ABB Automation Inc.
Substation Automation and Protection Division
Coral Springs, FL 33065

Instruction Leaflet

41-242.2F

Effective: October 1975

Supersedes I.L. 41-242.4E, dated October 1973

✪ Denotes Change Since Previous Issue

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 setting and electrical connections.

1.0 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 voltage transformers. The type CWP relay is voltage polarized by residual voltage obtained across the open corner of the delta winding of a grounded wye-delta voltage transformer.

At stations where the power transformer bank natural 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.

2.0 CONSTRUCTION

The type CWC and CWP relays consists of an operating unit, an indicating contactor switch, and optional indicating instantaneous trip unit. In addition to the above components, the type CWP relay has a phase shifter network. The principal component parts of the relay and their locations are shown in Fig. 1-8.

2.1 OPERATING UNIT

This unit is an induction disc unit with an electromagnet that has poles above and below the disc as shown in Fig.2 and 4. The upper pole of both the CWC and CWP relays are tapped. In addition, the lower pole is tapped on the type CWC relay.

The electromagnets are connected to the protested apparatus in a manner so that out-of-phase fluxes are produced by the flow of currents in both the upper and lower pole circuits. The out-of-phase fluxes cause either a contact opening or a contact closing torque depending upon the relative direction of current flow in the upper and lower pole circuits.

2.2 PHASE SHIFTER NETWORK

The phase shifter network of the type CWP relay consists of a capacitor and resistor connected in series with the lower pole circuit.

2.3 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,

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local ABB Power T&D Company Inc. representative should be contacted.

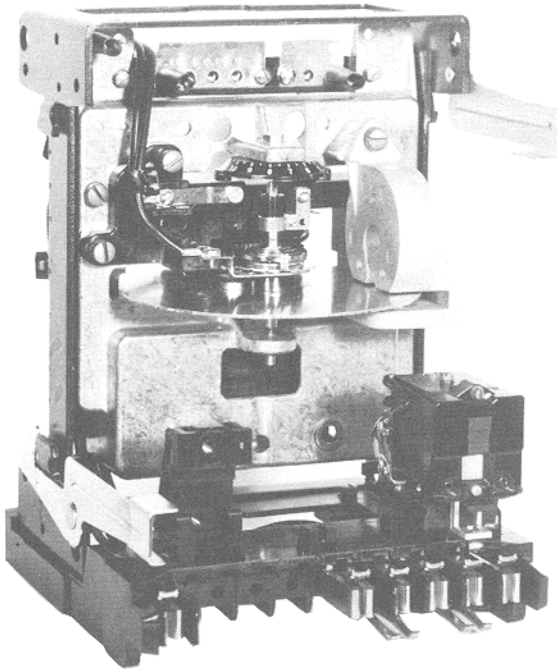


Fig. 1. Type CWC Relay (front view)

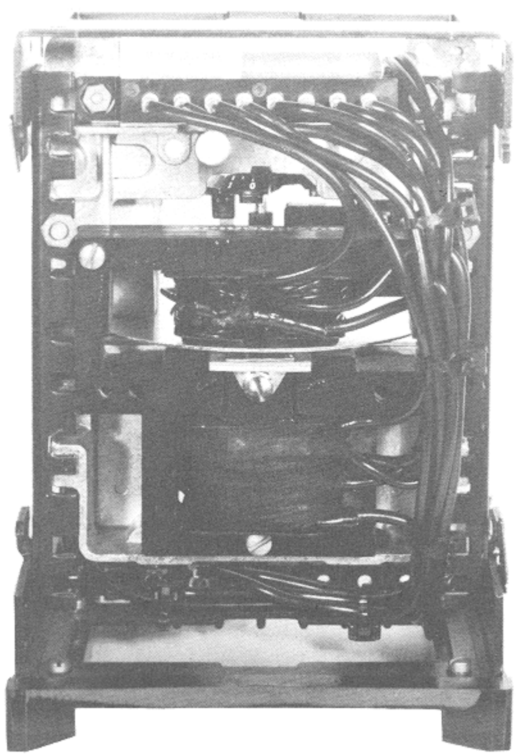


Fig. 2. Type CWC Relay (rear view)

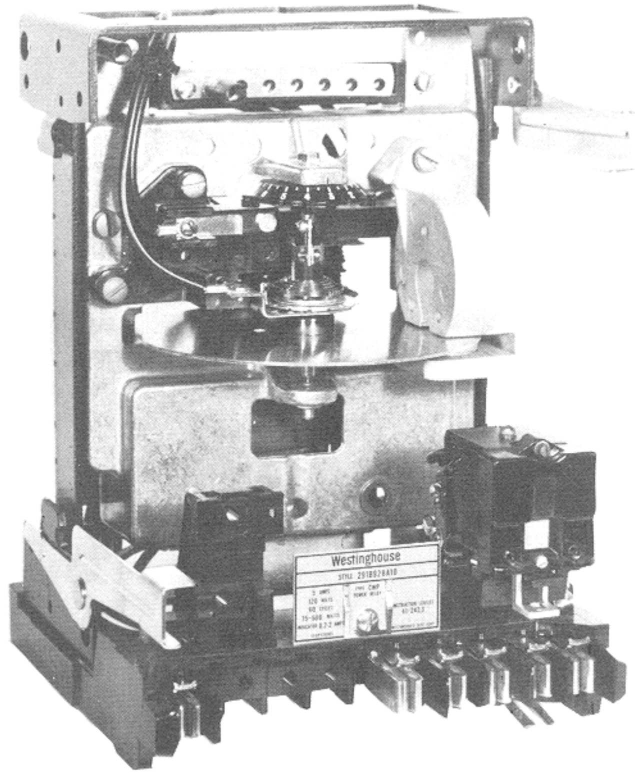


Fig. 3. Type CWP Relay (front view)

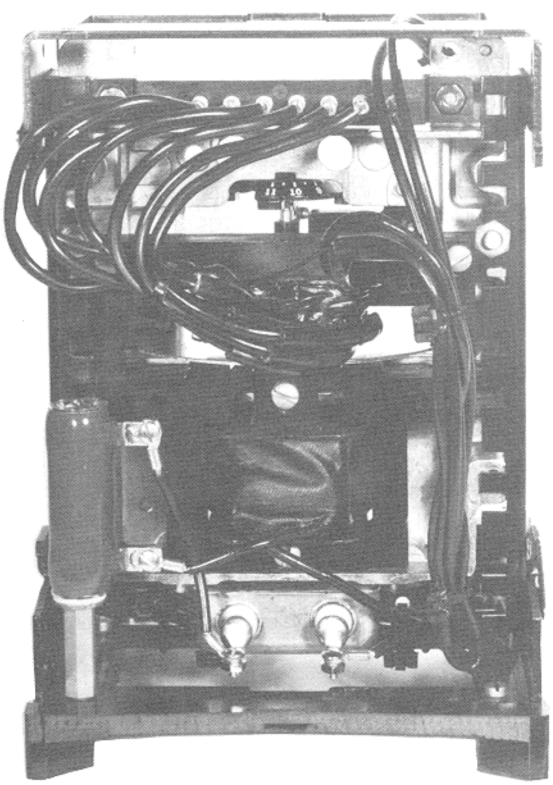


Fig. 4. Type CWP Relay (rear view)

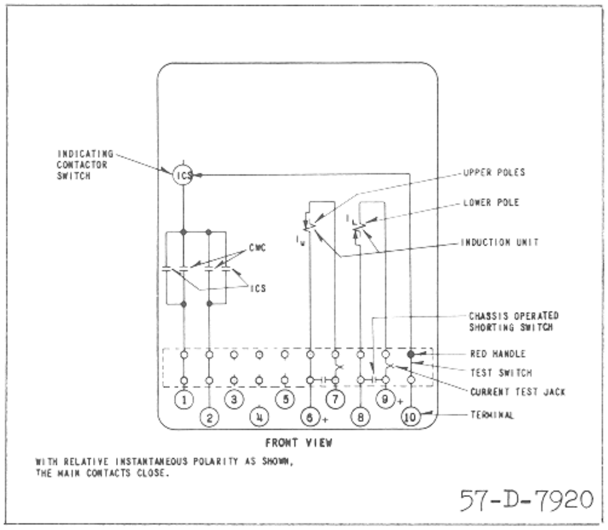


Fig. 5. Internal Schematic of Double Trip Type CWC Relay in the Type FT-21 Case. For the Single Trip Relay the Circuits Associated with Terminal 2 are omitted.

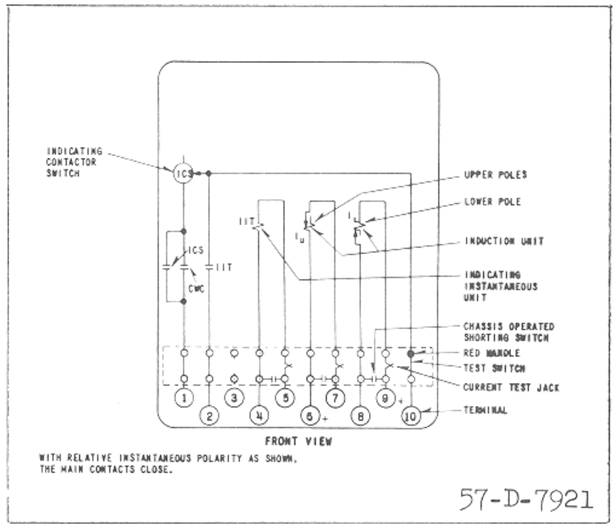


Fig. 6. Internal Schematic of the Type CWC Relay with Indicating Instantaneous Trip Unit in the Type FT-21 Case.

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.

2.4 INDICATING INSTANTANEOUS TRIP UNIT (IIT)

The instantaneous trip 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.

3.0 OPERATION AND CHARACTERISTICS

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 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.

3.1 TYPE CWC RELAY

The type CWC relay has two taps on the upper pole and four on the lower pole. They are marked in product which is the minimum pickup product of two equal or unequal currents.

Type CWC Relay Ranges and taps are:

.25 to 4 Product Range

Product .25 .36 .64 1.0 1.44 2.56 4.0

2.25 to 36 Product Range

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 tap

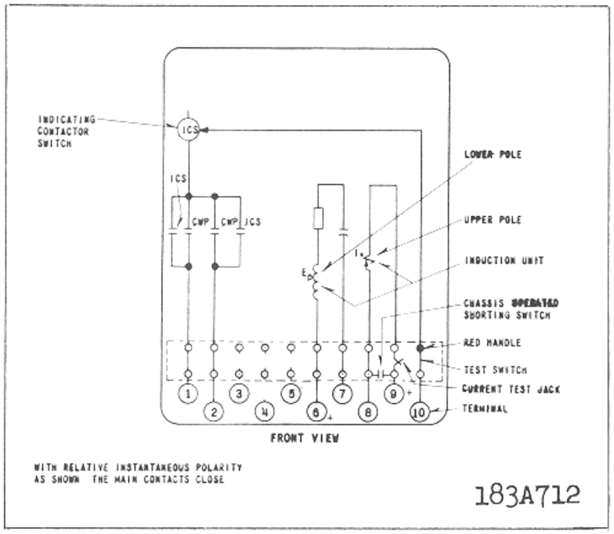


Fig. 7. Internal Schematic of the Type CWP Relay in the Type FT-21 Case. For the Single Trip Relay the Circuits Associated with Terminal 2 are omitted.

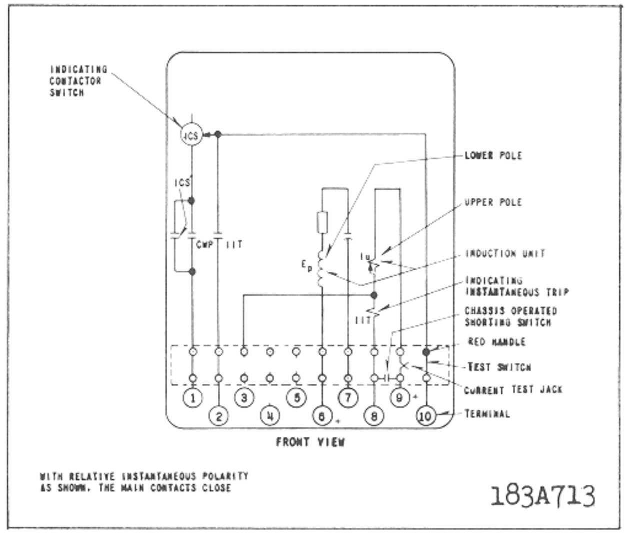


Fig. 8. Internal Schematic of the Type CWP Relay with Indicating Instantaneous Trip Unit in the Type FT21 Case.

plate. The upper pole tap plate is marked x 1 and x 4 Product. The last four values are obtained by using the x 4 tap with the four lower pole taps.

Typical 60 Hertz time-product curves for the type CWC relay are shown in Fig. 9. These curves are taken at maximum torque which occurs with the currents in phase. For residual and Ground currents out of phase the relay operating time may be obtained by determining the operating time corresponding to the product P' - P Cos Ø, where P is the actual relay product in amperes squared, and Ø is the angle between the residual and polarizing currents.

The limits for which these curves are accurate within ± 7% are shown in Fig. 10.

3.2 TYPE CWP RELAY

The type CWP relay taps are on the upper pole current coil. They represent the minimum pickup product of current times voltage at maximum torque when the current lags the voltage by 60 °. The range 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 Hertz time product curves for the type CWP relay are shown in Fig. 11. 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 p' = P Cos (60 ° - 6), where P is the actual relay V.A. product and a 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.

3.3 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.

3.4 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

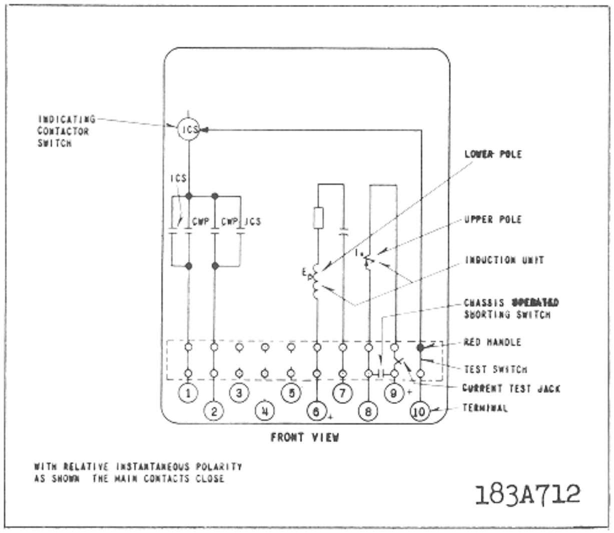


Fig. 7. Internal Schematic of the Type CWP Relay in the Type FT-21 Case. For the Single Trip Relay the Circuits Associated with Terminal 2 are omitted.

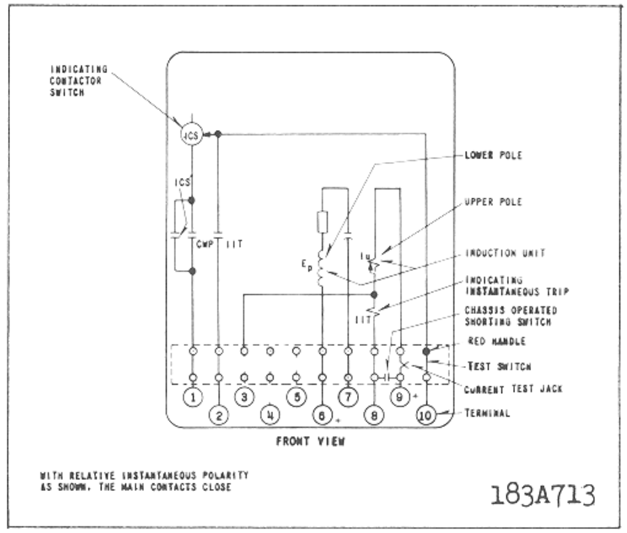


Fig. 8. Internal Schematic of the Type CWP Relay with Indicating Instantaneous Trip Unit in the Type FT21 Case.

4.0 SETTING

4.1 CWC INDUCTION UNIT

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

4.2 CWP INDUCTION UNIT

Select the desired upper pole tap. Set the dial position by applying a preselected voltage and current (current lagging voltage by 60 ° - see Fig. 16 to the relay coils and adjusting the dial position to obtained the desired time of operation. Alternatively the dial may be set by inspection, if the timing coordination is not critical.

4.3 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. When the relay energizes a 125 or 250 volt d-c type WL relay switch, or equivalent, use the 0.2 ampere tap; for 48 volt d-c applications set relay in 2 tap and use S#304C209GO1 Type WL Relay or equivalent.

4.4 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 the pickup current desired.

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

5.0 SETTING CALCULATIONS

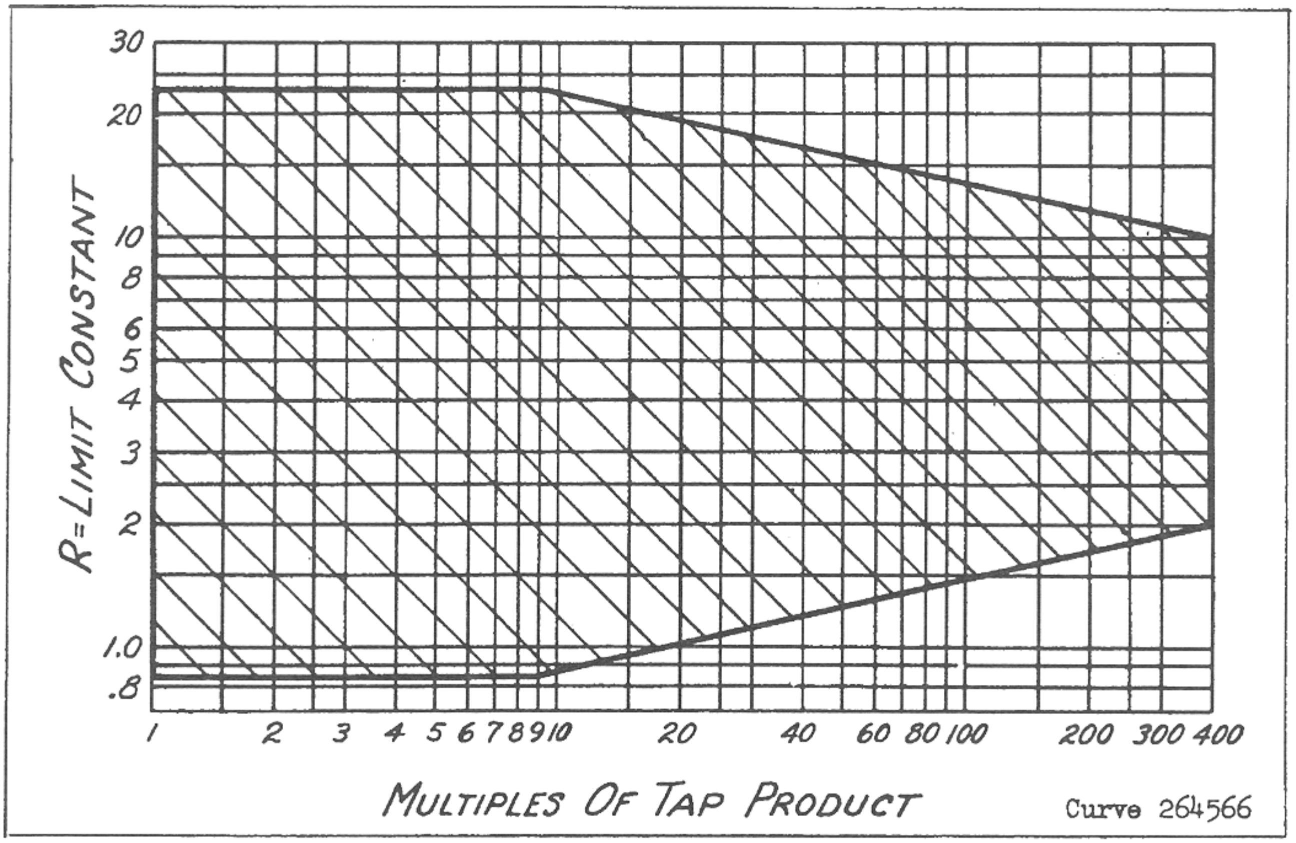
The following information is required to set these relays:

1. The maximum and minimum ground fault current 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



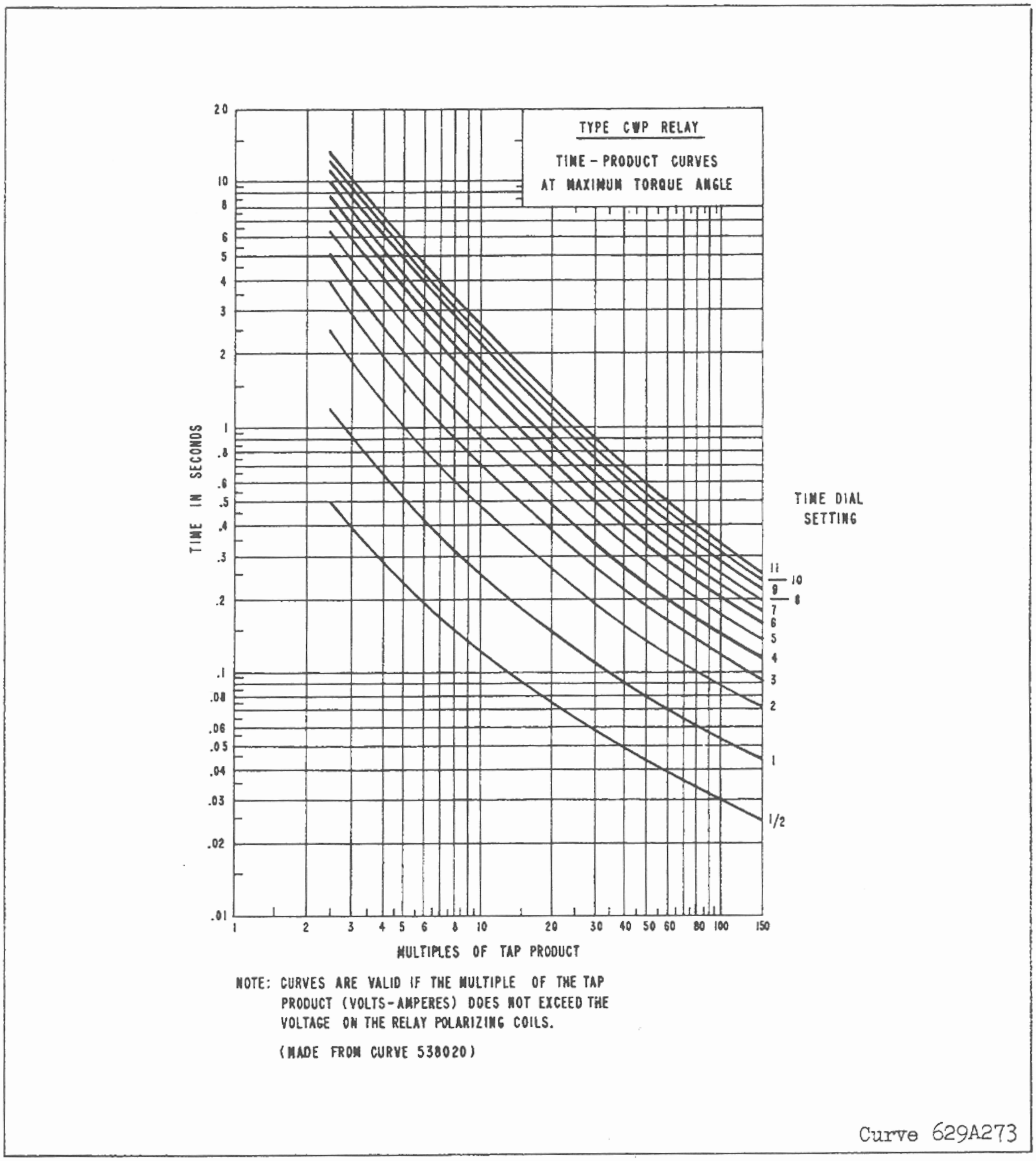
For the 0.25 to 4 Product Range	For the 2.25 to 36 Product Range
$R = M \frac{I_L}{I_U}$	$R = N \frac{I_L}{I_U}$
where I_L = the lower pole current. I_U = the upper pole current. M = value from the table below for various tap combinations.	where I_L = the lower pole current. I_U = the upper pole current. N = value from the table below for various tap combinations.

Tap Product	Upper Pole Product Tap	Lower Pole Product Tap	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

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. 10. 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. 11. 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.

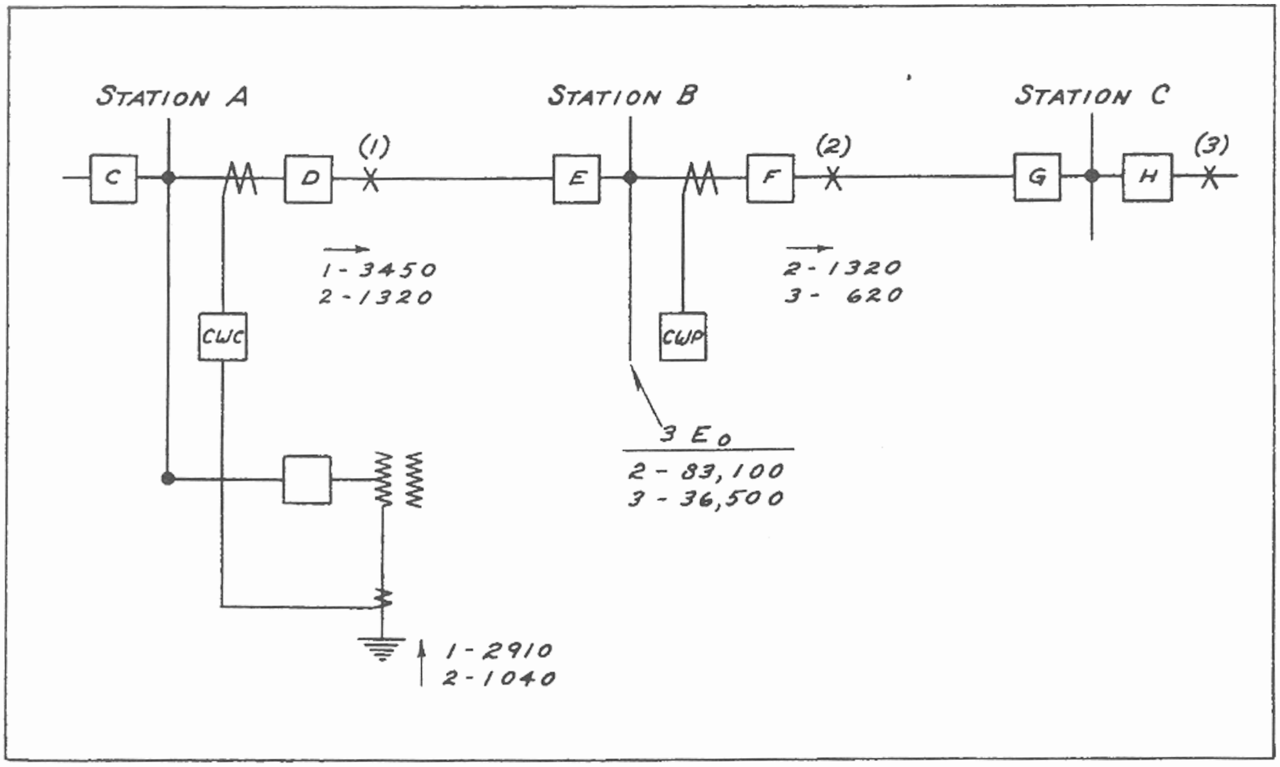


Fig. 12. Typical System for Setting Type CWC and CWP Relays.

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. 9 and 11.

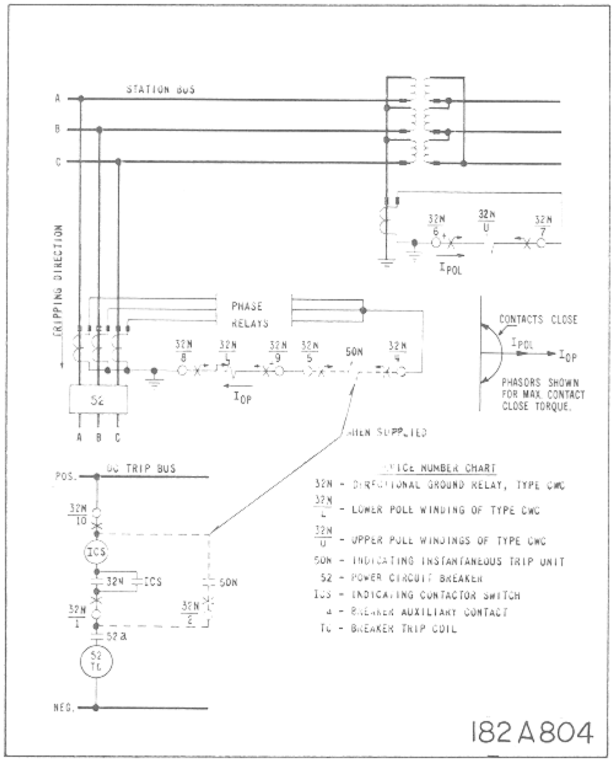
However, the relays cannot distinguish between a fault on the line near the remote breaker for which they should operate, and a similar fault on the bus or adjacent line for which they should not operate until the bus differential or adjacent line relays have had an opportunity to operate and clear the 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 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 current and voltage for single line-to-ground faults under minimum conditions for this system are shown in Fig. 12.

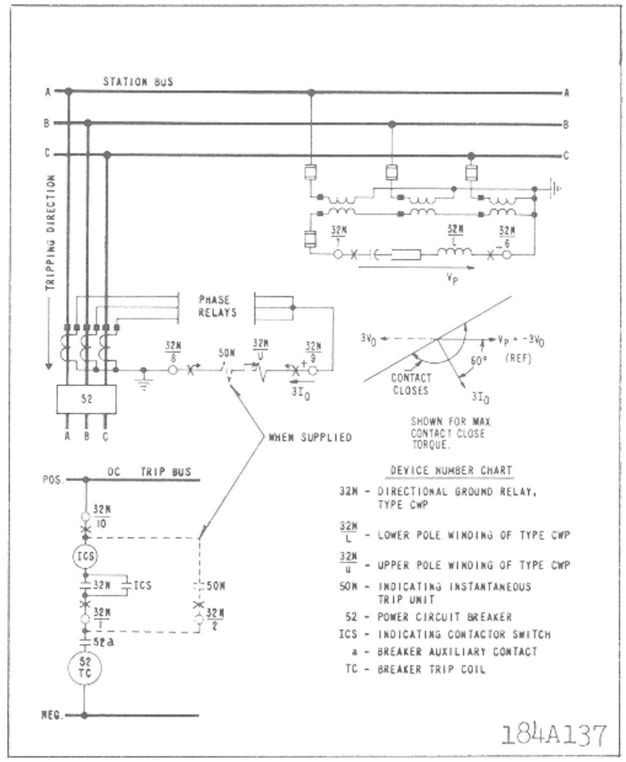
In setting the type CWC and CWP relays, it is convenient to set up Table as shown.

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 of voltage. The relay current for the lower pole windings is



✪ *Fig. 13. External Schematic of the Type CWC Relay for Ground Protection.*



✪ *Fig. 14. External Schematic of the Type CWP Relay for Ground Protection.*

TABLE 1

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 Time Dial	15 Time In Seconds
D	1	3450	300/5	2910	300/5	57.5	48.5	2780	1.19	36	77	4.76	2	.11
D	2	1320		1040		22.0	17.3	381	1.27		10.6	5.1		.52
F	2	1320	100/5	83,100V	1000/1	66.0	83.1V	5485		300	18.3		¾	.13
F	3	620		36,500V		31.0	36.5V	1130			3.8			.53

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 I_L/I_U is written in Column 10. All of this data is fixed by the system constants and characteristics, 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 .12 second for close-in faults and about .52 second for the remote faults. These times for the type CWC

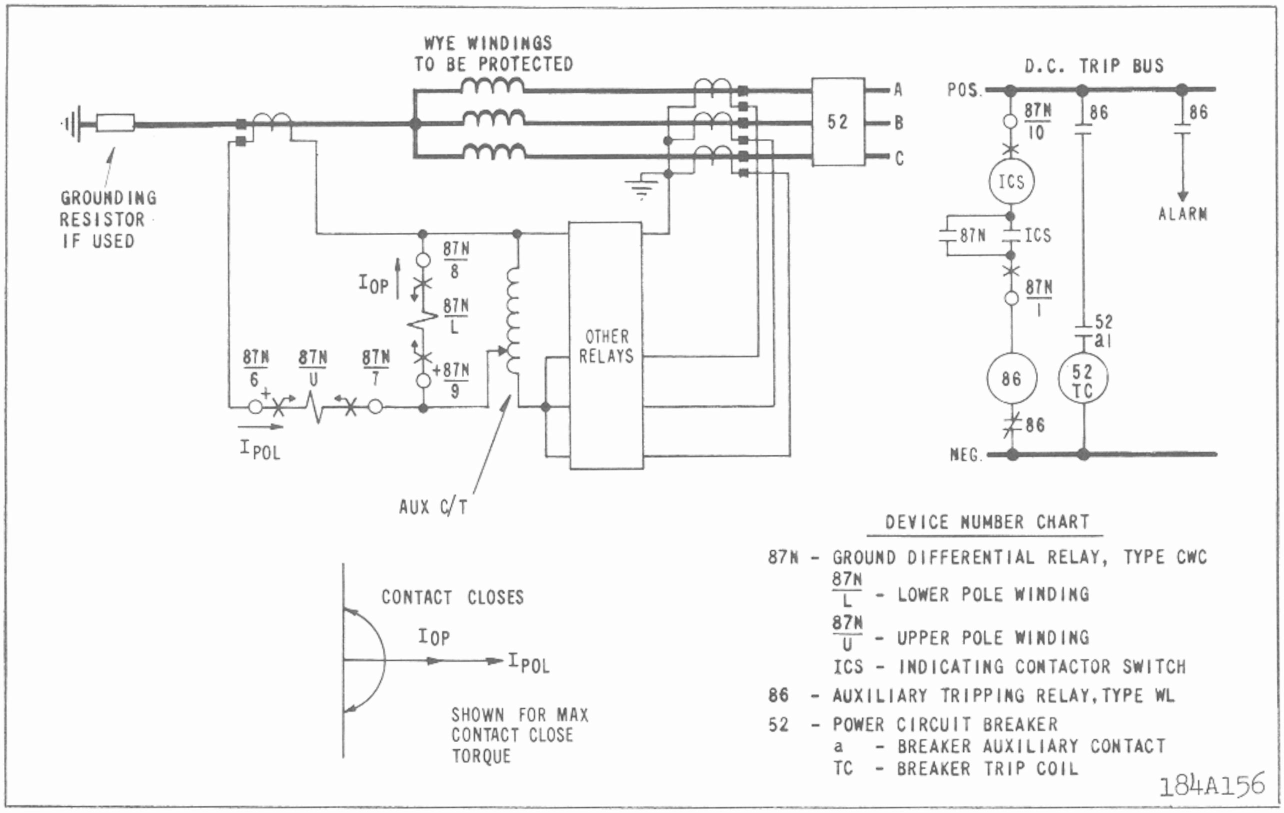


Fig. 15. External Schematic of the Type CW Relay for Ground Differential Protection of Wye or Zig-zag Winding of a Transformer or Rotating Machine.

relay were obtained using time dial setting

With the selection of a satisfactory tap value, the curves of Fig. 10 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 10.

The same process is allowed in setting the type CWP relay at Station B on breaker F. Here tap 300 was selected with dial to provide relay operating times of 0.13 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 not be less than 0.13 second plus 0.4 = 0.53 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 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 setting 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 dial settings are required, particularly if the maximum and minimum fault values are quite different.

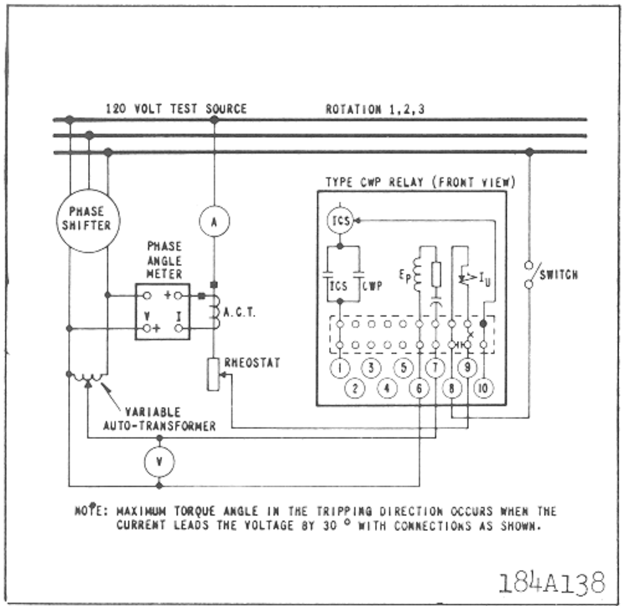


Fig. 16. Diagram of Test Connections for the Type CWP Relay in FT-21 Case.

6.0 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 be means of the four mounting holes on the flange for semi-flush mountings 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.

7.0 ADJUSTMENTS AND MAINTENANCE

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

For relays which include an indicating instantaneous trip unit (IIT), the junction of the induction and indicating instantaneous trip coils is brought out to switch jaw #3. With this arrangement the overcurrent units can be tested separately.

7.1 ACCEPTANCE CHECK

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

1. Contact
By turning the time dial, move the moving contacts until they deflect the stationary contact to a position where the stationary contact is resting against its backstop. The index mask located 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. For double trip relays, the follow on the stationary contacts should be approximately 1/32”.

2. Minimum Trip Current
For the CWC relay, connect the upper and lower pole coils in series and pass a current equal to $\sqrt{\text{Tap product x multiplier}}$ in polarity thru both coils. For the CWP relay connect the relay as per Fig. 16 and apply tap value product. The moving contacts on both relays should close within 5% of the applied values.

3. Time Curve
CWC Relay - Connect the upper and lower poles in series and pass current in polarity thru both coils. Set the time dial on the 6 position and taps on .25 or 2.25 product and 1 multiplier. Check several points on the time curve. Timing should be within 7% of that of Figure 9. (The multiples of tap product shown in Figure 9 equal the square of the current thru the coils divided by the tap product.)

CWP Relay - Connect the relay per Figure 16. Set the time dial on the 6 position and the tap in the 20 or 75 product. Check several points on the time curve by applying current leading the voltage by 300°. The timing should be within ±7% of the values shown on Fig. 11.

4. Indicating Instantaneous Trip Unit (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%.

The making of the contacts and target indication should occur at approximately the same instant. Position the stationary contact for a minimum of 1/32” wipe. The bridging moving contact should touch both stationary contacts simultaneously.

Apply sufficient current to operate the IIT. The operation indicator target should drop freely.

5. Indicating Contactor Switch (ICS)
Close the main relay contacts and pass sufficient d-c current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The operation indicator target should drop freely. The contact gap should be approximately 0.47" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

7.2 ROUTINE MAINTENANCE

All relays should be inspected and checked periodically to assure proper operation.

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.

8.0 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”).

1. Contact
By turning the time dial, move the moving contacts until they deflect the stationary contact to a position where the stationary contact is resting against its backstop. The index mark located on the movement frame will coincide with the “O” mask 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. For double trip relays, the follow on the stationary contacts should be approximately 1/32”.

2. Minimum Trip Current
Type 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 .25 product tap for the .25-4 product range or the 2.25 product tap for the 2.25 - 36 product range, apply current and adjust the spring tension so that the contacts just close at tap value product.

Type CWP Relay - Connect the relay per Fig. 16. 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.

3. Time Curve Calibration
Type CWC relay - Set the time dial to position 6 and the product tap to .25 or 2.25. Set the multiplier tap to 1. Connect the upper and lower pole coils in series and pass a current equal to 4 x v tap product in polarity thru the coils. Adjust the permanent magnet keeper until the operating time is between .95 and 1.01 seconds. Other points on the time curve of Figure 9 should be within ± 7% of the values shown. (The multiples of tap product shown in Figure 9 equal the square of the current passed thru the coils divided by the tap product.)

Type CWP Relay - Connect the relay per the test circuit of Fig. 16. Set the 6 time dial and the lowest tap. Apply 100 volts to potential coil and 10 times tap current. (Current leading voltage by 300°). relay operate between 1.43 and 1.51 seconds. Other points of the time curve should be within ±7% of the value shown on Fig. 11.

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

5. Indicating Instantaneous Trip Unit (IIT)

The core screw must be adjusted tot he value of pickup current desired.

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

9.0 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.

10.0 ENERGY REQUIREMENTS

CWC

The burden of the Type CWC relays at 5 amperes, 60 Hertz 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
2.25-36	1.00	20.6	1.83	20.7	5.10
	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 CWC relays at 5 amperes, 115 volts, 60 Hertz 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 Windings
(between relay terminals 6 and 7)

	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.

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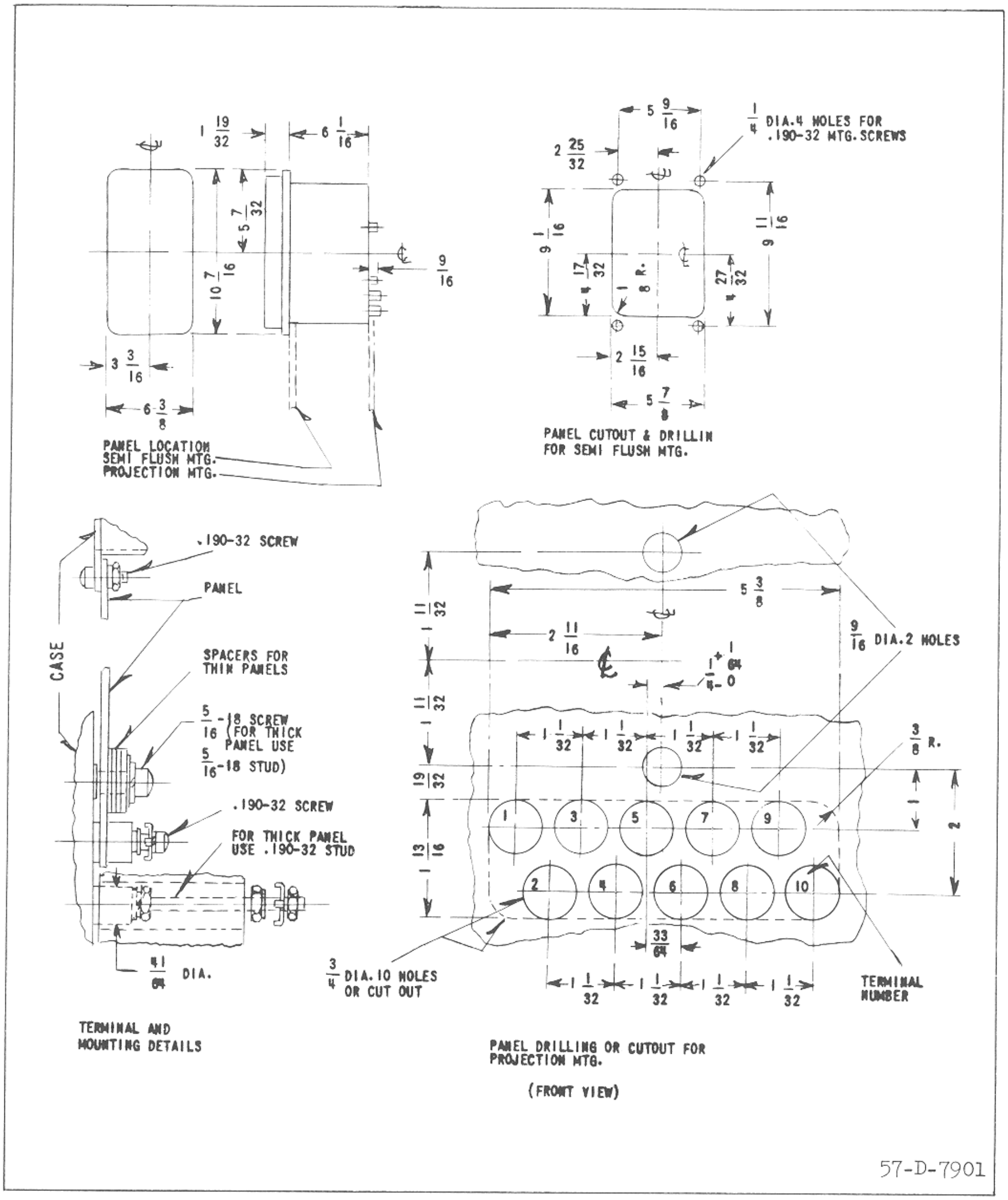

Fig. 17. Outline & Drilling Plan for the Type CWC and CWP Relays in the Type FT-21 Case.

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