INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CF-1 UNDER AND OVERFREQUENCY RELAY

CAUTION

Before putting 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 close properly, and operate the relay to check the settings and electrical connections.

APPLICATION

The type CF-1 relay is an induction disc type frequency relay. It is used for the protection or control of equipment on systems where the frequency of the system changes. A typical application is in the protection of local generators in industrial plants from severe overload when the power company tie is lost.

CONSTRUCTION AND OPERATION

The type CF-1 relay contains an electromagnet condenser and resistors, and an indicating contactor switch unit.

FREQUENCY UNIT

The operating unit consists of an electromagnet operating on a conducting disc. The electromagnet has potential windings on both the upper and lower poles. The lower pole circuit has capacitance in series, the upper pole has not. The underfrequency relay is so designed that at normal frequency the upper pole current leads the lower pole current and the two out of phase fluxes thus produced act to give contact opening torque on the disc. When the frequency drops, the phase angle of the lower pole circuit becomes more leading, until at the frequency setting of the relay the lower pole current begins to lead the upper pole current, and the relay torque is reversed to the tripping direction. The lower the frequency the greater the phase angle displacement and hence the faster the relay trips. An adjustable resistor in the upper pole circuit is provided to set the frequency at which the relay trips.

INDICATING CONTACTOR SWITCH UNIT (ICS)

The d-c indicating contactor switch is a small clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also during this operation two fingers on the armature deflect a spring located on the front of the switch, which allows the operation indicator target to drop. The target is reset from the outside of the case by a push rod located at the bottom of the cover.

The front spring, in addition to holding the target provides restraint for the armature and thus controls the pickup value of the switch.

CHARACTERISTICS

The type CF-1 relay is available in two forms – either as an underfrequency relay or an overfrequency relay. Where operation on both underfrequency and overfrequency is desired, two relays are required, one of each form. The relay contacts are single or double pole single throw, or single pole double throw.

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

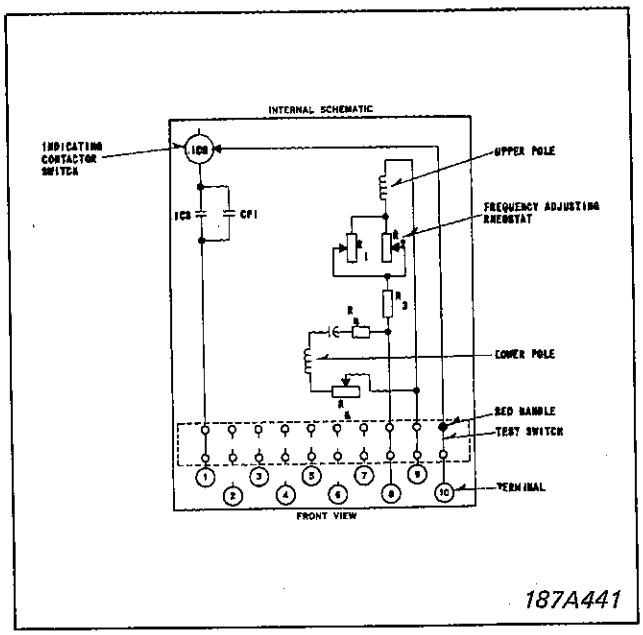


Fig. 1. Internal Schematic of the Single Pole, Single Throw Type CF-1 Relay in the Type FT-21 Case

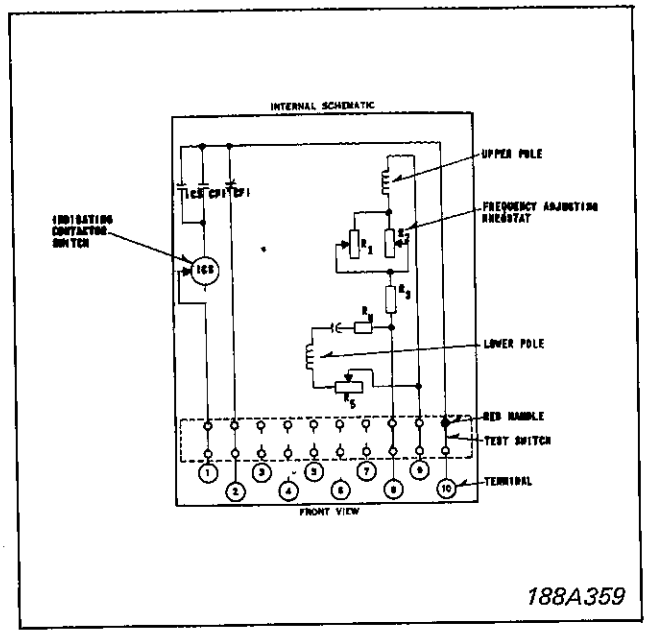


Fig. 2. Internal Schematic of the Single Pole, Double Throw Type CF-1 Relay in the Type FT-21 Case

The underfrequency relay can be set to close contacts for any desired frequency between 50 and 60 Hz (40 and 50 Hz for 50 Hz relays) and the overfrequency relay can be set to close contacts for any desired frequency between 60 and 70 Hz (50 and 60 Hz for 50 Hz relays) by setting the knob of the frequency adjusting rheostat to the desired frequency marked on the calibrated dial. Since the relay at minimum trip operates like a directional element near zero torque, the relay is very sensitive to phase angle change resulting from a frequency change. Thus minimum trip is little affected by voltage variation. Typical voltage vs. minimum trip frequency curves are shown in Fig. 3 (Fig. 12, Curve 537991 for 50 Hz Relay). The circuits are also designed to minimize temperature error to less than ±0.3 Hz over the temperature range. Typical minimum trip frequency vs. temperature curves are shown in Fig. 4 (Fig. 13, Curve 537990 for 50 Hz Relay).

The relays have inverse time characteristics. Desired time settings may be made by means of the time dial which is continuously adjustable from the #1/2 to the 7 for the underfrequency relay and from the #1/2 to the 11 for the overfrequency. Typical time curves for the time dial positions are shown in Figs. 5 through 10 (Figs. 11 and 14 through 18 for 50 Hz relays).

The frequency relay contact closing and opening points are essentially the same. The relay will reset to the maximum time lever setting when the frequency changes, 1 to .3 Hz from the setting. For example, suppose the 60 Hz underfrequency relay is set to close its contacts at 59 Hz from the #7 lever setting. The contact will start to move at 59.1 to 59.3 Hz but will not close until the frequency drops to 59 Hz or below. As the frequency rises just above 59 Hz, the contacts open, but will not completely reset to the #7 lever setting until the frequency rises to 59.1 or 59.3 Hz. With the time lever set at less than its maximum position, the .1 to .3 Hz differential is correspondingly less.

TRIP CIRCUIT

The main contacts will safely close 30 amperes at 250 volts d-c and the seal-in contacts of the indicating contactor switch will safely carry this current long enough to trip a circuit breaker.

The indicating contactor switch has two taps that provide a pickup setting of 0.2 or 2 amperes. To change taps requires connecting the lead located in front of the tap block to the desired setting by means of a screw connection.

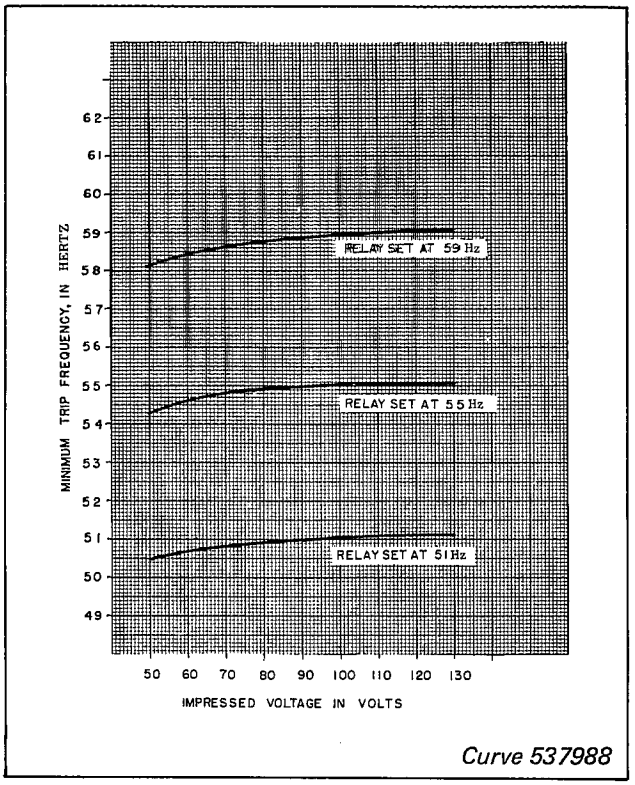


Fig. 3. Typical Voltage-Minimum Trip Frequency Curves of the Type CF-1 Underfrequency Relay

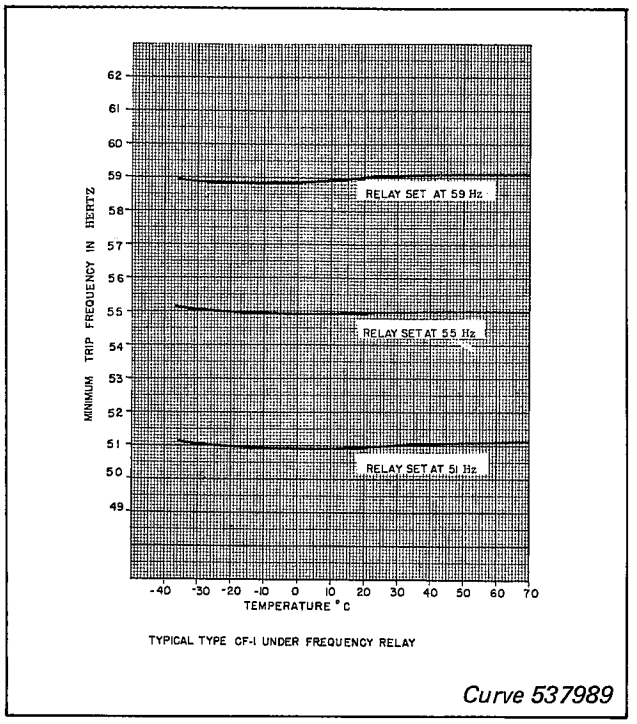


Fig. 4. Typical Temperature Minimum Trip Frequency Curves of the Type FT-1 Underfrequency Relay

TRIP CRICUIT CONSTANT

Indicating Contactor Switch (ICS):
0.2 ampere tap 6.5 ohms d-c resistance
2.0 ampere tap 0.15 ohms d-c resistance

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 four mounting holes on the flange for semi-flush mounting or by means of the rear mounting stud or studs for projection mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

For detailed FT case information refer to I.L. 41-076.

The operating windings of the relay should be connected across a suitable potential transformer.

SETTINGS

The relay is set for minimum trip by means of the frequency adjusting rheostat. The time dial position determines relay timing. The curves are drawn for variation of frequency in hertz below the frequency adjusting rheostat setting.

To adjust the CF-1 relay contacts to be quick opening, screw in the small set screw on the stationary contact assembly until the contact rivet rests solidly on the Micarta support. When this is done, the position of the contact stop on the time lever should be shifted so that the moving and stationary contacts barely touch when the time lever is set on zero. The contact opening time with no follow will be 3 to 6 cycles.

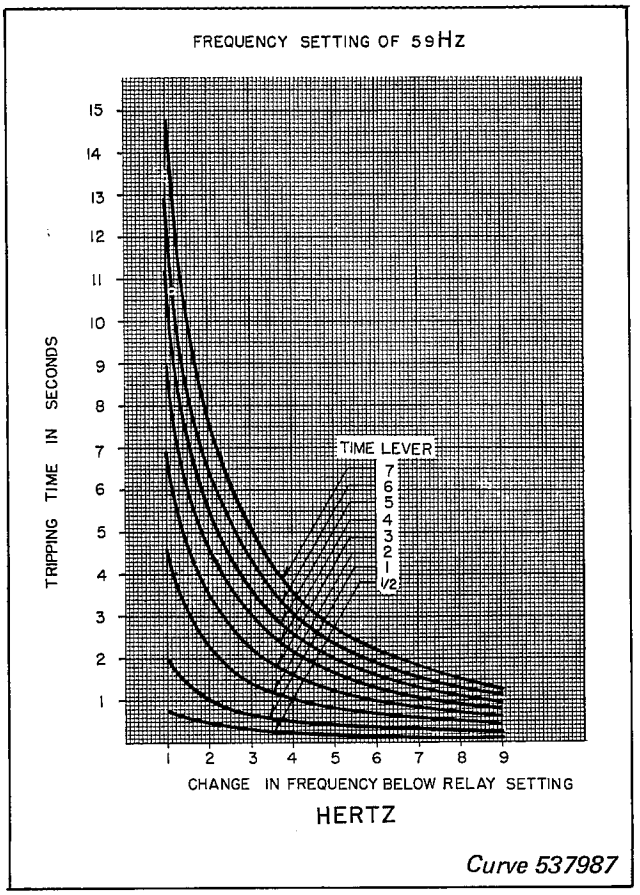


Fig. 5. Typical 59 Hz Time Curves of the Type CF-1 Underfrequency Relay

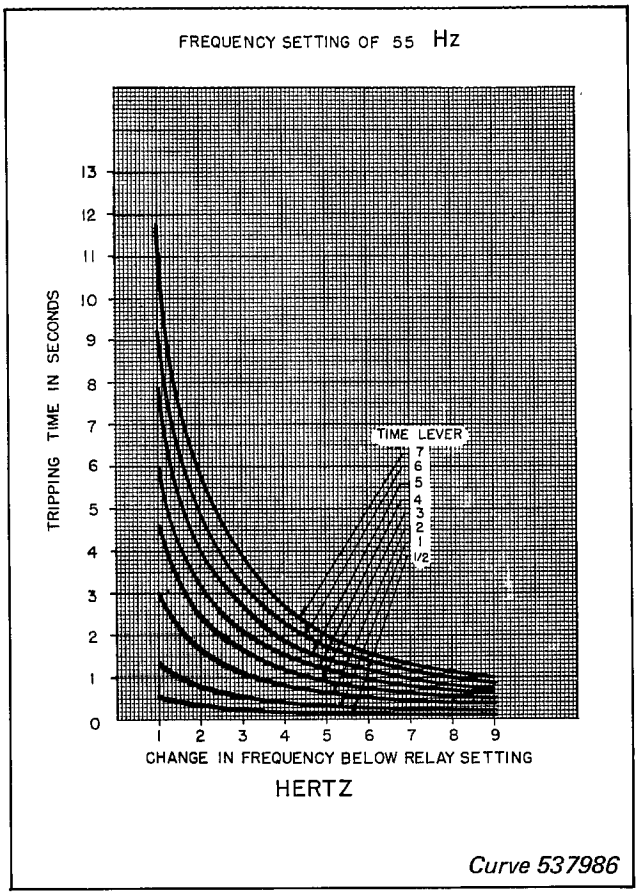


Fig. 6. Typical 55 Hz Time Curves of the Type CF-1 Underfrequency Relay

INDICATING CONTACTOR SWITCH (ICS)

No setting is required on the ICS unit except the selection of the 0.2 or 2.0 ampere tap setting. This selection is made by connecting the lead located in front of the tap block to the desired setting by means of the connecting screw.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay no customer adjustments, other than those covered under "SETTINGS" should be required.

ACCEPTANCE CHECK

The following check is recommended to insure that the relay is in proper working order.

A. Frequency Unit – Underfrequency

1. MINIMUM TRIP

Connect the relay to a variable frequency source and apply 120 volts, at rated frequency for at least 1 hour. Set the frequency adjusting rheostat to rated frequency and apply to the relay. The contacts should just close. Repeat for all major scale divisions on the frequency adjusting rheostat.

2. TIME CURVE

Set the time dial at the 6 position and the frequency adjusting rheostat at 2 Hz below rated frequency. Apply 120 volts rated frequency to the relay for at least 1 hour to allow the coils to reach their final temperature. Deenergize the relay and suddenly apply 6 Hz below rated frequency. The relay contacts should close in 3.1 ± 10% seconds.

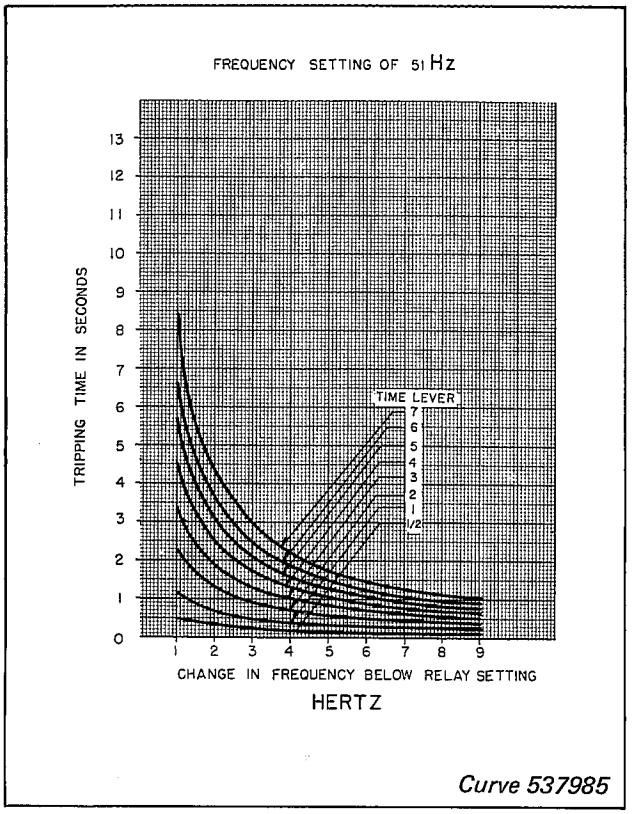


Fig. 7. Typical 51 Hz Time Curves of the Type CF-1 Underfrequency Relay

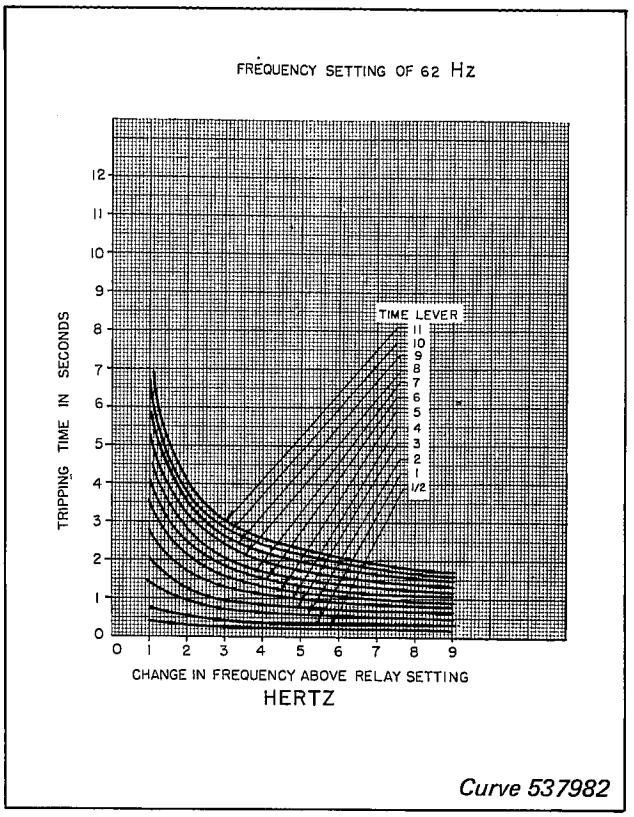


Fig. 8. Typical 62 Hz Time Curves of the Type CF-1 Overfrequency Relay

B. Frequency Unit – Overfrequency

1. MINIMUM TRIP

Connect the relay to a variable frequency source and apply 120 volts, rated frequency to the relay for at least 1 hour. Set the frequency adjusting rheostat at 10 Hz above the rated frequency and apply to the relay. The contacts should just close. Repeat for all major scale divisions on the frequency adjusting rheostat.

2. TIME CURVE

Set the time dial at the 6 position and the frequency adjusting rheostat at 5 Hz above rated frequency. Apply 120 volts rated frequency to the relay for at least 1 hour to allow the coils to reach their final temperature. De-energize the relay and suddenly apply 9 Hz above rated frequency. The relay contacts should close in 1.9 ± 10% seconds.

C. Indicating Contactor Switch (ICS)

Close the main relay contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The operation target should drop freely.

The contact gap should be approximately .047 inch between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

ROUTINE MAINTENANCE

All contacts should be periodically cleaned. 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.

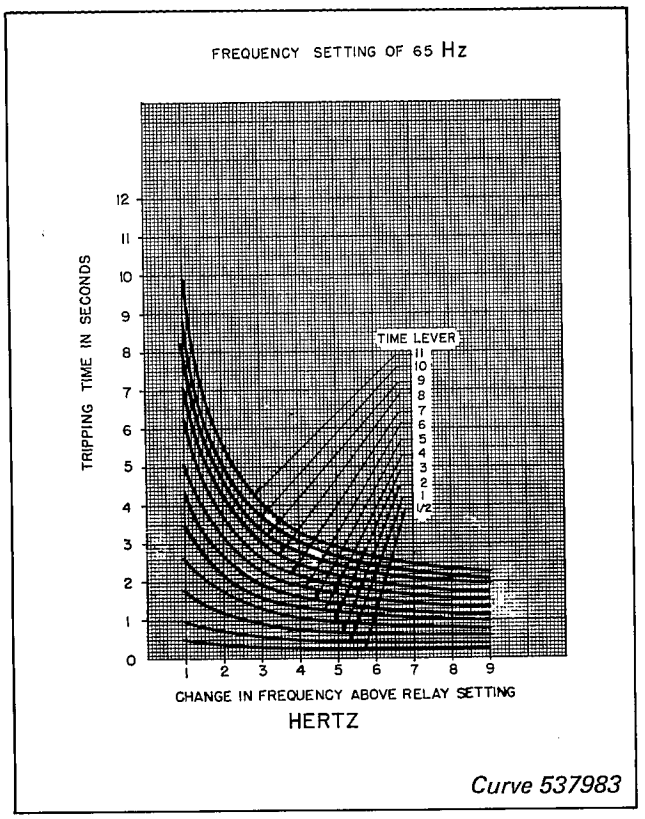


Fig. 9. Typical 65 Hz Time Curves of the Type CF-1 Overfrequency Relay

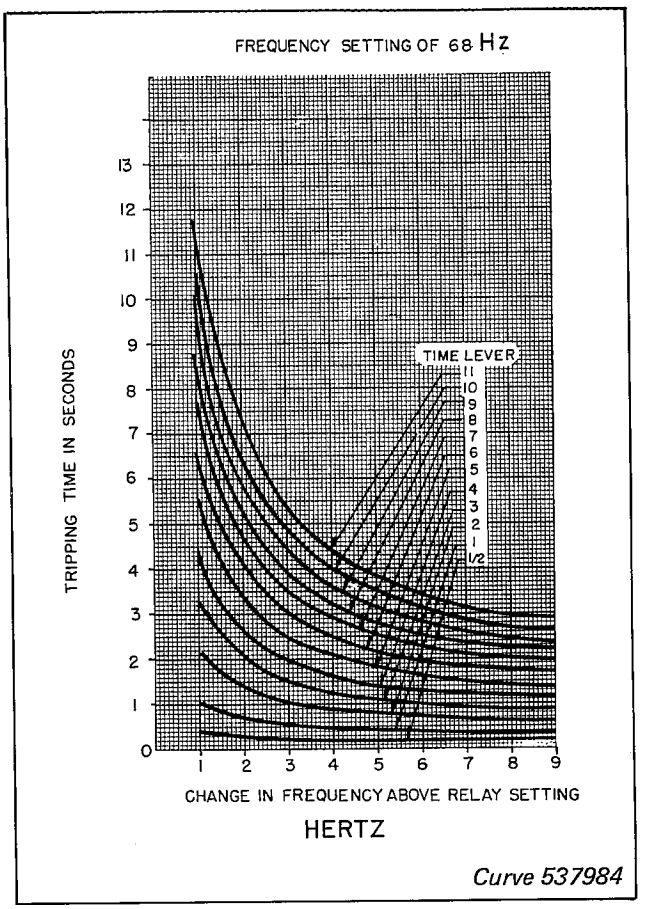


Fig. 10. Typical 68 Hz Time Curves of the Type CF-1 Overfrequency Relay

CALIBRATION

Use the following procedure for calibrating the relay if the relay has been taken apart for repairs or the adjustments disturbed. This procedure should not be used until it is apparent that the relay is not in proper working order. (See "Acceptance Check".)

A. Spring Tension Overfrequency Relay

Adjust the spring tension such that the moving contact just resets to the #11 time dial position when the relay is de-energized. Then give the adjuster an additional 1/8 to 1/4 turn initial tension.

B. Spring Tension Underfrequency Relay

Adjust the spring tension such that the moving contact just resets to the #7-1/2 time dial position when the relay is de-energized.

C. Frequency Adjusting Rheostat

Allow the relay to warm up for at least 1 hour at 120 volts, rated frequency before making any adjustments. Set the frequency adjusting rheostat in the maximum counter-clockwise position and apply frequency marked on dial to the relay. Adjust the 3-1/2 inch resistors in the relay until the relay contacts just close.

Set the frequency adjusting rheostat in the extreme clockwise position and apply frequency marked on the dial to the relay. Adjust the resistor in the lower left hand corner of the relay until the contacts just close. Intermediate frequency points may then be checked by applying these frequencies to the relay and observing if the contacts just close. The trip frequencies of the relay may not agree with the markings on the frequency adjusting rheostat if components in the relay have been changed. If such is the case the scale plate should be remarked to agree with the tripping frequencies of the relay.

D. Time Curves

Energize the relay with 120 volts rated frequency for at least an hour before making any checks. De-energize the relay and then apply the desired frequency at 120 volts. The timing may be determined by means of a cycle counter. The damping magnet may be adjusted to make the relay timing agree with the curves.

E. Indicating Contactor Switch (ICS)

Close the main relay contacts and pass sufficient d-c current through the trip circuit to close the contact of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The indicator target should drop freely.

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 nameplate data.

ENERGY REQUIREMENTS

Typical burden characteristics of the Under and Overfrequency relays are as follows:

Frequency Adjusting Rheostat Set For	Angle	V.A.
Underfrequency		
1 Hz below rated	36.8°	16.4
5 Hz below rated	31.4°	15.4
9 Hz below rated	16.0°	13.7
Overfrequency		
9 Hz above rated	24.1°	22.8
5 Hz above rated	20.6°	22.1
1 Hz above rated	19.6°	16.3

These relays will continuously stand 110% of rated voltage.

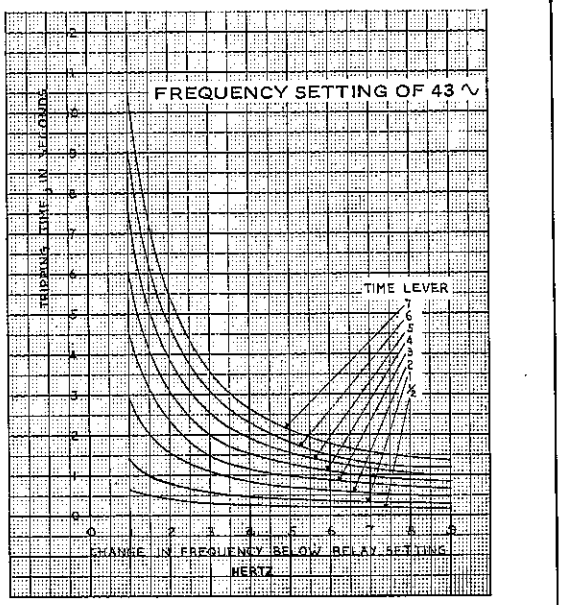


Fig. 11. Typical Type CF-1 Underfrequency Relay, A-11 Time Curve

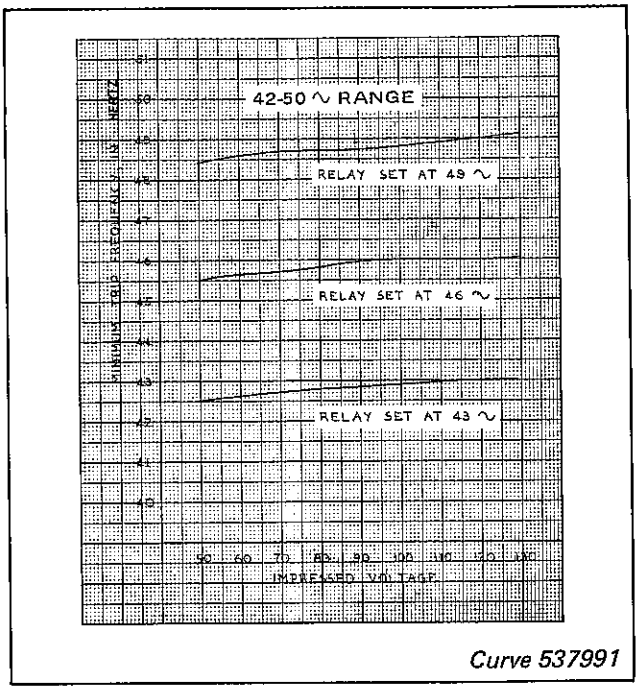


Fig. 12. Typical Type CF-1 Underfrequency Relay, A-11 Temperature Curve

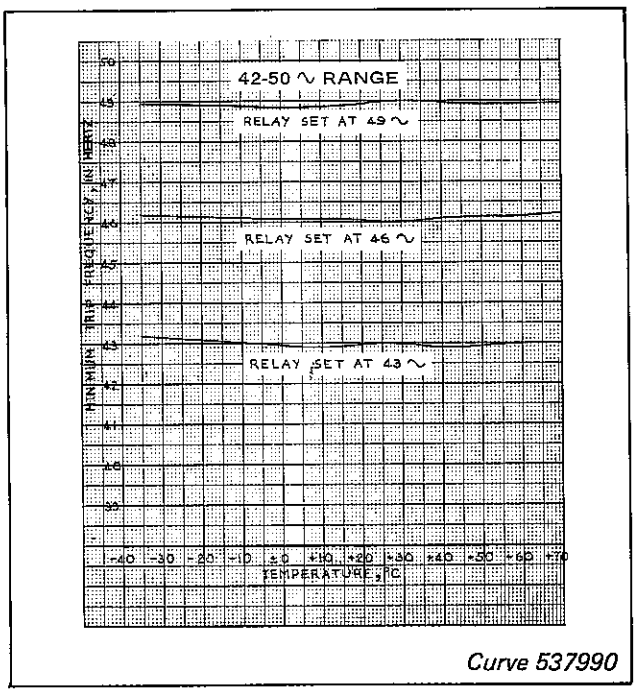


Fig. 13. Typical Type CF-1 Underfrequency Relay, A-11 Temperature Curve

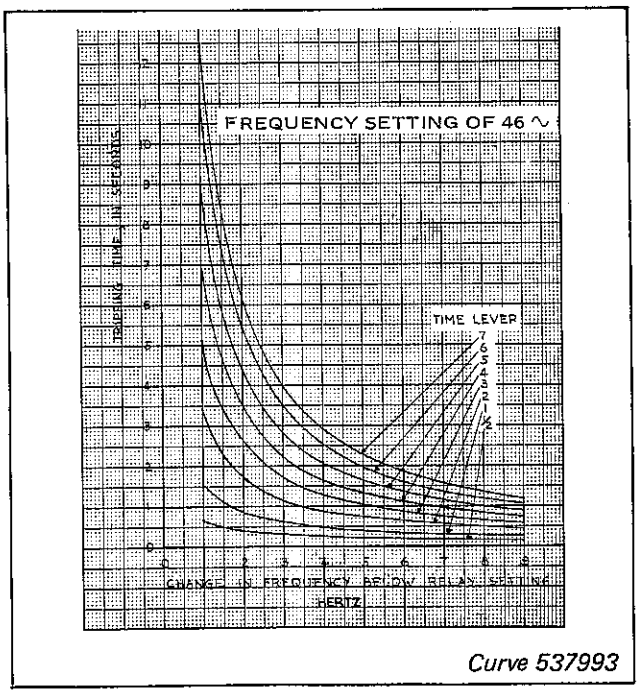


Fig. 14. Typical Type CF-1 Underfrequency Relay, A-11 Time Curve

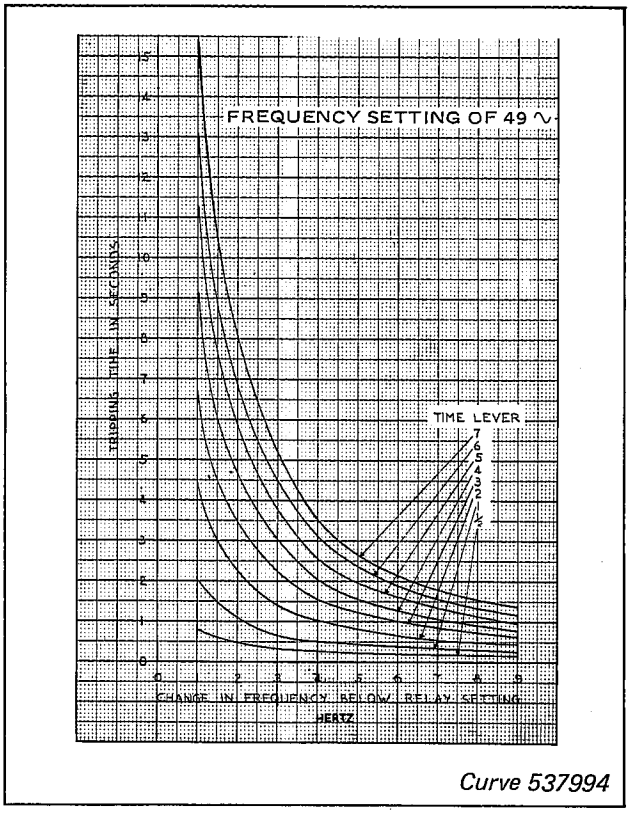


Fig. 15. Typical Type CF-1 Underfrequency Relay, A-11 Time Curve

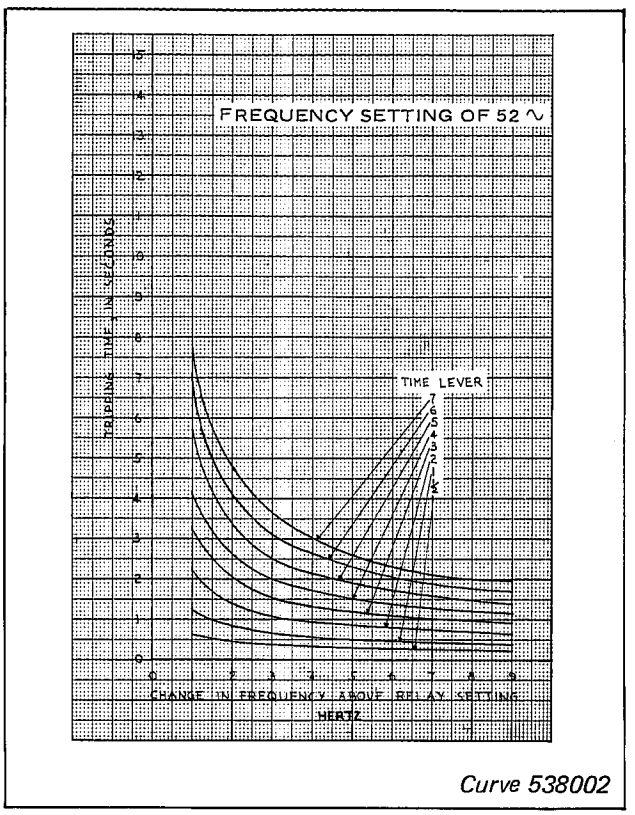


Fig. 16. Typical Type CF-1 Overfrequency Relay, A-13 Time Curve

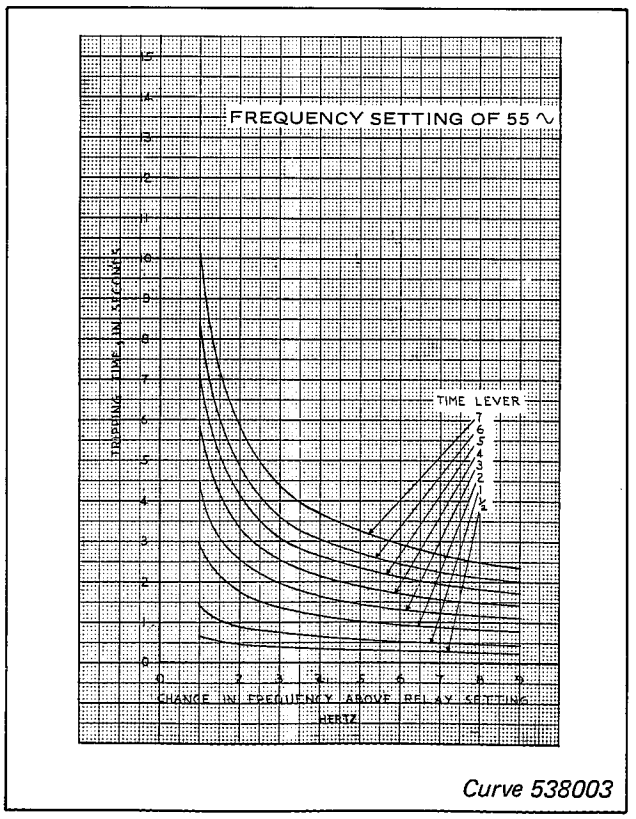


Fig. 17. Typical Type CF-1 Overfrequency Relay, A-13 Time Curve

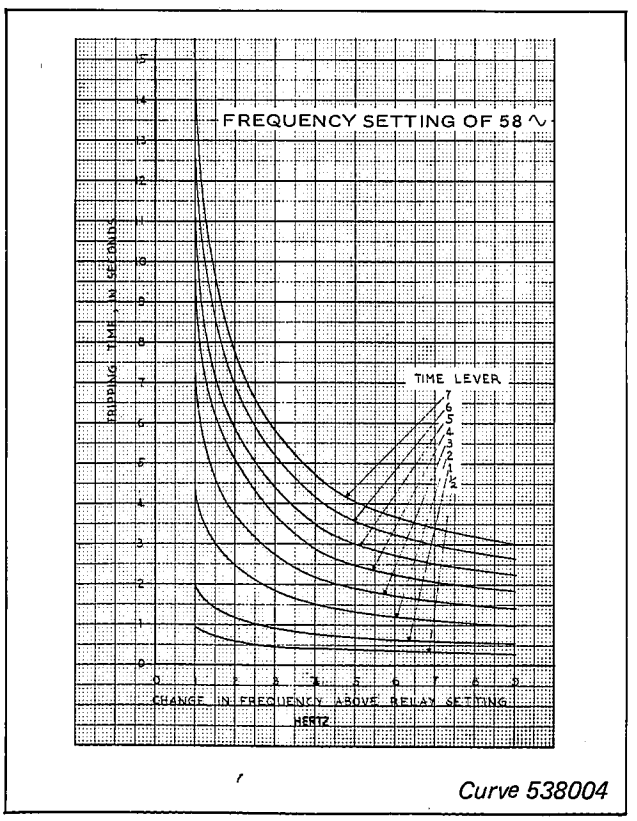
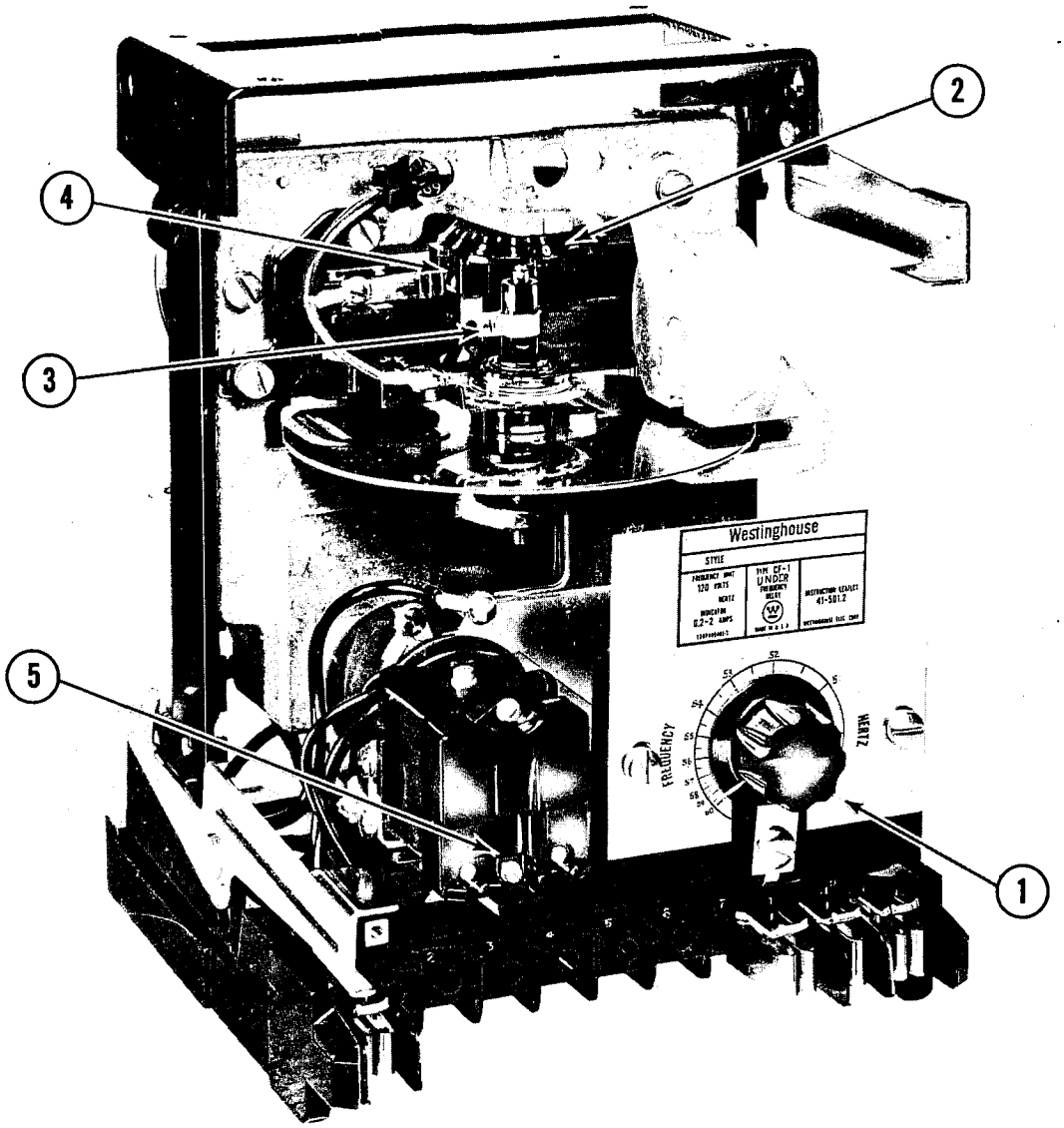


Fig. 18. Typical Type CF-1 Overfrequency Relay, A-13 Time Curve



1. *Frequency Setting Rheostat*
2. *Time Dial*
3. *Moving Contact*
4. *Stationary Contact*
5. *Indicating Contactor Switch (ICS)*

Fig. 19. Type CF-1 Relay Without Case

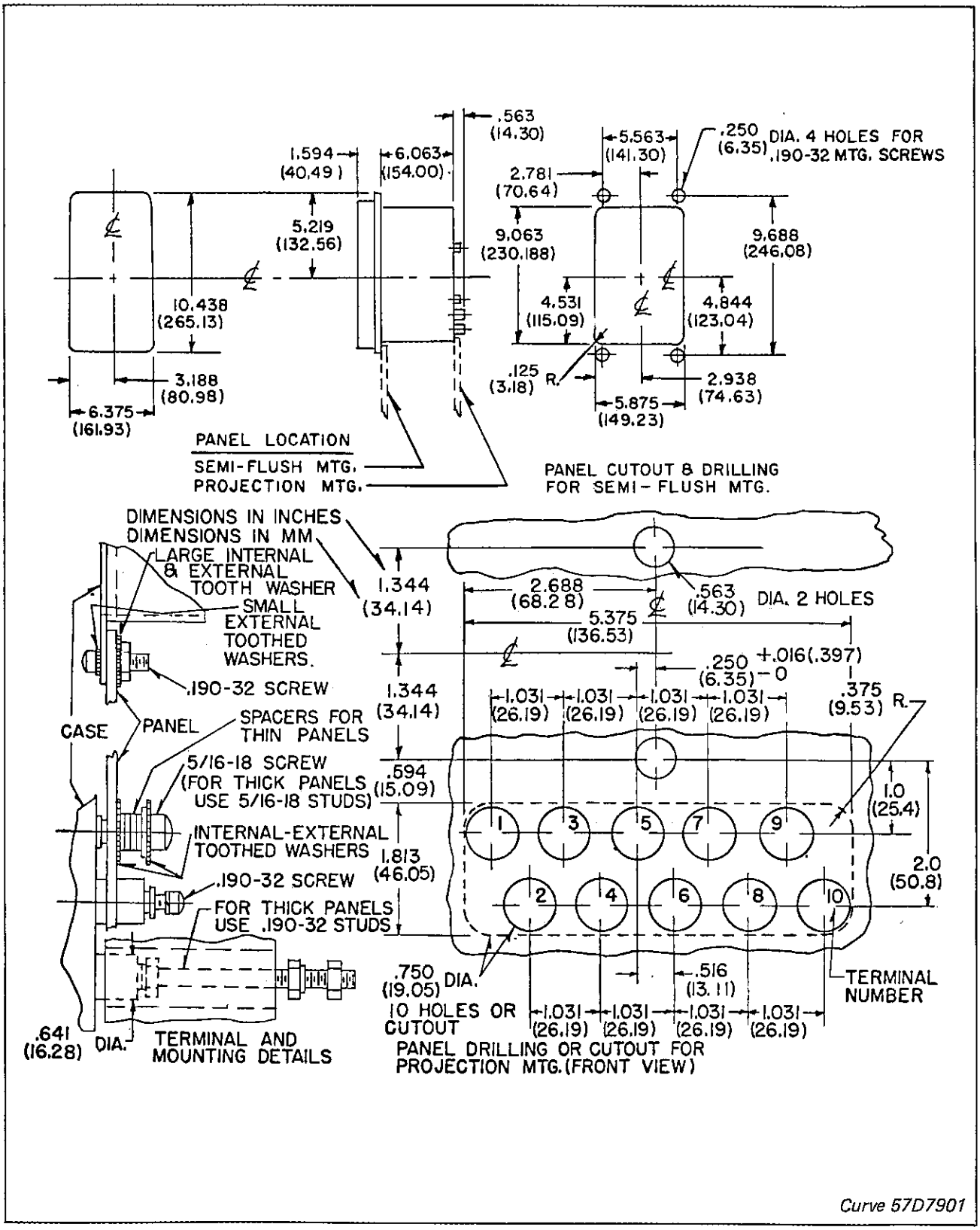


Fig. 20. Outline and Drilling Plan for the Type CF-1 Relay in the Type FT-21 Case

WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION

CORAL SPRINGS, FL 33065

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