



INSTRUCTION BOOK

EQUIPMENT FOR CHANGING TRANSFORMER TAPS UNDER LOAD

Type UTR

Westinghouse Electric Corporation

L. B. 46-712-7

SPECIAL INQUIRIES

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*For a permanent record, it is suggested that all nameplate data be duplicated and retained in a convenient location.



INSTALLATION • OPERATION • MAINTENANCE
INSTRUCTIONS

**EQUIPMENT FOR CHANGING
TRANSFORMER TAPS UNDER LOAD**
Type UTR

WESTINGHOUSE ELECTRIC CORPORATION

SHARON PLANT • TRANSFORMER DIVISION • SHARON, PA.

NEW INFORMATION

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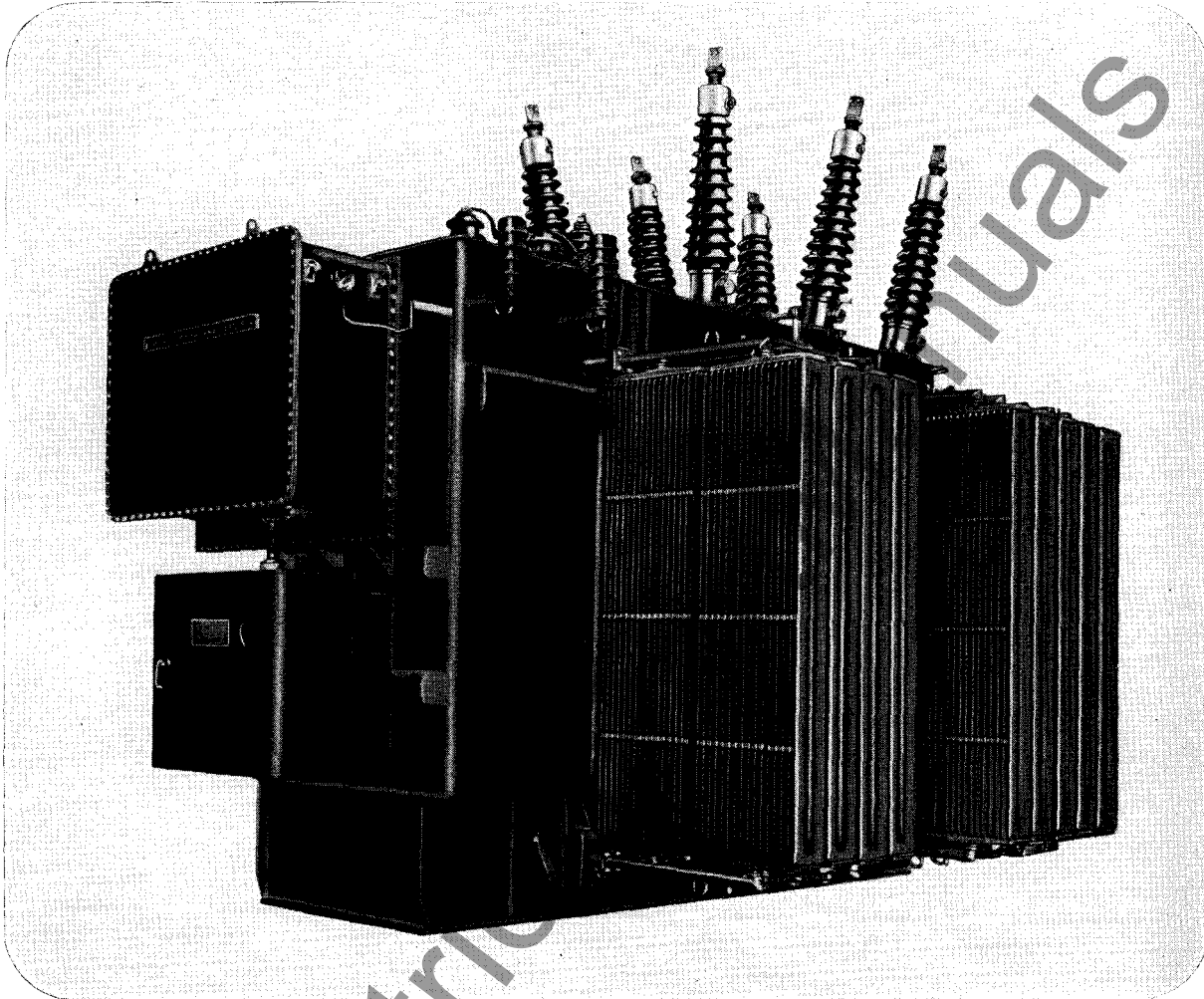
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THE "UTR" TAPCHANGER is used for changing transformer taps without removing the load from the transformer. The equipment is mounted on the side of the transformer tank and may be either single-phase or three-phase. The tapchanger may be operated manually from manual control switches or automatically controlled by a primary relay which responds to the voltage at a point where it is desired to maintain a predetermined value.

Selector switches working in proper sequence with three transfer switches and in conjunction with an auto-transformer in the transformer case change the circuit from one tap to the next and hence vary the voltage without having to de-energize the transformer.

DESCRIPTION

TAP CHANGING MECHANISM

The Type UTR tap changer affords eight full tap positions on both sides of neutral, or a total of thirty-three bridging positions, as shown in Fig. 9.

The tap changer is designed to be bolted to and mounted directly on the side of the transformer tank. Neoprene gaskets are used to make an oil tight joint. The micarta base plate, on which the transfer switches are mounted, forms an oil-tight barrier between the transfer and selector switches. The selector switches are always fully immersed in clean insulating oil, and the oil from the transfer switch compartment cannot contaminate the oil in the transformer tank.

Fig. 1 shows the construction of the transfer switches of the single-phase Type UTR tap changer, the front cover plate and inspection plate on top having been removed. The barriers between switches also have been removed. The transfer switch compartment of the three-phase UTR tap changer is similar except that there are nine switches instead of three and the cam mechanism is extended to operate the nine switches. Fig. 3 shows the construction of the transfer switch of the three-phase Type UTR tap changer.

Fig. 2 shows schematically the arrangement of a single-phase Type UTR tap changer and operating mechanism.

The transfer switch contacts consist of two sets of contacts in parallel, the main current carrying contacts and the arcing contacts. These contacts are of the wedge and finger type and are rigidly held in the closed position, thereby eliminating any tendency to open up under heavy overloads or short circuits. As denoted by the name, the current carrying contacts carry the main current and the arcing contacts, which are made of arc resisting material, make the circuit and break the arc during a tap change. This action is accomplished by the arcing contacts closing before and opening after the main contacts close or open. This arrangement confines all arcing to the arcing contacts which are so located that they can readily be replaced when necessary. See Figs. 13-16.

The stationary contacts are mounted on porcelain bushings which in turn are mounted on a micarta plate attached to the transfer switch housing. Gaskets are used to make an oil tight joint

between the porcelain bushings and the micarta plate and the stationary contacts.

The moving contacts are actuated by cams which operate the switch arms, See Fig. 4. As stated above, the contacts are so designed that the arcing contact makes before the main contact. When the switch is opened, the current carrying contact opens first, followed by the arcing contact. The opening of this arcing contact is greatly accelerated by means of a spring mechanism, thereby reducing the amount of burning of the contacts and the oil. These moving contacts are supported by parallel bar mechanisms made of insulating material. This mechanism affords approximately straight line motion of the moving contacts and makes possible a maximum break distance with minimum travel of the mechanism.

Insulating barriers are provided between adjacent tap changer transfer switches. These barriers

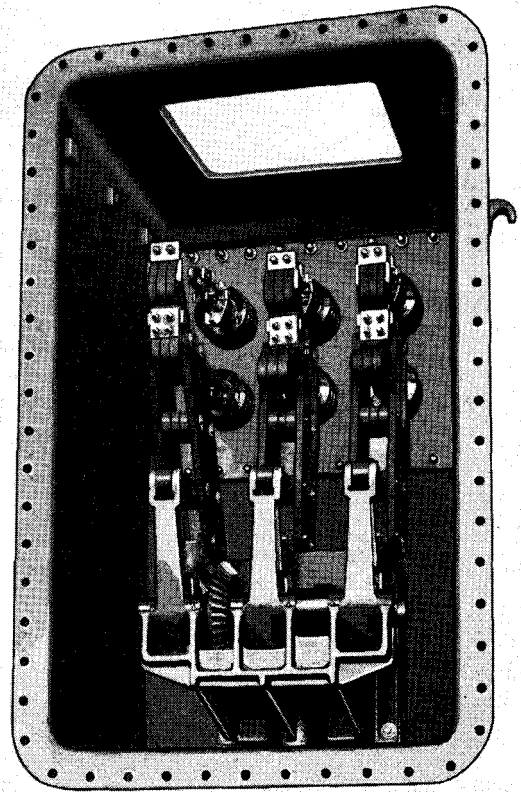


FIG. 1. Single-Phase Transfer Switch Assembly.

DESCRIPTION

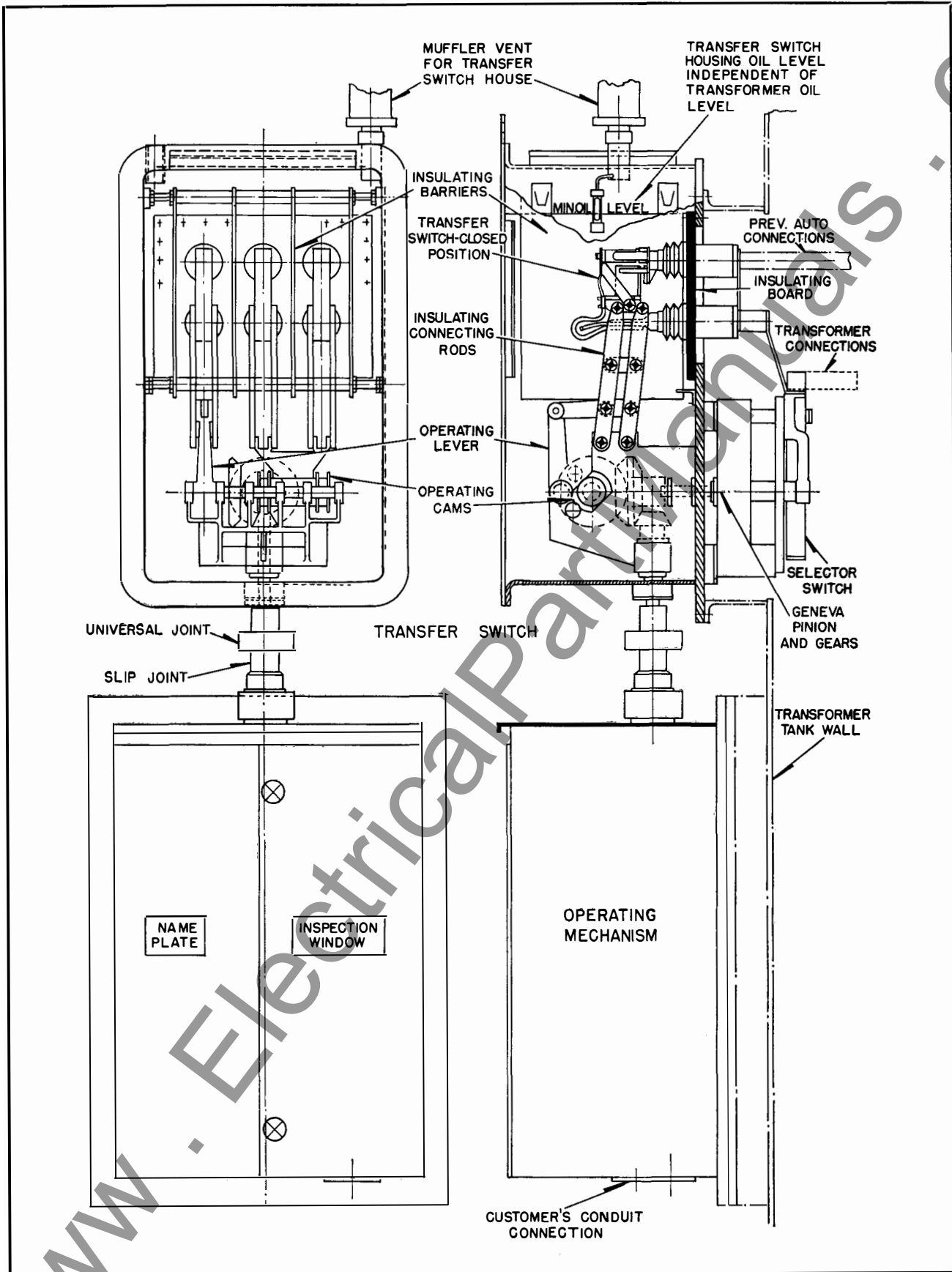


FIG. 2. Schematic Arrangement of Type UTR Tap Changer and Operating Mechanism.

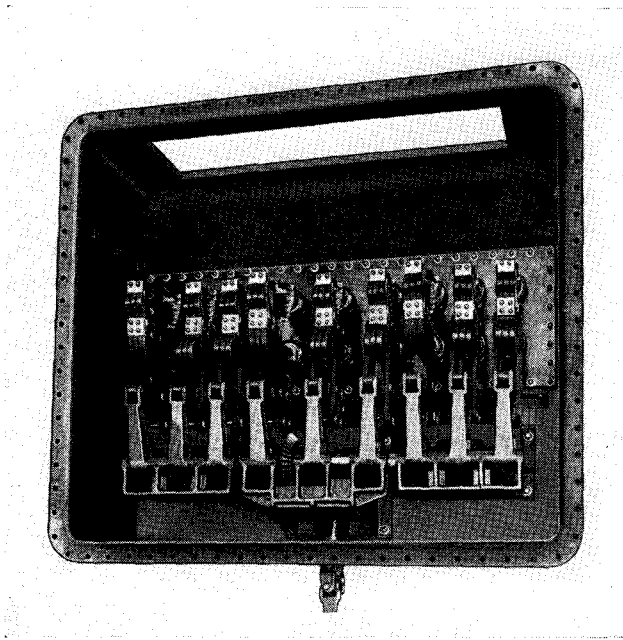


FIG. 3. Three-Phase Transfer Switch Assembly.

prevent an arc from jumping between switches but permit free circulation of oil.

The selector switch assembly, Fig. 6 (three phase), is constructed of three selector switch panels (Fig. 5) within which are mounted two insulated shafts for the moving arms of the selector switches and one insulated shaft for the moving arm of the reversing switch. Each of the selector switch shafts operate separately and alternately by means of a Geneva gear and a driving pinion shown in Fig. 7. Also mounted on the same shaft as the selector switch driving pinion is a driving pinion to drive the reversing switch geneva gear mounted directly below this driving pinion. The reversing switch geneva gear in turn mounts a driving pinion which drives the reversing switch shaft. The reversing switch operates only when going through the neutral position.

The arrangement of leads is such that the four even numbered taps and an end point of winding regulated by tapped section are connected to one section, and one of the transfer switches, and the five odd numbered taps are connected to the other section and another transfer switch (a total of nine transformer taps assumed). The Geneva gear and pinion arrangement will not permit one section of the selector switch unit to turn while the other section is moving. At the completion of a tap change, both sections are rigidly locked in position.

The tap changer drive shaft enters the bottom of the transfer switch housing through a stuffing box, the pressure on the packing being maintained by a backing spring on the retaining gland. The

selector switch driveshaft extends into the transfer switch housing through a similar seal.

OPERATING MECHANISM

The operating mechanism motor and associated reduction gearing, together with control and position indicating equipment, are contained in a separate housing mounted on the transformer tank wall below the transfer switch compartment. The operating mechanism housing is provided with a hinged door, thus making the mechanism readily accessible. The operating shaft is provided with a simple rain shield to exclude water from the internal mechanism. Fig. 8 shows the operating mechanism with the door open.

The motor is controlled by means of "raise" or "lower" three-pole contactors contained within the mechanism housing and mounted on the mechanism base plate.

As soon as the mechanism starts to move, a cam-operated pilot motor switch 120 (Figs. 10-11) completes a holding-in circuit by which the motor contactor is held closed until the tap changing operation has been completed.

A mechanical stop is provided, attached to the large gear wheel which is driven by the motor pinion. For normal operation within the operating range of the tap changer, this stop is allowed to turn with the gear wheel without interference. If, for any reason, the motor is turned by hand past the end position of the normal operating range approximately $4\frac{1}{2}$ motor turns, a latch drops into the path of the above stop and will not permit the motor to turn further. The latch is so designed that the gear

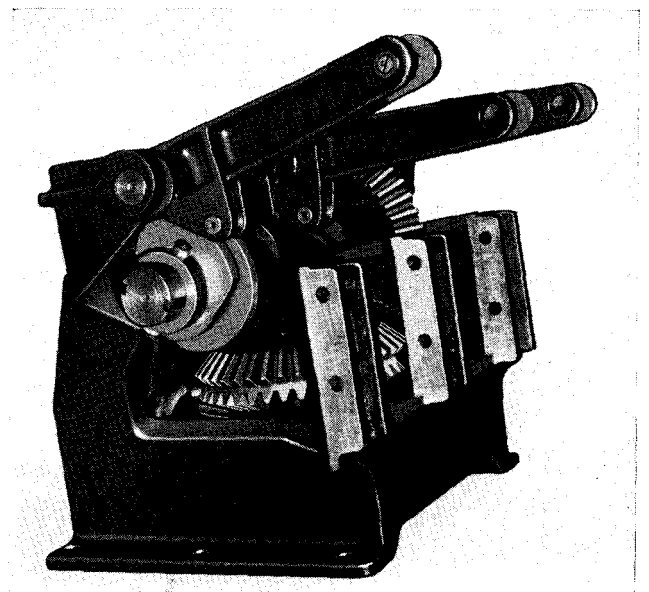


FIG. 4. Cam Shaft Assembly.

DESCRIPTION

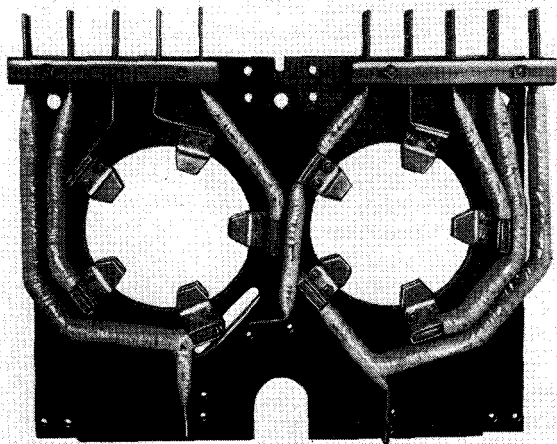


FIG. 5. Single-Phase Selector Switch Panel.

wheel stop strikes against a leaf spring which absorbs the kinetic energy of the motor and gears, bringing the mechanism to a stop without damage.

Note: To reset the mechanical stop, turn the motor by hand so that the stop on the large gear wheel moves away from the leaf spring; then raise the latch manually, compressing its operating spring, and continue to turn the motor in the direction toward the mid-position of the operating range. Note the brake must be released by hand before the motor can be turned.

Limit switches #124-130-132-LRA and "LR" open with #120 on the end position in the "raise" direction, switches #125-131-133-LLA and "LL" open with #120 on the end position in the "lower" direction. These switches prevent the tap changer from going past the end positions when operated by motor. In case of brake failure, the mechanical stop prevents the tap changer from going past the end position.

However, if the tap changer should operate beyond the extreme "Raise" or "Lower" position then all the limit switches for both "Raise" and "Lower" direction are opened before the mechanical stop is reached. It is then necessary to turn the tap changer by hand as explained before until it is back on position and reset the trip latch if it has tripped. The tap changer can then be operated electrically in a direction opposite to that in which it was moving when it was locked out.

When hand operation is used, the operator should, immediately upon opening of housing doors, place the safety switch in the "off" position. This

is accomplished when the hand crank is removed from its bracket and swung to the right. This operation will disconnect all remote control circuits and at the same time release the crank. The mechanism may then be rotated by attaching the hand crank to the motor pinion, after the motor brake has been released by hand. The motor brake is released by depressing the plunger found at the rear of brake, and which is normally operated by its solenoid coil. After hand operation, the tap changer should always be left on an operating position as shown by the mechanical position indicator and with the 120 cam switch open and on the center of cam lobe. When the tap changer has been placed on the desired position, the hand crank must be placed on the safety switch shaft in order to reclose the safety switch, thereby permitting electrical operation of the tap changer.

Caution: Before leaving the mechanism for future operation by remote or automatic control, the operator should check to make sure that (1) the motor brake is in the "brake on" position, (2) the safety switch has been reclosed, and (3) the housing doors have been securely closed.

The operation counter in the motor compartment registers the number of tap changes.

The transfer switch shaft and the operating mechanism shaft are connected by a vertical drive shaft having two universal joints and suitable slip joints, thereby making the accurate alignment between the transfer switch and mechanism shaft and the two housings of lesser importance.

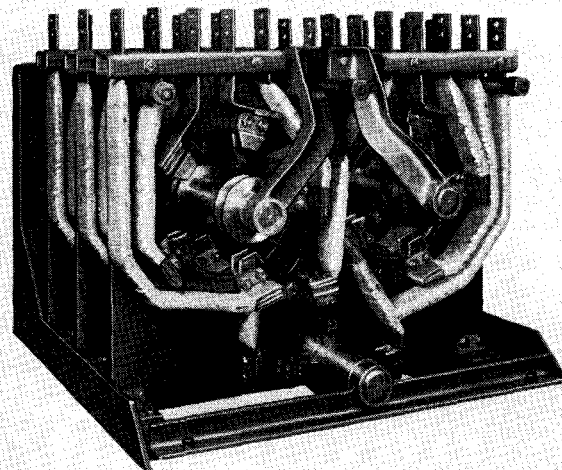


FIG. 6. Three-Phase Selector Switch Assembly, Showing the Reversing Switch at Bottom Center.

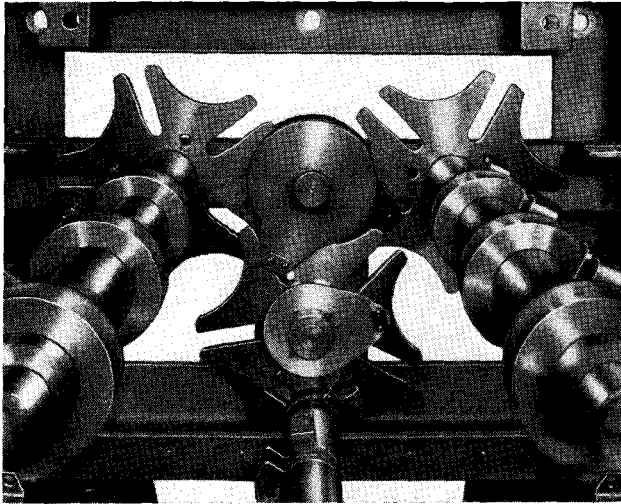


FIG. 7. Geneva Gear Assembly.

The universal joints outside the housing are of special design suitable for outdoor applications, having all moving contact surfaces sealed.

CONTROL EQUIPMENT

The control equipment of the tap changer may be arranged for either full automatic or remote

manual control. Provision is usually made for local manual control for testing when full automatic control is used.

This equipment usually consists of control switches and position indicating equipment mounted on customer's switchboard, control equipment in control cabinet (where automatic control is provided), and motor starter and auxiliary switches, etc., mounted on the tap changer mechanism.

The motor starter which is used to energize the circuit of the tap changer motor consists of two magnetic contactors mounted side by side (or back to back) on insulating panels, with a mechanical interlock between them so that but one contactor may be closed at a time.

An automatic thermal breaker is usually provided for protection of the motor circuit supply and is mounted in the operating mechanism housing.

A safety switch is provided for disconnecting the 3-phase supply from the motor, and control circuits at the control equipment. This is located in the upper right hand part of the operating mechanism and is the same switch previously mentioned which

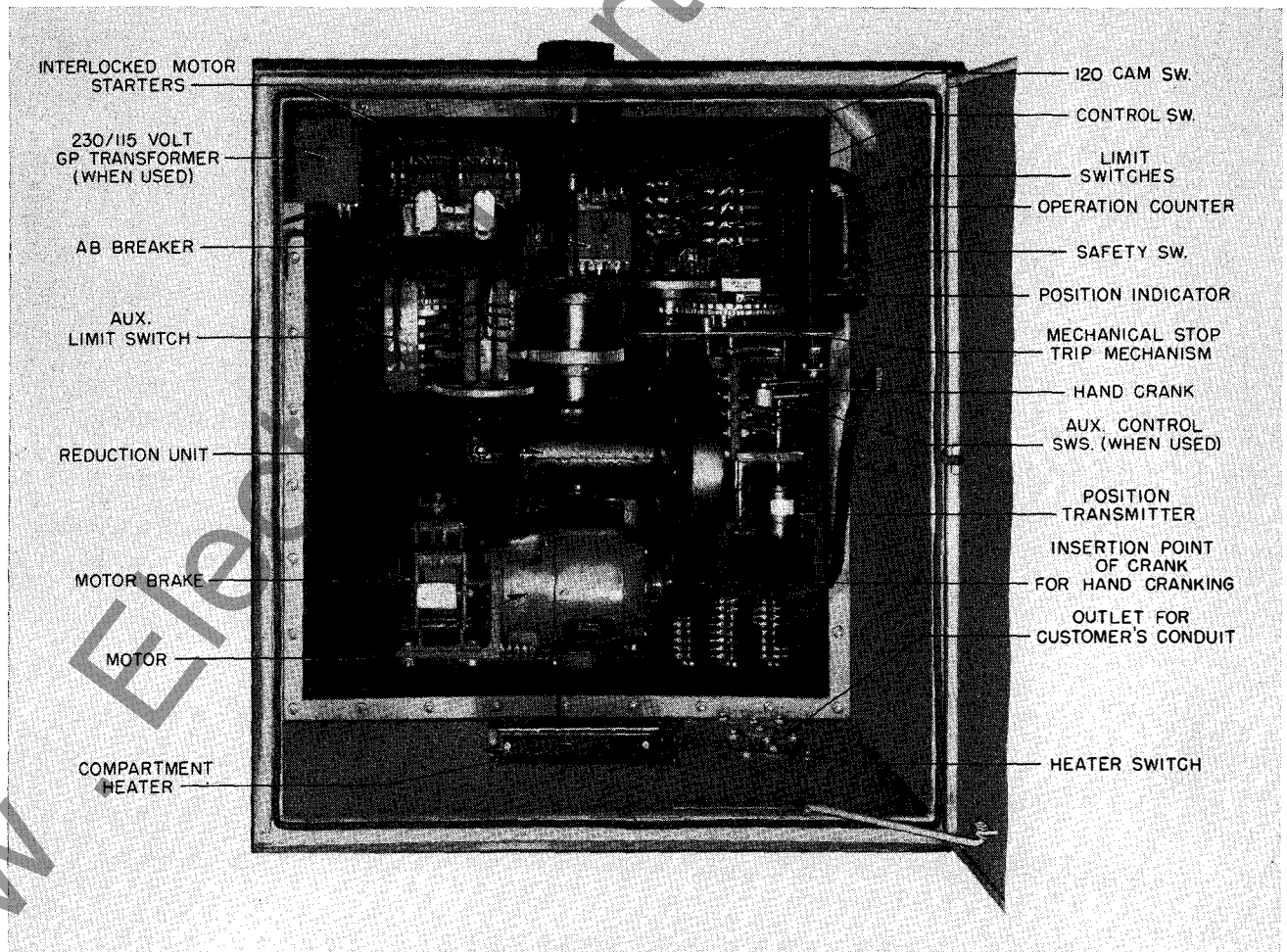


FIG. 8. Operating Mechanism Assembly.

DESCRIPTION

must be opened before the mechanism can be operated by the hand crank. An automatic thermal breaker is provided for protection of the single-phase power supply used with the automatic control.

REMOTE MANUAL CONTROL

For remote manual control, one remote and two local switches are provided. The remote switch and one of the local switches are the operating switches. These switches are provided with a neutral or "OFF" position and two operating positions, the switches being spring-returned to the neutral position. The operating positions are designated as "RAISE" and "LOWER" to correspond to "raise" and "lower" of the voltage under regulation by the tap changer. The remaining local switch determines which of the two control switches is in control. It has two operating positions designated as "REMOTE" and "LOCAL" to correspond to the controlling station. This switch is normally left on "REMOTE" to give control to the remote station.

A remote position indicator is provided for mounting on the customer's panel and indicates the position of the tap changer. A red and a white light are also provided for mounting on the customer's panel. The red light indicates when the tap changer is "off" position and the white light indicates when the safety switch in the operating mechanism is open or the remote-local switch is on the local position.

Position Indicator and Signal Equipment.

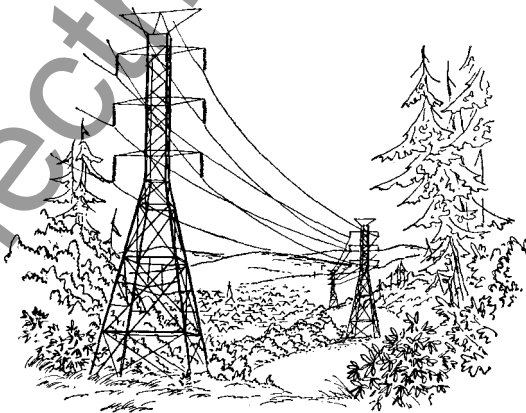
Either the dial (Selsyn) type position indicator, or the lamp type position indicator, may be used with the Type UTR Tap Changer. The dial (Selsyn) type is used as standard on a-c control circuits and the lamp type is used as standard on d-c control circuits.

Dial (Selsyn) Type Position Indicator. The receiver element of the position indicator may be mounted on the switchboard, so that the operator can determine the tap position of the transformer while operating the equipment. The transmitter element of the position indicator, which is mounted on the tap changing mechanism, consists of a wound-rotor induction motor having a single-phase primary and a three-phase secondary winding. See Instruction Leaflet 43-249 under Supplementary Data, Part Five of this book.

Lamp Type Position Indicator. When the lamp type position indicator is used, the transmitter is replaced by auxiliary contacts arranged to indicate the tap positions of the transformer by means of light signals. See Instruction Leaflet T-43-250.1 under Supplementary Data, Part Five of this book.

HEATERS

Heaters are provided to prevent condensation forming in the equipment due to sudden changes in the temperature of the atmosphere. The heater for the control cabinet is controlled automatically by a thermostat, while that in the operating mechanism cabinet is operated as required by means of a manual switch.



RECEIVING AND INSTALLATION

RECEIVING

The Type UTR Tap Changer may or may not be shipped mounted on the transformer tank, depending on railroad clearances. When the tap changer is shipped separately from the transformer, the tap changer and operating mechanism may be shipped as separate units.

When shipped separately, the selector switch will be enclosed by a shipping cover. This compartment will be filled with nitrogen. When installing, it will be necessary to remove the shipping cover, bolt the tap changer to the transformer and connect the leads to the selector switch bus connectors, as shown on the diagram nameplate. If the transfer switch housing has been shipped filled with nitrogen, the compartment should be filled with oil to the proper level *after* installation. Extreme care must be exercised to keep all moisture out of the transfer and selector switches.

INSTALLATION

All identification tags necessary for the correct assembly and wiring of the tap changer equipment should remain attached to their respective pieces of equipment. The tap changer should be wired in line with the nameplate and wiring diagram furnished with the equipment. All conduits leading to the operating mechanism housing may be brought through an iron plate bolted to the bottom of the tap changer housing. Terminal blocks are located inside the tap changer operating mechanism housing to which all the tap changer operating mechanism control and power supply are connected.

Before operating the tap changer and before energizing the transformer, the tap changer should be carefully inspected to see that no foreign material has been left inside the tap changer.

If the tap changer and operating mechanism have been shipped as separate units, it will be necessary to couple them together. Care must be taken to insure that the tap changer and operating mechanism are exactly on the same relative position before assembling the connecting shaft. Check the tap position of the tap changer contact arms before mounting on the transformer and again after connections are completed.

It is recommended that the tap changer be operated over the entire range by hand and then by manual control with the motor before the transformer is energized. Before operating the tap changer by motor, move the tap changer by hand to a position other than an end position.

Note: The reason for this is that in a condition of reverse phase rotation, which gives opposite motor action, the limit switches do not open until the tap changer is off position and almost tripping the mechanical stop. When the phase rotation is correct, the limit switches are opened as the tap changer comes onto position, giving plenty of time for the brake mechanism to function before reaching the mechanical stop.

First operate the tap changer one position only, to determine that the tap changer moves properly with respect to manual control switch operation. Then check operation for complete range.

The transfer switch compartment should be filled with insulating oil, the worm gear housing should be filled with oil, and the brake and universal joints lubricated. The reading of the operation counter should be recorded. See Maintenance, Part Four.

If the tap changer is equipped for automatic control and a 110-volt single-phase a-c source is available, open the safety switch, open the breaker to the customer's potential transformer used to operate the primary relay, and connect the 110-volt source to the test terminals. Turn the automatic-manual transfer switch to the manual position, and operate the tap changer over entire range by means of manual control switch. Turn automatic-manual switch to the automatic position and close primary relay contacts manually to operate tap changer one step in each direction.

By varying the tension of the spring attached to the balance arm, adjust the primary relay to the voltage it is desired to maintain at load center. Set line drop compensator for reactance and resistance of the line between the regulator and the load center. See the applicable Instruction Leaflets in the Supplementary Data Section.

Remove 110-volt source and then close safety switch and the potential transformer breaker.

OPERATION AND ADJUSTMENTS

PRINCIPLE OF TAP CHANGER

Fig. 9 shows the sequence of operation of the Type UTR tap changer. Taps from the transformer winding connect to the tap selector switches (10-19) as shown on Figure 9. These switches are in turn connected to the load transfer switches R, S, and T.

At the neutral position the reversing switch (U and D in schematic) switches the polarity of the regulating winding so that eight full tap positions on either side of neutral (or 33 bridging positions) are obtained. The tap selector switches and reversing switch do not interrupt or close in on current carry-

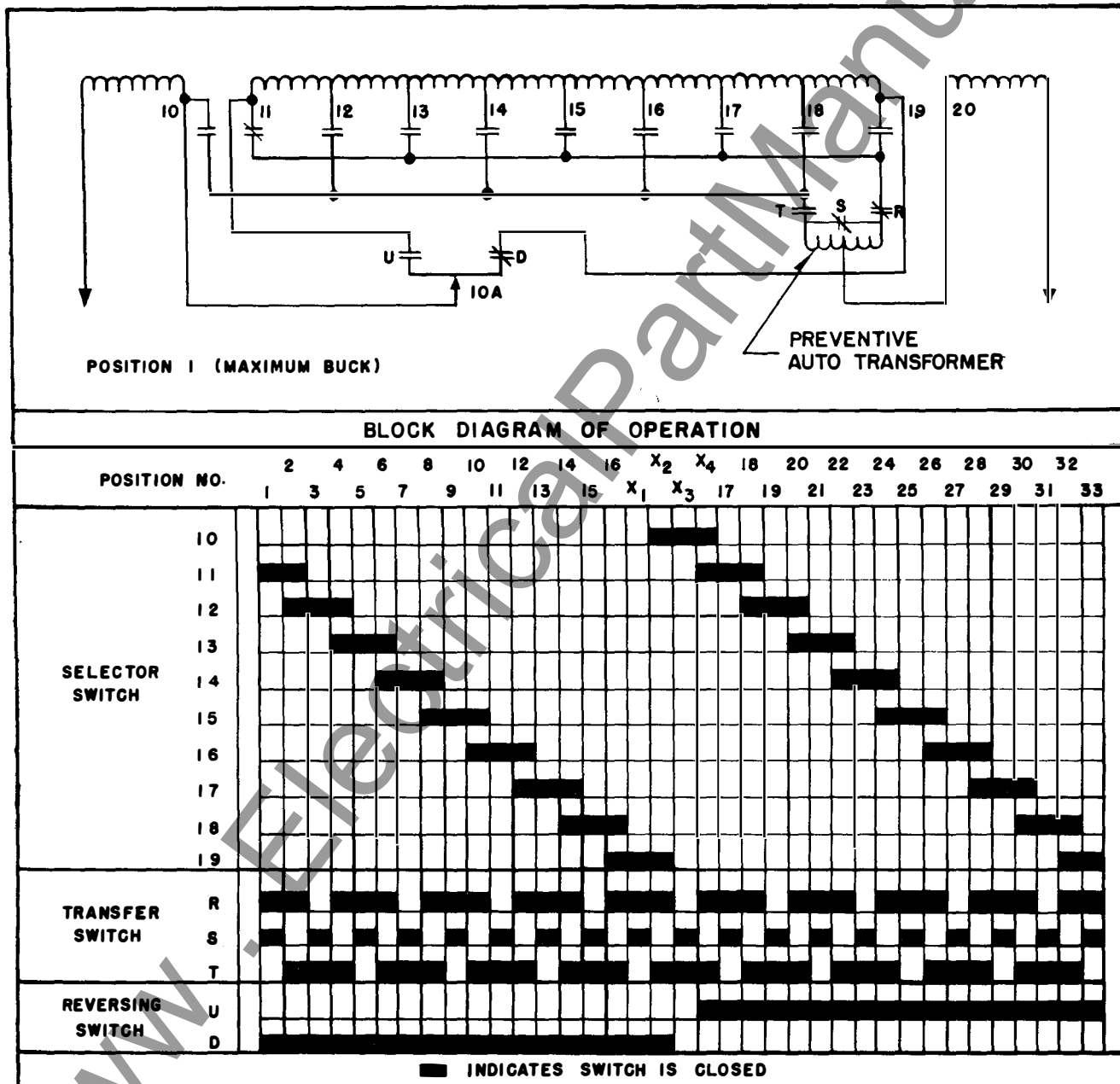


FIG. 9. Block Diagram of Tap Changing Connections.

ing circuits. The load transfer switches (R, S, and T), as the name implies, perform all the load switching operations, opening before and closing after the tap selector switches, thereby restricting all arcing to the transfer switches.

Referring to Fig. 9, the voltage of tap 11 is obtained at the mid-point of the preventive auto transformer with selector switch 11 closed, load transfer switches R and S closed, and reversing switch D closed. To change taps one tap point (two positions), the switches are operated in the following sequence:

1. Selector Switch 12 is closed.
2. Transfer Switch S is opened.
3. Transfer Switch T is closed (Position 2).
4. Transfer Switch R is opened.
5. Transfer Switch S is closed.
6. Selector Switch 11 is opened (Position 3).

The voltage of the mid-tap of the preventive auto transformer is now the voltage of the second tap point. Note that this is position 3. Position 2 is obtained by leaving the preventive auto transformer in the bridging position between these tap points.

When going through the neutral position, there are four stages of transition that correspond to normal positions. However, they are not positions in that the mechanism will not stop at these points. Once the transition begins, the 126 cam closes in parallel with the 120 cam and does not open until this transition has been completed.

On position 16, the following switches are closed: Selector switches 18 and 19, and Transfer Switches T and R. In going from position 16 to position 17, the sequence of operations is as follows:

1. Transfer Switch T opens.
2. Transfer Switch S closes.
3. Selector Switch 18 opens (Position XI).
4. Selector Switch 10 closes.
5. Transfer Switch S opens.
6. Transfer Switch T closes (Position X2).
7. Transfer Switch R opens.
8. Transfer Switch S closes.
9. Reversing Switch D opens.
10. Selector Switch 19 opens (Position X3).
11. Selector Switch 11 closes.
12. Reversing Switch U closes.
13. Transfer Switch S opens.
14. Transfer Switch R closes (Position X4).

15. Transfer Switch T opens.
16. Transfer Switch S closes.
17. Selector Switch 10 opens (Position 17).

When operating from position 17 to position 16, a similar sequence of operations occurs.

Note that during this transition the load is first by-passed from the regulating winding, followed by reversal in the polarity of the regulating winding and then the load is transferred back to the regulating winding.

TYPICAL OPERATION, MANUAL CONTROL

The functioning of the control equipment for a transformer tap changing operation may be observed by referring to the control wiring diagram, Fig. 10. The details of the control will vary slightly for different installations (shown by the wiring diagram supplied with the particular equipment), but in general the control functions as follows:

A single control switch operates the equipment in either the "RAISE" or "LOWER" direction.

The manual control switch should be held in the operating position until the tap changer has started to move as indicated by the lighting of the "off" position red signal lamp. As soon as the red signal lamp is lighted, the manual control switch should be released and allowed to return to the neutral position. The signal light indicates that the tap changer has moved far enough to complete the holding-in circuit of the motor contactor which then remains closed until the tap changing operation has been completed. If the manual control switch is held in the operating position too long, a second tap change will be started upon the completion of the first. If the operator desires to make two or more consecutive tap changes the above procedure should be followed for each tap change, allowing one tap change to be fully completed before initiating a further change.

The closing of the motor starter (as pointed out previously) completes the circuit to the operating motor, and as soon as the mechanism starts to move, the mechanically operated pilot motor switches close and complete the control circuit until a tap changing operation has been completed, irrespective of the action of the operator. If power to the motor fails during a tap change, the circuit through 120 (closed between positions) and R2 will bring the tap changer back on the next lower operating position, when power is restored.

OPERATION AND ADJUSTMENTS

TYPICAL OPERATION, AUTOMATIC CONTROL EQUIPMENT

All of the control equipment (except the motor, starter contactors and motor pilot switches) is mounted either on the customer's switchboard or on a panel in a separate weatherproof house attached to the transformer tank wall. The equipment may be operated either by manual control, remote-manual control or full automatic control. The following accessories are mounted on the panel for operation of the equipment.

- 1 Primary Relay
- 2 Time Delay Relays

- 2 Auxiliary Relays
- 1 Line Drop Compensator (when specifically ordered)
- 1 Automatic-Manual Transfer Switch
- 1 Manual "Raise-Lower" Control Switch
- 1 Set of Voltage Testing Terminals
- 1 Red Lamp

Where remote-manual control is included, additional required equipment will consist of:

At Unit:

- 1 Remote-Local Switch

On Remote Switchboard:

- 1 Manual "Raise-Lower" Control Switch

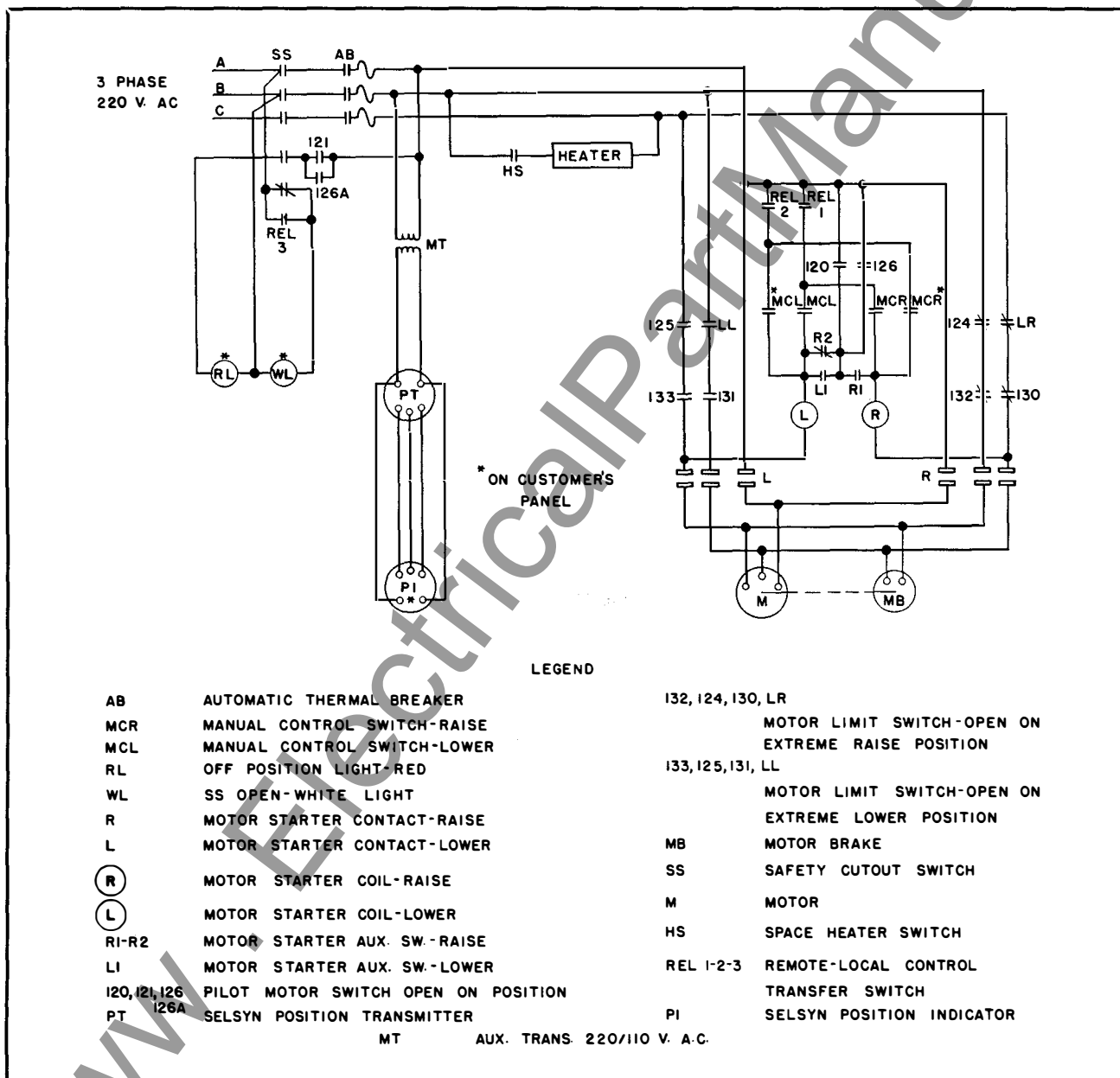


FIG. 10. Diagram of Connections, Remote Manual Control.

- 1 Automatic-Manual Switch (when specifically requested)
- 1 Red Lamp
- 1 White Lamp
- 1 Position Indicator

Primary Relay. Automatic operation is initiated by means of a primary relay which is responsive to a change in voltage at its terminals. When a line drop compensator is used, this initiation can be made to be responsive to a particular load center voltage. The primary relay is energized from a

potential transformer connected to the regulated side of the transformer. When a line drop compensator is used, this voltage is modified by the proportional line drop voltage.

Time-Delay Relay. The time-delay relay introduces a time delay between the closing of the primary relay contacts and the closing of the motor starter contacts thus eliminating needless operations which would otherwise be initiated by momentary fluctuations in the line voltage. The time delay may be adjusted from fifteen to sixty seconds to meet the needs of any specific use.

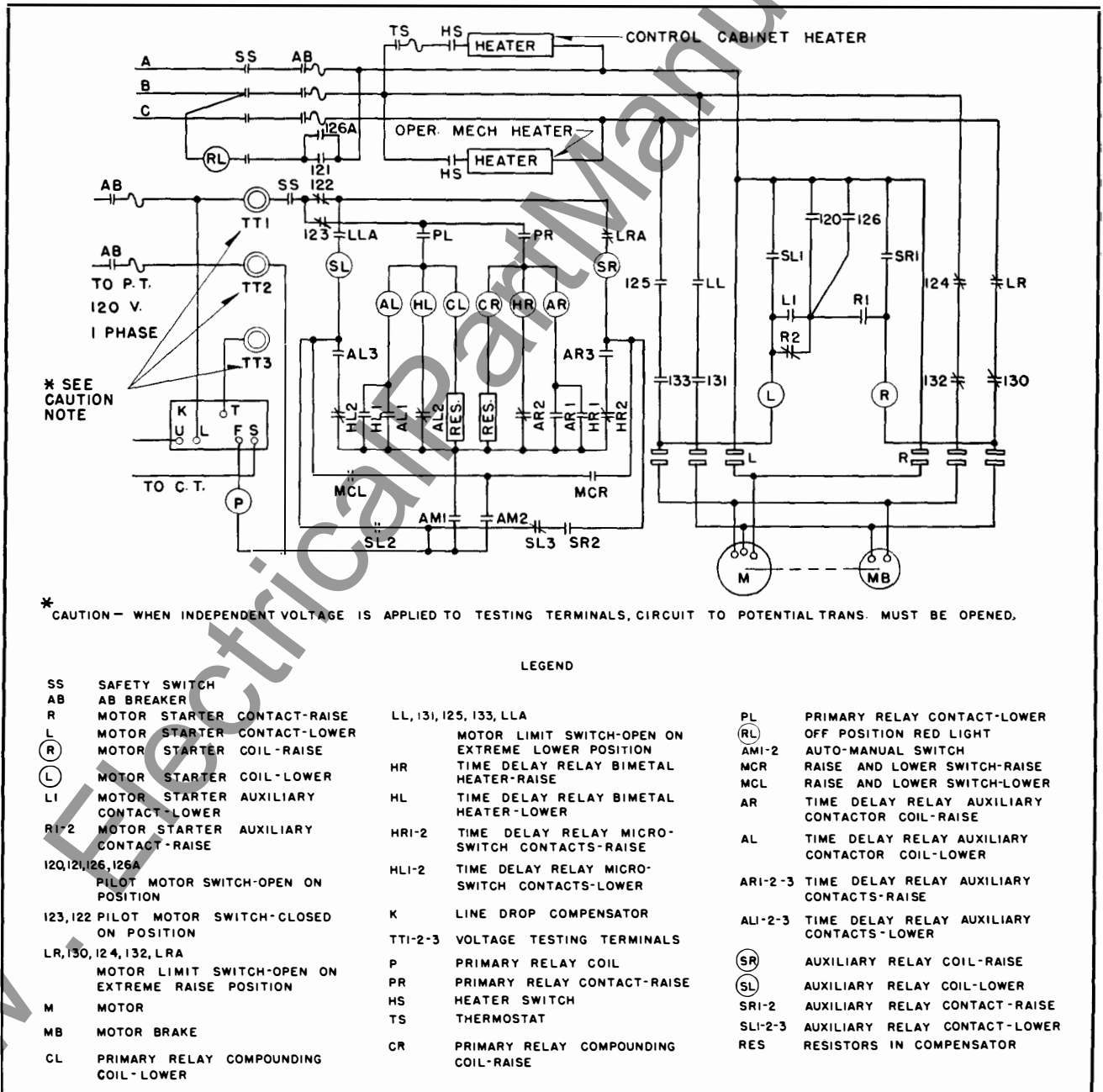


FIG. 11. Diagram of Connections, Automatic Control.

OPERATION AND ADJUSTMENTS

Auxiliary Relays. Two auxiliary relays are used to activate the motor control contactors.

Line Drop Compensator. A suitable line drop compensator will be furnished (if specified) when it is desired to maintain constant normal voltage at the load center.

Automatic-Manual Transfer Switch. This switch functions to connect the control circuit for manual or full automatic control. The two systems of control cannot exist simultaneously.

"Raise-Lower" Control Switch. This switch is used to operate the regulator manually in either the "RAISE" or "LOWER" direction as desired.

"Remote-Local" Transfer Switch. (When Required). This switch is used to determine the controlling station.

Voltage Testing Terminals. These terminals are used for reading the regulated voltage.

Red Lamp. This lamp is lighted whenever the tap changer is "off" position.

White Lamp. This lamp when lighted, indicates the drum type safety switch on the operating mechanism is in the "open" position or Remote-Local Switch is on local control position.

Position Indicator. Either a synchrotie or a lamp-type position indicator will be provided. See applicable Instruction Leaflets in Supplementary Data Section.

PRINCIPLE OF OPERATION OF AUTOMATIC CONTROL EQUIPMENT

The details of the control will vary slightly for different installations (shown by wiring diagram supplied with the particular equipment), but in general the control functions as follows. A typical schematic diagram is shown in Fig. 11. The diagram shows the relays in the de-energized position and on tap one (lowest position).

The automatic-manual transfer switch is a two-position switch which functions to connect the control circuit for either automatic or manual control as shown in Fig. 11. The two systems of control cannot exist simultaneously.

When manual operation is being used, operation of the tap changer is initiated by the "RAISE-LOWER" switch MCR—MCL, to operate the tap changer

in the "RAISE" or "LOWER" direction as desired. The automatic-manual switch AM1—AM2 must be in the manual position (AM2).

As soon as the mechanism moves through a small angle, the cam-operated pilot motor switch 120 completes a holding-in circuit by which the motor starter is held closed until the tap changing operation has been completed regardless of the action of the operator, as previously described.

With the "Automatic-Manual" Switch on "Automatic" (AM1) the operation is initiated by means of the primary relay which is responsive to a change in voltage at its terminals, which, when a line drop compensator is used, is equivalent to the load center voltage. This relay is energized from a potential transformer connected across one phase of the line on the regulated output side of the main transformer. When used with a compensator, a current transformer is required in order that the compensator will correct for the line drop between the regulator and the load center.

The line drop compensator when requested will usually be the Type RE for reproducing load center voltage at the equipment.

In order that momentary fluctuations of line voltage will not cause needless operations of the tap changer, time delay relays are included in the control circuit. The timing on these relays is adjustable from 15 to 60 seconds. The relay is usually adjusted to give a time delay of about 40 seconds.

By referring to Fig. 11, the following describes a typical automatic operation of the tap changer.

Assume that the load on the regulator is such as to cause a drop in the voltage impressed on primary relay coil P. This will close the relay contact PR which in turn closes the circuit to energize the bimetal heater HR of the time delay relay.

If the primary relay contact PR remains closed long enough to allow the bimetal HR to heat to a temperature determined by the time setting of the relay, this bimetal will operate a microswitch, opening HR2 and closing HR1. The closing of HR1 energizes the auxiliary contactor coil AR which in turn opens AR2 and closes AR1 and AR3. The opening of contact AR2 opens the bimetal heater circuit and allows the bimetal element to cool. The time required for the bimetal element to cool is the major part of the time delay, the length of this time being determined by the setting of the relay. During this cooling period, fluctuations of voltage have no effect whatever on whether or not a tap change will

be called for at the end of the cooling period. After the microswitch once operates, the primary relay is the deciding factor in determining whether or not a tap change will be made.

At the end of the cooling period, the bimetal element allows the microswitch to return to its original position with HR2 closed and HR1 open. If the line voltage has returned to normal allowing PR to open, AR has become de-energized, AR3 has opened, and the reclosing of HR2 does not cause a tap change. However, if the primary relay still calls for "raise" in voltage, AR is still energized and AR3 is closed. Thus the reclosing of HR2 completes a circuit through HR2 and AR3 to auxiliary contactor coil SR. The energizing of coil SR closes contact SR which in turn energizes motor starter contactor coil R which closes the R contacts and starts the motor for a tap change.

When the R contacts close, and the tap changer starts to move to the next position, cam-operated switch 120 closes before 123 opens. The closing of 120 seals in the R contactor through auxiliary contact R1. This sealing-in action insures that the R contactor will remain energized until a tap change is completed.

Pilot switch 123 (cam-operated) is closed on position and opens during a tap changing operation after pilot switch 120 has closed. Pilot switch 123 functions to cause a time delay between consecutive tap changes by resetting the TH Timing Relay. If desired, the control can be modified to eliminate the time delay between successive positions, but retain the initial time delay by shorting out pilot switch 123.

The Transformer Division (Sharon Works), Tap Changing Under Load Engineering, should be consulted on the particular application if the 123 switch is to be by-passed.

In case the load on the transformer is such as to cause an increase in the voltage impressed on primary relay coil P, the operation is similar to that described above except that the L contacts function to operate the tap changer in the "LOWER" direction.

Primary Relay. The primary relay (see instruction leaflets) is usually connected through a line drop compensator (as shown by Fig. 11) to the potential transformer and is sensitive to voltage changes.

Adjustments of Primary Relay. When first installed, the spring in the primary relay may have

to be adjusted to change the normal setting of the relay as may be required for the particular circuit. Except for this adjustment, it is recommended that no other adjustment be made until the operation is carefully observed for a time so that any change in adjustment may be made intelligently.

After adjusting the tension of the spring to change the normal voltage of the relay, see that the loop of the spring which is attached to the moving arm is at right angles to the moving arm, and also see that the adjusting nuts are properly tightened.

As shipped from the factory, the relays are adjusted for a normal voltage corresponding to that of the system which is to be regulated. The stationary contacts are adjusted to make contact when the voltage increases or decreases by an amount equal to the percentage of the voltage steps of the regulator, i.e., if regulator taps give $1\frac{1}{4}$ per cent (based on normal voltage) voltage change between each step, the primary relay will be adjusted at the factory to close when voltage changes $1\frac{1}{4}$ per cent from normal. For other adjustments refer to instruction leaflets.

Line Drop Compensator. The object of the compensator is to so affect the operation of the primary relay that the tap changer will automatically increase the voltage as the load increases and take care of the increasing drop in the line, thus maintaining a constant voltage at the load center.

The Type RE Compensator is usually used, but the Type RC may also be used. See Instruction Leaflets.

Compensator Setting. Set the compensator for the compensation required for the particular circuit. If the resistance and reactance of the line are known or can be calculated, it is preferable to calculate the percentage drop at full load and to set the compensator dials accordingly. The voltage compensation given on the compensator nameplate will be obtained only when current as stamped on the nameplate is flowing in the compensator. With smaller currents the voltage compensation will be proportionately reduced. If the resistance and reactance of the line are not known, this setting of the compensator must be made by trial.

Motor and Brake. Before placing in operation, examine the motor to see that no damage has been done during shipment and that the shaft turns freely with motor brake released.

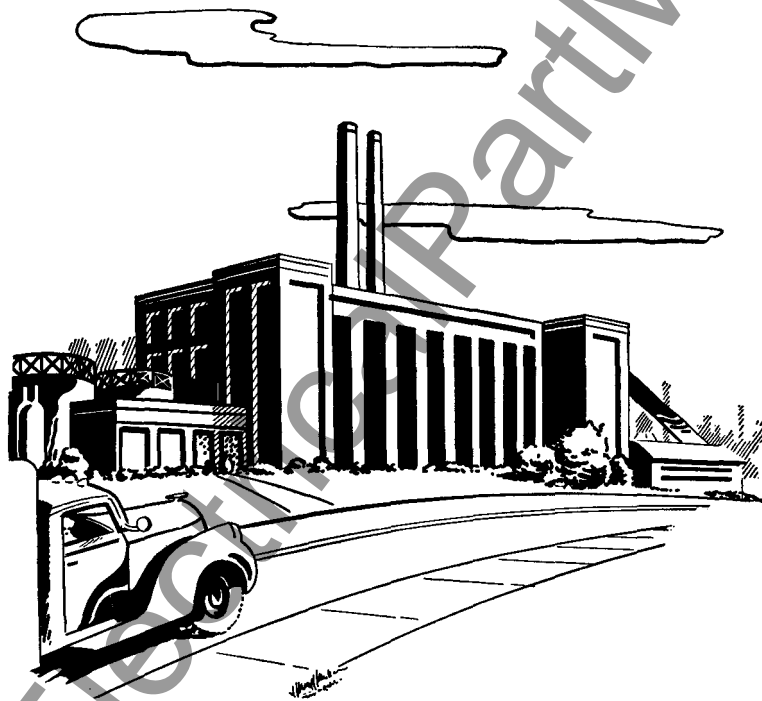
The brake is mounted directly on the motor and is designed to stop the motor quickly when the motor circuit is opened.

OPERATION AND ADJUSTMENTS

Motor and Brake Adjustments. The brake requires practically no adjustment until considerable wear takes place on the brake shoes. The air-gap in the brake magnet (inside the brake coil) should not be more than $11/16$ inch when there is no current on the motor and brake; that is, when the brake is set. This gap can be measured by observing the distance which the magnet core moves into the magnet coil when the brake is released and the air-gap closed. When the travel of the magnet becomes excessive new brake shoe linings should be furnished or spacers should be placed behind the old linings.

Both brake shoes should lift off the brake wheel an equal amount. If this is not the case, the pin bearings in the brake magnets should be examined, and if they have become dirty they should be thoroughly cleaned and oiled. If the brake magnet becomes noisy, it probably indicates that dirt has settled in the air-gap of the magnet inside the coil. In this case the brake shoes and coil should be dismantled and the pole faces of the magnet inside the coil should be cleaned.

Refer to Instruction Leaflet 2134-B in Supplementary Data Section.



MAINTENANCE

GENERAL INSPECTION

Westinghouse tap changers are designed to operate in service with a minimum of maintenance, but should be given a periodic inspection.

Oilless bearings are used throughout the mechanism so that the lubrication consists mainly in keeping the worm gear housing filled to the proper level with oil, and occasional greasing of universal joints. It is recommended that Westinghouse oil M-5114 (approximately S.A.E. 20) be used in the worm gear housing. Only sufficient oil should be used to fill the gear housing up to the filling plug level as excess oil will work out along the shaft.

The motor brake should be inspected occasionally, the pivot pins oiled, and adjustments made if the shoe linings show signs of wear or if the tap changer does not stop on position.

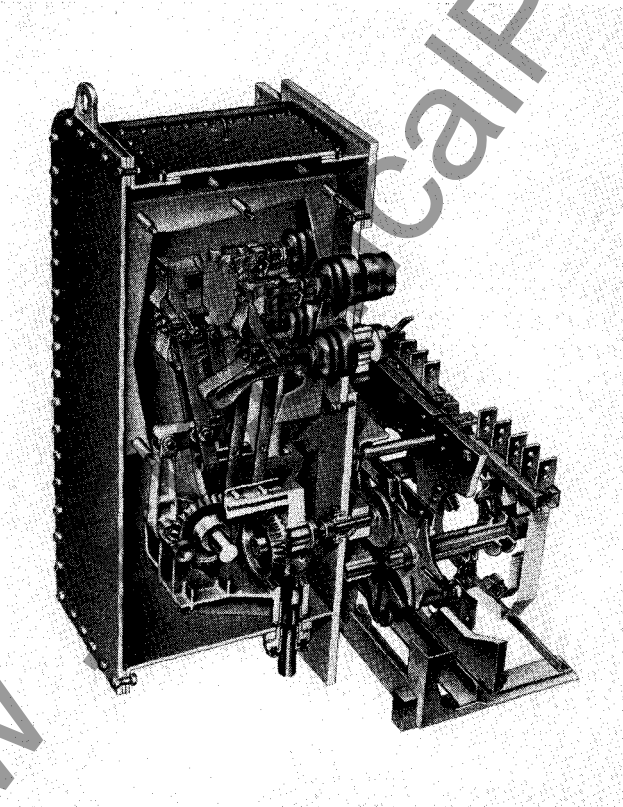


FIG. 12. Cutaway View of UTR₁ Tap Changer, Showing One Switch Open and One Switch Closed.

MAINTENANCE OF TRANSFER SWITCH ARCING CONTACTS

Satisfactory operation of a load tap changer depends on proper design and functioning of its contacts for load transfer. A satisfactory record of transfer switch performance and life may be maintained by following the important steps in the adjustment of these contacts.

All contacts which are to be replaced for any reason should be replaced with the improved design. The adjustment procedure is applicable equally to old and new design contacts.

It is recommended that, wherever possible, a Westinghouse engineer assist in any routine inspection or maintenance of these tap changers to insure the proper adjustments being made.

Maintenance of the transfer switch contacts will depend to a great extent on the current which they

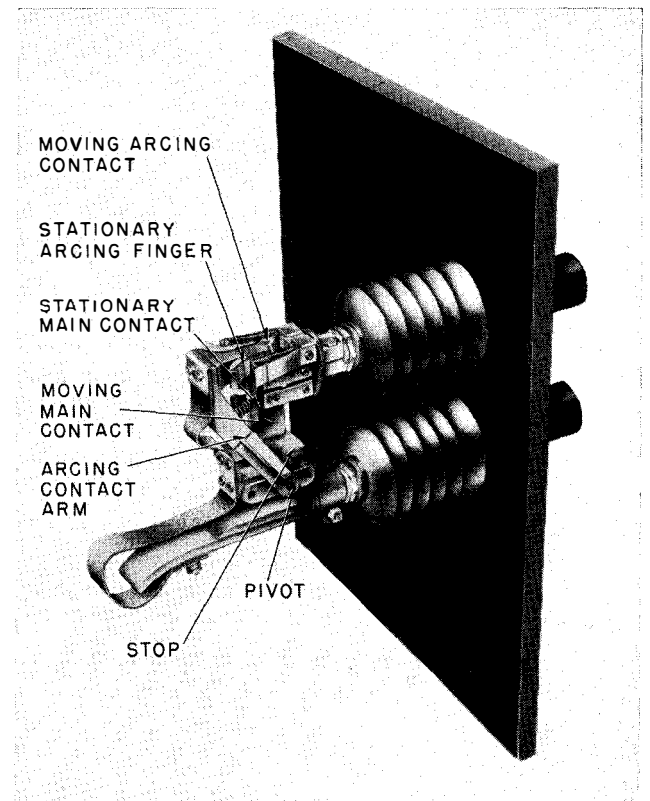


FIG. 13. Transfer Switch, Closed Position.

carry. Replacement of the arcing contacts should be made before the arcing contacts burn to the extent that arcing will take place on the main contacts. It is recommended that the entire tap changer be thoroughly inspected after the first 1000 operations. The transfer switches should be inspected periodically (at least once a year) thereafter. Should the tap changer operate through a major fault in the system, and transfer switches show undue burning, the entire tap changer should be inspected. The tap changer should never be energized with the oil testing less than 15 kv in the standard test cup.

IMPROVED MOVING CONTACT

The improved design moving arcing contact for the Type UTR tap changer can best be seen in Fig. 16. The improvement consists of brazing on the arcing tip at an angle to the main axis of the contact. Previous contacts had the tip perpendicular to the axis of the arcing contact and parallel to the edge of the current carrying contact below it.

The action of this contact is shown by the sequence of Fig. 13 to Fig. 16. Fig. 12 is a cut-away view of the entire Type UTR tap changer showing one switch closed and one open. It is apparent from Fig. 12 that the main current contact is moved by the long Micarta arms in a path almost horizontal. But the cast arm holding the upper or arcing contact is pivoted near the end of the long arms, and moves in a short arc about the main contact support.

Fig. 13 shows the contacts with the switch in its closed position. As the switch begins to open, the main contact begins to withdraw from its fingers and the arcing contact withdraws within its fingers until the shoulders on the arcing contact mesh with the shoulders on its fingers as shown in Fig. 14.

Further withdrawal of the main contact separates it from its fingers and current is now carried by the arcing fingers. But the shoulders on the arcing contacts prevent their separation and cause the arcing contact arm to pivot and compress its bias spring. When the spring becomes fully compressed and the arm reaches its stop, further motion will force the fingers apart to release the moving arcing contact. This condition is shown in Fig. 15. Note that the main contacts have now separated an adequate distance so no arc can be drawn between them.

When the fingers release the moving arcing contact, the spring snaps the moving contact away as shown in Fig. 16. This produces a high parting speed to interrupt efficiently the arc formed, and all arcing takes place on the elkonite tips of the arcing contacts, leaving the copper main contacts clean for carrying load current on operating positions.

The object of the keystone shape of the moving contact and the corresponding shoulders of the stationary contact is to hold the moving contact

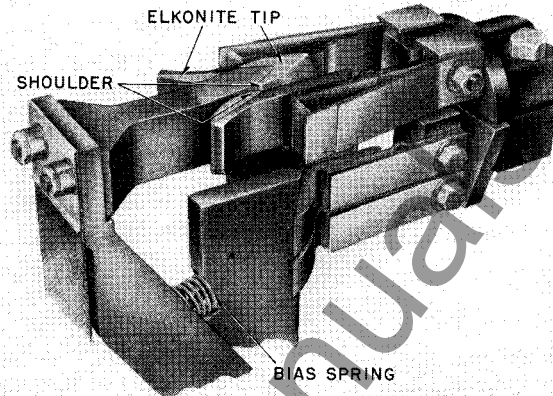


FIG. 14. Main Contact Partially Withdrawn—Arcing Contact Held by Shoulders.

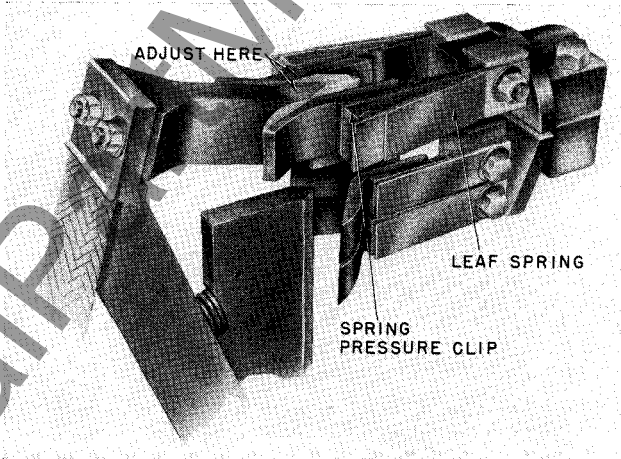


FIG. 15. Main Contact Withdrawn—Arcing Contact Pivoting.

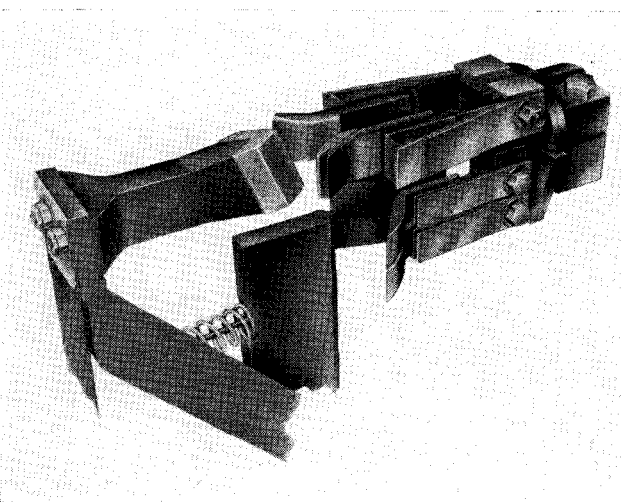


FIG. 16. Arcing Contact Free of Shoulders, and Sprung Clear.

within the stationary contacts until the mechanism definitely forces it out due to the bias spring going solid and the contact arm coming to its stop. This is necessary so that when the spring flips the contact open, there will be enough contact separation to cause the arc to go out quickly. Should the contact open sooner, the separation might be too small and the arc might hang on until the relatively slow motion of the main arms provide the necessary separation. This would increase arc burning enormously. Therefore, it is very important that the moving arcing contact be retained by the shoulders until its arm reaches the stop.

The new design contact has its retaining shoulder at an angle to its axis such that the shoulder is vertical when the contact arm is fully pivoted. This means that upon initial withdrawal it meets the shoulders of the stationary contacts at an angle (Fig. 14.) As the withdrawal action continues, the arcing contact, in traveling a shorter arc, swings out so that the stationary shoulder and the moving shoulder become parallel.

Thus the parting pressure required to open the arcing contact becomes greatest just before the bias spring becomes solid.

The speedy flipping action is thereby increased by the use of the new design contacts, since a greater force is required to break the arcing contacts apart after the main contacts have parted.

IMPROVED STATIONARY CONTACT

The retaining action just described could be prevented should some other factor cause premature spreading of the fingers. One way this could happen is by the moving contact shoulders striking the stationary shoulders with enough momentum to drive them apart.

The only way this can occur is if the moving contact is held by friction before it is withdrawn far enough to engage the shoulders. If this friction is strong enough, the arm may pivot and compress the bias spring. When the friction is overcome, the spring will then snap the contact outward, possibly with enough force to pass the shoulders. At this time the main arms will not have moved far enough to give adequate separation for arc extinction, and the arc will be broken under slow motion.

One way to avoid friction is to apply the contact pressure from the leaf springs at the point where it is desired. The leaf springs press on a clip on the back of the stationary contact. Formerly this clip was located between the two rivets which hold the contact and shunt together. The improved

contact has a clip which extends from the extreme forward end of the copper shoe. This applies the leaf spring pressure exactly opposite the contact shoulders where it is required.

CONTACT ADJUSTMENT

1. To avoid another source of the friction just described, the spacing between stationary contacts must be sufficient to avoid the moving contact wedging between the rear heels of the stationary contacts. Revised drawings used on new units include spacers to assure free motion when the contacts are fully closed. Older units may not have contacts properly spaced, and copper spacers should be inserted between the contact and its foot casting if necessary. The spacers should be sufficient so that, in the fully closed position, practically all the spring pressure is taken on the elkonite tip of both the moving and stationary contacts, the greater portion being on the elkonite tips of the stationary contact.

2. Another source of insufficient holding action can be unequal engagement of the shoulders by the two fingers. In adjusting a tap changer, it should be moved to the position shown in Fig. 16, and a very careful check made to be sure both fingers are engaging equally at the shoulders. This must be done by "feel" and is fairly sensitive. Any adjustment is made by moving the stationary fingers. The importance of this factor may be seen by realizing that if one shoulder fails to engage even slightly, the retaining effect is greatly reduced.

RENEWAL PARTS

The Renewal Parts Order Section at the Sharon Plant will supply contacts for replacement as follows:

1. Moving Contacts. Moving contacts for Type UTR are new design and will ordinarily be furnished in sets sufficient for changing all the contacts in the subject tap changer, regardless of the quantity specified. This applies to tap changers not originally having the improved contact. Should additional replacement be required after a tap changer has once been changed over to the improved contacts, less than a full set may be obtained by noting on the order "do not supply full set".

2. Stationary Contacts. If the tap changer did not originally have the improved contacts, any order for stationary contacts will be filled by shipping enough new design fingers for the entire tap changer, and also enough springs and spacers to match. Less than this bill of material may be obtained by noting on the order "do not supply full set" and/or "do not supply springs".

MAINTENANCE

SPARE PARTS

The customer will find that only a minimum of spare parts will be required for the Type UTR Tap Changer. It is recommended that a complete set of stationary and moving arcing contacts be kept in stock for replacement when necessary. These are the only parts which will be required normally, but the following list is recommended if the cus-

tommer desires a more complete stock of spare parts:

SPARE PARTS	QUANTITY
Motor and Brake Complete	1
Contactors Coils for Motor Starter	2
Cover Plate Gaskets	1 Set
Porcelain Bushing for Transfer Switch	1
Relay Coils and Contacts (For Automatic Control)	1 Set

PART FIVE

SUPPLEMENTARY DATA

This Part of the book consists of the leaflets which follow in numerical order.

www.ElectricalPartManuals.com

TYPES AI AND DI MAGNETIC BRAKES—FRAMES 43 AND 63

INSTRUCTIONS

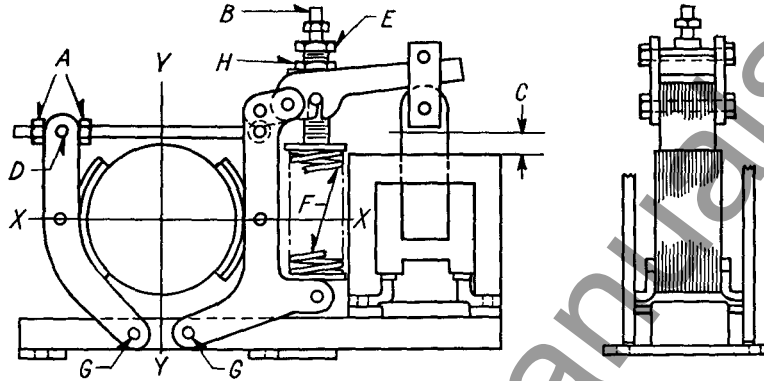


FIG. 1—TYPE AI BRAKE

General

The types AI and DI magnetic brakes are designed so that when the magnet is energized the shoes will clear the wheel, and when de-energized the shoes are closed against brake wheel by means of a compression spring (F). The brake shoes have a friction pivot for self-alignment and preventing shoes dragging. Being a spring set brake, the torque is produced by the springs forcing the shoes against the wheel and the plunger movement or stroke (magnet) removes the spring force from the shoes, thus freeing the wheel. In order to maintain a quick-acting and full-rated brake, it is essential that all adjustments be the same as given on the nameplate marking.

Advantages

1. Frame is fabricated steel, giving maximum rigidity and minimum weight.
2. Laminated magnetic circuit is of the open type, with maximum ventilation with a reduction in input for a given torque. It is bolted directly into frame.
3. All adjustments are accessible from the top and easily made.

Mounting

While extreme accuracy in alignment is not essential, reasonable care should be taken to have the center of shaft at the intersection of lines x—x and y—y. These lines, indicated in above outline, are with y—y midway between arm pins G and x—x through center of the brake shoe bolts.

Motor mounted brakes, except the mountings, are identical with floor mounted brakes. To attach a motor mounted brake, proceed as follows:

1. Attach the brake and adapter to the motor with clamping bolts furnished. Sufficient clearance has been provided to allow the brake to be shifted to give correct alignment described in the foregoing paragraph.
 - (a) Tighten the adapter clamping bolts securely.
 - (b) Remove brake frame from adapter bracket.
 - (c) Drill the motor frame and drive in securely the two dowel pins furnished with the brake. The adapter has been drilled at the factory and may be used as a drill jig.

2. Replace brake on the adapter, tighten bolts securely and proceed with adjustments.

Adjustments

The brakes have been adjusted according to the nameplate marking before shipment and are ready for use. The factory adjustments were made as outlined on nameplate #21490, attached to brake and the following is a partial repetition.

Adjustments should be made in the following order with the brake securely fastened. Refer to outline, Fig. 1, for all locations mentioned in the following procedure.

1. **Plunger Travel Stroke**—By means of nuts A, adjust the stroke C to agree with nameplate marking.
2. **Shoe Clearance**—Energize magnet

and adjust bolt B until the clearance between each shoe and the wheel is the same.

3. **Spring or Torque**—There are two stages to the spring adjustment; first, a balancing or no torque stage, and second, an adjustment for the rated torque of the brake.

After adjusting stroke and shoe clearance as in paragraphs 1 and 2, turn bolt E, controlling spring force, until plunger requires little or no effort to move up and down. With the parts balanced, measure the distance between top of bolt E and trunnion and decrease this measurement by the amount of spring compression given on the name plate by turning bolt E. This last adjustment will give the rated torque. Lock bolt E in position with nut H.

4. **Shoe Wear**—As the shoe lining wears down with use, the plunger travel stroke increases. This should be checked periodically, and the travel readjusted to the proper amount as shown on the nameplate (see par. 1). The plunger travel should not be allowed to exceed twice the value marked on nameplate because the coil will be liable to burn out.

After adjustments, be sure all the lock nuts are securely tightened.

5. **Manual release** is obtained by removing pin from nut on bolt B and screwing nut down far enough to release shoes. Nut must be securely fastened with pin when brake is in normal operation.

TYPES AI AND DI MAGNETIC BRAKES—FRAMES 43 AND 63

INSTRUCTIONS—Continued

Brake Shoe Lining

Only the best grade of brake shoe material is used to meet the general trade requirements based on:

1. Uniformity of coefficient of friction over a wide range of temperatures.
2. Low wear factor.
3. Little change in coefficient in presence of oil or moisture.
4. Compressibility.

The following three brands of lining have proven by test and experience to give the best results for general industrial service.

1. Raybestos Gold Edge.
2. U. S. Industro Truck.
3. Ferodo Brake Lining.

We have no preference as to which of the above brands is used. On some applications one lining may give better service than another. However, this can only be determined through experience.

Maintenance

Lubrication. All bearings and pins should be kept lubricated. Judgment should be used as to quantity and how frequently. Excessive oiling accumulates dust. Where the dust is of an abrasive character, the bearings soon show the effects in the form of wear.

Brake Shoe. Inspection of brake shoes should be made at regular intervals. As the lining wears away, the clearance should be reduced, as explained above in paragraph 6 under "Adjustments".

To reline brake shoe, remove connecting rod pin -D-, also the shoe bearing bolts and slide the shoe toward the top of brake wheel. Frequency of use and character of service will determine how often it will be necessary to reline

Table of Magnet Coils

Frame No.	Style Numbers					
	110 V. 60 Cyc.	110 V. 50 Cyc.	220 V. 60 Cyc.	220 V. 50 Cyc.	440 V. 60 Cyc.	440 V. 50 Cyc.
Cont. Duty 43	844304	856002	832942	844262	844303	844238
Cont. Duty 43-S	844301	856001	844262	844300	844238	844266
Cont. Duty 63	845402	856003	845401	844308	874126	844306

shoes. Care should be used in maintaining the proper tightness of the shoe bearing bolt nuts to prevent unnecessary dragging on the wheel.

To Remove Magnet Coil

43 and 43-S Brakes. The stationary magnet is fastened to the frame by two bolts beneath coil and passing through bars and magnet punchings. Removal of these two bolts will permit moving stationary magnet diagonally away and free from operating lever. By removing spool bolts, the coil can be replaced.

63 Brake. The Stationary magnet is bolted to frame with four holding bolts and when removed permits moving magnet away from operating lever. The additional removal of link between plunger and operating lever permits removal of magnet parallel to axis of shaft which need be resorted to only where there is insufficient space at side of brake.

Coil Replacement

For new coils, refer to the nearest Westinghouse Sales Office and give complete nameplate reading.

Failure to Operate

The magnet may fail to close for any of the following reasons:

1. The lead wire to the operating coil may be disconnected.
2. The operating coil may be open circuited.
3. There may be mechanical friction.
4. The voltage may be below normal.
5. Excessive magnet strike. Adjust periodically to maintain strike shown on name plate.
6. Excessive spring compression.

Magnet Noise

Humming on the alternating-current magnet may develop. Should it become excessive, check to see if any of the following conditions exist:

1. The pole face of the magnet may be corroded, which will not permit the magnet to seat properly.
2. The voltage may be below the minimum rating of the operating coil.
3. The shading coil on the magnet may be broken or the spring pressure may be too high.
4. The coils may be connected to oppose each other.

Westinghouse Electric Corporation
Buffalo, N. Y.



INSTALLATION • OPERATION • MAINTENANCE INSTRUCTIONS

TYPE SG AUXILIARY RELAY

APPLICATION

INSTALLATION

Inspect the relay carefully after unpacking to see that no damage has been done in shipment. Operate the relay by hand several times to see whether the moving element is properly aligned and free from friction. Check the nameplate rating to see that it agrees with conditions under which relay will be used. The SG for use on A-C has a rectangular copper loop clamped in the top of the core, over which the coil is placed. The D-C relay has no loop, but has a small bronze button in the center of the core front to prevent the armature from being held closed by residual magnetism.

Mount the relay with the base against a vertical plane and with the contacts at the top.

Relays having a voltage rating which requires a resistor in series with the coil are supplied with a vitrified tube resistor which has heavy screw-type terminal lugs. The resistor is assembled on an insulated mounting stud by which it can be mounted either directly on a panel or any convenient bracket.

When sheet metal cabinets are ordered for open-type relays, the relays and cabinets are shipped separately. The relays can be assembled on the tapped mounting holes in the bottom of the case by means of the mounting screws which are provided. The cabinets have knockouts for conduit connections on top, bottom and sides.

The relay can be supplied for use on the following voltages without an external resistor by the use of suitable coils. The standard coils are:

6, 12, 24, 48, 125 and 250 Volts D-C
115 and 230 Volts - 25 Cycles
115, 230, 440 and 575 Volts- 50 or 60 Cycles

and for higher D-C or 25-cycle voltages with an external resistor. For further information regarding application consult Westinghouse Relay Catalog, Section #41-350 or the nearest Westinghouse Sales Office.

The relay is intended for use as an auxiliary relay for miscellaneous automatic and remote control switching. It is suitable for many industrial applications also.

The operating and reset time of the type SG at rated voltage or current is 1 to 2 cycles (60 cycle basis).

CONSTRUCTION

The standard relay is furnished in two forms: A front-connected, open-type and a rear-connected, enclosed-type. The operating elements are identical in the two types and consist of four parts: core, yoke, armature and coil.

The open-type relay normally is provided with two contacts and is shipped with both stationary contacts arranged to close when the relay is energized. However, either or both contacts can be converted quickly into a break contact merely by removing the screw which holds the stationary contact bracket and turn-

TYPE SG AUXILIARY RELAY

ing the bracket over. After tightening the screw, the contact bracket may be bent slightly with the fingers if necessary to change the back contact follow or alignment. When the make contacts are closed, the moving contact fingers should be deflected approximately $3/64$ " measured at the contacts, or slightly over $1/32$ " measured at the upper edge of the molded armature block. The assembly of the moving contact fingers on the armature block is arranged to provide spring follow with either make or break stationary contacts. The closed-type relay is provided with two make and two break stationary contacts with the moving contacts common, and the open-type relay is provided with such a contact arrangement for applications which require it.

Relays for use on A-C are assembled with a thin bronze washer between the yoke and core. A brass screw holds the yoke and core together. This washer helps to prevent the armature from being held closed by residual magnetism after the relay is de-energized. In case the relay should be dismantled, it is important that this washer be replaced on re-assembling it.

CHARACTERISTICS

All relays should pick up on 80% of the nameplate voltage rating. No adjustments are provided for varying the pick-up. The arma-

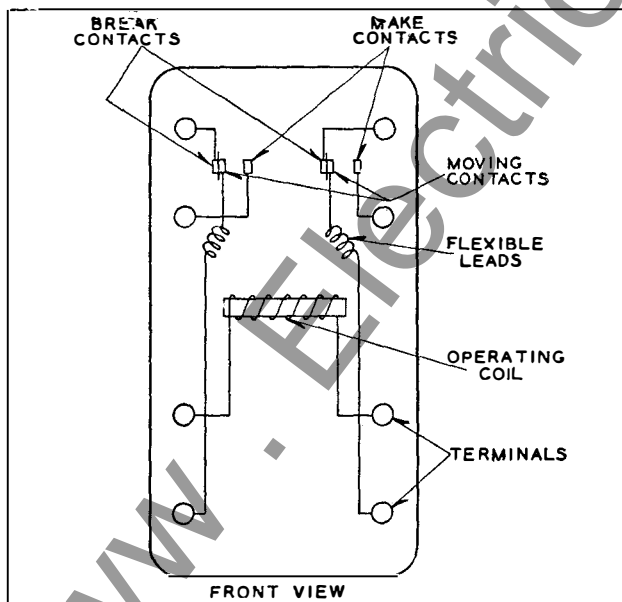


Fig. 1—Internal Connections for Closed Type SG Relay.

ture will open at 30% or less (on D-C) and at 60% or less (on A-C).

The volt-ampere burden at rated voltage (60 cycles) is 10, at a power-factor of approximately 50%. The watt consumption at rated D-C voltage is 3.5.

Each contact will carry 12 amperes continuous and 30 amperes for one minute.

The contact interrupting ratings are as follows: All values are non-inductive currents.

External connections may be made with the contacts in series if desired.

INTERRUPTING RATING IN AMPERES

Volts	D-C		A-C
	1 Contact	2 Contacts in Series	1 Contact
24	15	50	50
48	8	35	45
115	2.4	20	30
230	0.75	2.5	20
550	0.25	0.5	10

REPAIRS AND RENEWAL PARTS

Major repairs can be most satisfactorily done at the factory or Westinghouse Service Shops. However, for customers equipped to do their own work, parts may be furnished on order. In ordering any part or requesting any other information, always give entire nameplate reading.

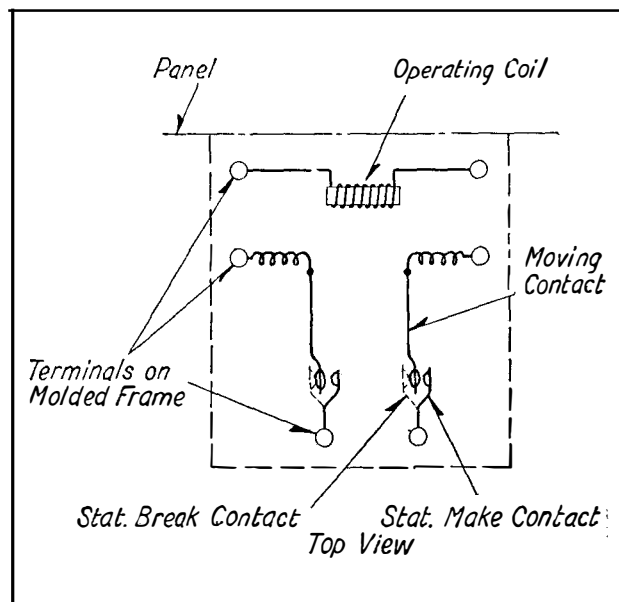


Fig. 2—Internal Connections for Open Type SG Relay with Reversible Contacts.

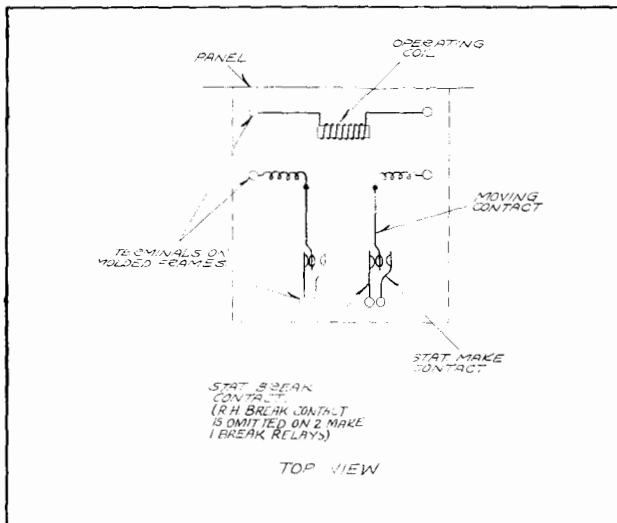


Fig. 3—Internal Connections for 2-Make and 2-Break Contact Open Type SG Relay.

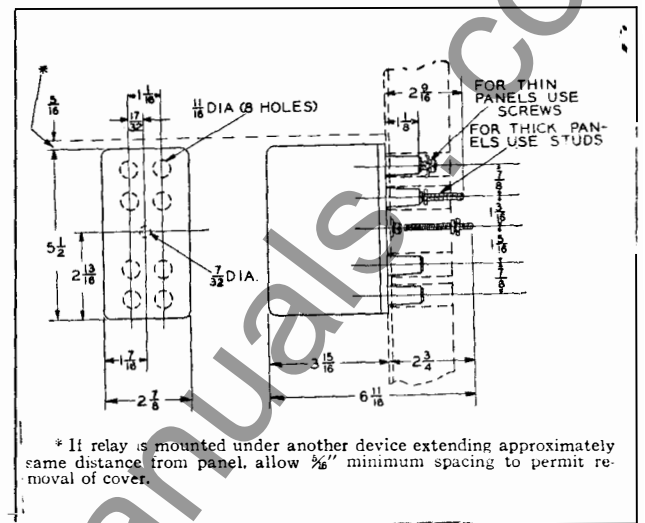


Fig. 4—Outline and Drilling Plan for the Closed Type SG Auxiliary Relay. For Reference Only.

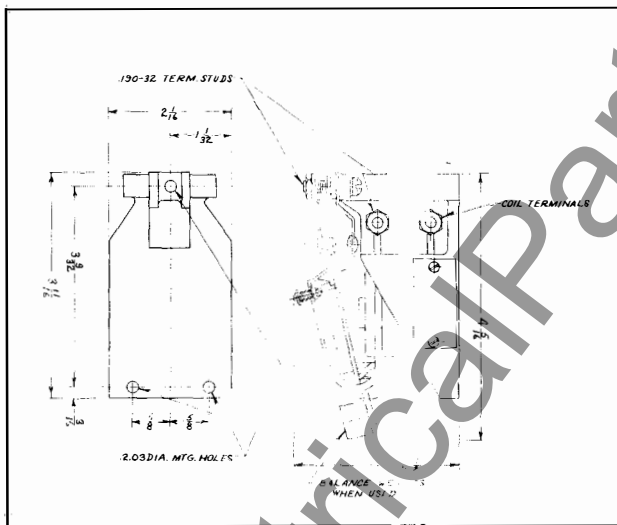


Fig. 5—Outline and Drilling Plan for the Open Type SG Auxiliary Relay with Reversible Contacts. For Reference Only.

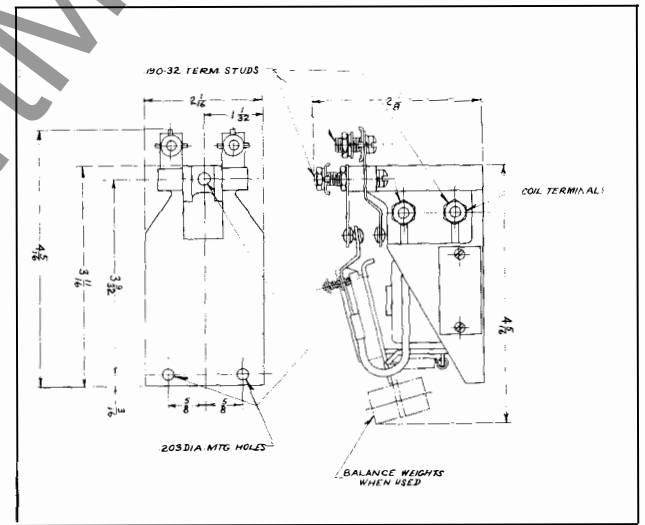


Fig. 6—Outline and Drilling Plan for the 2-Make and 2-Break Contact Open Type SG Relay.

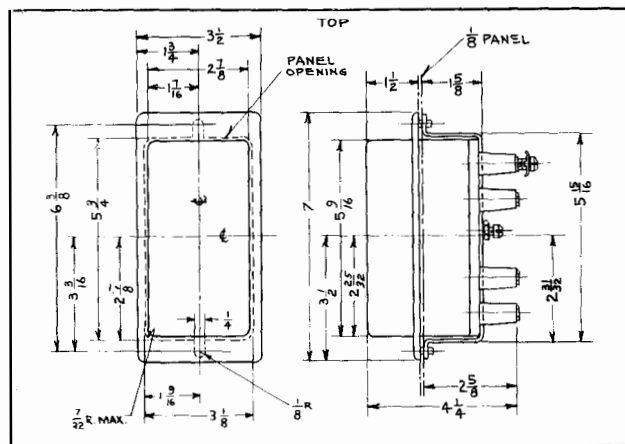


Fig. 7—Outline and Drilling Plan for the Semi-flush Case for the Type SG Relay. For Reference Only.



WESTINGHOUSE ELECTRIC CORPORATION

METER DIVISION

NEWARK, N.J.

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INSTALLATION • OPERATION • MAINTENANCE INSTRUCTIONS

TYPE TH THERMAL TIMING RELAY

CAUTION Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

APPLICATION

The type TH thermal timing relay is a simple and rugged time delay device developed expressly to meet the requirements of Westinghouse tap-changing-under-load equipment, where reliability of operation and freedom from maintenance are items of major importance. The relay also may be used in other applications where its characteristics are suitable. As adjusted at the factory, the time delay on a recycling basis can be varied from approximately 15 seconds with the control knob set on the MIN dial position, to approximately 60 seconds with the knob on the MAX position, with 120 volts applied to the relay. A 105 to 135 volt variation of applied voltage has negligible effect on the relay timing when the control knob is set on the MIN position. When set on the MAX position, the effect of voltage variation is more noticeable, but the relay timing is still within the calibration limits. The standard relay is designed for use on a 120 volt 60 cycle circuit. Special relays can be supplied for certain other voltages and frequencies if required.

Two timing elements are required in the control of a tap-changing equipment. The type TH relay is available both with a single timing element in a projection mounted case (Fig.1), and as a duplex timing relay containing two timing elements in an 8 terminal Flexitest case (Fig.4).

The complete operating cycle of the relay is composed of two parts; (1) the time required for the bimetal actuating system to deflect

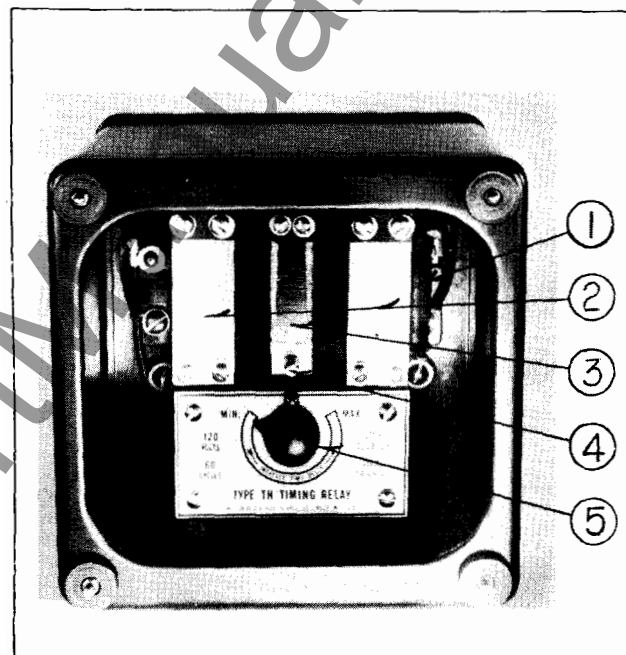


Fig. 1—Type TH Single-Element Thermal Timing Relay.
1—Resistor, 2—Side Bimetal Strips, 3—Heater Coil and Center Bimetal Strip, 4—"F" Bimetal Screw, 5—"T" Timing Screw.

under the influence of heat and operate a micro switch, and (2) the time required for the bimetal system to cool until the micro switch resets. The mechanical construction of the relay is rugged, simple and reliable, with a minimum number of moving parts. The entire assembly is enclosed in a dust-proof case and after installation will require only a routine inspection to keep it in operating condition.

CAUTION The relay is designed specifically for application on Westinghouse regulators and tap-changing-under-load equipment and when so used should give a minimum of well over a million operations. If used otherwise, the effect of possible higher current in the controlled circuit upon the life of the relay should be considered.

TYPE TH RELAY

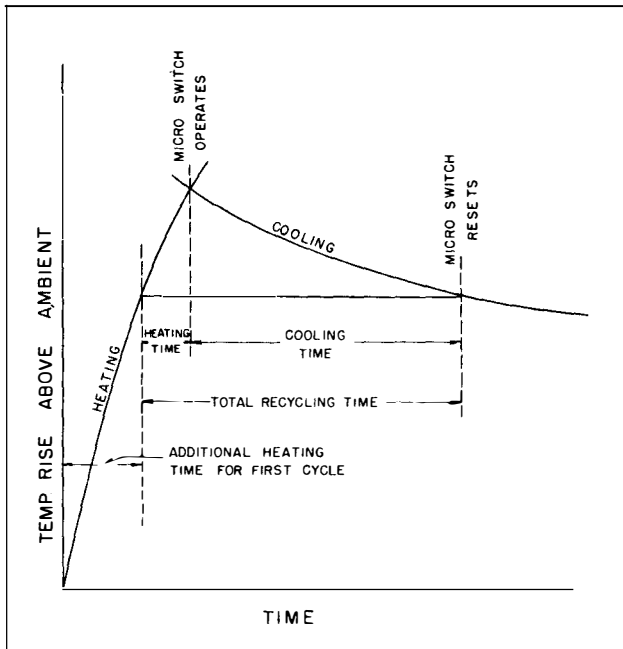


Fig. 6—The Time-Temperature Characteristic of the Type TH Relay.

thus closing the circuit between terminals 3 and 8. The relay is reset by de-energizing the coil, of the auxiliary contactor.

The controlled circuits of the duplex relay are between terminals 1 and 3, and between 2 and 4 (Fig. 8). The duplex relay does not have contacts corresponding to contact A-11 of the single-element relay.

RELAYS IN TYPE FT CASE

The type TH duplex timing relay is supplied in the S size FT case. The type FT cases are dust-proof enclosures combining relay elements and knife-blade test switches in the same case. This combination provides a compact flexible assembly easy to maintain, inspect, test and adjust. There are three main units of the type FT case; the case cover and chassis. The case is an all welded steel housing containing the hinge half of the knife-blade test switches and the terminals for external connections. The cover is a drawn steel frame with a clear window which fits over the front of the case with the switches closed. The chassis is a frame that supports the relay elements and the contact jaw half of the test switches. This slides in

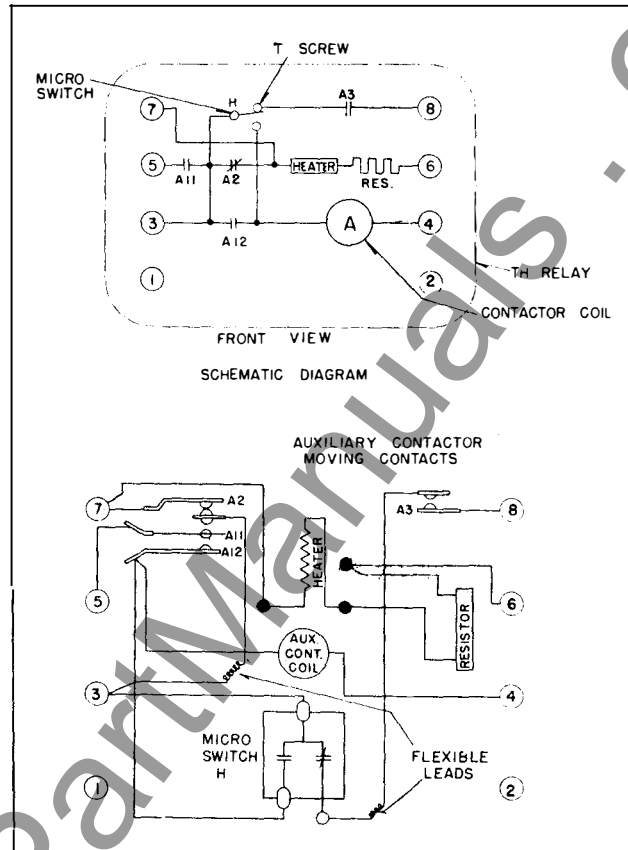


Fig. 7—Schematic and Wiring Diagrams of the Type TH Single-Element Relay.

and out of the case. The electrical connections between the base and chassis are completed through the closed knife-blades.

Removing Chassis

To remove the chassis, first remove the cover by unscrewing the captive nuts at the two corners. This exposes the relay elements and all the test switches for inspection and testing. The next step is to open the test switches. In opening the test switches they should be moved all the way back against the stops. With all the switches fully opened, grasp the two cam action latch arms and pull outward. This releases the chassis from the case. Using the latch arms as handles, pull the chassis out of the case. The chassis can be set on a test bench in a normal upright position as well as on its top, back or sides for easy inspection, maintenance and test.

After removing the chassis a duplicate

chassis may be inserted in the case or the blade portion of the switches can be closed and the cover put in place without the chassis.

When the chassis is to be put back in the case, the above procedure is to be followed in the reversed order.

Electrical Circuits

Each terminal in the base connects thru a test switch to the relay elements in the chassis as shown on the internal schematic diagrams. The relay terminal is identified by numbers marked on both the inside and outside of the base. The test switch positions are identified by letters marked on the top and bottom surface of the moulded blocks. These letters can be seen when the chassis is removed from the case.

The potential and control circuits thru the relay are disconnected from the external circuit by opening the associated test switches.

A cover operated switch can be supplied with its contacts wired in series with the trip circuit. This switch opens the trip circuit when the cover is removed. This switch can be added to the existing type FT cases at any time.

Testing

The relays can be tested in service, in the case but with the external circuits isolated, or out of the case as follows:

Testing In Service

Voltages between the potential circuits can be measured conveniently by clamping #2 clip leads on the projecting clip lead lug on the contact jaw.

Testing In Case

With all blades in the full open position, the ten circuit test plug can be inserted in the contact jaws. This connects the relay elements to a set of binding posts and com-

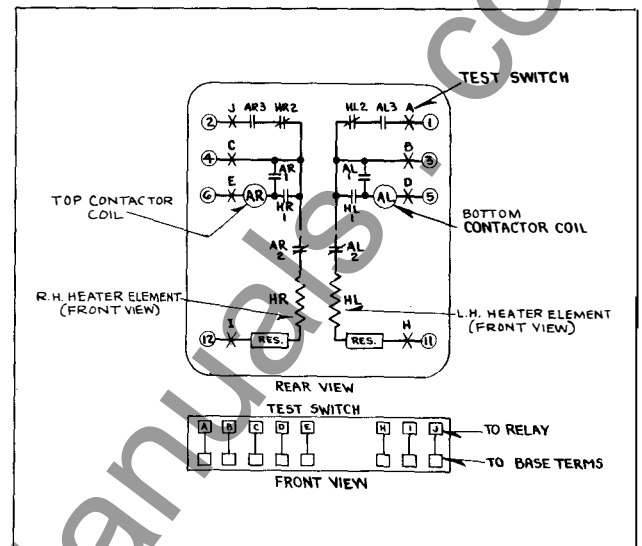


Fig. 8—Schematic Diagram of Type TH Duplex Relay.

pletely isolates the relay circuits from the external connections by means of an insulating barrier on the plug. The external test circuits are connected to these binding posts. The plug is inserted in the bottom test jaws with the binding posts up and in the top test switch jaws with the binding posts down.

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug.

Testing Out of Case

With the chassis removed from the base, relay elements may be tested by using the ten circuit test plug or by #2 test clip leads as described above. The factory calibration is made with the chassis in the case and removing the chassis from the case will change the calibration values of some relays by a small percentage. It is recommended that the relay be checked in position as a final check on calibration.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of

TYPE TH RELAY

the two mounting studs. The electrical connections may be made direct to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony-asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed:

All contacts should be periodically cleaned with a fine file. S#1002110 file is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

All moving contacts of the duplex relay, and the RH moving contact of the single-element relay, should deflect $3/64$ " when the armature is closed. The inner end of the terminal strip for the LH make contact of the single-element relay should just touch the contact back-up spring when the armature is open. Both the moving and the stationary LH make contacts will deflect when the armature closes and the moving contact deflection should be approximately $1/32$ ". Sufficient contact deflection is important, both to provide good electrical circuits and to avoid any possibility of having residual magnetism hold the armature closed when de-energized, after the plating has been worn from the pole faces by numerous operations. The contact gaps should be $1/8$ " to $5/32$ " (sum of both gaps on LH side of single-element relay) and the outward travel of the armature should be limited by the back stationary contact and not by the tongue of the yoke which projects through the opening in the armature between the hinge points.

If the adjustment of the timing screw or the bimetals is disturbed, the instructions below may be used as a guide in restoring the normal adjustment of the relay. If only the bimetal assembly requires replacement, no re-adjustment should be necessary in the timing dial but only in the adjusting screws at the movable end of the center bimetal. Should the timing screw assembly be replaced, the only adjustment required should be in the timing screw, none in the bimetal system. But if the micro switch is replaced, both the timing screw and the bimetal screw will have to be readjusted.

1. Equipment Required

- a) A source of 120 volt, 60 cycle power.
- b) A high impedance circuit tester. An ohm meter or a neon glow lamp connected as a circuit indicator is recommended.

WARNING: - If any appreciable current is passed through the micro switch contact during adjustment, the switch contacts may be damaged.

2. To Adjust Timing Screw "T"

- a) Connect circuit tester in series with power source and apply to terminals 3 and 4 of the single-element relay, or terminals 3 and 5 or 4 and 6 of the duplex relay.
- b) Check operation of micro switch by pressing bimetal screw "F". The micro switch should close the circuit and operate the indicator. When "F" screw is released, micro switch should open indicator circuit.
- c) Remove knob from timing screw "T". Turn screw clockwise until circuit indicator shows that micro switch normally-open contacts are just barely closed. From this position turn screw counter-clockwise slightly over one-eighth ($1/8$) turn. This is the approximate MIN setting. Replace knob on screw shaft

with pointer at MIN position and tighten set screw.

- d) Recheck micro switch operation.

3. To Adjust Bimetal Screw "F"

- a) Follow instructions given in section 2-a and 2-b.
- b) Turn screw "F" clockwise until circuit indicator shows that micro switch normally-open contacts just barely stay closed when "F" screw is pressed down and then released. From this position, turn screw counter-clockwise one and one-quarter (1-1/4) complete turns. The center bimetal strip must be at the same temperature as the side strips during this adjustment.

4. To Check Timing Adjustment

(Note: Contact designations and terminal numbers in the following paragraphs apply to the single-element relay. Refer to Figs. 7 and 8 and make corresponding connections when checking the duplex relay).

- a) Place a short-circuiting jumper across contact A-3. Insulate contact A-12 with a piece of stiff paper. Place cover on relay.
- b) Connect circuit indicator as follows: If ohm-meter is used, connect between terminals 3 and 8; if glow lamp circuit tester is used, connect between terminals 4 and 8 of relay. Place a test jumper between terminals 4 and 6 and connect 120 volt, 60 cycle power source to terminals 3 and 6.
- c) Timing cycle will begin when supply voltage is turned on. The heating portion of the cycle will be complete when the indicator shows that its circuit has been opened.
- d) Note that the first cycle will take longer time than subsequent cycles, due

to the additional time required for the bimetal temperature rise and resultant deflection to reach the point at which the micro switch resets. This is shown diagrammatically in Fig. 4. Adjustment should not be made on the basis of the first cycle but on the average of several subsequent cycles following immediately after the first. All times referred to in this leaflet are "re-cycling" time defined as the average time consumed by a complete cycle consecutively following the first cycle.

- e) When properly adjusted the time of one complete re-cycling operation should be between 11 and 16-1/2 seconds with pointer on "T" set at MIN, and between 54 and 69 seconds with pointer set at MAX. Individual readings should not vary more than approximately 2 seconds at MIN or 3 seconds at MAX. If the re-cycling times for these two positions of the knob are both high or both low, correction may be made by changing the position of the knob on screw "T".
- f) If adjustment of "F" screw has been made closer adjustment may be affected when necessary by turning screw "F" in 1/16 revolution steps. Clockwise rotation will increase re-cycling time; counter-clockwise rotation will decrease time.

IMPORTANT: Readjustment should not be made on either element unless its factory adjustment has been disturbed.

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete name-plate data.

ENERGY REQUIREMENTS

At 120 volts, 60 cycles, the contactor element burden is 11 voltamperes at approximately 50% power-factor. The heater circuit burden is 18 watts.

TYPE TH RELAY

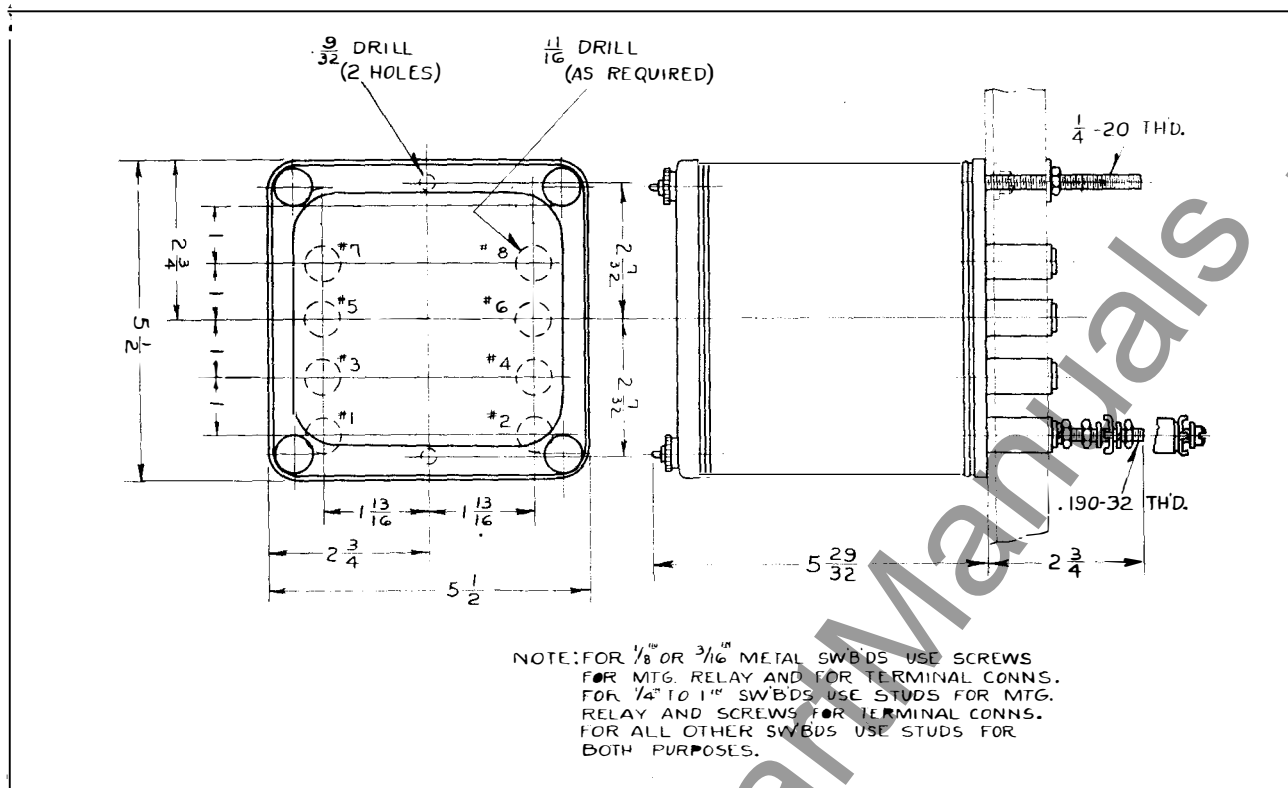


Fig. 9—Outline and Drilling Plan for the Type TH Single-Element Relay.

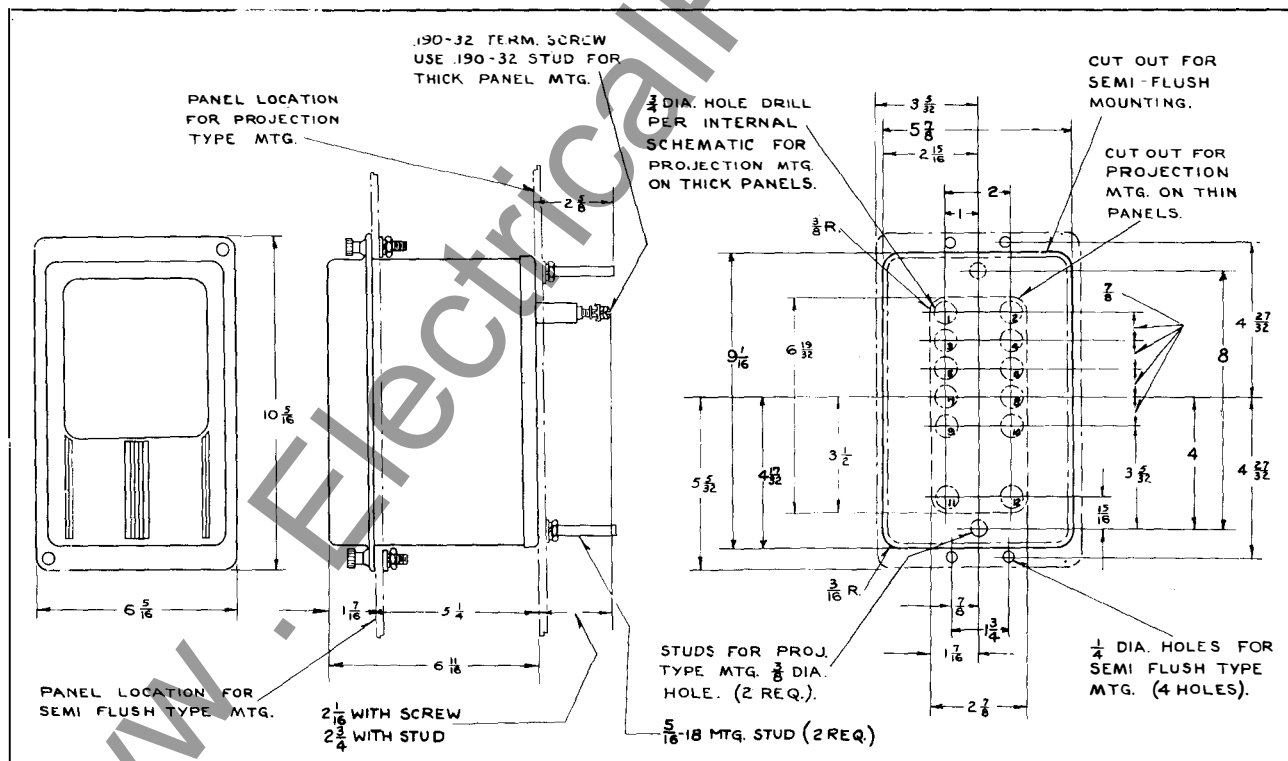


Fig. 10—Outline and Drilling Plan for the Type TH Duplex Relay. See Internal Schematic for the Terminals Supplied. For Reference Only.



INSTALLATION • OPERATION • MAINTENANCE INSTRUCTIONS

SYNCHROTIIE INDICATING AND RECORDING INSTRUMENTS

GENERAL

The Westinghouse Synchrotie measuring equipment operates upon the Duplicate Position Telemeter principle.

PRINCIPLE OF OPERATION

The transmitter and receiver motors are similar in general size and construction to small synchronous motors. The stators are wound for two-pole, single-phase, and the rotors are wound as for three-phase. The three rotor terminals on each unit are connected to corresponding rotor terminals on the receivers or transmitters. The single-phase stators are both connected to a-c circuits from the same source, or synchronous and in phase as shown in the diagram. Fig. 1.

The synchronizing action is due to voltages induced in the three windings of the rotor by the single-phase stator field. When all rotors are in the same position, the voltages induced in corresponding rotor windings of the transmitter and receivers are equal so that no current flows between rotors. Should the position of the transmitter rotor change, the induced voltage in its rotor windings will change, causing a voltage difference to be set up between the rotor windings of the transmitter and receivers. This will cause a current to flow between the rotors, and if the transmitter rotor position is fixed, the rotor current will cause the receiver rotors to turn by motor action until the rotors occupy the same relative positions and induced voltages are equalized. This action causes the receivers to take up the same position as the transmitter and follow any motions it may make.

A number of receivers may be operated from a

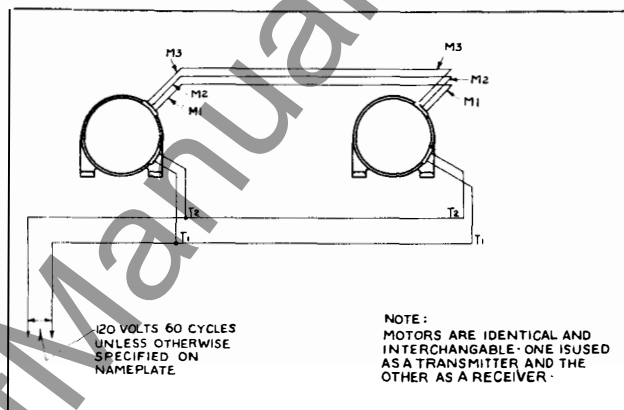


Fig. 1—Diagram of Connections Synchrotie Transmission.

single transmitter with reduced receiver torque. In the formula:

$$TR = \frac{2}{N + 1}$$

TR is the torque of each receiver when N receivers are operated from a single transmitter. Thus, with two receivers, each receiver has two-thirds normal torque; with three receivers, each receiver has one-half normal torque, etc.

The number of receivers permissible for one transmitter is thus dependent upon line resistance, voltage variation, and allowable lag-error.

The energy consumption per motor at rated voltage and frequency is 15 watts, 60 volt-amperes.

Telemetry Line Conditions

Connection between the transmitter and the receiver consists of three conductors as shown in Fig. 1. The transmitter and the receiver are also both connected at their respective

SYNCHROTI INDICATING AND RECORDING INSTRUMENTS

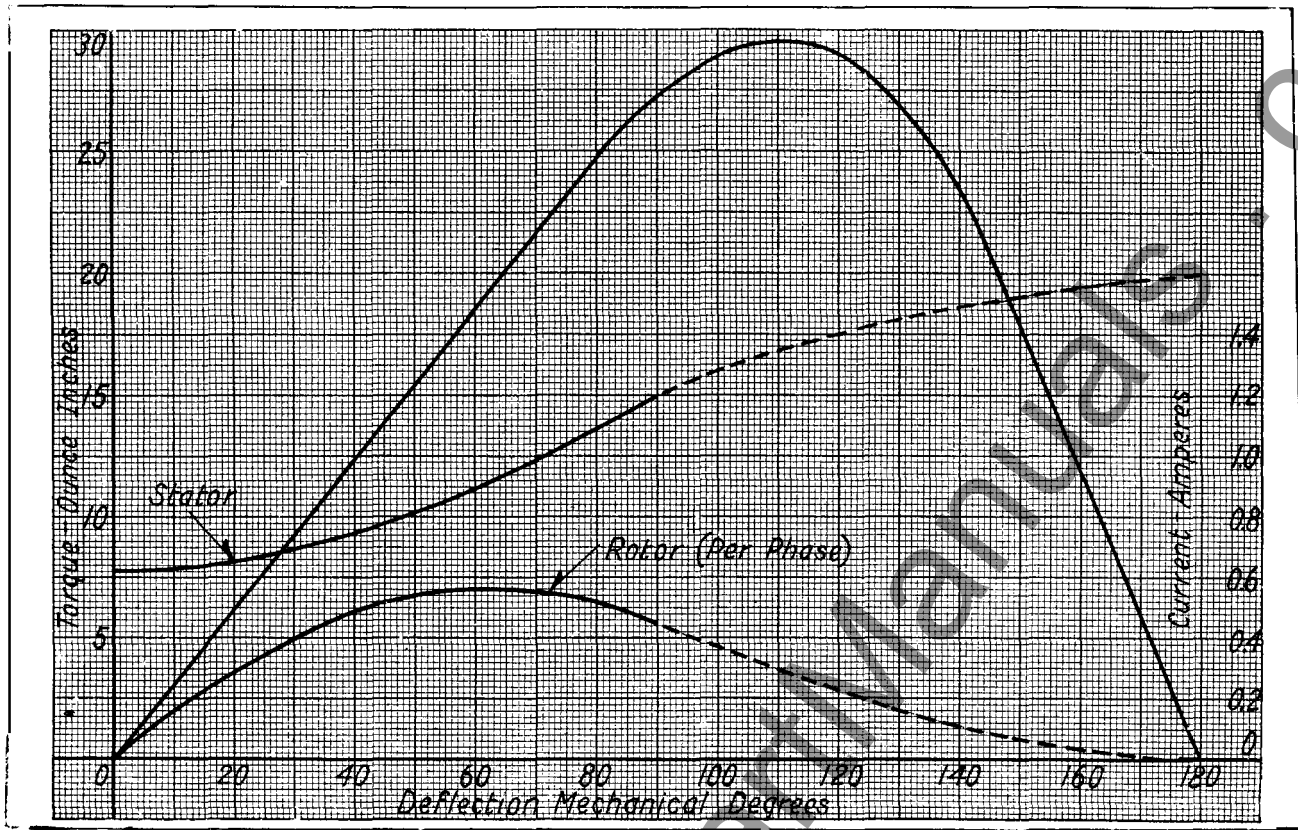


Fig. 2—Type ADS Position Indicator Meter Torque Displacement Characteristics.

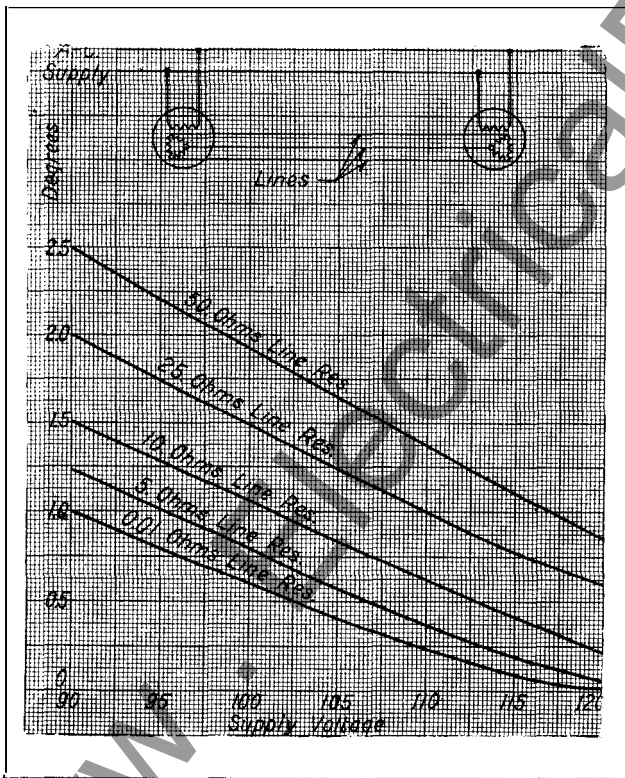


Fig. 3—Receiver Lag in Degrees With Supply Voltage Variation For Various Line Resistance.

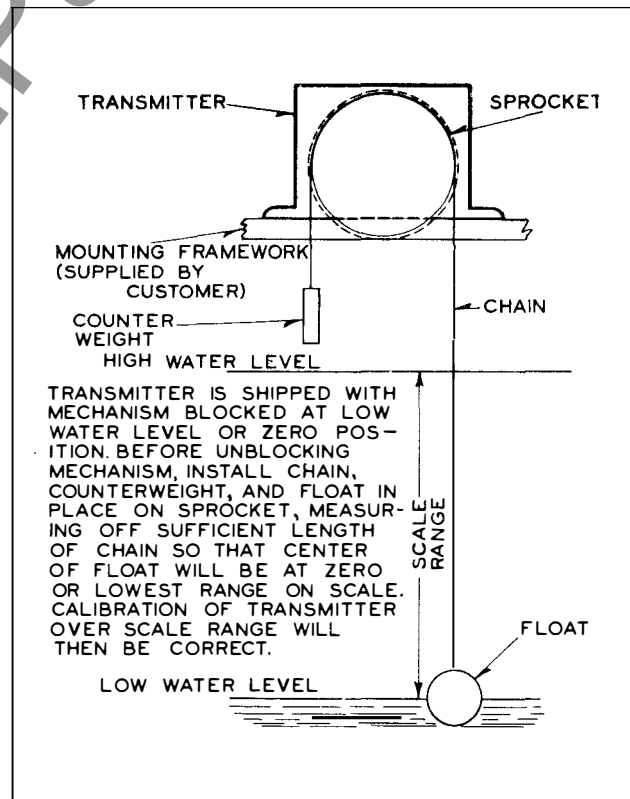


Fig. 4—Water Level Transmitter Installation.

locations to the same a-c single-phase, power-supply circuit or one derived from the same. If a circuit is not available from the same source at both transmitting and receiving stations, an additional pair of wires is necessary to energize the stator of one or the other unit from the power supply when available only at one end. The telemeter wires should have suitable insulation for the service.

The size of wire or cable required for the telemeter line will depend upon the distance. Line resistance reduces the restoring torque of the receiving instruments, and, thus, if the line resistance is too high, friction will cause a lag angle error in the indicators or recorders. This is illustrated in the curve, Fig. 3.

TRANSMITTERS

Water-Level Transmitters

The transmitter consists of a Synchronie unit mounted in a cast moisture-proof case. The motor is connected through a gear train to a sprocket which is connected by means of a chain to a float and counterweight. The position of the float governs the position of the transmitter rotor, and in operation the receivers follow all movements of the transmitter and indicate the float position.

The outline and mounting dimensions are shown on Fig. 5. Although the case is moisture-proof and weather-proof, it is recommended that a protective housing be built over the apparatus to protect it from foreign objects and assure long life.

Sufficient chain is provided to mount the transmitter five feet above high water level. Should the transmitter be mounted higher than five feet above high water, the necessary length of wire should be added to the ends of the chain. The transmitter is shipped with the mechanism blocked in the zero position. The chain, counterweight, and float should be mounted in position accordingly, so that the float is at the lower position of the scale range by measuring the chain length to include

the distance from the base of the transmitter to the center of the float. This should include the length of chain to cover the scale range, as well as the distance from high water level to the base of the transmitter.

Other Position Transmitters

The "TS" transmitter, as described above for water-level indication, is also adaptable for mechanical connection to any mechanism, the position of which it is desired to indicate or record at a distance. Thus, instead of a sprocket wheel operated by a float, suitable gearing or links can be arranged to drive the transmitter.

Transmitter Attachment For Recording Instrument

The Synchronie unit may be directly geared to the recording mechanism of any Westinghouse type "R" recording instrument, single circuit or totalizing, to transmit the readings of the recorder to another location.

Hand-Operated Transmitters

By means of a hand-operated Synchronie transmitter, Fig. 7, fitted with a knob and a pointer arm, signals or readings corresponding to any markings desired on the face plate, may be transmitted to a remote position to operate a receiving instrument.

RECEIVING INSTRUMENTS

Description

Receiving instruments for the duplicate position system may be either of the indicating type or of the recording type, as desired. Indicating position type instruments are operated by the Synchronie motor units like those in the transmitters.

Type HB boiler-room indicators are large size square instruments suitable for being read from a distance in large rooms. Types US-25 and KS-25 are of the rectangular switch-board type, to match the types H and 25 lines of instruments.

SYNCHROTIÉ INDICATING AND RECORDING INSTRUMENTS

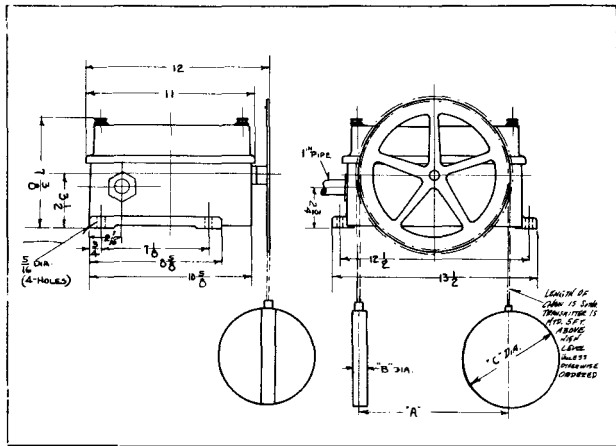


Fig. 5—Outline of Type TS Water Level Transmitter.

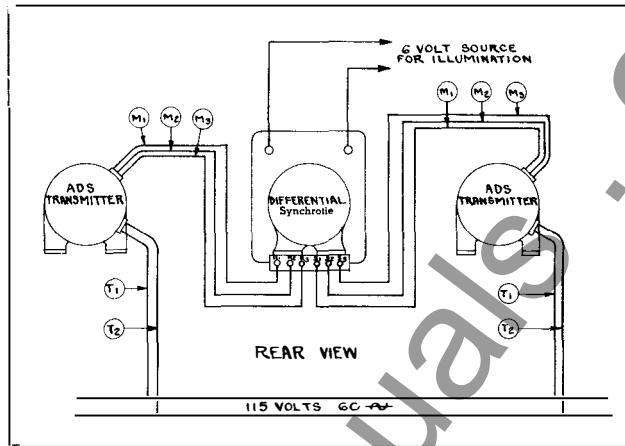


Fig. 6—Diagram of Connections, Differential Position Indicator .

INSTALLATION

Boiler-room indicators of the suspension type should be attached to overhead structures, with due regard to their weight. The connections may be brought into the cases by means of one-inch pipe conduits, either from the bottom of the case or from one side. Boiler-room indicators are often provided with an additional "Anticipatory" hand. This is operated from a separate receiving Synchrotie motor within the case, which is operated by means of a hand-operated transmitter.

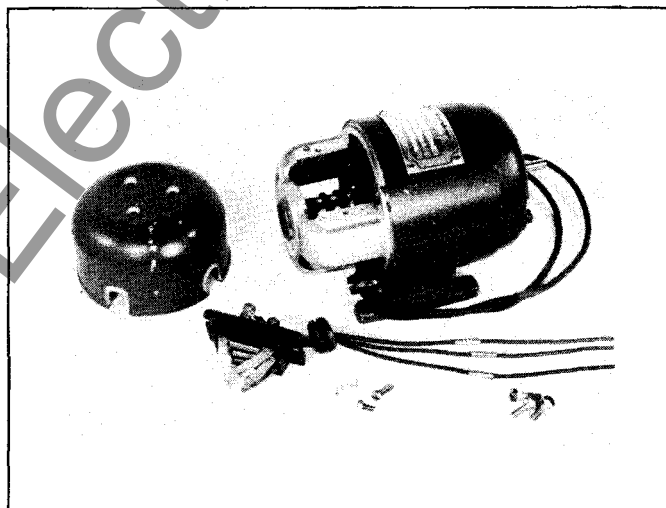
Flush-type boiler-room indicators and the types US-25 and KS-25 position indicators are designed for panel mounting. Connections for all receiving instruments are to be made per Fig. 1.

A half-revolution error in the indications of any receiving instrument is caused by a reversal of the leads to the single-phase supply line. Reversed direction of operation is caused by incorrect sequence of the three-wire system of rotor connections, M_1, M_2, M_3 .

Differential Receiving Instruments

The differential type of position indicator is used in conjunction with two transmitters. When connected as shown in the wiring diagram, the indicator will read the difference between the relative rotor positions of the two transmitters.

The differential type of position indicator motor differs from the standard Synchrotie position indicator in that both rotor and stator



Synchrotie Motor Unit—Opened for Service Inspection.

windings are wound as for three-phase.

When properly connected and the rotor of one transmitter blocked, the position indicator will follow the rotor of the other transmitter in both direction and angle displacement. If the indicator turns in a direction opposite to that of the transmitter, it will be found that two of the leads between that transmitter and the indicator are interchanged.

If the rotors of the two transmitters are turned in the same direction by the same amount, the position indicator will remain stationary.

Position Recorders

The type "GS-40" strip chart-type position recorder consists of a Synchrotie motor unit, geared to directly operate a recording pen. The case, clock, and other recording mechanism correspond to the construction of the other

type "G-40" recorders. For complete operating instructions, see separate I.L. 43-400.

MAINTENANCE

The end-bells of the frames are removable, giving access to the brushes and slip rings for any necessary cleaning and inspection. Such servicing may be required at intervals of a year or more.

REPAIRS AND RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

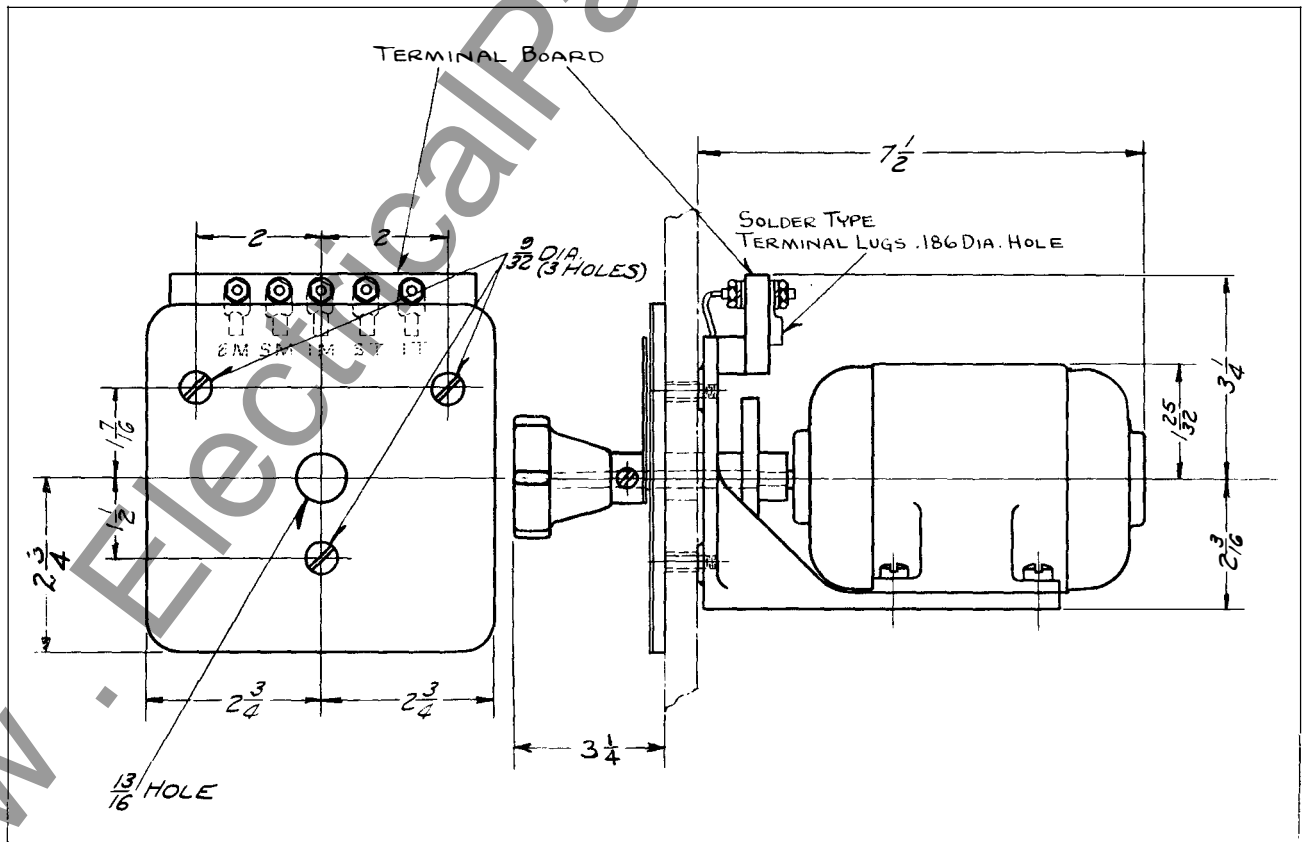


Fig. 7 — Hand-operated Synchrotie Position Transmitter .

SYNCHROTIE INDICATING AND RECORDING INSTRUMENTS

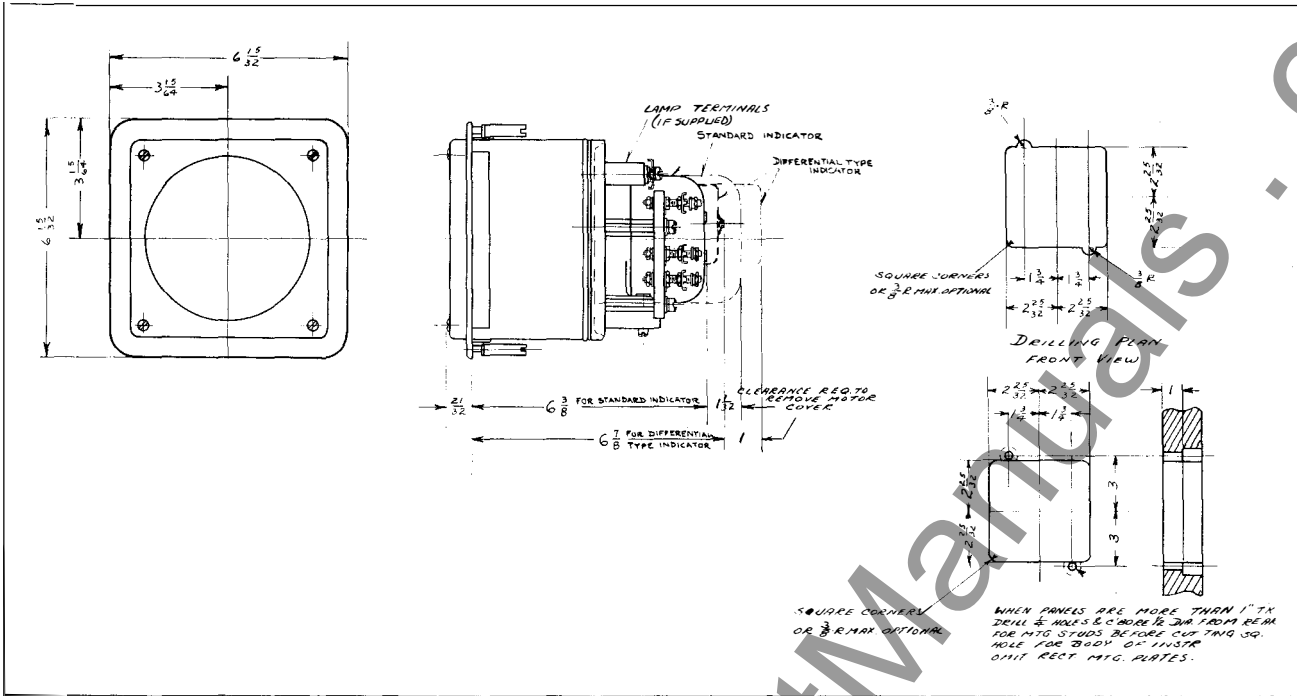


Fig. 8 — Type KS-25 Receiving Instrument Flush Type.

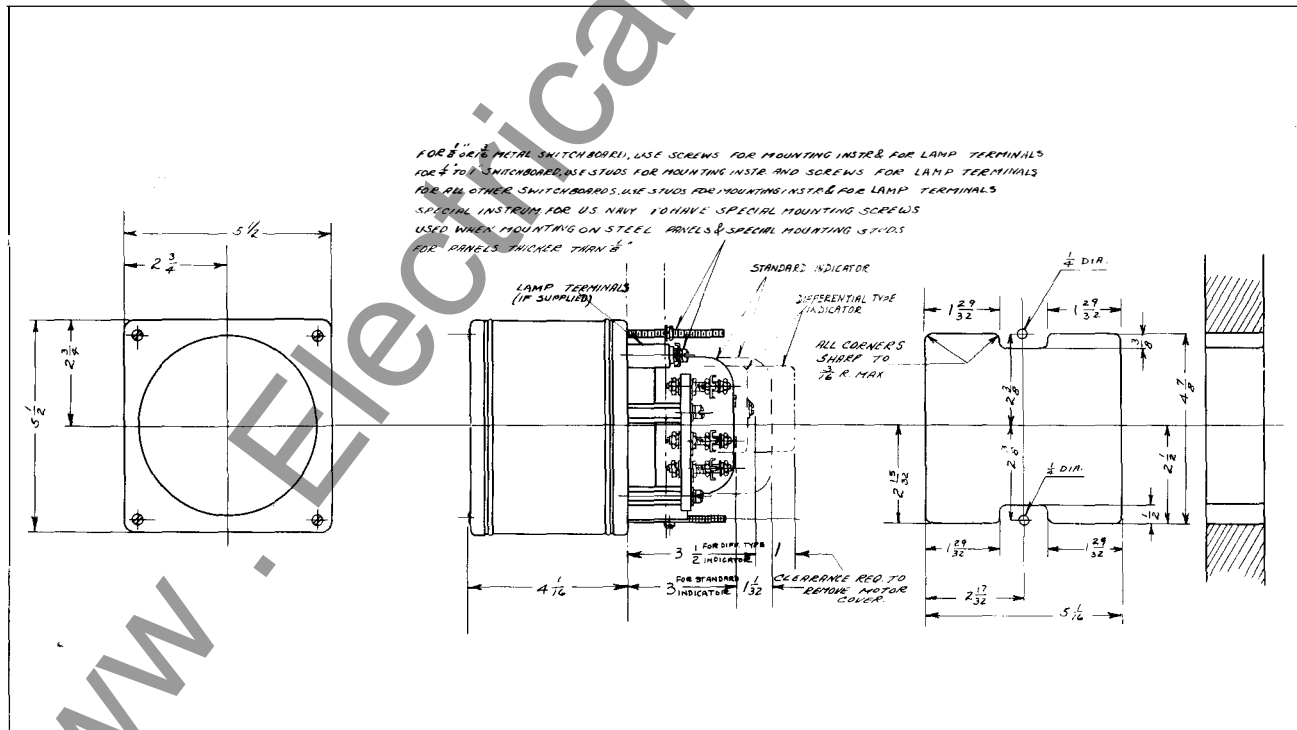


Fig. 9—Type US-25 Receiving Instrument Projecting Type.

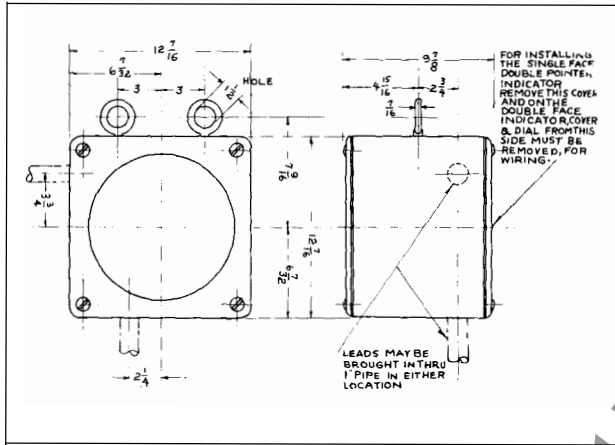


Fig. 10—Type HB Boiler Room Indicator 10" Dial.

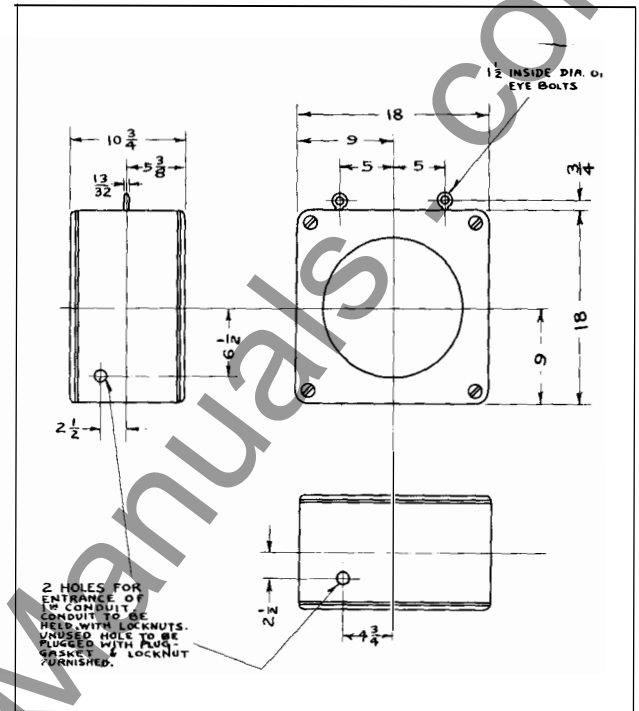


Fig. 11—Type HB Boiler Room Indicator, 15" Dial.

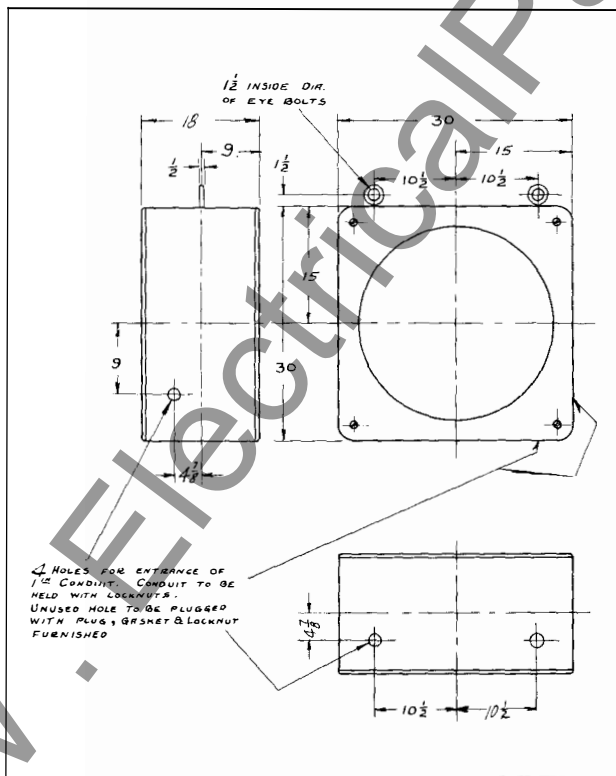


Fig. 12—Outline of Type HB Boiler Room Indicator With 25 inch Dial.

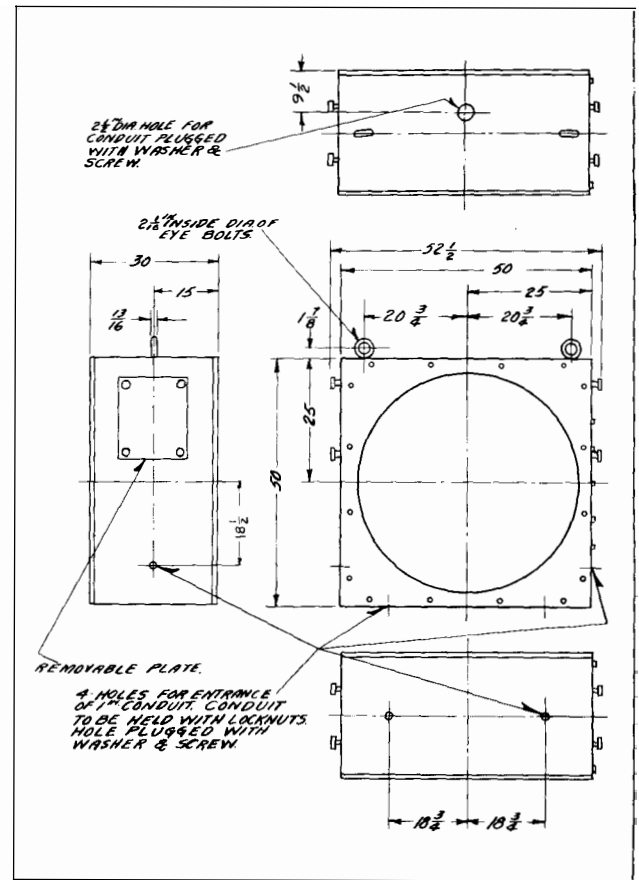


Fig. 13—Outline of Type HB Boiler Room Indicator With 40 inch Dial.

SYNCHROTIE INDICATING AND RECORDING INSTRUMENTS

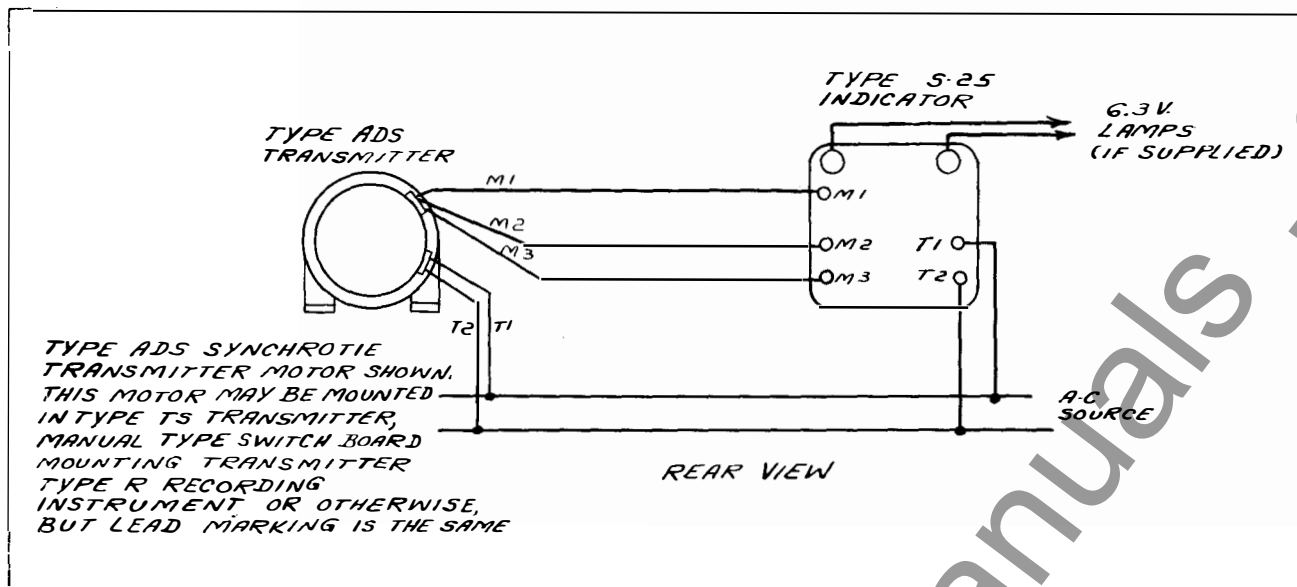


Diagram of Connections, Synchrotie Position Indicator.

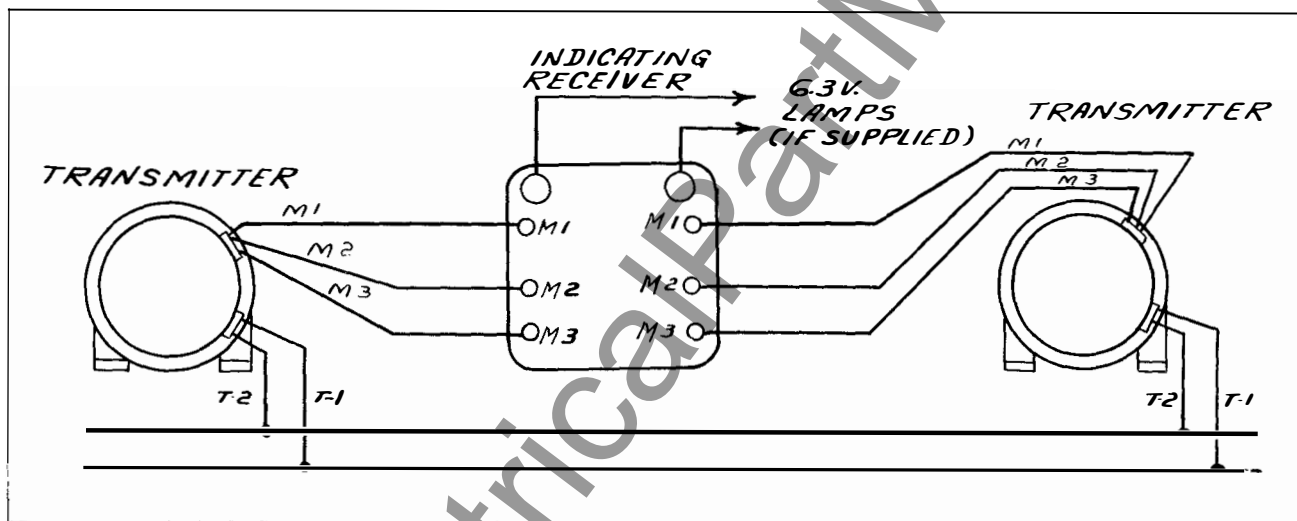


Diagram of Connections, Differential Position Indicator.

WESTINGHOUSE ELECTRIC CORPORATION
METER DIVISION

NEWARK, N.J.

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TYPE UL-25 POSITION INDICATOR

Lamp Signal Type

INSTRUCTIONS

120 Volt Style

- S# 1009633— 9 positions
- S# 1009635—17 positions

GENERAL

The Westinghouse lamp type position indicator consists of a square case, in the front of which are mounted signal lamps behind numbered lenses to indicate the exact position of a tap changer such as used on Westinghouse step type regulators. There being no moving parts, no maintenance is required except the occasional replacement of lamps. Fig. 1 shows a 9 position indicator. The lights are controlled by a drum switch mounted on the tap changer.

When provided with suitable dial marking this indicator may be used for other signalling purposes.

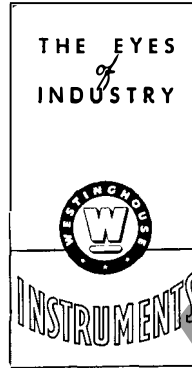
CONSTRUCTION

The case is similar in construction to the cases on Westinghouse instruments and relays, matching them in general appearance. Each position of the tap changer has a correspondingly numbered red lens, behind which a light glows whenever the tap changer is on that particular tap. There is also a white lens which indicates when the safety switch is opened for any reason, such as hand operation, and an unnumbered red lens which indicates whenever the tap changer is "off" position.

The lens are held by a brass tube holder which is held in place by friction.

INSTALLATION

It is only necessary to mount the indicator on the switchboard panel and



240 Volt Style

- S# 1009634— 9 positions
- S# 1009636—17 positions

stops between positions both lights will continue to burn.

The white light is connected whenever the type "W" control switch on the tap changer operating mechanism is turned to the "off" or safety positions. The unnumbered red lens is lighted whenever the tap changer is "off" position, as in changing taps or stopping between positions. (Note the white light is used only with type UT or UTN tap changers.)

MAINTENANCE

Inspect the indicator occasionally to see that no lamps are burned out. If lamps fail to light and are not burned out inspect the contacts of the drum switch on the tap changer operating mechanism.

To replace a lamp, remove the four screws in the front cover of the indicator and remove cover. Pry up on the brass lens retainer to remove the lens and then remove the lamp.

REPAIRS AND RENEWAL PARTS

Major repairs can be most satisfactorily done at the factory or Westinghouse Service Shops. However, for customers equipped to do their own work, parts may be furnished on order. In ordering any part or requesting any other information, always give entire nameplate reading.

Order replacement lamps by Style Number 1275074.

make connections to the drum switch as shown on the transformer or regulator diagram. One lead is required for each position indicated, with an additional lead for the common return and 3 other leads to take care of the white and unnumbered red lenses.

After installing, operate the tap changer and check each position as shown on the tap changer operating mechanism dial plate with the tap number shown on the position indicator.

Refer to diagram Fig. 3 and note external resistors used for 240 volt applications.

OPERATION

The circuits to the lamps are closed by a drum type switch rigidly connected to, mounted on and driven by the operating mechanism of the tap changer. There is one contact for each tap position. There is a slight over-lap of contacts so that when changing taps, the light indicating the new tap position comes on before the light indicating the old tap position has gone out. Therefore, if for any reason the tap changer

TYPE UL-25 POSITION INDICATOR

Lamp Signal Type

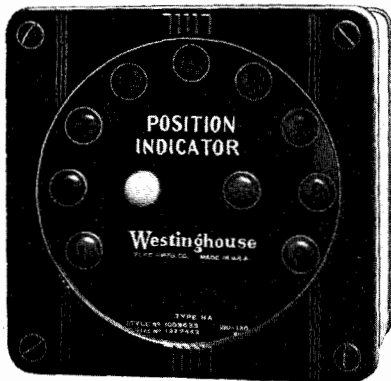


FIG. 1—TYPE UL-25 LAMP SIGNAL POSITION INDICATOR—FRONT VIEW

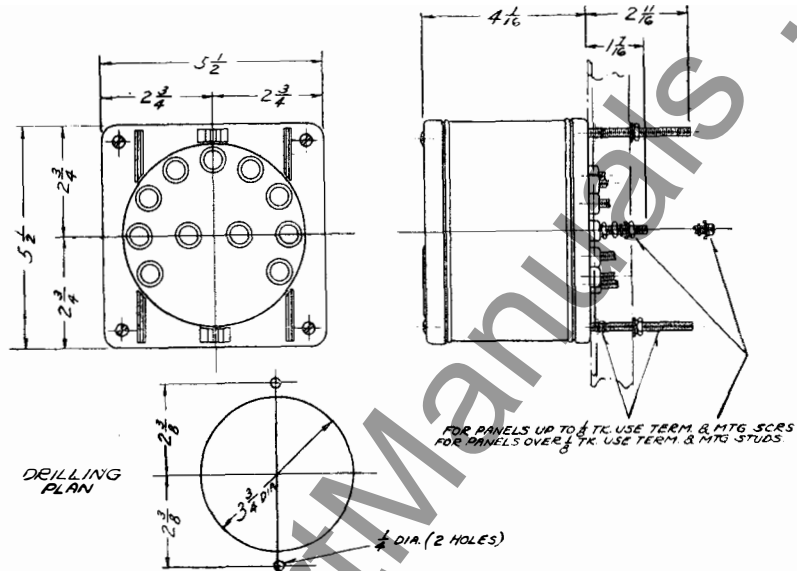


FIG. 2—LAMP TYPE SIGNAL INDICATOR IN TYPE U25 OR HY CASE
OUTLINE AND DRILLING PLAN

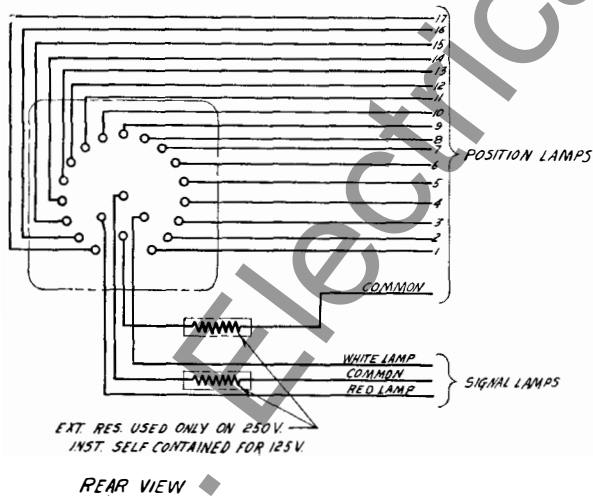


FIG. 3—TYPICAL EXTERNAL CONNECTION DIAGRAM, 17 CIRCUITS.
FOR OTHER COMBINATIONS OF CIRCUITS SEE
TRANSFORMER OR REGULATOR

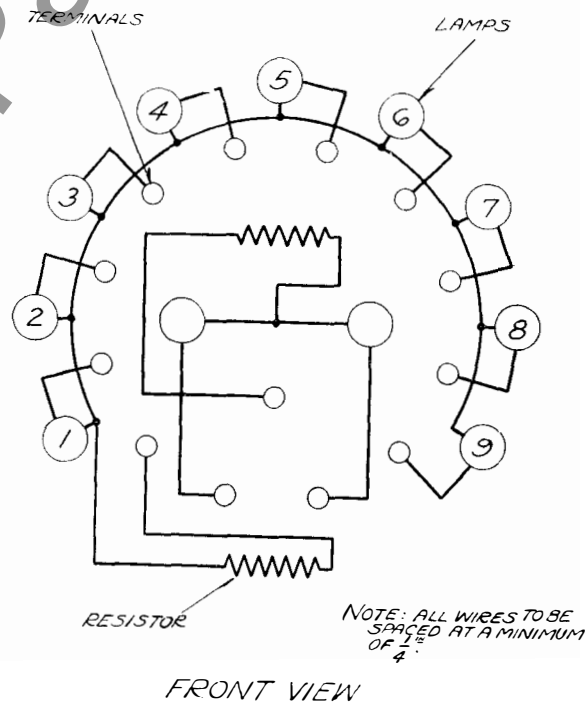


FIG. 4—TYPICAL INTERNAL DIAGRAM, 9 CIRCUITS. OTHER COMBI-
NATIONS OF CIRCUIT ARE SIMILARLY ARRANGED

Westinghouse Electric Corporation
Meter Division, Newark, N. J., U.S.A.



INSTALLATION • OPERATION • MAINTENANCE INSTRUCTIONS

LIQUID LEVEL INDICATORS Magnetic Type

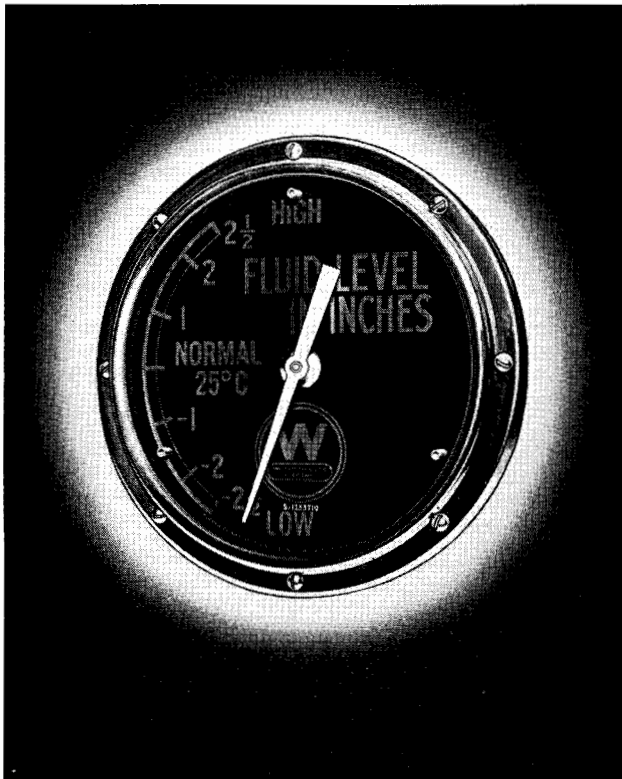


FIG. 1. Front View of Liquid Level Indicator.

THE LIQUID LEVEL INDICATOR permits visible reading, from a reasonable distance, of the fluid level in oil or Inerteen insulated apparatus. The indicator consists of a magnet attached to a float operated lever on the inside of the tank, which in turn operates a magnetic needle in front of a non-magnetic dial plate to indicate the fluid level. The indicator is weather proof, and it is only necessary to maintain a tight joint by means of a gasket between the tank wall and the indicator flange. The size of the magnetic type indicator used is determined by the distance from which visible reading is desired, variation of fluid level, and clearances.

Fig. 2 shows a magnetic type liquid level indicator with the float equipped with low level alarm contacts, which are arranged for opening or closing an alarm circuit whenever the fluid level falls below a predetermined level.

INSTALLATION

The indicator is usually shipped mounted in place on the transformer; although, if shipped separately

or if a replacement is made, be sure to check the operation of the float over its entire range to see that it operates freely and that the pointer follows the movement of the float. The indicator flange should be drawn up tightly against the gasket between it and the tank in order to insure a tight joint.

OPERATION

The magnetic type liquid level indicator is constructed so that it is impossible for the fluid to reach or affect the scale on the etched dial. The float is limited in its travel to 15 degrees from the vertical in the "down" position to 15 degrees from the vertical in the extreme "up" position. The "NORMAL" level on the dial corresponds to the 25°C fluid level.

If the tank is filled with fluid at any other temperature it must be filled to the level indicated in the Fluid Temperature Table. If this is not done, excessive pressures may be built up in sealed tank transformers or excessive breathing may be produced in Inertia transformers causing excessive use of nitrogen, or the low level alarm may operate unnecessarily due to insufficient fluid.

Alarm Contacts. Fig. 3 shows a cut-away view of the indicator with alarm contacts. The indicator mounting flange has an extension to which is bolted the switch housing, within which is a pivoted arm having a permanent magnet mounted on the upper end and on the lower end a small roller that engages the switch arm of a S.P.D.T. microswitch.

Mounted on the float arm shaft is a permanent magnet with its pole faces close to the cylindrical wall of the indicator housing.

When the magnet (B) on the rotating shaft partially covers the magnet (A) on the switch arm, the attraction between the two magnets is sufficient to operate the switch. This switch is of the toggle type, giving snap action so that slowly rising or falling fluid level does not cause the contacts to open or close slowly.

A second magnet (C) for use as a checking magnet may be furnished. By moving a strong permanent magnet close to the checking magnet the indicator pointer will move slightly and indicate whether any of the parts are binding. The movement will be limited because the magnet is not strong enough to depress the float below or raise it above the liquid level.

LIQUID LEVEL INDICATORS

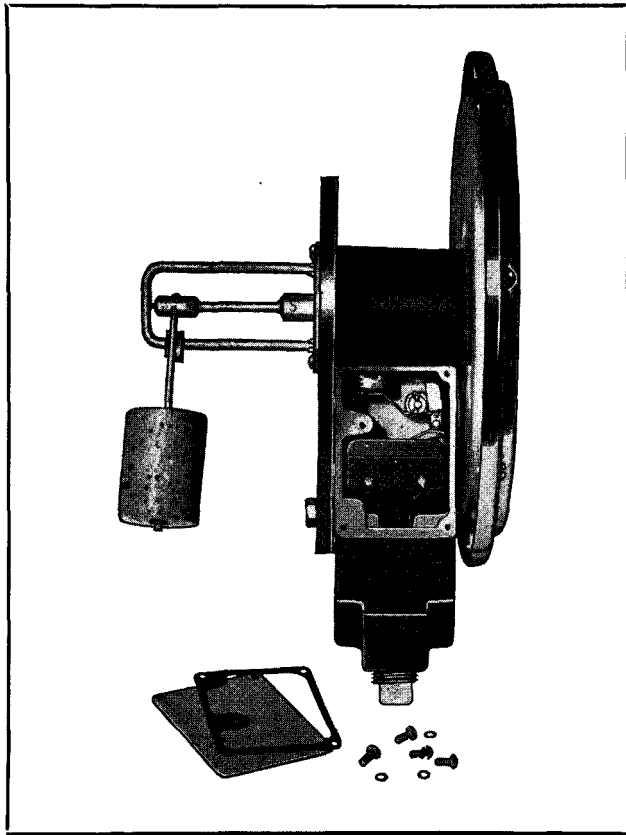


FIG. 2. Magnetic Type Liquid Level Indicator With Cover of Microswitch Removed.

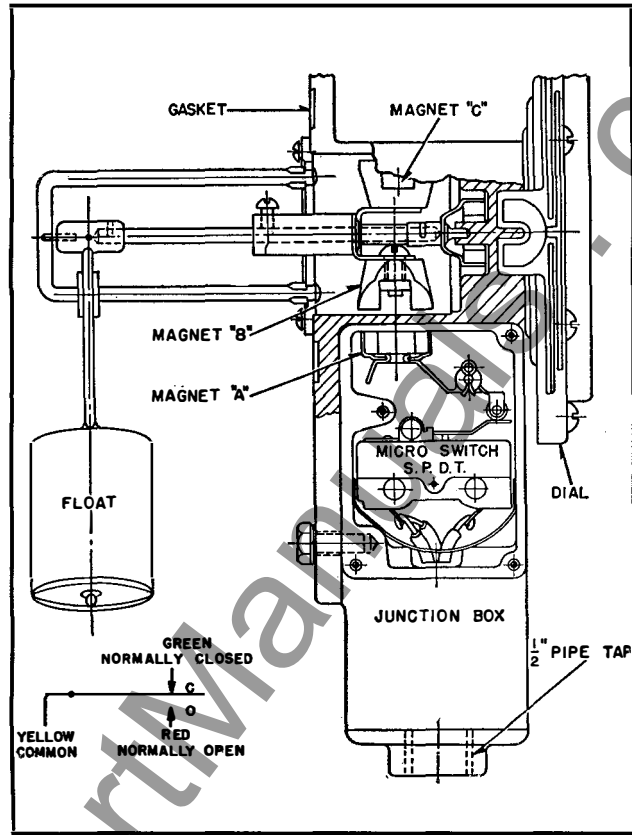


FIG. 3. Magnetic Type Liquid Level Indicator Showing Alarm Contacts.

Magnet "C" can also be used to operate the microswitch in order to give high liquid level alarm.

The liquid level at which the switch operates is adjusted at the factory by rotating the magnet or magnets on the float arm shaft and then securing the magnets to the shaft.

The switch housing has an inspection plate for access to the microswitch. The bottom of the switch housing has an opening tapped for $\frac{1}{2}$ inch pipe.

MAINTENANCE

The liquid level indicator will ordinarily require no attention; although, if for some reason it becomes inoperative it should be replaced.

The complete indicator with the float attached can be withdrawn from the tank by removing the four mounting bolts.

REPLACEMENT

When ordering a new indicator, address all correspondence to the nearest Westinghouse Office.

Be sure to give style number of the indicator or the stock order and serial number stamped on the nameplate attached to the transformer tank.

FLUID TEMPERATURE TABLE

AVERAGE FLUID TEMP. °C.	CORRECT LEVEL FOR FILLING			
	8" SCALE	6" SCALE	4" SCALE	2½" SCALE
85	8	6	4	
70	6	4½	3	
55	4	3	2	2½
40	2	1½	1	1¼
25-Normal	0	0	0	0
10	-2	-1½	-1	-1¼
-5	-4	-3	-2	-2½



WESTINGHOUSE ELECTRIC CORPORATION

SHARON PLANT • TRANSFORMER DIVISION • SHARON, PA.

Printed in U.S.A.



DESCRIPTION • OPERATION • MAINTENANCE INSTRUCTIONS

PRIMARY RELAY

Style No. 779 601

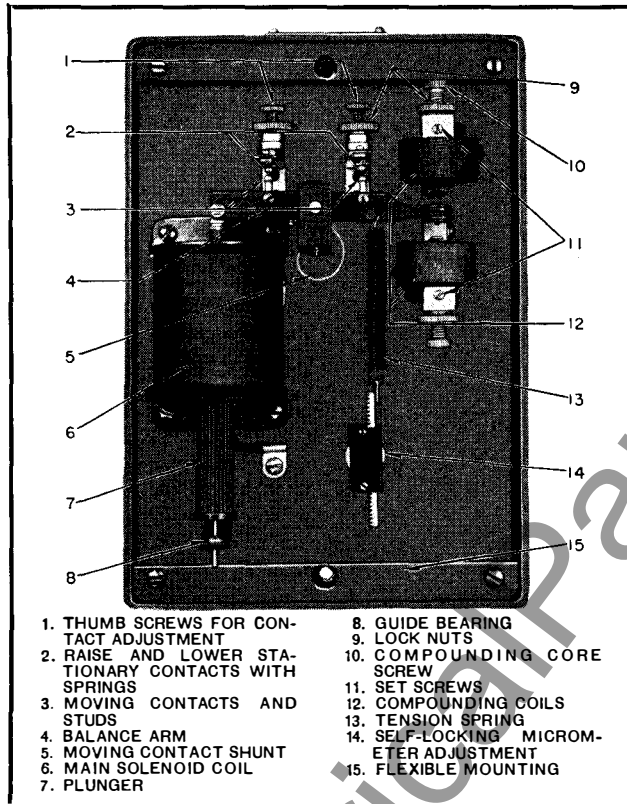


FIG. 1. Primary Relay With Cover Removed

THE PRIMARY RELAY consists of a solenoid operated balance arm, pivoted at the center, with contacts on either side working in conjunction with two adjustable stationary contacts. In the balanced or horizontal position neither pair of contacts are closed. The closing of either contact energizes a corresponding compounding coil, which increases the pressure on the contacts and prevents chattering and holds the contacts firmly closed until the balance voltage is nearly reached again.

CONSTRUCTION

The solenoid plunger is hung at one end of the balance arm and its weight is partially counter-balanced by a spring at the opposite end. The solenoid exerts an upward pull on the plunger, the amount of pull depending upon the voltage ap-

plied to the solenoid. By adjusting the pull on the spring, the arm can be brought to a balance position for various voltages. Voltages above this value will close the left hand contact (the one closest to the solenoid) and voltages below this value will close the right hand contact. The tension on the spring is varied by a rack and pinion having a self-locking micrometer adjustment.

Adjustment thumb screws and lock nuts are provided on the stationary contacts and compounding coil cores so that the limits within which the relays operate may be changed. In addition, set-screws are provided to positively hold the compounding coil cores in position after adjustments have been made.

The moving contacts on the balance arm can be replaced by releasing a set-screw. The set-screws are not used when making ordinary adjustments but only when replacing the contacts.

The lower end of the plunger is guided by a small needle shaft working in a bearing which is countersunk to give only a line contact and is practically frictionless.

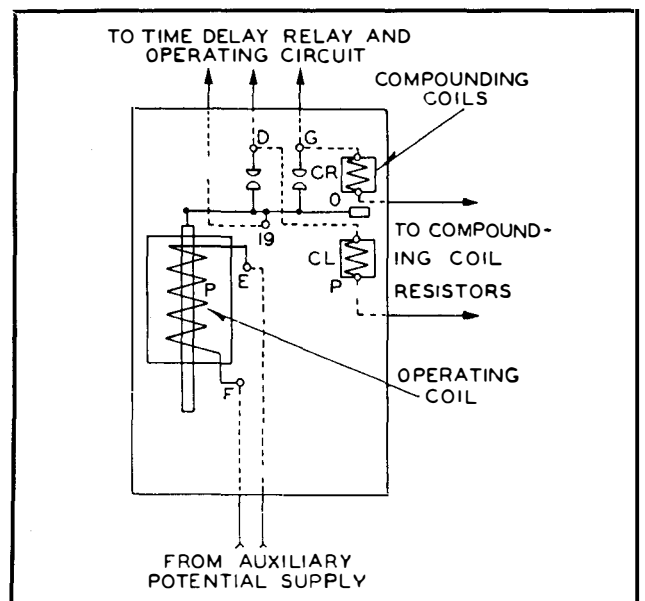


FIG. 2. Schematic Diagram

PRIMARY RELAY

The contacts are of silver and the stationary ones are carried on a double leaf spring to prevent chattering.

The standard relay may be adjusted to operate from 90 to 140 volts 60 cycles (115 volts normal). One volt is the minimum change in voltage from the balance voltage at which the relay contacts should close and one half volt is the minimum change in voltage from the balance voltage at which the compounding coils would release.

The relay panel has a shock-proof mounting and is enclosed in a dust-proof metal cover. A glass front allows ready inspection of the operating parts.

OPERATION

Before attempting to operate the relay, remove the blocking between contacts and between the solenoid and plunger. See that the balance arm moves freely.

The schematic diagram of the relay is shown in Fig. 2.

On increase in voltage the plunger is raised, closing the left hand contact which completes a circuit from the balance arm to the external relays and also energizes the lower compounding coil which assists the solenoid to hold the contact closed. When the voltage again begins to decrease, the pull from the solenoid decreases but the compounding coil still exerts a pull until it is finally overcome by the weight of the plunger when it suddenly releases and opens the relay contacts with a minimum of burning.

On decrease in voltage, the pull on the plunger is decreased until the weight of the plunger overcomes the spring tension and the right hand contact is closed. As previously described the circuits are completed to the external apparatus and now the upper compounding coil is energized which helps to keep the contact closed. As the voltage again increases, the first additional pull on the plunger does not open the contact but finally it overcomes the pull of the upper compounding coil and the contacts snap apart and the relay comes to the balanced position.

ADJUSTMENT

As received by the customer, mounted on a regulator, no adjustment should be made to the contacts or compounding coil cores. If it is desired to operate the relay at a higher "balance" voltage this is accomplished by decreasing the spring tension and thereby increasing the un-

balanced weight of the plunger. Conversely, if it is desired to lower the "balance" voltage operating point then the spring tension should be increased until the relay balances at the desired new voltage.

If the relay is out of adjustment as regards the range in voltage required to close the contacts, balance the relay arm at a convenient steady voltage with the contacts open, then reduce the voltage (an amount corresponding to a step change of voltage) and adjust right hand contact until it just closes and raise voltage one half this amount and adjust the upper compounding coil core by turning it in or out until it just releases. Now adjust the left hand contact by raising the voltage (an amount corresponding to a step change of voltage) above the steady balance voltage value and adjust the left hand contact until it just makes and then adjust the compounding coil until it just releases on decrease of one half this voltage step.

When making adjustments be sure that the contact arm does not touch the compounding coil cores, or the relay will chatter. The final stop should be the moving contact against the stationary contact.

One volt is the minimum range of adjustment but larger ranges are obtainable and desirable on some applications. These can be obtained by increasing the gap between the contacts so that they will close on 3, 4 or 5 volts change in voltage as desired.

MAINTENANCE

The relay should be inspected at regular intervals to see that the balance arm works freely and that the contacts are not burned. If contacts should be burned, dress down with 000 sandpaper or crocus paper.

If plunger is sluggish, remove the screw holding the guide bearing and then remove bearing screw at top and withdraw plunger and clean. There may be dirt or packing in the solenoid opening, or a bent needle shaft or dirt in the guide bearing.

Important: Do not lubricate bearings. Keep cover on tight.

Renewal Parts. Information concerning renewal parts may be obtained through the nearest Westinghouse Sales Office. Include all information found on the nameplate, as well as a description of the parts needed.



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DESCRIPTION • OPERATION • MAINTENANCE INSTRUCTIONS

PRIMARY RELAY—STYLE NO. 568845 With No-Voltage Release Device

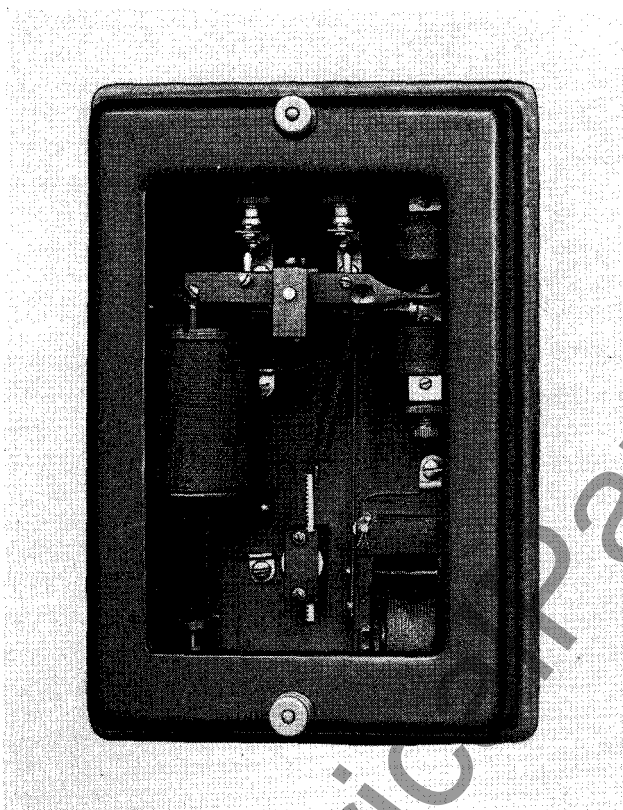


FIG. 1. Primary Relay

This relay is used on step type regulators when the operating motor is supplied from a source other than the line being regulated.

The primary relay consists of a solenoid operated balance arm, pivoted at the center, with contacts on either side working in conjunction with two adjustable stationary contacts. In the balanced or horizontal position neither pair of contacts are closed. The closing of either contact energizes a corresponding compounding coil, which increases the pressure on the contacts and prevents chattering and holds the contacts firmly closed until the balance voltage is nearly reached again. The tripping of the no-voltage device opens a contact supplying voltage to the balance arm and prevents the tap changer from operating. See Figs. 1 and 2.

The solenoid plunger is hung at one end of the balance arm and its weight is partially counter-balanced by a spring at the opposite end. The solenoid exerts an upward pull on the plunger, the amount of pull depending upon the voltage applied to the solenoid. By adjusting the pull on the spring, the arm can be brought to a balance position for various voltages. Voltages above this value will close the left hand contact and voltages below this value will close the right hand contact. The tension on the spring is varied by a rack and pinion having a self-locking micrometer adjustment.

Adjusting thumb screws and lock nuts are provided on the stationary contacts and compounding coil cores so that the limits within which the relays operate may be changed. In addition set screws are provided to positively hold the compounding coil cores in position after adjustments have been made.

The moving contacts on the balance arm can be replaced by releasing a set screw. They are not used when making ordinary adjustments but only when replacing the contacts.

The lower end of the plunger is guided by a small needle shaft working in a bearing which is

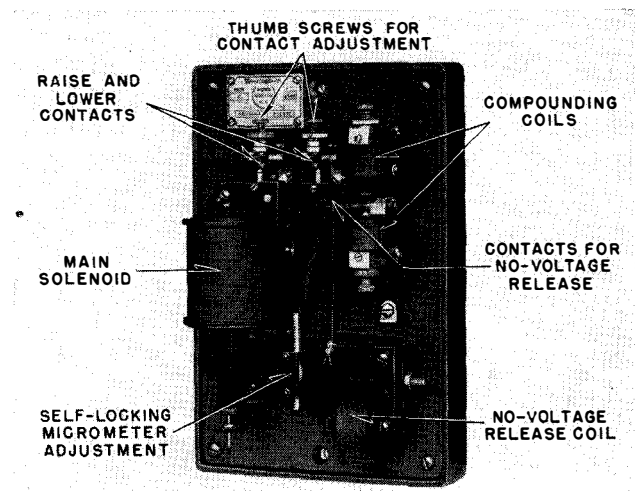


FIG. 2. Primary Relay with Cover Removed

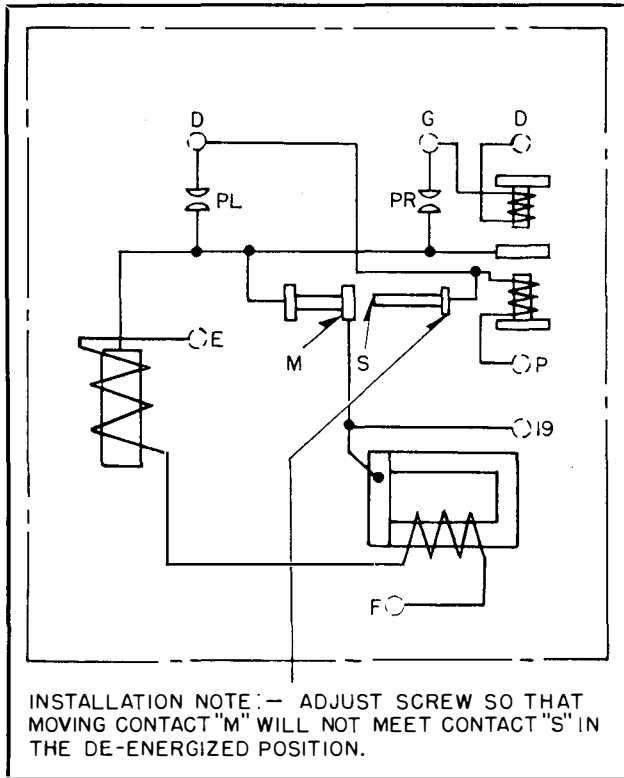


FIG. 3. Front View of Primary Relay in Balanced Energized Position

countersunk to give only a line contact and is practically frictionless.

The contacts are of silver and the stationary ones are carried on a double leaf spring to prevent chattering.

The standard relay may be adjusted to operate from 90 to 140 volts, 60 cycles (115 volts normal). One volt is the minimum change in voltage from the balance voltage at which the relay contacts should close and $\frac{1}{2}$ volt is the minimum change in voltage from the balance voltage at which the compounding coils should release.

The no-voltage release device is mounted in the lower right hand corner of the relay. Under normal operation, contacts on an arm attached to the armature of the release device supplies current to the balance arm. When the line voltage fails, the balance arm tilts to the raise position, but the no-voltage coil releases and the armature swings outward and the attached contact arm breaks the circuit to the balance arm and holds the tap changer at the position it was on when the voltage failed.

Special coils can be furnished for special voltages and frequencies.

The relay panel has a shock-proof mounting and is enclosed in a dust-proof metal cover. A glass front allows ready inspection of the operating parts.

OPERATION

Before attempting to operate the relay, remove the blocking between contacts and between the solenoid and plunger and on the no-voltage device. See that the balance arm and no-voltage release arm move freely.

The schematic diagram of the relay is shown in Fig. 3.

On increase in voltage the plunger is raised, closing the left hand contact which completes a circuit from the balance arm to the external relays and also energizes the lower compounding coil which assists the solenoid to hold the contact closed. When the voltage again begins to decrease, the pull from the solenoid decreases but the compounding coil still exerts a pull until it is finally overcome by the weight of the plunger, when it suddenly releases and opens the relay contacts with a minimum of burning.

On decrease in voltage, the pull on the plunger is decreased until the weight of the plunger overcomes the spring tension and the right hand contact is closed. As previously described the circuits are completed to the external apparatus and now the upper compounding coil is energized which helps to keep the contact closed. As the voltage again increases the first additional pull on the plunger does not open the contact but finally it overcomes the pull of the upper compounding coil and the contacts snap apart and the relay comes to the balanced position.

The no-voltage release device armature closes when the line voltage is first applied and remains closed until the line voltage fails, when it will release and open the circuit to the balance arm, thereby preventing the regulator from operating.

As received by the customer, mounted on a regulator no adjustment should be made to the contacts or compounding coil cores. If it is desired to operate the relay at a higher "balance" voltage this is accomplished by decreasing the spring tension and thereby increasing the unbalanced weight of the plunger. Conversely, if it is desired to lower the "balance" voltage operating point, then the spring tension should be increased until the relay balances at the desired new voltage.

If the relay is out of adjustment as regards the range in voltage required to close the contacts, balance the relay arm at a convenient steady voltage with the contacts open, then reduce the voltage (an amount corresponding to one step) and ad-

just right hand contact until it just closes and next raise voltage one half this amount and adjust the upper compounding coil core by turning it in or out until it just releases. Now adjust the left hand contact by raising the voltage an amount corresponding to one step above the steady balance voltage value and adjust the left hand contact until it just makes and then adjust the compounding coil until it just releases on decrease of one half this voltage step.

When making adjustments be sure that the contact arm does not touch the compounding coil cores, or the relay will chatter. The final stop should be the moving contact against the stationary contact.

The no-voltage release moving contact should positively close against the left contact when the coil is energized and snap open when the coil is de-energized.

MAINTENANCE

The relay should be inspected at regular intervals to see that the balance arm works freely and that the contacts are not burned. If contacts should be burned, dress down with .000 sandpaper or crocus paper.

If plunger is sluggish, remove the screw holding the guide bearing and then remove bearing screw at top and withdraw plunger and clean. There may be dirt or packing in the solenoid opening or a bent needle shaft or dirt in the guide bearing.

Caution: Do not lubricate bearings. Keep cover on tight.

RENEWAL PARTS

The following are recommended as renewal parts to provide proper maintenance of this relay.

Description of Part	Style No.	No. Per Unit
Moving Contact and Stud	817 696	2
Stationary Contact with Spring	817 697	2
Moving Contact Shunt	127 466	1
Main Solenoid Coil	757 128	1
Compounding Coils	406 173	2
No Voltage Release Coil	406 172	1

Complete Renewal Parts information may be obtained from the nearest Westinghouse Electric Corp. Sales Office. Be sure to specify the part needed and give complete nameplate reading of the relay for positive identification.

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www.ElectricalPartManuals.com

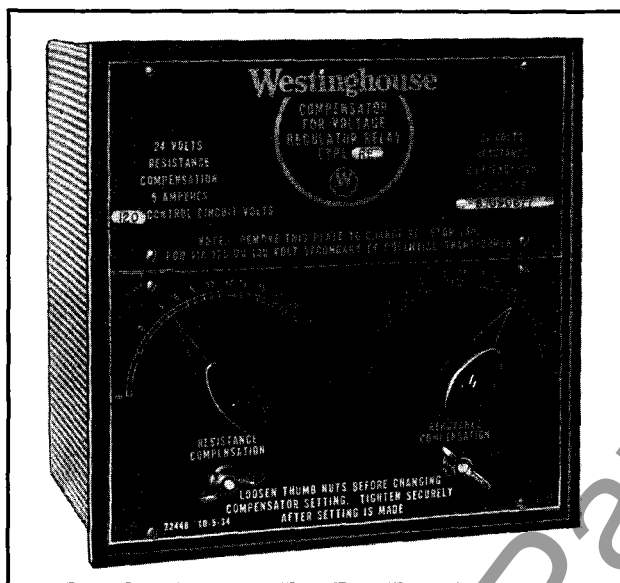




DESCRIPTION • OPERATION • MAINTENANCE INSTRUCTIONS

LINE DROP COMPENSATOR

Type RE



TYPE RE COMPENSATOR consists essentially of an adjustable reactance and an adjustable resistance voltage. It is used in connection with a current transformer and a voltage transformer to produce a voltage at the primary relay terminals which is proportional to that at the distribution end of the feeder. It is usually shipped mounted on the control panel, and is ready for operation merely by setting the dials for the desired reactive and resistance compensation. Once adjusted it needs no further attention until a new setting is necessary.

The compensator maintains a constant voltage at the load center by so affecting the operation of the primary relay that the tap changer will automatically increase the voltage as the load increases and take care of the increasing drop in the line. The primary relay then acts as though it actually were located at the distribution end of the feeder, actuating the regulator to raise the voltage at the regulator high enough to compensate for the line drop, at varying loads and power factors, between the point on the feeder where the regulator is located and the distribution end of the feeder.

DESCRIPTION

The two miniature induction regulators which form the main part of the compensator are mounted horizontally in the lower part of the compensator case. (See B, Fig. 1).

Variable resistance and reactance in exact proportion to the resistance and reactance of the line are obtained by means of these small induction regulators. There are no contacts or taps in the compensator as the resistance and reactance are varied by turning the rotors of the miniature regulators to the proper setting on the scale. After the

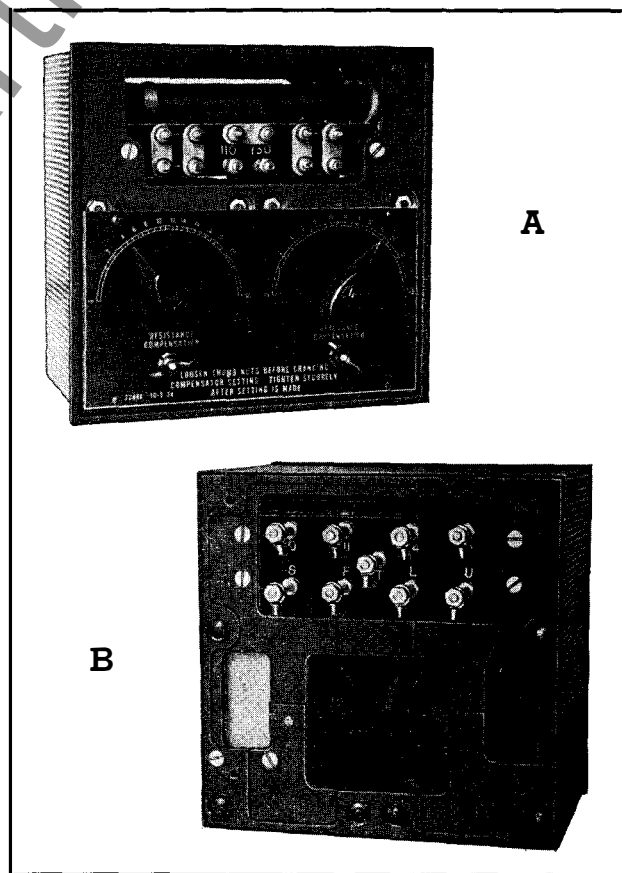


FIG. 1. (A) Upper Half of The Compensator Nameplate Removed to Show Resistors and Terminal Block With Links; (B) Rear of Compensator Showing Miniature Regulators in Lower Part of Case With Resistor Terminal Board in Upper Part of Case.

LINE DROP COMPENSATOR

setting has once been made, the rotors are locked in place by means of screw clamps located just below the rotor knobs. The setting of the compensator is not limited to a definite number of taps but any desired value of compensation may be obtained within the limits of the compensator. (24 volts resistance and 24 volts reactance.) The volt-ampere burden on the current transformer varies with the compensator setting. At maximum setting and full-load current the burden amounts to approximately 65 volt-amperes.

Above the small regulators in the top of the compensator case are fastened the resistance for the primary-relay compounding coils, the series resistances for the primary relay, and the compensating resistance. See A, Fig. 1. The four studs and two links at the left control the direction of the resistance compensation. The four studs and two links at the right control the direction of the reactance compensation. The four studs and the single link in the middle control the series resistance for the primary relay. The latter link should be placed on studs to cover the markings 110, 120, or 130 for similar voltages on the secondary of the voltage transformer. The links are connected as shown in Figs. 1 and 2 at the factory.

Separating the primary-relay resistor from the resistance element of the compensator increases

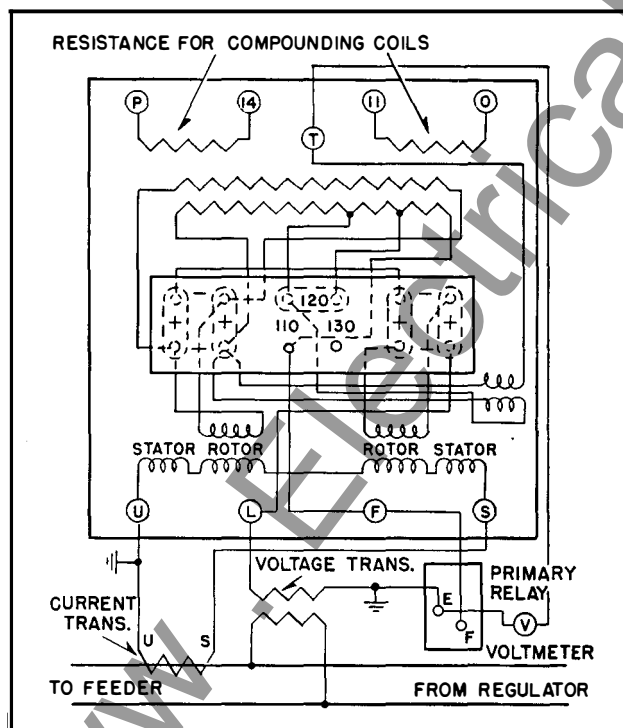


FIG. 2. Diagram of Connections for Type RE Compensator.

the losses of the Type RE compensator above those of the Type RC compensator. The resistor for the primary relay may be used over the wide range of voltage that is obtained from the voltage transformer, there being taps for 110, 120, 130 volts. They may be changed by removing the upper half of the compensator nameplate (see A, Fig. 1) and changing only one link on the terminal block provided for this purpose. The final adjustment of the primary relay is made by means of the spring adjustment on the relay itself.

The RE compensator is rear connected and intended for panel mounting. Typical connections are shown in Fig. 2. For detail connections refer to diagram supplied with regulator.

The separation of the relay and compensator resistors makes possible the reading of the compensated, as well as the regulated voltage. A small booster transformer is used in the voltmeter circuit to partially compensate for the drop due to the relay current flowing through the compensator resistor. A small error is introduced, due to the voltmeter current being taken through the compensator, and depends upon the amount of current drawn by the voltmeter. Suitable voltage-testing terminals to which a portable voltmeter may be connected are usually mounted on the panel to which the compensator is fastened.

The Type RE compensator is wound for either 5 or 8.7 amperes, but not for both in the same compensator. The 5-ampere compensator is used when only one current transformer is required on a single or a 3-phase circuit and the 8.7-ampere model when three current transformers are required on a 3-phase circuit.

OPERATION

The two small horizontally-mounted regulators are indicated as stator and rotor in Fig. 2. These two regulators are excited directly from the line-current transformers. Their primary current is fixed by the ratio of the current transformer, and is directly proportional to the line current. The exciting or primary winding of each small regulator consists of two parts, connected in series, half on the rotor and half on the stator.

When set for zero compensation, the two halves of the winding neutralize each other and no voltage is induced in the secondary winding. As the rotor is turned to increase the compensator setting, the voltage induced in the secondary is increased until the maximum setting is reached, at which point the

two halves of the primary winding are aiding each other.

The resistance regulator has a very small air gap and acts as a variable ratio current transformer, producing a current in the secondary winding proportional to the line current and in phase with it. This current passes through a resistor, which is part of the primary relay circuit, and introduces an additional resistance drop in the relay circuit proportional to the resistance drop in the line at all loads.

The small reactance regulator is similar in general construction to the resistance unit except a large air gap is introduced between the rotor and stator.

To force the flux across the large air gap requires a large magnetomotive force and all of the primary current is used as exciting current. The voltage induced in the secondary winding is therefore in quadrature with the primary current and the line current. The secondary of this regulator is not loaded, but is connected in series with the primary relay circuit. The voltage induced in it adds a reactance drop to the relay circuit which is proportional to the reactive drop on the line at all loads.

If the unit upon which the RE compensator is mounted is to be placed in a network system fed by similar units, then any one of the units may start in raising the voltage before one or more of the other units. With this raise in voltage the units that did not change may now operate to lower it. This condition will cause one or more of the units to take more than their share of the network load and will also produce a circulating current. The condition just described depends on the amount of reactance between the units to limit this circulating current.

In a great many network systems the reactance between units is small as compared to the resistance drop. In networks of this type the units and their tap changers would not operate satisfactorily under the conditions mentioned in the previous paragraph. When a Type RE compensator is used, reversing the reactance element by changing the two right hand links from over the positive to over the negative will eliminate this difficulty. Under normal operation with the load on the units operating close to unity power factor, the resistance compensation will have to be increased some to offset the reversed reactance. However, the resistance compensation will be greater than the reactance compensation

for the low reactance network and the tap changers will operate normally to boost or buck. If the tap changers get out of step as described previously, causing a large amount of circulating current to flow, then this current which is a low power factor current will cause the low voltage unit to operate to raise the voltage and the high voltage unit to operate to lower the voltage, thus keeping the units in step.

Caution: Open the motor power control switch and short circuit the current transformer terminals S and U, Fig. 2, before re-locating the links on the compensator.

Compensator Setting. Set the compensator for the compensation required for the particular circuit. If the resistance and reactance of the line are known or can be calculated, it is preferable to calculate the percentage drop at full load and to set the compensator dials accordingly. The voltage compensation given on the nameplate will be obtained only when current as stamped on the nameplate is flowing in the compensator. With smaller currents the voltage compensation will be proportionally reduced. If the resistance and reactance of the line are not known, this setting of the compensator must be made by trial. This can best be done with a recording meter at the station (if the station bus is not constant) and one at the center of distribution. After comparing simultaneous readings at different loads, make trial adjustments until the proper combination is obtained.

If there is telephonic communication between the center of distribution and the station, adjustments can be made as follows: Use two carefully calibrated voltmeters, noting immediately the result of changes in the compensator setting. On a circuit of widely varying power factor, adjust the resistance dial only at high power factor and the reactance dial only at very low power factor. If the tap changer causes the voltage on the line to decrease instead of increase as the load increases, the secondary leads from the current transformer or from the voltage transformer must be reversed.

There is another method which produces good results using the following procedure: Adjust the primary relay to balance at the regulated voltage, for example 115 volts, which is to be maintained at the load center. Establish telephone connections between the tap changer installation and the load center, and connect a portable voltmeter at the load center to read the regulator voltage at that point. The results will be better if the line is carry-

LINE DROP COMPENSATOR

ing at least 50 per cent of full load during the test, since the varying of the resistance and reactance units will then produce a greater effect on the primary relay. The power factor of the load should be either the maximum or minimum possible.

Take a set of readings, starting with the lowest point on the resistance unit of the compensator and finding a point on the reactance unit which will give the desired voltage at the load center. Continue doing this, progressing one step at a time on the resistance unit, and for each step finding a point on the reactance unit which gives the desired voltage at the load center; repeat the test using the opposite condition of power factor. Tabulate the two sets of data and plot curves.

Permanent settings on the compensator units can now be made at the values of resistance and re-

actance corresponding to the point where the curves intersect. This can be checked by a voltmeter chart run through a complete cycle of load and power factor change. It should indicate a constant voltage at the load center through the entire period.

MAINTENANCE

Type RE compensators require very little attention. Inspect them occasionally and blow out any dust or dirt that has collected in the resistors and small regulators.

Except for replacing the compounding coil resistors P-14 and O-11 (See Fig. 2) return the complete unit to the nearest Westinghouse Service Department for any needed repairs.



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DESCRIPTION • OPERATION • MAINTENANCE INSTRUCTIONS

TYPE W SWITCH FOR TRANSFORMER EQUIPMENT

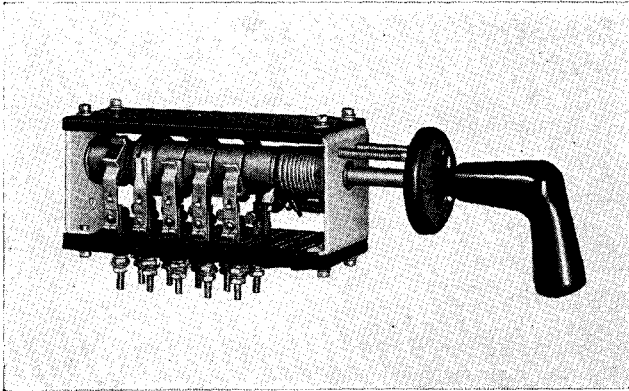


FIG. 1. Control Switch with Side Plates Removed

TYPE W SWITCHES are of the rotary type, of rugged construction, easily accessible for inspection and require very little maintenance. They may be used as instrument, control or auxiliary switches.

DESCRIPTION

A control switch with pistol grip operating handle is shown in Fig. 1.

The type W switch consists of a built-up rotor or drum supported in end frames to which are attached the stationary contact finger base and a steel top. In some combinations of switches the steel top is replaced by an additional finger base. See Fig. 2. The switch is usually entirely enclosed by side plates of Micarta which can be slid out of grooves, for inspection of contacts.

The opening shaft, of 7/16-inch diameter cold rolled steel, rotates in bronze bearings which are riveted in steel end plates. These end plates also provide support for the top. The enameled steel top is channel-shaped, providing additional strength. This arrangement assures permanent alignment of contacts.

Brass moving contacts with a corrosion-resisting finish are separated by molded moisture-proof spacers. These contacts have numbered key notches to facilitate assembly, and are keyed to Micarta insulating tubes covering the shaft. Spacers

and contacts are clamped to the shaft.

Stationary contacts are self-aligning and provide positive contact pressure by use of noncurrent-carrying compression springs. The high-pressure wiping action with the moving contacts assures clean, low-resistance and long-life contacts. Multiple laminated copper shunts conduct the current to the studs which are mounted on the base in a manner that eliminates turning or looseness.

The base of black, molded material has high mechanical and dielectric strength, and is ribbed to give ample creepage distance between studs. Each stud hole is numbered to identify the connection on the wiring diagram.

The maximum number of circuits in the unit switch are 10. Additional circuits can be arranged by using a double base switch as in Fig. 2 or multiple switches operated from one handle as in Fig. 3.

INSTALLATION

The switch is usually mounted on a panel with the other control parts and shipped with the transformer. In some instances these switches are to be mounted by the customer on a station switchboard and in such cases an outline and a drilling plan are supplied.

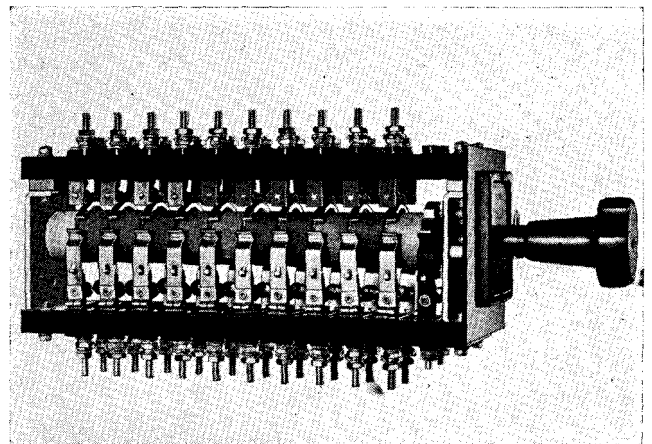


FIG. 2. Ten Pole, Double Throw Type W Switch

TYPE W SWITCHES

The switches can be arranged for 1/8 to 2-inch thick panels by changing the mounting screws.

The correct shaft length is obtained by moving the handle and pointer screw to the proper tapped hole in the shaft.

Three-hole mounting is standard for all instrument and control switches.

OPERATION

Being of the rotary type, the operation of the different classes of type W switches is similar.

The ammeter, regulator transfer and temperature switches are operated by a fixed handle; all other instrument switches are operated by a removable key.

The control switches are operated by a fixed handle with a spring that automatically returns the switch to the "off" position. See Fig. 1.

The auxiliary switch is operated by a lever clamped to the squared end of the shaft.

MAINTENANCE

Only occasional inspections of the contacts are

needed, at which time any accumulated dust should be blown out.

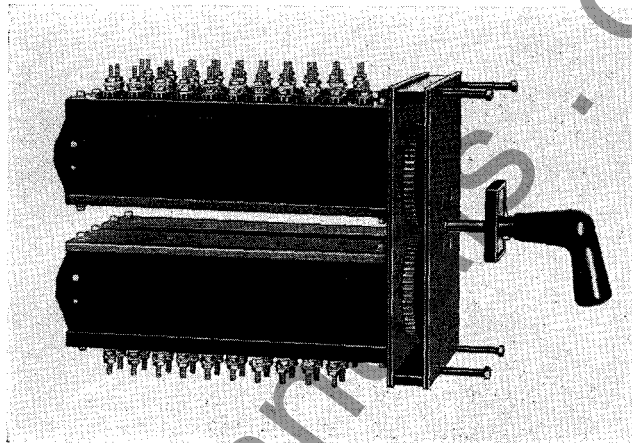


FIG. 3. Four 10-Circuit Geared Units

RENEWAL PARTS

In case renewal parts are required order from the nearest Westinghouse Sales Office or direct from the Sharon Works, giving description of the parts required and S.O. or serial number as stamped on the diagram nameplate on the transformer.



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DESCRIPTION • OPERATION • MAINTENANCE
I N S T R U C T I O N S

TYPE AB DE-ION CIRCUIT BREAKERS

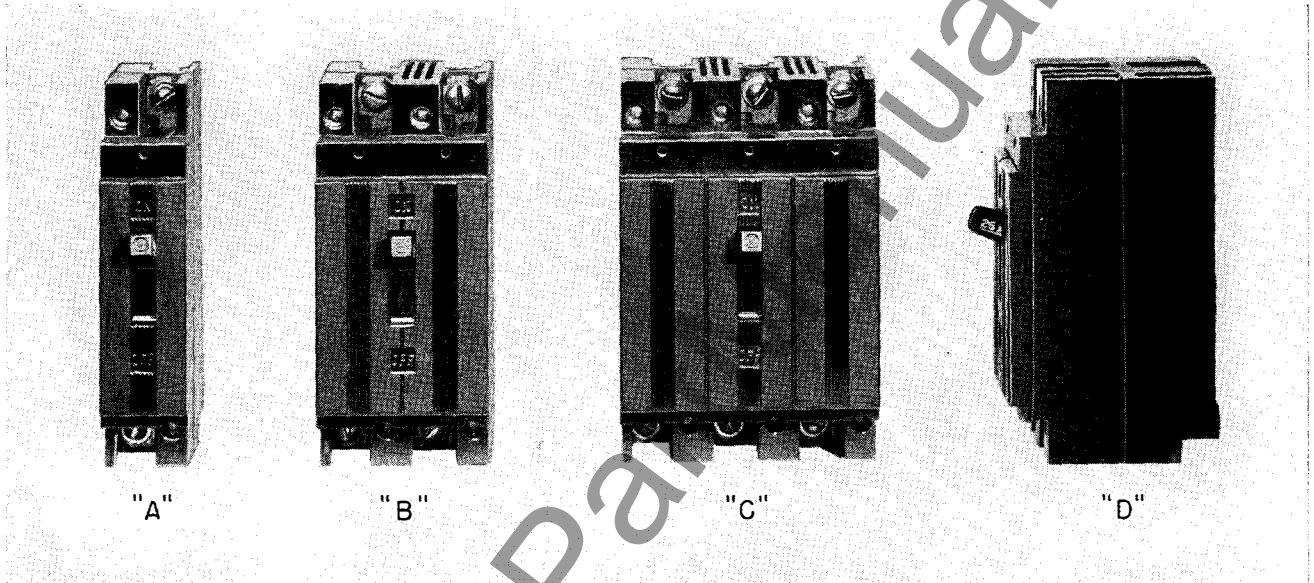


FIG. 1. Type "AB" De-ion Breakers: "A", Single-pole; "B", Two-pole; "C", Three-pole; "D", Side View of Three-pole

TYPE "AB" DE-ION BREAKERS with thermal and magnetic overload trip as used on Westinghouse tap changer equipment are intended to protect from overloads the auxiliary transformer windings that supply power for the control. The mechanism is completely enclosed in a sealed case and requires no maintenance.

CONSTRUCTION AND OPERATION

The case baffles, which resist entrance of dust into the mechanism, and also the operating lever, are moulded from insulating material. The breaker is dead front, only the terminals being exposed, and it is not necessary to open the sealed case to make connections.

Figure 1, ("A", "B" and "C") shows the front views of the single, double and three pole breakers respectively. Figure 1, "D", shows a side view.

The butt type contacts are operated by a spring toggle which snaps them either open or closed with a quick make and break action. When released due to overload, the toggle is trip free from the

handle so that it is impossible to hold the contacts closed on a fault.

The contacts open in front of a De-ion grid stack and the proper magnetic circuit is set up by the current to move the arc off the contacts and into the grid. The De-ion grid divides the arc into a series of short arcs and on the first current zero, the arc is extinguished by the action of a large number of cathodes in series.

When De-ion Breakers are mounted in the transformer oil they have openings in the case opposite the De-ion grids to allow free circulation of oil.

The breaker is tripped on overload by a bi-metal and magnetic latch which is calibrated to carry full load continuously but to trip eventually on 125% load. On high overloads, the breaker has inverse time characteristics which make it almost instantaneous on short circuits.

When the breaker trips from overload, the handle moves to a mid-position which gives a visible indication that the breaker has tripped. Before the breaker can be closed again, it has to be reset by

TYPE AB DE-ION CIRCUIT BREAKERS

pushing the operating handle downward and then closed by raising handle. On multipole units, the separate trip mechanisms are connected by an insulated common trip bar so that an overload on one element will trip all elements.

MAINTENANCE

The entire mechanism is enclosed in its moulded case and sealed at the factory against tampering and to insure permanent calibration. As the contacts

are protected by the de-ion chamber against burning, no maintenance is necessary.

RENEWAL PARTS

In case the breaker should become inoperative or damaged a new one should be ordered from the nearest Westinghouse Electric Corporation Sales Office or directly from the Sharon, Pa. Plant giving serial and stock order number as stamped on the transformer nameplate, and style number and rating of breaker.



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