Westinghouse

Type MF
Oil Circuit-Breaker

INSTRUCTION BOOK

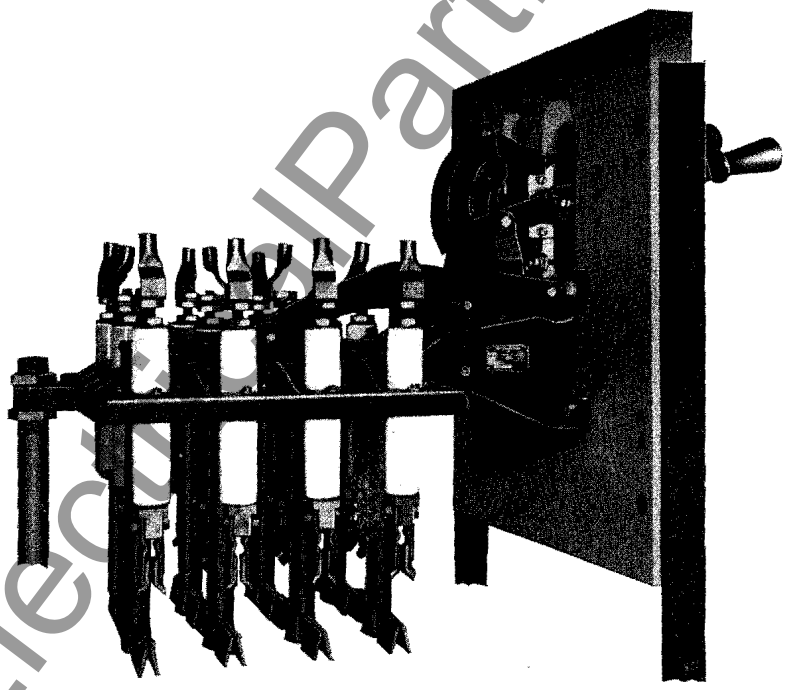

FIG. 1—200 AMPÈRE CIRCUIT-BREAKER, PANEL MOUNTED, TANK REMOVED

Westinghouse Electric & Manufacturing Company
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I. B. 5335-B
(Filing No. 33-000)

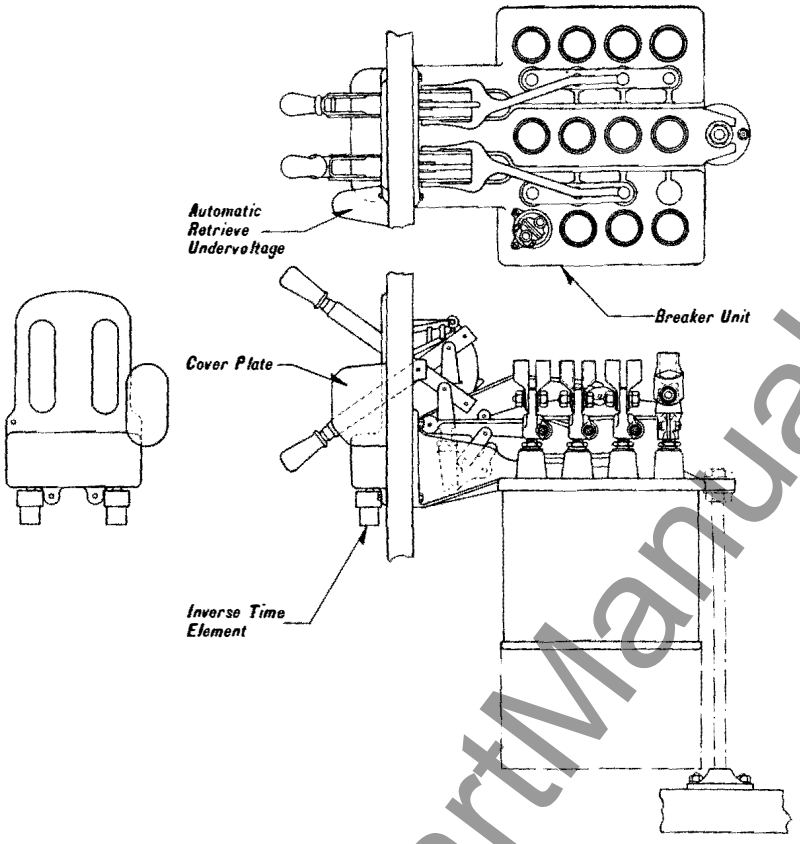


FIG. 2—800 AMPERE CIRCUIT-BREAKER, SWITCHBOARD MOUNTING

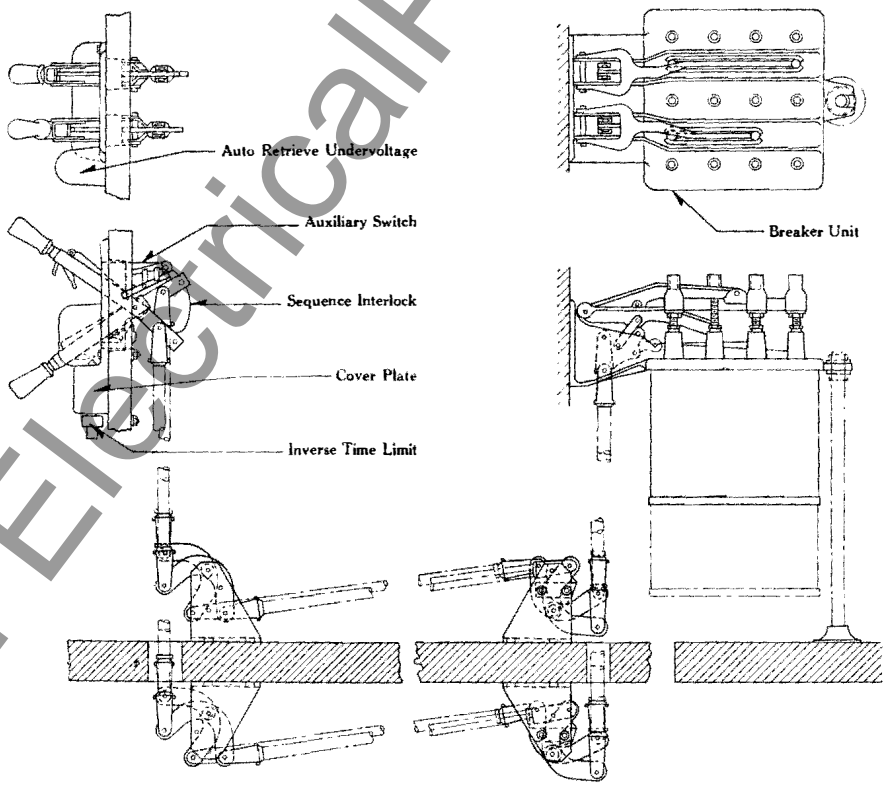


FIG. 3—200 AMPERE CIRCUIT-BREAKER, REMOTE CONTROL

Westinghouse

Type MF
Oil Circuit-Breaker

General

The type MF oil circuit-breaker is especially adapted to starting when used in conjunction with an auto transformer. It is a double-throw breaker, one throw applying reduced voltage to the motor to bring it up to speed and the other throw applying full voltage for running, after the motor has been brought to speed. The breakers are equipped with an automatically retrieved time delay undervoltage release attachment to trip the breaker open upon failure of voltage, and to prevent unexpected starting when voltage is restored. Overload tripping attachments are provided to prevent the motor carrying an overload, which would be injurious to the motor. These overload trip attachments are equipped with inverse time element dash pots, to prevent tripping the breaker on overloads of only momentary duration, or during starting.

Before shipment all breakers, coverplates and attachments are given a thorough test to determine whether their operation is satisfactory.

Shipment

The circuit-breakers with auxiliaries are shipped in unit assemblies; that is, breaker units will be in one box, coverplates with handles will be in another box, bell cranks will be in another, and so on. Each package or box will be marked plainly as to its contents.

Unpacking

Care should be used in unpacking the circuit-breakers and parts, so that small parts are not damaged. Extra precautions should be taken so that the bushings are not damaged.

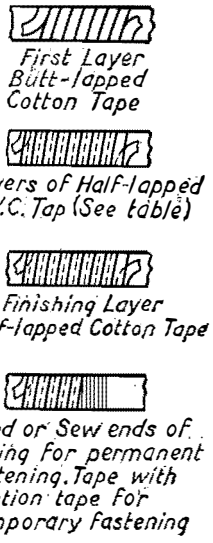
A careful inspection should be made, to insure that no parts were broken or damaged during shipment. In case of damage the proper claims should be made to the transportation company.

Installation

1. Attach the breaker to the supporting structure, first making sure that the structure is level.
2. Remove the tank and examine the inside for evidence of moisture and foreign matter. Flush with insulating oil.
3. Connect the breaker to the operating mechanism. Remove the wire or blocking which holds the breaker in the closed position, and allow the breaker to open slowly.
4. Examine the contacts and note that they are clean and in alignment. For adjustment see section covering adjustment.
5. Operate the circuit-breaker by hand several times, watching each pole and the operating mechanism to be sure all parts move smoothly and freely.
6. When the mechanism is remote mounted, adjust the connections between the breaker and operating mechanism so that full contact is obtained and the breaker rests on the bumpers when in the open position.
7. Install connections to the breaker studs.
8. Insulate the connections with varnished cambric and non-elastic webbing in accordance with Westinghouse Standards for the various operating potentials. See Fig. 4.
9. With the tank removed, fill with Wemco "C" oil to the line marked on the tank or as directed on the breaker name plate.
10. Bolt the tank in place, being sure that it is drawn up evenly all around.
11. Connect the breaker frame, through one of the mounting bolts, to ground. The National Electric Code requires grounding cable to have one-fifth of the main circuit capacity except that it must never be smaller than No. 8 and need not be larger than No. 0, B & S gauge.

Adjustments

Breaker Mechanisms—The toggle mechanism is designed for reversible operation, so that the direction of operation can be changed by a simple change in the position of the operating lever and connecting links. Both assemblies are shown in Fig. 5. To change from one direction of operation to the other the toggle lever and links are assembled as shown. The clearance between the operating links and the stop pin should be approximately $\frac{1}{16}$-inch in either case, when the contacts are in full contact.



Service Volts	Layers of Varnished Cambric Tape
2500	4
4000	5
4500	6
6600	7
7500	8

Wrap the conductor with butt-lapped layer of .007 white cotton tape and cover with one coat of No. 9 insulating varnish (Westinghouse Catalog No. 311). Then wrap with half-lapped layers of .010 varnished cambric tape (Westinghouse No. 1225 Tan Treated Cloth) applying as many layers as given in the above table. Apply a coat of No. 9 insulating varnish (Westinghouse No. 311) between layers. Tape over the cambric with one layer of .007 cotton tape and wrap the ends with cord to keep them in place. Finish with two coats of M-1736 black insulating varnish (Westinghouse Catalog No. 414).

FIG. 4—INSTRUCTIONS FOR TAPING CONNECTIONS

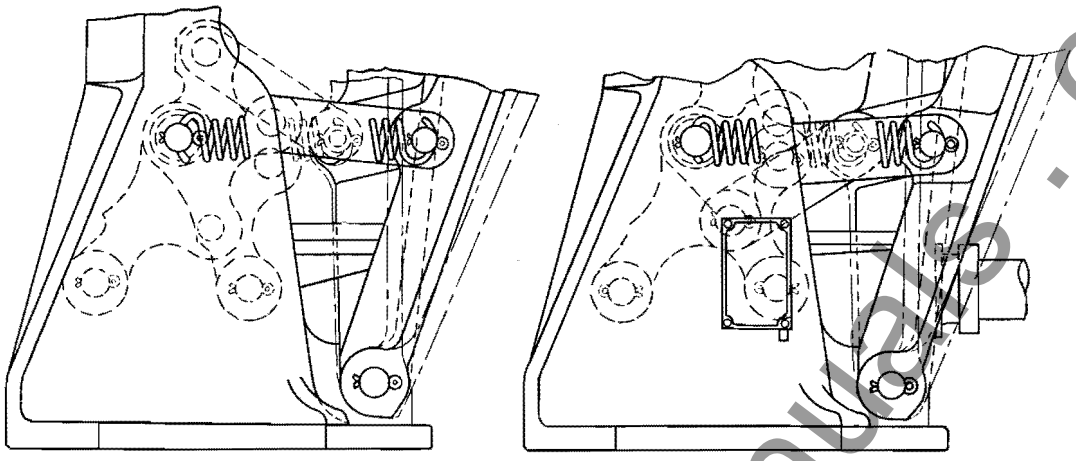


FIG. 5—SHOWING ASSEMBLY OF BREAKER MECHANISM FOR UPWARD AND DOWNWARD PULL

Operation

Points to be observed in operation—

1. Before making any adjustment to an oil circuit-breaker, make sure that all lines leading to it are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively by the electrical operating mechanism when the oil tank is removed.
4. Examine all contacts frequently, especially after severe short-circuits. See that contacts are aligned properly. Replace those badly burned.
5. After making adjustments, operate the breaker carefully by hand to make sure that it operates smoothly and correctly.
6. Inspect the oil regularly and after severe short-circuits. If it shows signs of moisture, carbonization or dirt, filter and retest it before replacing it in service. See that the oil level in the tanks is maintained at the proper height.
7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, terminal bushings, etc., at least once a year.
8. Thoroughly inspect all bolts and nuts—and tighten if necessary. Inspect all pins, links and bearings especially for excessive wear. Check all cotter pins.
9. Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit-breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom of the tank. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil.
10. Arrange for regular inspection to see that the apparatus is in adjustment, the oil is of good quality, and that the complete breaker functions as required. Regular inspection periods pay dividends.

Care of Circuit-Breaker Oil—The care of the insulating oil in circuit-breakers is of the utmost importance in their successful operation. Contamination by dirt, moisture, metallic particles, lint, etc., all reduce the dielectric strength, upon which the operation and current interrupting ability largely depend. Consequently, the most careful attention should be given to keeping the oil clean, not only in filling the tanks originally but in later maintenance or other work on the breakers which might involve opening the tanks.

Only the highest grade, such as Wemco "C" or other approved oil should be used in the breakers. The oil should be new or at least thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured between 1-inch diameter discs spaced .1 inch apart.

Before filling, the tanks should be thoroughly cleaned and flushed out with insulating oil. The same treatment should be given the inside of the top of the breaker and the operating linkage and contact system. In doing this, rags which will leave lint should not be used as this absorbs and holds moisture.

The same care should be used during inspection or maintenance work on the breaker, which should preferably be done only under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank, and entire inside of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil handling will be well repaid in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

Mounting of Switchboard Breaker (on Panel or on Panel Bracket)

Before mounting the coverplate and the breaker to the panel, first assemble the signal switch and bell alarm, if they are ordered, to the coverplate as shown

on Fig. 6. Then place the tripping coils from the overload attachment, if supplied, in the coil box of the coverplate, and mount the coverplate and the breaker to the panel. The breaker should be mounted as nearly level as possible. The nipple supplied with the breaker units should be screwed into the rod end on the rear of the operating handle, the rear supporting pipe put in place and the mechanical set-up will be complete. By adjusting the amount by which the nipple is screwed into the rod end, it is possible to vary the contacts in the breaker. This adjustment should be made in such a way that full contact is obtained in the breaker when the handle is latched closed. In adjusting the breaker special care should be taken to see that the toggle lever is $\frac{1}{16}$ of an inch from the stop in the closed position. See Fig. 5 and instructions under "Adjustments." If this adjustment is not correct, the latch load on the coverplate will be excessive and the tripping attachments may not function properly. With this adjustment correct, the signal switch should make good contact in both the open and closed positions of the breaker. It should be observed that proper contact in the breaker is necessary in order to get proper contact on the signal switch.

When the adjustment of the breaker and signal switch is correct and operating properly, then the tripping cores can be put in place, and the nuts put on which hold them. If an under-voltage release is supplied, it may now be mounted on the coverplate and the leads thrust through the clearance between the coverplate and the panel, and then drawn back through the holes drilled in the panel for the leads.

For mounting other auxiliaries on the switchboard mounting breaker, see description under the heading of "Mounting of the Auxiliaries". (See page 6).

Mounting of Remote Control Breaker

The remote control breaker unit should be mounted in place upon the wall or pipe as nearly level as possible, and the rear supporting pipe put in place. The auxiliary switch and bell alarm contacts, if supplied, should be mounted in the coverplate before the coverplate is mounted on the panel or panel bracket. The coverplate can then be mounted as shown in Fig. 3, with the coils in place in the coil box. The tripping cores can then be put in place on the coverplate and tightened. Here again, if an under-voltage release is used, it may be placed on the coverplate after it is assembled to the panel by pushing the leads through the clearance between the coverplate and the panel, and pulling them through the drilled holes in the panel. All connections should be made after the mechanical assembly is complete. The coverplate and breaker units should then be connected together with operating rods through the bell cranks as shown in Fig. 3.

The connecting pipes are $\frac{3}{4}$-inch x-strong pipe, and should be cut 4 inches shorter than the distance between fulcrums of the levers to be connected. These pipes should be threaded $2\frac{3}{4}$ inches on each end with $\frac{3}{4}$-inch straight pipe thread. A $\frac{3}{4}$-inch pipe lock nut should be put at one end or the other of each pipe, with the exception of the

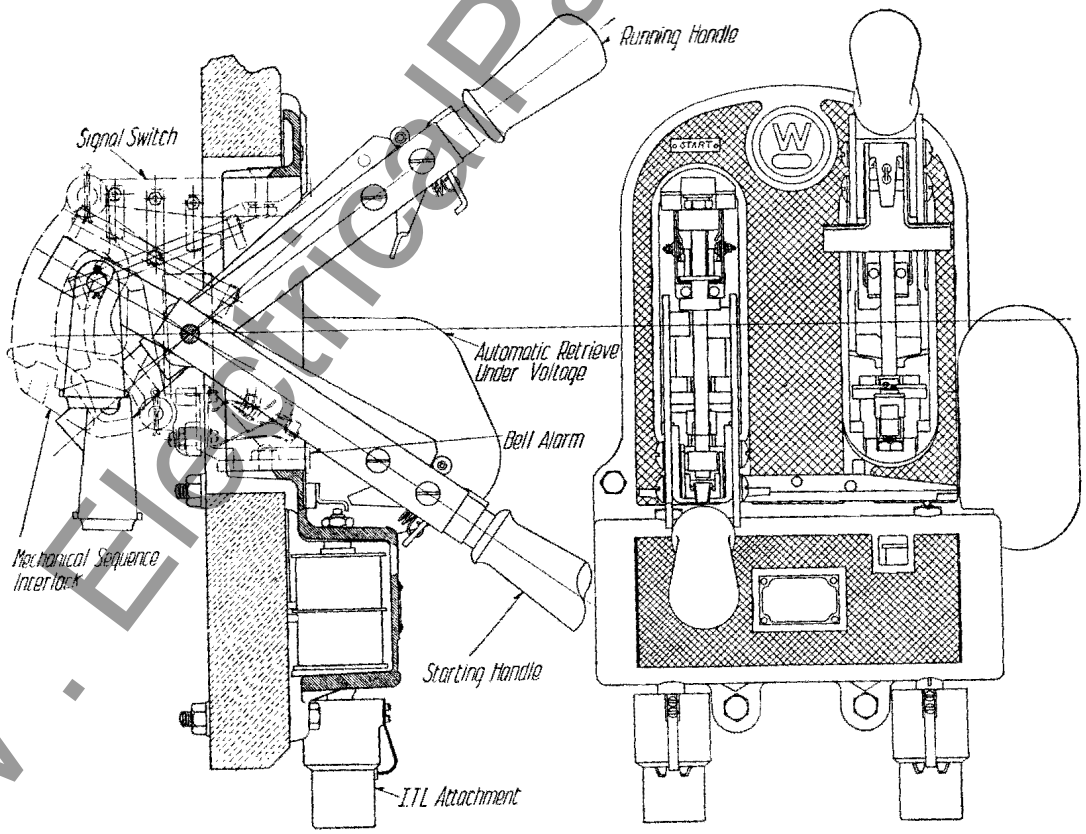


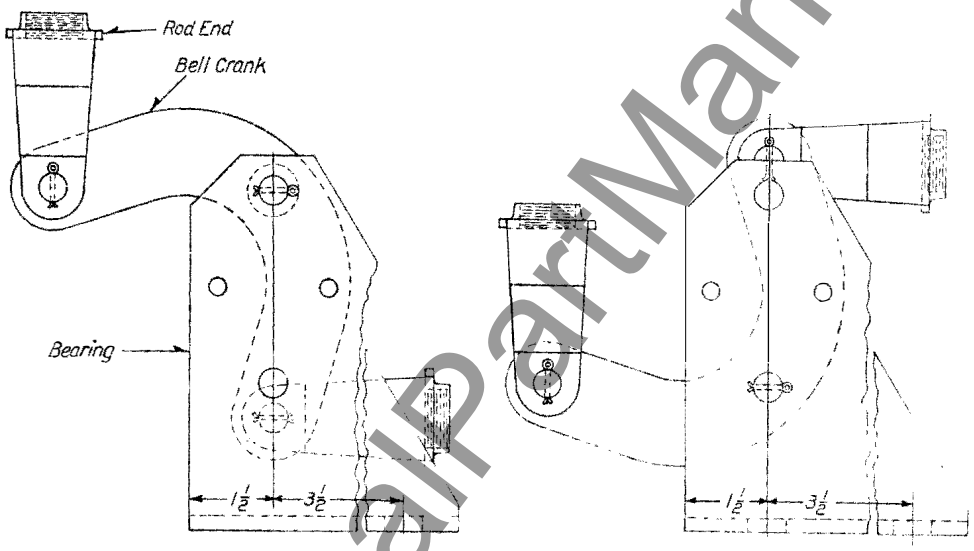
FIG. 6—DOUBLE HANDLE COVERPLATE FOR MOTOR STARTING EQUIPMENT

breaker unit end. A pipe nut should never be used on the breaker unit end. The length of the pipe should be adjusted so that the travel of each crank lever is approximately equal on each side of the horizontal or vertical center line. The last length should be adjusted so that with the handle in the latched position, the contacts in the breaker are making full contact, as previously described. With proper adjustment on the breaker contacts, it will be observed that proper contact is secured on the signal switch if one is used. The bell cranks as supplied are for mounting above the floor. If it is desired to mount the bell cranks below the floor, it is necessary to reverse them. To reverse the bell cranks, remove the fulcrum pin and replace it in the lower hole. To reverse the accelerating device, it is necessary to remove the fulcrum pin and to replace it in the upper hole. It is also necessary to change the accelerating spring on the accelerating device. See Fig. 7.

Any length of pipe exceeding 12 feet should have an intermediate support. The operating rods should all be in tension except the one next to the breaker, and in applications where this vertical rod is long enough, to cause buckling under strain of closing the breaker, it will be necessary to reverse the accelerating device and also to reverse the toggle in the breaker so that this rod will be in tension instead of compression. To reverse the toggle in the breaker the toggle lever should be reversed and the toggle links connected to the hole in the other end of the toggle lever. The contacts should always be checked after making this change, as it may be necessary to re-adjust the connecting pipes. This will cause the toggle to close the breaker with a downward motion of the operating rod. See Fig. 5.

Mounting of the Auxiliaries

Electric Lock-out Device—The electric lock-out device mounts on the rear



Bell Crank Showing Assemblies for Above and Below Floor Mounting

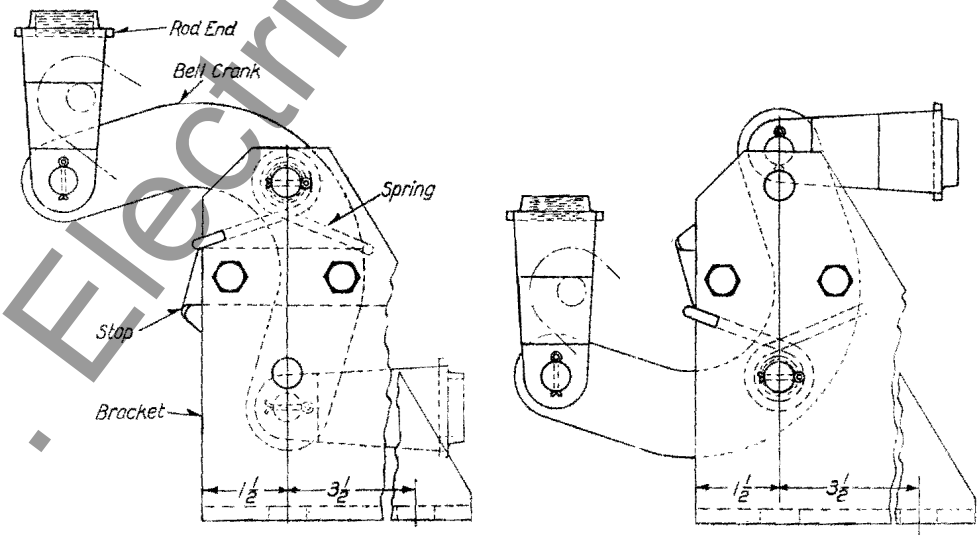


Fig. 7—Accelerating Device Showing Assembly for Above and Below Floor Mounting

of the panel, and is attached to the coverplate as shown in Fig. 24. It is necessary to take out the fulcrum pin of the coverplate and remove the two washers which space the handle on either side from the lugs on the coverplate. The steel piece of the electric lock-out device occupies space left by the removal of the washer. The lock-out device can then be mounted as shown, and the set screws tightened so that it is held rigidly in place. It should be observed that the armature moves freely, and that with the armature closed, the handle has clearance to pass; while with the coil de-energized, and the armature open the lug is over the trip lever of the handle and successfully prevents it from closing.

Mechanical Interlock—When the two handles of a double-handle coverplate are to be interlocked so that only one can be closed at a time, the mechanical interlock is used. See Fig. 25. In order to mount this attachment, it is necessary to remove the fulcrum pin from the coverplate handle, and take off the spacing washer for the handles on the side next to the coverplate with which it is to be interlocked. Then the mounting brackets of the interlock may be placed on the coverplate as shown in the picture, and all screws tightened. It will be found that to put the brackets on first and to insert the interlock bar in place after the brackets are lined up will make the assembly easy. It should be observed that the interlock bar moves freely and is returned to the neutral position by the spring when the handle releases it.

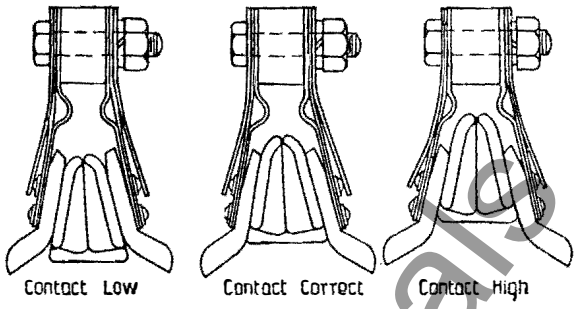


FIG. 8—CONTACT ADJUSTMENT

The movement of one handle to the closed position should move the interlock bar over the other handle so that it locks on the straight part of the bar and not the beveled part. Adjustment is provided so that the length may be altered when assembling. When this interlock is used in addition to a lock-out device on one of the handles, a hole in the mounting bracket of the electric lock-out device takes the interlock bar and one of the interlock mounting brackets should be omitted. If for any reason the interlock bar does not move freely, it will be necessary to properly line up the holes in which it is supported. This can be done by loosening the coverplate mounting bolt and moving the coverplate bodily to alignment. In very extreme cases it may be found necessary to file the top lug of the mounting bracket to line up.

Mechanical Sequence Interlock—The mechanical sequence interlock can be mounted on a double-handle coverplate only. The brackets for the sequence interlock are held in place by a special pin which replaces the fulcrum pin of the handles, omit spacing washers for handle on one side of each handle only. The adjusting screws at top and bottom should be adjusted so that there will be no binding between the cam-shaped slot and the interlock pins on the coverplate lever. The interlock pins replace the standard pins for the rod ends. See Figs. 18 to 23.

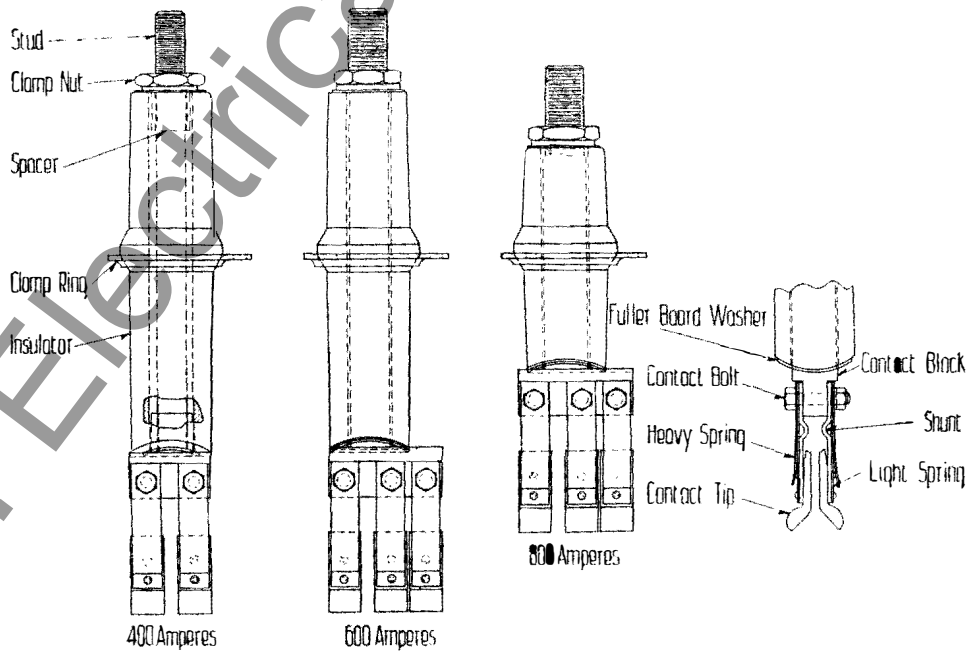


FIG. 9—STATIONARY CONTACTS

Undervoltage Release Attachment—The hand retrieved undervoltage release attachment mounts on the left hand mounting bolt of the coverplates. It is necessary to remove this bolt and to put it in from the rear of the panel, screwing it into the undervoltage cover. Tightening the two undervoltage release mounting bolts clamps the undervoltage release tightly in the proper position. After it is completely mounted, operate it a few times by hand to see that the movement is free and that it operates properly. See Fig. 26.

The automatic retrieve undervoltage release mounts on the right hand side of the coverplate in a similar manner. It is necessary to bolt a reset pin to the trip lever of the coverplate to operate this device. See Fig. 13.

Other Tripping Devices—The **overload trip,** the **shunt trip,** and the **overload trip with dashpot,** as well as the **direct trip attachment,** mount on the coverplate by passing the core up through from the bottom into position in the coverplate and then securing it there by means of one nut. With the direct trip attachment, it is necessary that the leads from the lower coils be taken through the panel immediately below the coverplate. However, the tripping cores with the dashpot or direct trip below, should not be mounted on the coverplate until the mechanical installation is complete. This is necessary in order that all the bolt heads will be easily accessible.

Signal Switch and Bell Alarm—As indicated above, it is necessary to mount the signal switch and bell alarm in position on the coverplate as shown in Fig. 6, before the coverplate is put on the panel, otherwise it would be very difficult to tighten the screw which clamps it in position. This attachment is mounted in the coverplate by a flat-head machine screw.

Connections

After the breaker has been assembled, with its operating handle and auxiliaries as described above, the electrical connections should be made in accordance with the diagram furnished for the complete installation, if covered by a complete diagram, or in accordance with the diagram furnished in this instruction book. The main leads should be carefully soldered into the cable terminal furnished with the circuit-breaker. In case copper strap connections are to be used, they should be carefully grained before putting on and the contact nuts should be drawn down so as to bear evenly over their entire area. The lower contact nut should not touch the upper clamping nut of the bushing. The connection should have an area of not less than that given by the National Electric Code tables on allowable carrying capacity of wires and cables. After fastening in the main leads, the terminals should be insulated with tape or insulating tube. See Fig. 4 for taping instructions. Good engineering practice demands that all terminals on circuit-breakers be insulated.

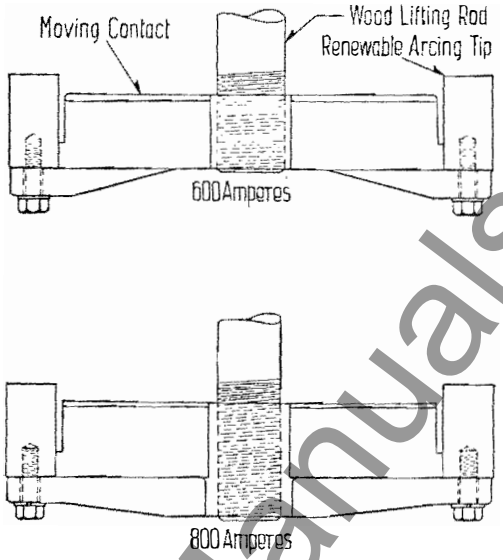


FIG. 10—TYPE MF-22, MOVING CONTACTS

Description and Adjustments of Auxiliaries

Coverplate—The coverplate contains the operating handle with space for overload coil, auxiliary switch, bell alarm, undervoltage and other auxiliaries. The running operating handle is in twoparts. The trip lever is attached to the breaker unit through a rod at the rear of the panel and engages the trigger in the handle lever on the front of the panel. The handle trigger holds the handle lever down after the circuit-breaker has been closed by pushing the handle. The auxiliaries will operate to disengage the trigger from the trip lever. Raising the handle disengages the handle trigger and permits the breaker unit to open.

The moving contact for the 200 ampere and 400 ampere breakers is a punched piece of copper, which is clamped rigidly to the welded end of the wood lifting rod. The moving contact of the 600 ampere and 800 ampere breakers is a heavy copper casting, fastened on the threaded end of the lifting rod. It has a renewable arcing tip of solid copper, which has a very high thermal capacity and reduces the burning, due to arcing, to a minimum.

All of the arcing on the 600 ampere and 800 ampere breakers takes place on this arcing tip and when it has been badly pitted due to the opening of very heavy short circuits, it should be replaced by a new arcing tip, and the pair of fingers which makes contact on it should also be renewed.

The latches are removed from starting handle side so that it is impossible to leave the motor running on starting voltage.

Undervoltage Release—The hand retrieve undervoltage release must be connected so as to leave the coil deenergized when the circuit-breaker is open. This may be done by energizing from the load side of breaker or wiring through the signal switch. Upon the reduction of the voltage across the coil to approximately 50 per cent of the normal voltage, the armature will be drawn downward by the tripping springs. The armature will strike the tripping arm which will raise the trigger on the coverplate and allow the circuit-breaker to open. The armature is not reset by the circuit-breaker in opening and must be reset by rotating the retrieving handle to the left before the coil is reenergized.

The coil will burn out if the current is flowing in the coil when the armature is not in the retrieved position. The retrieving handle must be released quickly to secure positive tripping action, in case the undervoltage coil is not energized.

If noise develops, the face of the armature and magnetic circuit should be inspected to see that a good clean seat is obtained when they are together. If necessary to clean this seat be careful to leave it bearing over its entire area. The coils are marked with their style number, the style number of the series resistor and the voltages and frequencies on which they may be used. Reference to these should be made in all correspondence regarding the device. The device is made for use with or without resistor, depending upon whether it is desired to trip the breaker by short-circuiting the undervoltage coil. When this is done it is necessary to have a resistor in the circuit in order that a short-circuit on the control wiring will not be obtained.

A screw adjustment is provided for the opening springs by which it is possible to alter the drop-out point over a considerable range.

The automatic retrieve undervoltage mounts on the right-hand side of the coverplate. Its operation is identical with that of the hand retrieve device except that an additional reset lever and spring are provided which will retrieve the armature to the closed gap position when the breaker opens. When the breaker closes, a pin on the coverplate trip lever engages this lever and holds it back so that the armature is free to trip the breaker. This undervoltage release should be energized from the line side of the breaker.

Overload Release (Fig. 14)—The overload release consists of the parts shown in the picture. The moving core is magnetically drawn against the trip rod which is pushed up against the trigger. The calibration is varied by changing the air gap between the moving and stationary cores, by raising and lowering the calibration screw. The lock nuts must be drawn tight after changing calibration. The calibration setting is indicated by figures on the tube opposite the line on the moving core and corresponds to amperes in the secondary of the current transformer.

If the opening of the circuit-breaker is not desired unless the overload continues, an oil dashpot is attached to the end of the moving core. The calibration is then inscribed on the dashpot and is varied by screwing the pot into the cover. The time is varied by changing the number of the holes in the bottom of the piston uncovered by the diaphragm. Instantaneous tripping is possible because the check valve action of the washer at the time of tripping varies inversely with the amount of overload and directly with the variation in the viscosity of the oil. Fig. 15 shows approximate variations of the time with the variations of the overload and the effect of changed temperature on the standard dashpot oil as supplied with the dashpot.

The values given in Fig. 15 are approximate and will vary somewhat with changes in temperature, and changes in viscosity of the oil. Where a definite time delay is required the delay should be obtained by the use of suitable relays. The oil in the dashpots should be renewed periodically to obtain the best service.

Fill with oil to ¾-inch above the inside bottom surface of the pot, with the plunger removed.

Direct Trip Attachment (Figs. 27, 28)—Two opposed trip coils are added below the overload trip coil when a definite time delay in tripping is desired. The holding coil, the terminals of which are marked 3 and 4, retains the armature which is fastened to the moving core until the terminals to the relay coil are short-circuited. The terminals are marked 1 and 2. The adjusting screw pushes on the balance spring which balances the weight of the moving core and armature and allows the armature to drop just far enough to touch the magnetic yoke when no current is flowing.

All dust and excelsior from packing must be removed from between the magnetic poles in order to permit the

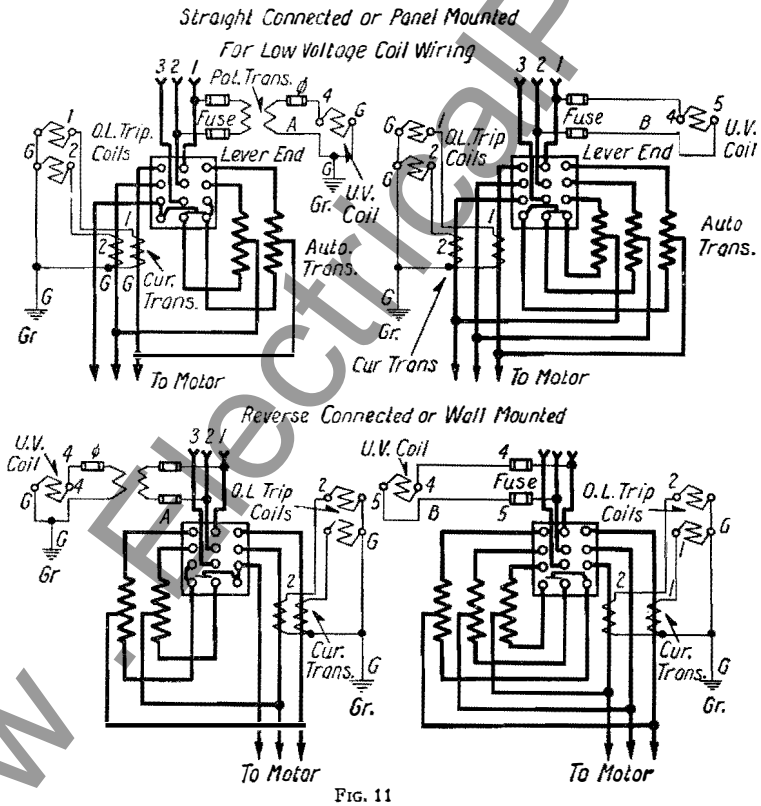
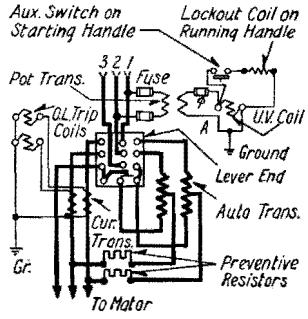


FIG. 11



BREAKER FOR USE WITH PREVENTIVE RESISTOR

armature seating properly. Figure 17 shows the points that should be inspected to detect trouble.

Be sure that the flat armature is making good contact with the holding coil frame at point (b). If surfaces are dirty they should be cleaned off by rubbing lightly with a fine piece of emery cloth.

The flat armature must be able to move freely on the screw at point (a). Do not draw the screw tightly, as it is purposely left free to provide alignment of armature. If the setting of the adjusting screw (c) has been disturbed it should be readjusted until the proper pressure is put on the spring (e). This pressure is determined by the point at which the armature will remain seated when the breaker closes and it will trip when the secondary of the holding coil is short-circuited. After this setting is made and adjusted properly then the lock nut (d) should be tightly fastened.

Auxiliary Switch (Fig. 16)—The auxiliary switch is operated by the trip lever striking the fibre block in between the blades. The switch should be examined occasionally to be sure that the blades are making firm contact in the jaws, that the connections are tight and that the nuts are drawn tight on the clip washers at the hinge jaw.

Bell Alarm Switch (Fig. 17)—The bell alarm switch makes contact only when the handle is drawn down with the circuit-breaker open, as would be the case if tripped by any attachment. The upper block is depressed by the handle side bars and the lower block by the tripping lever. It should be examined occasionally to make sure that the contacts and all connections are secure.

Panel Bracket—The panel bracket is an iron casting with U-bolts to mount it to pipe structure and provided with holes so that the coverplate and breaker, or the coverplate alone, may be mounted on this bracket. It is especially adaptable to mounting the breaker on pipe structures where no panel is required, or where it is desirable to mount the breaker separately from the panel.

Pipe Bracket—The pipe mounting bracket for the breaker consists of pieces of angle iron provided with standard pipe fittings and holes so that the breaker unit is bolted to the angle iron and the angle iron is held to the pipe.

Pipe Structure—The pipe structure as supplied is a simple arrangement made of 1¼-inch pipe and standard switchboard clamps, arranged to support the breaker by means of a panel bracket. It should be assembled with 12 inches

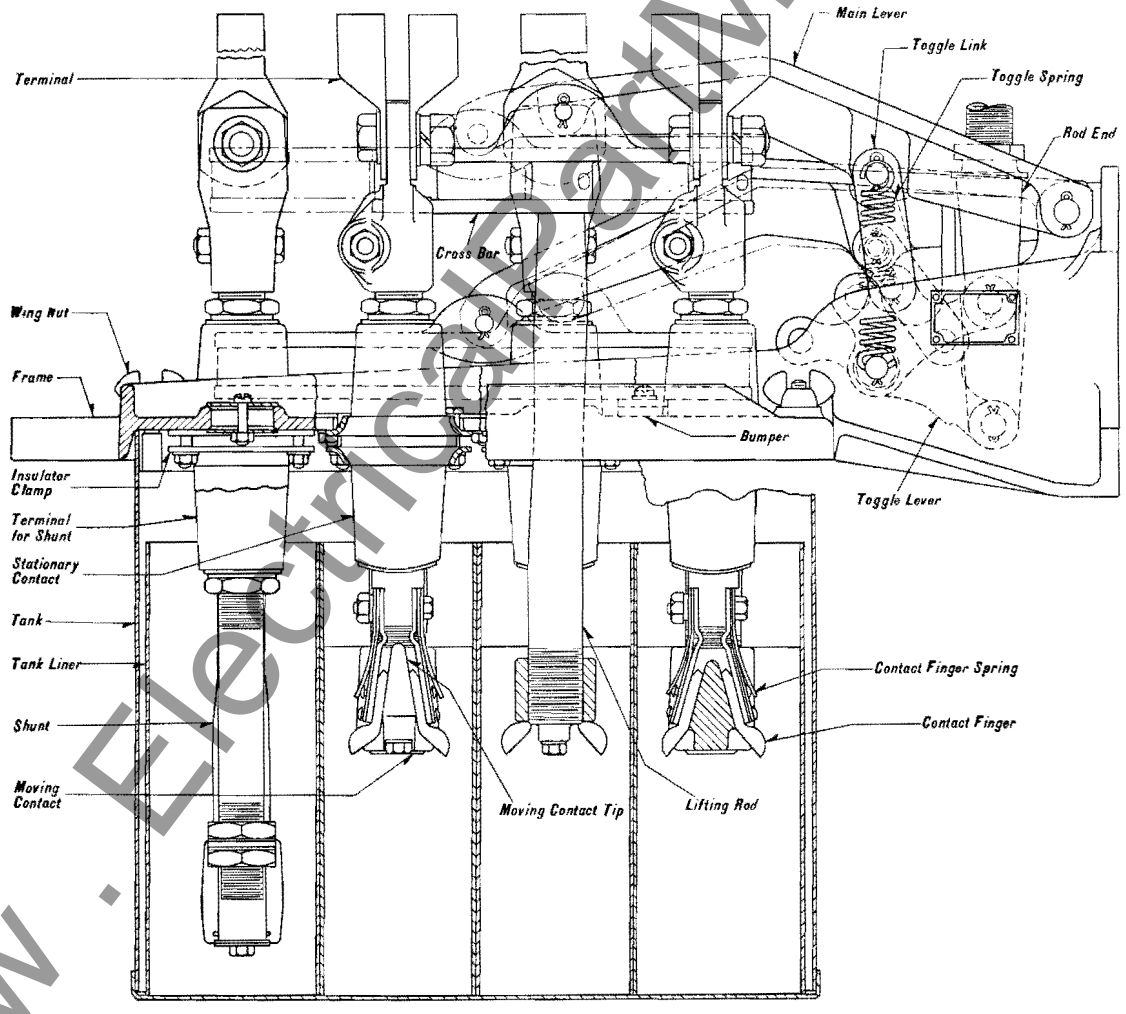


FIG. 12—800 AMPERE CIRCUIT-BREAKER UNIT

of vertical pipe protruding above the horizontal pipe. This projection is for mounting transformers. When transformers are not used this pipe may be cut off.

Panel Frame Mounting Bracket—This bracket is designed for mounting the breaker 4½ inches back of the panel on a pipe structure, with the coverplate mounted on the front of the panel.

Mechanical Sequence Interlock (Fig. 18)—The sequence interlock provides first that both handles cannot be closed at the same time; second, the running handle cannot be closed until the starting handle has been completely opened; third, if the running handle is not thrown in within a very limited period of time after the starting handle is opened, it will be impossible to close the running side without first throwing in the starting side again.

With both sides of the circuit-breaker in the open position, the following operation should take place in putting the motor on the line with full voltage across the terminals. First, the starting handle is closed applying reduced voltage across the terminals on the motor. The upward motion of the starting handle at the upper end of its travel touches the upper projection of the unlocked lever and releases the interlocking casting.

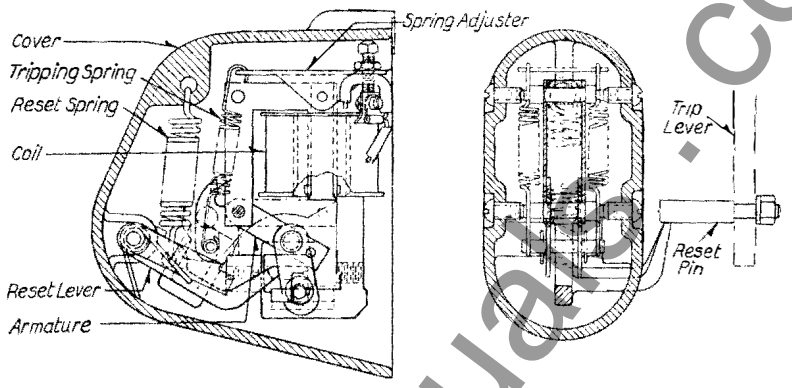


FIG. 13—AUTOMATIC RETRIEVE UNDERVOLTAGE RELEASE

The interlocking casting then rotates on its axis to such a position that when the starting side of the circuit-breaker is open, the starting handle will then strike the unlocking surface of the interlocking casting and withdraw it from in front of the running handle pin and allowing the running handle pin to raise, as would occur if the running side of the circuit-breaker had started to close. Thus it is easy to see that it is impossible to close the running side of the circuit-breaker until the starting side has been fully closed and has reached its full open position. At the opening of the circuit-breaker the interlock castings return to their original positions. The operation of the device can readily be seen by reference to the illustrations. Figs. 19 to 13.

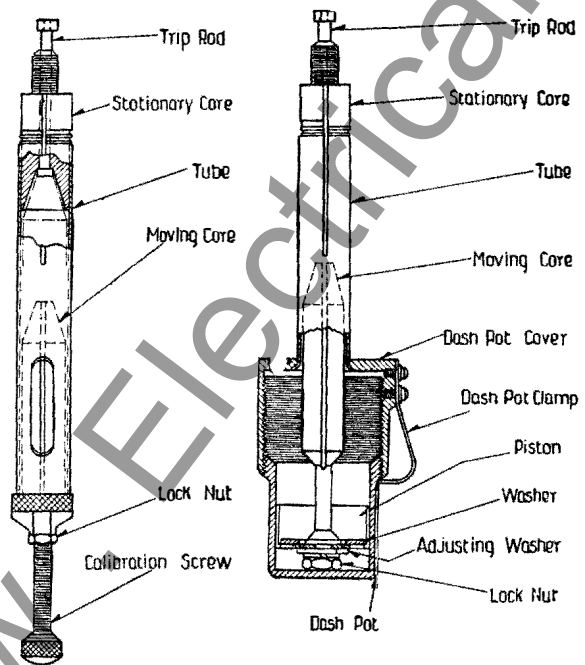


FIG. 14—OVERLOAD RELEASE CORES

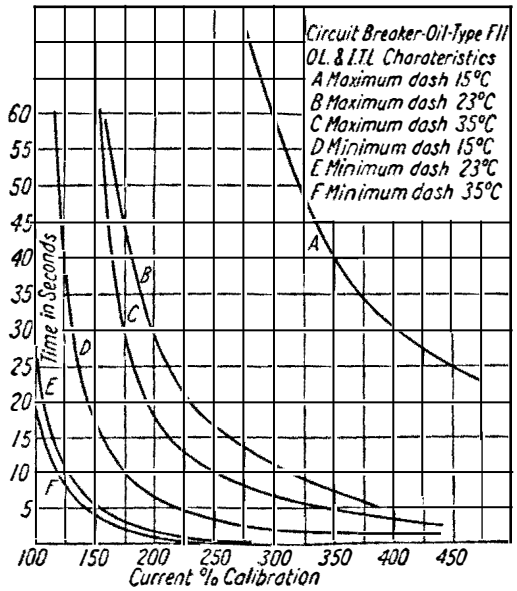


FIG. 15—CALBIRATION CURVE

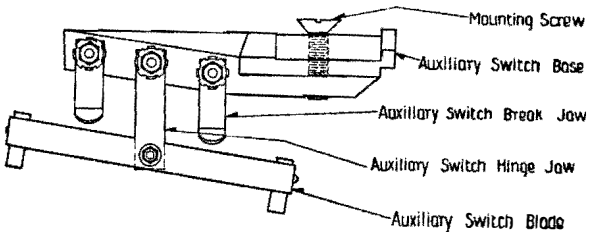


FIG. 16—AUXILIARY SWITCH

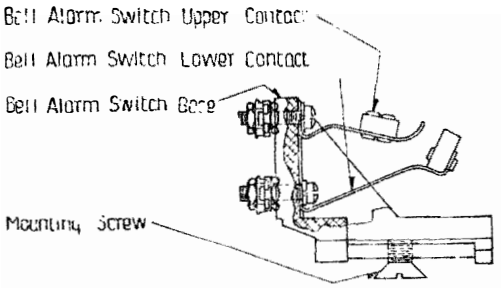


FIG. 17 – BELL ALARM SWITCH

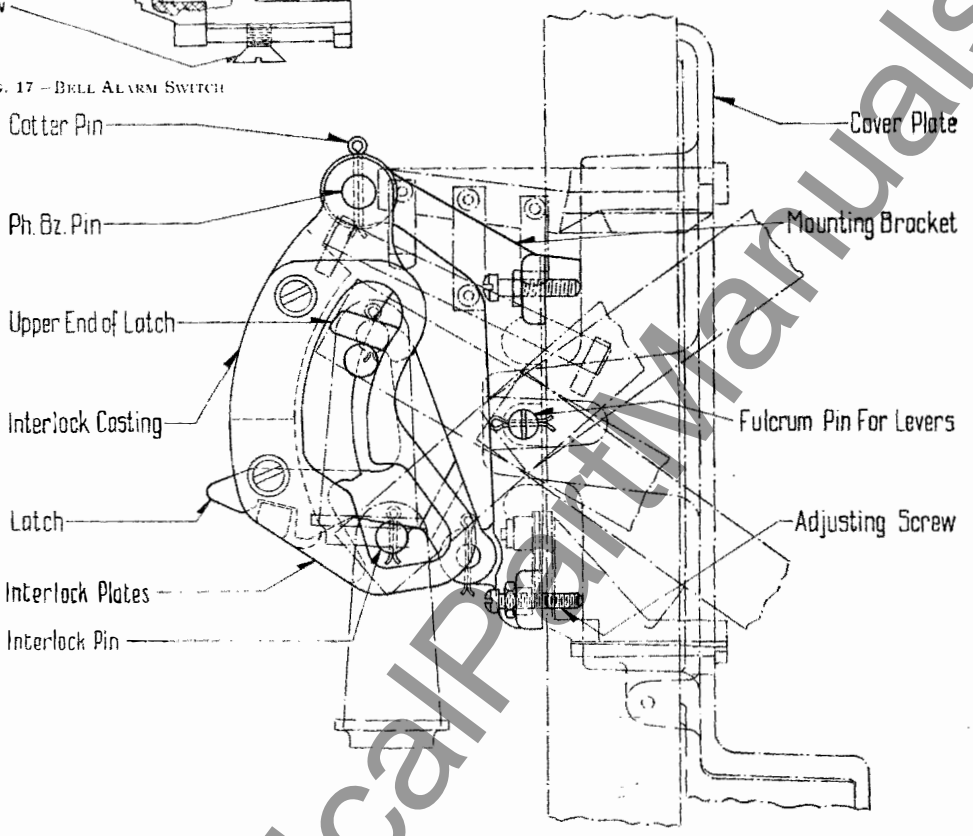


FIG. 18 – MECHANICAL SEQUENCE INTERLOCK

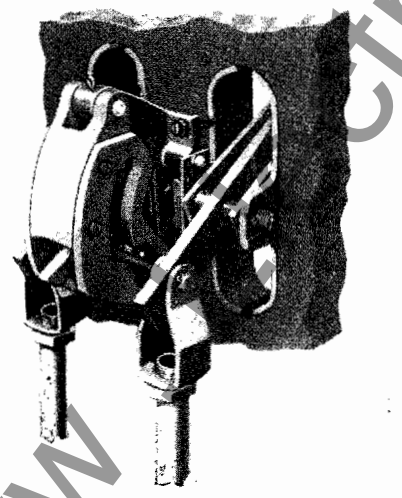


FIG. 19—VIEW OF STARTING SIDE WITH BOTH HANDLES OPEN

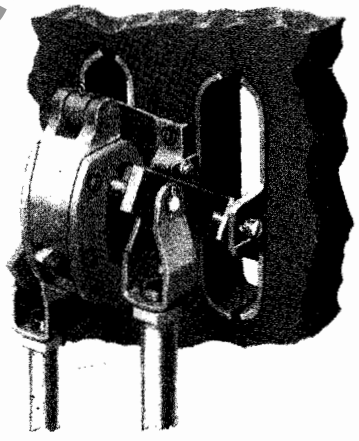


FIG. 20—VIEW OF STARTING SIDE WITH STARTING SIDE CLOSED

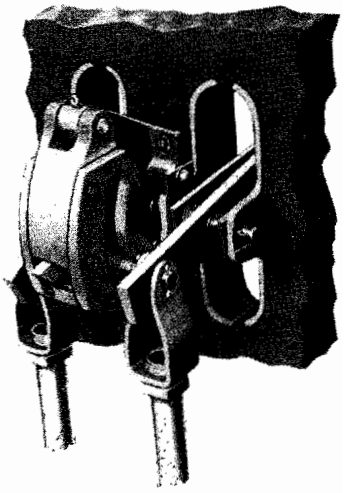


FIG. 21—VIEW OF STARTING SIDE JUST AS STARTING HANDLE IS REACHING ITS OPEN POSITION

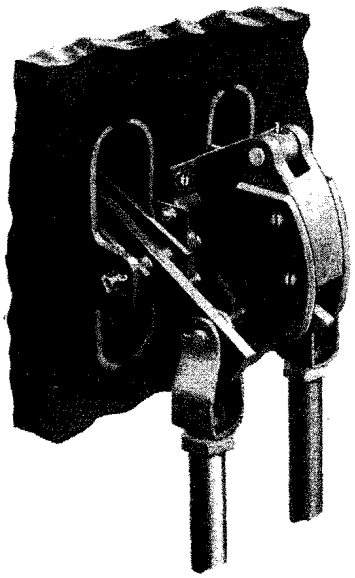


FIG. 22—VIEW OF RUNNING SIDE WITH BOTH HANDLES OPEN

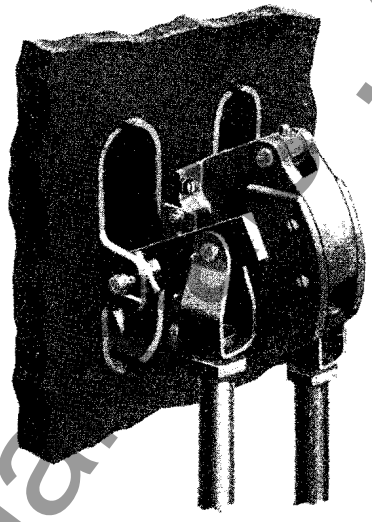


FIG. 23—VIEW OF RUNNING SIDE WITH RUNNING SIDE CLOSED.

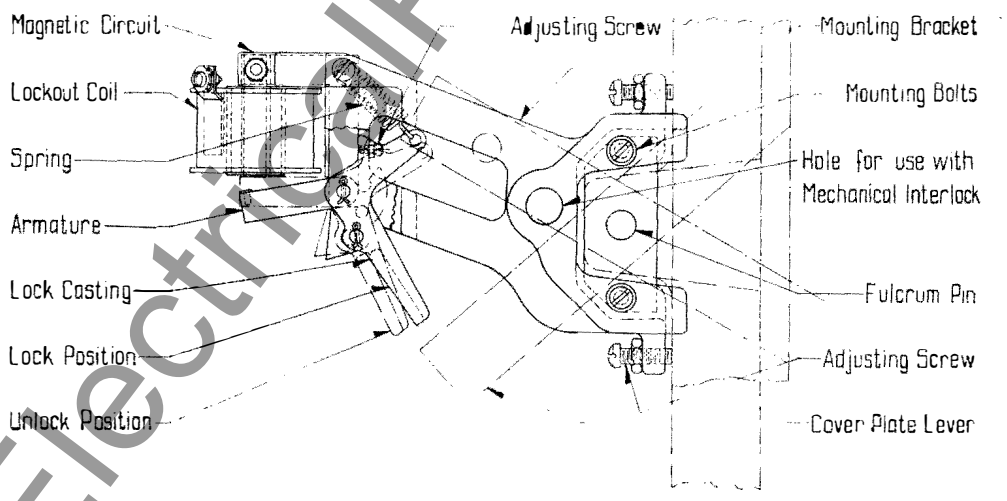
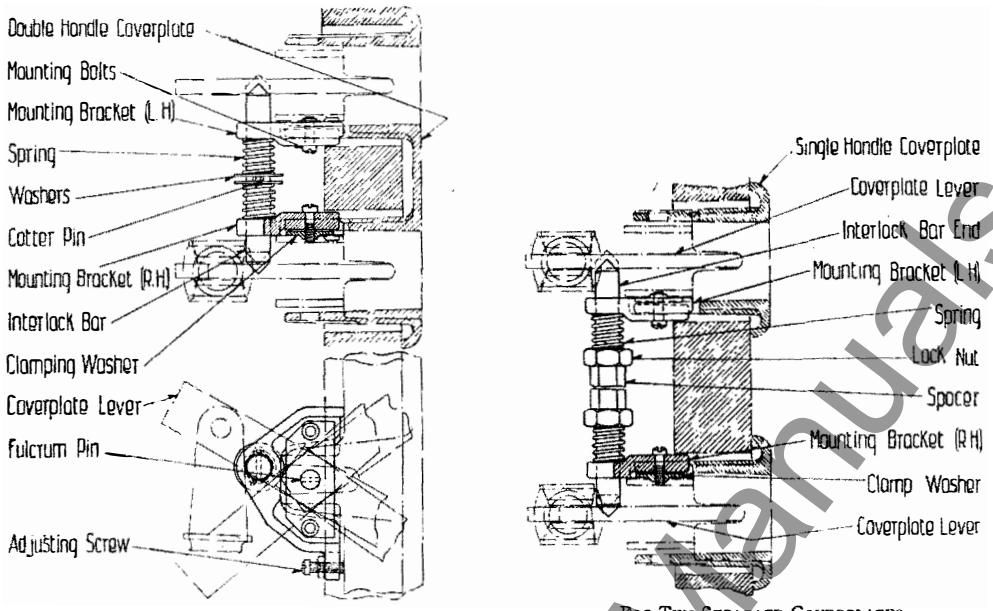


FIG. 24 —ELECTRICAL LOCKOUT DEVICE



FOR DOUBLE HANDLE COVERPLATE — FOR TWO SEPARATE COVERPLATES

FIG. 25—MECHANICAL INTERLOCK

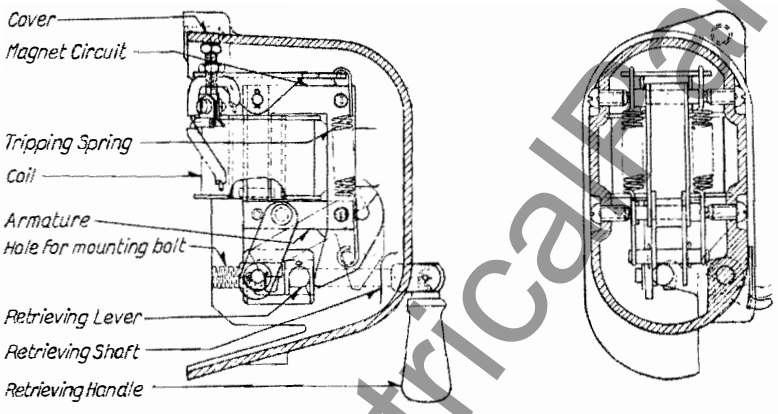


FIG. 26—HAND RETRIEVE UNDERVOLTAGE RELEASE

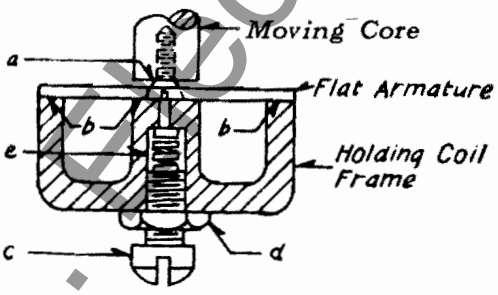


FIG. 28—DIRECT TRIP ARMATURE

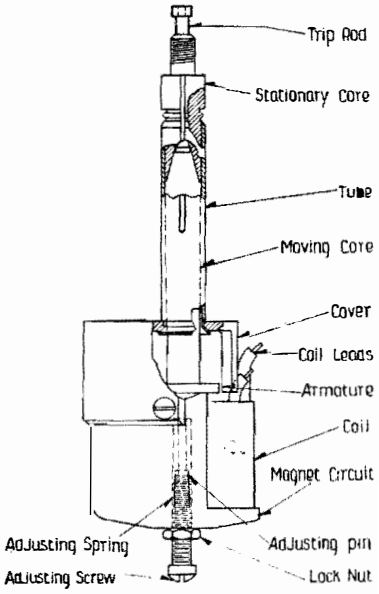


FIG. 27—DIRECT TRIP ATTACHMENT

Renewal Parts Data
Recommended Stock of Renewal Parts
TYPE MF OIL CIRCUIT BREAKER

Indoor Service—Panel or Wall Mounted
Manually Operated—Non-Automatic Trip Starting—Automatic Trip Running
200 or 400 Amperes—5000 Volts—600 Amperes—7500 Volts—800 Amperes—2500 Volts—3 Pole—Single Throw—Running—4 Pole—Single Throw—Starting
This list covers the minimum amount of renewal parts that should be carried in stock.
Breakers in use up to and including 2, 5 and 15 breakers.
For illustration of parts see Figures 5, 9, 11, 13, 14, 15 and 16

Description of Part	STYLE NUMBERS — AMPERES 200	400	600	800	200 Amperes Figure 13 — No. Req.	Breakers in Use 1 (Recommended for Stock)	5	400 Amperes Figure 13 — No. Req.	Breakers in Use 1 (Recommended for Stock)	5	600 Amperes Figure 14 — No. Req.	Breakers in Use 1 (Recommended for Stock)	5	800 Amperes Figure 14 — No. Req.	Breakers in Use 1 (Recommended for Stock)	5
Breaker Complete—Direct Control, Panel Mounted	438 580	438 581	438 582	438 583	1	0	0	1	0	0	1	0	0	1	0	0
Breaker Complete—Remote Control, Wall Mounted, Direct Connected	438 584	438 585	438 586	438 587	1	0	0	1	0	0	1	0	0	1	0	0
Breaker Complete—Remote Control, Wall Mounted, Reverse Connected	438 588	438 589	438 590	438 591	1	0	0	1	0	0	1	0	0	1	0	0
Breaker Unit Complete—Direct Control, Panel Mounted	438 572	438 573	438 576	438 577	1	0	0	1	0	0	1	0	0	1	0	0
Breaker Unit Complete—Remote Control, Wall Mounted, Direct Connected	438 572	438 573	438 576	438 577	1	0	0	1	0	0	1	0	0	1	0	0
Breaker Unit Complete—Remote Control, Wall Mounted, Reverse Connected	438 574	438 575	438 578	438 579	1	0	0	1	0	0	1	0	0	1	0	0
Bumper	300 743	300 743	496 019	496 019	8	2	4	8	2	4	8	2	4	8	2	4
Toggle Spring	315 770	315 770	315 770	315 770	4	1	2	4	1	2	4	1	2	4	1	2
Moving Contact Complete	... ...	... ...	... ...	... ...	7	0	0	7	0	0	7	0	0	7	0	0
Lift Rod	472 816	472 816	478 670	... ...	7	1	3	7	1	3	7	1	3	..	..	..
Lift Rod—Starting	... ...	... ...	... ...	478 670	..	..	..	..	..	..	..	..	..	4	1	2
Lift Rod—Running	... ...	... ...	... ...	472 855	..	..	..	..	..	..	..	..	..	3	1	2
Moving Contact	300 751	300 751	472 856	... ...	14	4	7	14	4	7	7	1	4	..	..	..
Moving Main Contact—Starting	... ...	... ...	... ...	472 856	..	..	..	..	..	..	..	..	..	4	1	2
Moving Main Contact—Running	... ...	... ...	... ...	478 669	..	..	..	..	..	..	..	..	..	3	1	2
Moving Arcing Contact	... ...	... ...	328 470	328 470	..	..	..	..	..	..	14	14	28	14	14	28
Moving Contact Shunt	439 089	439 090	439 091	439 091	1	0	1	1	0	1	1	0	1	1	0	1
Stationary Contact—Single	... ...	... ...	439 082	439 082	..	..	..	..	..	..	4	0	2	4	0	2
Stationary Contact—Double	... ...	... ...	439 083	439 084	..	..	..	..	..	..	3	0	2	3	0	2
Stationary Contact—Shunt	... ...	... ...	439 086	504 598	..	..	..	..	..	..	3	0	2	3	0	2
Stationary Contact—Starting	... ...	... ...	439 085	439 085	..	..	..	..	..	..	1	0	0	1	0	0
Stationary Contact—Running	300 730	300 732	... ...	... ...	7	0	2	7	0	2	..	..	..	..	..	..
Stationary Contact—Center #1, 2 and 3 Pole	300 731	424 124	... ...	... ...	3	0	2	3	0	2	..	..	..	..	..	..
Stationary Contact—Center #4 Pole	439 087	439 088	... ...	... ...	1	0	0	1	0	0	..	..	..	..	..	..
Porcelain Insulator	300 725	... ...	328 480	328 480	11	2	6	..	..	..	11	2	6	11	2	6
Porcelain Insulator for S# 300732, 424124	... ...	300 725	... ...	... ...	..	..	..	10	2	5	..	..	..	..	..	..
Porcelain Insulator for S# 439088	... ...	282 653	... ...	... ...	..	..	..	1	0	1	..	..	..	..	..	..
Stationary Contact Finger	424 123	424 123	328 455	328 455	28	28	56	56	56	112	68	68	136	68	68	136
Stationary Contact Finger Spring	300 726	300 726	751 540	751 540	28	14	28	56	28	56	136	68	136	40	20	40
Stationary Contact Finger Spring—Short	... ...	... ...	825 671	825 671	..	..	..	..	..	..	28	14	28	28	14	28
Stationary Contact Finger Spring—Ruuning	... ...	... ...	... ...	1 017 454	..	..	..	..	..	..	..	..	..	96	48	96
Shunt Terminal	439 092	439 093	439 094	439 094	1	0	0	1	0	0	1	0	0	1	0	0
Porcelain Insulator	282 653	282 653	300 367	300 367	1	0	1	1	0	1	1	0	1	1	0	1
Oil Tank	439 035	439 035	439 036	439 036	1	0	0	1	0	0	1	0	0	1	0	0
Tank Liner—#1 and 3 Pole	496 018	496 018	478 671	478 671	2	0	1	2	0	1	2	0	1	2	0	1
Tank Liner—#2 Pole	496 016	496 016	472 853	472 853	1	0	1	1	0	1	1	0	1	1	0	1
Tank Liner—#4 Pole	496 017	496 017	478 672	478 672	1	0	1	1	0	1	1	0	1	1	0	1
*Tank Liner Barrier	496 015	496 015	478 673	478 673	1	0	1	1	0	1	1	0	1	1	0	1
*Handle Trigger for Running Handle	317 586	317 586	317 586	317 586	1	0	1	1	0	1	1	0	1	1	0	1
*Automatic Trigger for Running Handle	317 566	317 566	317 566	317 566	1	0	1	1	0	1	1	0	1	1	0	1
*Automatic Trigger Spring	377 613	377 613	377 613	377 613	2	0	1	2	0	1	2	0	1	2	0	1
Overload Trip Attachment	296 773	296 773	296 773	296 773	2	0	0	2	0	0	2	0	0	2	0	0
Overload Trip Coil	476 493	476 493	476 493	476 493	2	0	1	2	0	1	2	0	1	2	0	1
Unvervoltage Trip Attachment—110 Volt, 60 Cycles	375 188	375 188	375 188	375 188	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Coil	259 035	259 035	259 035	259 035	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Attachment—110 Volt, 25 Cycles, 220 Volt, 60 Cycles	375 189	375 189	375 189	375 189	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Coil	259 034	259 034	259 034	259 034	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Attachment—220 Volt, 25 Cycles, 440 Volt, 60 Cycles	375 190	375 190	375 190	375 190	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Coil	259 033	259 033	259 033	259 033	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Attachment—440 Volt, 25 Cycles	375 191	375 191	375 191	375 191	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Coil	259 032	259 032	259 032	259 032	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Attachment—550 Volt, 25 Cycles	375 192	375 192	375 192	375 192	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Coil	259 031	259 031	259 031	259 031	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Attachment—550 Volt, 60 Cycles	375 193	375 193	375 193	375 193	1	0	0	1	0	0	1	0	0	1	0	0
Undervoltage Trip Coil	259 033	259 033	259 033	259 033	1	0	0	1	0	0	1	0	0	1	0	0

*Not indicated on illustration.
Parts indented are included in the part under which they are idented.

(Order Parts by Style Number and Description)

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

Business Addresses

Headquarters, Pittsburgh, Pa.

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*ALLENTOWN, PA., 522 Maple St.
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†APPLETON, WISC., 1029 So. Outagamie St.
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†*CHICAGO, ILL., 2211 W. Pershing Road
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①*COLUMBUS, OHIO, 85 E. Gay St.
*DALLAS, TEXAS, 209 Browder St.
*DALLAS, TEXAS, 1712 Carter St.
*DAVENPORT, IOWA, 206 E. Second St.
*DAYTON, OHIO, 30 North Main St.
*DENVER, COLORADO, 910 Fifteenth St.
*DENVER, COLORADO, 1700 Sixteenth St.
†DENVER, COLORADO, 988 Cherokee St.
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*EL PASO, TEXAS, 450 Canal St.
§EL PASO, TEX., c/o Zork Hdwe. Co., 309 N. El Paso St.
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†HOUSTON, TEXAS, 2315 Commerce Ave.
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§READING, PA., 619 Spruce St.
*RICHMOND, VA., Fifth & Byrd
*§ROANOKE, VA., 726 First St., S. E.
*†ROCHESTER, N. Y., 410 Atlantic Ave.
*ROCKFORD, ILL., 130 South Second St.
*SACRAMENTO, CALIF., 1805 20th St.
*SALT LAKE CITY, UTAH, 10 West First South St.
†*SALT LAKE CITY, UTAH, 346 A Pierpont Ave.
§SALT LAKE CITY, UTAH, McCormick Bldg.
*SAN ANTONIO, TEXAS, 115 W. Travis St.
§SAN FRANCISCO, CALIF., 1355 Market St.
*SAN FRANCISCO, CALIF., 1 Montgomery St.
*SEATTLE, WASH., 603 Stewart St.
†*SEATTLE, WASH., 3451 East Marginal Way
xSHARON, PA., 469 Sharpsville Ave.
*SIOUX CITY, IOWA, 2311 George St.
*SOUTH BEND, IND., 216 East Wayne St.
§SOUTH BEND, IND., 107 E. Jefferson St.
xSOUTH PHILA. WKS., Essington, Pa.
*SOUTH PHILA. WKS., P.O. Box 7348, Philadelphia, Pa.
*SPOKANE, WASH., So. 158 Monroe St.
*SPRINGFIELD, ILL., 601 E. Adams St., Box 37
*†SPRINGFIELD, MASS., 395 Liberty St.
xSPRINGFIELD, MASS., 653 Page Boulevard
*ST. LOUIS, MO., 411 North Seventh St.
†*ST. LOUIS, MO., 717 South Twelfth St.
*SYRACUSE, N. Y., 420 N. Geddes St.
*TACOMA, WASH., 1023 "A" St.
*TAMPA, FLA., 417 Ellamae Ave., Box 230
*TOLEDO, OHIO, 245 Summit St.
*TULSA, OKLA., 303 East Brady St.
*#†UTICA, N. Y., 113 N. Genesee St.
*WASHINGTON, D. C., 1434 New York Ave., N. W.
*WATERLOO, IOWA, 328 Jefferson St., P. O. Box 598.
*WICHITA, KAN., 233 So. St. Francis Ave.
*†WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
*†WORCESTER, MASS., 32 Southbridge St.
*YORK, PA., 143 So. George St.
*YOUNGSTOWN, OHIO, 25 E. Boardman St.

Where address and P. O. box are both given, send mail to P. O. box, telegrams to address indicated.

WESTINGHOUSE ELECTRIC SUPPLY COMPANY AND AGENT JOBBERS

Fully equipped sales offices and warehouses are maintained at all addresses

ABILENE, KAN., Union Electric Co.
AKRON, OHIO, The Moock Electric Supply Co.
ALBANY, N. Y., 454 No. Pearl St.
ALLENTOWN, PA., 522 Maple St.
ATLANTA, GA., 96 Poplar St., N. W.
AUGUSTA, MAINE, 90 Water St.
BALTIMORE, MD., 40 South Calvert St.
BANGOR, MAINE, 175 Broad St.
BINGHAMTON, N. Y., 87 Chenango St.
BIRMINGHAM, ALA., Moore-Handley Hdwe. Co.
BLUEFIELD, W. VA., Superior-Sterling Co.
BOSTON, MASS., 76 Pearl St.
BUFFALO, N. Y., McCarthy Bros. & Ford
BURLINGTON, VT., 208 Flynn Ave.
BUTTE, MONTANA, 50 East Broadway
CANTON, OHIO, The Moock Electric Supply Co.
CHARLOTTE, N. C., 210 East Sixth St.
‡CHATTANOOGA, TENN., Mills & Lupton Supply Co.
CHICAGO, ILL., Hyland Electrical Supply Co.
CHICAGO, ILL., 113 North May St.
CINCINNATI, OHIO, The Johnson Electric Supply Co.
CLEVELAND, OHIO, 3950 Prospect Ave.
COLUMBIA, S. C., 915 Lady St.
COLUMBUS, OHIO, Pixley Electric Supply Co.
DALLAS, TEXAS, 409 Browder St.
‡DENVER, COL., The Mine & Smelter Supply Co.
①DES MOINES, IOWA, 1400 Walnut St.
DETROIT, MICH., 547 Harper Ave.
DULUTH, MINN., 308 W. Michigan St.
①EL PASO, TEX., Mine & Smelter Supply Co.
ERIE, PA., Star Electrical Co.
EVANSVILLE, IND., 201 N. W. First St.
FLINT, MICH., 1314 N. Saginaw St.
FORT WORTH, TEXAS, 501 Jones St.
①GRAND RAPIDS, MICH., 511 Monroe Ave., N. W.
GREENVILLE, S. C., 200 River St.
HOUSTON, TEXAS, 1903 Ruiz St.
HUNTINGTON, W. VA., Banks-Miller Supply Co.
INDIANAPOLIS, IND., 137 S. Pennsylvania St.
JACKSONVILLE, FLA., 37 South Hogan St.
KANSAS CITY, MO., Columbian Elec'l Co.
KANSAS CITY, MO., Continental Elec. Co.
LOS ANGELES, CALIF., 905 East Second St.
LOUISVILLE, KY., Tafel Electric Co.
MADISON, WISC., 1022 E. Washington Ave.
MIAMI, FLA., 1036 North Miami Ave.
MEMPHIS, TENN., 366 Madison Ave.
MILWAUKEE, WISC., 546 N. Broadway
MONROE, LA., Monroe Hardware Co.
MINNEAPOLIS, MINN., 215 South Fourth St.
NASHVILLE, TENN., Tafel Electric Co.
NEWARK, N. J., 49 Liberty St.
NEW HAVEN, CONN., 240 Cedar St.
NEW ORLEANS, LA., Electrical Supply Co.
NEW YORK, N. Y., Times Appliance Co., Inc.
zNEW YORK, N. Y., 150 Varick St.
①NORFOLK, VA., 320 City Hall Ave.
OAKLAND, CALIF., Tenth & Alice Sts.
OKLAHOMA CITY, OKLA., 10 E. California St.
OMAHA, NEB., 117 North Thirteenth St.
PEORIA, ILL., 104 East State St.
PHILADELPHIA, PA., 1101 Race St.
PHOENIX, ARIZONA, 315 West Jackson St.
PITTSBURGH, PA., Iron City Electric Co.
PORTLAND, OREGON, 134 N. W. Eighth Ave.
PROVIDENCE, R. I., 66 Ship St.
RALEIGH, N. C., 322 S. Harrington St.
READING, PA., 619 Spruce St.
RICHMOND, VA., 301 South Fifth St.
ROANOKE, VA., 726 First St., S. E.
①ROCHESTER, N. Y., 1048 University Ave.
ST. LOUIS, MO., 1011 Spruce St.
ST. PAUL, MINN., 145 East Fifth St.
SACRAMENTO, CALIF., 20th and R Sts.
SALT LAKE CITY, UTAH, 235 West South Temple St.
SAN ANTONIO, TEXAS, 1201 E. Houston St.
SAN DIEGO, CALIF., The Electric Supplies Distributing Co.
SAN FRANCISCO, CALIF., 260 Fifth St.
SCRANTON, PA., Penn Elect'l Engineering Co.
SEATTLE, WASH., 558 First Ave., South
SIOUX CITY, IOWA, 1005 Dace St.
SPOKANE, WASH., 152 So. Monroe St.
SPRINGFIELD, MASS., 46 Hampden St.
SYRACUSE, N. Y., 961 W. Genesee St.
TAMPA, FLA., 417 Ellamae St.
TOLEDO, OHIO, 812 Lafayette St.
TRENTON, N. J., 245 N. Broad St.
TULSA, OKLA., 303 East Brady St.
UTICA, N. Y., 113 N. Genesee St.
WASHINGTON, D. C., 1216 "K" St., N. W.
WATERLOO, IOWA, 328 Jefferson St.
WICHITA, KANSAS, 233 So. St. Francis Ave.
WILMINGTON, DEL., 216 E. Second St.
WORCESTER, MASS., 24 Southbridge St.
YORK, PA., 143 S. George St.
YOUNGSTOWN, OHIO, Moock Electric Supply Co.

* Sales Office † Service Shop x Works # Warehouse ° First Class Mail Only § Merchandising Products Only z Headquarters ‡ Apparatus Products Only
① Changed or added since previous issue.