

# Type UR Tap Changer Control

## INSTRUCTIONS

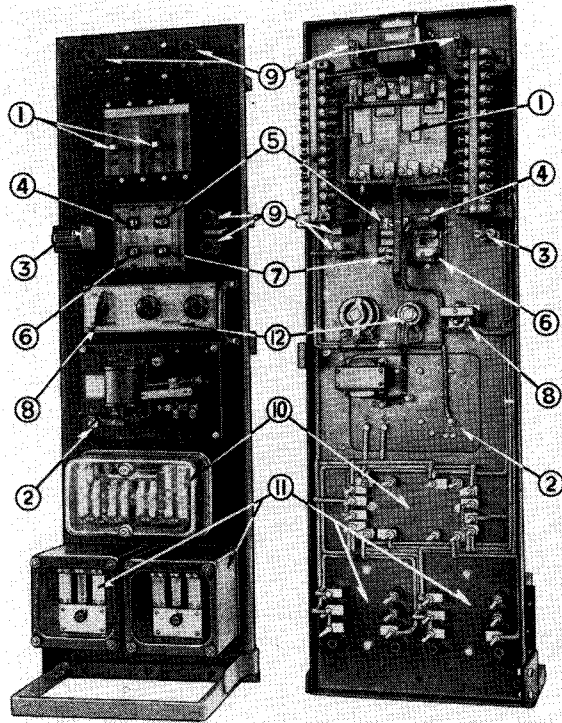


FIG. 1

FIG. 2

### 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 of a typical control circuit. The diagram supplied with the regulator consists of a schematic and wiring diagram with a legend to identify the relays. This diagram should be referred to for any particular installation. A study of this leaflet will be found helpful in understanding the operation of the actual circuit diagram furnished with the regulator or CSP transformer.

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 cabinet. 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 control panel consists of the following: (See Fig. 1 and 2).

### CIRCUITS

The control circuit for a Type UR tap changer is shown in Fig. 3. When contact AM1 of the automatic-manual switch is closed AM2 is open and the circuit can be energized only by the raise-and-lower switch MC. When contact AM2 is closed, contact AM1 is open and the circuit is set up for automatic control.

### LEGEND

- 1 — Type AB Breaker Safety Switch.
- 2 — Voltage Regulating Relay.
- 3 — Operation Counter, Electrically Operated.
- 4 — Automatic-Manual Switch.
- 5 — "Off-Position" Red Lamp
- 6 — Changeover Switch for Sequential or Non-Sequential Operation.
- 7 — 17:33 Position Switch.
- 8 — Raise-and-Lower Switch.
- 9 — Voltage Testing Terminals.
- 10 — Motor Control Relay, Type SG.
- 11 — Time-Delay Relays, Type TH.
- 12 — Line Drop Compensator.

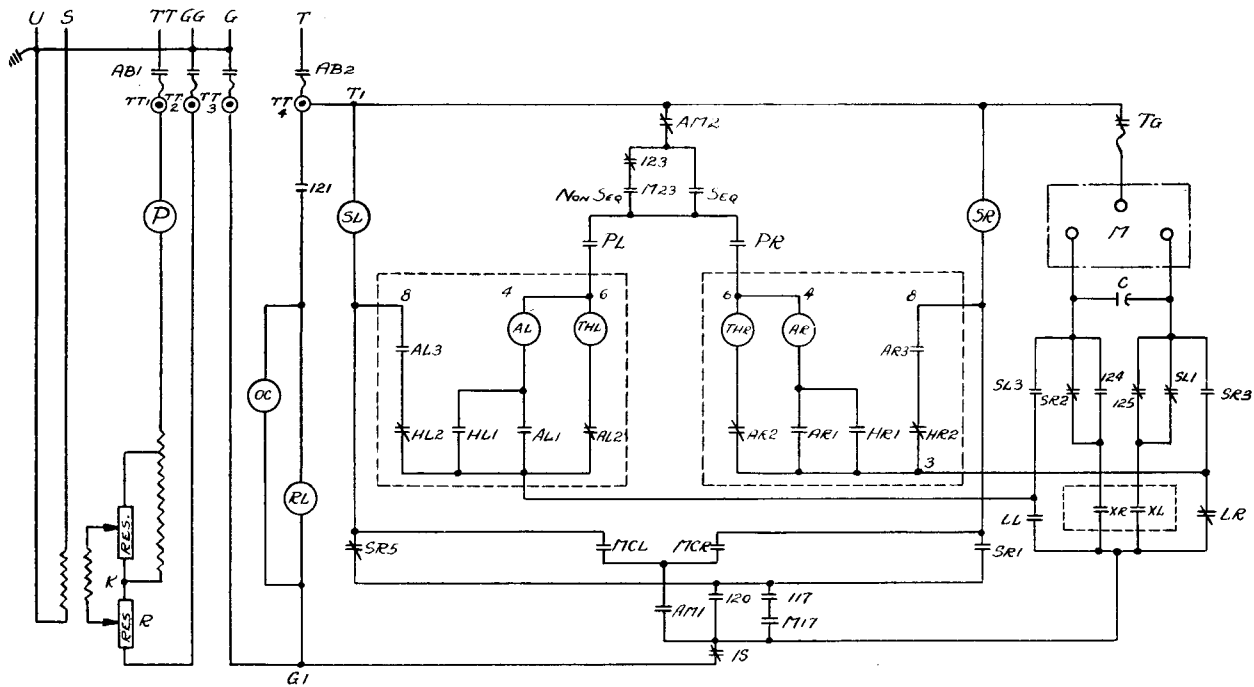
When the hand crank is used to operate the tap changer, the mechanical interlock switch IS protects the operator by making it impossible to energize the motor while the crank is engaged. AB breakers AB-1 and AB-2 provide a means of disconnecting the control circuit from the transformer for testing or adjusting.

### CONTROL CIRCUIT OPERATION

(a) **Automatic Control:** The voltage regulating relay is the initiating element for tap changes when the automatic-manual switch "AM" is in the automatic position. The relay is sensitive to voltage changes on the line which are transmitted to its coils 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 linedrop compensa-

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### INSTRUCTIONS—Continued



LEGEND

- |   |  |
|---|--|
| <p>P VOLTAGE REGULATING RELAY COIL<br/>                 PR VOLTAGE REGULATING RELAY CONTACTS-RAISE<br/>                 PL VOLTAGE REGULATING RELAY CONTACTS-LOWER<br/>                 THR TIME DELAY RELAY BIMETAL HEATER-RAISE<br/>                 THL TIME DELAY RELAY BIMETAL HEATER-LOWER<br/>                 HRI } TIME DELAY RELAY MICROSWITCH<br/>                 HR2 } CONTACTS-RAISE<br/>                 HLI } TIME DELAY RELAY MICROSWITCH<br/>                 HL2 } CONTACTS-LOWER<br/>                 AR } TIME DELAY RELAY AUXILIARY<br/>                 CONTACTOR COIL-RAISE<br/>                 AL } TIME DELAY RELAY AUXILIARY<br/>                 CONTACTOR COIL-LOWER<br/>                 AR1- } TIME DELAY RELAY AUXILIARY<br/>                 2-3 } CONTACTOR CONTACTS-RAISE<br/>                 AL1- } TIME DELAY RELAY AUXILIARY<br/>                 2-3 } CONTACTOR CONTACTS-LOWER<br/>                 SR MOTOR CONTROL RELAY COIL-RAISE<br/>                 SL MOTOR CONTROL RELAY COIL-LOWER<br/>                 SR1,2,3,5 MOTOR CONTROL RELAY CONTACTS-RAISE<br/>                 SL1,3 MOTOR CONTROL RELAY CONTACTS-LOWER<br/>                 XR PLUGGING SWITCH CONTACTS-RAISE<br/>                 XL PLUGGING SWITCH CONTACTS-LOWER<br/>                 120 PILOT MOTOR SWITCH-OPEN ON POSITION<br/>                 121 PILOT MOTOR SWITCH-OPEN ON POSITION<br/>                 123 PILOT MOTOR SWITCH-CLOSED ON POSITION</p> | <p>124 BRAKE LIMIT SWITCH-RAISE<br/>                 125 BRAKE LIMIT SWITCH-LOWER<br/>                 117 PILOT MOTOR SWITCH-CLOSED ON EVEN-NO. POS.<br/>                 M17 17:33 POSITION CHANGEOVER SWITCH<br/>                 LR MOTOR LIMIT SWITCH-RAISE<br/>                 LL MOTOR LIMIT SWITCH-LOWER<br/>                 AM1 AUTOMATIC-MANUAL SWITCH CONTACTS-<br/>                 CLOSED FOR MANUAL<br/>                 AM2 AUTOMATIC-MANUAL SWITCH CONTACTS-<br/>                 CLOSED FOR AUTOMATIC<br/>                 MCR RAISE-AND-LOWER SWITCH-RAISE<br/>                 MCL RAISE-AND-LOWER SWITCH-LOWER<br/>                 M23 SEQUENTIAL-NON-SEQUENTIAL SWITCH<br/>                 IS INTERLOCK SWITCH-OPEN FOR HAND OPERATION.<br/>                 M TAP CHANGER MOTOR<br/>                 C MOTOR CAPACITOR<br/>                 TG THERMOGUARD<br/>                 OC OPERATION COUNTER<br/>                 RL RED LAMP-ON BETWEEN POSITIONS<br/>                 TT1-4 VOLTAGE TESTING TERMINALS<br/>                 K LINE-DROP COMPENSATOR<br/>                 ABI-2 THERMAL BREAKERS</p> |
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FIG. 3—SCHEMATIC DIAGRAM FOR TYPE UR TAP CHANGER

tor, which requires a current transformer. The line drop compensator will compensate for the line drop between the regulator and the load center.

A drop in voltage causes voltage regulating relay "raise" contact PR to

close, energizing time-delay relay heater THR. If the heater remains energized long enough, the bimetal will operate the microswitch HR. Operation of the microswitch opens contact HR2 and closes contact HR1. Closing contact HR1 en-

ergizes the auxiliary contactor coil AR, which operates to open contact AR2 and close contact AR1 and AR3. Opening contact AR2 de-energizes the bimetal heater THR, allowing the bimetal to cool. Closing contact AR1 shunts the

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### INSTRUCTIONS—Continued

microswitch contact HR1 and holds the auxiliary contactor AR closed as long as PR remains closed. When the bimetal has cooled to the temperature determined by the time setting, it allows the microswitch to return to its original position, opening HR1 and closing HR2. If the auxiliary contactor AR is still held closed by PR through AR1, then AR3 is still closed and the reclosing of HR2 completes the circuit, energizing the motor control relay SR.

Energizing the motor control relay SR opens contacts SR2 and SR5 and closes contacts SR1 and SR3. Closing contact SR3 energizes the motor to operate the changer in the "raise" direction.

If the control is set for sequential operation, the motor control relay SR will remain energized as long as the voltage regulating relay contact PR remains closed. When PR opens, cam-operated switch 120 keeps SR sealed in through contact SR1 until the tap change then under way has been completed. If the control is set for non-sequential operation, cam-operated switch 123 de-energizes the time-delay relay auxiliary contactor shortly after motor control relay coil SR is sealed in by switch 120 through contact SR1, thus de-energizing SR at the completion of one tap change. If the voltage regulating relay calls for a further raise in voltage, the above sequence is repeated, including another time delay before each tap change.

While the motor is in motion in the raise direction, the plugging switch closes contact XR. De-energizing SR opens contact SR3, removing power from the motor in the "raise" direction. This also closes contact SR2 which applies power to the motor in the "lower" direction through XR as long as the motor continues to run in the "raise" direction. This plugging action brings the motor to a positive stop.

When, instead, a rise in voltage causes

contact PL to close, the same description applies except with L substituted for R in the symbols above and back contact SR5 used instead of a front contact on the motor control relay SL.

The reason for using back contact SR5 for lowering operation in preference to a front contact on SL is to prevent damage to the tap changer following a power failure during a tap change. When power is restored after such a failure, the motor control relay coil SL is energized through back contact SR5 and cam switch 120 (which is closed when the tap changer is off position), thus returning the tap changer to its next lower position. From this point, voltage adjustment can then take place in the usual manner.

Switch 124 is open except on position 33 and beyond. Switch 125 is open except on position 1 and below. These switches provide automatic plugging in case the motor should move beyond tap changer limit positions. Changeover Switch M-17 may be set for either 17 or 33 position operation.

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 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 changeover switch for 17 positions.

(b) **Manual Control:** For manual control, contact AM2 of automatic manual switch is open and contact AM1 is closed. When higher voltage is desired, contact MCR of raise-and-lower switch is closed, energizing motor control relay coil SR. From this point on, the tap changing, braking, and positioning are the same as for automatic control.

If a voltage lowering operation is desired, contact MCL is closed, energizing

motor control relay coil SL. The operation then continues as for automatic control.

### 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 voltage regulating relay and line-drop compensator, no adjustments are necessary. Adjust the regulating 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. See Instruction Leaflets on this apparatus for detailed instructions.

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 voltage regulating relay contacts by hand. If improper operation is noted, the necessary corrective steps should be taken before the unit is placed in service.

### 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.

If detailed information is desired concerning maintenance or instructions for obtaining renewal parts for this apparatus, see Instruction Leaflets in the complete transformer instruction book.

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