INSTALLATION • ADJUSTMENT • MAINTENANCE

INSTRUCTIONS

VOLTAGE REGULATING RELAY

Style No. 1511 723 With Compensator For Step Type Regulators

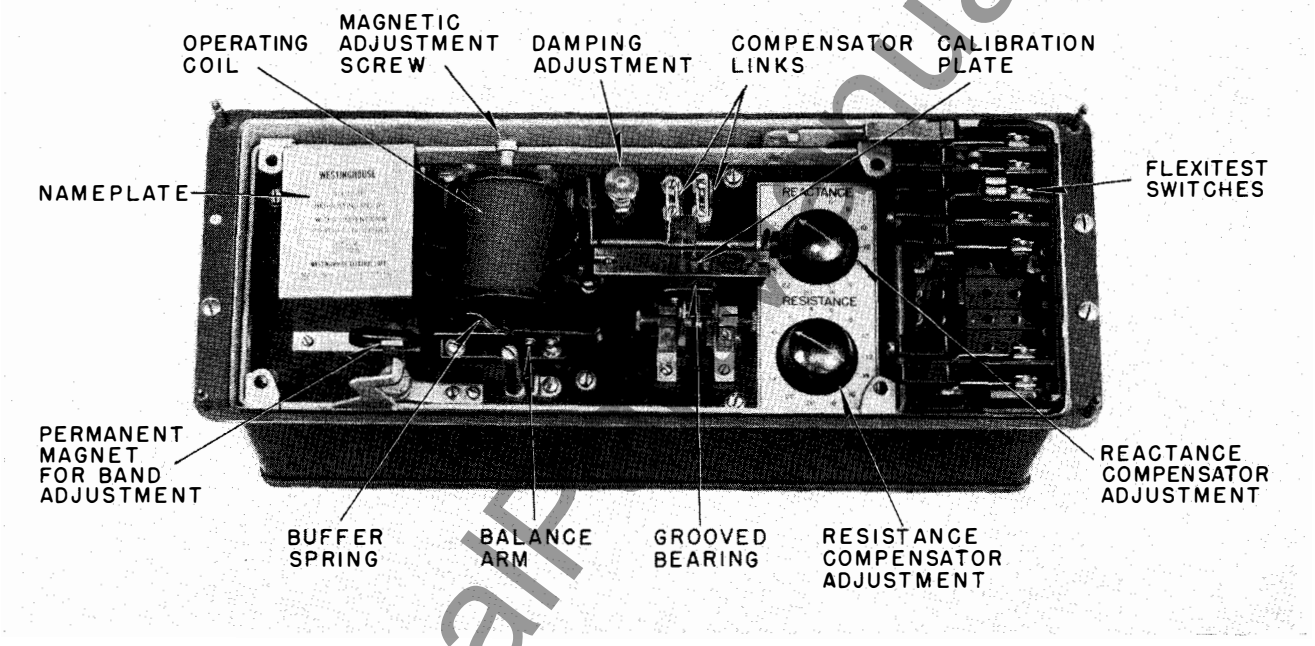

FIG. 1. Front View with Relay in Case (Cover Removed)

VOLTAGE REGULATING RELAY Style No. 1511 723 is of the alternating current solenoid type. Compounding is obtained by means of a permanent magnet. Adjustments for different values of balance voltage are made by shifting a counterweight along a scale which is calibrated in volts.

CONSTRUCTION

The Flexitest type of construction employs a metal case with a tight-fitting removable cover having a glass front. Fig. 1 shows the voltage regulating relay with the cover removed. The complete relay unit is mounted on a chassis which is readily removable from the Flexitest case by opening all the test switches at the right of the case and pulling out the holding levers at the top and bottom. This disengages the chassis from the case and the complete relay is then lifted out by means of the holding levers. See Fig. 2.

The operating parts have been combined into a single moving element which is mounted on a square shaft resting on a knife edge. This construction provides a very sturdy bearing with a negligible amount of friction. The shaft and bracket are made of nitrided steel which is exceptionally hard and resistant to wear and corrosion. A damping device is attached to the beam and is adjustable to provide stability to the action of the relay.

The contacts are made of silver, which results in long life and smooth contact points. They are designed to eliminate contact "sticking".

A "no-voltage" device is included as part of the main assembly with its operating coil connected across the potential source of the voltage regulating relay, and its contacts in series with the common point of the voltage regulating relay contacts. See Fig. 4. This device prevents control mechanism operation in case of voltage failure supplying the voltage regulating relay coil.

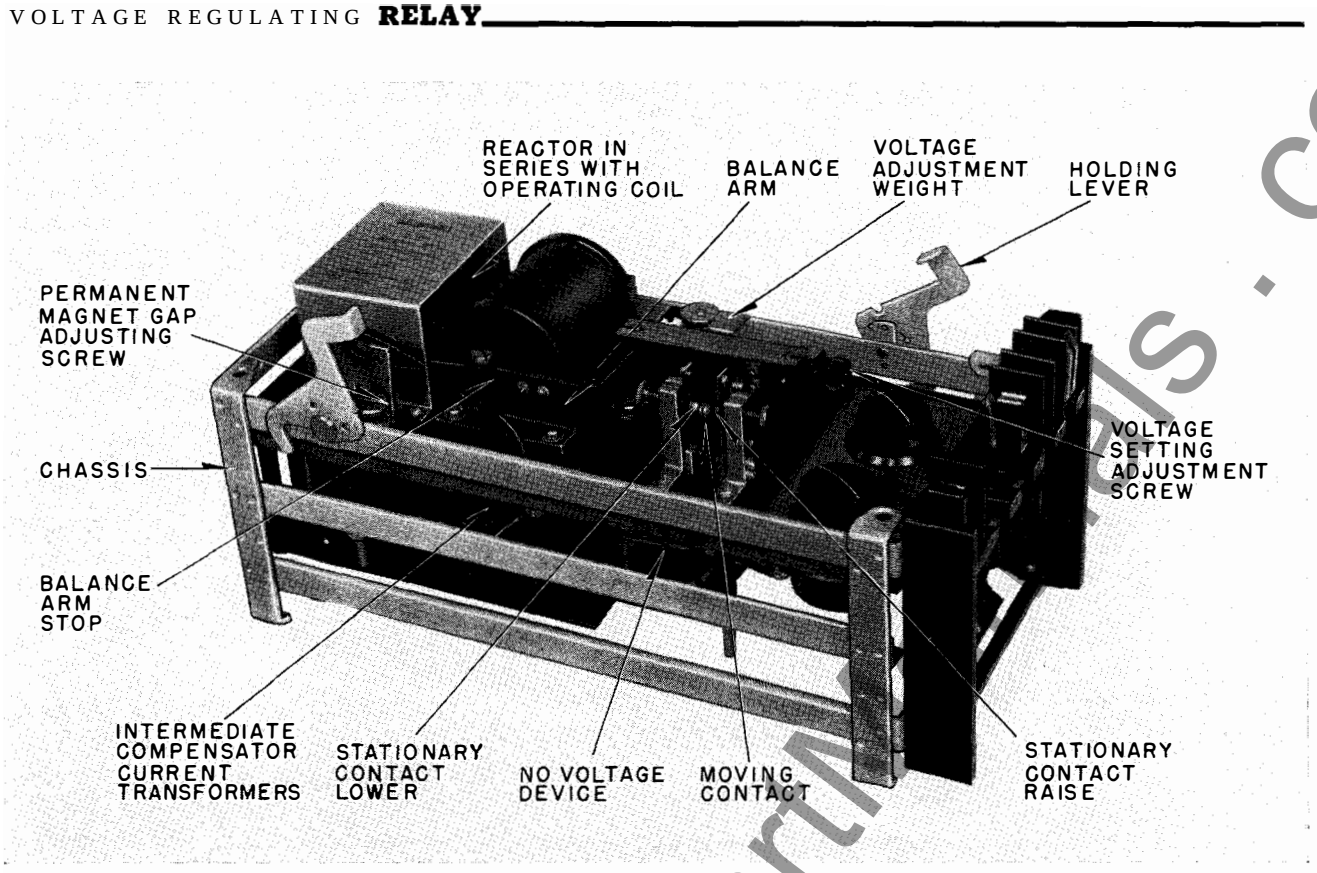

FIG. 2. View of Voltage Regulating Relay and Compensator (Removed from Case)

INSTALLATION

This relay is usually shipped mounted on the tap changer control panel. Before putting into service, the blocking should be removed and its operation 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 supported 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 retighten these screws. The relay contacts should be in line and should not require any other adjustment, except as specified in the adjustment procedure.

A damping device mounted at the rear of the balance arm and connected to the arm by a link is for the purpose of supplying the required amount of friction to give stability to the relay. This device should not require adjustment and if the relay appears to be slow or sluggish in operation, the relay should be checked carefully for friction at other points before changing the adjustment of the damping device. If the voltage relay balance arm moves too freely and swings excessively, the spring tension should be increased on the damping device by moving the adjusting nut a fraction of a turn.

ADJUSTMENT

The voltage regulating relay is usually adjusted to make contact on a plus or minus 1½ or 2-vol change across the relay coil.

To change the adjustment of the relay, it is desirable to have a source of variable voltage with a range of approximately +5 volts from the normal voltage on the regulator control circuit. A 50-ohm, 25-watt variable rheostat Model H, No. 0149, supplied by the Ohmite Manufacturing Company, Chicago, Ill., can be conveniently used for making the voltage change as described herein. Connect this rheostat in series with the voltage regulating coil and vary it as required. If the regulator is carrying load, the line compensator if used should be set at zero. Be sure to place the Type AB supply circuit breaker in the "off" position before applying an external voltage to the control circuit test terminals.

Fig. 3 shows a voltage regulating relay with its various parts identified. Each part has an important function which should be clearly understood. As the steps in adjusting this relay are

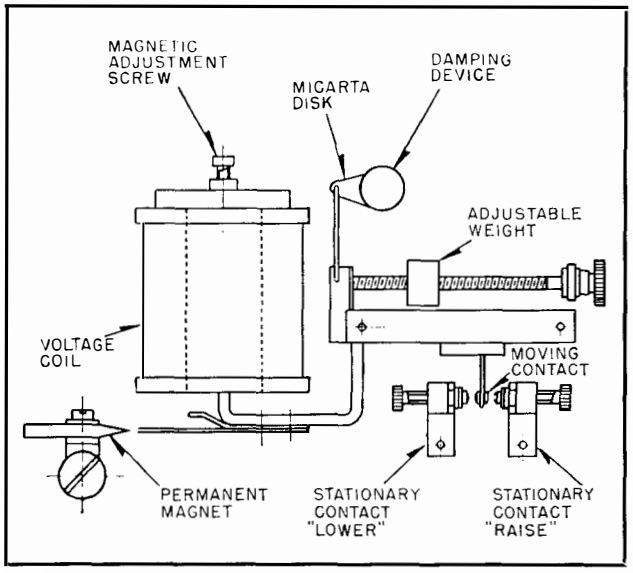

FIG. 3. Voltage Regulating Relay Assembly

followed, the effect that each part contributes to the successful operation of the relay will be apparent.

Checking for Mechanical Friction. If friction is present, it will result in a sluggish or erratic relay. To make this check, the following steps should be taken (see Fig. 3):

1. Revolve the permanent magnet about 90 degrees.

2. Lift the small round Micarta disk on the damping device to relieve the damping effect of the tension spring. This can be easily done by pulling this disk back and then catching it on the pin that protrudes to normally keep this disk in place.

3. Remove the magnetic circuit adjusting screw on top of the voltage coil.

4. Open the stationary contacts wide, seeing that the leaf spring on each stationary contact has a travel of approximately 3/32 inch.

5. Apply a voltage to the test terminals until the beam balances. The weight should be near the middle of the scale.

Under these conditions and if no friction is present, the beam will float without any apparent interference, its movement corresponding to any slight voltage fluctuation.

Upon striking the beam lightly, it will oscillate up and down and gradually come to rest.

However, if there is dirt or foreign material on the knife bearing, or if the end of the beam is rubbing the inside of the solenoid due to misalignment, these movements of the beam will not be smooth and the beam will come to an abrupt stop when it is struck lightly. The bearing should be examined to make certain it is free of any foreign material which would hamper consistent performance of the relay. The surfaces of this knife bearing are of steel, nitrided to a very high hardness and require no lubrication.

Setting the Balance Beam Weight. To adjust the balance beam weight until it balances at the desired balance voltage, proceed as follows:

1. Replace the magnetic circuit adjusting screw on top of the coil. Turn the screw fully down and back off approximately two turns. This is the position of the screw which will give the best operating characteristics to the relay especially on small voltage bands.

2. Turn the permanent magnet to its operating position, and set it with about 1/16-inch gap between the tip of the beam and the face of the magnet.

3. Apply the desired balance voltage to the coil and adjust the position of the weight until the beam will balance opposite the permanent magnet. This can be most easily done if the tip of the beam is lightly held between the finger tip at the balance position while the position of the weight is adjusted to the point where the beam will remain balanced when released.

4. It is, of course, necessary that the position of the weight remain fixed after it is once set. This is accomplished by a spring washer between the end of the beam and the thumb nut which is used to adjust the position of the weight. Check to be certain that there is sufficient friction here to prevent ordinary vibrations from turning the thumb nut, thus resulting in a change of calibration.

Damping Adjustment. After the relay is balanced, next proceed to make it less susceptible to slight voltage fluctuations and vibrations. This is done by restoring the damping disk to its proper position and turning the small nut at the end of the spring until the desired spring pressure on the disk is obtained. Very little spring pressure is required to effect an appreciable damping. From the condition of "free spring" with the adjusting nut just touching the spring, one and one-half (1½) turns of the nut will usually result in sufficient damping. This should cause the balance arm to stabilize within approximately four swings when the control switch is thrown off and on.

Setting Band Width. To set the desired voltage band width; that is, the voltage above and below the balance value at which the beam will move to close its contacts:

and replace in the horizontal position. This position is indicated by dotted lines in Fig. 4 (diagram of voltage regulating relay and compensator).

Caution: Do not remove these links unless the secondary of the line current transformer is short circuited as these links carry the current from the secondary of the line current transformer.

OPERATION

Correct settings for line-drop compensation are most commonly obtained from calculated values of reactance and resistance line drop from the regulator to the load center reduced to full load regulator rating and 120 volts, and later corrected if necessary, from voltage charts taken at the load center.

Calculated values are likely to be sufficiently accurate in ratio of resistance to reactance drop. The compensation for both should be increased if load center voltage falls at periods of high loads and decreased if load center voltage rises at periods of high load.

The regulated voltage may be read between terminals "F" and "G" of the primary relay if separate test terminals are not available. The load center voltage may be read from the scale on the beam of the relay, when balanced.

MAINTENANCE

Voltage Regulating Relay. 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 contacts on this relay polished as on older types of relays, since the contacts on this relay are made by rolling rather than by sliding action.

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

Caution: Do not lubricate the bearings. Keep cover tight.

Compensator. Since the rheostats are very seldom moved after adjustment, there is small chance that they will require any maintenance other than an occasional blowing out to remove any dust which may have accumulated.

Renewal Parts. Order renewal parts from the nearest Westinghouse Sales Office or from the Sharon Plant. Give the style or stock order number and serial number as stamped on the regulator nameplate, together with description of parts required (see Figs. 1 and 2).

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1. Set the permanent magnet with a very small air gap between the tip of the beam and the face of the magnet (1/32 inch or less) using adjusting screw.

2. Gradually increase the voltage to the value of the upper band limit. For example, this would be 2 volts above the balance value for a plus and minus 2-volt band.

3. By means of the knurled adjusting screw, located below the permanent magnet, increase the air gap between the magnet and beam until the beam just breaks away from balance and moves up into the coil.

Note: There is a change in voltage across the coil of about one volt when the beam is moved from the extreme bottom to the top of its travel. For this reason, the voltage should be read at the instant the beam breaks away.

4. Manually return the beam to balance and decrease the voltage to the balance value.

5. Gradually decrease the voltage from the balance value until the beam just breaks away and falls to its bottom stop. Note the voltage at the instant it breaks away.

If it is observed that the beams fall out too soon, adjust the position of the weight on beam to the right slightly until the beam will fall out at the desired voltage. If the beam does not fall out until some voltage below the desired value, adjust the position of the weight to the left slightly until beam falls out at the desired value. These adjustments should be very slight. A large adjustment will affect the upper limit.

In making the final adjustments of the band width, for small voltage bands, the position of the magnetic circuit adjusting screw, the position of the weight on the beam, and the position of the permanent magnet should be carefully coordinated to obtain the correct break-away voltages.

Adjusting the Compounding. The final adjustment or the adjustment of the stationary contacts determine the "compounding" of the relay. The "compounding" is the difference between the voltage at which the contact will close and the voltage at which the contact opens. The compounding can be increased by increasing the contact spacing and decreased by decreasing the contact spacing. It is recommended that at least 3/4-volt compounding be used; that is, with a plus and minus two-volt band and 3/4-volt compounding, the contacts should open at plus or minus 1 1/4 volts.

1. With the beam at its upper limit of travel, set the voltage to the value at which it is desired that these contacts open.

2. By means of the contact adjusting screw, gradually move the left-hand stationary contact inward until the beam will just return to balance. Make certain that the contacts are open at balance.

3. With the beam at its lower limit of travel, set the voltage to the value at which it is desired that this contact open.

4. By means of the contact adjusting screw, gradually move the right-hand stationary contact inward until the beam will just return to balance. Make certain that both contacts are open to balance position.

Final Checking. The relay now being fully adjusted, its over-all operation should be checked. Increase and decrease the voltage from the balance value and observe the voltages at which the contacts make and break. When assured that the operation is satisfactory, tighten the locking nut on the magnetic circuit adjusting screw, and mark the position of the weight on the metal plate below it.

Plus and Minus 1-Volt Band Widths. When voltage band widths of plus and minus 1 volt are required, it is necessary to replace the standard permanent magnet with a smaller more pointed one, Style No. 1080 890, and make adjustments as described above.

Note: The smaller magnet may be ordered from the nearest Westinghouse Sales Office.

The line-drop compensator for use with the voltage regulating relay consists of two rheostats, one for resistance compensation and one for reactance compensation. They are connected to the voltage regulating relay coil series reactor and two small intermediate current transformers, the secondaries of which supply the required current to the compensator. The primary windings are arranged for connecting to the main current transformer supplying the compensator circuit.

The compensator is mounted in the same chassis with the primary relay so as to form a single unit. The rheostats for the resistance and reactance compensation are mounted on the rear of the primary relay panel and are operated by dials accessible from the front. These are set to a desired degree of compensation as indicated by an engraved steel plate having a graduated scale.

The two intermediate current transformers are mounted on a plate suspended from the primary relay panel and their primaries are connected to the compensation reversing posts with removable links so that when the links are connected in the vertical position as shown in Fig. 1, normal compensation is obtained. To obtain reverse reactance compensation, remove both links from the posts

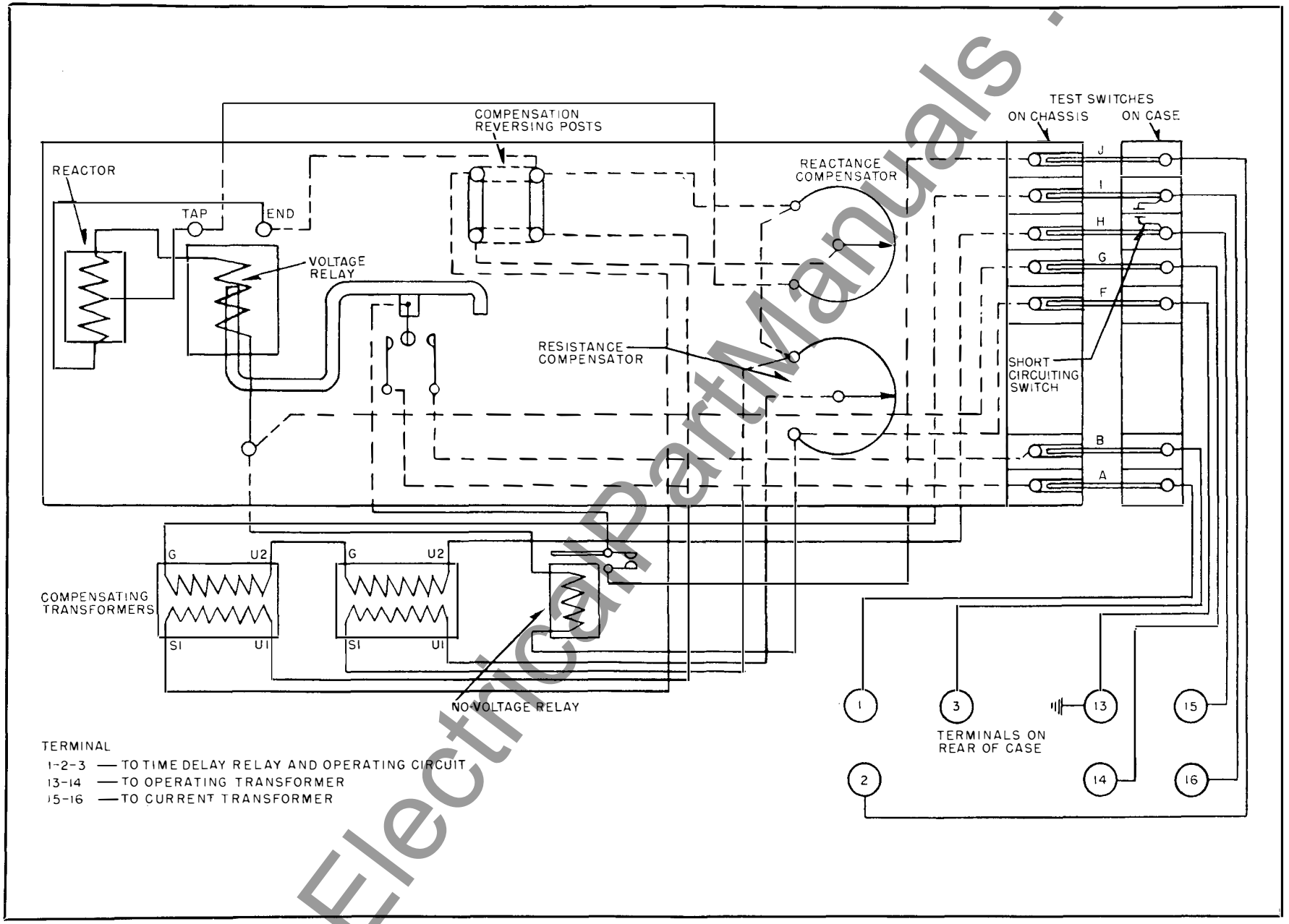


FIG. 4. Diagram of Voltage Regulating Relay and Compensator

INSTRUCTIONS

VOLTAGE REGULATING RELAY

Style No. 1511 723 With Compensator

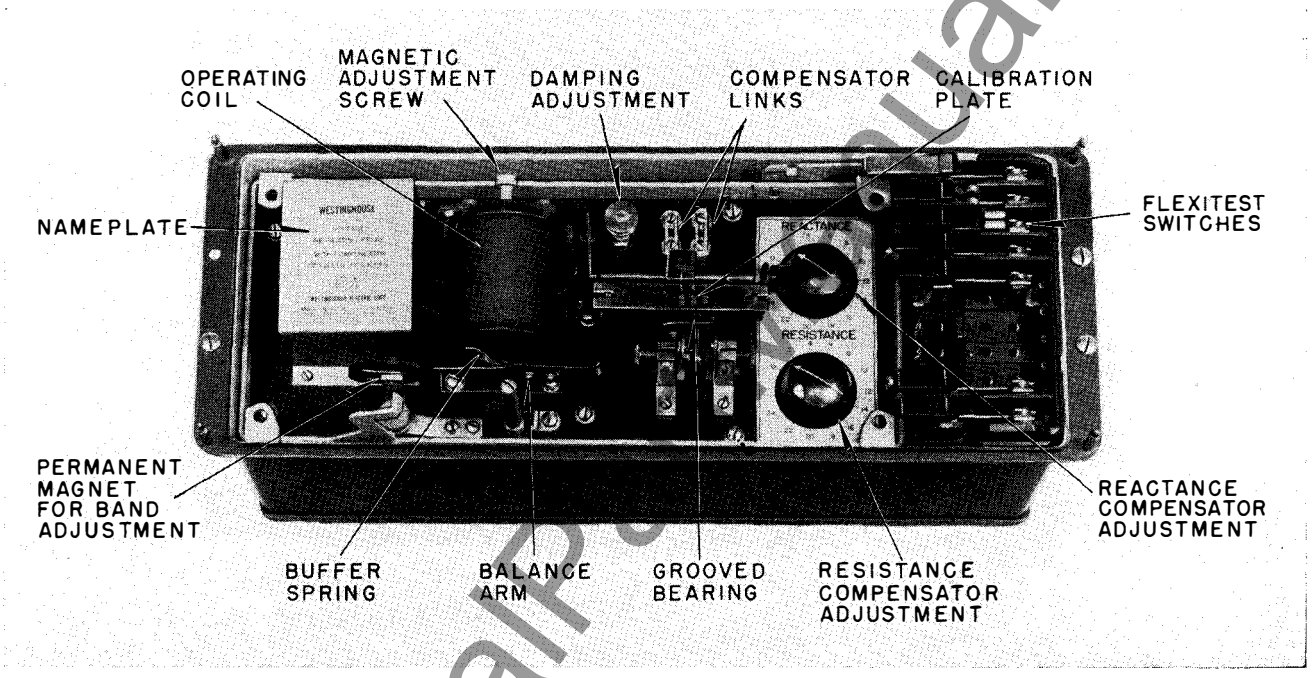


FIG. 1. Front View with Relay in Case (Cover Removed).

VOLTAGE REGULATING RELAY Style No. 1511 723 is of the alternating current solenoid type. Band width adjustment is obtained by means of a permanent magnet. Adjustments for different values of balance voltage are made by shifting a counterweight along a scale which is calibrated in volts.

CONSTRUCTION

The Flexitest type of construction employs a metal case with a tight-fitting removable cover having a glass front. Fig. 1 shows the voltage regulating relay with the cover removed. The complete relay unit is mounted on a chassis which is readily removable from the Flexitest case by opening all the test switches at the right of the case and pulling out the holding levers at the top and bottom. This disengages the chassis from the case and the complete relay is then lifted out by means of the holding levers. See Fig. 2.

The operating parts have been combined into a single moving element which is mounted on a "V" bearing resting on a knife edge. This construction provides a very sturdy bearing with a negligible amount of friction. The shaft and bracket are made of nitrided steel which is exceptionally hard and resistant to wear and corrosion. A damping device is attached to the beam and is adjustable to provide stability to the action of the relay.

The contacts are made of silver, which results in long life and smooth contact points. They are designed to eliminate contact "sticking".

A "no-voltage" device is included as part of the main assembly with its operating coil connected across the potential source of the voltage regulating relay, and its contacts in series with the common point of the voltage regulating relay contacts. See Fig. 3. This device prevents control mechanism operation in case of voltage failure supplying the voltage regulating relay coil.

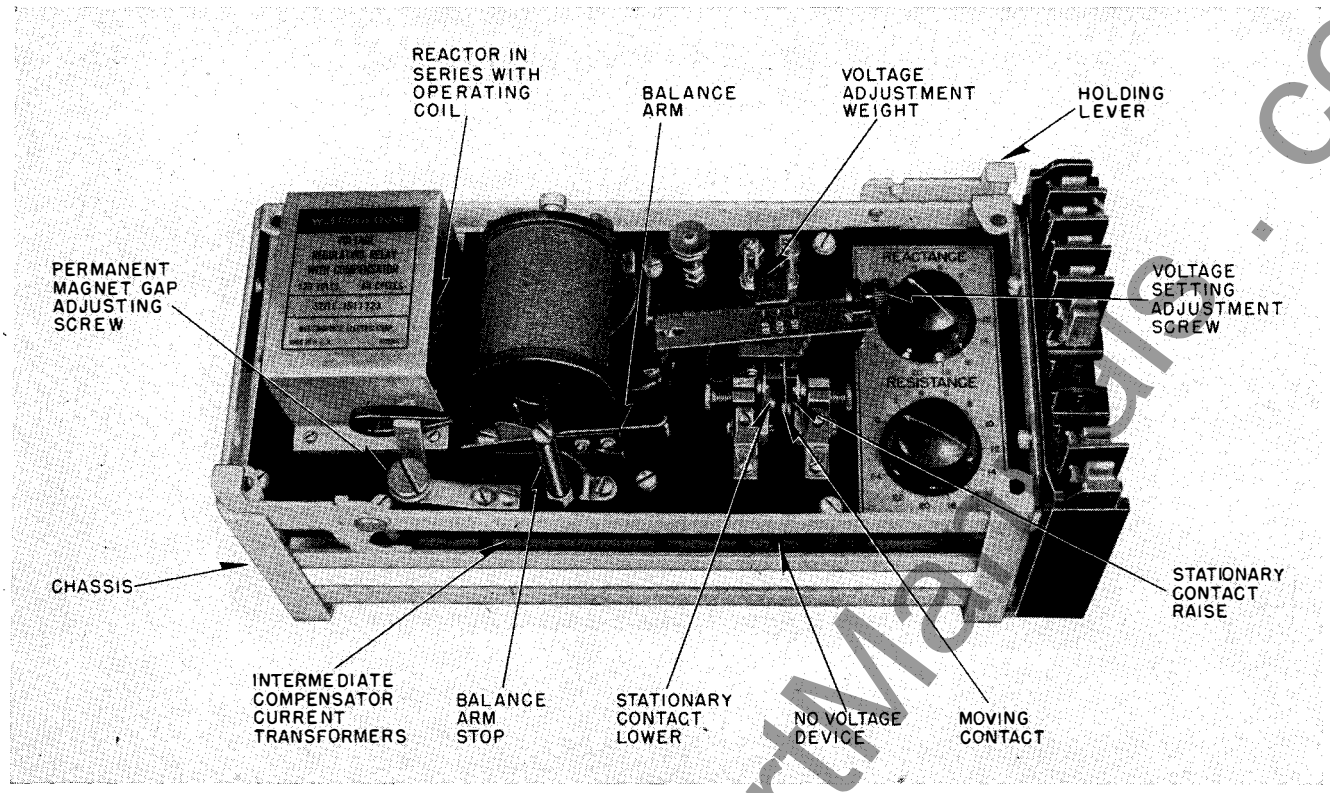


FIG. 2. View of Voltage Regulating Relay and Compensator (Removed from Case).

INSTALLATION

This relay is usually shipped mounted on the tap changer control panel. Before putting into service, the blocking should be removed and its operation 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 supported bearing. To adjust the clearance, loosen the two screws which hold the balance arm to the moving part of the bearing, move the arm until it lines up, and retighten these screws. The relay contacts should be in line and should not require any other adjustment, except as specified in the adjustment procedure.

A damping device mounted at the rear of the balance arm and connected to the arm by a link is for the purpose of supplying the required amount of friction to give stability to the relay. This device should not require adjustment and if the relay appears to be slow or sluggish in operation, the relay should be checked carefully for friction at other points before changing the adjustment of the damping device. If the voltage relay balance arm moves too freely and swings excessively, the spring tension should be increased on the damping device by moving the adjusting nut a fraction of a turn.

ADJUSTMENT

The voltage regulating relay is usually adjusted to make contact on a plus or minus 1½ or 2-volt change across the relay coil.

To change the adjustment of the relay, it is desirable to have a source of variable voltage with a range of approximately +5 volts from the normal voltage on the regulator control circuit. A 50-ohm, 25-watt variable rheostat Model H, No. 0149, supplied by the Ohmite Manufa cturin Company, Chicago, Ill., can be conveniently used for making the voltage change as described herein. Connect this rheostat in series with the voltage regulating coil and vary it as required. If the regulator is carrying load, the line drop compensator, if used, should be set at zero. Be sure to place the supply circuit breaker in the "off" position and remove the test link when it is supplied before applying an external voltage to the control circuit test terminals.

Fig. 2 shows a voltage regulating relay with its various parts identified.

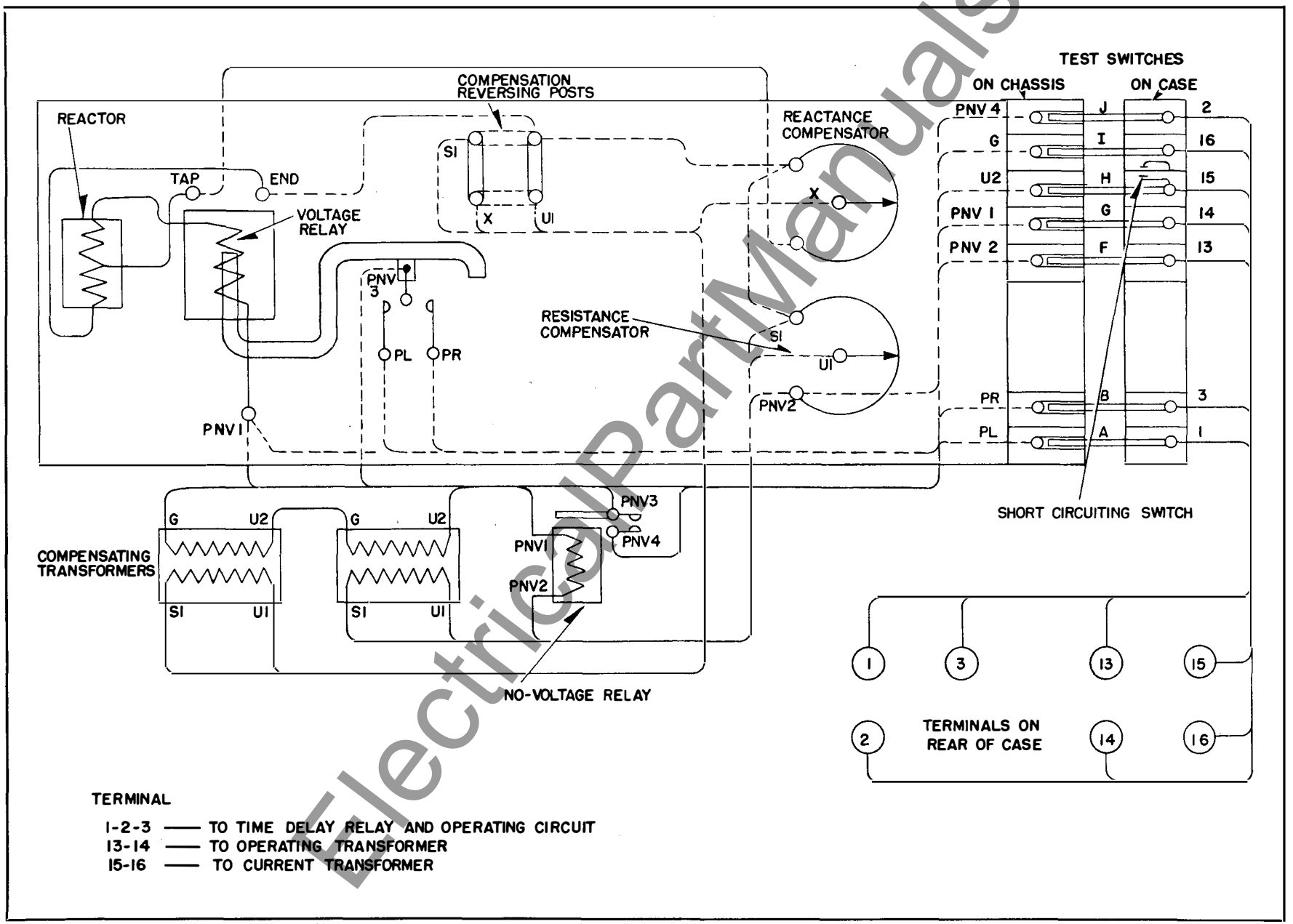


FIG. 3. Diagram of Voltage Regulating Relay and Compensator.

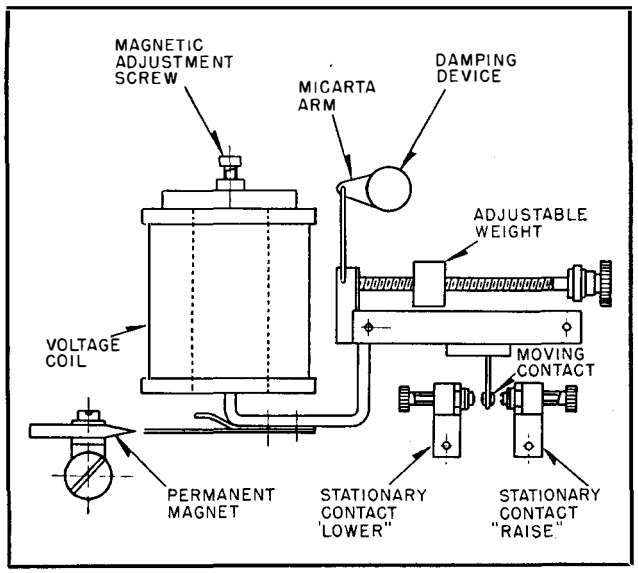


FIG. 4. Voltage Regulating Relay Assembly.

Checking for Mechanical Friction. If friction is present, it will result in sluggish or erratic relay operation. To make this check, the following steps should be taken (see Fig. 4):

1. Revolve the permanent magnet so that its' poles point away from the panel.

2. Move the small round steel disk on the damping device to relieve the damping effect of the compression spring. This can be easily done by pushing this disk back and catching it on the pin that protrudes to normally keep this disk in place.

3. Remove the magnetic circuit adjusting screw on top of the voltage coil.

4. Open the stationary contacts wide, seeing that the leaf spring on each stationary contact has a travel of approximately 3/32 inch.

5. Apply a nominal operating voltage to the test terminals until the beam balances. The weight should be near the middle of the scale.

Under these conditions and if no friction is present, the beam will float without any apparent interference, its movement corresponding to any slight voltage fluctuation. This is the preliminary balance condition.

Upon striking the beam lightly, it will oscillate up and down and gradually come to rest.

However, if there is dirt or foreign material on the knife bearing, or if the end of the beam is rubbing the inside of the solenoid due to misalignment, these movements of the beam will not be smooth and the beam will come to an abrupt stop when it is struck lightly. The bearing should be examined to make certain it is free of any foreign material which would hamper consistent performance of the relay. The surfaces of this knife bearing are of steel, nitrided to a very high hardness and require no lubrication.

Damping Adjustment. After the relay has undergone the preliminary balancing, next proceed to make it less susceptible to slight voltage fluctuations and vibrations. This is done by restoring the damping disk to its proper position and turning the small nut at the end of the spring until the desired spring pressure on the disk is obtained. Very little spring pressure is required to effect an appreciable damping. From the condition of "free spring" with the adjusting nut just touching the spring, only sufficient pressure should be applied to stabilize the balance arm within approximately four swings when the control switch is thrown off and on, with nominal operating voltage maintained.

Setting the Balance Beam Weight. To attain the final balance point at the desired balance voltage, proceed as follows:

1. Replace the magnetic circuit adjusting screw on top of the coil. Turn the screw down until the balance arm tip moves upward about 1/8 inch. This is the position of the screw which will give the best operating characteristics to the relay especially on small voltage bands.

2. Turn the permanent magnet to its operating position, and set it with about 1/16-inch gap between the tip of the beam and the face of the magnet.

3. Apply the desired balance voltage to the coil and adjust the position of the weight until the beam will balance opposite the permanent magnet. This can be most easily done if the tip of the beam is lightly held between the finger tip at the balance position while the position of the weight is adjusted to the point where the beam will remain balanced when released.

4. It is necessary that the position of the weight remain fixed after it is once set. This is accomplished by a spring washer between the end of the beam and the thumb nut which is used to adjust the position of the weight. Check to be certain that there is sufficient friction here to prevent ordinary vibrations from turning the thumb nut, thus resulting in a change of calibration.

Setting Band Width. To set the desired voltage band width; that is, the voltage above and below the balance value at which the beam will move to close its contacts:

1. Set the permanent magnet with a very small air gap between the tip of the beam and the face of the magnet (1/32 inch or less) using adjusting screw.

2. Gradually increase the voltage to the value of the upper band limit. For example, this would be 2 volts above the balance value for a plus and minus 2-volt band.

3. By means of the knurled adjusting screw, located below the permanent magnet, increase the air gap between the magnet and beam until the beam just breaks away from balance and moves up into the coil.

Note: There is a change in voltage across the coil of about one volt when the beam is moved from the extreme bottom to the top of its travel. For this reason, the voltage should be read at the instant the beam breaks away.

4. Manually return the beam to balance and decrease the voltage to the balance value.

5. Gradually decrease the voltage from the balance value until the beam just breaks away and falls to its bottom stop. Note the voltage at the instant it breaks away.

If it is observed that the beams fall out too soon, adjust the position of the weight on beam to the right slightly until the beam will fall out at the desired voltage. If the beam does not fall out until some voltage below the desired value, adjust the position of the weight to the left slightly until beam falls out at the desired value. These adjustments should be very slight. A large adjustment will affect the upper limit.

In making the final adjustments of the band width, for small voltage bands, the position of the magnetic circuit adjusting screw, the position of the weight on the beam, and the position of the permanent magnet should be carefully coordinated to obtain the correct break-away voltages.

Adjusting the Compounding. The final adjustment or the adjustment of the stationary contacts determine the "compounding" of the relay. The "compounding" is the difference between the voltage at which the contact will close and the voltage at which the contact opens. The compounding can be increased by increasing the contact spacing and decreased by decreasing the contact spacing. It is recommended that at least 3/4-volt compounding be used; that is, with a plus and minus two-volt band and 3/4-volt compounding, the contacts should open at plus or minus 1 1/4 volts.

1. Open Flexitest switches A, B, and J.

2. With the beam at its upper limit of travel, set the voltage to the value at which it is desired that these contacts open.

3. By means of the contact adjusting screw, gradually move the left-hand stationary contact inward until the beam will just return to balance. Make certain that the contacts are open at balance.

4. With the beam at its lower limit of travel, set the voltage to the value at which it is desired that this contact open.

5. By means of the contact adjusting screw, gradually move the right-hand stationary contact inward until the beam will just return to balance. Make certain that both contacts are open to balance position.

6. Turning the magnet circuit adjusting screw in increases the compounding also. However, if the magnetic circuit adjusting screw is moved, the balance voltage as well as the compounding will be changed.

Final Checking. The relay now being fully adjusted, its over-all operation should be checked. Increase and decrease the voltage from the balance value and observe the voltages at which the contacts make and break. When assured that the operation is satisfactory, tighten the locking nut on the magnetic circuit adjusting screw, and mark the position of the weight on the metal plate below it.

Plus and Minus 1-Volt Band Widths. For the special cases where the voltage band widths of plus and minus 1 volt are required, it is necessary to replace the standard permanent magnet with a smaller and weaker one, and make adjustments as described above.

Note: The smaller magnet may be ordered from the nearest Westinghouse Sales Office as 12-C-5743 Group 2.

Two things determine the effect of the permanent magnet; the strength and the contour of the magnetic field. For narrow band widths, the strength of the field must be reduced, but the balance arm

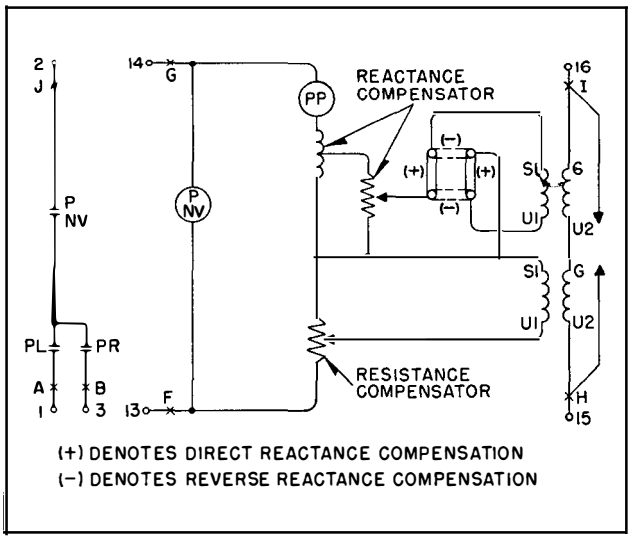


FIG. 5. Schematic Diagram of Relay and Compensator.

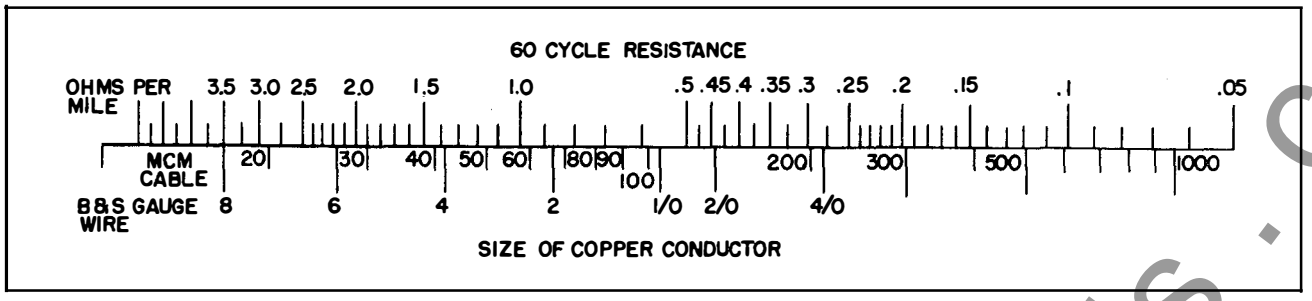


FIG. 6. Resistance Chart, Showing Ohms per Conductor, per Mile, 60 Cycle Circuit.

tip must still enter a fairly highly concentrated field as it approaches balance position. If the permanent magnet is so strong that a large air gap is required to reduce the band width, the desired field contour does not exist in the region of the tip of the balance arm.

The desired field pattern is obtained by installing the weaker magnet. This will permit the use of a smaller air gap, which gives a concentrated field in the region of balance position for the tip of the balance arm in spite of the fact that the field is weaker.

The line-drop compensator for use with the voltage regulating relay consists of two rheostats, one for resistance compensation and one for reactance compensation. The dials of these rheostats are so designed that the settings represent the amount of bias voltage on the primary relay with 5 amps flowing in the line-drop compensator circuit and are proportional to the volts of compensation at the load center. The rheostats are connected to the voltage regulating relay coil series reactor and two small intermediate current transformers, the secondaries of which supply the required current to the compensator. The primary windings are arranged for connecting to the main current transformer supplying the compensator circuit.

The compensator is mounted in the same chassis with the primary relay so as to form a single unit. The rheostats for the resistance and reactance compensation are mounted on the rear of the primary relay panel and are operated by dials accessible from the front. These are set to a desired degree of compensation as indicated by an engraved steel plate having a graduated scale.

The two intermediate current transformers are mounted on a plate suspended from the primary relay panel and their secondaries are connected to the compensation reversing posts with removable links so that when the links are connected in the vertical position as shown in Fig. 1, normal compensation is obtained. To obtain reverse reactance compensation, remove both links from the posts and replace in the horizontal position. This position is indicated by dotted lines in Fig. 3 (diagram of voltage regulating relay and compensator).

Caution: **Do not remove these links unless the secondary of the line current transformer is short circuited as these links carry the current from the secondary of the line current transformer.**

LINE-DROP COMPENSATOR SETTING

The settings on the line-drop compensator may most satisfactorily be made by field adjustments, but if the data on the particular line is known, the curves in Figs. 6 and 7 may be used, and values calculated.

The proper line-drop compensator settings can be derived by the use of the following expressions:

Dial Setting for Resistance Compensation =

$$5 \times \frac{N_{C.T.}}{N_{POT.}} \times R_L \times d.$$

Dial Setting for Reactance Compensation =

$$5 \times \frac{N_{C.T.}}{N_{POT.}} \times X_L \times d.$$

Where

$N_{C.T.}$ = current transformer ratio
$= \frac{\text{primary current}}{\text{secondary current}}$

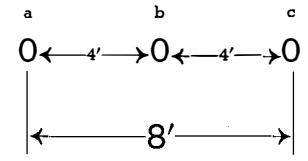
$N_{POT.}$ = potential transformer ratio
$= \frac{\text{primary voltage}}{\text{secondary voltage}}$

R_L = resistance per conductor from unit to load center, in ohms per mile.

X_L = inductive reactance per conductor from unit to load center, in ohms per mile.

d = miles from unit to load center.

A typical three-phase example is as follows:



500,000 CM copper conductor, with flat spacing shown above.

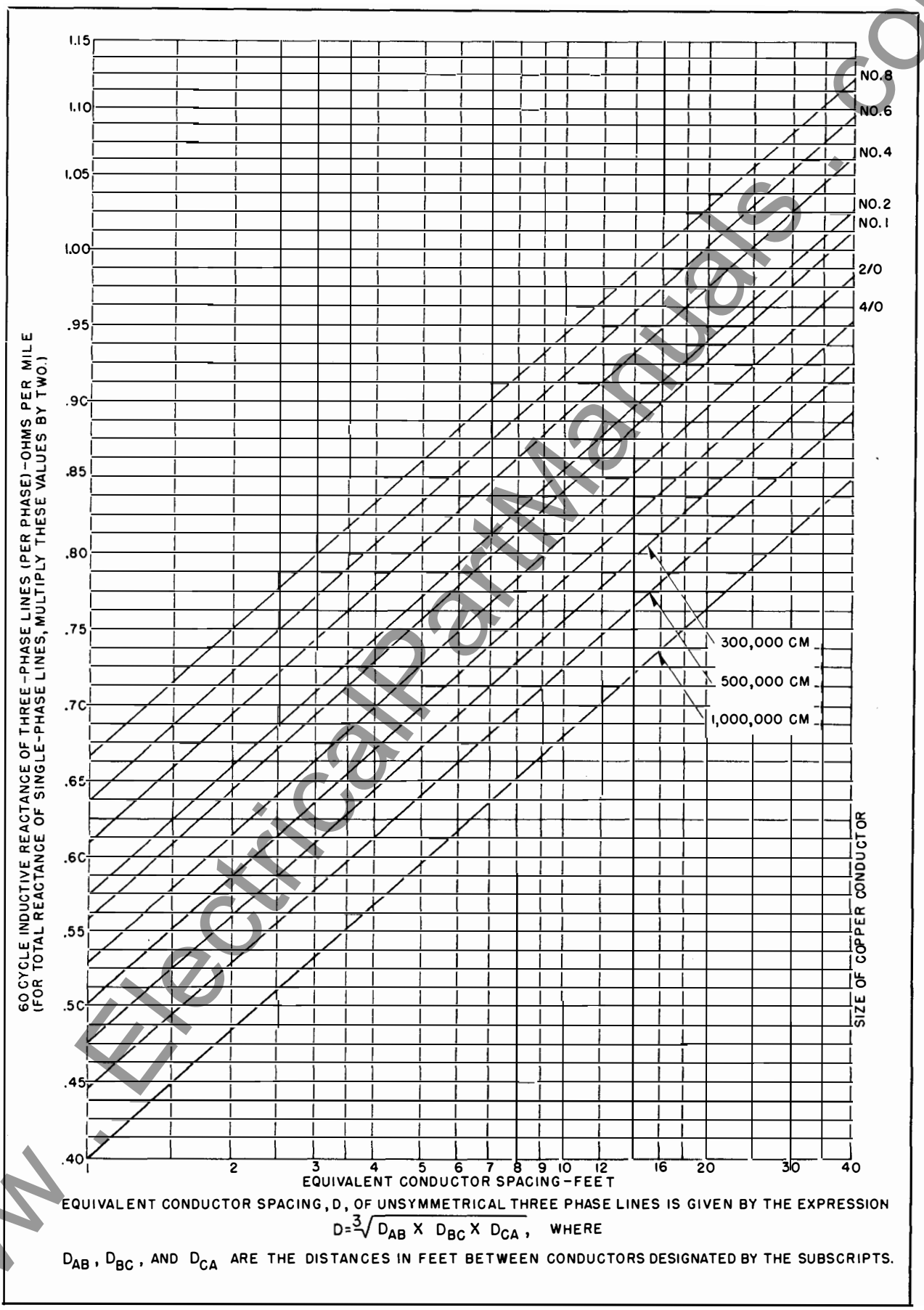


FIG. 7. Reactance Chart, Size of Conductor and Spacing, for 3-Phase Lines (per Phase), 60 cycle circuit.

Line Voltage = 12000 volts

Current Transformer Ratio = 600/5

Potential Transformer Ratio = 6928/120

Distance from unit to load center = 3.5 miles.

A unit energizes a typical distribution circuit whose characteristics are given above. Determining the contants for this circuit on a per phase basis,

From Fig. 7:

$R_L = 0.12$ ohms per mile

From Fig. 6:

$D = \sqrt[3]{4 \times 4 \times 8} = 5.04$ feet

$X_L = 0.64$ ohms per mile

The line-drop compensator resistance setting is:

$$\frac{5 \times 600/5}{6928/120} \times .12 \times 3.5 = 4.36$$

The line-drop compensator reactance setting is:

$$\frac{5 \times 600/5}{6928/120} \times .64 \times 3.5 = 23.3$$

These settings may be adjusted as found necessary as shown by load center voltage measurements.

MAINTENANCE

Voltage Regulating Relay. 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 contacts on this relay polished as on older types of relays, since the contacts on this relay are made by rolling rather than by sliding action.

If the contacts on the relay should become worn to an uneven shape, they may be smoothed and reshaped with Style No. 1002 110 file and readjusted. Never use sandpaper, as non-conducting particles may lodge in the soft contact material and cause faulty relay operation.

Caution: Do not lubricate the bearings. Keep cover tight.

Compensator. Since the rheostats are very seldom moved after adjustment, there is small chance that they will require any maintenance other than an occasional blowing out to remove any dust which may have accumulated.

Renewal Parts. Order renewal parts from the nearest Westinghouse Sales Office or from the Sharon Plant. Give the style or stock order number and serial number as stamped on the regulator nameplate, together with description of parts required (see Figs. 1 and 2).

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