Type UR Tap Changer Control Equipment For Full Automatic Control of Regulators and CSP Transformers

INSTRUCTIONS

GENERAL

The control equipment for Type UR tap changers for use on regulators or CSP transformers is designed for full automatic operation with provision for manual control, for emergency operation or for testing. This leaflet gives instructions for the operation and maintenance for a typical control circuit. The diagram supplied with the regulator consists of a schematic and wiring diagram with a legend to identify the relays and should be referred to for the particular installation. A study of this leaflet will be found helpful in understanding the operation and circuits of the actual diagram furnished with the regulator or CSP transformers.

The relays and control equipment will require the inspection and maintenance usually necessary on this class of apparatus. Instruction leaflets covering the individual relays and control apparatus are contained in the instruction book, covering the complete transformer.

CONSTRUCTION

The relays and switches are mounted on a hinged panel and enclosed in a metal house. The motor pilot and limit switches are a part of the tap changer operating mechanism, and are operated by cams.

The apparatus on a standard panel consists of the following: See Fig. 1 and 2.

1 Type AB Breaker Safety Switch
2 Primary Relay
3 Operation Counter, electrically operated
4 Automatic Manual Control Switch
5 "off position" Red Lamp
6 Changeover Switch for sequential or non-sequential operation
7 17:33 Position, Changeover Switch
8 Manual Control Switch
9 Stabilizer Transformer and Rheostat
10 Test Terminals
11 Secondary Relays, Type SG in a common case
12 Timing Relays, Type TK
13 Line Drop Compensator

CIRCUITS

The control circuits are shown schematically in Figure 3. Those circuits to the right of the automatic-manual transfer switch "AM" are involved when the switch "AM" is on the manual position. To the left are those additional circuits involved when switch "AM" is in the automatic position. Safety switch "SS" provides a means for disconnecting the control circuits from the transformer for testing and adjustment. When the hand crank is used to move the tap changer, the interlock switch IS protects the operator by preventing possible electrical operation.

MANUAL OPERATION

Move the automatic-manual transfer switch "AM" to the manual position connecting "AM-1" to T-1. The automatic control portion of the circuit is now disconnected. "Raise" and "lower" operation of the tap changer can now be produced with the manual control switches "MC-1" and "MC-2" respectively.

For "raise" operation, the manual control switch MC-1 is moved to the "raise" position for a short interval of time, completing a circuit from T-1 through AM1, MC1, SR, LR and IS to G1. LR is normally closed except on the extreme "raise" position. The auxiliary relay coil SR is energized causing contact SR1 to be opened and contacts SR2, SR3 and SR4 to be closed. Contact SR4 completes a circuit from T-1 through the Thermo-Guard TG, the motor, SR4, LR and IS to G1. At the same instant SR3 completes a circuit from TG-1 through the brake coil, contact SR3 and cam operated switch 124, releasing the brake. The motor starts and the tap changer moves toward the next higher position. Shortly after the motor starts and the tap changer mechanism has moved a few degrees, cam switch 120 is closed. A holding circuit can now be traced from T1 through switch 120 and the secondary relay contact SR2 to SR. Once the holding circuit is made the operation of the tap changer is independent of the switch "MC-1".

As the tap changer reaches the new position (33 position operation) the cam opens switch 120. Relay coil SR is de-energized, its contacts open, stopping the motor and setting the brake.

If change over switch M-17 is closed the cam operated switch 117 parallels switch 120. Switch 117 is closed during the bridging cycle of the tap changer, hence the motor cannot stop on these

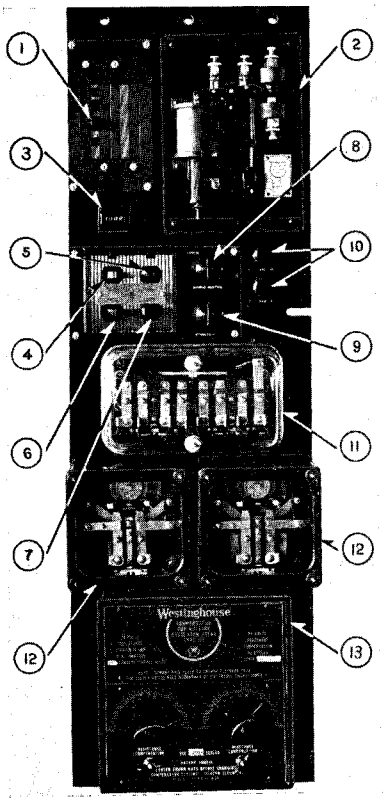

FIG. 1

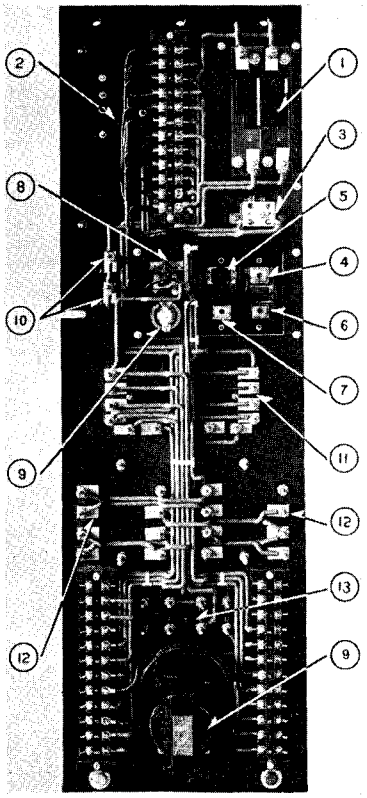

FIG. 2

Type UR Tap Changer Control Equipment for Full Automatic Control of Regulators and CSP Transformers—Continued

INSTRUCTIONS—Continued

positions. The tap changer therefore stops only on odd numbered positions at which time both switches are open. This gives 17 position operation.

To move the tap changer to next higher "raise" position switch MC-1 must again be operated. The sequence is repeated for each position until the extreme raise position is reached and at this point a cam opens the limit switch LR, stopping the tap changer on the end position.

For "lower" operation, move the manual control switch to the lower position. Switch MC-2 is closed and a circuit is completed from T-1 through AM-1, MC-2, SL, LL and IS to G1. As LL is normally closed except on the extreme lower position the auxiliary relay coil SL is energized causing contacts SL1, SL2, SL3 and SL4 to close. Contact SL4 completes a circuit from T-1 through the thermo-guard TG, the motor, SL4, LL and IS to G1. At the same time SL3 closes a circuit from TG-1 through the brake release coil and cam switch 125, releasing the brake. The motor starts and the tap changer moves toward the next lower position as previously described. Switch 120 closes a holding circuit through contacts SL2 (SR1) which prevents stopping of the motor before the tap change is completed. Once the holding circuit is made, the operation is independent of the initiating switch MC-2. SR-1 also prevents stalling between positions in case power fails during tap change, for as soon as voltage is restored a circuit is complete through SR-1 to close the contacts of "lower" relay SL and operate the tap changer to the nearest lower position.

As the tap changer reaches the new position cam switch 120 opens. Relay coil SL is de-energized, its contacts open, the motor stops and the brake sets. To move to the next lower position the manual control switch MC-2 must again be operated. The sequence is repeated for each "lower" step position, until the extreme lower position is reached. At this point a cam opens the limit switch LL stopping the tap changer on the lowest position.

Cam operated switches 124 and 125 operate in the same sequence as LR and LL. They make the brake action positive and prevent overtravel beyond the end positions.

AUTOMATIC OPERATION

The primary relay is the initiating element for tap changes when the automatic-manual transfer switch "AM" is in the automatic position. The relay is sensitive to voltage changes on the line which are transmitted to its coil through a voltage transformer in one phase of the line or through an auxiliary winding on the regulating transformer core. The relay is usually used with a line drop compensator, and requires a current transformer. The line drop compensator will compensate for the line drop between the regulator and the load center.

Usually the Type "RC" Line Drop Compensator is supplied. In cases where load center voltage is to be measured at the equipment the Type "RD" or "RE" Compensator is substituted.

STABILIZER

When the motor starts, an additional load is thrown on the auxiliary transformer. The effect of the voltage drop is to open the primary relay lower contacts should they be closed. The effect of the stabilizer is to compensate for this voltage drop and to make the primary relay independent of the load in the control circuit. The stabilizer is adjusted at test and should not be changed.

A drop in voltage at the load center is reflected to the primary relay coil causing it to close its raise contact and three coils are energized: the time delay coils TRM, TR and the compounding coil CR. The latter acts to obtain more positive action just at the instant when the primary relay contact is opening or closing. Holding contact TR3 is closed instantly by relay coil TR but contact TR1 cannot close until (usually set for 60 sec.) the time delay mechanism operates a latch which releases the contactor arm of TR1 allowing it to close. When TR1 closes, a circuit through the secondary relay SR is completed causing it to pull up its contacts and tap changing is carried out as for manual operation.

In order to prevent too frequent tap changes caused by sudden dips or surges on the line, provision is made in the time delay relay to open contact TR2 after 30 seconds. If the primary relay contact is open, the relay resets and no tap change occurs. If PR remains closed for 60 seconds, contact TR1 closes as already described.

Similarly, if a rise in voltage at the load center occurs, it effects the primary relay coil P causing lower contact PL to close and relay coils CL, TL and TLM are energized. There is a 30 second delay and then if the primary relay contact PL remains closed, TL1 will close at the end of 60 seconds. Tap changing occurs as explained for manual operation.

When the hand controlled switch M23 is in the position for non-sequential operation, cam operated switch 123 is in series with the automatic circuit. Switch 123 is closed on position. After the timing relays have operated and the tap changer set in motion switch 123 opens causing the time relays to open their contacts. The tap changer continues to the next position, however, because cam switch 120 is closed forming a holding circuit. Switch 123 is closed again on the next position. After the time delay mechanism has completed its cycle another tap change can be made if required.

In the case of sequential operation, switch 123 is by-passed. After the delay mechanism has operated, the tap changer will move as many positions as necessary to bring the primary relay back in balance before stopping.

Secondary relay contact SL1 is used to by-pass the primary relay contact PL during tap changing. It protects against possible opening of the lower primary relay contact during tap changing.

Operation counter OC and the red indicating lamp RL are controlled by the cam operated switch 121. This switch is closed between positions and the red lamp therefore, indicates when the tap changer is off position. The number of operations registered are as for 33 position operation and is not affected by the change over switch for 17 positions.

INSTALLATION

All parts used in the construction of Type UR regulator control are assembled, adjusted and tested at the factory as a unit. Except for the primary relay and compensator no adjustments are necessary. Adjust the primary relay to balance at the voltage which is to be used at the load center. The compensator should be adjusted to correct for the voltage drop in the line between the regulator and the load center.

With the safety switches on the control panel opened, a separate source of power should be applied to the control circuit and all relays checked for freedom from binding and for any parts bent or broken during shipment. All blocking should be removed. The tap changer should be operated over its full range by hand crank then with the manual control switch and finally automatically by raising and lowering the test voltage. If this cannot be done make a similar test by operating the primary relay contacts by hand. If there is any binding or excessive friction, it should be adjusted, to operate smoothly.

MAINTENANCE

A periodical inspection of the relays and relay contacts should be made. An occasional dressing with a very fine file will keep the contacts clean and insure positive action of the relay.

For detail instructions on the maintenance of and renewal parts for the relays see Instruction Leaflets in the complete transformer instruction book.

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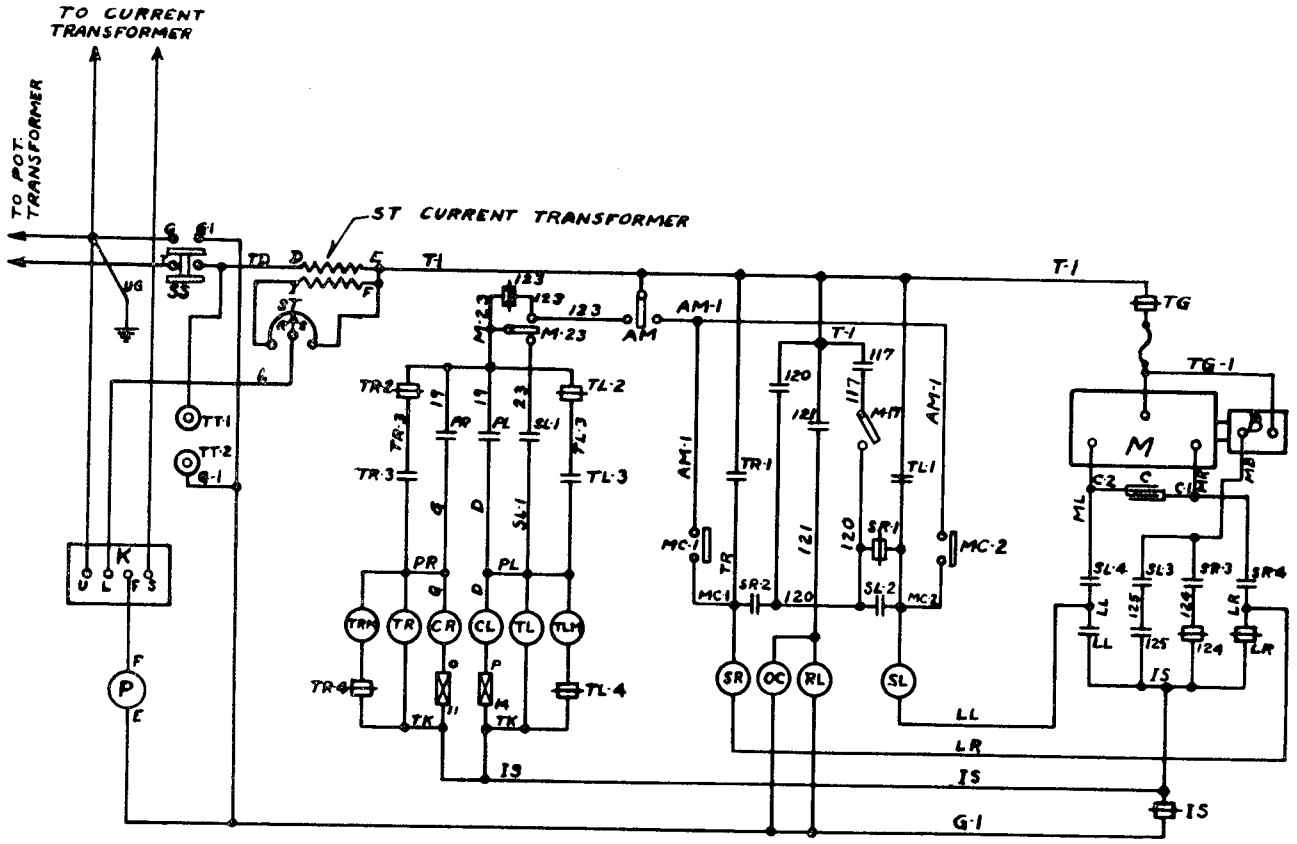
INSTRUCTIONS—Continued



LEGEND

(P) — PRI. RELAY COIL
(CR) — " " COMPOUNDING COIL - RAISE
(CL) — " " " " - LOWER
(TR) — TIME DELAY RELAY CONTACTOR - RAISE
(TL) — " " " " - LOWER
(TRH) — " " " MOTOR - RAISE
(TLH) — " " " " - LOWER
(SR) — AUX. RELAY CONTACTOR - RAISE
(SL) — " " " - LOWER
(RL) — RED LAMP - ON BETWEEN POSITIONS
(OC) — OPERATION COUNTER
PR - PRIMARY RELAY CONTACTS - RAISE
PL — " " " - LOWER
TR-1 — TIME DELAY RELAY CONTACTS - RAISE
TL-1 — " " " " - LOWER
TR-2 — " " BACK " - RAISE
TL-2 — " " " " - LOWER
TR-3 — " " SEALING " - RAISE
TL-3 — " " " " - LOWER
TR-4 — " " MOTOR " - RAISE
TL-4 — " " " " - LOWER
SR-1; SR-2; SR-3; SR-4 } AUXILIARY RELAY CONTACTS - RAISE
SL-1; SL-2; SL-3; SL-4 } AUXILIARY RELAY CONTACTS - LOWER
117 — PILOT MOTOR SWITCH - CLOSED ON EVEN NUMBERED POSITIONS.

120 — PILOT MOTOR SWITCH - OPEN ON POSITION.
121 — " " " " " " "
123 — " " " - CLOSED " "
124 — BRAKE LIMIT SWITCHES - RAISE
125 — " " " - LOWER
LR — MOTOR " " - RAISE
LL — " " " - LOWER
M-17 — 17:33 POSITION CHANGEOVER SWITCH.
MC — MANUAL CONTROL SWITCH
AM — AUTOMATIC-MANUAL CONTROL SWITCH.
SS — AB BREAKER SAFETY SWITCH
TT-1 — TEST TERMINALS
TT-2 — " "
M — MOTOR
B — MOTOR BRAKE
C — CAPACITOR
K — LINE DROP COMPENSATOR
IS — INTERLOCK SWITCH - OPEN FOR HAND OPERATION
TG — THERMOGUARD
ST — STABILIZER
RS — STABILIZER RHEOSTAT
M-23 — CHANGEOVER SWITCH FOR SEQUENTIAL OR NON-SEQUENTIAL OPERATION.

FIG. 3—TYPE UR REGULATOR, SCHEMATIC DIAGRAM

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