Type SU Primary Relay

With Dynamic Line-Drop Compensator

INSTRUCTIONS

GENERAL

The type SU primary relay with dynamic line-drop compensator is of the alternating current solenoid type and is ruggedly designed. Compounding is obtained by means of a permanent magnet rather than electro-magnets. Adjustments for different values of balance voltage are made by shifting a counter weight along a scale which is calibrated in volts. In addition, a small coil, energized by rectified current from a current transformer, and attached to the balance arm and operating in a permanent magnetic field, provides a means for compensating for line drop. Usually the only maintenance required is an occasional inspection and dressing of the contacts.

CONSTRUCTION

The relays as used on step type regulators are mounted on individual panels and provided with a tight fitting cover having a glass front (see Fig. 1). Fig. 2 shows a schematic diagram of the relay connections, the rectox unit and adjusting rheostat. The operating parts have been combined into a single moving element which is mounted on a square shaft resting on a knife edge. This provides a very sturdy bearing with a negligible amount of possible friction. The shaft and bracket are made of nitrided steel which is exceptionally hard and resistant to wear and corrosion.

The contacts are made of silver which results in long life and smooth contact points. They are designed in such a way that contact sticking is eliminated.

The compounding is accomplished by the use of a permanent magnet acting

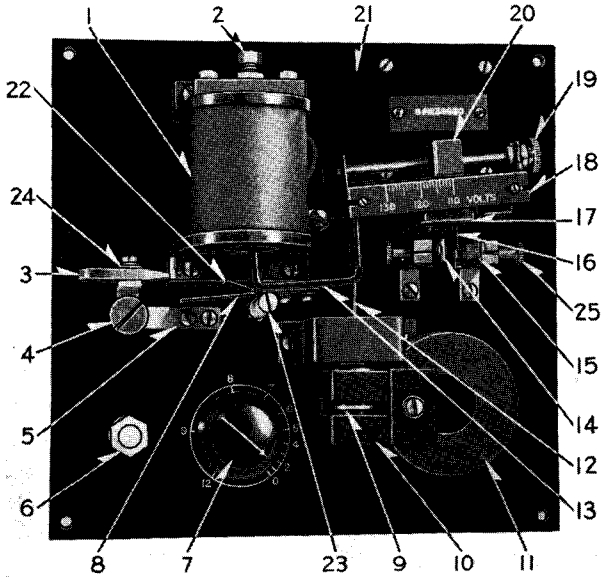

FIG. 1—TYPE SU PRIMARY RELAY, COVER REMOVED

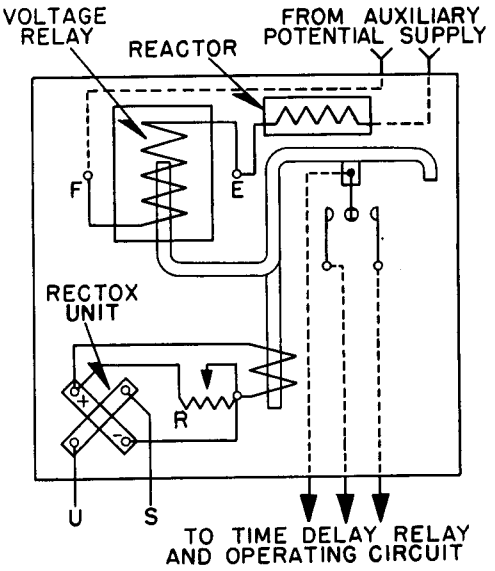

FIG. 2—WIRING DIAGRAM TYPE SU PRIMARY RELAY

LEGEND

1—Relay main operating coil
2—Magnetic circuit adjusting screw
3—Permanent magnet for band adjustment
4—Permanent magnet air gap adjusting screw
5—Permanent magnet supporting bracket
6—Mounting stud for rectox unit for compensator
7—Compensating rheostat operating knob
8—Soft iron armature
9—Compensator operating coil
10—Compensator magnet poles
11—Compensator permanent magnet
12—Link connecting compensator coil to balance arm
13—Balance Arm
14—"Lower" contact
15—"Raise" contact
16—Moving contact
17—Bearing block
18—Voltage calibrated plate
19—Voltage setting adjusting screw
20—Voltage adjusting weight
21—Micarta panel
22—Buffer spring
23—Balance arm stop
24—Permanent magnet clamping washer and screw
25—Contact adjusting screw

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on a soft iron armature attached to the moving element. The action of the magnet is to hold the relay element in a neutral position until a sufficient change in voltage has taken place to overcome the magnetic pull in the balance position. The moving element requires a predetermined unbalanced force to overcome the magnet pull which results in a quick and positive movement and contact. After the voltage has been corrected a sufficient amount to cause the contacts to separate, the relay moving element is again drawn back to a neutral or balanced position by the permanent magnet.

The sensitivity of the relay or the amount of voltage change required to close the relay contacts is determined by the air gap between the magnet poles and the moving iron armature. The gap spacing is made adjustable to vary the voltage band setting of the relay. If the gap is decreased, the magnet pull is greater and a greater change of voltage on the solenoid coil is required to operate the relay. If the gap is increased, the magnet pull is less and operation is obtained with a smaller voltage deviation. In this way, the relay sensitivity to voltage change may be controlled.

The balanced voltage setting of the relay is determined by the position of the movable weight on the relay balance arm. The setting may be changed through the use of a knurled adjusting screw which engages the movable weight.

The relay includes a simple dynamic type line-drop compensator. A small coil is attached by a link to the relay balance arm and is located in a permanent magnetic field. A small rectox unit is mounted on the back of the relay panel to rectify the current from the secondary of a current transformer located in the output circuit of the regulator. A rheostat on the back of the panel and operated by a knob on the front, shunts the output of the rectox unit and regulates the current to the compensating coil, thereby providing means for varying the amount of compensation. The scale around the knob is calibrated in volts when referred to a 120 volt circuit. The compensating device also acts as a dampening device to give stability to the relay. When checking operation of the compensator, it will be necessary to have a load on the regulator in order to get current from the current transformer to operate the compensator.

INSTALLATION

The relays are usually shipped mounted on the control panel. Before putting in service the blocking should be removed from the relays and they should be checked as follows:

Press down on the relay balance arm so that the pivot shaft is held firmly in the grooved bearing. There should be clearance between the balance arm and the inside of the operating coil, also clearance between the balance arm and the sides of the supporting bearing. To adjust the clearance, loosen the two screws which hold the balance arm to the moving part of the bearing and move the arm until it lines up and then tighten the screw again. The relay contacts should be in line and should not require any other adjustment, except as specified in the adjustment procedure.

OPERATION AND ADJUSTMENTS

The voltage regulating relay is usually adjusted to make contact on plus or minus two or three volts change across the relay coil, the exact value depending upon the type of regulator on which it is used and the circuit conditions. The contacts will break and the relay will return to neutral position when the voltage returns to within approximately one volt of balance voltage. Both values of voltage, the one at which the contact makes, and the one at which it breaks, are adjustable independently, as explained below. For values of setting of relays for regulators, refer to the general instructions in the regulator Instruction Book.

For the purpose of brevity in the subsequent explanation, we shall refer to the difference between the balancing, or normal voltage, and that, required to make a contact—as "the band". Likewise, we shall term the voltage difference between the voltage required to make the contact, and that at which the contact is broken—as "the compounding".

Before shipping, the relay is adjusted to suit the type of the regulator and the conditions of service. Therefore, only minor adjustments, if any, will be required in the field.

To change the adjustment, it is necessary to have a source of variable voltage with a range of $\pm$ 5 volts from the normal voltage on the regulator control circuit. If the regulator is carrying load, the line drop compensator, if used, should be set at zero. Be sure to place the AB switches in the "off" position before applying an external voltage to the control circuit test terminals.

If only a small change in the balancing, or normal voltage is required, this can be accomplished by means of changing the position of the balancing weight. Apply the exact value of the desired balancing voltage to the control circuit and shift the weight until the moving arm balances directly opposite the permanent magnet. Then, ascertain the central position of the balancing voltage with respect to the relay voltage band, by varying the voltage in the positive and negative direction until the "lower" or the "raise" contact is made. The same amount of voltage deviation from normal should be required for the "raise" and the "lower" contact to close. If this condition does not obtain, further shifting of the weight will be required.

To make a complete adjustment of the relay, proceed as follows:

1. Swing the permanent magnet 90° so that the pole tips will be some distance from the moving armature tip on the balance arm. Adjust the screw at the top of the operating coil so that the relay is unstable and the balance arm will always swing through the complete distance from "lower" contact to "raise" contact or vice versa, once it starts to move, without any further change in voltage. The adjusting screw should be set no lower than necessary to accomplish this. If the relay arm moves slowly with each small change in voltage, the adjusting screw has not been lowered sufficiently. Tighten the lock nut.

2. Adjust the permanent magnet to give the required operating band. The balance position is not necessarily at the point where the balance arm tip is directly opposite the permanent magnet. Adjust the air gap by means of the adjusting screw until the balance arm tip breaks away from the permanent

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magnet at the desired voltage. The average of the break away voltage for "raise" and "lower" is the balance point. A small air gap gives a wide band while a large air gap gives a narrow band.

3. Adjust the stationary contacts to give the required amount of compounding. In this adjustment, care must be exercised to have the contacts not too close together to allow positive operation of the relay in making contact. Adjusting the contacts farther apart increases the compounding and bringing them closer together reduces the compounding.

4. Adjust for the desired balance voltage by the screw and weight on top of the balance arm.

For very narrow bands, replace the brass washer, holding the permanent magnet with an iron washer. The iron washer will by-pass a part of the magnet flux and allow smaller air gap setting.

A properly adjusted relay should give a positive, non-chattering operation even on extremely slow and small changes of voltage. The arm movements should make and break contact with a positive snap action. Should this not be the case, the stationary contact separation, and the strength of the permanent magnet (#3, Fig. 1) should be checked. The latter should be strong enough to lift a weight of 2 oz. at its tips.

ADJUSTMENT OF COMPENSATOR

The action of the compensator is such that when rectified current is passed through the coil, on the lower end of the plunger, a force is produced on the plunger in opposition to that produced by the field of the main operating coil, thus requiring a higher voltage on the operating coil to maintain a balance. The result is a compensation effect which is substantially proportional to the load and which, at a given load and compensator setting, is a constant value independent of the phase relation of the current and voltage of the load.

No provision is made for independent adjustment of resistance and reactance compensation as this device has a fixed ratio of these values, but the total mount of compensation may be readily adjusted to any value within the usual range. On feeders of small capacity a resistance drop equal to twice the reactance drop is a common ratio. With this ratio the compensation of the dynamic compensator is within the accuracy of setting of a standard full size line-drop compensator with both X and R compensation for load power factors between 70 and 98 percent.

The correct setting is found by the following formula:

$$C = \frac{120}{\text{Line Voltage}} (IX \sin \varnothing + IR \cos \varnothing)$$

C = Compensator setting in volts

$\varnothing$ = Angle of lag of current behind voltage at the prevailing full-load power factor

*IX = Reactance voltage in line to be compensated

*IR = Resistance voltage in line to be compensated

* For single-phase circuits, use twice the values found for a single wire.

MAINTENANCE

The amount of relay maintenance which may be required will depend largely upon the voltage conditions existing on the circuit and the degree of sensitivity to which the voltage regulating relay is adjusted. It is recommended that during the first few months of service, inspection be made at rather frequent intervals to prevent excessive tap changer operation. After satisfactory operation is once established, inspections at periods of six months to one year should be sufficient.

It is not necessary to keep the voltage relay contacts on the SU relay polished as on older types of relays, since contact on the SU relay is made by rolling rather than by sliding action.

If the contacts on the voltage regulating relay should become worn to an uneven shape, they may be smoothed and reshaped with fine sandpaper and readjusted.

If the operation of the relay is sluggish examine the compensator coil to be sure there is no friction between it and the permanent magnet.

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

RENEWAL PARTS

Order renewal parts from nearest Westinghouse Electric and Manufacturing Company Office or from the Sharon, Pa. Works giving style or S.O. number and serial number as stamped on name plate of regulator and description of parts required. Refer to Fig. 1.

Westinghouse Electric & Manufacturing Company

Sharon, Pa.

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