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OPERATION & MAINTENANCE INSTRUCTIONS FOR THE TYPE CB-50 AIR CIRCUIT BREAKER

'ENGLISH ELECTRIC'

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ENGLISH ELECTRIC COMPANY OF CANADA, LIMITED

OB–50 AIR CIRCUIT BREAKER

CONTENTS

FOREWORD

This Publication has been compiled to provide detailed information to assist in maintaining the equipment in a satisfactory operating condition, thus reducing the possibility of breakdowns and their resulting inconvenience and giving the equipment its longest possible operating life.

It is recommended that maintenance work should be carried out on a routine basis, with records taken of the inspections made, along with their findings.

Under normal service conditions circuit breakers should be inspected annually, and those on more important circuits or those subject to frequent operation, should be inspected at shorter intervals. If the frequency of operation is as high as ten per day, it would be advantageous to carry out a detailed examination after every two thousand (2000) operations.

GENERAL DESCRIPTION (See Figure 1)

The English Electric Type OB-50 Air Circuit Breaker is in the 5 KV, 250 MVA Class and is suitable for interrupting capacities of 250 MVA at 4.16 KV or 150 MVA at 2.3 KV. Current ratings of 1200, 1600 and 2000 amperes are available.

The Circuit Breaker is arranged as a horizontal drawout unit, the main disconnecting devices being of the cluster type.

The Circuit Breaker main and arcing contacts are arranged to allow the contacts to close almost simultaneously, but on breaking the main contacts part well in advance of the arcing contacts. This arrangement allows the Breaker to have a high latching capacity, yet on opening the commutation of the current from the main contact to arcing system is guaranteed.

The arc is controlled by the blow-out magnets, which become energized the instant the main contacts part. This ensures that the magnet field is established well in advance of the arcing contacts parting.

The arc chute is made up of ceramic splitter plates in a Paxolin jacket, with an asbestos board exhaust chamber. The arc chute is pivoted about the front of the Breaker and can be supported in this position for contact inspection.

OPERATING INSTRUCTIONS

1. WITHDRAWING THE CIRCUIT BREAKER TRUCK FROM SERVICE.

With the equipment in normal service position, i.e., with the hinged front door closed, the following controls, etc., are externally accessible.

(a) Control switch or switches as specified for electrical closing and tripping, local and remote operation, hand/auto operation, etc.

(b) Meters, Relays and Instruments as required.
Coloured indicating lights are provided on the hinged door to clearly show the position of the circuit breaker. With the hinged front door open, access is available to the front of the truck (See Figure 2) and the following operations can be carried out:

1. Tripping of the Breaker. Before Operation No. 2 can be carried out, the breaker must be tripped. When the breaker is in service, it is preferable to trip it with the hinged front door closed, by means of the electrical control switch.

2. Removal of the Breaker. The procedure is as follows:

a. Rotate the interlock bar handle clockwise. This operation will remove the cover plate from a hole on the front of the breaker truck. Unless the breaker has been tripped, as stated in Operation No. 1, the interlock handle cannot be turned.

b. Insert the racking handle provided into the hole uncovered by the previous operation.

c. Turn the racking handle in a counter clockwise direction. This will screw the breaker truck 2" out of the service position.

d. Remove the racking handle, and manually pull the breaker truck into either the test position or completely clear of the cubicle. (At the test position the primary contacts are isolated and the grounded metal shutters fall into position.)

11. RETURNING THE BREAKER TRUCK TO THE CUBICLE.

Before the Breaker truck can be returned to the cubicle, the following operations must be carried out:

1. If the circuit breaker is in the closed position, it must first be tripped. (A manual trip button is provided on the front of the truck.)

2. The interlock bar handle must be turned clockwise, thus raising the interlock and maintaining the breaker mechanism in a "tripped free" position. This operation cannot be carried out before the breaker has been tripped by the previous operation.

3. Push the truck as far into the cubicle as possible.

4. Insert the racking handle and turn clockwise until the primary contacts are fully engaged. (Resistance to turning will make it obvious when the truck is fully home.)

5. Withdraw the racking handle and return the interlock bar handle to the operating position. (Turn counter clockwise.)

6. The door of the cubicle may now be closed and locked and the circuit breaker operated.

111. PUTTING CIRCUIT BREAKER INTO TEST POSITION.

A. Starting from Circuit Breaker in Operating Position:

1. Trip the breaker.
2. Open the hinged front door.
3. Turn the interlock bar handle clockwise - this maintains the circuit breaker mechanism in a tripped free position and allows the circuit breaker to be moved.

4. Insert racking handle into the hole uncovered by the last operation and turn in a counter-clockwise direction. This will move the truck about 2" and disengage the primary contacts.
5. Remove the racking handle and turn the interlock handle counter clockwise. (This last operation will remove the interlock handle from the "over-toggle" position and allow the spring loading on the interlock bar to become effective.)
6. Pull the breaker truck towards the front of the cubicle. The truck will travel approximately 9", before the spring loaded interlock bar engages in a precisely located hole and locks the circuit breaker in the test position. To return the truck back into the service position, it is necessary to trip the breaker, turn the interlock handle clockwise and proceed as described in Part 11 above.

B. <u>Starting with the Breaker Truck Withdrawn.</u>

With the breaker truck removed from the cubicle, the male part of the secondary bayonet type contacts will be in an extended position, with reference to the truck body. (See Figure 3)
This secondary contact assembly is mounted on the breaker truck by means of two sliding shafts that normally telescope into the truck when the truck is pushed onto the primary contacts in the cubicle.

If it is wished to put truck into the test position without first putting it into the operating position, it will be necessary to lock the secondary contacts on the truck in the extended position and prevent them from telescoping. Proceed as follows:

1. Trip the Breaker; unless this is done it will be impossible to turn the interlock handle in a later operation.
2. Lock the secondary contacts in the extended position. This is done with two latching plates, located adjacent to the telescoping shafts, and pivotted on a channel, mounted on the truck. This channel is mounted low on the back of the truck, and supports the moving portion of the secondary contact assembly. (See Figure 3). Swing the latching plates up and over the telescoping shafts until they drop into notches cut into the top side of the shafts. This prevents the shafts from sliding back into the truck and thus effectively locks the secondary contact assembly in position.
3. Turn the interlock bar handle clockwise. This action immobilizes the breaker mechanism in the 'tripped-free' position, uncovers the hole in the front of the breaker truck for the racking handle and permits the truck to be pushed into the cubicle.
4. Push the truck partially into the cubicle until the interlock bar (male component) is riding over the start of the punched metal strip (female component), on the cubicle floor.
5. Turn the interlock bar handle counter-clockwise, so that it is no longer in the 'over-toggle' position, and the spring loading

on the interlock bar becomes effective.

6. Continue pushing the truck into the cubicle. When the truck has reached the test position, the spring loading on the interlock bar will force the bar into the locating hole on the cubicle floor, and lock the truck in the test position.
7. With the truck locked in the test position, the secondary contacts will be engaged and the breaker mechanism will be reset and ready for operation.
8. To put the breaker truck into the operating position from the test position, it is first necessary to withdraw it from the cubicle and reverse procedure No. 2 above; i.e., free the movement of the male secondary contacts.

SPECIAL NOTES:

1. Although a manual trip button is provided, general good practice makes it preferable to trip the Breaker electrically, with the hinged front door closed, when the Breaker is in service.

2. When the truck is withdrawn from the cell it can be closed manually with the closing lever provided. (See Figure 4)

INTERLOCKS

The Circuit Breaker is fully interlocked to prevent mal-operation and possible injury to the operator.

Before the Breaker can be withdrawn from its cell the operator must lift the interlock bar which is operated from the knob on the front of the breaker. (See Figure 2). Before the interlock bar can be raised the circuit breaker must be tripped. It is to be noted here that the Circuit Breaker cannot be tripped by attempting to operate the interlock bar. It must be tripped electrically or manually by the control switch or the manual trip button.

Raising the interlock bar lifts and holds the mechanism trip catch 'N' in the tripped position and thus prevents the breaker from being closed. It also lifts a cover which allows access to the racking mechanism and permits the operator to insert the racking handle and disconnect or connect the circuit breaker.

The lower end of the interlock bar fouls a bracket on the cubicle floor which only permits it to be in the down position (circuit breaker operative) when the breaker is in either the test or connected position.

The manual closing lever socket has been placed in a position which prevents the handle from being inserted when the breaker is in the cubicle. This has been done to prevent the operator from attempting to close the breaker manually when it is in the connected position.

CIRCUIT BREAKER OPERATING MECHANISM

MOVING CONTACT DRIVING MECHANISM. (See Figure 1)

The main moving contact is driven by an insulating rod 'T' which is connected to the moving contact arms by means of a pin. The pin passes through steel reinforcing plates which are rivetted to the main contact arms. These steel plates also carry a captive pin which is used to drive the arcing contact assembly through a pad of shims into steel reinforcing plates rivetted to the arcing contact brass arms. (See Figure 5)

When the circuit breaker is closed the main and arcing contact arms move together and engage with their respective fixed contacts. The contact system is held in engagement by the main driving rod. In addition to the main driving rod there is an insulated support which is pivotted between the brass arcing contact arms. This support engages with a roller below the puffer cylinder when the breaker is in the latched position.

When the circuit breaker is opened the main driving rod will allow the main contacts to recede up to a pre-determined position, the arcing contacts remaining substantially stationary and held by the insulating support member. At this position a pair of slotted links transmit a pull from the main driving rod to the support member and frees it from its latch, allowing the arcing contacts to part.

The insulated driving rods to the main contact arms are controlled by the main driving shaft 'z' running in bearings on the front panel. The driving shaft levers and the driving rods (coupled by a trunnion pin) form the two members of a toggle system. In the open position the toggle is collapsed and to close the contacts the toggle is driven to a position slightly "under toggle" by driving links 'A' from the solenoid mechanism.

Attached to the driving shaft levers also are sets of opening springs, links to an overtravel stop, to a dashpot buffering assembly and to auxiliary switches.

The overtravel stop controlling the limit of the permitted movement ties the shaft levers to the solenoid mechanism frame, thereby confining the control to the items concerned in the drive only. It should be noted that when the breaker mechanism is properly adjusted the overtravel stop does not stop the main shaft travel, but only comes into use should maladjustment occur.

THE SOLENOID MECHANISM. (See Figure 1)

The drive to the main shaft is through links 'A' which are controlled by the travel of Lever 'B' about pivot 'C'. The remote end of this lever operates the ON/OFF indicator and positions the check lever 'D' cooperating with the truck interlock shaft 'E'. This check ensures that the main linkage is in the open position before the interlock can be released. A collapsible parallelogram linkage connects the main driving clevis 'F' from the solenoid to the lever 'B'. During the closing stroke the solenoid drives almost straight through the links onto pin 'G' of lever 'B', the fixed pivots being 'C', 'H' and 'J'. On completing the closing movement a latch 'K" is biased into engagement with a roller 'L' which maintains that position after the solenoid power has been cut off.

In order to collapse the mechanism to open the circuit breaker, support pivot 'H' can be released by unlatching the remote end of component 'M' from catch 'N'. This is done by displacing 'N' by means of the manual or electrical trip mechanism. The collapsing component force is achieved by the "off-toggle" position of 'G. P.' and 'L' and when the mechanism collapses pin 'Q' at the end of link 'R' ejects the latch 'K'. The solenoid moving plunger drops when this latch is removed and resets the mechanism. The mechanism is fitted with opening springs which assist those fitted to the main shaft levers by exerting an opening pull on lever 'B'.

THE CONTACT SYSTEM (See Figure 1)

The contact system is comprised of the following basic parts:

Fixed and Moving Arcing Contacts,
Fixed and Moving Main Contacts,
Fixed and Moving Intermediate Contacts,
Primary Disconnects,
Secondary Disconnects.

Fixed and Moving Arcing Contacts.

The fixed arcing contact consists of durable arc metal tip brazed to the fixed arc runner which is connected through the magnetic blowout coil to the circuit breaker main contacts. (See Figure 7)

The moving arcing contact is carried by the outer or brass contact arms and consists of a brass casting on to which is brazed a durable arc metal tip. (See Figure 6) The brass casting is heavily spring loaded to prevent contact separation on high peak values of short circuit current.

Fixed and Moving Main Contacts

The fixed main contacts consist of finger type sections of a copper extrusion tipped with silver and heavily spring loaded to give the breaker a more than adequate short time and making capacity. (See Figures 7 and 8)

The moving main contacts consist of a copper pressing brazed to two side arms of copper which hinge on the lower bushing. These contacts are again tipped with silver to give the lowest possible contact resistance.

Fixed and Moving Intermediate Contacts.

The fixed intermediate contacts consist of finger type sections of a copper extrusion tipped with an arc resisting material and are arranged to remain in contact with their moving opposites for 1/16" of travel more than the silver or current carrying main contacts. They are the outer two fingers in each main contact bank, and are separated from the current carrying main contacts by an asbestos compound barrier. The fixed intermediate contacts have additional spring loading to that of the current carrying contacts to prevent premature contact separation and its subsequent arcing, when carrying current with high peak values.

The moving intermediate contacts are the outer two contacts on the moving main contact block and are tipped with an arc resisting material.

Contact Operation.

(a) Closing.

On closing the arcing and main contacts make at approximately the same time, and since there is very little "in contact" travel, the breaker mechanism is latched before a major peak occurs, thus giving the breaker a very high making capacity with low closing power.

The arcing contact arm is supported by a prop which latches in position on a low friction roller support just before the mechanism latches, thus providing a secondary support for the arcing contact on the opening operation.

(b) Opening.

On opening, the circuit breaker mechanism collapses, causing the main contact drive toggle to collapse, allowing the main contacts to part. The arcing contact falls back on the prop mentioned above and is therefore supported independently of the mechanism and main contact drive.

Once the main and intermediate contacts have parted, the current is transferred through the blowout coil to the arcing contact system. This builds up the magnetic field required for arc control prior to arcing contact separation.

After the main contacts have travelled a predetermined distance which assures that all arcing has ceased on the intermediate contacts, and the possibility of a restrike across them is negligible, the arcing contact prop is dragged from its stop by means of the slotted connecting links between the main contact driving arm and the prop itself.

The arc is then drawn initially between the fixed and moving arcing contacts and is rapidly forced upward from the moving arcing contact to the moving arc runner in the arc chute which is electrically connected to the lower bushing. This rapid transfer extends and quenches the arc and its associated gases, rapidly completing the interruption.

Primary Disconnects.

The fixed half of the primary disconnect consists of a precision copper casting molded in a glastic shroud which separates the disconnects from the bus-bar chambers.

The moving portion of the disconnect is fixed to the end of the circuit breaker bushing. It is of the cluster type, the fingers consisting of sections cut from a copper extrusion, and heavily spring loaded by means of garter springs around the assembly. All current carrying components of the disconnect are silver plated to reduce contact resistance.

Secondary Disconnects.

The secondary contacts are of the plug and socket type, with the socket mounted in the circuit breaker cell. The plug or the moving portion of the secondary contact is mounted on sliding rods on the rear of the circuit breaker truck. This permits the breaker to be withdrawn to the test position before the secondary disconnects part.

When it is necessary to test the circuit breaker before connecting it to the main circuit the secondary contacts may be locked in the extended position by means of two locking flaps which engage in the sliding rods.

ARC CONTROL DEVICES

Arc Chute Assembly and Vent. (See Figure 9)

The arc chute is built as a separate assembly and includes the following items:

(a) Arc chute splitter plate assembly.
(b) Moving contact arc runner.
(c) Gas expansion and exhaust vent.

The arc chute splitter plates are made of a ceramic material which has a high resistance to thermal shock, and good insulating properties. The plates are manufactured by a special process to maintain the necessary flatness and are accurately cut to provide the correct air flow and arc lengthening configuration. The plates are then cemented together in a fixture which automatically assures that they are in their correct sequence and that the cemented assembly is flat and within optimum limits dimensionally.

The arc runner associated with the moving arcing contact is a brass casting, mounted on an asbestos material and then fixed between the arc chute side sheets.

The exhaust vent is made of an asbestos board and mounted on the arc chute. This vent has two outlet ports on either end which allow the cooled gases to pass from the arc chute through the exhaust vents provided in the top of the circuit breaker housing.

The splitter plate assembly is clamped between two side sheets of Paxolin and held at each end by adjustable blocks of asbestos board. This adjustment allows for any dimensional differences in the length of the splitter plate assemblies.

Blowout Magnet and Coil Assembly. (See Figure 7)

The blowout magnet consists of two side cheeks which are rivetted assemblies of steel laminations, proportioned to give the required flux densities throughout the length of the arc chute.

The two side cheeks are linked through the centre of the blowout coil by means of a wound iron core. The whole assembly is clamped to the blowout coil by means of a through bolt, and each side cheek is supported at the other end by an insulated support.

The blowout coil is made from heavy copper, of ample cross section, to enable it to carry the maximum current the breaker may expect to meet in service. The coil is molded in a resin to give it the required mechanical strength. Four steel inserts are cast into the coil molding for fastening it to the breaker back panel.

Puffer System. (See Figure 5)

The puffer system is comprised of a cylinder mounted on the inside of the breaker front plate. A rubber piston is driven into the cylinder when the breaker is tripped, which forces a jet of air down the puffer tube and out the puffer nozzle which is located directly underneath the arcing contact. This jet of air is used to assist in extinguishing low current arcs.

MAINTENANCE

ACCESS TO CIRCUIT BREAKER CONTACTS

REMOVAL AND ASSEMBLY OF ARC CHUTES

The contact arrangement is shown in Figure 7 and for the purpose of inspecting the contacts it is necessary to remove the phase barriers and hinge the arc chute on to the support bracket provided. The procedure is as follows:

1. Remove the six acorn nuts securing the steel plate to the front of the arc chutes. The steel plate can then be withdrawn.

2. Remove the four 1/4" screws fastening the phase barriers across

the rear of the breaker.

3. Remove the four 1/4" screws fastening the phase barriers across the front of the breaker.

4. Withdraw the phase barriers by lifting them vertically.

5. Remove the gas sealing plate from the rear of the arc chute. This is accomplished by releasing the 1/4" lock nut and turning the eccentric screw holding the Sindanyo gate which jams the gas sealing plate in position. The gas sealing plate can then be withdrawn. (See Figures 9 and 10)

6. Disconnect the front arc runner connections. This can be accomplished by using an 11/16" socket wrench on an extension bar. (See Figure 11). With the circuit breaker partially closed (held in this position by the manual closing lever) access is possible from both sides of the truck to the nuts fastening the connectors. These nuts are held captive on their studs to prevent them from being removed, and to facilitate the assembling of the arc chute on the breaker, and therefore they need only be loosened.

7. The arc chute can then be hinged around its pivot point and rested against the arc chute support or lifted from the breaker. (See Figure 12)

The arcing contacts and main contacts can now be examined for wear, etc.

When assembling the arc chute to the breaker, the procedure is as follows:

(1) Lift the arc chute and place the pivot pin in the slot in the hinge block.

(2) Swing the arc chute around its pivot point, taking care that the studs in the front arc runner drop into the slots in the connectors as the arc chute is lowered. If no assistance is available for this operation it is easier for one person to remove the connectors from the lower bushing, and replace them after positioning the arc chute.

(3) Secure the connectors to the front arc runners by tightening the nuts on the arc runner connectors. This can be accomplished by using an extension bar and an 11/16" socket and tightening three of the six arc runner nuts from each side of the breaker with the breaker partially closed.

<u>NOTE</u>: To facilitate the operation of replacing the arc chutes it is advisable to replace and connect the arc runners on the outer two phases before replacing the centre phase arc chute.

(4) Place the gas sealing plate in the rear of the arc chute and lock it in position. The plate is locked in position by turning the eccentric bolt above the sealing plate which forces the locking gate against the plate. The eccentric bolt can then be locked in position by tightening the nut on the stud through it.

CONTACT MAINTENANCE

When servicing contact assemblies the following procedure should be adopted:

1. Clean and dress (with a fine file) the fixed and moving arcing and intermediate contacts thoroughly.

2. The main fixed and moving contacts should be cleaned with a fine metal polish. All traces of metal polish should be removed when the cleaning has been completed.

ADJUSTMENT OF MAIN CONTACT PRESSURE

This adjustment is made to ensure that the contact pressure is sufficient to prevent contact "blow off" when the breaker is required to carry currents in the order of its interrupting rating.

The correct contact pressure is determined by measuring from the back of the Permali spring block to the end of the spring. (See Figure 13) This dimension should be 2-5/16" plus .031", minus .000".

The adjustment of the main contact pressure can be made by removing the masking panel from the front of the breaker and then removing the split pins from the castle nuts securing the moving contact arm drive rod to the mechanism main shaft. Access can be gained to these through openings in the breaker front panel. The castle nut can then be removed.

If the dimension mentioned above is too large, it can be reduced by adding shim washers between the moving contact drive rod and the mechanism main shaft trunnion.

If the dimension mentioned above is too small, it can be increased by removing shim washers from between the moving contact drive rod and the mechanism main shaft trunnion.

NOTE: There is a nominal number of shims provided to maintain the correct location of the castle nut relative to the cotter pin hole in the drive rod. Therefore when extra shims are required or shims are to be removed to correct the adjustment, they should be taken from or added to the shims found between the castle nut and the trunnion.

Replace the castle nut and insert the split pin locking it in position. Replace the masking panel.

ADJUSTMENT OF ARCING CONTACT PRESSURE

This adjustment is made to ensure that the contact pressure is sufficient to prevent contact "blow off" when the breaker is required to carry currents in the order of its interrupting rating during the opening operation.

The correct contact pressure is determined by measuring between the rear edge of the service hole in the contact and the rear face of the arcing contact spring block. To assist in taking this measurement, a 3/16" diameter pin 3/4" long is temporarily inserted in the service hole, slightly projecting from the side on which you intend to make your measurement. This dimension should be -- 2-13/32" plus 3/32", minus 0. (See Figure 14)

NOTE: Be sure the pin used to assist in making the measurement is removed.

The adjustment of the arcing contact pressure can be made by removing the P. V. C. covers from either side of the moving contact arms. On the trailing edge of the steel plate rivetted to each of the brass arcing contact arms there is a pack of shims to align the arcing contact arm with the pin through the main contact arm which supplies the closing effort for the arcing contacts.

To decrease the dimension mentioned above and therefore increase the spring pressure shims must be added to the pack. To increase the dimension mentioned above and therefore decrease the spring pressure shims must be removed from the pack.

NOTE: In order to distribute the closing effort equally to each side of the contact arms involved, care should be taken to ensure that the driving pin is resting on both packs of shims as the arcing contacts touch.

The P. V. C. covers should then be replaced. Use Nylon nuts only.

ARCING CONTACT "PROP" ADJUSTMENT

This adjustment is made to ensure that there is sufficient clearance between the end of the prop and its stop, when the breaker is in the latched position, to allow the prop to clear its stop.

The correct clearance between the prop and its stop is .025" plus .020", minus .000" on the two outer phases, and .030" plus .020", minus .000" on the centre phase. (See Figure 15)

The adjustment is made by adding or removing shims behind the roller stop bracket. Adding shims decreases the clearance and removing shims increases the clearance.

NOTE: As the arcing contact pressure is dependent on the main contact pressure, and the setting of the arcing contact "prop" is dependent on both

REPLACEMENT OF INTERMEDIATE CONTACTS.

The need for replacing the intermediate contacts is recognized when the gap between the fixed and moving main silver contacts is .020" or less. This can be measured by slowly closing the circuit breaker until one of the two intermediate contacts just touch, and holding the contacts in this position, feeler gauges can then be used to determine the clearance between the main contacts.

The loss of metal from the moving intermediate contacts can be allowed for by dressing the moving contact assembly (both silver mains and intermediates, until they are flat.)

The fixed intermediate contacts can be removed by releasing the keeper plate on each side of the contact assembly and removing the tapered screw which releases the spring pressure from the intermediate contact hinge. These screws are found in the top of the Permali spring block on either side of the contact assembly, and it is necessary to slack off the blow-out coil which is secured to the circuit breaker back panel to gain access to them.

With the circuit breaker held in a position exerting some pressure on the fixed contacts by means of the manual closing lever, the contact finger retaining plate can be removed. The breaker can then be allowed to open and the contact fingers removed, taking care not to lose any of the spring caps.

Fit the new contact fingers and their barrier in position, and tighten down the tapered screws, loading the contact hinge springs. The breaker can now be partially closed compressing the main contact fingers until the contact retaining plate can be tightened in position.

Reconnect and tighten the blow-out coil in position.

THE OPERATING MECHANISM ADJUSTMENTS. (See Figure 1)

SOLENOID ADJUSTMENT.

The solenoid adjustment is made to prevent the breaker main toggle (Points 'X', 'Y', 'Z') from being driven overtoggle and to give sufficient mechanism travel to permit the main mechanism latch (K) to drop into position under roller (L) during the closing stroke.

With the solenoid fixed and moving cores held together by pressure on the manual closing lever, there should be a gap of .031" plus or minus .010" between the top of the prop (K) and the roller (L). (Figure 18)

This can be adjusted by removing the masking panel from the front of the breaker and loosening the solenoid moving plunger locking screw which is located in the bottom solenoid plate. This screw when locked in position engages in a slot in the moving plunger. There are four of these slots in the plunger at 90^{o} intervals around it.

contact adjustments, care must be taken when either the main contacts or the arcing contacts are adjusted to be sure that any adjustments dependent on the adjustment made should be checked.

REPLACEMENT OF CIRCUIT BREAKER CONTACTS.

Under normal operating conditions such as load switching, etc., the circuit breaker contacts should last for the normal life of the circuit breaker with only minor adjustments and normal maintenance. Should the breaker interrupt a fault, the contacts should be inspected as soon as possible with careful attention paid to the points mentioned regarding contact wear in the following section.

Replacement of arcing contacts is necessary when sufficient metal has been burned from the contact faces to reduce the arcing contact spring pressure and the consequently increased dimension of spring pressure setting (see arcing contact adjustment in previous section) to 2-17/32".

To assist in replacing the arcing contact assemblies it is advisable to remove the blow-out magnet side cheeks. This can be accomplished by removing the bolt through the centre of the blow-out coil assembly and removing the screw from the magnet support. When replacing the blow-out magnets it is necessary to replace the centre phase magnet before the outer two phases.

NOTE: When tightening the bolt through the blow-out coil, care must be taken not to trap the P. V. C. insulating barrier on the magnet side cheek between the blow-out coil core and the magnet side cheek.

REPLACEMENT OF FIXED ARCING CONTACT.

To replace the fixed arcing contact, remove the nuts from the studs securing the contact to its support and disconnect the blow-out coil. When reassembling the new component, make certain that the insulating tubes are placed over the studs securing the arcing contact. (See Figure 13)

REPLACEMENT OF MOVING ARCING CONTACT. (See Figure 16)

Release the spring pressure from the contact by removing the spring keeper plate from the spring block.

Release the hinge clamping stud and withdraw the contact. Care must be taken in removing the contact not to drop the spring caps or the hinge washers into the assembly of the contact arms.

A new contact and bush may be inserted. (See Figure 17) Tighten the hinge clamping stud and lock it, and then tighten the hinge keeper plate in position.

To increase the dimension mentioned above turn the moving solenoid plunger in a clockwise direction. To decrease the dimension mentioned above turn the moving plunger in an anti-clockwise direction.

When the adjustment has been made tighten the locking screw and replace the masking panel on the front of the breaker.

MAIN TOGGLE OVERTRAVEL STOP

This stop is provided to prevent the main toggle 'X', 'Y', 'Z' from going over-toggle, i.e., going to the position where the toggle will not collapse when the breaker is tripped.

This is accomplished by attaching a link to the driving levers from shaft 'Z' on the right hand phase. The other end of the link is slotted and is located on the right hand side of the solenoid frame. The pin which projects through the slot can be raised or lowered to set the correct travel of the link.

The correct position of the stop pin is such that when the breaker is in the latched position there should be 1/8" plus or minus 1/64" clearance between the bottom of the slot in the link and the bottom of the pin.

This clearance can be increased by adding shims under the stop pin mounting, or decreased by removing shims from under the stop pin mounting.

CIRCUIT BREAKER DASHPOT ADJUSTMENT. (See Figures 19 and 20)

This adjustment is made to establish the correct "open" position of the breaker contact system.

With the breaker in the correct open position the distance from the centre of the service hole in the centre phase moving arcing contact and the fixed arcing contact tip should be 6-21/32" plus or minus 1/64". (See Figure 19)

This dimension can be adjusted by slackening the nut locking the buffer piston on its clevis and raising the piston to increase the clearance vs. lowering the piston to decrease the clearance.

NOTE: This adjustment must be made with the breaker in the closed position. Therefore care must be taken to ensure that the breaker is not tripped while the adjustment is being made. When the adjustment has been made tighten the lock nut.

ADJUSTMENT OF THE SOLENOID MICRO-SWITCH

This micro-switch is on the side of the mechanism adjacent to the over-travel stop. Its purpose is to actuate the solenoid anti-pumping circuit on the completion of the solenoid stroke. This setting ensures that the switch cannot be damaged by the solenoid attempting to drive it farther than the free travel of the switch will permit, yet still have sufficient travel to close the switch.

With the closing solenoid plungers held together the switch should have 1/16" plus 1/32", minus 0" free travel remaining.

This can be adjusted by loosening the bolts securing the micro-switch bracket to the mechanism and moving the bracket which is provided with suitable clearance holes for this adjustment.

MANUAL TRIP ADJUSTMENT.

This adjustment is made to ensure that the trip catch 'N' is positioned by the top of the shunt trip mechanism and not by the manual trip button.

With the manual trip button in its correct position there should be a gap of 1/8" plus 0", minus 1/32" between the head of the adjusting screw in the trip button shaft and the trip catch 'N'.

TRIP BRACKET ADJUSTMENT. (See Figure 20)

This setting is made to ensure the correct positioning of the tripping mechanism.

The correct position can be determined by measuring the clearance between the trip catch 'N' when it is held in the tripped position and the top of the trip lever 'M' which must pass the trip catch on either tripping or resetting the mechanism. This condition may be obtained by holding the trip catch in the tripped position and slowly operating the manual closing mechanism until the tip of the trip lever is opposite the trip catch and the minimum clearance between the two can be measured. This clearance should be 3/32" plus .000", minus 1/32".

To adjust this clearance the trip bracket may be raised or lowered on its two mounting studs. Riasing the bracket will increase the clearance and lowering the bracket will decrease the clearance.

TRUCK HANDLING.

For normal truck handling, e.g., moving the circuit breaker from one compartment to another, a dolly is provided. This dolly locates in a socket under the toe plate on the front of the circuit breaker. (See Figure 21)

For lifting the truck it is recommended that steel hooks be used to fit in the round observation holes at the top of the side plates on the front of the breaker, and a second set of hooks used to catch the top angle on the circuit breaker back plate.

Care must be taken to avoid putting any pressure on the arc chutes.

TECHNICAL DATA

1. CIRCUIT BREAKER RATING

(a) Voltage rating	- 5 KV
(b) Current rating	- 1200, 1600 & 2000 amp.
(c) One second current rating	- 47 KA
(d) Four second current rating	- 37.5 KA
(e) Rated making current	- 96 KA
(f) Rated latching current	- 96 KA
(g) Rated Interrupting current	- 37.5 KA at 3.85 KV
(1) Symmetrical	- 35 KA at 4.16 KV 30.6 KA at 4.76 KV
(2) Asymmetrical	- 42 KA at 4.16 KV
(h) Operating times on a 60 cycle basis:	
(1) From energizing trip coil to contact part	- 3.96 cycles
(2) Arc duration at 100% interrupting rating	- .96 cycles
(3) Interrupting time at 100% interrupting rating	- 4.92 cycles
(4) From energizing trip coil to break full open	- 6.3 cycles
(5) From energizing close coil to contacts touch	- 12.5 cycles
(6) Full making stroke	- 12.9 cycles
(7) Closed time on an instantaneous (but no pre-tripped) MB cycle	- 3.6 cycles
(i) Opening speed of contacts (fps)	- 7.5 Av. at 100% current
(j) Closed speed of contacts (fps)	- 4.75 Av.
(k) Rebound (% of stroke)	- NIL
(l) Maximum current interrupted on test at 4.16 KV or over -	
Symmetrical test	- 41.8 KA
Asymmetrical test	- 65.6 KA
(m) Maximum latching current from tests	- 117 KA peak with 90 V. DC closing volts.
(n) Derating factor for instantaneous reclosure	- NIL
(o) Closing coil current	- 115 amp. at 125 V. D.C.
(p) Tripping coil current	- 2.0 amp. at 125 V. D.C.

NOTE: All opening times shown are with 80% of normal voltage on the trip coil.

2. CIRCUIT BREAKER MECHANICAL FEATURES

(a) Weight of movable circuit breaker element	- 1600 lbs. approx.
(b) Type of main contacts	- Multiple Butt
(c) Material of main contacts	- Silver tipped copper
(d) Type of arcing contacts	- Butt
(e) Material of arcing contacts	- Copper tungsten tipped brass
(f) Number of breaks per pole	- One
(g) Length of each break	- 3-3/4" minimum
(h) Location of position indicator	- On breaker front panel
(i) Provision for circuit breaker analyser	- Yes
(j) Location of operation counter	- On breaker front panel
(k) Type of bushing disconnect	- Cluster contact
(l) Material of auxiliary switches for use of customer	- As required

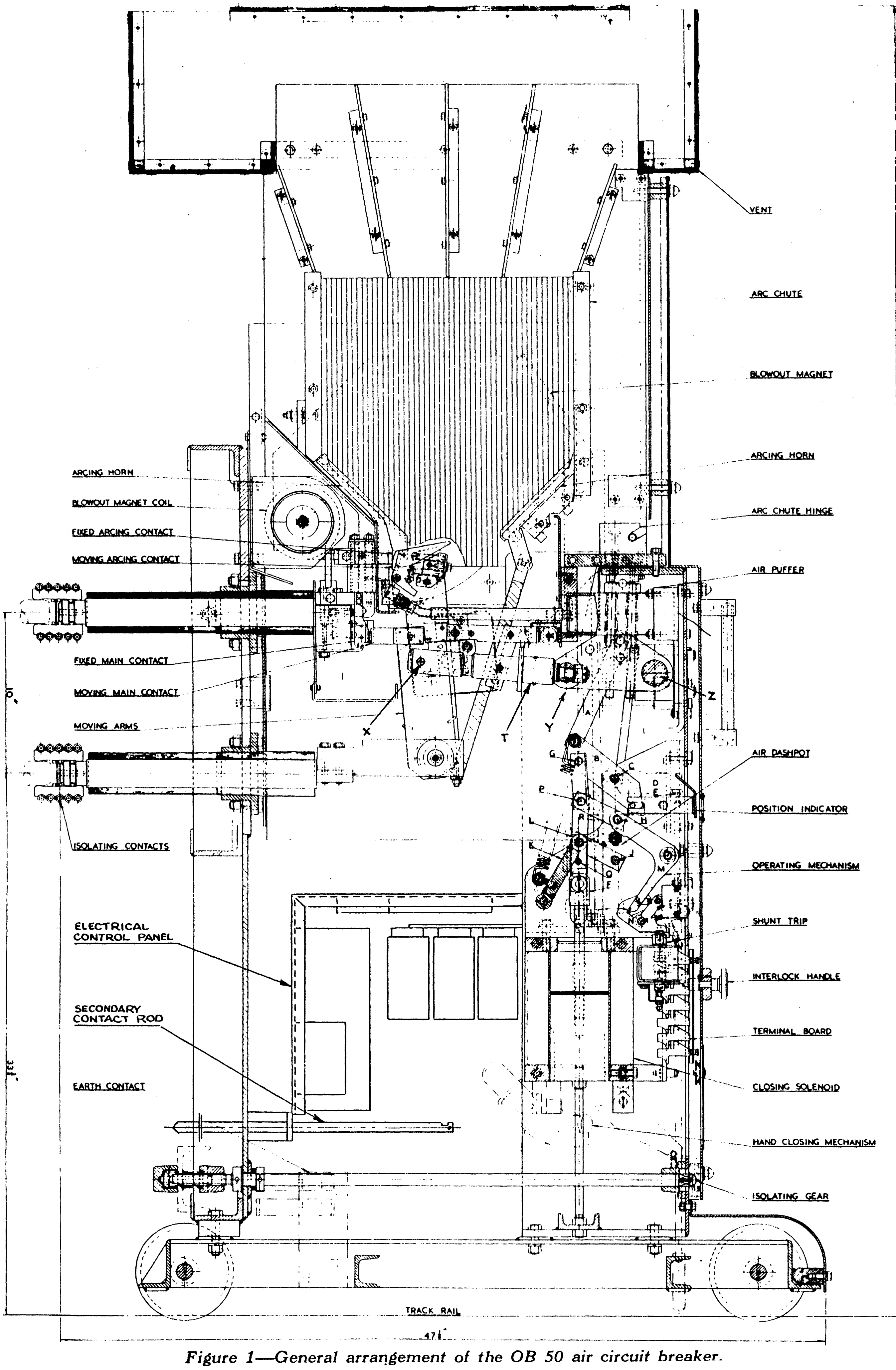


Figure 1—General arrangement of the OB 50 air circuit breaker.

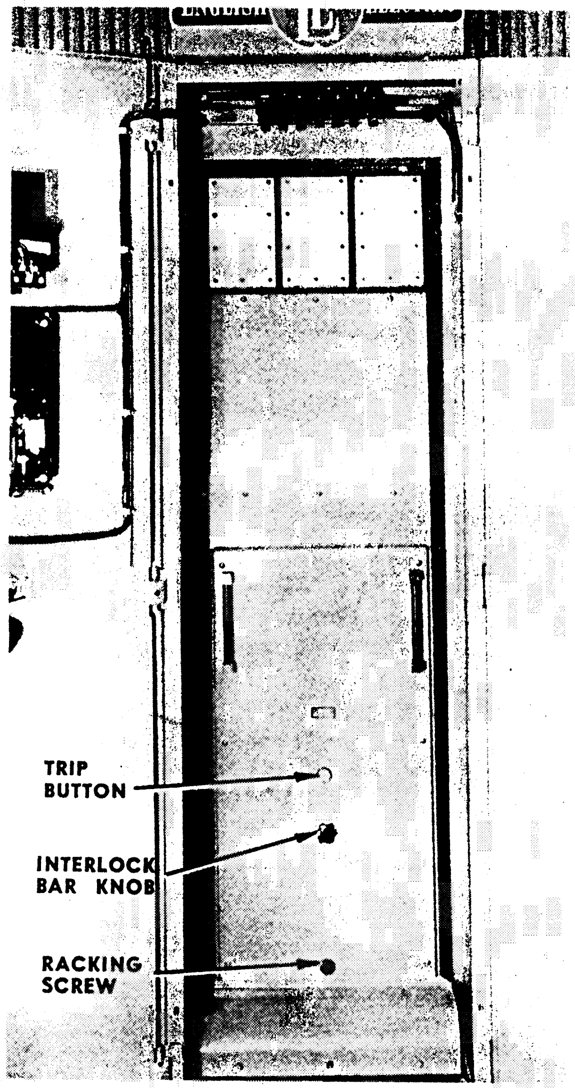


Figure 2—OB 50 air circuit breaker in the service position.

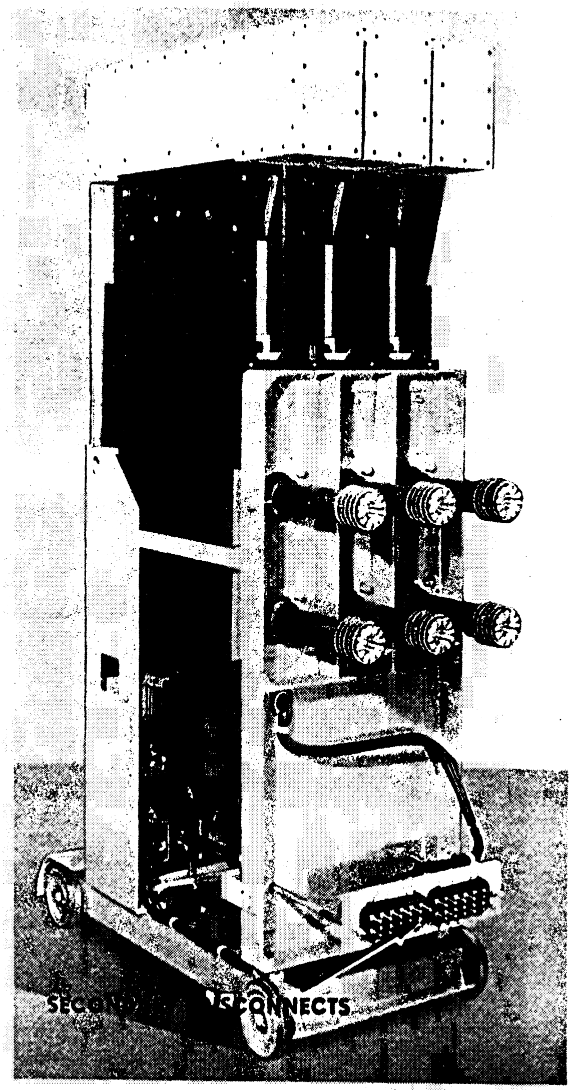


Figure 3—Rear view showing main and secondary disconnects.

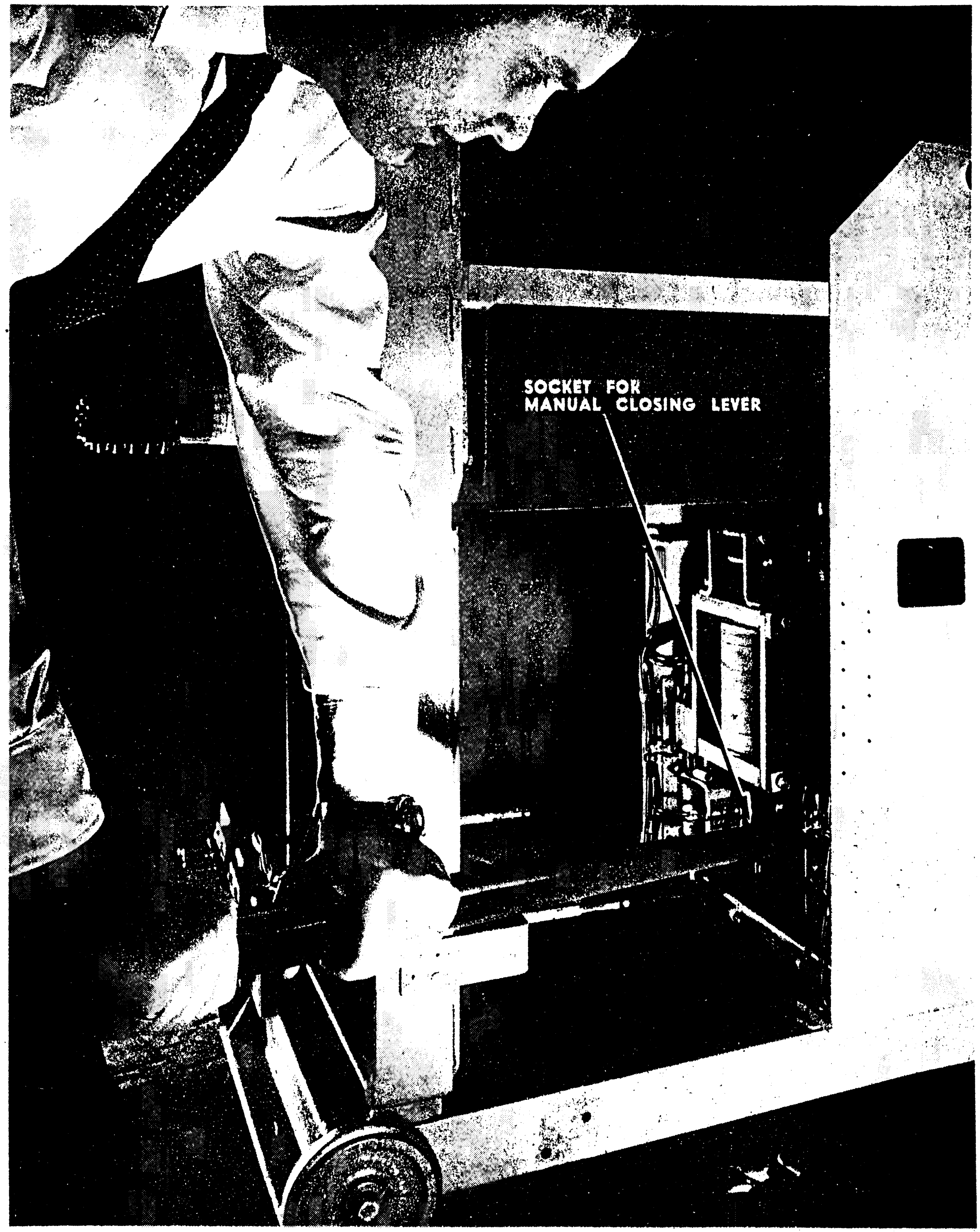


Figure 4—Manual closing lever in operation.

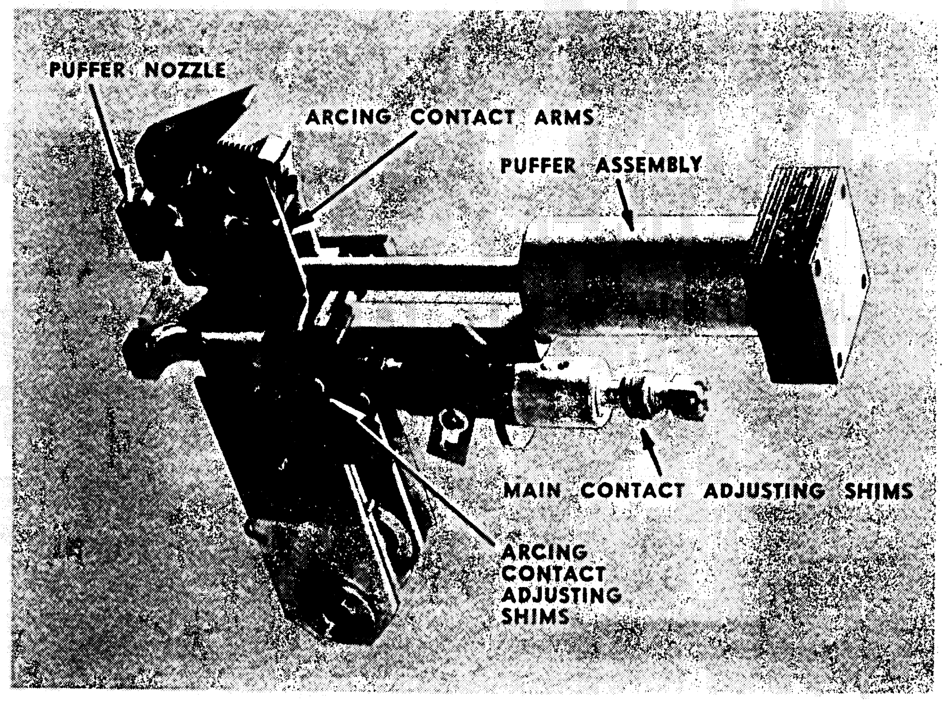
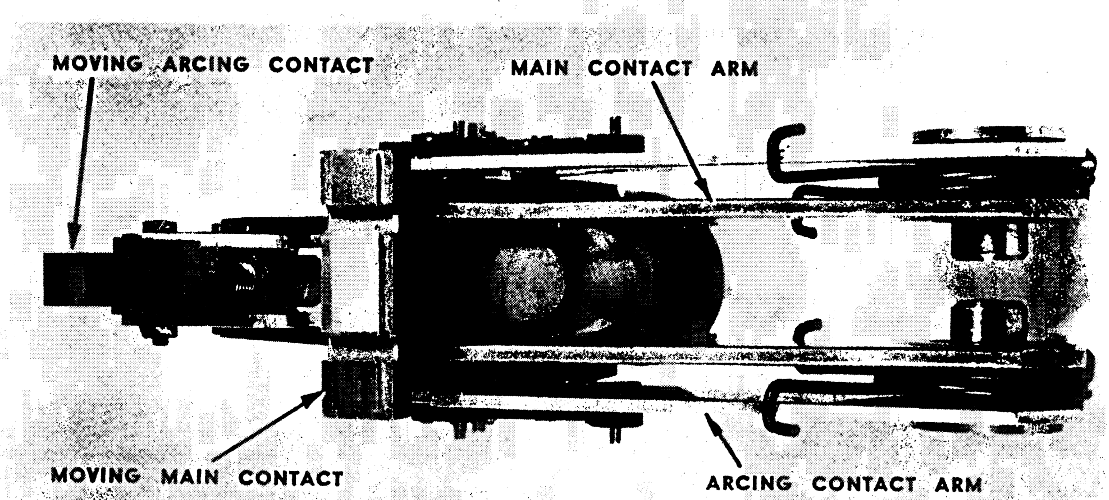


Figure 5—Moving contact and puffer system.

Figure 6—Moving contact assembly.



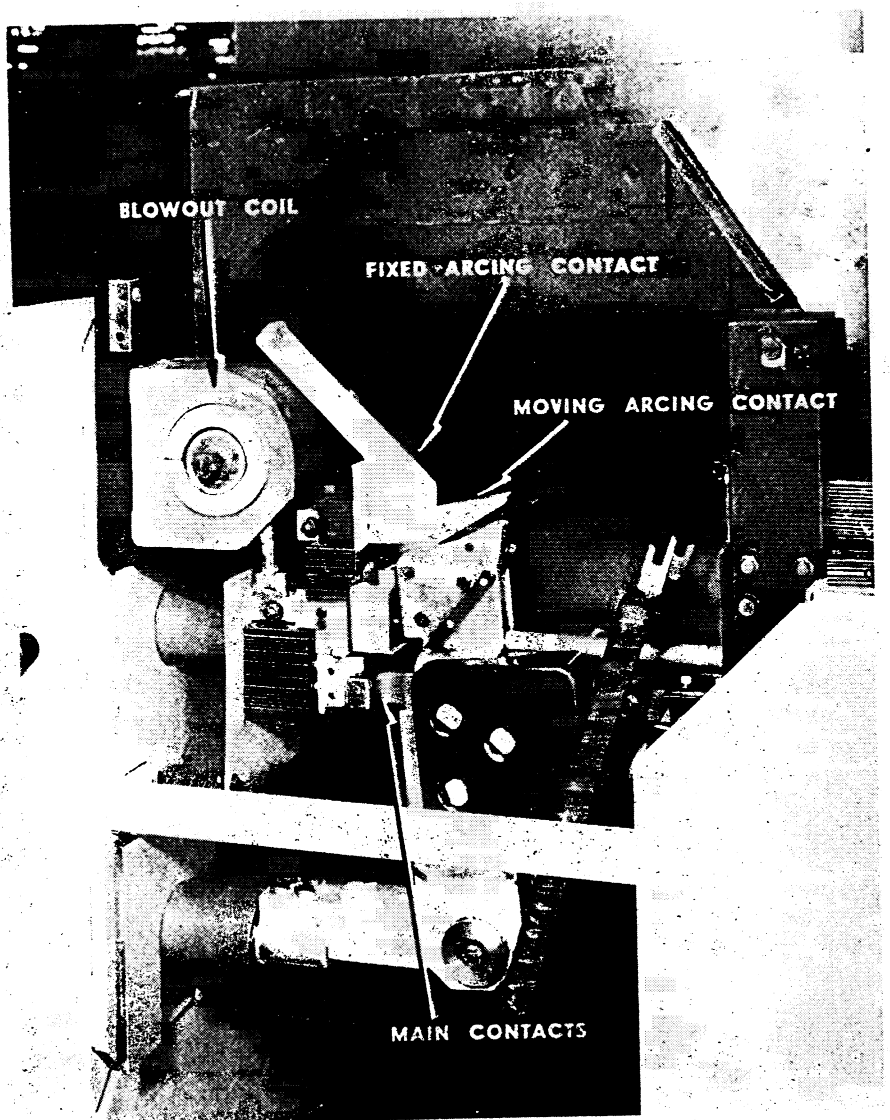


Figure 7—Contacts and magnetic blowout assembly circuit breaker closed.

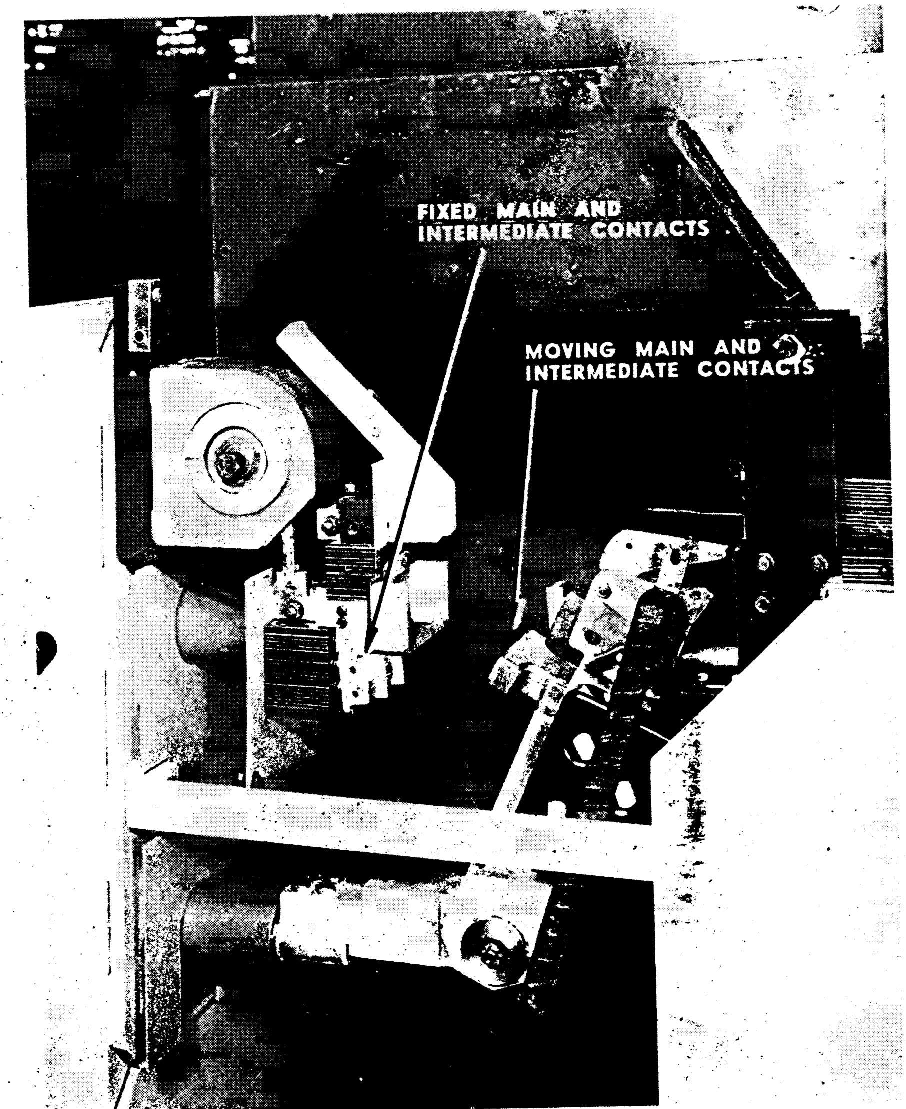


Figure 8—Contacts and magnetic blowout assembly circuit breaker open.

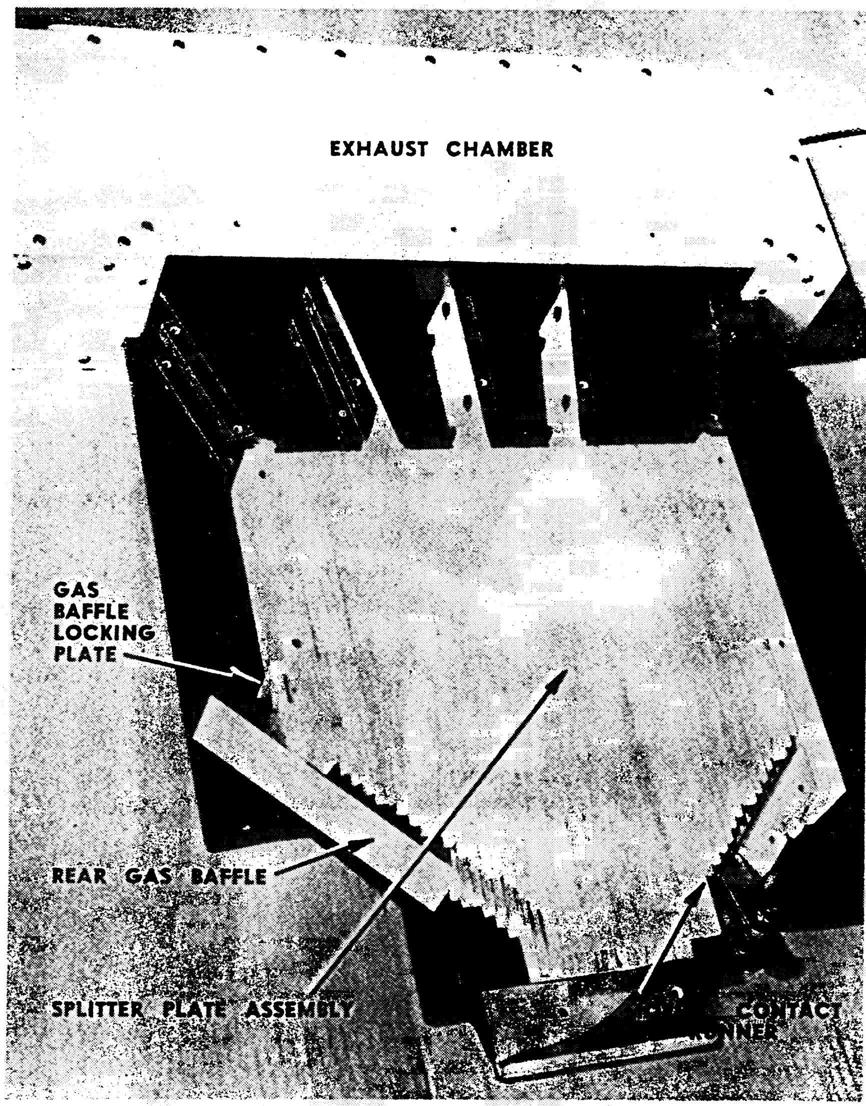


Figure 9—Arc chute assembly complete with gas vent.

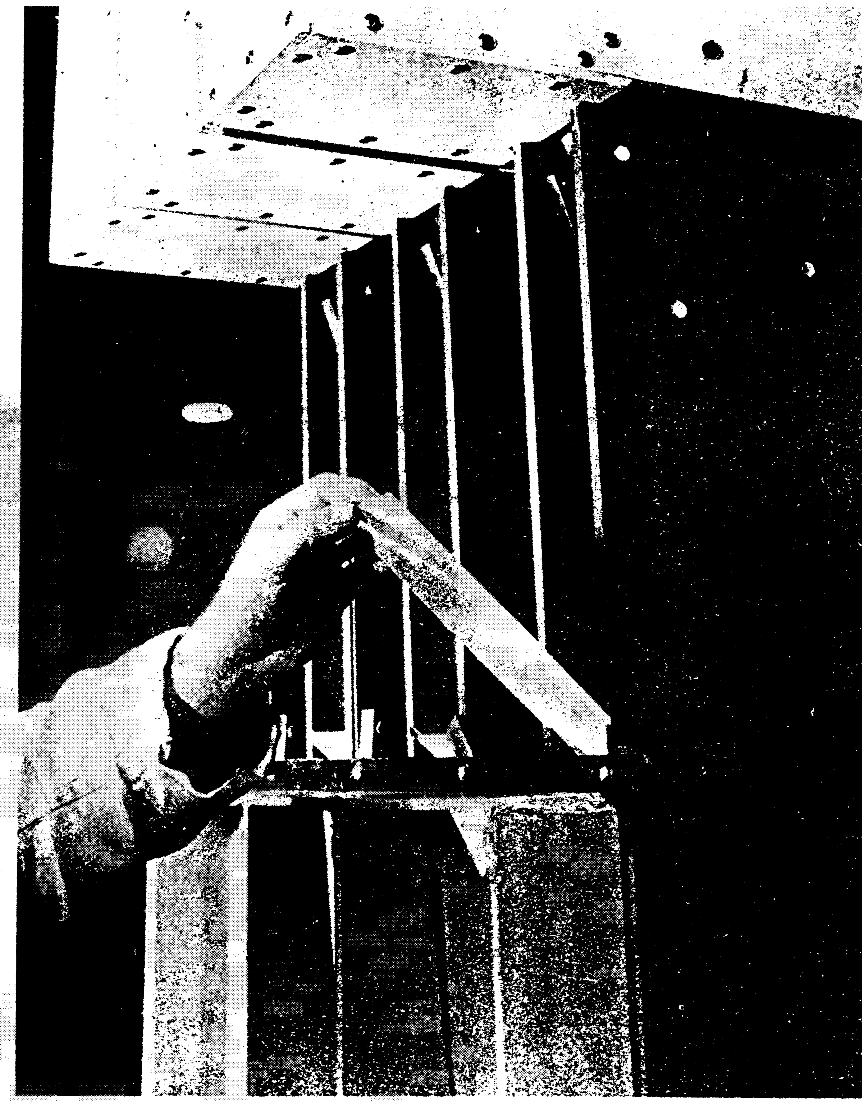


Figure 10—Removal of gas barrier from the arc chute.

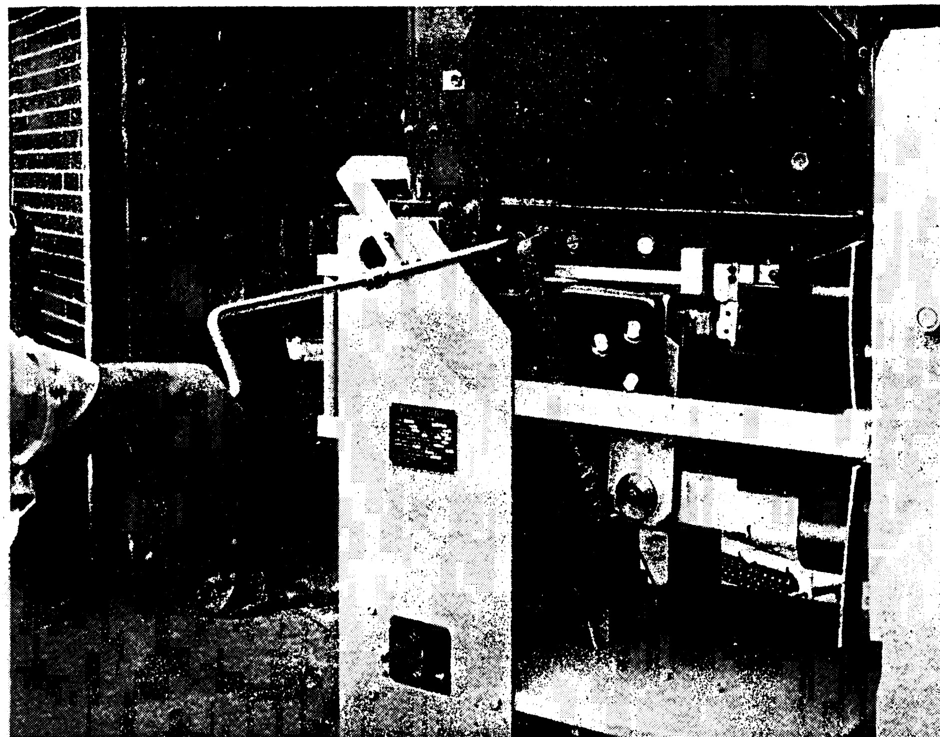


Figure 11—Unfastening arc runner connector.

Note: Circuit breaker is partially closed.

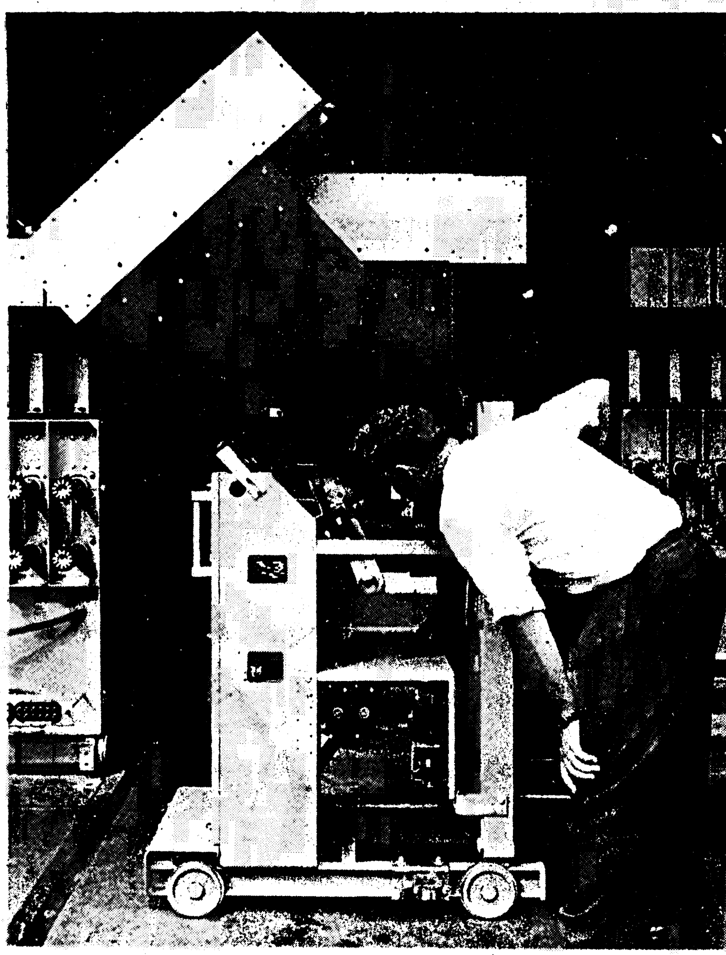
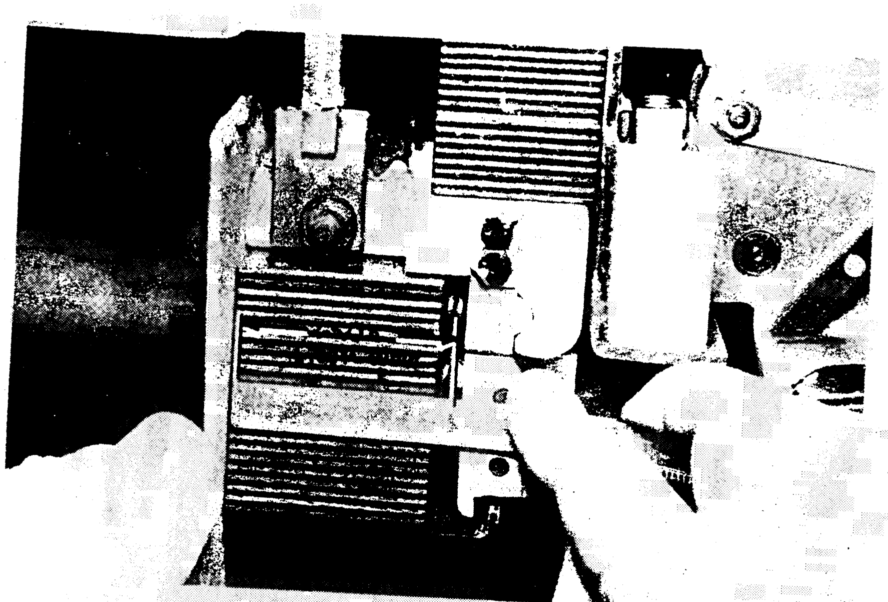
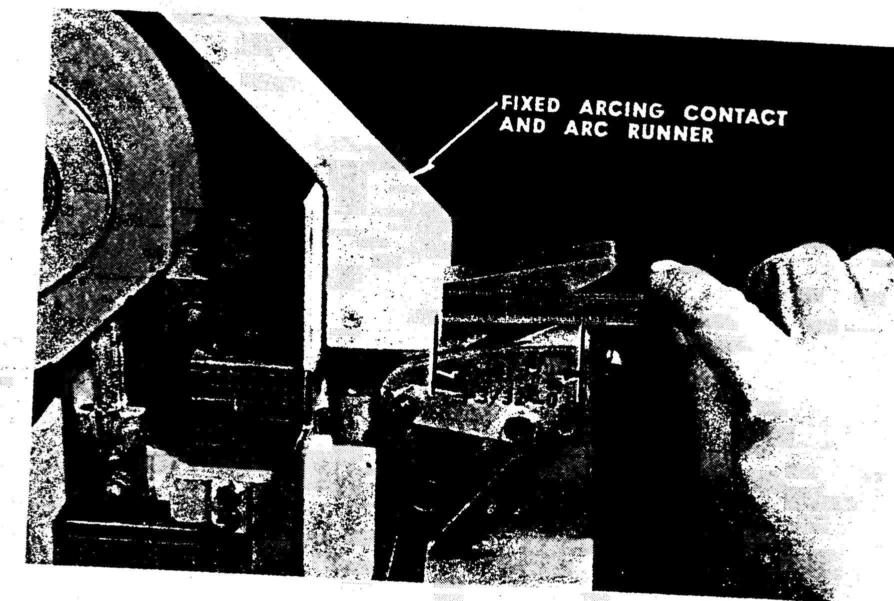


Figure 12—Examining the circuit breaker contacts with the arc chute in the hinged position.





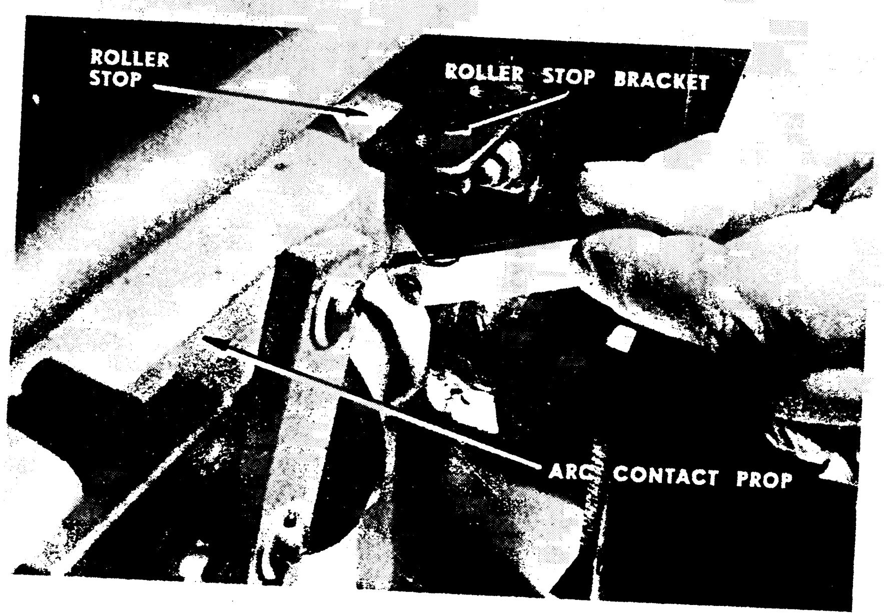


Figure 13—Checking main contact setting.

Figure 14—Checking the arcing contact setting.

Figure 15—Checking clearance of the areing contact support roller assembly.

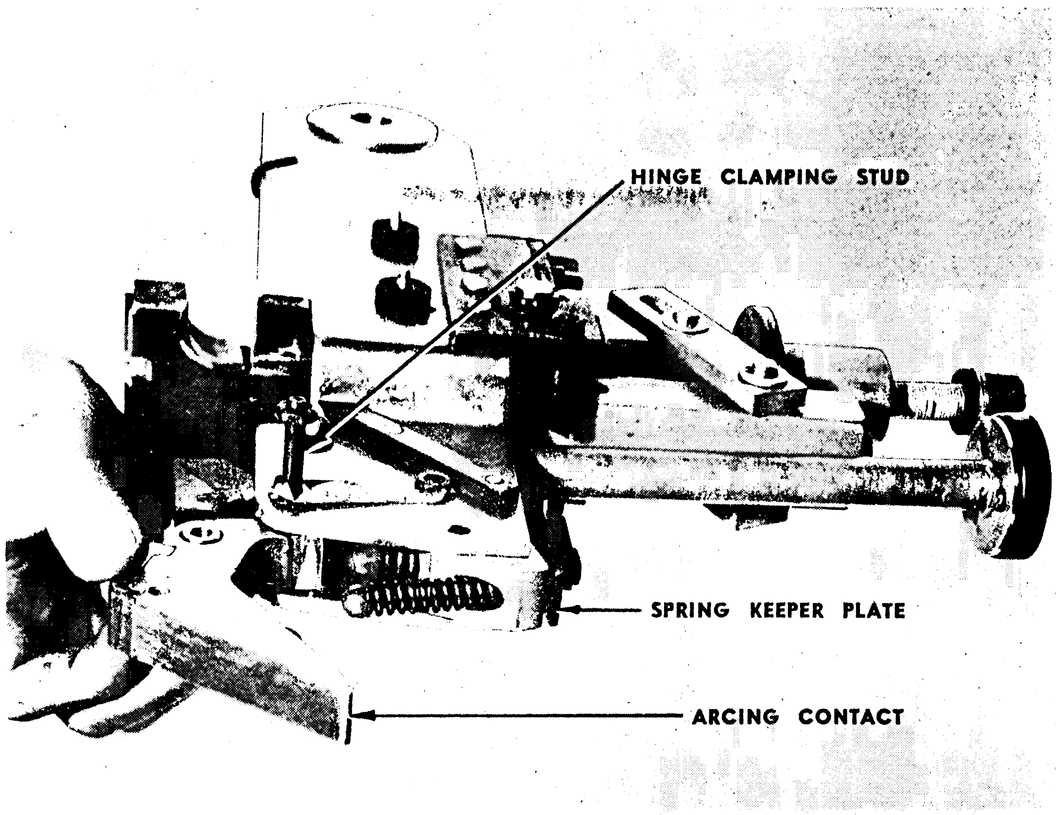


Figure 16—Replacing the moving arcing contact.

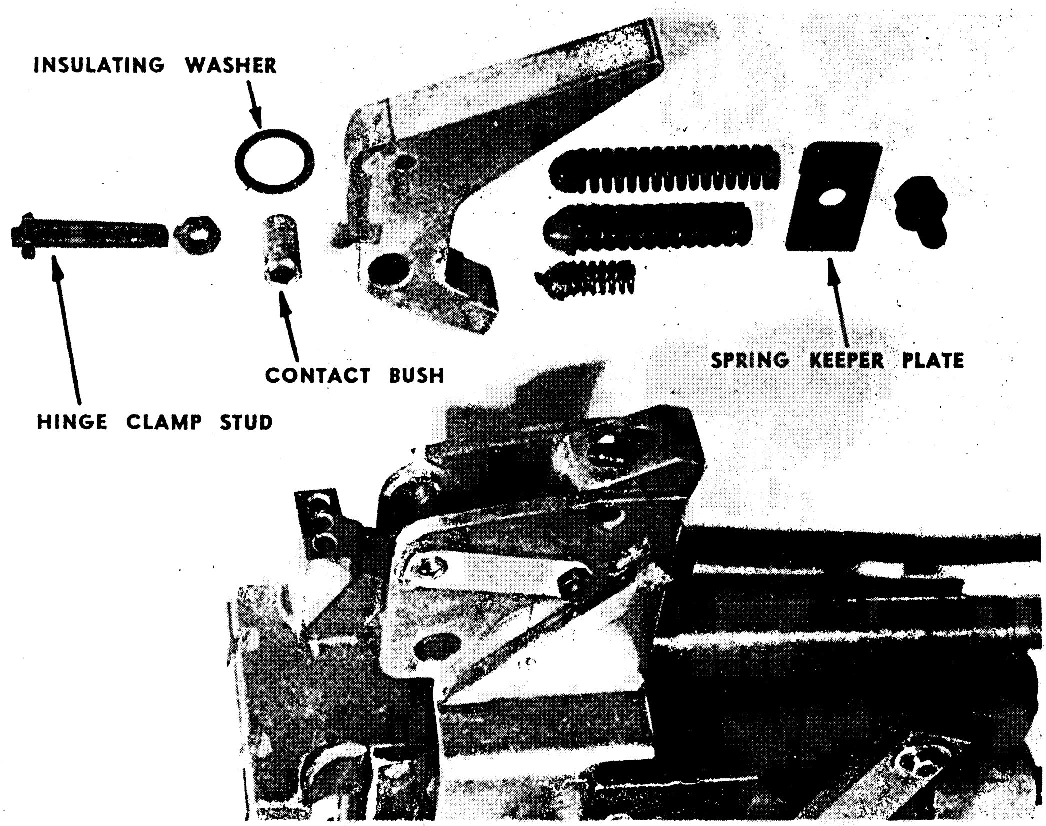


Figure 17—Moving arcing contact assembly.

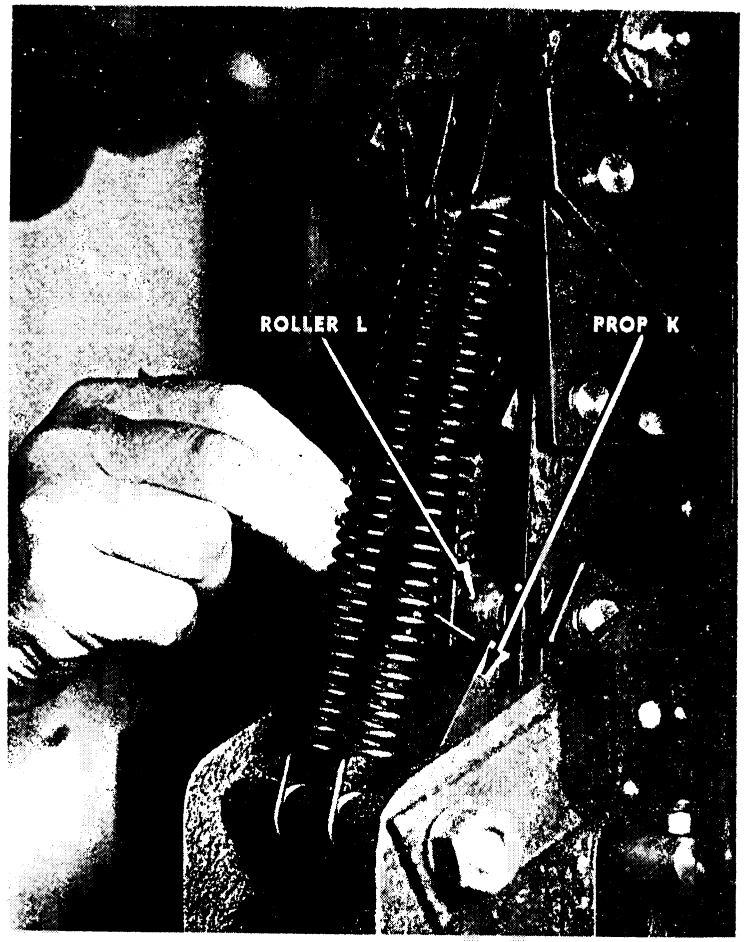


Figure 18 — Checking clearance between mechanism prop and roller.

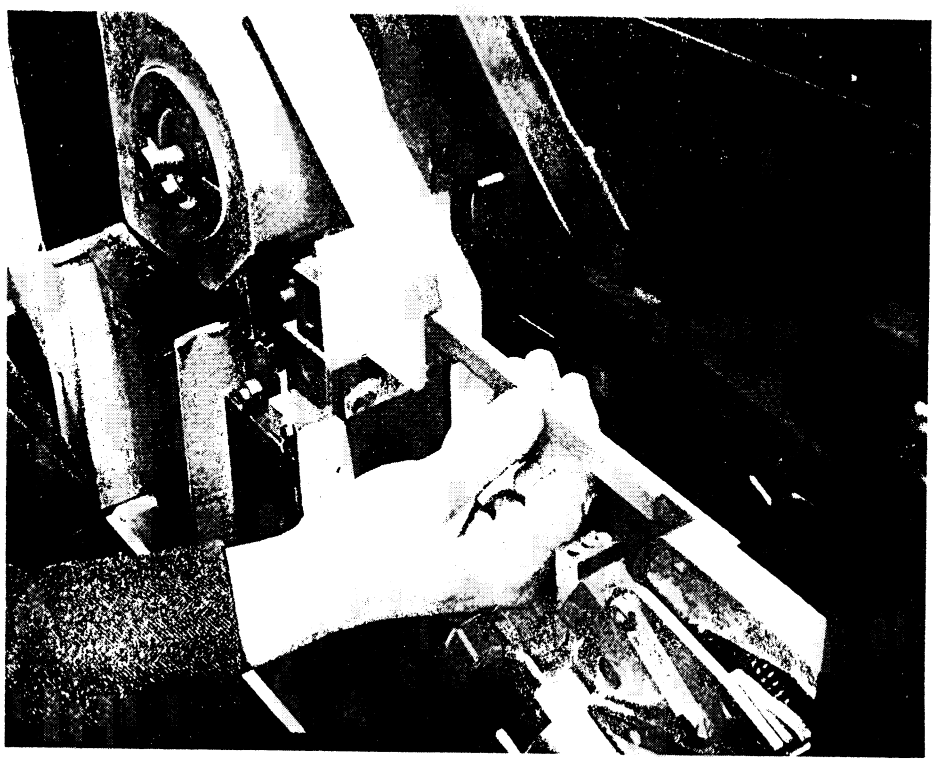


Figure 19 — Checking circuit breaker open position.

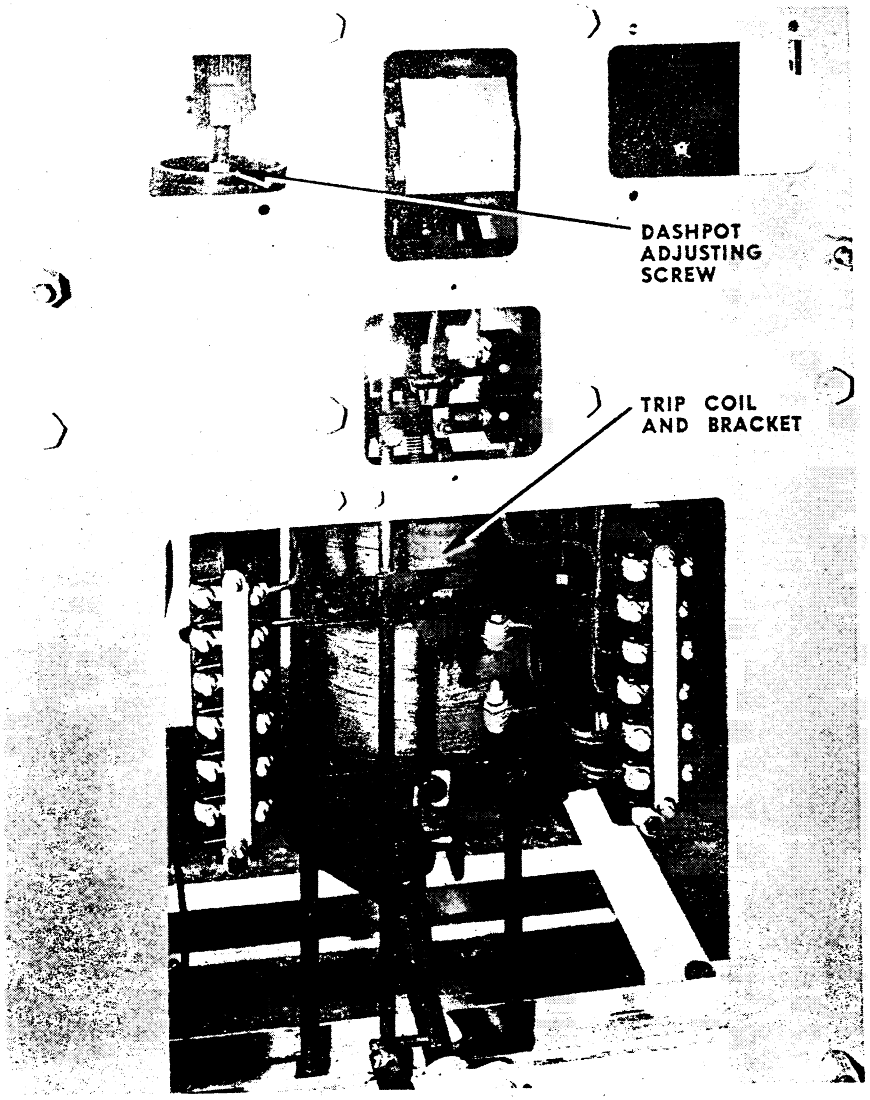


Figure 20—Circuit breaker front panel.

Figure 21—Moving circuit breaker with dolly.

CLASS HD-50, HORIZONTAL DRAWOUT METALCLAD SWITCHGEAR

INCORPORATING TYPE OB-50, 5 KV, MAGNETIC AIR CIRCUIT BREAKERS

ENGLISH ELECTRIC CANADA, A DIVISION OF JOHN INGLIS CO. LTD.

ST. CATHARINES ONTARIO

VANCOUVER, CALGARY, WINNIPEG, TORONTO, OTTAWA, MONTREAL, AND HALIFAX

CLASS HD–50, HORIZONTAL DRAWOUT METALCLAD SWITCHGEAR

INCORPORATING TYPE OB–50, 5 KV, MAGNETIC AIR CIRCUIT BREAKERS

English Electric, Class HD-50, 5 KV, metalclad switchgear has been designed in St. Catharines, Ontario to provide a highly standardized metalclad unit, with the maximum economy in production and installation costs, which meets all the requirements of the recognized North American Standards for this class of equipment, and which at the same time can be readily adapted to meet the various special requirements of individual switchgear purchasers. The complete equipment fully meets all C.S.A. requirements.

HD-50 metalclad switchgear incorporates the English Electric Type OB-50 magnetic air circuit breaker, a circuit breaker which represents the results of the efforts of a first class switchgear design team backed up by the short circuit testing facilities of English Electric's Nelson Engineering Laboratories, and many years of service experience with high voltage magnetic air circuit breakers.

TYPE OB–50 CIRCUIT BREAKER

RATING: The Type OB-50 air circuit breaker is in the 5 KV, 250 MVA class and is suitable for interrupting capacities of 250 MVA at 4160 volts, or 150 MVA at 2300 volts. Current ratings of 1200, 1600 and 2000 amp. are available. A schedule of technical data giving full details of interrupting currents and operating times is enclosed.

SHORT CIRCUIT PERFORMANCE: A notable feature of the performance of the OB-50 air circuit breaker is the high latching current, the circuit breaker being designed for a latching current of 96 KA peak. It will be noted that a latching current of 105 KA peak has actually been achieved on test at 4.16 KV. This performance results from the special contact design referred to later. Full details of the breaker performance on short circuit tests are given in a test report, copies of which are available on request.

During short circuit tests on this circuit breaker, tests were carried out in a typical metalclad enclosure to ensure the correct design of the housing, and particular care was taken to detect the occurrence of any flashovers to the housing during interruption. In these tests the housing was insulated from the floor and grounded through a fuse, an oscillograph being connected across the fuse to detect any transient voltages to ground such as would occur if a flashover to the housing occurred during interruption.

In addition due to the fact that the breaker, in common with other magnetic air circuit breakers, is not symmetrical in contact arrangement, tests were carried out with the power flow in both directions.

GENERAL DESCRIPTION OF CIRCUIT BREAKER: The OB-50 air circuit breaker is arranged as a horizontal drawout unit, the main disconnecting devices being of the cluster type. The circuit breaker is arranged for D.C. solenoid operation with the provision of a manual closing lever for maintenance purposes. A.C. closing is accommodated by the addition of suitable breaker closing rectifiers.

A two stage contact system, comprising main and arcing contacts, is incorporated, these contacts being linked by an ingenious lost motion device which ensures that on making the two contacts close practically simultaneously but on breaking, the main contacts open in advance of the arcing contacts. The simultaneous closing of the two sets of contacts on making is a big factor in providing the high latching rating, while in the opening sequence, the magnetic blowout coils are inserted into the circuit as soon as the main contacts part, thus materially assisting in rapid arc extinction particularly for the lower interrupting currents.

A cross section of the OB-50 air circuit breaker is shown in Figure 11 and from this drawing, the air piston and nozzle will be seen. These provide a puff of air at the moment of arc interruption to assist in moving arcs of small current value into the chute.

The construction of the arc chute itself can be seen from Figures 6 and 11. The splitter plates consist of a zircon based refractory ceramic which effectively splits up and cools the arc. The estimated time required, by two men, to remove three arc chutes is ten minutes and a complete contact inspection should be possible in thirty minutes.

CLASS HD–50 METALCLAD ENCLOSURE

GENERAL DESCRIPTION: Class HD-50 metalclad switchgear incorporates three main compartments for (a) the circuit breaker, (b) the bus bars, and (c) the current transformers and potheads or cable connectors. In accordance with current North American practice, each compartment is separated by grounded metal barriers and particular care is taken to avoid the possibility of faults occurring in one compartment being transferred to adjacent compartments.

BUS BARS: The bus bars are of hard drawn copper and are fully insulated with plastic sleeving over the main length of the bus and connections, and sealed at the ends. All joints are silver plated and completely insulated, by virtue of high pressure fittings, insulated spacers and plastic cap nuts.

The clearance in the main bus and cable compartments meet the requirements of C.S.A. for rigid connections in air, i.e. 3-3/4" phase to phase, and 2-7/8" phase to ground. It should be noted that these are clearances in air for uninsulated connections, so that in this design, the solid insulation, which is provided on all main connections and bus bars, is in addition to the standard air clearances for this voltage class.

BASIC IMPULSE LEVEL: The basic impulse level of the complete equipment, including the circuit breaker, is 60 KV.

AUXILIARY EQUIPMENT COMPARTMENTS: Reference to Drawing C6712C020 will indicate that the basic cell design provides for the addition of rear compartments to house potential transformers, control transformers, fuses, arresters, transfer bus and other special arrangements without affecting the basic standard breaker cell. Where necessary auxiliary cells can be provided in the line up but in the majority of applications a more compact and economical arrangement can be provided by housing these components in auxiliary equipment compartments.

SHUTTERS: Automatic shutters are provided and these are of grounded metal. The design is such that the shutters are closed when the circuit breaker is in the test position.

SECONDARY WIRING: All secondary wiring is run in enclosed metal ducts completely segregating the secondary wiring from the main compartments. This ducting can be seen in the photographs, and figure 9 in particular.

INTERLOCKING: An interlocking knob is provided on the front panel of the breaker. The interlock is arranged so that the breaker must be tripped before the knob can be turned to the free position. Only in the free position can the circuit breaker be removed in the fixed housing. A test position with positive location of the breaker is provided. In the test position, the secondary contacts are made but the primary contacts are broken and the shutter is closed.

INSTRUMENT TRANSFORMER ACCOMMODATION: Ample current and potential transformer accommodation is provided, current transformers being accommodated at the rear of the unit, and potential transformers in the auxiliary equipment compartments described above.

SERVICE EXPERIENCE WITH HIGH VOLTAGE MAGNETIC AIR CIRCUIT BREAKERS

English Electric has had world wide experience with high voltage magnetic air circuit breakers extending over a period of nearly twenty years. Many of these circuit breakers have been provided as station service switchgear for large steam generating stations, and in addition, similar installations have been provided for large industrial users such as steel works, oil refineries, chemical plants, etc.

Since the introduction in 1956 by English Electric Canada of the Class HD-50 5 KV metalclad switchgear English Electric 5 KV magnetic air circuit breakers have been available to the Canadian user, and several installations are now in service in Canada. A list is available of the circuit breakers of this type installed or on order for Canadian customers.

TYPE OB–50 AIR CIRCUIT BREAKER

TECHNICAL DATA

RATING 5 KV 250 MVA

1. CIRCUIT BREAKER RATING:

(a) Voltage rating	5 KV
(b) Current rating	1200, 1600 & 2000 amps
(c) One second current rating	47 KA
(d) Four second current rating	37.5 KA
(e) Rated making current	96 KA
(f) Rated latching current	96 KA
(g) Rated interrupting current	37.5 KA at 3.85 KV
(1) Symmetrical	35 KA at 4.16 KV
	30.6 KA at 4.76 KV
(2) Asymmetrical	42 KA at 4.16 KV
(h) Operating times on a 60 cycle basis:	
(1) From energizing trip coil to contact part	4.2 cycles (0.07 sec.)
(2) Arc duration at 100% interrupting rating	.90 cycles (0.015 sec.)
(3) Interrupting time at 100% interrupting rating.	5.1 cycles (0.085 sec.)
(4) From energizing trip coil to breaker fully open	7.4 cycles (0.123 sec.)
(5) From energizing close coil to contacts touch.	11.4 cycles (0.19 sec.)
(6) Full making stroke	15.0 cycles (0.25 sec.)
(7) Closed time on an instantaneous (but not pre-tripped) MB cycle	3.0 cycles (.05 sec.)
(i) Opening speed of contacts (fps)	7.75 Av. at 100% curren
(j) Closing speed of contacts (fps)	3.3 Av. " " "
(k) Rebound (% of stroke)	Nil
(l) Maximum current interrupted on test at 4.16 KV or over - Symmetrical test	43.4 KA
- Asymmetrical test	65.6 KA
(m) Maximum latching current from tests	117 KA peak with 90V DC closing volts
(n) Derating factor for instantaneous reclosure	Nil
(o) Closing coil current	130 amp. at 125V D.C.
	65 amp. " 250V "
(p) Tripping coil current	2.5 amp. " 125V "
	1.25 amp. " 250V "

Note: All opening times shown are with 80% of normal voltage on the trip coil.

2. CIRCUIT BREAKER MECHANICAL FEATURES:

(a) Weight of movable circuit breaker element	1600 lbs. approx.
(b) Type of main contacts	Multiple Butt
(c) Material of main contacts	Silver tipped copper
(d) Type of arcing contacts	Butt
(e) Material of arcing contacts	Copper tungsten tipped brass
(f) Number of breaks per pole	One
(g) Length of each break	4-3/8" minimum
(h) Location of position indicator	On breaker front panel
(i) Provision for circuit breaker analyser	Yes
(j) Location of operation counter	On breaker front panel
(k) Type of bushing disconnect	Cluster contact
(l) Number of auxiliary switches for use of customer	As required (6 standard)

3. STATIONARY CELL:

(a) Weight including circuit breaker (single breaker, indoor)	3600 lbs. - 2000 amps. 3300 lbs. - 1200 amps.
(b) Type of primary disconnect shutters	Grounded metal
(c) Bus arrangement	Single Double Transfer
(d) Bus insulation	PVC Sleeving
(e) Bus Rating	5 KV - 1200 amp. 1600 amp. 2000 amp.
(f) Bus Material	Hard drawn copper silver flashed at joints.

(g) Width of cell:

1200 amps.	- 27"
1600 amps.	- 27"
2000 amps.	- 36"

(h) Alternative ratings:

The following alternative ratings are available by the use of forced ventilation of the breaker compartment.

2000 amps.	- 27" wide cell
2500 amps.	- 36" wide cell

Due to improvements in design, the Company reserves the right to modify equipment from time to time without prior notice.

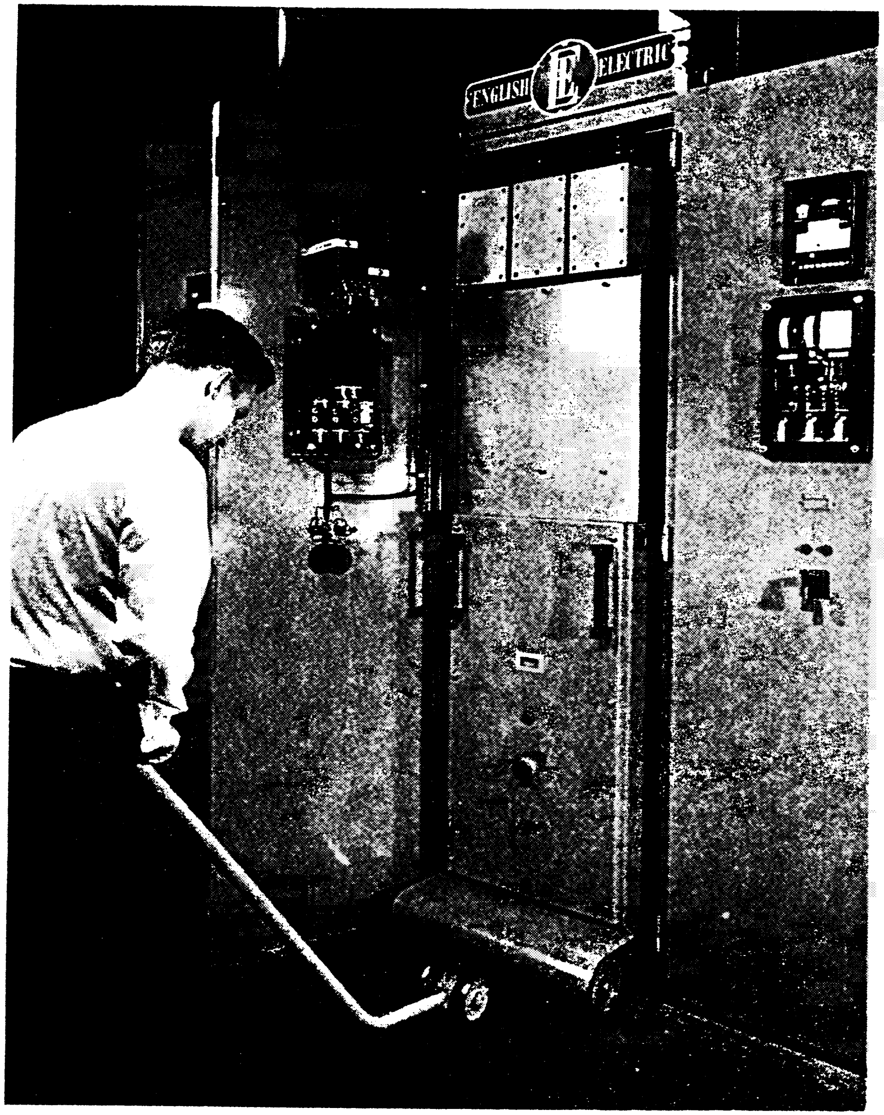


Figure 2—The transport dolly in use.

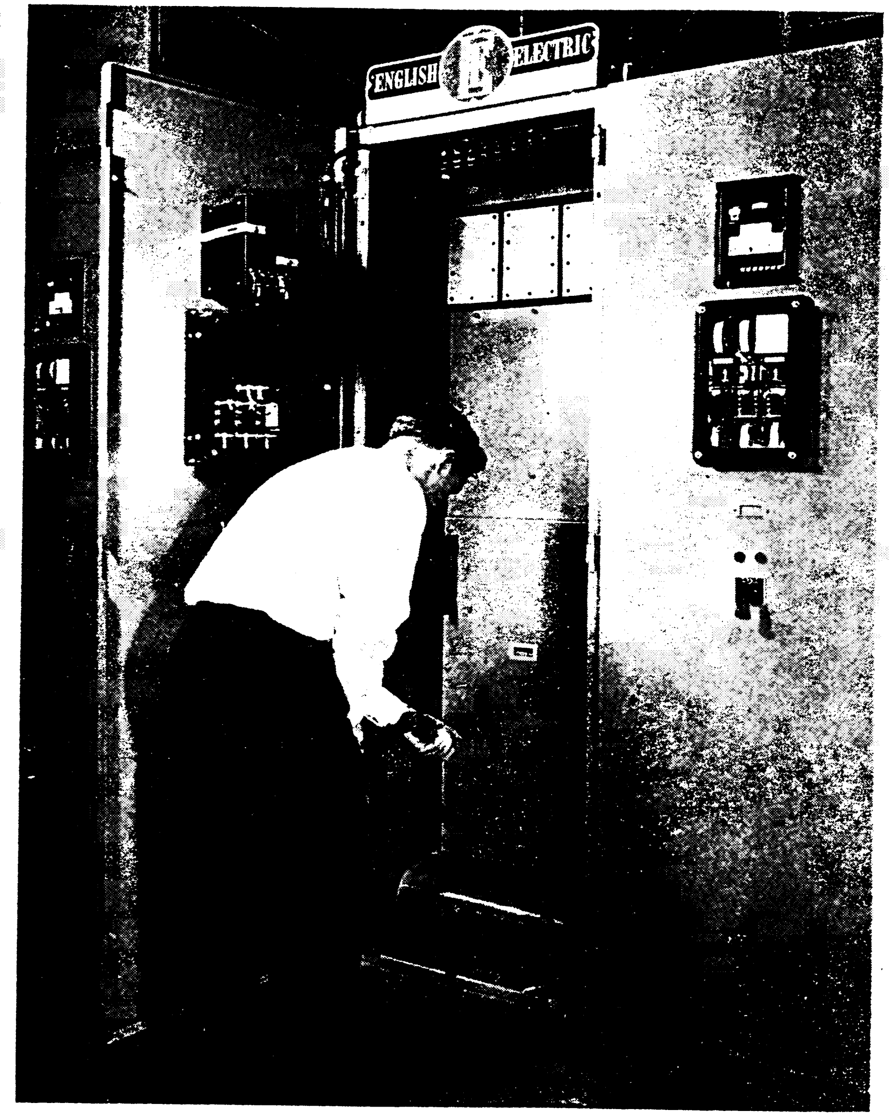


Figure 3—The racking handle in use.

5 kV. class HD-50 metalclad switchgear incorporating type OB-50 magnetic air circuit breakers.

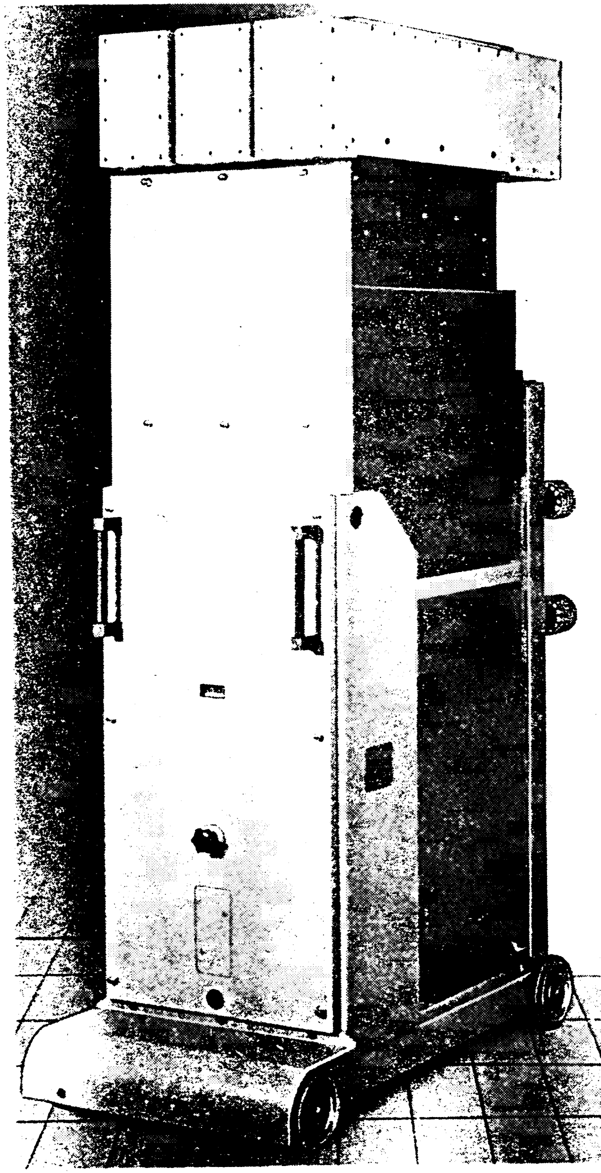


Figure 4—*Front view.*

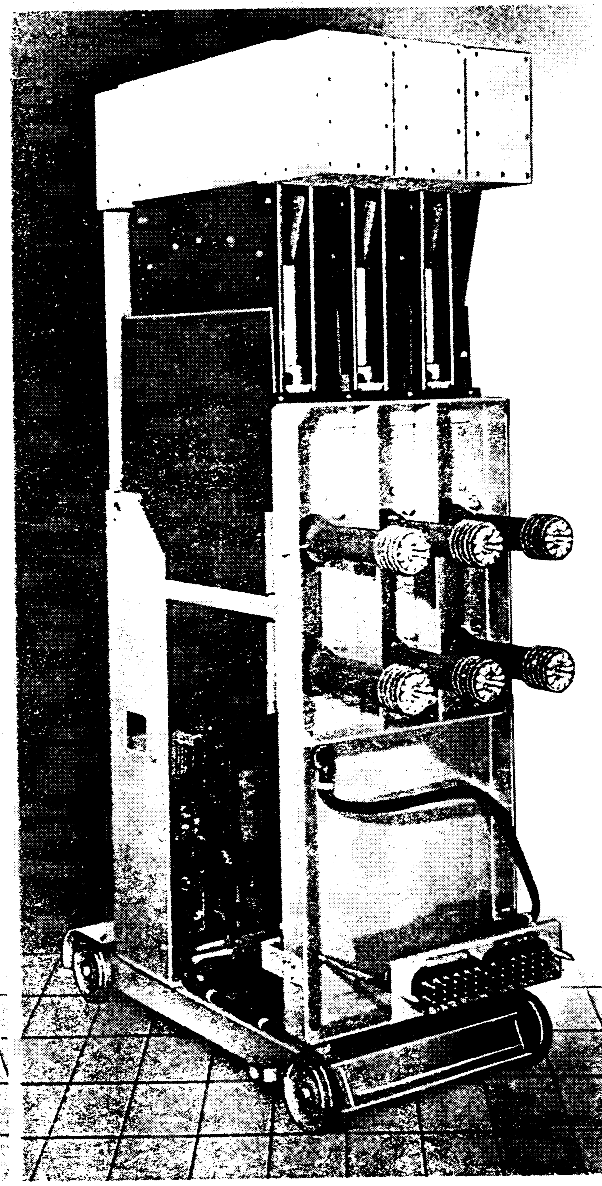


Figure 5—*Rear view.*

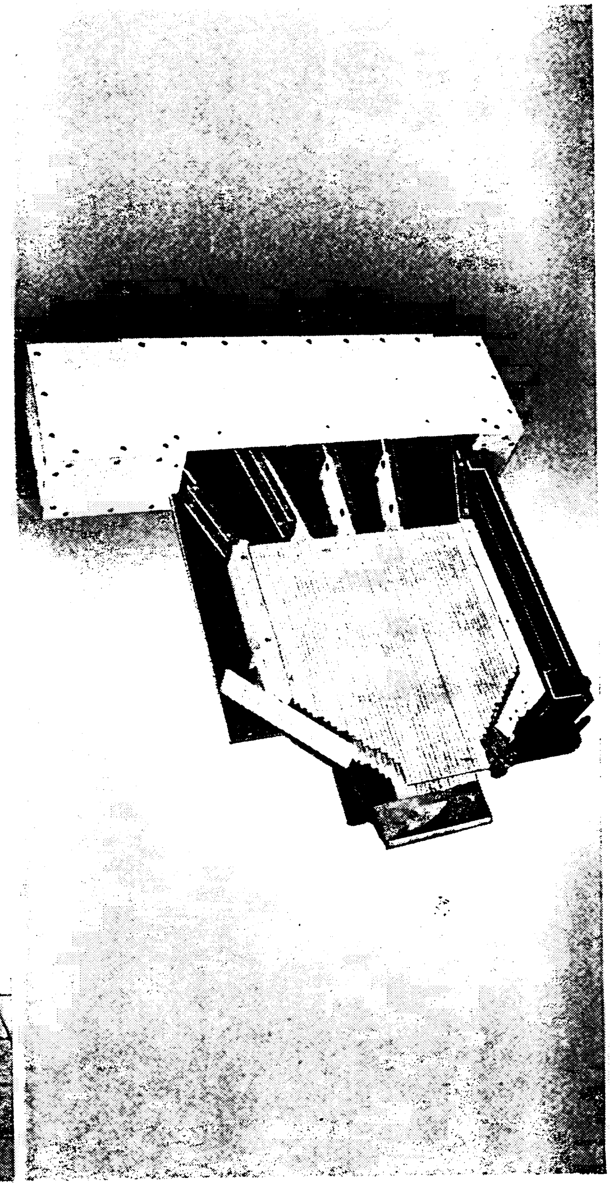


Figure 6—*The arc chute assembly.*

Type OB-50 5 kV. magnetic air circuit breaker.

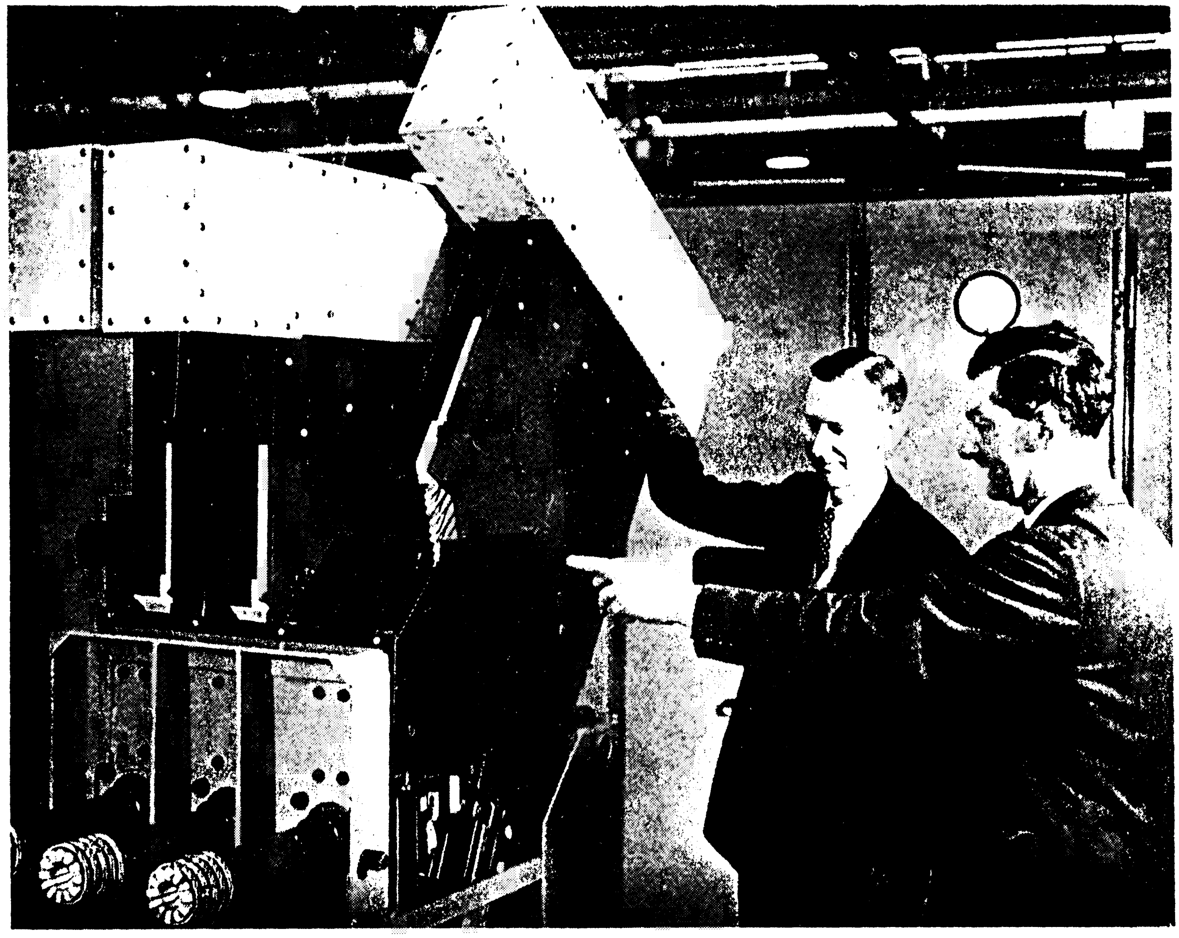


Figure 7—The type OB-50 air circuit breaker with one arc chute hinged back for contact inspection.

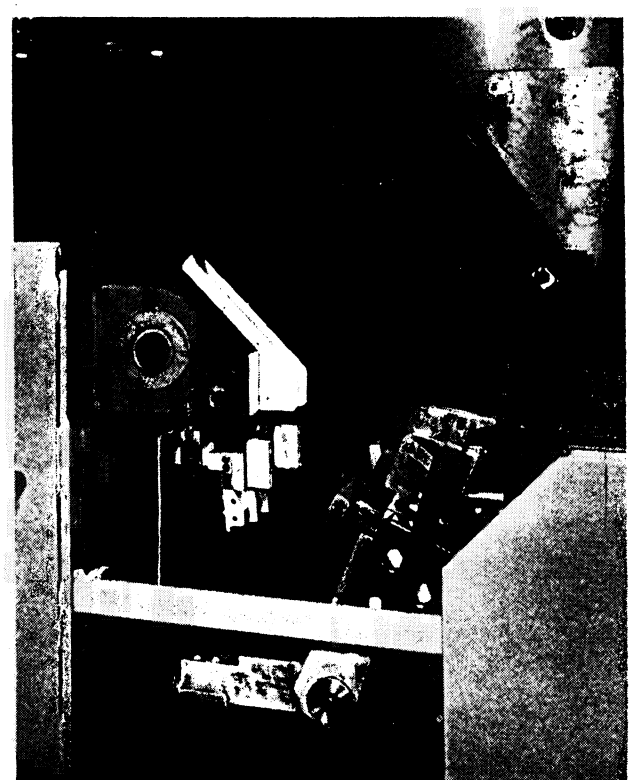


Figure 8—Close up of the contacts and blow out coil.

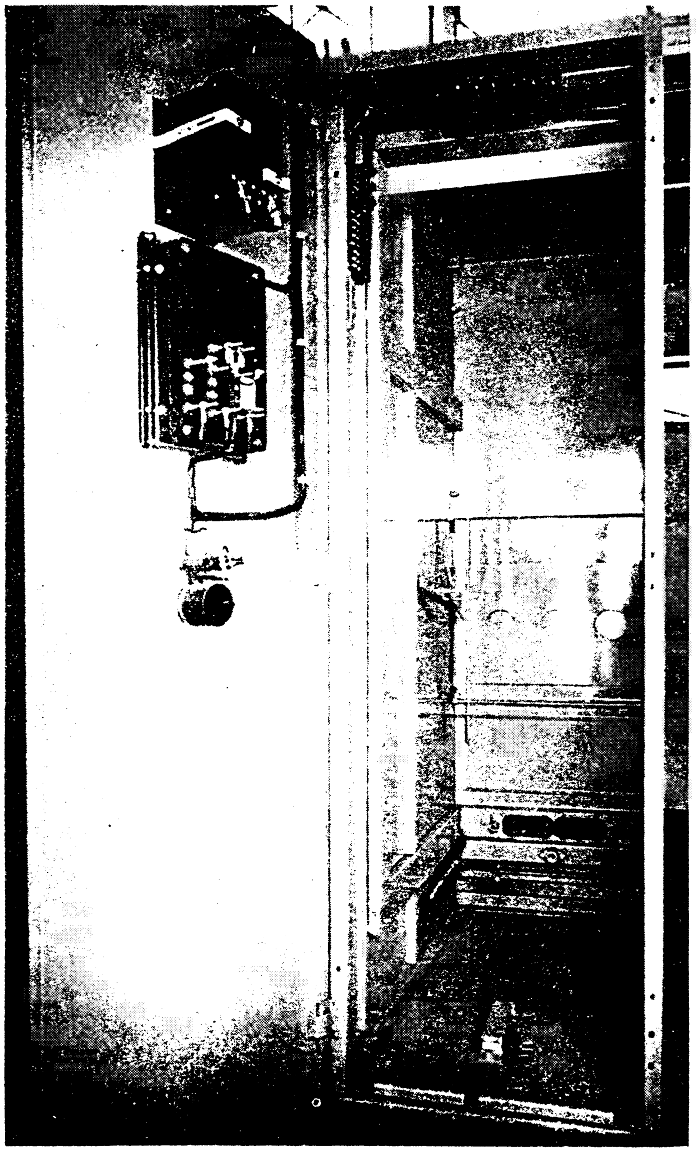


Figure 9—Interior of standard 1200 amp. cell.

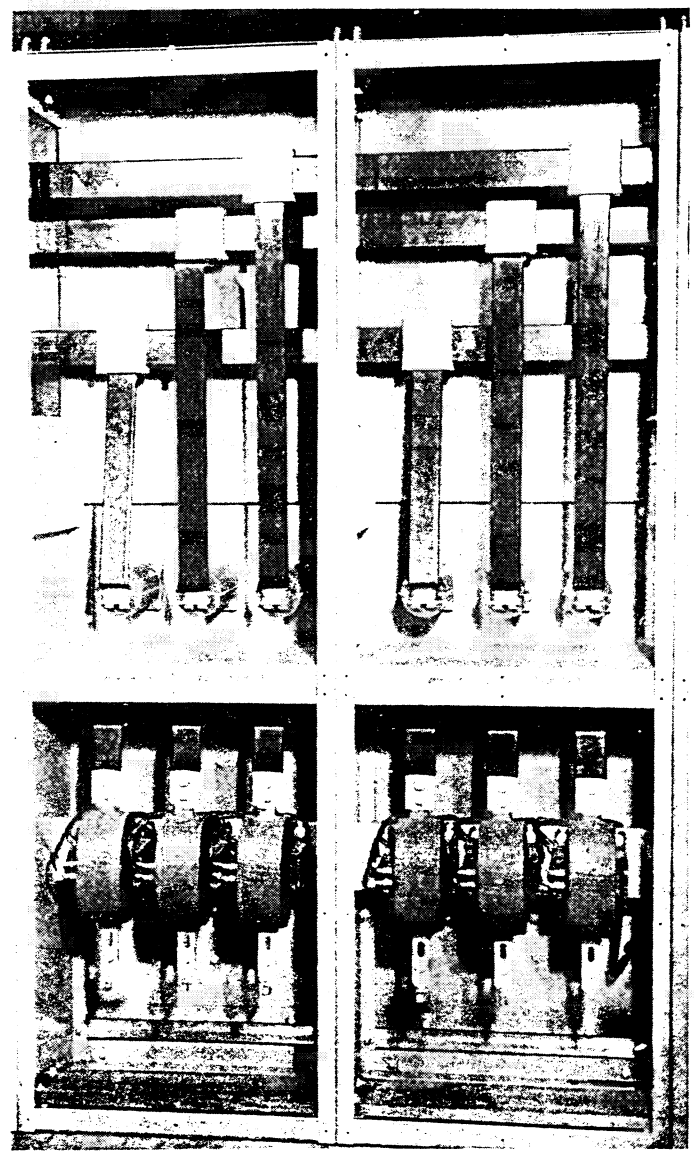


Figure 10—Rear view of typical switchboard.

5 kV. class HD-50 metalclad switchgear incorporating type OB-50 magnetic air circuit breakers.

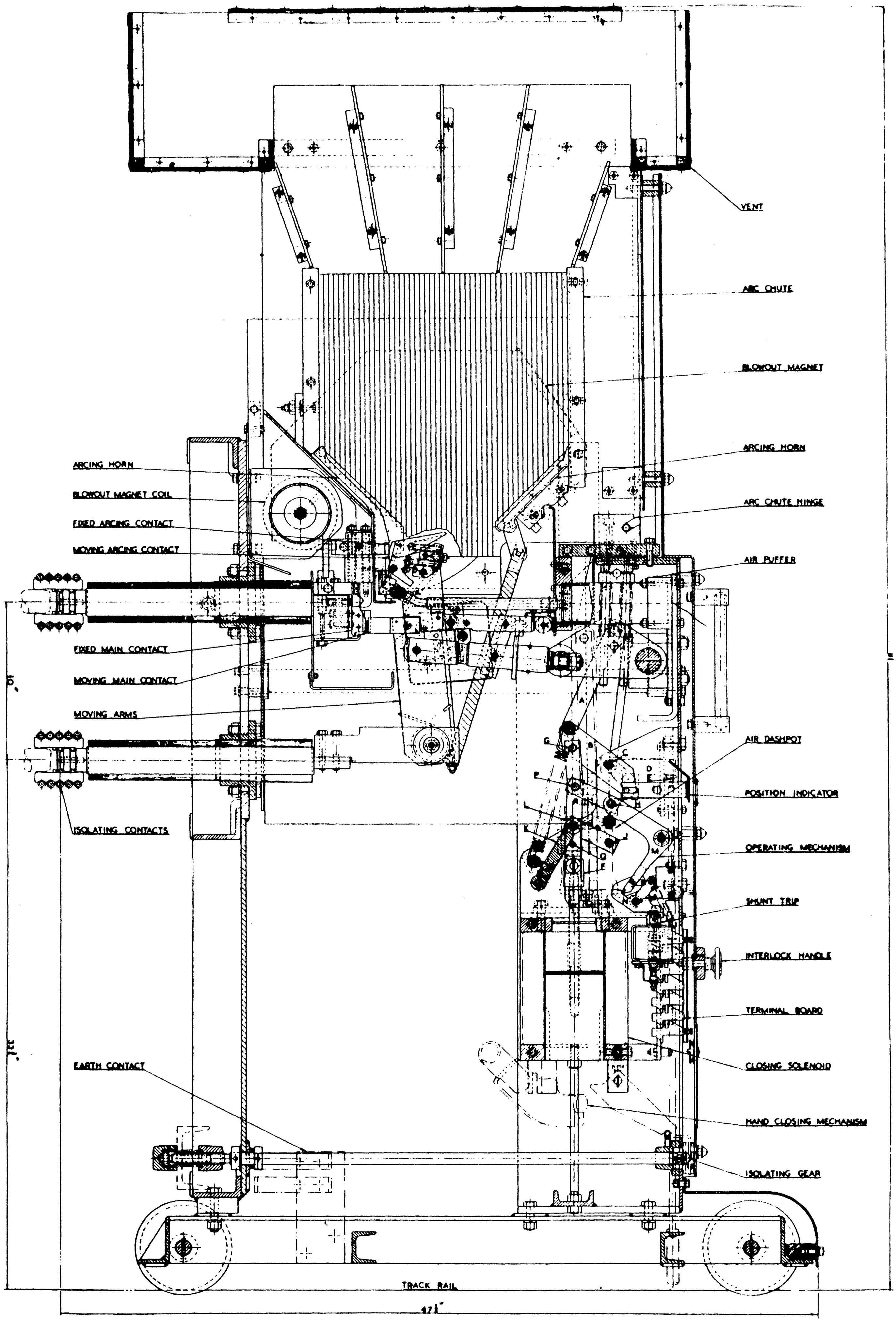
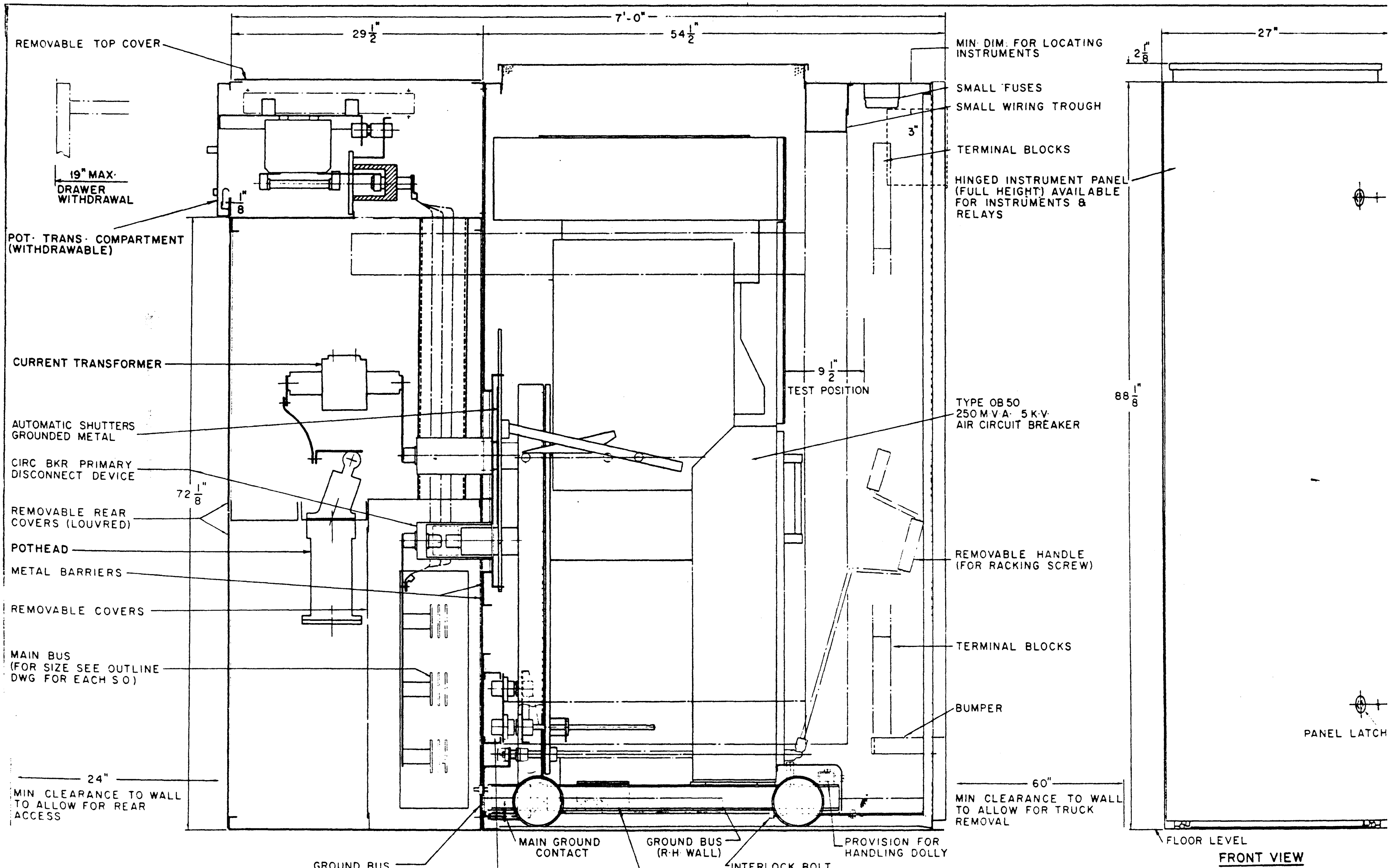


Figure 11 – Cross-section [illegible]



TYPICAL SECTIONAL VIEW

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CUSTOMER'S ORDER No.	

DR.	ENGLISH ELECTRIC CANADA A DIVISION OF JOHN INGLIS CO. LIMITED ST. CATHARINES, ONTARIO	
CH.		DRAWING NUMBER
APP.	TYPE 'HD-50' ACB CELL GENERAL ARRANGEMENT	
DATE ISSUED		C6712C02