Type RE Line-Drop Compensator

INSTRUCTIONS

GENERAL

The type "RE" 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. See Fig. 1.

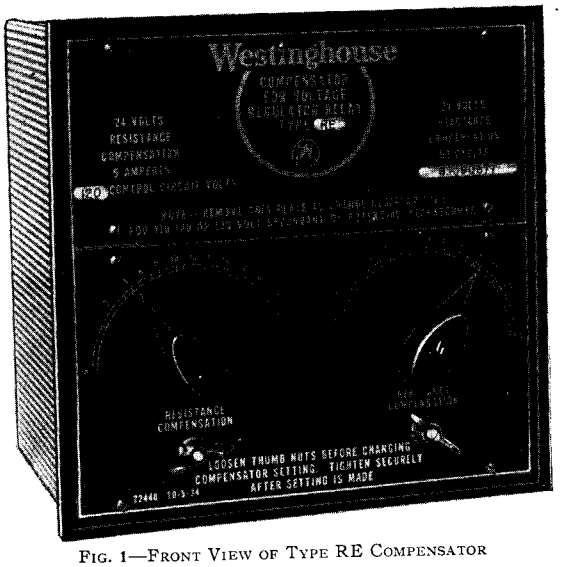

FIG. 1—FRONT VIEW OF TYPE RE COMPENSATOR

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 primary relay then acts as through 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 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 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, and the series resistances for the primary relay and the compensating resistance. (See Fig. 3).

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 in the middle and the single link 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. 3 and 4 at the factory.

Separating the primary-relay resistor from the resistance element of the compensator increases the losses of the type "RE" compensator above those of the type "RC" compensator. The resistor for the primary-relay may be used over

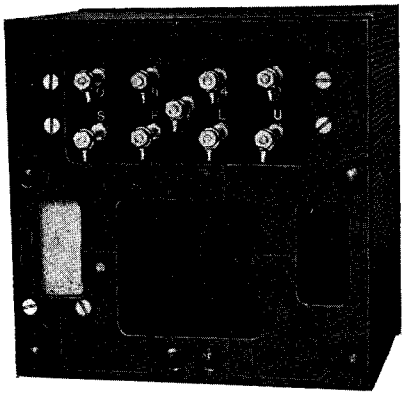

FIG. 2—REAR OF COMPENSATOR SHOWING MINIATURE REGULATORS IN LOWER PART OF CASE WITH RESISTOR TERMINAL BOARD IN UPPER PART OF CASE

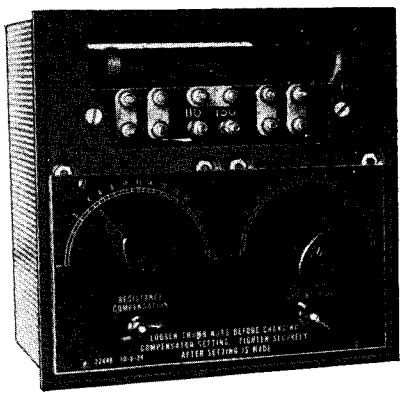

FIG. 3—UPPER HALF OF THE COMPENSATOR NAMEPLATE REMOVED TO SHOW RESISTORS AND TERMINAL BLOCK WITH LINKS

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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 Fig. 3) and changing only one link on the 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 "RE" compensator is rear connected and intended for panel mounting. Typical connections are shown in Fig. 4. 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 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 volt-meter 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 compensator when three current transformers are required on a three phase circuit.

OPERATION

The two small horizontal-mounted regulators are indicated as stator and rotor in Fig. 4. These two regulators are excited directly from the line-current transformers. The primary current of these small regulators 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.

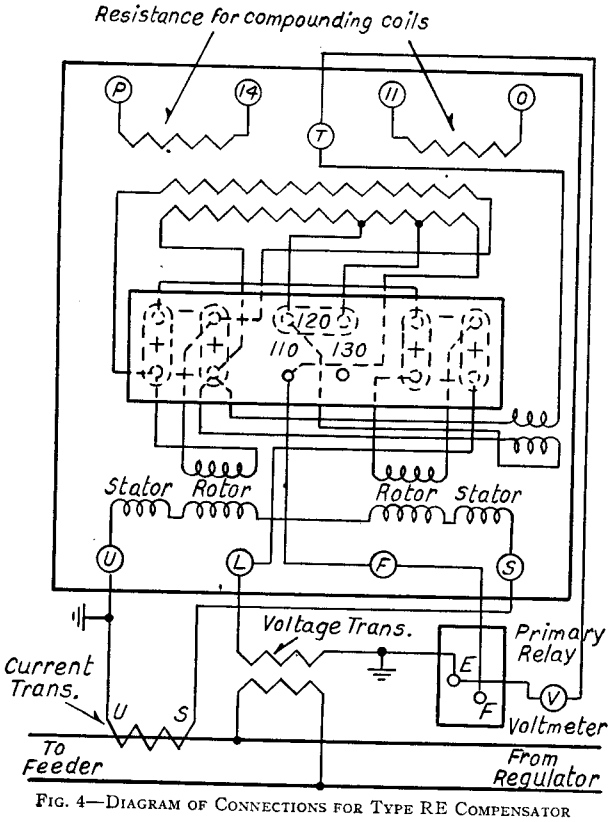

FIG. 4—DIAGRAM OF CONNECTIONS FOR TYPE RE COMPENSATOR

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 which will be 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. This condition will cause one or some 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 mention-

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ed in the previous paragraph. To eliminate this difficulty, when a type "RE" compensator is used, it is only necessary to change the two right hand links from over the + to over the —. This reverses the reactance element. 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.

As a matter of safety, the motor power control switch should be opened and the current transformer terminals S and U should be short circuited before relocating 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 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 primary 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 percent 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. 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

The type "RE" 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, for other defects that may develop, that the complete unit be returned to the nearest Westinghouse Service Department for repairs.

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