Westinghouse

Types O-1 and O-2 Oil Circuit-Breakers

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

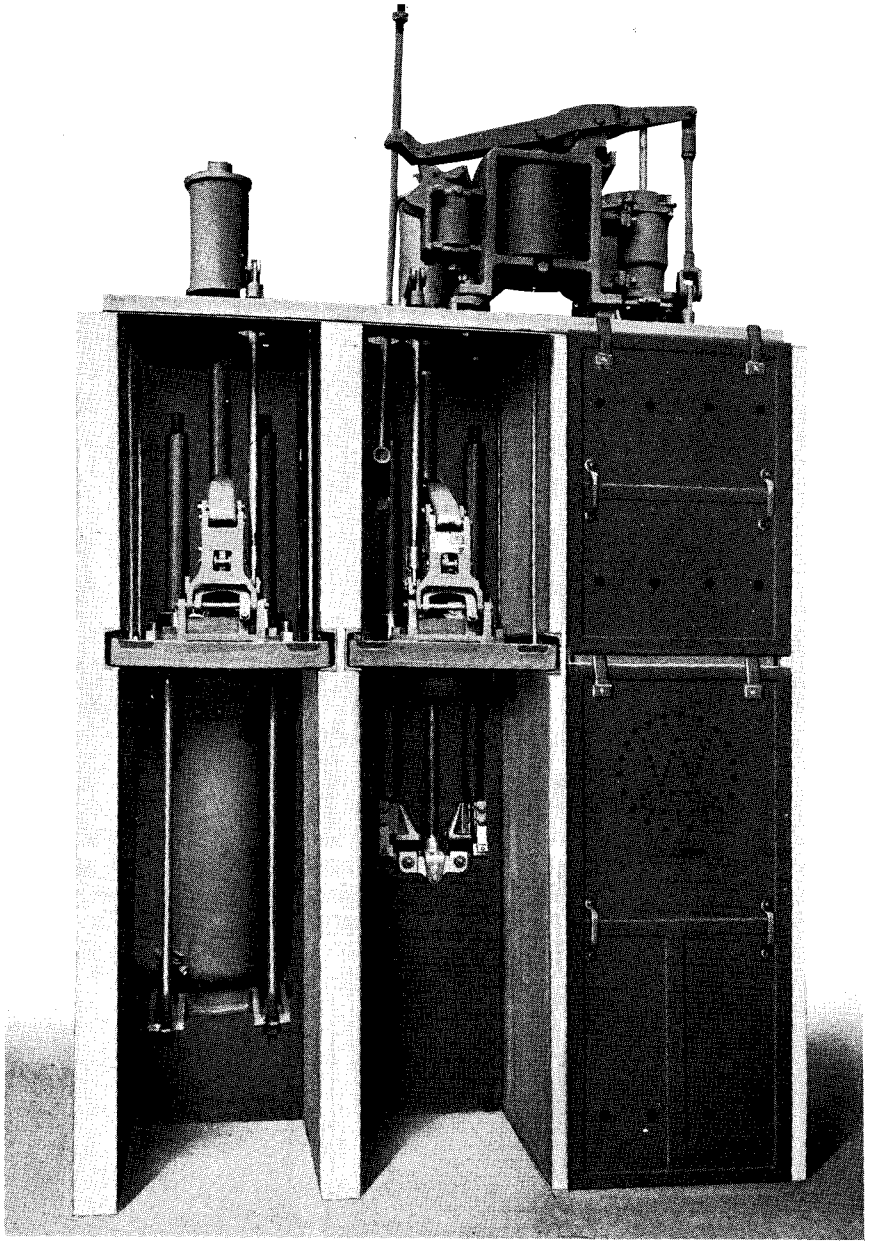

Fig. 1—Type O-1 Oil Circuit-Breaker

Westinghouse
Types O-1 and O-2 Oil Circuit-Breakers

General Information

GENERAL CONSTRUCTION

The Types 0-1 and 0-2 oil circuit-breakers are designed especially for heavy power-house service, and are built in ampere capacities up to 4000 amperes at 60 cycles and voltages up to 25,000 volts. See Figs. 1 and 7. All these circuit-breakers are made up of individual pole units, all connected mechanically to a common operating mechanism which insures simultaneous closing and tripping of all pole units. The final adjustment of the pole units with their shaft and solenoid mechanism is done in the field.

INSTRUCTIONS FOR UNPACKING

Care should be used in unpacking to see that no damage is done to delicate parts. Clean all parts of apparatus free from excelsior, dust, etc. Examine mechanism parts for breakage, distortion, or anything else that might cause improper operation. Examine condenser terminals to see that they have not been injured by nails or bruises. Examine tank linings for signs of mechanical injury or damage by moisture. Be sure that there is no foreign matter in the tanks that might float in the oil or dissolve in it. Check to see that all packing blocks are removed from the mechanism, and remove the wooden blocks from the contact. The electric mechanism, especially, should be gone over carefully to remove particles of dirt from the cores, dashpots, auxiliary switches, and to see that same are in proper operating conditions.

GENERAL ARRANGEMENT OF CIRCUIT-BREAKERS

Figure 2 shows the general arrangement of pole units and electric mechanism of a three-pole Type O circuit-breaker, typical of the capacities up to 2000 amperes, and fig. 8 shows the general arrangement of a three-pole electrically operated breaker, typical of the heavy ampere capacity circuit-breaker. Fig. 2 covers generally the Type 0-1 circuit-breaker, while fig. 8 generally covers the heavy ampere capacity Type 0-2 circuit-breaker.

The general features of design of all these circuit-breakers are the same. The pole units are each equipped with a complete self contained brush lifting mechanism provided with a toggle and thumb to limit the travel in both the open and closed position. These pole unit mechanisms which keep the heavy brush contact loads self contained in the pole unit, are then connected to pull rods to the common operating mechanism above.

GENERAL INSTALLATION INSTRUCTIONS

The following procedure should be carried out before trying to make final adjustment. First, mount the pole units in their respective cells with the base surfaces horizontal and the terminals vertical. Bolt the pole units securely to the wall channels or the wall insets as the case may be. Mount the complete electric mechanism with top plates, all of which is generally shipped in one piece, in position and fastened securely by means of the tie rods or wall insets. Be sure that the holes through the top plate will allow free movement of the pole pull rods. Place the pull rod of one pole in position and adjust its length by means of the rod end. When

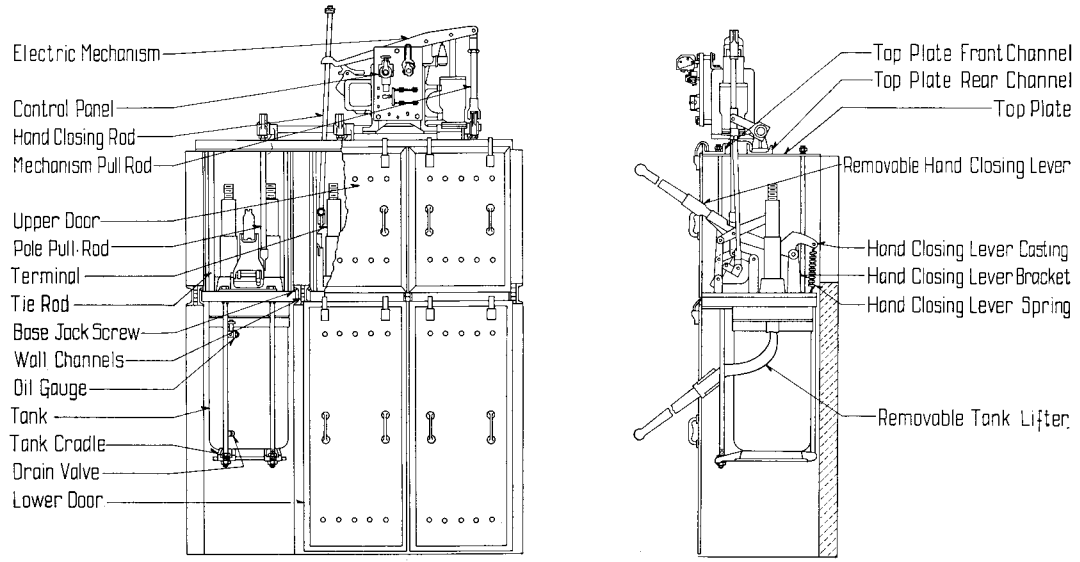

Fig. 2—General Arrangement of Pole Unit and Mechanism

the latch of the electric mechanism engages the roller properly, the toggle lever should be somewhat $\frac{1}{16}''$ to $\frac{1}{8}''$ away from its stud. Now drop the breaker pole to the open position so that it rests against its bumper. It should move freely and, in the open position the dashpot follower is the accelerating device where one is provided, should not hit the dashpot head. Connect up the other poles in the same manner. When all poles are connected it may be necessary to take up a little further on the rod of the first pole.

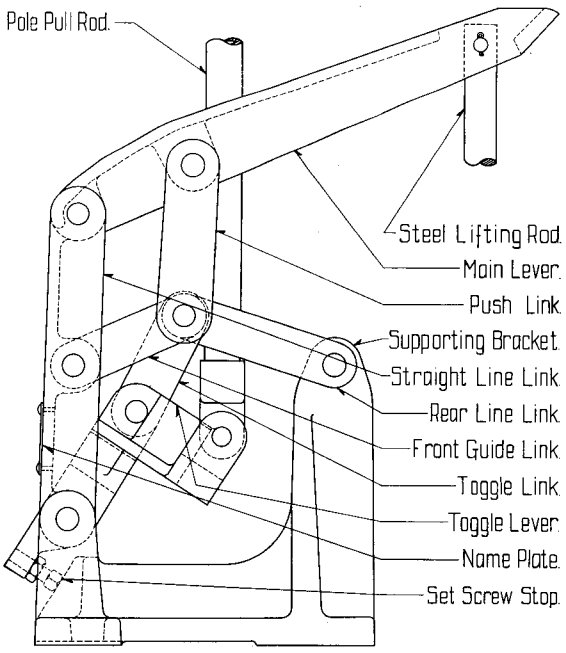

Fig. 3—Pole Mechanism

In the lining of the pole units with the mechanism, it should not be necessary to change any of the adjustments on the pole unit itself or on the electric mechanism. These parts are adjusted at the Factory. Read carefully the following instructions with regard to their installation and maintenance.

In making adjustments of pull rods use the long pipe end which is provided on each rod for that purpose. After adjusting, lock all pipes by setting up the lock nuts. Take up all lost motion in pipe by means of these nuts.

When the electric mechanism cores come together and the latch has over traveled the roller by $\frac{1}{8}''$ approximately, the pole unit stop should just clear, by say $\frac{1}{32}''$.

POLE MECHANISM CONSTRUCTION FOR 600 AMPERE TO 3000 AMPERE CIRCUIT-BREAKERS

Fig. 3 shows the arrangement of pole units operating mechanism for the light circuit-breakers. The main lever which carries the lifting rod for the moving contact element, is operated from the electric mechanism by the pull rod connected to the toggle lever. The point on the main lever to which the

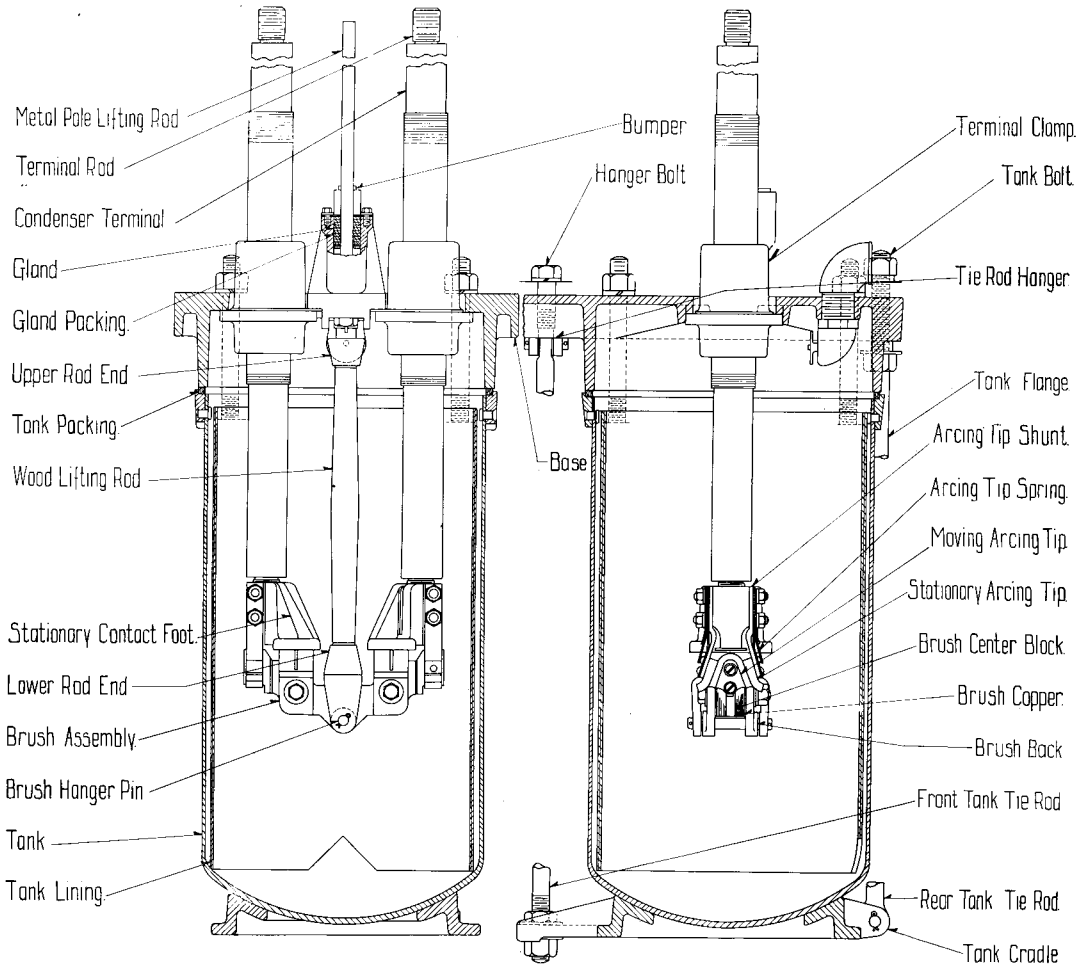

Fig. 4

lifting rod is attached, has a straight line motion in a vertical plane by virtue of the design of the toggle lever and attached linkage The main lever and consequently the lifting rod and brushes are brought to a stop in the closing position of the circuit-breaker by the toggle stop screw shown coming against the supporting bracket upon over travel of the electric mechanism. In the open position, the moving contacts are brought to a positive stop by the bumpers on which the main levers of the pole units sit.

All the joints of this pole mechanism should be oiled lightly from time to time with machine oil. If this is not attended to, the friction in the mechanism will in time reduce considerably the speed of opening and closing the circuit-breaker.

CONSTRUCTION AND ADJUSTMENT OF POLE UNITS FOR TYPE O-1 CIRCUIT-BREAKERS

Figure 4 shows in detail the construction of the light ampere capacity of the Types 0-1 and 0-2 circuit-breakers. The lifting rod attaches to the main lever of the pole mechanism described under figure 3 and this pole mechanism is mounted on the pole unit base. The main terminals are of the condenser type and the moving contacts and arcing tips of the so called divided parallel path design. The wood lifting rod which provides insulation from the moving contacts to ground is of the best quality hard wood properly seasoned and treated.

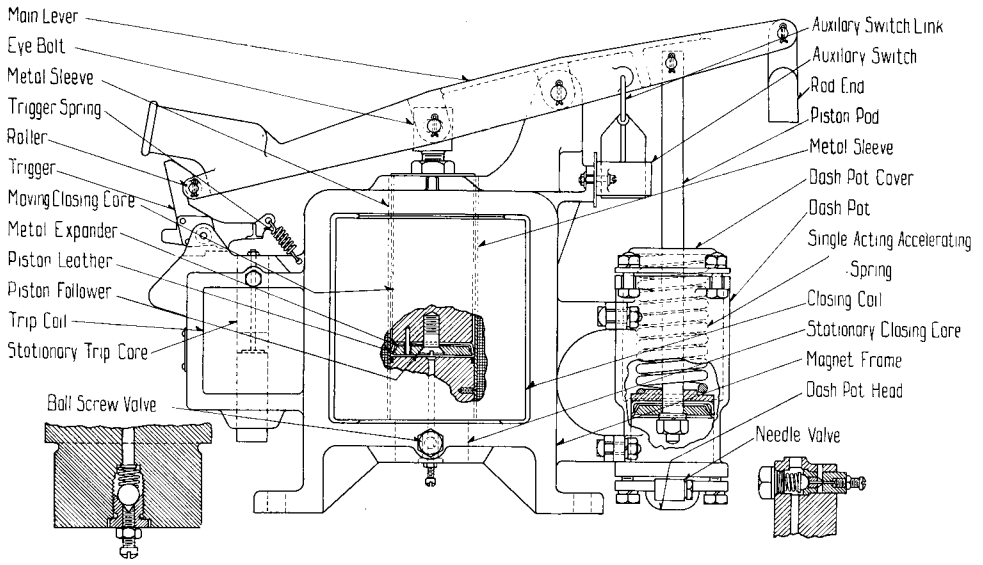

Fig. 5—Direct-Current Operating Mechanism

Contacts

When closing the circuit-breaker, the arcing tips should touch approximately 1¼ inches to 1½ inches before the end of the closing stroke. When the circuit-breaker is completely closed and latched, the contacts of all phases should exert a firm positive pressure on their complete surfaces against the stationary contact feet and the inside leaves should be definitely lifted away from the center blocks. On the other hand, the brushes must not be pulled so far that the outside leaves commence to loose their contacts against the stationary contact feet. The arcing tips must make positive contact for at least ¾ of an inch after the main brush has parted from the contact foot during the opening operation, but it is not necessary that the arcing contacts fit together all over their surfaces. The function of the arcing tip is to shunt the current after the main contact has parted. They are not relied upon to carry current while the main contact is in position.

Adjustment of the contact is made by the screw threads provided that the junction of the steel lifting rod and the wood lifting rod, which gives half turn adjustment. When replacing contact feet the threads of the terminal rods allow a vertical adjustment.

GENERAL POLE UNIT ADJUSTMENT

All type O circuit-breakers are completely assembled, adjusted and tested at the factory. When the circuit-breaker is taken apart for shipment the adjustments of the individual pole units are not disturbed, and therefore it should not be necessary to disturb them in the field when assembling the circuit-breaker. It should only be necessary to go carefully over the adjustments to see that they are correct and no adjusting screws are loose. Clean up the contact surface with fine emery and slightly oil the joints. Only in case the original adjustment has been impared in shipment, or otherwise, should it be necessary to change the settings of the contacts or the pole levers.

ELECTRIC CLOSING MECHANISM FOR LIGHT TYPE O CIRCUIT-BREAKERS

The mechanism shown in figure 5 is furnished when it is desired to close the circuit-breaker electrically from a distant point. This mechanism consists essentially of a moving core operating on a main lever to close the circuit-breaker, the main lever being retained in the closed position by the latch until tripped free by the hand trip device or the shunt trip solenoid. The closing core is equipped with a dash pot with an adjustable valve to diminish the shock to the circuit-breaker parts on closing. The mechanism is also equipped with an accelerating device to speed up the opening of the circuit-breaker, and this accelerating

device is also provided with a dashpot which retards the operation on the end of the opening stroke.

When the control switch at a distant point is thrown to the position for closing the circuit-breaker, current flows through the closing solenoid drawing down the moving closing core toward the stationary closing core. It is customary to use a control relay so that the current coming from the control switch to the electric mechanism will only be that necessary to operate the relay switch coil which in turn connects the solenoid coil to the control bus. (See description of control relay panels—figure 6, page 6).

The operation of the closing solenoid is as follows: When the moving closing core is drawn by the solenoid, air is entrapped in the space between the two cores giving a cushioning action on the end of the closing stroke.

The leather washer mounted on the end of the moving closing core, which slides down inside the metal sleeve, is kept pushed out against the metal sleeve by the metal expander. Should it become necessary to remove the moving closing core from the metal sleeve it can be replaced readily by first forcing a tube of the same inside diameter down over the leather and then lining up the two tubes so that the leather slides freely. The leather washers on the metal expander are held in the end of the moving closing core by means of the piston follower. A steel pin passes through the follower, the expander and the leather washer into the moving closing core, thus preventing the turning of these three items. The metal sleeve is fastened to the stationary closing core by means of screws and the joint between the two is packed to make it air tight.

An adjustable air valve is placed in the bottom of the stationary core so that the escapement of air from the closing core dashpot can be regulated. Turning the screw shown on the bottom of the stationary core to the right raises the ball off of its seat and permits the more easy escape of air, thus reducing the cushioning effect and allowing more speedy closing. Rotation of the valve screw to the left drops the ball into its seat and limits the escapement of air from the dashpot, thus cushioning the closing action of the circuit-breaker.

This closing core dashpot should be adjusted for each particular circuit-breaker to give the best closing operation with the control voltage that will actually be used.

The moving closing core of the mechanism is connected to the operating lever by an eye bolt which is adjustable in the core to secure the proper position of the roller on the main lever with respect to the latch when the closing cores come together. The mechanism is adjusted at the factory to latch properly when the moving closing core draws the lever down so that there is a clearance between the roller and the latching surface at the trigger of an $\frac{1}{8}$ of an inch with the coil energized. This condition should be kept as closely as possible in actual operation. Owing to lost motion in the linkage, it will be possible to draw the lever down by hand to obtain a somewhat greater backlash than the $\frac{1}{8}$ inch. Adjustment of this backlash, which is very important to successful operation of the circuit-breaker, is made by loosening the lock nut on the eye bolt and running the moving closing core up or down on the eye bolt until correct adjustment is obtained. Make sure that the lock nut on the eye bolt is drawn down securely after any adjustment.

The mechanism trigger consists of a piece of hardened tool steel set in a casting. In case the trigger does not trip on the minimum voltage required, its latching surface should be rubbed up with fine emery. It should not be necessary to change the angle of the trigger unless same has been spoiled through neglect, but if necessary this can be done by grinding on an emery wheel. Should the trigger fail to hold in operation, it can also be touched up on an emery wheel to secure a positive holding face.

The mechanisms are equipped with accelerating devices shown in figure 5 to speed up the opening operation of the breaker. This accelerating device consists of a powerful spring mounted in a cylinder, the spring being under compression when the breaker is closed. This accelerating device is also equipped with an air dashpot consisting of a follower casting on the rod, a leather washer and a metal expander for holding the leather washer against the sides of the dash pot piston. The dash pot head is equipped with a ball valve which allows a regulated escapement of air from the

dashpot on the end of the opening stroke of the circuit-breaker. Regulation of this valve is obtained by an adjusting screw, rotation of the screw to the right causing the ball to be lifted from its seat and facilitating the exit of air from the dashpot, and rotation of the screw to the left causing the ball to return to its seat, thus closing up the valve opening. Its dashpot and valve are similar to those described above in connection with the closing cores.

Installation of Electric Mechanism

The following should be carefully checked upon the installation of the mechanism:

(1) That all parts are free from dirt and grit, and operate freely.

(2) That the air dashpot between the moving closing core is in good condition.

(3) That the backlash is correct.

(4) That the trigger stop is set correctly.

(5) That the tripping core upon being raised disengages the trigger from the main lever.

(6) That the signal switch makes contact in both the open and closed position of the magnet.

(7) That with the electric mechanism in the open and closed position, the circuit-breaker to which it is attached is in the open and closed position.

Maintenance

The following points should be checked from time to time to insure that the mechanism remains in the operating condition which is obtained when it is installed:

(1) That the backlash is correct.

(2) That the air dashpots are functioning properly. The leather washer should be kept oiled by a few drops of oil which will not coagulate or gum. It is essential that the leather be kept pliable, but that it not be flooded with oil because it will cause the softening of the leather. Arcticammonia, or a mixture obtained by warming vaseline and cylinder oil, is recommended for this purpose.

(3) The air valves be kept clean and free from dirt.

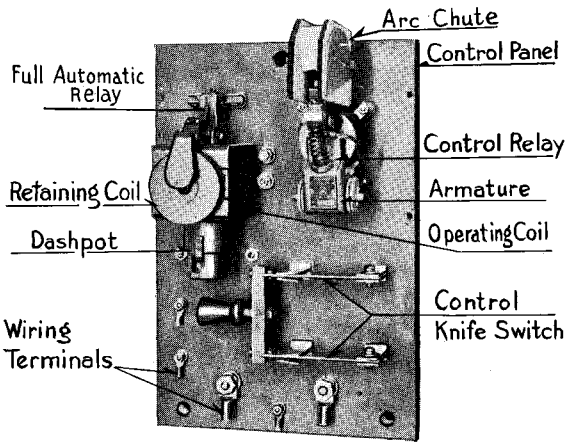

Fig. 6—Control Relay Panel

(4) The bolts holding the stationary closing and tripping cores should be checked up to see that none of them have become loosened.

(5) The auxiliary switch should be examined to see that it is making contact properly and the contacts wiped with a small amount of vaseline. The connections to the auxiliary switches should be checked to see that none of them have become loosened.

CONTROL RELAY PANEL

Each type "O" electrically operated oil circuit-breaker is equipped with a control relay panel attached to the electric mechanism as shown in figure 6. This panel consists essentially of a control relay, a full automatic relay, a knife switch for opening the main control circuits, and terminals for complete circuit-breaker control wiring. The control relay has a coil which 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 contact which causes current to flow through the main solenoid of the circuit-breaker so that it operates. When the circuit-breaker reaches the latter part of its closing stroke, the auxiliary switch on the circuit-breaker excites the tripping coil of the full automatic relay which interrupts the circuit of the control relay coil by opening of the full automatic relay contacts.

The action of the full automatic relay in opening the coil of the control relay is retarded by the action of the dashpot thus giv-

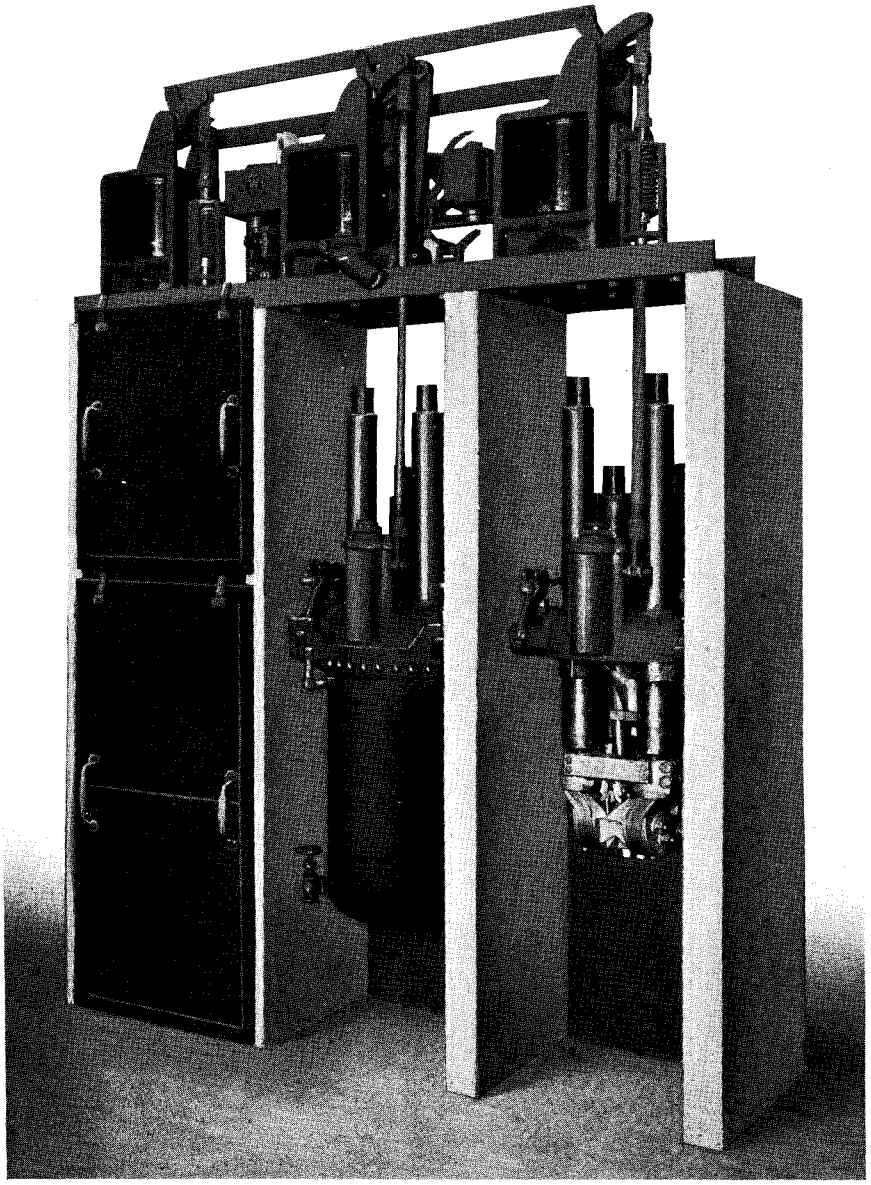

Fig. 7—4000 Ampere Type O-2 Oil Circuit-Breaker

ing the circuit-breaker ample time to close and latch before the control relay is de-energized and its main contacts opened and current removed from the main closing solenoid.

Upon operation of the full automatic relay coil, the retaining armature of the cut off relay is thrown to a sealed position and retained there as long as current remains on the control switch at the switchboard.

The function of the control relay, therefore, is to relieve the control switch at the switchboard of the large amount of current necessary to close these large circuit-breakers. The function of the cut-off relay is to remove energy from the main closing coils by de-energizing the coil of the control relay as soon as the circuit-breaker has been properly latched. This action also makes the circuit-breaker ready to trip instantly should an overload or short-circuit exist on the main power lie when the circuit-breaker is closed. The action of the retaining coil is to prevent re-establishment of

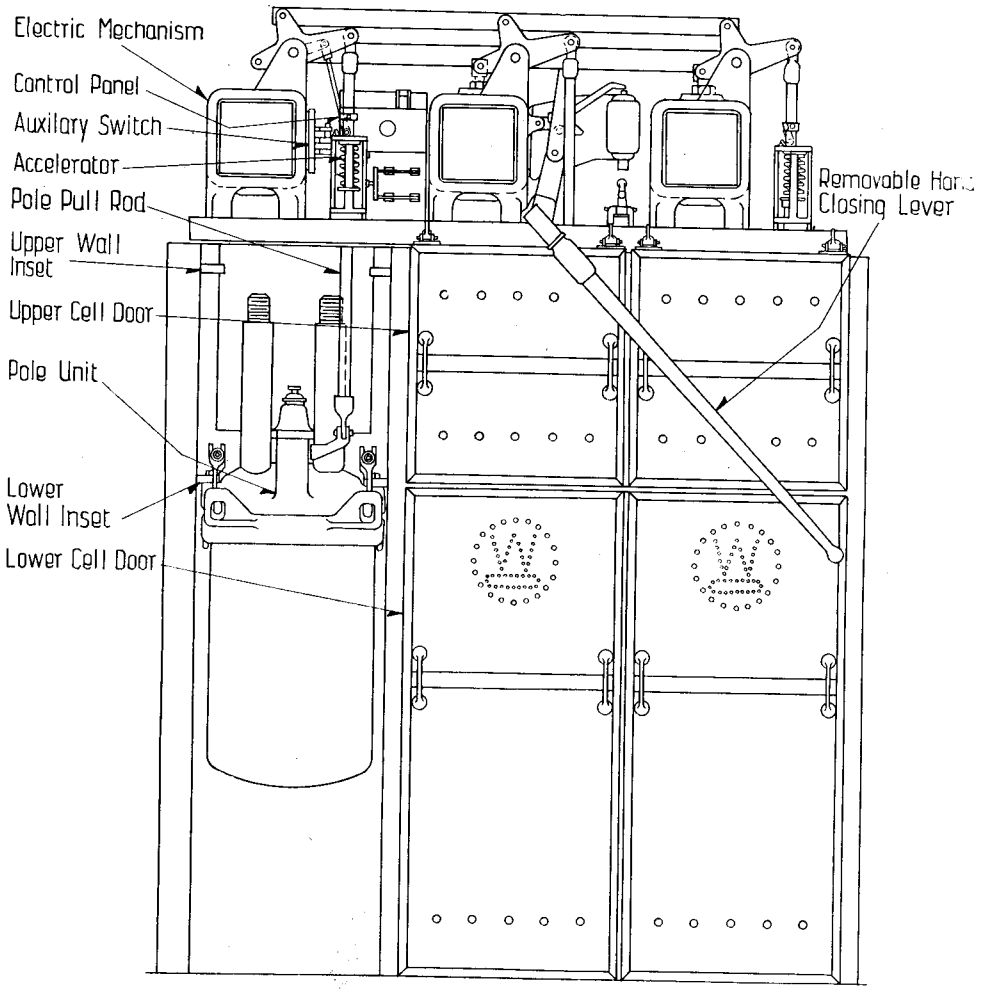

Fig. 8—General Arrangement of 4000 Ampere Type O-2 Circuit-Breaker

the cut-off relay contacts should an operator retain the closing switch in the closed position on the switchboard and thus prevent pumping of the circuit-breaker.

The two-pole knife switch is provided so that the main control power to the circuit-breaker can be interrupted in case it is desired to work on the mechanism thus preventing either closing or tripping from a distant point.

Adjustment and Operation

To make sure that this control panel is in proper operating condition, the following points should be checked:

(1) The control relay should pick up and close its contacts on minimum closing voltage.

(2) The cut-off relay's tripping coil must open the relay contacts when energized by minimum voltage.

(3) The retaining coils must hold the retaining armature and the cut-off relay contacts in the open position when energized by minimum voltage after the relay contacts have been opened by the relay coil.

(4) The retaining coil must not open the cut-off relay contacts when excited by maximum voltage. The cut-off relay must be so adjusted that the circuit-breaker positively latches before the closing coil is demagnitized when operated over the full range of control voltage. Adjustment of this relay plunger consists of rotating the outer piston to raise or lower the plunger in its air gap.

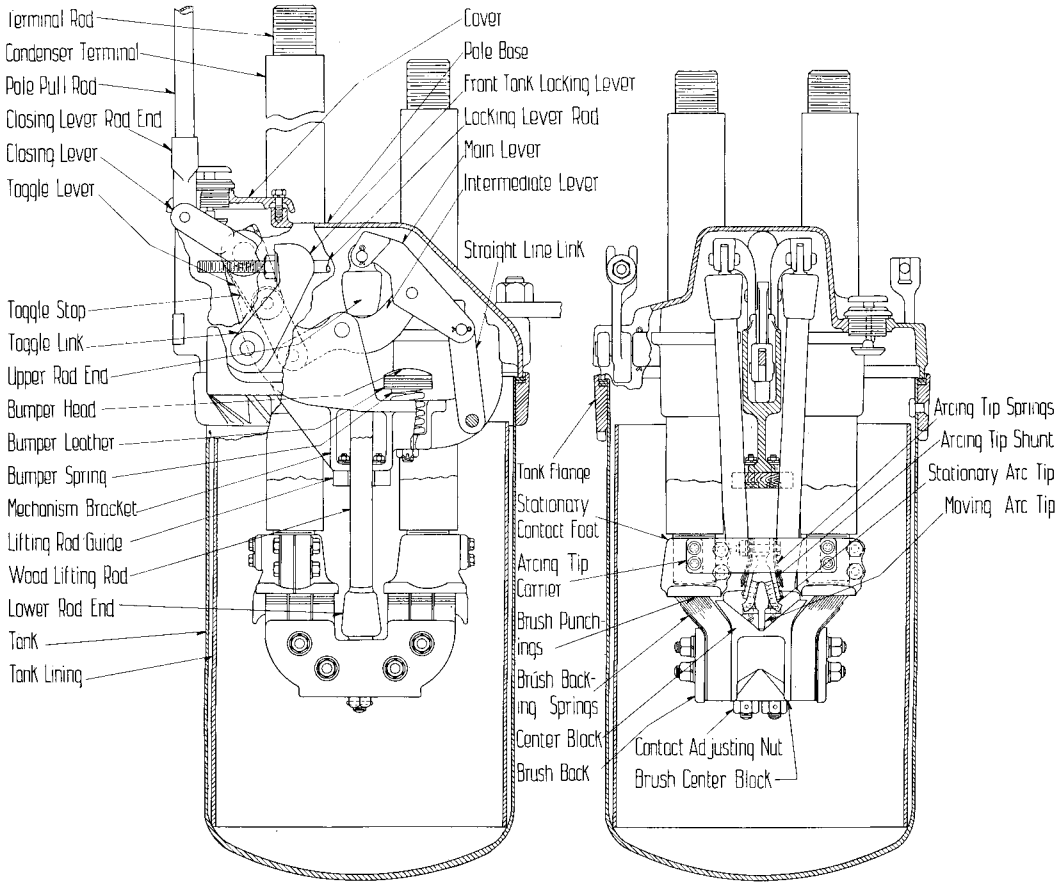

Fig. 9—Pole Unit for 4000 Ampere Type O-2 Circuit-Breaker

Maintenance

The following points should be checked from time to time to insure proper operation of this control relay panel:

(1) That all parts are free from dust and dirt and operate freely.

(2) That the control relay contacts are in good condition.

(3) That the cut-off relay plunger is properly adjusted as outlined above.

GENERAL ARRANGEMENT OF HEAVY AMPERE CAPACITY OF TYPE O-2 CIRCUIT-BREAKER

Figure 8 shows a general arrangement of a 3-pole electrically operated 4000 ampere Type 0-2 breaker. The pole units of this breaker are self contained with all adjustments made in the factory, in the same way as on the light circuit-breakers as previously described. The pole unit is connected through its pole rods, to the top mechanism so that all poles open and close simultaneously. The paragraphs on general installation instructions, control relay panel etc. apply to this circuit-breaker.

POLE UNIT CONSTRUCTION OF HEAVY TYPE O-2 CIRCUIT-BREAKERS

Fig. 9 shows the detailed pole unit construction of a 4000 ampere type 0-2 circuit-breaker. The chief difference between the circuit-breaker and those previously described, is that the pole levers are mounted inside the frame casting and are connected to the operating mechanism through the closing lever, which comes out of the same casting in a shaft fit. The main lever carrying the lifting rod and moving contact element, is lifted to the closed position, by means of the closing lever and toggle lever, acting through the toggle link and intermediate lever. The pole mechanism

is in the correct closed position when the toggle lever is approximately ⅛ of an inch away from the machine stop on the mechanism bracket. The relationship of this toggle stop can be seen by removing the cover on the front of the pole frame casting. The toggle on all pole units should come to the same position in the closed position of the operating mechanism, and when the circuit-breaker is allowed to drop open, all pole main levers should rest against the bumpers.

Before placing the circuit-breaker in operation, oil lightly the pin fits of this pole mechanism and repeat when making thorough inspection of the circuit-breaker. Ordinarily the operation of the circuit-breaker will keep this internal mechanism fairly well oiled.

Contacts

The contacts shown in figure 9 are of the paralled path type. When closing the circuit-breaker the arcing tips should touch approximately 1¼ to 1½ inches before the end of the closing stroke. When the circuit-breaker is completely closed and latched, the contacts of all phases should exert a firm positive pressure on their complete surfaces against the stationary contact feet, and the inside leaf should be definitely lifted away from the center blocks. On the other hand, the brushes must not be pulled up so far that the outside leaves commence to loose their contact against the stationary contact feet. The arcing tips must make positive contact for at least ¾ of an inch after the main brush has parted from the contact foot, but it is not necessary that the arcing contact fit together all over their surfaces. The function of the arcing tips is to shunt the current after the main contacts have parted. They are not relied upon to carry current while the main contact is in position. Adjustment of the contact is made by the adjusting nut at the bottom of the lifting rod below the main brush unit.

As all contacts are adjusted at the factory, it should be only necessary before placing a circuit-breaker in operation to go carefully over the adjustment, clean up the contact surfaces with emery and see that all adjustments are tight. Only in case the original adjustments have been impaired in shipment or otherwise, should it be necessary to change the contact setting.

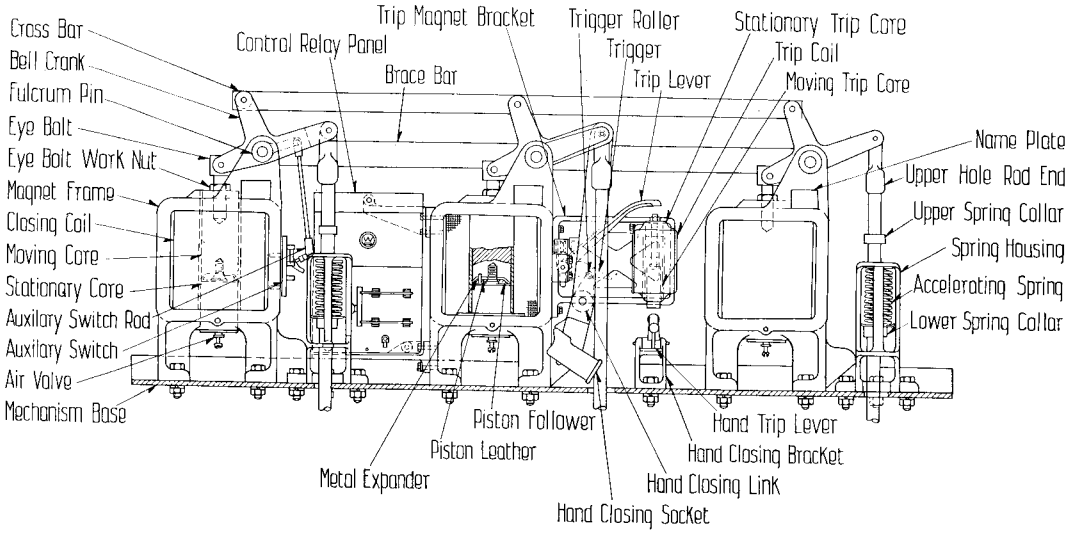

Fig. 10—Electric Operating Mechanism

ELECTRIC MECHANISM FOR HEAVY AMPERE CAPACITY TYPE O-2 CIRCUIT-BREAKER

Figure 10 shows the Electric Operating mechanism for a 3-pole 4000 ampere type O-2 circuit-breaker. This consists of 3 closing magnets, operating in tandem through a common pull rod and retained in the closing position by a single toggle link and latch.

Closing Magnets

The general construction of all 3 closing magnets, is the same as that given on page 6 and the same instructions should be followed.

The control relay panel used on this circuit-breaker is the same as that previously described.

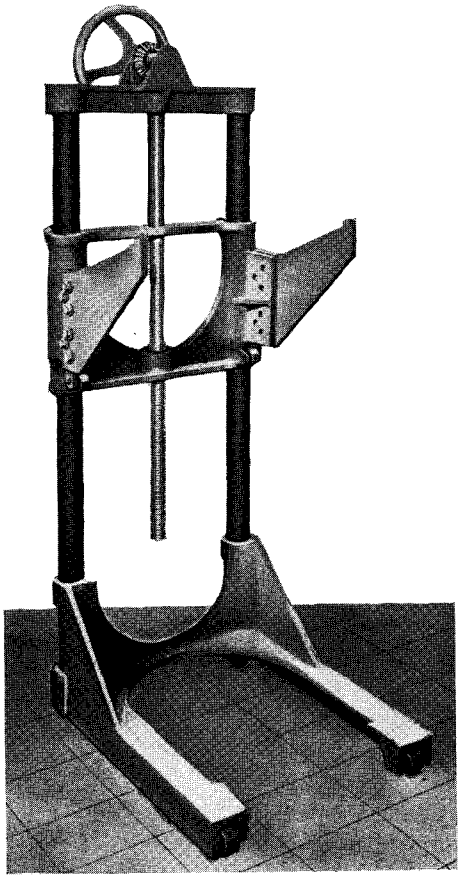

Fig. 11—Tank Lifter

TANK LIFTER

Figure 11 shows a buggy form of tank lifter, recommended for use on all Type O circuit-breakers. By the use of this lifter, one man can readily remove and replace tanks and make all necessary adjustments on a circuit-breaker.

INSPECTION AND MAINTENANCE OF TANK STRUCTURE

Before a circuit-breaker is placed in service, each tank should be thoroughly cleaned and free from moisture. The tank liner should be inspected and free from mechanical damage. Fill all tanks to the level of the gauge glass with the oil specified by the manufacturer for use with this circuit-breaker. Do not use oils that are not authorized by the circuit-breaker manufacturers. Pull up all tank supports firmly so that the tank gasket is compressed in order that oil will not be thrown around the gasket in case of a short circuit.

Periodic inspection should be made of the interior of tank structure and the frequency of these inspections should vary with the severity of service to which the circuit-breaker is exposed. Test the main contacts at these inspection periods to see that neither the stationary or the moving contacts have been burned or pitted in such a way that good contact service is not secured. Check the arcing tip to see that they are not burned away to a point where burning might ensue on the main contact, in case of a heavy short circuit. If necessary renew the arcing tips. Check the tank lining for burning. Take dielectric tests of the oil to see that it is reasonably good for circuit-breaker work.

If a circuit-breaker has opened on an unusually severe short circuit, or for some reason has shown signs of distress, it would probably be advisable to inspect it at the earliest convenience.

See instructions for care of insulating oil on page 14.

ADJUSTMENTS

For correct operation of the 3 magnets in tandem it is necessary that the closing cores on all 3 solenoids, come together at the same time and allow the latch roller approximately $\frac{1}{8}$ inch over travel on the triggers.

Accelerating Devices

The two accelerating devices supplied, serve to throw the circuit-breaker rapidly to the open position when it is unlatched and also balance the weight of the moving contact when the circuit-breaker is open.

CONDENSER TERMINALS

The terminals furnished with type O circuit-breakers are of the protected end condenser form and are not easily damaged. However, it is not well to expose them, due to moisture. They should not be stored under a leaky roof or where water may drip upon them. Before placing a circuit-breaker in

service, clean off any accumulation of dirt or moisture, with oily waste.

TAPING OF LEADS

It is recommended that on 2200 volts and above, the lead connections into and out of circuit-breakers be adequately taped after installation and before the circuit-breaker is placed in service.

CARE OF INSULATING OILS

Deterioration in Use: All insulating oils are subject to carbonization through arcing

INSULATING OILS. The Westinghouse Electric and Manufacturing Company assumes the responsibility of oil circuit-breaker operation only, when the insulating oil employed is in accordance with its recommendation. WEMCO-A oil should be used in all indoor breakers and may be used in outdoor breakers where the temperature will not be lower than 0 degrees Centigrade (32 degrees Fahrenheit.) Where a heavier oil than WEMCO-A is desired, WEMCO-B oil may be used under same conditions. Where lower temperatures may be encountered, WEMCO-C oil should be used.

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insulating oil for oil circuit-breaker use is shipped either in soldered tin cans or sealed drums provided with screw bungs which are sealed before shipment or in tank cars used exclusively for the purpose. All oil in drums which are not sealed, all oil in sealed drums, which has been stored exposed to the weather, and all oil shipped in tank cars should be tested before using by taking sample from each container. Drums stored out of doors should always be placed on their sides, never turned up on end, and when storing drums out of doors, protection against direction precipitation of rain or snow should be provided.

Handling: Extreme Precautions are required to insure that all containers and any apparatus therein are absolutely dry when oil is transferred to it from a drum, soldered can, or tank car. A drum of cold oil, when taken into a warm room will "sweat" and the resulting moisture on its outer surface may mix with the oil when drawing it from the drum. The containers should always be allowed to stand long enough to reach room temperature before breaking the seals. Tank cars should never be emptied during wet weather. Any vessels used in transferring oil should be absolutely dry and free from any foreign matter, especially metalic or carbonaceous particles.

Filtering: Although the drums are thoroughly washed and dried at the refinery before filling, a certain amount of scale is generally loosened inside in transit. This must be removed by passing the oil through two layers of ordinary finely woven cotton cambric which has been thoroughly washed to remove the sizing, and then dried. The cloth may be stretched across a funnel of large size. The oil will pass through the cloth more rapidly if slightly warmed. If the funnel does not discharge directly into the tank of the circuit-breaker, the oil should not be returned to an empty drum unless it is known to be thoroughly clean and dry. The thoroughness of the filtering should be determined by dielectric test.

Detection of Moisture: It is impossible to over emphasize the effects of relatively small amounts of moisture in the oil in high voltage circuit-breakers, and the effects which such moisture may have on circuit-breaker operation from breakdown on voltage surges or on interrupting short circuits. The amount of moisture which will seriously lower the insulating value of the oil is of the order of one part in twenty thousand. This is too small an amount to be detected by settling out or by the well known hot metal test. It can only be done by a dielectric test. The Westinghouse Electric and Manufacturing Company manufactures a special device for this purpose, and furnishes instructions for its use.

Removal of Moisture: Moisture may be entirely removed by passing the oil through a Westinghouse Oil Drying and Purifying Outfit. When this outfit is not available, the oil may be dried in a fairly satisfactory, although slow and inconvenient, manner by passing it through a bag of clean dry lime and filtering afterwards to remove particles of suspended matter. It is not advisable to use various other methods, such as passing hot dry air through the oil, on account of the difficulty of entirely removing all moisture from the air, or heating the oil for a considerable length of time on account of the liability of injuring the oil during the heat treatment.

Oil Maintenance: 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 purpose. Only oil that carries the recommendation of the circuit-breaker manufacturer should be used.

Maintenance of Oil Level: Great care should be exercised to see that the oil level is kept at the proper height in the gauge glass. Considerable alternation of this level may be caused by evaporation, rupturing of heavy short circuits, or possibly leakage from the circuit-breaker structure in case of defects or injury.

Improper oil level may result in hazardous operation from flash over of switching, or failure to properly open heavy short circuits.

REPAIR PARTS

When ordering repair parts, specify the name of the part wanted as shown in the illustrations in this book, give the number of the circuit-breaker, for example: One closing lever link for Type O-2 circuit-breaker, S. O. 43B675 as shown in Instruction Book No. 5249. The stock order number of the circuit-breaker will be found stamped on the name plate.

WIRING DIAGRAM

Fig. 12 shows the complete control connection for an electrically operated light ampere capacity Type O circuit-breaker using a control relay panel.

The complete control connection for the heavy ampere capacity circuit-breakers is the same except the three coils are connected in parallel.

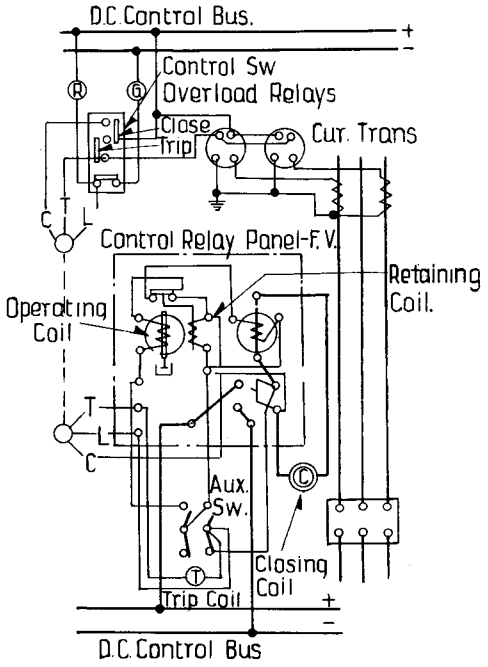
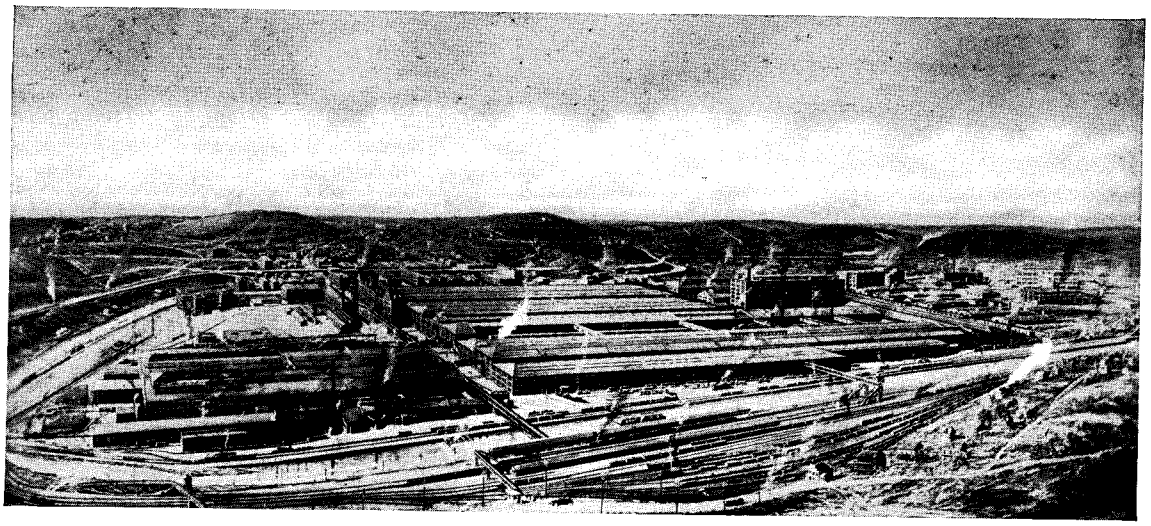


Fig. 12—Control Diagram



The Company's Works at East Pittsburgh, Pa.

Westinghouse Products

A few of the Westinghouse Products are listed below and will furnish some idea of the great variety of electrical apparatus manufactured by the Company and the many extensive fields for their use.

For Industrial Use

Instruments

Motors and controllers for every application, the more important of which are: Machine shops, woodworking plants, textile mills, steel mills, flour mills, cement mills, brick and clay plants, printing plants, bakeries, laundries, irrigation, elevators and pumps.

Welding outfits

Gears

Industrial heating devices, such as: Glue pots, immersion heaters, solder pots, hat-making machinery and electric ovens.

Lighting Systems

Safety switches

For Power Plants and Transmission Lines

Circuit-breakers and switches
Condensers
Controllers
Control switches
Frequency changers
Fuses and fuse blocks
Generators
Insulating material
Instruments
Lamps, incandescent and arc
Lightning arresters
Line material
Locomotives
Meters
Motors
Motor-generators
Portable Power Stands, 110 volts
Rectifiers
Regulators
Relays
Solder and soldering fluids
Stokers
Substations, portable and automatic
Switchboards
Synchronous converters
Transformers
Turbine-generators

For Transportation

Locomotives
Railway equipment
Marine equipment

For Mines

Lamps
Locomotives
Motors for hoists and pumps
Motor-generators
Portable substations
Switchboards
Line material
Ventilating outfits

For Farms

Fans

Household appliances

Motors for driving churns, cream separators, corn shellers, feed grinders, pumps, air compressors, grindstones, fruit cleaning machines and sorting machines.

Generators for light, power and heating apparatus

Portable Power Stands, 32 Volts
Radio Apparatus
Transformers

For Office and Store

Electric radiators
Fans
Arc lamps
Incandescent lamps

Small motors for driving addressing machines, dictaphones, adding machines, cash carriers, moving window displays, signs, flashers, envelope sealers, duplicators, etc.

Ventilating outfits

For Electric and Gasoline Automobiles and the Garage

Battery charging outfits
Charging plugs and receptacles
Lamps
Instruments
Motors and controllers

Small motors for driving lathes, tire pumps, machine tools, polishing and grinding lathes.

Solder and soldering fluids

Starting, lighting and ignition systems, embracing: Starting motor generators, ignition units, lamps, headlights, switches, etc.

Tire vulcanizers

For the Home

Electric ware, including: Table stoves, toasters, irons, warming pads, curling irons, coffee percolators, chafing dishes, disc stoves, radiators and sterilizers.

Automatic electric ranges
Fans
Incandescent lamps
Radio Apparatus

Small motors for driving coffee grinders, ice cream freezers, ironing machines, washing machines, vacuum cleaners, sewing machines, small lathes, polishing and grinding wheels, pumps and piano players

Sew-motors