Westinghouse

Types F-11 and F-22
Oil Circuit-Breakers

Manually-Operated

INSTRUCTION BOOK

Westinghouse Electric & Manufacturing Company
East Pittsburgh Works East Pittsburgh, Pa.

I. B. 5229-K

INDEX

	Page
Care of Insulating Oils	17
Connections	8, 20, 21
Description of Breakers and Auxiliaries	10 to 16
Auxiliary Switch	15
Bell Alarm Switch	15
Breaker Unit and Contacts	10
Coverplate	10
Direct Trip Attachment	14
Electrical Lockout Device	15
Mechanical Interlock	15
Motor Starting Breaker	16
Overload Release	13
Panel Brackets	15
Pipe Brackets and Structure	15–16
Undervoltage Release	12
Drilling Dimensions	22–23
General Information	3
Installing	3 to 8
Mounting of the Auxiliaries	6
Bell Alarm	7–8
Electric Lockout Device	6
Mechanical Interlock	6
Other Tripping Devices	7
Signal Switch	7
Mounting of Remote Control Breaker	5
Mounting of Switchboard Breaker	3
Instructions for Tapping Connections	8
Maintenance	9
Operations of Mechanical Sequence Interlock	16
Renewal Parts	17 to 19
Shipping	3

Westinghouse

Types F-11 and F-22 Oil Circuit-Breakers

Manually-Operated

General Information

The types "F-11" and "F-22" oil circuit-breakers comprise a line of low capacity oil circuit-breakers. The design of this line of oil circuit-breakers is unique in that the breaker unit, the hand operating mechanism and all auxiliaries are unit assemblies. These unit assemblies are carried in stock packed ready for shipment. Upon the receipt of an order, the unit assemblies necessary to make up the particular breaker which the customer orders, together with the necessary auxiliaries, are shipped in separate packages. This facilitates shipment and enables the Westinghouse Company to render better service to their customers.

Before shipment, all breakers, operating mechanism and auxiliaries are given thorough testing to determine that they are adequate, and that their operation is correct.

Shipping

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

Installing

There is a method of procedure for each circuit-breaker set-up which, if followed, will greatly facilitate the work of installing the breaker, and will avoid troubles which otherwise might be encountered during the installations of breakers.

Unpacking—Care should be used in unpacking the circuit-breakers so that the porcelain insulators and small mechanical parts will not be damaged or broken. All of the excelsior and dirt should be blown or cleaned from all operating parts. A careful inspection should be made to see that none of the parts are broken during shipment, and that all the details are in good operating condition.

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 in Fig. 4. Then place the 5-ampere tripping coils or series coils from the overload attachment, if supplied, in the coil box of the coverplate, and then mount the coverplate and the breaker to the panel, using the same mounting bolts for mounting both. The breaker should be mounted as nearly level as possible. The nipple supplied with the breaker units can then be screwed into the rod end on the rear of the operating handle and the mechanical set-up will then 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. See Fig. 2. With the Type F-22 breaker it is necessary to observe that good contact is secured on the main contact as well as the arcing tips, as the arcing tips make contact before the main contacts. With this adjustment correct, the signal switch should make good contacts in both the open and closed position 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.

In adjusting the breaker special care should be taken to see that the toggle lever is from one thirty-second to one sixteenth of an inch away from the stop in the closed position. On the 2 and 3-pole breakers the stop is the end of the slot on the side of the frame, and on the single-pole and 4-pole breakers, the stop is a rib on the inside of the frame.

If this adjustment is not correct, the latch load on the cover plate will be excessive and the tripping attachments may not function promptly.

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 direct trip attachment or 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. After this, the necessary electrical connections can be made as described later.

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

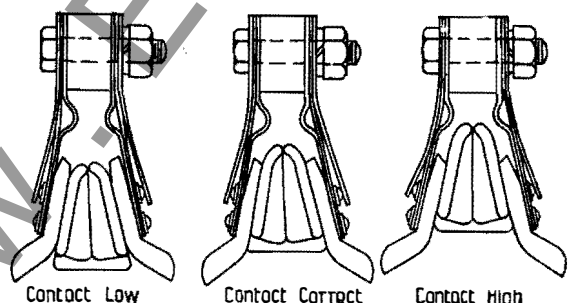


FIG. 2—CONTACT ADJUSTMENT FOR TYPE F-11 OIL CIRCUIT-BREAKER

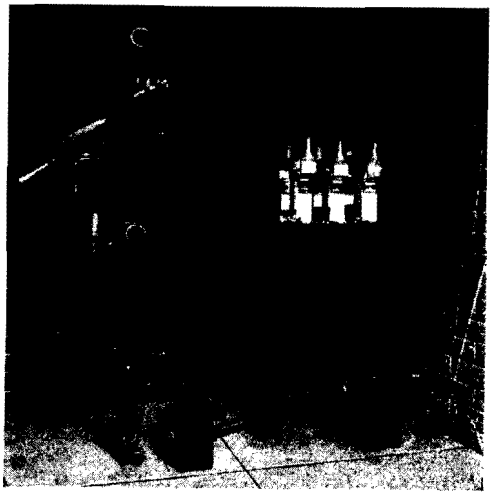


FIG. 3—REMOTE-CONTROL WALL-MOUNTED TYPE F-11 OIL CIRCUIT-BREAKER

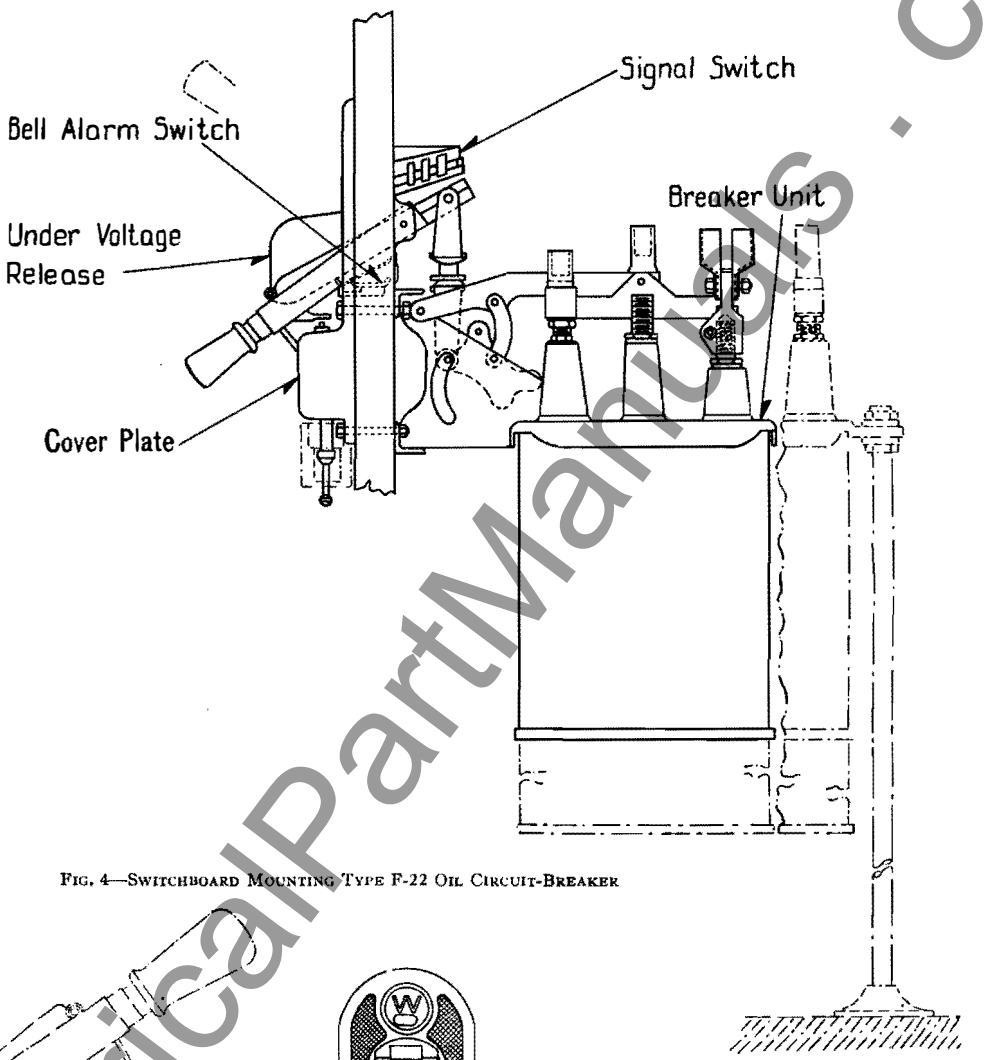


FIG. 4—SWITCHBOARD MOUNTING TYPE F-22 OIL CIRCUIT-BREAKER

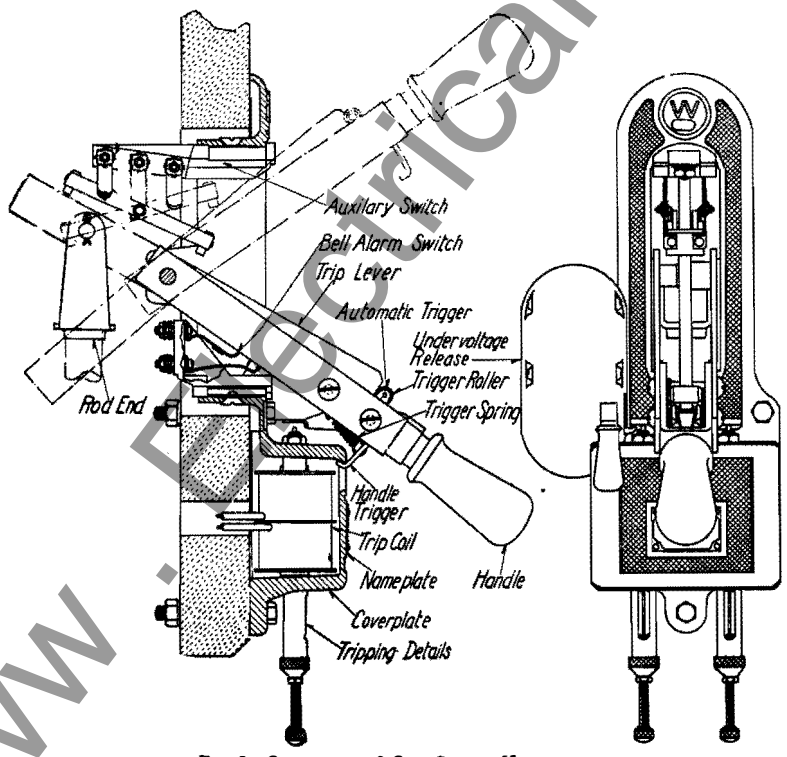


FIG. 5—COVERPLATE 2-COIL SINGLE HANDLE

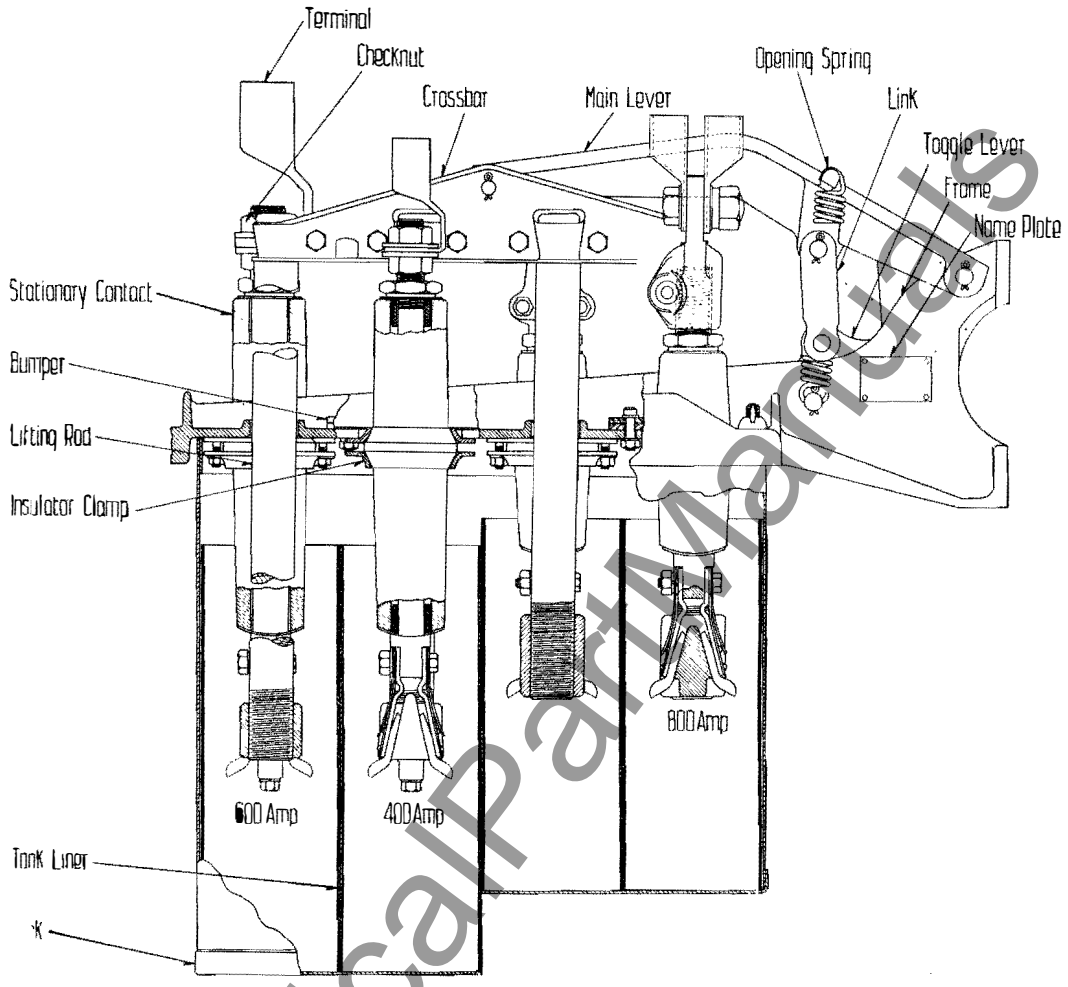


FIG. 6—TYPE F-22, 4 P.S.T. OIL CIRCUIT-BREAKER

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. The auxiliary switch and bell alarm contacts, if supplied, should be mounted in the coverplate before the coverplate is mounted on the panel or on the panel bracket. The coverplate can then be mounted as shown in Fig. 5, with the coils in place in the coil box. The tripping cores can then be put in place on the coverplate and tightened up. Here again, if direct trip attachments or undervoltage release are used, they 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 back 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 up with operating rods through the bell cranks as shown in Fig. 3.

The connecting pipes are ¾ inch wrought iron, and should be cut 4 inches shorter than the distance between fulcrums of the levers to be connected. These pipes should be threaded 2¾ inches on each end with a 1.041-14 (¾ inch straight pipe thread) die. A ¾ inch pipe lock nut should be put at one end or the other of each pipe. The length of the pipe should be adjusted so that the travel of each bell 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. 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 and Fig. 8.

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 the 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 pin between the toggle lever and the toggle link should be moved to the hole farther back. This will cause the toggle to close the breaker with a downward motion of the operating rod. See Fig. 9.

Mounting of the Auxiliaries

Mounting of the Electric Lock-out Device

The electric lock-out device mounts on the rear of the panel, and is attached to the coverplate as shown in Fig. 25. 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.

Mounting of the Mechanical Interlock

When two single handle coverplates, or 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. 26. When two handles are used to operate a double-throw F-11 Breaker an interlock is provided as an integral part of the breaker. In any other case the interlock as here described should be used. In order to mount this attachment, it is necessary to remove the fulcrum pin from the coverplate handle, and to take off the spacing washer for the handles on the side next to the coverplate with which it is to be interlocked. Then

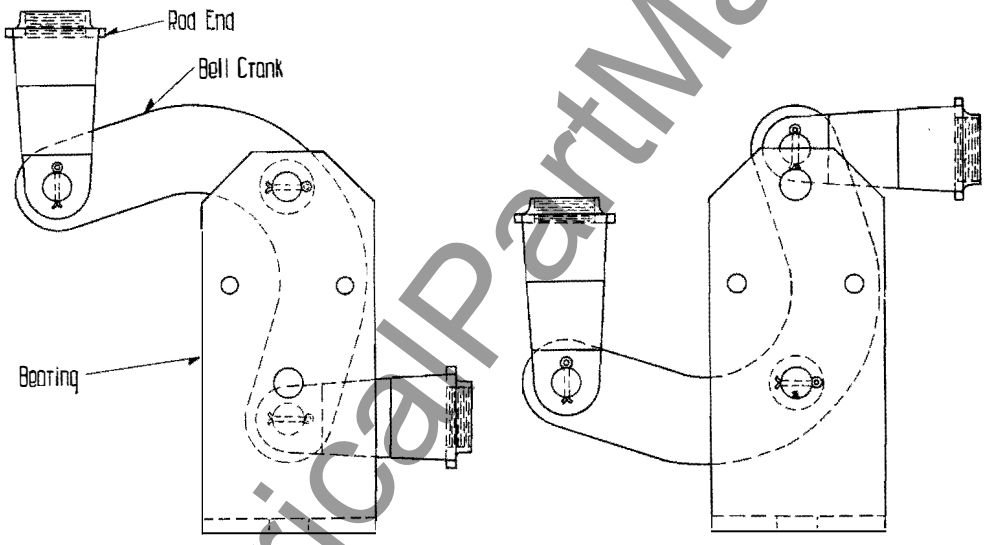


FIG. 7—BELL CRANK SHOWING ASSEMBLIES FOR ABOVE AND BELOW FLOOR MOUNTING

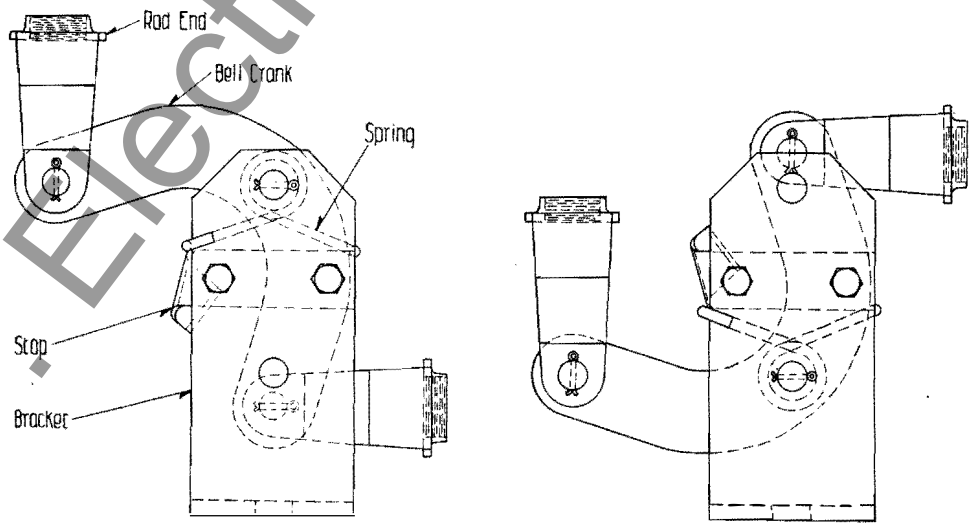


FIG. 8—ACCELERATING DEVICE SHOWING ASSEMBLY FOR ABOVE AND BELOW FLOOR MOUNTING

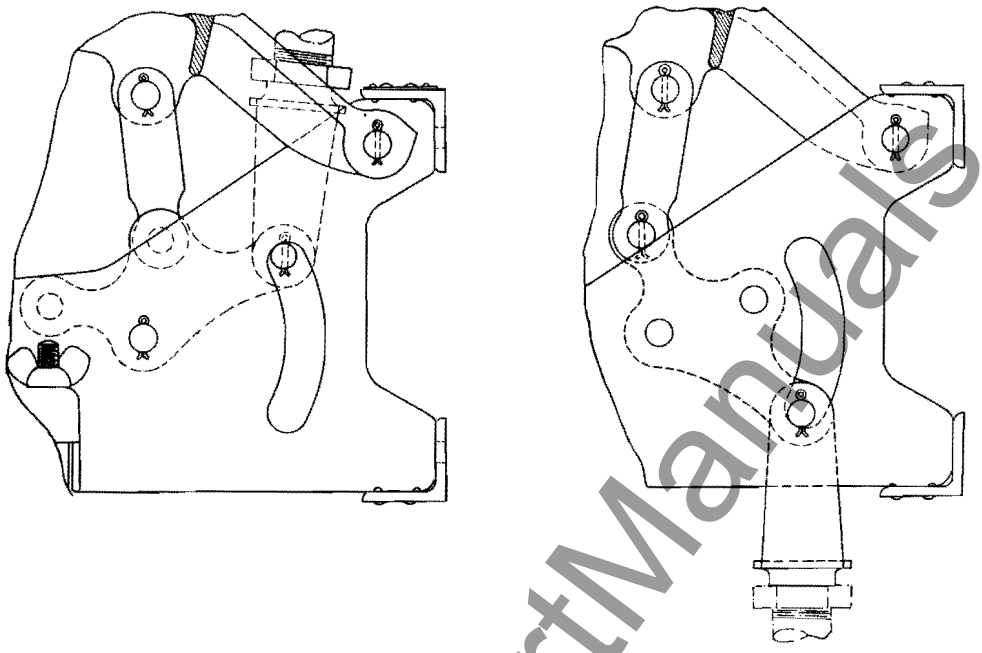


FIG. 9—SHOWING ASSEMBLY OF BREAKER MECHANISM FOR UPWARD AND DOWNWARD PULL

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. The movement of one handle to the close position should move the 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 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 more 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.

Mounting the 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 Fig. 27.

Mounting of the Undervoltage Release Attachment

The hand retrieved undervoltage release attachment mounts on the left hand mounting bolt for the coverplate. It is necessary to take out this bolt and to put it in from the rear of the panel, and thus screwing it into the undervoltage cover, tightening this bolt 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. 17.

The automatic retrieve undervoltage release mounts on the right hand side of the coverplate in a similar manner. It is necessary to put a pin in the trip lever of the coverplate to operate this device. See Fig. 18.

Mounting of Other Tripping Devices

The overload trip, the shunt trip, and the overload trip with dash-pot, 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. The coil should be put in the coil box of the coverplate, before the coverplate is mounted on the panel. However, the tripping cores with the dash-pot 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.

Mounting of 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 the picture before the coverplate is put on the panel, otherwise it would be very difficult to tighten the screw which clamps it in position.

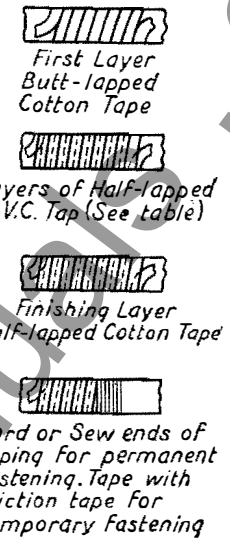
Connections

When the breaker has been assembled with its operating handle and auxiliaries as described above, then the connections should be made in accordance with the diagram furnished for the complete installation if covered by a complete diagram, or according to the diagram furnished with 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 nut should be drawn down so as to bear evenly over their entire area on the strap. The lower contact nut should not touch the upper clamping nut of the insulator. The connection should have an area of not less than that given by the National Electric Code, in the tables on allowable carrying capacity for wires and cables. After fastening in the main leads, the terminals should be insulated with tape or insulating tube, so that any gas expelled from the circuit-breaker in opening heavy short circuit, will not cause a short circuit outside of the circuit-breaker. Good engineering practice demands that all terminals on circuit-breakers, be insulated.

INSTRUCTIONS FOR TAPING CONNECTIONS

Service Volts	Layers of Varnished Cambric Tape
2500	4
4000	5
4500	6
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.)



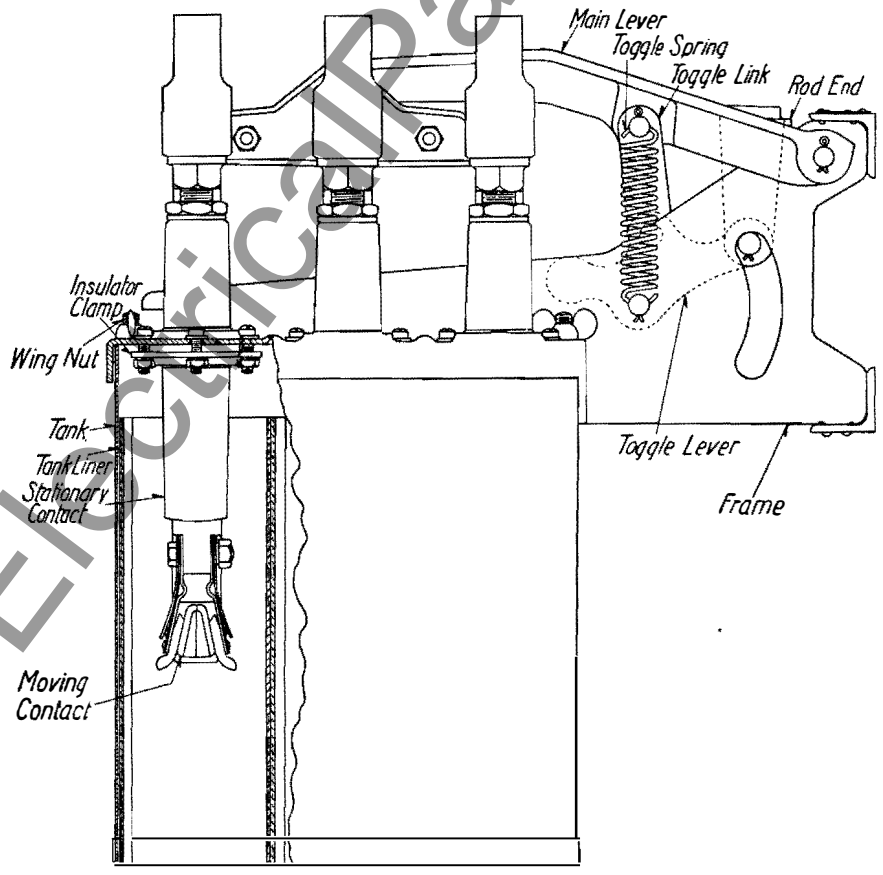


FIG. 10—TYPE F-11, 3 P.S.T. CIRCUIT-BREAKER UNIT

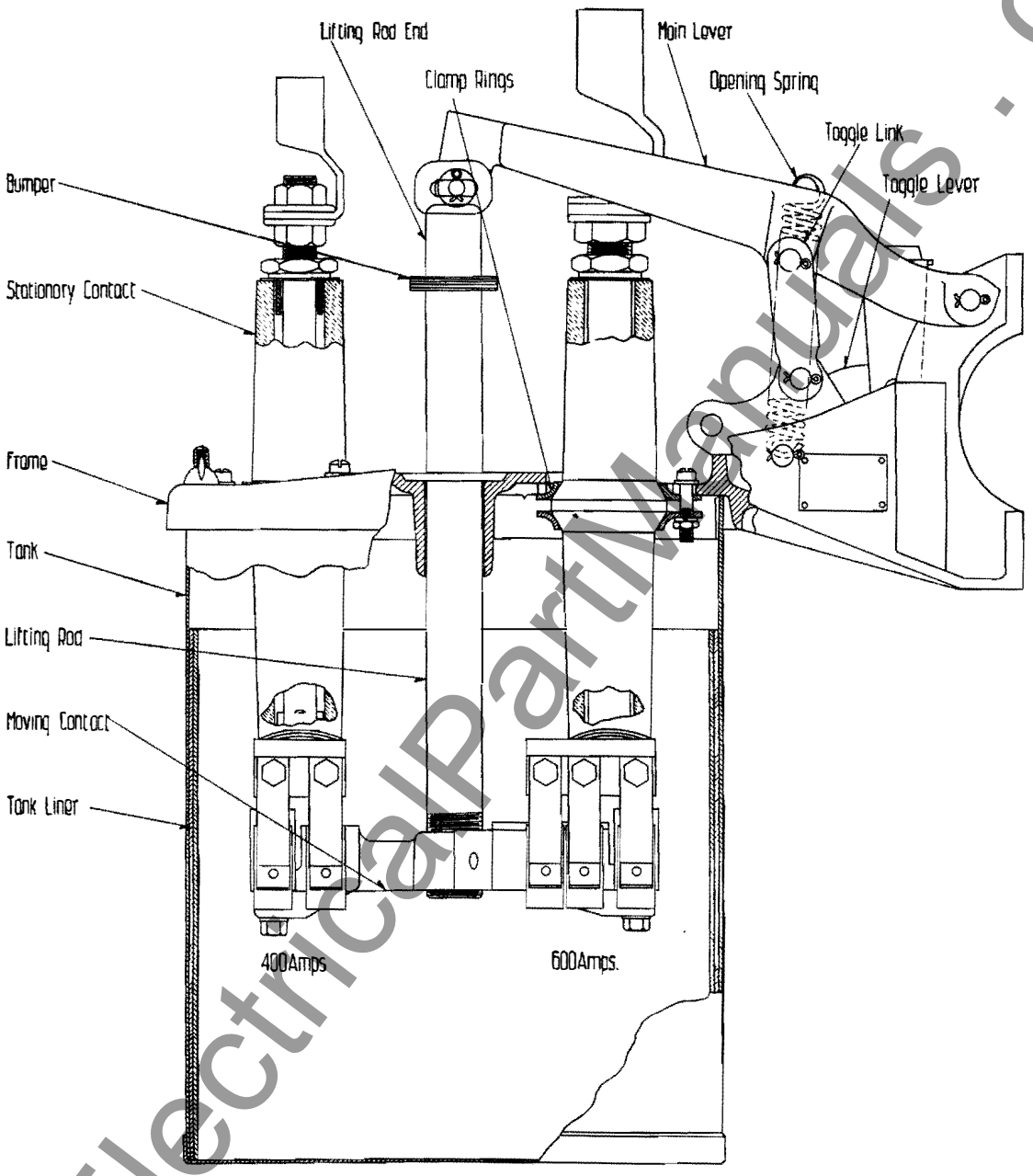


FIG. 11—TYPE F-22, SINGLE-POLE OIL CIRCUIT-BREAKER

As a safety measure the frame of the circuit-breaker should be grounded.

Caution— Before connecting power to the circuit, remove the tank from the breaker and after thoroughly cleaning and drying, fill with clean dry insulating oil. Clean the oxide from the contacts so that they are clean and bright. It is also recommended that the breaker be operated several times by hand to see that all the parts are free to move and operating properly.

Maintenance

Circuit-Breaker Unit— Wherever possible, periodic inspection should be made of circuit-breakers, at which time the tank should be removed and the contacts inspected. Any pitting of the contacts which has been caused by arcing should be cleaned off and the contacts put in good condition. If the contacts are too badly burned to be repaired so as to give good contact, new parts should be put on. If the oil is very much carbonized, it should be replaced by new clean dry insulating oil.

Coverplate and Handle— The mechanical part of the coverplate and handle should be kept in good condition in order that the tripping function will be properly performed. A little oil on the bearings at intervals will keep the parts in good operating condition.

Other Devices— Though there is nothing about the construction of the other auxiliaries and tripping devices which

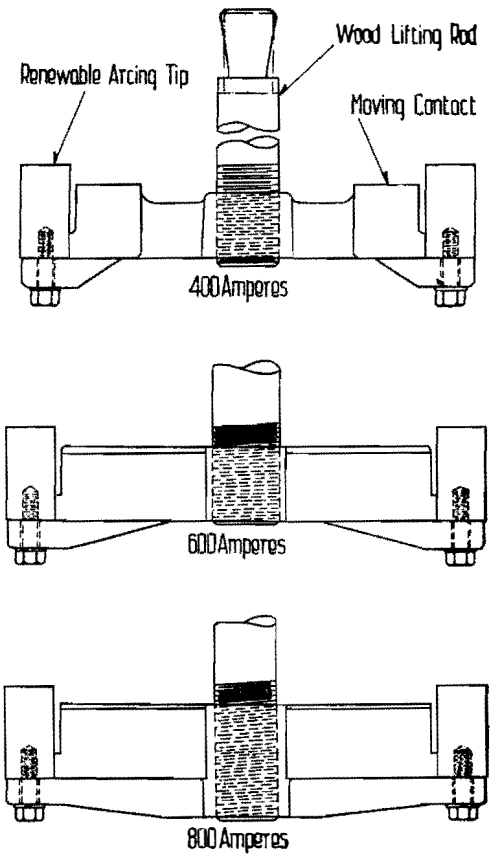


FIG. 12—TYPE F-22, MOVING CONTACTS

would require the attention of the operator periodically, yet it is recommended that the tripping devices be given a casual inspection to see that cotter pins have not become lost and that screws and bolts are tight. Moving parts should be operated by hand to see that they are free on their bearings and do not bind.

Description of Breakers and Auxiliaries

Breaker Unit and Contacts—The circuit-breaker units include the main current carrying parts and operating details. See Fig. 10. The two and three-pole "F-11" and "F-22" have frames of punched steel, while the double throw "F-11" and the single and four-pole "F-22" breakers have frames of heavy cast iron. The stationary contacts are clamped to these frames by clamping rings which have bolts spaced 120 degrees apart. This makes it easy to swing the contacts so that the moving contacts will enter exactly between the fingers. At the lower end of the stationary contact stud, the contact fingers are bolted. These may be renewed when badly burned by removing the bolt which holds them in place. The moving contact of the Type "F-11" breaker is a punched piece of copper, which is clamped rigidly to the wedged end of the wood lifting rod.

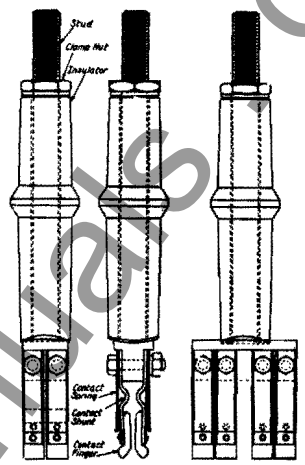


FIG. 13—TYPE F-11, STATIONARY CONTACTS

The moving contact of the Type "F-22" breaker is a heavy copper casting with a renewable arcing tip of solid copper, which has a very high thermal capacity, which reduces the burning due to arcing to a minimum. All of the arcing on the Type "F-22" breaker takes place on this arcing tip and when it has become badly pitted, due to opening very heavy short-circuits, it should be replaced by a new arcing tip and the pair of fingers which make contact on it should also be renewed.

Coverplate—The coverplate contains the operating handle with space for overload coil, auxiliary switch, bell alarm, undervoltage and other auxiliaries. The operating handle is in two parts. 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.

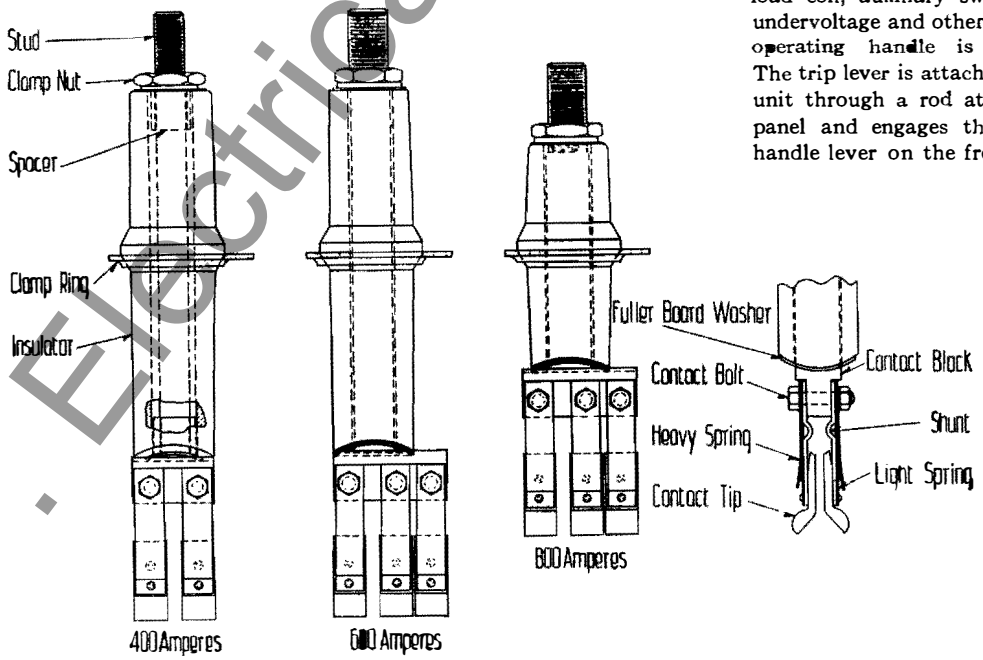


FIG. 14—TYPE F-22, STATIONARY CONTACTS

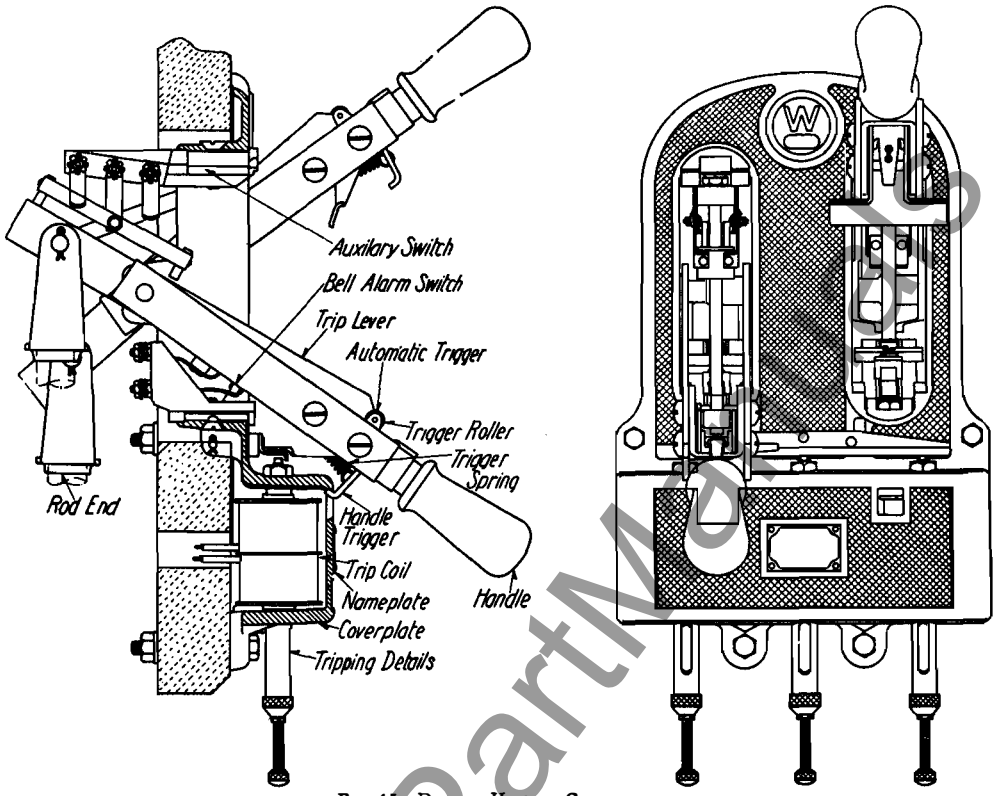


FIG. 15—DOUBLE HANDLE COVERPLATE

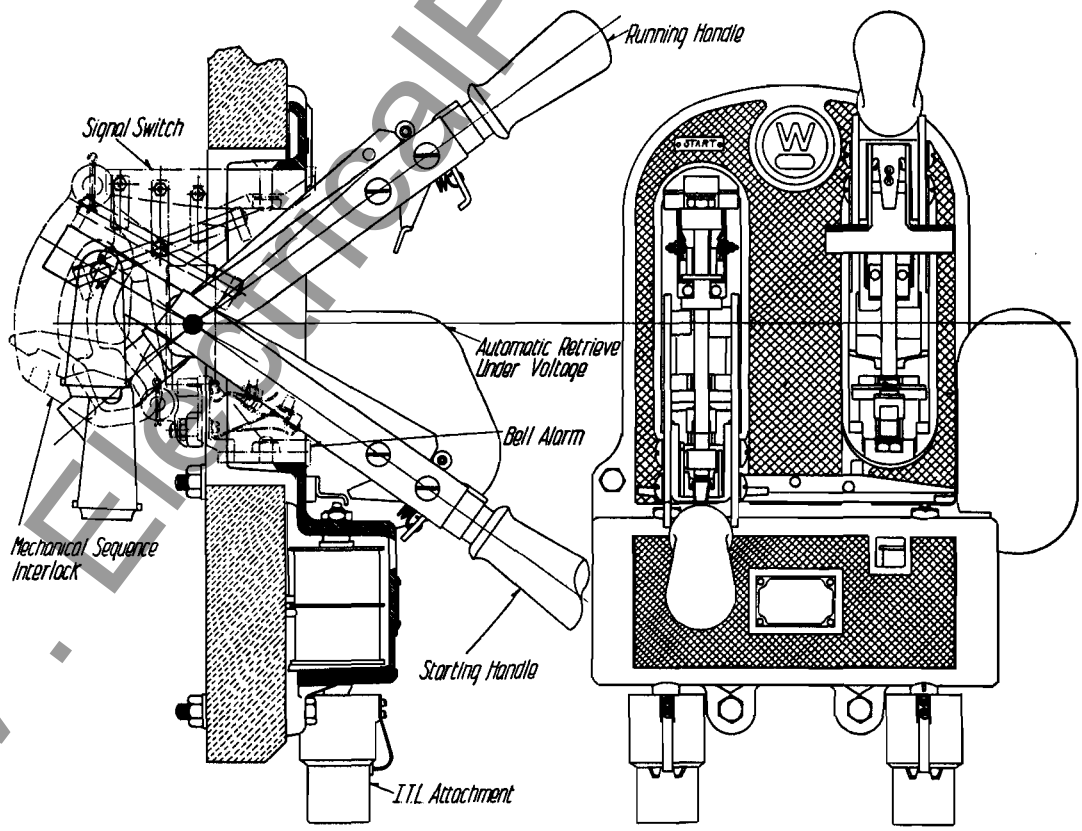


FIG. 16—DOUBLE HANDLE COVERPLATE FOR MOTOR-STARTING EQUIPMENT

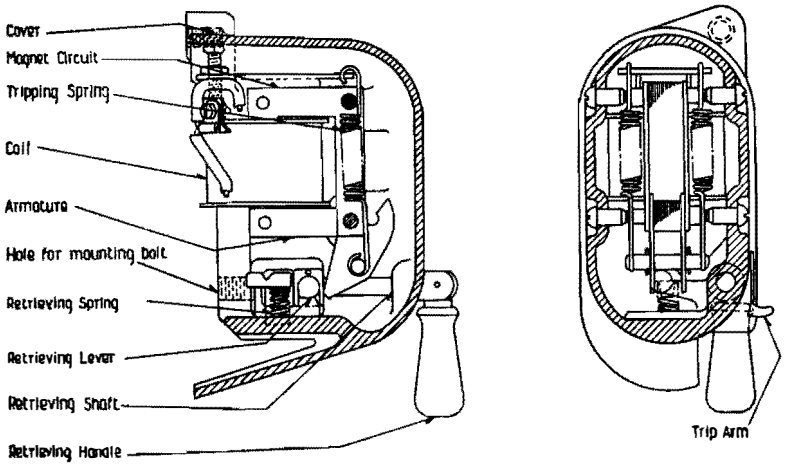


FIG. 17—HAND RETRIEVE UNDERVOLTAGE

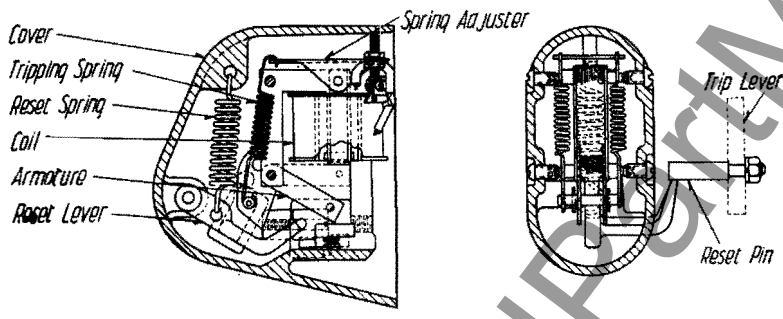


FIG. 18—AUTOMATIC RETRIEVE UNDERVOLTABE RELEASE

The handle trigger holds the handle lever down after the circuit-breaker has been closed by pushing the handle. The auxiliaries all operate to disengage the trigger from the trip lever. Raising the handle disengages the handle trigger and permits the breaker unit to open.

The coverplate is made in three arrangements, the two-coil single handle coverplate is used on non-automatic or automatic single-throw breakers unless special requirements demand the three-coil single handle coverplate.

The double handle coverplate is used with all automatic and non-automatic double-throw breakers or motor starting combination of breakers.

A special assembly of this double handle coverplate is used with motor starting combinations. It is provided with a pin to operate the automatic retrieve undervoltage release and latches are removed from starting 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 de-energized when the circuit-breaker is open. This may be done by energizing from the dead side of breaker or wiring through the signal switch. The undervoltage device is designed with a closed magnetic circuit. Upon the reduction of the voltage across the coil to approximately 50 percent of the normal voltage, the armature will be drawn downward by the spring. 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 re-energized. The coil will burn out if the current is flowing in the coil when the armature is not in the retrieved position.

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 cor-

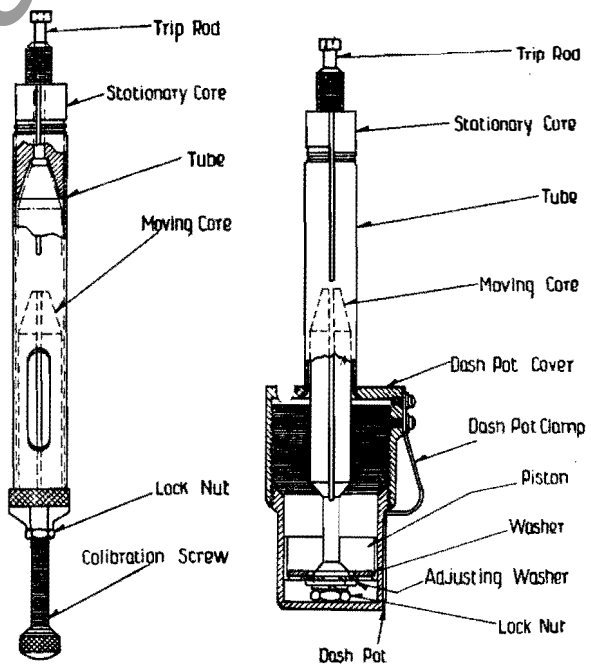


FIG. 19—OVERLOAD RELEASE CORES

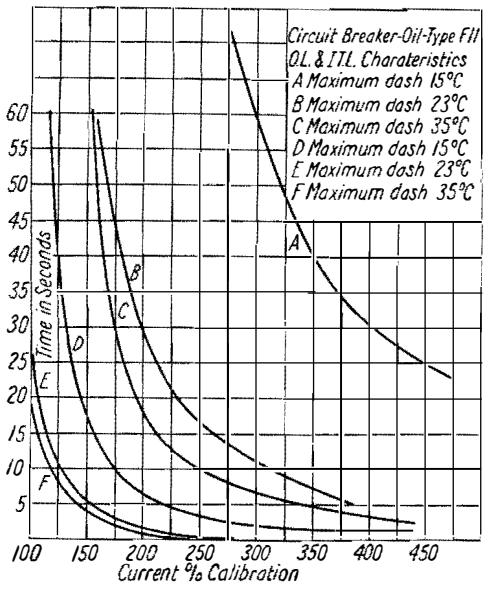


FIG. 20—CALIBRATION CURVE

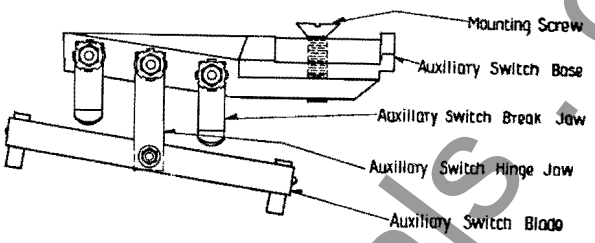


FIG. 22—AUXILIARY SWITCH

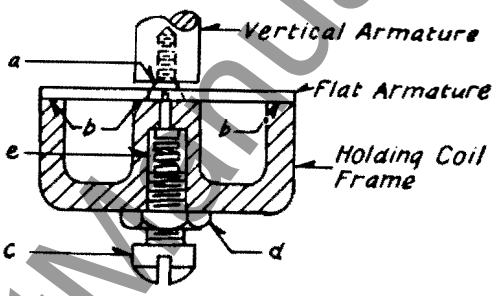


FIG. 23—DIRECT TRIP ARMATURE

respondence 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 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 is intended primarily for use with the double handle coverplate for use with motor starting equipments, but may also be used on single handle coverplates. It mounts on the right hand side of the coverplate. Its operation is identical with that of the hand retrieve device except that an additional lever and spring is provided which will retrieve the armature to the closed gap position when the breaker opens. When the breaker closes, a pin on the trip lever engages this lever and holds it back so that the armature is free to trip the breaker. This undervoltage release may be energized from either the live or the dead side of the breaker.

Overload Release (Fig. 19)—The overload release consists of the part shown in the picture. The moving core is drawn by the magnetic pull up against the trip pin which is pushed up against the trigger. The calibration is varied by changing the air gaps between the moving and stationary cores by raising and lowering the calibration screw. The lock nuts to be drawn tight after changing calibration. The calibration setting is indicated by figures on the tube opposite the line on the moving core. For series trip coils, the calibration is directly in ampere. For current transformer trip coils, the calibration 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 dash pot is attached to the end of the moving core. The calibration is then inscribed on the dash pot and is varied by screwing the pot into the cover. The time is varied by changing the number of holes in the bottom

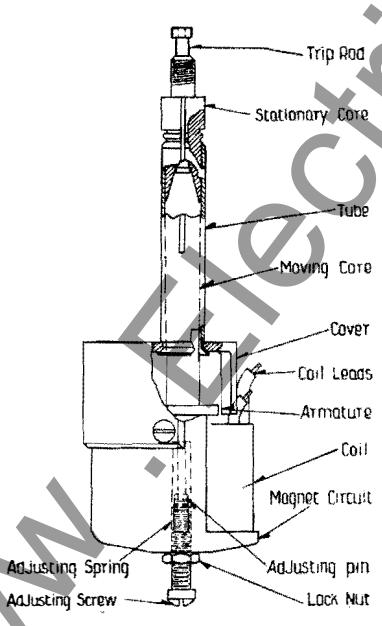


FIG. 21—DIRECT TRIP ATTACHMENT

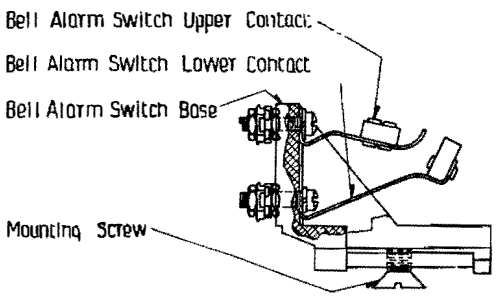


FIG. 24—BELL ALARM SWITCH

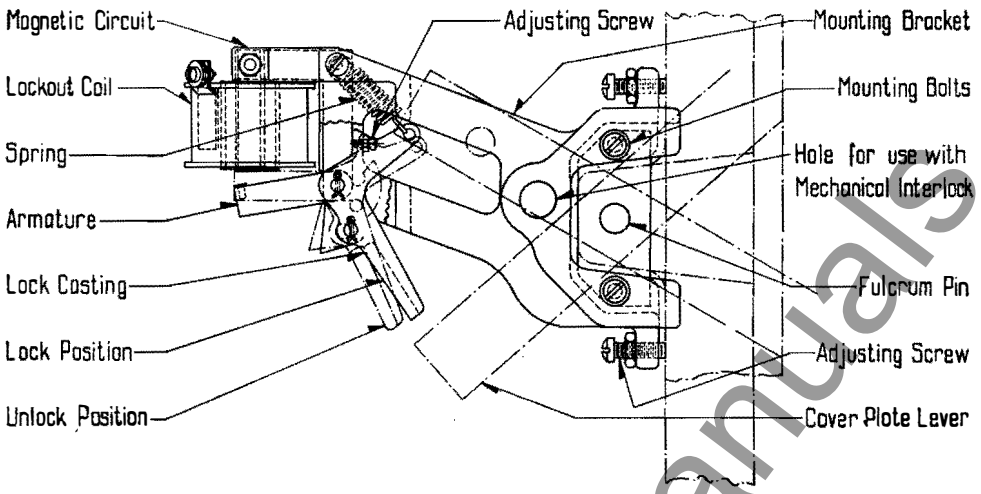


FIG. 25—ELECTRICAL LOCKOUT DEVICE

of the piston uncovered by the diaphragm. Instantaneous resetting 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. 20 shows approximate variations of the time with the variations of the overload and the effect of changed temperature on the standard dash pot oil as supplied with the dash pot.

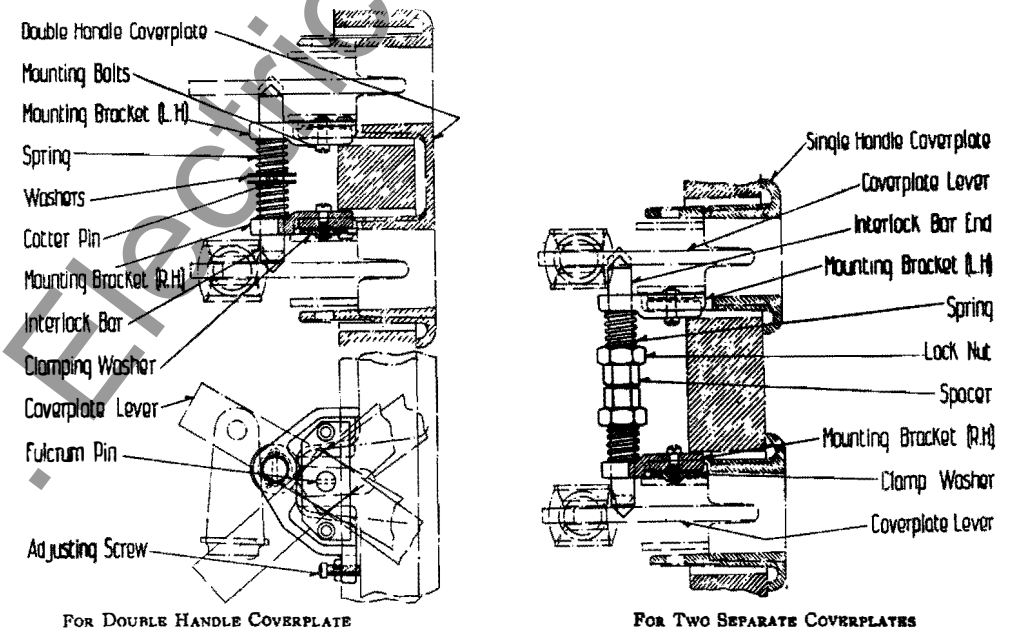
The values given in figure 20 are approximate and will vary somewhat with changes in temperature, and changes in viscosity of the oil. Where a definite time delay is required the delay should be obtained by the use of suitable relays. The oil in the dash pots should be renewed periodically to obtain the best service.

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

Direct Trip Attachment (Fig. 21)—Two opposed trip coils are added below the overload trip coil when a definite delay time 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 armature seating properly. Figure 23 shows the points that should be inspected to detect trouble.

Be sure that the flat armature is making good contact with the holding



FOR DOUBLE HANDLE COVERPLATE

FOR TWO SEPARATE COVERPLATES

FIG. 26—MECHANICAL INTERLOCK

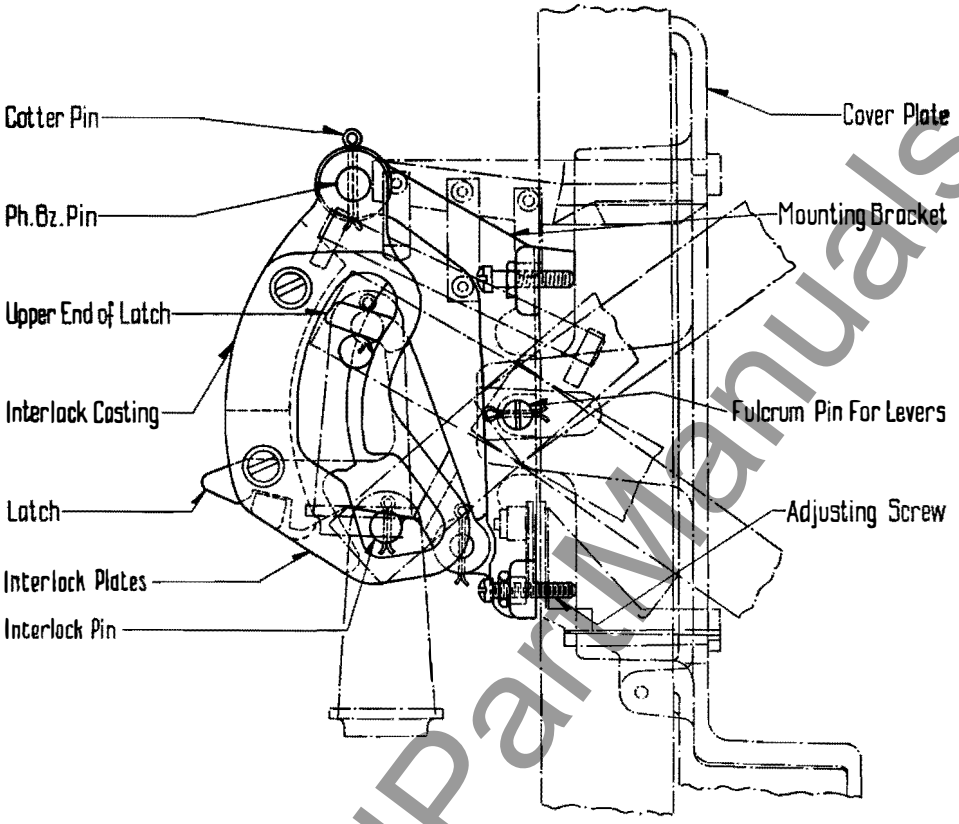


FIG. 27—MECHANICAL SEQUENCE INTERLOCK

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 up 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. 22)—The auxiliary switch is mounted in the coverplate by a flat head screw. It is operated by the trip lever striking the fiber block in between the blades. The switch should be examined occasionally to be sure that the blades are making firm contact in the jars, that the connections are on tight and that the nuts are drawn up tight on the clip washers at the hinge jaw.

Bell Alarm Switch (Fig. 24)—The bell alarm switch only makes contacts 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.

Electrical Lockout Device (Fig. 25)—The electrical lockout device is used in various schemes where it is desired to interlock the breaker so that it cannot be closed unless predetermined conditions exist. The device consists of a magnetic circuit with a moving armature to which is attached a lever. When the coil is de-energized the armature is open and the lever is interposed over the trip lever so that it is impossible to close the circuit-breaker. When the coil is energized the lever is drawn away from the trip lever and allows the circuit-breaker to be closed.

Mechanical Interlock (Fig. 26)—The mechanical interlock consists of a bar and centralizing springs so arranged that it is impossible to close but one of two levers at a time. This may be used on two single handle coverplates on various center lines or on the two handles of a double handle coverplate. Its chief application is a double-throw breaker made of two single-throw units operated from two handles of the coverplate. The double-throw F-11 breaker has an equivalent interlock which is an integral part of the breaker unit. See Fig. 26.

Panel Brackets—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 structure where no panel is required, or where it is desirable to mount the breaker separate 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

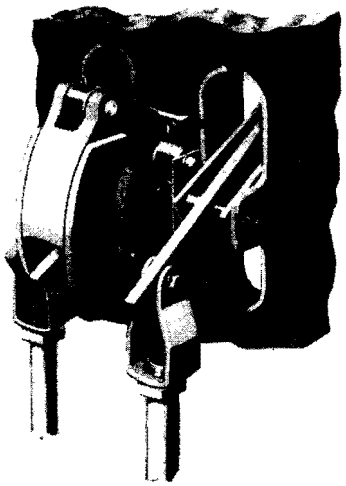


FIG. 28—VIEW OF STARTING SIDE WITH BOTH HANDLES OPEN

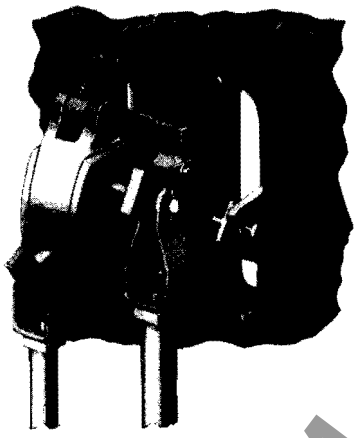


FIG. 29—VIEW OF STARTING SIDE WITH STARTING SIDE CLOSED

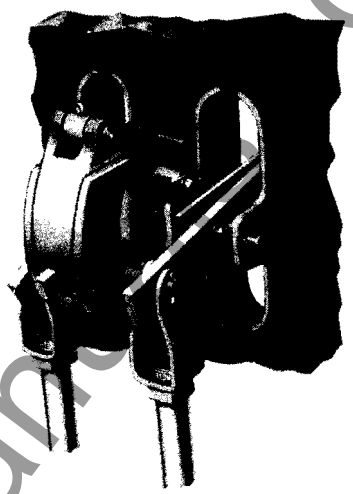


FIG. 30—VIEW OF STARTING SIDE JUST AS STARTING HANDLE IS REACHING ITS OPEN POSITION

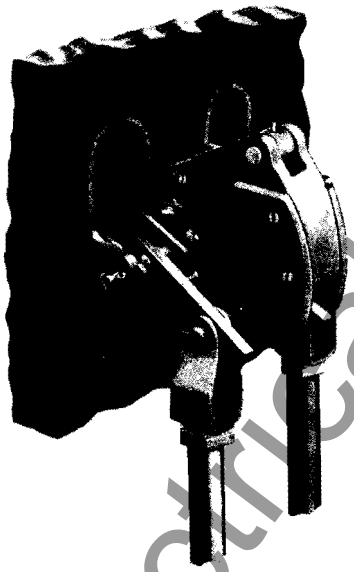


FIG. 31—VIEW OF RUNNING SIDE WITH BOTH HANDLES OPEN

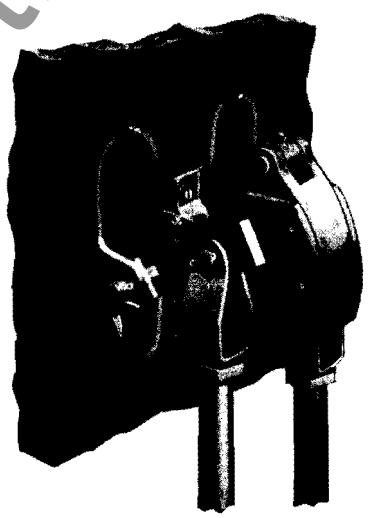


FIG. 32—VIEW OF RUNNING SIDE WITH RUNNING SIDE CLOSED

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 installation where panels are not desired for other equipment than the breaker. It should be assembled with 12 inches of vertical pipe protruding above the top 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.

Motor Starting Breaker—Combination of "F-11" and "F-22" oil circuit-breakers may be used in connection with auto transformers for the starting of 3-phase squirrel-cage induction motors and self-starting synchronous motors. When used for this kind of service two handles are provided so that the throwing of one handle imposes partial voltage upon the motor to bring it to speed and then throwing the other handle throws full voltage on the motor for running duty. For this type of service the handles are provided with a mechanical sequence interlock. This 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 closed and 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. A special automatic undervoltage release is used with these combinations to facilitate operation.

Operations of the Mechanical Sequence Interlock

(Fig. 27) 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 terminal. First, the starting handle is closed applying reduced voltage across the terminal 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. 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 allows 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 start 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 position. The operation of the device can readily be seen by reference to the illustration. Figures 28 to 32

Number of Starts

Auto transformers are designed to start the motor from rest twice in succession with an interval of 45 seconds before the cycle is repeated. Auto transformers built on this basis have demonstrated their ability to meet operating conditions where more than two starts are made in rapid succession, without allowing the machine to come to rest.

Under abnormal operating conditions, requiring a number of starts the auto transformer should be kept under observation to prevent their coming to destructive temperatures.

Care of Insulating Oils

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" diameter discs spaced .1" 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 the reliable and dependable operation for which the breaker is designed and built.

Renewal Parts

For renewal or spare parts refer to Part Catalogue No. 6186 for F-11 Circuit-Breakers and to Catalogue No. 6195 for F-22 Circuit-Breakers.

In case renewal parts are required, consult the nearest Sales Office, as shown in list given on the inside back cover of this book. In all cases give the following information and give a description of parts. First, nameplate reading complete on breaker unit and coverplate. Second, normal voltage frequency applied to all coils. Third, refer to parts by name as given in this book.

Recommended Stock of Renewal Parts

The following is a list of the renewal parts and the minimum quantities of each that should be carried in stock. These are the parts most subject to wear in ordinary operation and damage or breakage due to possible abnormal conditions. The maintenance of such stock will minimize service interruptions due to breakdown.

Recommendations for stocking Renewal Parts for your complete equipment will be supplied upon request to the nearest Sales Office.

Ordering Instructions: When ordering renewal parts, give the nameplate reading. Always give the name of the part wanted, also the stock order number or the style number of the apparatus on which the part is to be used. For list of parts refer to the tables on the following pages and the illustrations in the preceding pages.

RENEWAL PARTS DATA

Type F-22 Oil Circuit-Breaker
Single Throw
400-600 Amperes—7500 Volts
800 Amperes—2500 Volts

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure renewals.

Breaker Units in Use up to and including		1	5		1	5		1	5		1	5
Name of Part	Style No.	Single Pole		2 Pole			3 Pole			4 Pole		
		No. Per Unit	Recommended for Stock	No. Per Unit	Recommended for Stock		No. Per Unit	Recommended for Stock		No. Per Unit	Recommended for Stock	
Breaker Unit Complete		1	0 0	1	0	0	1	0	0	1	0	0
Leather Bumper	315915	..	.. ..	1	0	0	1	0	0	..	..	..
Leather Bumper	329474	..	.. ..	..	..	..	..	..	..	4	0	0
*Front Bumper	408878	..	.. ..	1	0	0	1	0	0	..	..	..
Lift Rod—400-600 Amperes	329465	1	0 1	..	..	..	..	..	..	..	..	..
Lift Rod—400-600 Amperes	328471	..	.. ..	2	0	1	3	0	2	..	..	..
Lift Rod—400-600 Amperes	372311	..	.. ..	..	..	..	..	..	..	4	1	2
Lift Rod—800 Amperes	329466	1	0 1	..	..	..	..	..	..	..	..	..
Lift Rod—800 Amperes	328473	..	.. ..	2	0	1	3	0	2	..	..	..
Lift Rod—800 Amperes	372312	..	.. ..	..	..	..	..	..	..	4	1	2
*Idler Rod	328472	..	.. ..	1	0	0	..	..	..	..	..	..
Moving Contact Bar—400 Amperes	328467	1	0 1	2	0	1	3	0	2	4	1	2
Moving Contact Bar—600 Amperes	328468	1	0 1	2	0	1	3	0	2	4	1	2
Moving Contact Bar—800 Amperes	328469	1	0 1	2	0	1	3	0	2	4	1	2
Arcing Contact—Moving	328470	2	2 4	4	4	8	6	6	12	8	8	16
Stationary Contact—400 Amperes	328459	2	0 1	4	0	1	6	0	2	8	0	2
Stationary Contact—600 Amperes	328460	2	0 1	4	0	1	6	0	2	8	0	2
Stationary Contact—800 Amperes	328461	2	0 1	4	0	1	6	0	2	8	0	2
Porcelain Insulator—400-600 Amperes	328479	2	0 1	4	0	2	6	0	2	8	0	2
*Porcelain Insulator—800 Amperes	328480	2	0 1	4	0	1	6	0	2	8	0	2
Contact Finger—400 Amperes	328455	8	8 16	16	16	32	24	24	48	32	32	64
Contact Finger—600-800 Amperes	328455	12	12 24	24	24	48	36	36	72	48	48	96
Contact Spring—400 Amperes	751540	16	8 16	32	16	32	48	16	48	64	16	64
Contact Spring—600-800 Amperes	751540	24	12 24	48	24	48	72	24	72	96	24	96
Contact Stud—400 Amperes	328456	2	0 1	4	0	1	6	0	2	8	0	2
Contact Stud—600 Amperes	328457	2	0 1	4	0	1	6	0	2	8	0	2
Contact Stud—800 Amperes	328458	2	0 1	4	0	1	6	0	2	8	0	2
Operating Spring	328466	1	0 1	..	..	..	..	..	..	..	..	..
Operating Spring	588075	..	.. ..	2	0	1	2	0	1	2	0	1
*Tank—400-600 Amperes	329463	1	0 0	..	..	..	..	..	..	..	..	..
*Tank—400-600 Amperes	328487	..	.. ..	1	0	0	1	0	0	..	..	..
*Tank—400-600 Amperes	329477	..	.. ..	..	..	..	..	..	..	1	0	0
*Tank—800 Amperes	329464	1	0 0	..	..	..	..	..	..	..	..	..
*Tank—800 Amperes	328454	..	.. ..	1	0	0	1	0	0	..	..	..
*Tank—800 Amperes	329478	..	.. ..	..	..	..	..	..	..	1	0	0
*Tank Liner—400-600 Amperes	364636	1	0 0	3	0	2	3	0	2	4	0	2
*Tank Liner—800 Amperes	377519	1	0 0	3	0	2	3	0	2	4	0	2
Main Lever—400-600 Amperes	329461	1	0 0	..	..	..	..	..	..	..	..	..
Main Lever—400-600 Amperes	328462	..	.. ..	1	0	0	1	0	0	..	..	..
Main Lever—400-600 Amperes	328471	..	.. ..	..	..	..	..	..	..	1	0	0
Main Lever—800 Amperes	329461	1	0 0	..	..	..	..	..	..	..	..	..
Main Lever—800 Amperes	329462	..	.. ..	1	0	0	1	0	0	..	..	..
Main Lever—800 Amperes	329471	..	.. ..	..	..	..	..	..	..	1	0	0
Cross Bar—400-600 Amperes	328465	..	.. ..	2	0	0	2	0	0	..	..	..
Cross Bar—400-600 Amperes	372310	..	.. ..	..	..	..	..	..	..	1	0	0
Cross Bar—800 Amperes	328465	..	.. ..	2	0	0	2	0	0	..	..	..
Cross Bar—800 Amperes	372310	..	.. ..	..	..	..	..	..	..	1	0	0
Supporting Frame—400-600 Amperes	329468	1	0 0	..	..	..	..	..	..	..	..	..
Supporting Frame—400-600 Amperes	328485	..	.. ..	1	0	0	1	0	0	..	..	..
Supporting Frame—400-600 Amperes	329475	..	.. ..	..	..	..	..	..	..	1	0	0
Supporting Frame—800 Amperes	329458	1	0 0	..	..	..	..	..	..	..	..	..
Supporting Frame—800 Amperes	328486	..	.. ..	1	0	0	1	0	0	..	..	..
Supporting Frame—800 Amperes	329475	..	.. ..	..	..	..	..	..	..	1	0	0
Toggle Link—400-600 Amperes	329476	2	0 0	..	..	..	..	..	..	2	0	0
Toggle Link—400-600 Amperes	328464	..	.. ..	2	0	0	2	0	0	..	..	..
Toggle Link—800 Amperes	329476	2	0 0	..	..	..	..	..	..	..	..	..
Toggle Link—800 Amperes	328464	..	.. ..	2	0	0	2	0	0	..	..	..
Toggle Link—800 Amperes	329476	..	.. ..	..	..	..	..	..	..	2	0	0
Bearing Shaft—400-600 Amperes	329460	1	0 0	..	..	..	..	..	..	..	..	..
Bearing Shaft—400-600 Amperes	315916	..	.. ..	1	0	0	1	0	0	..	..	..
Bearing Shaft—400-600 Amperes	315917	..	.. ..	..	..	..	..	..	..	1	0	0
Bearing Shaft—800 Amperes	329460	1	0 0	..	..	..	..	..	..	..	..	..
Bearing Shaft—800 Amperes	315916	..	.. ..	1	0	0	1	0	0	..	..	..
Bearing Shaft—800 Amperes	315917	..	.. ..	..	..	..	..	..	..	1	0	0

Parts indented are included in the part under which they are indented.
Illustrated on page 9-10.
*Not illustrated.

RENEWAL PARTS DATA

Type F-22 Oil Circuit-Breaker

Double Throw

600-800 Amperes—2500 Volts

Breaker Units in Use up to and including		1	5		1	5		1	5
Name of Part	Style No.	2 Pole			3 Pole			4 Pole	
		No. Per Unit	Recommended for Stock		No. Per Unit	Recommended for Stock		No. Per Unit	Recommended for Stock
Breaker Unit Complete	.....	1	0	0	1	0	0	1	0	0
Leather Bumper	496019	8	0	2	8	0	2	8	0	2
Lift Rod—600 Amperes	478670	4	1	2	6	1	4	8	1	4
Lift Rod—800 Amperes	472855	4	1	2	6	1	4	8	1	4
Moving Contact Bar—600 Amp.	472856	4	1	2	6	1	4	8	1	4
Moving Contact Bar—800 Amp.	478669	4	1	2	6	1	4	8	1	4
Arcing Contact—Moving	328470	8	8	16	12	12	24	16	16	32
Stationary Contact—600 Amp.	439157	4	0	2	6	0	2	8	0	2
Stationary Contact—800 Amp.	439158	4	0	2	6	0	2	8	0	2
Stationary Contact—Center—600 Amp.	439159	2	0	1	3	0	1	4	0	1
Stationary Contact—Center—800 Amp.	439160	2	0	1	3	0	1	4	0	1
*Porcelain Insulator	328480	6	0	2	9	1	2	12	1	2
Contact Finger	328455	48	48	96	72	72	144	96	96	192
*Contact Spring	751540	96	48	96	144	36	144	192	48	192
Contact Stud—600 Amp.	496935	6	0	2	9	0	2	12	0	2
Contact Stud—800 Amp.	403980	6	0	2	9	0	2	12	0	2
Operating Spring	315770	4	0	2	4	0	2	4	0	2
*Tank	439096	1	0	0	1	0	0	1	0	0
*Tank Liner with Barrier Slots	472853	3	0	2	2	0	1	2	0	1
*Tank Liner with One Barrier Slot	478671	1	0	1	2	0	1	2	0	1
*Tank Liner Barrier	472854	1	0	1	1	0	1	1	0	1
Main Lever—Right Hand	757879	1	0	0	1	0	0	..	..	..
Main Lever—Right Hand	757877	..	..	..	..	..	..	1	0	0
Main Lever—Left Hand	757880	1	0	0	1	0	0	..	..	..
Main Lever—Left Hand	757878	..	..	..	..	..	..	1	0	0
Cross Bar	945579	1	0	0	1	0	0	..	..	..
Cross Bar	945580	..	..	..	..	..	..	1	0	0
Supporting Frame	945581	1	0	0	1	0	0	1	0	0
Toggle Link	300721	2	0	0	4	0	0	4	0	0
Bearing Shaft	315917	2	0	0	2	0	0	2	0	0

Parts indented are included in the part under which they are indented.
Illustrated on pages 9-10.
Not illustrated.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number, and the type of Circuit Breaker, as shown on the nameplate. For example:

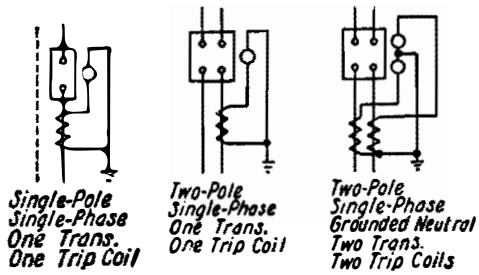
One Moving or Stationary Contact Complete, 1200 Amperes, for Type B-28-B Oil Circuit Breaker, S.O. 19-F-470, shown in Instruction Book 5706, Figure 2.

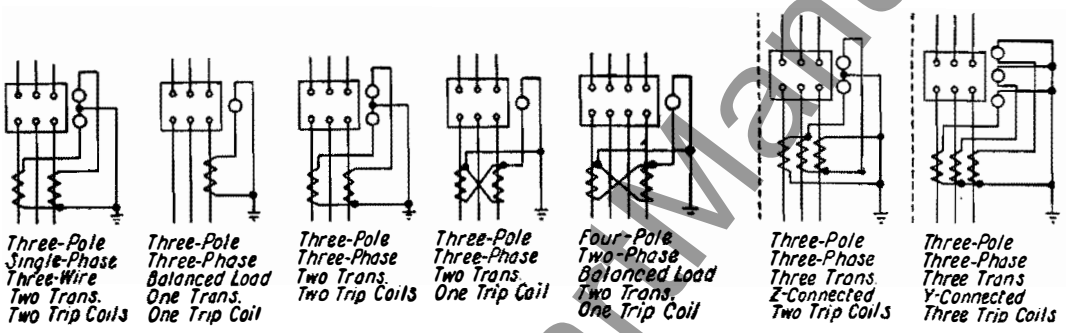
To avoid delays and misunderstandings, note carefully the following points:

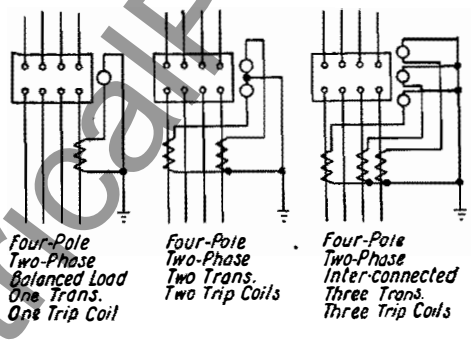
1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.







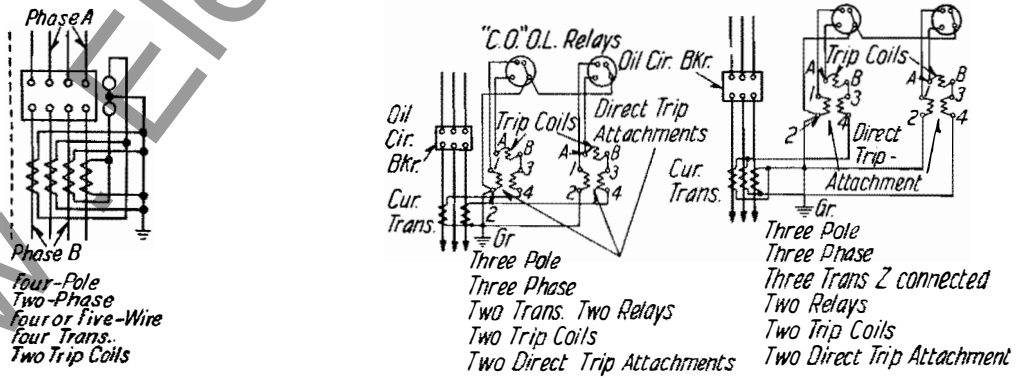


FIG. 33—DIAGRAMS OF CONNECTIONS

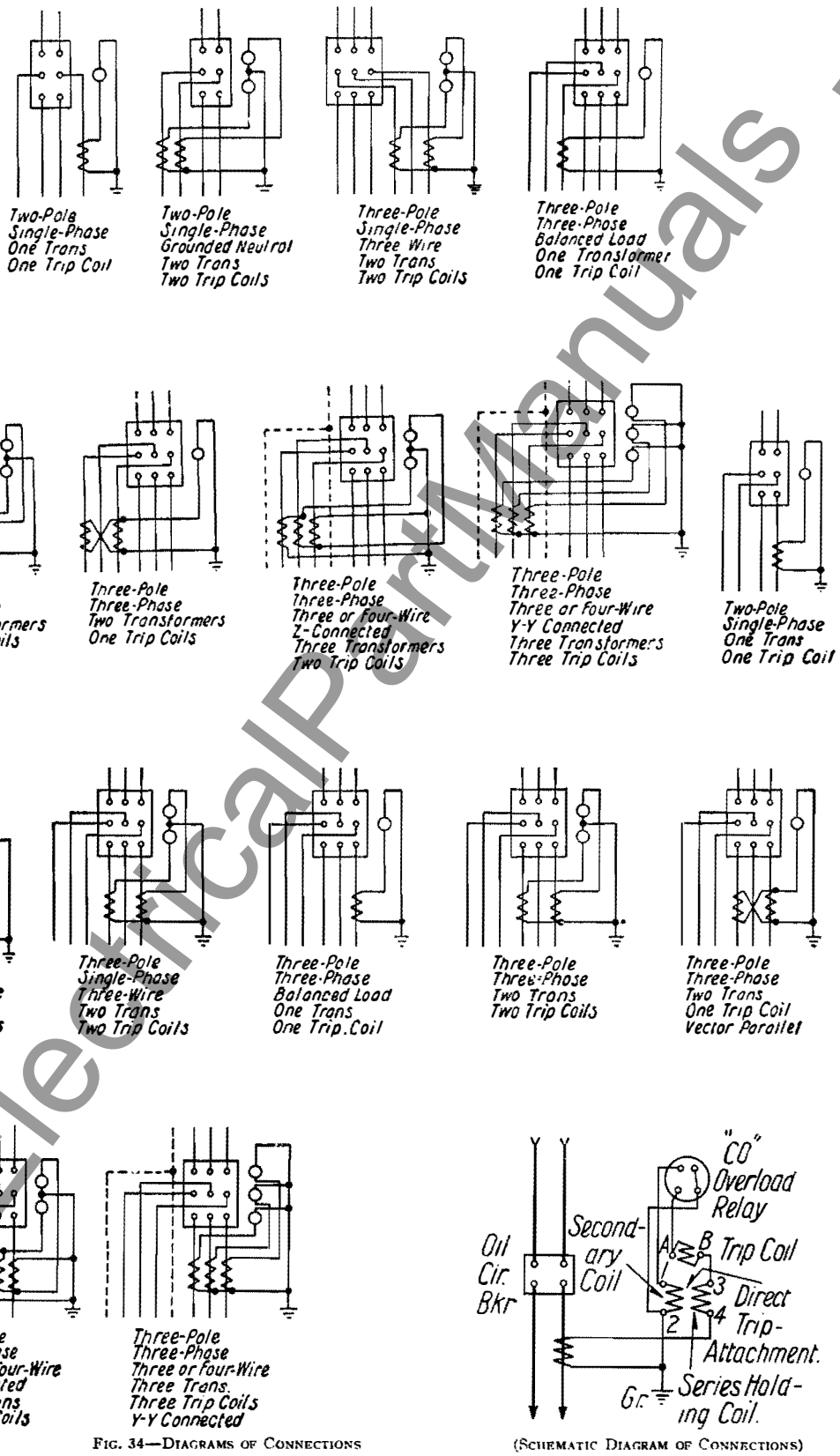
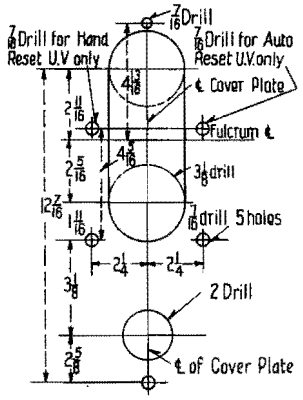


FIG. 34—DIAGRAMS OF CONNECTIONS

(SCHEMATIC DIAGRAM OF CONNECTIONS)

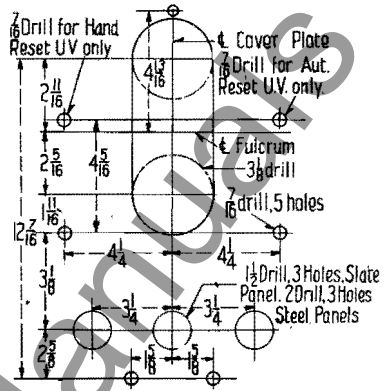
Drilling Dimensions in Inches

FOR INSTANTANEOUS AND INVERSE TIME LIMIT ATTACHMENTS



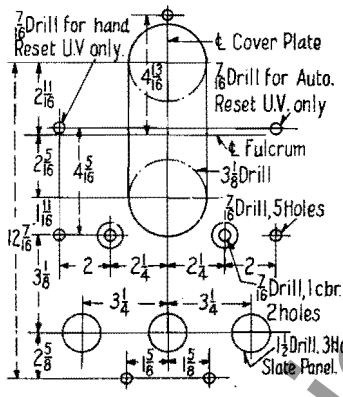
DWG. NO. 390982

S. T., 2-5 AMP., OR SHUNT COILS, SWBD. MTG. OR REMOTE CONTROL



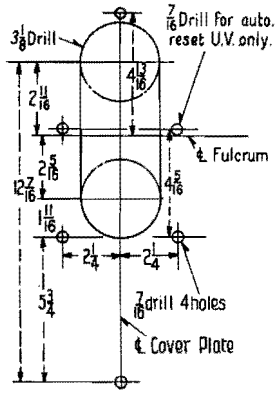
DWG. NO. 390945

S. T., 3-5 AMP. OR SHUNT COIL REMOTE CONTROL



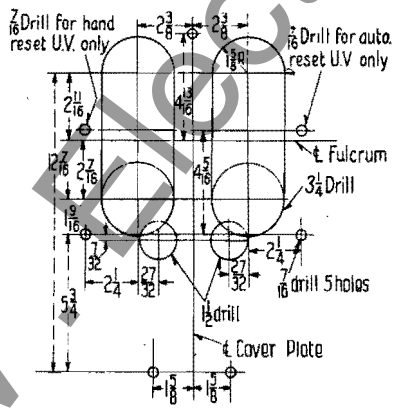
DWG. NO. 390946

S. T., 3-5 AMP. OR SHUNT COILS, SWBD. MTG.



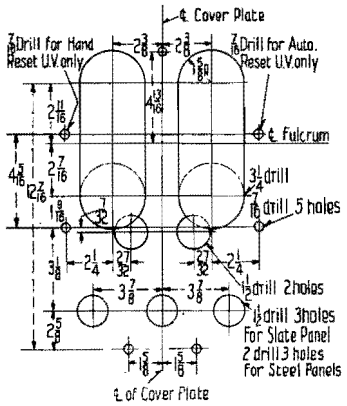
DWG. NO. 394579

S. T., NON-AUTO, SWBD. MTG. OR REMOTE CONTROL



DWG. NO. 394583

D. T., NON-AUTO. SWBD. MTG. OR REMOTE CONTROL



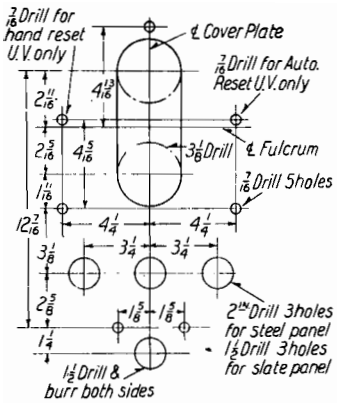
DWG. NO. 390968

D. T., 3-5 AMP. OR SHUNT COILS, SWBD. MTG. OR REMOTE CONTROL

FIG. 35—DRILLING PLANS

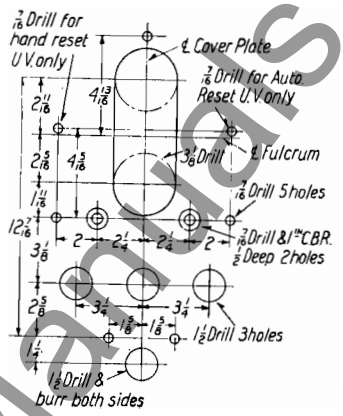
Drilling Dimensions in Inches

FOR DIRECT TRIP ATTACHMENTS



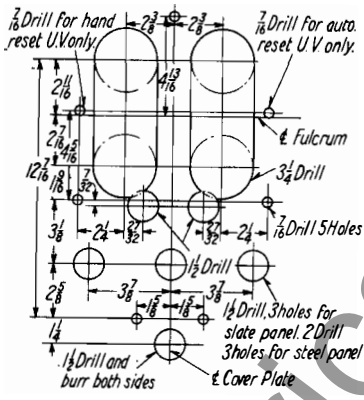
DWG. NO. 898890

S. T., 3-5 AMP. OR SHUNT COIL REMOTE CONTROL



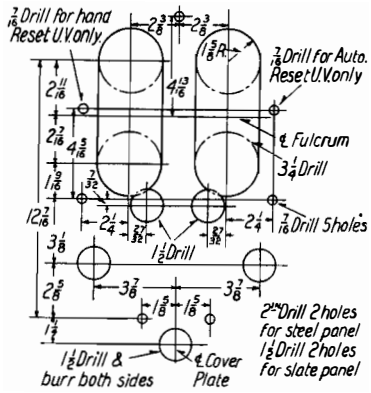
DWG. NO. 898891

S. T., 3-5 AMP. OR SHUNT COILS, SWBD. MTG.



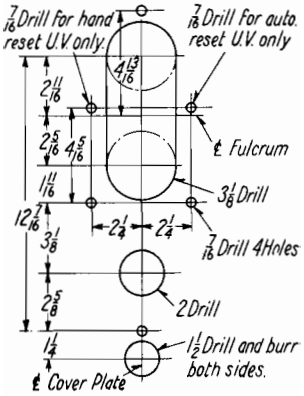
DWG. NO. 898892

D. T., 3-5 AMP. OR SHUNT COILS, SWBD. MTG. OR REMOTE CONTROL



DWG. NO. 898893

D. T., 2-5 AMP. OR SHUNT COILS, SWBD. MTG. OR REMOTE CONTROL



DWG. NO. 898894

S. T., 1-5 AMP., OR SHUNT COILS, SWBD. MTG. OR REMOTE CONTROL

FIG. 36—DRILLING PLANS

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Address nearest Sales Office or Agent-Jobber

WESTINGHOUSE SALES OFFICES

AKRON, OHIO, 11 S. Main St.
ALBANY, N. Y., 360 Broadway
ALLENTOWN, PA., 522 Maple St.
APPLETON, WIS., #1 Bellaire Court
*ATLANTA, GA., 426 Marietta St. N. W.
BAKERSFIELD, CALIF., 2224 San Emedio St.
BALTIMORE, MD., 118 E. Lombard St.
BEAUMONT, TEX., La Salle Horel
BIRMINGHAM, ALA., 2030 Second Ave.
BLUEFIELD, W. VA.. 208 Bluefield Ave.
*BOSTON, MASS., 10 High St.
BRIDGEPORT, CONN., Bruce Ave. and Seymour St.
*BUFFALO, N. Y., 814 Ellicott Square
BURLINGTON, IOWA, P. O. Box 197
BURLINGTON, VT., 208 Park Ave.
*BUTTE, MONT., 52 E. Broadway
CANTON, OHIO, 120 Tuscarawas St., West
*CHARLOTTE, N. C., 210 E. Sixth St.
CHATTANOOGA, TENN., 536 Market St.
CHICAGO, ILL., 20 N. Wacker Drive
*CINCINNATI, OHIO, 207 W. Third St.
*CLEVELAND, OHIO, 1216 W. 58th St.
†COLUMBUS, OHIO, Gay & Third St.
*DALLAS, TEX., 209 Browdet St.
DAVENPORT, IOWA, 206 E. Second St.
DAYTON, OHIO, 32 N. Main St.
*DENVER, COLO., 910 Fifteenth St.
*DETROIT, MICH., 5757 Trumbull Ave.
DULUTH, MINN., 10 East Supetior Street
ELMIRA, N. Y., 338 E. Water St.
*EL PASO, TEXAS, 303 N. Oregon St.
*EMERYVILLE, CALIF., 5815 Peladeau St.
†ERIE, PA., 1003 State St.
EVANSVILLE, IND., P. O. Box 457.
FAIRMONT, W. VA., 602 Cleveland Ave.
FORT WAYNE, IND., 1010 Packard Ave.
FORT WORTH, TEX., 501 Jones St.
GARY, IND., 735 Arthur St.
GRAND RAPIDS, MICH., 507 Monroe Ave. N.W.
GREENVILLE, S. C., West Earle St.
HAMMOND, IND., 403 Waltham St.
*HOUSTON, TEX., 608 Fannin St.
*HUNTINGTON, W. VA., 209 Ninth St.
INDIANAPOLIS, IND., 539 Madison Ave.
ISHPEMING, MICH., 433 High St.
JACKSON, MICH., 212 W. Michigan Ave.
JOHNSTOWN, PA., 47 Messenger St.
KANSAS CITY, MO., 2124 Wyandotte St.
KNOXVILLE, TENN., 602 Gay St.
LITTLE ROCK, ARK., 1115 West Twenty-fourth St.
*LOS ANGELES, CALIF., 420 S. San Pedro St.
LOUISVILLE, KY., 322 W. Broadway
MADISON, WIS., 508 Edgewood Ave.
†MARSHALL, TEXAS, 202 W. Merritt St.
MEMPHIS, TENN., 130 Madison Ave.
†MIAMI, FLA., 1036 N. Miami St.
MILWAUKEE, WIS., 546 N. Broadway
*MINNEAPOLIS, MINN., 2303 Kennedy St. N.E.
MONROE, LA., 1610 N. Fourth St.
NASHVILLE, TENN., 219 N. Second Ave.
*NEWARK, N.J., Haynes Ave. and Lincoln Highway
NEW HAVEN, CONN., 240 Cedar St.
*NEW ORLEANS, LA., 333 St. Charles St.
NEW YORK, N. Y., 30 Rockefeller Plaza
NIAGARA FALLS, N. Y., 205 Falls St.
†NORFOLK, VA., 254 Tazewell St.
OKLAHOMA CITY, OKLA., 10 E. California St.
OMAHA, NEB., 409 S. Seventeenth St.
PEORIA, ILL., 104 E. State St.
*PHILADELPHIA, PA., 3001 Walnut St.
PHOENIX, ARIZ., 11 W. Jefferson St.
PITTSBURG, KAN., P. O. Box 15
*PITTSBURGH, PA., 435 Seventh Ave.
PORTLAND, ME., P. O. Box 1797
*PORTLAND, ORE., 309 Southwest Sixth Ave.
PROVIDENCE, R. I., 393 Hartis Ave.
RALEIGH, N. C., 803 N. Person St.
RICHMOND, VA., 301 S. Fifth St.
ROCHESTER, N. Y., 410 Atlantic Ave.
ROCKFORD, ILL., 130 S. Second St.
†SACRAMENTO, CALIF., 719 "K" St.
*SALT LAKE CITY, UTAH, 10 W. First South St.
SAN ANTONIO, TEX., 212 East Houston St.
SAN FRANCISCO, CALIF., 1 Montgomery St.
*SEATTLE, WASH., 603 Stewart St.
SIOUX CITY, IOWA, 2311 George St.
SOUTH BEND, IND., 216 E. Wayne St.
SPOKANE, WASH., 158 S. Monroe St.
SPRINGFIELD, ILL., 130 S. Sixth St.
SPRINGFIELD, MASS., 395 Liberty St.
*ST. LOUIS, MO., 411 N. Seventh St.
SYRACUSE, N. Y., 420 N. Geddes St.
TACOMA, WASH., 1023 "A" Street
TAMPA, FLA., 417 Ellamae Ave.
TOLEDO, OHIO, 245 Summit St.
TULSA, OKLA., 303 E. Brady St.
*UTICA, N. Y., 113 N. Genesee St.
WASHINGTON, D.C., 1434 New York Ave. N.W
WATERLOO, IOWA, 328 Jefferson St.
WICHITA, KAN., 400 South Emporia St.
WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
WORCESTER, MASS., 32 Southbridge St.
YORK, PA., 143 S. George St.
YOUNGSTOWN, OHIO, 25 E. Boardman St.
The HAWAIIAN ELECTRIC CO., Ltd., Honolulu, T. H.—Agent

*Warehouses located in these cities.

WESTINGHOUSE AGENT-JOBBERS

ABILENE, KAN., Union Electric Co.
AKRON, OHIO, The Moock Elec. Supply Co.
ALBANY, N. Y., Westinghouse Elec. Sup. Co., Inc.
ALLENTOWN, PA., Westinghouse Elec. Sup. Co
ATLANTA, GA., Westinghouse Elec. Sup. Co.
AUGUSTA, ME., Wetmore-Savage Elec. Supply Co.
BALTIMORE, MD., Westinghouse Electric Supply Co.
BANGOR, ME., Wetmore-Savage Elec. Sup. Co.
BINGHAMTON, N. Y., Westinghouse Electric Supply Co., Inc.
BIRMINGHAM, ALA., Moore-Handley Hdwe. Co.
BLUEFIELD, W. VA., Supetior-Sterling Co.
BOSTON, MASS., Wetmore-Savage Elec. Sup. Co.
BUFFALO, N. Y., McCarthy Bros. & Ford
BURLINGTON, VT., Wetmore-Savage Elec.Sup.Co.
BUTTE, MONT., Westinghouse Elec. Sup. Co.
CANTON OHIO, The Moock Elec. Supply Co.
CHARLOTTE, N. C., Westinghouse Elec. Sup. Co.
CHATTANOOGA, TENN., Mills & Lupton Sup. Co.
CHICAGO, ILL., Hyland Elec. Supply Co.
CHICAGO, ILL., Westinghouse Elec. Sup. Co., Inc.
CINCINNATI, O., The Johnson Elec. Sup. Co.
CLEVELAND, O., Westinghouse Elec. Sup. Co.
COLUMBIA, S. C., Westinghouse Elec. Sup. Co.
COLUMBUS, O., The Hughes-Peters Elec. Corp.
COLUMBUS, O., Pixley Elec. Supply Co.
DALLAS, TEX., Westinghouse Elec. Sup. Co.
DENVER, COLO., The Mine & Smelter Sup. Co.
DES MOINES, IA., Westinghouse Elec. Sup.Co.,Inc.
DETROIT, MICH., Westinghouse Elec. Sup. Co.
DULUTH, MINN., Westinghouse Electric Supply Co., Inc.
EL PASO, TEX., The Mine & Smelter Sup. Co.
EL PASO, TEX., Zork Hardware Co.
ERIE, PA., Stat Electrical Co.
EVANSVILLE, IND., Westinghouse Elec. Sup. Co.
FLINT, MICH., Westinghouse Elec. Sup. Co.
FORT WORTH, TEX., Westinghouse Elec. Sup. Co.
GRAND RAPIDS, MICH., Westinghouse Electric Supply Co.
GREENVILLE, S. C., Westinghouse Elec. Sup. Co.
HOUSTON, TEX., Westinghouse Elec. Sup. Co.
HUNTINGTON, W. VA., Banks-Miller Sup. Co.
INDIANAPOLIS, IND., Westinghouse Elec. Sup. Co.
JACKSONVILLE, FLA., Westinghouse Elec.Sup.Co.
KANSAS CITY, MO., Columbian Electrical Co.
KNOXVILLE, TENN., Westinghouse Elec. Sup. Co.
LOS ANGELES, CALIF., Westinghouse Electric Supply Co.
LOUISVILLE, KY., Tafel Electric Co.
MADISON, WIS., Westinghouse Elec. Sup. Co.,Inc.
MEMPHIS, TENN., Westinghouse Elec. Sup. Co.
MILWAUKEE, WIS., Westinghouse Electric Supply Co., Inc.
MINNEAPOLIS, MINN., Westinghouse Electric Supply Co., Inc.
MONROE, LA., Monroe Hardware Co.
NASHVILLE, TENN., Tafel Electtic Co.
NEWARK, N. J., Westinghouse Elec. Sup. Co., Inc.
NEW HAVEN, CONN., Westinghouse Elec.Sup. Co.
NEW ORLEANS, LA., Electrical Supply Co.
NEW YORK, N. Y., Times Appliance Co., Inc.
NEW YORK, N. Y., Westinghouse Elec.Sup.Co.,Inc.
†NORFOLK, VA., Westinghouse Elec. Supply Co.
OAKLAND, CALIF., Westinghouse Electtic Supply Co.
OKLAHOMA CITY, OKLA., Westinghouse Electric Supply Co.
OMAHA, NEB., Westinghouse Elec. Sup. Co., Inc.
PEORIA, ILL., Westinghouse Elec. Sup. Co., Inc.
PHILADELPHIA, PA., Westinghouse Electric Supply Co.
PHOENIX, ARIZ., Westinghouse Electric Supply Co.
PITTSBURGH, PA., Iron City Electric Co.
PORTLAND, ORE., Westinghouse Elec. Supply Co.
PROVIDENCE, R. I., Wetmore-Savage Elec.Sup. Co.
RALEIGH, N. C., Westinghouse Electric Supply Co.
READING, PA., Westinghouse Elec. Sup. Co.
RICHMOND, VA., Westinghouse Elec. Sup Co..
ROCHESTER, N.Y., Westinghouse Elec. Sup. Co., Inc.
SALT LAKE CITY, UTAH, Westinghouse Electric Supply Co.
SAN ANTONIO, TEX., Westinghouse Elec.Sup.Co.
SAN FRANCISCO, CALIF., Westinghouse Electric Supply Co.
SCRANTON, PA., Penn. Elec'l. Engineering Co.
SEATTLE, WASH., Westinghouse Elec. Supply Co.
SIOUX CITY, IA., Westinghouse Elec. Sup. Co., Inc.
SPOKANE, WASH., Westinghouse Elec. Sup. Co.
SPRINGFIELD, MASS., Wetmore-Savage Elec. Supply Co.
ST. LOUIS, MO., Westinghouse Elec. Sup. Co.
ST. PAUL, MINN., Westinghouse Electtic Supply Co., Inc.
SYRACUSE, N. Y., Westinghouse Elec.Sup.Co.,Inc.
TAMPA, FLA., Westinghouse Electric Supply Co.
TOLEDO, OHIO, Westinghouse Elec. Sup. Co.
TRENTON, N. J., Westinghouse Elec. Sup. Co., Inc.
TULSA, OKLA., Westinghouse Elec. Sup. Co.
UTICA, N. Y., Westinghouse Elec. Sup. Co., Inc.
WASHINGTON, D. C., Westinghouse Electric Supply Co.
WATERLOO, IA., Westinghouse Elec. Sup. Co.,Inc.
WICHITA, KAN., Westinghouse Electric Supply Co.
WILMINGTON, DEL., Westinghouse Elec. Sup. Co.
WORCESTER, MASS., Wetmore-Savage Elec. Sup. Co.
YORK, PA., Westinghouse Elec. Sup. Co.
YOUNGSTOWN, OHIO, Moock Elec. Supply Co

WESTINGHOUSE SERVICE SHOPS

APPLETON, WIS., 1029 S. Outagamie St.
ATLANTA, GA., 426 Marietta St., N. W.
BALTIMORE, MD., 501 East Preston St.
BOSTON, MASS., 12 Farnsworth St.
BRIDGEPORT, CONN., Bruce Ave. and Seymour St.
BUFFALO, N. Y., 1132 Seneca St.
CHARLOTTE, N. C., 210 E. Sixth St.
CHICAGO, ILL., 2211 W. Pershing Road
CINCINNATI, OHIO, 207 W. Third St.
CLEVELAND, OHIO, 1216 W. 58th St.
DENVER, COLO., 2644 Walnut St.
DETROIT, MICH., 5757 Trumbull Ave.
FAIRMONT, W. VA., 602 Cleveland Ave.
HOUSTON, TEX., 2315 Commerce St.
HUNTINGTON, W. VA., 209 Ninth St.
INDIANAPOLIS, IND., 551 W. Merrill St.
JOHNSTOWN, PA., 47 Messenger St.
KANSAS CITY, MO., 2124 Wyandotte St.
LOS ANGELES, CALIF., 420 S. San Pedro St.
MILWAUKEE, WIS., 1669 N. Water Street
MINNEAPOLIS, MINN., 2303 Kennedy St., N. E.
NEWARK, N. J., Haynes Ave. and Lincoln Highway
NEW YORK, N. Y., 460 W. Thirty-fourth St.
PHILADELPHIA, PA., 3001 Walnut St.
PITTSBURGH, PA., 543 N. Lang Ave.
PORTLAND, OREGON, 2138 N. Interstate Ave.
PROVIDENCE, R. I., 393 Hartis Ave.
ROCHESTER, N. Y., 410 Atlantic Ave.
SALT LAKE CITY, UTAH, 346-A Pierpont Ave.
SAN FRANCISCO, CALIF., 1466 Powell Street, Emeryville, Calif.
SEATTLE, WASH., 3451 East Marginal Way
SPRINGFIELD, MASS., 395 Liberty St.
ST. LOUIS, MO., 717 S. Twelfth St.
UTICA, N. Y., 113 N. Genesee St.
WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
WORCESTER, MASS., 32 Southbridge St.

†Change from previous issue.

WESTINGHOUSE ELECTRIC INTERNATIONAL CO.
30 ROCKEFELLER PLAZA, NEW YORK, U. S. A.

Westinghouse Press—Printed in U. S. A.—S. A. J. S.-1--6-35

CANADIAN WESTINGHOUSE CO., Limited
HAMILTON, ONTARIO