INSTALLATION • OPERATION • MAINTENANCE

# INSTRUCTIONS

# TYPE COQ
# NEGATIVE SEQUENCE GENERATOR RELAY

**CAUTION** Before putting protective relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment. Make sure that all moving parts operate freely. Inspect the contacts to see that they are clean and can close properly. Operate the relay to check the settings and electrical connections.

## APPLICATION

A COQ relay operates to disconnect a generator from a faulted line before negative sequence currents can damage the machine.

## CONSTRUCTION AND OPERATION

The type COQ relay consists of an induction disc type overcurrent element, a contactor switch, an operation indicator, and a negative sequence current filter.

## OVERCURRENT ELEMENT

This is an induction-disc type element operated by negative sequence quantities supplied to an electromagnet in the rear of the relay. A voltage is induced in the secondary coil of this electromagnet by transformer action of the main coil. Both coils are located on the center leg of the electromagnet. Current flow is from the secondary coil to coils on the outer legs of the electromagnet. The reaction between the outer leg coil fluxes and the main coil flux creates an operating torque on a spiral shaped aluminum disc mounted on a vertical shaft.

The vertical shaft is supported to the element frame by a pin and end stone type bearing on the lower end and a pin and olive bearing on the upper end. Both shaft bearings as well as their adjustable pins are removable. A set screw and nylon plug locks the bottom pin in position, and a shoulder nut of the time dial locks the top pin in position.

Attached to an insulated section of the disc shaft is a rigid arm holding a small silver hemisphere. This combination of arm and silver hemisphere comprises the moving contact assembly which is part of an electrical circuit. This circuit is completed by a spiral spring with one end soldered to the rigid arm and the other end fastened to a slotted spring adjuster which in turn fastens to the element frame.

The stationary contact assembly consists of a silver contact attached to the free end of the leaf spring. This spring is fastened to a Micarta block mounted on the element frame. A small set screw permits the adjustment of contact follow.

### Contactor Switch

This switch is a small d-c solenoid type connected in series with the main contacts of the relay and the trip coil of a breaker. When the relay contacts close, the solenoid coil becomes energized and moves a cylindrical plunger upward. A silver disc is mounted on the plunger's lower end, and it bridges three contacts which are in parallel with the main contacts. The main contacts are thereby relieved of the duty of carrying tripping currents. These three contacts remain closed until the trip circuit is opened by an auxiliary switch on the breaker.

### Operation Indicator

The operation indicator is a small solenoid

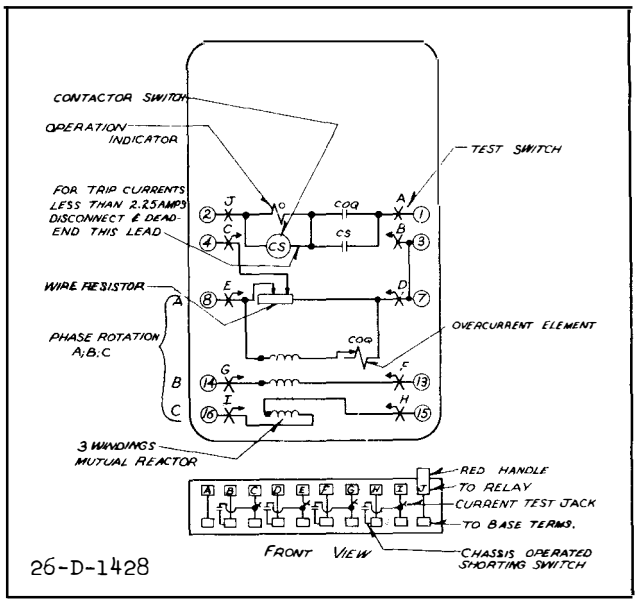



**Fig. 1—Internal Schematic Of The COQ Relay In FT Case.**

coil connected in the trip circuit. When the coil is energized a spring-restrained armature releases the white target which falls by gravity to indicate completion of the trip circuit. The indicator may be reset from outside of the case.

Negative Sequence Current Filter

The negative sequence current filter consists of a reactor and an adjustable resistor. These elements are connected in such a manner that the output of the filter is proportional to the negative sequence input.

## CHARACTERISTICS

The COQ negative sequence relay is available with the following negative sequence current taps:

3 3.25 3.5 3.8 4.2 4.6 5.0

These tap values represent the current transformer secondary amperes which correspond to one per unit generator current. At these values of negative sequence currents, the moving contact will leave the time dial stop and reach the stationary contacts in a time as determined by the time dial setting and as shown by Fig. 3. For example, with a time dial setting of "4" the relay will close its contacts in 30 seconds with the above tap currents applied to the relay.

As shown by the curves of figure 2, the relay's characteristic is defined by a generator characteristic $I_2^2T = K$. The relay characteristic is such that it coincides with the generator characteristic at 1 per unit negative sequence current but at higher values of negative sequence current, the relay characteristic is substantially parallel and slightly less than the generator characteristic. In this manner, a suitable margin of safety is obtained between the two characteristics.

Figure 2 defines the relay characteristics for two generators - one with a permissible constant of "30" and the other with a constant of "90". The time dial settings for these constants are "4" and "11" respectively. Similar protection for other generators with $I_2^2T$ constants between "30" and "90" is obtained by settings of the time dial. Figure 3 shows the necessary time dial settings for various $I_2^2T$ constants. By referring to this figure, the time dial can be set so that the relay protects different generators whose $I_2^2T$ constants range from "30" to "90".

Typical operating characteristics of the relay are shown in figure 4.

* Minimum pickup of the relay is approximately .6 per unit.

The burdens and thermal ratings are listed under Energy Requirements.

3.25 Circuit

The main contacts will safely close 30 amperes at 250 V. d-c, and the switch contacts will safely carry this current long enough to trip a breaker.

As shipped from the factory, the operation indicator and the contactor switch are connected in parallel. This circuit is suitable for all trip currents above 2.25 amperes d-c. If the trip current is less than 2.25 amperes, there is no need for the contactor switch and it should be disconnected. To disconnect the coil remove the short lead to the coil on the front stationary contact of the contactor switch. This lead should be fastened

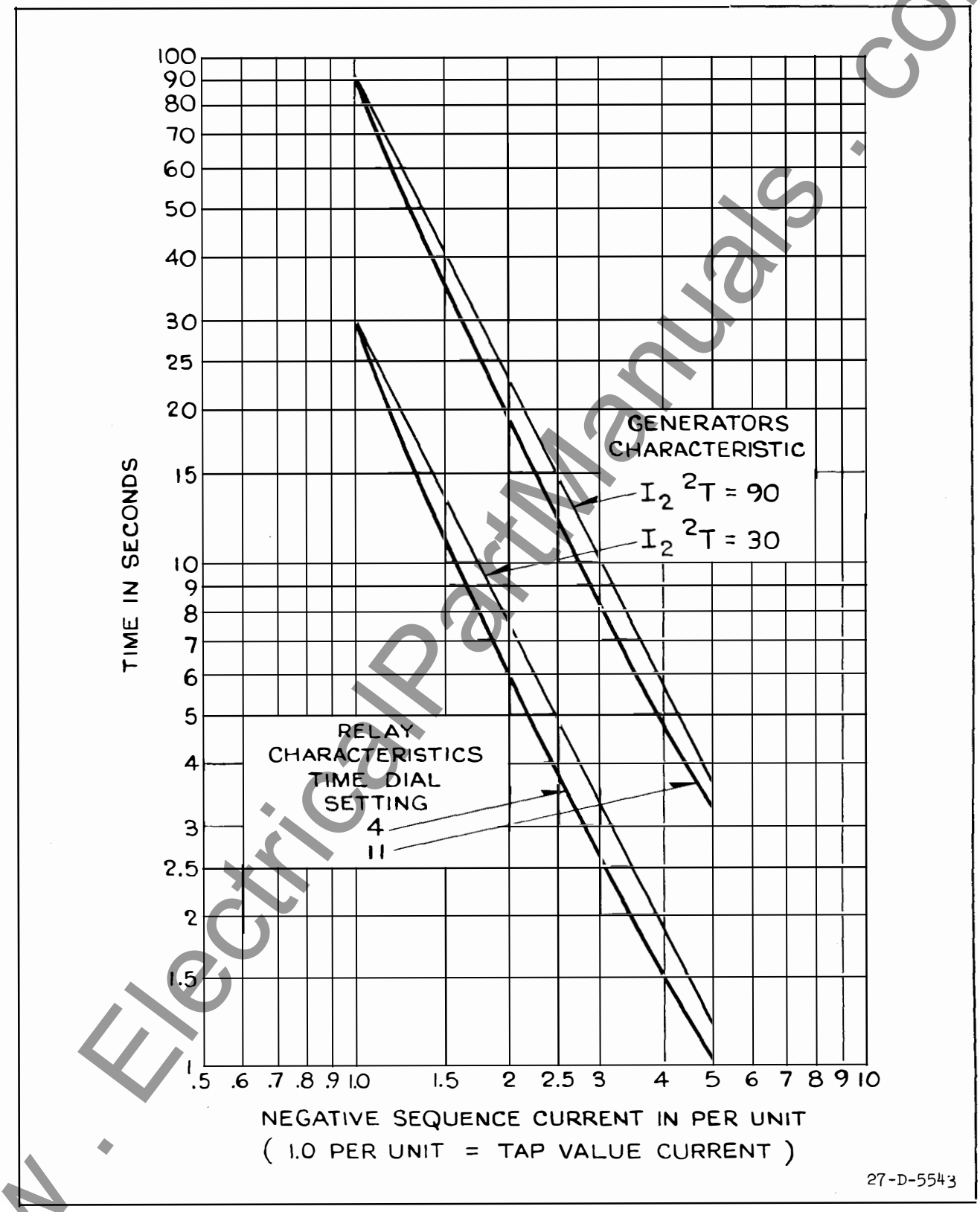



**Fig. 2—Comparison Of Relay Characteristic With Generator Characteristic.**

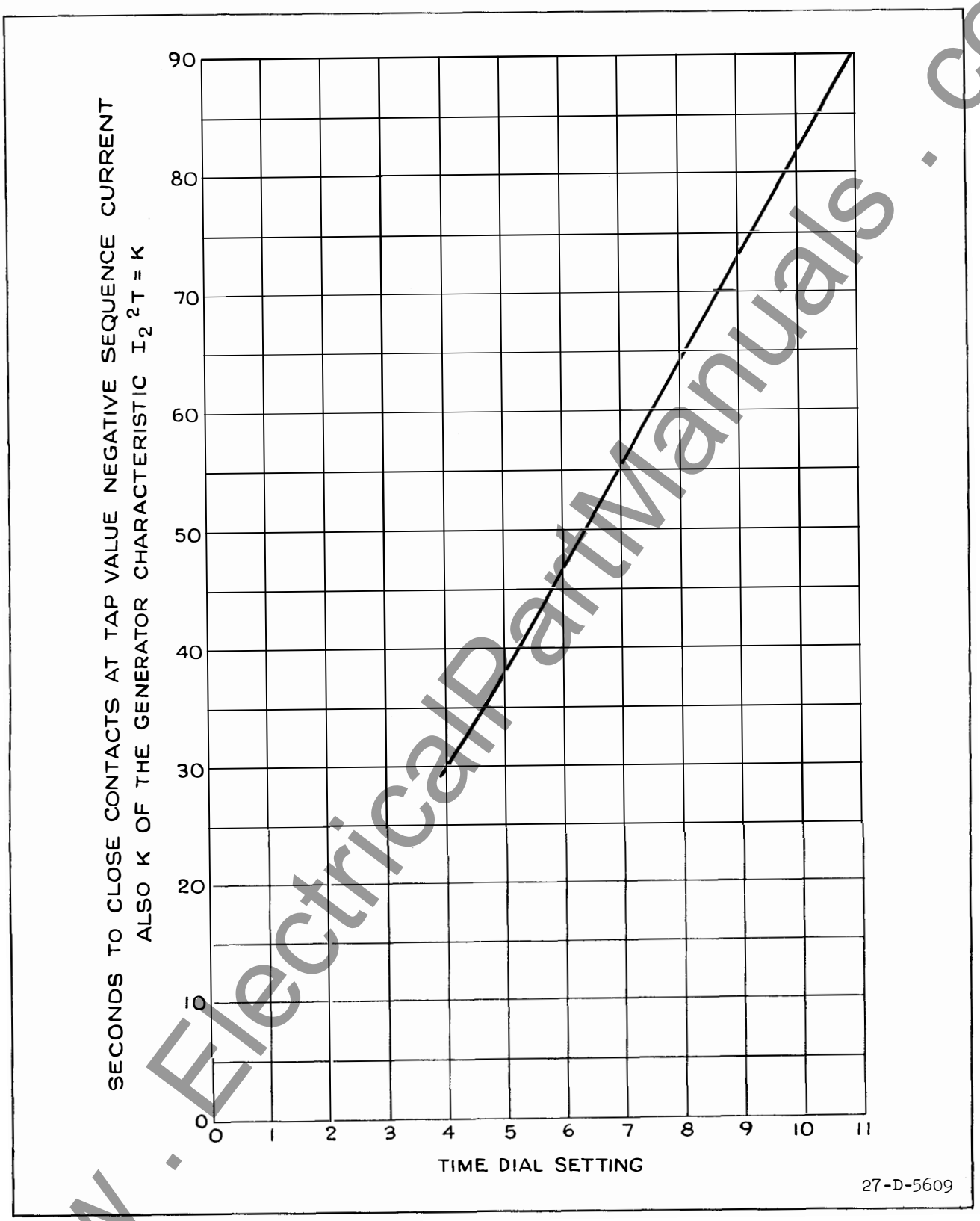



**Fig. 3—Time Dial Setting Versus Permissible Constant Of Generator.**

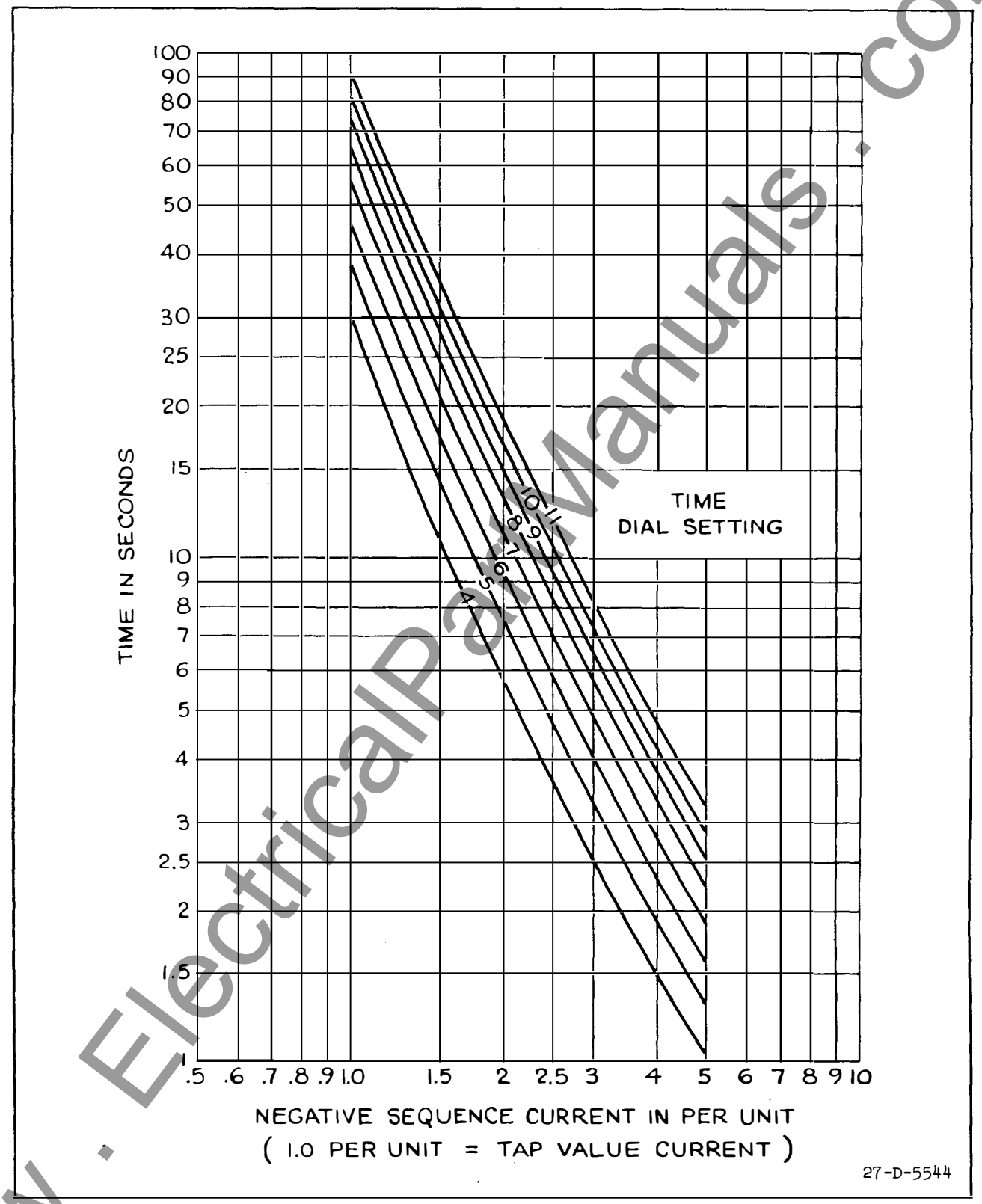



**Fig. 4—Typical Operating Curves Of The COQ Relay.**

(dead-ended) under the small filister head screw located in the Micarta base of the contactor switch.

## CONTACT CIRCUIT CONSTANTS

Universal Trip Circuit

Resistance of 0.2 ampere Target .... 2.88 ohms
Resistance of 2.0 ampere
Contactor Switch..... 0.25 ohms
Resistance of Target and
Switch in Parallel..... 0.23 ohms

## INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs for the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. Either of the studs or the mounting screws may be utilized for grounding the relay. The electrical connections may be made direct to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony-asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench.

## SETTINGS

There are two settings - namely, the tap value and the time dial settings. For the protection of generators from excessive negative sequence currents, the settings must be determined by the type of machine and the full load current rating of the machine.

Tap Value Setting

This setting is determined by the full load current of the generator expressed in current transformer secondary amperes.

Time Dial Setting

Settings of the time dial are determined by the type of machine to be protected. The time dial indicates a $I_2^2T = K$ curve of a generator for which the relay protects. By turning the time dial, the relay can be used to protect generators with $I_2^2T$ constants varying from "30" to "90" as shown in Fig. 3.

## ADJUSTMENTS AND MAINTENANCE

All the relays should be inspected periodically and the time of operation should be checked at least once every six months or at such other time intervals as may be dictated by experience to be suitable to the particular application. Phantom loads should not be used in testing induction-type relays because of the resulting distorted current wave form which produces an error in timing.

All contacts should be cleaned periodically. A contact burnisher S#182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

The proper adjustments to insure correct operation of this relay have been made at the factory and should not require readjustment after receipt by the customer. If the adjustments have been changed or the relay taken apart for repairs, the instructions below should be followed.

Adjust the stationary contact by means of its adjusting screw such that the contact spring is just free of the front spring stop. By means of the time dial, move the moving contacts until they deflect the stationary contacts approximately 1/64 inch. Set the index pointer such that it points to the "0" mark on the time dial. Adjust the stationary contact by means of its adjusting screw until the moving and stationary contacts just touch. This adjustment is to set "0" on the time dial and provide follow for the contacts.

Negative Sequence Filter

Adjustment of the filter resistor to obtain no response to positive sequence currents is obtained as follows:

a) Connect terminal 8 to terminal 14

b) Remove tap screw from the COQ element

c) Pass 10 amperes into terminal 7 and out terminal 13

d) With a low reading, high resistance Rectox voltmeter, measure the voltage between * terminal 8 and the tap plate.

e) Place the voltmeter across terminals 7 and 8. Adjust the resistor lead on the right of the reactor until the voltmeter reads 1.732 times the voltage reading of step (d.

Adjustment of the filter resistance to obtain no response to the zero sequence current is conveniently made by referring to Fig. 5. Pass 5 amperes into terminal 8 and 10 amperes into terminal 7. Adjust the resistor lead on the left of the reactor until the voltmeter reads zero.

## TIME CURVE CALIBRATION

With the time dial set on "0", wind up the spring until approximately 5-1/2 convolutions show. This is an initial rough adjustment. From this preliminary setting, and using minimum tap setting and time dial setting of "11", adjust the permanent magnet until the relay operates in 8.2 seconds with 15.6 amperes single phase or 3 per unit between terminals 8 and 14. This adjustment is made by means of the damping magnet screw. A diagram of the test connections is shown in Fig. 6.

Next adjust the spring tension until the relay will close contacts in 90 seconds with 5.2 amperes single phase (tap value or one per unit negative sequence current) applied between terminals 8 and 14. This adjustment is made by means of the spiral spring adjuster. All spring convolutions must be free.

## TRIP CIRCUIT

Universal Trip

This combination uses a 2.0 amp. contactor switch and a 0.2 amp. operation indicator connected in parallel. Adjust the contactor switch and indicator as outlined below:

Contactor Switch - Turn the relay up side down. Screw up the core screw until the contact ring starts rotating. Now back off the core until the contact ring stops rotating. Back off the core screw one more turn and lock in place. Adjust the two nuts at the bottom of the switch so that there is 3/32 inch clearance between the moving contact ring and the stationary contacts in the open position. The guide rod may be used as a scale as it has 52 threads per inch, therefore, 5 turns of the nuts will equal approximately 3/32 inch.

Combination Test - Close the main relay contacts and pass 2.25 amps d.c. through the trip circuit. The contactor switch must pick-up. Adjust the operation indicator by moving the flag holder such that the indicator operates with the application of the 2.25 amps. Pass 30 amps d.c. through the trip circuit. The indicator and contactor switch must not stick in the operated position when the current is interrupted.

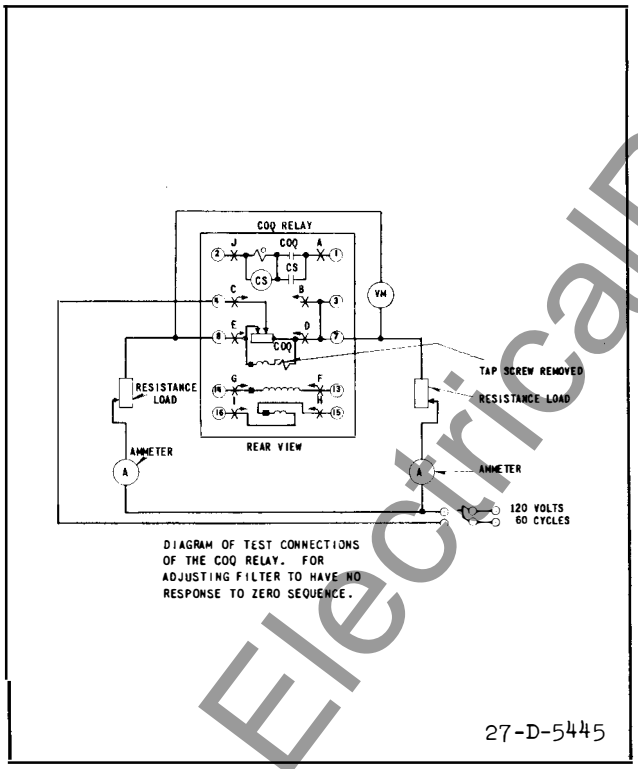
## RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete name-plate data.

## ENERGY REQUIREMENTS

The burdens of the type COQ Relay are as follows:

| Phase | Continuous Rating-Amps | One Second Rating-Amps | Watts at 5 Amps | Volt Amps at 5 Amps | Power Factor Angle |
|---|---|---|---|---|---|
| A | 5 | 100 | 5.3 | 5.3 | 0° |
| B | 5 | 100 | 0.0 | .98 | 90° Lag |
| C | 5 | 100 | 4.0 | 7.25 | 56° Lag |




*** Fig. 5—Diagram Of Test Connections Of The Type COQ Relay. For Adjusting Filter To Have No Response To Zero Sequence.**

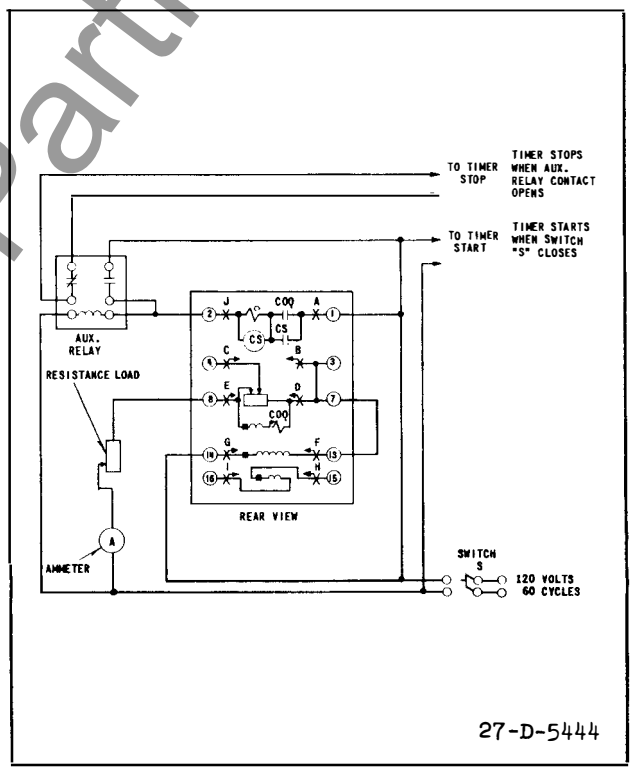



**Fig. 6—Diagram of Single Phase Test Connections Of The COQ Relay For Time Curve Check.**

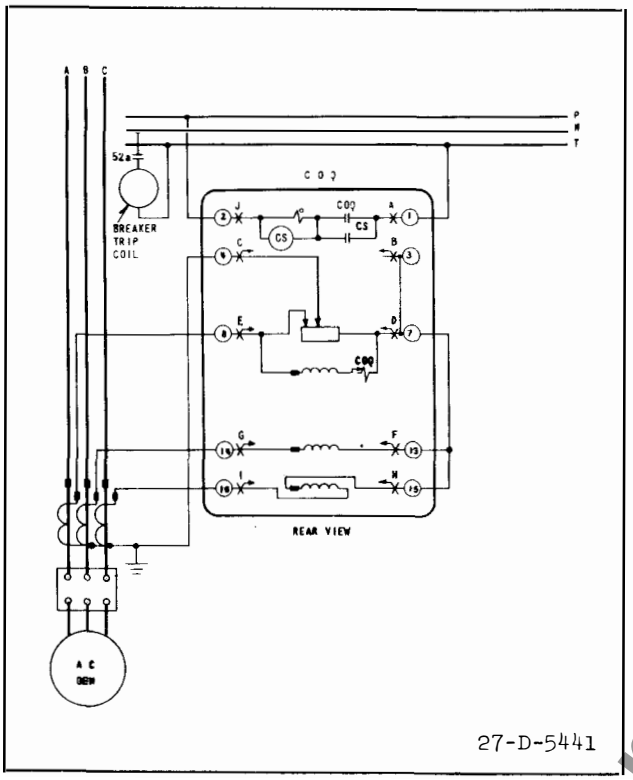



Fig. 7—External Connections Of The COQ Relay With Neutral Formed at Relay.

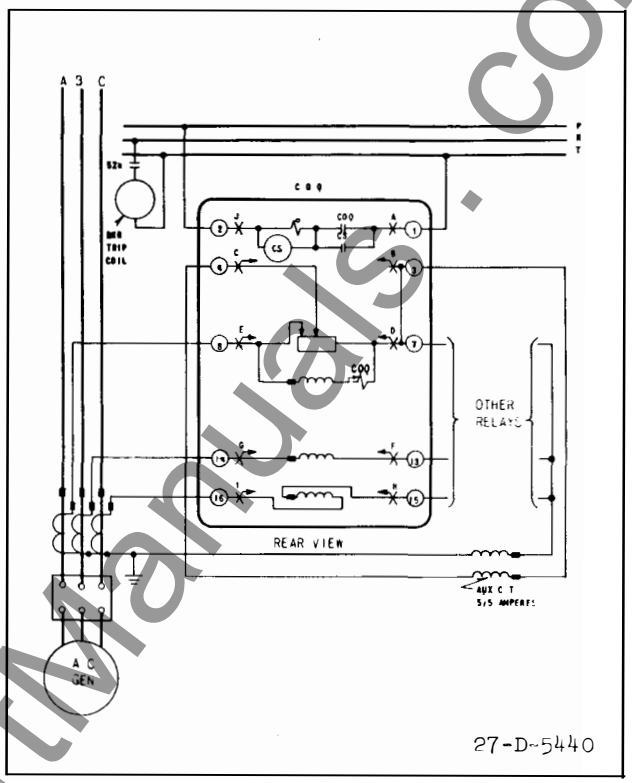



Fig. 8—External Connections Of The COQ Relay With Neutral Formed At Point Other Than COQ.

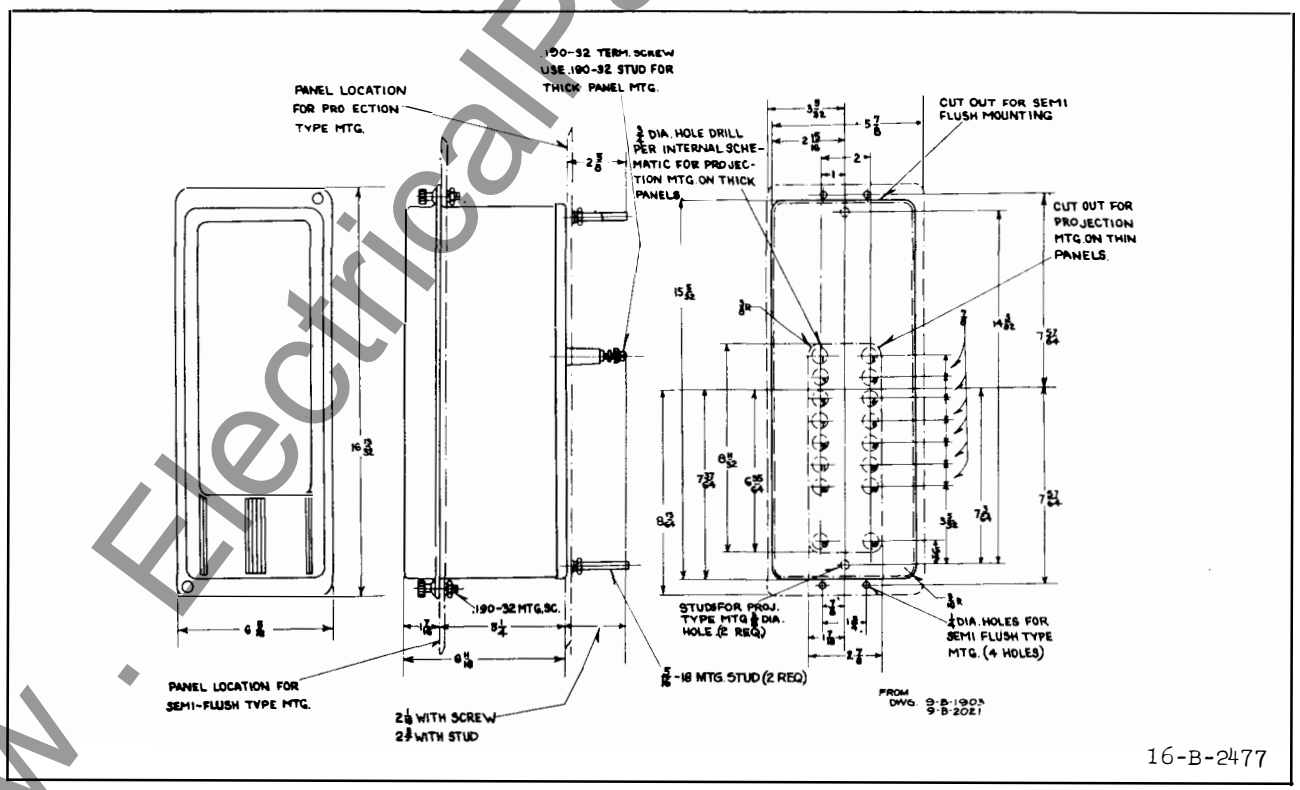



Fig. 9—Outline And Drilling Plan Of The M10 Projection Or Semi-Flush FT Flexitest Case.

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