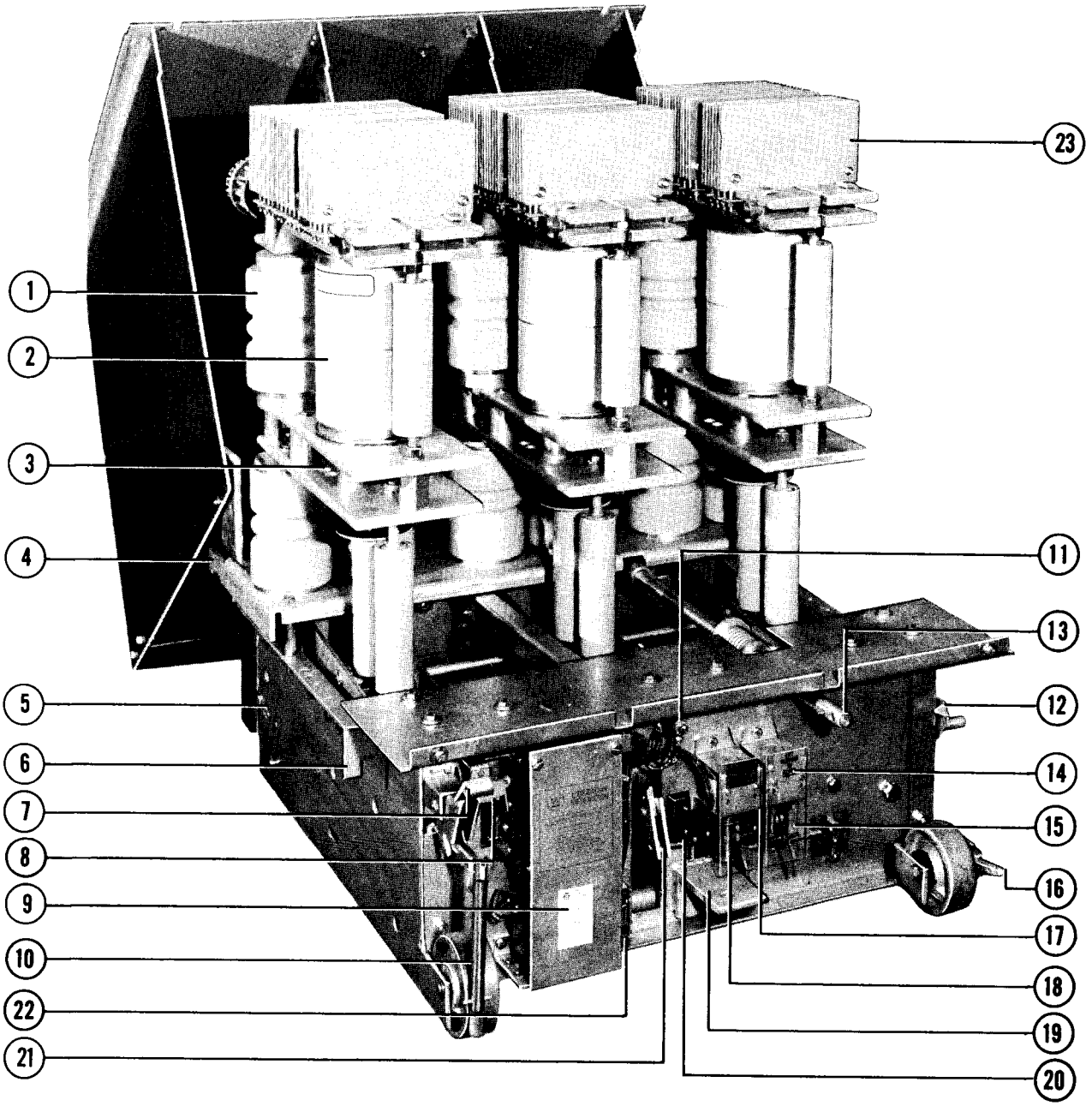
Part	Figure	Item	Number Required Per Breaker
1. Motor Limit Switch Assembly	1	22	1
2. Latch Check Switch	1	20	1
3. "X" Washers	21	85	3
	20	6	1
4. Cotter Pins	20	10	1
	20	13	1

Table 1
Table of Approximate Weights

Breaker Type	Continuous Amps	Weight in Pounds Breaker with Barrier
150 DV-P 500	1200	880
150 DV-P 500	2000	905
150 DV-P 750	1200	905
150 DV-P 750	2000	930

Table 2 – Rating Table

Vacuum Circuit Breaker Type	Continuous 60 Hertz Current in Amperes	Rated Short Circuit Current KA	K-Factor	Max. KV	BIL KV	Interrupting Time in Cycles	Close and Latch Amperes
150 DV-P 500	1200	18	1.30	15	95	3	37,000
150 DV-P 500	2000	18	1.30	15	95	3	37,000
150 DV-P 750	1200	28	1.30	15	95	3	58,000
150 DV-P 750	2000	28	1.30	15	95	3	58,000



1 Post Insulator Pole Unit
2 Vacuum Interrupter
3 Roller Contact
4 Rear Lifting Tab
5 Cell Coding Plate
6 Front Lifting Notch
7 Secondary Contact Handle
8 Veeder Counter
9 Auxiliary Switch Control Relay "Y" Cover
10 Secondary Contact Hand Operating Rod
11 Control Relay "Y" Resistor
12 MOC Switch Operating Pin and Indicator Bracket
13 Levering Device
14 Spring Release Coil "SR"
15 Closing Trigger
16 Rail Latch
17 Tripping Trigger
18 Tripping Coil "TC"
19 Handling Dolly Bracket
20 Latch Check Switch "LC"
21 Manual Ratchet Lever for Charging Closing Spring by Hand
22 Motor Limit Switch "LS"
23 2000 A. Cooling Fins

Fig. 1 *Front of Breaker with Barrier Removed*

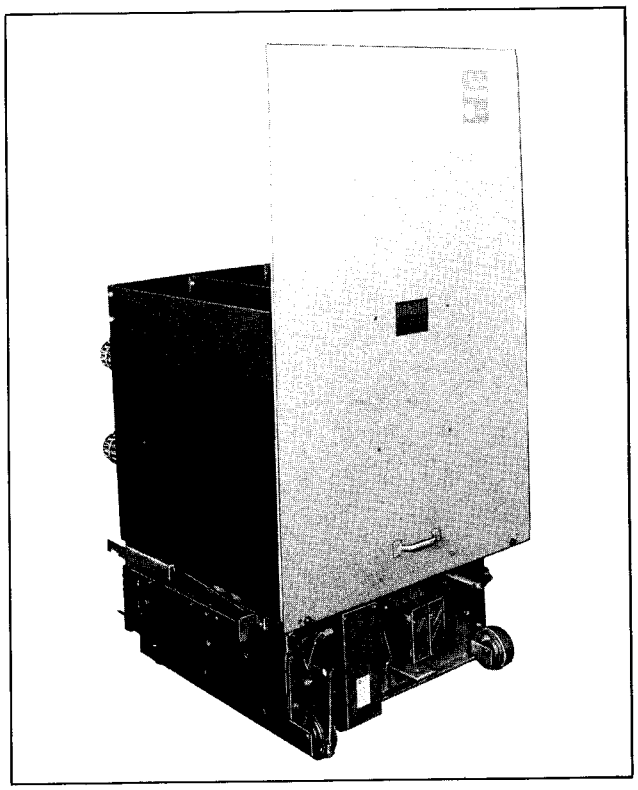


Fig. 2 *Left Side of Breaker with Barrier in Place*

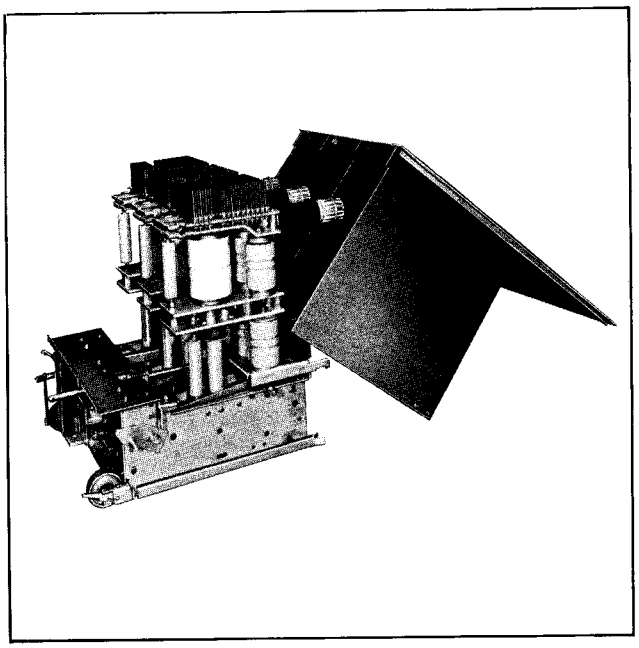


Fig. 3 *DV-P Breaker with Barrier Tilted Back*

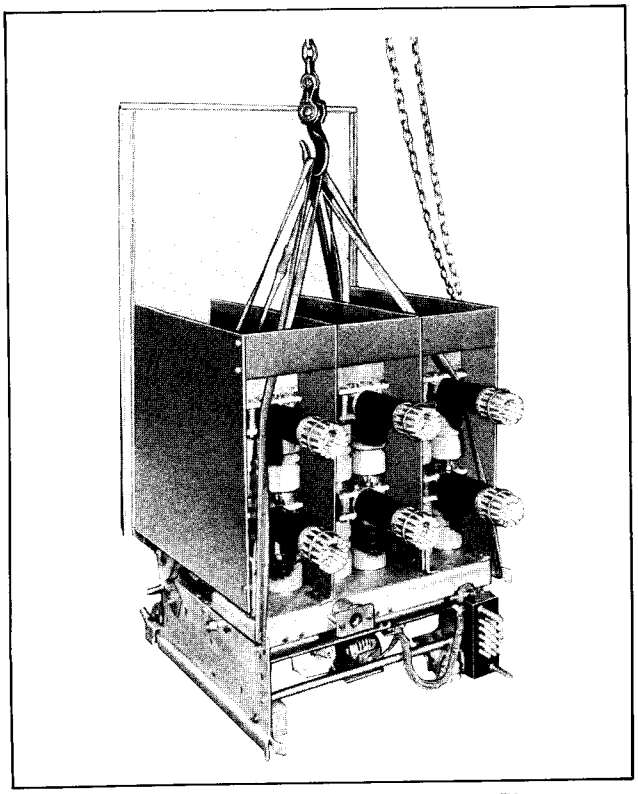


Fig. 4 *Lifting the Breaker with the Barrier in Place*

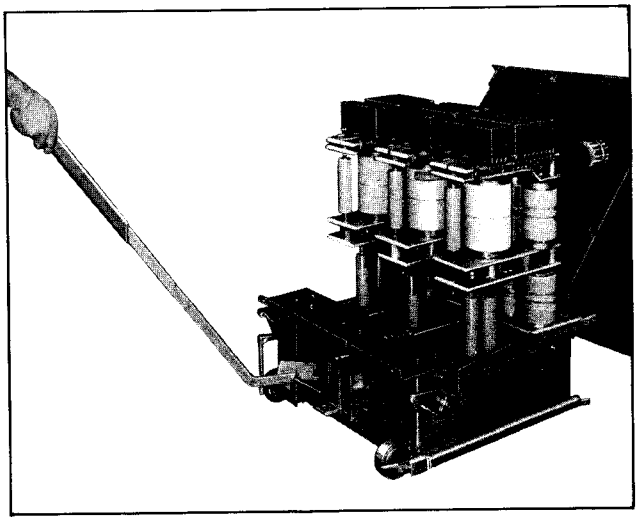


Fig. 5 *Charging the Closing Spring by Hand*

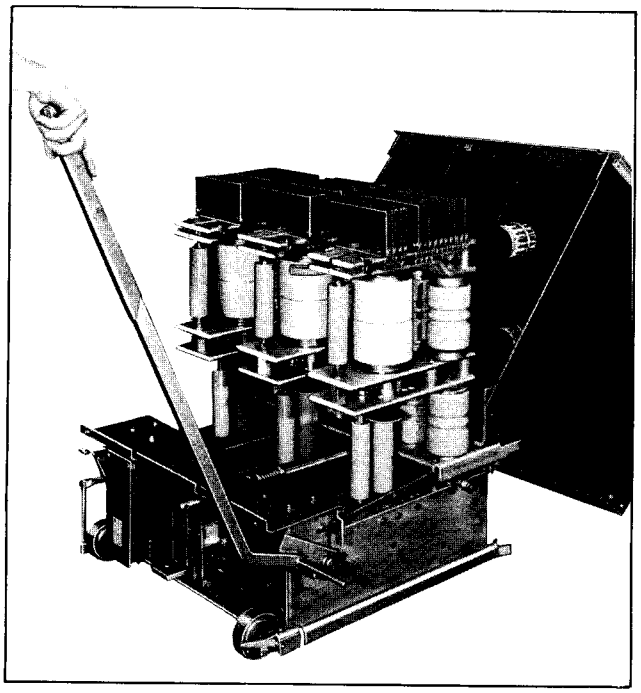


Fig. 6 *Closing Handle on End of Main Shaft*

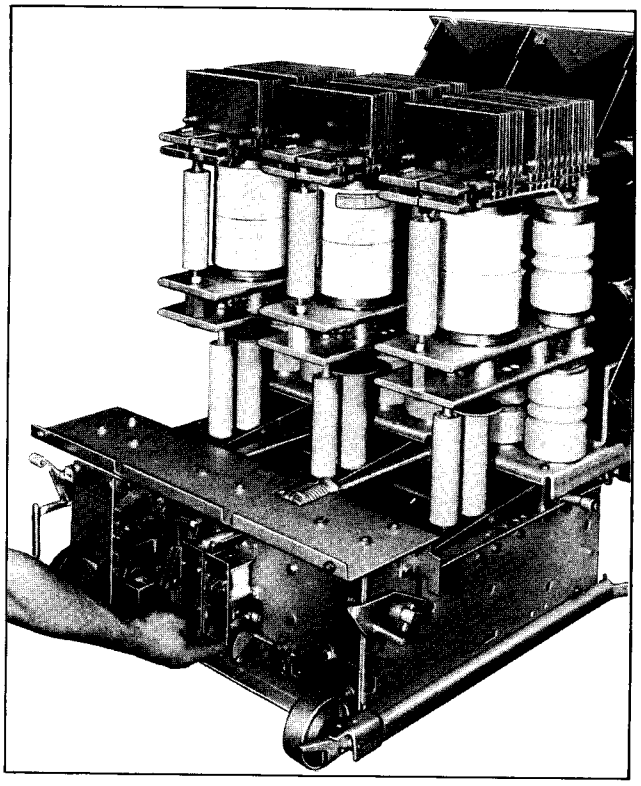


Fig. 7 *Spring Closing the Breaker by Hand*

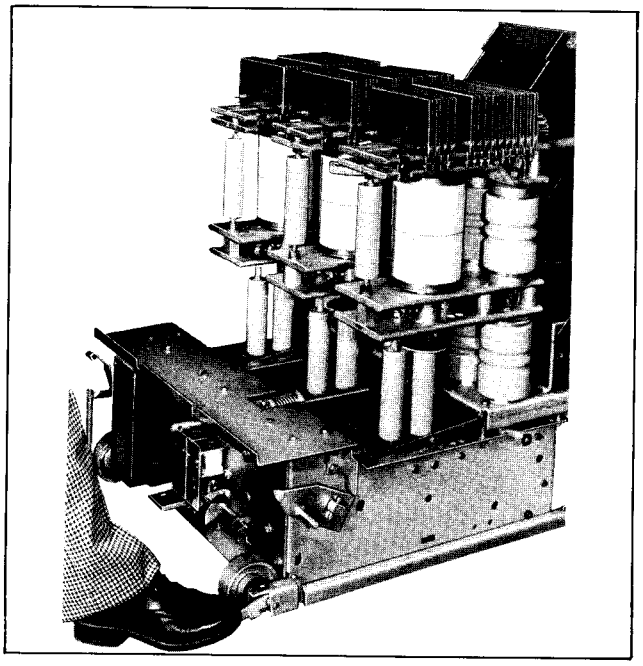


Fig. 8 *Releasing Rail Latch*

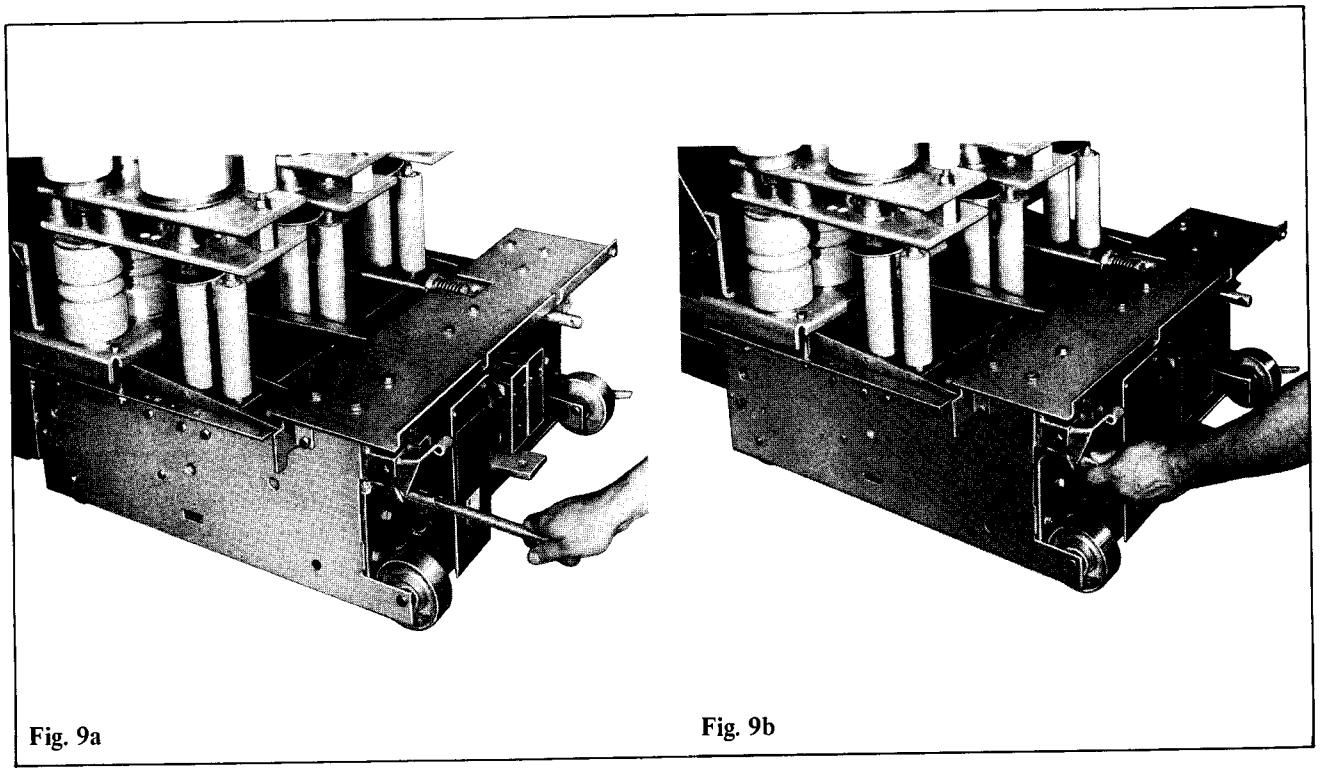
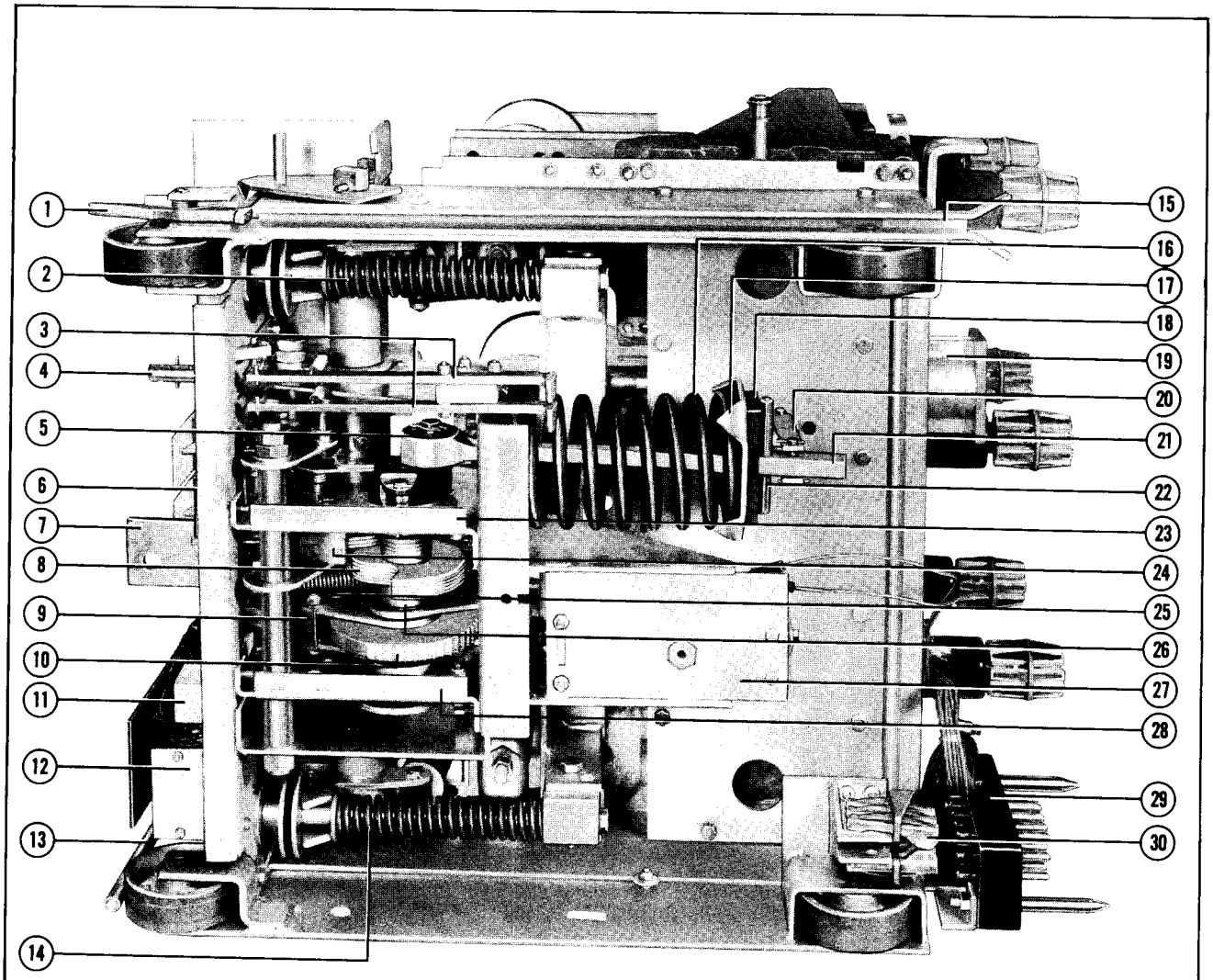


Fig. 9a

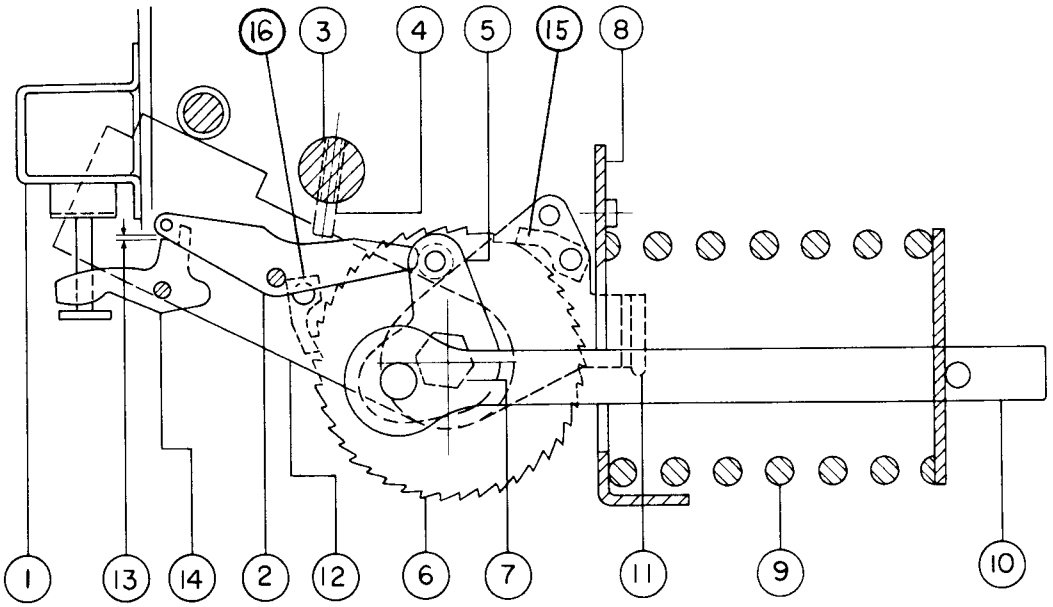
Fig. 9b

Fig. 9 *Operation of Secondary Contacts in Test Position*



1 Rail Latch
2 Opening Spring
3 Automatic Floor Tripping Levers
4 Levering Device - Operating Shaft
5 Closing Spring Connecting Rod
6 Opening Trigger Adjusting Screw
7 Handling Dolly Bracket
8 Closing Cam
9 Manual Ratchet Lever
10 Ratchet
11 Motor Limit Switch
12 Control Relay "Y"
13 Secondary Contact Hand Operating Rod
14 Opening Spring
15 Rail Guide
16 Closing Spring
17 Closing Spring Retainer Plate
18 Closing Spring Spacer
19 Levering Device Nut
20 Closing Spring Idler Link
21 Closing Spring Connecting Rod
22 Closing Spring Retainer Pin
23 Mechanism Frame R.H. Side Plate
24 Tripping Cam
25 Main Link Retrieving Spring
26 Crank Shaft
27 Spring Charging Motor Bracket
28 Mechanism Frame L.H. Side Plate
29 Secondary Contact Block
30 Ground Contact

Fig. 10 *Bottom View of Stored Energy Mechanism*



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

Fig. 11a *Stored Energy Mechanism: Spring Charged*

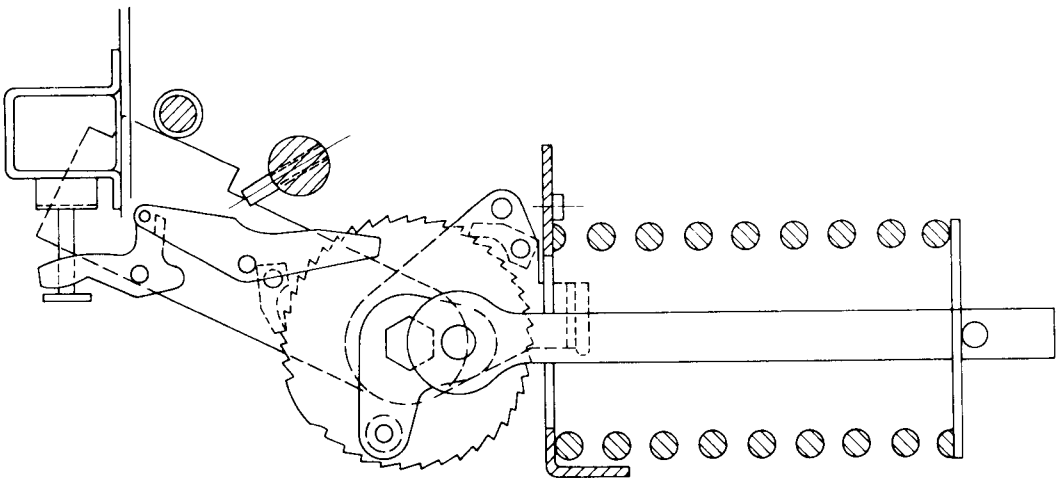
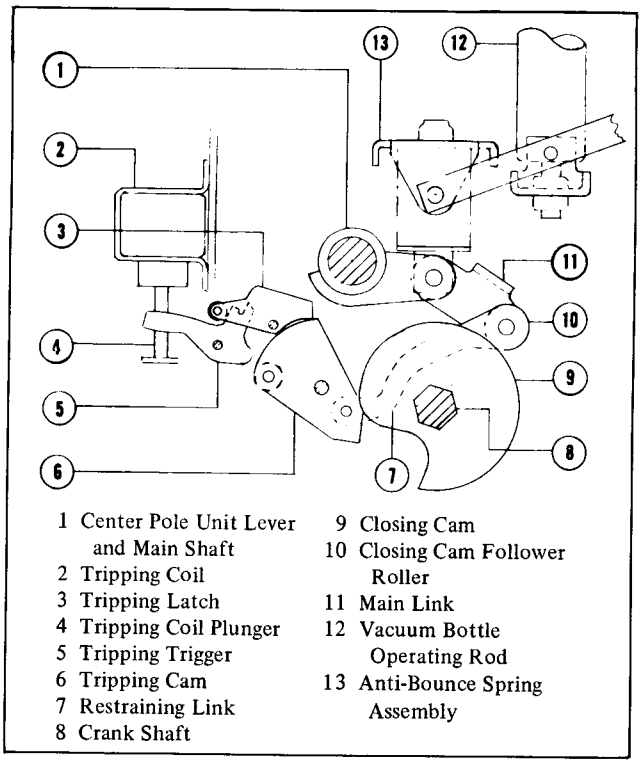


Fig. 11b *Stored Energy Mechanism: Spring Discharged*

Fig. 11 *Schematic Views of Stored Energy Mechanism; Spring Charging and Close Latch Parts*



1 Center Pole Unit Lever and Main Shaft
2 Tripping Coil
3 Tripping Latch
4 Tripping Coil Plunger
5 Tripping Trigger
6 Tripping Cam
7 Restraining Link
8 Crank Shaft
9 Closing Cam
10 Closing Cam Follower Roller
11 Main Link
12 Vacuum Bottle Operating Rod
13 Anti-Bounce Spring Assembly

Fig. 12a *Breaker Open and Spring Not Charged*

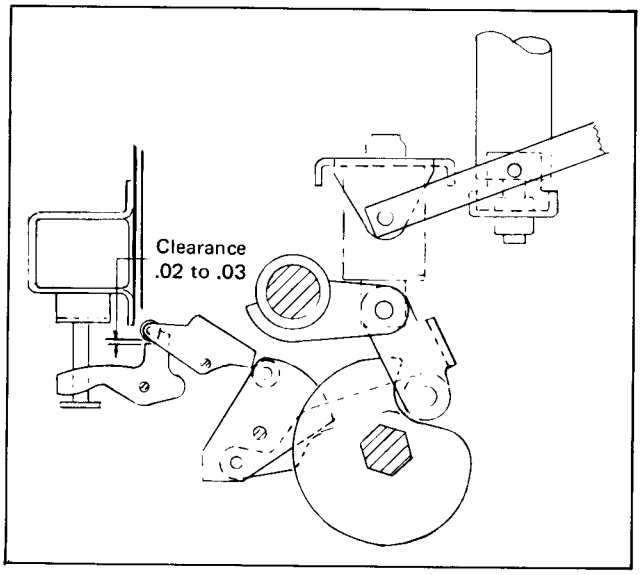


Fig. 12b *Breaker Open and Spring Charged*

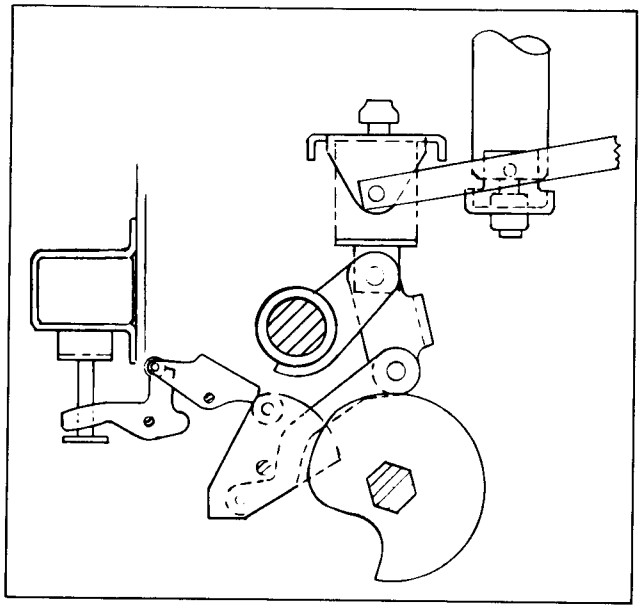


Fig. 12c *Breaker Closed Spring Not Charged*

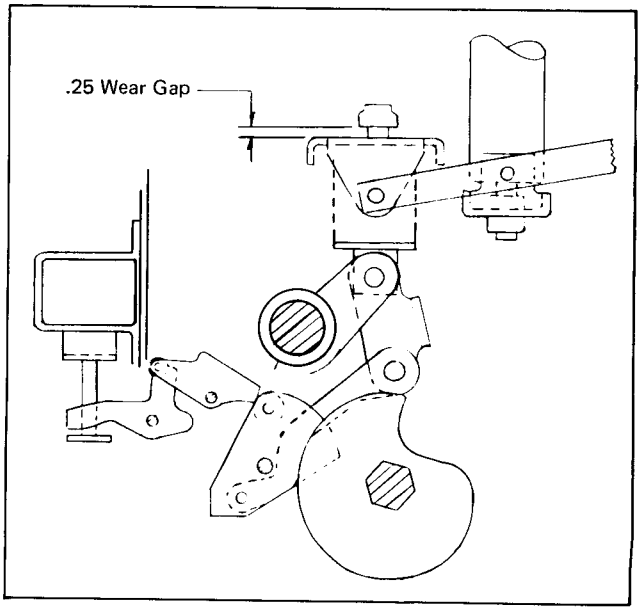


Fig. 12d *Breaker Closed and Spring Charged*

Fig. 12 *Four Positions of the Closing Cam and Tripping Linkage*

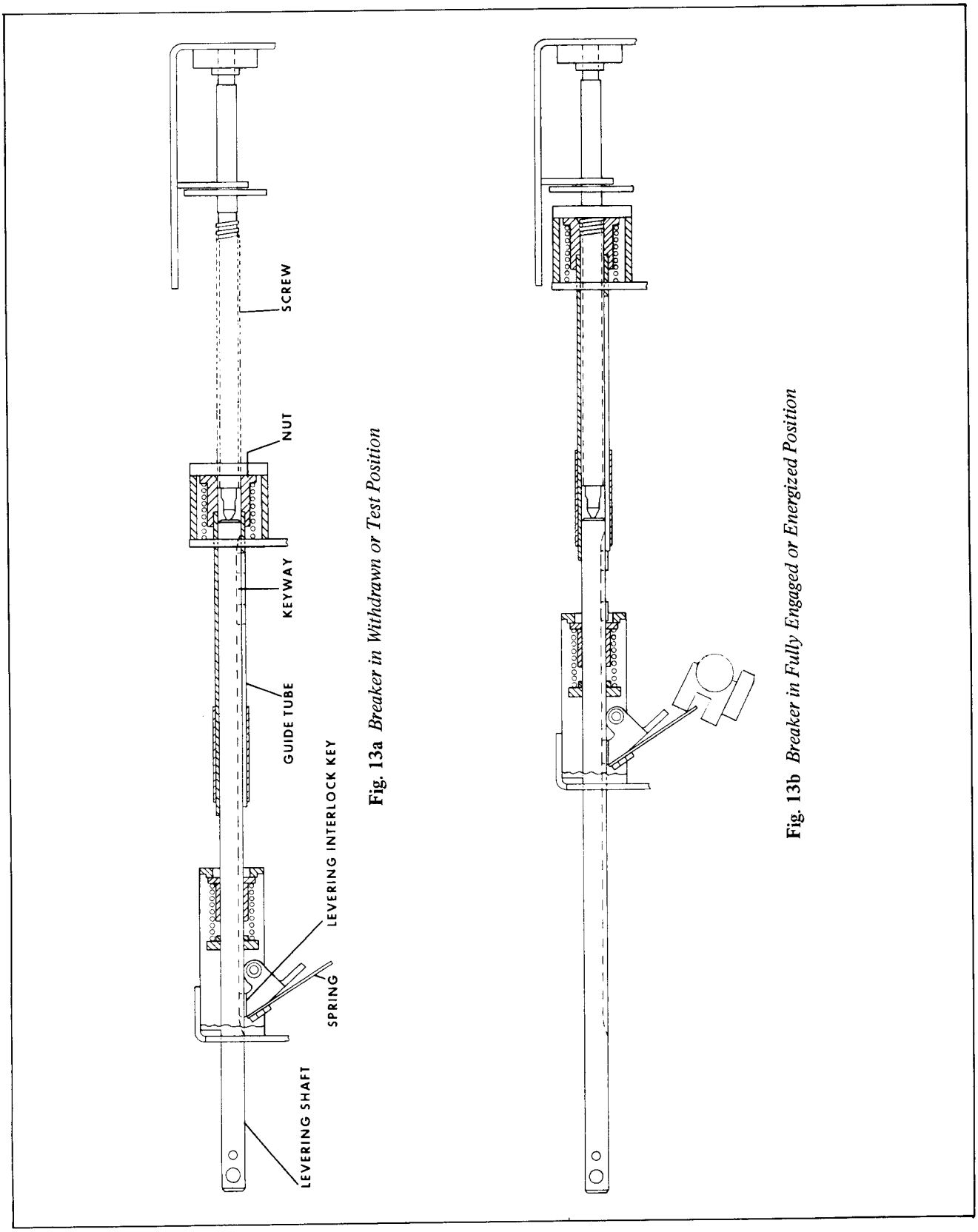
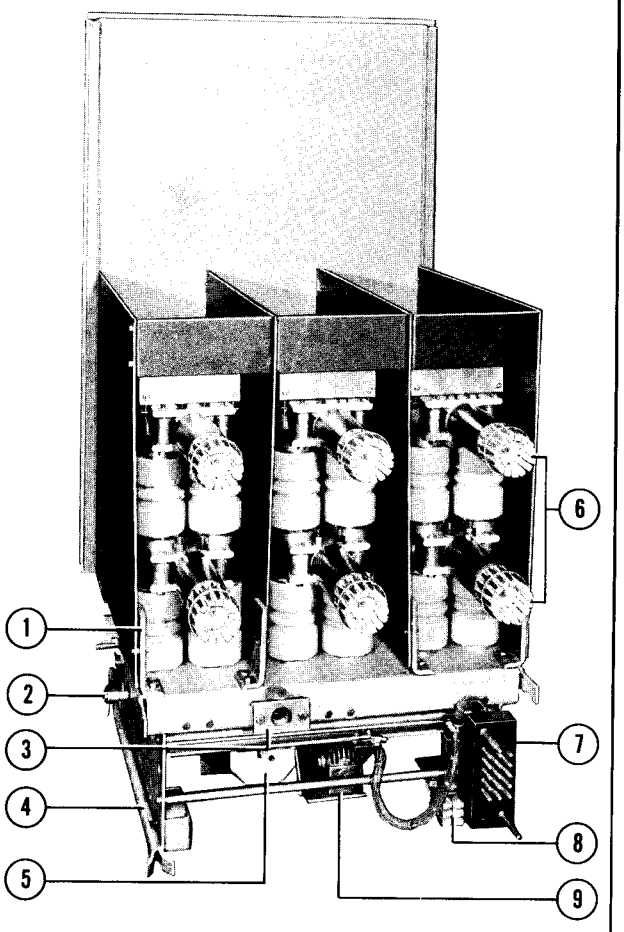


Fig. 13a *Breaker in Withdrawn or Test Position*

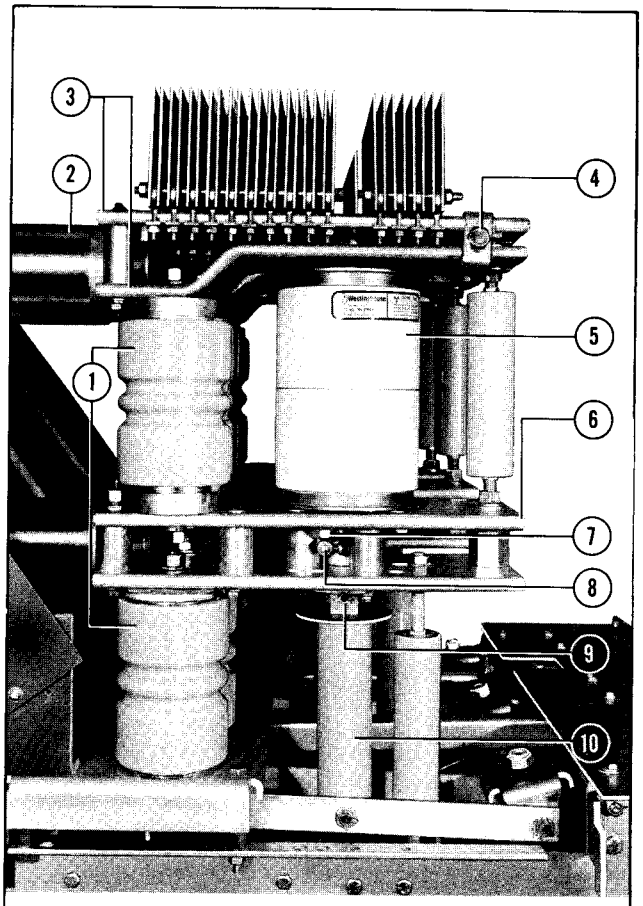
Fig. 13b *Breaker in Fully Engaged or Energized Position*

Fig. 13 *Schematic Drawings of Levering Device*



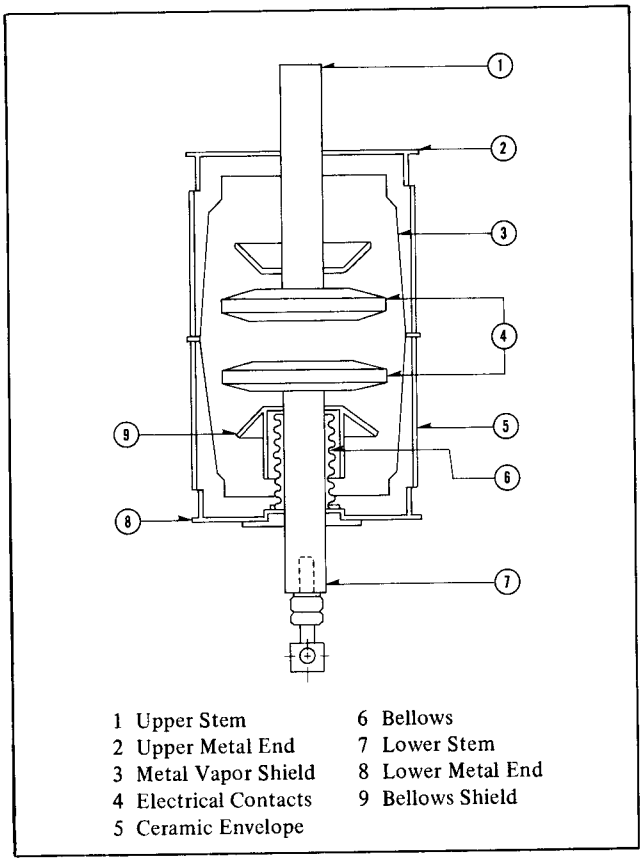
1 Barrier Mounting Bracket
2 Shutter Operating Roller
3 Levering Device Nut
4 Rail Guide
5 Closing Spring
6 Disconnecting Finger Clusters
7 Secondary Contact Block
8 Grounding Contact
9 Spring Charging Motor

Fig. 14 *Rear View of Breaker and Levering Device*



1 Post Insulator
2 Upper Stud
3 Upper Clamping Plates
4 Clamping Bolt
5 Interrupter
6 Lower Mounting Assembly
7 Mounting Nuts
8 Roller Contacts and Lubricant
9 Operating Rod Pin (1) and X-Washers (2)
10 Operating Rod

Fig. 15 *150 DV-P 500 Pole Unit in Closed Position*



1 Upper Stem
2 Upper Metal End
3 Metal Vapor Shield
4 Electrical Contacts
5 Ceramic Envelope
6 Bellows
7 Lower Stem
8 Lower Metal End
9 Bellows Shield

Fig. 16 *Vacuum Interrupter*

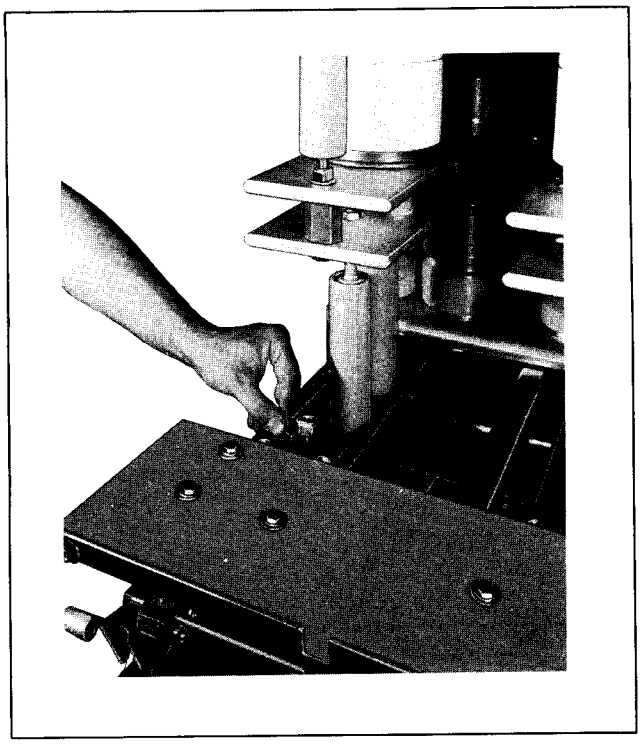
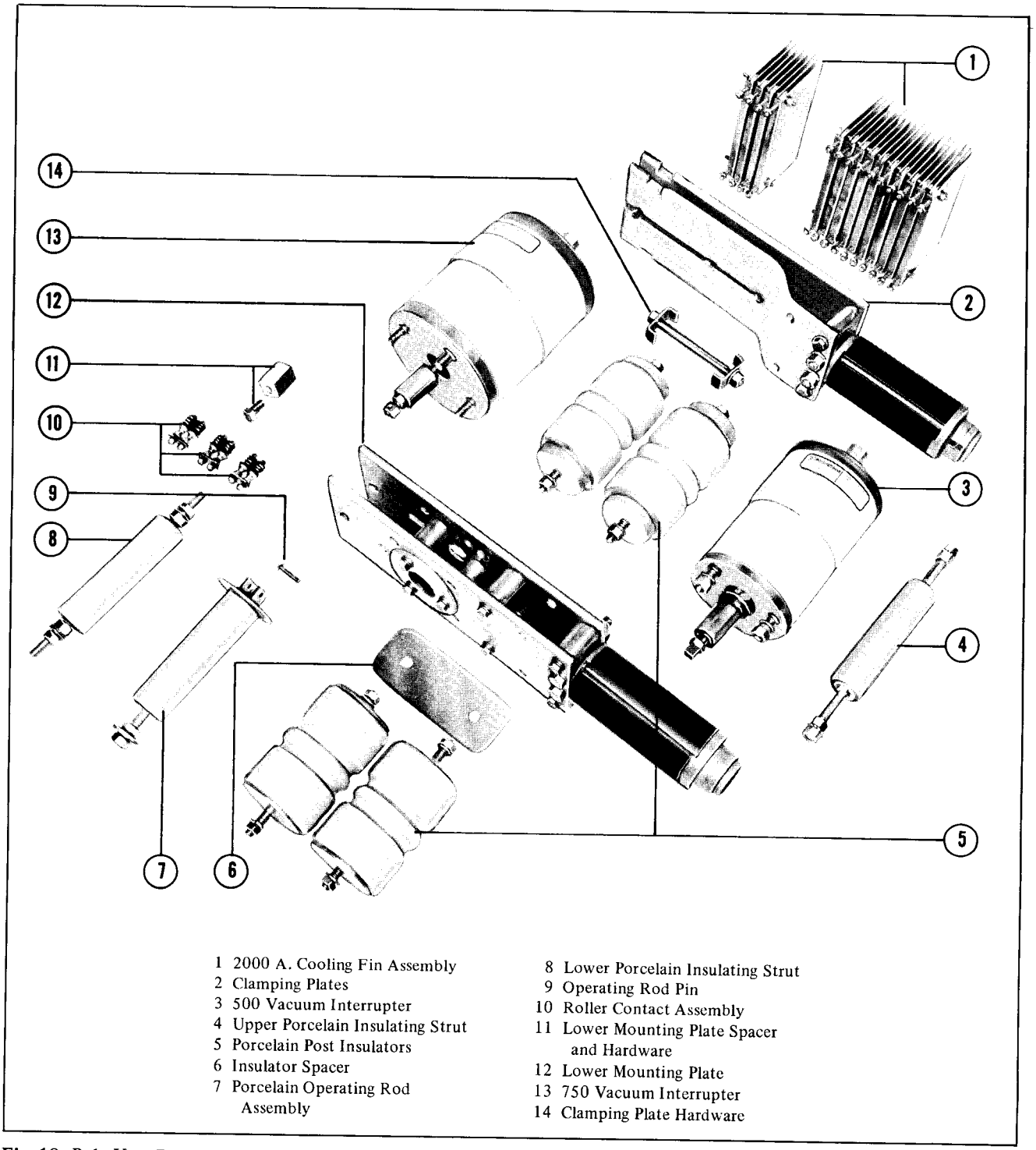


Fig. 17 *Measuring Wear Gap*



1 2000 A. Cooling Fin Assembly
2 Clamping Plates
3 500 Vacuum Interrupter
4 Upper Porcelain Insulating Strut
5 Porcelain Post Insulators
6 Insulator Spacer
7 Porcelain Operating Rod Assembly
8 Lower Porcelain Insulating Strut
9 Operating Rod Pin
10 Roller Contact Assembly
11 Lower Mounting Plate Spacer and Hardware
12 Lower Mounting Plate
13 750 Vacuum Interrupter
14 Clamping Plate Hardware

Fig. 18 *Pole Unit Details*

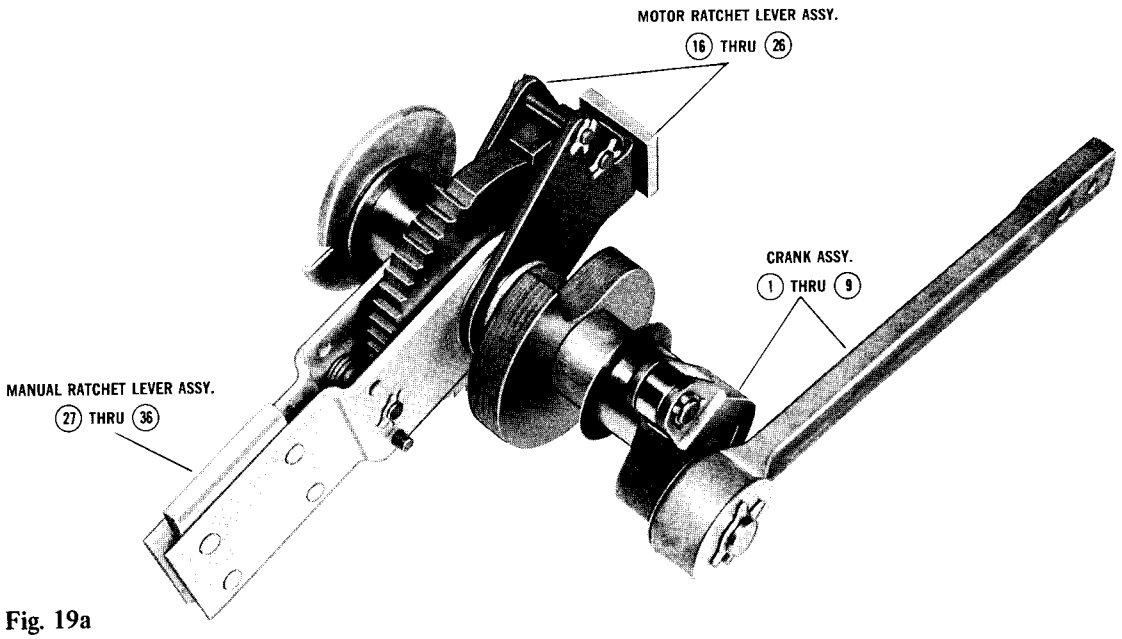


Fig. 19a

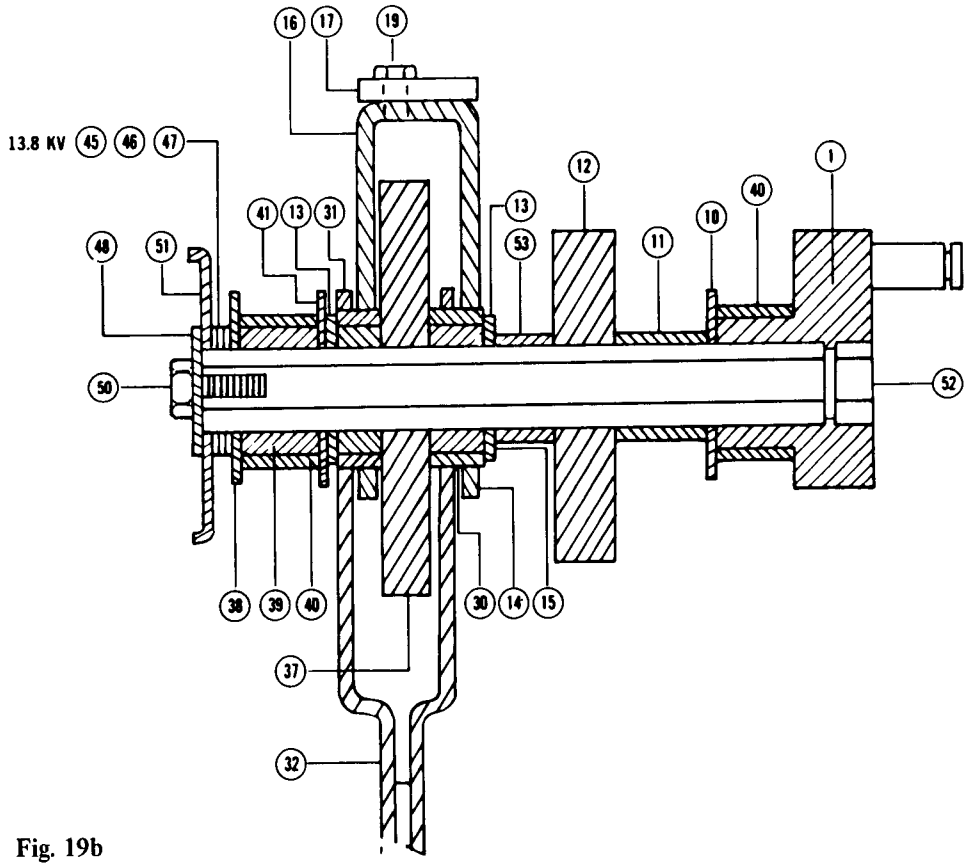
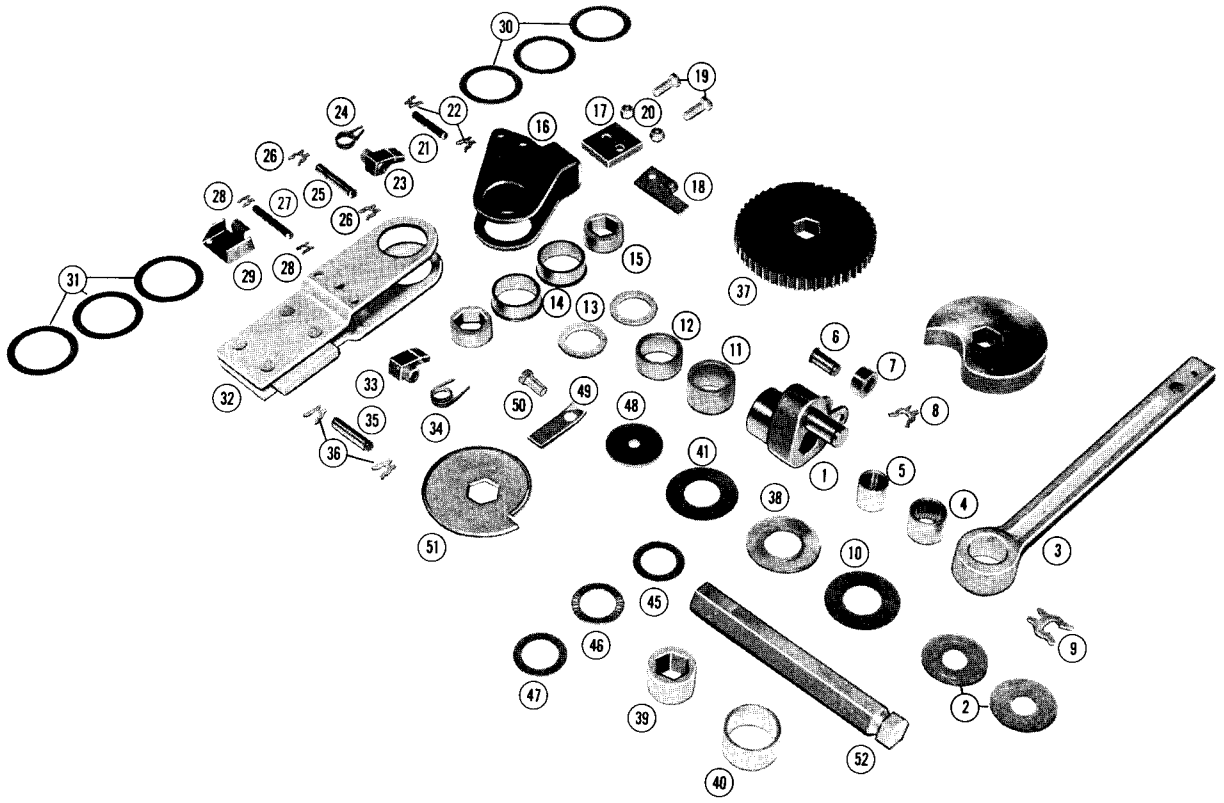


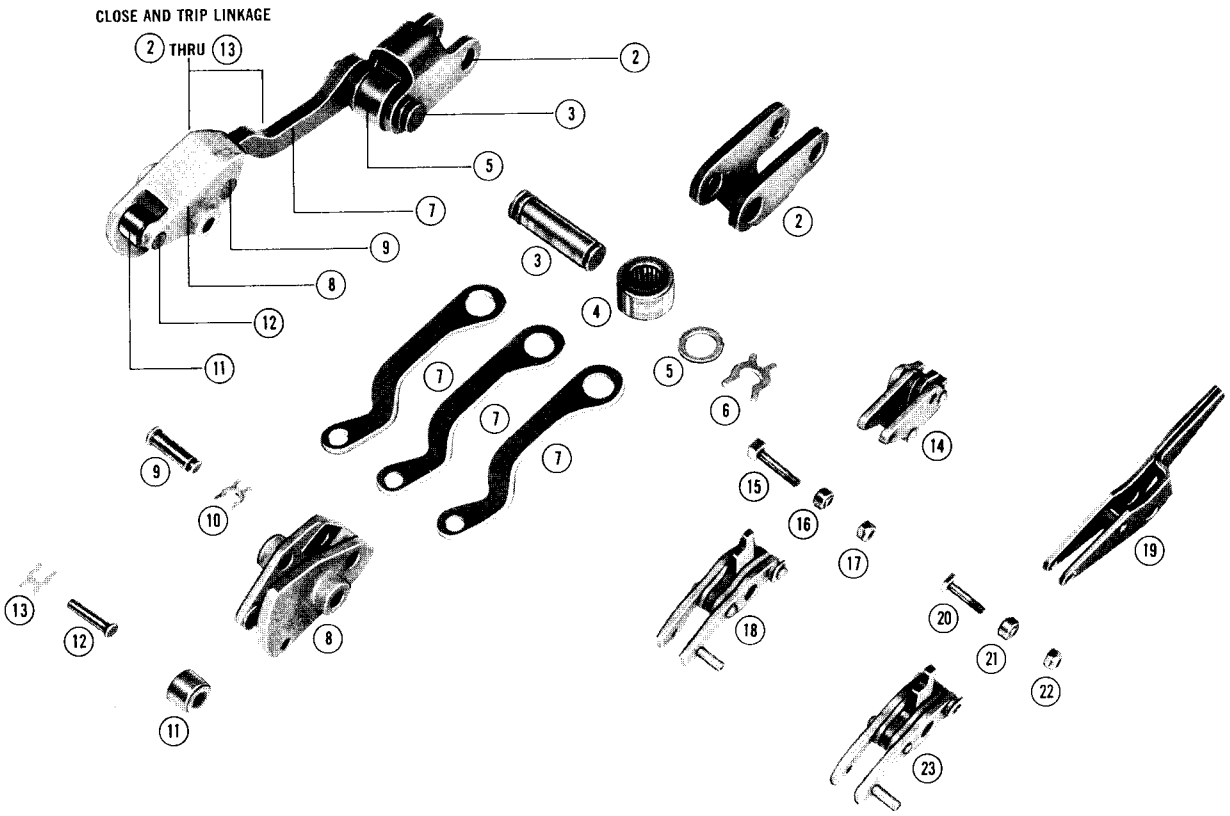
Fig. 19b

Fig. 19 *Stored Energy Mechanism; Crank Shaft Subassembly*



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

Fig. 19c *Stored Energy Mechanism; Parts for Crank Shaft Subassembly*



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

Fig. 20 *Stored Energy Mechanism; Parts for Close and Trip Linkage Subassembly*

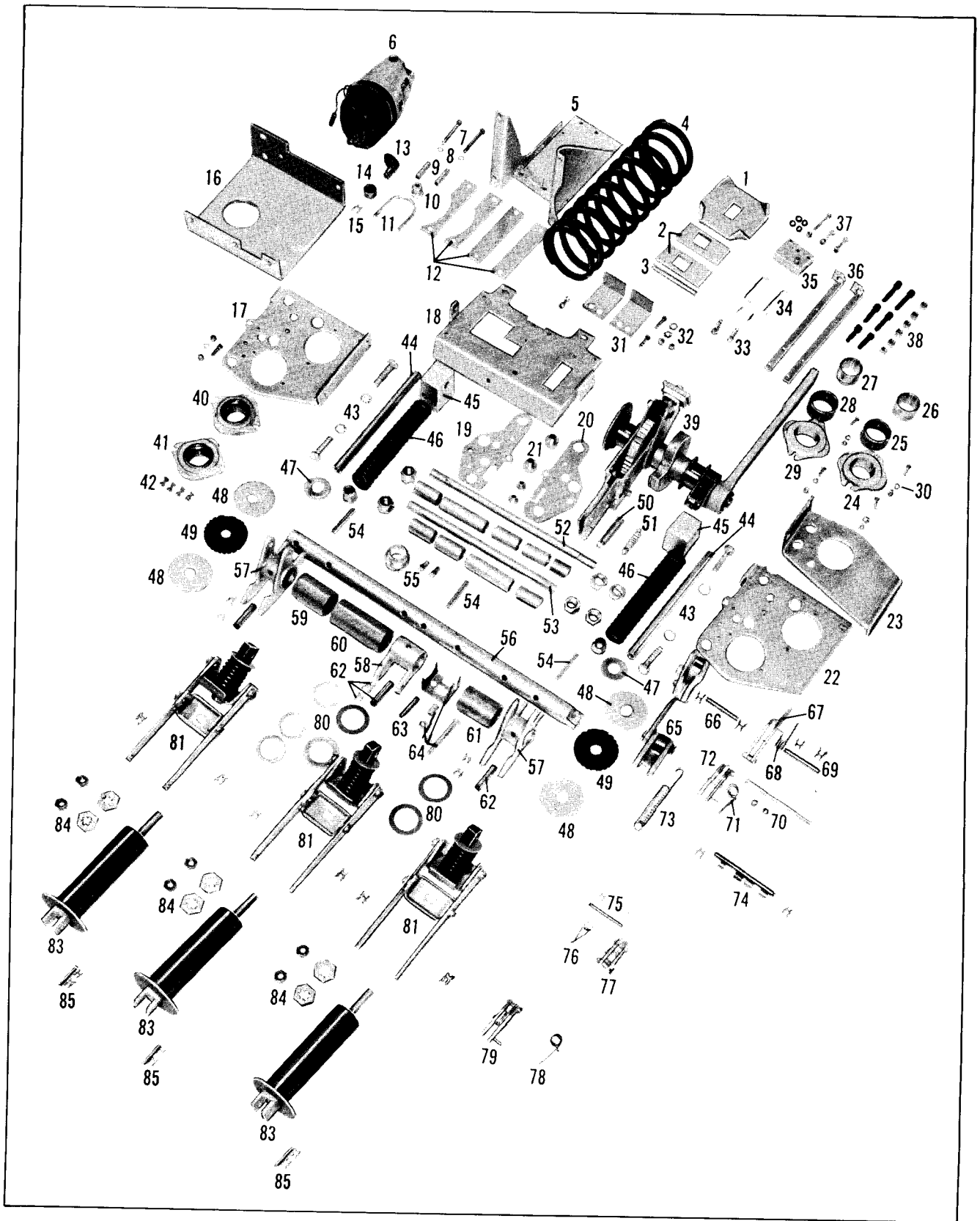


Fig. 21 *Parts for Stored Energy Mechanism*

1 Closing Spring Retainer Plate
2 Closing Spring Spacers
3 Closing Spring Retaining Pin
4 Closing Spring
5 Mechanism Frame: Motor Mounting Bracket
6 Spring Charging Motor
7 Rear Motor Mounting Bolts (2)
8 Washers for Item 7
9 Spacers for Item 7
10 Pipe Plug
11 U-Bolt
12 Motor Mounting Plates
13 Driving Eccentric
14 Driving Roller
15 X-Washer for Item 13
16 Mechanism Frame L.H. Bearing Plate
17 Mechanism Frame L.H. Side Plate
18 Mechanism Frame Rear Plate
19 Mechanism Frame L.H. Front Plate
20 Mechanism Frame R.H. Front Plate
21 Inserts for Items 19 and 20 (4)
22 Mechanism Frame R.H. Side Plate
23 Mechanism Frame R.H. Bearing Plate
24 Pole Shaft Bearing Casting
25 Pole Shaft Bearing
26 Pole Shaft Bearing Inner Race
27 Crank Shaft Bearing Inner Race
28 Crank Shaft Bearing
29 Crank Shaft Bearing Casting
30 Bearing Assembly: Mounting Hardware
31 Main Link Stops (2)
32 Hardware for Item 31
33 Floor Interlock Retrieving Springs (2)
34 Floor Interlock Connecting Links (2) and Hardware (2)
35 Floor Interlock Mounting Block
36 Floor Interlock Operating Levers (2)
37 Hardware for Floor Interlock
38 Frame Member Fastening Bolts (6) and Nuts (6)
39 Crank Shaft Sub Assembly
40 Crank Shaft Bearing Assembly
41 Pole Shaft Bearing Assembly
42 Bearing Assembly: Mounting Hardware
43 Opening Spring Guide Rod Hardware (8)
44 Opening Spring Guide Rod (2)
45 Opening Spring Guide Rod Mounting Block (2)
46 Opening Spring (2)
47 Opening Spring Compressing Washer (2)
48 Opening Spring Stop Plate (4)
49 Opening Spring Stop Pad (2)
50 Motor Ratchet Lever Retrieving Spring
51 Manual Ratchet Lever Retrieving Spring
52 Upper Frame Tie Bolt, Spacers and Hardware
53 Lower Frame Tie Bolt, Spacers and Hardware
54 Pole Unit Operating Lever Pins (3)
55 Manual Ratchet Lever Adjusting Collar (1) and Hardware (2)
56 Pole Unit Operating Shaft
57 Pole Unit Operating Lever Outside Poles (2)
58 Pole Unit Operating Lever Center Pole
59 Pole Unit Operating Shaft Spacer
60 Pole Unit Operating Shaft Spacer
61 Pole Unit Operating Shaft Spacer
62 Pole Unit Operating Lever Pin (3) and X-Washers (6)
63 Closed Breaker Interlock Adjusting Screw
64 Levering in Device Interlock Bracket (1) and Hardware (3)
65 Close and Trip Linkage Subassembly
66 Main Link Connecting Pin (1) and X-Washers (2)
67 Closing Latch
68 Closing Latch Spring
69 Closing Latch Pivot Pin (1) and X-Washers (2)
70 Latch and Trigger Spring Stop Pin (1) and Hardware (2)
71 Closing Trigger Spring
72 Closing Trigger
73 Main Link Retrieving Spring
74 Trigger Pivot Pin, Spacers, and X-Washers
75 Tripping Latch Pivot Pin (1) and X-Washers (2)
76 Tripping Latch Spring
77 Tripping Latch
78 Tripping Trigger Spring
79 Tripping Trigger
80 Pole Unit Operating Shaft Shims (7)
81 Anti Bounce Operating Lever Assemblies (3)
82 Hinges (6) and X-Washers (6) for Item 81
83 Porcelain Operating Rod Assemblies (3)
84 Hardware for Item 83
85 Operating Rod Connecting Pins (3) and X-Washers (6)

Legend for Figure 21