Instructions for De-ion® Air Circuit Breakers

Types DM, DM2F, DMD

Westinghouse Electric Corporation

Switchgear Division, East Pittsburgh, Pa.

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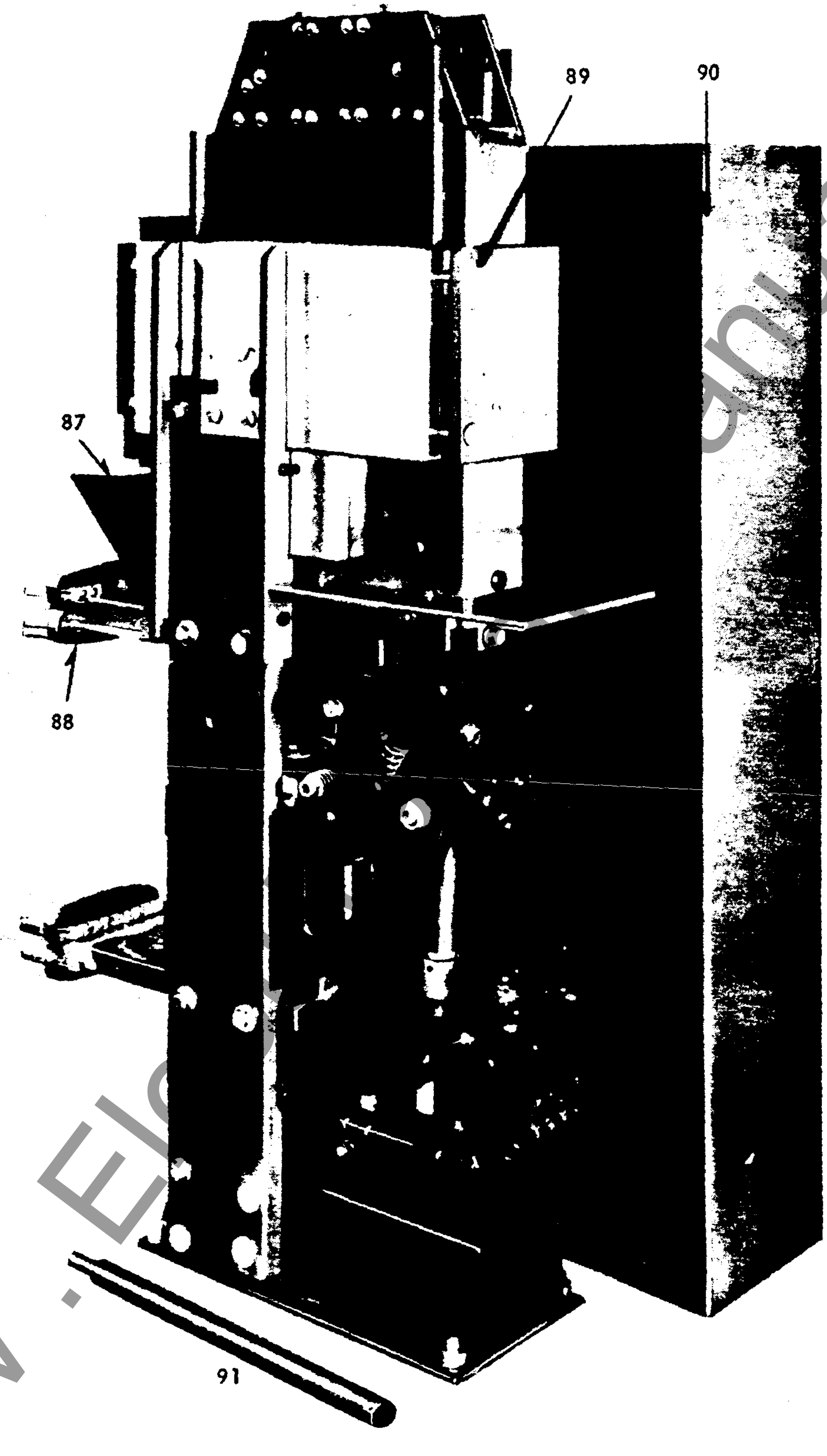
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HANDLING, UNLOADING AND UNPACKING

INTRODUCTION

The purpose of this instruction book is to familiarize the user with the characteristics of the Type DM anode air circuit breaker. The book contains important information concerning installation, operation and maintenance so that the apparatus will give the service for which it was designed.

The Type DM breaker differs from conventional circuit breakers in that it trips at high speed on reverse current only. The user should become thoroughly familiar with the method of operation.

APPLICATION

The Type DM pole unit is intended primarily for use with mercury arc rectifiers. The standard breaker installation normally consists of one pole unit in each anode circuit of the rectifier. If an arc-back occurs in any of the rectifier units, the Type DM pole unit in that circuit will open because of the reverse current which flows.

Each pole unit has its own closing solenoid which is designed for intermittent operation at 125 volts D.C. The control circuit must be arranged to cut off the closing current immediately after the breaker is closed. The final steady-state value of the closing current is approximately 23 amperes.

Ordinarily, the holding coils of six pole units are connected in series and are supplied with a direct current of one ampere which corresponds to a drop of approximately eleven volts across each coil. During the closing period, the holding current should be increased to about two amperes by the control relays as an added precaution against having the breaker open from mechanical shock.

SHIPMENT AND STORAGE

The pole unit is completely assembled, inspected and tested at the factory before shipment. The arc chambers and barriers are shipped separately from the breaker. These items can be mounted on the breaker readily with standard tools. Installation details are given on Page 7.

Immediately after receiving the shipment, it should be examined for any damage sustained after leaving the factory. If any damage is evident, or if indication of rough handling is visible, a claim for the damage should be filed with the carrier firm at once, and the nearest Westinghouse Sales office notified promptly.

If the breaker is to be stored, it should be kept in a warm, dry location, protected from water, oil, dirt, or other damage. The arc chambers must be kept covered to prevent foreign particles lodging between the ceramic arc plates. If the arc chambers have been stored under humid conditions, they must be dried by baking for 24 hours at 60°C. before being placed in service.

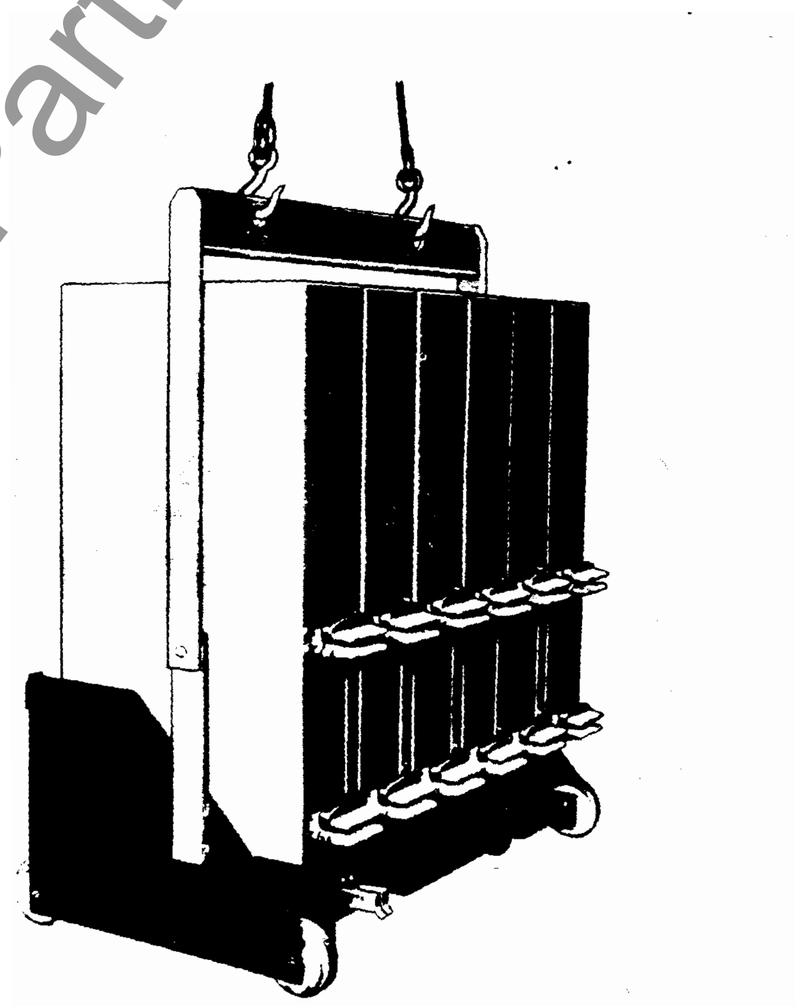


FIG. 1. Lifting Six-Pole Breaker

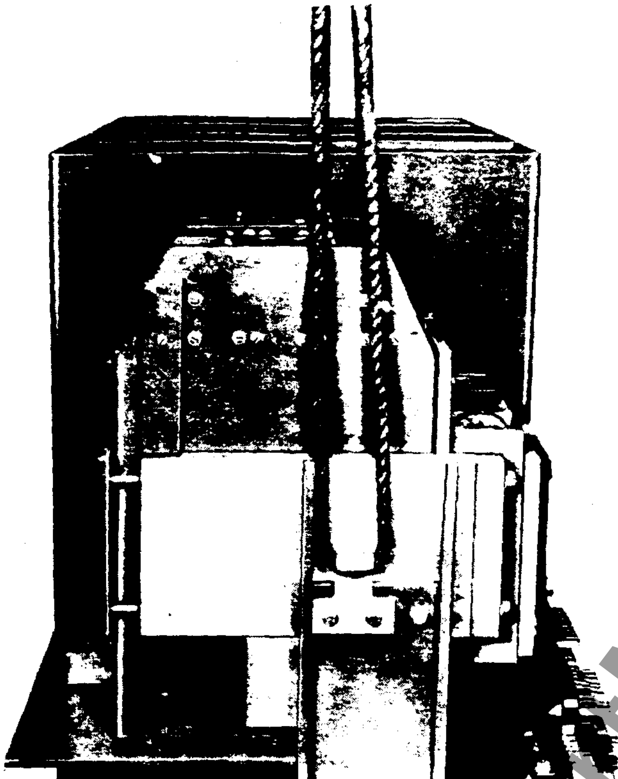


FIG. 2. Lifting Single Pole Unit

UNLOADING AND UNPACKING

The breaker is crated in a firm wooden container that can be lifted safely at the ends of the box with rope or cable slings. The box may be moved about on pipe rollers in the usual manner. The crate must be kept upright since the equipment has been so packed for ease of handling at the destination. Lifts should be made smoothly, and sudden drops should be avoided.

For unpacking, a nail-puller or claw-bar is recommended for removing the top crating material. Crow-bars should be used cautiously to avoid possible damage to parts or wiring, or change in adjustment.

After removing the top of the crate, remove the fastening blocks securing the breaker to the bottom of the crate. The complete truck assembly can then be lifted from the crate, using the lifting assembly shown in Fig. 1. Do not use the lifting hooks at the top of each pole unit. Care should be taken not to apply strain against the sides of the pole units when lifts are made. **Make certain that all shipping braces and supports are removed from the arc chambers and breaker mechanism before installation.**

If it is desired to remove a single pole unit from the frame, it is necessary to disconnect the wiring from the terminal blocks at the front of the pole unit base and remove the nuts from the mounting studs located on the truck at the corners of the pole unit base. The pole unit may then be lifted from the truck with a rope sling under the lifting hooks as shown in Fig. 2. **These hooks must not be used to lift a complete truck assembly because the excessive load will force the pole units out of alignment.**

Separate pole units must always be in the open position when handling. This avoids the possibility of bending the interlock pin which extends from the bottom of the closing solenoid when the breaker is closed.

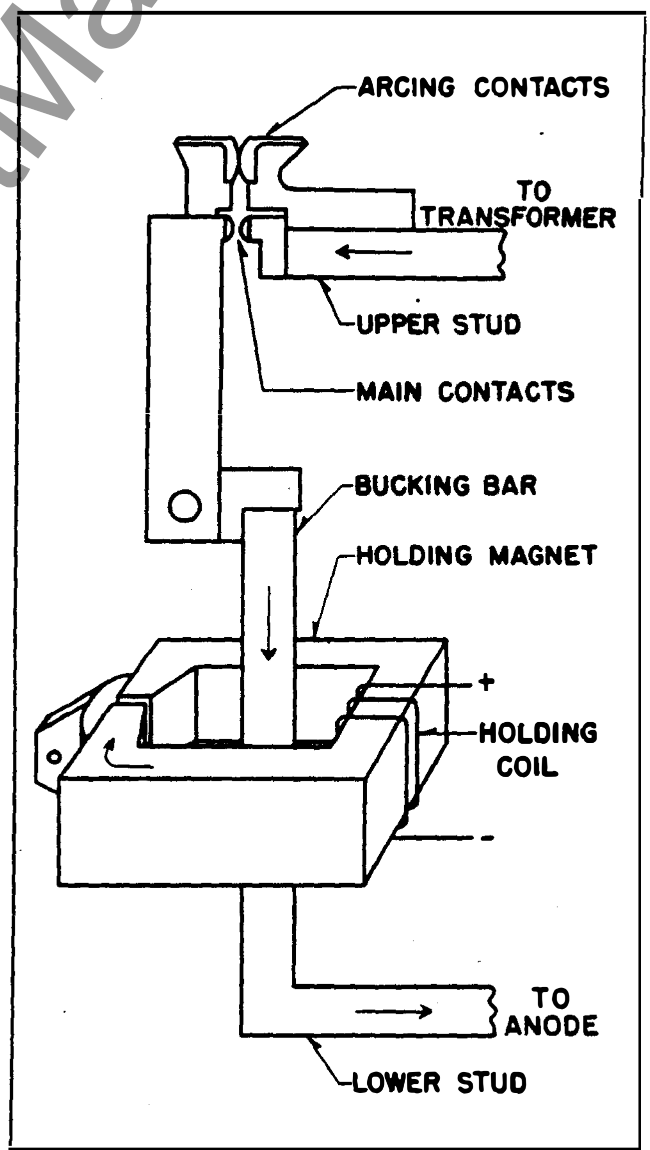


FIG. 3. Diagram of Breaker Operation

DESCRIPTION AND INSTALLATION

DESCRIPTION AND OPERATING PRINCIPLES

For the following principles of operation, refer to Fig. 3 on page 5. Normal load current enters the upper stud and travels down through the bucking-bar and out through the lower stud. Current flowing through the bucking-bar in the normal direction sets up magnetic flux in the holding magnet in the direction indicated in the figure. The holding coil, which is energized by a separate direct current source, also sets up magnetic flux in the same direction. The holding coil flux alone is sufficient to hold the breaker closed, so that the breaker remains closed even when the bucking-bar current falls to zero.

The main terminals may be connected in the opposite direction to that shown. If they are, the holding coil connections also should be reversed.

Whenever the current through the breaker reverses, the bucking-bar current tends to set up a flux through the holding magnet and armature which is opposite to the flux set up by the holding coil. As the bucking-bar current rises, the resultant flux through the armature will be reduced to a value that permits the armature to be pulled away by the spring load on the linkage, and the breaker will open.

As the breaker starts to open, the main contacts part first and cause the current to flow through the arcing contacts as shown on Fig. 4. The arcing contacts then part and an arc forms between them. The arc increases in length and rises until it impinges on the arc horns. The current then must flow through the coils of the blow-out magnet. Thus a strong magnetic field is produced between the side magnets on either side of the arc chamber. The arc, travelling through this strong magnetic field, is then forced upward into the slot of the ceramic plates of the arc chamber and is extinguished.

The general construction of the breaker is indicated in Fig. 5, which shows the moving contact arm in the position where the arcing contact tips are just touching. The closing linkage is comprised of three links which form two toggle systems. The first toggle is comprised of pin B, Fig. 5, and the links on either side. Although pin B does not go over center, the toggle cannot collapse as long as the armature, H, is held by the magnetic attraction of the holding magnet. However, if the bucking-bar current reverses, or if the holding coil current is interrupted, the armature will be released and pin B will move upward which causes its toggle to collapse and the moving contact arm will be pulled open by the spring F. Pin C remains nearly stationary until the contact arm is open, then it is moved upward by the retrieving spring, S, in the closing magnet.

The other toggle is comprised of pin C, Fig. 5, and the links on either side. In this toggle, pin C moves over center, but it is prevented from moving further by the compressive force present in the pull rod, G, when the closing solenoid plunger hits the bottom of the closing magnet. This toggle can be closed or opened manually by inserting a maintenance closing handle in the closing lever casting,

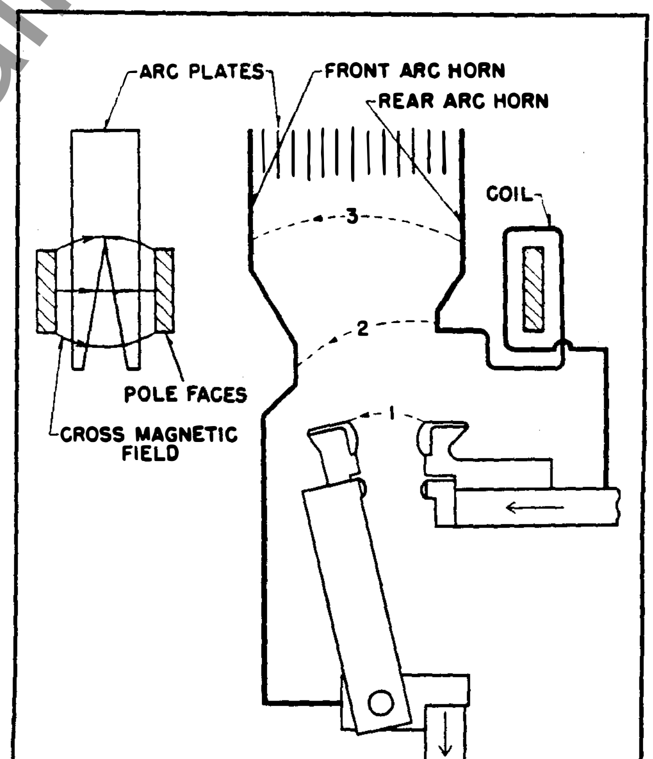


FIG. 4. Schematic of Current Interruption

E, and raising or lowering the handle. In order to close the breaker, the armature must be held by energizing the holding magnet coil or by means of the locking-bar illustrated in Fig. 10. If the armature is not held, the toggle nearest the moving contact arm will collapse and the breaker will open.

Illustrations of the breaker base and frame parts are shown in Fig. 6. The links, studs, holding magnet, and arc chamber magnets are shown in Fig. 7. Arc chamber details are illustrated in Fig. 8. The moving contact arm assembly and details are shown in Fig. 9.

Metal-clad draw-out equipment is shipped with the pole units mounted on the truck. Arc chambers and barriers are shipped separately and must be mounted on the pole units before putting the breaker into service.

For stationary mounting the individual pole units, arc chambers and barriers are shipped in separate containers. The pole units must be mounted on the pedestal framework and connected to the control wiring. The arc chambers and barriers are then mounted on the pole units.

For either type of mounting, the pole units have been completely adjusted. No change of adjustment should be necessary and none should be made unless it is apparent that adjustments have been disturbed during shipment.

INSTALLATION

After the breaker has been uncrated, all dust and foreign particles should be wiped off with a dry cloth or blown out with dry compressed air. The protective grease should be thoroughly removed from the contacts, armature, and holding magnet surfaces. The control wiring should be checked for possible damage to the insulation.

The polarity of the holding current supply should be checked carefully to insure proper tripping of the breaker. If the upper main breaker terminal is connected to the transformer and the lower terminal is connected to the rectifier anode, then the voltage across the holding coil must be positive on the side connected to terminal #1 of the terminal block in order to have the breaker trip on reverse current.

A preliminary check of the operation of the individual pole units should be made before installation. The holding armature should be held to t magnet surface by supplying the holding coil with one ampere at about eleven volts for each pole unit. In case holding current is not available, a locking-bar for the armature may be used and is supplied with each order for breakers. Its use is shown in Fig. 10. The forcing screw of the locking-bar should hold the armature against the face of the holding magnet securely. If the armature tends to pull away from the holding magnet when the breaker is closed, then the forcing screw must be re-tightened. However, the breaker must always be in the open position when adjusting the forcing screw.

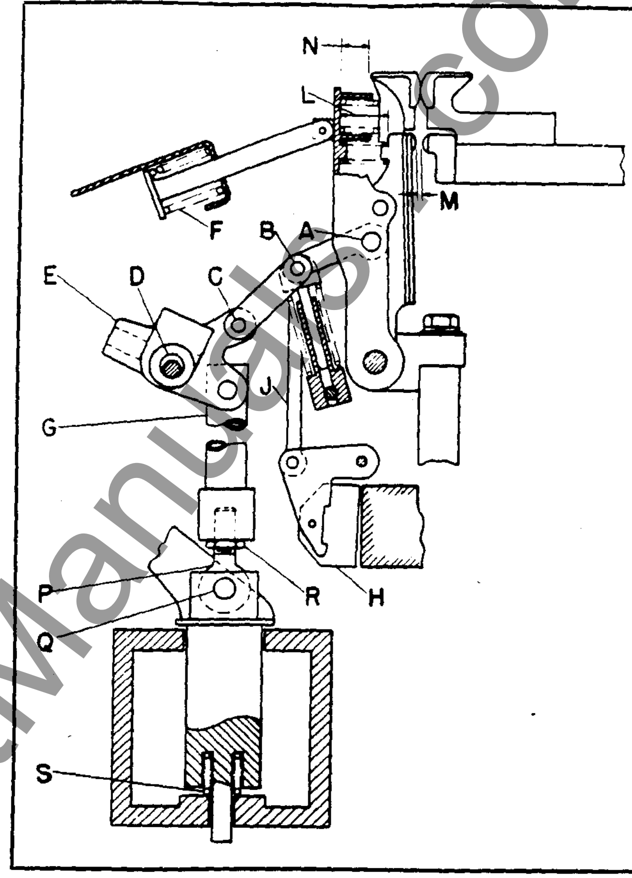


FIG. 5. Schematic of Operating Mechanism

For closing tests, about 23 amperes at 125 V.D.C. should be supplied to the closing coil of each pole unit tested. The current must not be applied for more than a few seconds at a time since the closing coil is designed for intermittent duty only. During the period when closing coil current is applied, the holding coil current should be increased to about two amperes to avoid having the breaker re-open from mechanical shock.

After the mechanism has been checked, the arc chambers should be installed next. Blow out all dust and foreign particles from the arc chambers with dry compressed air and wipe clean with a dry cloth. Remove the clamping plates across the front of the arc chamber side magnets. Lift the arc chamber with the projecting coil connection turned toward the breaker and insert the chamber between the side magnets. Lift the front of the arc chamber slightly and slide it gently into place. Make certain that the coil connection at the rear of the arc chamber is engaged properly in the clip connections of the blow-out magnet. Bolt the terminal at the lower front end of the arc chamber to the frame of the pole unit. Then install the clamping plate across the front of the arc chamber and tighten the screws securely. Check to make certain that the moving contact arm can close completely without interference. After making certain that all tools, locking-bars and foreign materials are removed from the mechanism, the boot barrier may be placed over each pole unit. The breaker is then ready to install in the cell.

INSPECTION AND MAINTENANCE

The frequency of inspection, cleaning and re-adjustment of contacts will depend on the duty to which the breaker is subjected and the cleanliness of the surroundings. A preliminary inspection should be made after the first several power interruptions to make sure that all adjustments are in order. The initial detailed inspection should be made after the first ten interruptions, or at the end of the first three months of service, whichever occurs first. Further inspections should be determined from accumulated operating experience for the particular installation, although inspection periods should not be longer than six months.

Each pole unit should be carefully inspected and be serviced accordingly. All insulating surfaces should be wiped clean at each inspection. After two or three years of service, the insulating surfaces should be sanded lightly, cleaned thoroughly and coated with a good grade of insulating varnish.

CAUTION

All parts of the pole unit mechanism are at line potential when the breaker is connected to an energized circuit, regardless of whether the breaker is opened or closed. The breaker should not be operated by hand while connected to an energized circuit. The closing handle, while insulated, is intended primarily for maintenance and adjustment operations.

As a safety precaution, no work should be done on the breaker while it is in the closed position. A locking-bar is provided to hold the armature on the holding magnet for adjustment purposes when holding current is not available. But even with the locking-bar in place, the breaker can still open accidentally if the toggle adjustments have not been made properly. Hence, it is advisable to keep fingers out of the mechanism at all times when the breaker is closed. Make certain that the locking-bar, tools or other loose parts are removed before the breaker is operated or put into service.

Avoid closing the breaker repeatedly when arc-backs continue to occur shortly after the breaker is closed. When such conditions are encountered, the rectifier unit should be shut down and repaired. It must be remembered that the duty imposed on the breaker pole unit will be determined by the condition of the particular rectifier tank.

DETAILED INSPECTION

Make sure that all bolts, nuts, terminal connections, etc. are fastened securely. Check for evidence of wear or improper adjustment and operation of the various parts.

The machined surfaces of the armature and holding magnet should be inspected carefully to make sure that they are free of dirt or magnetic particles. The surfaces should be cleaned occasionally with a clean cotton cloth dipped in kerosene. Cotton waste should be avoided since loose fibers may be left on the magnet surfaces.

After a long period of service, or exposure to moist or corrosive air the magnet surfaces may be rusted or corroded to some extent. A small amount of rust will not interfere with breaker operation. If

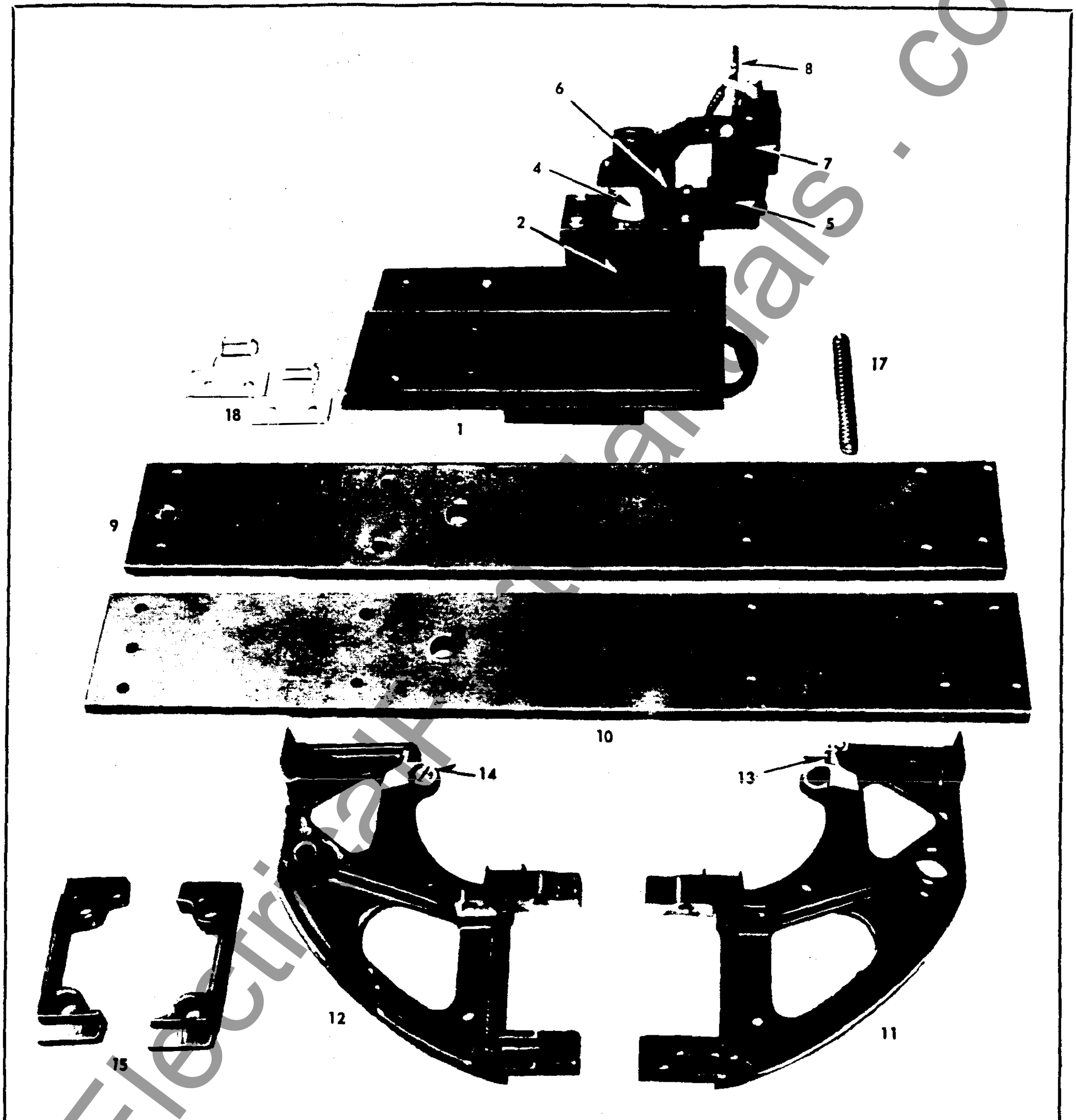


FIG. 6. Base Assembly, Uprights, and Side Frames

rust or distortion occurs to the extent of interfering with proper holding, the surfaces may be trued up as follows:

1. Holding magnet—use a fine grit, flat stone and carefully rub it over the surface of the magnet until flatness is restored.

2. Armature surface—remove the armature from the breaker. Lay a sheet of polishing cloth or very fine emery paper with the grit side up on a surface plate. Lay the armature on the polishing cloth and move it about carefully with a circular motion until all high spots are removed.

ARC CHAMBERS

Caution: The arc chamber contains ceramic material. Handle carefully. Do not drop, tip over or bump.

Insulating parts of the arc chamber must withstand more than the full line potential when the breaker is interrupting. Successful breaker operation depends largely on the care given to the arc chambers. Periodically, they should be removed and inspected for worn or broken ceramic parts and for excessive metallic spray deposits.

Since arc-back currents vary in severity, the life of an arc chamber cannot be predicted accurately. Renewals should be determined by inspection. If the ceramic plates are eroded to sharp edges, or if the slots in the plates have increased more than 1/8 inch in width in the widest portion, the arc chamber should be replaced. If any of the ceramic plates are badly cracked, the arc chamber should be replaced.

When installing the arc chamber on the breaker, make certain that the rear arc-horn connection engages the clips on the blow-out magnet assembly.

CONTACT ASSE BLY

The contacts should be checked periodically for wear and adjustment. Under normal conditions, the contacts should be good for a large number of operations. A small amount of surface pitting on the main contacts will not impair the normal current carrying capacity of the breaker. Any excess roughness can be smoothed up with fine sandpaper, making certain that at least 70% of the contact surface is effective.

The arcing contacts are subject to the intense heat of the arc when interrupting current. Each arc interruption will burn away some of the arcing contact metal. When they have reached the point where only 1/8 inch of contact material remains, the contact block or moving contact finger should be replaced.

The moving contact assembly is illustrated in Fig. 9. The following steps are necessary to remove

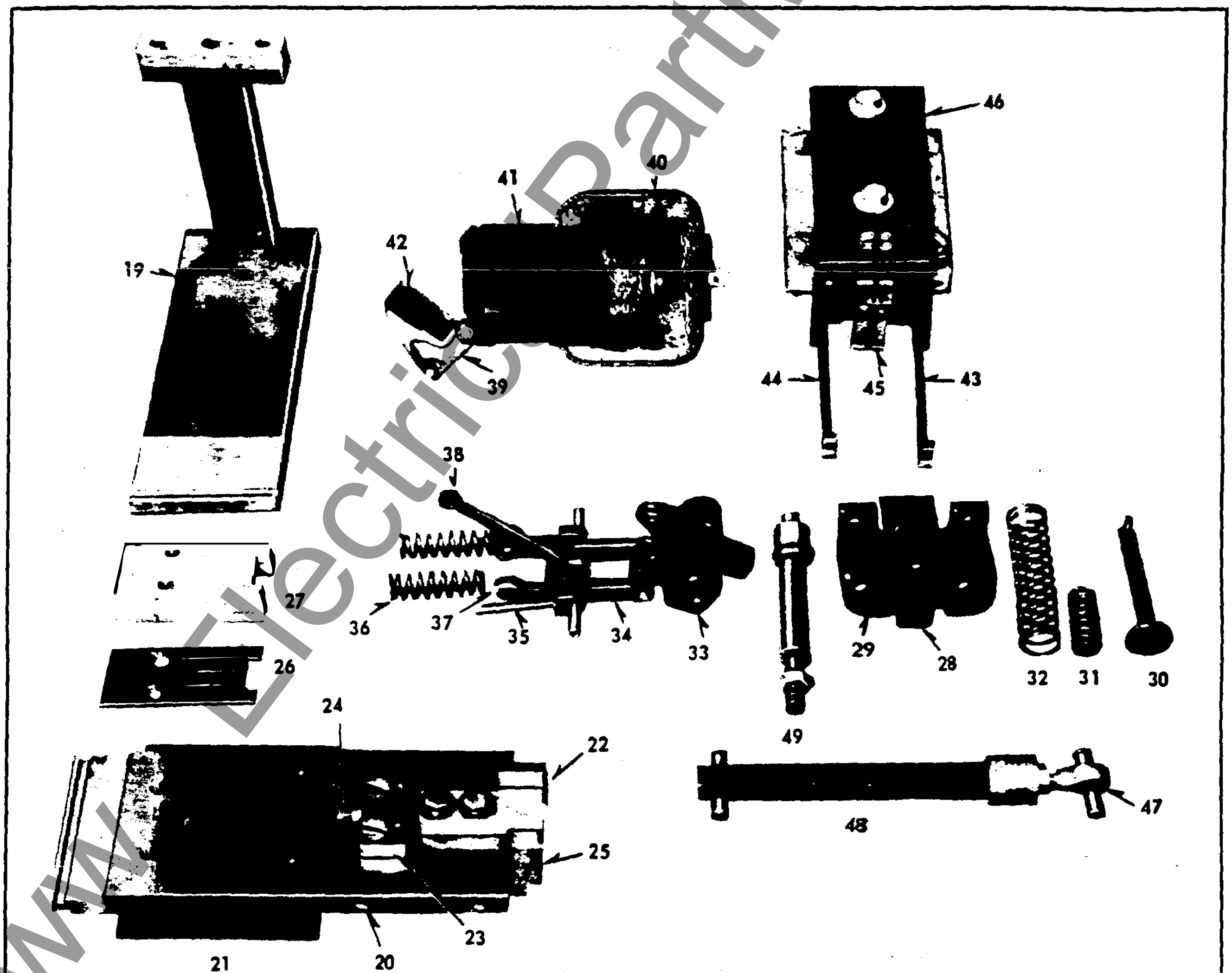


FIG. 7. Pole Unit Details

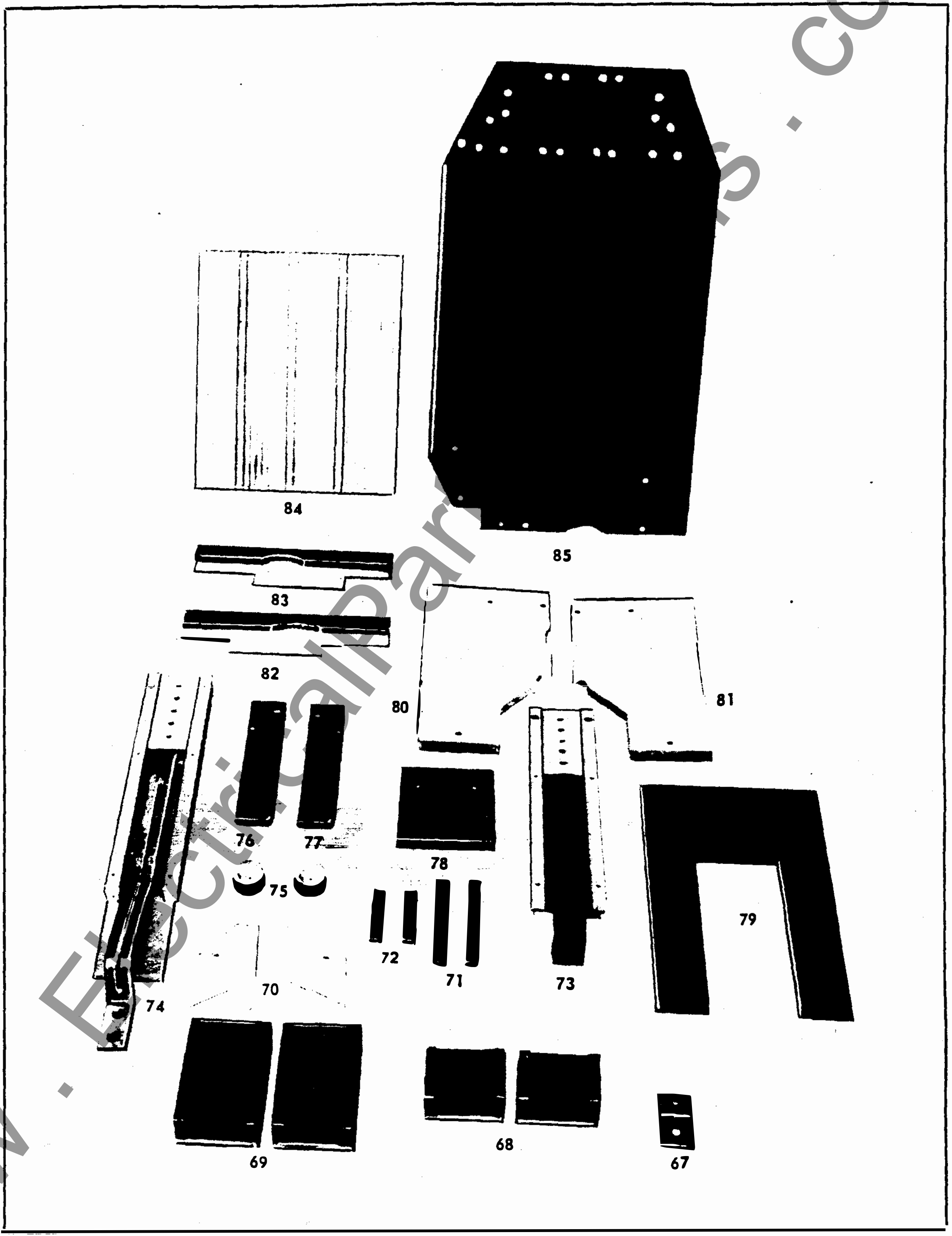


FIG. 8. Arc Chamber Details

the complete assembly from the breaker for servicing:

1. Remove the pin, item 64 in Fig. 9, which disconnects the toggle linkage.

2. Remove the pin fastening the opening spring guide to the top of the contact arm casting.

3. Remove the three bolts holding the hinge block to the bucking-bar.

4. Lift the contact assembly out of the breaker.

ADJUSTMENTS

CONTACT ADJUSTMENT

To completely re-adjust the contacts, start by removing the copper arc runner and laminated iron stack which are located over the stationary arcing contact. Loosen the bolts holding the stationary arcing contact and back off the jack screw so that the contact is free to slide back on the upper stud. If a source of direct current is available, it is best to make the following adjustments with the holding coil energized with a current of one ampere which produces a drop of about eleven volts across each of the holding coils included in the circuit. A sufficient number of coils on adjacent pole units may be used in series to suit the voltage available from the D.C. source. If a holding current is not available, adjustments may be made with the armature held by the locking-bar as shown in Fig. 10.

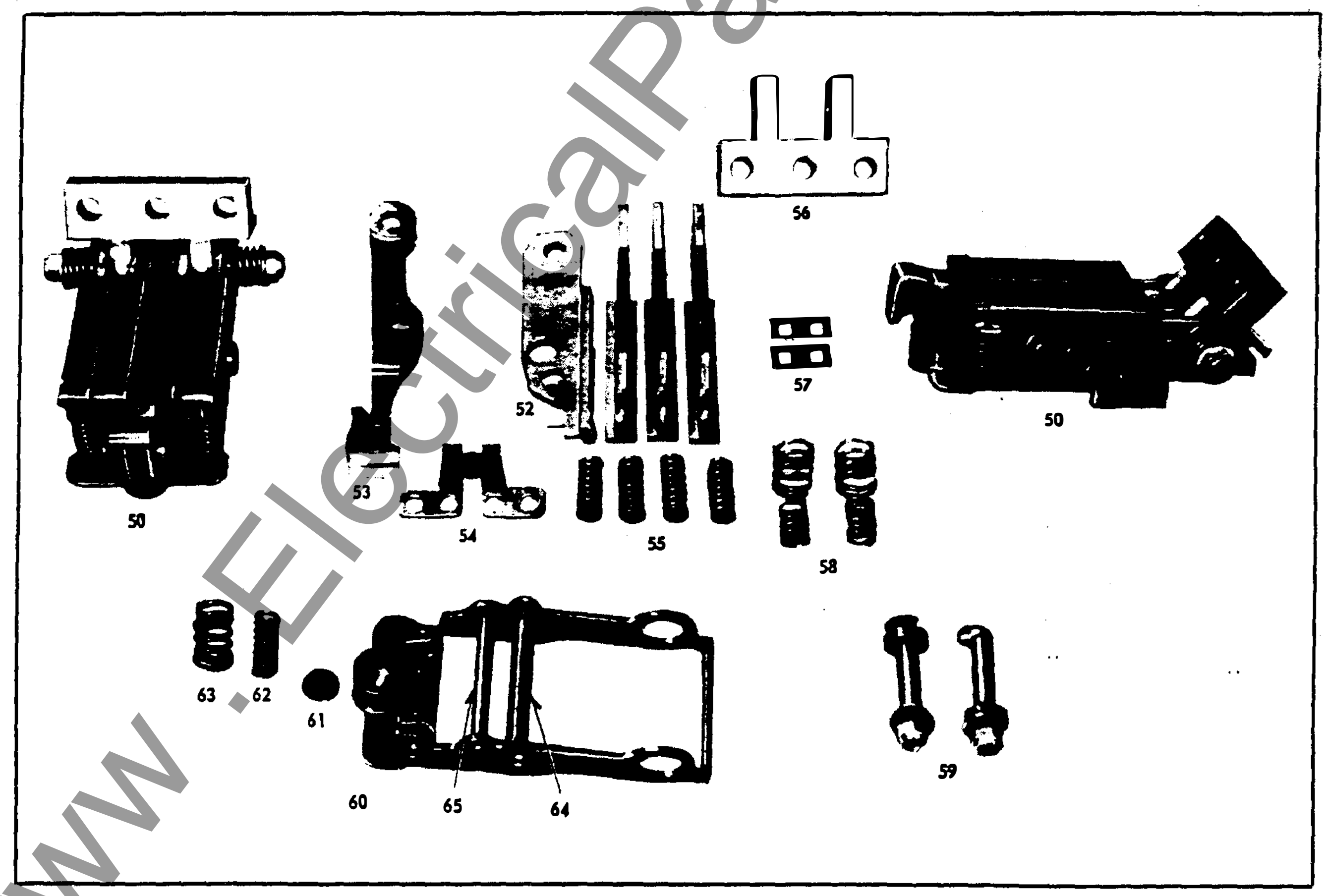


FIG. 9. Moving Contact Details

FIG. 10. Use of Locking Bar

Make certain that the armature does not pull away from the holding magnet as the breaker is closed.

Contact adjustments should be started by checking the compression of the main contact finger springs on each side of the moving contact arm assembly. This can be done by comparing the measurements of dimension L, Fig. 5, with the breaker open and with it closed. The main contact spring compression should be .063 ± .020 as indicated by the difference in dimension L. If these measurements are not within tolerance, open the breaker, loosen the lock nut on the eccentric pin D, Fig. 5, and turn the pin clockwise to ~~increase~~ de the spring compression, or counter-clockwise to In ~~decrease~~ it. In general, only a few degrees of rotation will be required. Lock the eccentric pin and close the breaker to re-check the main contact finger spring compression.

The next adjustment to be checked is the length of the pull rod G, in Fig. 5, which controls the amount that pin C moves over toggle. If pin C moves too far over toggle position, then the contact arm will close and then re-open slightly as the closing handle reaches its final closed position. If pin C does not move far enough, then the breaker will tend to slam open during electrical closing. The pull rod length should be adjusted so that the operator can feel a definite snap as pin C goes over toggle, but cannot notice any return motion of the tip of the moving contact arm.

The pull rod length can be adjusted, if necessary, by loosening the lock nut R, removing pin Q, and rotating the universal joint P to shorten or lengthen the pull rod assembly. The universal joint has R.H. threads. After adjustment, place a screw-driver blade between the frame of the universal joint and the inside of the slot in the closing solenoid plunger to keep the universal joint centered in the slot, and tighten the lock nut R.

The stationary arcing contact should be set last. This can be done by closing the breaker by hand until a 1/8 inch shim can be placed between the main contacts at dimension M, Fig. 5, and moving the stationary arcing contact forward until it just touches the moving arcing contact. Then tighten the mounting bolts on the stationary arcing contact. Re-check the gap between the main contacts to make certain that the 1/8 shim is a snug fit when the arcing tips just touch.

As a final check, the breaker should be tested for electrical closing and for holding coil drop-out. The breaker should close at 95 volts and should not slam out at 130 volts. Slam-out tests should be made with 2 amperes through the holding coil during the closing stroke of the breaker. The closing voltage figures are obtained by measuring the closing coil cold resistance and multiplying it by the measured closing coil current. This method must be used since the closing coil resistance will change due to heating and make measured closing coil voltages meaningless. The closing coil current times the cold coil resistance will give the voltage conditions corresponding to the initial operation of the breaker regardless of the present temperature of the coil. During electrical closing tests, the closing coil should be checked occasionally to make sure that it does not reach temperatures high enough to burn out the coil. This coil is intended for momentary duty only and should not have current applied for more than a few seconds at a time.

The drop-out can be checked by connecting the holding coil to a source of variable direct current. Set the current to one ampere and close the breaker. Reduce the current slowly until the breaker opens. The measured value of current should be within the range of .15 to .40 ampere. If the drop-out current is not within these limits, re-check the breaker adjustments. If adjustments are properly made and the drop-out current is still not within tolerance, the factory should be consulted.

LUBRICATION

All pins and bearing surfaces except the moving contact hinge joint are coated at the factory with molybdenum disulphide. If the breaker linkage is dismantled, the pins and bearing surfaces should be wiped clean and coated with molybdenum disulphide dissolved in carbon tetrachloride and applied with a small brush. The carbon tetrachloride will evaporate rapidly and leave a deposit of molybdenum disulphide on the surface.

The moving contact hinge joint must be lubricated only with a good grade of graphite grease such as WEMCO PDS 1022-1. Do not apply molybdenum disulphide to the moving contact hinge joint, since this lubricant is not a good electrical conductor.

OPERATING IRREGULARITIES

As with any equipment, the proper functioning of the apparatus will depend on the adjustment and care which it receives. Certain irregularities in operation and their possible causes are listed:

Pole Units failing to close

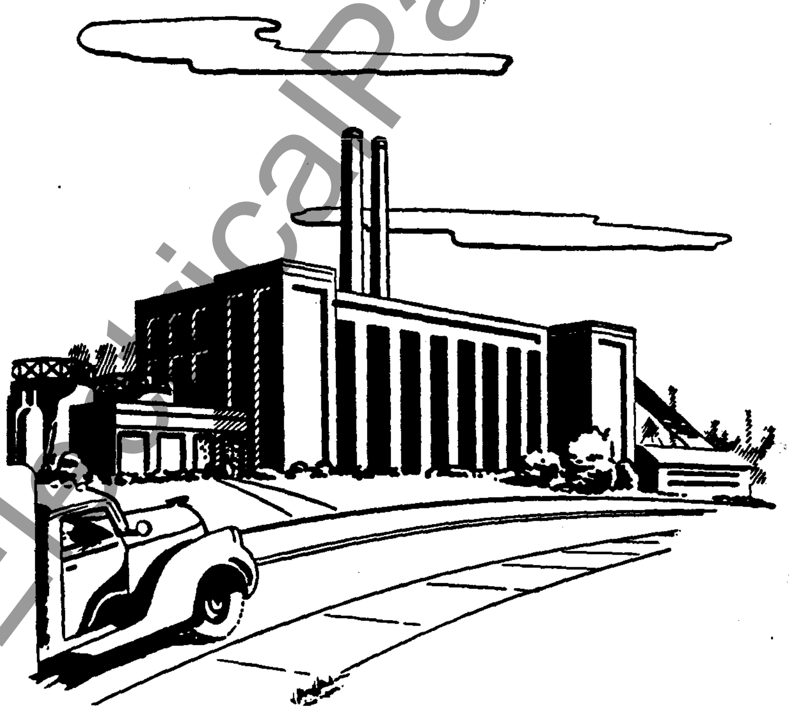
1. Dirt around the closing magnet plunger.
2. Poor connections to the closing coil.
3. Closing coil burned-out.
4. Binding in the auxiliary switch operating arm.

Holding armature fails to hold

1. Dirt under the armature.
2. Armature or holding magnet surface is not flat.
3. Poor connection in the holding coil circuit.

Breaker slams open when closing

1. Holding coil current not increased to 2 amperes during closing.
2. Improper adjustment of toggle links.
3. Faulty holding magnet or armature.



BREAKER PARTS IDENTIFICATION

Figure 6 Reference

Item No.	Part
1	Base
2	Closing Coil
4	Solenoid Core
5	Terminal Block
6	Solenoid Core Guide
7	Auxiliary Switch
8	Veeder Counter Assembly
9	Upright Support (Right Side)
10	Upright Support (Left Side)
11	Frame (Right Side)
12	Frame (Left Side)
13	Rebound Stop (Right Side)
14	Rebound Stop (Left Side)
15	Frame Clamps (Right and Left Side)
17	Retrieve Spring (Solenoid Core)
18	Lifting Hooks

Figure 7 Reference

Item No.	Part
19	Bucking Bar and Lower Terminal
20	Stationary Contact Block
21	Barrier
22	Arc Contact (Stationary)
23	Jackscrew Block
24	Jackscrew
25	Main Contact Block (Stationary)
26	Arc Plate
27	Arc Plate Magnet
28	Bumper Support Casting
29	Bumper Stops
30	Opening Spring Link
31	Opening Spring (Inner)
32	Opening Spring (Outer)
33	Closing Lever
34	Closing Links (Right and Left)
35	Toggle Telescoping Links (Right and Left)
36	Toggle Accelerating Springs (Right and Left)
37	Toggle Yoke
38	Armature Link
39	Armature Bell Crank
40	Holding Coil
41	Holding Magnet
42	Holding Armature
43	Blowout Coil (Left)
44	Blowout Coil (Right)
45	Blowout Coil Jaw Connection
46	Blowout Magnet Core Assembly consisting of Magnet Core, Insulating Plate, Coil Washers, Coil Wedge Plate (not shown) and Back up Plate

Figure 9 Reference

Item No.	Part
50	Moving Contact Assembly
52	Moving Contact Fingers
53	Moving Arc Contact Assembly
54	Contact Shunt
55	Moving Contact Compression Springs
56	Moving Contact Hinge Yoke
57	Moving Contact Spring Insulating Spacers
58	Inner and Outer Hinge Compression Springs
59	Hinge Pin Assembly
60	Moving Contact Support
61	Arc Tip Spring Insulating Spacer
62	Inner Arc Tip Spring
63	Outer Arc Tip Spring

Figure 8 Reference

Item No.	Part
67	Front Arc Horn Spacer (Not used on later models)
68	Arc Chute Deflector (Short)
69	Arc Chute Deflector (Long)
70	Asbestos Shield
71	Deflector Spacer (Long)
72	Deflector Spacer (Short)
73	Rear Arc Horn Assembly
74	Front Arc Horn Assembly
75	Insulating Caps
76	Arc Chute Support Strip (Right)
77	Arc Chute Support Strip (Left)
78	Arc Chute Rear Support Plate
79	External Barrier
80	Arc Plate (Right)
81	Arc Plate (Left)
82	External Shield (Lower Right)
83	External Shield (Lower Left)
84	Ceramic Stack
85	Arc Chute Jacket

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Item No.	Part
87	Rear Vent Baffle
88	Upper and Lower Primary Contacts
89	Arc Chute Retainer & Pole Faces
90	Boot Barrier
91	Manual Closing Handle

Type DMD Air Circuit Breaker

DESCRIPTION

The type DMD breaker is similar to the type DM anode circuit breaker and uses many of the same parts. The principal difference is that the DMD breaker will carry current in either direction and will trip in response to the magnitude of current, while the DM breaker trips upon reversal of current flow. This is achieved by replacing the holding magnet assembly of the DM breaker with an overcurrent tripping device.

Physically, the DMD breaker has two pole units mounted on a truck, while the DM usually has six poles mounted on one truck. Another major difference is the manner in which the current connections are made to the breaker studs. On the DM breaker the current is conducted from the breaker stud to the cell bus by a cluster of bridging fingers held in a retaining ring. On the DMD breaker, the breaker studs overlap the studs from the cell, and the junction is clamped by means of a toggle operated by a lever projecting from the front of the truck. The mechanism is arranged so that all four connections are clamped simultaneously by the one operating lever.

The overcurrent tripping device was designed to operate on the magnitude of current with no intentional time delay. The air gap in the magnetic circuit, indicated by dimension "W" in Figure 11, is approximately 7/16, and is not adjustable. Calibration is obtained by changing the spring load applied to the trip beam. This is done by changing the location of the lower end of the spring which is held by an angle bracket fastened to a slotted plate. This plate has several marks on it which indicate calibrated values of current which is required to trip the breaker.

Interruption of current flow is achieved as indicated in Figure 4 and described on page 6 of the Instruction Book.

The operation of the toggle linkage is exactly the same as the type DM breaker except that a trip lever, item T in Figure 10, is used instead of a holding armature. Adjustment of the toggle linkage to set the contact gaps and provide proper opening speed is described on page 13 of the instruction book. However, there is an error on page 13 in the first paragraph. It should read "If these measurements are not within tolerance, open the breaker, loosen the lock nut on the eccentric pin D, Figure 5, and turn the pin counterclockwise to increase the spring compression or clockwise to decrease it."

SHUNT TRIP

The shunt trip device allows the breaker to be tripped by an electrical impulse from a remote location. The shunt trip is a solenoid device which, when energized, lifts an insulated rod to push on the trip lever and trip the breaker. The shunt trip system is designed with clearance between the various parts. If parts are removed, they should be re-installed so that the extreme travel of the shunt trip solenoid is just sufficient to trip the breaker.

INTERLOCKS

Both breaker pole units should be in the open position before attempting to remove the truck from the cell. As a further precaution, mechanical and electrical interlock arrangements are provided which will trip both breakers before the clamping force is removed from the overlapping stud connections. The mechanical interlock functions through a linkage from the contact operating lever to the trip levers of both breakers. The electrical interlock energized whenever the contact operating lever is lifted slightly and functions by energizing the shunt trip units on each breaker pole unit.

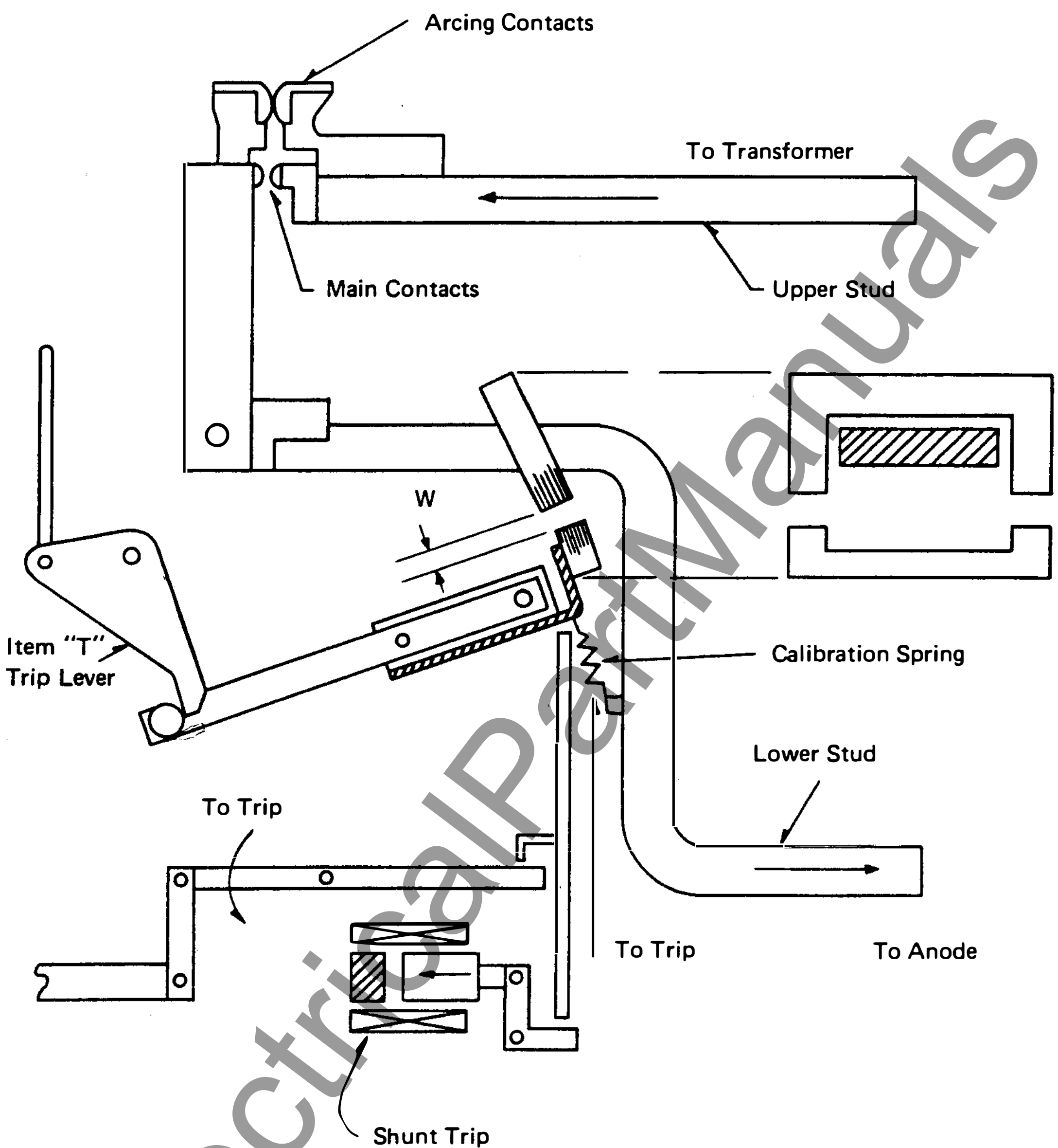

Arcing Contacts
To Transformer
Main Contacts
Upper Stud
W
Item "T"
Trip Lever
Calibration Spring
Lower Stud
To Trip
To Trip
To Anode
Shunt Trip

Figure 11

Type DM2F Air Circuit Breaker

Supplement No. 2
I.B. 32-410-1

The DM2F breaker unit is the same as the DM breaker unit except the breaker studs are modified to use butt type engagement with the cell contacts instead of the finger type engagement, and the lower stud is shaped to go around the holding coil magnetic circuit rather than thru it.

All instructions in I.B. 32-410-1 apply except Fig. 3 is modified as shown in Fig. 11-12 attached. The arrangement shown in Fig. 3 is for tripping on reverse current whereas the arrangement shown in Fig. 12 is for tripping on forward current.

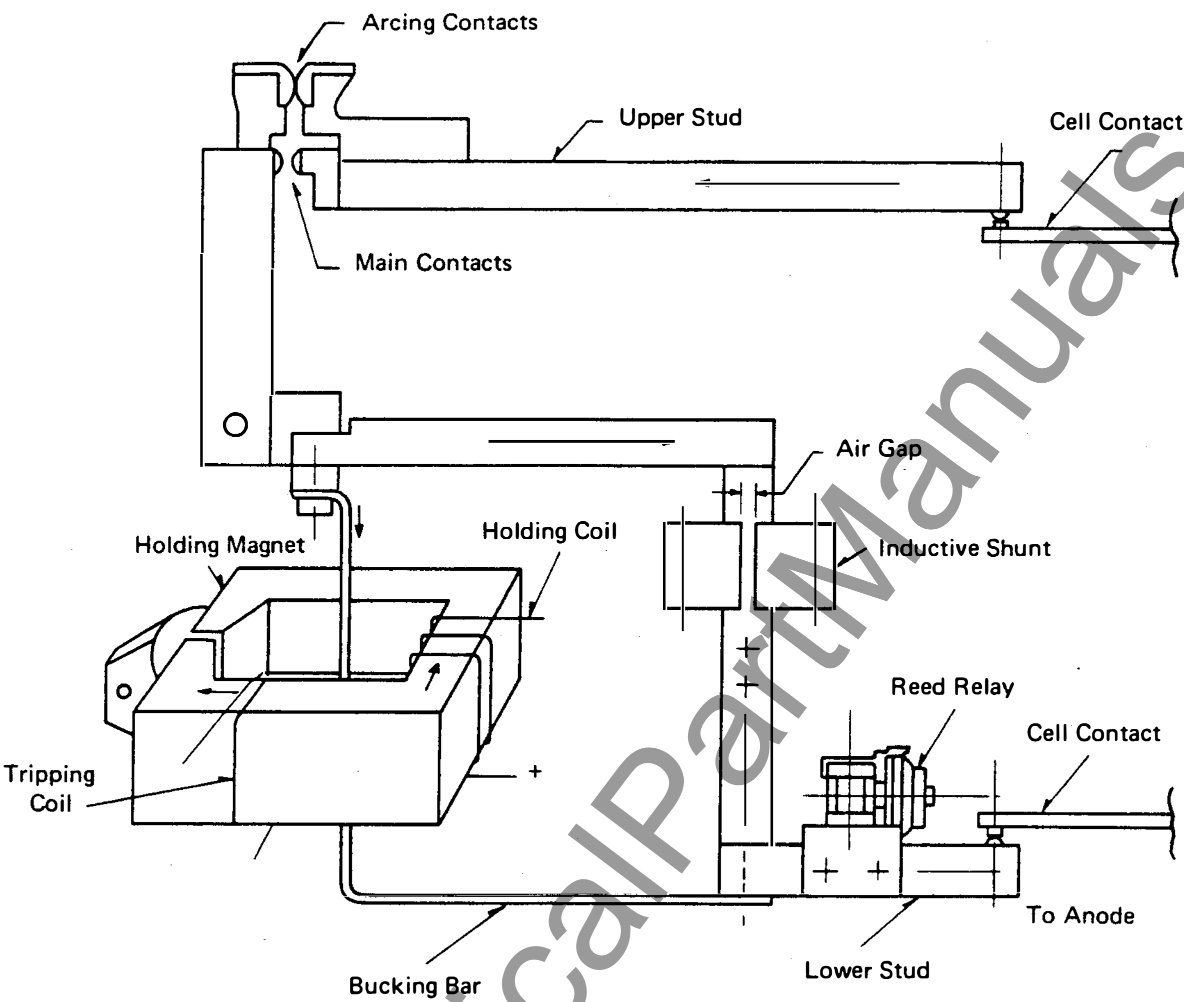
Additional features include a bucking bar-inductive shunt combination to trip the breaker on high rates of rise in the forward direction, such as normally occur on faults; and an overcurrent contact to energize an extra tripping winding on the holding coil spool to trip the breaker on abnormal overloads.

The bucking bar-inductive shunt combination consists of a small bucking bar running thru the holding coil magnetic circuit, and a laminated iron circuit around the lower stud to force additional current thru the bucking bar on high rates of current rise. The current thru the bucking bar under normal conditions is small and has very little neutralizing effect on the holding coil pull. Adjustments are made by changing the inductive shunt air gaps or the number of laminations in the iron circuit. Reducing the gap reduces the rate of rise required for tripping, and increasing the air gap increases the rate of rise required for tripping.

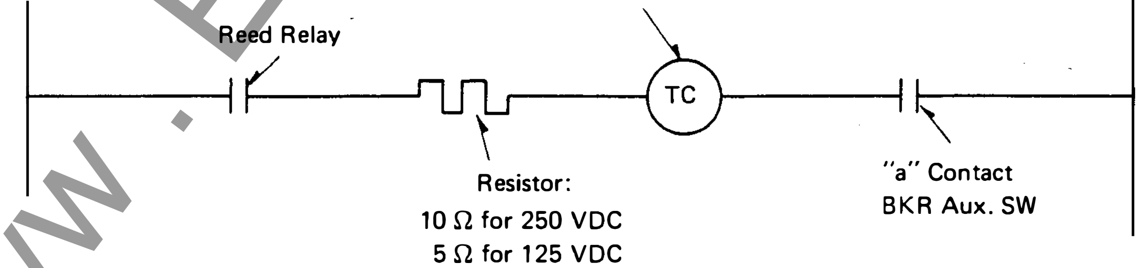
The overcurrent contact is of the magnetic reed type and mounts on the lower stud beyond the bucking bar connection. The pickup current is adjustable within a range of approximate plus or minus 30%. Turning the dial to the right increases the pickup current required and turning the dial to the left reduces the pickup current required. The contact energizes a separate tripping winding on the holding coil spool to neutralize the holding coil pull. Since the tripping current is relatively large (approximately 25 amps) the circuit is run thru an auxiliary switch contact to interrupt the current.

The breaker truck includes either one or two breaker units, the primary contact operating lever to secure the proper pressure of the breaker unit studs against the cell contacts (approximately 100 lbs. operating force required on the operating lever), secondary contacts, a mechanical position indication of the breaker contacts, a mechanical interlocking system to locate the breaker in the proper cell position and an interlock contact to make sure the primary contacts are engaged before the breaker can be closed electrically. Releasing the operating lever will trip the breaker before the primary contacts part.

Refer to Instruction Drawing 502B927 on inside cell wall for detail operating instructions for truck.



Bucking Bar - Inductive Shunt
Fig. 11



Tripping Circuit
Fig. 12