INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CW POWER RELAY

30° CHARACTERISTIC FOR THREE PHASE

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 CW relay for three-phase application is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

* The CW relay for three-phase application uses phase-to-phase voltage and line current, with maximum torque occuring when the relay current leads the relay voltage by 30 ° at system unity power factor. Tap value is the volt-amperes at which the contacts close with relay current leading relay voltage by 30°. One CW relay is required for balanced three phase system and three relays are required for unbalanced conditions.

CONSTRUCTION

The relay consists of a product operated unit, a phase shifter and an indicating contactor switch (ICS).

Product Type Unit

The electromagnet for the main element has a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the tapped coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current leads the voltage by 30 degrees. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon direction of the line current. The combination of voltage and current produces an operating torque proportional to power.

Phase Shifter – The phase shifter network consist of a resistor in series with the potential coils.

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 CW relays are available in the following ranges and taps:

Volts Line-to Line	$\left(\frac{(I_L\ V_{LL})}{\sqrt{3}\ \text{single phase watts}}\right)$	
	Range	Taps
120	20– 120	20– 30– 40– 60– 80–100– 120
	100– 600	100–150–200–300–400–500– 600
208	35– 200	35– 50– 70–100–140–175– 200
	175–1000	175–250–350–500–700–875–1000

Typical 60 cycle Time-Power Curves are shown in Figs. 3 & 4. The curves are taken at maximum torque which occurs with the current leading the voltage by 30 degrees. (within ±4°)

SUPERSEDES I.L. 41-241.3G
*Denotes change from superseded issue.

EFFECTIVE SEPTEMBER 1974

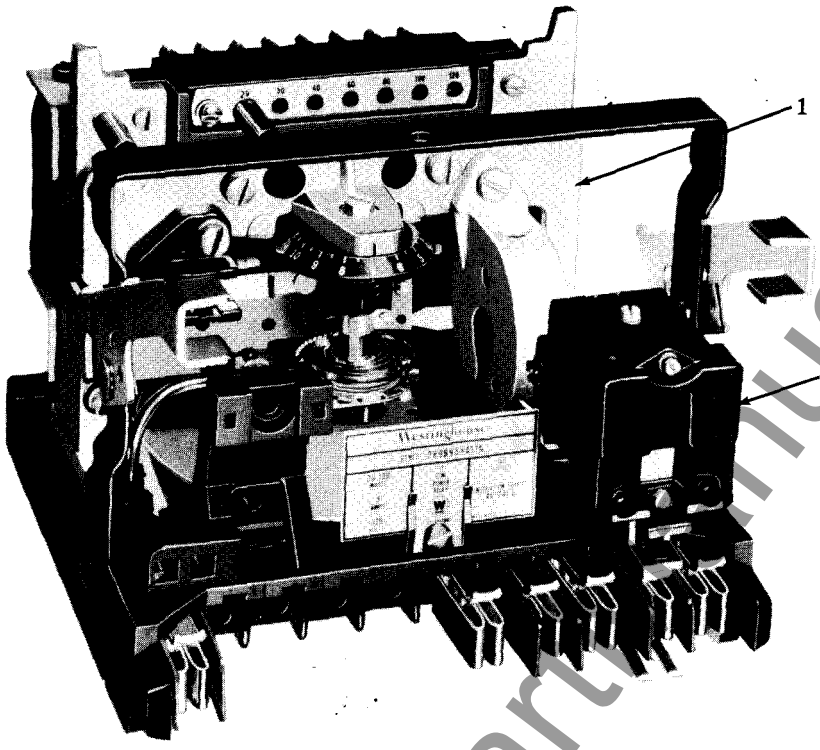


Fig. 1. 1. Time-power unit. 2. Indicating Connector Switch (ICS). Note: Phase shifting resistor is mounted in rear.

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 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.

Trip Circuit 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.

SETTINGS

Product Unit

There are two settings to be made. One is the current tap setting, and the second, the time dial setting.

The CW relay for three-phase application has taps which represents single phase watts multiplied by $\sqrt{3}$. The power to operate the relay equals the three phase primary power divided by the quantity ($\sqrt{3}$ times the current and potential transformer ratios).

$$* \text{TAP} = \frac{\sqrt{3}\ P1\phi}{Rc\,Rv} = \frac{P3\phi}{\sqrt{3}\ Rc\,Rv}.$$

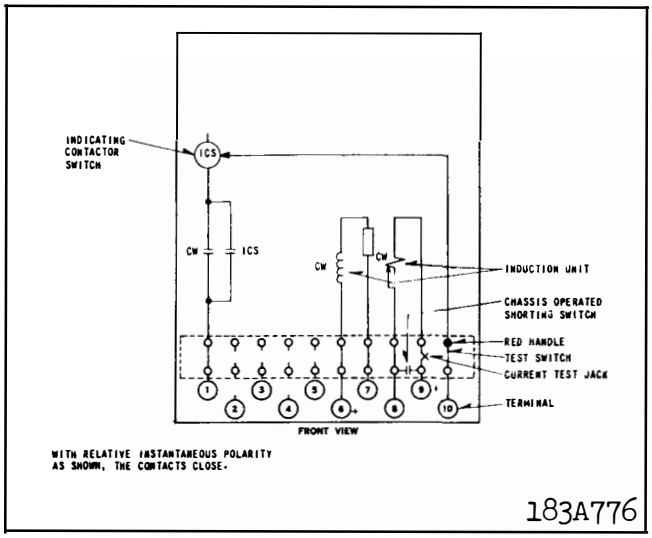


Fig. 2. Internal Schematic of the Type CW Relay in the Type FT11 Case.

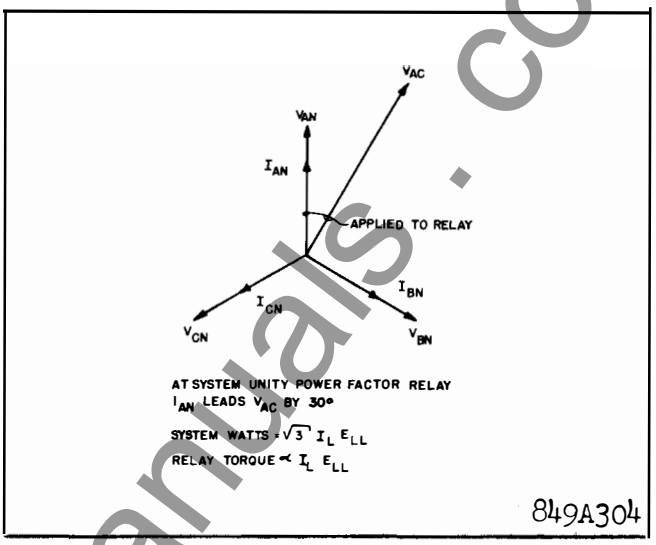


Fig. 3 Current and Voltage Phasors at System Unity Power Factor Applied to Type CW Relay.

This relay power expressed as multiples of the chosen tap locates a value on the abscissa of the Time-Power Curves of Fig. 3 and 4. The relay operating time for various time dial settings then is observed on the ordinate. By changing taps or time dial, the required operating time can be selected for specific power value.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole before removing the old tap screw. This prevents open-circuiting the current transformers.

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.

ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

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.

Product Unit

Contacts — The index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves.

Minimum Trip Volt Amperes — Set the time dial to position 6. Using the lowest tap setting, alternately apply tap value volt amperes plus 3% and tap value volt amperes minus 3% with the current leading the voltage by 30°. The moving contact should leave the backstop at tap value plus 3% and should return to the backstop at tap value minus 3%. The relay should be calibrated with 10 times tap value at the number six time dial position. Check several points on the typical time curves. Time curve calibration is affected by adjusting the position of the permanent magnet keeper. Note that with current leading voltage by 30 degrees the actual watts applied to the relay are .866 times tap value at pickup.

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 indicator target should drop freely.

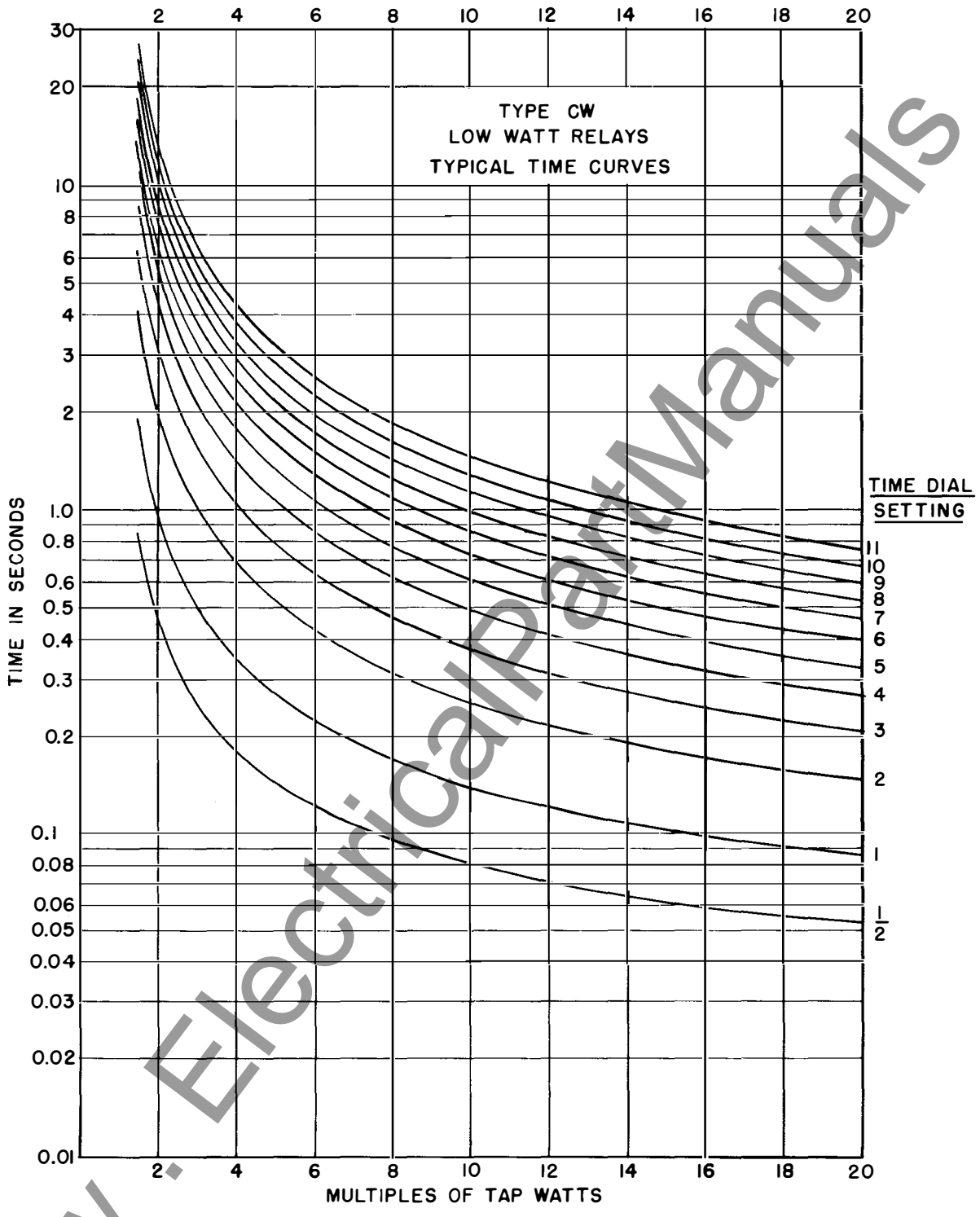


Fig. 4 Typical 60 cycle Time Curves of the 20-120 and 35-200 watt Type CW Relay.

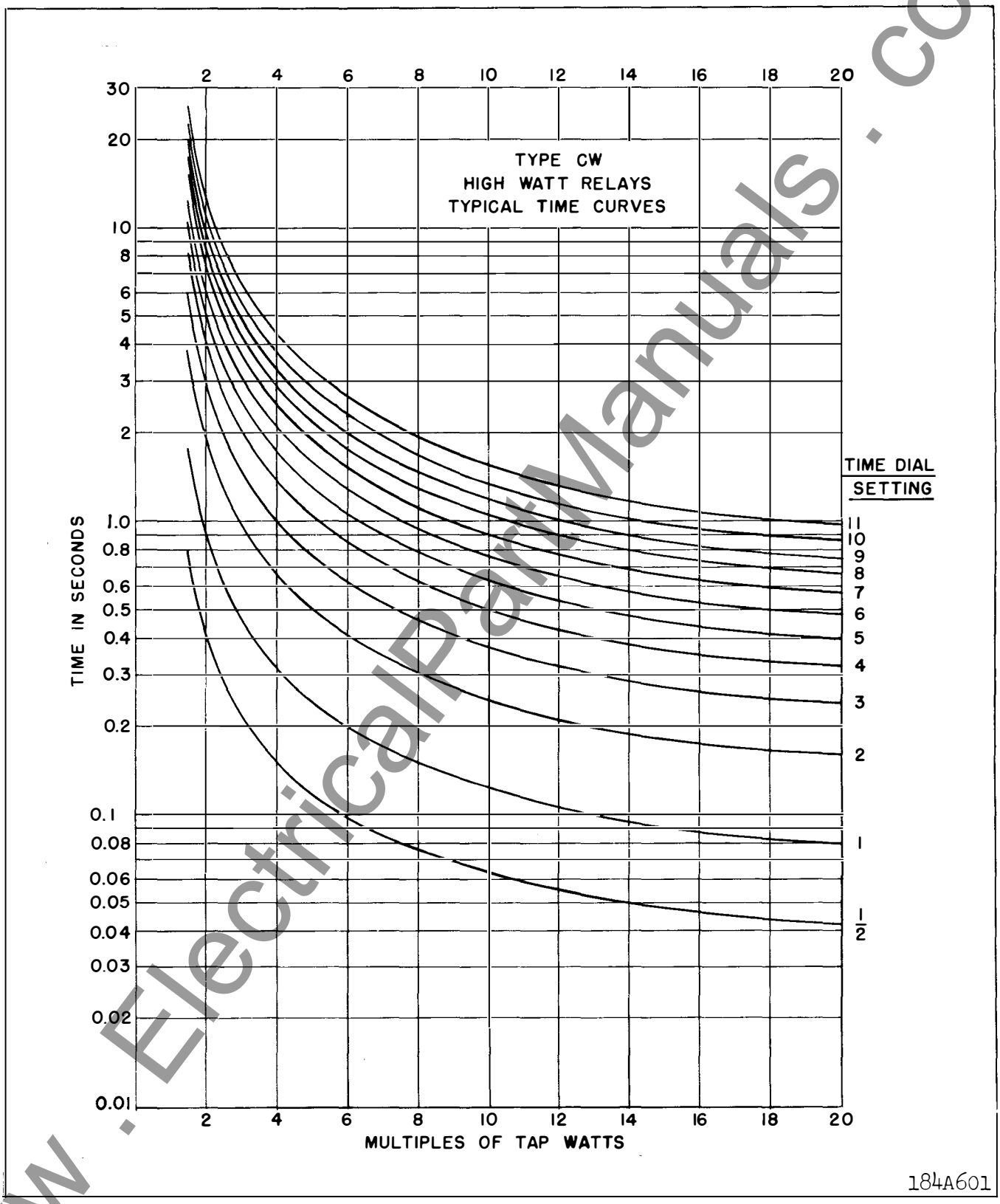


Fig. 5 Typical 60 cycle Time Curves of the 100-600 and 175-1000 watt Type CW Relay.

ENERGY REQUIREMENTS

The 60 cycle burdens of the type CW Relay Three-Phase Application are as follows:

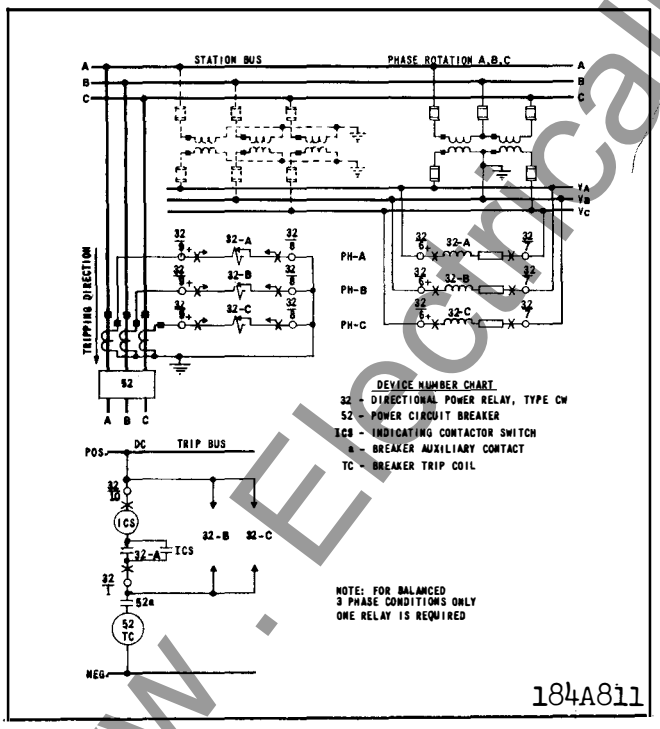
Relay Range	Potential Circuit			Current Circuit			
Watts	Voltage	Voltamperes	Current lags by	Current	Relay Tap	Voltamperes	Current lags by
20 – 120	120	17.9	60°	5 amp.	20	16.2	78°
100 – 600	120	17.9	60°	5 amp.	100	5.4	77°
35 – 200	208	18.8	59°	5 amp.	35	16.2	78°
175 – 1000	208	18.8	59°	5 amp.	175	5.4	77°

Current Coil Ratings:

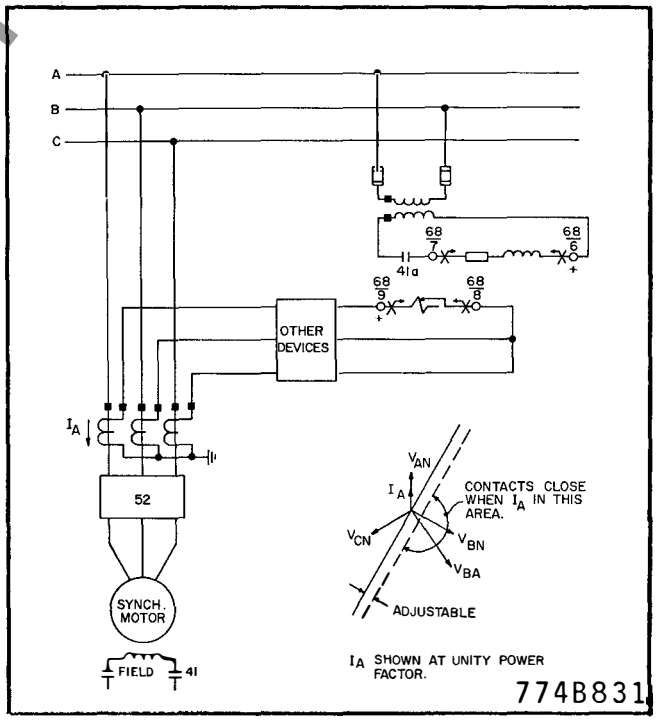
	Continuous	1 Sec.
A. 20-120 Watt Range 35-200 Watt Range	5 Amperes	230 Amperes
B. 100-600 Watt Range 175-1000 Watt Range	8 Amperes	370 Amperes

RENEWAL PARTS

Repair work can be done most satisfactorily at 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.



* *Fig. 6 External Schematic of Three Type CW Relays on a Three-Phase System. Note: For Balanced Three Phase Conditions only One CW Relay is reqyired.*



* *Fig. 7. External Schematic of Three Phase CW Relays for Loss of Field Protection.*

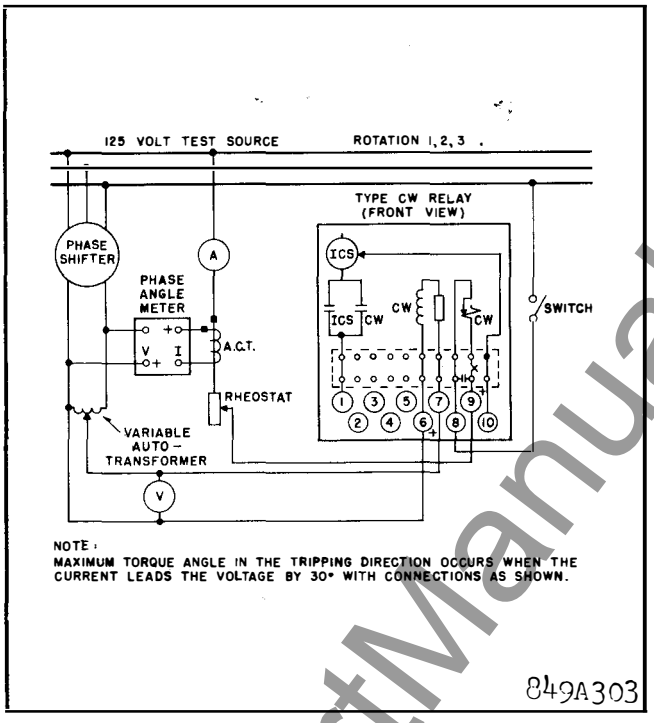
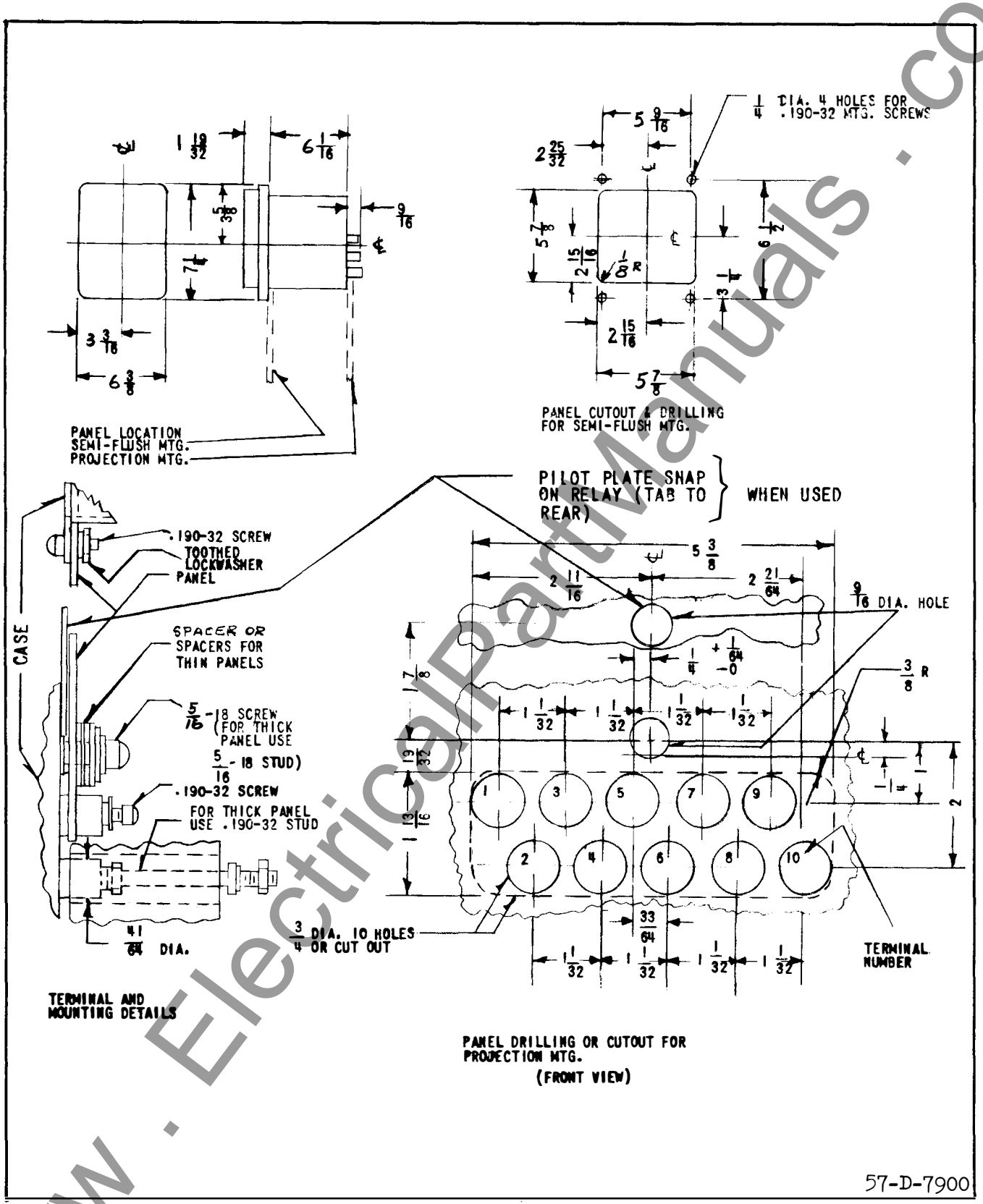


Fig. 8 Diagram of Test Connections for Type CW Relay in FT-11 Case.



* *Fig. 9. Outline and Drilling Plan for the Type CW Relay in the Type FT11 Case.*

WESTINGHOUSE ELECTRIC CORPORATION
RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**
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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CW POWER RELAY
ZERO DEGREE CHARACTERISTIC

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 CW relay is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

CONSTRUCTION

The relay consists of a product operated unit, a phase shifter and an indicating contactor switch (ICS).

Product Type Unit

The electromagnet for the main element has a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the tapped coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current and voltage are in phase. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon direction of the line current. The combination of voltage and current produces an operating torque proportional to power.

Phase Shifter The phase shifter network consists of a capacitor in parallel with the potential coils and a reactor in series with the above combination.

Indicating Contractor 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 CW relays are available in the following ranges and taps:

SINGLE PHASE WATT RANGE	POTENTIAL COIL	TAPS
20 – 120	120	20-30-40-60-80-100-120
100 – 600	120	100-150-200-300-400-500-600

Typical 60 cycle Time-Power Curves are shown in Figs. 3 & 4. The curves are taken at maximum torque which occurs with the current and voltage in phase (within ±4°).

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 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.

SUPERSEDES I.L. 41-241.2B
*Denotes change from superseded issue.

EFFECTIVE MAY 1967

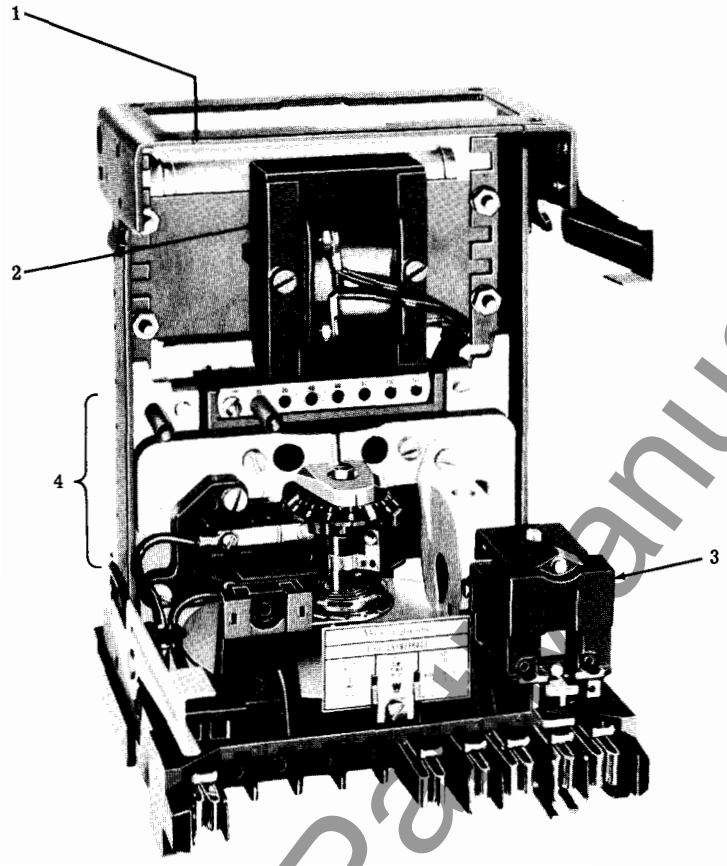


Fig. 1 Type CW Relay Without Case. 1 - Capacitor. 2 - Reactor. 3 - Indicating Contactor Switch (ICS). 4 - Time-Power Unit.

Trip Circuit 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.

SETTINGS

Product Unit

There are two settings to be made. One is the current tap setting, and the second, the time dial setting.

The power to operate the relay equals the primary power divided by the current and potential transformer ratios. This relay power expressed as multiples of the chosen tap locates a value on the abscissa of the Time-Power Curves of Fig. 3 and 4. The relay operating time for various time dial settings then is observed on the ordinate. By changing taps or time dial, the required operating time can be selected for a specific power value.

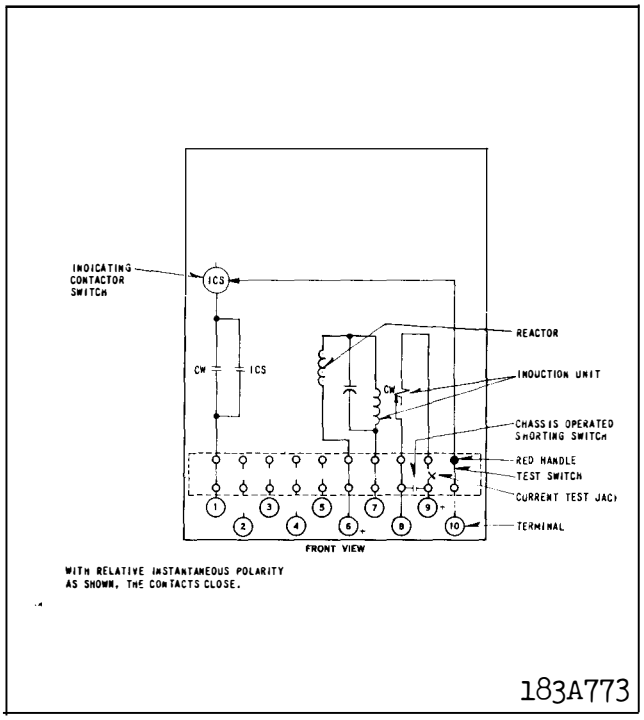


Fig. 2 Internal Schematic of the Type CW Relay in the Type FT 21 Case.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole before removing the old tap screw. This prevents open-circuiting the current transformers.

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.

ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

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 danget of embedding small particles in the face of the soft silver and thus impairing the contact.

Product Unit

Contacts — The index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves.

Minimum Trip Watts — Set the time dial to position 6. Using the lowest tap setting, alternately apply tap value watts plus 3% and tap value watts minus 3% with the current and the voltage in phase. The moving contact should leave the backstop at tap watts plus 3% and should return to the backstop at tap value watts minus 3%. The relay should be calibrated with 10 times tap value watts at the number six time dial position. Check several points on the typical time curves. Time curve calibration is effected by adjusting the position of the permanent magnet keeper.

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 indicator target should drop freely.

ENERGY REQUIREMENTS

The 60 cycle burdens of the type CW Relay Single Phase Application are as follows:

1. The 20-120 Watt, 120 Volt Relay

   A. Potential Circuit Burden at Rated Voltage

Current Lags By	Volt Amperes
26.5°	5.4

   B. Curent Coil at 5 Amperes

TAP	CURRENT LAGS BY	VOLT AMPERES
20	78°	16.2

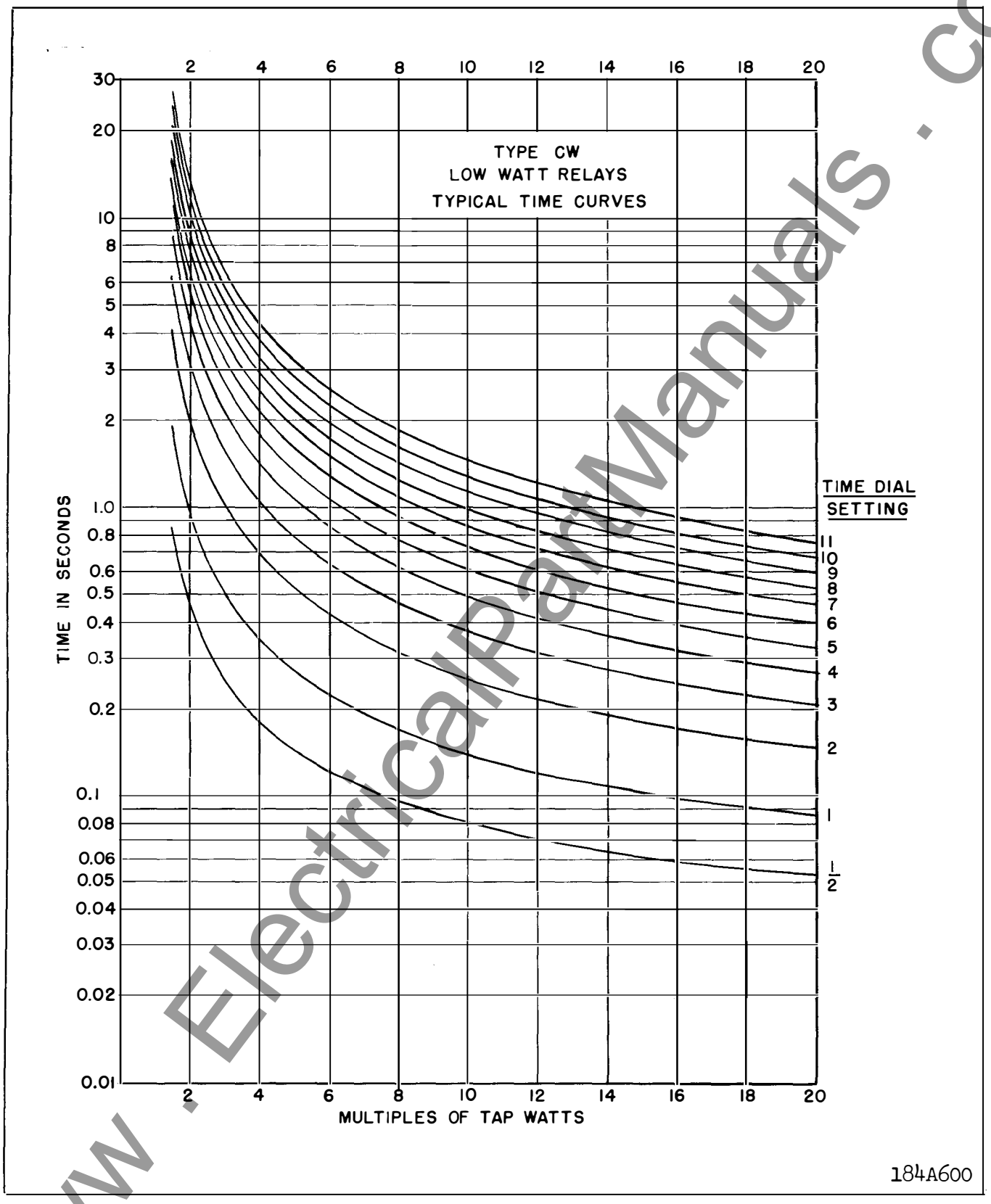


Fig. 3 Typical 60 cycle Time Curves of the 20-120 watt Type CW Relay.

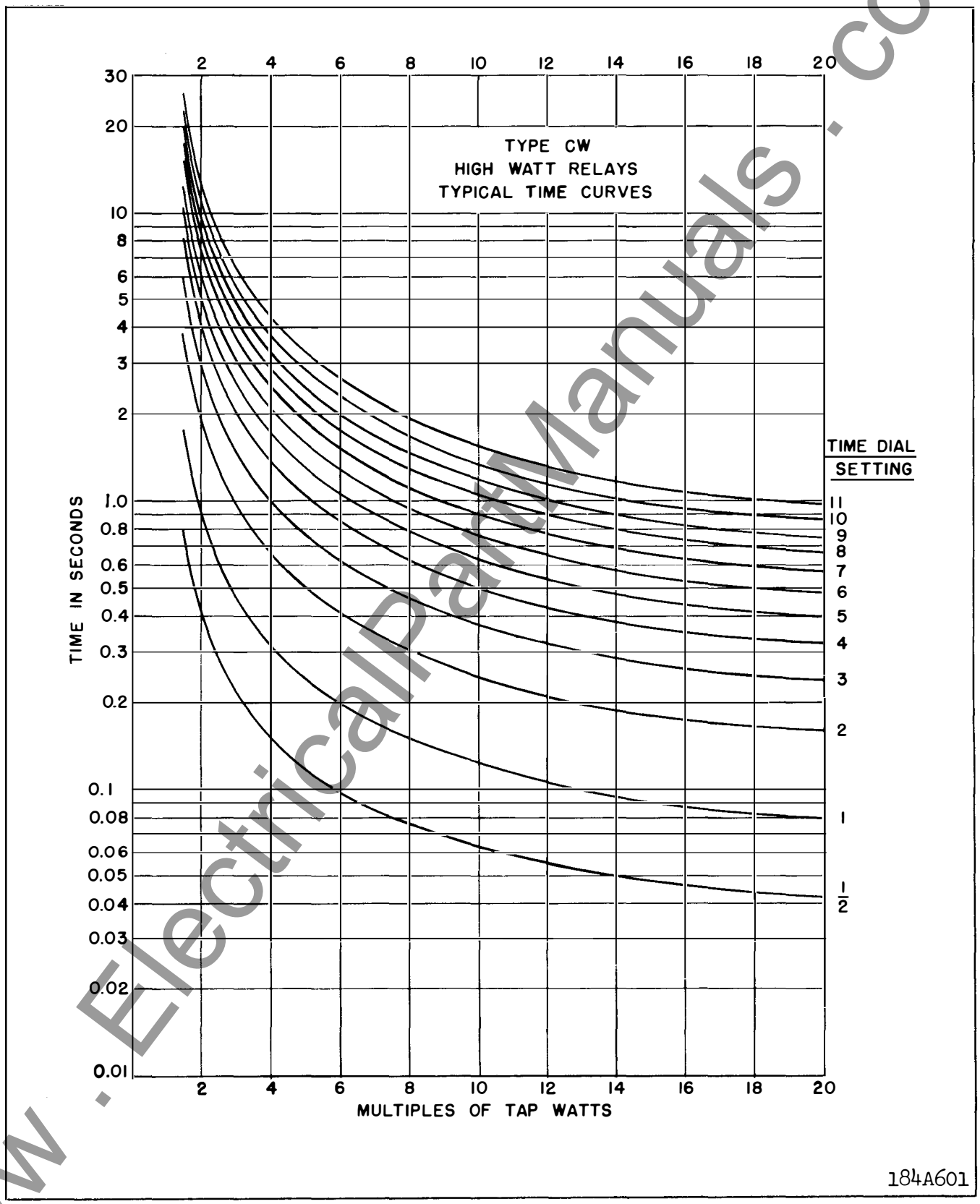


Fig. 4 Typical 60 cycle Time Curves of the 100-600 watt Type CW Relay.

2. The 100-600 Watt, 120 Volt Relay

A. Potential Circuit Burden at Rated Voltage

Current Lags by	Volt Amperes
20°	5.9

B. Current Coil Burden at 5 Amperes

TAP	CURRENT LAGS BY	VOLT AMPERES
100	67°	5.4

Current Coil Ratings

	Continuous	1 Sec.
A. 20-120 Watt Range	5 Amperes	230 Amperes
B. 100-600 Watt Range	8 Amperes	370 Amperes

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.

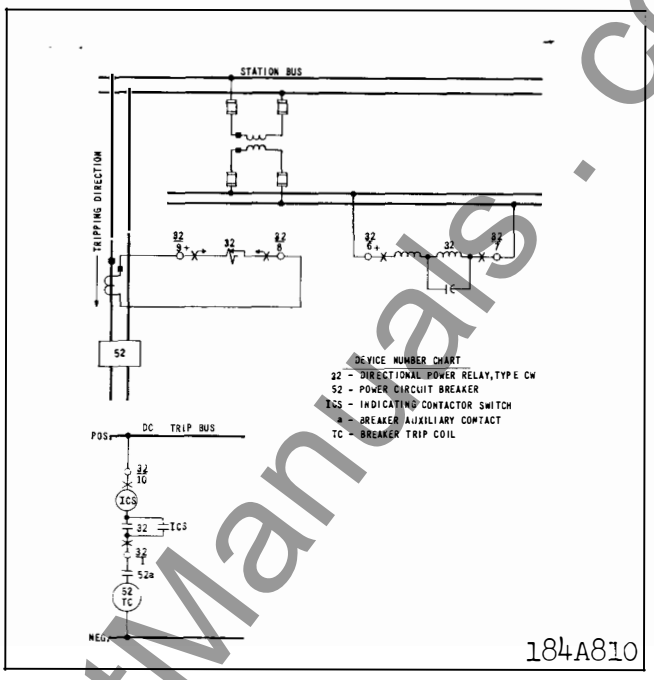


Fig. 5 External Schematic of One Type CW Relay on a Single Phase System.

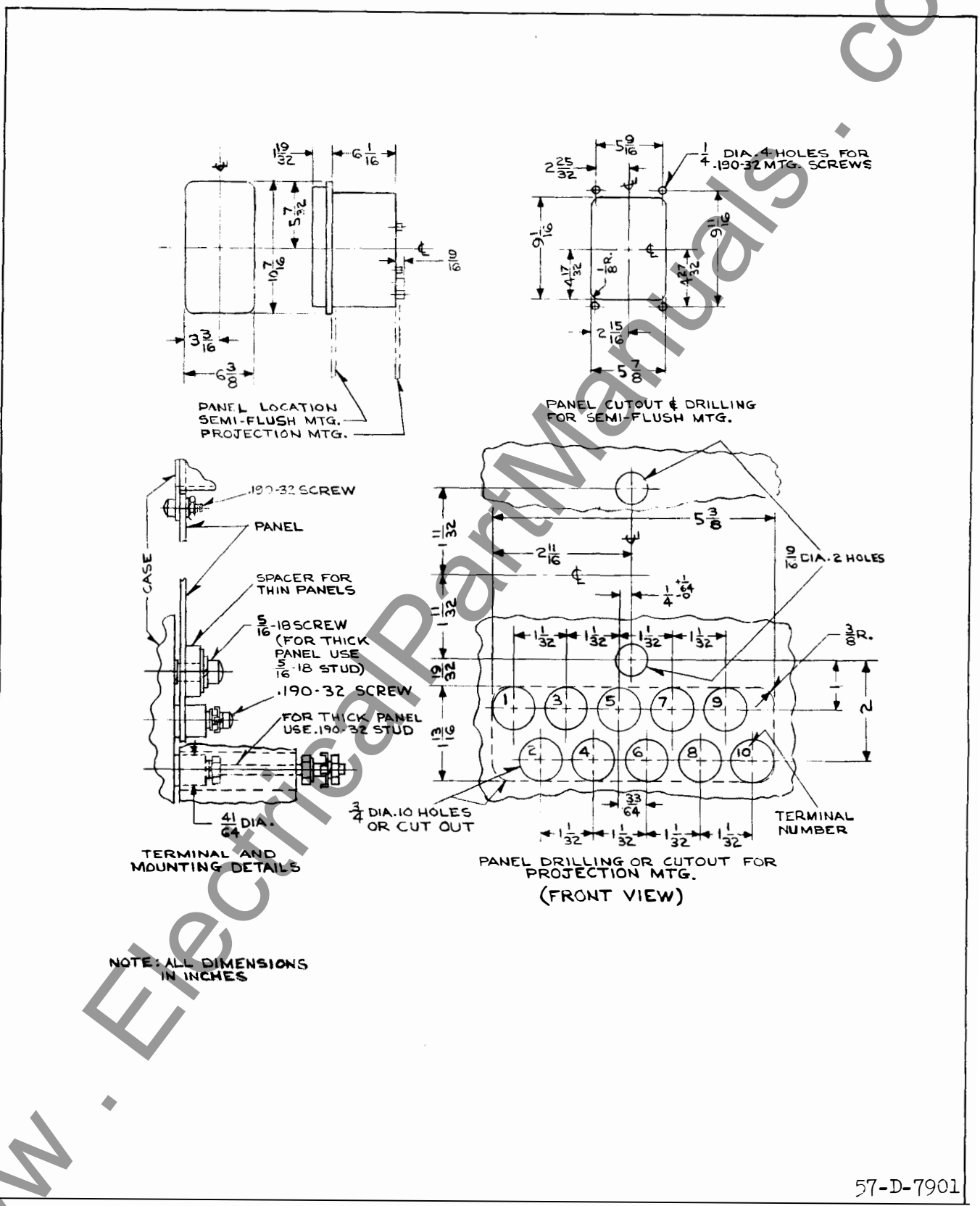
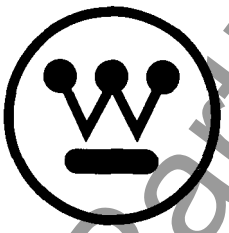


Fig. 6 Outline and Drilling Plan for the Type CW Relay in the Type FT 21 Case.



WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CWD POWER RELAY
Three Phase Watt Sensing 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

These relays are used to initiate switching or control operations when the line watts rises above a preset value, or falls below a preset value, Thus the relay is a current sensing device with high and low current settings.

The CWD relay for the three-phase application uses phase-to-phase voltage and line current, with maximum torque occuring when the relay current leads the relay voltage by 30° at system unity power factor. The relay operates on single phase watts multiplied by $\sqrt{3}$. One CWD relay is required for balanced three phase system and three relays are required for unbalanced conditions.

CONSTRUCTION

The relay consists of an induction disc type watt sensing unit containing a phase shifter.

Product Type Unit

The electromagnet for the main element may have a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the current coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current leads the voltage by 30 degrees. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon magnitude of the line current. The combination of voltage and current produces an operating torque proportional to power.

When the watt sensing unit contact closes to the right this indicates that the line watts are at or above the value of watts desired. Conversely when the watt sensing unit contact closes to the left this indicates that the line watt is at or below value of current desired.

Phase Shifter

The phase shifter network consist of a resistor in series with the potential coils.

CHARACTERISTICS

The type CWD relays are available in the following ranges and taps:

Volts Line-to Line	$\frac{(I_L V_{LL})}{\sqrt{3}}$ (single phase watts)	
	Range	Taps
120	20- 120 100- 600	20-30-40-60-80-100-120 100-150-200-300-400-500-600
208	35- 200 175-1000	35-50-70-100-140-175-200 175-250-350-500-700-875-1000
120	10- 60 20- 120 50- 300 100- 600 150- 900	None None None None None

SUPERSEDES I.L. 41-241.4

* Denotes Change from Superseded Issue.

EFFECTIVE APRIL 1966

The type CWD watt sensing relay has adjustable high and low wattage contacts that can be set around a 150° arc which is calibrated in watts on non-tapped relays, or in percent of tap value watts on tapped relays. These values represent the tripping position of the moving contacts when the value of watts is applied to the relay. For the tapped relays the percent scale markings are 80, 85, 90, 95, 100, 105 and 100.

The moving contacts will assume a position corresponding to the watts applied to the relay and will stay in that position until the wattage changes. If the wattage changes either gradually or suddenly, the contact will assume a new position corresponding to the change unless the travel is limited by the setting of the adjustable contacts. If the contacts are set to close for a particular value of watts, and if a wattage of that exact amount is applied, then the relay is operating at its minimum trip point and the times on repeated operations are not repetitive within close tolerances. However, wattage appreciably greater than the wattage setting, or appreciably less than the wattage setting, result in relay timing operations which are consistent for repeated trials.

The induction unit has inverse timing; that is, the greater the change in watts, the faster the relay contact will travel.

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.

SETTINGS

Product Unit

The CWD relay for three-phase 208V application has taps which represents single phase watts multiplied by $\sqrt{3}$. The power to operate the relay equals the three phase primary power divided by the quantity $\sqrt{3}$ times the current and potential transformer ratios.

The watt sensing unit settings can be defined either by contact settings or tap setting. The high and low watt contact settings are described under "Characteristics".

Relays which are tapped have a connector screw on the terminal plate above the scale which makes connections to various turns on the operating coil. The tap setting is made by placing this screw in the desired tap as marked on the terminal plate.

Caution

Since the tap block connector screw carries operating current, be sure that the screw is turned tight. In order to avoid opening the current transformer circuits when changing taps under load, connect the spare connector screw in the desired tap position before removing the other tap screw from the original tap position.

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 "SETTING" should be required.

Acceptance Check

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

A. Current Sensing Unit

1. Contact Adjustment Check — Set the left-hand contact in the center of the scale and adjust the wattage until the moving contact just makes. Move the left-hand contact out of the way and bring the right-hand contact up until the contacts just make. The right pointer should be within ± 1/32" of where the left-hand pointer was.

2. Calibration Check — Check the scale markings by setting either of the two contacts at a value marked on the scale, then alternately apply this wattage plus 5% and minus 5% for non-tapped relays, and plus and minus 3% for tapped relays. The under wattage contact should make at the lower wattage and break at the higher wattage. For the over wattage contact check, the contact will make for the higher wattage and break at the lower wattage.

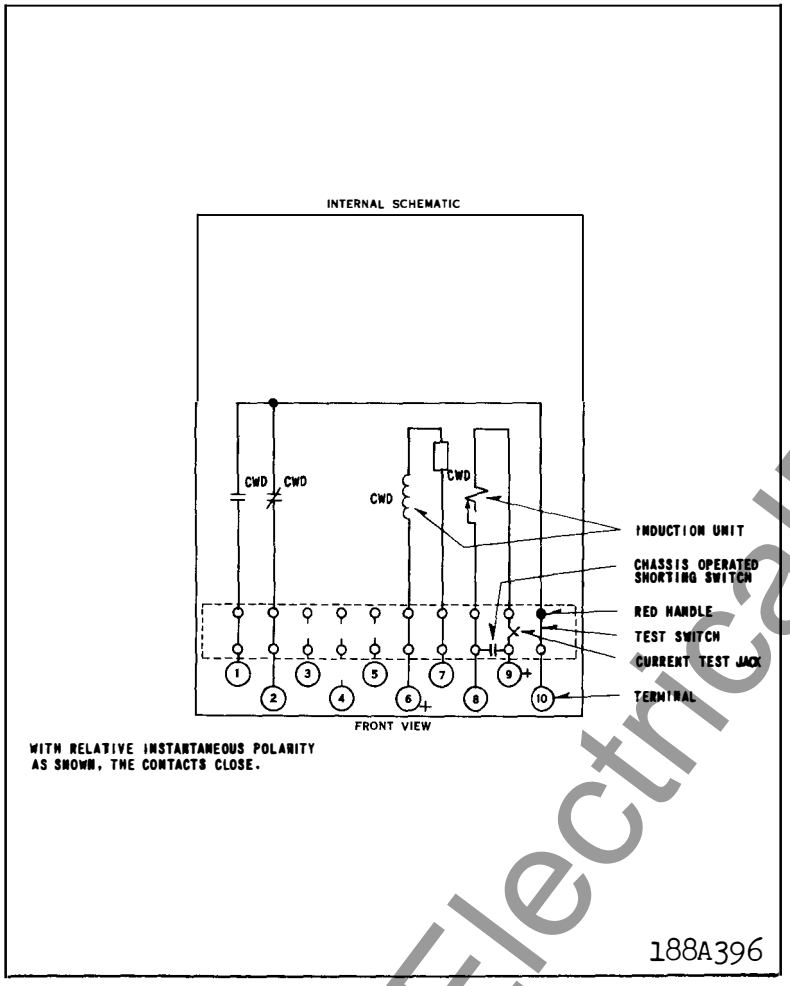


Fig. 1 Internal Schematic of the Tapped Type Relay in the Type FT 11 Case.

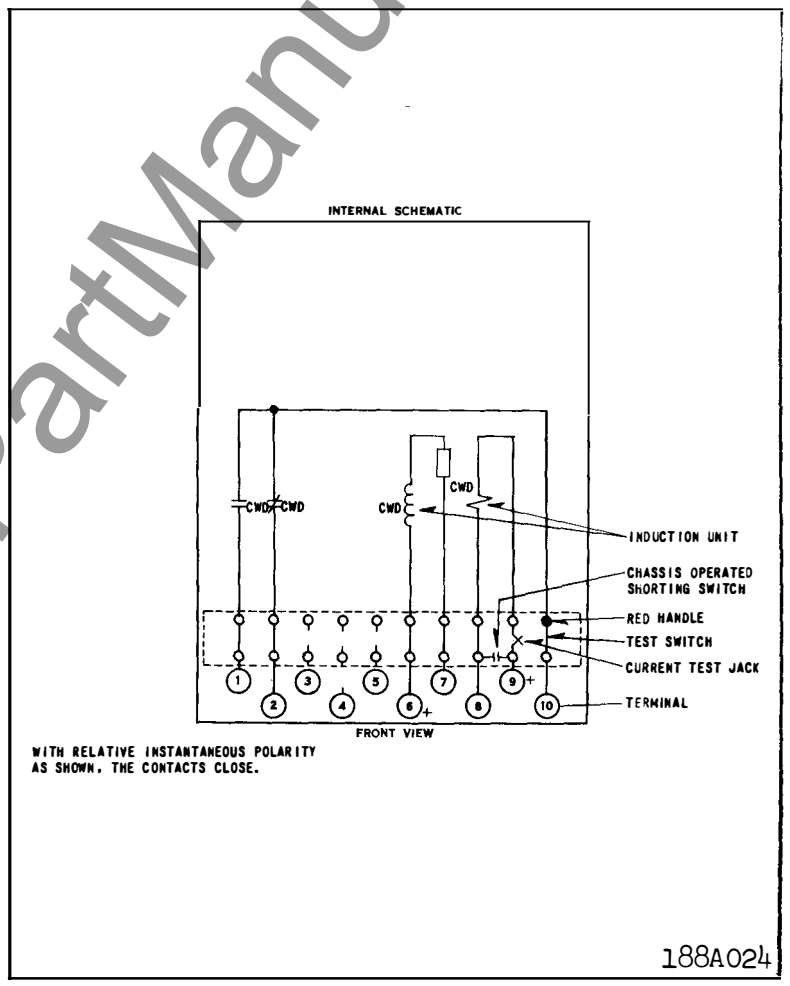


Fig. 2. Internal Schematic of the Non-Tapped Type Relay in the Type FT 11 Case.

Routine Maintenance

All relays should be inspected periodically and the time of operation should be checked at least once every year or at such other time intervals as may be dictated by experience to be suitable to the particular application. The use of phantom loads, in testing induction-type relays, should be avoided, since the resulting distorted current wave form will produce an error in operation.

All contacts should be periodically cleaned. A contact burnisher #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.

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. Watts Sensing Unit

1. Contacts – Apply sufficient wattage to the relay, to make the disc float in the center of its travel. Move both of the adjustable contacts until they just make with the moving contact. If the two contact pointers do not meet at the same point on the scale (± 1/32"), adjust the follow on both adjustable contacts. Approximately the same follow should be in each of the adjustable stationary contacts.

2. Calibration Check – The adjustment of the spring tension in calibrating the relay is most conveniently made with the damping magnet removed.

Set either of the adjustable stationary contacts in the center of its travel and apply this wattage to the relay. Wind up the spiral spring by means of the spring adjuster until the stationary contact and moving contact just make.

Check the other markings by setting the adjustable contact on these markings and applying the corresponding wattage to the relay. The contacts should make within plus or minus 5% of contact setting for non-tapped relays and plus or minus 3% of contact setting for tapped relays.

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

The 60 cycle burdens of the type CWD Relay Three-Phase Applications are as follows:

Relay Range	Potential Circuit			Current Circuits			
Watts	Voltage	Voltamperes	Current lags by	Current	Relay Tap	Voltamperes	Current lags by
10 – 60 20 – 120 50 – 300 100 – 600 150 – 900	120	20.5	68°	5 amp.	None	16.2	78°
35 – 200	208	18.8	59°	5 amps.	35	16.2	78°
100 – 600	120	20.5	68°	5 amps.	100	5.4	67°
175 – 1000	208	18.8	59°	5 amps.	175	5.4	67°

Current Coil Ratings:

	Watt Range	Continuous	1 Sec.
A. Non-Tapped	10 – 60 20 – 100 50 – 300 100 – 600 150 – 900	5 amps.	230 amps.
B. Tapped	35 – 200	5 amps.	230 amps.
	100 – 600 175 – 1000	8 amps.	370 amps.

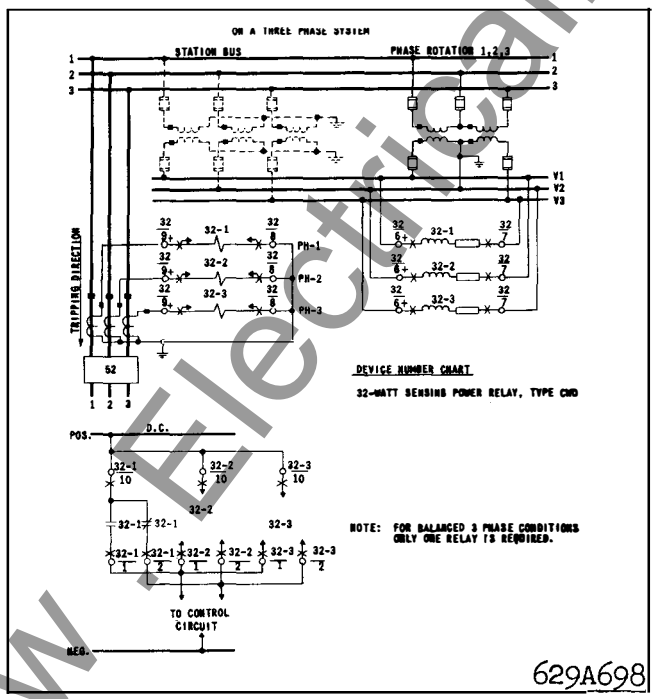


Fig. 3 External Schematic of Three Type CWD Relays on a Three-Phase System. Note: For Balanced Three Phase Conditions only One CWD Relay is required.

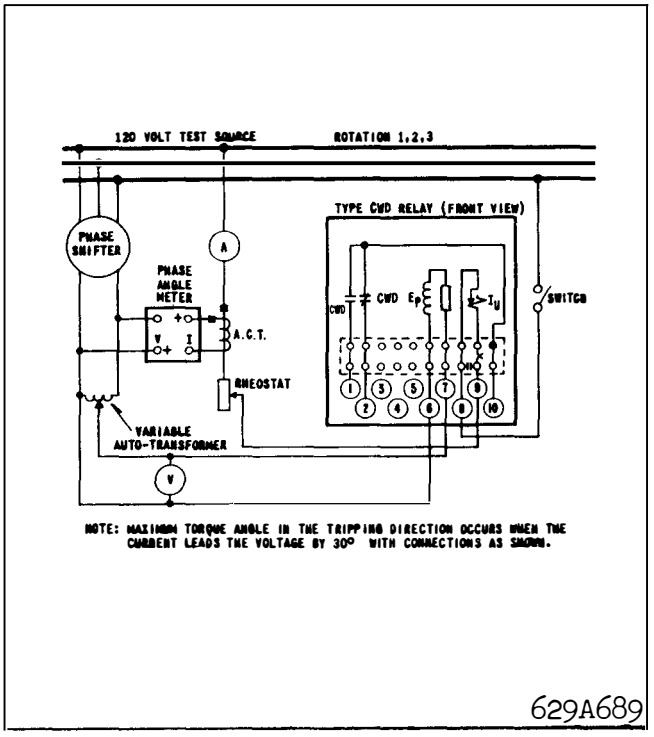


Fig. 4 Diagram of Test Connections for CWD Relays.

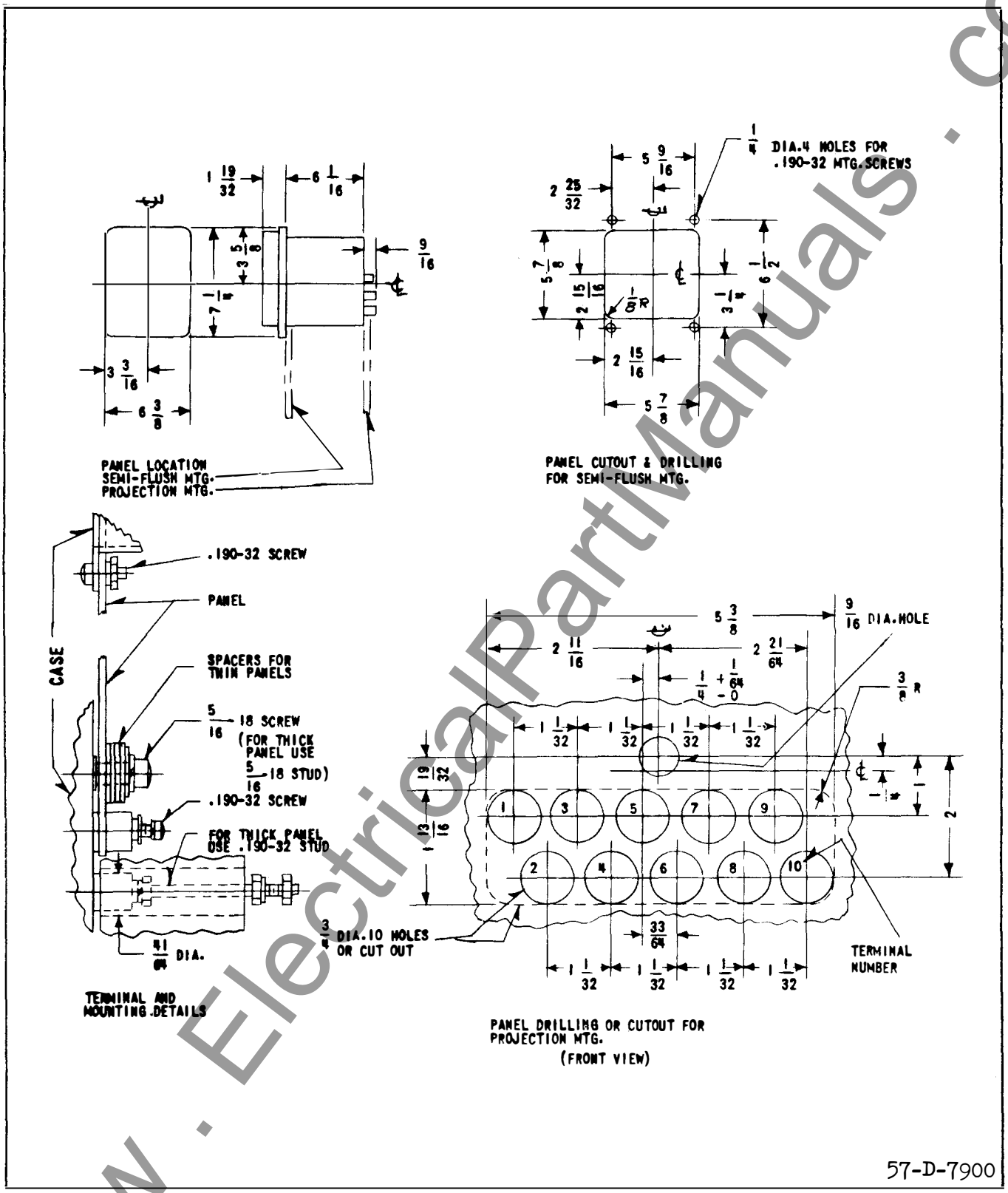
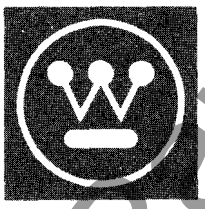


Fig. 5 Outline and Drilling Plan for the Type CWD Relay in the Type FT 11 Case.



WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CW POWER RELAY

30° CHARACTERISTIC FOR THREE PHASE

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 CW relay for three-phase application is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

* The CW relay for three-phase application uses phase-to-phase voltage and line current, with maximum torque occuring when the relay current leads the relay voltage by 30° at system unity power factor. Tap value is the volt-amperes at which the contacts close with relay current leading relay voltage by 30°. One CW relay is required for balanced three phase system and three relays are required for unbalanced conditions.

CONSTRUCTION

The relay consists of a product operated unit, a phase shifter and an indicating contactor switch (ICS).

Product Type Unit

The electromagnet for the main element has a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the tapped coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current leads the voltage by 30 degrees. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon direction of the line current. The combination of voltage and current produces an operating torque proportional to power.

Phase Shifter – The phase shifter network consist of a resistor in series with the potential coils.

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 CW relays are available in the following ranges and taps:

Volts Line-to Line	$\left(\frac{(I_L V_{LL})}{\sqrt{3}} \text{ single phase watts}\right)$	
	Range	Taps
120	20– 120	20– 30– 40– 60– 80–100– 120
	100– 600	100–150–200–300–400–500– 600
208	35– 200	35– 50– 70–100–140–175– 200
	175–1000	175–250–350–500–700–875–1000

Typical 60 cycle Time-Power Curves are shown in Figs. 3 & 4. The curves are taken at maximum torque which occurs with the current leading the voltage by 30 degrees. (within ±4°)

SUPERSEDES I.L. 41-241.3G

*Denotes change from superseded issue.

EFFECTIVE SEPTEMBER 1974

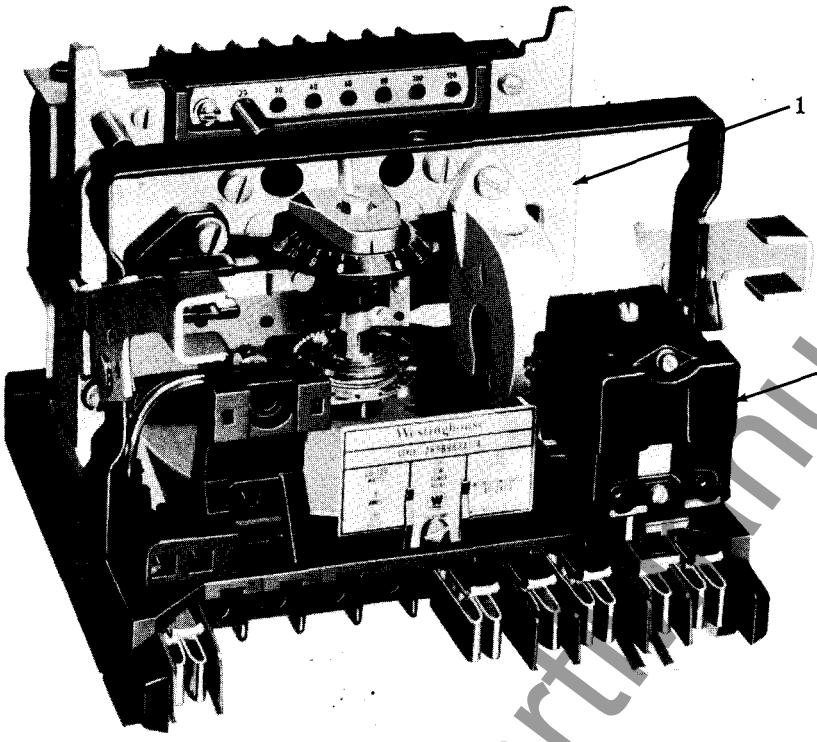


Fig. 1. 1. Time-power unit. 2. Indicating Connector Switch (ICS). Note: Phase shifting resistor is mounted in rear.

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 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.

Trip Circuit 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.

SETTINGS

Product Unit

There are two settings to be made. One is the current tap setting, and the second, the time dial setting.

The CW relay for three-phase application has taps which represents single phase watts multiplied by $\sqrt{3}$. The power to operate the relay equals the three phase primary power divided by the quantity ($\sqrt{3}$ times the current and potential transformer ratios).

$$* \text{TAP} = \frac{\sqrt{3}\ P1\phi}{Rc\,Rv} = \frac{P3\phi}{\sqrt{3}\ Rc\,Rv}.$$

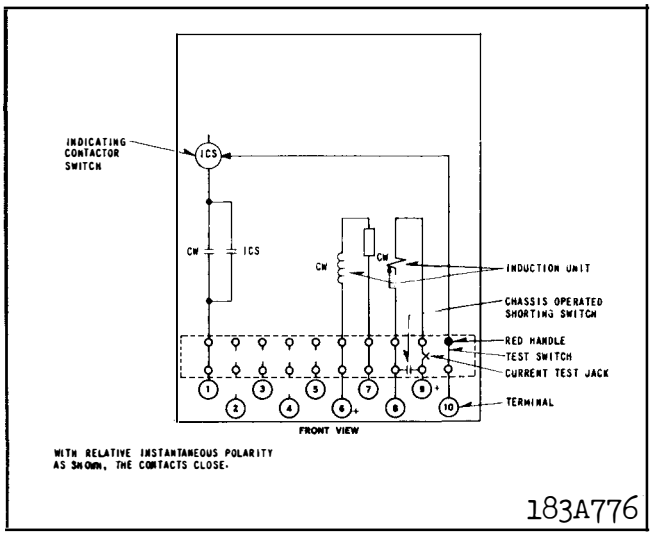


Fig. 2. Internal Schematic of the Type CW Relay in the Type FT11 Case.

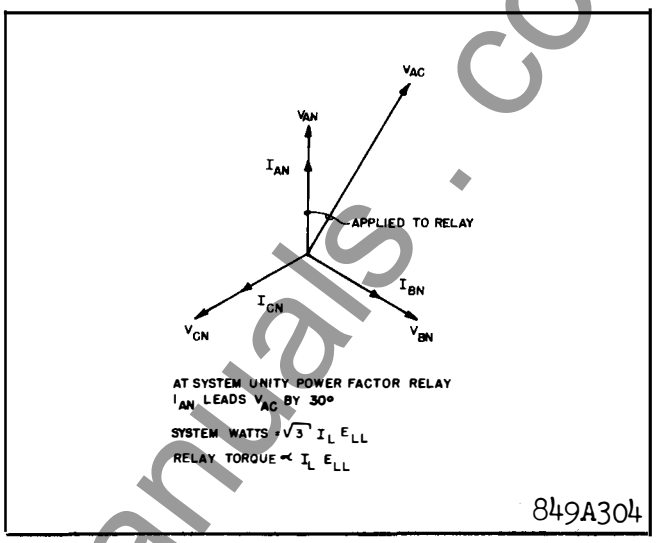


Fig. 3 Current and Voltage Phasors at System Unity Power Factor Applied to Type CW Relay.

This relay power expressed as multiples of the chosen tap locates a value on the abscissa of the Time-Power Curves of Fig. 3 and 4. The relay operating time for various time dial settings then is observed on the ordinate. By changing taps or time dial, the required operating time can be selected for specific power value.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole before removing the old tap screw. This prevents open-circuiting the current transformers.

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.

ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

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.

Product Unit

Contacts – The index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves.

Minimum Trip Volt Amperes – Set the time dial to position 6. Using the lowest tap setting, alternately apply tap value volt amperes plus 3% and tap value volt amperes minus 3% with the current leading the voltage by 30°. The moving contact should leave the backstop at tap value plus 3% and should return to the backstop at tap value minus 3%. The relay should be calibrated with 10 times tap value at the number six time dial position. Check several points on the typical time curves. Time curve calibration is affected by adjusting the position of the permanent magnet keeper. Note that with current leading voltage by 30 degrees the actual watts applied to the relay are .866 times tap value at pickup.

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 indicator target should drop freely.

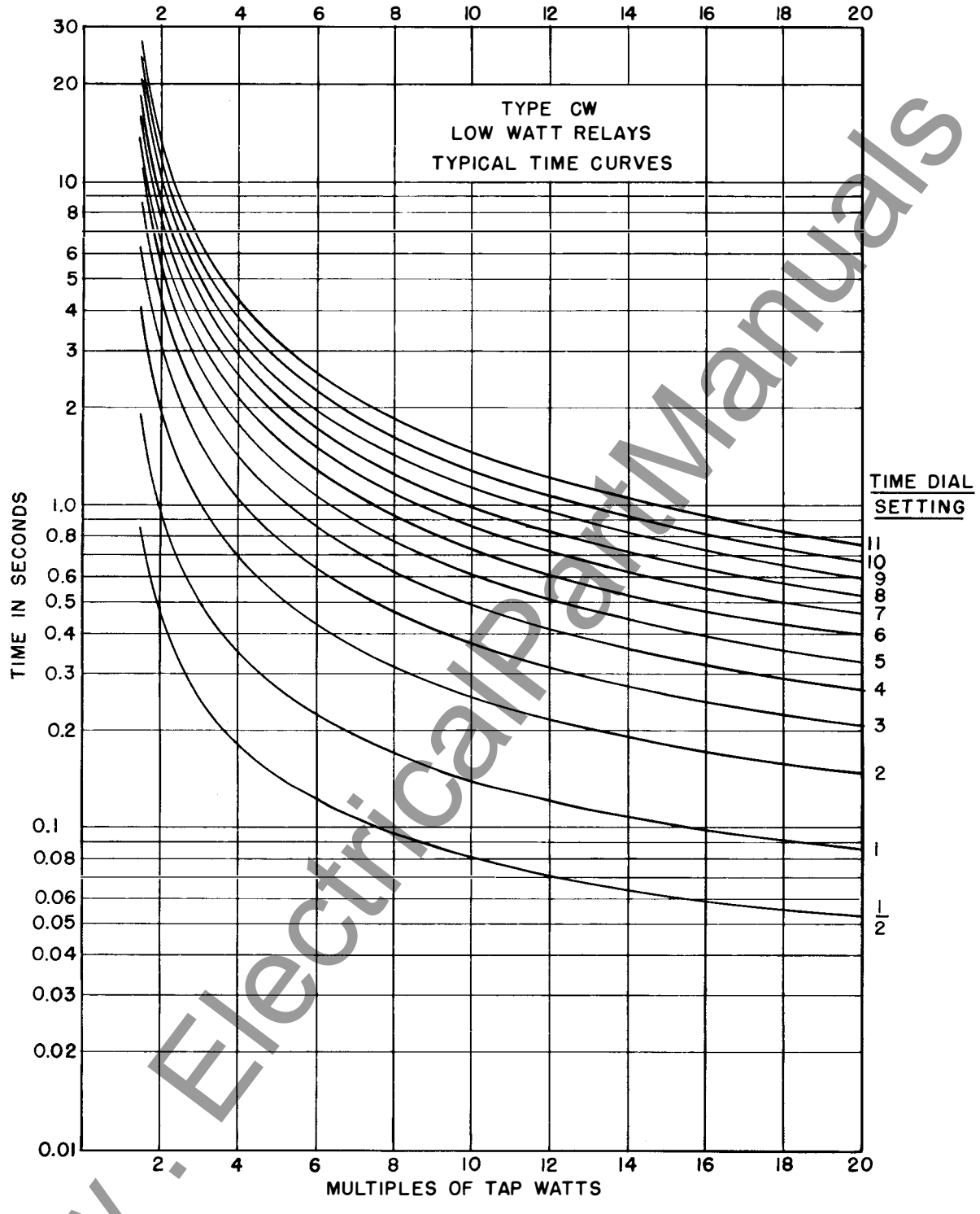


Fig. 4 Typical 60 cycle Time Curves of the 20-120 and 35-200 watt Type CW Relay.

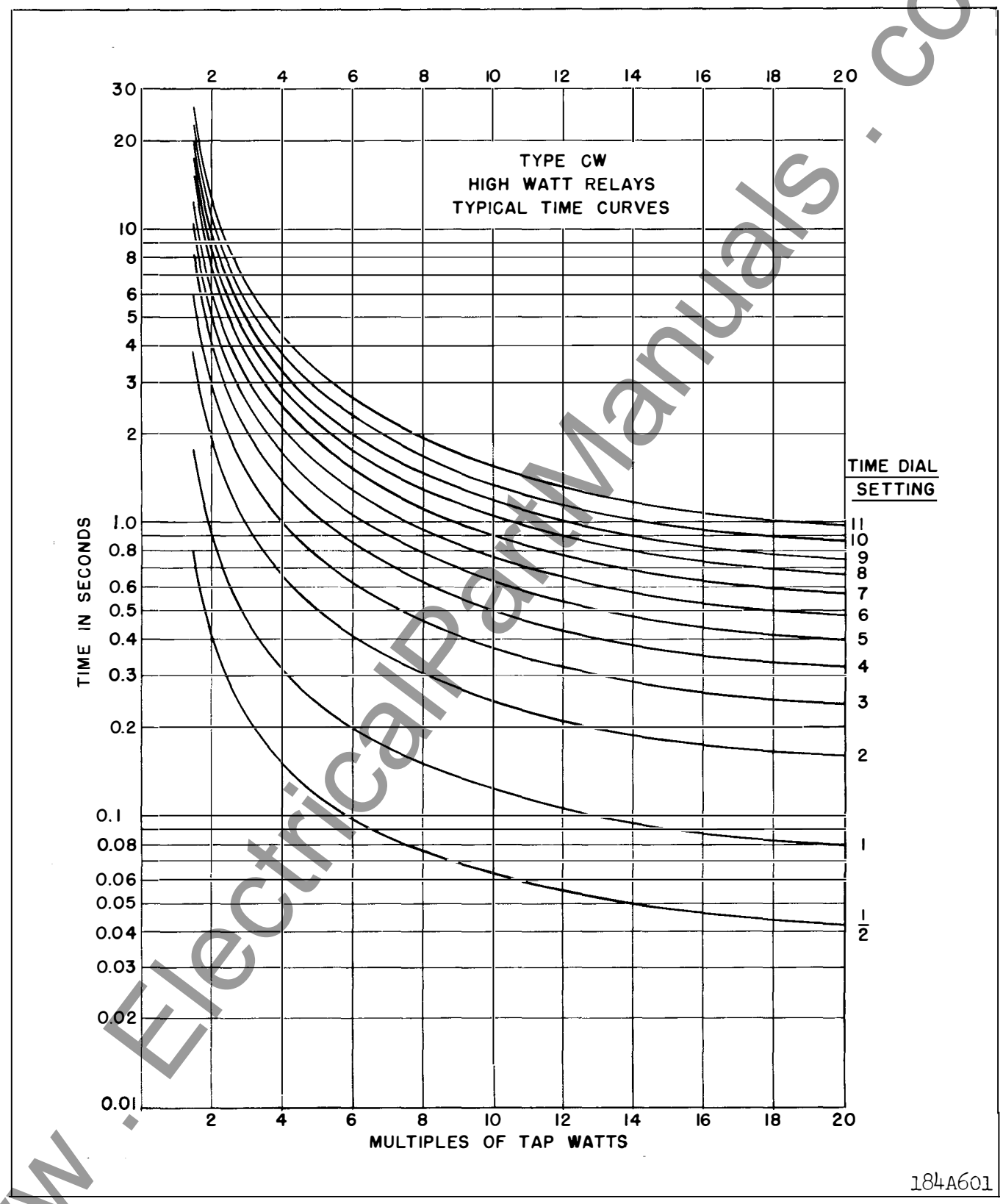


Fig. 5 Typical 60 cycle Time Curves of the 100-600 and 175-1000 watt Type CW Relay.

ENERGY REQUIREMENTS

The 60 cycle burdens of the type CW Relay Three-Phase Application are as follows:

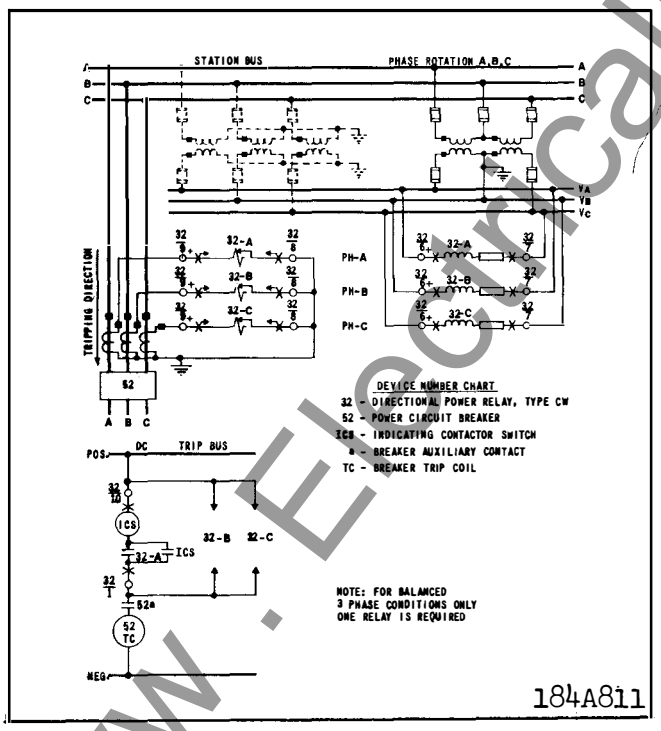
Relay Range	Potential Circuit			Current Circuit			
Watts	Voltage	Voltamperes	Current lags by	Current	Relay Tap	Voltamperes	Current lags by
20 – 120	120	17.9	60°	5 amp.	20	16.2	78°
100 – 600	120	17.9	60°	5 amp.	100	5.4	77°
35 – 200	208	18.8	59°	5 amp.	35	16.2	78°
175 – 1000	208	18.8	59°	5 amp.	175	5.4	77°

Current Coil Ratings:

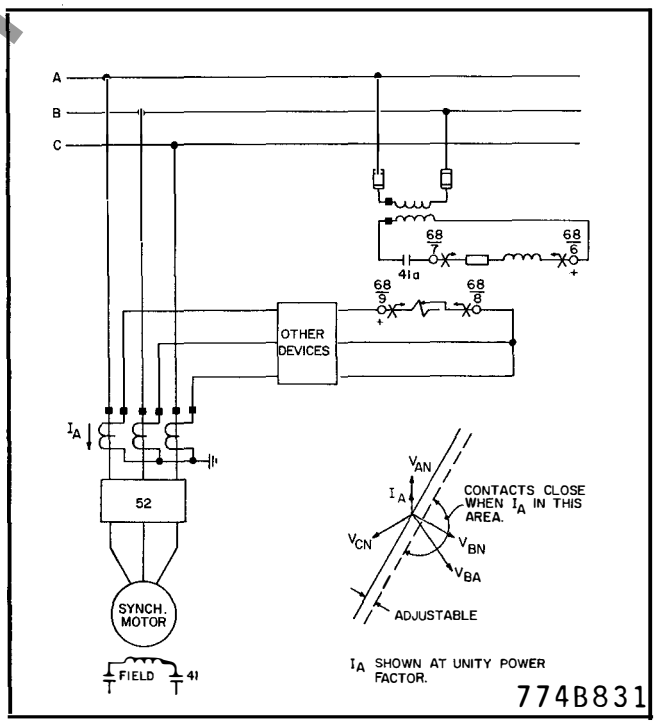
	Continuous	1 Sec.
A. 20-120 Watt Range 35-200 Watt Range	5 Amperes	230 Amperes
B. 100-600 Watt Range 175-1000 Watt Range	8 Amperes	370 Amperes

RENEWAL PARTS

Repair work can be done most satisfactorily at 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.



* *Fig. 6 External Schematic of Three Type CW Relays on a Three-Phase System. Note: For Balanced Three Phase Conditions only One CW Relay is required.*



* *Fig. 7. External Schematic of Three Phase CW Relays for Loss of Field Protection.*

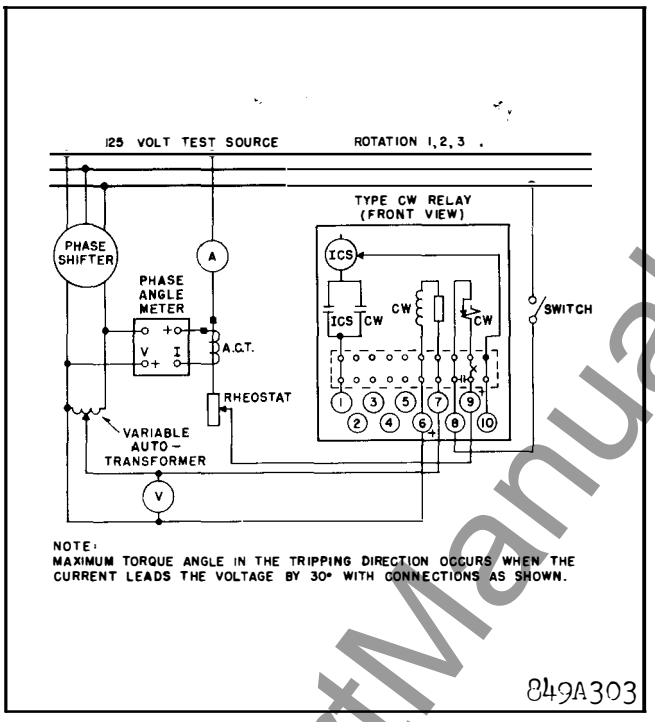
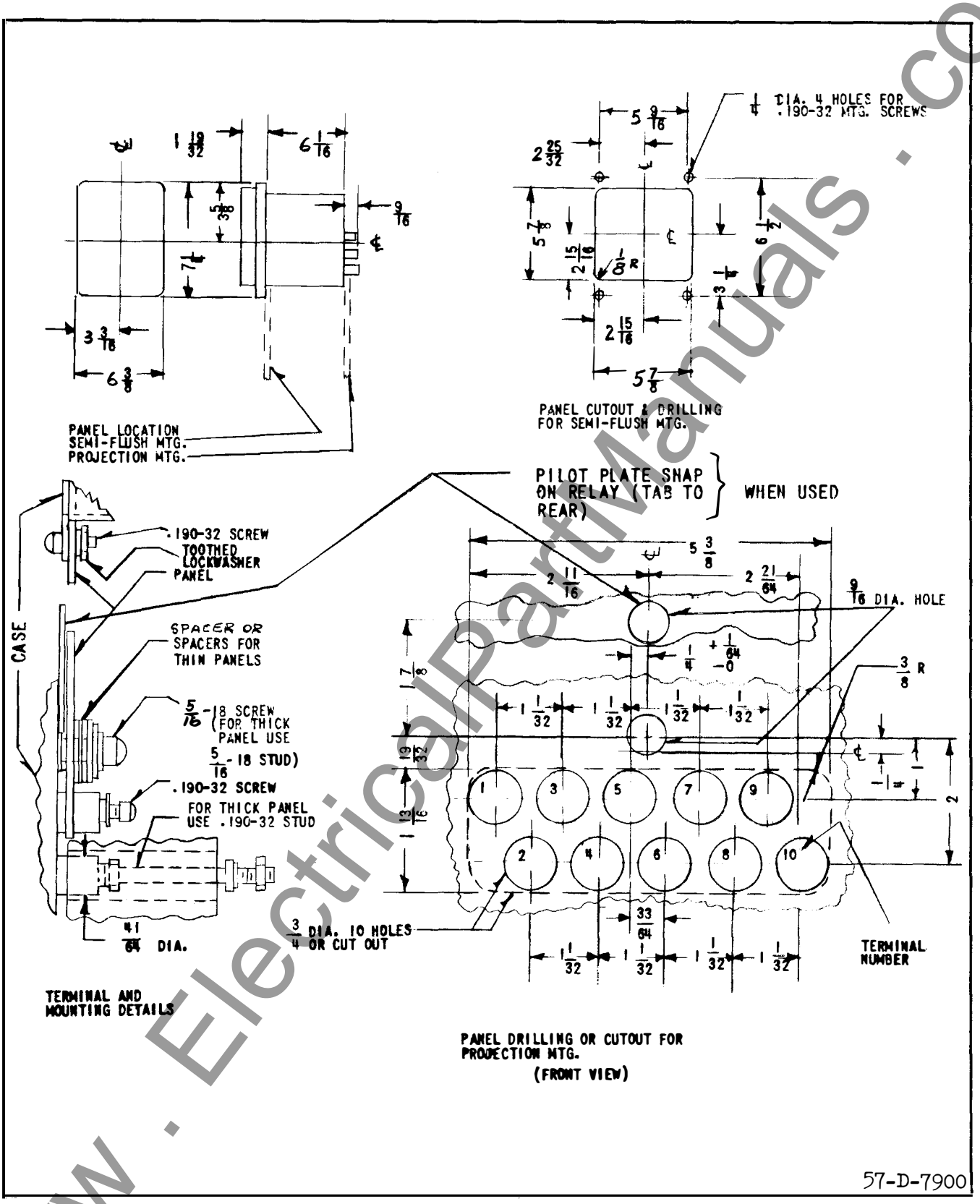


Fig. 8 Diagram of Test Connections for Type CW Relay in FT-11 Case.



* *Fig. 9. Outline and Drilling Plan for the Type CW Relay in the Type FT11 Case.*

WESTINGHOUSE ELECTRIC CORPORATION
RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**
Printed in U.S.A.

instruction leaflet 41-242.3 pgs. 1-12
dated February, 1961
type CWP-1
sensitive directional ground relay

THIS PUBLICATION IS TEMPORARILY OUT OF STOCK. A COPY WILL BE SENT TO YOU AS SOON AS IT IS AVAILABLE

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CWD POWER RELAY
Three Phase Watt Sensing 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

These relays are used to initiate switching or control operations when the line watts rises above a preset value, or falls below a preset value, Thus the relay is a current sensing device with high and low current settings.

The CWD relay for the three-phase application uses phase-to-phase voltage and line current, with maximum torque occuring when the relay current leads the relay voltage by 30° at system unity power factor. The relay operates on single phase watts multiplied by $\sqrt{3}$. One CWD relay is required for balanced three phase system and three relays are required for unbalanced conditions.

CONSTRUCTION

The relay consists of an induction disc type watt sensing unit containing a phase shifter.

Product Type Unit

The electromagnet for the main element may have a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the current coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current leads the voltage by 30 degrees. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon magnitude of the line current. The combination of voltage and current produces an operating torque proportional to power.

When the watt sensing unit contact closes to the right this indicates that the line watts are at or above the value of watts desired. Conversely when the watt sensing unit contact closes to the left this indicates that the line watt is at or below value of current desired.

Phase Shifter

The phase shifter network consist of a resistor in series with the potential coils.

CHARACTERISTICS

The type CWD relays are available in the following ranges and taps:

Volts Line-to Line	$\frac{(I_L V_{LL})}{\sqrt{3}}$ (single phase watts)	
	Range	Taps
120	20- 120 100- 600	20-30-40-60-80-100-120 100-150-200-300-400-500-600
208	35- 200 175-1000	35-50-70-100-140-175-200 175-250-350-500-700-875-1000
120	10- 60 20- 120 50- 300 100- 600 150- 900	None None None None None

SUPERSEDES I.L. 41-241.4

* Denotes Change from Superseded Issue.

EFFECTIVE APRIL 1966

The type CWD watt sensing relay has adjustable high and low wattage contacts that can be set around a 150° arc which is calibrated in watts on non-tapped relays, or in percent of tap value watts on tapped relays. These values represent the tripping position of the moving contacts when the value of watts is applied to the relay. For the tapped relays the percent scale markings are 80, 85, 90, 95, 100, 105 and 100.

The moving contacts will assume a position corresponding to the watts applied to the relay and will stay in that position until the wattage changes. If the wattage changes either gradually or suddenly, the contact will assume a new position corresponding to the change unless the travel is limited by the setting of the adjustable contacts. If the contacts are set to close for a particular value of watts, and if a wattage of that exact amount is applied, then the relay is operating at its minimum trip point and the times on repeated operations are not repetitive within close tolerances. However, wattage appreciably greater than the wattage setting, or appreciably less than the wattage setting, result in relay timing operations which are consistent for repeated trials.

The induction unit has inverse timing; that is, the greater the change in watts, the faster the relay contact will travel.

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.

SETTINGS

Product Unit

The CWD relay for three-phase 208V application has taps which represents single phase watts multiplied by $\sqrt{3}$. The power to operate the relay equals the three phase primary power divided by the quantity $\sqrt{3}$ times the current and potential transformer ratios.

The watt sensing unit settings can be defined either by contact settings or tap setting. The high and low watt contact settings are described under ''Characteristics''.

Relays which are tapped have a connector screw on the terminal plate above the scale which makes connections to various turns on the operating coil. The tap setting is made by placing this screw in the desired tap as marked on the terminal plate.

Caution

Since the tap block connector screw carries operating current, be sure that the screw is turned tight. In order to avoid opening the current transformer circuits when changing taps under load, connect the spare connector screw in the desired tap position before removing the other tap screw from the original tap position.

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 ''SETTING'' should be required.

Acceptance Check

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

A. Current Sensing Unit

1. Contact Adjustment Check — Set the left-hand contact in the center of the scale and adjust the wattage until the moving contact just makes. Move the left-hand contact out of the way and bring the right-hand contact up until the contacts just make. The right pointer should be within ± 1/32'' of where the left-hand pointer was.

2. Calibration Check — Check the scale markings by setting either of the two contacts at a value marked on the scale, then alternately apply this wattage plus 5% and minus 5% for non-tapped relays, and plus and minus 3% for tapped relays. The under wattage contact should make at the lower wattage and break at the higher wattage. For the over wattage contact check, the contact will make for the higher wattage and break at the lower wattage.

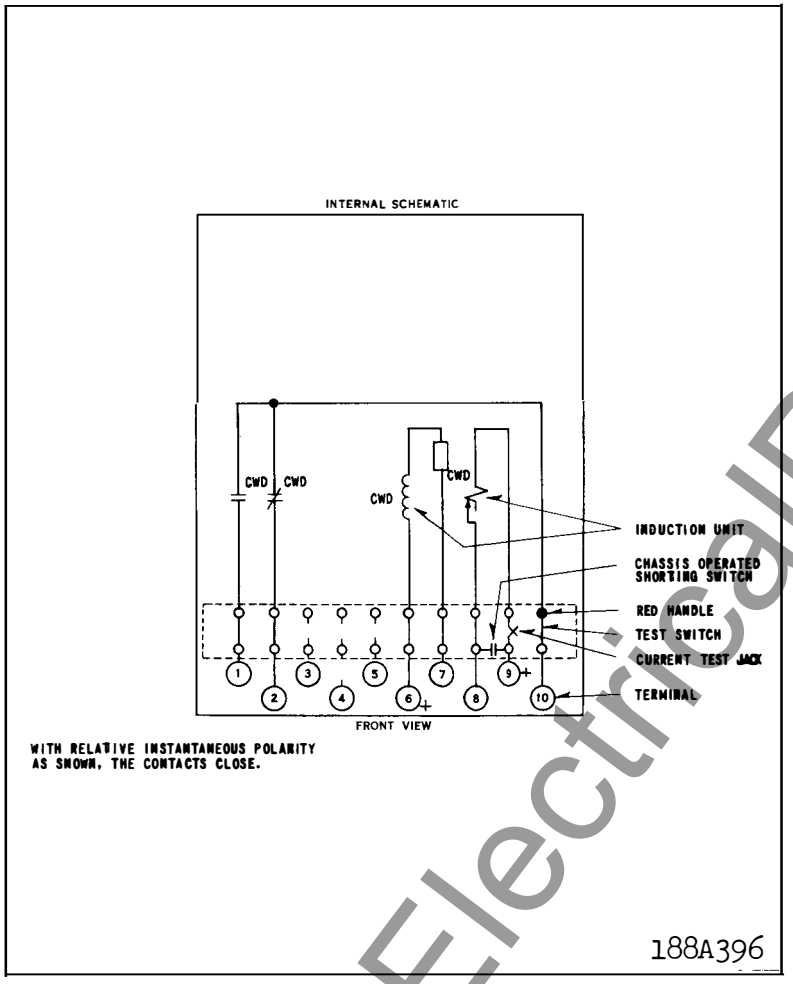


Fig. 1 Internal Schematic of the Tapped Type Relay in the Type FT 11 Case.

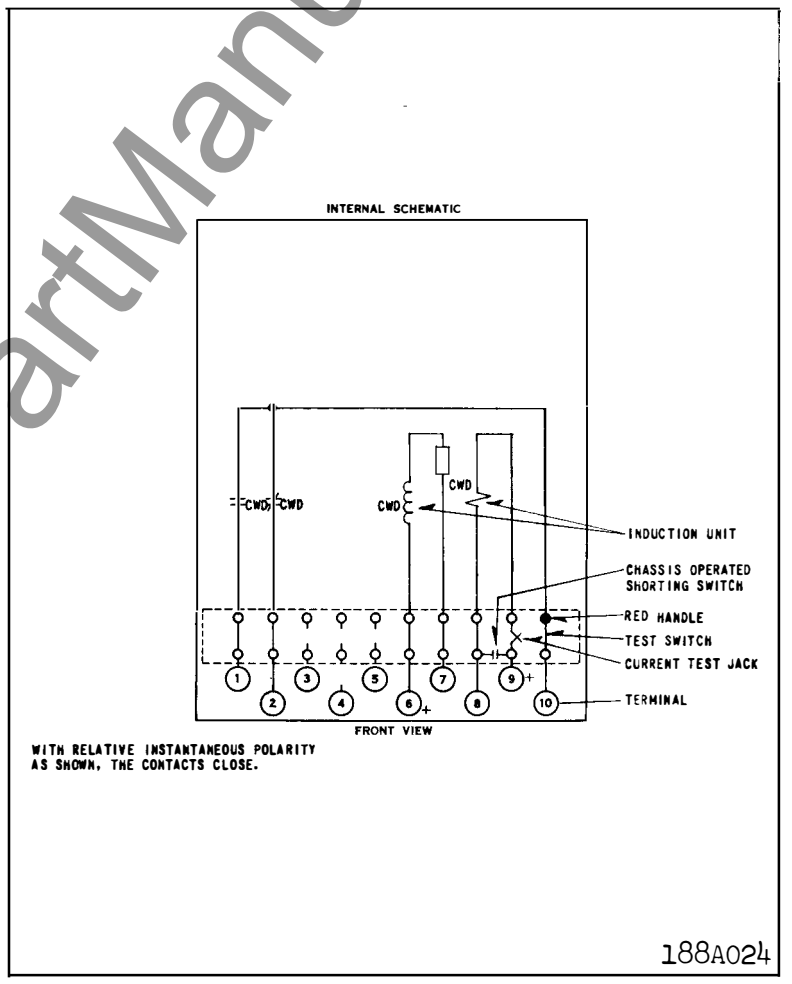


Fig. 2. Internal Schematic of the Non-Tapped Type Relay in the Type FT 11 Case.

Routine Maintenance

All relays should be inspected periodically and the time of operation should be checked at least once every year or at such other time intervals as may be dictated by experience to be suitable to the particular application. The use of phantom loads, in testing induction-type relays, should be avoided, since the resulting distorted current wave form will produce an error in operation.

All contacts should be periodically cleaned. A contact burnisher #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.

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. Watts Sensing Unit

1. Contacts — Apply sufficient wattage to the relay, to make the disc float in the center of its travel. Move both of the adjustable contacts until they just make with the moving contact. If the two contact pointers do not meet at the same point on the scale (± 1/32"), adjust the follow on both adjustable contacts. Approximately the same follow should be in each of the adjustable stationary contacts.

2. Calibration Check — The adjustment of the spring tension in calibrating the relay is most conveniently made with the damping magnet removed.

Set either of the adjustable stationary contacts in the center of its travel and apply this wattage to the relay. Wind up the spiral spring by means of the spring adjuster until the stationary contact and moving contact just make.

Check the other markings by setting the adjustable contact on these markings and applying the corresponding wattage to the relay. The contacts should make within plus or minus 5% of contact setting for non-tapped relays and plus or minus 3% of contact setting for tapped relays.

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

The 60 cycle burdens of the type CWD Relay Three-Phase Applications are as follows:

Relay Range	Potential Circuit			Current Circuits			
Watts	Voltage	Voltamperes	Current lags by	Current	Relay Tap	Voltamperes	Current lags by
10 – 60 20 – 120 50 – 300 100 – 600 150 – 900	120	20.5	68°	5 amp.	None	16.2	78°
35 – 200	208	18.8	59°	5 amps.	35	16.2	78°
100 – 600	120	20.5	68°	5 amps.	100	5.4	67°
175 – 1000	208	18.8	59°	5 amps.	175	5.4	67°

Current Coil Ratings:

	Watt Range	Continuous	1 Sec.
A. Non-Tapped	10 – 60 20 – 100 50 – 300 100 – 600 150 – 900	5 amps.	230 amps.
B. Tapped	35 – 200	5 amps.	230 amps.
	100 – 600 175 – 1000	8 amps.	370 amps.

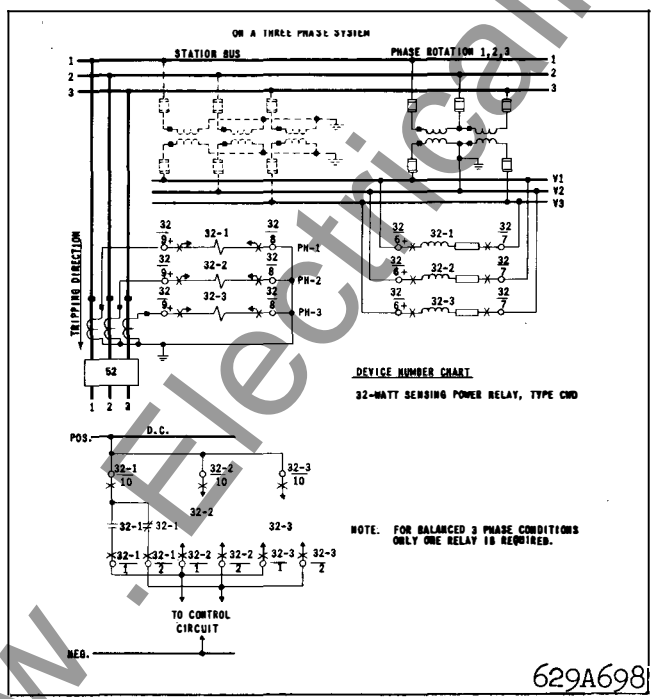


Fig. 3 External Schematic of Three Type CWD Relays on a Three-Phase System. Note: For Balanced Three Phase Conditions only One CWD Relay is required.

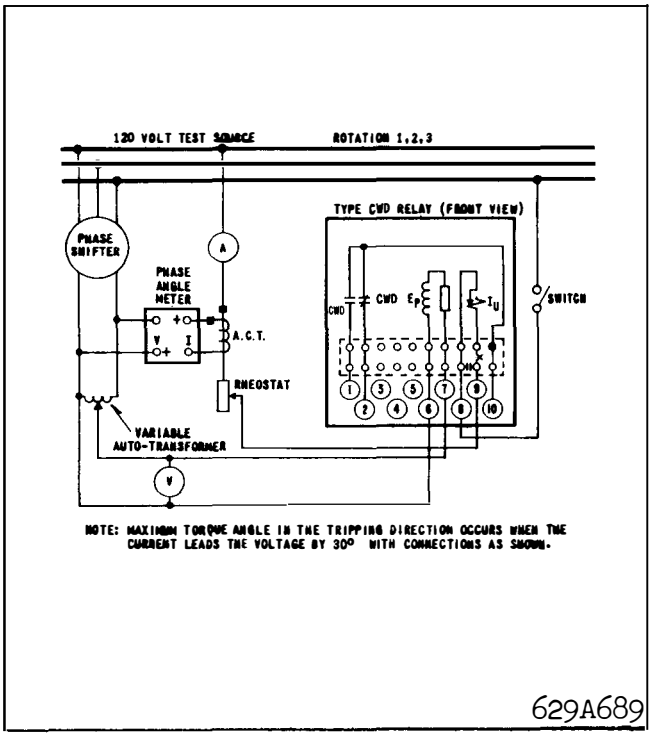


Fig. 4 Diagram of Test Connections for CWD Relays.

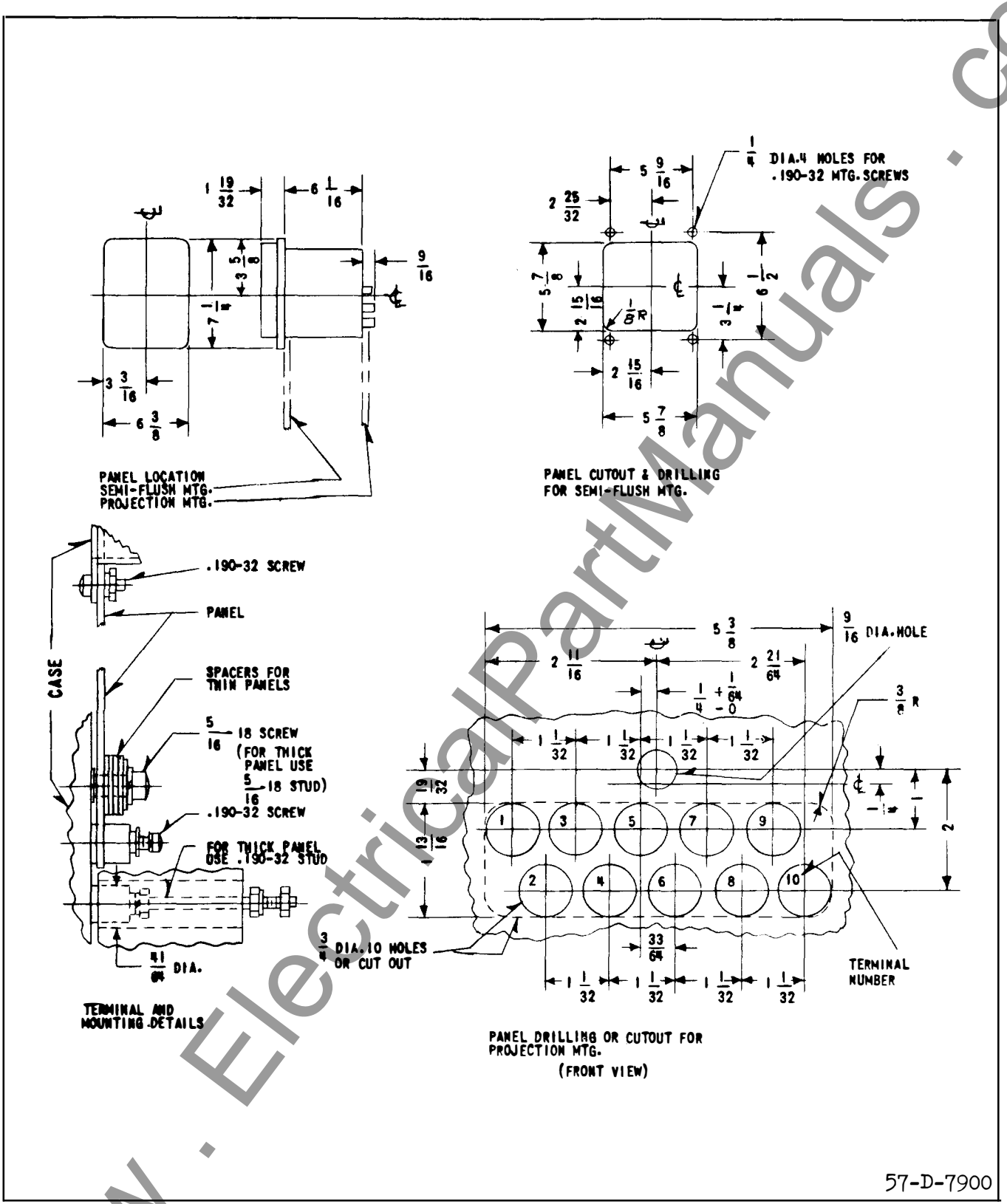
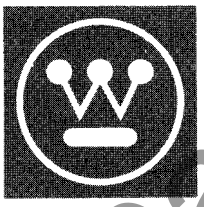


Fig. 5 Outline and Drilling Plan for the Type CWD Relay in the Type FT 11 Case.



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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CW POWER RELAY

30° CHARACTERISTIC

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 CW relay for three-phase application is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

The CW relay for three-phase application uses phase-to-phase voltage and line current, with maximum torque occuring when the relay current leads the relay voltage by 30° at system unity power factor. The relay operates on single phase watts multiplied by $\sqrt{3}$. One CW relay is required for balanced three phase system and three relays are required for unbalanced conditions.

CONSTRUCTION

The relay consists of a product operated unit, a phase shifter and an indicating contactor switch (ICS).

Product Type Unit

The electromagnet for the main element has a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the tapped coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current leads the voltage by 30 degrees. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon direction of the line current. The combination of voltage and current produces an operating torque proportional to power.

Phase Shifter – The phase shifter network consist of a resistor in series with the potential coils.

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 CW relays are available in the following ranges and taps:

Volts Line-to Line	$\left(\frac{(I_L\ V_{LL})}{\sqrt{3}\ \text{single phase watts}}\right)$	
	Range	Taps
120	20– 120	20– 30– 40– 60– 80–100– 120
	100– 600	100–150–200–300–400–500– 600
208	35– 200	35– 50– 70–100–140–175– 200
	175–1000	175–250–350–500–700–875–1000

Typical 60 cycle Time-Power Curves are shown in Figs. 3 & 4. The curves are taken at maximum torque which occurs with the current leading the voltage by 30 degrees. (within ±4°)

SUPERSEDES I.L. 41-241.3E
*Denotes change from superseded issue.

EFFECTIVE MAY 1967

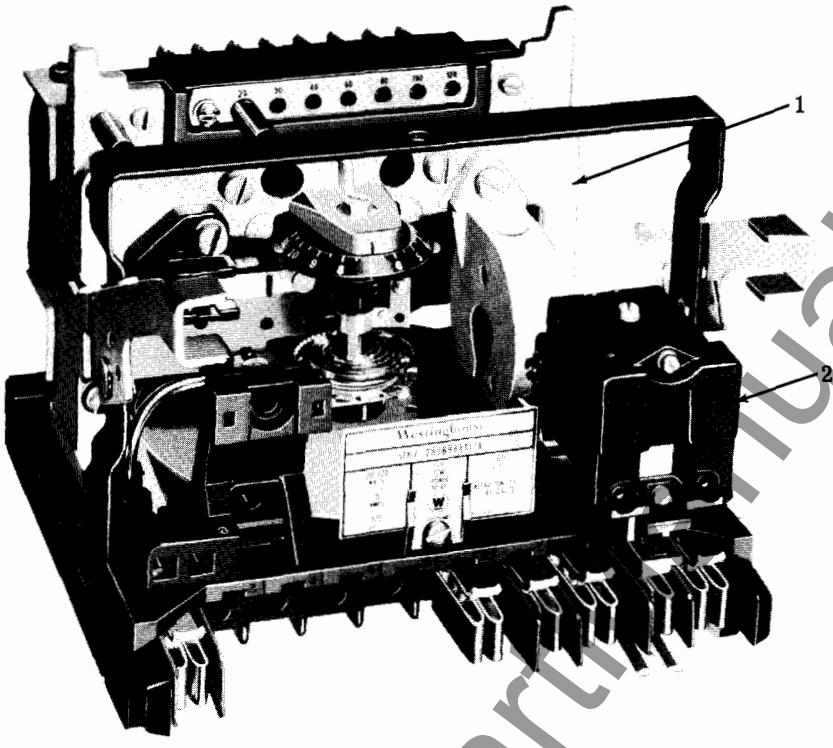

Fig. 1. 1. Time-power unit. 2. Indicating Connector Switch (ICS). Note: Phase shifting resistor is mounted in rear.

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 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.

Trip Circuit 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.

SETTINGS

Product Unit

There are two settings to be made. One is the current tap setting, and the second, the time dial setting.

The CW relay for three-phase application has taps which represents single phase watts multiplied by $\sqrt{3}$. The power to operate the relay equals the three phase primary power divided by the quantity ($\sqrt{3}$ times the current and potential transformer ratios).

$$\star \text{ TAP} = \frac{\sqrt{3}\ P1\phi}{Rc\,Rv} = \frac{P3\phi}{\sqrt{3}\ Rc\,Rv}.$$

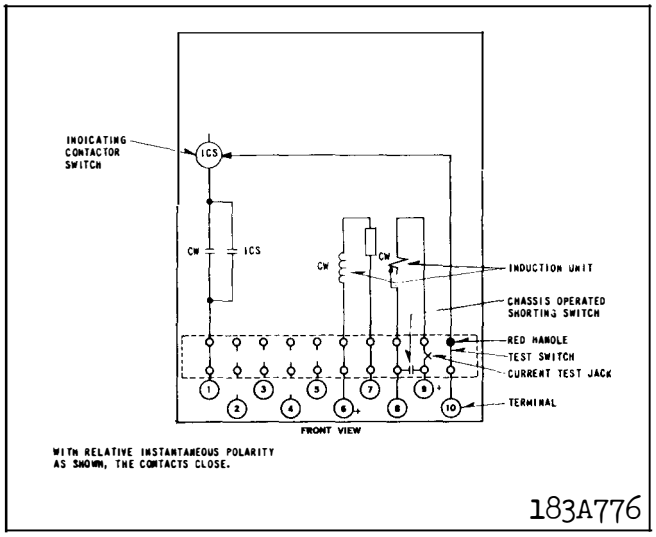

Fig. 2. Internal Schematic of the Type CW Relay in the Type FT11 Case.

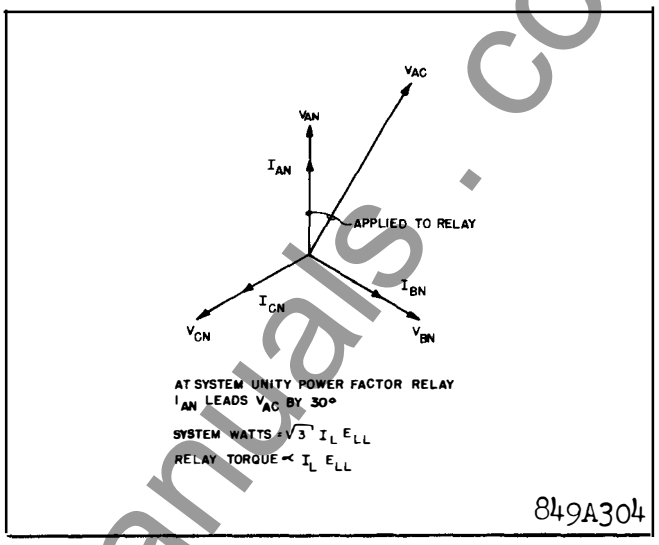

Fig. 3 Current and Voltage Phasors at System Unity Power Factor Applied to Type CW Relay.

This relay power expressed as multiples of the chosen tap locates a value on the abscissa of the Time-Power Curves of Fig. 3 and 4. The relay operating time for various time dial settings then is observed on the ordinate. By changing taps or time dial, the required operating time can be selected for specific power value.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole before removing the old tap screw. This prevents open-circuiting the current transformers.

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.

ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

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.

Product Unit

Contacts — The index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves.

Minimum Trip Volt Amperes — Set the time dial to position 6. Using the lowest tap setting, alternately apply tap value volt amperes plus 3% and tap value volt amperes minus 3% with the current leading the voltage by 30°. The moving contact should leave the backstop at tap value plus 3% and should return to the backstop at tap value minus 3%. The relay should be calibrated with 10 times tap value at the number six time dial position. Check several points on the typical time curves. Time curve calibration is affected by adjusting the position of the permanent magnet keeper. Note that with current leading voltage by 30 degrees the actual watts applied to the relay are .866 times tap value at pickup.

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 indicator target should drop freely.

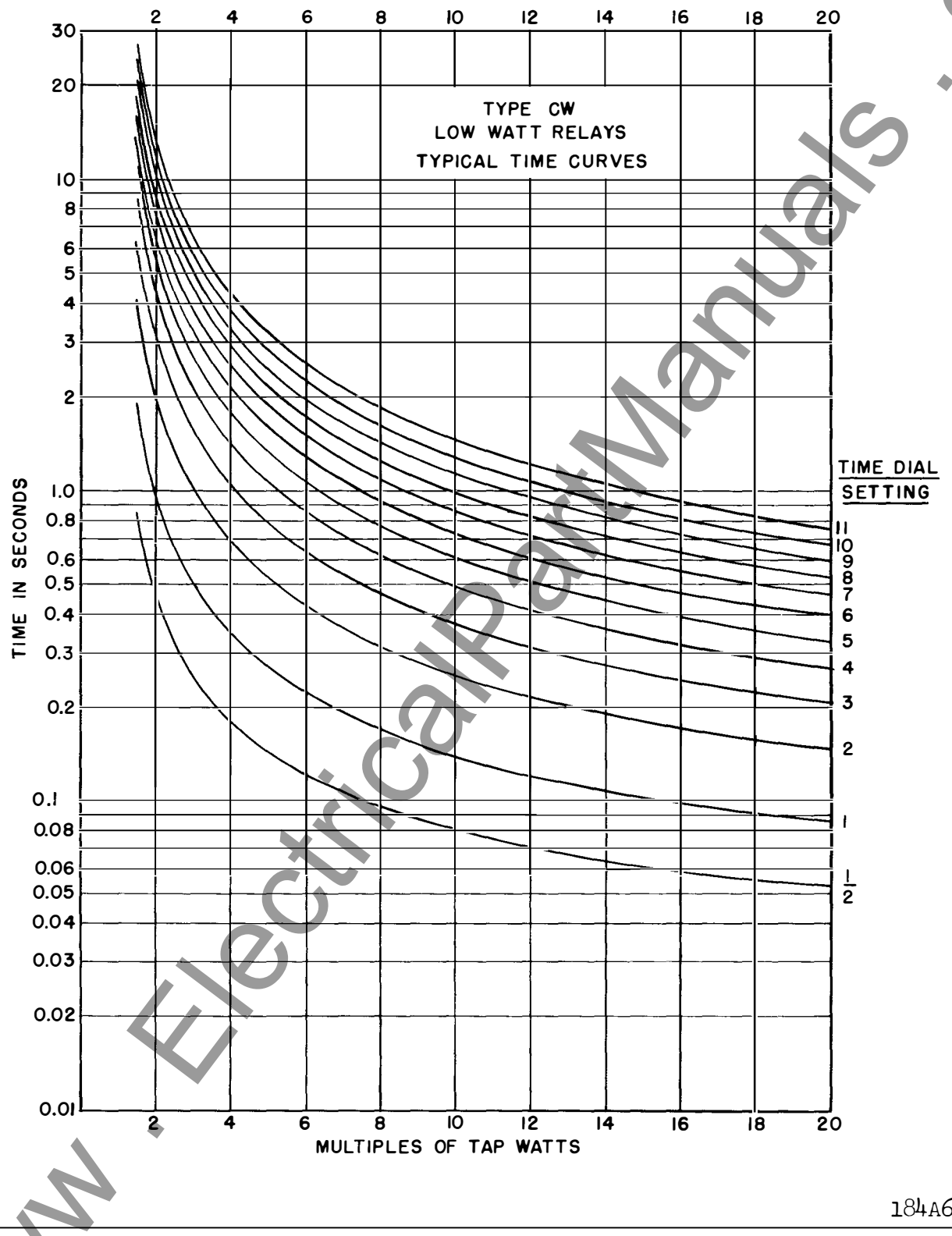

Fig. 4 Typical 60 cycle Time Curves of the 20-120 and 35-200 watt Type CW Relay.

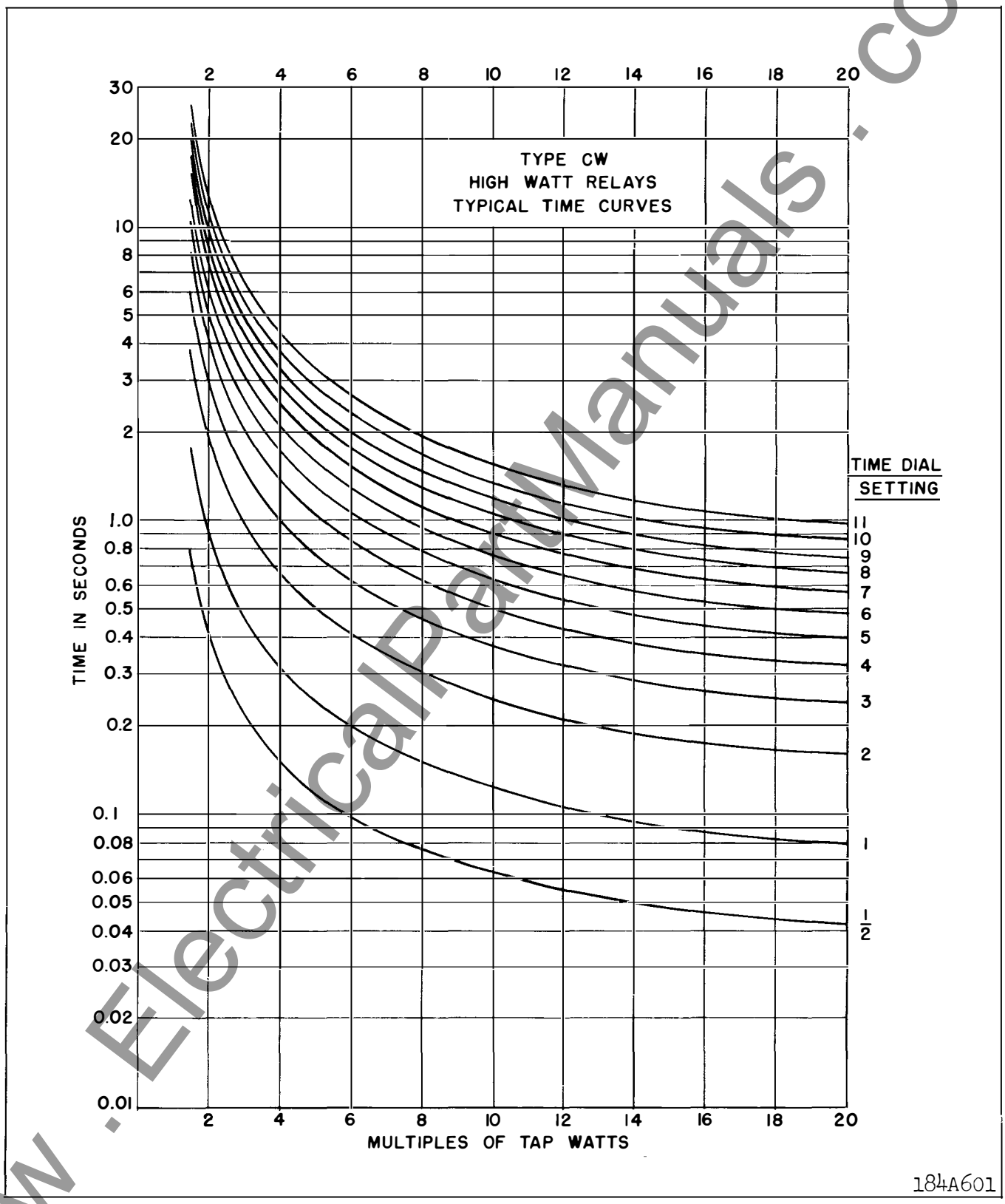

Fig. 5 Typical 60 cycle Time Curves of the 100-600 and 175-1000 watt Type CW Relay.

ENERGY REQUIREMENTS

The 60 cycle burdens of the type CW Relay Three-Phase Application are as follows:

Relay Range	Potential Circuit			Current Circuit			
Watts	Voltage	Voltamperes	Current lags by	Current	Relay Tap	Voltamperes	Current lags by
20 – 120	120	20.5	68°	5 amp.	20	16.2	78°
100 – 600	120	20.5	68°	5 amp.	100	5.4	67°
35 – 200	208	18.8	59°	5 amp.	35	16.2	78°
175 – 1000	208	18.8	59°	5 amp.	175	5.4	67°

Current Coil Ratings:

	Continuous	1 Sec.
A. 20-120 Watt Range 35-200 Watt Range	5 Amperes	230 Amperes
B. 100-600 Watt Range 175-1000 Watt Range	8 Amperes	370 Amperes

RENEWAL PARTS

Repair work can be done most satisfactorily at 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.

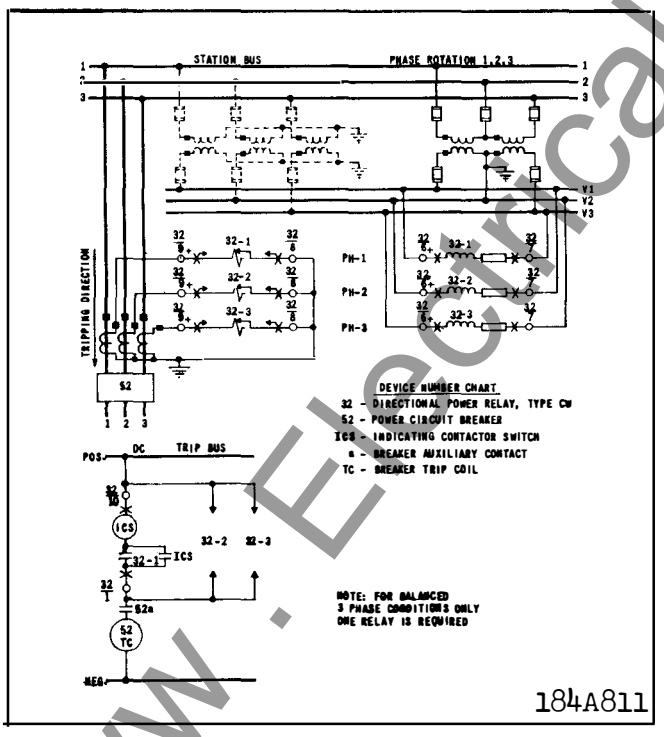

Fig. 6 External Schematic of Three Type CW Relays on a Three-Phase System. Note: For Balanced Three Phase Conditions only One CW Relay is required.

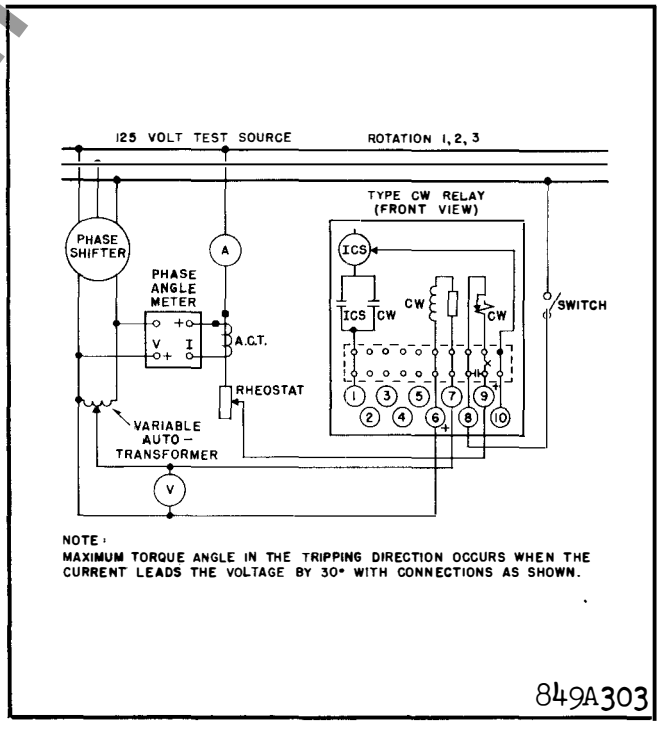

Fig. 7 Diagram of Test Connections for Type CW Relay in FT-11 Case.

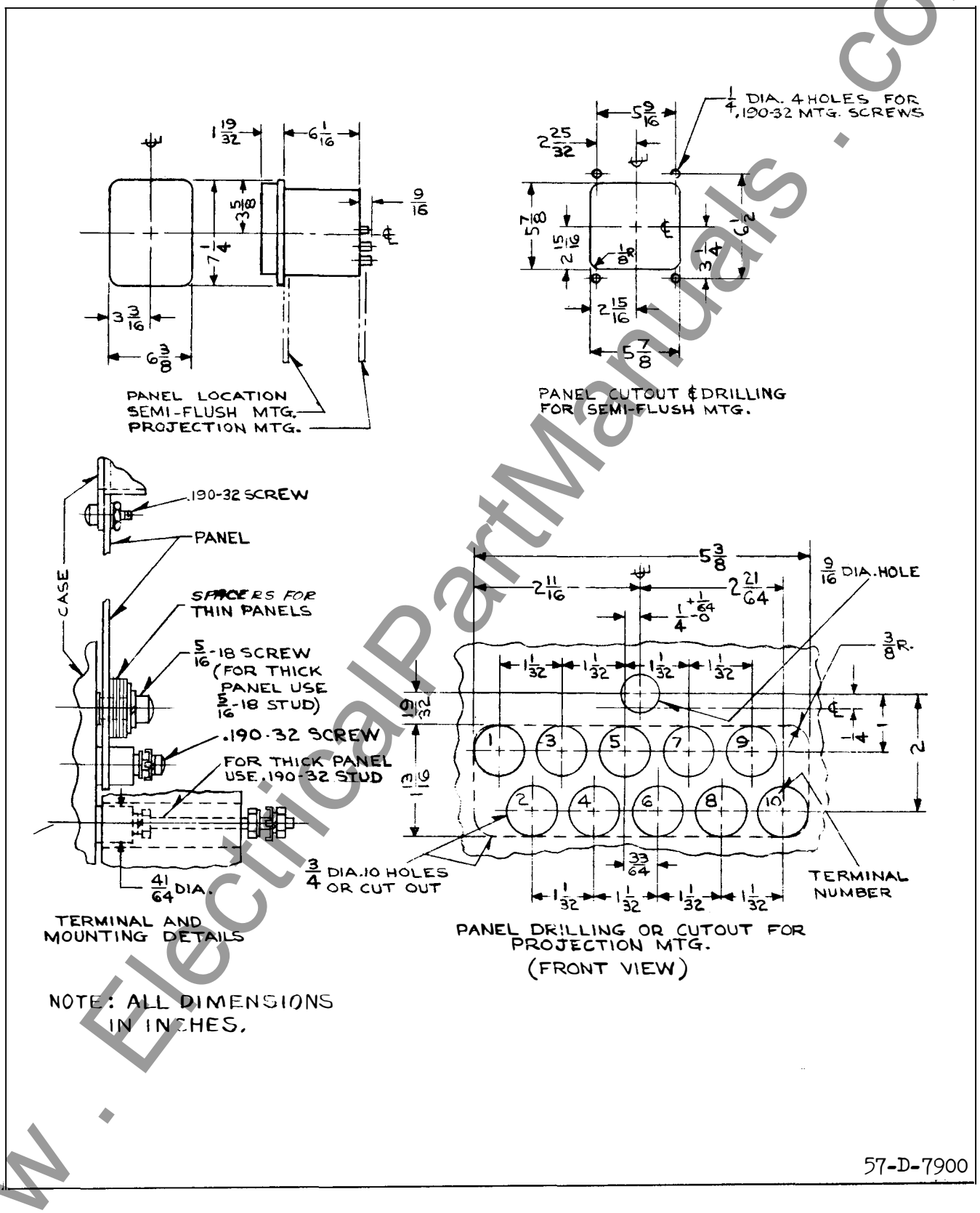

Fig. 8 Outline and Drilling Plan for the Type CW Relay in the Type FT11 Case.

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INSTRUCTIONS

TYPE CW POWER RELAY
ZERO DEGREE CHARACTERISTIC

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 CW relay is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

CONSTRUCTION

The relay consists of a product operated unit, a phase shifter and an indicating contactor switch (ICS).

Product Type Unit

The electromagnet for the main element has a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the tapped coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current and voltage are in phase. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon direction of the line current. The combination of voltage and current produces an operating torque proportional to power.

Phase Shifter The phase shifter network consists of a capacitor in parallel with the potential coils and a reactor in series with the above combination.

Indicating Contractor 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 CW relays are available in the following ranges and taps:

SINGLE PHASE WATT RANGE	POTENTIAL COIL	TAPS
20 – 120	120	20-30-40-60-80-100-120
100 – 600	120	100-150-200-300-400-500-600

Typical 60 cycle Time-Power Curves are shown in Figs. 3 & 4. The curves are taken at maximum torque which occurs with the current and voltage in phase (within ±4°).

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 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.

SUPERSEDES I.L. 41-241.2B
*Denotes change from superseded issue.

EFFECTIVE MAY 1967

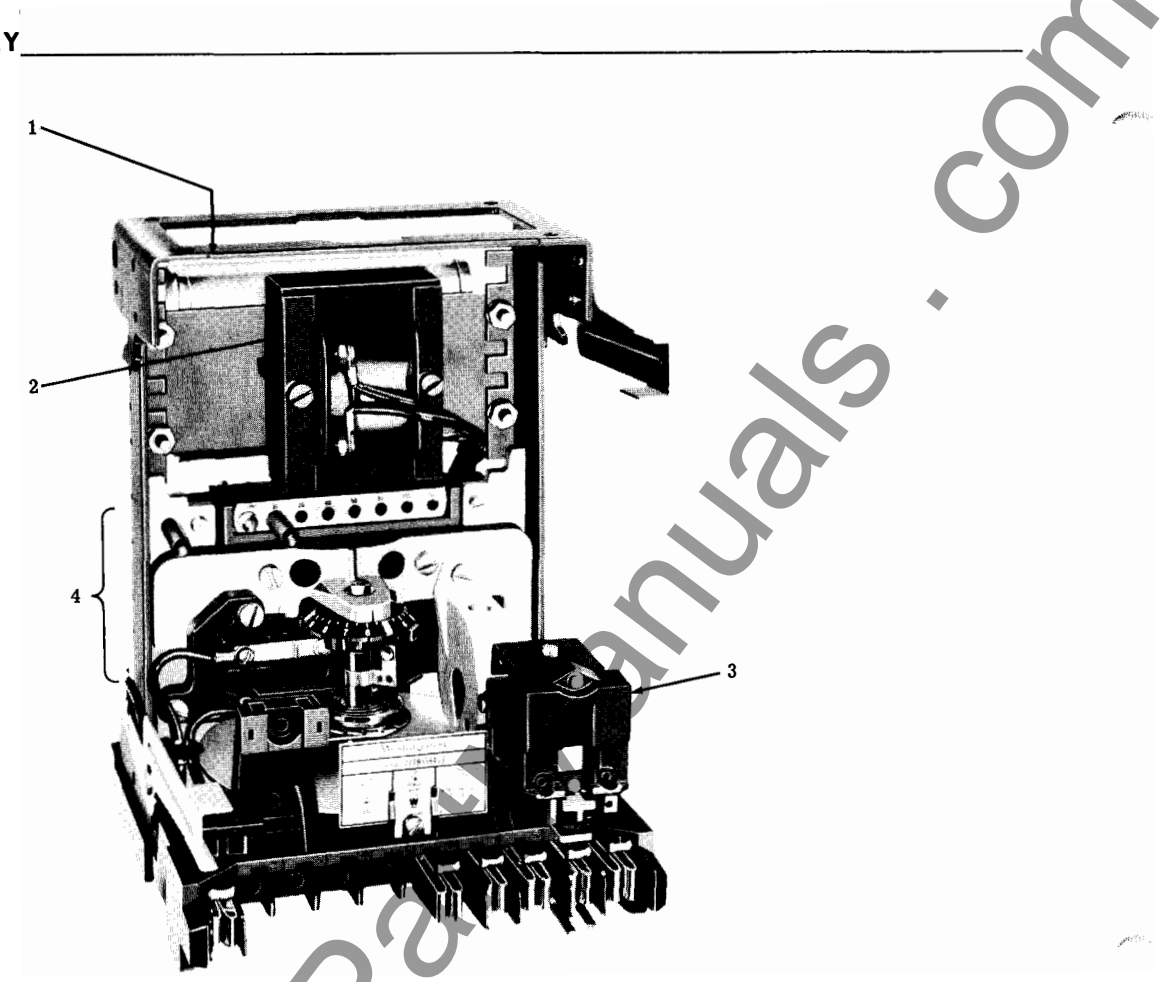

Fig. 1 Type CW Relay Without Case. 1 - Capacitor. 2 - Reactor. 3 - Indicating Contactor Switch (ICS). 4 - Time-Power Unit.

Trip Circuit 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.

SETTINGS

Product Unit

There are two settings to be made. One is the current tap setting, and the second, the time dial setting.

The power to operate the relay equals the primary power divided by the current and potential transformer ratios. This relay power expressed as multiples of the chosen tap locates a value on the abscissa of the Time-Power Curves of Fig. 3 and 4. The relay operating time for various time dial settings then is observed on the ordinate. By changing taps or time dial, the required operating time can be selected for a specific power value.

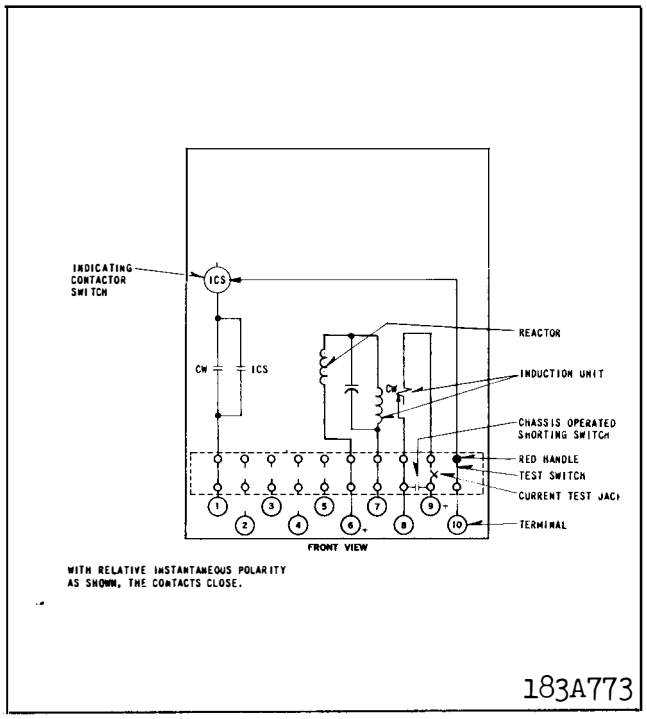

Fig. 2 Internal Schematic of the Type CW Relay in the Type FT 21 Case.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole before removing the old tap screw. This prevents open-circuiting the current transformers.

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.

ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

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 danget of embedding small particles in the face of the soft silver and thus impairing the contact.

Product Unit

Contacts — The index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves.

Minimum Trip Watts — Set the time dial to position 6. Using the lowest tap setting, alternately apply tap value watts plus 3% and tap value watts minus 3% with the current and the voltage in phase. The moving contact should leave the backstop at tap watts plus 3% and should return to the backstop at tap value watts minus 3%. The relay should be calibrated with 10 times tap value watts at the number six time dial position. Check several points on the typical time curves. Time curve calibration is effected by adjusting the position of the permanent magnet keeper.

Indicating Contactor Switch (ICS)

Close the main relay contacts and pass sufficicient 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 indicator target should drop freely.

ENERGY REQUIREMENTS

The 60 cycle burdens of the type CW Relay Single Phase Application are as follows:

1. The 20-120 Watt, 120 Volt Relay

   A. Potential Circuit Burden at Rated Voltage

Current Lags By	Volt Amperes
26.5°	5.4

   B. Curent Coil at 5 Amperes

TAP	CURRENT LAGS BY	VOLT AMPERES
20	78°	16.2

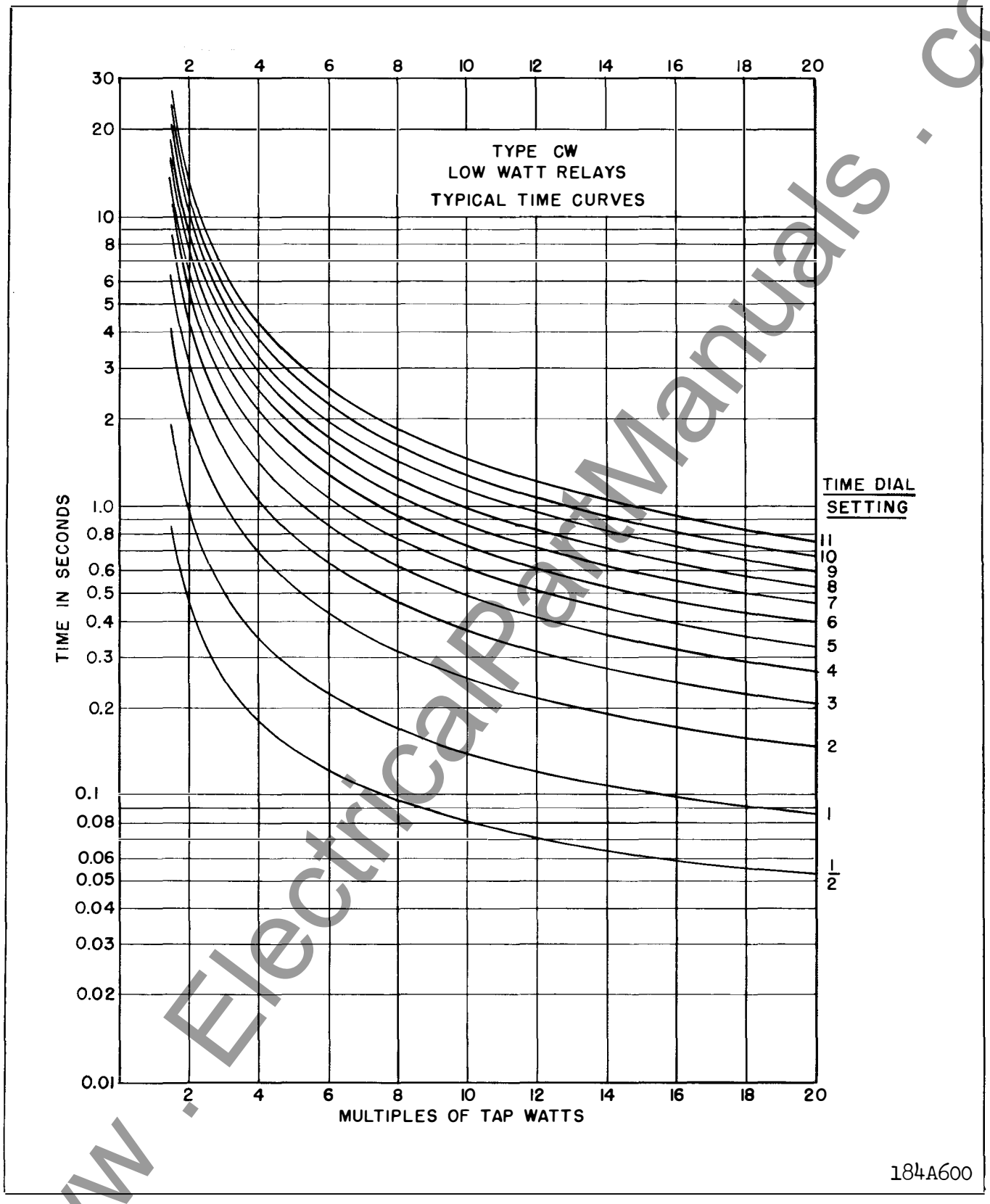

Fig. 3 Typical 60 cycle Time Curves of the 20-120 watt Type CW Relay.

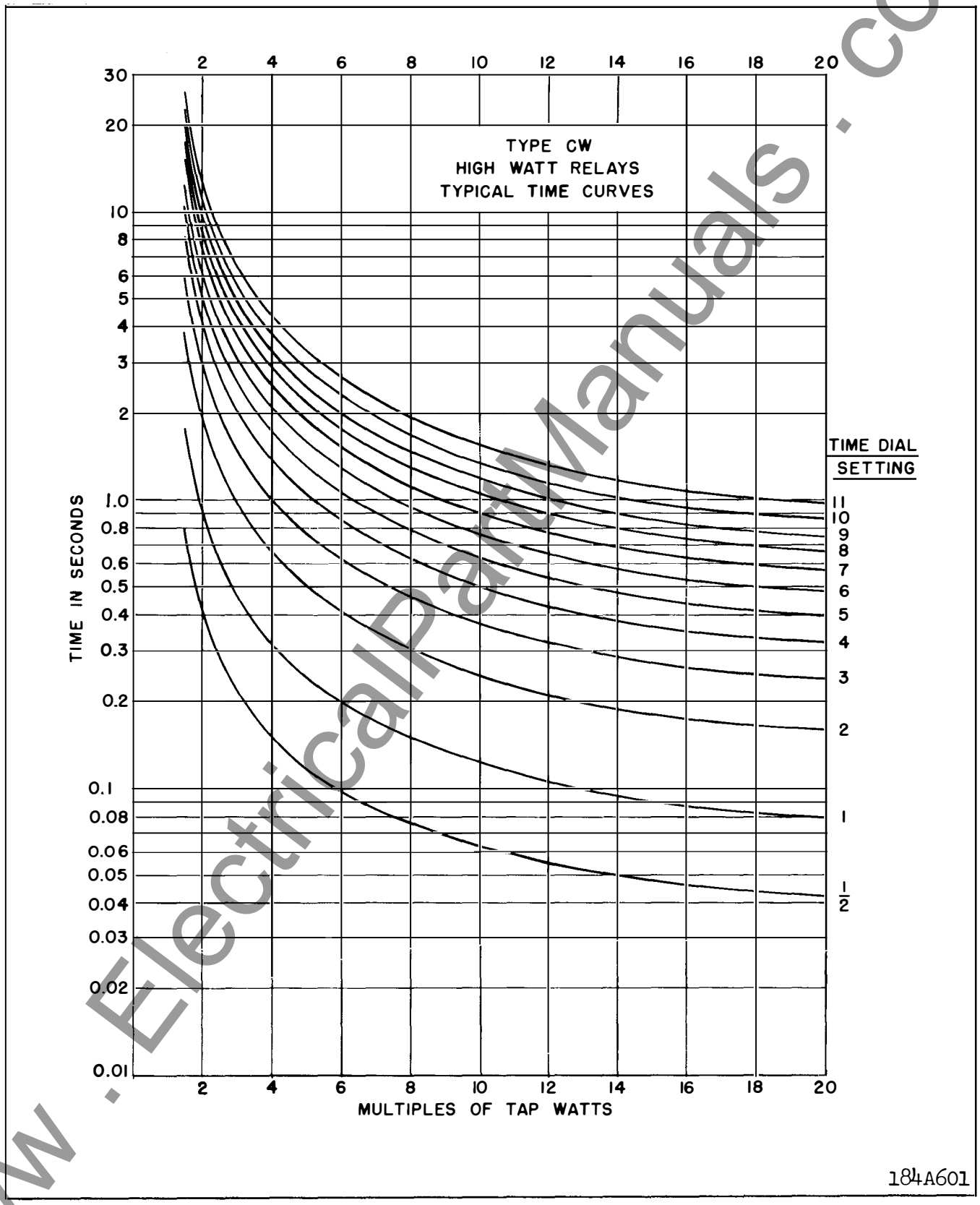

Fig. 4 Typical 60 cycle Time Curves of the 100-600 watt Type CW Relay.

2. The 100-600 Watt, 120 Volt Relay

A. Potential Circuit Burden at Rated Voltage

Current Lags by	Volt Amperes
20°	5.9

B. Current Coil Burden at 5 Amperes

TAP	CURRENT LAGS BY	VOLT AMPERES
100	67°	5.4

Current Coil Ratings

	Continuous	1 Sec.
A. 20-120 Watt Range	5 Amperes	230 Amperes
B. 100-600 Watt Range	8 Amperes	370 Amperes

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.

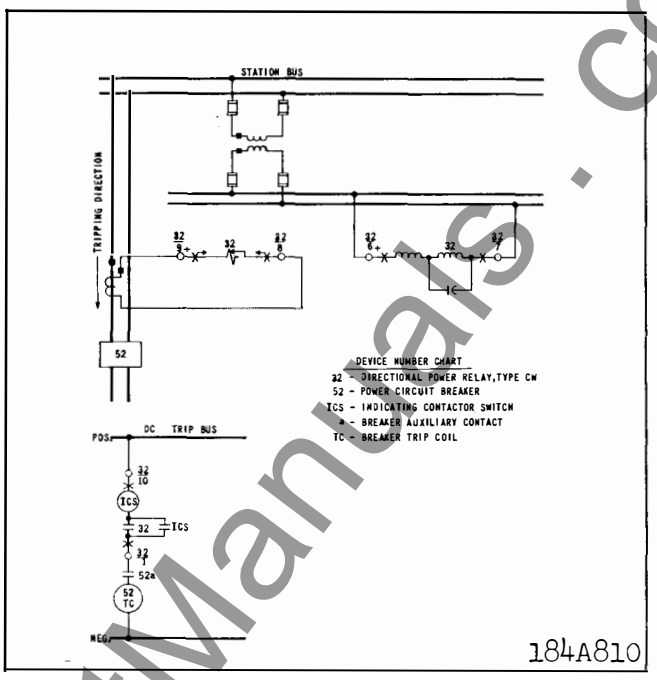

Fig. 5 External Schematic of One Type CW Relay on a Single Phase System.

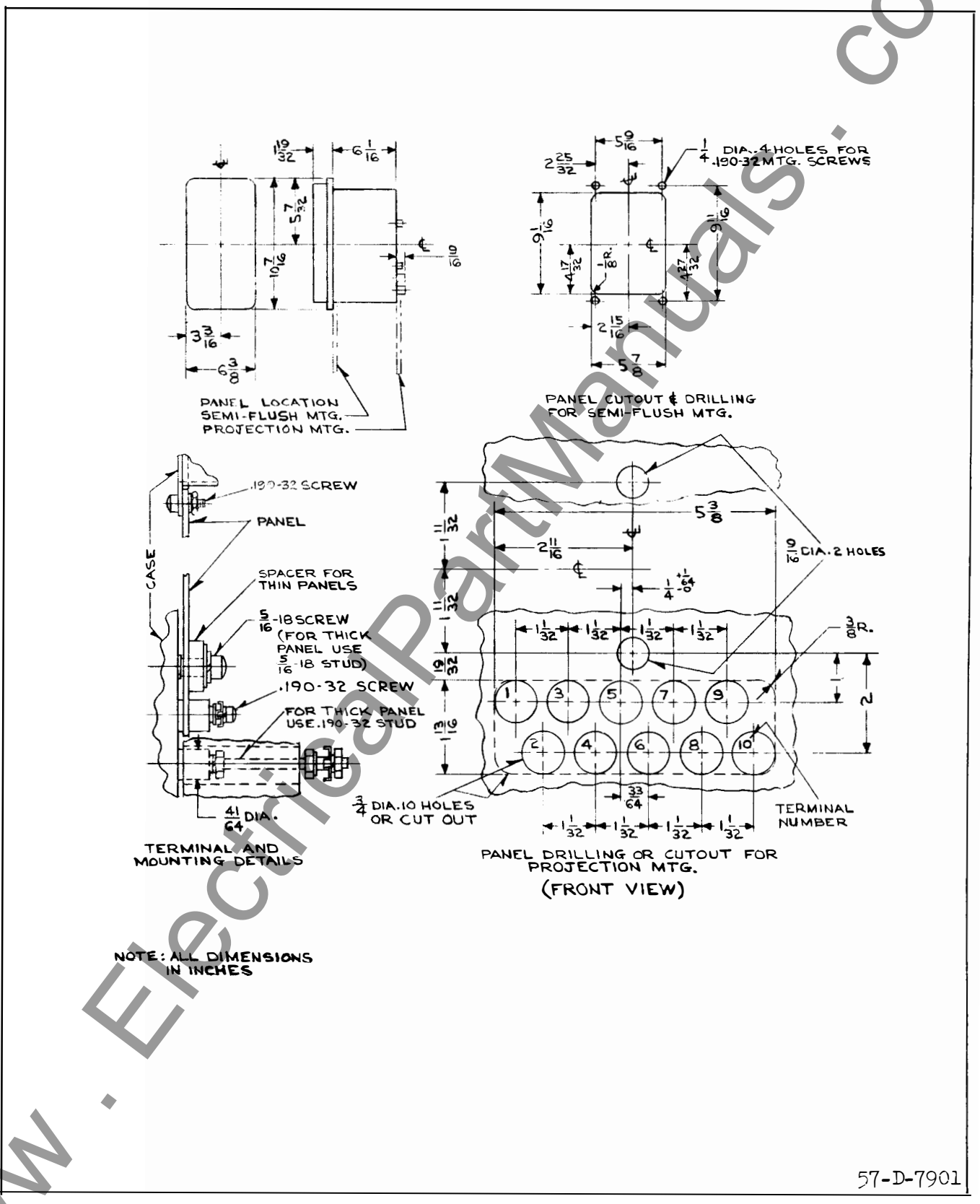

Fig. 6 Outline and Drilling Plan for the Type CW Relay in the Type FT 21 Case.

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INSTRUCTIONS

TYPE CWD POWER RELAY
Three Phase Watt Sensing 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

These relays are used to initiate switching or control operations when the line watts rises above a preset value, or falls below a preset value, Thus the relay is a current sensing device with high and low current settings.

The CWD relay for the three-phase application uses phase-to-phase voltage and line current, with maximum torque occuring when the relay current leads the relay voltage by 30° at system unity power factor. The relay operates on single phase watts multiplied by $\sqrt{3}$. One CWD relay is required for balanced three phase system and three relays are required for unbalanced conditions.

CONSTRUCTION

The relay consists of an induction disc type watt sensing unit containing a phase shifter.

Product Type Unit

The electromagnet for the main element may have a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the current coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current leads the voltage by 30 degrees. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon magnitude of the line current. The combination of voltage and current produces an operating torque proportional to power.

When the watt sensing unit contact closes to the right this indicates that the line watts are at or above the value of watts desired. Conversely when the watt sensing unit contact closes to the left this indicates that the line watt is at or below value of current desired.

Phase Shifter

The phase shifter network consist of a resistor in series with the potential coils.

CHARACTERISTICS

The type CWD relays are available in the following ranges and taps:

Volts Line-to Line	$\frac{(I_L V_{LL})}{\sqrt{3}}$ (single phase watts)	
	Range	Taps
120	20- 120 100- 600	20-30-40-60-80-100-120 100-150-200-300-400-500-600
208	35- 200 175-1000	35-50-70-100-140-175-200 175-250-350-500-700-875-1000
120	10- 60 20- 120 50- 300 100- 600 150- 900	None None None None None

NEW INFORMATION

EFFECTIVE JUNE 1964

The type CWD watt sensing relay has adjustable high and low wattage contacts that can be set around a 150° arc which is calibrated in watts on non-tapped relays, or in percent of tap value watts on tapped relays. These values represent the tripping position of the moving contacts when the value of watts is applied to the relay. For the tapped relays the percent scale markings are 80, 85, 90, 95, 100, 105 and 100.

The moving contacts will assume a position corresponding to the watts applied to the relay and will stay in that position until the wattage changes. If the wattage changes either gradually or suddenly, the contact will assume a new position corresponding to the change unless the travel is limited by the setting of the adjustable contacts. If the contacts are set to close for a particular value of watts, and if a wattage of that exact amount is applied, then the relay is operating at its minimum trip point and the times on repeated operations are not repetitive within close tolerances. However, wattage appreciably greater than the wattage setting, or appreciably less than the wattage setting, result in relay timing operations which are consistent for repeated trials.

The induction unit has inverse timing; that is, the greater the change in watts, the faster the relay contact will travel.

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.

SETTINGS

Product Unit

The CWD relay for three-phase 208V application has taps which represents single phase watts multiplied by $\sqrt{3}$. The power to operate the relay equals the three phase primary power divided by the quantity $\sqrt{3}$ times the current and potential transformer ratios.

The watt sensing unit settings can be defined either by contact settings or tap setting. The high and low watt contact settings are described under "Characteristics".

Relays which are tapped have a connector screw on the terminal plate above the scale which makes connections to various turns on the operating coil. The tap setting is made by placing this screw in the desired tap as marked on the terminal plate.

Caution

Since the tap block connector screw carries operating current, be sure that the screw is turned tight. In order to avoid opening the current transformer circuits when changing taps under load, connect the spare connector screw in the desired tap position before removing the other tap screw from the original tap position.

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 "SETTING" should be required.

Acceptance Check

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

A. Current Sensing Unit

1. Contact Adjustment Check — Set the left-hand contact in the center of the scale and adjust the wattage until the moving contact just makes. Move the left-hand contact out of the way and bring the right-hand contact up until the contacts just make. The right pointer should be within ± 1/32" of where the left-hand pointer was.

2. Calibration Check — Check the scale markings by setting either of the two contacts at a value marked on the scale, then alternately apply this wattage plus 5% and minus 5% for non-tapped relays, and plus and minus 3% for tapped relays. The under wattage contact should make at the lower wattage and break at the higher wattage. For the over wattage contact check, the contact will make for the higher wattage and break at the lower wattage.

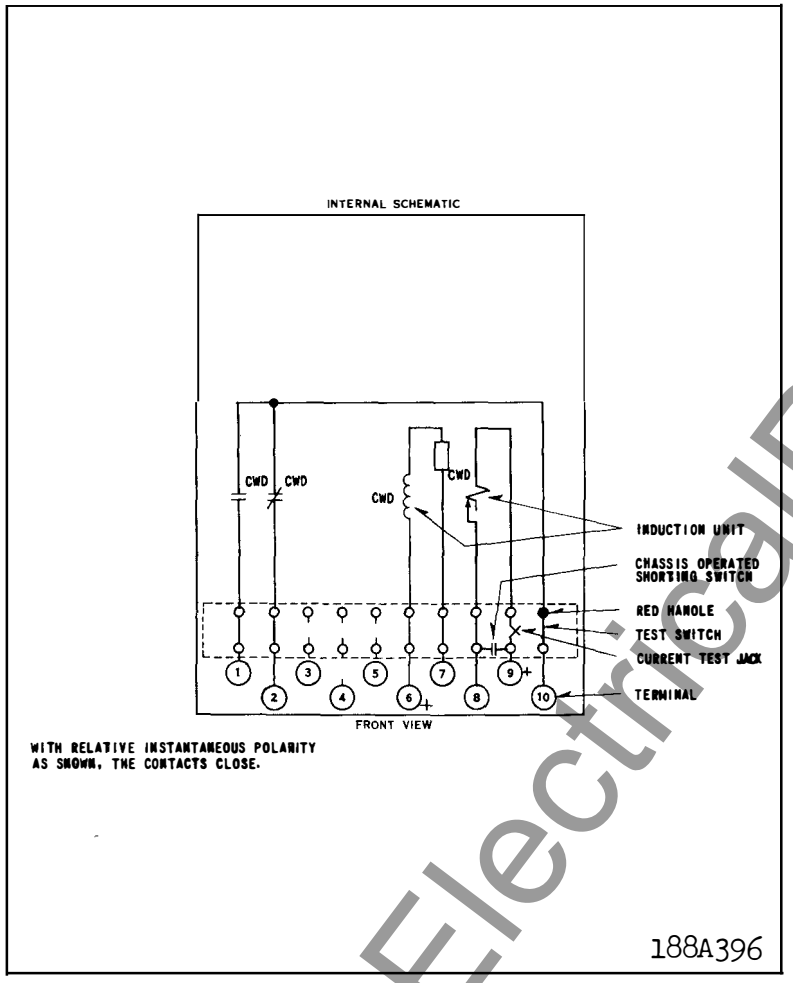


Fig. 1 Internal Schematic of the Tapped Type Relay in the Type FT 11 Case.

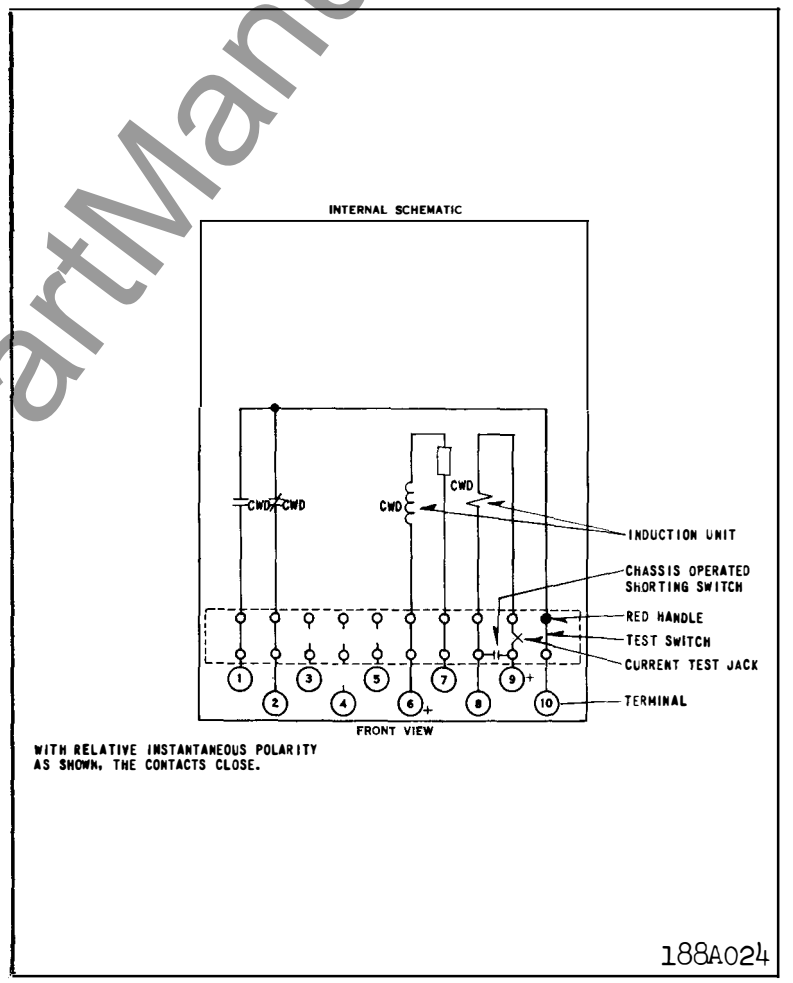


Fig. 2. Internal Schematic of the Non-Tapped Type Relay in the Type FT 11 Case.

Routine Maintenance

All relays should be inspected periodically and the time of operation should be checked at least once every year or at such other time intervals as may be dictated by experience to be suitable to the particular application. The use of phantom loads, in testing induction-type relays, should be avoided, since the resulting distorted current wave form will produce an error in operation.

All contacts should be periodically cleaned. A contact burnisher #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.

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. Watts Sensing Unit

1. Contacts — Apply sufficient wattage to the relay, to make the disc float in the center of its travel. Move both of the adjustable contacts until they just make with the moving contact. If the two contact pointers do not meet at the same point on the scale (± 1/32"), adjust the follow on both adjustable contacts. Approximately the same follow should be in each of the adjustable stationary contacts.

2. Calibration Check — The adjustment of the spring tension in calibrating the relay is most conveniently made with the damping magnet removed.

Set either of the adjustable stationary contacts in the center of its travel and apply this wattage to the relay. Wind up the spiral spring by means of the spring adjuster until the stationary contact and moving contact just make.

Check the other markings by setting the adjustable contact on these markings and applying the corresponding wattage to the relay. The contacts should make within plus or minus 5% of contact setting for non-tapped relays and plus or minus 3% of contact setting for tapped relays.

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

The 60 cycle burdens of the type CWD Relay Three-Phase Applications are as follows:

Relay Range	Potential Circuit			Current Circuits			
Watts	Voltage	Voltamperes	Current lags by	Current	Relay Tap	Voltamperes	Current lags by
10 – 60 20 – 120 50 – 300 100 – 600 150 – 900	120	20.5	68°	5 amp.	None	16.2	78°
35 – 200	208	18.8	59°	5 amps.	35	16.2	78°
100 – 600	120	20.5	68°	5 amps.	100	5.4	67°
175 – 1000	208	18.8	59°	5 amps.	175	5.4	67°

Current Coil Ratings:

	Watt Range	Continuous	1 Sec.
A. Non-Tapped	10 – 60 20 – 100 50 – 300 100 – 600 150 – 900	5 amps.	230 amps.
B. Tapped	35 – 200	5 amps.	230 amps.
	100 – 600 175 – 1000	8 amps.	370 amps.

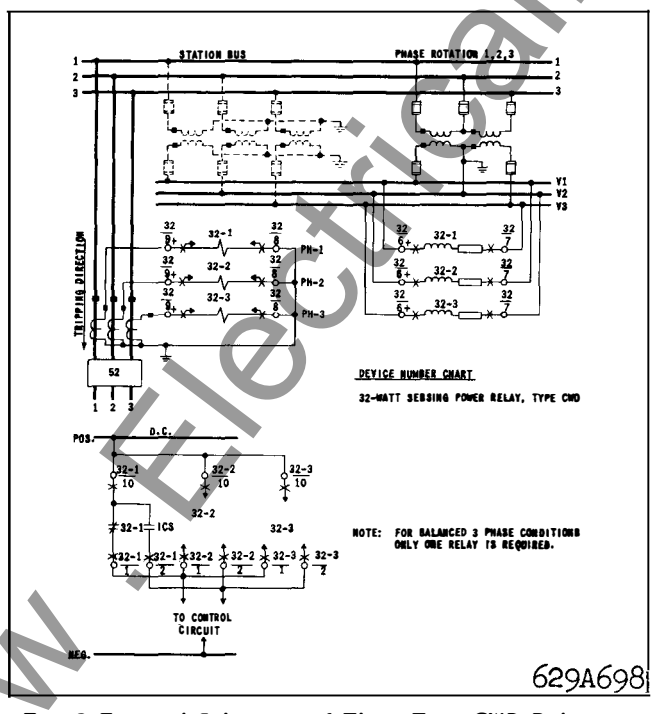


Fig. 3 External Schematic of Three Type CWD Relays on a Three-Phase System. Note: For Balanced Three Phase Conditions only One CWD Relay is required.

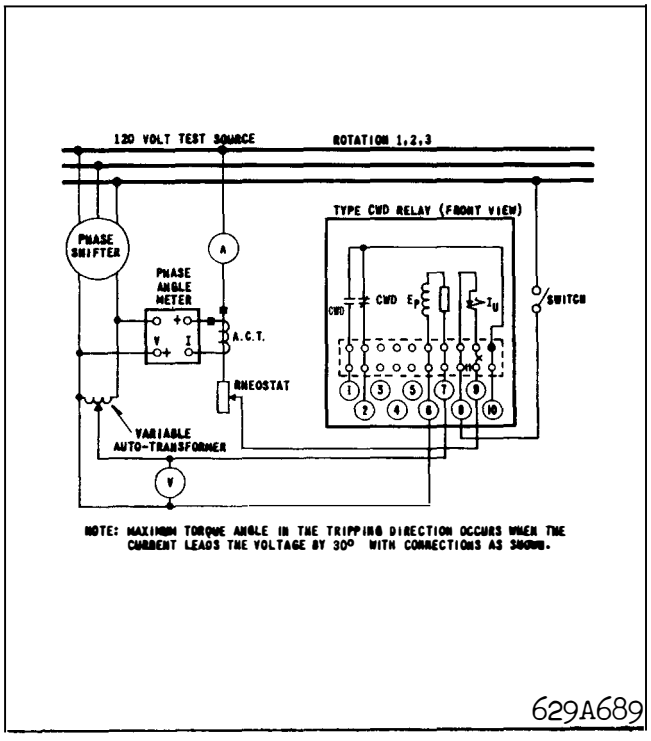


Fig. 4 Diagram of Test Connections for CWD Relays.

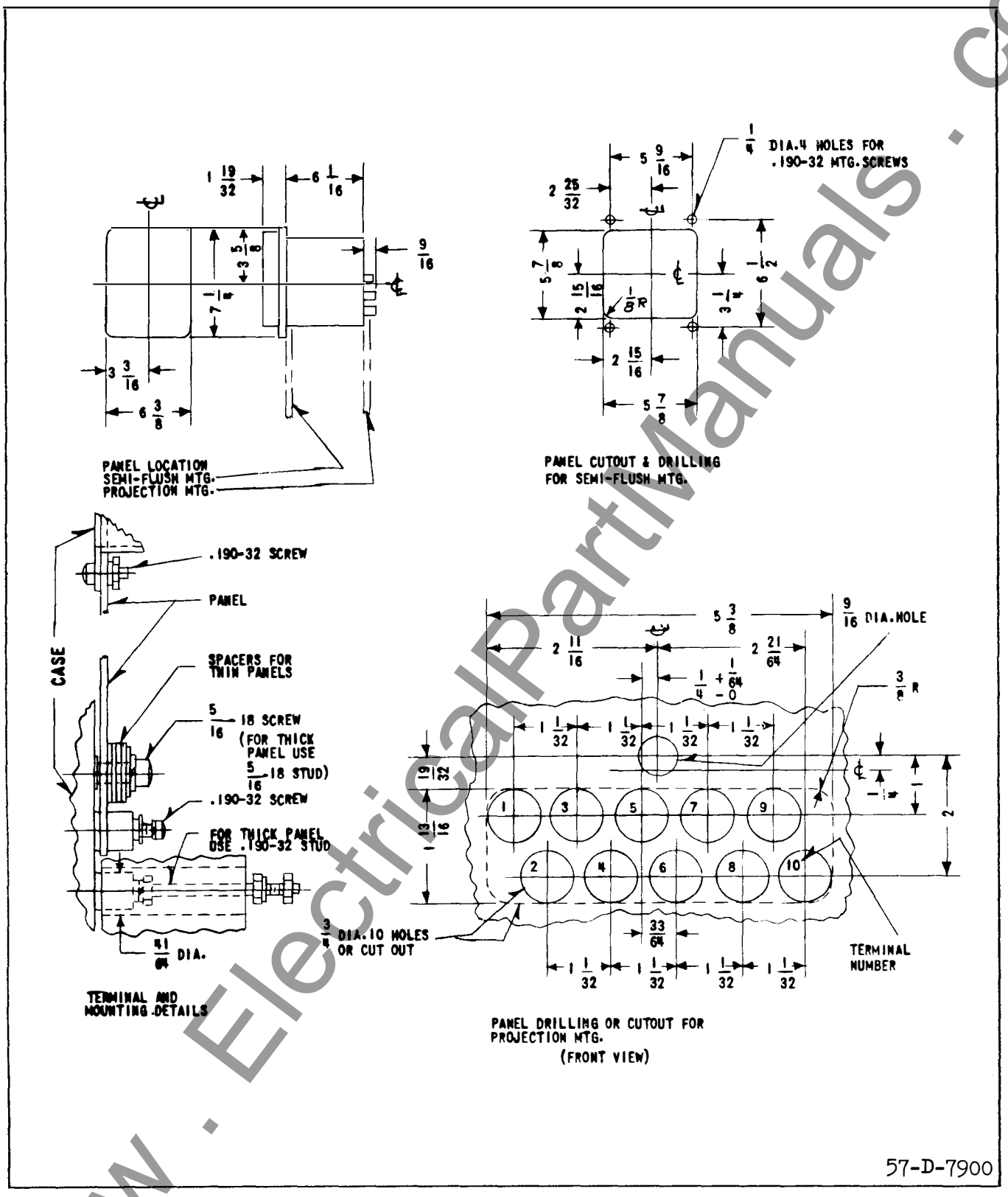


Fig. 5 Outline and Drilling Plan for the Type CWD Relay in the Type FT 11 Case.

WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CW POWER RELAY

THREE PHASE APPLICATION

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 CW relay for three-phase application is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

The CW relay for three-phase application uses phase-to-phase voltage and line current, with maximum torque occuring when the relay current leads the relay voltage by 30° at system unity power factor. The relay operates on single phase watts multiplied by $\sqrt{3}$. One CW relay is required for balanced three phase system and three relays are required for unbalanced conditions.

CONSTRUCTION

The relay consists of a product operated unit, a phase shifter and an indicating contactor switch (ICS).

Product Type Unit

The electromagnet for the main element has a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the tapped coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current leads the voltage by 30 degrees. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon direction of the line current. The combination of voltage and current produces an operating torque proportional to power.

Phase Shifter – The phase shifter network consist of a resistor in series with the potential coils.

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 CW relays are available in the following ranges and taps:

Volts Line-to Line	$\sqrt{3}$ (single phase watts)	
	Range	Taps
120	20– 120	20– 30– 40– 60– 80–100– 120
	100– 600	100–150–200–300–400–500– 600
208	35– 200	35– 50– 70–100–140–175– 200
	175–1000	175–250–350–500–700–875–1000

Typical 60 cycle Time-Power Curves are shown in Figs. 3 & 4. The curves are taken at maximum torque which occurs with the current leading the voltage by 30 degrees. (within ±4°)

SUPERSEDES I.L. 41-241.3A
*Denotes change from superseded issue.

EFFECTIVE JANUARY 1962

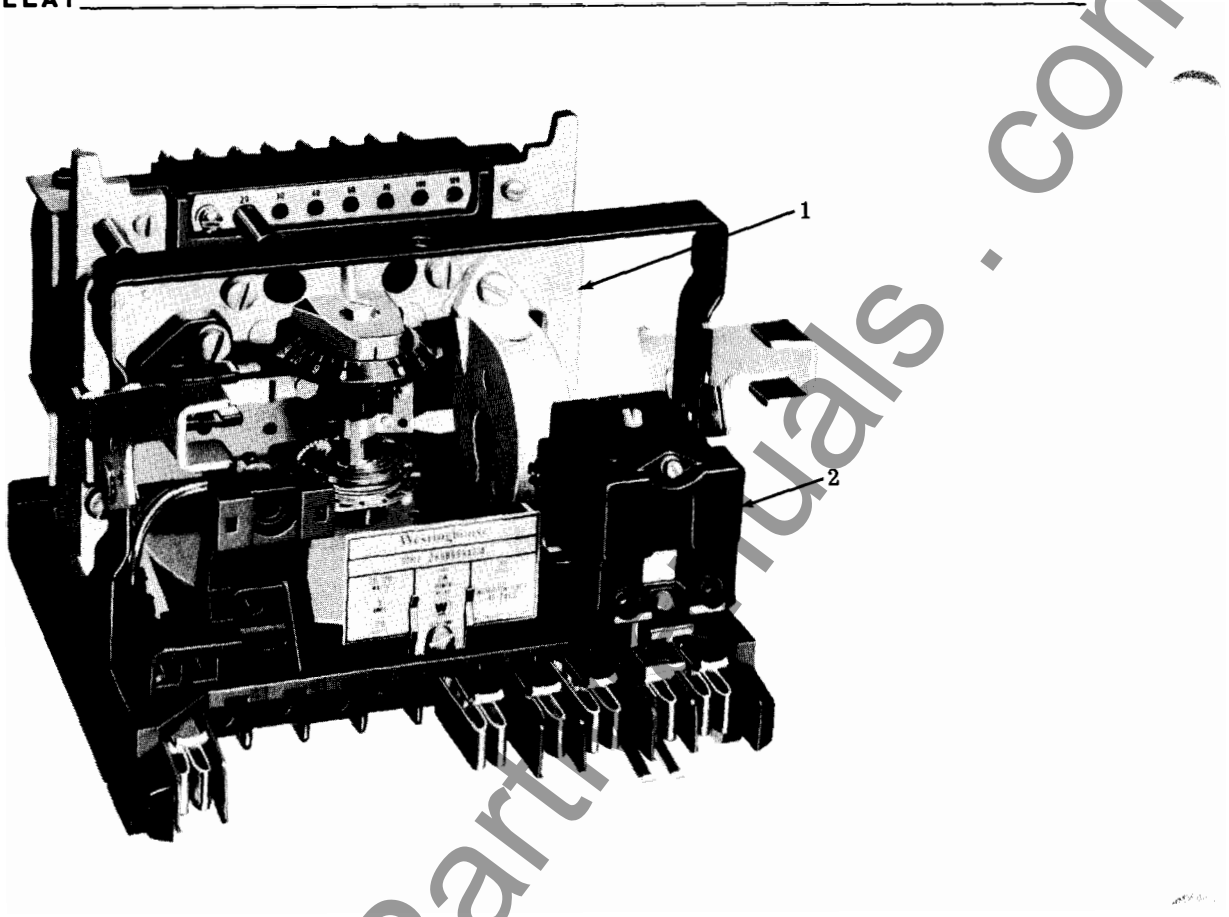


Fig. 1. 1. Time-power unit. 2. Indicating Connector Switch (ICS). Note: Phase shifting resistor is mounted in rear.

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 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.

Trip Circuit 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.

SETTINGS

Product Unit

There are two settings to be made. One is the current tap setting, and the second, the time dial setting.

The CW relay for three-phase application has taps which represents single phase watts multiplied by $\sqrt{3}$. The power to operate the relay equals the three phase primary power divided by the quantity $\sqrt{3}$ times the current and potential transformer ratios.

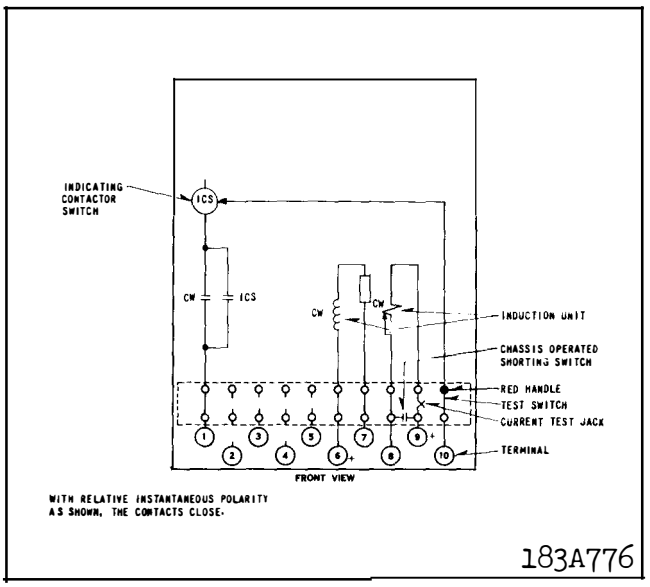


Fig. 2. Internal Schematic of the Type CW Relay in the Type FT11 Case.

This relay power expressed as multiples of the chosen tap locates a value on the abscissa of the Time-Power Curves of Fig. 3 and 4. The relay operating time for various time dial settings then is observed on the ordinate. By changing taps or time dial, the required operating time can be selected for specific power value.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole before removing the old tap screw. This prevents open-circuiting the current transformers.

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.

ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

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.

Product Unit

Contacts – The index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves.

Minimum Trip Watts – Set the time dial to position 6. Using the lowest tap setting, alternately apply tap value watts plus 3% and tap value watts minus 3%. The moving contact should leave the backstop at tap value watts plus 3% and should return to the backstop at tap value watts minus 3%. The relay should be calibrated with 10 times tap value watts at the number six time dial position. Check several points on the typical time curves. Time curve calibration is affected by adjusting the position of the permanent magnet keeper.

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 indicator target should drop freely.

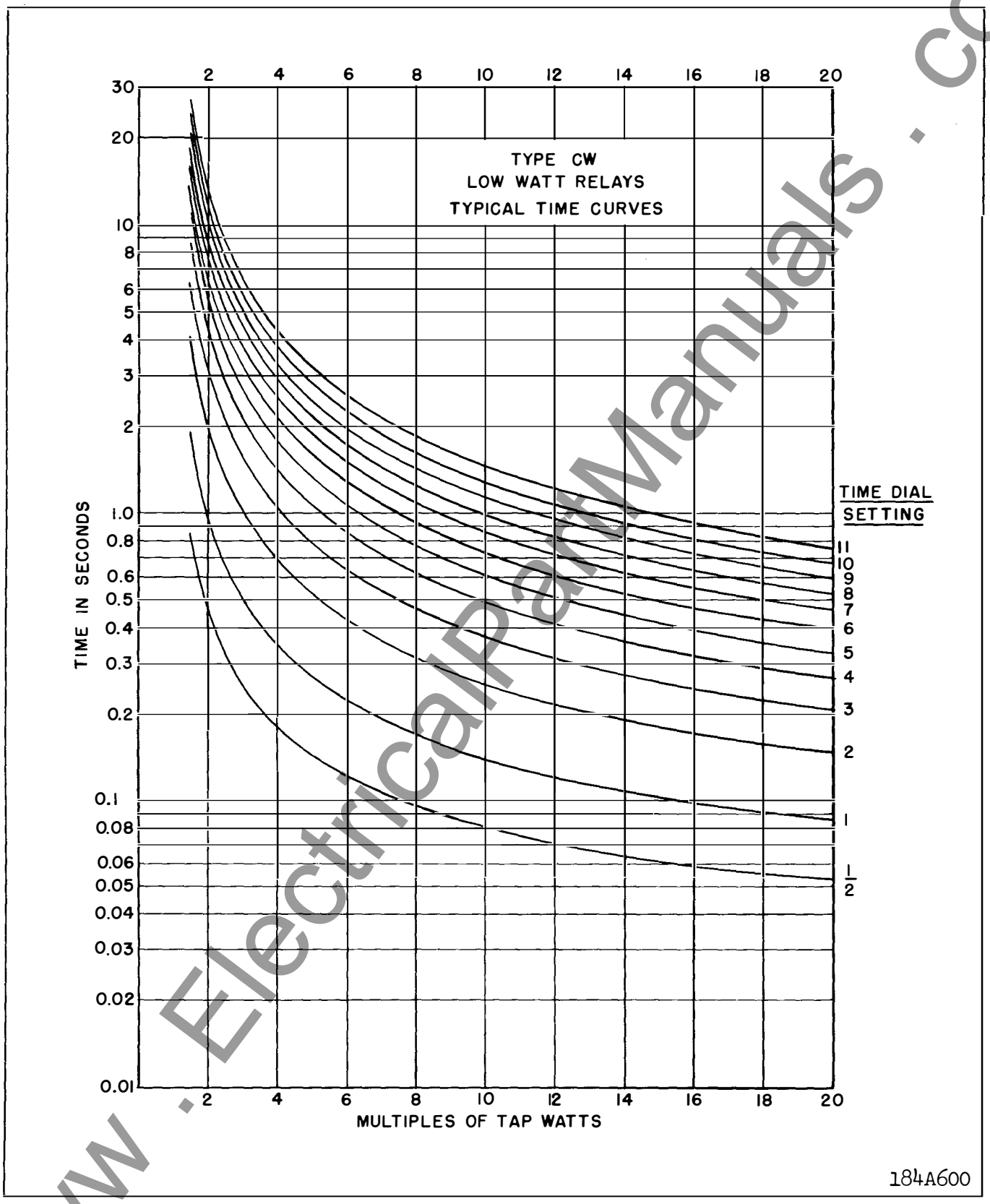


Fig. 3. Typical 60 cycle Time Curves of the 20-120 and 35-200 watt Type CW Relay.

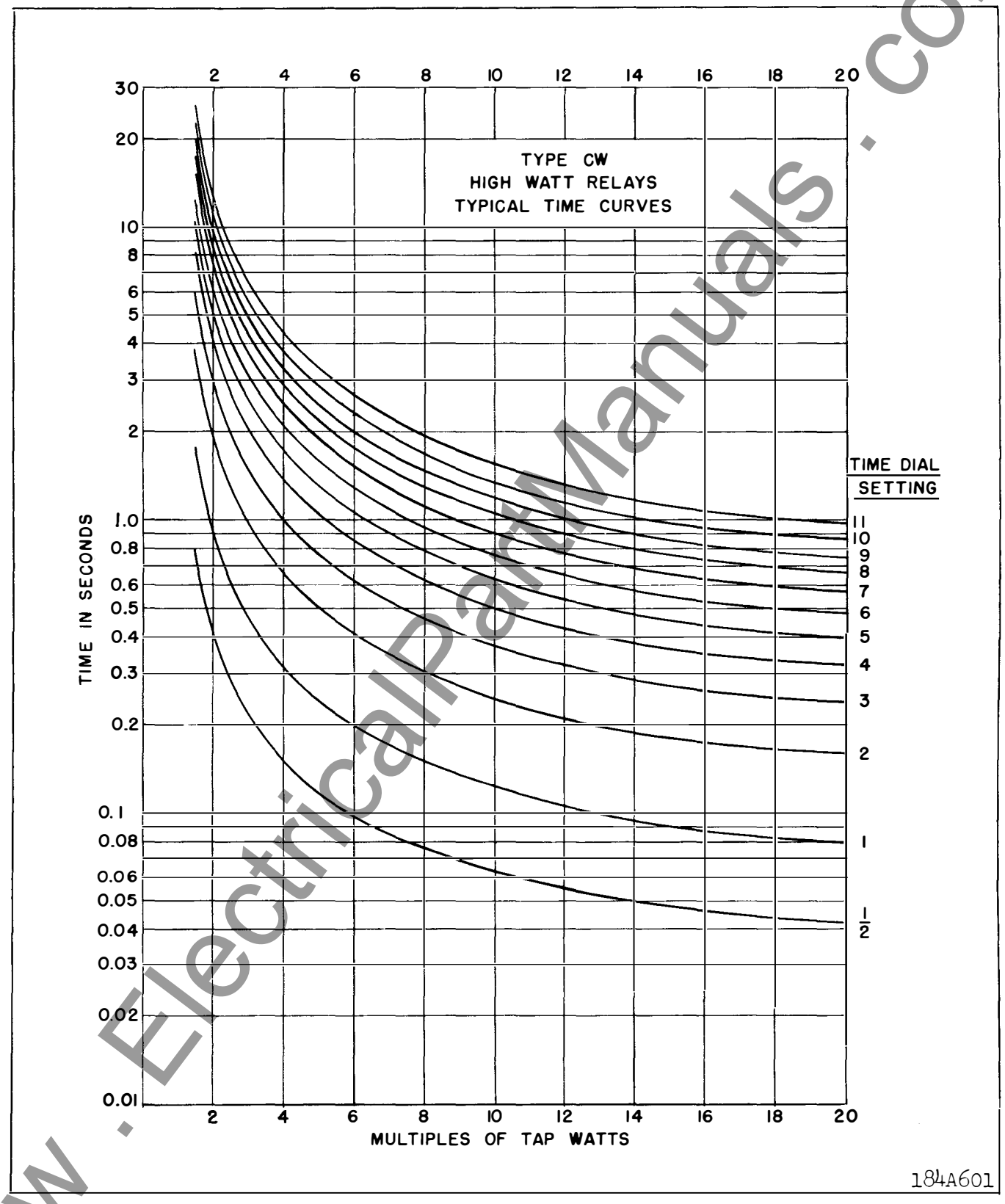


Fig. 4. Typical 60 cycle Time Curves of the 100-600 and 175-1000 watt Type CW Relay.

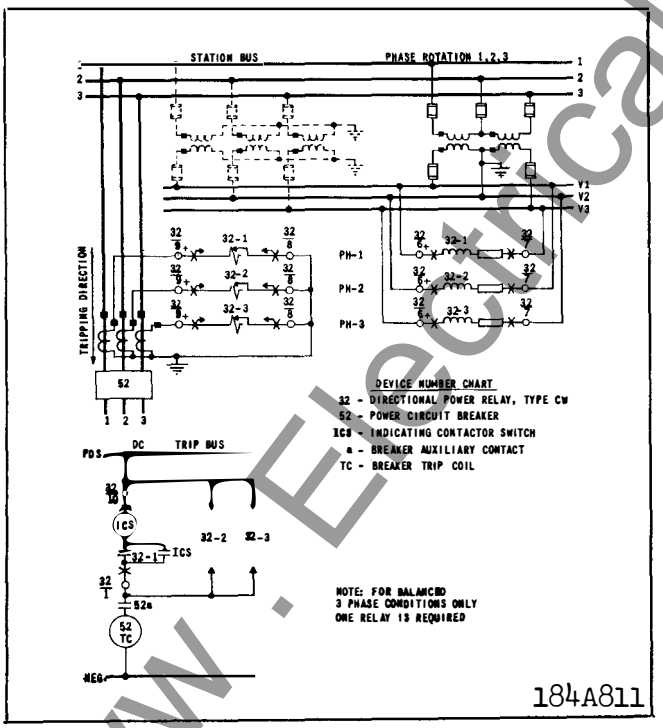
ENERGY REQUIREMENTS

The 60 cycle burdens of the type CW Relay Three-Phase Application are as follows:

Relay Range	Potential Circuit			Current Circuit			
Watts	Voltage	Voltamperes	Current lags by	Current	Relay Tap	Voltamperes	Current lags by
20 – 120	120	20.5	68°	5 amp.	20	16.2	78°
100 – 600	120	20.5	68°	5 amp.	100	5.4	67°
35 – 200	208	18.8	59°	5 amp.	35	16.2	78°
175 – 1000	208	18.8	59°	5 amp.	175	5.4	67°

Current Coil Ratings:

	Continuous	1 Sec.
A. 20-120 Watt Range 35-200 Watt Range	5 Amperes	230 Amperes
B. 100-600 Watt Range 175-1000 Watt Range	8 Amperes	370 Amperes



* *Fig. 5. External Schematic of Three Type CW Relays on a Three-Phase System. Note: For Balanced Three Phase Conditions only One CW Relay is required.*

RENEWAL PARTS

Repair work can be done most satisfactorily at 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.

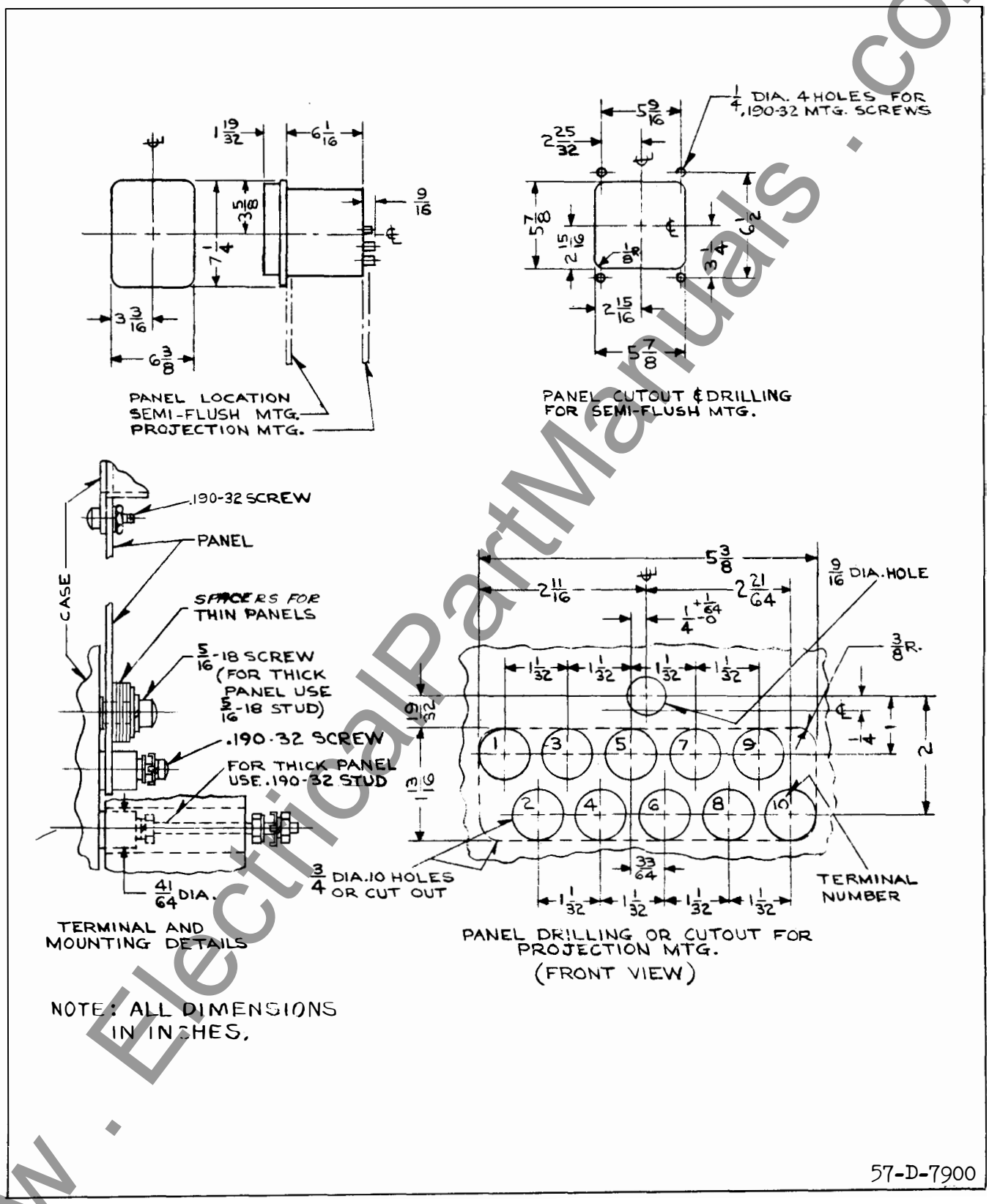


Fig. 6. Outline and Drilling Plan for the Type CW Relay in the Type FT11 Case.

WESTINGHOUSE ELECTRIC CORPORATION

RELAY – INSTRUMENT DEPARTMENT **NEWARK, N. J.**

Printed in U. S. A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CWD POWER RELAY

Three Phase Watt Sensing 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

These relays are used to initiate switching or control operations when the line watts rises above a preset value, or falls below a preset value. Thus the relay is a current sensing device with high and low current settings.

The CWD relay for the three-phase application uses phase-to-phase voltage and line current, with maximum torque occuring when the relay current leads the relay voltage by 30° at system unity power factor. The relay operates on single phase watts multiplied by $\sqrt{3}$. One CWD relay is required for balanced three phase system and three relays are required for unbalanced conditions.

CONSTRUCTION

The relay consists of an induction disc type watt sensing unit containing a phase shifter.

Product Type Unit

The electromagnet for the main element may have a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the current coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current leads the voltage by 30 degrees. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon magnitude of the line current. The combination of voltage and current produces an operating torque proportional to power.

When the watt sensing unit contact closes to the right this indicates that the line watts are at or above the value of watts desired. Conversely when the watt sensing unit contact closes to the left this indicates that the line watt is at or below value of current desired.

Phase Shifter

The phase shifter network consist of a resistor in series with the potential coils.

CHARACTERISTICS

The type CWD relays are available in the following ranges and taps:

Volts Line-to Line	$\frac{(I_L V_{LL})}{\sqrt{3}}$ (single phase watts)	
	Range	Taps
120	20- 120	20-30-40-60-80-100-120
	100- 600	100-150-200-300-400-500-600
208	35- 200	35-50-70-100-140-175-200
	175-1000	175-250-350-500-700-875-1000
120	10- 60	None
	20- 120	None
	50- 300	None
	100- 600	None
	150- 900	None

NEW INFORMATION

EFFECTIVE JUNE 1964

The type CWD watt sensing relay has adjustable high and low wattage contacts that can be set around a 150° arc which is calibrated in watts on non-tapped relays, or in percent of tap value watts on tapped relays. These values represent the tripping position of the moving contacts when the value of watts is applied to the relay. For the tapped relays the percent scale markings are 80, 85, 90, 95, 100, 105 and 100.

The moving contacts will assume a position corresponding to the watts applied to the relay and will stay in that position until the wattage changes. If the wattage changes either gradually or suddenly, the contact will assume a new position corresponding to the change unless the travel is limited by the setting of the adjustable contacts. If the contacts are set to close for a particular value of watts, and if a wattage of that exact amount is applied, then the relay is operating at its minimum trip point and the times on repeated operations are not repetitive within close tolerances. However, wattage appreciably greater than the wattage setting, or appreciably less than the wattage setting, result in relay timing operations which are consistent for repeated trials.

The induction unit has inverse timing; that is, the greater the change in watts, the faster the relay contact will travel.

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.

SETTINGS

Product Unit

The CWD relay for three-phase 208V application has taps which represents single phase watts multiplied by $\sqrt{3}$. The power to operate the relay equals the three phase primary power divided by the quantity $\sqrt{3}$ times the current and potential transformer ratios.

The watt sensing unit settings can be defined either by contact settings or tap setting. The high and low watt contact settings are described under "Characteristics".

Relays which are tapped have a connector screw on the terminal plate above the scale which makes connections to various turns on the operating coil. The tap setting is made by placing this screw in the desired tap as marked on the terminal plate.

Caution

Since the tap block connector screw carries operating current, be sure that the screw is turned tight. In order to avoid opening the current transformer circuits when changing taps under load, connect the spare connector screw in the desired tap position before removing the other tap screw from the original tap position.

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 "SETTING" should be required.

Acceptance Check

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

A. Current Sensing Unit

1. Contact Adjustment Check — Set the left-hand contact in the center of the scale and adjust the wattage until the moving contact just makes. Move the left-hand contact out of the way and bring the right-hand contact up until the contacts just make. The right pointer should be within ± 1/32" of where the left-hand pointer was.

2. Calibration Check — Check the scale markings by setting either of the two contacts at a value marked on the scale, then alternately apply this wattage plus 5% and minus 5% for non-tapped relays, and plus and minus 3% for tapped relays. The under wattage contact should make at the lower wattage and break at the higher wattage. For the over wattage contact check, the contact will make for the higher wattage and break at the lower wattage.

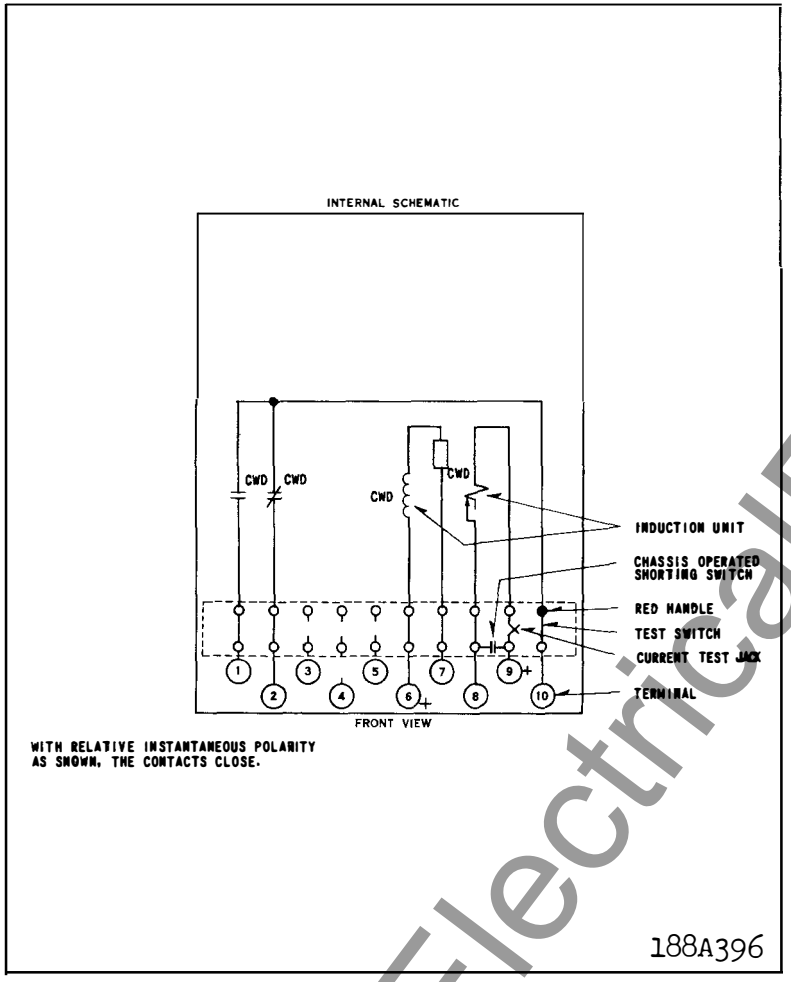


Fig. 1 Internal Schematic of the Tapped Type Relay in the Type FT 11 Case.

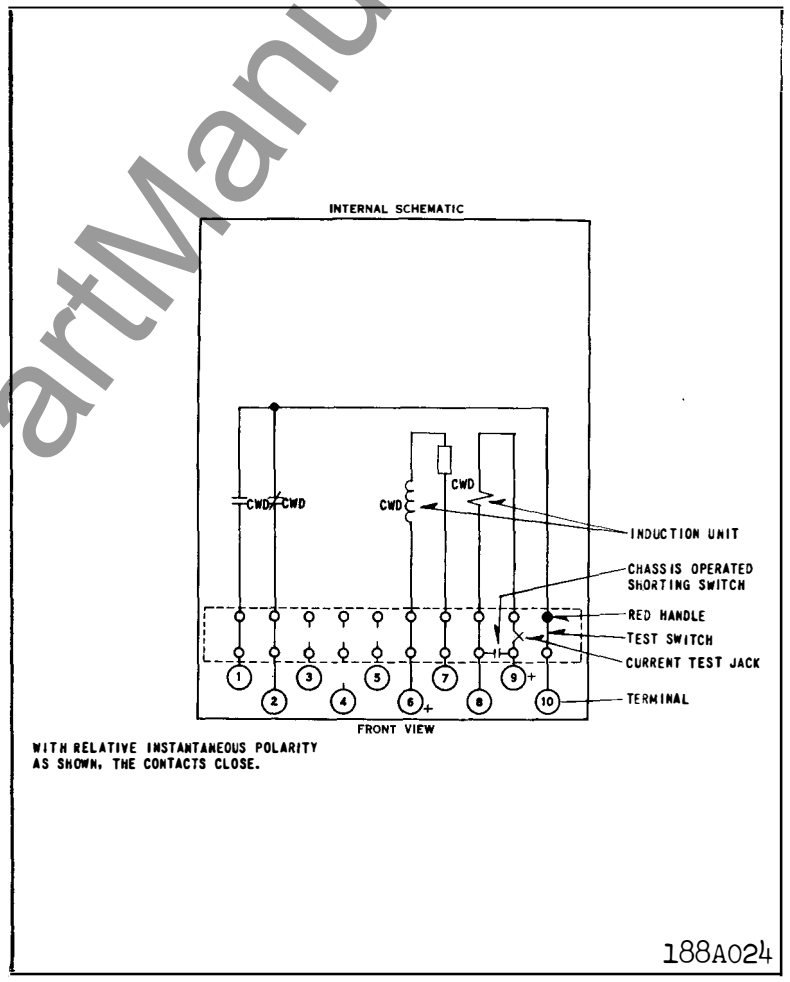


Fig. 2. Internal Schematic of the Non-Tapped Type Relay in the Type FT 11 Case.

Routine Maintenance

All relays should be inspected periodically and the time of operation should be checked at least once every year or at such other time intervals as may be dictated by experience to be suitable to the particular application. The use of phantom loads, in testing induction-type relays, should be avoided, since the resulting distorted current wave form will produce an error in operation.

All contacts should be periodically cleaned. A contact burnisher #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.

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. Watts Sensing Unit

1. Contacts — Apply sufficient wattage to the relay, to make the disc float in the center of its travel. Move both of the adjustable contacts until they just make with the moving contact. If the two contact pointers do not meet at the same point on the scale (± 1/32"), adjust the follow on both adjustable contacts. Approximately the same follow should be in each of the adjustable stationary contacts.

2. Calibration Check — The adjustment of the spring tension in calibrating the relay is most conveniently made with the damping magnet removed.

Set either of the adjustable stationary contacts in the center of its travel and apply this wattage to the relay. Wind up the spiral spring by means of the spring adjuster until the stationary contact and moving contact just make.

Check the other markings by setting the adjustable contact on these markings and applying the corresponding wattage to the relay. The contacts should make within plus or minus 5% of contact setting for non-tapped relays and plus or minus 3% of contact setting for tapped relays.

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

The 60 cycle burdens of the type CWD Relay Three-Phase Applications are as follows:

Relay Range	Potential Circuit			Current Circuits			
Watts	Voltage	Voltamperes	Current lags by	Current	Relay Tap	Voltamperes	Current lags by
10 – 60 20 – 120 50 – 300 100 – 600 150 – 900	120	20.5	68°	5 amp.	None	16.2	78°
35 – 200	208	18.8	59°	5 amps.	35	16.2	78°
100 – 600	120	20.5	68°	5 amps.	100	5.4	67°
175 – 1000	208	18.8	59°	5 amps.	175	5.4	67°

Current Coil Ratings:

	Watt Range	Continuous	1 Sec.
A. Non-Tapped	10 – 60 20 – 100 50 – 300 100 – 600 150 – 900	5 amps.	230 amps.
B. Tapped	35 – 200	5 amps.	230 amps.
	100 – 600 175 – 1000	8 amps.	370 amps.

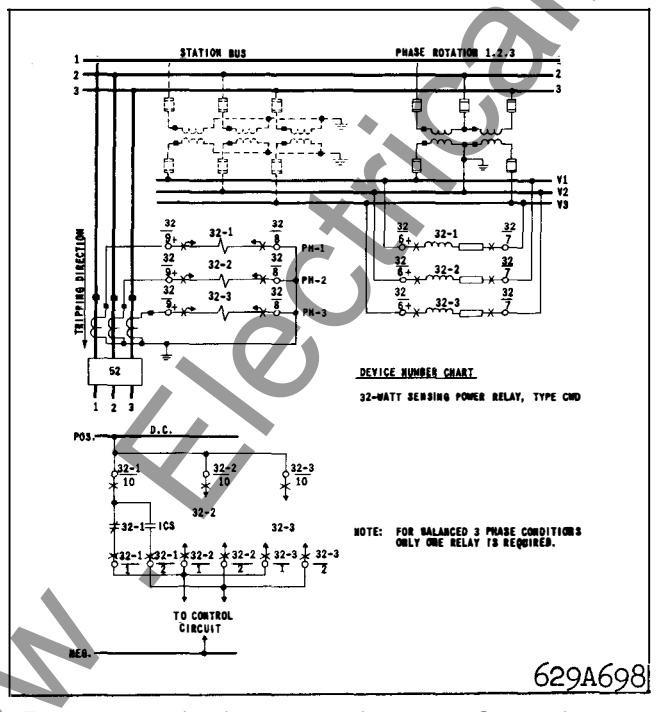


Fig. 3 External Schematic of Three Type CWD Relays on a Three-Phase System. Note: For Balanced Three Phase Conditions only One CWD Relay is required.

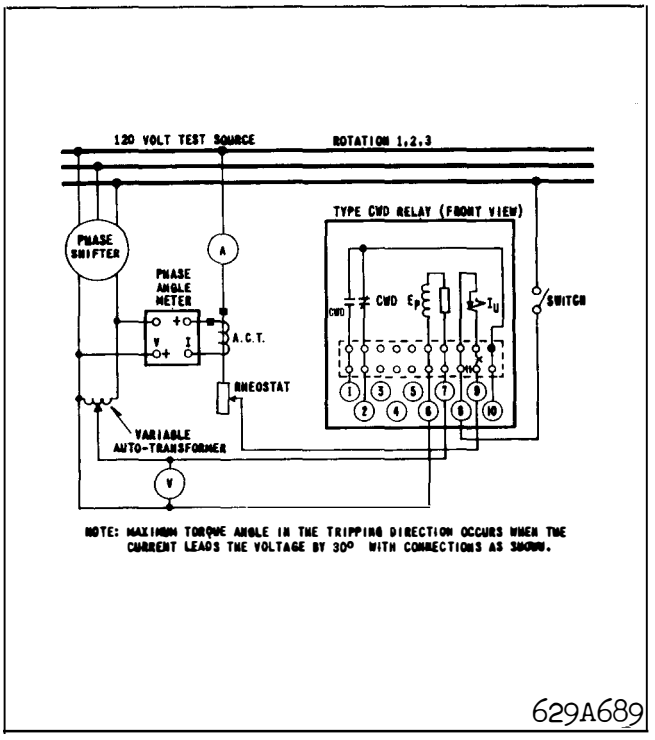


Fig. 4 Diagram of Test Connections for CWD Relays.

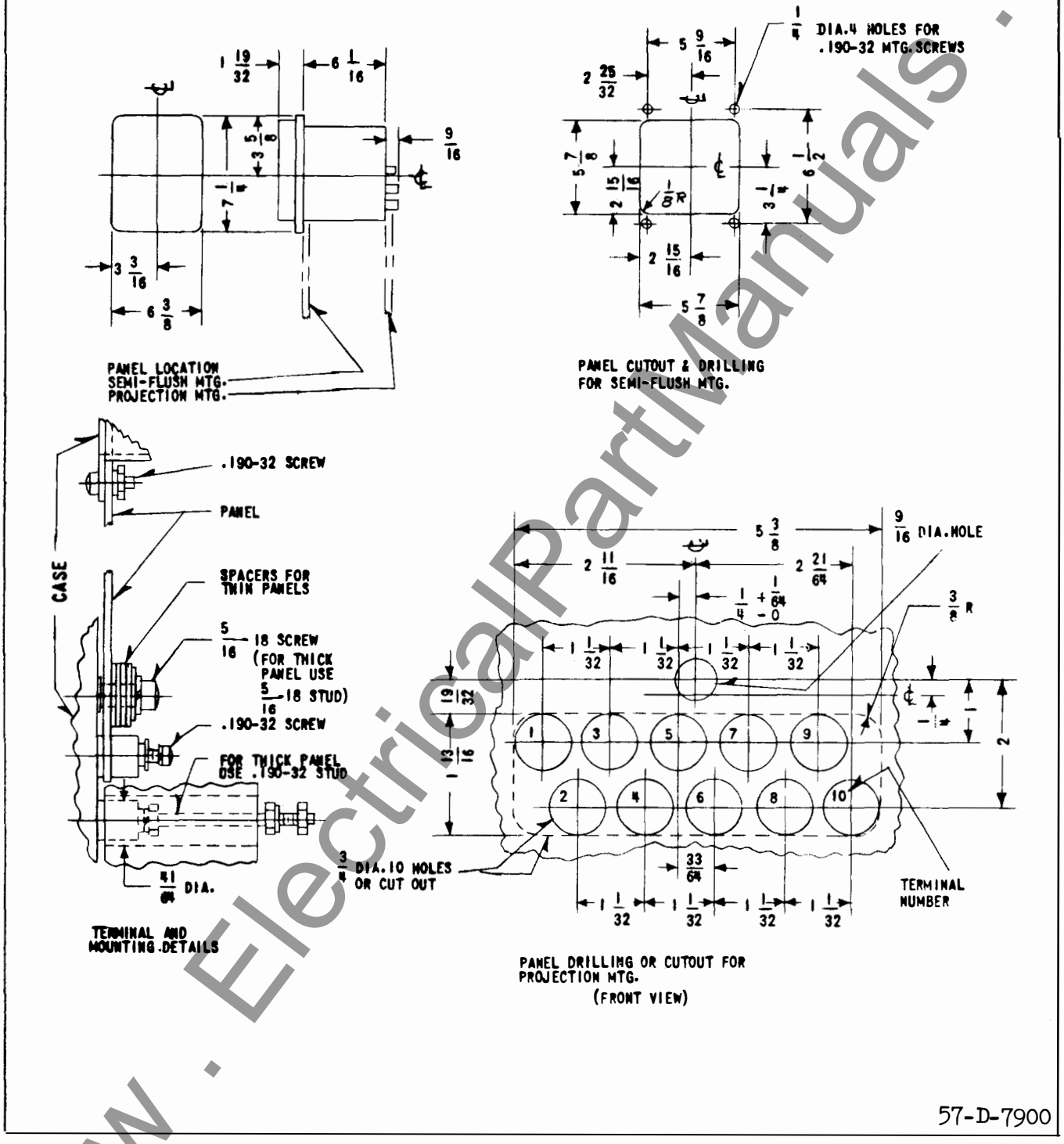


Fig. 5 Outline and Drilling Plan for the Type CWD Relay in the Type FT 11 Case.

WESTINGHOUSE ELECTRIC CORPORATION

RELAY-INSTRUMENT DIVISION **NEWARK, N. J.**

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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CW POWER RELAY

THREE PHASE APPLICATION

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 CW relay for three-phase application is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

The CW relay for three-phase application uses phase-to-phase voltage and line current, with maximum torque occuring when the relay current leads the relay voltage by 30° at system unity power factor. The relay operates on single phase watts multiplied by $\sqrt{3}$. One CW relay is required for balanced three phase system and three relays are required for unbalanced conditions.

CONSTRUCTION

The relay consists of a product operated unit, a phase shifter and an indicating contactor switch (ICS).

Product Type Unit

The electromagnet for the main element has a tapped current coil located on the center leg of an "E" typed laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the tapped coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current leads the voltage by 30 degrees. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon direction of the line current. The combination of voltage and current produces an operating torque proportional to power.

Phase Shifter – The phase shifter network consist of a resistor in series with the potential coils.

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 CW relays are available in the following ranges and taps:

Volts Line-to Line	$\sqrt{3}$ (single phase watts)	
	Range	Taps
120	20– 120 100– 600	20– 30– 40– 60– 80–100– 120 100–150–200–300–400–500– 600
208	35– 200 175–1000	35– 50– 70–100–140–175– 200 175–250–350–500–700–875–1000

Typical 60 cycle Time-Power Curves are shown in Figs. 3 & 4. The curves are taken at maximum torque which occurs with the current leading the voltage by 30 degrees. (within ±4°)

NEW INFORMATION

EFFECTIVE JUNE 1960

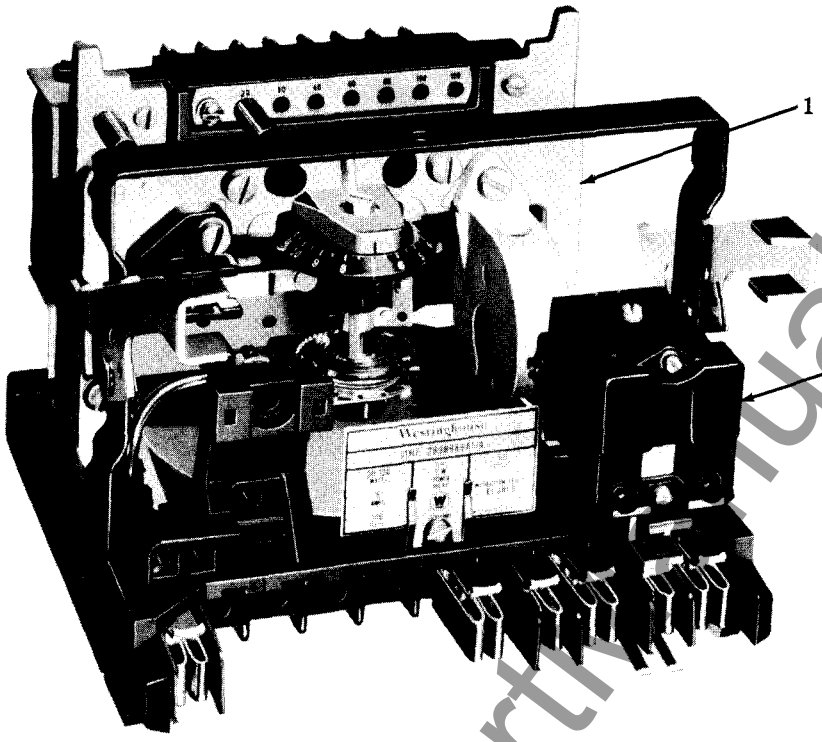

Fig. 1. 1. Time-power unit. 2. Indicating Connector Switch (ICS). Note: Phase shifting resistor is mounted in rear.

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 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.

Trip Circuit 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.

SETTINGS

Product Unit

There are two settings to be made. One is the current tap setting, and the second, the time dial setting.

The CW relay for three-phase application has taps which represents single phase watts multiplied by $\sqrt{3}$. The power to operate the relay equals the primary power divided by the current and potential transformer ratios. This relay power expressed as

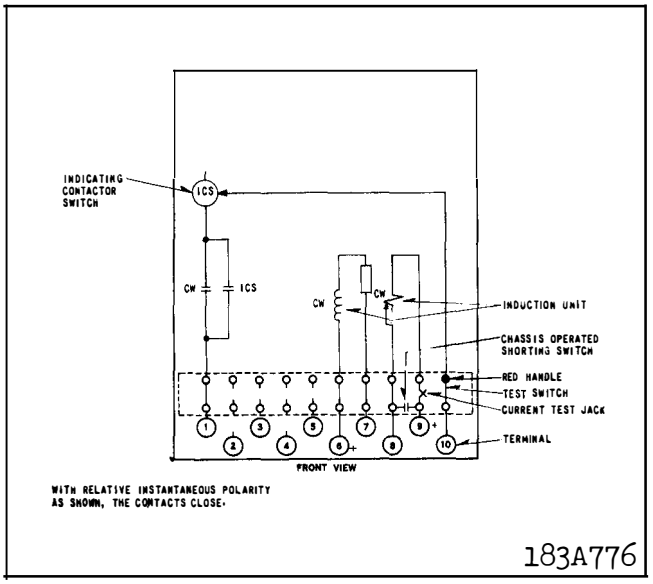

Fig. 2. Internal Schematic of the Type CW Relay in the Type FT11 Case.

multiples of the chosen tap located a value on the abscissa of the Time-Power Curves of Fig. 3 and 4 The relay operating time for various time dial settings then is observed on the ordinate. By changing taps or time dial, the required operating time can be selected for specific power value.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole before removing the old tap screw. This prevents open-circuiting the current transformers.

Indicating Contactar 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.

ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

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.

Product Unit

Contacts – The index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves.

Minimum Trip Watts – Set the time dial to position 6. Using the lowest tap setting, alternately apply tap value watts plus 3% and tap value watts minus 3%. The moving contact should leave the backstop at tap watts plus 3% and should return to the backstop at tap value watts minus 3%. The relay should be calibrated with 10 times tap watts at the number six time dial position. Check several points on the typical time curves. Time curve calibration is affected by adjusting the position of the permanent magnet keeper.

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 indicator target should drop freely.

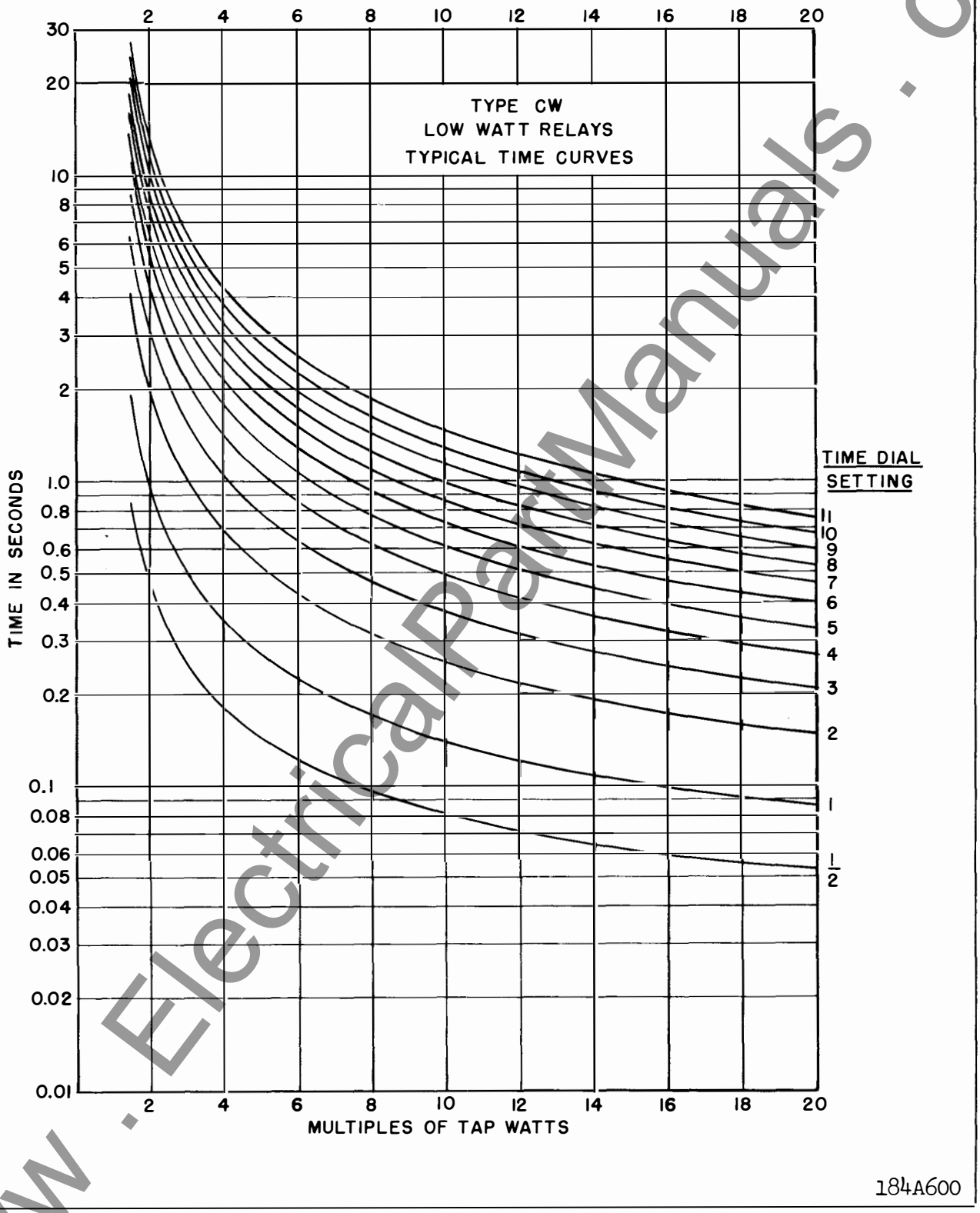

Fig. 3. Typical 60 cycle Time Curves of the 20-120 and 35-200 watt Type CW Relay.

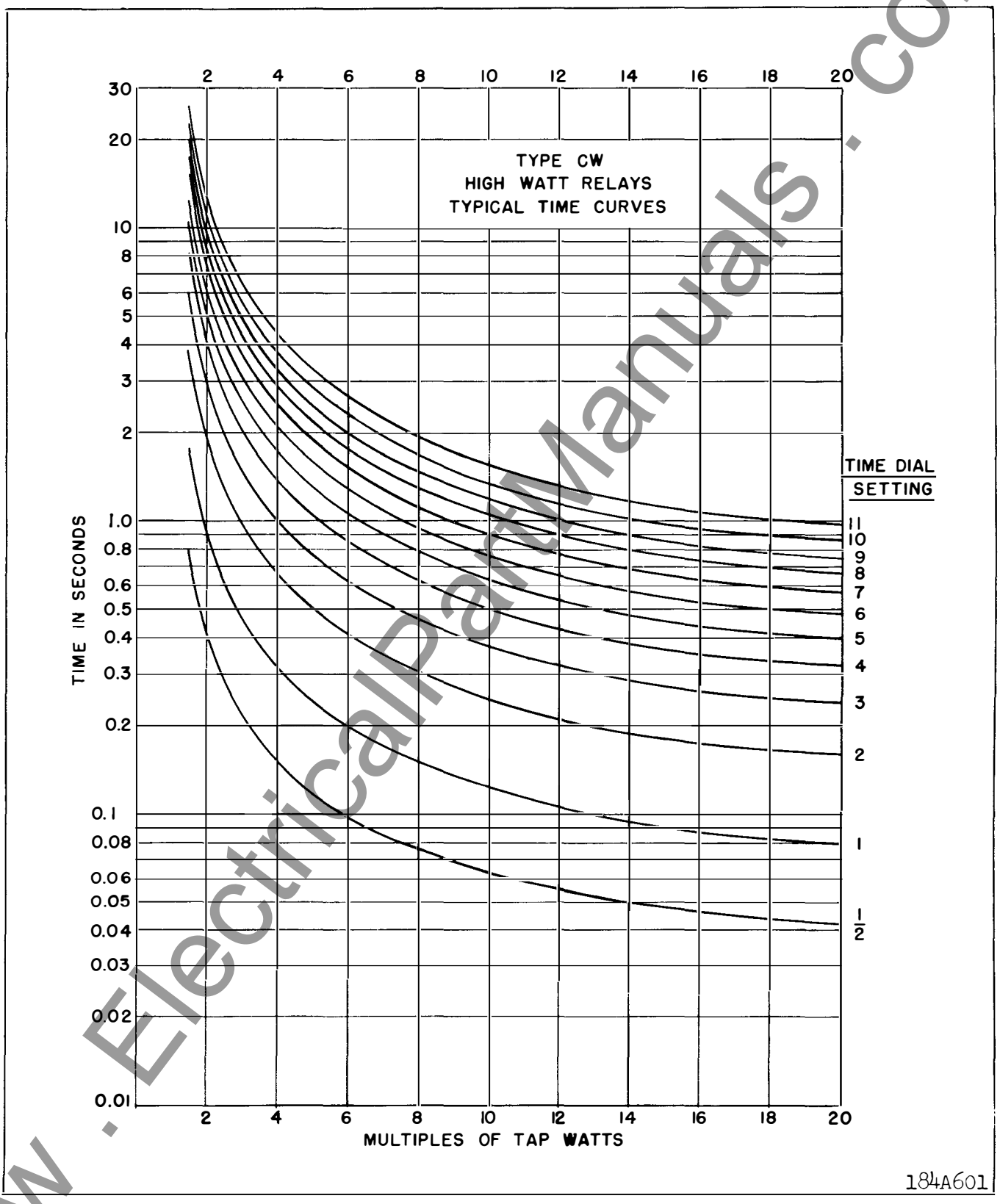

Fig. 4. Typical 60 cycle Time Curves of the 100-600 and 175-1000 watt Type CW Relay.

ENERGY REQUIREMENTS

The 60 cycle burdens of the type CW Relay Three-Phase Application are as follows:

Relay Range	Potential Circuit			Current Circuit			
Watts	Voltage	Voltamperes	Current lags by	Current	Relay Tap	Voltamperes	Current lags by
20 – 120	120	20.5	68°	5 amp.	20	16.2	78°
100 – 600	120	20.5	68°	5 amp.	100	5.4	67°
35 – 200	208	18.8	59°	5 amp.	35	16.2	78°
175 – 1000	208	18.8	59°	5 amp.	175	5.4	67°

Current Coil Ratings:

	Continuous	1 Sec.
A. 20-120 Watt Range 35-200 Watt Range	5 Amperes	230 Amperes
B. 100-600 Watt Range 175-1000 Watt Range	8 Amperes	370 Amperes

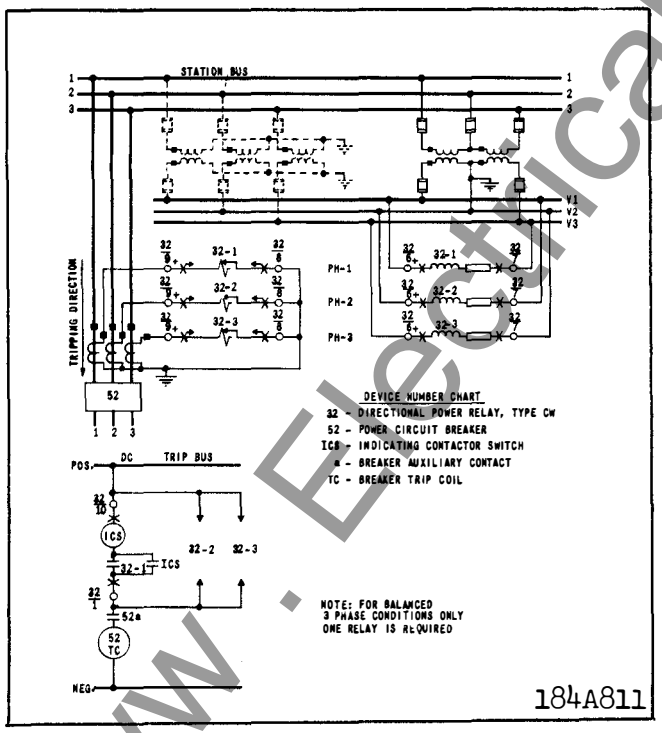

Fig. 5. External Schematic of Three Type CW Relays on a Three-Phase System. Note: For Balanced Three Phase Conditions only One CW Relay is required.

RENEWAL PARTS

Repair work can be done most satisfactorily at 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.

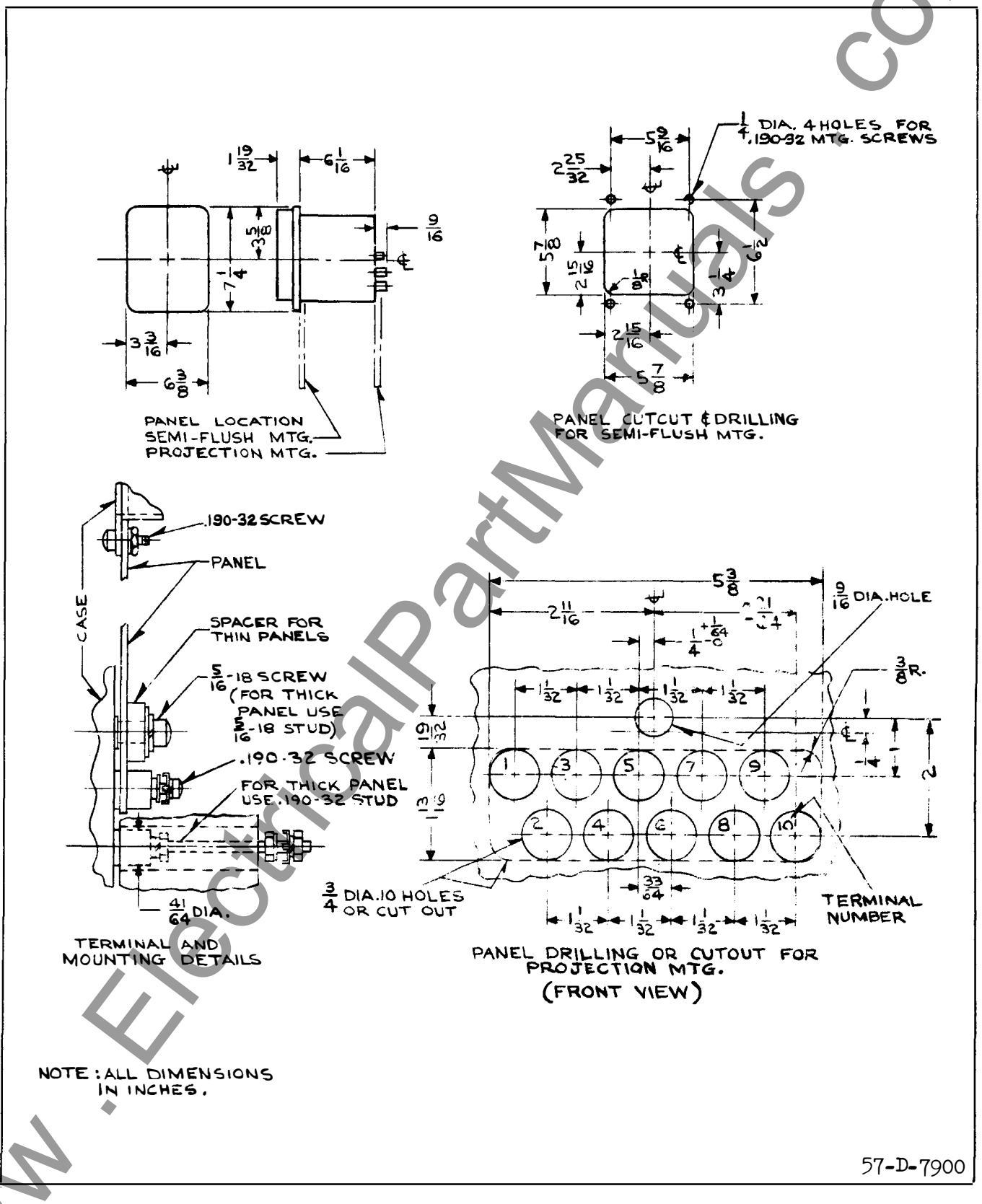

Fig. 6. Outline and Drilling Plan for the Type CW Relay in the Type FT11 Case.

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RELAY DEPARTMENT **NEWARK, N. J.**

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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CW POWER RELAY

SINGLE PHASE APPLICATION

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 CW relay is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

CONSTRUCTION

The relay consists of a product operated unit, a phase shifter and an indicating contactor switch (ICS).

Product Type Unit

The electromagnet for the main element has a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the tapped coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current and voltage are in phase. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon direction of the line current. The combination of voltage and current produces an operating torque proportional to power.

Phase Shifter The phase shifter network consists of a capacitor in parallel with the potential coils and a reactor in series with the above combination.

Indicating Contractor 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 CW relays are available in the following ranges and taps:

SINGLE PHASE WATT RANGE	POTENTIAL COIL	TAPS
20 – 120	120	20-30-40-60-80-100-120
100 – 600	120	100-150-200-300-400-500-600

Typical 60 cycle Time-Power Curves are shown in Figs. 3 & 4. The curves are taken at maximum torque which occurs with the current and voltage in phase (within ±4°).

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 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.

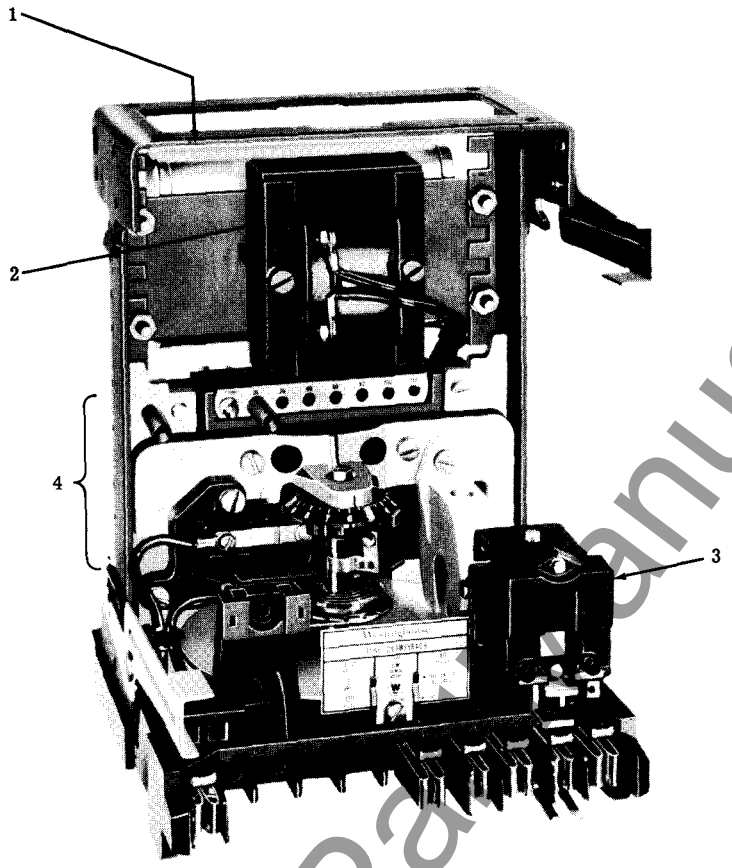

Fig. 1 Type CW Relay Without Case. 1 - Capacitor. 2 - Reactor. 3 - Indicating Contactor Switch (ICS). 4 - Time-Power Unit.

Trip Circuit 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.

SETTINGS

Product Unit

There are two settings to be made. One is the current tap setting, and the second, the time dial setting.

The power to operate the relay equals the primary power divided by the current and potential transformer ratios. This relay power expressed as multiples of the chosen tap locates a value on the abscissa of the Time-Power Curves of Fig. 3 and 4. The relay operating time for various time dial settings then is observed on the ordinate. By changing taps or time dial, the required operating time can be selected for a specific power value.

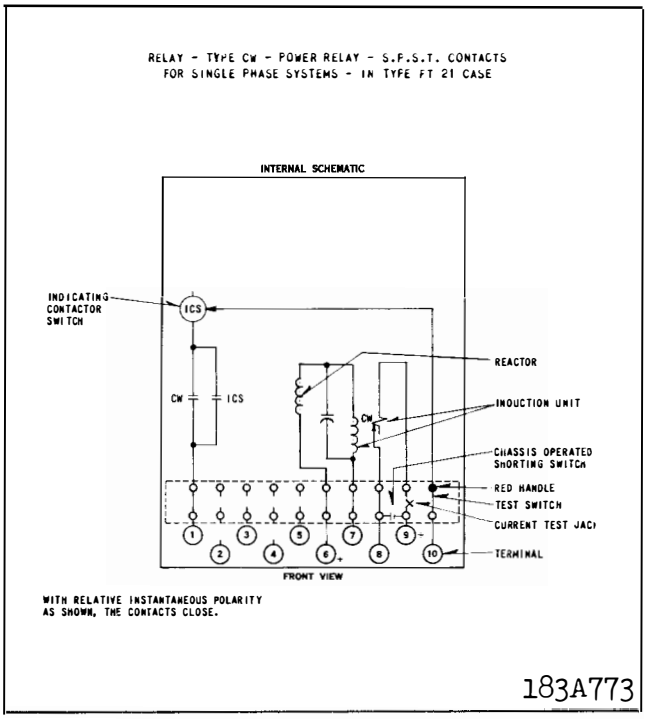

Fig. 2 Internal Schematic of the Type CW Relay in the Type FT 21 Case.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole before removing the old tap screw. This prevents open-circuiting the current transformers.

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.

ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

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 danget of embedding small particles in the face of the soft silver and thus impairing the contact.

Product Unit

Contacts — The index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves.

Minimum Trip Watts — Set the time dial to position 6. Using the lowest tap setting, alternately apply tap value watts plus 3% and tap value watts minus 3%. The moving contact should leave the backstop at tap watts plus 3% and should return to the backstop at tap value watts minus 3%. The relay should be calibrated with 10 times tap watts at the number six time dial position. Check several points on the typical time curves. Time curve calibration is effected by adjusting the position of the permanent magnet keeper.

Indicating Contactor Switch (ICS)

Close the main relay contacts and pass sufficicient 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 indicator target should drop freely.

ENERGY REQUIREMENTS

The 60 cycle burdens of the type CW Relay Single Phase Application are as follows:

1. The 20-120 Watt, 120 Volt Relay

A. Potential Circuit Burden at Rated Voltage

Current Lags By	Volt Amperes
26.5°	5.4

B. Curent Coil at 5 Amperes

TAP	CURRENT LAGS BY	VOLT AMPERES
20	78°	16.2

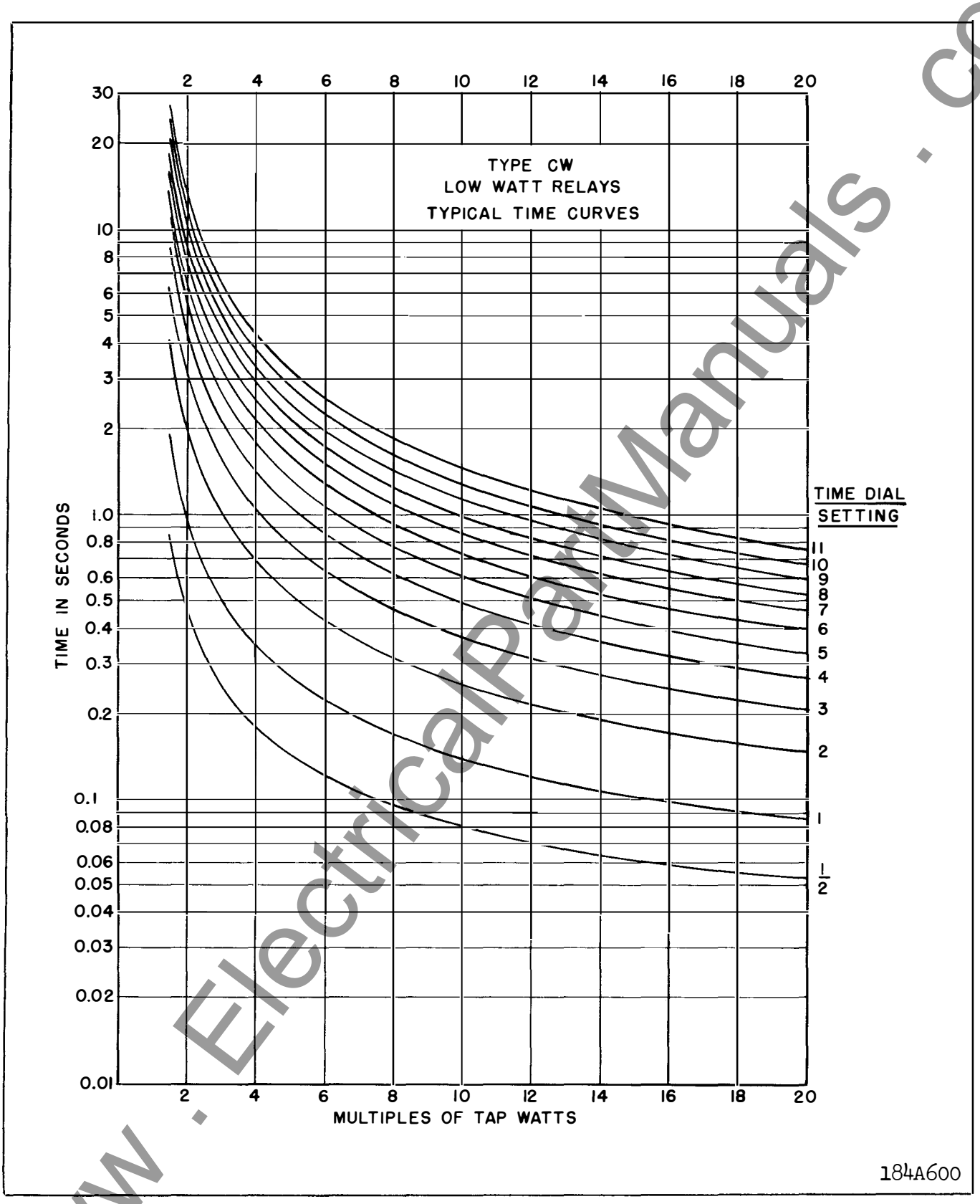

Fig. 3 Typical 60 cycle Time Curves of the 20-120 watt Type CW Relay.

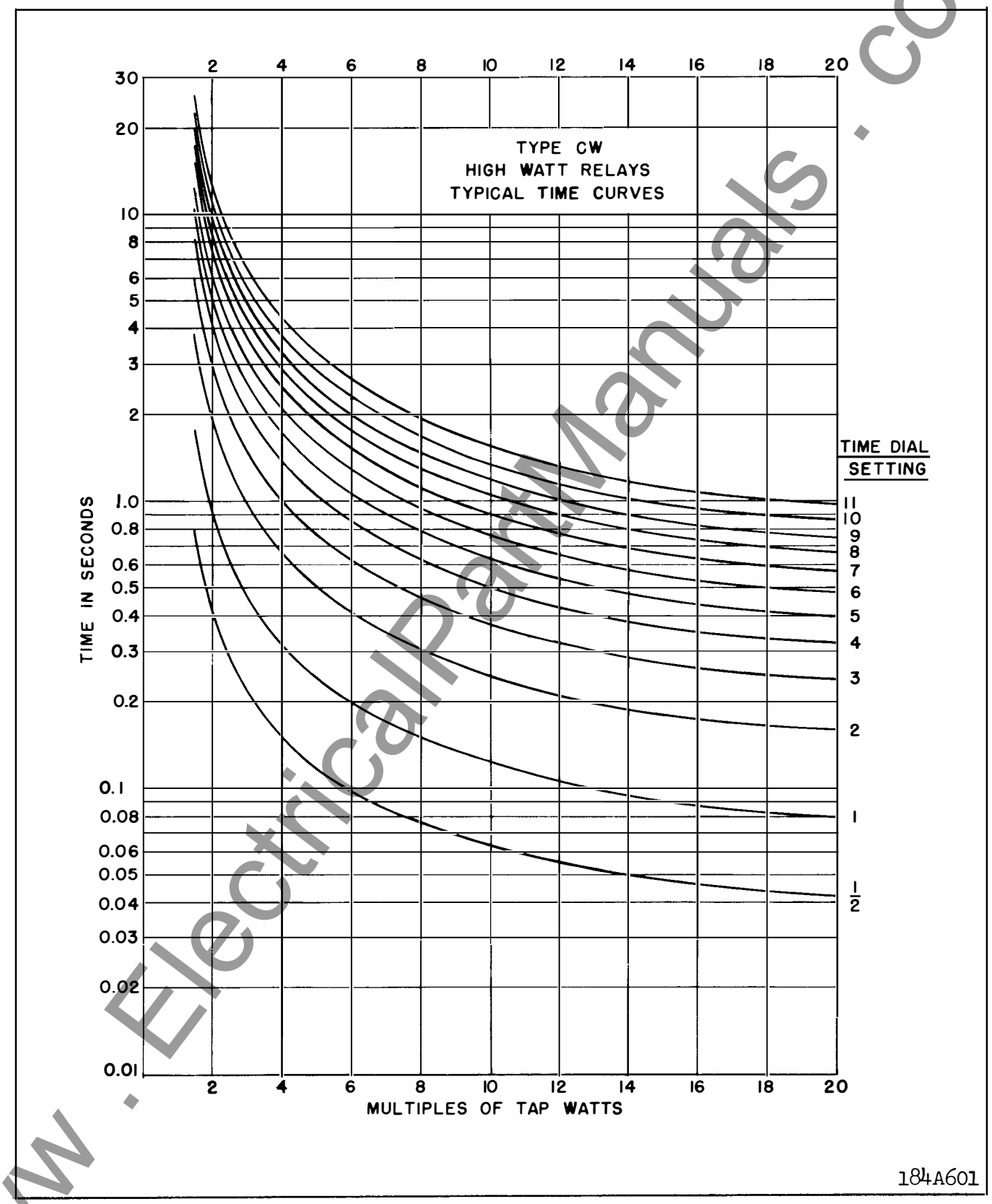

Fig. 4 Typical 60 cycle Time Curves of the 100-600 watt Type CW Relay.

2. The 100-600 Watt, 120 Volt Relay

A. Potential Circuit Burden at Rated Voltage

Current Lags by	Volt Amperes
20°	5.9

B. Current Coil Burden at 5 Amperes

TAP	CURRENT LAGS BY	VOLT AMPERES
100	67°	5.4

Current Coil Ratings

	Continuous	1 Sec.
A. 20-120 Watt Range	5 Amperes	230 Amperes
B. 100-600 Watt Range	8 Amperes	370 Amperes

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.

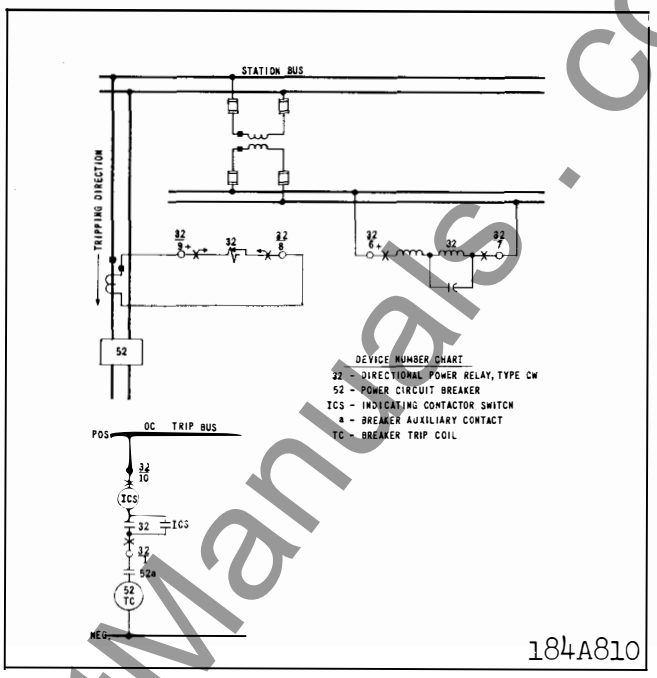

Fig. 5 External Schematic of One Type CW Relay on a Single Phase System.

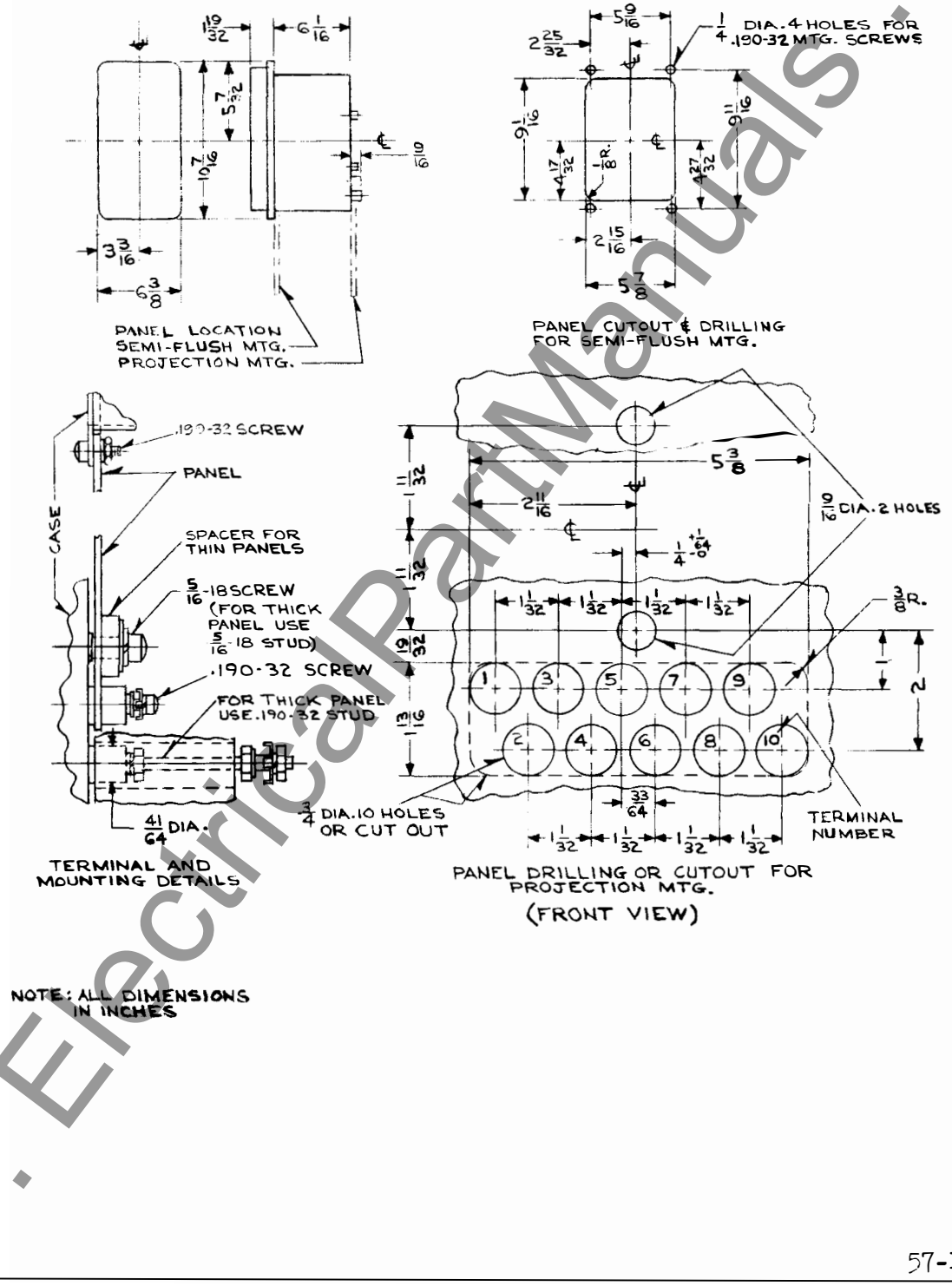

Fig. 6 Outline and Drilling Plan for the Type CW Relay in the Type FT 21 Case.

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RELAY DEPARTMENT **NEWARK, N. J.**

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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CW POWER RELAY

SINGLE PHASE APPLICATION

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 CW relay is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

CONSTRUCTION

The relay consists of a product operated unit, a phase shifter and an indicating contactor switch (ICS).

Product Type Unit

The electromagnet for the main element has a tapped current coil located on the center leg of an "E" type laminated structure and two potential coils on the outer legs. Operating torque is obtained by energizing the tapped coil with line current and the two outer coils with line potential from the line potential transformers. Out of phase air gap fluxes necessary for operating torques are produced by a phase shifting network in conjunction with the potential coils. Maximum torque occurs when the current and voltage are in phase. The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon direction of the line current. The combination of voltage and current produces an operating torque proportional to power.

Phase Shifter The phase shifter network consists of a capacitor in parallel with the potential coils and a reactor in series with the above combination.

Indicating Contractor 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 CW relays are available in the following ranges and taps:

SINGLE PHASE WATT RANGE	POTENTIAL COIL	TAPS
20 – 120	120	20-30-40-60-80-100-120
100 – 600	120	100-150-200-300-400-500-600

Typical 60 cycle Time-Power Curves are shown in Figs. 3 & 4. The curves are taken at maximum torque which occurs with the current and voltage in phase (within ±4°).

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 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.

SUPERSEDES I.L. 41-241.2
*Denotes change from superseded issue

EFFECTIVE FEBRUARY 1961

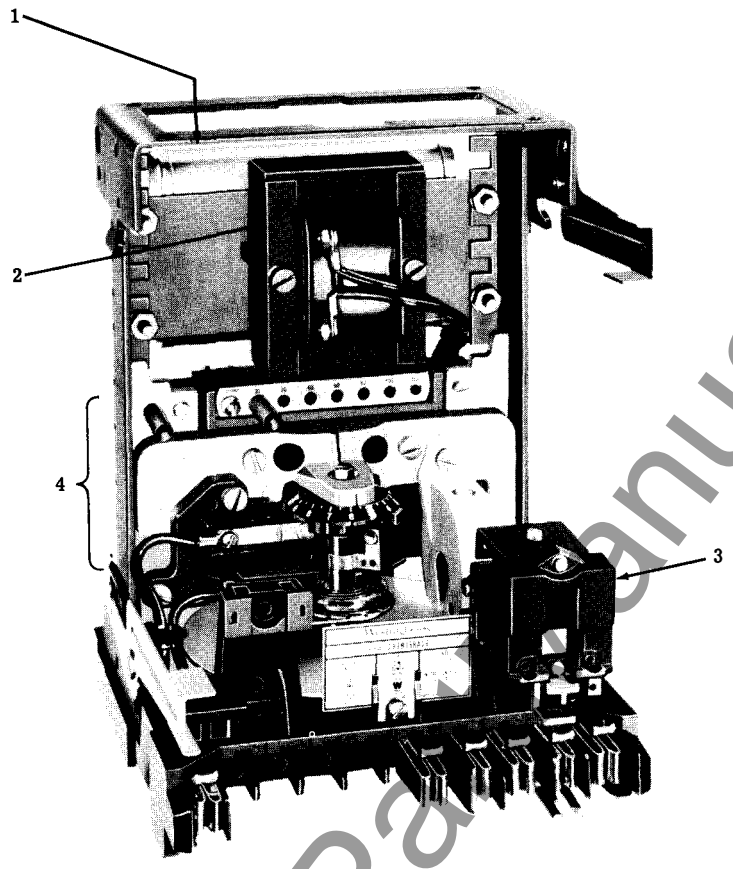


Fig. 1 Type CW Relay Without Case. 1 - Capacitor. 2 - Reactor. 3 - Indicating Contactor Switch (ICS). 4 - Time-Power Unit.

Trip Circuit 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.

SETTINGS

Product Unit

There are two settings to be made. One is the current tap setting, and the second, the time dial setting.

The power to operate the relay equals the primary power divided by the current and potential transformer ratios. This relay power expressed as multiples of the chosen tap locates a value on the abscissa of the Time-Power Curves of Fig. 3 and 4. The relay operating time for various time dial settings then is observed on the ordinate. By changing taps or time dial, the required operating time can be selected for a specific power value.

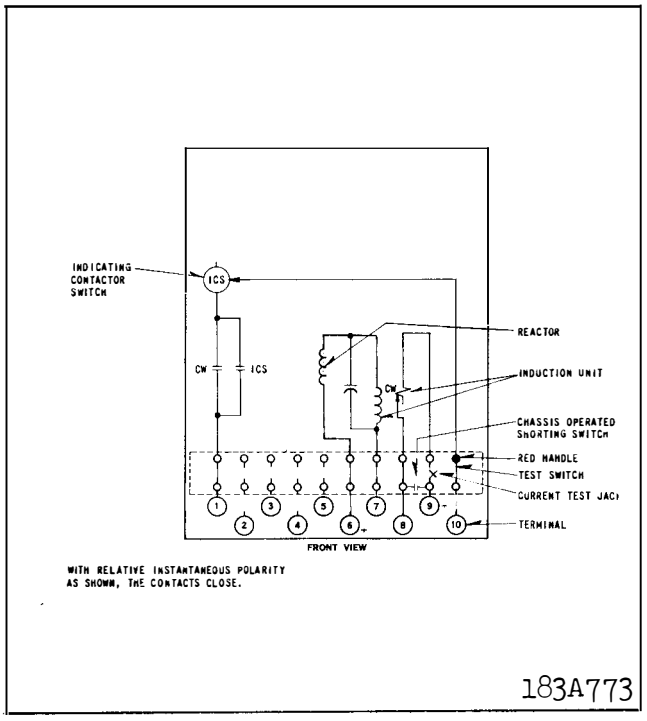


Fig. 2 Internal Schematic of the Type CW Relay in the Type FT 21 Case.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole before removing the old tap screw. This prevents open-circuiting the current transformers.

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.

ADJUSTMENT AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

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 danget of embedding small particles in the face of the soft silver and thus impairing the contact.

Product Unit

Contacts — The index mark on the movement frame will coincide with the "O" mark on the time dial when the stationary contact has moved through approximately one-half of its normal deflection. Therefore, with the stationary contact resting against the backstop, the index mark is offset to the right of the "O" mark by approximately .020". The placement of the various time dial positions in line with the index mark will give operating times as shown on the respective time-current curves.

* Minimum Trip Watts — Set the time dial to position 6. Using the lowest tap setting, alternately apply tap value watts plus 3% and tap value watts minus 3%. The moving contact should leave the backstop at tap watts plus 3% and should return to the backstop at tap value watts minus 3%. The relay should be calibrated with 10 times tap value watts at the number six time dial position. Check several points on the typical time curves. Time curve calibration is effected by adjusting the position of the permanent magnet keeper.

Indicating Contactor Switch (ICS)

Close the main relay contacts and pass sufficicient 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 indicator target should drop freely.

ENERGY REQUIREMENTS

The 60 cycle burdens of the type CW Relay Single Phase Application are as follows:

1. The 20-120 Watt, 120 Volt Relay

A. Potential Circuit Burden at Rated Voltage

Current Lags By	Volt Amperes
26.5°	5.4

B. Curent Coil at 5 Amperes

TAP	CURRENT LAGS BY	VOLT AMPERES
20	78°	16.2

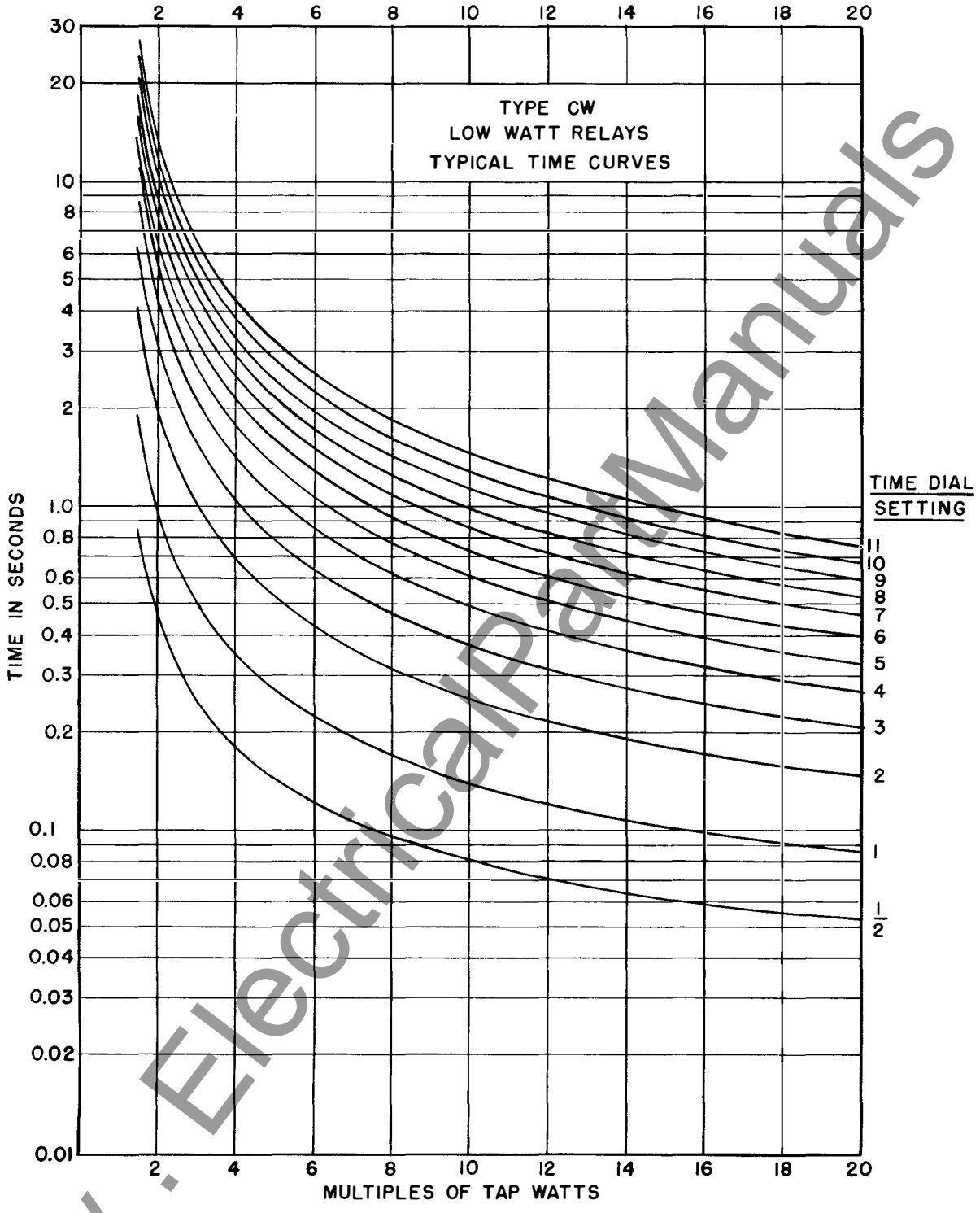


Fig. 3 Typical 60 cycle Time Curves of the 20-120 watt Type CW Relay.

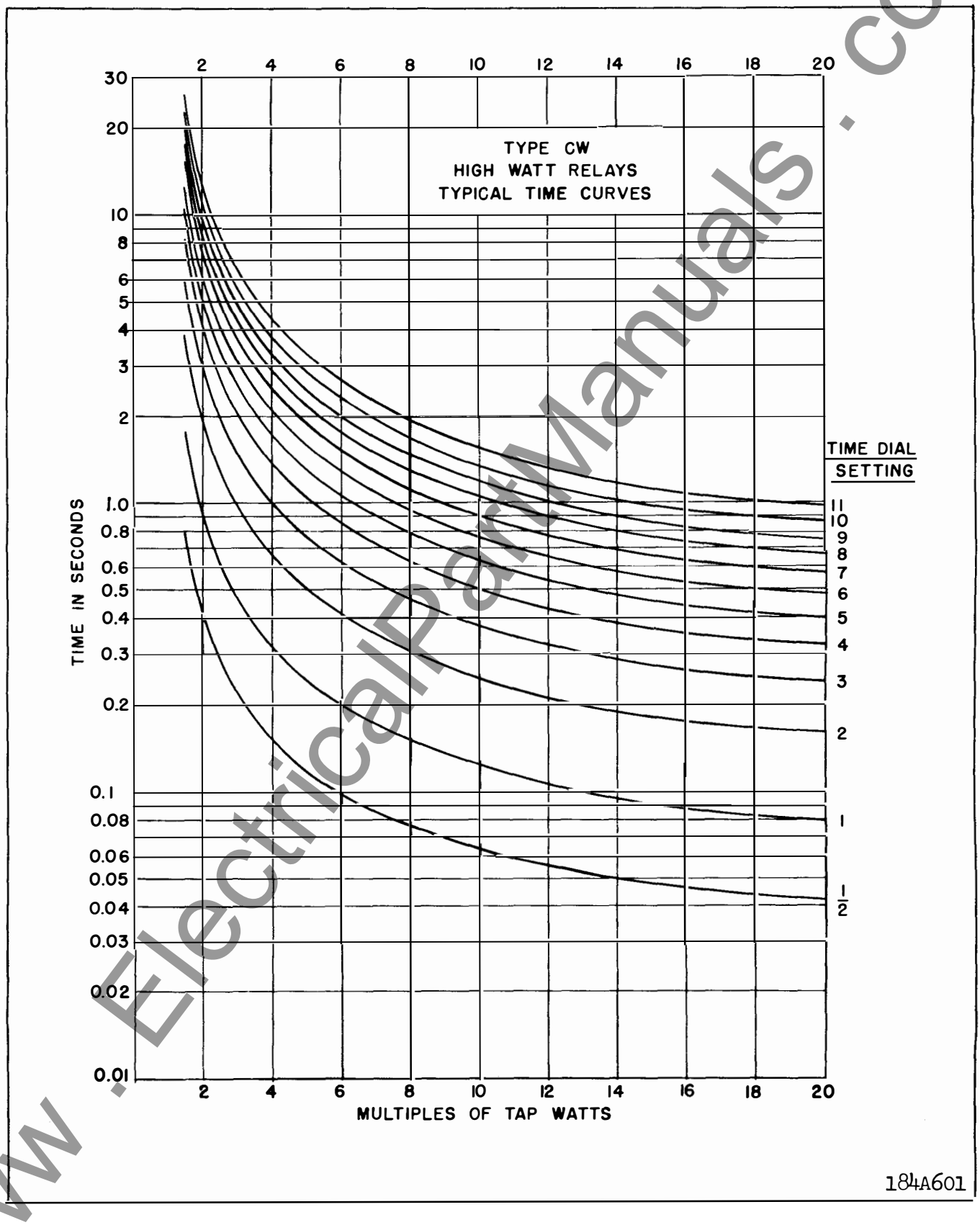


Fig. 4 Typical 60 cycle Time Curves of the 100-600 watt Type CW Relay.

2. The 100-600 Watt, 120 Volt Relay

A. Potential Circuit Burden at Rated Voltage

Current Lags by	Volt Amperes
20°	5.9

B. Current Coil Burden at 5 Amperes

TAP	CURRENT LAGS BY	VOLT AMPERES
100	67°	5.4

Current Coil Ratings

	Continuous	1 Sec.
A. 20-120 Watt Range	5 Amperes	230 Amperes
B. 100-600 Watt Range	8 Amperes	370 Amperes

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.

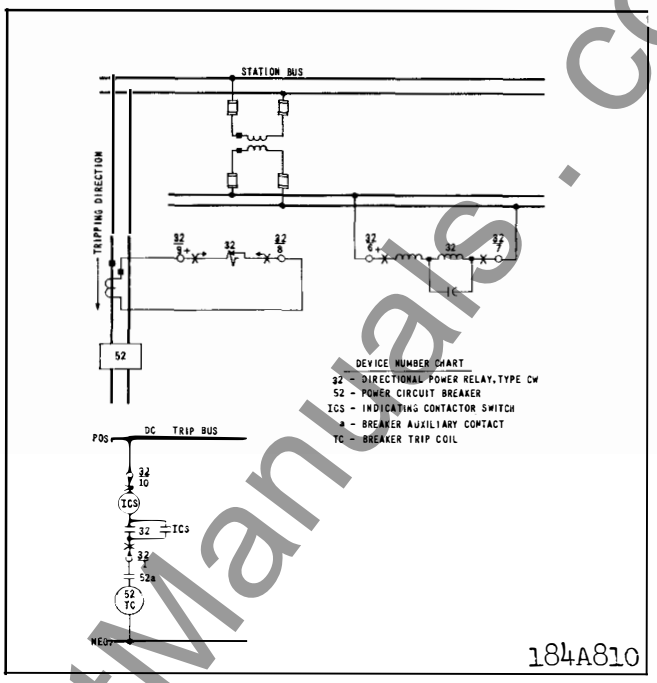


Fig. 5 External Schematic of One Type CW Relay on a Single Phase System.

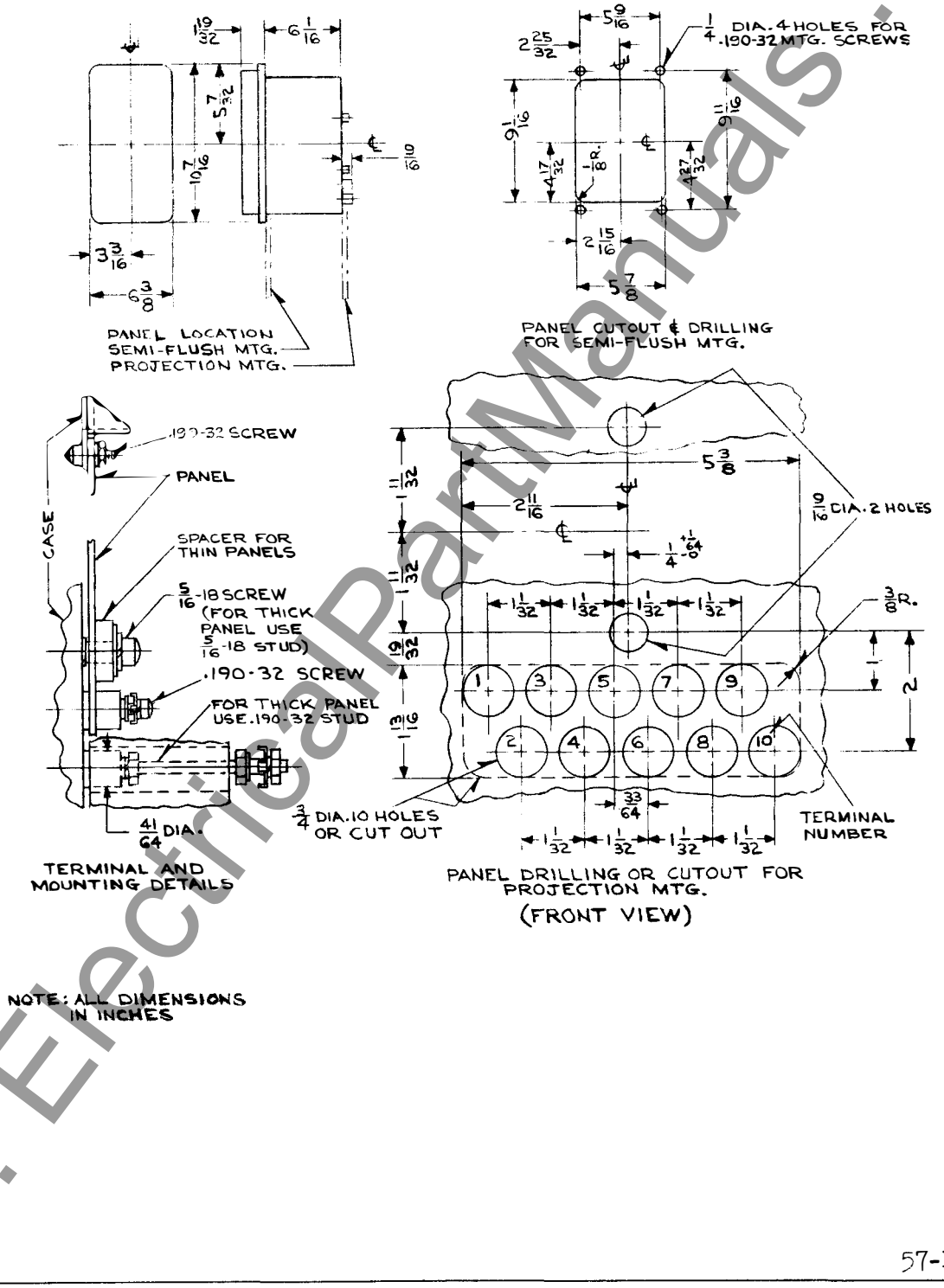


Fig. 6 Outline and Drilling Plan for the Type CW Relay in the Type FT 21 Case.

WESTINGHOUSE ELECTRIC CORPORATION
RELAY DEPARTMENT **NEWARK, N. J.**
Printed in U. S. A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CW POWER 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 CW relay is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

CONSTRUCTION

The relay consists of a watt element, a contactor switch and an operation indicator.

Watt Element

This element is a non-geared induction disc type element. The induction disc is mounted on a vertical shaft supported on the lower end by a steel ball bearing riding between concave sapphire jewel surfaces, and at the upper end by a stainless steel pin.

The moving contact is a small silver hemisphere fastened on the end of an arm. The other end of this arm is clamped to an insulated shaft geared to the disc shaft. The electrical connection is made from the moving contact thru the arm and a spiral spring. One end of the spring is fastened to the arm, and the other to a slotted spring adjuster disc which in turn fastens to the moulded block mounted on the element frame.

The stationary contact assembly consists of a silver contact attached to the free end of a leaf spring. This spring is fastened to the moulded block. A small set screw provides adjustment of the contact follow. When double trip is required, another leaf spring contact is mounted on the moulded block and a double contact is mounted on the rigid-moving arm. The set screws on the stationary contact assembly provide adjustment so that both circuits will be made simultaneously.

The disc is rotated by an electromagnet in the rear and damped by a permanent magnet in the front. The operating torque is obtained by energizing the two tapped upper pole coils with line current, and the lower pole coil potential from the line potential transformers. The fluxes produced by the current in the upper and lower pole coils react with the induced eddy currents in the disc to produce rotation of the disc.

The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon the direction of current flow in the upper pole coils. The combination of voltage and current produce an operating torque proportional to power.

Contactor Switch

The d-c contactor switch in the relay is a small solenoid type switch. A cylindrical plunger with a silver disc mounted on its lower end moves in the core of the solenoid. As the plunger travels upward, the disc bridges three silver stationary contacts. The coil is in series with the main contacts of the relay and with the trip coil of the breaker. When the relay contacts close, the coil becomes energized and closes the switch con-

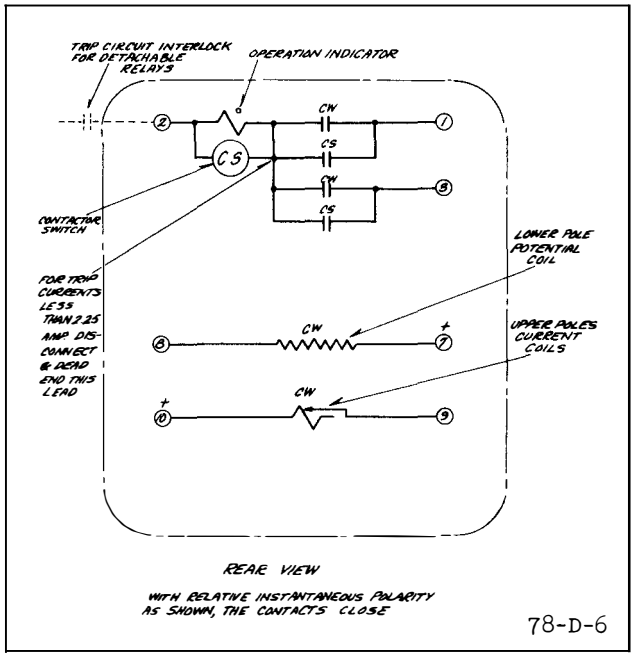


Fig. 1—Internal Schematic Connections of the Double Pole Single Throw Type CW Relay in the Standard Case. The Single Pole Relay Is The Same Except Terminal 3 And Associated Circuits Are Omitted.

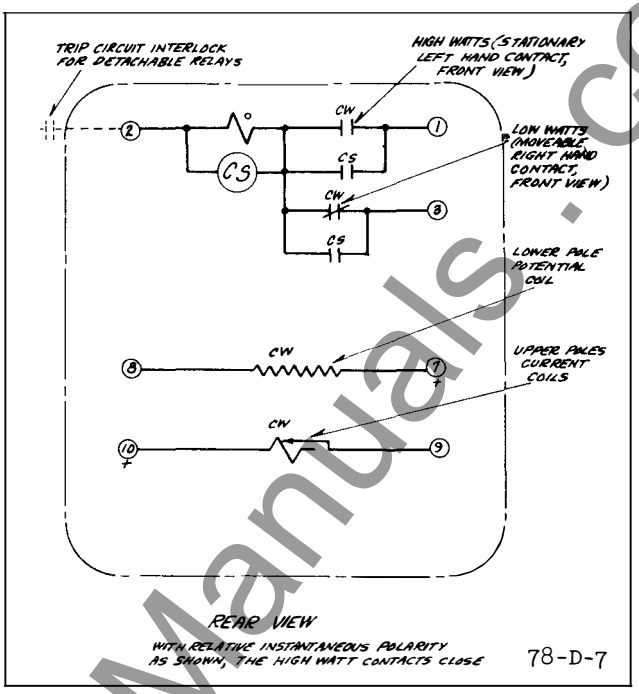


Fig. 2—Internal Schematic Connections of the Single Pole Double Throw Type CW Relay In the Standard Case.

tacts. This shunts the main relay contacts, thereby relieving them of the duty of carrying tripping current. These contacts remain closed until the trip circuit is opened by the auxiliary switch on the breaker.

Operation Indicator

The operation indicator is a small solenoid 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 is reset from outside of the case by a push rod in the cover stud.

CHARACTERISTICS

The type CW relays are available in the following ranges and taps:

10 to 60 watt range, 70 volt potential coil. Taps marked 10-15-20-30-40-50-60.

20 to 120 watt range, 115 volt potential coil. Taps marked 20-30-40-60-80-100-120.

50 to 300 watt range, 70 volt potential coil. Taps marked 50-75-100-150-200-250-300.

100 to 600 watt range, 115 volt potential coil. Taps marked 100-150-200-300-400-500-600.

The tap values are the minimum watts required to just close the relay contacts at rated voltage. In addition to the taps, the initial position of the moving contact is adjustable around a semi-circular lever scale calibrated in 10 divisions. In the double throw type relays, the low watt contacts are adjustable around this scale.

Typical 60 Cycle Time-Power Curves are shown in Figs. 5 & 6. The curves are taken at maximum torque which occurs with the current and voltage in phase (within $\pm$ 4°). The relays are non-geared.

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

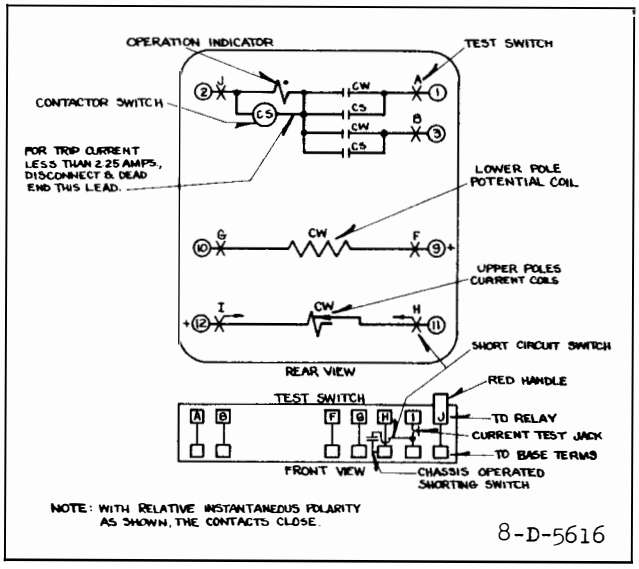


Fig. 3—Internal Schematic of the Double Pole Single Throw Type CW Relay in the Type FT Case. The Single Pole Relay Is The Same Except Terminal 3 And Associated Circuits Are Omitted.

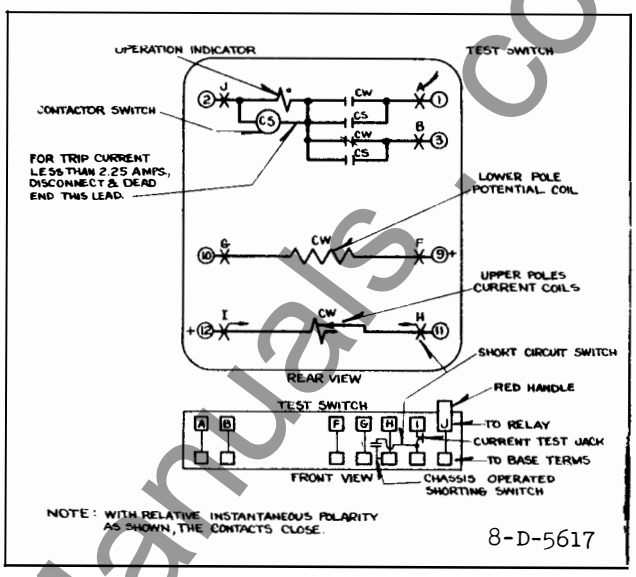


Fig. 4—Internal Schematic of the Single Pole Double Throw Type CW Relay in the Type FT Case.

the two mounting studs for the standard cases and 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.

A-C Connections

For over or reverse power protection, the relay should be connected so that maximum torque occurs at unity power factor on the system. On a balanced three phase system, only one relay is necessary and the external connections are shown in Figs. 7 & 9. Two auxiliary reactors (Fig. 11) are required to form a dummy neutral where the neutral is not available as would be the case with open-delta potential transformers.

The external connections for three type CW relay on a three phase system are shown in Fig. 8 and 10.

Trip Circuit

The main contacts will safely close 30 amperes at 250 volts d-c and the switch contacts will safely carry this current long enough to trip a breaker. The relay is shipped with the operation indicator and the contactor switch connected in parallel. This circuit has a resistance of approximately 0.25 ohm and is suitable for all trip currents above 2.25 amperes. For current values less than 2.25 amperes there is no need for the contactor switch and it should be disconnected. To disconnect the coil in the standard case relay, remove the short lead to the coil on the front stationary contact of the contactor switch. This lead should be fastened (dead ended) under the small filisterhead screw located in the Micarta base of the contactor switch. For the Flexitest relays, the coil is disconnected by removing the coil lead at the spring adjuster and dead-ending it under a screw at the top of the Micarta support. The operation indicator will operate for trip currents above 0.2 ampere d-c. The resistance of its coil is approximately 2.8 ohms.

When using the contactor switch, it is necessary to use an auxiliary switch on the

circuit breaker so that when the circuit breaker is tripped, the tripping circuit will be opened by this switch.

The time for the main contacts to break after operation can be decreased by eliminating the follow. This is done by screwing in the small set screw on the stationary contact assembly until the contact rivet rests solidly on the moulded 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.

SETTINGS

There are two settings to be made. One is the current tap setting, and the second, the time lever setting.

The power to operate the relay equals the primary power divided by the current and potential transformer ratios. This relay power expressed as multiples of the chosen tap locates a value on the abscissa of the Time-Power Curves of Fig. 5 & 6. The relay operating time for various time lever settings then is observed on the ordinate. By changing taps or time levers, the required operating time can be selected for a specific power value.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole before removing the old tap screw. This prevents open-circuiting the current transformers.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

* 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.

Watt Element

Adjust the back stop on the time lever so that the moving contact just touches the stationary contacts at the zero time lever setting. For double trip relays, adjust the small adjustment screw on the stationary contacts so that both circuits make at the same instant.

Connect the relay on the lowest tap as shown in Fig. 7 or 9 and adjust the spiral spring so the contacts just close from the No. 10 lever position at the tap value of watts. The convolutions of the spiral spring should not touch each other for all positions of the moving contacts. Check several points on the typical time curves. This may necessitate shifting the positions of the damping magnets, as their position affects the time characteristics.

Contactor Switch

Adjust the stationary core of the switch for a clearance between the stationary core and the moving core when the switch is picked up. This can be most conveniently done by turning the relay up-side-down. Screw up the core screw until the moving core starts rotating. Now back off the core screw until the moving core stops rotating. This indicates the point where the play in the moving contact assembly is taken up, and where the moving core just separates from the stationary core screw. Back off the stationary core screw one turn beyond this point and lock in place. This prevents the moving core from striking and sticking to the stationary core because of residual magnetism. Adjust the contact clearance for 3/32 inch by means of the two small nuts on either side of the Micarta disc. The switch should pick up at 2 amperes d-c. Test for sticking after 30 amperes d-c have been

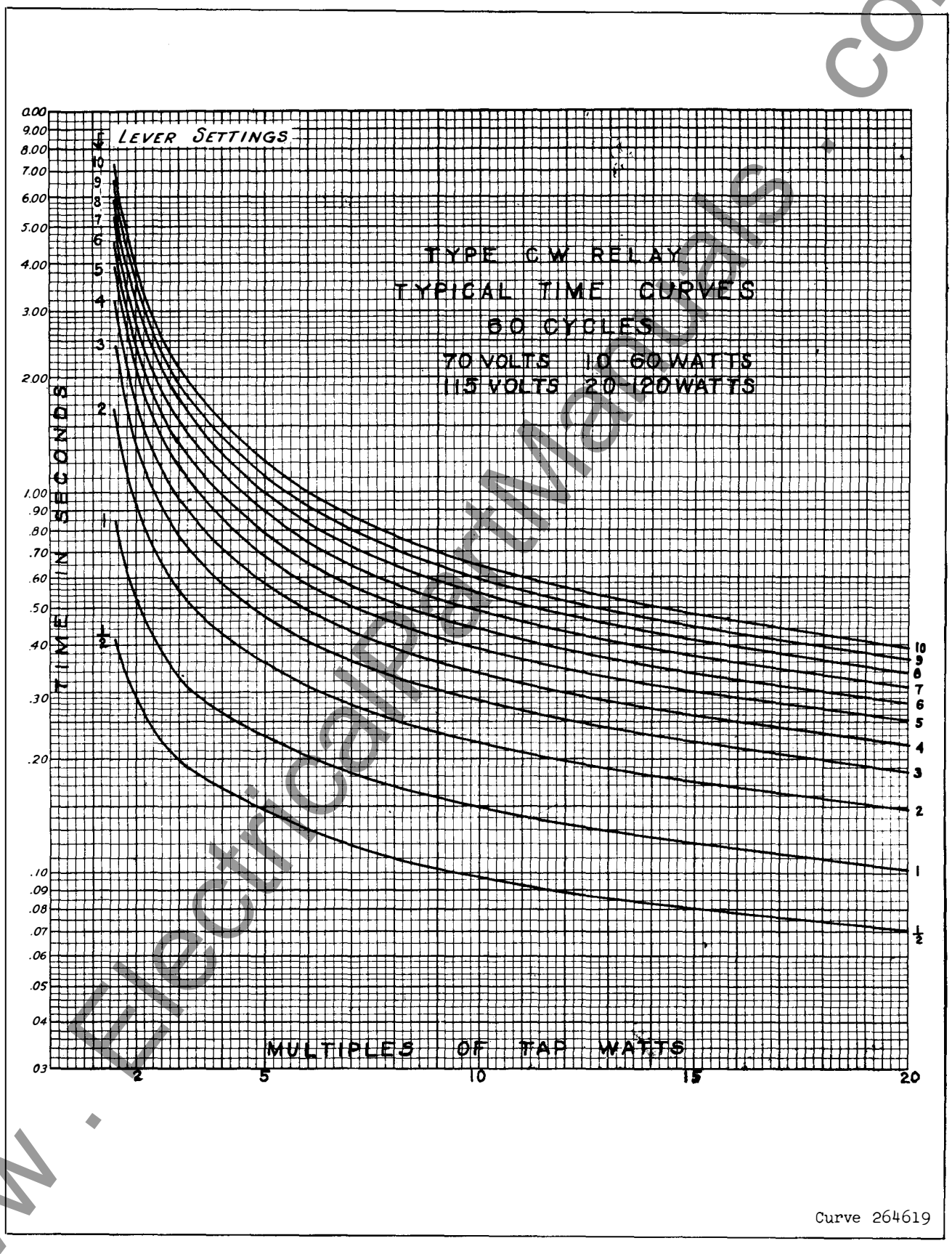


Fig. 5—Typical 60 Cycle Time Curves Of The 10-60 And 20-120 Watt Type CW Relays.

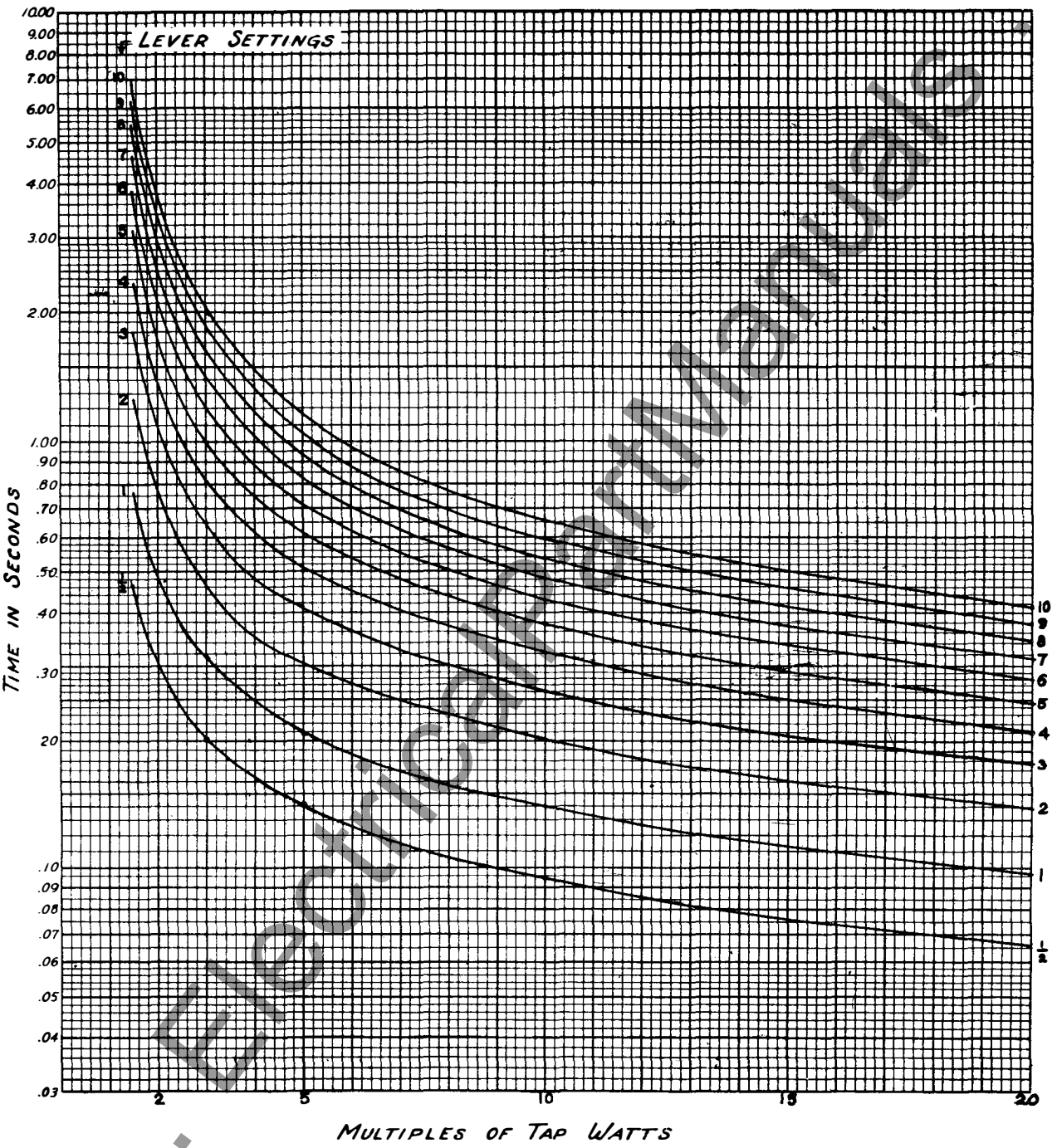


Fig. 6—Typical 60 Cycle Time Curves Of The 50-300 And 100-600 Watt Type CW Relays.

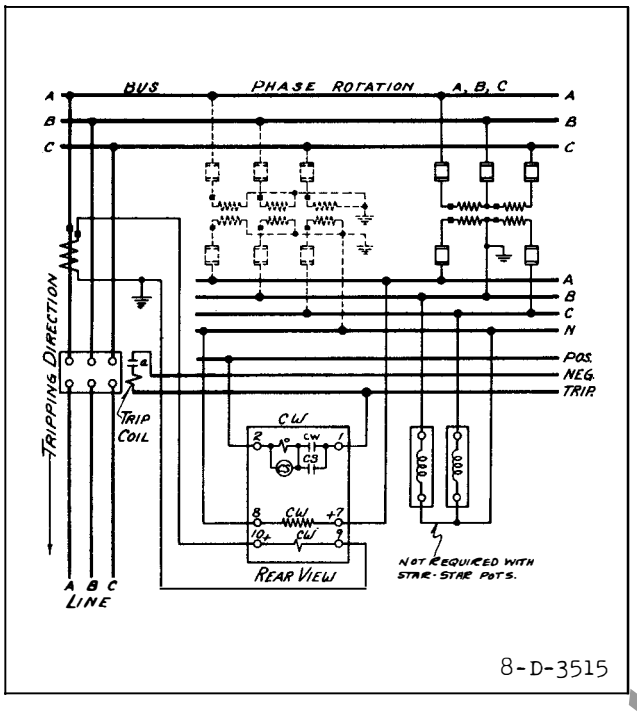


Fig. 7—External Connections Of One Type CW Relay In The Standard Case On A Three Phase System With Balanced Load. (Reactors Not Required With Star-Star Pots.)

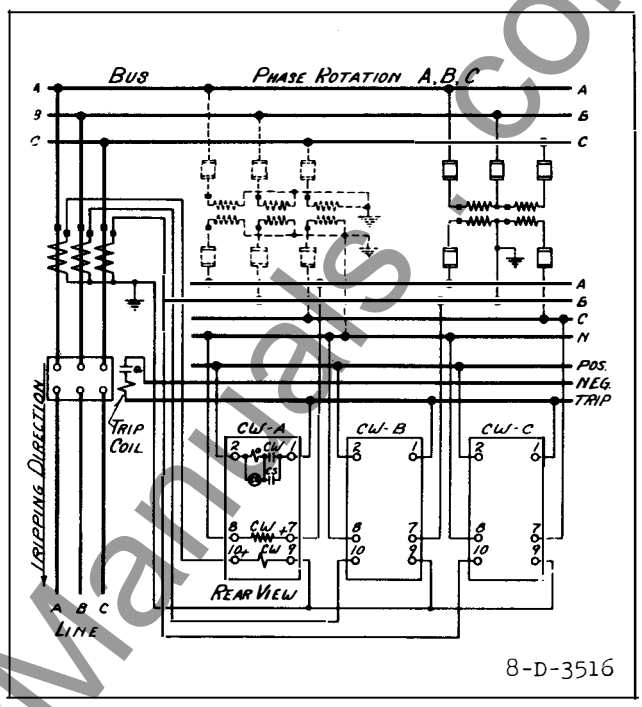


Fig. 8—External Connections of Three Type CW Relays In The Standard Case On A Three Phase System.

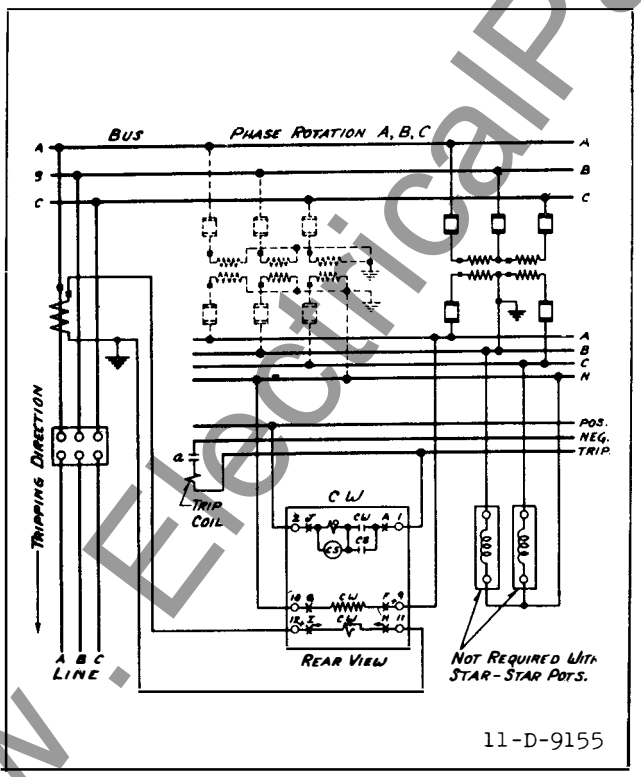


Fig. 9—External Connections Of One Type CW Relay In The Type FT Case On A Three Phase System With Balanced Load.

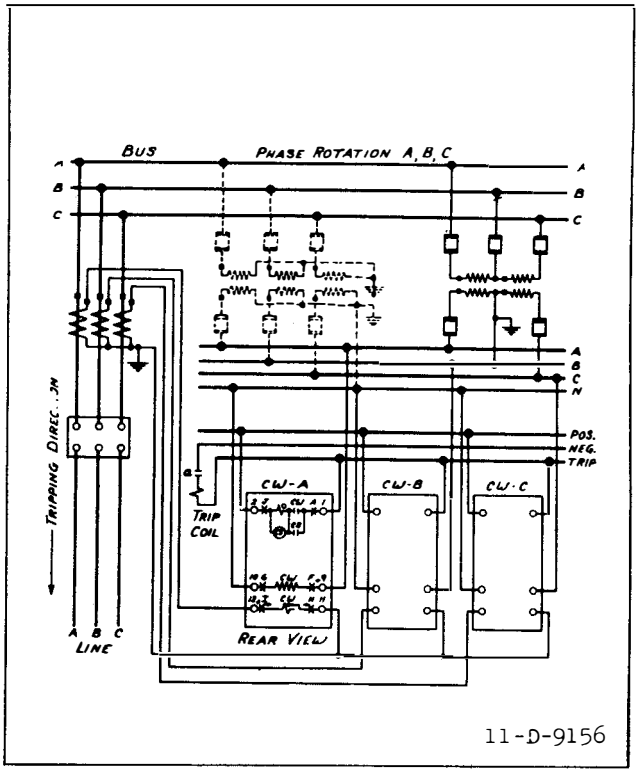


Fig. 10—External Connections Of Three Type CW Relays In The Type FT Case On Three Phase System.

passed thru the coil. The coil resistance is approximately 0.25 ohm.

Operation Indicator

Adjust the indicator to operate at 0.2 ampere d-c gradually applied by loosening the two screws on the under side of the assembly, and moving the bracket forward or backward. If the two helical springs which reset the armature are replaced by new springs, they should be weakened slightly by stretching to obtain the 0.2 ampere calibration. The coil resistance is approximately 2.8 ohms.

External Reactors

Connect the potential coil of the type CW Relay in series with the two reactors. Apply 3 times rated voltage to the combination (220 volts for 70 volt relays). Using a high resistance voltmeter, check the voltage across each reactor and across the potential coil. All three voltages should be equal within ± 2 volts. Adjustments may be made by varying the air gap in the reactor iron.

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

The 60 cycle burdens of the type CW relay are as follows:

I. Low Watt Relay (10-60 Watt Relay or the 20-120 Watt Relay).

A. Potential Coil Burdens at rated Voltage.

Range Values at	10-60 Watts 70 Volts	20-120 Watts 115 Volts
Z Ohms	177.2	497
R Ohms	30.2	100
X Ohms	175.0	487
Current Lags by	80.2°	78.4°
Volt-Amperes	27.7	26.6

B. Current Coil Burdens at 5.0 Amperes

Watt Tap	R Ohms	X Ohms	Z Ohms	Volt-Amps.	Current Lags By
10,20	.164	.176	.24	6.02	47.0°
15,30	.113	.0855	.142	3.56	37.0°
20,40	.0760	.0463	.0890	2.23	31.4°
30,60	.0480	.0184	.0514	1.29	21.0°
40,80	.0330	.0093	.0342	.855	15.7°
50,100	.0239	.0052	.0244	.610	12.2°
60,120	.0196	.0035	.0199	.498	10.2°

II. High Watt Relay (50-300 Watt Relay or the 100-600 Watt Relay).

A. Potential Coil Burdens at Rated Voltage.

Range Values at	50-300 Watts 70 Volts	100-600 Watts 115 Volts
Z Ohms	159.3	470
R Ohms	27.1	93.0
X Ohms	157.0	462
Current Lags By	80.2°	78.6°
Volt-Amperes	30.0	28.1

B. Current Coil Burdens at 5.0 Amps.

Watt Tap	R Ohms	X Ohms	Z Ohms	Volt-Amps.	Current Lags By
50,100	.0467	.0283	.0546	1.37	31.2°
75,150	.0338	.0155	.0370	.926	24.0°
100,200	.0243	.0075	.0254	.636	17.1°
150,300	.0185	.0033	.0188	.470	10.2°
200,400	.0139	.0017	.0140	.350	7.0°
250,500	.0103	.0010	.0103	.258	5.3°
300,600	.0079	.0007	.00786	.197	4.8°

Current coil ratings 10-60, 20-120 watt range 5 amps. cont. 140 amps. 1 sec.
For 50-300 & 100-600 watt range 8 amps. cont. 230 amps. 1 sec.

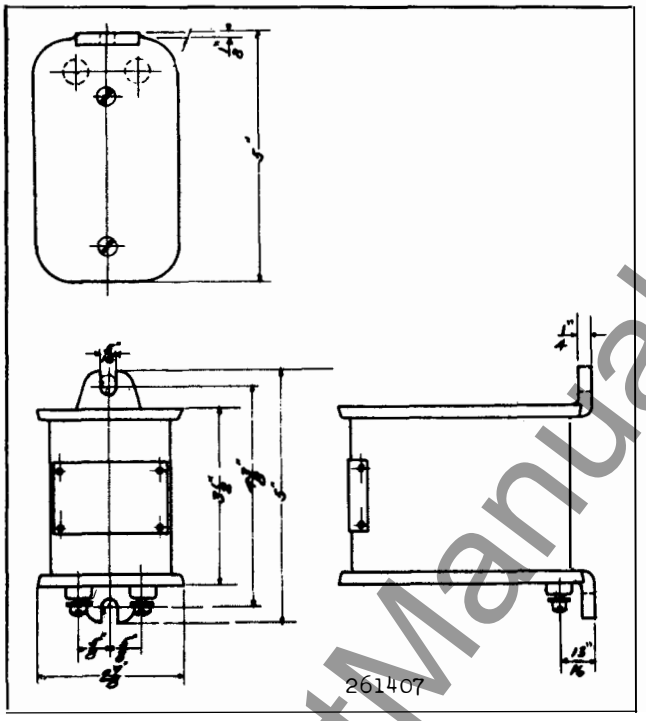


Fig. 11—Outline and Drilling Plan For The External Reactor When Supplied. For Reference Only.

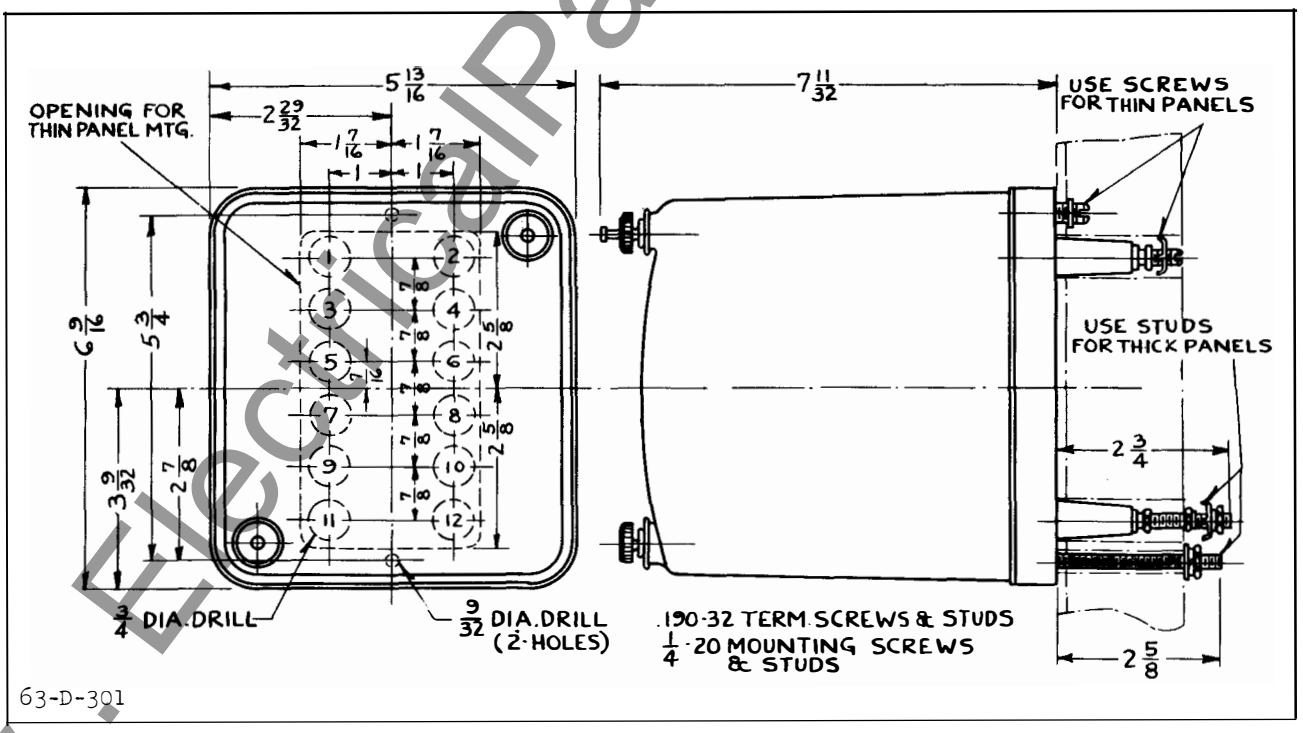


Fig. 12—Outline and Drilling Plan For The Standard Projection Type Case. See The Internal Connections For The Terminals Supplied. For Reference Only.

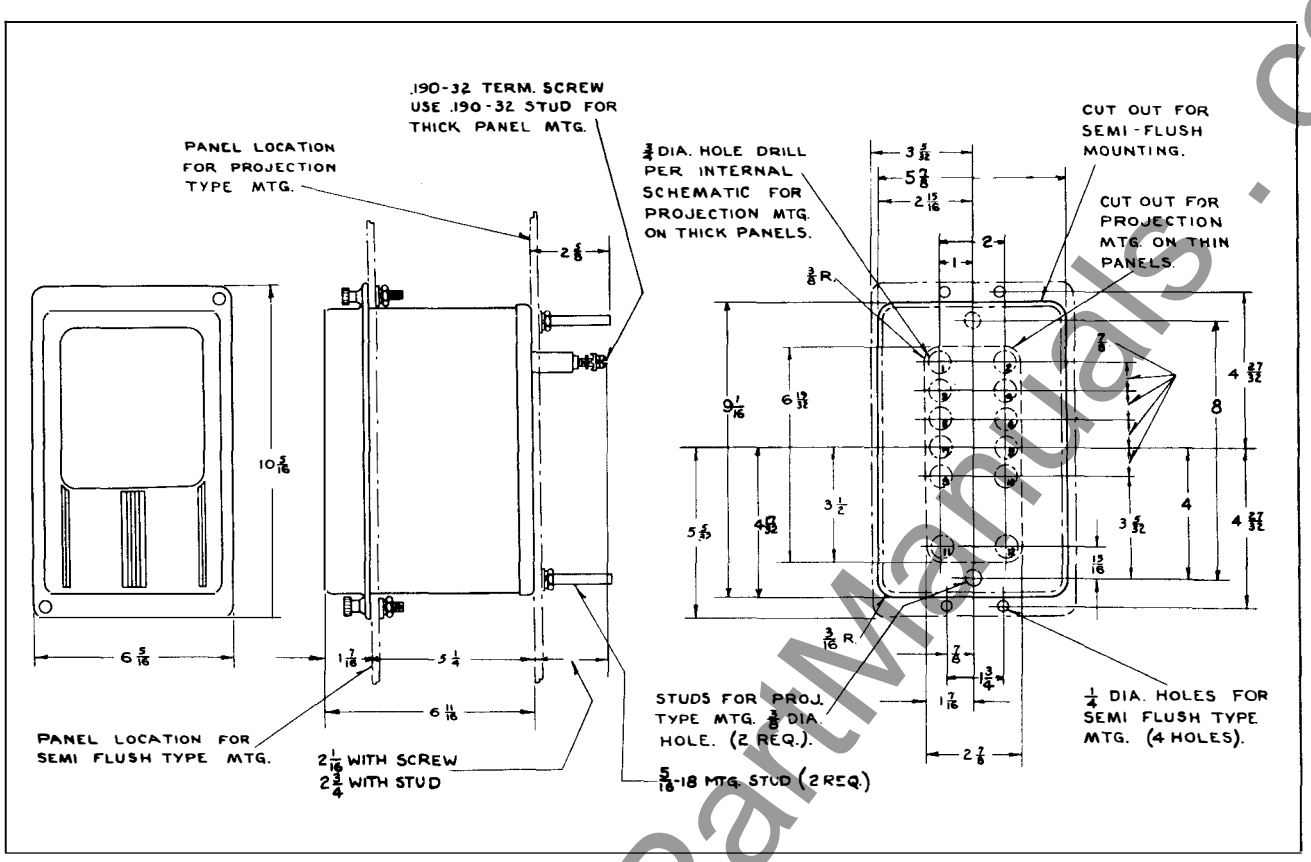


Fig. 13—Outline And Drilling Plan For The S10 Projection Type FT Case. See the Internal Schematic For The Terminals Supplied. For Reference Only.

WESTINGHOUSE ELECTRIC CORPORATION

METER DIVISION • **NEWARK, N.J.**

Printed in U. S. A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CW POWER 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 CW relay is a single phase induction type relay providing over power or reverse power protection for electrical equipment or circuits. It is not intended for use as a fault protective relay.

CONSTRUCTION

The relay consists of a watt unit & an indicating contactor switch (ICS).

WATT ELEMENT

This element is a non-geared induction disc type unit. The induction disc is mounted on a vertical shaft supported on the lower end by a steel ball bearing riding between concave sapphire jewel surfaces, and at the upper end by a stainless steel pin.

The moving contact is a small silver hemisphere fastened on the end of an arm. The other end of this arm is clamped to an insulated shaft geared to the disc shaft. The electrical connection is made from the moving contact thru the arm and a spiral spring. One end of the spring is fastened to the arm, and the other to a slotted spring adjuster disc which in turn fastens to the moulded block mounted on the element frame.

The stationary contact assembly consists of a silver contact attached to the free end of a leaf spring. This spring is fastened to the moulded block. A small set screw provides adjustment of the contact follow. When double trip is required, another leaf spring contact is mounted on the moulded block and a double contact is mounted on the rigid-moving arm. The set screws on the stationary contact assembly provide adjustment so that both circuits will be made simultaneously.

The disc is rotated by an electromagnet in the rear and damped by a permanent magnet in the front. The operating torque is obtained by energizing the two tapped upper pole coils with line current, and the lower pole coil potential from the line potential transformers. The fluxes produced by the current in the upper and lower pole coils react with the induced eddy currents in the disc to produce rotation of the disc.

The voltage is independent of the direction of power flow. This provides a reference so that the disc can rotate in either direction depending upon the direction of current flow in the upper pole coils. The combination of voltage and current produce an operating torque proportional to power.

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 CW relays are available in the following ranges and taps:

10 to 60 watt range, 70 volt potential coil. Taps

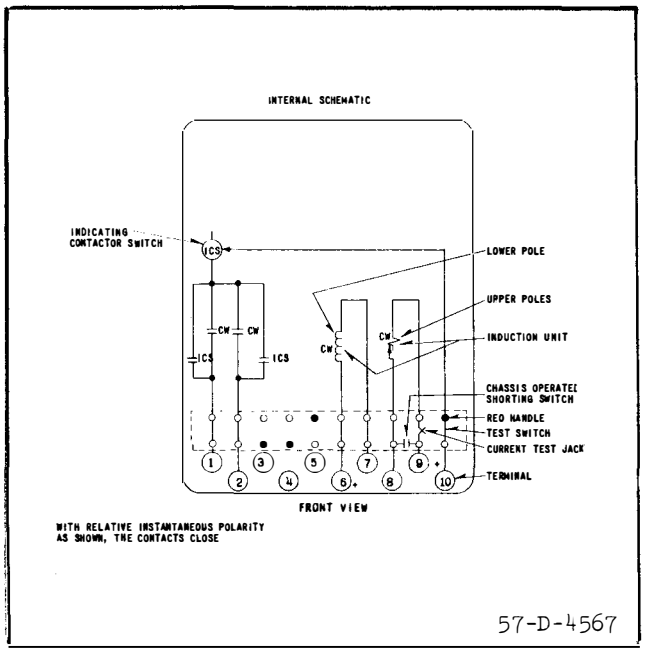


Fig. 1. Internal Schematic of the Double Trip CW Relay. For the Single Trip Relay the Circuits associated with Terminal 2 are omitted.

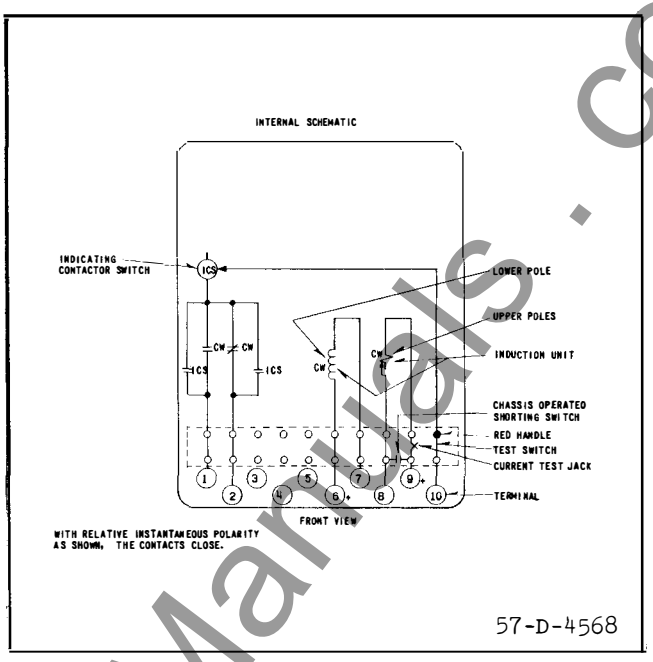


Fig. 2. Internal Schematic of the type CW Relay with single pole, double throw contacts.

marked 10-15-20-30-40-50-60.

20 to 120 watt range, 115 volt potential coil. Taps marked 20-30-40-60-80-100-120.

50 to 300 watt range, 70 volt potential coil. Taps marked 50-75-100-150-200-250-300.

100 to 600 watt range, 115 volt potential coil. Taps marked 100-150-200-300-400-500-600.

The tap values are the minimum watts required to just close the relay contacts at rated voltage. In addition to the taps, the initial position of the moving contact is adjustable around a semi-circular lever scale calibrated in 10 divisions. In the double throw type relays, the low watt contacts are adjustable around this scale.

Typical 60 Cycle Time-Power Curves are shown in Figs. 3 & 4. The curves are taken at maximum torque which occurs with the current and voltage in phase (within ± 4°). The relays are non-geared.

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.

TRIP CIRCUIT 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

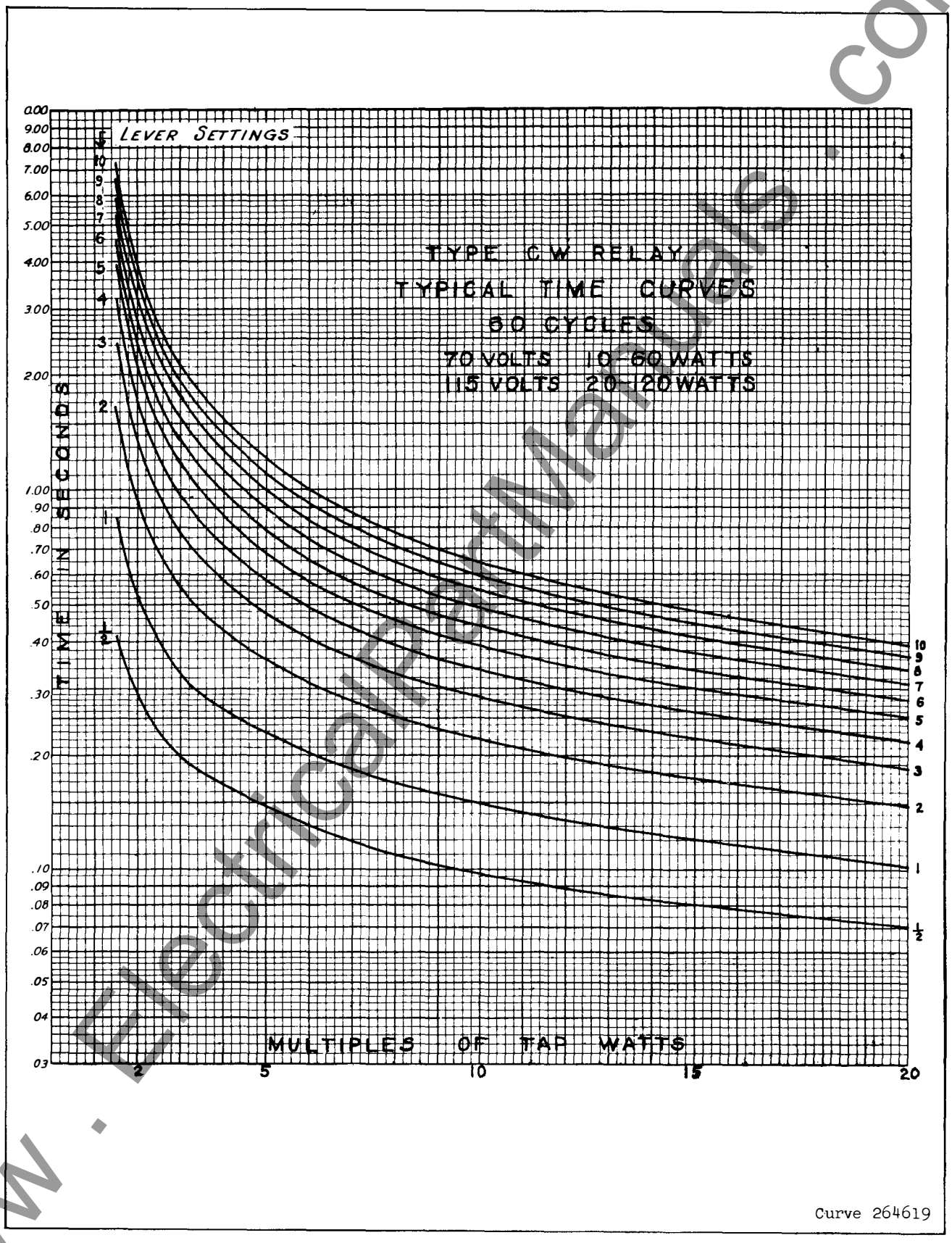


Fig. 3. Typical 60 cycle Time Curves of the 10-60 and 20-120 watt Type CW Relays.

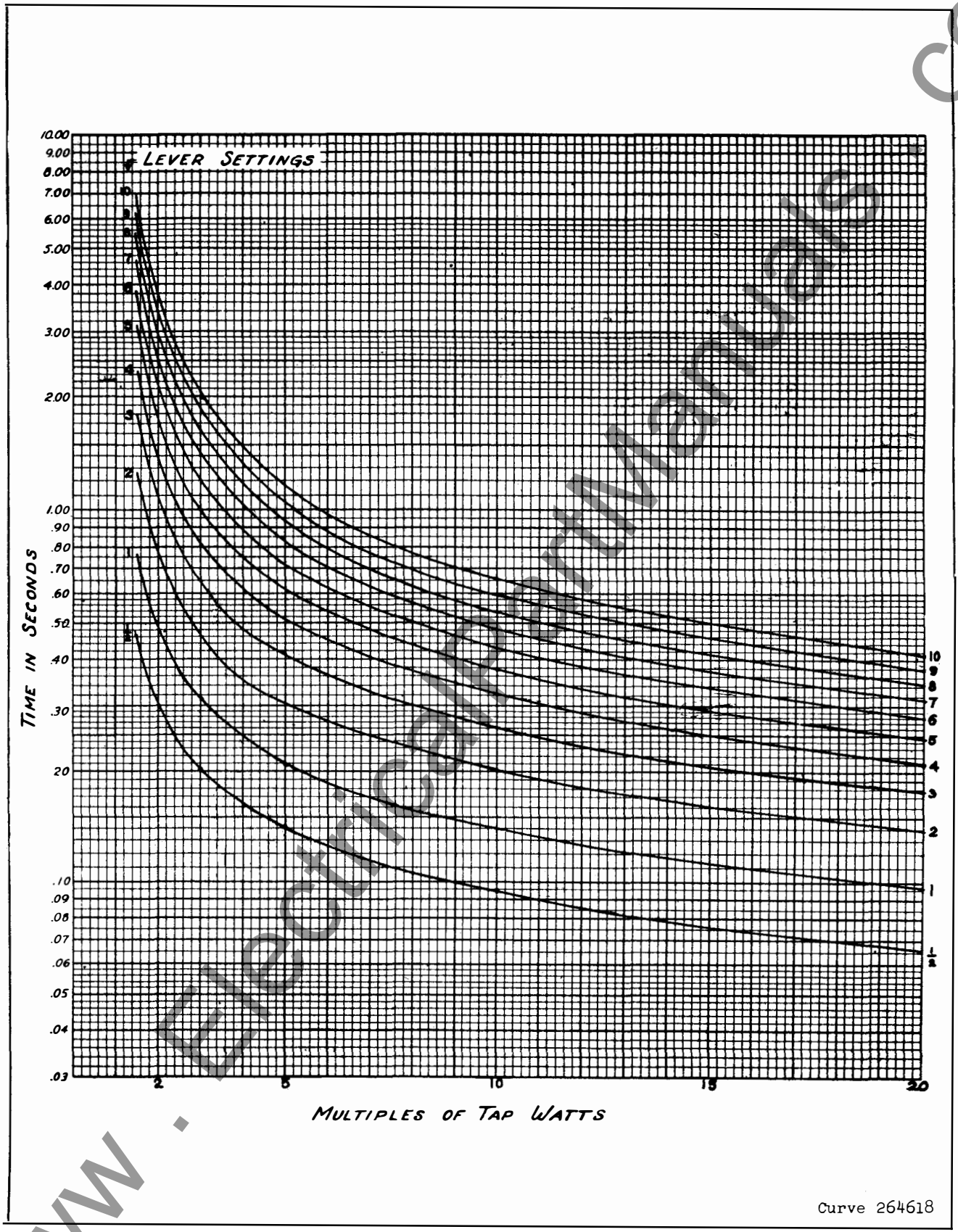


Fig. 4. Typical 60 cycle Time Curves of the 50-300 and 100-600 watt Type CW Relays.

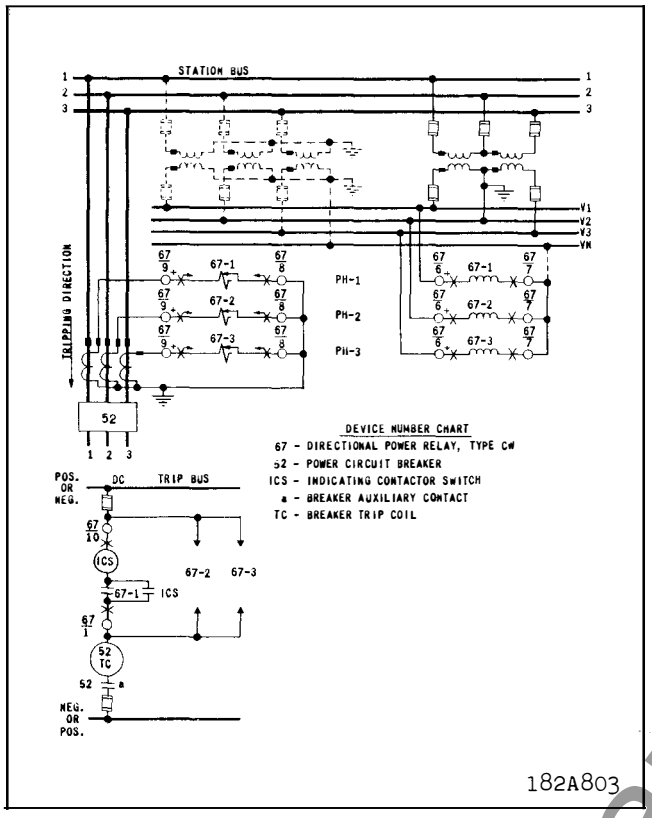


Fig. 5. External Schematic of Three Type CW Relays on a Three Phase System.

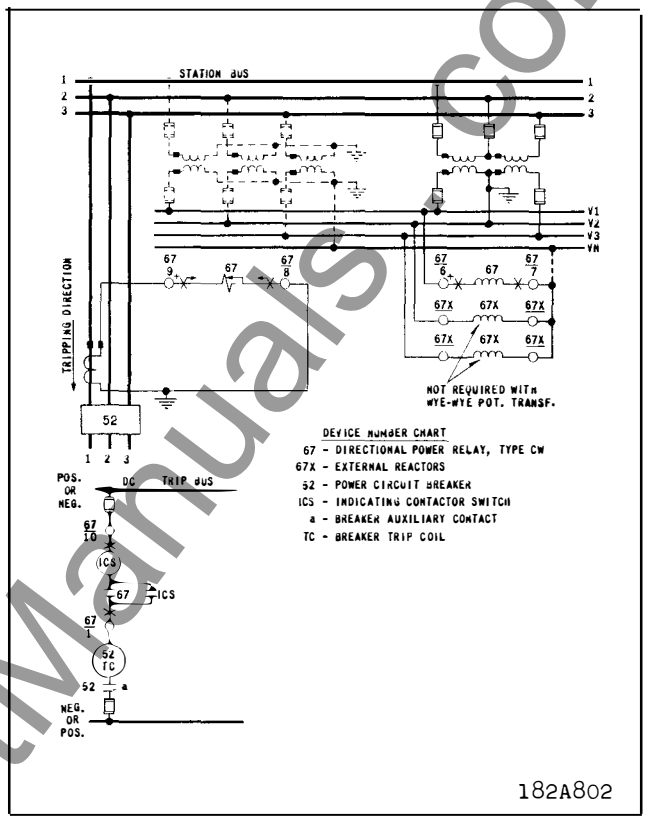


Fig. 6. External Schematic of One Type CW Relay on a Three Phase System.

with a wrench.

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

A-C CONNECTIONS

For over or reverse power protection, the relay should be connected so that maximum torque occurs at unity power factor on the system. On a balanced three phase system only one relay is necessary and the external connections are shown in Fig. 6. Two auxiliary reactors (Fig. 7) are required to form a dummy neutral where the neutral is not available as would be the case with open-delta potential transformers.

The external connections for three type CW relay on a three phase system are shown in Fig. 5.

SETTINGS

WATT UNIT

There are two settings to be made. One is the current tap setting, and the second, the time lever setting.

The power to operate the relay equals the primary power divided by the current and potential transformer ratios. This relay power expressed as multiples of the chosen tap locates a value on the abscissa of the Time-Power Curves of Fig. 5 & 6. The relay operating time for various time lever settings then is observed on the ordinate. By changing taps or time levers, the required operating time can be selected for a specific power value.

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.

CAUTION

When changing taps with the relay in service, screw the extra tap screw in the new tap hole be-

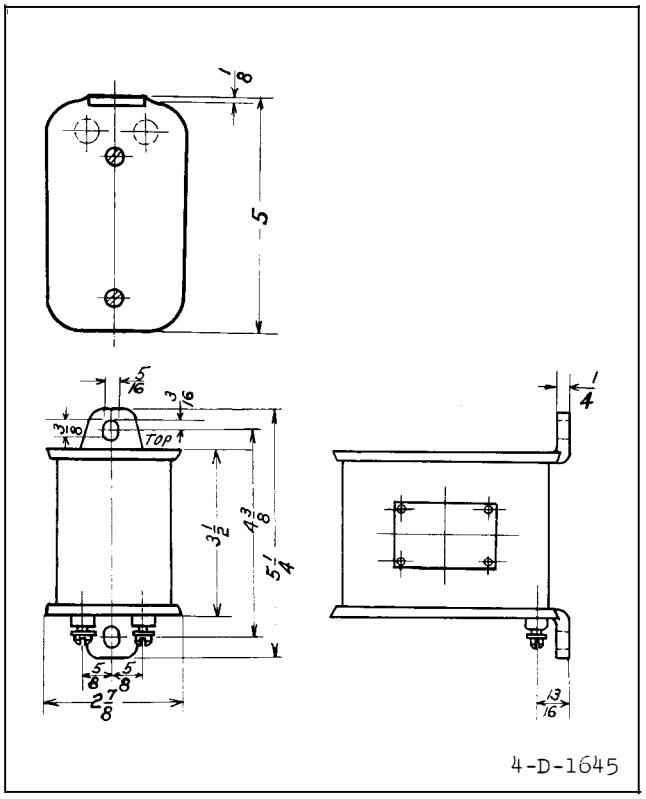


Fig. 7. Outline and Drilling for the External Reactor (When supplied.)

fore removing the old tap screw. This prevents open-circuiting the current transformers.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operating of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

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.

WATT UNIT

Adjust the back stop on the time lever so that the moving contact just touches the stationary contacts at the zero time lever setting. For double trip relays, adjust the small adjustment screw on the stationary contacts so that both circuits make at the same instant.

Connect the relay on the lowest tap and adjust the spiral spring so the contacts just close from the No. 10 lever position at the tap value of watts. The convolutions of the spiral spring should not touch each other for all positions of the moving contacts. Check several points on the typical time curves. Time curve calibration is effected by shifting the position of the damping magnet.

The time for the main contacts to break after operation can be decreased by eliminating the follow. This is done by screwing in the small set screw on the stationary contact assembly until the contact rivet rests solidly on the moulded 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.

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 indicator target should drop freely.

EXTERNAL REACTORS (WHEN USED)

Connect the potential coil of the type CW Relay in series with the two reactors. Apply 3 times rated voltage to the combination (220 volts for 70 volt relays). Using a high resistance voltmeter, check the voltage across each reactor and across the potential coil. All three voltages should be equal within ± 2 volts. Adjustments may be made by varying the air gap in the reactor iron.

ENERGY REQUIREMENTS

The 60 cycle burdens of the type CW relay are as follows:

I. Low Watt Relay (10-60 Watt Relay or the 20-120 Watt Relay).

A. Potential Coil Burdens at rated Voltage.

Range Values at	10-60 Watts 70 Volts	20-120 Watts 115 Volts
Z Ohms	177.2	497
R Ohms	30.2	100
X Ohms	175.0	487
Current Lags by	80.2°	78.4°
Volt-Amperes	27.7	26.6

B. Current Coil Burdens at 5.0 Amperes

Watt Tap	R Ohms	X Ohms	Z Ohms	Volt-Amps.	Current Lags By
10,20	.164	.176	.24	6.02	47.0°
15,30	.113	.0855	.142	3.56	37.0°
20,40	.0760	.0463	.0890	2.23	31.4°
30,60	.0480	.0184	.0514	1.29	21.0°
40,80	.0330	.0093	.0342	.855	15.7°
50,100	.0239	.0052	.0244	.610	12.2°
60,120	.0196	.0035	.0199	.498	10.2°

II. High Watt Relay (50-300 Watt Relay or the 100-600 Watt Relay).

A. Potential Coil Burdens at Rated Voltage.

Range Values at	50-300 Watts 70 Volts	100-600 Watts 115 Volts
Z Ohms	159.3	470
R Ohms	27.1	93.0
X Ohms	157.0	462
Current Lags By	80.2°	78.6°
Volt-Amperes	30.0	28.1

B. Current Coil Burdens at 5.0 Amps.

Watt Tap	R Ohms	X Ohms	Z Ohms	Volt-Amps.	Current Lags By
50,100	.0467	.0283	.0546	1.37	31.2°
75,150	.0338	.0155	.0370	.926	24.0°
100,200	.0243	.0075	.0254	.636	17.1°
150,300	.0185	.0033	.0188	.470	10.2°
200,400	.0139	.0017	.0140	.350	7.0°
250,500	.0103	.0010	.0103	.258	5.3°
300,600	.0079	.0007	.00786	.197	4.8°

Current coil ratings 10-60, 20-120 watt range 5 amps. cont. 140 amps. 1 sec.

For 50-300 & 100-600 watt range 8 amps. cont. 230 amps. 1 sec.

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.

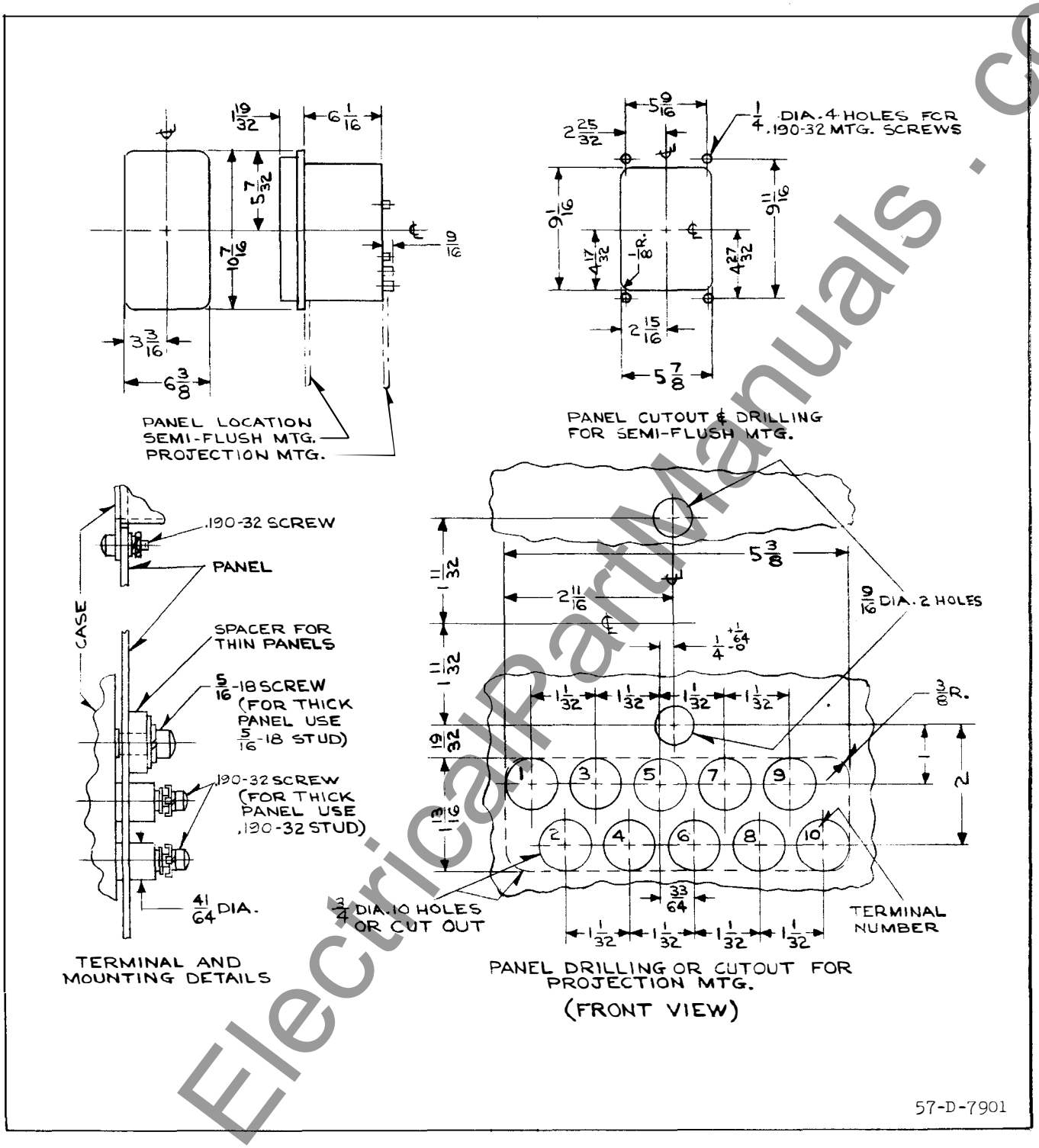


Fig. 8. Outline and Drilling Plan for the Type CW Relay in the Type FT21 Case.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CWC AND CWP DIRECTIONAL GROUND RELAYS

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 CWC and CWP relays are induction disc type relays used for directional ground fault protection on grounded neutral power systems. The type CWC relay is polarized by current from a suitably grounded power transformer bank neutral. Therefore, its application does not require potential transformers. The type CWP relay is potential polarized by residual voltage obtained across the open corner of the delta winding of a grounded star-delta potential transformer.

At stations where the power transformer bank neutral is grounded, the residual voltage will be small generally, and the type CWC relay is recommended. At ungrounded stations, or at ground stations where the power transformer bank neutral is not available, the type CWP relay is applicable.

CONSTRUCTION AND OPERATION

The Type CWC and CWP relays consist of an induction disc type unit, an indicating contactor switch, and an optional indicating instantaneous trip unit. In addition an external phase shifting capacitor is supplied with the type CWP relays.

INDUCTION DISC UNIT

The induction disc unit contains a thin four-inch diameter disc mounted on a vertical shaft. The shaft is supported on the lower end by a steel ball bearing riding between concave sapphire jewel surfaces, and on the upper end by a stainless steel pin.

The moving contact is a small silver hemisphere fastened on the end of an arm. The other end of this arm is clamped to an insulated section of the disc shaft. The element is not geared. The electrical connection is made from the moving contact thru the arm and spiral spring. One end of the spring is fastened to the arm, and the other to a slotted spring adjuster disc which in turn fastens to the element frame.

The stationary contact assembly consists of a silver contact attached to the free end of a leaf-spring. This spring is fastened to a moulded block mounted on the element frame. A small set screw permits the adjustment of contact follow. When double trip is required, another leaf spring is mounted on the moulded block and a double contact is mounted on the rigid moving arm. Then the stationary contact set screws permit adjustment so that both circuits will be made simultaneously.

The moving disc is rotated by an electromagnet in the rear and damped by a permanent magnet in front. The operating torque for the CWC relay is obtained by energizing the lower pole coil with residual current (usually obtained from the line current transformer) and the 2 tapped upper pole coils with residual current from the current transformer in the power transformer bank neutral. For the CWP relay the operating torque is obtained by energizing the upper pole coils with residual current (usually obtained from the line current transformer) and the lower pole with residual voltage.

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

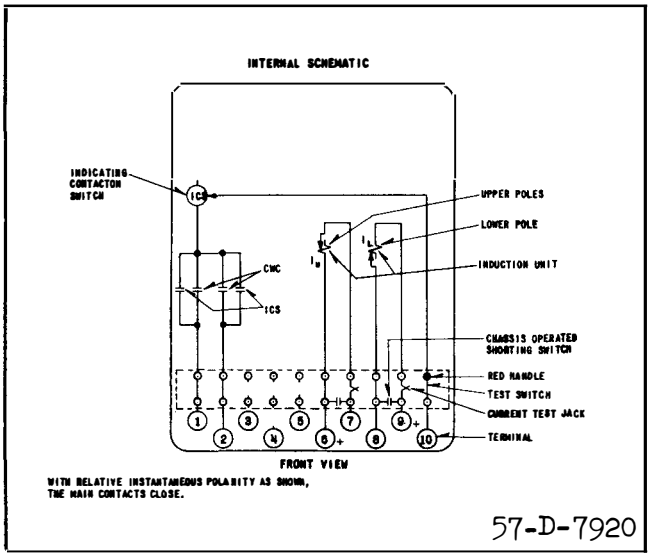


Fig. 1. Internal Schematic of Double Trip Type CWC Relay in the Type FT 21 Case. For the Single Trip Relay the Circuits Associated with Terminal 2 are omitted.

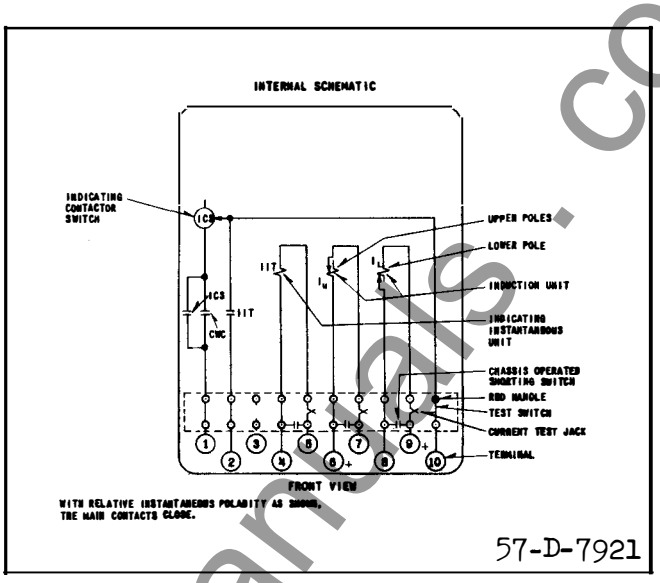


Fig. 2. Internal Schematic of the Type CWC Relay with Indicating Instantaneous Trip Unit in the Type FT 21 Case.

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.

INDICATING INSTANTANEOUS TRIP UNIT (IIT)

The instantaneous trip unit is a small a-c operated 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 the 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.

A core screw accessible from the top of the switch provides the adjustable pickup range. The minimum and maximum pickup points are indicated on the scale, which is located to the rear of the core screw.

CHARACTERISTICS

TYPE CWC RELAY

The type CWC relay has two taps on the upper pole and four on the lower pole. They are marked in amperes which is the current thru both windings in series at minimum pick-up, and in product which is the minimum pick-up product of two equal or unequal currents.

Type CWC Relay Ranges and taps are:

.5 to 2 ampere (.25 to 4 Product) Range

Amperes	.5	.6	.8	1.0	1.2	1.6	2.0
Product	.25	.36	.64	1.0	1.44	2.56	4.0

1.5 to 6 ampere (2.25 to 36 Product) Range

Amperes	1.5	2.0	2.5	3.0	4.0	5.0	6.0
Product	2.25	4.0	6.25	9.0	16.0	25.0	36.0

The first four values are marked on the lower pole top plate. The upper pole tap plate is marked x1 and x2 (x1 and x4 Product). The last four values are obtained by using the x2 tap with the four lower pole taps.

Typical 60 Cycle time-product curves for the type CWC relay are shown in Fig. 5. These curves are taken at maximum torque which occurs with the currents in phase. For residual and Ground currents

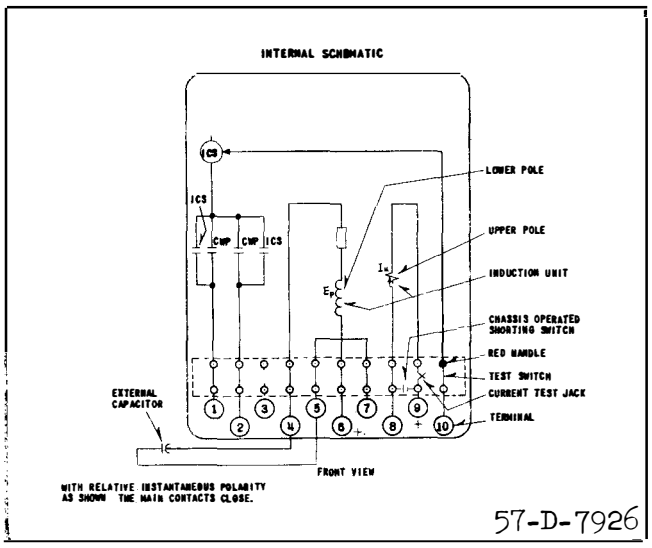


Fig. 3. Internal Schematic of the Type CWP Relay in the Type FT21 Case. For the Single Trip Relay the Circuits Associated with Terminal 2 are omitted.

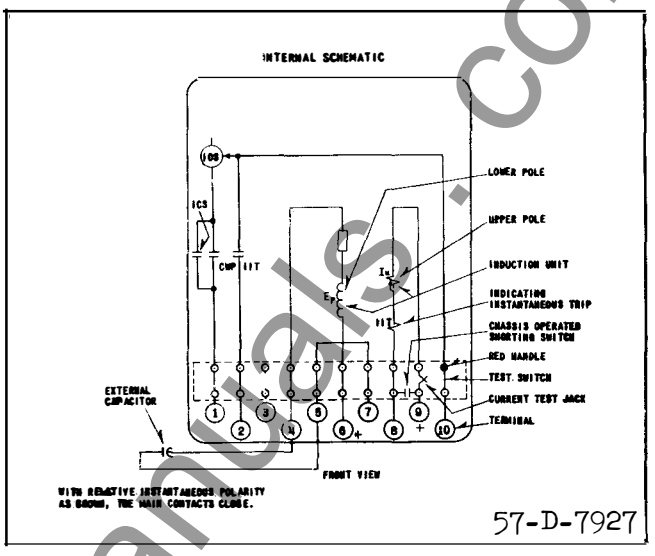


Fig. 4. Internal Schematic of the Type CWP Relay with Indicating Instantaneous Trip Unit in the Type FT21 Case.

out of phase the relay operating time may be obtained by determining the operating time corresponding to the product P = P Cos θ, where P is the actual relay product in amperes squared, and θ is the angle between the residual and polarizing currents.

The limits for which these curves are accurate within ± 7% are shown in Fig. 6.

TYPE CWP RELAY

The type CWP relay taps are on the upper pole current coil. They represent the minimum pick-up product of current times voltage at maximum torque when the current lags the voltage by 60°. The ranges and taps are:

Product Range	Tap Markings						
20 - 150	20	30	40	50	75	100	150
75 - 600	75	100	150	200	300	400	600

Typical 60 cycle time product curves for the type CWP relay are shown in Fig. 7. These curves are taken at maximum torque which occurs with the current lagging the voltage 60°. For currents not lagging by this angle, the relay tripping time may be obtained by determining the operating time corresponding to the product pl = P Cos (60° - θ), where P is the actual relay V.A. product and θ is the angle the current lags the voltage. The curves are accurate within ±7% if the multiple of tap product does not exceed the voltage on the relay coil.

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 instantaneous trip contacts will safely close 30 amperes at 250 volts d-c, and will carry this current long enough to trip a 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.

TRIP CIRCUIT 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

SETTING CALCULATIONS

The following information is required to set these relays:

1. The maximum and minimum ground fault cur-

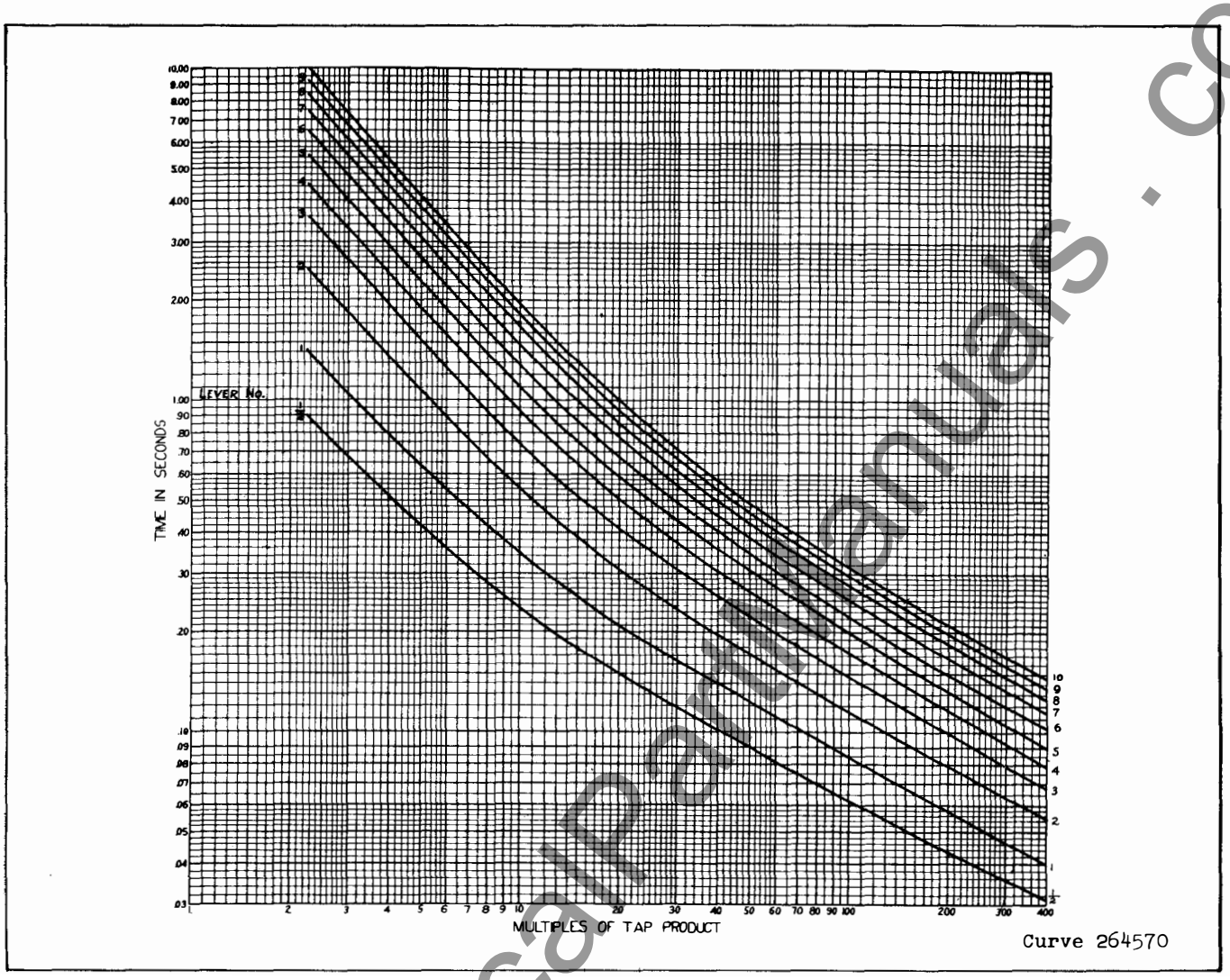


Fig. 5. Typical Time Curves of the Type CWC Relay - Current Coils in Series - See Figure 6 for application limits.

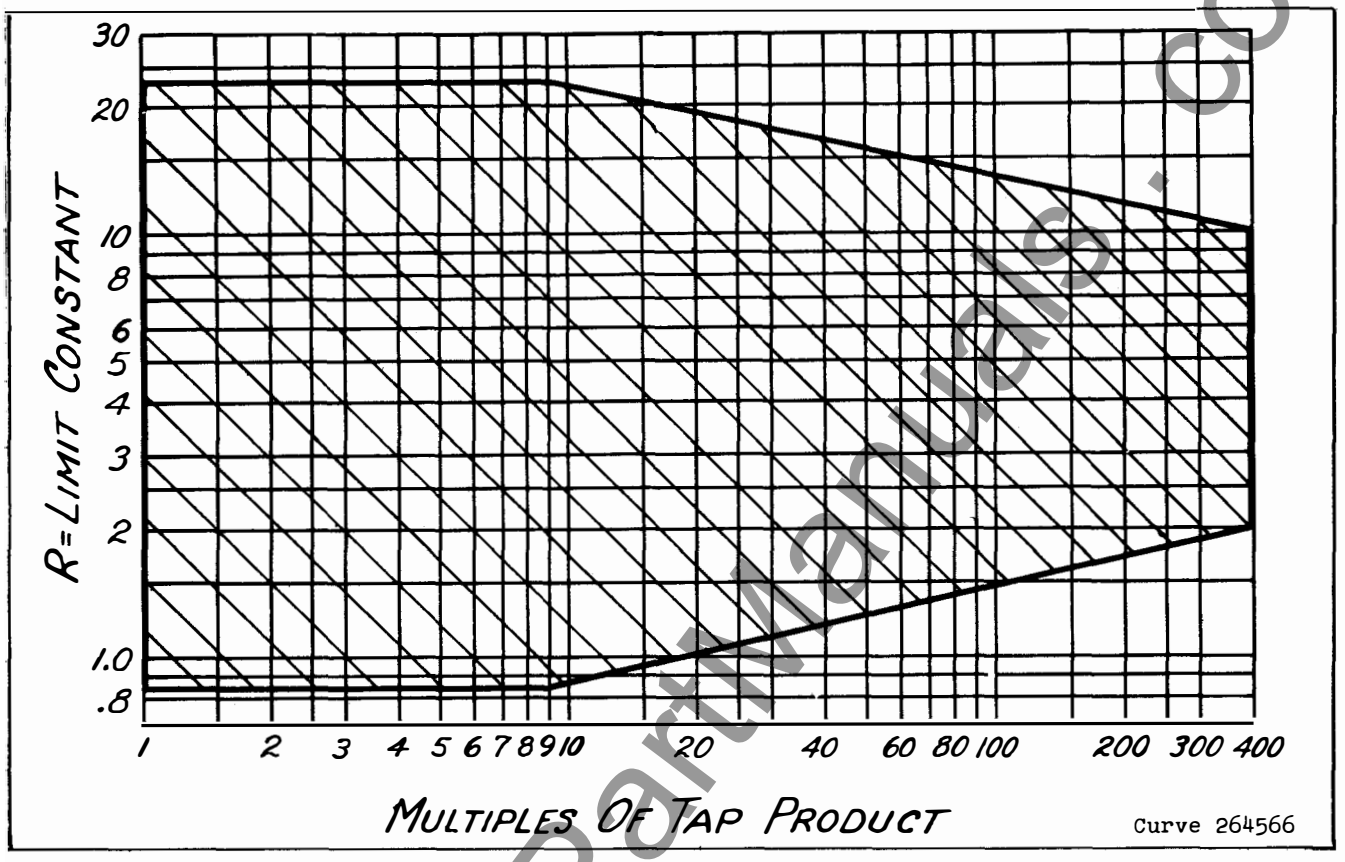
rents for faults at the relay and at the remote bus. These values should be residual current which is three times the zero sequence current.

2. The maximum and minimum polarizing current or voltage values for the faults above. The values should be residual currents or voltage which are three times the zero sequence values.

3. The current transformer ratios of the main and polarizing current transformers for the type CWC relay applications or the main current transformer ratio and the polarizing potential transformer ratio for the type CWP relay application.

Each relay should be set to operate as rapidly as possible for ground faults on the transmission lines near the breaker. The product available for the relay in these cases should be large enough to represent a large multiple of the tap product value so the operating times can be in range of 0.05 to 0.20 second as seen from the curves of Figs. 5 and 7.

However, the relays cannot distinguish between a fault on the line near the remote breaker for which they should operate, and a similar fault on the bus or adjacent line for which they should not operate until the bus differential or adjacent line relays have had an opportunity to operate and clear the fault. This requires an increased time setting of the relay for faults near the remote terminal. The product available for the relay in these cases will be smaller than that for the close faults and should represent a smaller multiple of the tap product previously chosen so the operating time can be from .4 to .75 second longer than the remote line or bus



For the 0.25 to 4 Product Range

$$R = M\frac{I_L}{I_U}$$

where I_L = the lower pole current.
I_U = the upper pole current.
M = value from the table below for various tap combinations.

Tap Product	Upper Pole Product Tap	Lower Pole Product Tap	M	K
.25	1	.25	4.0	10
.36	1	.36	2.78	12
.64	1	.64	1.56	16
1.0	1	1.0	1.0	20
1.0	4	.25	16.0	20
1.44	4	.36	11.1	24
2.56	4	.64	6.25	32
4	4	1.00	4.0	40

For the 2.25 to 36 Product Range

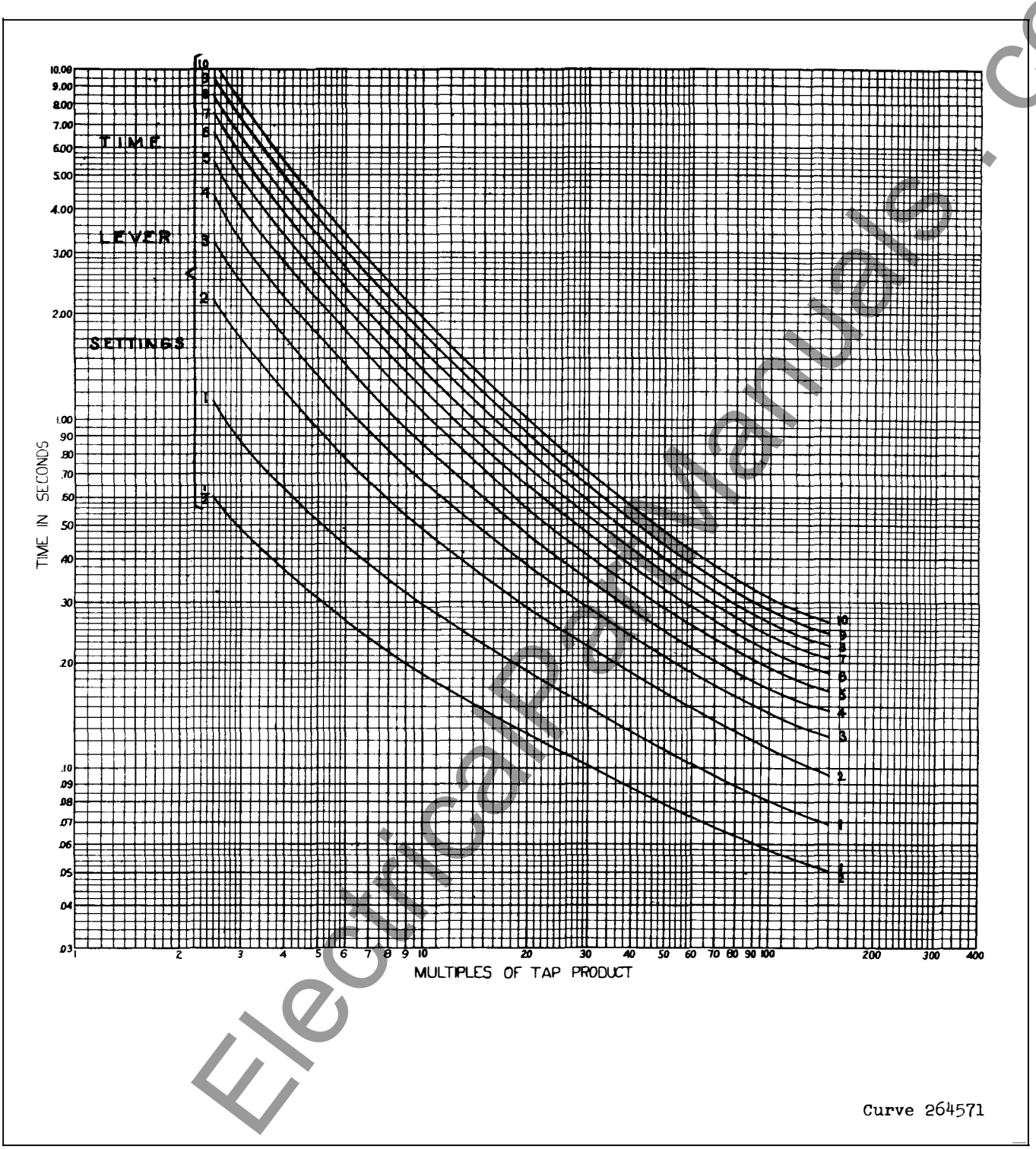
$$R = N\frac{I_L}{I_U}$$

where I_L = the lower pole current.
I_U = the upper pole current.
N = value from the table below for various tap combinations.

Tap Product	Upper Pole Product Tap	Lower Pole Product Tap	N	K
2.25	1	2.25	4.0	30
4.0	1	4.0	2.25	40
6.25	1	6.25	1.44	50
9.0	1	9.0	1.0	60
9.0	4	2.25	16.0	60
16.0	4	4.0	9.0	80
25.0	4	6.25	5.76	100
36.0	4	9.0	4.0	120

The Typical time curves for the Type CWC Relay apply if the values of R falls within the shaded area of the curve above, and if neither relay current is greater than K in amperes.

Fig. 6. Limits for Application of the CWC Time Curves.



These Curves are valid if the multiple of tap Product (volt-amperes) does not exceed the voltage on the relay polarizing coils.

Fig. 7. Typical Time Curves of the Type CWP Relay at Maximum Torque Angle - Curves Apply if the Multiple of Tap Product In Volt-Amperes Does Not Exceed the Polarizing Voltage In Volts.

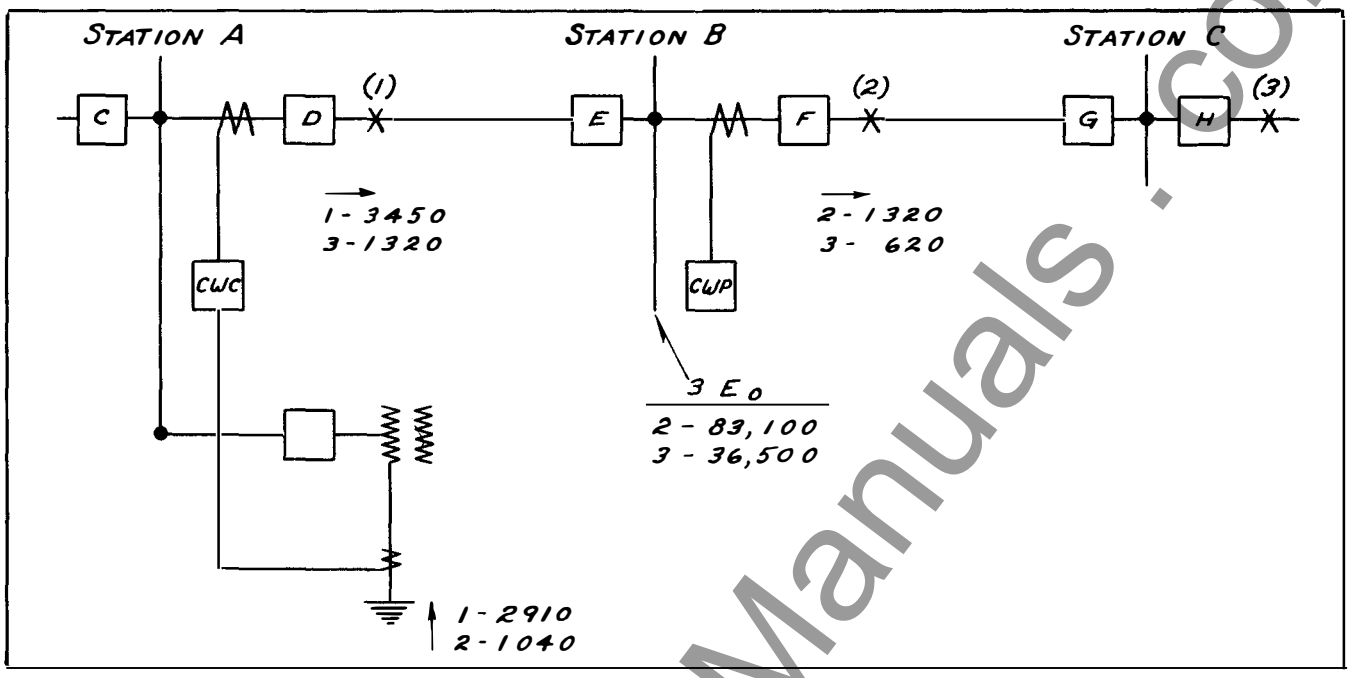


Fig. 8. Typical System for Setting Type CWC and CWP Relays.

TABLE I

1 Relay Location	2 Fault No.	3 Line Primary Amps.	4 Line C.T. Ratio	5 Polarizing Primary Amps. or Volts	6 Polarizing C.T. or P.T. Ratio	7 Line Secondary Amps. (I_L)	8 Polarizing Secondary Amps. (I_U)	9 Product $I_U \times I_L$	10 $\frac{I_L}{I_U}$	11 Tap	12 Multiples of Tap Product	13 R	14 Lever	15 Time In Seconds
D	1	3450	300/5	2910	300/5	57.5	48.5	2285	1.19	36	63.5	4.76	2-1/4	.16
D	2	1320		1040		22.0	17.3	381	1.27		10.6	5.1		.56
F	2	1320	100/5	83,100V	1000/1	66.0	83.1V.	5485	—	300	18.3	—	3/4	.16
F	3	620		36,500V		31.0	36.5V.	1130	—		3.8			.53

relay operating time. This .4 to .75 second interval is known as the coordinating time interval. It includes the circuit breaker operating time plus a factor allowing for difference between actual fault currents and calculated values, differences in individual relay performance, etc. For 8 cycle breakers the value of .4 second is commonly used, while for 30 cycle breakers .75 second is used.

As an example, a type CWC relay is to be connected at Station A and set to protect the line running to Station B. It must select or coordinate with the type CWP relay connected at Station B and set to protect the line running to Station C. The fault currents and voltage for single line-to-ground faults under minimum conditions for this system are shown in Fig. 8.

In setting the type CWC and CWP relays, it is convenient to set up Table as shown. The relay location is shown in Column 1 and the fault location in Column 2. The primary line residual current available for the relay is recorded in Column 3. The ratio of these current transformers is specified in Column 4.

The primary fault current or voltage available for the polarizing winding is shown in Column 5 and the associated current or potential transformer ratio in Column 6. All of these fault values are residual values or three times the zero sequence current or voltage. The relay current for the lower pole windings is the value of Column 3 divided by the ratio of Column 4. The value is recorded in Column 7. The upper pole relay current is the value of Column 5 divided by the ratio of Column 6, and is recorded in Column 8. The relay operating product is the values of Column 7 and 8 multiplied together and recorded in Column 9. For the type CWC relays, the ratio of $\frac{I_L}{I_U}$ is written in Column 10. All of this data is fixed by the system constants and characteristics,

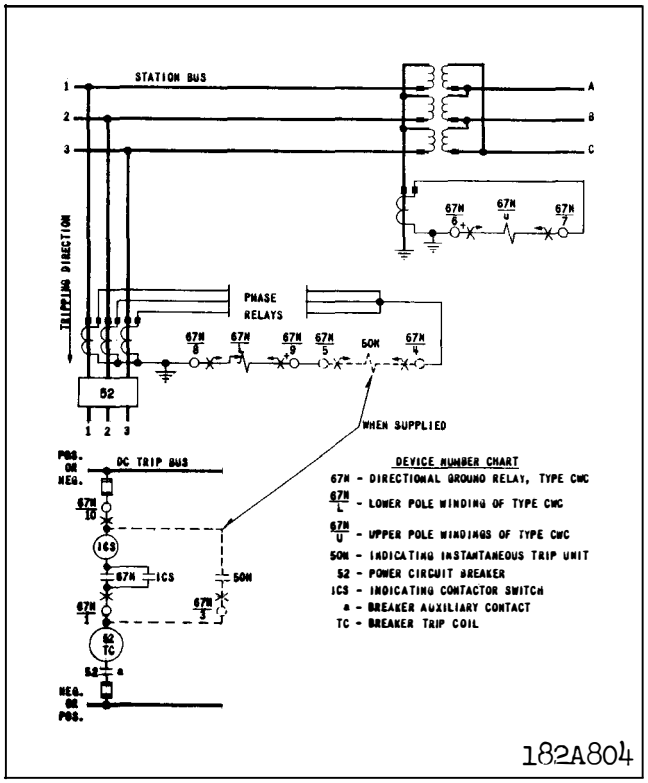


Fig. 9. External Schematic of the Type CWC Relay for Ground Protection.

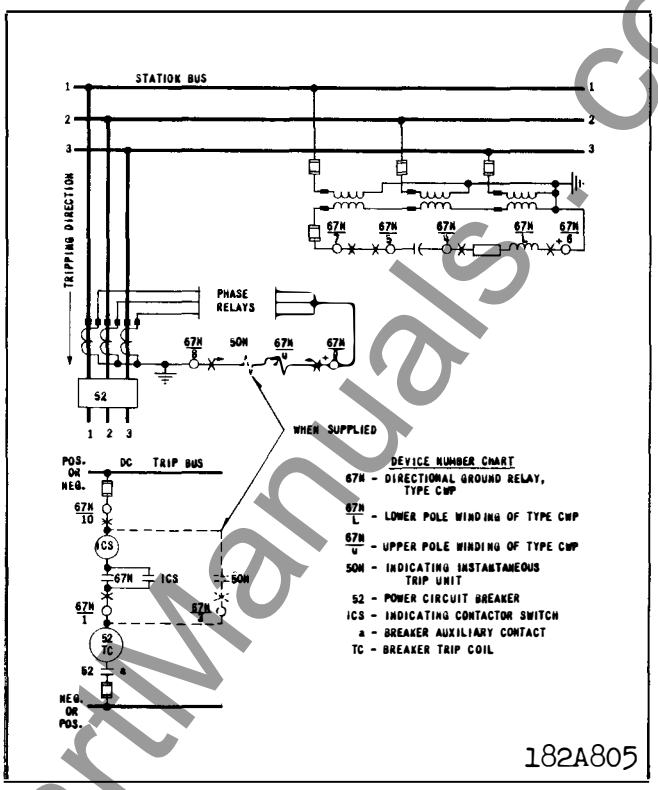


Fig. 10. External Schematic of the Type CWC Relay for Ground Protection.

and is preliminary to making the actual relay setting.

The choice of a tap recorded in Column 11 and of the time lever in Column 14 is a matter of trial and error. The breakers on this system have 8 cycle operating time so that the coordinating time interval should be about .4 second. The tap should be chosen so that the relay times for the close-in fault and remote fault product values will differ by about the coordinating time interval or .4 second in this case. Practically this can be accomplished by several taps with equal results. Tap 36 was selected in this example. The product value divided by the tap is recorded in Column 12. This value is the abscissa of the time product relay curves. From these curves the lever Column 14 and relay operating time Column 15 were chosen so that the relay would operate at about .16 second for close-in faults and about .57 second for the remote faults. These times for the type CWC relay were obtained using time lever setting no. 2-1/4.

With the selection of a satisfactory tap value, the curves of Fig. 6 will quickly show if the combination of tap and current values provide relay operating times as indicated by the curve. The value of Column 10 multiplied by N = 4.0 for tap 36 gives the R values of Column 13. These are within the curve of Figure 15.

The same process is allowed in setting the type CWP relay at Station B on breaker F. Here tap 300 was selected with lever 3/4 to provide relay operating times of 0.16 and 0.53 seconds respectively for close-in and remote faults. The operating limits using this tap are fulfilled since neither multiples of tap product value (Column 12) is greater than the polarizing voltage (Column 8).

After individual relay settings are made, it is necessary to check to see if the relays select properly with associated relays. In the example the coordinating time interval was 0.4 second. Therefore, for fault 2, the relay at D should not operate before the relay at F plus the coordinating time interval. In other words, the operating time of D should be not less than 0.16 second plus 0.40 = 0.56 second.

Similarly the time of the relay at breaker H should not be greater than 0.13 second in order to select with relay F for fault 3. If the time of relay

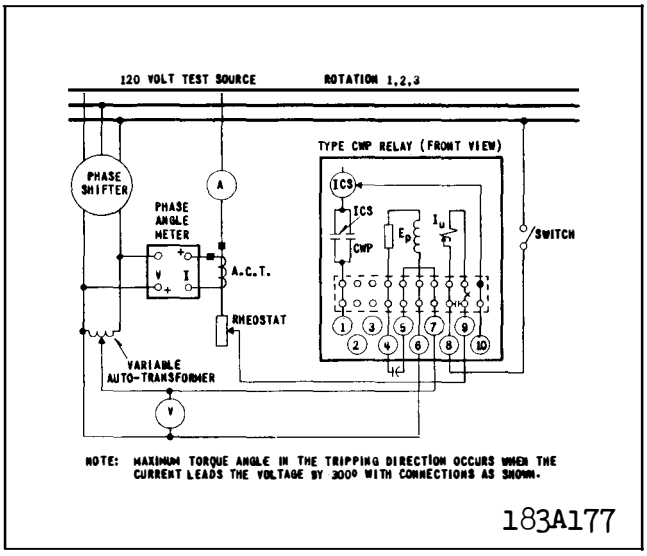


Fig. 11. Diagram of Test Connections for the Type CWP Relay in FT 21 Case.

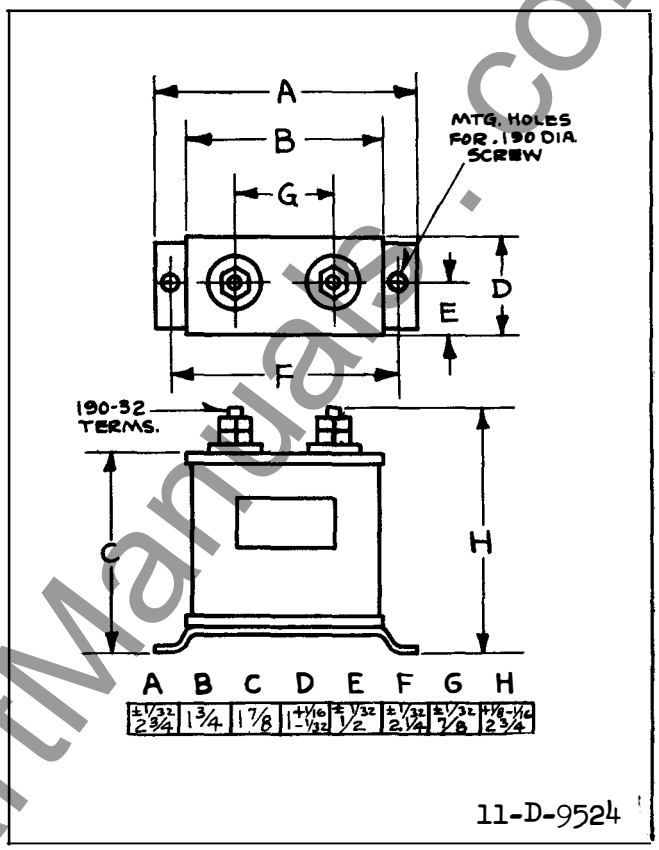


Fig. 12. Outline & Drilling Plan of the External Capacitor for the Type CWP Relay.

H is greater, then the time of relay at F must be increased to provide proper selection. This change may be accomplished by a change in the time lever setting only, although often a new tap and lever setting may provide a more satisfactory setting. Changing the setting of relays at B probably will require a change in the setting of the relay at Station A.

After the settings are made for all the relays under minimum generating conditions, then it is necessary to check the relay operating time and coordination under the maximum generating conditions. Often additional changes in tap and lever settings are required, particularly if the maximum and minimum fault values are quite different.

SETTING THE RELAY

CWC INDUCTION UNIT

Select the desired upper and lower pole taps. Set the lever position by applying a preselected current to the relay coils, and adjusting the lever position to obtain the desired time of operation. Alternatively the lever may be set by inspection, if the timing coordination is not critical.

CWP INDUCTION UNIT

Select the desired upper pole tap. Set the lever position by applying a preselected voltage and current (current lagging voltage by 60° - see Fig. 11) to the relay coils and adjusting the lever position to obtain the desired time of operation. Alternatively the lever may be set by inspection, if the timing coordination is not critical.

INDICATING CONTRACTOR 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.

INDICATING INSTANTANEOUS TRIP (IIT)

Since the minimum and maximum markings on the scale only indicate the working range of the core screw, the core screw must be adjusted to the value of pick-up current desired.

The nameplate data will furnish the actual current range that may be obtained from the IIT unit.

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.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintanance periods, the instructions below should be followed.

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.

INDUCTION UNIT

The upper bearing screw should be screwed down until there is only 3 to 5 thousandths inch clearance between it and the shaft and then securely locked in position with the lock nut. This adjustment can be made best by carefully screwing down the top bearing screw until the disc fails to turn freely and then backing up a fraction of a turn. Great care must be taken in making this adjustment to prevent damage to the bearings.

Adjust the contacts to just barely touch when the time lever is set on zero by shifting the position of the contact stop on the time lever. This should be done with approximately the required contact follow. Final adjustment of the contacts can be more easily made by the contact follow set screw after the contact stop is securely fixed.

A maximum contact follow of approximately 5/64 inch is obtained when the set screw on the stationary contact is all the way out. Where rigid contacts for quick reopening are required, the set screw should be all the way in to hold the stationary contact against the Micarta bracket. Readjust the zero setting after this is done.

CWC RELAY

Connect the upper and lower pole coils in series and pass current in polarity on both coils. With one tap screw in the 1 multiplier position and the other screw in the .36 product tap for the .25-4 product range or the 4 product tap for the 2.25-36 product range, apply current and adjust the spring tension so that the contacts just close with tap value of current flowing. This is 0.6 ampere, 60 cycles, on the .25-4 product range or 2.0 amperes, 60 cycles, on the 2.25-36 product range. The spring tension may by changed by means of a screw driver inserted in one of the notches of the plate to which the outside convolution of the spring is fastened.

Various points on the typical time-product curves can be checked approximately with the current coils in series. The multiples of tap product will be the square of the current passed thru the two coils, divided by the tap product. The timing can be checked with a cycle counter by averaging a number of trials. Make sure that the coils do not overheat, otherwise the curves cannot be checked. Time curve calibration is obtained by adjusting the position of the permanent magnet.

TYPE CWP RELAY

Use the following procedure to check the zero torque line. Adjust the control spring for zero tension and connect per Fig. 11. Apply 120 volts across terminals 6 and 7 and five times minimum pick up current (tap value divided by 24). Zero torque should occur when the currents lead the voltage by 19° to 36°.

To calibrate the control spring, connect per Fig. 11, set in the lowest tap, apply 100 volts across terminals 6 and 7, and apply minimum pickup current, leading the voltage by 300°, (0.20 amperes for the 20-150 range, 0.75 amperes for the 75-600 range). Then, adjust the spring tension so that the contacts just close. Spring adjustment is changed by inserting a screw driver in one of the spring adjuster plate notches.

To check points on the time curve, connect per Fig. 11, and apply preselected current and voltage values, with current leading the voltage by 300° and measure the time of operation with a cycle counter. The time of several trials should be averaged. If the current coil is allowed to overheat, the timing will be affected. The potential coil should not be continuously energized above 115 volts.

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 indicator target should drop freely.

INDICATING INSTANTANEOUS TRIP (IIT)

The core screw which is adjustable from the top of the trip unit determines the pickup value. The trip unit has a nominal ratio of adjustment of 1 to 4 and an accuracy within the limits of 10%.

Apply sufficient current to operate the IIT. 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

CWC

The burden of the Type CWC relays at 5 amperes, 60 cycles is as follows:

Lower Pole Windings

Product Range	Product Tap Value	Watts	Vars	Volt-Amperes	P.F. Angle Degrees Lag
.25-4	.25	82.7	29.3	88.0	19.5
	.36	57.3	14.1	59.0	13.8
	.64	32.1	4.43	32.4	7.85
	1.00	20.6	1.83	20.7	5.10
2.25-36	2.25	8.50	3.26	9.1	21.0
	4.0	4.78	1.03	4.89	12.1
	6.25	3.01	0.41	3.04	7.7
	9.0	2.13	0.21	2.14	5.5

Upper Pole Windings

Product Range	Product Tap Value	Watts	Vars	Volt-Amperes	P.F. Angle Degrees Lag
.25-4	1	6.08	8.58	10.5	55
	4	1.52	0.54	1.61	20
2.25-36	1	0.79	0.95	1.24	50
	4	0.20	0.06	0.21	17

CWP

The burden of the type CWP relays at 5 amperes, 115 volts, 60 cycles is as follows:

Upper Pole Windings

Product Range	Product Tap Value	Watts	Vars	Volt-Amperes	P.F. Angle Degrees Lag
75-600	75	0.633	0.144	0.660	12.6
	100	0.557	0.095	0.560	9.8
	150	0.494	0.043	0.495	5.0
	200	0.460	0.032	0.460	4.0
	300	0.370	0.013	0.370	2.0
	400	0.340	0.006	0.340	1.0
	600	0.290		0.290	0.5
20-150	20	4.70	2.66	5.4	29.5
	30	3.23	1.21	3.45	20.5
	40	2.93	0.87	3.05	16.5
	50	2.31	0.57	2.38	14.0
	75	1.50	0.28	1.52	10.7
	100	1.15	0.11	1.15	5.5
	150	0.80	0.014	0.80	1.0

Lower pole Potential Winding including external 0.38 mfd. phase shifting capacitor.

	Watts	Vars	Volt-Amperes	P.F. Angle Degrees Lead
All ranges -	5.5	2.78	6.15	26.8

CWC & CWP THERMAL RATINGS

Relay	Range	Pole Winding	Continuous Amperes	1 Sec Amperes
CWC	.25-4	All	4	110
CWC	2.25-36	Upper	10	280
		Lower	12.7	370
CWP	20-150	Upper	3.2	88
	75-600	Upper	6.4	185

The potential coil circuit of the type CWP relay will stand 250 volts for 15 seconds.

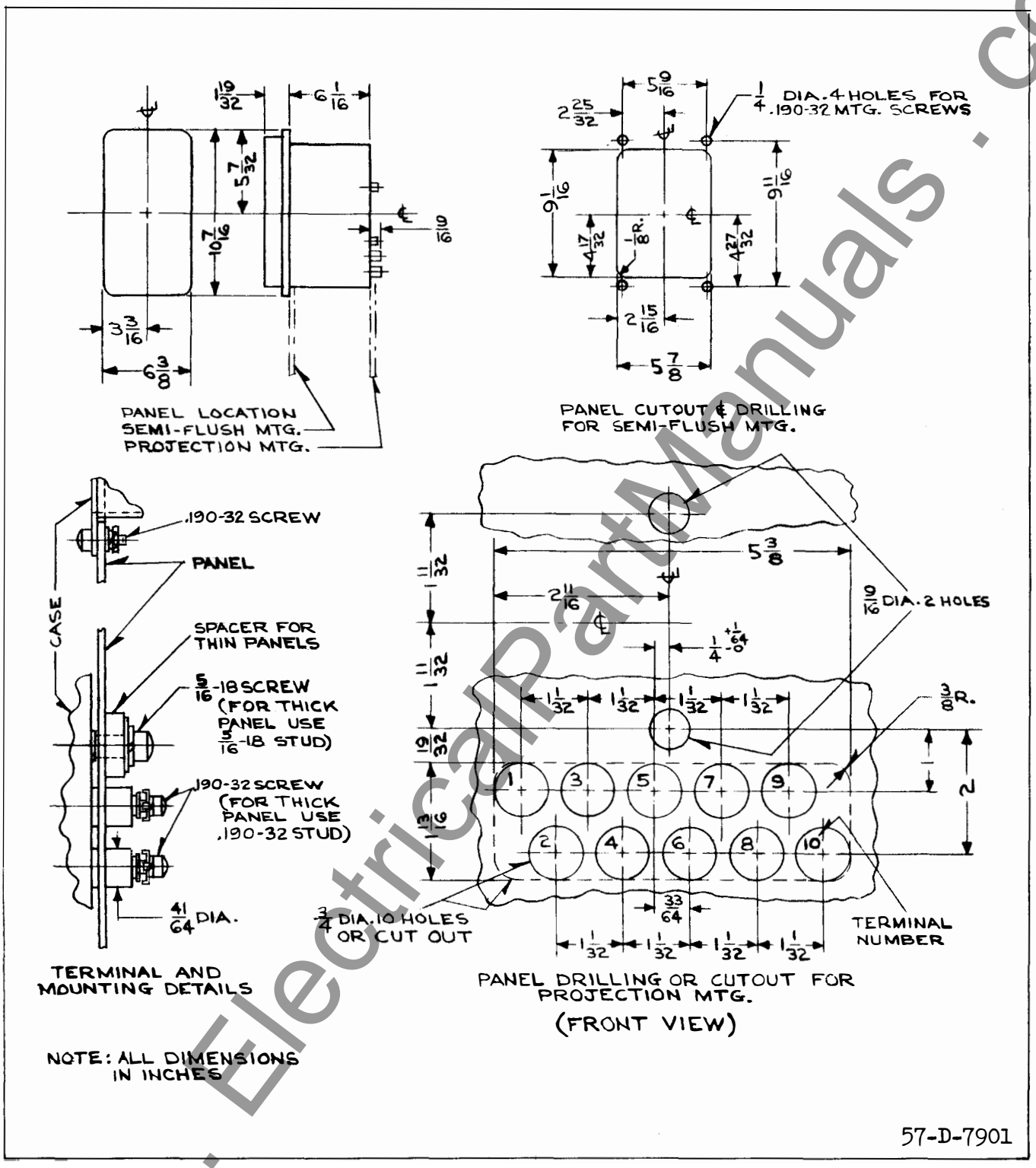


Fig. 13. Outline & Drilling Plan for the Type CWC and CWP Relays in the Type FT 21 Case.