SUPPLEMENTARY INSTRUCTIONS

For

AIR CIRCUIT BREAKER TYPES 75DH250E/500E AND 150DH150E/250E/500E 1200-2000 AMPERE RATINGS

These supplementary instructions are to be used in conjunction with DH Breaker Instruction Book I.B. 32-251-3. Only those features which apply to the Types listed above are covered by these instructions. These instructions provide additional information, and serve as a guide to references of sections in Instruction Book 32-251-3 for easy reference.

NOVEMBER, 1959

WESTINGHOUSE ELECTRIC CORPORATION

ASSEMBLED SWITCHGEAR DEVICES

EAST PITTSBURGH PLANT • EAST PITTSBURGH, PA.

DESCRIPTION

The Type 75 DHE and 150 DHE Air Circuit Breakers are 3-pole, electrically operated, horizontal drawout units for metal-clad switchgear. The rating of the breakers are as follows:

Breaker Type	75DH250E	75DH500E	150DH150E	150DH250E	150DH500E
Interrupting Rating	250 MVA	500 MVA	150 MVA	250 MVA	500 MVA
Continuous 60 Cycle Rating	1200-2000 A.	1200-2000 A.	1200 A.	1200-2000 A.	1200-2000 A.
Rated Voltage	7200 V.	7200 V.	13800 V.	13800 V.	13800 V.
Maximum Design Voltage	8250 V.	8250 V.	15000 V.	15000 V.	15000 V.
Minimum Voltage For Interrupting Capacity	4600 V.	6600 V.	6600 V.	6600 V.	11500 V.
Interrupting Current At Rated Voltage	20000 A.	40000 A.	6300 A.	10600 A.	21000 A.
Maximum Interrupting Current	32000 A.	44000 A.	13000 A.	22000 A.	25000 A.

Figure 1 shows a typical breaker completely assembled as it is placed into the cell.

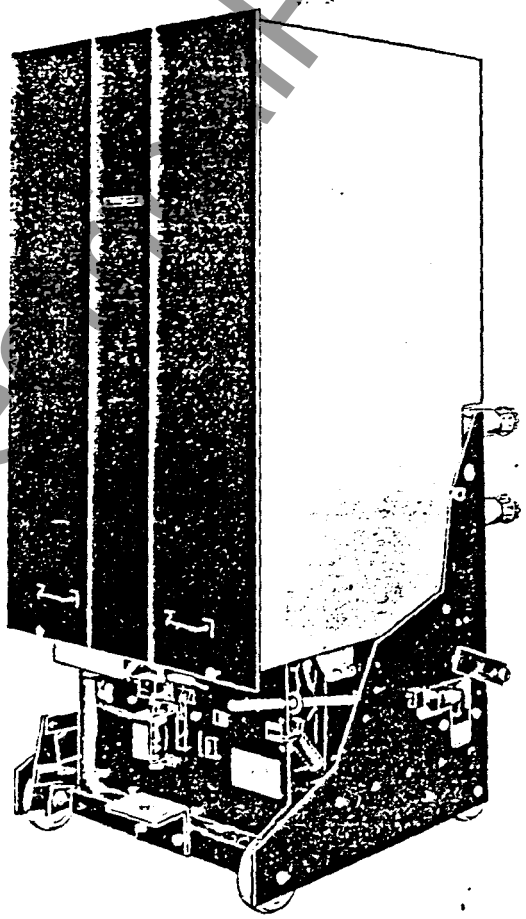

FIG. 1 TYPICAL BREAKER COMPLETELY ASSEMBLED

Figure 2 shows the barrier removed, the arrangement of the center coil arc chutes, the contacts, and the solenoid operating mechanism.

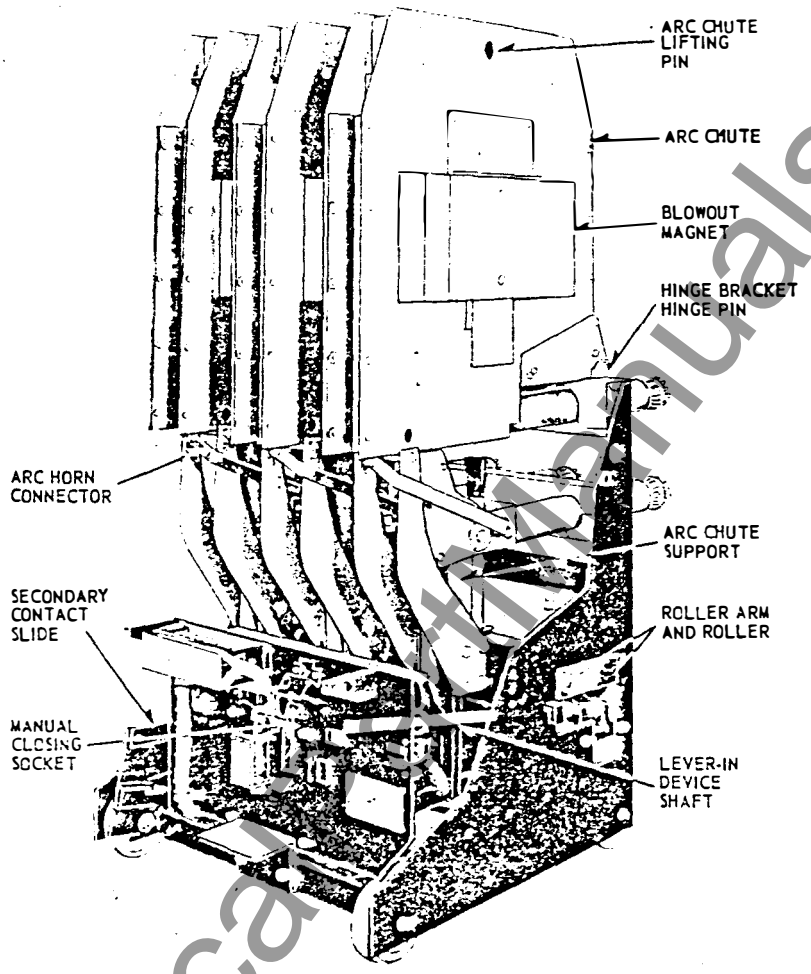

FIG. 2. CIRCUIT BREAKER WITH MAIN BARRIER REMOVED

These components are supported on a welded steel frame which is mounted on flanged wheels for driving it into the metal clad cell. In the lower part of the frame is also located the levering-in device for moving the breaker into final contact engagement. This device is interlocked with the mechanism to prevent inserting or withdrawing the breaker with the contacts closed. Also located in the lower part of the frame are the secondary contacts for automatically disconnecting the control wiring when the breaker is withdrawn, the auxiliary switch, and other auxiliary devices.

The arc chutes on this breaker are of the center coil design. In this type of construction, the magnetic circuit is H-shaped with the cross member of the H passing through the center of the arc chute. The blowout coils are wound around the cross member of the H and lie in the center of the arc chute.

With this type of construction, the magnetic core passes through the center of the arc chute, and is an integral part of the arc chute assembly. To provide easy accessibility for contact maintenance and inspection, the arc chutes are hinged at the rear, and a simple tilting device is provided. Figure 3 shows the breaker with the arc chutes tilted back. The levering-in device is used to supply the mechanical advantage for tilting the arc chutes.

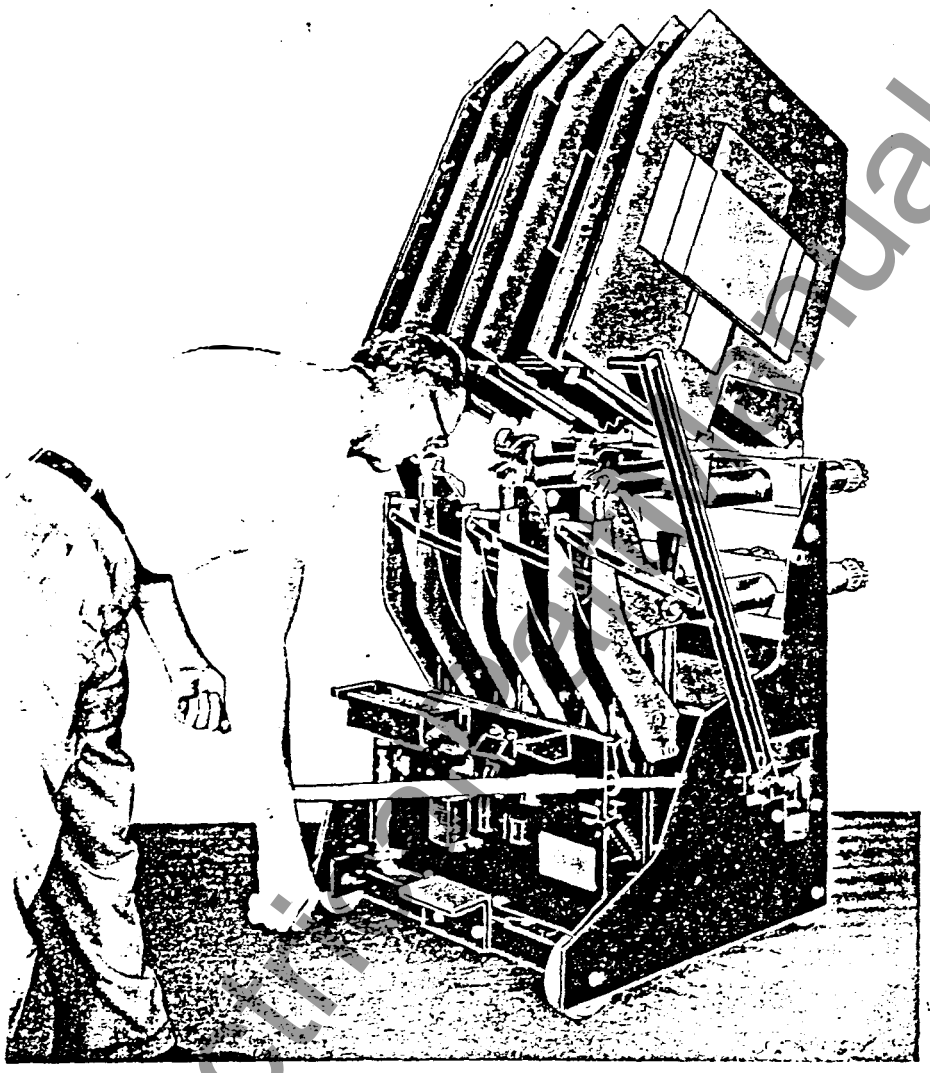

FIG. 3. CIRCUIT BREAKER WITH MAIN BARRIER REMOVED AND ARC CHUTES RAISED

A barrier assembly is placed on the breaker before it is rolled into its cell. The front sheet is 1/8 inch steel to form a grounded barrier between personnel and live parts when the unit is in the cell. The barrier assembly is in four parts for convenience in handling. There are three separate insulating barrier compartments - a left, center, and right unit placed side by side. The front steel barrier is supported by two hangers which engage the barriers at the top. The bottom of the barrier is secured with two hexagon head bolts which attach to the frame structure.

RECEIVING, HANDLING AND STORING

The receiving, handling and storing of the breakers should be done in the manner set forth in the instruction book I.B. 32-251-3. The approximate weight of the breakers and the various parts are as follows.

Breaker Parts	1200 Amperes	2000 Amperes
Breaker without arc chute and barriers	950 pounds	1230 pounds
Single arc chute	265 pounds	265 pounds
Barrier assembly	200 pounds	200 pounds
Complete breaker	1945 pounds	2225 pounds

INSTALLATION

With the exception of the arcing chambers and the barriers, these breakers are shipped completely assembled and adjusted. No adjustment should be required and none should be made unless obviously needed.

CAUTION: Severe injury may be sustained if any part of the body is struck by the contact arms since they move very rapidly in the opening stroke. Personnel working about the breaker should stay clear of the space in which the contact arms move while the breaker is closed or being closed. If breaker has been closed by hand, always remove the hand closing lever before tripping.

The following sequence of operation should be performed in preparing the breaker for use:

1. Breakers are usually shipped with the contacts closed and with a tie on the trip lever to prevent tripping. After the breaker is unpacked and the shipping ties and braces removed, take off the tie on the trip lever and trip the breaker. Then close the breaker carefully by hand using the removable hand closing lever. Make certain that all parts are functioning properly in that there is no binding or excessive friction. As the contacts touch near the end of the closing stroke, the force necessary to close the breaker increases rapidly.

2. With the breaker in the closed position, check the contacts to make certain that the adjustments have not been disturbed. For proper settings, refer to Figure 24 of I.B. 32-251-3. If adjustments are required, they may be made as described on Page 23. A light film of grease is applied to both the arcing and main contacts before the breaker is operated at the factory. This film is normally removed before shipment. Before the breaker is placed in service, inspect all contacts to see that they are free of oil or grease.

3. The breaker is more easily handled with the arc chutes and barriers removed. Mount these parts after the breaker has been moved near the metal clad cell structure. Before installing the arc chutes, play a stream of dry compressed air through them from each end to remove any dust or foreign matter. Then examine the chutes to make certain that the vents and slots are free of any foreign material.

4. Mount the arc chutes one at a time in the following manner:

a. Place a rope sling through the 5/8 dia. stud located at the top center of each arc chute.

b. Lift the arc chutes and lower them carefully over each phase making certain that they center over the contact structure without striking the ceramic pieces.

c. Remove the hinge pin from the upper bushing flange.

d. Lower arc chute into place so that back end is between hinge bracket on upper bushing flange. Use care in lining up the arc chute so that rear arc horn clip makes good contact with upper contact foot.

e. Insert hinge pin and put cotter pins in place.

f. Bolt arc horn connector to front arc horn in the chute.

g. Tighten lower connection of arc horn connector since it may have come loose during shipment.

h. Make final check by operating breaker slowly by hand, and see that there is no interference with the movement of the contacts.

5. The interphase barrier should now be put in place. Because of the size and weight, the barrier assembly is divided into four parts. Three of the parts consist of insulating compartments - left phase, center phase and right phase. The compartments are not interchangeable due to the location of the hanger pin for the front steel barrier, one of which is at the top left side, and the other at the top right side. Interchanging the two end compartments will place the supporting pins at the incorrect location for the steel front barrier. After the compartments are slid into place, the steel barrier is placed flatly against the compartments at a slightly higher elevation and slowly lowered until the hooks engage the pins at both sides. The lower end of the steel barrier is then secured to the frame structure with two hex head bolts, making certain that the barrier is vertically straight in position to enter the cell opening.

6. The breaker is now ready to be operated electrically. Each breaker should be closed and tripped electrically several times before being connected to high voltage. These operations may be made at the test position in the cell or by means of other test facilities provided. See Pages 17, 18, 19, and 20 of I.B. 32-251-3 for information concerning placing the breaker in the cell. The hand closing lever must be always removed from the socket in the mechanism before making electrical operations. If electrical operation is quick and positive on both the close and trip, the breaker is now ready to be levered into the operating position.

CAUTION: Do not attempt to close the breaker by hand against an energized circuit. To insure sufficient closing force and speed, the breaker should be closed electrically from an adequate power source. See NEMA standard SG-6-213.

When the breaker is put into the cell and moved in beyond the test position, the high voltage parts will be energized. If the barrier is completely assembled on the breaker, personnel will be protected from contact with the live parts. If however, the barrier assembly is left off and the breaker rolled into the cell, live parts are exposed. The breaker never should be rolled into an energized cell structure beyond the test position without having the arc chutes and complete barrier assembly in place.

OPERATION AND ADJUSTMENT

The operation and adjustments of the breaker is the same as that for the breakers described in I.B. 32-251-3. Reference should be made to Pages 9 through 12 of the I.B. for information covering the Mechanism, Mechanism Panel with its associated tripping device and auxiliaries, and Mechanism Adjustments.

CONTACT ADJUSTMENT

The contacts on this breaker are the same as those described on Pages 23 and 26, in the instruction book. Any adjustments that are necessary should be made as outlined in that section.

ARC CHUTES

The arc chute, Fig. 15 of I.B. 32-251-3, consists of an H-shaped blowout magnet, blowout coils, transfer arc horns, transfer stacks, main interrupter stacks, a front arc horn, and a rear arc horn, all assembled in and about a fabricated rectangular chute jacket. The arc chute is hinged to the breaker and when it is in the normal position, its lower end completely surrounds the contact structure.

The blowout magnet is located so that the magnetic core passes through the center of the arc chute. The blowout coils are wound about the core and lie in windows cut in the chute side sheets. One terminal of each coil connects to a transfer arc horn and the other terminals are joined together with the shading coil. Two transfer stacks are placed in the space between the transfer arc horns and the shading coil. To either side of the transfer arc horns are the main interrupter stacks which are made up of a series of insulating refractory plates. These plates have inverted V-shaped slots. The slots are off set so that as the plates are stacked with the slots alternating from one side to the other, the arc must take a serpentine path as it moves up into the arc chute, thus increasing the length of the arc.

To either side of the main interrupter stacks are two metallic arc horns to which the arc transfers from the arcing contacts. The front arc horn is connected electrically to the moving contact hinge, and the rear arc horns automatically connects to the stationary contact when the arc chute is lowered to its normal position.

The action of the breaker in interrupting an arc is as follows: Referring to Figure 15, when the arcing contacts part and an arc is drawn, it loops up and impinges on the lower ends of the two transfer arc horns and the shading coil. The two short segments of arc from the transfer arc horns to the shading coil then move up into the transfer stacks and are quickly interrupted placing the blowout coil in series with the arc.

When the current starts to flow in the blowout coils, a magnetic field is established and the arc, which by this time is two separate arcs, extending from the two end arc horns to the transfer horns, is driven very rapidly up into the slots of the refractory plates. As the arc moves to the closed end of the slots, it is restricted, lengthened, cooled, and subject to to a strong magnetically induced blast of gas. All of these forces result in rapid "de-ionization" of the arc space, and for the arc to maintain itself it must continually ionize fresh gas. At current zero the formation of new ionization momentarily ceases, but the de-ionization continues so that dielectric strength is established in the arc space and the circuit is interrupted.

ARC CHUTE LIFTER

In order to raise the arc chutes for contact inspection and maintenance, an arc chute lifter is provided. This attachment which uses the mechanical advantage of the levering-in device to provide the lifting force, consists of a 1" diameter steel bar, and two channel shaped arms. The steel bar is inserted through the arc chute openings, and the arms are secured in place as shown in Fig. 3.

To raise the arc chutes refer to Figure 3 and proceed as follows:

1. Remove barrier assembly.

2. Place 1" diameter steel bar through large 1-1/8 diameter holes in front of arc chutes.

3. Fasten the channel arms to the ends of the 1" diameter bar.

4. Place crank on levering-in device operating shaft and rotate clockwise so that the rollers at each side of the breaker advance forward enough to insert the opposite end of the channel arms. Clamp the arms over the rollers.

5. Disconnect shunt straps from front arc horn.

6. Place crank on levering-in operating shaft and continue to rotate clockwise to raise the arc chute to position shown in Figure 3.

It is important that the arc chutes be raised until the indicator on the front of the breaker shows that the full travel of the levering-in device has been used. This releases the mechanism interlock and permits the breaker to be closed and tripped either electrically or manually with the arc chutes in the raised position.

To lower the arc chutes and prepare the breaker for return to service, repeat the steps 1 to 6 in reverse order.

CAUTION: After inspecting the contacts and arc chutes and before returning the breaker to service, make certain that the shunt connection to the front arc horns is bolted tight.

HORIZONTAL DRAWOUT ARRANGEMENT

The breaker is arranged for use in horizontal drawout metal clad equipment and any questions pertaining to this arrangement, which includes operation of the breaker levering-in device, should be referred to I.B. 32-251-3 Pages 8 through 22.

MAINTENANCE

Maintenance procedure for the air circuit breaker, refer to I.B. 32-251-3, Pages 26 through 30.

PARTS IDENTIFICATION

Instruction Book 32-251-3 illustrates similar parts used on these breakers. Parts for a particular breaker can be identified by these illustrations, specifically mentioning the

type and rating of the breaker for which the parts are required. The breaker nameplate will identify the breaker type and rating.

MOTOR OPERATED BREAKERS

A separate instruction book is supplied for breakers having a motor-spring type of closing mechanism, and are supplied with the order involving this type of equipment.

MEMORANDUM

MEMORANDUM

SUPPLEMENTARY INSTRUCTIONS

AIR CIRCUIT BREAKER TYPE 150-DH-750E

E
Coil #
Back Page

These supplementary instructions are to be used in conjunction with DH Breaker Instruction Book I.B. 32-251-3. Only those features which are peculiar to the Type 150-DH-750E Air Circuit Breaker are covered by these instructions.

APRIL, 1963

WESTINGHOUSE ELECTRIC CORPORATION
Assembled Switchgear & Devices

EAST PITTSBURGH PLANT • EAST PITTSBURGH, PA.

DESCRIPTION

The Type 150-DH-750E Air Circuit Breaker is a 3-pole, electrically operated, horizontal drawout unit for metal-clad switchgear. The rating of the breaker is as follows:

1.	Interrupting rating	750 MVA
2.	Continuous current at 60 cycles	1200 and 2000 amperes
3.	Rated voltage	13.8 KV
4.	Maximum design voltage	15.0 KV
5.	Minimum voltage for rated interrupting capacity	11.5 KV
6.	Interrupting current at rated voltage	31,500 amperes
7.	Maximum interrupting current	37,500 amperes

Figure 1 shows a typical breaker completely assembled as it is placed into the cell.

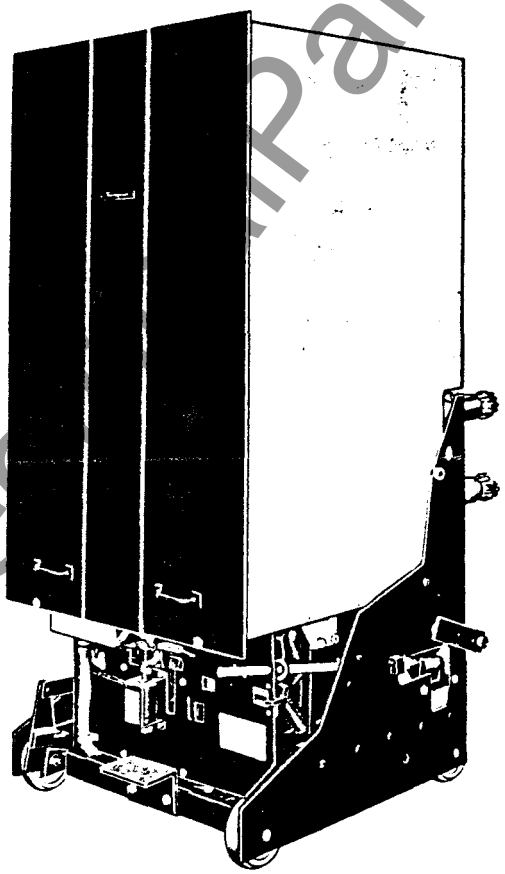

FIG. 1 150-DH-750E CIRCUIT BREAKER COMPLETELY ASSEMBLED

Figure 2 shows the arrangement of the center coil arc chutes, the contacts, and the solenoid operating mechanism.

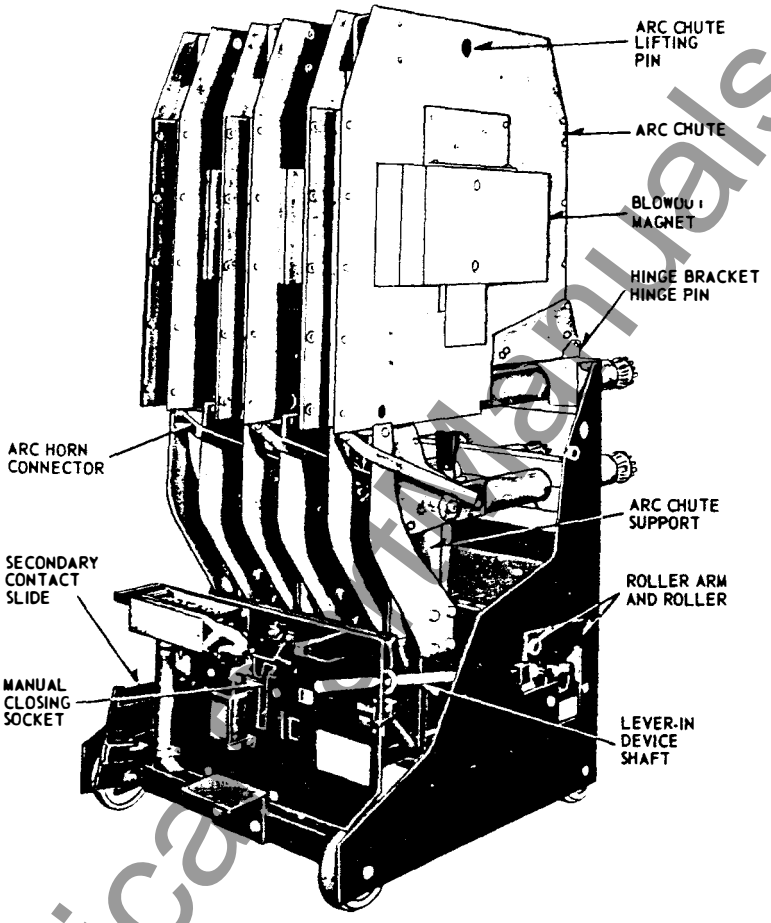

FIG. 2 CIRCUIT BREAKER WITH MAIN BARRIER REMOVED

These components are supported on a welded steel frame which is mounted on flanged wheels for driving it into the metal clad cell. In the lower part of the frame is also located the levering-in device for moving the breaker into final contact engagement. This device is interlocked with the mechanism to prevent inserting or withdrawing the breaker with the contacts closed. Also located in the lower part of the frame are the secondary contacts for automatically disconnecting the control wiring when the breaker is withdrawn, the auxiliary switch, and other auxiliary devices.

The arc chutes on this breaker are of the center coil design. In this type of construction, the magnetic circuit is H-shaped with the cross member of the H passing through the center of the arc chute. The blowout coils are wound around the cross member of the H and lie in the center of the arc chute.

With this type of construction, the magnetic core passes through the center of the arc chute, and is an integral part of the arc chute assembly. To provide easy accessibility

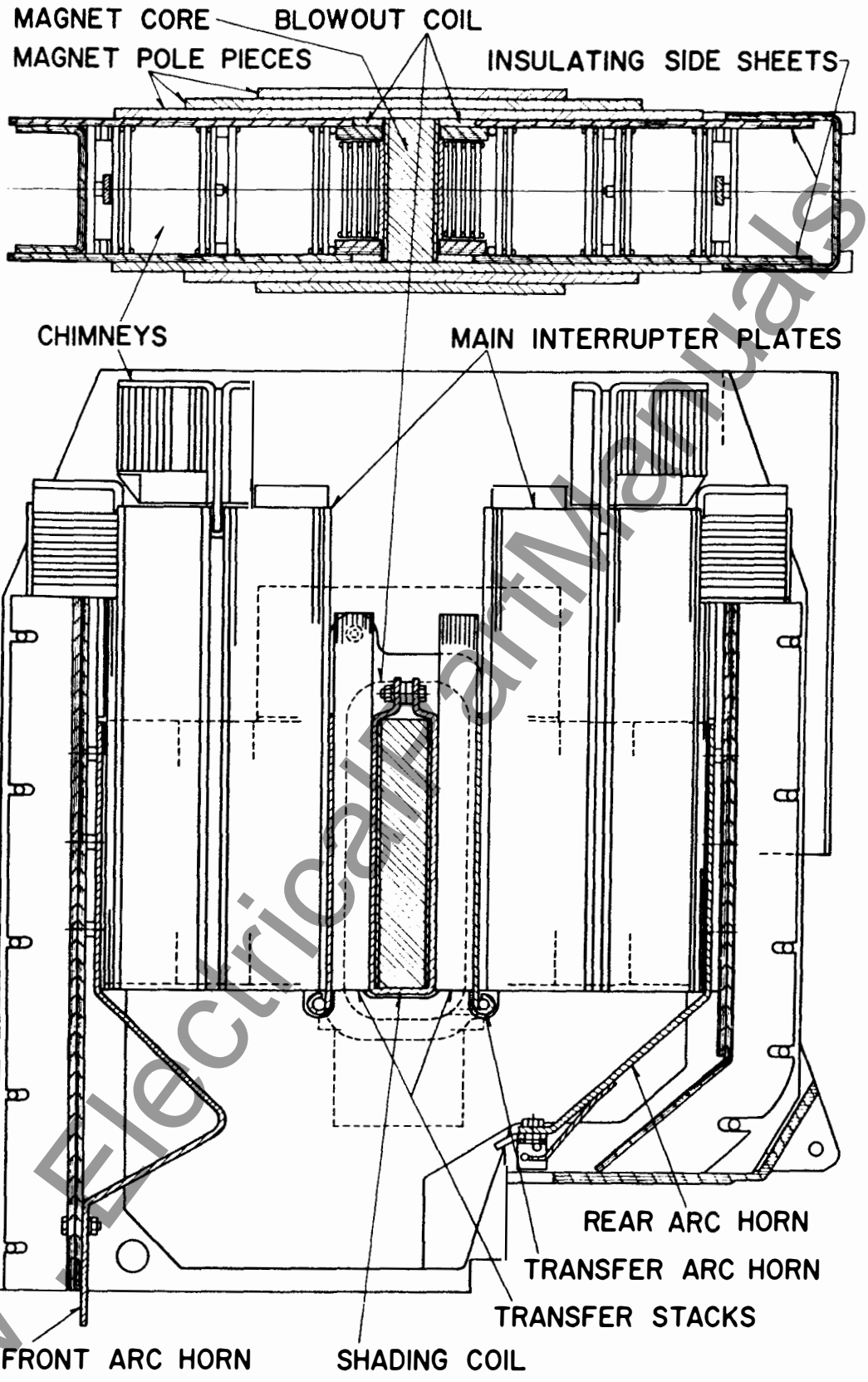

FIG. 3 SCHEMATIC CROSS-SECTION OF AN ARC CHUTE SHOWING COMPONENT PARTS

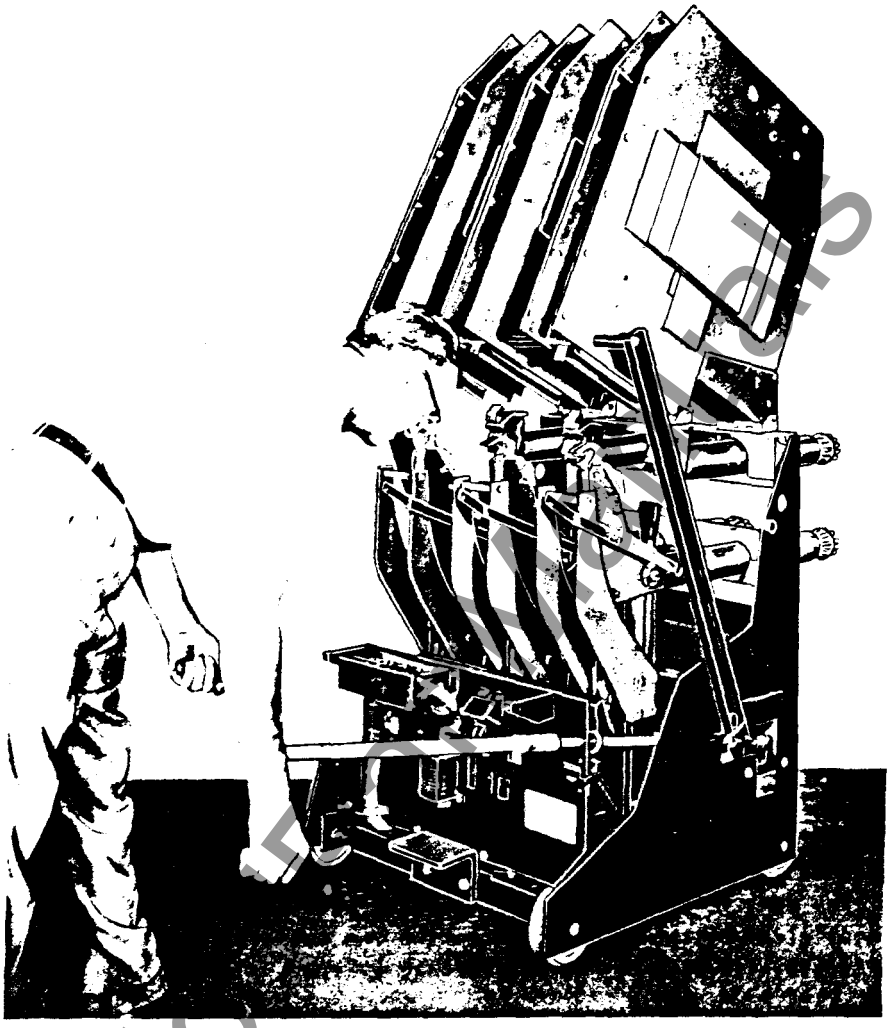

FIG. 4 CIRCUIT BREAKER WITH MAIN BARRIER REMOVED AND ARC CHUTES RAISED

for contact maintenance and inspection, the arc chutes are hinged at the rear, and a simple tilting device is provided. Figure 4 shows the breaker with the arc chutes tilted back. The levering-in device is used to supply the mechanical advantage for tilting the arc chutes.

A barrier assembly is placed on the breaker before it is rolled into its cell. The front sheet is 1/8 inch steel to form a grounded barrier between personnel and live parts when the unit is in the cell. On the 150-DH-750E breakers, the barrier assembly is in three parts for convenience in handling.

RECEIVING, HANDLING AND STORING

The receiving, handling and storing of the 150-DH-750E breaker should be done in the manner set forth in the instruction book I.B. 32-251-3. The approximate weight of the breaker and the various breaker parts is as follows.

Breaker Parts	1200 Amperes	2000 Amperes
Breaker without arc chute and barriers	950 pounds	1230 pounds
Single arc chute	350 pounds	350 pounds
Barrier assembly	200 pounds	200 pounds
Complete breaker	2200 pounds	2480 pounds

INSTALLATION

With the exception of the arcing chambers and the barriers, these breakers are shipped completely assembled and adjusted. No adjustment should be required and none should be made unless obviously needed.

CAUTION: Severe injury may be substained if any part of the body is struck by the contact arms since they move very rapidly in the opening stroke. Personnel working about the breaker should stay clear of the space in which the contact arms move while the breaker is closed or being closed. If breaker has been closed by hand, always remove hand closing lever before tripping.

The following sequence of operation should be performed in preparing the breaker for use:

1. Breakers are usually shipped with the contacts closed and with a tie on the trip lever to prevent tripping. After the breaker is unpacked and the shipping ties and braces removed, take off the tie on the trip lever and trip the breaker. Then close the breaker carefully by hand using the removable hand closing lever. Make certain that all parts are functioning properly in that there is no binding or excessive friction. As the contacts touch near the end of the closing stroke, the force necessary to close the breaker increases rapidly.

2. With the breaker in the closed position, check the contacts to make certain that the adjustments have not been disturbed. For proper settings, refer to Figure 24 of I.B. 32-251-3. If adjustments are required, they may be made as described on Page 23. A light film of grease is applied to both the arcing and main contacts before the breaker is operated at the factory. This film is normally removed before shipment. Before the breaker is placed in service, inspect all contacts to see that they are free of oil or grease.

3. The breaker is more easily handled with the arc chutes and barriers removed. Mount these parts after the breaker has been moved near the metal clad cell structure. Before installing the arc chutes, play a stream of dry compressed air through them from each end to remove any dust or foreign matter. Then examine the chutes to make certain that the vents and slots are free of foreign material.

4. Mount the arc chutes one at a time in the following manner:

   a. Place a rope sling through the 5/8 dia. stud located at the top center of each arc chute.

   b. Lift the arc chutes and lower them carefully over each phase making certain that they center over the contact structure without striking the ceramic pieces.

   c. Remove the hinge pin from the upper bushing flange.

   d. Lower arc chute into place so that back end is between hinge bracket on upper bushing flange. Use care in lining up the arc chute so that rear arc horn clip makes good contact with upper contact foot.

   e. Insert hinge pin and put cotter pins in place.

   f. Bolt arc horn connector to front arc horn in the chute.

   g. Tighten lower connection of arc horn connector since it may have come loose during shipment.

   h. Make final check by operating breaker slowly by hand, and see that there is no interference with the movement of the contacts.

5. The interphase barrier should now be put in place. Because of the size and weight, the barrier assembly is divided into four parts. The center part goes on first and is aligned by the two locating pins on the breaker frame. A single bolt in the center holds it in place. The two outside sections mount next. Make sure the lower rear corner of the Micarta plate goes to the inside of the steel gussets on the breaker frame. These two parts are aligned by locating pins in the lower front corners and bolts to the center barrier. Two bolts at the lower front corners hold these assemblies in place.

6. The breaker is now ready to be operated electrically. Each breaker should be closed and tripped electrically several times before being connected to high voltage. These operations may be made at the test position in the cell or by means of other test facilities provided. See Pages 17, 18, 19, and 20 of I.B. 32-251-3 for information concerning placing the breaker in the cell. The hand closing lever must be always removed from the socket in the mechanism before making electrical operations. If electrical operation is quick and positive on both the close and trip, the breaker is now ready to be levered into the operating position.

CAUTION: Do not attempt to close the 150-DH-750E breaker by hand against an energized circuit. To insure sufficient closing force and speed, the breaker should be closed electrically from an adequate power source. See NEMA standard SG-6-213.

When this breaker is put into the cell and moved in beyond the test position, the high voltage parts will be energized. If the barrier is completely assembled on the breaker, personnel will be protected from contact with the live parts. If however, the barrier assembly is left off and the breaker rolled into the cell, live parts are exposed. The breaker never should be rolled into an energized cell structure beyond the test position without having the complete barrier assembly in place.

OPERATION AND ADJUSTMENT

The operation and adjustments of the breaker is the same as that for the breakers described in I.B. 32-251-3. Reference should be made to Pages 9 through 12 of the I.B. for information covering the Mechanism, Mechanism Panel with its associated tripping device and auxiliaries, and Mechanism Adjustments.

CONTACT ADJUSTMENT

The contacts on this breaker are the same as those described on Pages 23 and 26 in the instruction book. Any adjustments that are necessary should be made as outlined in that section.

ARC CHUTES

The arc chute consists of an H-shaped blowout magnet, blowout coils, transfer arc horns, transfer stacks, main interrupter stacks, a front arc horn, and a rear arc horn, all assembled in and about a fabricated rectangular chute jacket. The arc chute is hinged to the breaker and when it is in the normal position, its lower end completely surrounds the contact structure. Figure 3 is a schematic cross section of the arc chute showing the component parts.

The blowout magnet is located so that the magnetic core passes through the center of the arc chute. The blowout coils are wound about the core and lie in windows cut in the chute jackets side sheets. One terminal of each coil connects to a transfer arc horn and the other terminals are joined together with the shading coil. Two transfer stacks are placed in the space between the transfer arc horns and the shading coil. To either side of the transfer arc horns are the main interrupters stacks which are made up of a series of insulating refractory plates. These plates have inverted V-shaped slots. The slots are off set so that when the plates are stacked with the slots alternating from one side to the other, the arc must take a serpentine path as it moves up into the arc chute, thus increasing the length of the arc.

To either side of the main interrupter stacks are two metallic arc horns to which the arc transfers from the arcing contacts. The front arc horn is connected electrically to the moving contact, and the rear arc horns is connected to the stationary contact when the arc chute is lowered to its normal position.

The action of the breaker in interrupting an arc is as follows: Referring to Figure 3, when the arcing contacts part and an arc is drawn, it loops up and impinges on the lower ends of the two transfer arc horns and the shading coil. The two short segments of arc from the transfer arc horns to the shading coil then move up into the transfer stacks and are quickly interrupted placing the blowout coil in series with the arc.

When the current starts to flow in the blowout coils, a magnetic field is established and the arc, which by this time is two separate arcs, extending from the two end arc horns to the transfer horns, is driven very rapidly up into the slots of the refractory plates. As the arc moves to the closed end of the slots, it is restricted, lengthened, cooled, and subject to a strong magnetically induced blast of gas. All of these forces result in rapid "de-ionization" of the arc space, and for the arc to maintain itself it must continually ionize fresh gas. At current zero the formation of new ionization momentarily ceases, but the de-ionization continues so that dielectric strength is established in the arc space and the circuit is interrupted.

ARC CHUTE LIFTER

In order to raise the arc chutes for contact inspection and maintenance, an arc chute lifter is provided. This attachment which uses the mechanical advantage of the levering-in device to provide the lifting force, consists of a 1" diameter steel bar, and two channel shaped arms. The steel bar is inserted through the arc chute openings, and the arms are secured in place as shown in Figure 4.

To raise the arc chutes refer to Figure 4 and proceed as follows:

1. Remove barrier assembly.

2. Place 1" diameter steel bar through large 1-1/8 diameter holes in front of arc chutes.

3. Fasten the channel arms to the ends of the 1" diameter bar.

4. Place crank on levering-in device operating shaft and rotate clockwise so that the rollers at each side of the breaker advance forward enough to insert the opposite end of the channel arms. Clamp the arms over the rollers.

5. Disconnect shunt straps from front arc horn.

6. Place crank on levering-in operating shaft and continue to rotate clockwise to raise the arc chute to position shown in Figure 4.

It is important that the arc chutes be raised until the indicator on the front of the breaker shows that the full travel of the levering-in device has been used. This releases the mechanism interlock and permits the breaker to be closed and tripped either electrically or manually with the arc chutes in the raised position.

To lower the arc chutes and prepare the breaker for return to service, repeat the steps 1 to 6 in reverse order.

CAUTION: After inspecting the contacts and arc chutes and before returning the breaker to service, make certain that the shunt connection to the front arc horns is bolted tight.

HORIZONTAL DRAWOUT ARRANGEMENT

The 150-DH-750E is arranged for use in horizontal drawout metal clad equipment and any questions pertaining to this arrangement, which includes operation of the breaker levering-in device, should be referred to I.B. 32-251-3 Pages 8 through 22.

MAINTENANCE

For maintenance procedure on the 150-DH-750E air circuit breaker, refer to I.B. 32-251-3, Pages 26 through 30.

PARTS IDENTIFICATION

Instruction Book 32-251-3 illustrates similar parts used on these breakers. Parts for a particular breaker can be identified by these illustrations, specifically mentioning the type and rating of the breaker for which the parts are required. The breaker nameplate will identify the breaker type and rating.

MOTOR OPERATED BREAKERS

A separate instruction book is supplied for breakers having a motor-spring type of closing mechanism, and are supplied with the order involving this type of equipment.

MEMORANDUM

250 VDC CC
FOR ALL DH 4E MECHS.
ON 75 DH500E
150 DH500E 300P564G01
150 DH750E

250 DC FOR 75 DH500E = 300P716G01

48Y5525

1976

INSTRUCTION BOOK

De-ion®

AIR CIRCUIT BREAKER

Types 50-DH-150E and 50-DH-250E

Westinghouse Electric Corporation

LB. 32-251-3

RECEIVING • OPERATION • MAINTENANCE

INSTRUCTIONS

De-ion®

AIR CIRCUIT BREAKER

Type DH

Horizontal Drawout

Indoor and Outdoor Service

AIR CIRCUIT BREAKER TYPE	3-PHASE INTERRUPTING RATING MVA.	VOLTAGE RATINGS			AMPERES CONTINUOUS 60 CYCLES	INTERRUPTING RATINGS—AMPERES	
		Rated KV.	Max. Design KV.	Min. KV. for Rated INT. MVA.		At Rated Voltage	Max. Amperes
50-DH-150-E	150	4.16	4.76	3.5	1200	21,000	25,000
50-DH-150-E	150	4.16	4.76	3.5	2000	21,000	25,000
50-DH-250-E	250	4.16	4.76	3.85	1200	35,000	37,500
50-DH-250-E	250	4.16	4.76	3.85	2000	35,000	37,500

WESTINGHOUSE ELECTRIC CORPORATION
SWITCHGEAR DIVISION

EAST PITTSBURGH PLANT • **EAST PITTSBURGH, PA.**

NEW INFORMATION

FEBRUARY, 1959

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

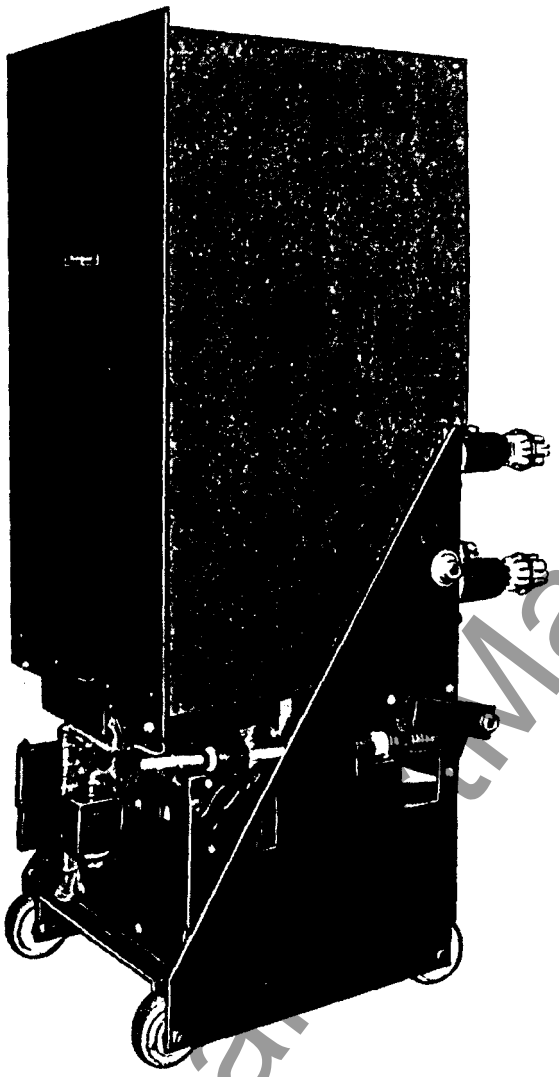


FIG. 1. Type 50-DH-250-E, 1200 Ampere Breaker, Completely Assembled

One of the outstanding improvements in modern power distribution has been the development of the air circuit breaker by Westinghouse for distribution circuit voltages. On circuits where the duty on breakers is heavy, long life with a minimum of maintenance makes the De-ion air breaker an outstanding performer. In the type DH magnetic De-ion air circuit breakers, Westinghouse offers a complete standard line for circuits from 2.3 to 15 kv.

Each of the type DH air circuit breakers is three-pole, electrically operated, and is built as a complete horizontal drawout unit for metal-clad switchgear. Breaker units of the same rating are interchangeable so that changing breakers is a matter of minutes. Since they are drawn out horizontally, no lowering or lifting is necessary. Steel barriers and automatic interlocks prevent contact with live parts while the breakers are being changed.

As in the case of most high voltage electrical equipment, these breakers should be inspected and maintained at regular intervals in order to obtain the most dependable performance.

PART ONE

DESCRIPTION

The type 50-DH-150-E and 50-DH-250-E air circuit breakers are three-pole, electrically operated, horizontal drawout units for use in metal-clad switchgear. The ratings of the breakers are tabulated on page 1.

Figure 1 shows the front and right side of a type 50-DH-250-E breaker completely assembled, while Fig. 2 shows the breaker from the left rear ready to be placed in the cell. Figure 3 is the same breaker with the main barrier removed, and shows the center-coil arc chutes in their operating positions. Part of the separating contacts, primary disconnecting contacts, insulated operating rods, auxiliary switch and part of the solenoid operating mechanism are visible. These components are supported on a welded steel frame which is mounted on flanged wheels for rolling into the metal-clad cell. In the lower part of the frame is located the levering-in device for moving the breaker into final contact engagement. This is interlocked with the mechanism to prevent inserting or withdrawing the breaker with the contacts closed, and also prevents closing the contacts unless the breaker is completely in or completely out of the cell. Also located in the lower part of the frame are the auxiliary switch, shunt trip, cut-off switch, latch check switch, operation counter, breaker contact position indicator, levering-in device position indicator, socket for maintenance closing lever, and secondary contacts for automatically disconnecting the control wiring when the breaker is in the withdrawn position.

The arc chutes on this breaker are of the center-coil design in which the magnetic circuit is H-shaped with the cross member of the H passing through the center of the arc chute. The blowout coils are wound around the cross member of the H, and are located inside the arc chute jacket. With this arrangement, the blowout magnet becomes an integral part of each arc chute assembly.

To provide accessibility for contact maintenance and inspection, the arc chutes are hinged at the rear. Figure 4 shows the breaker with the arc chutes tilted back. In this position, the contacts are readily available for inspection and maintenance.

A one piece barrier assembly is placed on the breaker before it is rolled into the cell. The front sheet is of one-eighth inch steel and forms a grounded barrier between personnel and live parts when the unit is in the cell.

The Type 50-DH-150-E and 50-DH-250-E air circuit breakers are arranged for use in metal-clad equipment from which they are drawn out horizontally. The series E breakers are interchangeable with the series D breakers of the same rating. As may be seen in Fig. 3, all parts are supported on a steel frame with four wheels, equipped with roller bearings, to facilitate moving the breaker. The wheel flanges engage with rails to align the breaker in the metal-clad cell.

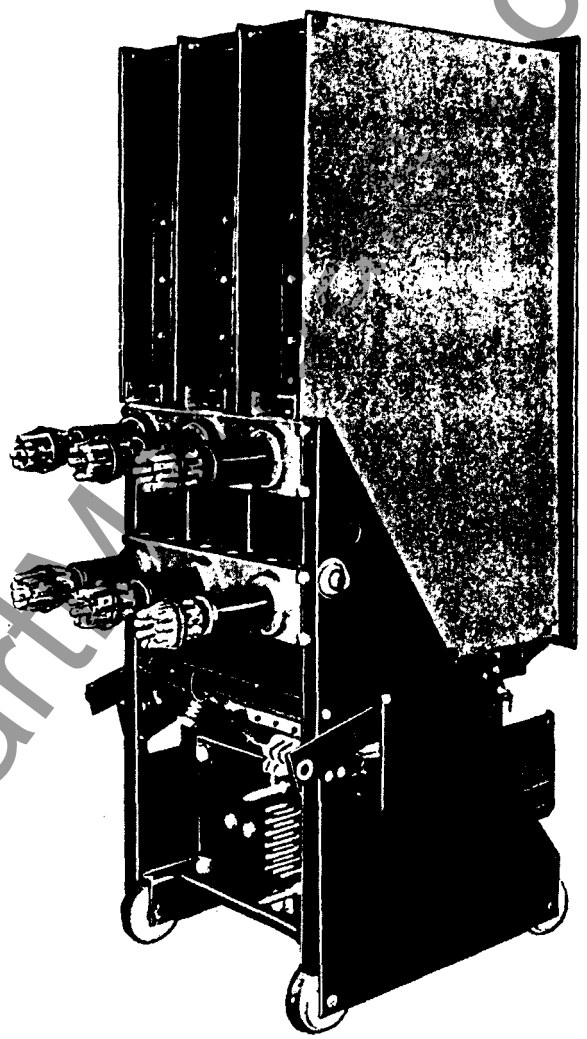


FIG. 2. Type 50-DH-250-E, 1200 Ampere Breaker, Completely Assembled, Rear View

The six main primary conductors project horizontally from the rear of the breaker, and are supported and insulated by Redarta bushings. At the rear of these main conductors are the primary disconnects which are clusters of contact fingers arranged to engage the primary conductors in the cell.

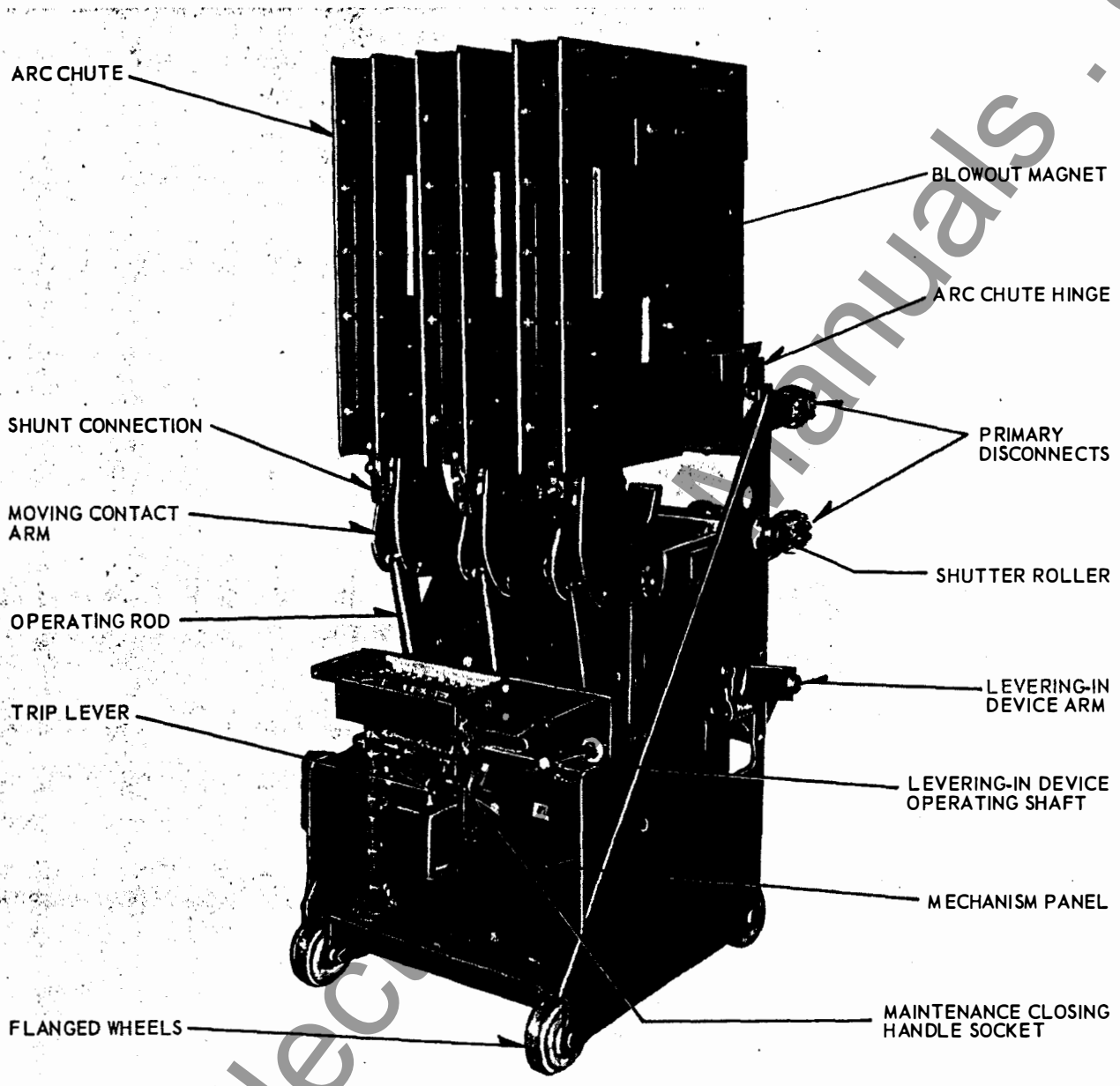


FIG. 3. Type 50-DH-250-E, 1200 Ampere Breaker with Barrier removed, Front View

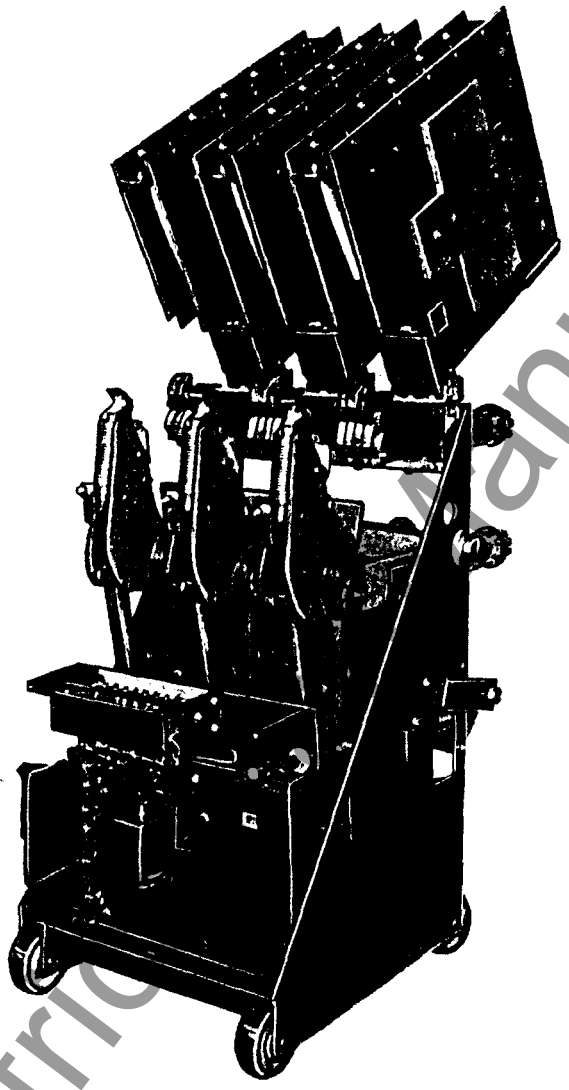


FIG. 4. Type 50-DH-250-E, 1200 Ampere Breaker, with Barrier removed and Arc Chutes tilted back for Inspection

PART TWO

RECEIVING, HANDLING, STORING

All Type DH breakers are assembled and given operating tests at the factory, after which they are carefully inspected and prepared for shipment by workmen experienced in the proper handling and packing of electrical equipment. The complete breaker is shipped in a single crate. The breaker frame is located at the front of the crate, with the interphase barrier installed. The three arc chutes are individually packaged and are located at the rear of the crate.

After the equipment has been unpacked, make a careful inspection for any damage which may have occurred in transit. If the apparatus has been damaged, file a claim immediately with the carrier and notify the nearest Westinghouse Sales Office.

HANDLING

Remove the crating and packing carefully. To avoid damage from improper handling of crow-bars or other tools, use a nail puller for the uncrating. Care must be used in handling the arc chutes since the splitter plates in them are made of a ceramic material which may break if dropped.

The base of the crate may be used as a skid for moving the breaker, or the breaker may be lifted with slings under the crate. If the breaker is to be lifted with slings, move it while it is still crated. After the breaker is unpacked, the best way to move it is by rolling on its own wheels.

If it is necessary to lift the breaker after it is uncrated, lift it without the barrier or arc chutes in place. Slings may be placed under the breaker frame or hooks used in the holes provided near the top of the frame.

STORING

The arcing chambers are shipped in separate containers located at the rear of the crate to guard against damage from rough handling and for better protection from dust and water or liquids. Store them in their shipping containers until ready for use.

Store all components of these breakers in a clean dry place. During the storage period, keep them sufficiently warm to prevent moisture condensation.

Table of Approximate Weights (In Pounds)

BREAKER TYPE	AMPERE RATING	BREAKER WITHOUT CHUTE & BARRIER	SINGLE ARC CHUTE	BARRIER ASSEMBLY	COMPLETE BREAKER
50-DH-150-E	1200	695	85	80	1030
50-DH-150-E	2000	960	85	100	1315
50-DH-250-E	1200	695	110	85	1110
50-DH-250-E	2000	960	110	100	1390

PART THREE

OPERATION

Before placing the circuit breaker in service, it is advantageous to become familiar with the construction and function of the various parts which are described in the following paragraphs. This material should be studied carefully.

The general arrangement of the breaker components is shown in Fig. 3. The solenoid coil is built to exert a horizontal force on the mechanically trip free linkage of the mechanism. This linkage, in turn, exerts an upward force on the three insulated operating rods which act on the moving contact arms to close the contacts. The breaker has two sets of contacts: the main contacts for carrying the continuous load current, and the arcing contacts for carrying the current during interruption. As the contacts close, the arcing contacts touch first to establish the circuit, and then the main contacts follow closed. On opening, the main contacts separate first and then the arcing contacts follow. This insures that the main contact surfaces will remain free of burning and pitting for good current carrying capacities. Above the arcing contacts are located the center-coil arc chutes for extinguishing the arc while the breaker contacts are separating. The breaker is tripped by lifting the primary latch either manually or electrically by means of the trip coil.

MECHANISM

The solenoid operating mechanism with its trip-free linkage is shown in Fig. 5, with the operation of the linkage diagrammed in Fig. 6. In this mechanism, the horizontal pull of the solenoid coil is transmitted to the contact operating rods through a system of links which rotate counterclockwise about the operating center. This linkage system consists of four major links: the non-trip free lever, trip free lever, upper trip free link, and lower trip free link. These members are arranged as shown and are held

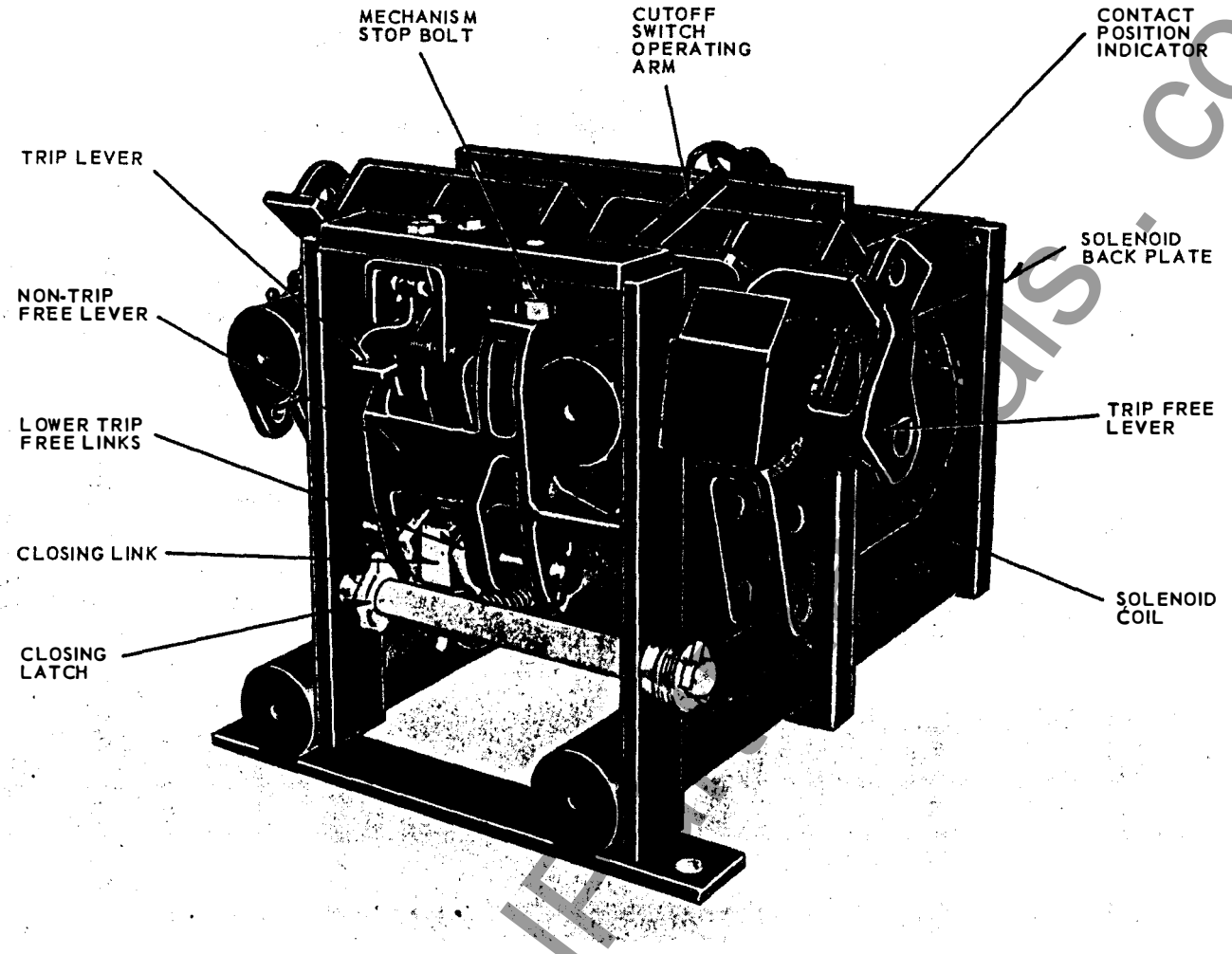


FIG. 5. Solenoid Operating Mechanism

to form a rigid member by the cam link and tripping cam. The tripping cam is prevented from rotating by the tripping latch.

When the solenoid is energized, the movable core pulls on the junction of the non-trip free lever and the lower trip free link through the closing link. This causes the system to rotate about the operating center as the parts move from the RESET POSITION, Fig. 6C, to the CLOSED POSITION, Fig. 6A. The trip free lever then exerts an upward force on the three operating rods to close the breaker contacts. The mechanism linkage is held in this position by the closing latch which locks on a pin at the bottom of the non-trip free lever.

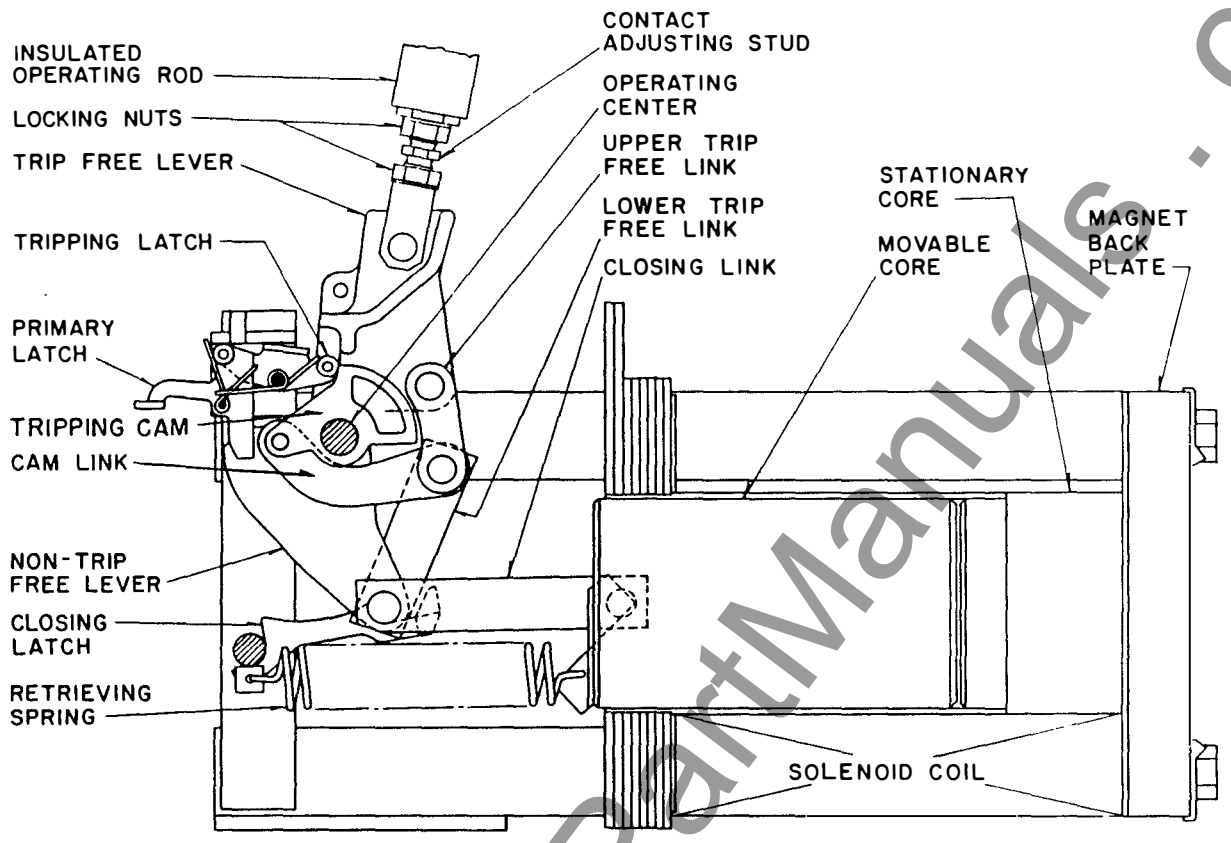
The breaker is tripped either electrically or manually by lifting the primary latch which disengages the tripping latch. This allows the tripping latch to rotate counterclockwise and release the tripping cam so that it is free to rotate counterclockwise. Without the restraining force of the cam and cam links, the upper and lower trip free links collapse under the force of the contact springs, and the accelerating springs on the puffer rods. The junction of these links moves to the right, and the trip free lever rotates clockwise opening the breaker contacts. The position of the linkage is then as shown in the TRIP FREE POSITION, Fig. 6B.

In moving to this position, the lower trip free link presses the closing latch downward, and disengages the pin in the non-trip free lever. The retrieving spring now pulls on the solenoid core which moves the linkage and the tripping cam to the reset position as shown in Fig. 6C. In this position the tripping latch is reset, and the breaker may be reclosed.

MECHANISM PANEL

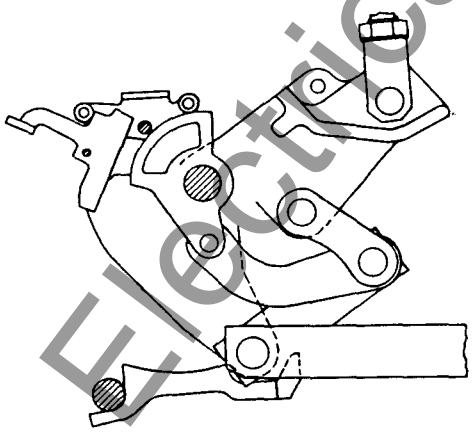
The mechanism panel is mounted on the front of the closing mechanism as shown in Fig. 7. On it are mounted the following auxiliary devices included as standard on all breakers:

Shunt Trip Magnet. The shunt trip magnet is a small electromagnet which is used to trip the



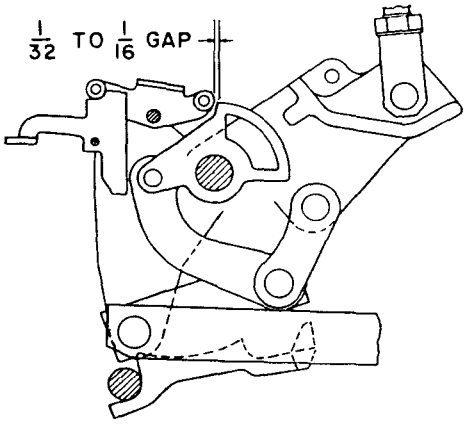
A

CLOSED POSITION



B

TRIP-FREE POSITION



C

RESET POSITION

FIG. 6. Solenoid Operating Mechanism—Diagram of Tripping Positions

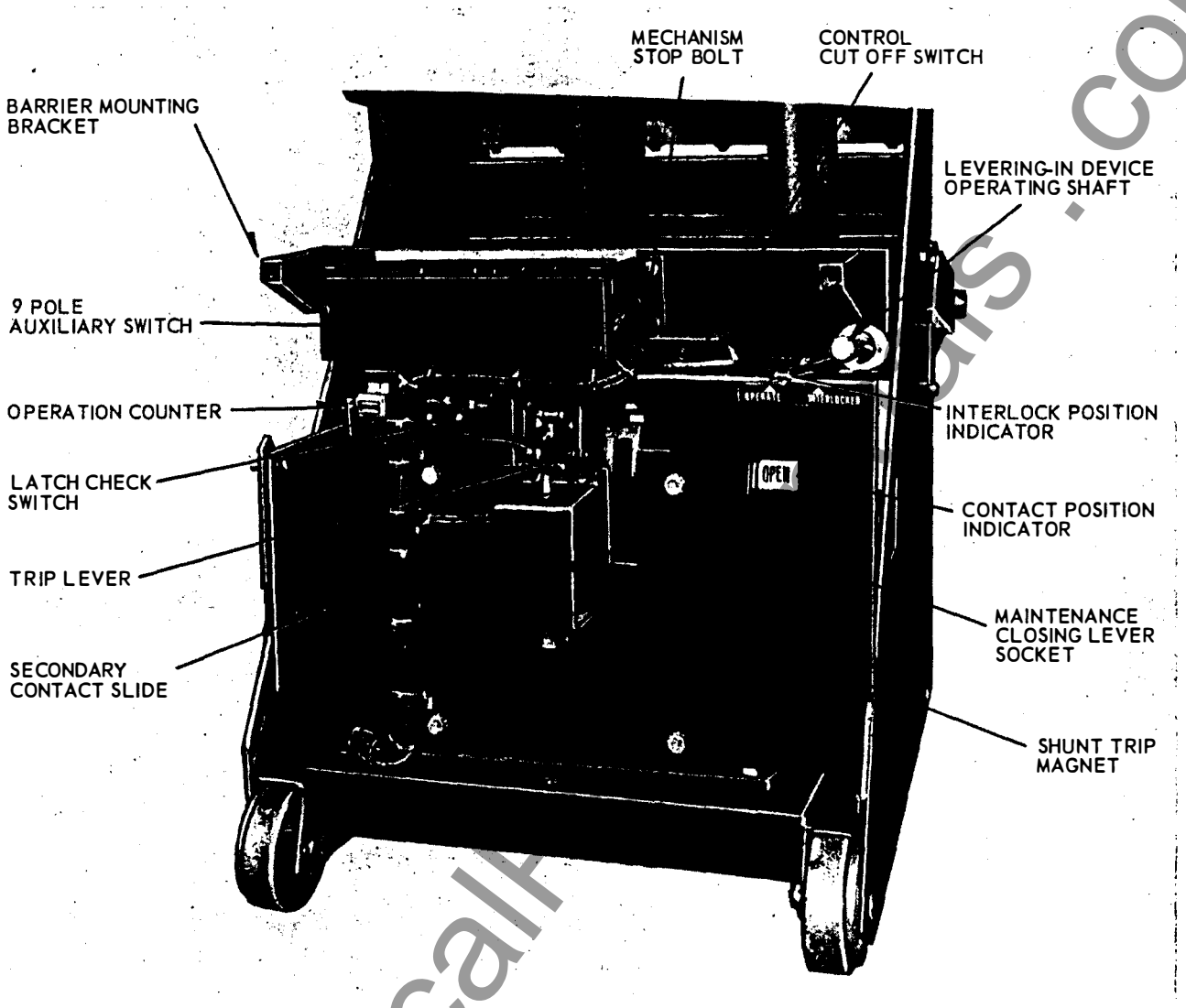


FIG. 7.5 Mechanism Front Panel

breaker electrically from an external source. It may be equipped with a coil for direct current, alternating current, or capacitor tripping. When the shunt trip magnet is energized, the moving core is drawn up into the magnet yoke toward the stationary core. An extension of the moving core protrudes through the top of the magnet assembly. As the core moves up, this extension moves against the trip lever directly above it. The force of the solenoid is sufficient to raise the trip lever which disengages the primary latch tripping the breaker. A bracket at the bottom of the assembly retains the moving core, and limits its travel to about 3/4 inch. A thin brass washer prevents the moving core from being retained by residual magnetism in the raised position after the coil is de-energized.

Cut-Off Switch. The cut-off switch is a single pole normally open contact which acts with the breaker control relays to cut off the closing coil current after the breaker is closed. The switch is operated by an arm attached to the trip-free lever in the mechanism and the contact remains closed as long as the breaker is closed.

Contact Position Indicator. The contact position indicator gives a positive indication that the breaker contacts are either open or closed. It operates directly on the trip-free lever in the mechanism.

Interlock Position Indicator. The interlock position indicator gives a positive indication of the position of the breaker interlock. It operates from the levering-in device shaft. When the indicator points to the word OPERATE, the interlock is free and the breaker may be closed or tripped. When the indicator points to the word INTERLOCKED, the interlock is functioning and the breaker cannot be closed. Since the interlock is operative only when

the breaker is in an intermediate position between fully engaged and fully withdrawn, it also serves as a means of indicating that the breaker is in the Operating Position and the main disconnecting contacts fully engaged, or that it is in the Test Position with the contacts separated.

Operation Counter. The operation counter records each operation of the breaker. It advances one count for each tripping operation. A spring type link from the trip free lever operates the counter.

Auxiliary Switch. The auxiliary switch is a nine pole rotary type, and is operated by a link from the trip free lever in the mechanism. There are five "a" contacts (closed when the breaker is closed), and four "b" contacts (closed when the breaker is open). These are arranged alternately, starting with an "a" contact nearest the operating lever.

The first and third segments of the rotor are longer than the others, and are connected on each side of the shunt trip coil. When the breaker closes, these complete the trip coil circuit just as the main contacts touch. The rotor turns approximately 90°, and is adjusted by the serrated operating lever.

Each contact is able to carry 20 amperes continuously, and interrupt the following current.

VOLTAGE	NON-INDUCTIVE	INDUCTIVE
125 d-c	8.	4.
250 d-c	2.	1.
600 d-c	0.5	0.2
125 a-c	50.	30.
250 a-c	25.	15.
600 a-c	5.	3.

Latch Check Switch. The latch check switch is a small, light force, snap action switch which is operated by the primary latch of the mechanism. When a breaker is to be automatically reclosed after being tripped free, the links in the mechanism must be completely returned to the Reset position before the closing solenoid is energized. See B and C of Fig. 6. Since the primary latch is the last part of the mechanism to reset, the switch will hold its contact open until the latch returns to its normal position.

In addition to the above items which are standard on all breakers, the following special devices may also be mounted on the mechanism panel when required.

Undervoltage Trip Attachment. The undervoltage trip attachment, shown in Fig. 8, is a magnetically held device which will trip the breaker when its control voltage drops below a predetermined value. This device uses the energy stored in

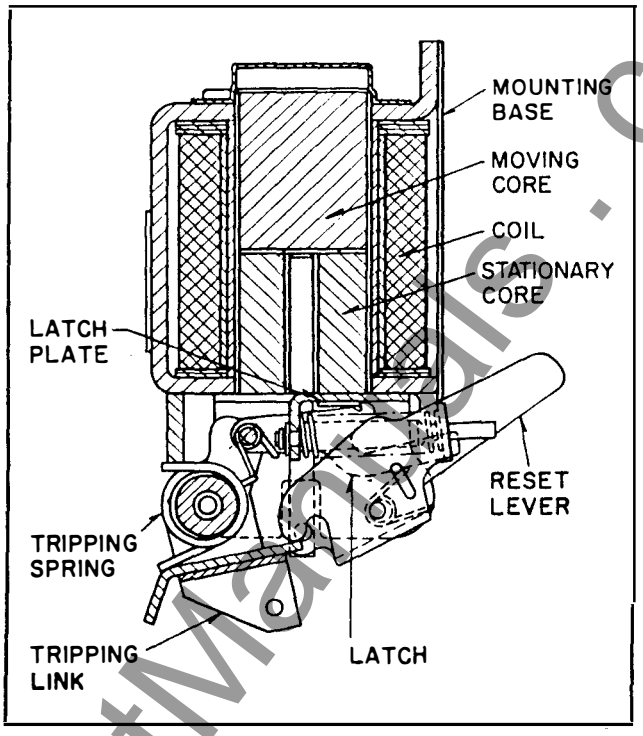


FIG. 8. Undervoltage Trip Unit

a spring during the breaker closing stroke to lift the primary latch of the breaker mechanism. The holding magnet coil may be directly connected to a d-c control source, or it may be supplied with low voltage d-c obtained from an a-c control voltage through a small transformer and Rectox assembly mounted in the cell structure. Normally the moving core of the device is held magnetically against the stationary core to hold the rod and consequently the reset lever in the reset position. When the coil voltage is reduced sufficiently, the reset lever spring overcomes the magnetic attraction of the cores and rotates the reset lever clockwise. As the reset lever rotates, the pin pushes against the latch to release it from its latch plate. When the latch releases, the trip spring rotates the trip lever to trip the breaker. The linkage is reset by the trip free lever of the mechanism as the breaker opens.

For time delay release on tripping, a very high resistance coil is employed in the holding magnet, and is supplied with about 300 volts d-c from a transformer, Rectox, and capacitor device mounted in the cell. The capacitor is connected across the coil, and provides a slowly decaying holding current. The time delay is adjusted by varying the charging voltage to the capacitor by a four step resistor, giving approximately one to three seconds delay.

Three-Coil Trip Attachment. The three-coil trip attachment, when supplied, mounts on the mechanism panel and is used in addition to the

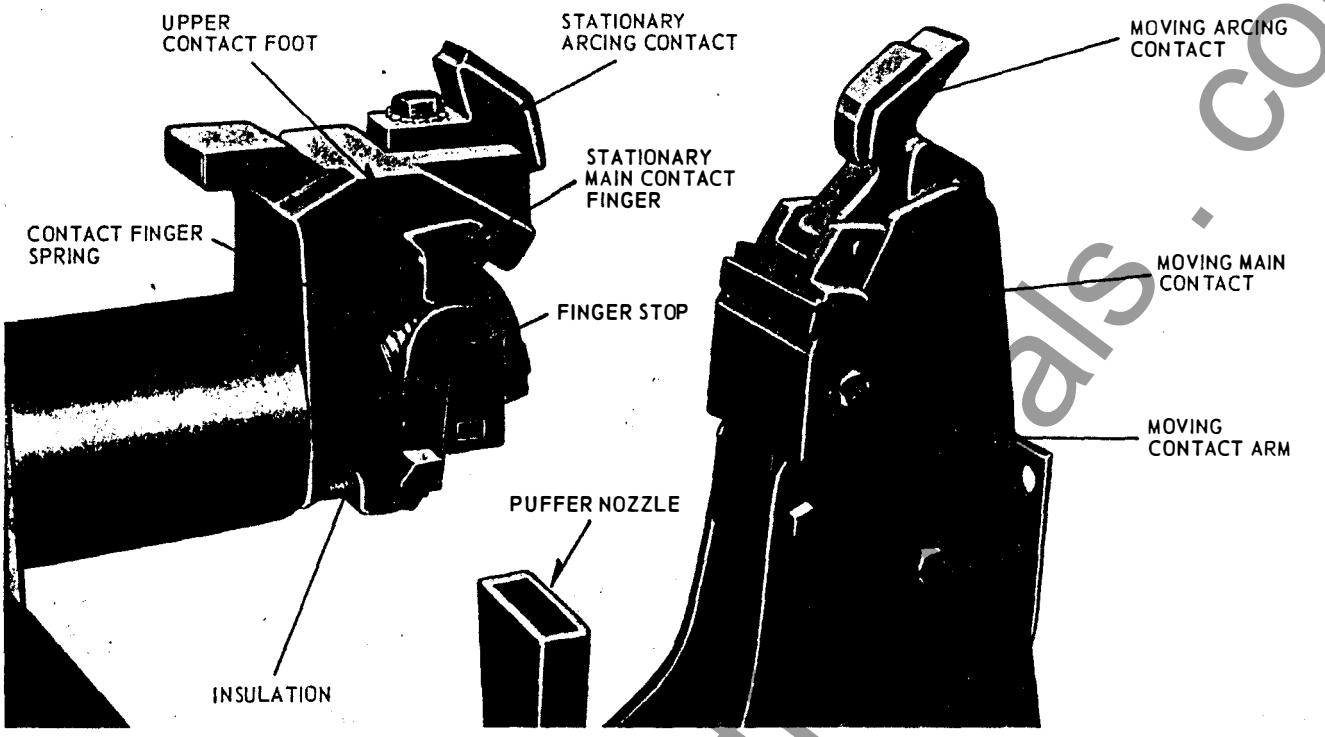


FIG. 9. Type 50-DH-150-E, 1200 Ampere Breaker Contacts Viewed from Rear

shunt trip magnet. It is designed to accommodate three instantaneous current transformer trip assemblies. The calibration of each current trip coil is engraved with the values of current required to trip the breaker.

CONTACTS

Each pole of the type 50-DH-150-E and 50-DH-250-E breakers is equipped with both main and arcing contacts. When the breaker is tripped, the main contacts separate first and then the arcing contacts follow. When the breaker is closed, they make up in the reverse order.

For the 1200 ampere rating, the body of the moving contact is a copper forging to which is brazed the main contact inlay. This assembly is bolted between two formed copper blades which hinge on the lower bushing foot and form the moving contact arm. See Fig. 9. These are moved between the closed and open positions by the mechanism through the Redarta operating rods. The load current is conducted across the hinge through silver electroplated surfaces, with pressure being supplied by spring washers on either side.

The moving arcing contact is hinged to the top of the main contact and the arcing current is carried by means of a flexible shunt inside the assembly. For the type 50-DH-150-E breaker the moving arcing contact consists of a single casting with a silver-tungsten inlay. See Fig. 9. On the Type 50-DH-250-E breaker, this contact is divided for carrying the higher interrupting current and is shown in Fig. 10.

For both the 50-DH-150-E and 50-DH-250-E ratings, the 2000 ampere breakers use the same moving contact as the 1200 ampere Type 50-DH-250-E breaker. However, four moving blades are employed instead of two, and five contact bolts instead of three. The four blades are hinged to a casting on the lower bushing as shown in Fig. 11.

All contact resiliance is built into the stationary contact assembly. Because of the high momentary rating of these breakers the stationary contacts have been divided to give multiplicity of contact surfaces.

The 1200 ampere Type 50-DH-150-E breaker employs four movable fingers for the main contact, each backed by a separate finger spring. Each has a silver inlay that mates with the moving main contact. The stationary arcing contact is located directly above. See Fig. 12.

The 1200 ampere Type 50-DH-250-E breaker stationary contact is shown in Fig. 13 and is similar with the exception that the arcing contact is wider.

The 2000 ampere rating employs six fingers on each stationary contact, and is shown in Fig. 14. Cooling fins are located on each side of the contact.

With this contact design, all current breaking and interrupting parts are completely enclosed by the arc chutes.

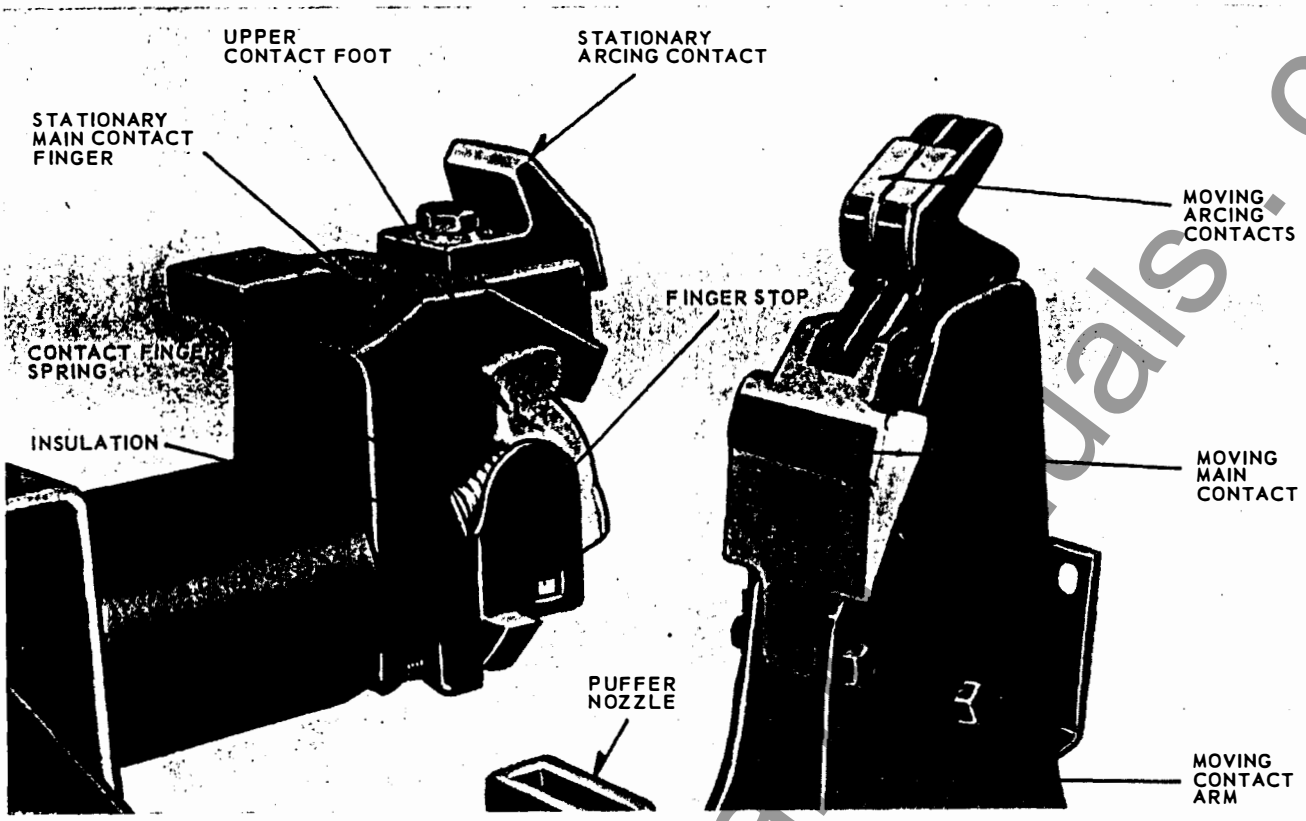


FIG. 10. Type 50-DH-250-E, 1200 Ampere Breaker Contacts, Viewed from Rear

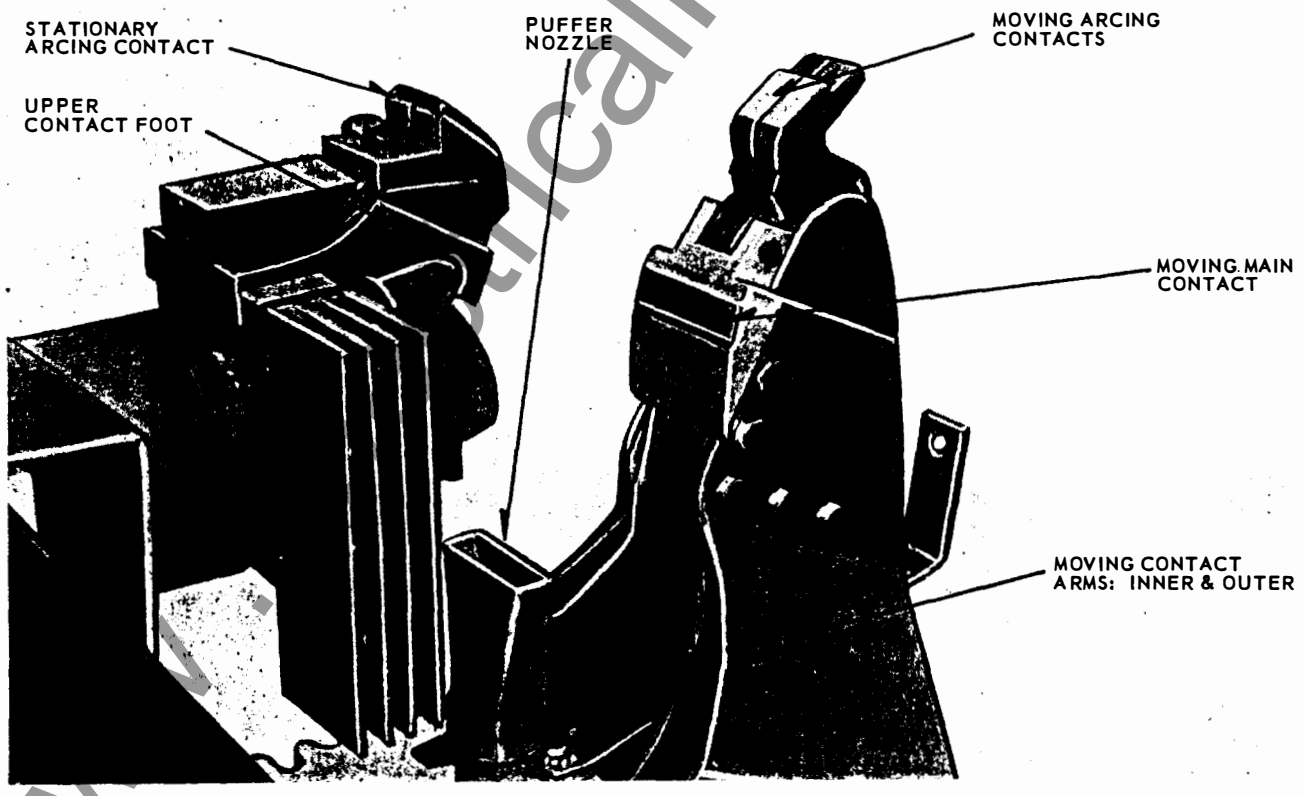


FIG. 11. Type 50-DH-150-E/250-E, 2000 Ampere Breaker Contacts, Viewed from Rear

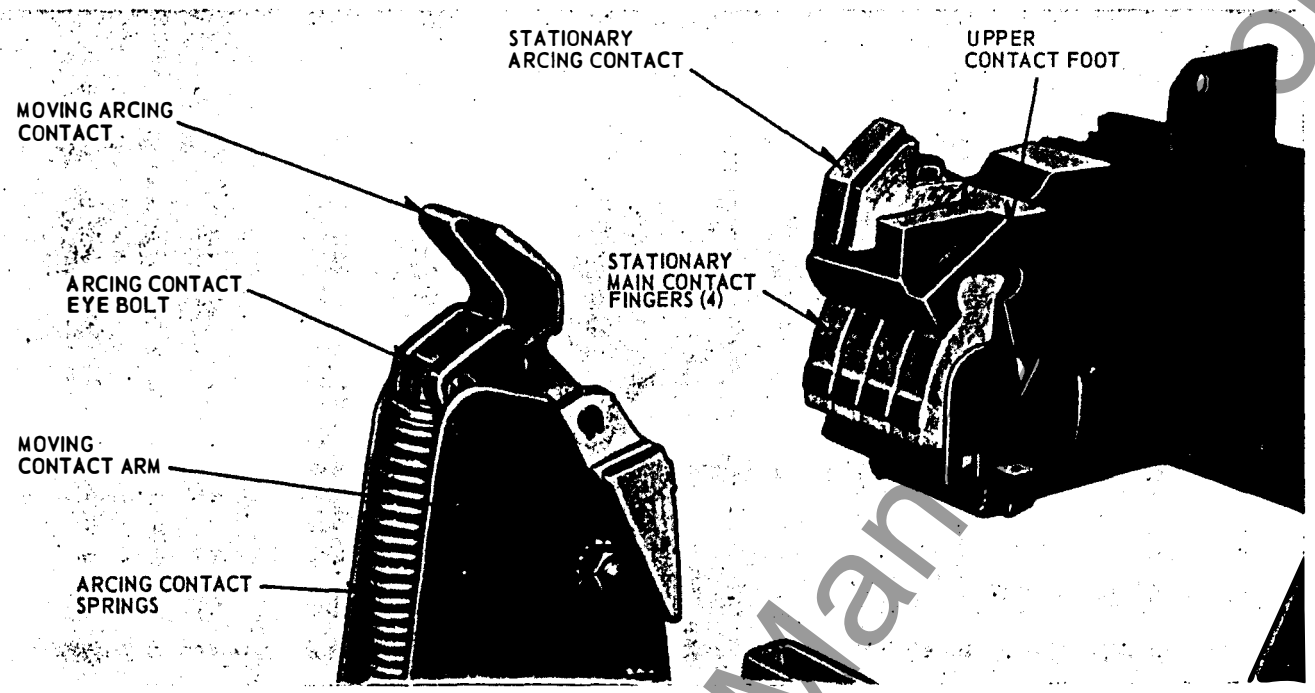


FIG. 12. Type 50-DH-150-E, 1200 Ampere Breaker Contacts, Viewed from Front

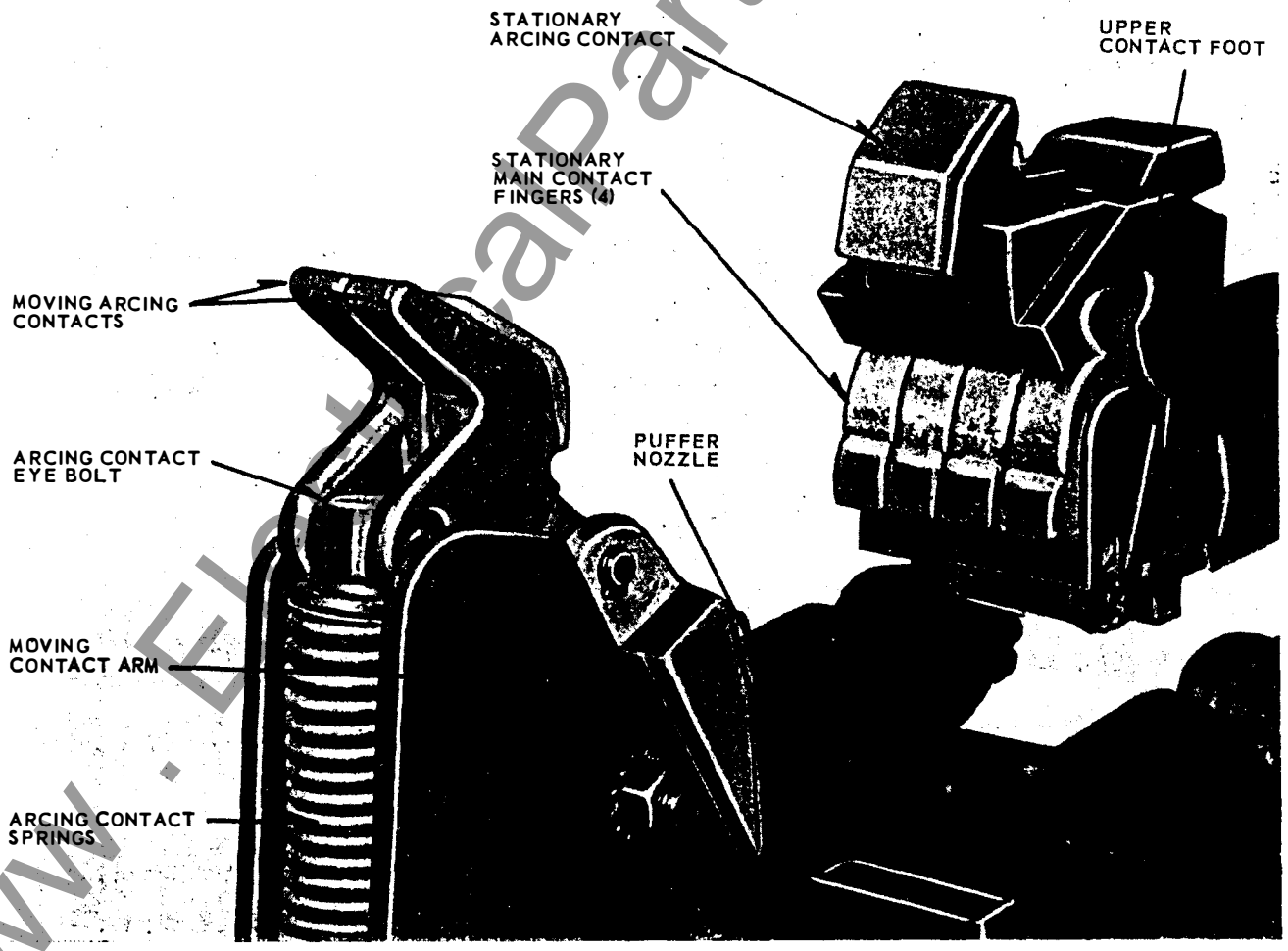


FIG. 13. Type 50-DH-250-E, 1200 Ampere Breaker Contacts, Viewed from Front

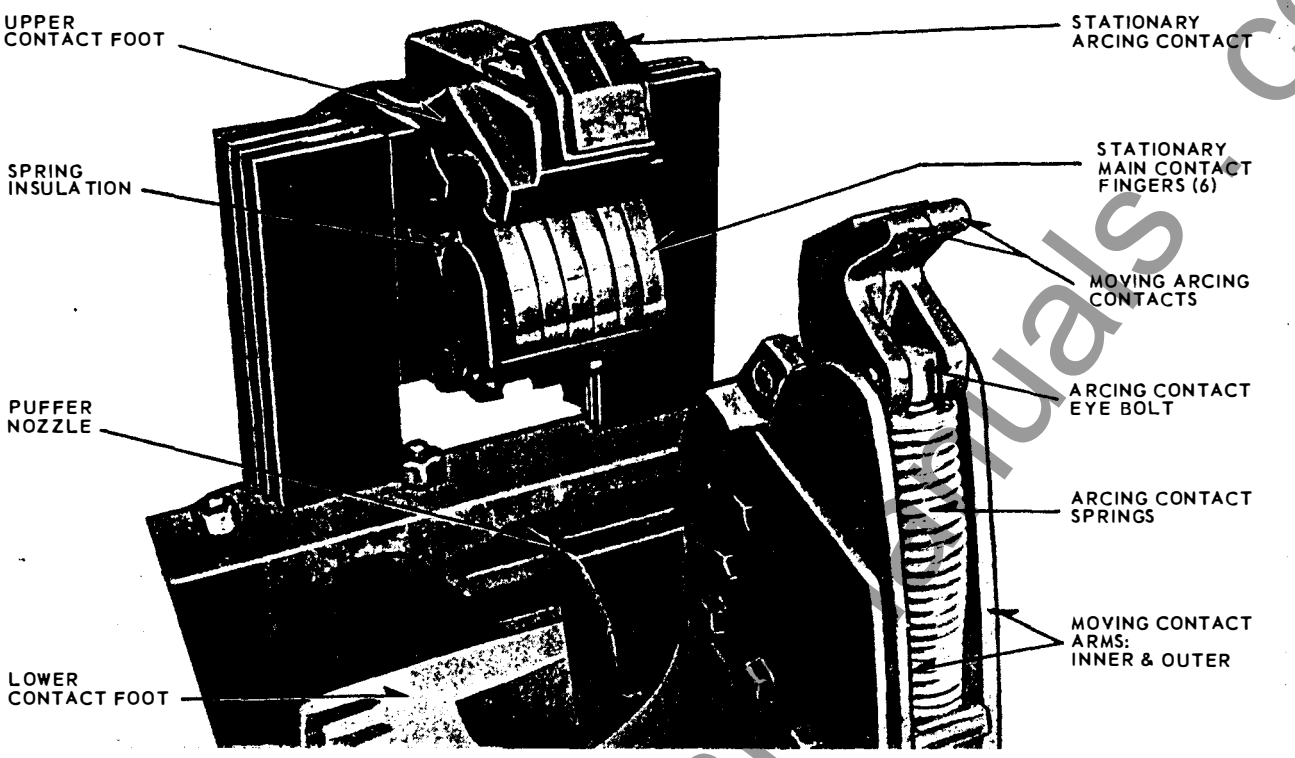


FIG. 14. Type 50-DH-150-E/250-E, 2000 Ampere Breaker Contacts, Viewed from Front

ARC CHUTES

The arc chute consists of an H-shaped blow-out magnet, blow-out coils, transfer arc horns, transfer stacks, main interrupter stacks, a front arc horn, and a rear arc horn all assembled in and about a fabricated rectangular Redarta chute jacket. The arc chute is hinged to the breaker; and when it is in the normal position, its lower end completely surrounds the contact structure. Fig. 15 is a schematic cross section of the arc chute showing the component parts.

The blow-out magnet is located so that the core passes through the center of the arc chute. A blow-out coil is wound near each end of the core and lays in a window cut in the side sheet of the chute jacket. One terminal of each coil connects to a transfer, or center arc horn, and the other terminals are joined at the top of the shading coil. Two transfer stacks are placed in the space between the transfer arc horns and the shading coil. To either side of the transfer arc horns are the main interrupter stacks which are made up of a series of insulating refractory plates. These plates have inverted V-shaped slots molded into them. The slots are offset so that when the plates are stacked with the slots alternating from one side to the other, the arc must take a serpentine path as it moves up into the arc chute increasing the length of the arc and at the same time restricting the diameter of the arc.

To either side of the main interrupter stacks are two metallic arc horns to which the arc transfers from the arcing contacts. The front arc horn is connected electrically to the moving contact, and the rear arc horn is connected to the stationary contact.

The action of a breaker in interrupting an arc is as follows. Referring to Fig. 15, when the arcing contacts part and an arc is drawn, it loops up and impinges on the lower ends of the two transfer arc horns and the shading coil. The two short segments of the arc, from the transfer arc horns to the shading coil, then move up into the transfer stacks and are quickly interrupted placing the blow-out coils in series with the arc.

When the current starts to flow in the blow-out coils, a magnetic field is established and the arc, which by this time is two separate arcs extending from the front and rear arc horns to the transfer horns, is driven very rapidly into the slots of the refractory plates of the main interrupter stacks under the influence of the powerful magnetic force. As the arc moves to the closed end of the slots, it is restricted, lengthened, and cooled. All of these forces result in rapid de-ionization of the arc space; and for the arc to maintain itself, it must continuously ionize fresh gas. At current zero the formation of new ionization momentarily ceases, but the de-ionization continues so that dielectric strength is established in the arc space and the circuit is interrupted.

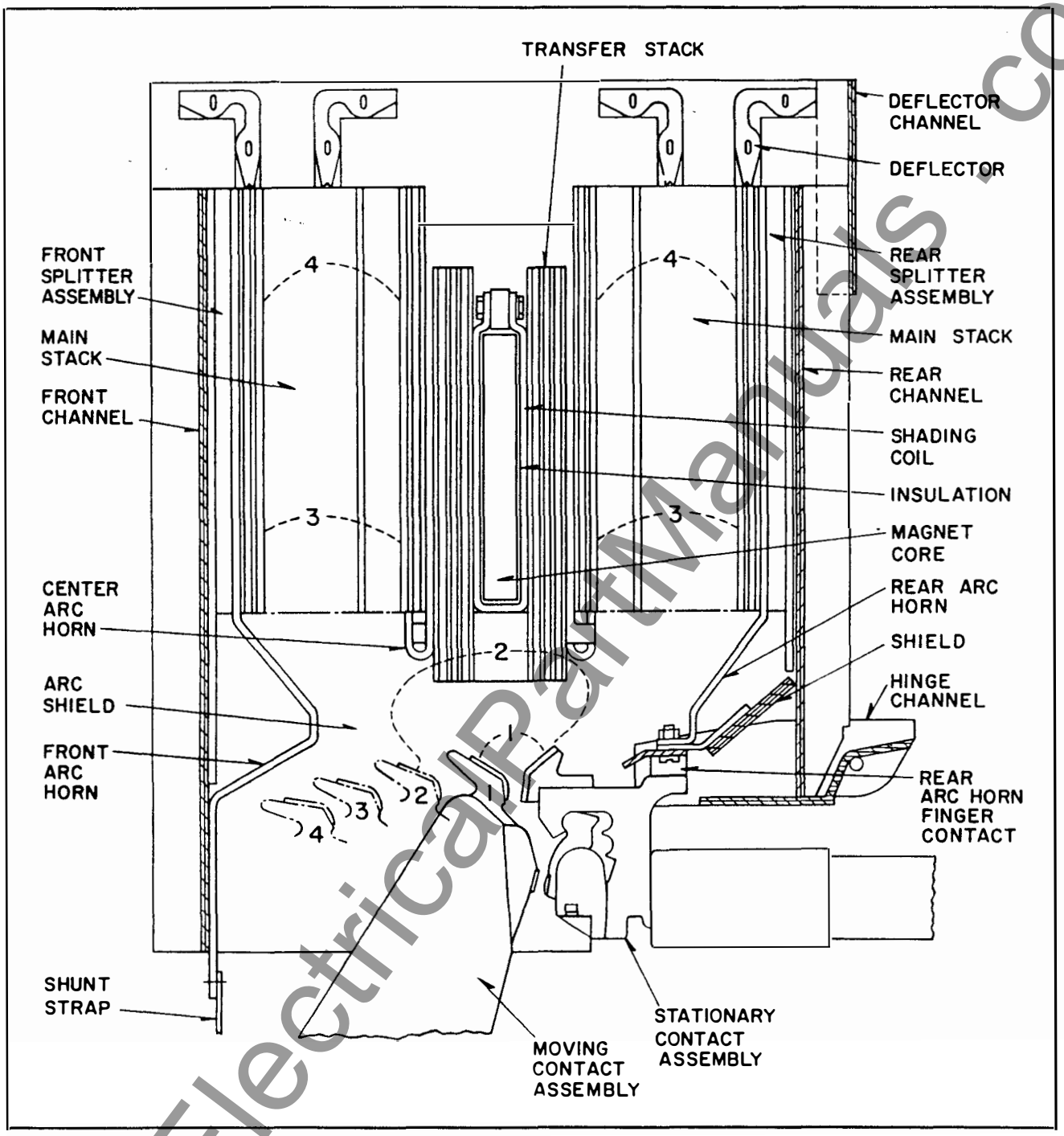
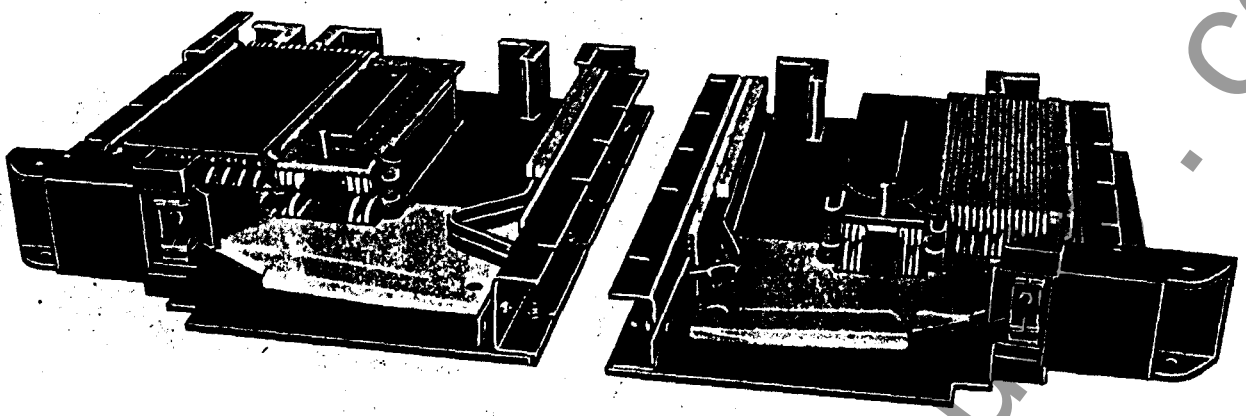


FIG. 15. Arc Chute Arrangement

Figure 16 is a photograph of partly assembled arc chutes. The Type 50-DH-250-E arc chute is on the left with the left pole of the magnet and the left side sheet removed. The front interrupter stack has been removed to show the front center arc horn. Similar parts have been removed from the right side of the Type 50-DH-150-E arc chute shown on the right of Fig. 16.

LEVERING-IN DEVICE

In order to move the breaker in or out of the metal clad cell against the resistance of the contact fingers on the rear of each bushing, a levering-in device is provided on each breaker. There is an arm on each side mounted on a common shaft across the back of the breaker. On each arm is a roller which engages a groove in the sidewall of the cell. A remov-



TYPE 50-DH-250E TYPE 50-DH-150E

FIG. 16. Partially Assembled Arc Chutes

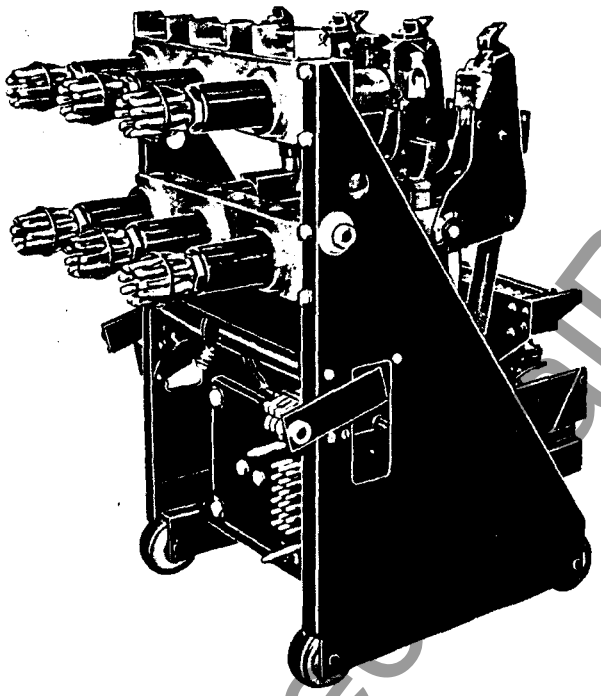


FIG. 17. Levering-In Device in position for Rolling into Cell

able crank engages another shaft in the right front corner of the breaker which turns the arms through a worm gear and pinion arrangement.

Before a breaker is rolled into a cell, the arms with rollers, at each side of the breaker must point to the rear and slightly downward as shown in Fig. 17. The arms travel 193 degrees and assume the horizontal position shown in Fig. 18 when the breaker is cranked into the operating position in the cell. To put the arms in the position shown in Fig. 17, place the crank on the operating shaft at the front right corner of the breaker (Refer to Fig. 3) push in, and rotate to engage the coupling in the levering-in device. The breaker contacts must be open to engage the coupling, and the indicator will show "Interlocked". Rotate the crank counterclockwise to the end of the travel. During this time the interlock mechanism will hold the coupling engaged. At the end of the travel, the interlock will release, the crank will move to the front, and the indicator on the mechanism panel will point to the word "OPERATE".

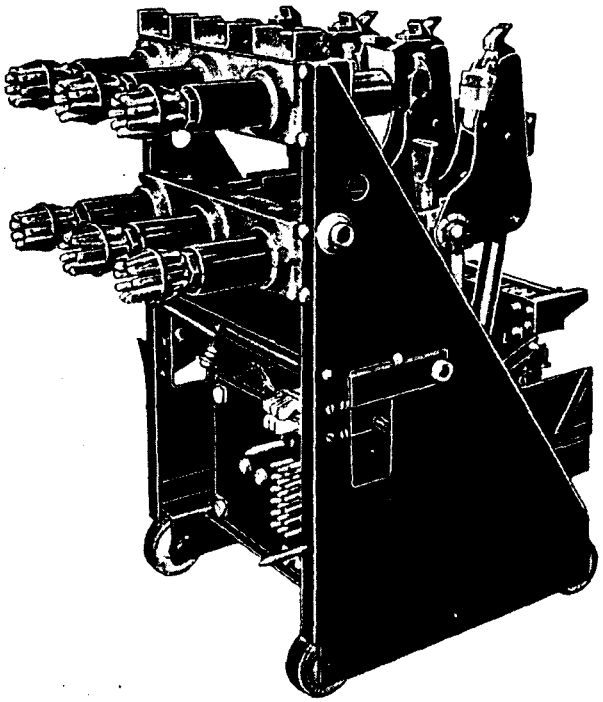


FIG. 18. Levering-In Device with Arms in position taken when Breaker is in Operating Position in Cell

With the arms to the rear and down as shown in Fig. 17, the breaker is ready to be rolled into the cell as far as the test position. The rollers on the arms strike vertical angles on the cell wall and stop the breaker at the test position. If the breaker is to be operated at this position, remove the crank and engage the secondary contacts in the manner described in the section under Secondary Contacts. To move the breaker from the test position to the fully engaged operating position, put the crank on the shaft, push in and rotate to engage the levering-in coupling, and crank clockwise. The torque required will increase when the primary contact fingers engage the stationary contact studs in the cell. Continue cranking to the end of the travel where the interlock will again fall free, pushing the crank back out. Remove the crank. The indicator on the panel will again point to the word "OPERATE".

To remove the breaker from the operating position, first check that the breaker is open. The levering-in device cannot be engaged unless the breaker contacts are open. Put the crank on the operating shaft, push in and rotate to engage the coupling, and turn counterclockwise until the breaker returns to the test position. Remove the crank. The breaker may now be operated at the test position or rolled out of the cell.

TEST POSITION

The breaker may be rolled into the metal clad cell until the rollers on the levering-in device stop against a pair of vertical angles welded into the cell. The levering-in device is not operated. This is the test position in which the breaker primary contacts are separated from the energized contacts in the cell, and a metal shutter is closed completely isolating all high voltage parts from the breaker. The secondary contacts may be engaged and the breaker operated safely for test purposes without the arc chutes or barrier.

Caution: THE BREAKER SHOULD NEVER BE MOVED BEYOND THE TEST POSITION WITHOUT THE ARC CHUTES AND BARRIER IN PLACE.

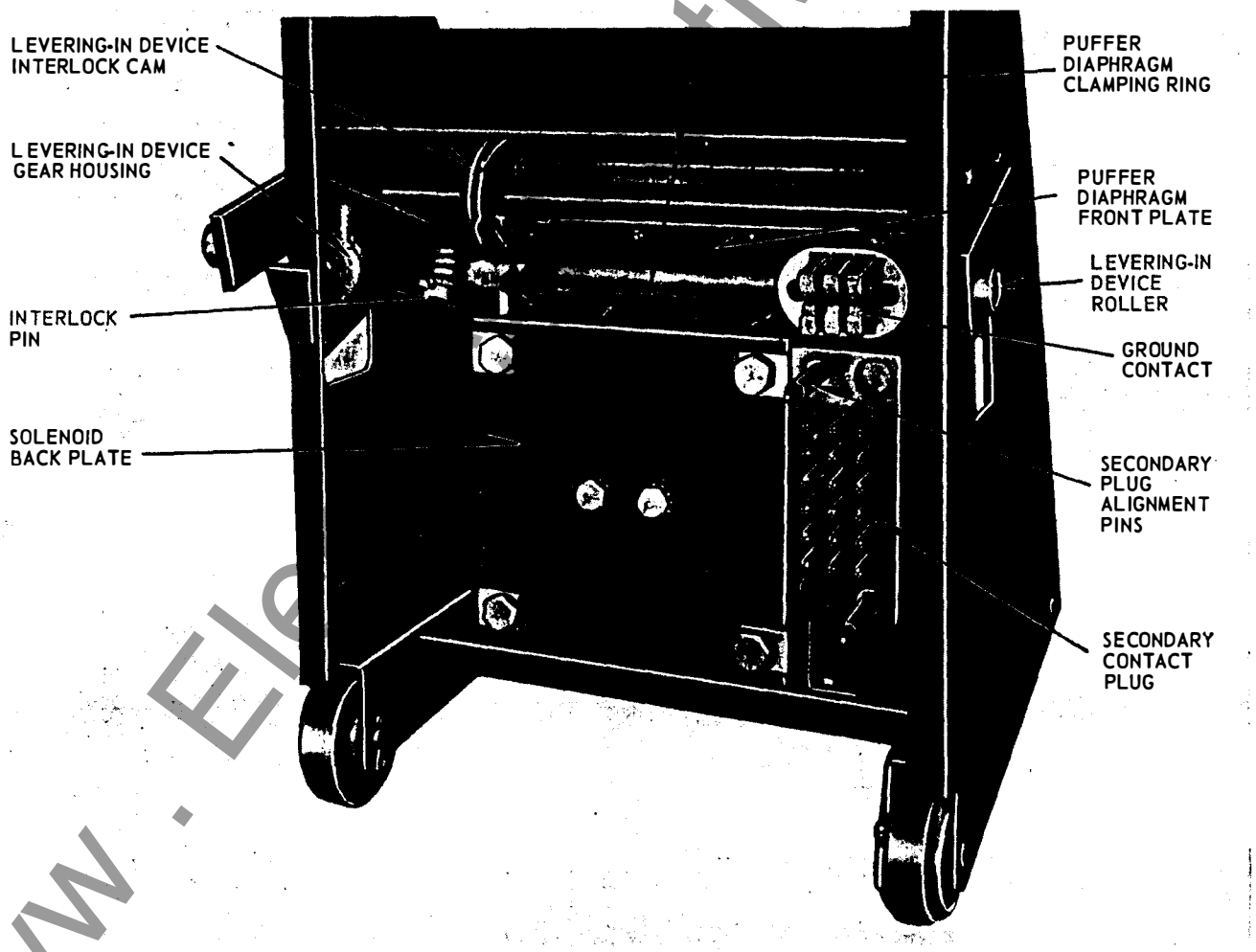


FIG. 19. View of Lower Part of Breaker from Rear

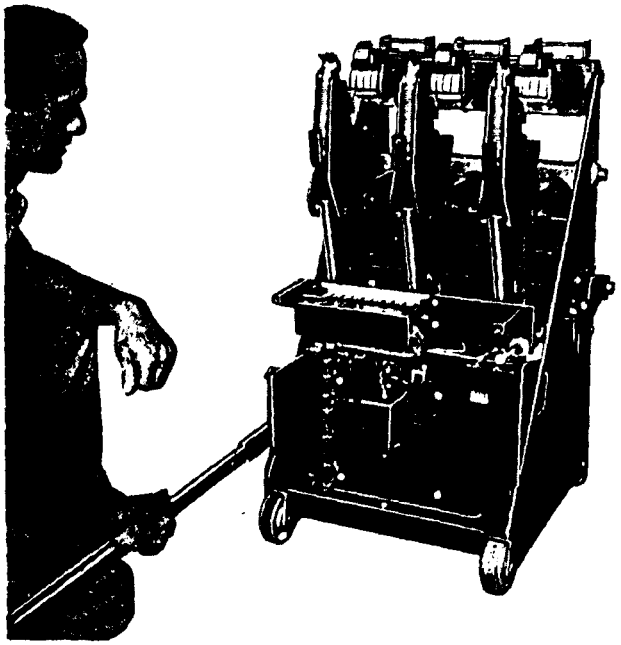


FIG. 20. Operating Secondary Contacts

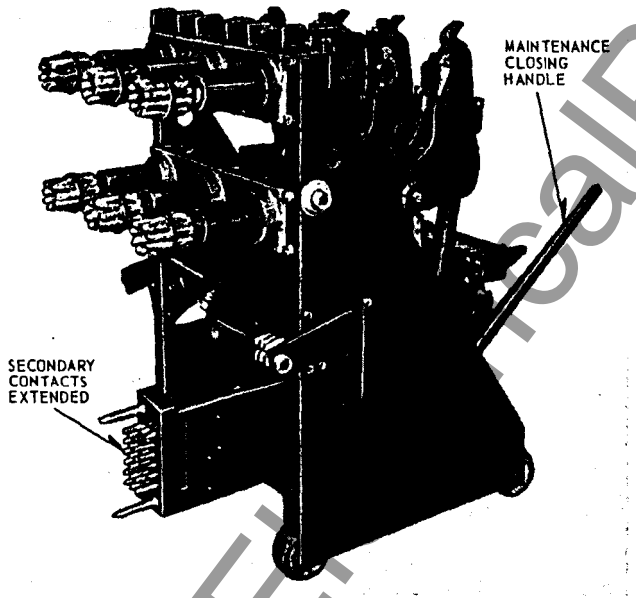


FIG. 21. Secondary Contacts extended for Completing Control Circuits when Breaker is in Test Postion

OPERATING POSITION

The breaker may be moved from the test to the operating position by engaging the levering-in device and rotating the levering-in crank clockwise. As the breaker travels beyond the Test Position, the metal shutter covering the high voltage primary contacts will be automatically opened by the shutter rollers which are located on each side of the breaker frame at the rear. See Fig. 17. At the end of the travel, all the breaker contacts are engaged. This is the Operating Position.

Caution: WHEN THE BREAKER IS IN THE OPERATING POSITION IT SHOULD NEVER BE CLOSED BY THE MAINTENANCE CLOSING HANDLE.

INTERLOCK

The interlock on the DH breakers has two functions to perform. First, it prevents the breaker from being moved from the test to the operate position or vice versa with the contacts closed. Second, if the breaker is in some intermediate position between the test and operate positions, it prevents the contacts from being closed.

This interlocking action is accomplished by having a rod, operated by the breaker mechanism, and a pin operated by the levering-in device, move at right angles to each other.

The puffer diaphragm is operated by two puffer rods extending through the puffer casting and connected to the trip-free lever of the mechanism. The right hand rod also extends beyond the rear of the diaphragm support plate and is directly above the levering-in gear housing, and at right angles to the interlock pin. See Fig. 19. When the breaker is closed, this puffer rod moves over the interlock pin and prevents the latter from moving upwards. This prevents the engagement of the split coupling on the levering-in crank shaft through the action of a bell-crank casting.

When the breaker is open, the puffer rod is clear of the interlock pin. As the levering-in crank is pushed toward the rear to engage the split coupling, the bell crank casting lifts the interlock pin which in turn will block any movement of the puffer rod. Thus the solenoid operating mechanism cannot move from the open position.

As the crank is turned, a cam on the levering-in shaft holds the interlock pin in the raised position until the arms are at either end of their travel. At this time the spring on the interlock pin will pull the pin down and separate the split coupling.

SECONDARY CONTACTS

The breaker control wiring is arranged for drawout disconnection by means of an 18-point connector plug arranged to connect to a mating receptacle mounted in rear of the cell. See Fig. 19. The secondary connector plug is mounted on a moveable bracket on the lower left hand side of the breaker frame. This permits it to be extended to the rear while the breaker is in the test position, and to make contact with the stationary receptacle so that the control circuits are completed. Sufficient clearance is provided in the mounting of both plug and receptacle,

and two large tapered pins on the plug provide positive alignment. The secondary contacts of the plug are made from high conductivity copper alloy and are slotted to provide a spring action which insures a good electrical contact. The flexible control wires are soldered to each plug and are arranged in a loop to allow free movement of the contact slide.

To engage the secondary contacts while the breaker is in the test position, place the breaker maintenance closing handle in the socket on the secondary contact slide at the lower left hand side of the breaker, Fig. 20. Push forward slightly to release the latch, then raise up on the handle to the end of travel. See Fig. 21. To disengage the secondary contacts, the maintenance closing handle is inserted into the socket and lowered. If the breaker is levered into the operating position, the secondary plug and slide will automatically return to the normal position; and the latch will hold it in place when the breaker is later moved to the test position.

GROUND CONTACT

A ground contact is located at the left rear of the breaker frame directly above the 18-point secondary plug, Fig. 19. Six spring loaded floating contact fingers engage the ground contact at the rear of the cell and insure a low impedance path to the ground.

PUFFER ASSEMBLY

Directly above the solenoid coil of the mechanism is a puffer arrangement that supplies a jet of air through an insulating tube and nozzle to each of the contacts. The diaphragm and clamping ring of the puffer are visible in Fig. 19. On low current interruptions the blow-out force of the small arcs is very light, so a jet of air is released at the instant the breaker is tripped. This facilitates the movement of the arc upward into the arc chute where it is quickly interrupted. The nozzle location is shown in Figs. 9 and 11. The diaphragm is connected to the trip free lever of the operating mechanism by means of two operating rods which also carry the accelerating

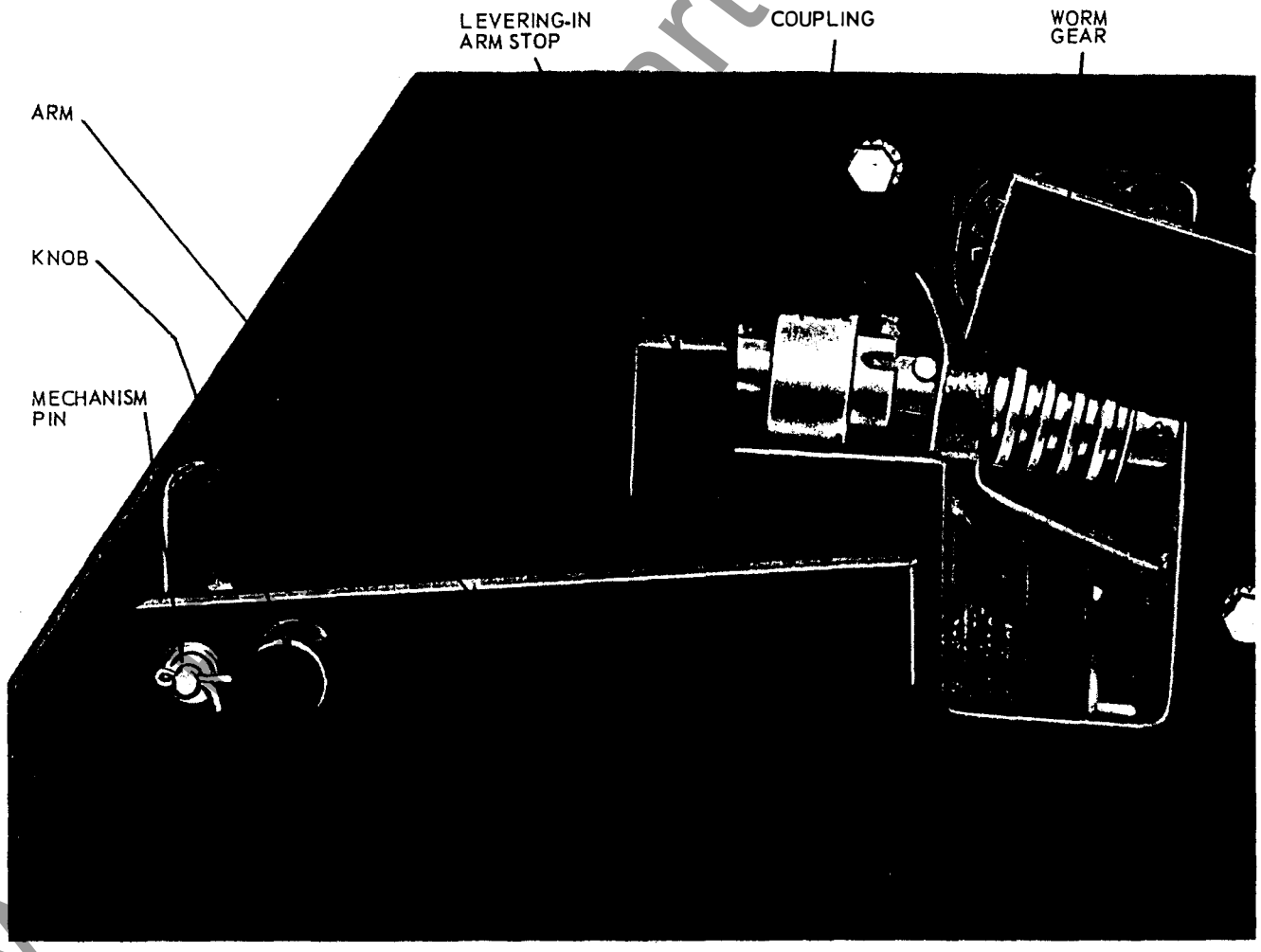


FIG. 22. "M-O-C" Switch Operating Arm

springs. As the breaker trips open, the diaphragm is drawn into the cavity expelling the air which is directed to the contacts by the three puffer nozzles. The diaphragm is made of a longlasting wide temperature range material and should never require replacement unless through accidental puncturing.

MECHANISM OPERATED CONTROL SWITCH

Some installations require more auxiliary switch contacts than are available on the nine pole auxiliary switch on the breaker. For this purpose additional rotary switches are mounted in the cell and are mechanically linked to the breaker mechanism.

An operating arm, shown in Fig. 22, on the right hand side of the breaker frame is connected to the trip free lever and moves with the mechanism. The knob at the end of the arm engages a link in the cell to operate the additional switches. This link may be arranged for operation of the switches when the breaker is in the operating position only, or both testing and operating positions.

SECONDARY CONTROL WIRING

The low voltage control wiring from the 18-point secondary plug to the various components consists of flexible stranded copper wire having flame retardant, moisture resistant insulation. The standard breaker internal wiring is shown on Connection Diagram, Fig. 23.

When an undervoltage trip device is used on the breaker, its coil is connected between secondary contacts 15 and 16; and the "a" contact at the end of the auxiliary switch is not wired.

One lead from each of the three current trip coils is connected to secondary contacts 13, 14 and 15 with the common connection from the three coils going to contact 16 when this type of tripping is used. This eliminates the connection to the last "a" and "b" contact of the auxiliary switch.

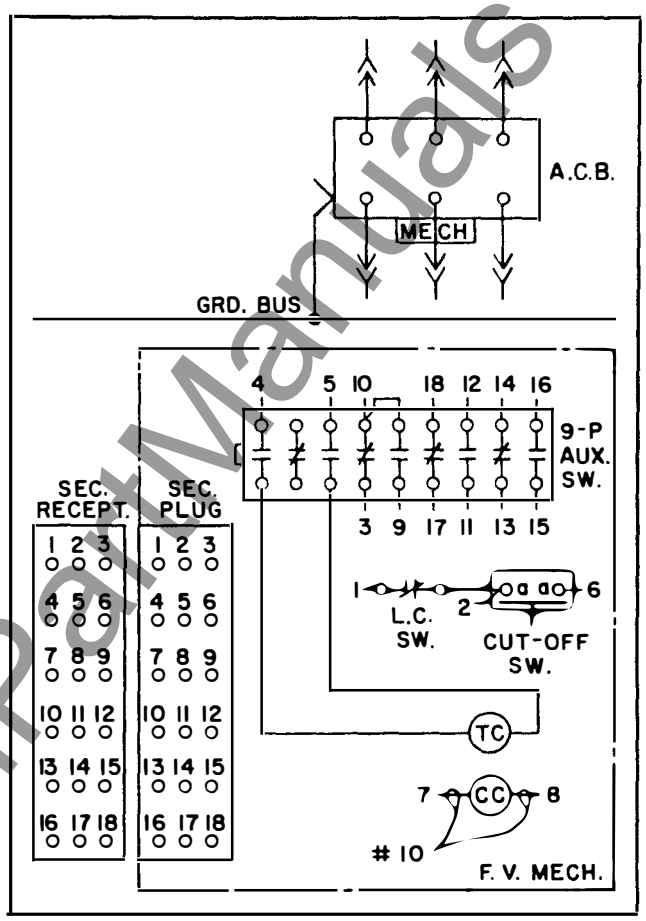


FIG. 23. Diagram of Breaker Internal Wiring

PART FOUR
INSTALLATION

With the exception of installing the arcing chambers these breakers are shipped completely assembled and adjusted. No change in adjustments should be required and none should be made unless it is obvious they have been disturbed.

Caution: Severe injury may be sustained if any part of the body is struck by the contact arms since they move very rapidly in the opening stroke. Personnel working about the breaker should stay clear of the space in which the contact arms move while the breaker is closed or being closed. Never trip the breaker with the maintenance-closing lever in place.

After the breaker has been removed from the shipping crate, place it in a convenient position adjacent to the test cabinet or in front of the metal clad cell in which it will go. Then perform the following sequence of operations to place the breaker in service.

1. Remove tie on hand-trip lever. Breakers are shipped with the contacts closed and a tie on the hand-trip lever to prevent tripping. Take off the tie on the trip lever being careful not to trip the mechanism until all personnel are clear of all moving parts, then trip the breaker.

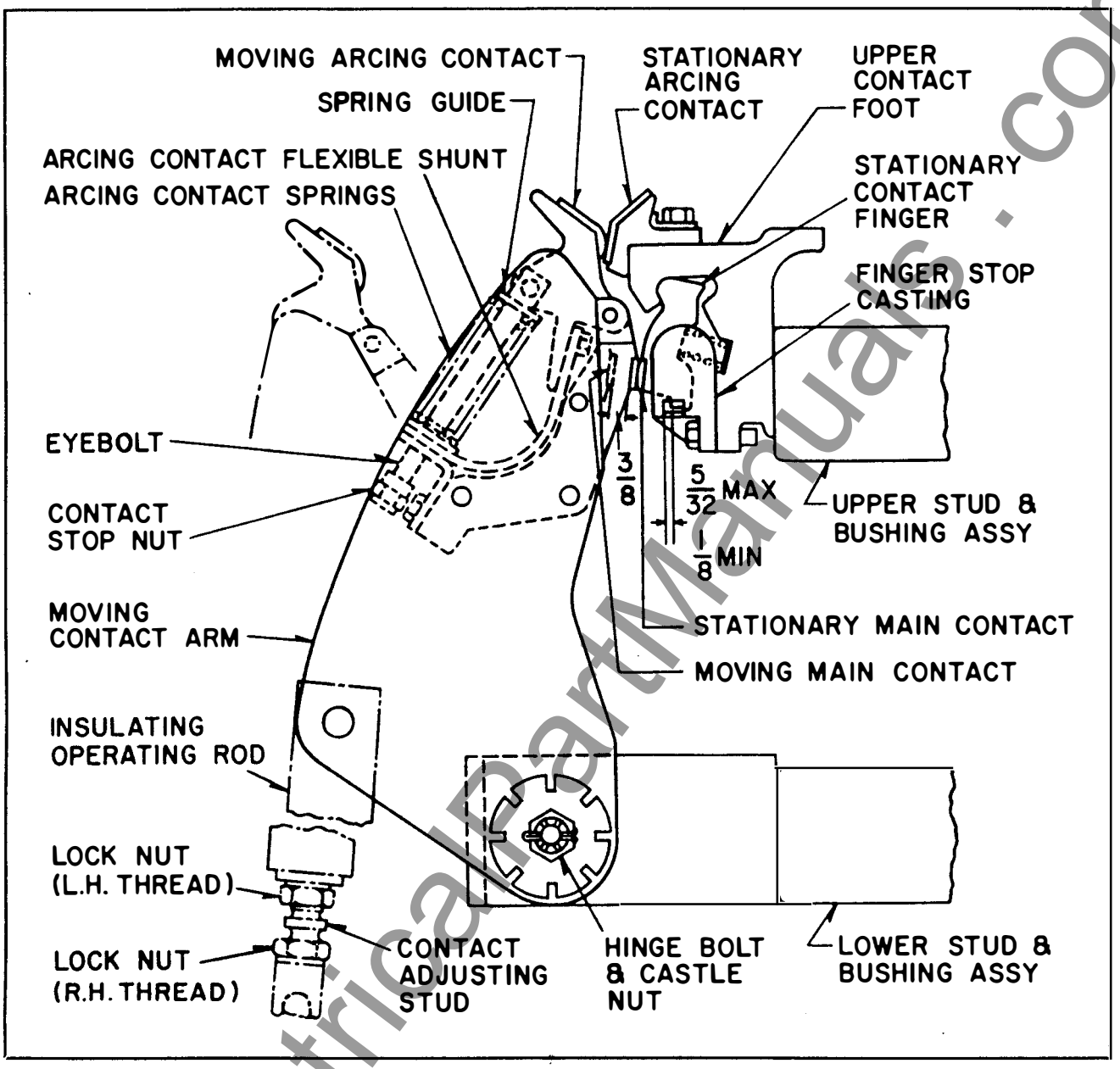


FIG. 24. Type 50-DH-150-E/250-E Contact Adjustment

2. Wipe off breaker main and arcing contacts. A light film of grease is applied to the contacts before the breaker is operated at the factory and is normally removed before shipment. Be sure contacts are free of grease or any foreign material before placing in service.

3. Close breaker by hand. Place the maintenance closing handle in the closing socket of the mechanism and push down to close the breaker. As the contacts touch near the end of the stroke, the force necessary to latch the breaker increases rapidly.

4. Check contact adjustment. The breaker main contacts are properly adjusted when the over-travel at the bottom of the outside stationary contact fingers is between 1/8 and 5/32 inch, with the breaker closed and latched. See Fig. 24. This may be measured through the rectangular opening on each side of the finger stop casting. If adjustment is required, it is made by loosening the two locknuts at the lower end of the operating rod; and turning the adjusting stud to lengthen or shorten the operating rod as required. Be sure to tighten the lock nuts after adjusting the contacts.

Trip the breaker, and close it again by hand until the main contact surfaces are separated 3/8 inch plus 1/16 minus 1/32 measured at the inside fingers. The outside fingers will be 7/32 plus 1/16 minus 1/32. Holding

this position, adjust the contact stop nut located below the moving arcing contact springs until the moving and stationary arcing contacts just touch.

Current is conducted across the hinge through silver contact rings on the inside of the moving contact arms and the outside of the lower contact foot, with the correct pressure being maintained by means of spring cup washers. There should be no need for changing this adjustment unless the moving contact arms have been removed. With the operating rod disconnected from the moving contact arms, open the arms to approximately 45 degrees from the "contact closed" position. Tighten the castle nut on the hinge bolt sufficiently to barely hold the 45° position. Replace the cotter pin, and reconnect the operating rod.

5. Trip the breaker. The breaker is tripped both manually and electrically by lifting up on the hand trip assembly on the front of the breaker mechanism panel. Refer to Fig. 7.

6. Close and trip the breaker. Close and trip the breaker manually several times to be certain that all parts are functioning properly.

7. Connect test jumper. Connect the test jumper from the test cabinet to the breaker secondary contact block and operate the breaker electrically several times. With some installation, a Test Jumper is furnished instead of a Test Cabinet. This jumper connects between the secondary receptacle in the cell and the secondary plug on the breaker, and allows the breaker to be operated electrically while in front of the cell. Breaker operation should be quick and positive in both closing and tripping.

8. Inspect arc chutes. Before installing the arc chutes, play a stream of dry compressed air through them from each end to remove any dust or foreign matter. Then examine the arc chutes to make certain the vents and slots are open and free from obstructions; and there are no broken parts.

9. Mount arc chutes. Mount the arc chutes one at a time in the following manner: (It will be advantageous to begin with the center pole since this arc chute hinge pin must be threaded through one of the outside pole hinge brackets).

(a) Remove the hinge pin from the hinge bracket on the bushing support.

(b) Lift the arc chute into place so that the two parts of the hinge bracket are aligned with the arc chute in the tilted back position. See Fig. 4. Slip the hinge pin into place, and secure with a cotter pin on each end. The arc chutes are balanced so that they will remain in this position.

Caution: DO NOT use the molded deflector angles at the top of the arc chutes for lifting as the seal to the ceramic plate will be broken.

(c) Carefully lower the arc chute to the horizontal position while checking the alignment with the moving and stationary contacts. The rear arc horn clip must make good contact with the rear projection of the upper contact foot.

(d) Bolt front arc horn to shunt strap of moving contact bushing.

(e) Make final check by operating breaker slowly by hand to see that there is no interference with movement of the contacts at any point in the travel.

(f) Check the nine pole auxiliary switch contacts to see that the fingers are approximately centered on the rotor segments for both open and closed positions of the breaker.

(g) The plunger of the single pole cutoff switch, located to the right of the nine pole switch, should be fully depressed when the breaker is latched closed.

10. Mount the barrier. When mounting the barrier, the lower rear corners of the outside plates go to the inside of the breaker frame. Two bolts in the lower front corners hold the assembly in place.

11. Prepare levering-in device to move breaker into cell. Breakers are shipped with levering-in device in the position shown in Fig. 18 with the arms pointing toward the breaker front. Before placing the breaker in the cell, the levering-in device roller arms must be pointed to the rear of the breaker and slightly downward as shown in Fig. 17. To put the levers in the position just described, place the crank over the shaft extending through the right front corner of the mechanism panel. Press in on the crank to engage the levering-in device coupling and rotate counterclockwise until the arms come around to the end of the travel against the solid stop. The breaker must be open to engage the levering-in device.

12. Place breaker in test position. Position the breaker in the cell and roll it in until it comes up against the solid stop. This is the test position.

13. Engage secondary contacts. Place the maintenance closing handle in the secondary contact socket and lift up to engage the secondary contacts, Figs. 20, and 21.

14. Operate breaker electrically. Close and trip the breaker several times electrically from the control switch on the front of the cell to check the control wiring in the cell. If the operation is satisfactory, the breaker may now be levered into the operating position.

15. Caution: When this breaker is put into the cell and moved in beyond the test position, the high voltage parts will be energized. If the barrier is completely assembled on the breaker, personnel will be protected from contact with the live parts. If however, the barrier assembly is left off and the breaker rolled into the cell, live parts are exposed. The breaker should NEVER be rolled into an energized cell structure beyond the test position without the barrier assembled in place, and the shunt strap bolted to the arc chute connection.

16. Lever breaker into cell. To move the breaker to the operating position, the contacts must be open. Place the crank on the levering-in device operating shaft, press in to engage the levering-in device, and rotate the crank clockwise to the end of the travel. At the end of the travel, the handle will come back out and the indicator on the breaker mechanism panel will point to "Operate". The breaker must be all the way in for the interlock to release to permit the contacts to close. Remove the levering-in crank.

17. Caution: Do not attempt to close this breaker by hand against an energized circuit. To insure sufficient force and speed, the breaker must be closed electrically, from an adequate power source. (See NEMA Standard SG-6-213).

18. Energize the breaker. Close and secure the cell door. Close the breaker electrically with the control switch on the cell door.

If a test cabinet is not available for checking the breaker electrically before placing it in the cell, it can be checked electrically in the test position in the cell. Observe the caution of Step 15 above and do not go beyond the test position unless the arc chutes and barrier are in place.

PART FIVE

ADJUSTMENT

MECHANISM

The mechanism of the breaker is adjusted at the factory and is designed to give long, trouble free performance. Do not make any adjustment unless faulty operation is observed.

Tripping Latch. If a breaker fails to close contacts although the moving core of the mechanism moves to the closed position, a probable cause is failure to reset. Refer to "C", Fig. 6. The gap indicated between the tripping latch roller and cam is an essential requirement to permit the tripping latch to fall into the cam notch. Watch the trigger handle (with words "lift to trip"), it should return to the horizontal position immediately after breaker has been opened.

If the trigger is prevented from returning to the full reset position by the primary latch roller above it, the cause may be that tripping latch roller cannot drop into cam notch. Remove the barrier from the breaker. This gives easy access to the gap. Using the hand closing lever, close the breaker part way, trip it, and then slowly retrieve the moving core. Note whether or not the tripping latch roller drops into the cam notch.

If it is necessary to increase the clearance to get 1/32 inch gap, loosen the locknut and adjust the mechanism stop bolt until the cam to roller clearance is within limits. When measuring this, the closing latch should be depressed to be sure the tripping cam is in its normal position. The stop bolt is accessible through the cut-out in the mechanism panel next to the shunt trip. See Fig. 7. The hand closing lever should be out of the socket during this adjustment.

Cut-Off Switch. Operation of this switch must occur at the proper time in the closing stroke. The contact must make positively before the end of motion of the trip free lever so that the current will always be cut off. In the other direction, cut-off must not occur too early in the stroke or the mechanism might fail to complete its closing stroke. **Proper action will be obtained when the switch plunger has from 1/32 to 1/8 inch over travel.** In other words between the position where the contacts touch and the position with the breaker closed and latched at rest, there must be 1/32 to 1/8 inch motion of this switch plunger. Ordinarily no adjustment is required. The resilience provided in the operating arm by the leaf spring prevents damage to the switch on the mechanism over travel. If it should be necessary to change the switch contact time, bend the switch operating arm to get the proper time.

Latch Check Switch. The action of this switch may be checked as follows. With the breaker open, raise the trigger (Lift to Trip) arm to end of the travel. Lower it slowly listening for the snap action. **Note the position of the arm when the switch snaps closed. The switch should close its contact when the trigger**

arm is in an interval from 3/8 to 1/8 inch above the normal reset position measuring at the shunt trip plunger centerline. A convenient method of measuring this is to raise and lower the trigger arm by pushing with the trip plunger and making pencil marks on the plunger rod. If the breaker is out of the cell, switch action may be indicated electrically by connecting to contacts number 1 and 2 on the secondary plug. If switch action must be made earlier or later, bend the switch arm near the middle of its length.

Contacts. Each time the breaker is operated, a small amount of the contact material is eroded away. In order to maintain proper pressure as the contacts erode, it is necessary to readjust the contacts from time to time to compensate for wear. **The contacts are properly adjusted when the over travel at the bottom of the outside stationary contact fingers is between 1/8 inch minimum and 5/32 inch maximum.** This may be measured through the rectangular opening on each side of the finger stop casting. Refer to Fig. 24 and Contact Adjustment Paragraph 4 under Installation.

Always tighten all locknuts securely, and then recheck measurements.

PART SIX

MAINTENANCE

The Westinghouse Type DH circuit breakers are designed to have a long life with a minimum of maintenance when operating duty is ordinary or average. However, with the many types of applications of these breakers, the operating duty will vary greatly as to frequency of operation and as to amount and power factor of current interrupted. Therefore, the frequency of inspection and the amount of maintenance for any particular application must be chosen with due regard to the kind of duty a breaker is performing. The following remarks are intended as a general guide. Experience on a particular application may show a need for varying the maintenance practice.

Breakers which operate only a few times per year with light to medium currents being interrupted will require only light routine maintenance. This should consist of a general inspection and a cleaning of deposited dust and dirt, particularly from insulation surfaces, and a few exercising operations. When making these exercising operations, observe the mechanical operations to be sure they are quick, snappy, and positive; and that there is no tendency of any parts to stick. If there is any stickiness or sluggish motion, operate slowly by hand to locate the place with high friction. See paragraphs on Lubrication. It is recommended that breakers which remain closed continuously without any automatic operations be given several "exercising" operations and a complete inspection once a year.

With breakers which operate a moderate number of times, say 100 to 1,000 times per year, mechanical stickiness is unlikely to develop and there will be no need for exercising operations. However, on inspections more attention should be paid to cleanliness of the interrupter, especially if there are many fault current interruptions. Large current arcs glaze the ceramic surfaces inside the arc chutes but leave them clean electrically. On the other hand, frequent operation at low or medium currents (about 1,000 amperes or less) tend to cause the accumulation of soot and condensed metal on the parts inside the arc chute, particularly on the ceramic arc shields near the contacts. These deposits may be conducting and may have to be removed as explained later under Arc Chutes. Breakers which have opened large fault currents near the maximum rating, should be inspected as soon as practical. The condition of the contact surfaces and the contact pressure adjustment should be checked. Also the interior of the arc chutes should be inspected for cleanliness, degree of erosion, etc.

For breakers which operate very frequently, more maintenance will be required especially when the breaker opens large fault currents as well as ordinary load currents. Until experience has been acquired on such an application, inspection should be scheduled at least every two months or every 1,000 operations which ever comes sooner. At inspection, such breakers will need close checking of contacts and mechanism for wear and may need cleaning in the arc chutes and readjustment of the mechanism.

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 condition to be observed is the extent of the erosion of the contact material. When half of the original 1/8 inch thickness is gone, the contact should be replaced. This is because the remaining 1/16 inch thickness will be mechanically weak and might suddenly be broken away.

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 silvers, removing only enough to take off the high spots. In other cases, the surfaces may become glazed or shiny, and this may be corrected by the use of fine sandpaper. 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.

Moving Contact Assembly. The moving contact assembly consists of a copper forging to which is brazed the main contact silver alloy inlay, with the arcing contact hinged to the top. To change this contact assembly remove the three bolts which hold the contact between the blades.

The moving arcing contact, springs, and shunt may be separated from the main contact forging by first removing the 3/8-16 hex head bolt located under the arcing contact stop nut. Refer to Fig. 24. One of the snap rings and the 5/16 inch diameter arcing contact hinge pin are removed.

If only the main contact is to be replaced, the parts are then reassembled in the reverse order.

To replace the moving arcing contact, the two 1/4-20 hex head bolts are removed at the top of the flexible shunt. For the 50-DH-150-E rating, the 3/8 inch diameter pin at the top of the spring eyebolt is driven out. In replacing the new contact, the pin may be started through the eyebolt by prying from the opposite side with a rod of similar diameter to force the spring guide down. For the 50-DH-250-E rating, the two halves of the arcing contact are slipped off the side. If only one half of the contact is changed at a time, the spring pressure will be reduced.

Caution: There is considerable spring pressure and the parts will have a tendency to fly apart as the spring guide snaps to the shoulder on the eye-bolt. Do not remove the adjusting nut at the bottom of the spring eyebolt.

The arcing contact assembly is then installed on the main contact forging. Make sure all bolts are tight, and the snap rings have been replaced on the hinge pin.

Stationary Main Contacts. The stationary main contact is made up of four or six individually sprung fingers held in the upper bushing contact foot for the 1200 ampere and 2000 ampere rating. See Figs. 12, 13, and 14. These are removed by partially closing the breaker with the maintenance closing handle far enough to hold the fingers in place.

Caution: Do not latch breaker. Remove the two 5/16—18 hex head bolts from the finger stop. The breaker is allowed to open slowly. The fingers and their springs may be slipped out the side of the contact foot.

A very thin coat of a graphite grease should be placed on the silver plated contact surface between the contact fingers and the contact foot before replacing the fingers. (W) No. 8831-9 is recommended.

In replacing the fingers, the thin strip of insulation must be located between the bottom of the finger springs and the contact foot.

The 1200 ampere rating with four fingers has a spring for each finger. The 2000 ampere rating has two concentric springs resting on a spring seat for each pair of fingers. One side of the spring seat has two ridges. In reassembling, the spring seat must be placed so that each ridge is parallel to the finger and rests on a single finger.

After the fingers are in place, the finger springs are compressed by partially closing the breaker with the maintenance closing handle. This will allow the finger stop to be bolted in place.

Stationary Arcing Contacts. These contacts are easily replaced by removing the one, or two 3/8—16 hex head bolts at the top of the contact foot. The new contact is then bolted in place.

ARC CHUTES

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.

On general inspections, blow-out the arc chutes with dry compressed air by directing the stream upward from the contact area and out through each of the slots between the arc splitter plates. Also direct the dry air stream thoroughly over the arc

shields. These are the ceramic liners in the lower end of the chute where the arc is drawn.

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

When inspecting an arc chute, look for the following:

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

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

3. Dirt in Arc Chute. In service the arc chute assembly will become dirty from three causes. First, dust deposited from the air which can readily be blown out of the chute with a dry compressed air stream. Second, loose soot deposited on the inside surfaces of the arc chute in the lower portions near the contacts which may be removed by wiping with cloths free of grease or metallic particles. Third, very tightly adhering deposits from the arc gases on the ceramic arc shields near the contacts. These deposits from the metal vapors boiled out of the contacts and arc horns, may accumulate to a harmful amount only 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 glass polyester or Redarta surfaces exposed to the arc 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. This dirt can be removed only by rubbing with coarse sand paper or other nonconducting abrasive 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 cycle 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 in the black deposits.

OPERATING MECHANISM

With average conditions, the breaker operating mechanism may be expected to operate 5000 times or more with only routine inspection and lubrication. During inspection, the following points should be kept in mind: (1) Remove loose dust and dirt with a compressed air stream. (2) Wipe off latch and roller surfaces. (3) With maintenance closing lever, move mechanism parts slowly closed to point where arcing contacts just touch; and then allow contact arms to fall slowly to open position, observing any evidence of stickiness or excessive friction. (4) Holding trigger up, move maintenance closing lever up and down slowly. The core should move freely in the solenoid, and the linkage system should reset positively when the weight of the maintenance closing lever is removed slowly.

Lubrication. In general, lubricants are not in wide spread use on circuit breakers. Yet the gains from the use of certain choice lubricants only follows principles of good mechanical practice. For many operating parts, lubricants can be avoided. In certain other parts, the use of special lubricant is desirable and beneficial—PROVIDED IT IS DONE CAREFULLY. This means applying it in small quantities to avoid drippings and accumulation. Experience will dictate the amount required. Those breakers having only a few operations per year, will perform best with the moving surfaces of the mechanism clean and only a very light film of lubrication. While those breakers having many operations per day will require more lubrication to prevent excessive wear.

If any excessive friction or binding is discovered on inspection, relieve it either by adding lubricant or if necessary by cleaning old dried lubricant from the bearing surfaces. In general, the addition of a few drops of oil should be sufficient. In a few cases, after long service, the accumulation of dried or oxidized lubricant may make it necessary to disas-

semble parts and clean them. Carbon tetrachloride is a good solvent for this.

Apply a small amount of a light oil to the wearing surfaces. Use a stable oil with a low rate of oxidation and with a low pour point. Wemco C is suggested. Avoid putting oil on insulating material surfaces. Also put no oil on the breaker contacts, the auxiliary switch, the puffer diaphragm, nor the rubber bumpers. Soft petrolatum may be used on the drawout connectors both primary and secondary.

For the closing magnet core use graphite grease (W) No. 8831-9. Apply a small quantity all around the core when the breaker is in the open position, and close and open the breaker several times to work in the grease.

The silver plated contact surfaces on the hinge of the moving contact arms should be lubricated with graphite grease (W) No. 8831-9.

When the stationary main contact fingers are replaced, the knuckle joint between the fingers and the contact foot should have a light film of graphite grease (W) No. 8831-9.

The rollers and pins on the hand trip assembly, Item 32 on Fig. 27, should receive a very small quantity of a molybdenum lubricant (W) No. 8577-2.

The levering-in device rollers and shutter rollers should also receive molybdenum lubricant (W) No. 8577-2. The levering-in shaft bearings and worm gear should receive (W) Material No. 5435-1.

Any good grade of grease can be used for the breaker wheel bearings.

In dusty, dirty locations, surplus oil may catch and hold grit near bearings and latches and cause faster wear. In such locations, it is recommended that all oil be omitted, and the steel parts in the mechanism be lubricated by rubbing with (W) Molkolube Powder, Material No. 8565-3.

Clearances. After a mechanism has operated several thousand times, the following points should be checked as part of routine inspection. With the breaker open and the mechanism reset, there should be 1/32 to 1/16 clearance between the tripping latch roller and the cam. See Fig. 6C. If readjustment is necessary, see explanation under Mechanism Adjustments. To permit the closing latch to move up to its holding position, the shaft at the lower end of the non-trip free lever must overtravel the latch surface slightly. With the breaker closed, look through the slot in the panel with a flashlight at the closing latch and shaft; and energize the close coil for one or two seconds several times.

The overtravel should be approximately 1/32 minimum to 3/32 maximum. With wear in the link holes and pins, this overtravel may decrease. Adjustment is made with steel shim washers between the magnet back plate and the four large magnetic return studs. This will change the position of the stationary core with respect to the latching points in the mechanism frame.

After about 15,000 operations, replacement of some parts may be required. During routine maintenance, the amount of wear should be observed on latch surfaces, rollers, pins and pin holes. If it becomes impossible to obtain correct adjustments or if latches fail to hold, replacements should be considered.

PUFFER

The puffer diaphragm is made of long lasting, wide temperature range material, and should never require replacement unless through accidental puncturing. If replacement is necessary, proceed as follows. Refer to Figs. 19 and 28.

1. Remove ground contact.

2. Remove two 3/4—10 castle nuts from clamping plate. The right castle nut will be captive until the right hand puffer rod is lowered.

3. Remove the links to the 9-pole auxiliary switch and the operation counter. Remove two drive pins from the front of the levering-in device shaft, and slip off the indicator collar.

4. After removing the four 3/8—16 bolts from the mechanism front panel, the panel may be swung to the side without disturbing any wiring.

5. Remove the 1/2 inch diameter pin between the bottom of the right hand puffer rod and the trip free lever of the mechanism. The rod will then move forward to clear the levering-in gear housing.

6. Remove twenty 1/4—20 clamping ring screws. With the levering-in device arms pointing to the rear, two of the screws may be reached through the openings in the side frame.

7. Remove the clamping ring, and the diaphragm and clamping plates.

8. Remove the two bolts which hold the diaphragm between the clamping plates.

9. Place the new diaphragm in the same position as the one removed, and replace the two bolts and locknuts. Do not overtighten so as to crush the diaphragm. .

10. Place this assembly in the cavity of the puffer casting, and return the clamping ring which may be held in place with several screws.

11. Replace the two castle nuts, but do not tighten until the pin has been replaced in the bottom of the right hand puffer rod.

12. After moderate tightening, secure the two castle nuts with cotter pins. Replace the twenty

clamping rings screws being careful to not crush the diaphragm.

13. Replace the cotter pins in the puffer rod pin, and return the front panel and links.

PUFFER NOZZLE

The puffer nozzle is molded directly to the puffer tube. The tube passes through the lower bushing foot and into the puffer casting. It can be changed by removing the bolt from the clip at the base of the tube where it passes through the breaker frame. When replacing the tube, be sure the clip is in the notch in the tube before tightening the bolt.

Auxiliary Switch

The contact fingers and rotor segments of the nine pole auxiliary switch may be inspected when the breaker main barrier and the insulating angle cover on the switch frame are removed. Refer to Fig. 29.

The rotor moves approximately 90 degrees starting from a position 22½ degrees below the horizontal when the breaker is closed. This is adjusted by loosening the ¼—20 locknut at the end of the operating lever and moving the serrated plate. The "V" tip of the stationary contact finger should be near the center of the contact segment when that stage is closed. Check "a" contacts with the breaker closed, and "b" contacts with the breaker open.

Normal operation is sufficient to keep the contacts clean. If the contacts do require cleaning, a very fine file should be used; and care taken not to remove more material than necessary.

Any burned segments and contact fingers should be replaced. The rotor is removed from the switch by loosening the operating lever and removing the end plates. The rotor is dismantled by removing the ¼—20 clamping bolt and end clamp. Refer to Fig. 29.

In reassembling, care must be taken that the insulating spacers are placed on the rotor shaft in the correct order. The various widths are given in Fig. 29 with the 7/32 and 15/32 spacers starting at the third position and alternating to the end of the rotor.

INSULATION

Flame retardent, glass-mat polyester insulating materials are used in high voltage air circuit breakers for bushing ties, barriers, braces, arc chutes and similar purposes, where it has been found to be more suitable than porcelain, The material used on Westinghouse breakers is Redarta, which has a long established record for insulation and mechanical dependability.

Insulation maintenance consists primarily in keeping the surfaces of the material clean. This can be done by wiping the surfaces with cloths free of grease or metallic particles each time the breaker is removed from the cell for inspection.

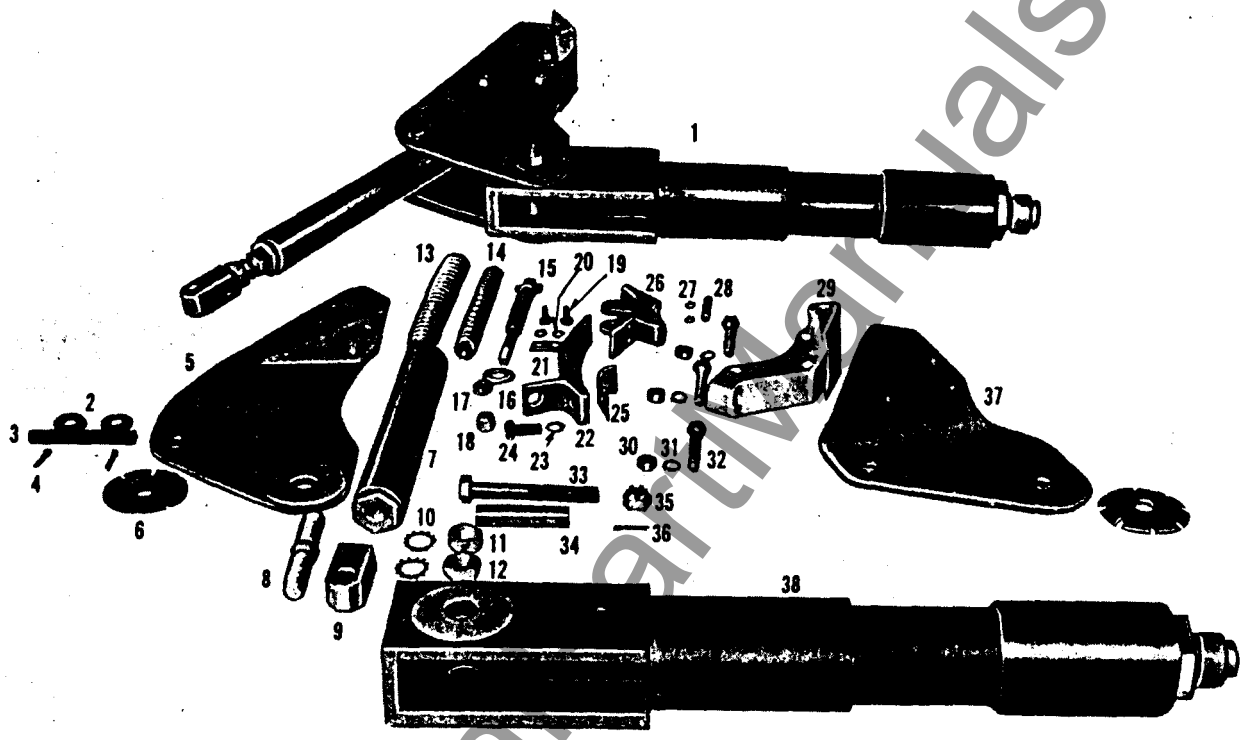
In case there is any tightly adhering dirt which will not come off by wiping, it can be removed with Westinghouse solvent No. 1609-1 or -2.

PART SEVEN

PARTS IDENTIFICATION

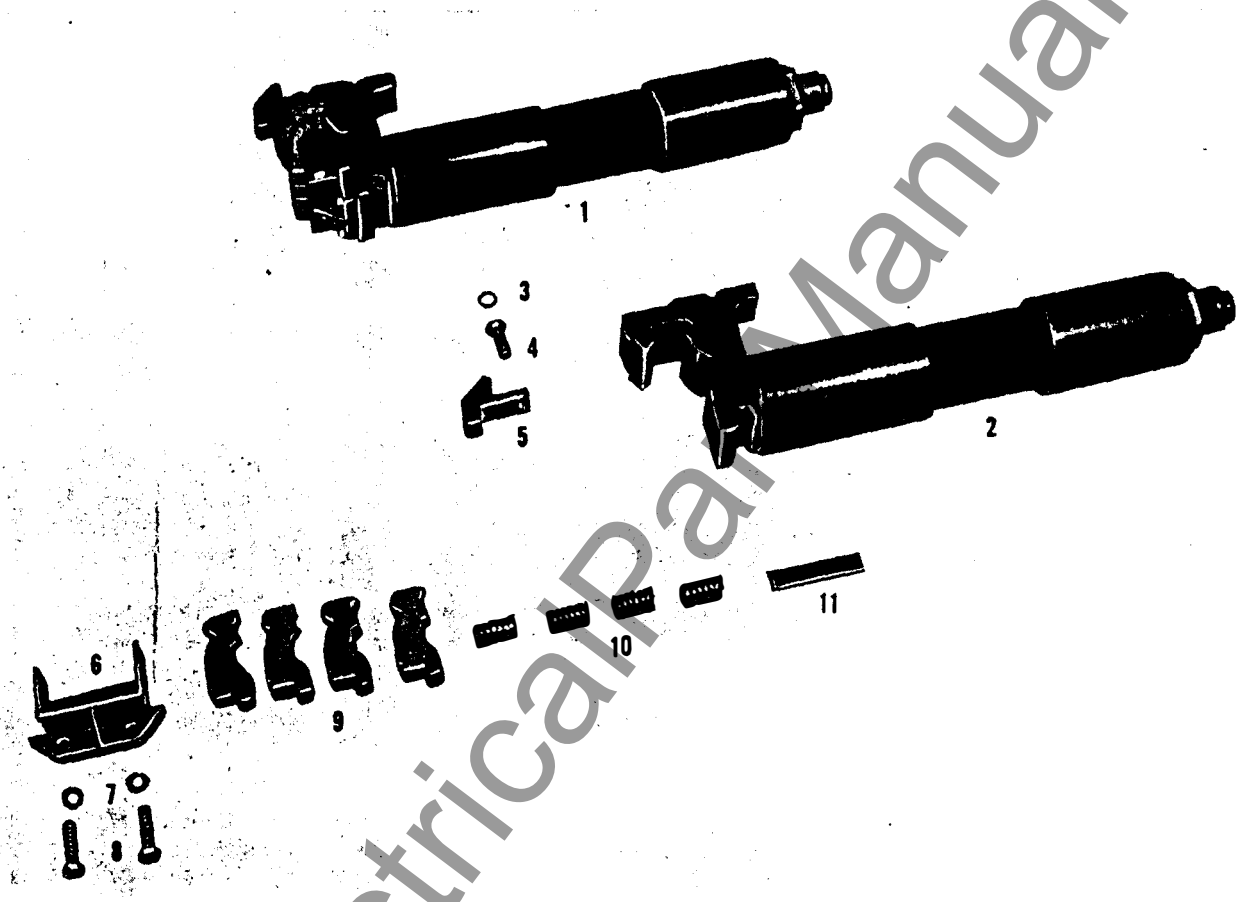
Detailed parts identification for the breaker are shown on the various figures throughout this book. Figure 3 shows the major components of the breaker. Figures 6 and 27 shows the mechanism linkage. Figure 7 shows the various components mounted on the mechanism front panel. Figure 25 shows the parts for the moving contact assembly, while Fig. 26 shows the parts for the stationary contact assembly. Figure 28 shows the parts in the puffer assembly.

Renewal Parts. A list of renewal parts recommended to be kept in stock will be furnished upon request. When ordering renewal parts, always specify the part name and style identification from the renewal parts data. If this is not available, identify the part by name from a particular figure in this instruction book, include the I.B. number. Also, always supply full information from the stamped nameplate on the front of the breaker along with the order.



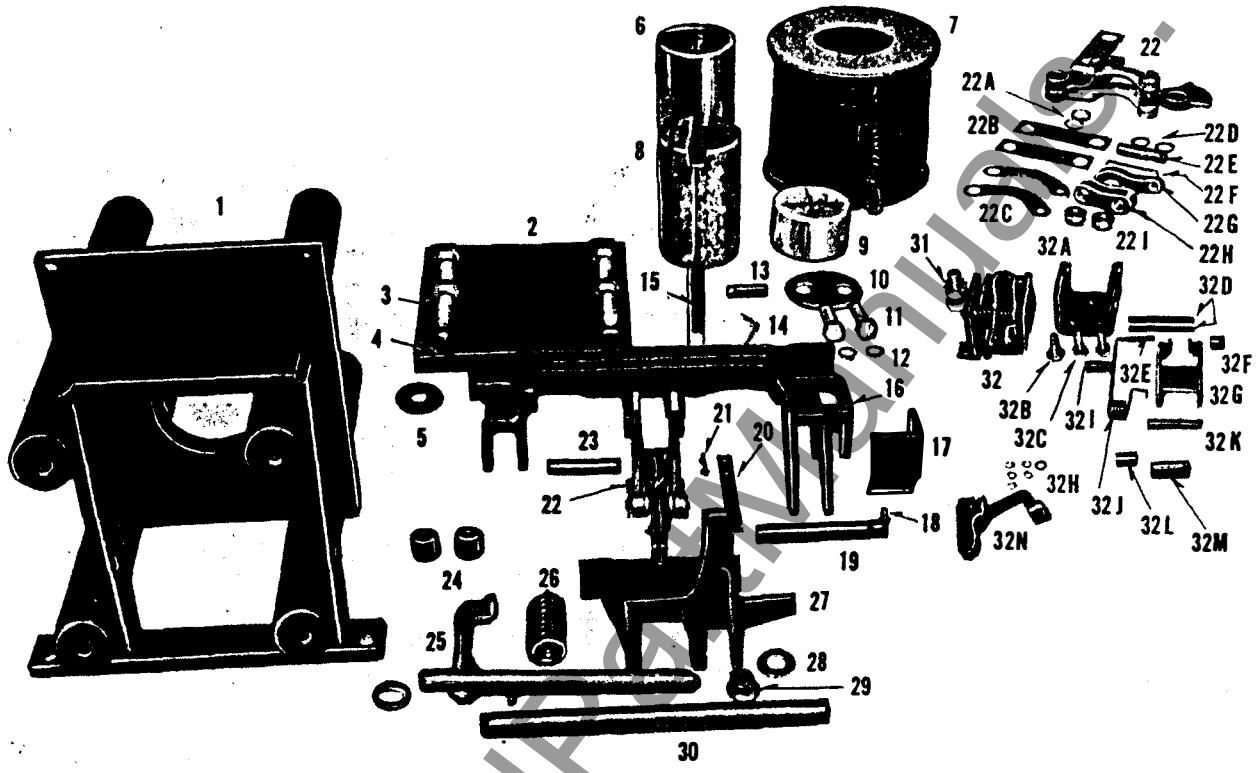
1. Moving Contact Assembly—Complete
2. Spacing Washers
3. Operating Rod Upper Pin
4. Cotter Pins
5. Left Hand Moving Contact Arm
6. Hinge Spring Washers
7. Operating Rod
8. Adjusting Stud
9. Rod End
10. Lockwashers
11. Locknut, Right Hand Thread
12. Locknut, Left Hand Thread
13. Moving Arcing Contact Spring, Outer
14. Moving Arcing Contact Spring, Inner
15. Eyebolt
16. Upper Spring Guide
17. Spacer
18. Arcing Contact Adjusting Nut
19. Shunt Bolts
20. Lockwashers
21. Shunt Clip
22. Arcing Contact Shunt
23. Lockwasher
24. Shunt Bolt
25. Shunt Guide
26. Moving Arcing Contact
27. Truarc Rings
28. Pin
29. Moving Main Contact
30. Nuts
31. Lockwashers
32. Main Contact Bolts
33. Hinge Bolt
34. Hinge Spacer
35. Castelated Nut
36. Cotter Pin
37. Right Hand Moving Contact Arm
38. Bushing, Stud, and Lower Foot Assembly

FIG. 25. Type 50-DH-150-E, 1200 Ampere Moving Contact Assembly



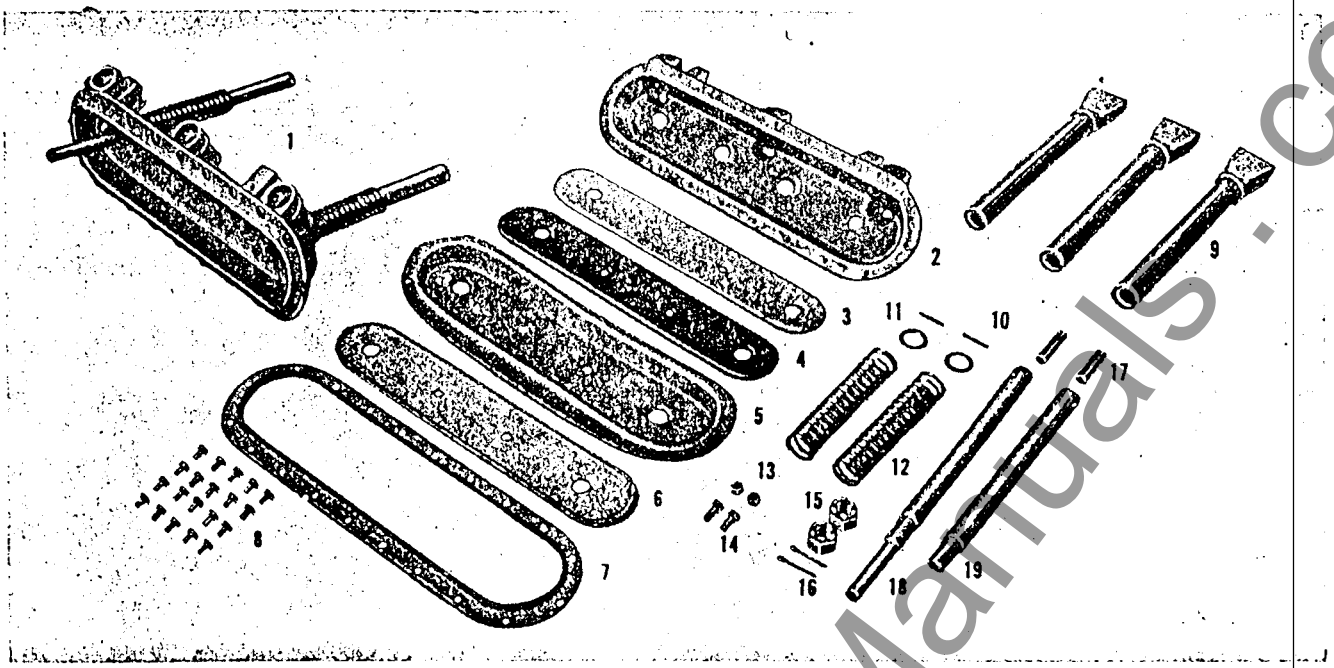
1. Stationary Contact Assembly—Complete
2. Bushing, Stud, and Contact Foot Assembly
3. Lockwasher
4. Arcing Contact Bolt
5. Stationary Arcing Contact
6. Finger Stop Casting
7. Lockwashers
8. Bolts
9. Stationary Main Contact Fingers
10. Main Contact Finger Springs
11. Spring Insulating Strip

FIG. 26. Type 50-DH-150-E, 1200 Ampere Stationary Contact Assembly



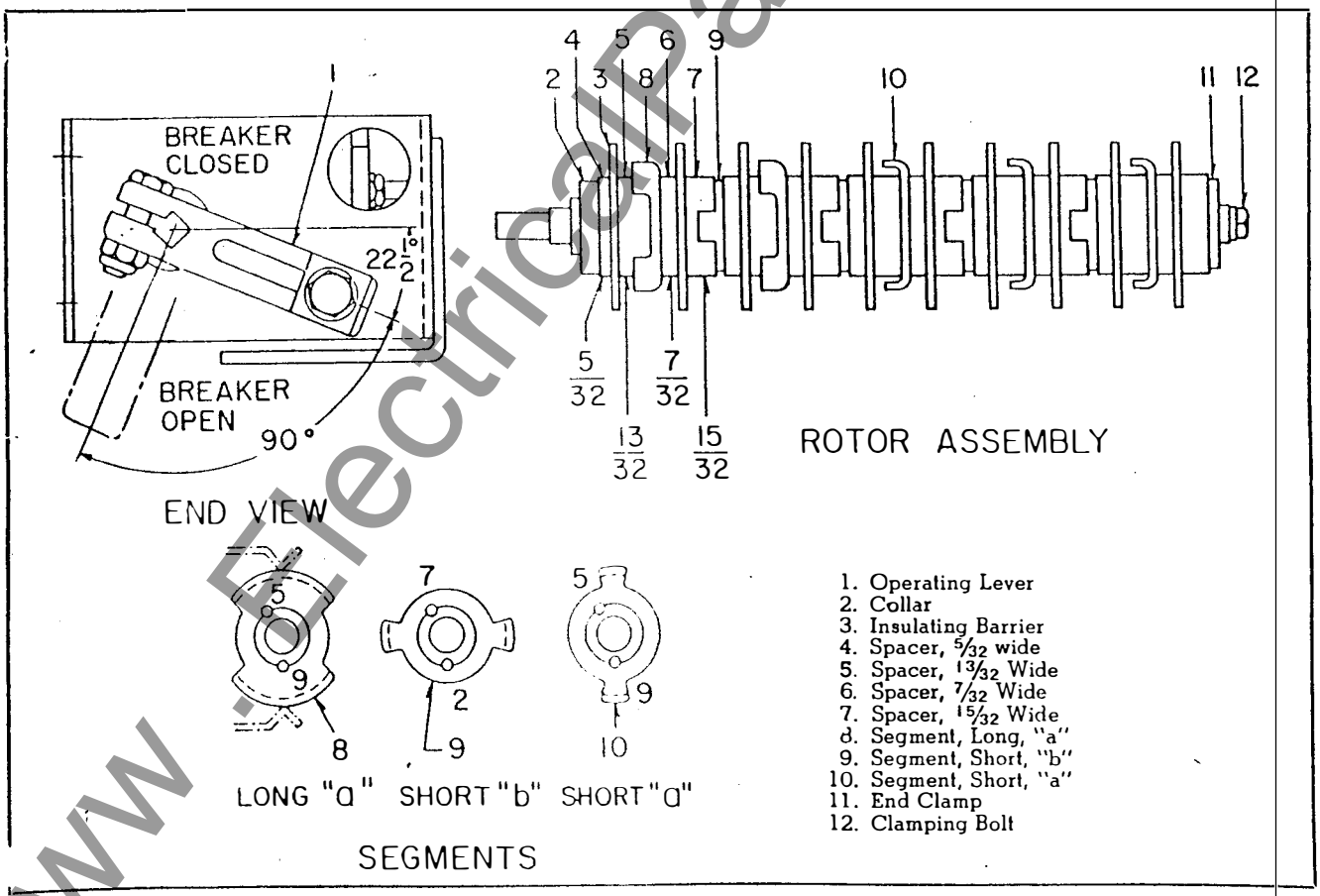
1. Mechanism Frame
2. Solenoid Back Plate
3. Back Plate Bolts
4. Bolt Locking Clips
5. Back Plate Shim Washer
6. Core Guide Tube
7. Solenoid Coil
8. Moving Core
9. Stationary Core
10. Stationary Core Shim Washer
11. Stationary Core Bolts
12. Lockwashers
13. Closing Link Pin
14. Pin Bracket
15. Closing Link
16. Trip Free Lever
17. Contact Position Indicator
18. Indicator Bolt
19. Latching Pin
20. Operating Arm for Cutoff Switch
21. Operating Arm Screws
22. Link Assembly
    - 22A. Spacers for Closing Link
    - 22B. Lower Trip Free Links
    - 22C. Cam Links
    - 22D. Washers
    - 22E. Pin Joining Upper and Lower Trip Free Links
    - 22F. Pin Joining Cam and Cam Link
    - 22G. Tripping Cam
    - 22H. Upper Trip Free Link
    - 22I. Cam Stop Rollers
23. Pin for Upper Trip Free Link
24. Rubber Stop Bumpers
25. Closing Latch
26. Retrieving Spring
27. Non-Trip Free Lever
28. Washers
29. Bushing
30. Operating Center Pin
31. Mechanism Stop Bolt and Locknut
32. Hand Trip Assembly
    - 32A. Bracket
    - 32B. Bracket Locating Bolt and Lockwasher
    - 32C. Bracket Mounting Bolts and Lockwashers
    - 32D. Trigger and Roller Lever Pins
    - 32E. Trigger Roller Pin
    - 32F. Trigger Roller
    - 32G. Roller Lever
    - 32H. Truarc Rings
    - 32I. Roller Lever Spring
    - 32J. Trigger Spring
    - 32K. Cam Roller Pin
    - 32L. Trigger Spring Guide
    - 32M. Cam Roller
    - 32N. Trigger

FIG. 27. Mechanism Assembly



1. Puffer Assembly Complete
2. Puffer Casting
3. Rear Clamping Plate, Steel
4. Gasket Plate
5. Diaphragm
6. Front Clamping Plate
7. Clamping Ring
8. Clamping Ring Screws
9. Puffer Tubes and Nozzles
10. Spring Stop Pins
11. Washers
12. Puffer and Accelerating Springs
13. Diaphragm Center Clamp Nuts
14. Diaphragm Center Clamp Bolts
15. Puffer Rod Castelated Nuts
16. Cotter Pins
17. Puffer Rod Pins
18. Puffer Rod, Long, Right Hand
19. Puffer Rod, Short, Left Hand

FIG. 28. Puffer Assembly



1. Operating Lever
2. Collar
3. Insulating Barrier
4. Spacer, 5/32 wide
5. Spacer, 13/32 Wide
6. Spacer, 7/32 Wide
7. Spacer, 15/32 Wide
8. Segment, Long, "a"
9. Segment, Short, "b"
10. Segment, Short, "a"
11. End Clamp
12. Clamping Bolt

FIG. 29. Auxiliary Switch Details

DESCRIPTION

The Type 75 DHE and 150 DHE Air Circuit Breakers are 3-pole, electrically operated, horizontal drawout units for metal-clad switchgear. The rating of the breakers are as follows:

Breaker Type	75DH250E	75DH500E	150DH150E	150DH250E	150DH500E
Interrupting Rating	250 MVA	500 MVA	150 MVA	250 MVA	500 MVA
Continuous 60 Cycle Rating	1200-2000 A.	1200-2000 A.	1200 A.	1200-2000 A.	1200-2000 A.
Rated Voltage	7200 V.	7200 V.	13800 V.	13800 V.	13800 V.
Maximum Design Voltage	8250 V.	8250 V.	15000 V.	15000 V.	15000 V.
Minimum Voltage For Interrupting Capacity	4600 V.	6600 V.	6600 V.	6600 V.	11500 V.
Interrupting Current At Rated Voltage	20000 A.	40000 A.	6300 A.	10600 A.	21000 A.
Maximum Interrupting Current	32000 A.	44000 A.	13000 A.	22000 A.	25000 A.

Figure 1 shows a typical breaker completely assembled as it is placed into the cell.

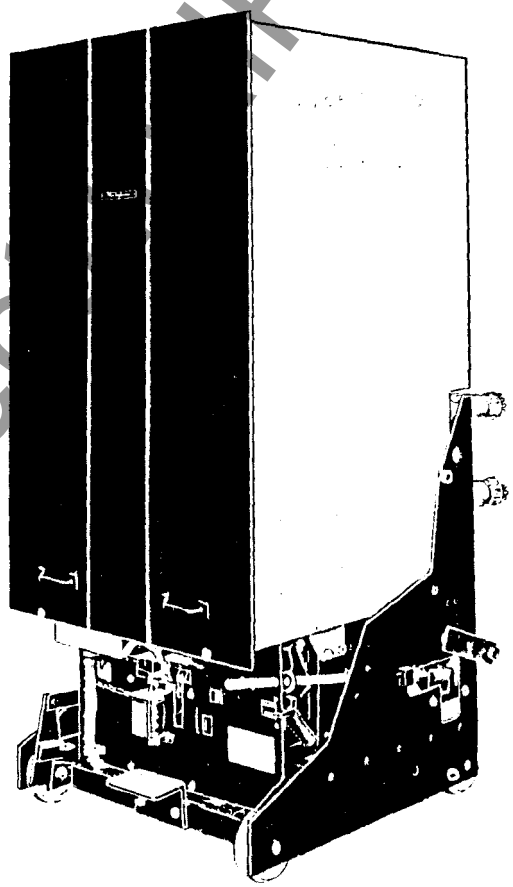


FIG. 1 TYPICAL BREAKER COMPLETELY ASSEMBLED

Figure 2 shows the barrier removed, the arrangement of the center coil arc chutes, the contacts, and the solenoid operating mechanism.

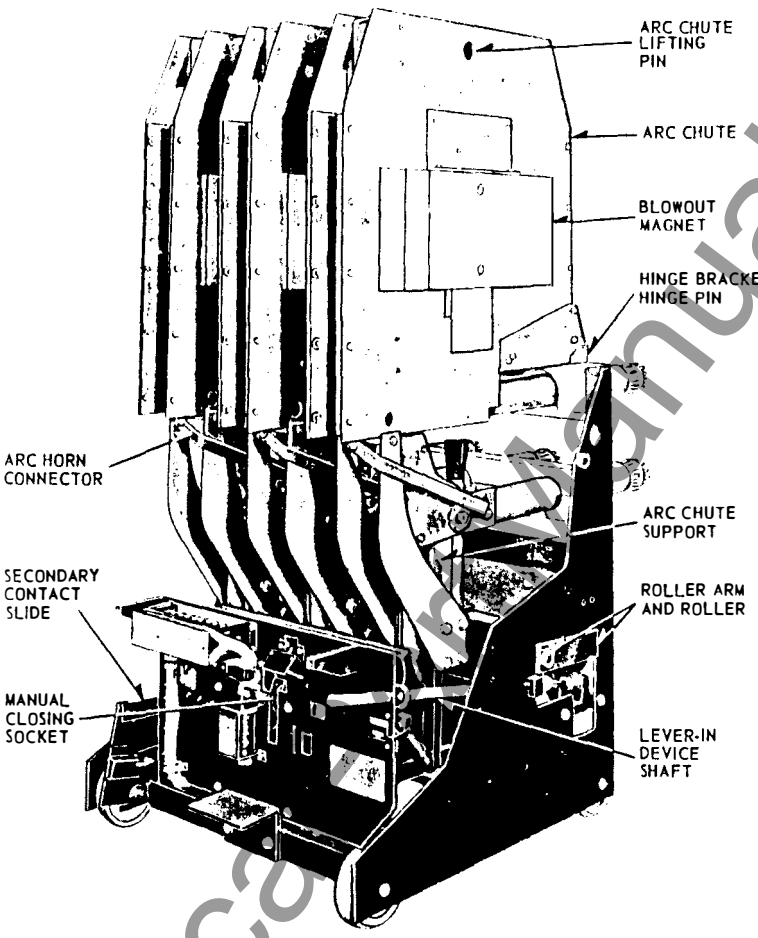


FIG. 2. CIRCUIT BREAKER WITH MAIN BARRIER REMOVED

These components are supported on a welded steel frame which is mounted on flanged wheels for driving it into the metal clad cell. In the lower part of the frame is also located the levering-in device for moving the breaker into final contact engagement. This device is interlocked with the mechanism to prevent inserting or withdrawing the breaker with the contacts closed. Also located in the lower part of the frame are the secondary contacts for automatically disconnecting the control wiring when the breaker is withdrawn, the auxiliary switch, and other auxiliary devices.

The arc chutes on this breaker are of the center coil design. In this type of construction, the magnetic circuit is H-shaped with the cross member of the H passing through the center of the arc chute. The blowout coils are wound around the cross member of the H and lie in the center of the arc chute.

With this type of construction, the magnetic core passes through the center of the arc chute, and is an integral part of the arc chute assembly. To provide easy accessibility for contact maintenance and inspection, the arc chutes are hinged at the rear, and a simple tilting device is provided. Figure 3 shows the breaker with the arc chutes tilted back. The levering-in device is used to supply the mechanical advantage for tilting the arc chutes.

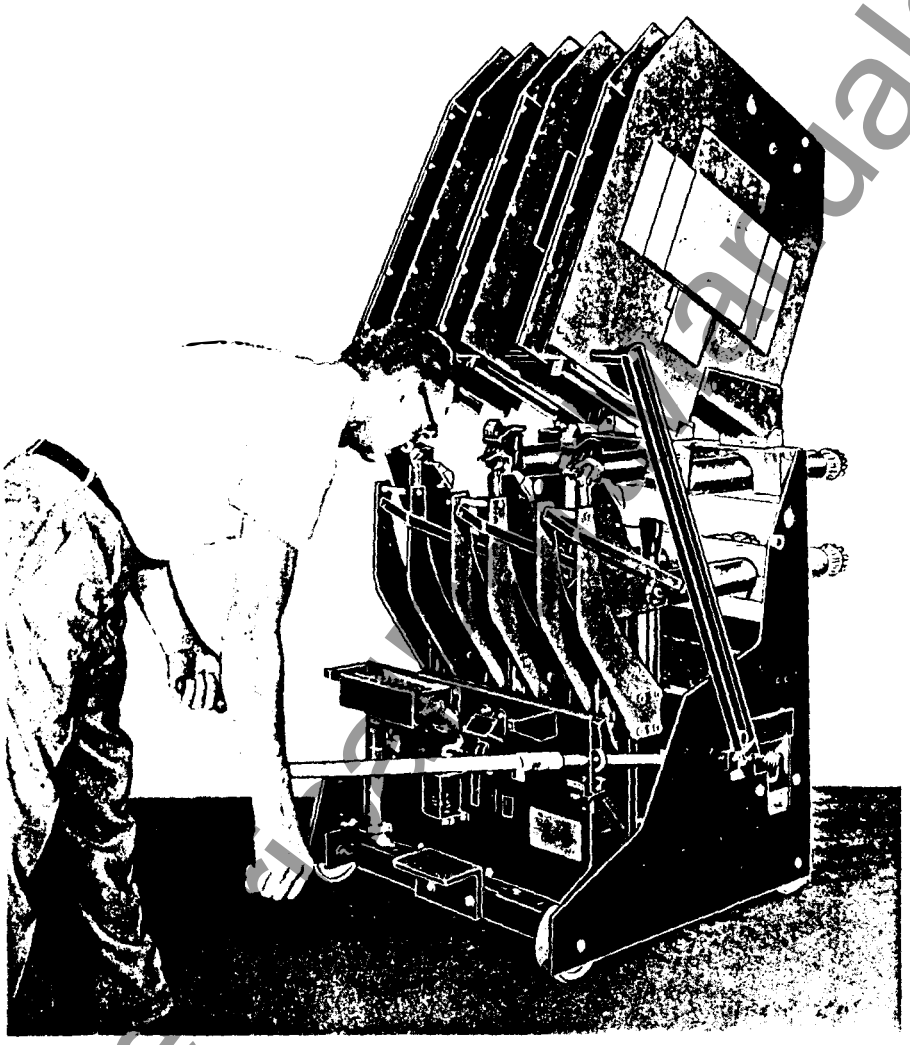


FIG. 3. CIRCUIT BREAKER WITH MAIN BARRIER REMOVED AND ARC CHUTES RAISED

A barrier assembly is placed on the breaker before it is rolled into its cell. The front sheet is 1/8 inch steel to form a grounded barrier between personnel and live parts when the unit is in the cell. The barrier assembly is in four parts for convenience in handling. There are three separate insulating barrier compartments - a left, center, and right unit placed side by side. The front steel barrier is supported by two hangers which engage the barriers at the top. The bottom of the barrier is secured with two hexagon head bolts which attach to the frame structure.

RECEIVING, HANDLING AND STORING

The receiving, handling and storing of the breakers should be done in the manner set forth in the instruction book I.B. 32-251-3. The approximate weight of the breakers and the various parts are as follows.

Breaker Parts	1200 Amperes	2000 Amperes
Breaker without arc chute and barriers	950 pounds	1230 pounds
Single arc chute	265 pounds	265 pounds
Barrier assembly	200 pounds	200 pounds
Complete breaker	1945 pounds	2225 pounds

INSTALLATION

With the exception of the arcing chambers and the barriers, these breakers are shipped completely assembled and adjusted. No adjustment should be required and none should be made unless obviously needed.

CAUTION: Severe injury may be sustained if any part of the body is struck by the contact arms since they move very rapidly in the opening stroke. Personnel working about the breaker should stay clear of the space in which the contact arms move while the breaker is closed or being closed. If breaker has been closed by hand, always remove the hand closing lever before tripping.

The following sequence of operation should be performed in preparing the breaker for use:

1. Breakers are usually shipped with the contacts closed and with a tie on the trip lever to prevent tripping. After the breaker is unpacked and the shipping ties and braces removed, take off the tie on the trip lever and trip the breaker. Then close the breaker carefully by hand using the removable hand closing lever. Make certain that all parts are functioning properly in that there is no binding or excessive friction. As the contacts touch near the end of the closing stroke, the force necessary to close the breaker increases rapidly.

2. With the breaker in the closed position, check the contacts to make certain that the adjustments have not been disturbed. For proper settings, refer to Figure 24 of I.B. 32-251-3. If adjustments are required, they may be made as described on Page 23. A light film of grease is applied to both the arcing and main contacts before the breaker is operated at the factory. This film is normally removed before shipment. Before the breaker is placed in service, inspect all contacts to see that they are free of oil or grease.

3. The breaker is more easily handled with the arc chutes and barriers removed. Mount these parts after the breaker has been moved near the metal clad cell structure. Before installing the arc chutes, play a stream of dry compressed air through them from each end to remove any dust or foreign matter. Then examine the chutes to make certain that the vents and slots are free of any foreign material.

4. Mount the arc chutes one at a time in the following manner:

a. Place a rope sling through the 5/8 dia. stud located at the top center of each arc chute.

b. Lift the arc chutes and lower them carefully over each phase making certain that they center over the contact structure without striking the ceramic pieces.

c. Remove the hinge pin from the upper bushing flange.

d. Lower arc chute into place so that back end is between hinge bracket on upper bushing flange. Use care in lining up the arc chute so that rear arc horn clip makes good contact with upper contact foot.

e. Insert hinge pin and put cotter pins in place.

f. Bolt arc horn connector to front arc horn in the chute.

g. Tighten lower connection of arc horn connector since it may have come loose during shipment.

h. Make final check by operating breaker slowly by hand, and see that there is no interference with the movement of the contacts.

5. The interphase barrier should now be put in place. Because of the size and weight, the barrier assembly is divided into four parts. Three of the parts consist of insulating compartments - left phase, center phase and right phase. The compartments are not interchangeable due to the location of the hanger pin for the front steel barrier, one of which is at the top left side, and the other at the top right side. Interchanging the two end compartments will place the supporting pins at the incorrect location for the steel front barrier. After the compartments are slid into place, the steel barrier is placed flatly against the compartments at a slightly higher elevation and slowly lowered until the hooks engage the pins at both sides. The lower end of the steel barrier is then secured to the frame structure with two hex head bolts, making certain that the barrier is vertically straight in position to enter the cell opening.

6. The breaker is now ready to be operated electrically. Each breaker should be closed and tripped electrically several times before being connected to high voltage. These operations may be made at the test position in the cell or by means of other test facilities provided. See Pages 17, 18, 19, and 20 of I.B. 32-251-3 for information concerning placing the breaker in the cell. The hand closing lever must be always removed from the socket in the mechanism before making electrical operations. If electrical operation is quick and positive on both the close and trip, the breaker is now ready to be levered into the operating position.

CAUTION: Do not attempt to close the breaker by hand against an energized circuit. To insure sufficient closing force and speed, the breaker should be closed electrically from an adequate power source. See NEMA standard SG-6-213.

When the breaker is put into the cell and moved in beyond the test position, the high voltage parts will be energized. If the barrier is completely assembled on the breaker, personnel will be protected from contact with the live parts. If however, the barrier assembly is left off and the breaker rolled into the cell, live parts are exposed. The breaker never should be rolled into an energized cell structure beyond the test position without having the arc chutes and complete barrier assembly in place.

OPERATION AND ADJUSTMENT

The operation and adjustments of the breaker is the same as that for the breakers described in I.B. 32-251-3. Reference should be made to Pages 9 through 12 of the I.B. for information covering the Mechanism, Mechanism Panel with its associated tripping device and auxiliaries, and Mechanism Adjustments.

CONTACT ADJUSTMENT

The contacts on this breaker are the same as those described on Pages 23 and 26, in the instruction book. Any adjustments that are necessary should be made as outlined in that section.

ARC CHUTES

The arc chute, Fig. 15 of I.B. 32-251-3, consists of an H-shaped blowout magnet, blowout coils, transfer arc horns, transfer stacks, main interrupter stacks, a front arc horn, and a rear arc horn, all assembled in and about a fabricated rectangular chute jacket. The arc chute is hinged to the breaker and when it is in the normal position, its lower end completely surrounds the contact structure.

The blowout magnet is located so that the magnetic core passes through the center of the arc chute. The blowout coils are wound about the core and lie in windows cut in the chute side sheets. One terminal of each coil connects to a transfer arc horn and the other terminals are joined together with the shading coil. Two transfer stacks are placed in the space between the transfer arc horns and the shading coil. To either side of the transfer arc horns are the main interrupter stacks which are made up of a series of insulating refractory plates. These plates have inverted V-shaped slots. The slots are off set so that as the plates are stacked with the slots alternating from one side to the other, the arc must take a serpentine path as it moves up into the arc chute, thus increasing the length of the arc.

To either side of the main interrupter stacks are two metallic arc horns to which the arc transfers from the arcing contacts. The front arc horn is connected electrically to the moving contact hinge, and the rear arc horns automatically connects to the stationary contact when the arc chute is lowered to its normal position.

The action of the breaker in interrupting an arc is as follows: Referring to Figure 15, when the arcing contacts part and an arc is drawn, it loops up and impinges on the lower ends of the two transfer arc horns and the shading coil. The two short segments of arc from the transfer arc horns to the shading coil then move up into the transfer stacks and are quickly interrupted placing the blowout coil in series with the arc.

When the current starts to flow in the blowout coils, a magnetic field is established and the arc, which by this time is two separate arcs, extending from the two end arc horns to the transfer horns, is driven very rapidly up into the slots of the refractory plates. As the arc moves to the closed end of the slots, it is restricted, lengthened, cooled, and subject to to a strong magnetically induced blast of gas. All of these forces result in rapid "de-ionization" of the arc space, and for the arc to maintain itself it must continually ionize fresh gas. At current zero the formation of new ionization momentarily ceases, but the de-ionization continues so that dielectric strength is established in the arc space and the circuit is interrupted.

ARC CHUTE LIFTER

In order to raise the arc chutes for contact inspection and maintenance, an arc chute lifter is provided. This attachment which uses the mechanical advantage of the levering-in device to provide the lifting force, consists of a 1" diameter steel bar, and two channel shaped arms. The steel bar is inserted through the arc chute openings, and the arms are secured in place as shown in Fig. 3.

To raise the arc chutes refer to Figure 3 and proceed as follows:

1. Remove barrier assembly.
2. Place 1" diameter steel bar through large 1-1/8 diameter holes in front of arc chutes.
3. Fasten the channel arms to the ends of the 1" diameter bar.
4. Place crank on levering-in device operating shaft and rotate clockwise so that the rollers at each side of the breaker advance forward enough to insert the opposite end of the channel arms. Clamp the arms over the rollers.
5. Disconnect shunt straps from front arc horn.
6. Place crank on levering-in operating shaft and continue to rotate clockwise to raise the arc chute to position shown in Figure 3.

It is important that the arc chutes be raised until the indicator on the front of the breaker shows that the full travel of the levering-in device has been used. This releases the mechanism interlock and permits the breaker to be closed and tripped either electrically or manually with the arc chutes in the raised position.

To lower the arc chutes and prepare the breaker for return to service, repeat the steps 1 to 6 in reverse order.

CAUTION: After inspecting the contacts and arc chutes and before returning the breaker to service, make certain that the shunt connection to the front arc horns is bolted tight.

HORIZONTAL DRAWOUT ARRANGEMENT

The breaker is arranged for use in horizontal drawout metal clad equipment and any questions pertaining to this arrangement, which includes operation of the breaker levering-in device, should be referred to I.B. 32-251-3 Pages 8 through 22.

MAINTENANCE

Maintenance procedure for the air circuit breaker, refer to I.B. 32-251-3, Pages 26 through 30.

PARTS IDENTIFICATION

Instruction Book 32-251-3 illustrates similar parts used on these breakers. Parts for a particular breaker can be identified by these illustrations, specifically mentioning the

type and rating of the breaker for which the parts are required. The breaker nameplate will identify the breaker type and rating.

MOTOR OPERATED BREAKERS

A separate instruction book is supplied for breakers having a motor-spring type of closing mechanism, and are supplied with the order involving this type of equipment.