

TYPE RC LINE-DROP COMPENSATOR

GENERAL

The type "RC" Compensator consists essentially of an adjustable reactance and an adjustable resistance voltage and 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 it is only necessary to set the compensator dials for the desired resistance and reactive compensation. Once adjusted it needs no further attention until it is desired to change the setting.

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 primary-relay then acts as though it actually were located at the distribution end of the feeder, and it actuates 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.

CONSTRUCTION

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 Fig. 2).

Variable resistance and reactance in exact proportion to the resistance and reactance of the line are obtained by means of these two 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 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

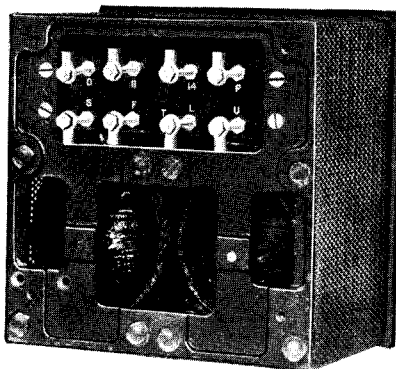


FIG. 2—REAR OF COMPENSATOR SHOWING MINIATURE REGULATORS IN LOWER PART OF CASE WITH RESISTOR TERMINAL BOARD IN UPPER PART OF CASE.

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 44 volt-amperes.

Above these regulators in the top of the compensator case are fastened the resistance for the primary-relay compounding coils and the resistance which serves both as the primary-relay series resistance and the compensating resistance. (See Fig. 3).

Combining the primary-relay resistor with the resistance element of the compensator keeps the losses of the type RC compensator to the lowest possible value. This combination resistor is provided with taps so that the primary-relay may be used over the wide range of voltage that is obtained from the voltage transformers. These taps are for 110, 120, 130 volts. They may be changed by removing the upper half of the compensator nameplate (See Fig. 3) and changing only one screw-plug in a terminal block provided for this purpose. Of course, the final adjustment of the primary-relay is made by means of the spring adjustment on the relay itself.

The RC compensator is rear connected and intended for panel mounting.

This compensator is so made that the regulated voltage of the line may be read, that is, the line voltage as it leaves the regulator. Suitable voltage-testing terminals to which a portable voltmeter may be connected are mounted on the panel to which the compensator is

fastened. It is impractical, however, to read the compensated voltage or center of distribution voltage with this type of compensator because to read this voltage with a standard type of voltmeter requires a compensator in which the primary-relay resistance is separated from the compensator resistance. This separation would sacrifice the type RC, low-loss feature.

The Type "RC" Compensator is wound for both 5 and 8.7 amperes. Two scales are provided, the upper scale being for a normal full-load current of 5 amperes such as obtained when operating the compensator on a single-phase circuit. The lower or 8.7 ampere scale is used on three-phase, three-wire circuits when three-current transformers are used. To facilitate the operator in knowing which scale is being used, a small sliding name plate is provided

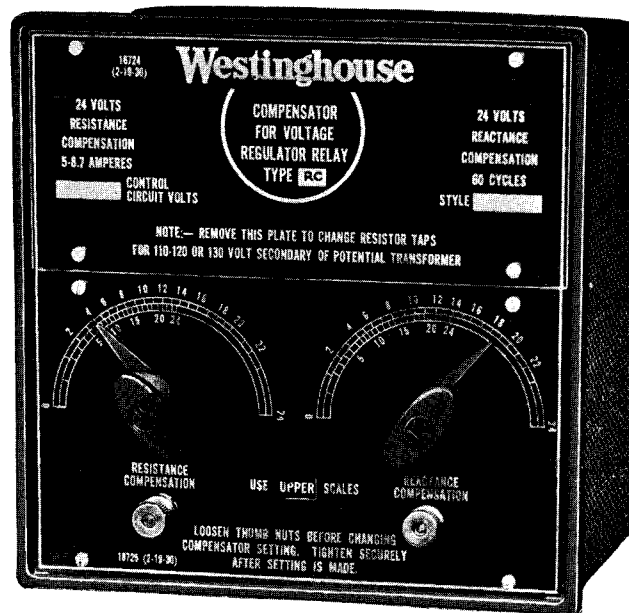


FIG. 1—FRONT VIEW OF THE TYPE RC COMPENSATOR

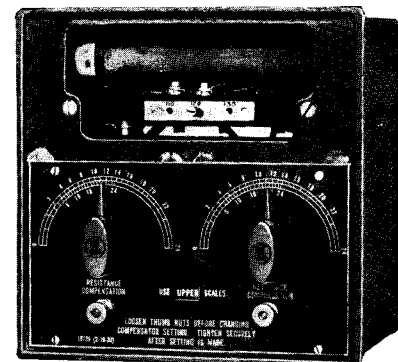


FIG. 3—UPPER HALF OF THE COMPENSATOR NAMEPLATE REMOVED TO SHOW RESISTORS AND TERMINAL BLOCK WITH SCREW-PLUG.

Type RC Line-Drop Compensator—Continued

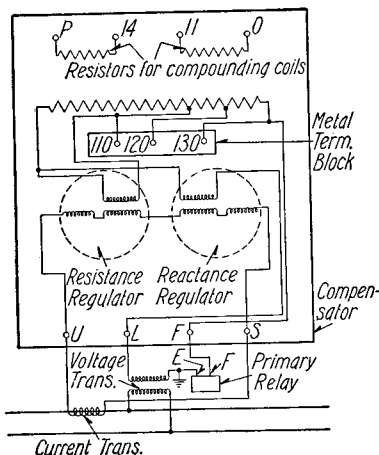


FIG. 4—SCHEMATIC DIAGRAM OF TYPE RC COMPENSATOR.

which states that either upper or lower scales are to be used. To change this indication, simply loosen the four screws holding the lower portion of the name plate and slide the name plate either to left or right depending on whether "Lower" or "Upper" is wanted.

OPERATION

The two small horizontal-mounted regulators are indicated by the two dotted circles in the diagram Fig. 4. These two regulators are excited directly from the line current transformers. The primary current of each regulator is fixed by the ratio of the current transformer, and is directly proportional to the line current. The exciting or primary winding of each 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, forming part of the primary relay circuit and introduces an additional resistance drop in the relay circuit which will be proportional to the resistance drop in the line at all loads.

The 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 second-

ary 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.

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 name plate will be obtained only when current as stamped on the name plate 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 by the use of 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 telephonic communication between the center of distribution and the station can be had, adjustments can be made as follows: Two carefully calibrated voltmeters should be used and the result of changes in the compensator setting can be noted immediately. On a circuit of widely varying power factor, it is advisable to adjust the resistance dial only at high power factor and to adjust 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 scheme which gives good results and for which the following set-up must be made:—Adjust the pri-

mary relay to balance at the regulated voltage, for example 115 volts, which it is desired to maintain 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. Better results will be had if the line is carrying at least 50 per cent of full load during the test, as 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. A set of readings can now be taken, 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. This can be continued, 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. The results should be tabulated. Repeating this test with the opposite condition of power factor gives two sets of data from which two curves can be plotted.

After the curves are plotted, the compensator units are given permanent settings, at the values of resistance and reactance corresponding to the point where the curves intersect.

MAINTENANCE

The type RC compensators require very little attention, however, they should be inspected occasionally and any dust or dirt blown out of the resistors and the small regulators.

RENEWAL PARTS

Except for the replacing of the compounding coil resistors P-14 and O-11 in the top of the compensator, it is recommended, that for other defects that may develop, that the complete unit be returned to the nearest Westinghouse Service Dept. for repairs.

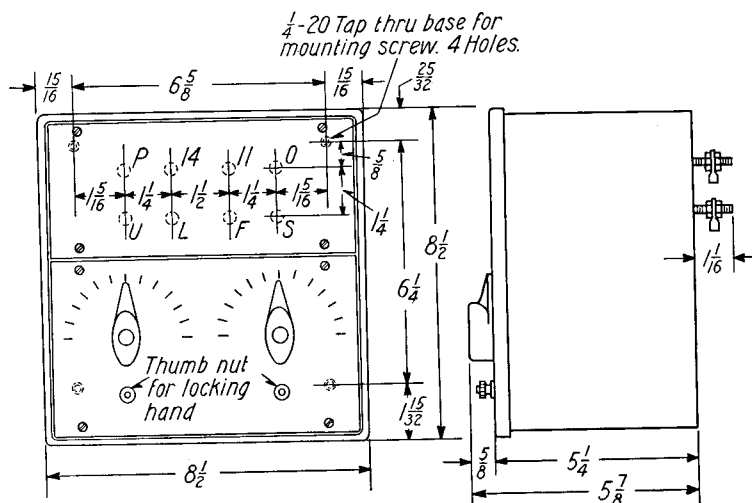


FIG. 5—OUTLINE DIAGRAM OF TYPE RG COMPENSATOR