Westinghouse

Types B-7, B-8 and B-10 Oil Circuit-Breakers

INSTRUCTION BOOK

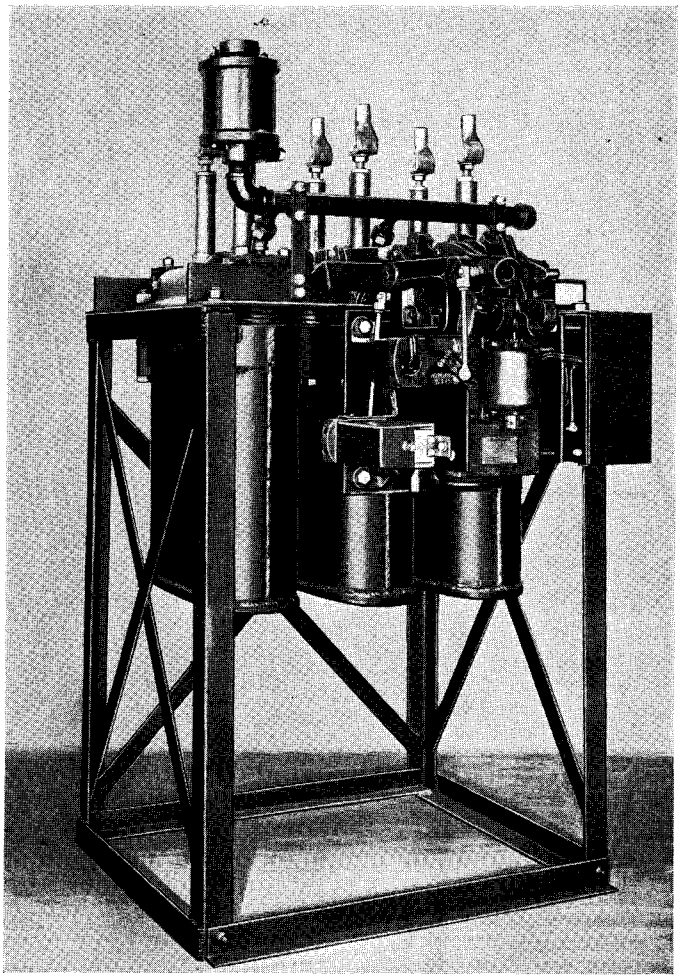

FIG. 1—ASSEMBLY OF COMPLETE 3-POLE TYPE B-8 BREAKER

Westinghouse Electric & Manufacturing Company

East Pittsburgh Works East Pittsburgh, Pa.

I. B. 5481

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GENERAL INFORMATION

Introduction

The oil circuit-breaker in a modern power system must always be ready to function. It must close when the operator energizes the closing solenoid on electrically-operated circuit-breakers or moves the operating handle on the manually-operated circuit-breakers. It must open promptly when tripped by the operator or by the control relays. It must be ready to operate under faulty conditions on the power system in which it is used. The circuit-breaker should be properly installed and given adequate maintenance so as to be ready to operate at all times in a desirable manner. A thorough knowledge of the construction of the circuit-breaker and a complete understanding of the instructions given in this book are essential to the satisfactory maintenance and operation of the apparatus. The standards of the American Institute of Electrical Engineers, the rules of the N.E.L.A. and the Hand Book for Power Switchboards and Switching Equipment published by the National Electric Manufacturers Association all give valuable rules covering the design, application, installation, and operation of circuit-breakers. This instruction book should be placed on file where it is handy to the maintenance staff after the installation work is complete. Additional copies can be obtained from the nearest sales office of the Westinghouse Electric & Manufacturing Company or from any representative of the Company.

Checking

Upon receipt of the breakers, all boxes, barrels, packages and loose pieces should be checked with the shipping list to make certain that all parts have been received.

Storage

In the event the breakers are not to be installed immediately, but are to be placed in storage awaiting installation, it is recommended that they be stored in the original shipping packages and containers. This serves to protect the breakers from dust, dirt and breakage. Do not store the breakers where they will be subjected to rain, sweating, corrosive gases, or damage; or in the immediate vicinity of construction work, as the dust incident to work on concrete structures will work into the bearings and sliding parts of the circuit-breaker, causing undue friction and destructive abrasion.

Machined surfaces should be slushed with a heavy oil or compound if the breakers are stored for any length of time. Inspect the circuit-breakers periodically to make sure that rusting has not started.

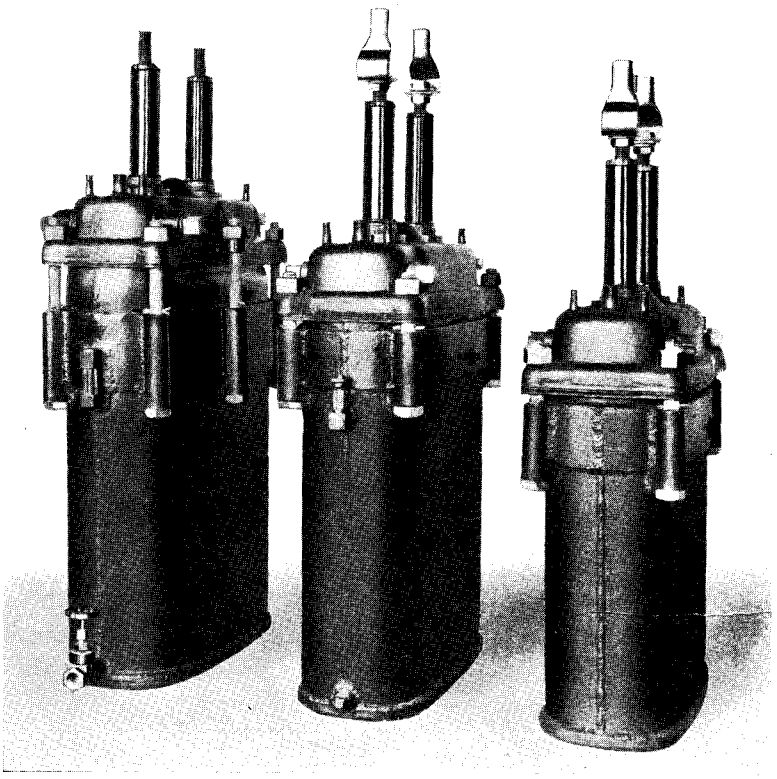


FIG. 2—MULTIPLE SINGLE-POLE UNITS FOR TYPES B-7, B-8 AND B-10 OIL CIRCUIT-BREAKERS

Unpacking

It is essential that care be used in unpacking the breakers, otherwise the bushings, mechanisms, or attachments may be injured resulting in unnecessary repair expense before installation is made. All apparatus should be moved as near as possible to the point of installation before it is unpacked. Do not open cases with a heavy hammer or a bar; use a nail puller. After the boxing has been removed from the breaker, all excelsior, packing, paper and other foreign matter should be removed from all of the breaker parts. Check each part as it is removed from the crate against the shipping list to be sure that all parts are accounted for. See that all instruction books or cards and all identification tags are kept with their respective parts and are available during installation. It is recommended that the tie wires and tanks be left on the breaker until after permanent installation is made.

Claims

Immediately upon receipt of a circuit-breaker an examination should be made for any damage sustained while enroute. If injury is evident, or indication of rough handling is visible, a claim for damage should be filed at once with the transportation company, and the nearest Westinghouse Sales Office notified promptly.

Handling

It is necessary to give proper consideration to the matter of handling, lifting and moving the breaker and its parts. Considerable damage may result to the breaker, and its operation be impaired by improper handling. Do not attempt to lift the breaker or its mechanism by the levers or bushings or move the attachments around by taking hold of the coil leads. In handling the breaker, operating mechanism, or attachments, always take hold of the frame, which is rugged and able to withstand handling.

INSTALLATION

Construction of Mounting

These breakers may be mounted in trucks, cells or on pipe or angle framework. Work should not be started on any type of supporting structure until the certified outline drawings of the breaker have been received and checked. The breaker supporting members must be level, rigid and of sufficient strength to withstand the dead load plus the dynamic load due to rated circuit interruptions.

Mounting of Breaker

The breaker should be carefully hoisted into place and securely bolted to its mounting support before the tie wires or tanks are removed from the breaker unit. Check the installation for rigidity and alignment.

Muffler Connection

The muffler on three pole breakers is shipped connected to the manifold by a short nipple which does not allow sufficient electrical clearance. The muffler should be removed and inspected to see that no dirt has entered. It should then be mounted in its final location and connected to the outlet header which should exhaust outside the building. **Caution: Arrange the exhaust outlet so that it will be impossible for rain or condensation to enter the muffler piping.** The required length of pipe for a given muffler height is shown on all outline drawings. An oil proof cement, such as litharge and glycerine, should be used on all connections.

Inspection

Examine the condenser bushings carefully to see that they have not been injured by nails or bruised. Inspect the threads on the copper terminal studs for signs of damage. If any evidence of "burring" appears, file out the damaged threads with a small three cornered file until the contact nuts will turn down easily by hand; do not use a wrench for this purpose. A light application of vaseline makes a good lubricant for copper threads.

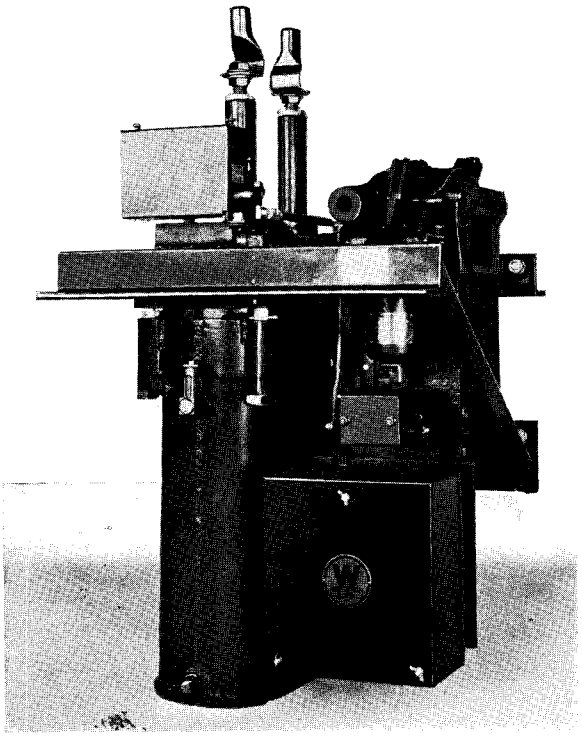


FIG. 3—ASSEMBLY OF COMPLETE SINGLE-POLE UNIT

The electric closing mechanisms should be gone over carefully to remove all particles of dirt from the cores, levers, auxiliary switches, etc. and to see that they are in proper operating condition.

The tank should then be lowered and the tank liner removed. Wipe off the liner and the inside of the tank with a clean cloth moistened with gasoline to insure that there is no foreign substance remaining which may float or dissolve in the oil. Examine the inside of the tank and the liner for evidences of moisture; both must be dried out thoroughly before oil is placed in the tank.

Electrical Connections

The main power leads may now be connected to the breaker terminals. The control leads should not be connected until the breaker has been given a thorough check by hand.

The size of the copper used to carry the main current should be adequate for the service and should not have a temperature rise exceeding 30°C. when carrying the full load current, or heating of the circuit-breaker may result. The connections between the copper and the circuit-breaker studs should be carefully made to insure that the joint is not a cause of heating. The cable should be carefully soldered into the terminal lugs and the terminal lugs carefully bolted to the circuit-breaker studs. The terminal lugs and the contact nuts, when used, should be carefully grained and should be clean

and free from dents or burrs. A coat of vaseline or linseed oil applied to the surfaces of the nuts before drawing them up will lubricate the contact surfaces so as to make them easier to tighten and eliminate danger of galling. There will also be less danger of galling when removal becomes necessary. The oil will also assist in making a better electrical connection between the nuts and the terminal.

The following table gives recommended sizes of cables and copper bus bars to be used for connecting different capacity circuits to the circuit-breaker.

The main current circuits within the circuit-breaker cell should all be taped with insulation equivalent to the circuit potential on all circuits of 2200 volts and above. This is in line with standard engineering practice. **All circuit-breakers must be adequately grounded.** The National Electrical Code requires grounding cables to have one fifth of the main circuit capacity except that it must never be smaller than #8 and need not be larger than #0 B & S gauge.

Recommended Sizes of Cables and Copper Bus Bars

Amps. 60 Cycl.	Amps. 25 Cycl.	Size R. C. Cable	Copper Strap
200	200	0000	2 x ¼
400	400	500,000	2 x ¼
600	700	1,000,000	3 x ¼
800	950	1,400,000	3 x ¼
1000	1200	1,900,000	4 x ¼
1200	1350	2–1,000,000	2–3 x ¼
1600	1800	3–1,000,000	2–4 x ¼
2000	2250	4–1,000,000	3–4 x ¼

OPERATION

Manual Check

Before replacing the tank, operate the circuit-breaker by hand several times, watching each pole and the closing mechanism to be sure that all parts move freely. Check the arcing tips to see that they operate satisfactorily and have the proper lead. With the breaker closed, check the main contacts with a 0.0015″ feeler gauge. It should be impossible to insert the feeler between any part of the finger or brush and the moving contacts. It is desirable to rub the contact surfaces lightly with fine sand paper before placing the breaker in service.

Adjustment

None of the adjustments of the breaker should be changed unless it is plainly seen that they have been disturbed after the breaker was operated on the test floor at the factory. It should not be necessary to alter any of these adjustments, as the circuit-breaker is not dismantled for shipment, and should arrive at the point of installation in exactly the same condition in which it left the factory. **For detail instructions on adjustment of any special part of this breaker see the second section of this book.**

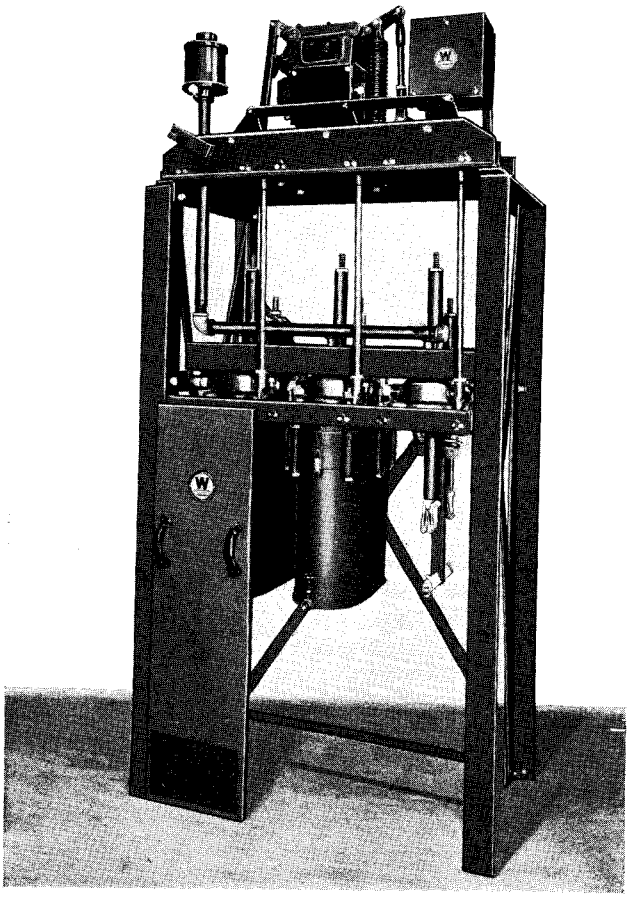


FIG. 4—ASSEMBLY OF COMPLETE 3-POLE OVERHEAD BREAKER

Electric Operation

When the breaker has been found to operate smoothy and easily by hand, the control circuit may be connected and the breaker operated electrically. Under electric operation, the breaker contacts should close rapidly, but without undue slamming. The operation of the cut-off relay should be carefully noted to see that it operates satisfactorily. The operating mechanism is designed to give correct operation on nameplate voltage at the coil terminals. When the mechanism is located a considerable distance from the battery, allowance should be made for the voltage drop between the bat-

tery and the terminals of the operating coils. When satisfactory electrical operation has been obtained, the tanks may be filled with oil to the level stated on the nameplate, and bolted in place. Be sure that the tank liners are in place before raising the tanks. Check the operation, both manually and electrically, with the tanks in place, after which the disconnects may be closed and the breaker placed in service. Note that the Westinghouse Electric & Manufacturing Company assumes the responsibility for oil circuit-breaker operation only when the insulating oil employed is in accordance with its recommendation. Wemco "C" oil should be used for all oil circuit-breaker installations. Although the oil is shipped in steel containers, it should be tested before being placed in the circuit-breaker tanks.

MAINTENANCE

Periodical Inspection

Periodic inspection should be made of the breaker structure in general to see that all bolts, nuts, and set screws are tight; that all cotters are in place, etc., as well as to note evidence of improper operation of the various mechanical parts. The mechanism and external connecting link bearings should be oiled occasionally with a light machine oil. An excess of oil should not be used because it collects dust which retards operation. The internal bearings are sufficiently "splash" oiled by normal breaker operation. In case the circuit-breaker is not in active service, it should be operated several times at each inspection.

The height of oil in the tanks, as indicated by the oil gauge, should be noted when the breaker is in the closed position, and these inspections should be of such frequency as to insure that the oil will be kept up to the required level. Otherwise, the ability of the breaker to interrupt short-circuits may be seriously impaired. All tank supporting bolts should be drawn up to a point where the packing between the tank rim and the breaker base is firmly compressed, in order that oil may be not forced out around this joint during the interruption of heavy short-circuits. The nature of this packing permits it to adjust itself under pressure only slowly, so that even though the holding bolts are drawn up as tightly as possible when the breaker is installed, they should be tightened again after a period of 4 days to one week. To insure a positive tight joint, a third inspection may be made after about 30 days.

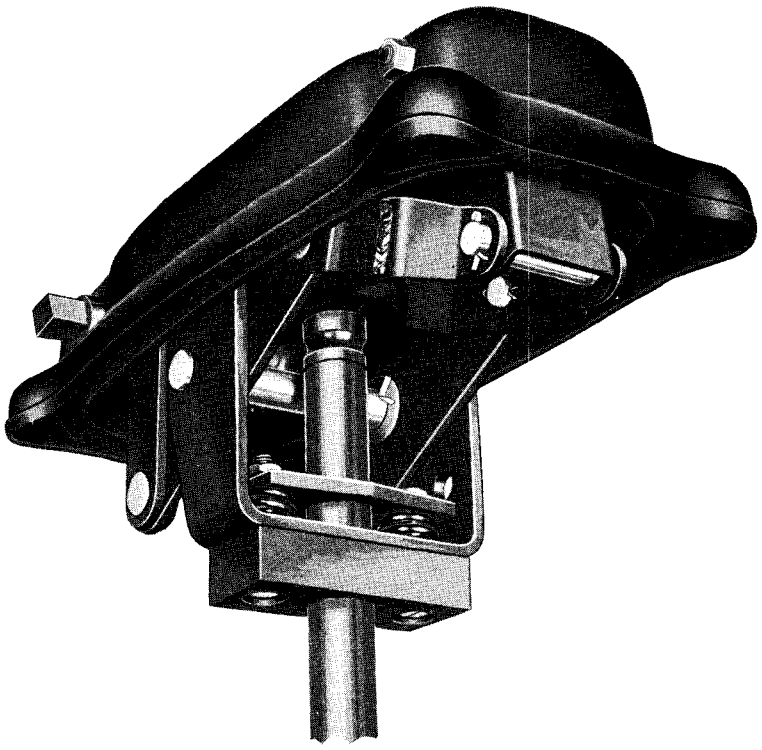


FIG. 5—LEVERS AND BASE OF TYPES B-7 AND B-8 OIL CIRCUIT-BREAKERS

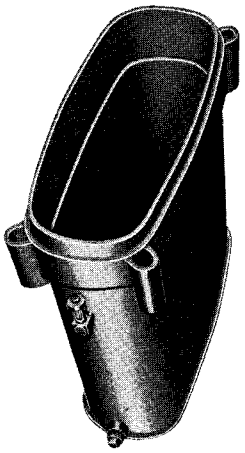


FIG. 6—TYPE B-8 TANK WITH FLAME PROOF LINER

Caution: Do not enter circuit-breaker cells nor attempt to remove tanks until all disconnects are open.

Periodic inspection should be made of the interior of the breaker chambers, the frequency of these inspections depending upon the severity of the service to which the breaker is exposed. At these inspections, check the mechanical parts within the breaker chamber for loose bolts, nuts, etc. as well as for evidences of mechanical injury. Examine the main contacts to see that neither the stationary nor the moving elements have been burned to such an extent that good contact is not secured. Check the arcing contacts to see that they are not burned away to a point where burning might ensue on the main contacts. If necessary, renew the arcing contacts. Examine the tank liners for burning whenever the oil is removed from the tanks. All tanks and liners should be thoroughly cleaned once each year.

When a circuit-breaker has opened an unusually severe short-circuit, or for some other reason has shown signs of distress, it is advisable to inspect the contacts without delay.

Insulating Oil

It is vital for the successful operation of high voltage circuit-breakers not to use oil in them which is not especially treated for this service. The Westinghouse Electric & Manufacturing Company assumes the responsibility for oil circuit-breaker operation only when the insulating oil employed is in accordance with its recommendations. Wemco "C" oil should be used for all oil circuit-breaker installations.

Dielectric tests of the oil should be made from time to time to insure that it is reasonably good for circuit-breaker work. Do not expect one sample to show all that should be known about the oil in a circuit-breaker tank. In testing for indications of water, take the sample from the bottom through the tank drain; if for indications of carbon, as after a heavy short-circuit, take the sample from the surface of the oil. For instructions as to the care and testing of insulating oil, see Instruction Book No. 5336.

Construction—Operation—Adjustments

GENERAL

Rating

The types B-7, B-8 and B-10 oil circuit-breakers are multiple single pole breakers of non-oil throwing design. They are all designed for 15,000 volt service in 600, 1200 and 2000 ampere capacities. The operating toggles and levers are all inside the breaker tops with connection to the outside by a square shaft running in bronze bushings.

Assemblies

These three breakers are mounted in one and three pole assemblies for either truck, cell, frame, or pipe mounting. Two and four pole assemblies can be made up to order. The truck may be either horizontal push or lift type. Operation may be either manual or electrical. In either case, the mechanism is trip-free in all positions.

POLE UNITS

Base

The base is pressed from steel plate and, therefore, is much lighter and smaller than a casting of similar strength. All holes through the top are counterbored and packed with an oil tight packing. An oil tight joint is secured between the tank and the base by means of a heavy impregnated flax packing in a groove around the underside of the base. The inner and outer walls of this groove serve to confine the packing when the tank is drawn up, thus preventing it from being blown out under internal pressure. The packing is sufficiently resilient to adjust itself under the pressure of the tank bolts, thus closing all openings and forming an air tight, oil tight joint. Note that the bumper plate is non-magnetic for 1200- and 2000-ampere breakers.

Tank

Figure 6 shows the complete tank and Micarta liner for the B-8 breaker. The tank consists of three formed plates welded together. A heavy reinforcing ring is welded around the tank near the top to which are welded the supports for the heavy tank bolts. These bolts are symmetrically located so that the tanks may be reversed to place the oil gauge and the drain at either the front or rear as desired. Lugs are welded to each side of the tank to permit the use of a tank lifter.

The oil gauge for the B-8 is of conventional design as shown in the figure, while the B-10 has a welded-in sight feed return type which is well protected against breakage, being built in as a part of the tank flange. The B-7 has neither oil gauge nor drain plug, as the tank is small. The B-8 has a drain plug, and the B-10 a drain valve.

A removable flame-proof tank liner is provided as an additional safeguard against arcing to the grounded shell of the tank under heavy short-circuit interruption. Tank liners should always be stored in a dry location. Both tanks and tank liners should be carefully dried and wiped off with a cloth moistened with gasoline before being placed in service.

Caution: Do not use tanks from 600- or 1200-ampere breakers on 2000-ampere breakers as excessive heating will result. The 2000-ampere tanks have one side non-magnetic.

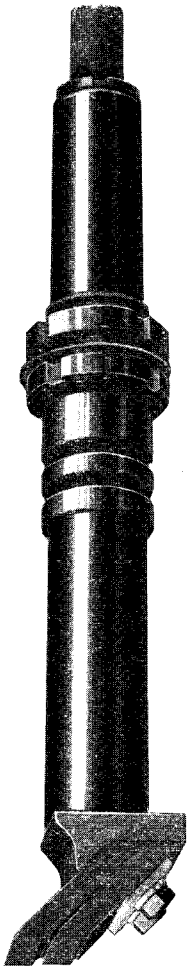


FIG. 7—BUSHING FOR 2000 AMP., TYPE B-8 OIL CIRCUIT-BREAKER

Terminal Bushings

The terminal bushings are of the condenser type which consist chiefly of a copper conductor rod on which are wound insulating layers of Micarta paper interspaced with strips of metal foil to give a uniform voltage stress distribution. The middle portion of the outer layer of Micarta is turned down in grooves to the outer, or ground, layer of foil and a brass sleeve is then slipped over the bushing and rolled into these grooves. This gives a good contact to the ground layer of foil and a rigid support for the entire bushing, as a collar which seats against the breaker top is threaded and brazed to the brass

sleeve. The bushing is prevented from turning by dowel pins through this collar and is held in place by a second nut which is screwed onto the rolled tube. Both the collar and the breaker top are machined to give perfect alignment, and the joint is made oil-proof by the use of a vellumoid gasket.

Repair: If the varnished surface is damaged or questionable, the surface should be revarnished with three coats of good quality, clear, air drying spar varnish. Each coat should be allowed to dry for 24 hours.

Contacts

Figure 10 shows the contact assembly for the 600-ampere finger type contact. These are of the multiple finger type, well-known for their ability to withstand rough usage; to provide adequate contact with the moving contacts without the close adjustment necessary for brush contacts and for the ease with which worn or damaged fingers may be replaced. This type of finger contact will not stick, the wide angle of contact is such as to insure positive opening—thus eliminating all hazards from sticking. The fingers are arranged in pairs which, with the moving contact wedge between, insures parallel path action

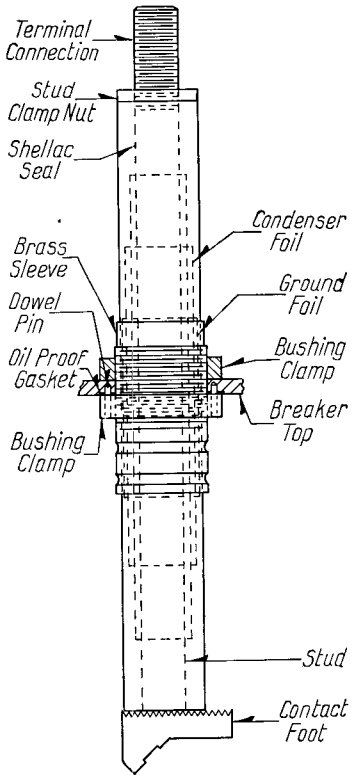


FIG. 8—DIAGRAM OF BUSHING SHOWN IN FIG. 7

in the stationary contacts, the magnetic forces between these two paths being such that under heavy current, the contact pressure is increased rather than diminished. The surfaces of the moving contact elements are such that the outer pair of stationary contact fingers, which are commonly called arcing fingers, always make contact first in closing the breaker, and break contact last in opening. This insures that the arc will always be drawn on the same pair of fingers, limiting the burning to this pair, and that the surface of the remaining fingers will be kept in proper condition for current carrying purposes.

Figure 9 shows the 2000-ampere brush contact. The 1200-ampere brush is similar, but has fewer laminations and does not have the middle pair of springs. These brushes are very flexible and have a long life when properly adjusted. Note that they are so designed that the current does not have to cross from one lamination to another, as full contact is made to each end of each lamination. In order to prevent distorting the brushes, it is essential that the stop on top of the lift rod be set to within $\frac{1}{32}$" of the breaker top when full contact is made on the brushes

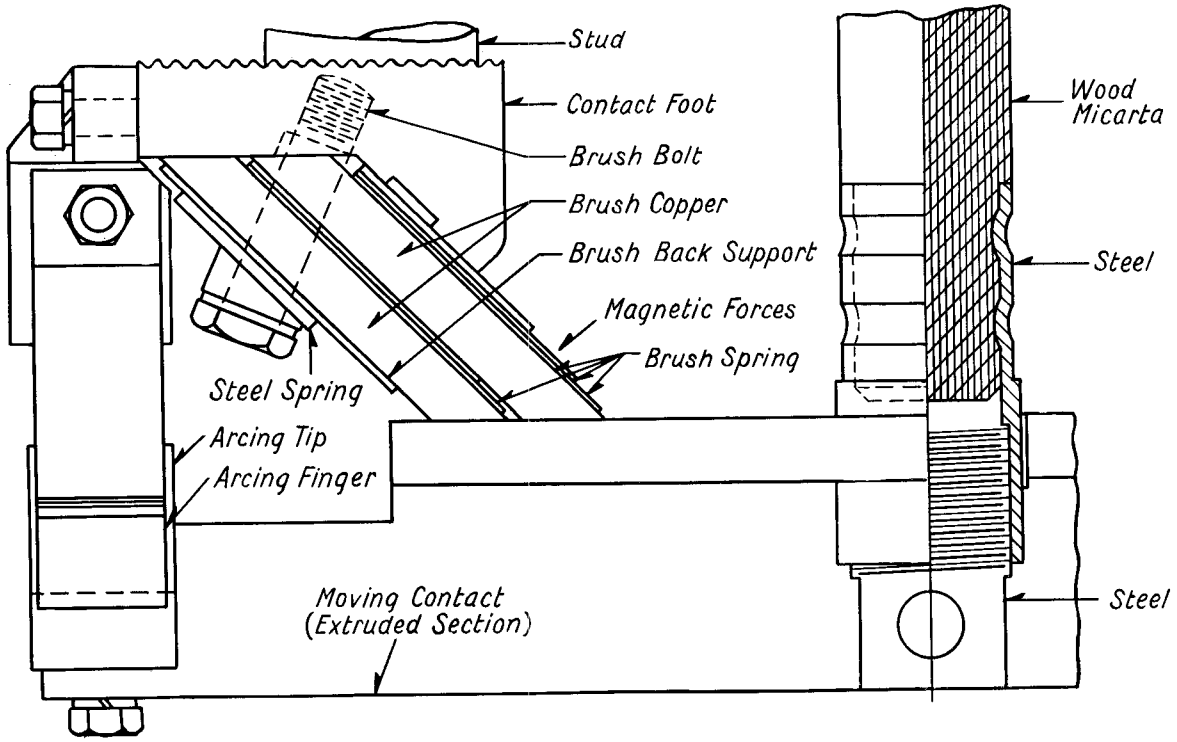


FIG. 9—CONTACT ASSEMBLY FOR 2000-AMPERE BREAKER

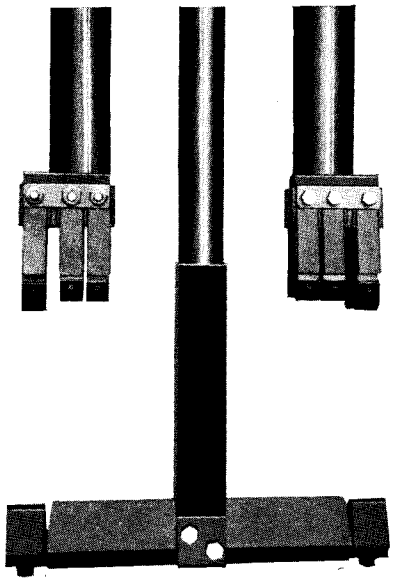


FIG. 10—CONTACTS FOR 600-AMPERE BREAKER IN OPEN POSITION

This adjustment is made on the link, outside the pole unit, which connects the pole unit lever to the mechanism. Adjust this link so that the stop makes contact with the breaker latched, but with the moving contact removed. Then connect the moving contacts and adjust for good contact. Check the stop and re-adjust if necessary. When replacing brushes, carefully grain all contact surfaces to remove the oxide and immediately cover the surfaces with a thin film of vaseline. Bolt the brushes securely in place and check the contact with an 0.0015-inch feeler gauge.

The arcing contacts used with the brush-type contacts are similar to those for the 600-ampere finger contacts except that they are larger and heavier as required for the greater interrupting rating.

Operation

These breakers are operated by a rotating square steel shaft which rotates in tight fitting bronze bushings. The internal links and levers are so designed that the lift rod has a straight line motion. In the closed position, the internal levers come to about one-half inch from the toggle position. This distance is held constant by the stop on the upper end of the lift rod hitting the breaker top. This stop has no adjustment as it is necessary for this toggle to stay approximately constant on all units. In the closed position, this stop should be within $\frac{1}{32}$" of making contact with the breaker top. There are no internal lever adjustments necessary or possible.

Muffler

One muffler is supplied for each single or 3-pole breaker to allow discharge of gases formed during interruption but to prevent any oil to escape. The muffler is composed of a series of baffles which allow the gases to escape, but deflect the oil toward the bottom and allow it to drain back toward the breaker when the pressure has been reduced to normal. In order to prevent any oil seal in the piping, the pipe should always slope upward from the breaker toward the muffler. In case it is necessary to run the pipe horizontal for any distance, it should be of larger section than would be necessary with a slope. It is recommended that the muffler outlets be connected to a common header exhausting outside of the building.

Tank Lifter

The tank lifter for these breakers is of the windlass type, with high ratio self-locking gearing. It is designed to fit securely on top of a pole unit without fastening. Its weight of 21 pounds is sufficient to hold it in place but small enough to allow easy handling.

This tank lifter is designed especially for power operation by means of an electric drill. Forward and reverse gearing is provided by a simple shift allowing the drill to both raise and lower the tank. A $\frac{5}{16}$" electric drill will raise a B-10 tank full of oil in about 15 seconds. In case electric power is not available, the lifter may be operated directly by a hand brace. In this case, it requires approximately 1½ minutes to lift a B-10 tank. The shaft ends are hardened to resist wear and are so designed that they will take a hexagon socket, three-jaw chuck, two jaw chuck or ½-inch pipe extension with ¼" bolts. This allows for simple operation under any condition of cell or truck mounting and with manual or electric power.

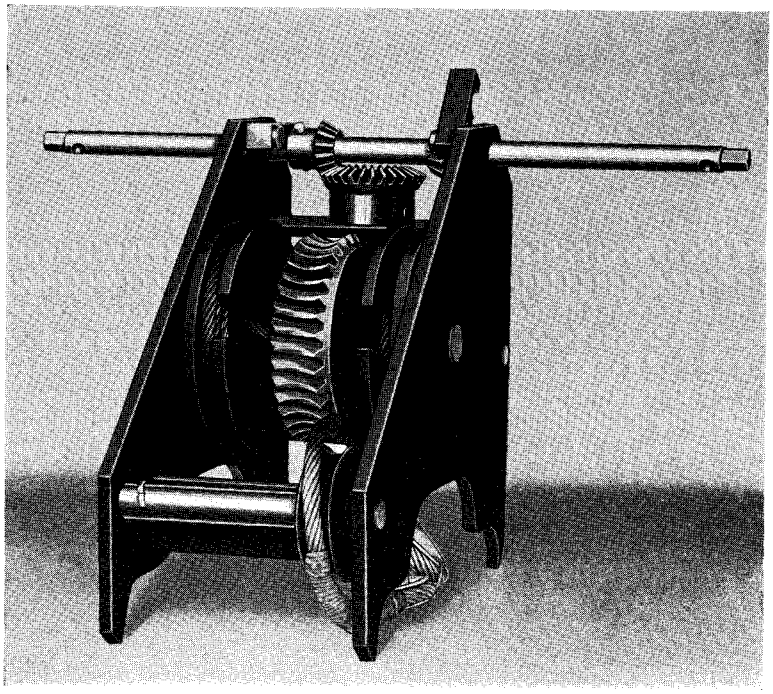


FIG. 10—WINDLASS TYPE TANK-LIFTER FOR B-7, B-8 AND B-10 OIL CIRCUIT-BREAKERS

ELECTRIC OPERATION

Type SA-3 Mechanism

The **unit construction,** where the mechanism and pole units are mounted together in one frame as a complete unit, is used throughout this line of breakers. This construction gives the neatest and best final installation as the complete unit may be located in place without changing any of the factory adjustments. The type SA-3 mechanically trip-free full-automatic solenoid closing mechanism is supplied as standard on the types B-7, B-8 and B-10 oil circuit-breakers. This mechanism is mechanically trip-free at any point in the closing stroke, making it impossible to hold the breaker in the closed position under predetermined conditions of overload on the line. Unlike many other types of solenoid mechanisms, this mechanism has no air valve, dashpot, or piston leathers. Two auxiliary switches, a 2-pole and a 6-pole, are ordinarily supplied with this mechanism. The 2-pole switch is connected to the main lever which carries the socket for hand closing and is used only to cut off the solenoid current at the end of the closing operation. The 6-pole switch is connected to the breaker side of the mechanism and is used to cut off the tripping circuit and for general indicating purposes.

Positive full opening of the circuit-breaker contacts is assured by an accelerating spring located at the rear of the mechanism.

The mechanism may also be closed manually when desired, by means of a hand closing lever, and tripped by raising the tripping lever. **Caution: Never "ease-in" a circuit-breaker. Always close it completely and positively with a fast, sure stroke.**

Operation—In closing the circuit-breaker, it should be noted that the roller at the end of the trip-free lever is properly latched. The moving core of the solenoid is then drawn up inside of the brass tube, until it has sufficiently raised the main pin in the closing lever to a point that allows the locking lever to snap under it and hold it in place. This position is maintained until the breaker is tripped out.

The moving closing core of the mechanism is suspended from the closing lever pin by a hook type rod end with a screw thread in order to give adjustment in relationship between the main pin on the closing lever and the locking lever when the closing cores come together.

Tripping is effected by means of the tripping solenoid as shown in Figure 14. When the tripping coil is energized, the moving core is drawn up, raising a striking pin which runs through the stationary core and engages the tripping lever. This tripping lever is connected to the latch by means of two links which form a toggle. In order to make the latch hold, the toggle must be on dead center or slightly over. This adjustment is secured through the use of an adjusting screw in the trip lever, backing the screw out, will ease off on the toggle and give very low tripping values. Running the screw in will allow the toggle to go farther over center and will, therefore, increase the tripping value.

Adjustment—All adjustments are made at the factory before the mechanism is shipped, and it should not be necessary to alter these in any way when placing the mechanism in service.

The mechanism should be adjusted to latch properly when the moving core pushes the pin in the closing lever up so that there is approximately $\frac{1}{32}$" clearance between it and the locking lever. This condition should be maintained as closely as possible in actual operation.

Adjustment of the back-lash, which is very important to successful operation of the circuit-breaker, is obtained by loosening the clamp bolts in the hooked rod end and releasing the locking key, and screwing the moving core up or down until the back-lash is correct. Be sure that the key is properly in place and the bolts securely drawn tight after any adjustment has been made.

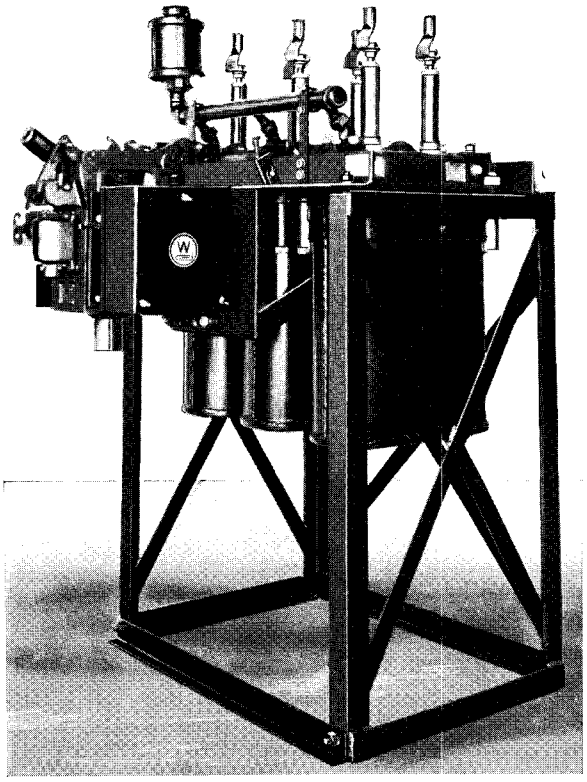


FIG. 11—ASSEMBLY OF COMPLETE ELECTRICALLY-OPERATED OIL CIRCUIT-BREAKER

The back-lash is the clearance between the moving and stationary cores. It is first set by hand in the following manner: with the breaker disconnected and the accelerating spring removed, the mechanism is closed by hand and the moving core run up until it stops against the stationary core; it is then backed off ½ to ¾ of a turn or until one of the keyways in the rod lines up with the key in the hooked rod end. The clamping bolts in the rod end are then drawn down tight. It is sometimes necessary to slightly alter this adjustment in order to secure positive latching with electric operation.

The back-lash may be checked electrically by closing the mechanism by hand and energizing the closing coil and observing the amount of lift on the main pin from which the moving core is suspended.

Auxiliary Switches—The 2-pole cut-off switch should be adjusted so that it makes contact as late in the closing stroke of the circuit-breaker as is consistent with obtaining adequate contact in the closed position. This is necessary, that the power be left on the closing coil long enough to insure that the breaker will completely close. The other auxiliary switch should be adjusted to give full contact in both the open and closed positions of the circuit-breaker.

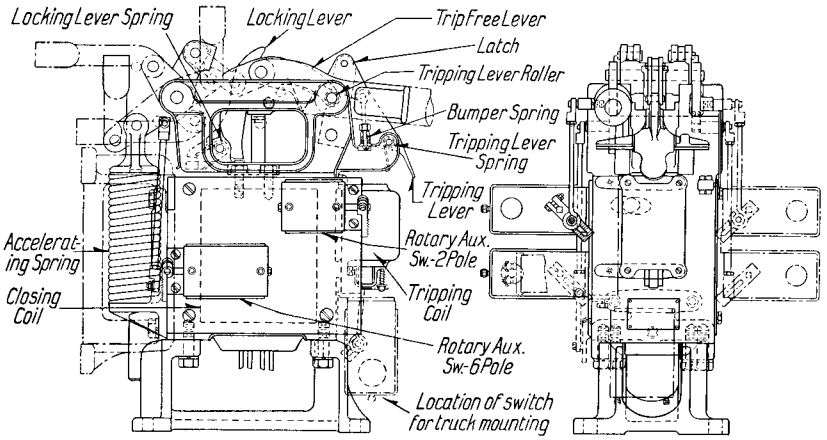


FIG. 14—ELECTRICALLY-OPERATED TYPE SA-3 MECHANISM

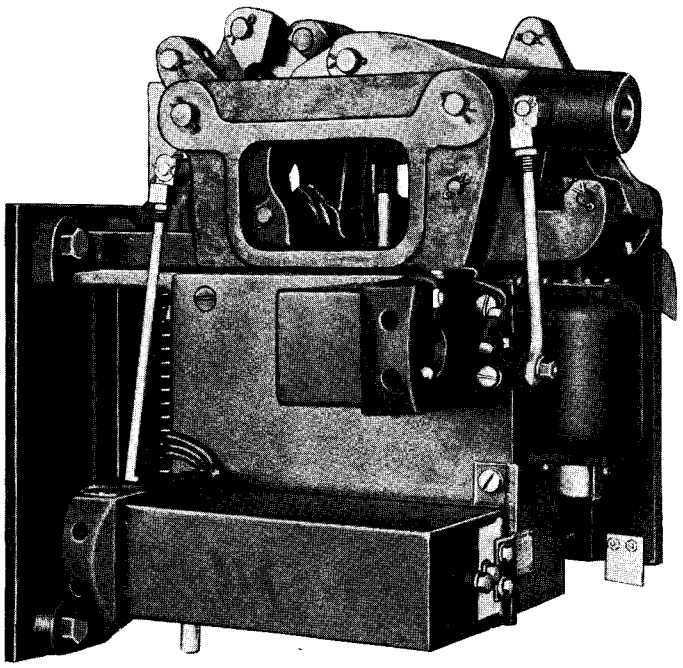


FIG. 13—ELECTRICALLY-OPERATED TYPE SA-3 MECHANISM (CLOSED POSITION)

Control Relay—These circuit-breakers are provided with a control relay panel (See Fig. 15) for operation in connection with the electric mechanism. This panel consists essentially of a control relay, a knife switch for opening the main control circuit, and terminals for complete circuit-breaker control wiring. The control relay operating coil is energized from a control switch on the switchboard when it is desired to close the circuit-breaker. The action of this coil closes the main control relay contacts, which allows current to flow through the main solenoid closing the circuit-breaker. When the circuit-breaker is nearly closed, the auxiliary switch on the circuit-breaker closes the circuit to the release coil of the control relay.

To make sure that this control panel is in the proper operating condition,

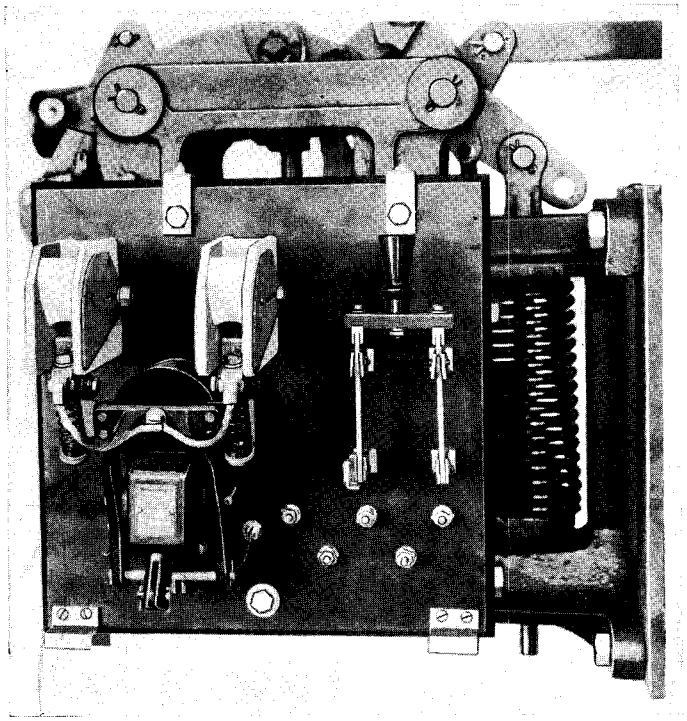


FIG. 15—TYPE SA-3 MECHANISM SHOWING CONTROL RELAY

the following points should be checked.

(1) The control relay should pick up and close the contacts on minimum closing voltage.
(2) The release coil must open the relay contacts when energized by minimum voltage. (Check with the relay in the closed position).
(3) The stop on the release coil housing should be set so as to allow the relay lever to open just far enough to permit the latch to re-engage.

Application to Circuit-Breakers—The mechanism may be arranged to mount in several positions with respect to the breaker such as in front, to one side, or above. These assemblies are made complete at the factory and should be installed without any change in adjustment. In case adjustment is necessary, it may be made by changing the length of the connecting links between the operating lever and pole units. These links should be adjusted so that all moving contacts start to close together and so that the stop on the upper end of each lift rod is within $\frac{1}{32}$" of the top when the circuit-breaker is closed. This may be checked by marking the lift rod at the guide with contacts on and off or by the use of a strip of $\frac{1}{32}$ material bent to fit over the lift rod in the closed position. If the strip is held tight between the stops the adjustment is correct.

A-C. Operation

Motor—A few standard assemblies are available for motor operation. For motor adjustments on these combinations, refer to I. B. 5331 "CF motor mechanism" or I. B. 5455 "CF-1 Motor Mechanism".

Rectox-Solenoid—Where a-c. operation is desired, it is recommended that the standard d-c. solenoid assembly be used in conjunction with a Rectox unit to supply the necessary direct current from the a-c. mains. For the proper care and operation of these circuit-breaker Rectox units, see Instruction Leaflet 1782 which is shipped with each unit.

Manual Operation

General Requirements—Circuit-breakers of high interrupting capacity should not be manually operated where they are subject to heavy short circuits. In case manual operation is necessary, the operator should be protected by a suit-

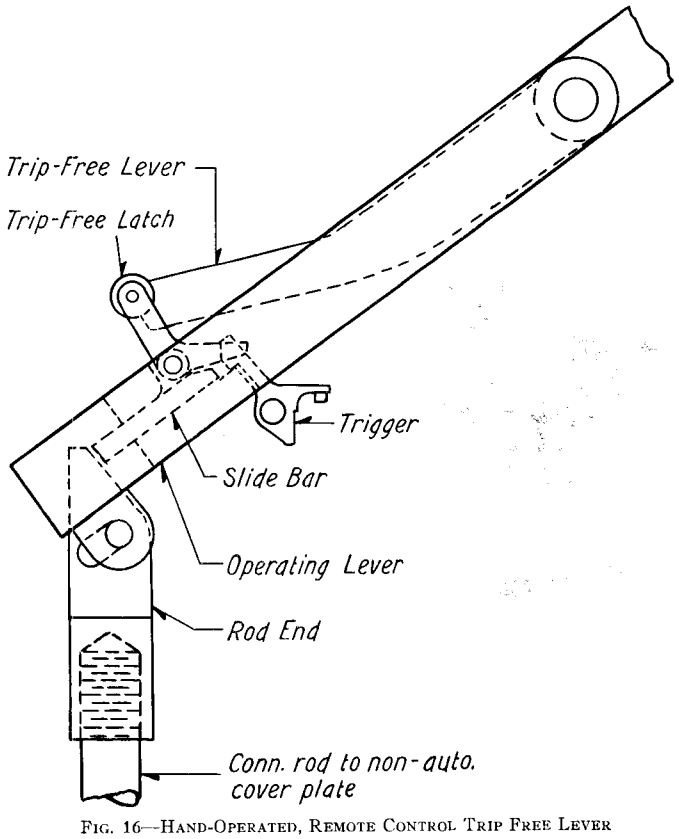


FIG. 16—HAND-OPERATED, REMOTE CONTROL TRIP FREE LEVER

able barrier. The operating rods should be trip-free from the breaker so that their inertia will not slow up the opening speed of the circuit-breaker and consequently reduce the interrupting capacity. **Note: Never close a circuit-breaker slowly. Always close it positively to the latched position with a smooth, fast stroke.**

Special Construction—Since power operation is recommended for this class of breakers, all standard manual operation assemblies are arranged from some standard solenoid assembly in such a manner that at any future date they may be easily changed over to electric operation. All bolt holes and levers are drilled for solenoid operation, and most of the manual additions are bolted in place so as to be readily removed. In some cases, it may be necessary to cut off a small lug which has been welded in place.

The standard manual operation assemblies have remote control operation using coverplates which are trip-free in all positions. A special feature is the use of two coverplates with the automatic one mounted directly on the breaker frame, thus making the breaker trip-free from all operating rods and bell cranks. This coverplate is remotely operated from a non-automatic coverplate at the operating position. The automatic coverplate has a special slide bar feature so that when the non-automatic handle is lifted slightly, it moves this slide bar against the trip free latch, tripping the breaker without any further motion of the connecting details. Additional lift of the handle forces the slide bar further releasing the main latch and allowing the handle to be lifted to the reset position.

Attachments—The automatic coverplate may be one, two, or three coil with attachments as follows:

(a) Standard overload coils—calibrated 5 to 9 amperes.

(b) Overload coils plus inverse time element oil dashpot.

(c) Overload coils plus direct trip. Requires CO relays, but gives accurate current-time calibration.

(d) Shunt trip. May have a-c. or d-c. coils as low as 12 volt d-c. Requires only one coil which may be used in conjunction with 2 overload coils.

(e) Undervoltage release attachments cannot be used with the standard assembly. Undervoltage release may be obtained by using a CV relay in conjunction with the shunt trip.

(f) Electric lockout or mechanical interlock cannot be supplied on the standard assembly.

(g) Bell alarm switch gives indication when the circuit-breaker has tripped, but handle has not been returned to the reset position.

(h) Auxiliary switch of the rotary type, 4-pole, single-throw, is supplied as standard.

For detail instructions on the care and adjustment of the above attachments, see the instruction card which is furnished with each.

Ordering Instructions

When ordering renewal parts, always specify the name of the part wanted as shown in the illustrations in this book, giving the shop order number, and the type of circuit-breaker, as shown on the nameplate. For example: One tank liner for type B-8 oil circuit-breaker, S. O. 87-E-432 as shown in Instruction Book No. 5481.

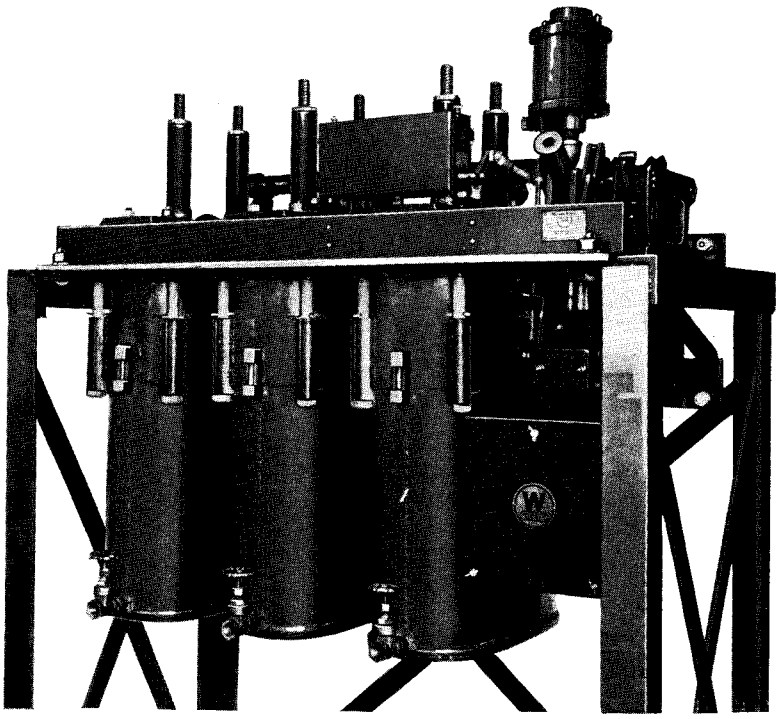


FIG. 17—ASSEMBLY OF TYPE B-10 OIL CIRCUIT-BREAKER WITH MECHANISM MOUNTED ON END

Renewal Parts Data

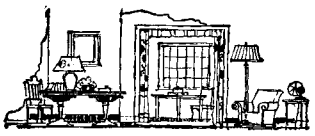
RECOMMENDED STOCK OF RENEWAL PARTS

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 to damage or breakage due to possible abnormal conditions. The maintenance of such stock will minimize service interruptions caused by breakdowns.

Name of Part	No. Per Pole Unit	Recommended for Stock: 1	Recommended for Stock: 5
Total Number of Pole Units Up To and Including		1	5
Parts Common for Types B-7, B-8 and B-10 Breakers But Special For Each Rating As Indicated			
Pole Unit Complete	1	0	0
Bumper Spring—Inner	2	0	1
Bumper Spring—Outer	2	0	1
Bumper Plate—600 Ampere	1	0	1
Bumper Plate—1200-2000 Ampere	1	0	1
Moving Main Contact—600 Ampere	1	0	1
Moving Main Contact—1200 Ampere	1	0	1
Moving Main Contact—2000 Ampere	1	0	1
Moving Arcing Contact—600 Ampere	2	2	6
Moving Arcing Contact—1200-2000 Ampere	2	2	6
Main Contact Finger—600 Ampere	8	4	16
Main Contact Finger Spring—600 Ampere	16	2	8
Main Contact Brush—1200 Ampere	4	0	1
Main Contact Brush—2000 Ampere	4	0	1
Arcing Contact Finger—600 Ampere	4	4	12
Arcing Contact Finger Spring—600 Ampere	8	1	4
Arcing Contact Finger—1200-2000 Ampere	4	4	12
Arcing Contact Finger Spring—1200-2000 Ampere	8	1	4
Parts Special for Each Type and Rating As Indicated			
Lifting Rod—Type B-7—600 Ampere	1	0	1
Lifting Rod—Type B-7—1200-2000 Ampere	1	0	1
Lifting Rod—Type B-8—600 Ampere	1	0	1
Lifting Rod—Type B-8—1200-2000 Ampere	1	0	1
Lifting Rod—Type B-10—600 Ampere	1	0	1
Lifting Rod—Type B-10—1200-2000 Ampere	1	0	1
Tank—Type B-7—600-1200 Ampere	1	0	0
Tank—Type B-7—2000 Ampere	1	0	0
Tank—Type B-8—600-1200 Ampere	1	0	0
Tank—Type B-8—2000 Ampere	1	0	0
Tank—Type B-10—600-1200 Ampere	1	0	0
Tank—Type B-10—2000 Ampere	1	0	0
Parts Common for All Ratings but Special for Each Type As Indicated			
Tank Liner—Type B-7	1	0	1
Tank Liner—Type B-8	1	0	1
Tank Liner—Type B-10	1	0	1
Oil Gauge—Type B-8	1	0	0
Oil Gauge Glass—Type B-8	1	0	1
Oil Gauge Glass—Type B-10	1	0	1
Parts Common to All Types and Ratings Except As Indicated	No. Per Mechanism		
Operating Mechanism Complete	1	0	0
Latch	1	0	0
Tripping Lever	1	0	0
Bumper Spring	1	0	1
Tripping Lever Spring	1	0	1
Tripping Lever Roller	1	0	0
Locking Lever	1	0	0
Locking Lever Spring	1	0	1
Accelerating Spring—200 pounds for Single Pole Breaker	1	0	0
Accelerating Spring—400 pounds for Multi-Pole Breaker	1	0	0
Trip Free Lever	1	0	0
Auxiliary Switches—2-Pole and 6-Pole	2	0	0
Moving Contact—8-Pole	8	0	1
Contact Finger—8-Pole	16	2	4
Tripping Coil—Varies only as per Control Voltage	1	0	0
Closing Coil—Varies as per Rating of Breaker and Control Voltage	1	0	0
Control Panel	1	0	0
Relay Contact	2	2	4
Operating Coil—Varies only as per Control Voltage	1	0	0
Release Coil—Varies only as per Control Voltage	1	0	0

Parts indented are included in the part under which they are indented.

Westinghouse Products

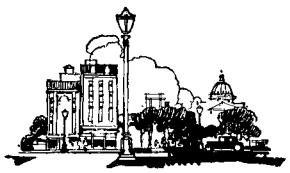


Homes—Farms

- Air Heaters
- Auto Engine Heaters
- Automatic Irons
- Automatic Percolators
- Automatic Ranges
- Cozy Glow Heaters
- Curling Irons
- Fans
- Hot Plates
- Light and Power Plants
- Lighting Equipment
- Mazda Lamps
- Motors for
  - Buffers and Grinders
  - Ice Cream Freezers
  - Ironers and Washers
  - Refrigerators
  - Sewing Machines
  - Vacuum Cleaners
- Newel Posts
- Panelboards
- Radio Equipment
- Rectigon Chargers for Automobiles and Radio Batteries
- Rectox Trickle Charger
- Refrigerators, Electrical
- Safety Switches
- Sollaire Luminaires
- Sol-Lux Luminaires
- Solar Glow Heaters
- Table Stoves
- Tumbler Water Heaters
- Turnover Toasters
- Vacuum Cleaners
- Wall-Type Heaters
- Waffle Irons
- Warming Pads
- Water Heaters

Buildings

- Arc Welding Equip.
- Circuit-Breakers
- Elevators and Control
- Glue and Solder Pots
- Instruments and Relays
- Kitchen Equipment
  - Bake Ovens
  - Hot Plates, Ranges
- Lighting Equipment
  - Brackets, Newels and Lanterns
  - Reflectors & Lamps
  - Sol-Lux Luminaires
- Lightning Arresters
- Micarta Trays
- Meters
- Meter Service Switches
- Motor Generators
- Motors and Control for:
  - Coal and Ash-Handling Equipment
  - Compressors
  - Elevators
  - Fans and Blowers
  - Laundry Equipment
  - Refrigerating Equip.
  - Vacuum Cleaners
  - Water & Sump Pumps
- Panelboards
- Radio Equipment
- Synchronous Converters
- Safety Switches
- Solar Glow Heaters
- Stokers
- Switchgear
- Transformers



City Improvements

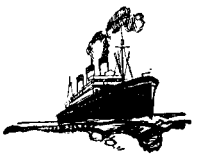
- Airport Floodlights
- Automatic Substations
- Constant Current Regulators
- Control Apparatus
- Elec. Railway Equip.
- Lighting Units
- Mazda Lamps
- Ornamental Standards
- Parkway Cables
- Street Brackets
- Streethoods

Offices and Stores

- Air Heaters
- Bread-baking Oven
- Elevators and Control
- Fans, Desk and Exhaust
- Fuses
- Lighting Equipment
- Mazda Lamps
- Meters
- Micarta Desk Tops
- Motors for
  - Adding Machines
  - Addressing Machines
- Motors for
  - Coffee and Meat Grinders, etc.
  - Dictaphones
  - Envelope Sealers
  - Fans and Blowers
  - Pumps
  - Refrigerating Machines
- Panelboards
- Safety Switches
- Switches
- Tumbler Water Heaters

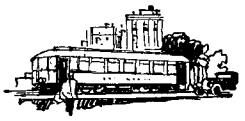
Aviation

- Approach, Boundary, Hangar, and Obstruction Lights
- Arc Welding Equip.
- Floodlight Projectors
- Motor-Generators
- Reflectors
- Transformers
- Mazda Lamps
- Micarta
  - Cabin-lining Plate
  - Fairleads
  - Hinge Bearings
  - Propellers
  - Pulleys
  - Tailwheels
- Radio Equipment



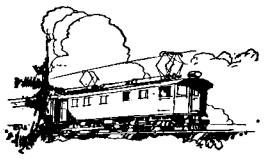
Ships

- Circuit-Breakers
- Condensing Equipment
- Deck Winch Motors
- Elec. Heating Appar.
- Eng. Room Auxiliaries
- Fans and Blowers
- Fuses
- Generating Equipment
- Instruments
- Light and Power Plants
- Lighting Equipment
- Micarta Trays
- Motors and Controllers
- Ovens, Ranges and Galley Equipment
- Panelboards
- Propulsion Equipment
  - Diesel-Electric
  - Geared Turbine
  - Turbine Electric
- Radio Equipment
- Safety Switches
- Switchgear



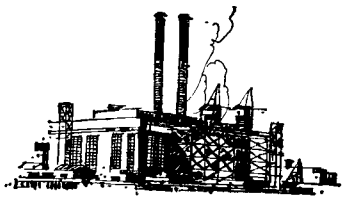
Electric Railways

- Arc Welding Equip.
- Automatic Substations
- Babbitt, Solder & Pots
- Baking Ovens
- Circuit-Breakers
- Elec. Trolley Coaches
- Fans
- Gas Electric Coaches
- Gears and Pinions
- Generators
- Insulating Material
- Insulators
- Lighting Fixtures
- Lightning Arresters
- Line Material
- Manual Substations
- Mazda Lamps
- Meters
- Motors and Control
- Panelboards
- Portable Substations
- Relays
- Signal Equipment
- Supervisory Control
- Switchgear
- Synchronous Convert's
- Transformers
- Trolley Poles



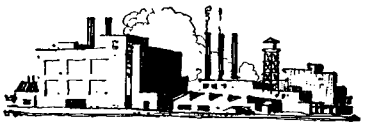
Railroads

- Arc Welding Equipment
- Automatic Substations
- Babbitt, Solder & Pots
- Baking Ovens
- Battery Charging Equip.
- Cars—Multiple-Unit. Gas-Elec., Oil-Elec.
- Circuit-Breakers
- Control Apparatus
- Elec. Heating Apparatus
- Fans
- Gears and Pinions
- Generators
- Headlight Equipment
- Instruments
- Insulating Materials
- Insulators
- Lighting Equipment
- Lightning Arresters
- Line Material
- Locomotives—Electric Gas-Elec., Oil-Elec.
- Manual Substations
- Mazda Lamps
- Micarta Gears
- Motors and Control
- Outdoor Substations
- Panelboards
- Power House Apparatus
- Radio Equipment
- Safety Switches
- Signal Equipment
- Stokers
- Supervisory Control
- Switchgear
- Transformers
- Yard Lighting Equip.



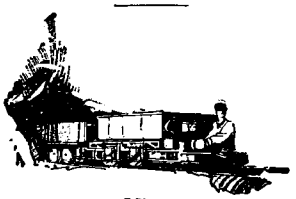
Electric Service Companies

- Automatic Switching Equipment
- Circuit-breakers
- Condensers
- Cutouts
- Fans
- Frequency-converters
- Fuses
- Generators
- Instruments & Meters
- Insulating Material
- Insulators
- Line Material
- Lighting Equipment
- Lightning Arresters
- Micarta
- Motors and Control
- Motor-Generators
- Network Protectors
- Network Transformers
- Oil Testing and Purifying Equipment
- Outdoor Substations
- Panelboards
- Porcelain Insulators
- Relays
- Safety Switches
- Steam Turbines
- Stokers
- Supervisory Control
- Switchgear
- Synchronous Conden'rs
- Synchronous Conv'ters
- Transformers
- Turbine Generators
- Voltage Regulators



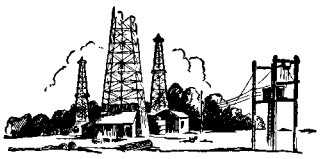
Mills and Factories

- Arc Welding Equip.
- Automatic Starters and Controllers
- Babbitt & Babbitt Pots
- Capacitors
- Circuit-Breakers
- Condensers
- Fans, Desk and Exhaust
- Furnaces and Ovens
- Fuses
- Generating Equipment
- Insulating Materials
- Knife Switches
- Larry Car Equipment
- Lighting Equipment
- Lightning Arresters
- Locomotives—Electric Gas-Elec., Oil Elec.
- Mazda Lamps
- Meters and Relays
- Micarta Gears
- Motors and Controllers
- Panelboards
- Pipe Fittings (Struct'al)
- Power House Apparatus
- Safety Switches
- Solder & Glue Pots
- Space Heaters
- Stokers
- Switchgear
- Transformers
- Turbines



Mines

- Arc Welding Equip.
- Auto. Feeder Equip.
- Automatic Starters and Controllers
- Automatic Substations
- Battery Charging Equip.
- Circuit-Breakers
- Clamps
- Elec. Heating Apparatus
- Fans
- Gears and Pinions
- Headlights
- Insulating Materials
- Insulators
- Larry Car Equipment
- Lightning Arresters
- Line Material
- Locomotives
- Manual Substations
- Mazda Lamps
- Meters & Instruments
- Micarta
- Motor Generators
- Motors for Hoists, Pumps, Tipples, and Breakers
- Panelboards
- Portable Substations
- Relays
- Safety Switches
- Switchgear
- Synchronous Conv'ters
- Transformers
- Ventilating Outfits



Oil Fields

- Arc Welding Equip.
- Change House Heaters
- Floodlight Projectors
- Gear Units
- Insulators
- Mazda Lamps
- Motors and Control
- Panelboards
- Reflectors
- Rig Lighters
- Safety Switches
- Small Light Plants
- Transformers
- Vapor Proof Fixtures

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

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BIRMINGHAM, ALA., 2030 Second Ave.
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*BOSTON, MASS., 10 High St.
*BRIDGEPORT, CONN., Bruce Ave. and Seymour St.
*BUFFALO, N. Y., 814 Ellicott Square Bldg.
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*BUTTE, MONT., 52 E. Broadway
CANTON, OHIO, 120 Tuscarawas St.
CEDAR RAPIDS, IOWA, 1400 Second Ave.
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*CHARLOTTE, N. C., 210 E. Sixth St.
CHATTANOOGA, TENN., 536-540 Market St.
*CHICAGO, ILL., 20 N. Wacker Drive
*CINCINNATI, OHIO, 207 W. Third St.
*CLEVELAND, OHIO, 2209 Ashland Rd. S. E.
COLUMBUS, OHIO, 209 S. Third St.
*DALLAS, TEX., 108-116 S. Akard St.
DAVENPORT, IOWA, 206 E. Second St.
DAYTON, OHIO, 30 Main St. N.
*DENVER, COLO., 910 15th St.
DES MOINES, IOWA, 604 Locust St.
*DETROIT, MICH., 5757 Trumbull Ave.
DULUTH, MINN., 408 Bradley Bldg.
ELMIRA, N. Y., 338-42 E. Water St.
*EL PASO, TEX., Oregon and Mills St.
EMERYVILLE, CALIF., 5815 Peladeau St.
ERIE, PA., State and Tenth St.
EVANSVILLE, IND., 14-16 N. W. Sixth St.
FAIRMONT, W. VA., 602 Cleveland Ave.
FERGUS FALLS, MINN., Kadatz Hotel
FORT WAYNE, IND., 1010 Packard Ave.
FORT WORTH, TEX., 2426 Tierney Rd.
GARY, IND., 1514 W. Fifth Ave.
*GRAND RAPIDS, MICH., 507 Monroe Ave. N. W.
HAMMOND, IND., 403 Waltham St.
*HOUSTON, TEX., 218 Main St.
*HUNTINGTON, W. VA., 209 Ninth St.
INDIANAPOLIS, IND., 20 N. Meridian St.
JACKSON, MICH., 212 W. Michigan Ave.
JACKSON, MISS., 519 Hemlock St.
JACKSONVILLE, FLA., 719 W. Forsyth St.
JOHNSTOWN, PA., 47 Messenger St.
*JOPLIN, MO., 420 School St.
*KANSAS CITY, MO., 2124 Wyandotte St.
KNOXVILLE, TENN., 612 S. Gay St.
*LOS ANGELES, CALIF., 420 San Pedro St. S.
LOUISVILLE, KY., 332 W. Broadway
MADISON, WIS., 508 Edgewood Ave.
MEMPHIS, TENN., 130 Madison Ave.
MIAMI, FLA., 82 N. E. Twentieth St.
MILWAUKEE, WIS., 735 N. Water St.
*MINNEAPOLIS, MINN., 2303 Kennedy St. N.E.
NASHVILLE, TENN., 309 Fourth Ave. N.
*NEWARK, N. J., 17-25 Academy St.
NEW HAVEN, CONN., 152 Temple St.
*NEW ORLEANS, LA., 333 St. Charles St.
NEW YORK, N. Y., 150 Broadway
NIAGARA FALLS, N. Y., 205 Falls St.
*OKLAHOMA CITY, OKLA., 128-32 W. Grand Ave.
OMAHA, NEB., 409 17th St. S.
PEORIA, ILL., 104 State St.
*PHILADELPHIA, PA., 3001 Walnut St.
*PHOENIX, ARIZ., 11 W. Jefferson St.
PINE BLUFF, ARK., 2103 Linden Ave.
*PITTSBURGH, PA., 310 Grant St.
PORTLAND, ME., 61 Woodford St.
*PORTLAND, ORE., 83 Sixth St.
PROVIDENCE, R. I., 393 Harris Ave.
PUEBLO, COLO., 1309 Claremont Ave.
QUINCY, ILL., 506 Main St.
RALEIGH, N. C., 803 Person St. N.
READING, PA., 438 Walnut St.
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ROCHESTER, N. Y., 89 East Ave.
ROCKFORD, ILL., 130 S. Second St.
SACRAMENTO, CALIF., 1107 Ninth St.
*SALT LAKE CITY, UTAH, 10 W. First South St.
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*SAN FRANCISCO, CALIF., 1 Montgomery St.
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*SEATTLE, WASH., 603 Stewart St.
SHREVEPORT, LA., 120 Milan St.
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SPOKANE, WASH., 428 Riverside Ave.
SPRINGFIELD, ILL., 130 Sixth St. S.
SPRINGFIELD, MASS., 395 Liberty St.
*ST. LOUIS, MO., 411 Seventh St. N.
SYRACUSE, N. Y., 108 W. Jefferson St.
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TOLEDO, OHIO, 420 Madison Ave.
*TULSA, OKLA., 602 S. Main St.
*UTICA, N. Y., 258 Genesee St.
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WICHITA, KAN., 918 N. Lawrence St.
WILKES-BARRE, PA., 267 Pennsylvania Ave. N.
WILMINGTON, CALIF., 305½ Avalon Blvd.
WORCESTER, MASS., 54 Commercial St.
YOUNGSTOWN, OHIO, 16 Central Square
The HAWAIIAN ELECTRIC CO., Ltd., Honolulu, T. H.—Agent

*Warehouses located in these cities and also in Marshall, Texas.

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