INSTALLATION - OPERATION - MAINTENANCE

INSTRUCTIONS

RECORDING WATT DEMAND METERS

(TYPES R-2, R-3, R-7, R-8, R-22, R-23, R-27, R-28, R-32, R-38)

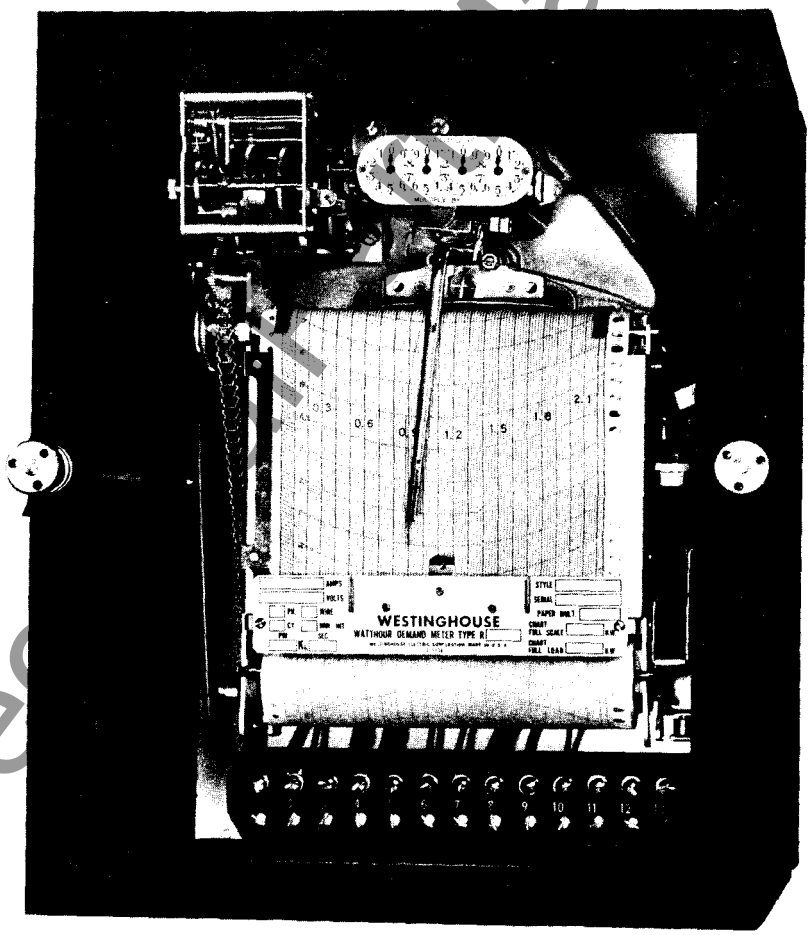

Fig. 1 – Type R-2 Recording Demand Meter

Supersedes I.L. 42-413D
dtd. March 1962

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INTRODUCTION

The Type R recording demand meters (Fig. 1) provide readings of kwh and a chart record of kw demand. The kw demand record is made on the chart by a pen which is driven from the meter shaft. At the end of the time interval, the pen is tripped by a synchronous motor-operated timing mechanism and returns by gravity action to zero. As the paper begins to move before the pen is tripped, a distinct vertical mark is made at the maximum demand point.

The paper mechanism is arranged so that the preceding demand record for a number of hours is visible. This complete mechanism may be removed as a unit or swung to one side on a hinge when the meter stator is being inspected or adjusted.

The meters are furnished with 15-, 30- or 60-minute intervals. Current capacities of 2.5 and 5 amperes and voltage ratings of 120 and 240 volts are furnished. The meter may be supplied to have chart full scale equal to either 125% or 83 1/3% nominal full load. The 2.5- and 5-ampere meters have direct reading charts and registers but a multiplier must be used for all indications on higher rating meters.

The meter is manufactured in the types described in the Application Chart.

The duplex meters, Types R-22, -23, -27, and -28 consist of two identical, independent meters mounted side-by-side in one case. The separate demand charts are operated by the same timing mechanism. One meter may be connected through external phase-shifting transformers to measure kvar hours and kvar demand.

The Type R-32 and R-38 totalizing meters consist of two independent, 2-stator polyphase meters mounted one above the other on the same shaft. It has one integrating register and makes only a totalized demand record.

INSTALLATION AND OPERATION

These meters are designed to be either front or rear connected. As received, it is adapted for front connection. However, brass studs are available which, when screwed into the terminals on the back of the meter, convert it into a rear-connected meter suitable for mounting on a switchboard or any panel where the wiring is from the rear. Outline and drilling plans are shown in Figs. 2 through 13, pages 7 through 8. Mount the meter taking care to have it level. Connect according to the appropriate diagram of Fig. 14 through 36, pages 9 through 16.

Remove the cord and paper to secure the pen, inkwell and disks.

Clock Operations

Check the clock operation as follows: Spring C on shaft 1 (Fig. 37, page 5) should have one and one-half turns tension just after tripping. If this condition has been disturbed, restore it as follows before putting the meter in operation. Pull latch arm G forward and allow the spring to run down.

APPLICATION CHART

Type	Number of Stators	Circuit Application
R-2	2	3-phase, 3-wire
R-3	3	3-phase, 4-wire wye
R-7	2	3-phase, 4-wire delta
R-8	2-Split Coil	3-phase, 4-wire wye
R-22	2-Duplex	3-phase, 3-wire or 2-phase, 3 or 4 wire
R-23	3-Duplex	3-phase, 4-wire, wye
R-27	2-Duplex	3-phase, 4-wire delta
R-28	2-Duplex split coil	3-phase, 4-wire wye
R-32	4-Totalizing	3-phase, 3-wire or 2-phase, 3 or 4 wire
R-38	4-Totalizing	3-phase, 4-wire wye

Turn knob N slowly until the pin on gear H is in a neutral position just below the trip latch. Then hold gear H and turn knob N 1-1/2 turns. Release gear H so that the pin is held by the latch arm. Reset pointer on zero and turn knob N one revolution to check operation.

Paper Mechanism

To facilitate adjustment of the paper mechanism and the insertion of new charts, the paper mechanism can be swung to one side. (Fig. 38). Loosen the two thumbscrews at the bottom of the movement frame until the large gear on the left side of the paper roll drum clears the pinion in the reset mechanism and until the post on the upper right-hand side of the paper mechanism clears the movement frame.

Before inserting a new roll of paper, cut the end as per Fig. 39 and swing the mechanism to one side as above. Slide the roll endwise over spindle, Fig. 38, and bring the end under the guide and over roll N. Slide the end of the paper into the slot in spool X and take several turns on this spool. See that the edges of the paper do not bind under the guides nor rub against the sides of the frame holding the spool and that the pins of the roll N fit into perforations along the edge of the paper without tearing. The paper must lie tight against the roll.

In duplex meters, the connecting device between the two paper mechanisms may be disengaged to allow individual adjustment. To accomplish this, loosen the thumbscrew S, Fig. 40, and slide the link out of the slot in the left-hand driving drum shaft.

Inking System

Remove the cleaning wire from the pen point (keep cleaning wire for future use). Leave enough slack in the plastic tubing between brackets and pen to prevent pen point being drawn off the paper. Move pen manually back and forth across chart to insure that tubing is not too tight. Adjust tubing in brackets if necessary. Pen should swing freely across chart.

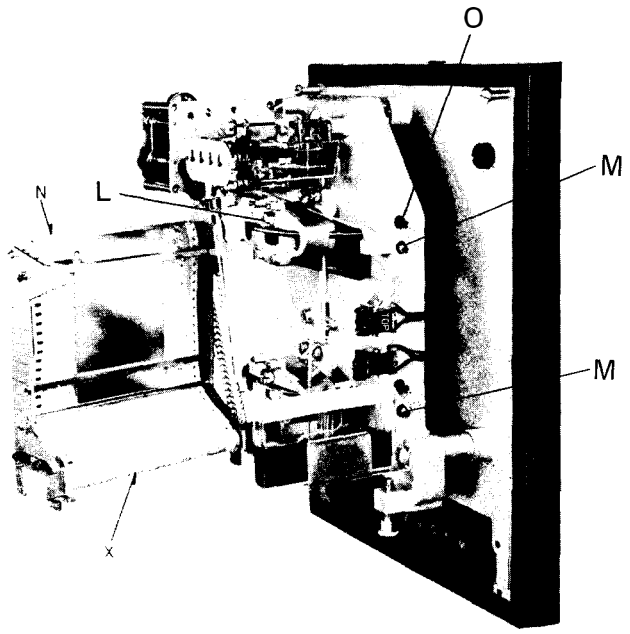


Fig. 38 — Type R-2 Meter with Chart Mechanism Swung to One Side

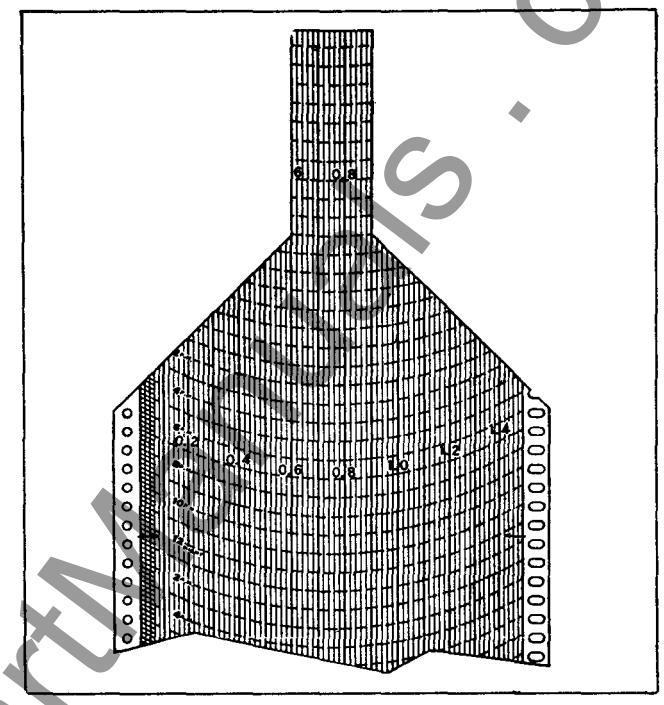


Fig. 39 — Suggested Method for Trimming Leading End of Paper Chart when Starting

Remove filler cap and fill container with ink dropper to 1/8" below the top of the ribs in center of container. Replace filler cap. As an alternate and faster method, the ink container cover can be removed and ink poured directly into the container. *CAUTION*: Do not fill above the level described above. Replace cover.

Prime the pen by depressing the bulb on the syringe and inserting the pen point in small hole in the syringe tube. Release bulb and allow it to expand until ink is drawn thru the tubing and pen point. Be sure that no air bubbles are left in the system and that a solid column of ink is in the plastic tube before removing syringe from pen point.

Make several lines back and forth across the chart manually to start pen inking properly.

Zero Check

Check zero as follows: Trip the clock and see that the worm wheel on shaft 4 (Fig. 41) is completely demeshed from the worm on shaft 2. If not, move collar M out on rod F and lock in place. If the pen does not return to zero but can be moved there by hand, move weight B further out on the cross arm. This weight should be set to make the pen return to zero even if the deflection was small. On the other hand, it should not be set in such a way that the pen returns with excessive speed from large deflections.

Turn worm BD so that the pen rests on zero. Check this setting by running the meter enough revolutions to bring the pen up to the first fine line on the chart. This is equal to 1/5 of the revolutions as determined in "Checking

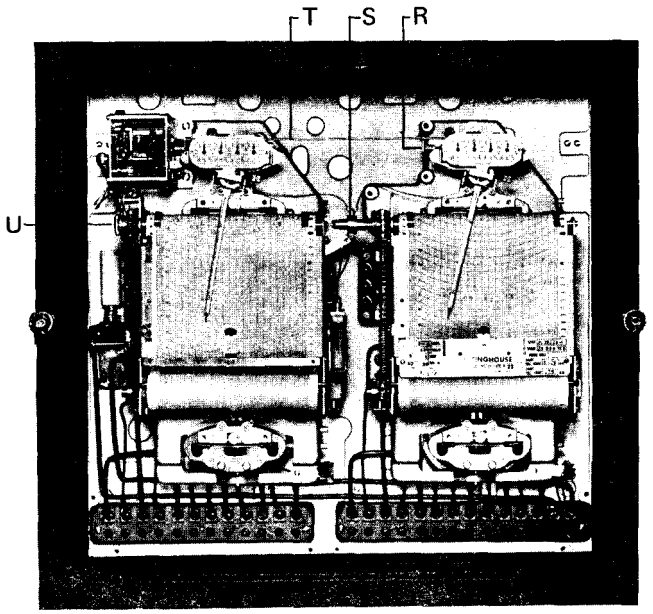


Fig. 40 — Type R-23 Duplex Recording Demand Meter

Correct Demand Registration." Loosen the thumbnut U (Fig. 40) and move the chart slightly to draw a line. If the pen is not exactly on chart line, turn worm BD until this is accomplished. Recheck by tripping the pen and running the required number of revolutions again.

It may be observed that there is a slight variation in the zero setting on successive resets. The amount of the variations depends on the capacity and interval of the meter and is unavoidable since on re-engagement, the wormwheel does not mesh in exactly the same way with the worm on each reset. By making several checks, the best compromise can be established.

Check that the pen makes distinct vertical marks at the end of the pen stroke. Hold the trip rod in and move the pen to a point near full scale. Then trip the clock and observe the action. If unsatisfactory, turn the worm P (Fig. 37) on the clock mechanism, tripping the wheel K (Fig. 37) until the arm has just passed over the tripping stud when the wheel is at rest. Recheck the operation.

Calibration Adjustments –
Two- and Three-Stator Meters (Fig. 38).

Full Load—Moving full load adjuster L to the left (counterclockwise) increases meter speed and vice-versa.

Light Load—Moving the screw to the right of the frame and below the disk in the clockwise direction increases meter speed and vice-versa (F in label indicates fast). See M, Fig. 38.

Phase Balance—Turning the screw at the right of the frame and above the disk moves the balance plate in or out of the electromagnet. Moving the plate out decreases torque. See O, Fig. 38.

Power Factor—Increasing the resistance of the loop mounted beside each electromagnet increases speed and vice-versa. The loop is closed with a soldered joint and resistance is increased by closing the loop closer to the end of the wire.

Calibration Adjustments—Four Stator Meters

On four-stator meters, the adjustments are the same as two- and three-stator meters except for the following:

Full Load—The adjuster is located above the disk gap and must be turned to the left (couterclockwise) to increase speed as indicated by F and arrow on the permanent magnet.

Light Load—The adjustment screws are similar to those of the two- and three-stator meters but are located alternately to the right and to the left of the frame. Those on the right are turned counterclockwise and those on the left are turned clockwise to increase speed.

Phase-Balance—The phase-balance adjusters are accessible from the front of the meters. Turning them clockwise increases speed.

Checking Correct Demand Registration of All Scale Points

The demand indication may be checked by noting the advancement of the pen for a definite number of disk revolutions. By means of the following formula, the number of disk revolutions between main chart division lines (.1, .2, etc.) can be computed:

$$\text{KW Disk Revs Between Main Chart Lines} = \frac{30 \times (\text{Interval in minutes} - 15, 30, \text{etc.})}{\text{number of Main Division Lines to Full Load}}$$

For example, the R-2, 120-volt, 5-ampere, 15-minute interval, full scale equal to 125% of full load meter, has a chart with full scale equal to 1.5 kw and 15 main division lines (at .1, .2, .3, etc., to 1.5). The number of main division lines to full load (1.2 kw) is 12.

Using the above formula:

$$\text{KW Disk Revs Between Main Chart Lines} = \frac{30 \times 15 = 37.5}{12}$$

37.5 would also be the correct number for a similar meter in which full scale equals full load since there would still be 12 main division lines to full load. For easy reference full load is always marked on the nameplate. This formula is applicable to all meters.

Placing Chart in Synchronism (Fig. 37, page 5)

To set the chart in synchronism with actual time, turn the pointer knob N until the escapement is released, allowing the chart to advance and the pen to trip. Then stop the disks of the meter and the motor. Loosen thumbnut U (Fig. 40) on the chart mechanism and rotate the chart until the pen is at the point where the present interval should have started and tighten the thumbnut. Set the pointer on the time dial to the number of minutes which have elapsed since the time indicated on the chart. Then allow the timing motor and disks to operate.

An example may make this clearer. Suppose the meter has a 15-minute interval and that it is 10:20 a.m. It is desired to start the next time interval at 10:30 a.m. First, the pen is tripped as described. Then the timing motor and meter disks are stopped. Next, the chart is advanced as described so that the pen rests on the 10:15 a.m. point. The pointer is then set to indicate 6 minutes if the time is 10:21 (10:21—10:15): 7 minutes if it is 10:22 . . . etc. and the meter disks and motor allowed to start.

MAINTENANCE

General

All recording demand meters should be given a periodic cleaning and lubrication. The frequency of the service varies according to the conditions to which the device is subjected.

It is not possible to specify in a general instruction leaflet any rigid rules to govern time intervals between servicing or

inspections. The conditions in applications are so variable that dependence must be placed upon the experience and judgement of the local operators. Some operating companies consider that the registers should be serviced once every two and a half or three years, or more frequently if installed where subject to high temperatures or unusual environments.

The register and the clock mechanism should be removed from the meter and the motor disassembled from the clock assembly. The register gearing should be cleaned with a good grade of clock-cleaning fluid. Rinse and dry the register thoroughly after cleaning.

The meter stators are serviced in the usual manner for watthour meters.

Lubrication

The motor and clock gearing are the only parts of the meter which need lubrication.

Open Gearing Motors Lubrication

These motors should be lubricated about every 2-1/2 years under normal conditions and every year if they have been subjected to high temperatures. Remove the cap and saturate the wool batting with oil Style No. 1723639. The gasket in the cap should be replaced with a new one Style No. 1336744. Replace cap and screw on tightly.

The shaft next to the motor has the same kind of bearing as the motor and lubrication should follow that of the above paragraph.

Clock Gearing Lubrication

Add a trace of oil Style No. 1723639 to the shaft bearings in the clock.

Changing Interval of Meter

Both the clock and the register must be changed in changing the interval of a meter. The 15-minute clock may be converted to a 30-minute clock by removal of two studs (180 degrees apart) and to a 60-minute clock by removal of three studs. The paper advances every 15 minutes for 15-, 30-, and 60-minute interval meters. A change in register gearing is involved in all interval changes.

PRINCIPLE OF OPERATION

Register Mechanism

The meter measures demand by the clock interval principle. Details of the register operation may be understood from Fig. 41. The disk shaft drives the watthour register through shaft assemblies 1, 3, 7, and 8. At the same time, pen shaft 6 is driven through shaft assemblies 1, 2, 4, and 5. At the end of the time interval, tripping rod F, pushed by the trip arm on the clock mechanism, disengages the worm wheel on shaft 4 from the worm on shaft 2.

Weight N and adjustable weights B counterbalance the pen and pen arm. When falling to zero, the worm on shaft 4 moves sector H against stop pin I on wormwheel S, thus determining the zero position of the pen. Spring O remeshes the pen gearing.

Jamming of the meter due to overloads is prevented by arm P on the pen shaft 6 hitting arm R and demeshing the gearing whenever the pen goes above full scale. The kilowatt-hours are still registered as this gearing is not disturbed.

Adjustment screw K regulates the mesh between the worm on shaft 2 and wormwheel S. Screw BC adjusts the overload trip-out point.

Clock Mechanism

The clock mechanism is shown in Fig. 37. Motor M drives shaft assemblies 10, 9, 8, and 7, and shaft 1 through ratchet B on gear A. Spring C is wound from shaft 1. Shaft 2 is also driven. At the end of the time interval, cam E trips latch arm G and it allows shaft 1A (held in tension by spring C) to revolve. This drives through 4A to 4 which has the paper mechanism pinion and tripping wheel K. Its speed is controlled by governor L, driven from the 1A shaft through 5 and 3. Manual tripping is possible through turning knob N one revolution which turns the No. 1 shaft and the above sequence is followed. Setscrew O controls the position of latch arm G with respect to the pin on gear H (shaft 1-A). For R-32 and R-38 clock diagram, see I.L.42-414.1D.

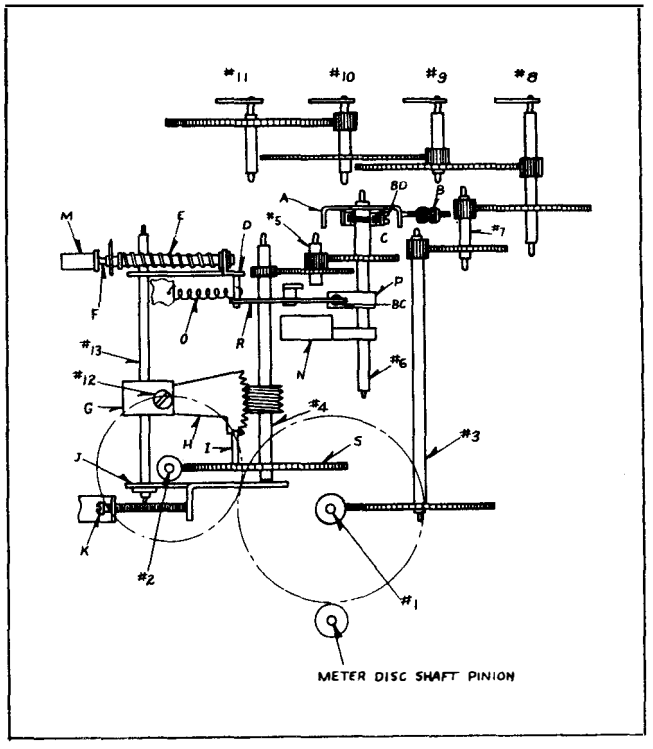


Fig. 41 – Schematic Diagram of Register Mechanism

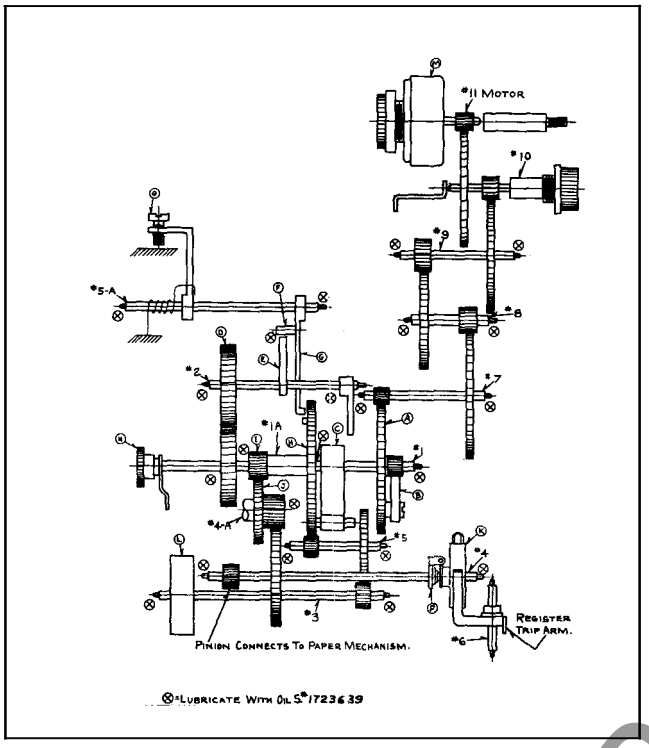


Fig. 37 — Schematic Diagram of Clock Mechanism

Details of Operations

Types R-22, R-23, R-27, R-28, Duplex Meters

The principles of operation of these meters is the same as that outlined above. Certain modifications are made as follows:

The tripping of both registers simultaneously is accomplished by trip rod T (Fig. 40) held by support on each register. Trip arms R are fastened to T by setscrews. They should be adjusted so as to allow the same time of disengagement for both registers.

The paper mechanism of the right-hand meter is operated by means of the connecting device between the upper paper rolls. It may be disconnected by loosening thumbscrew S and sliding the link out of the left-hand drum shaft.

Type R-32 and R-38 Totalizing Meter

These meters are of the four-element type totalizing two polyphase circuits. The clock mechanism has a synchronous motor to determine the time interval and a separate spring-operated mechanism to trip the pen and advance the paper. This synchronous motor requires the same maintenance as outlined on page 4.

ACCESSORIES

Alarm Contacts

Alarm contacts are provided for operating a signaling device whenever a predetermined value of demand is reached. One, two, or three contacts may be provided. These will operate up to three alarm devices at different scale points. The alarm devices do not affect the meter operation, and it will continue up scale after the contacts have been closed. The assembly is mounted on the right-hand side of the register, and the sector meshes with the gear on the pen shaft. The alarm point may be set anywhere desired by turning the adjusting screws on the cam shaft. Reconnect the motor to the meter potential terminals, if necessary, in order to procure adequate terminals. Additional terminals are furnished for accessories when needed.

Pulse Initiators

A CD-3 or CD-11 pulse initiator is available for the R-line meters. The unit is mounted in the frame bushings, located under the reroll mechanism of the meter. On existing meters, it will be necessary to change the standard disk shaft and add one with a pinion to mesh with the initiator. The disk shaft and pinion required for the R-2 is Style No. 1161066 and for the R-3, Style No. 1161067. See I.L. 42-950.7 and I.L. 42-950.4

Heaters

Heaters are provided for operation under low-temperature conditions. Bases are drilled for the mounting of these units, and they are wired as shown in the connection diagrams.

Contact Clock and Solenoid Tripping for Simultaneous Demand

When it is desirable to obtain simultaneous tripping of two demand meters, one meter is equipped with a contact-making clock and the other is equipped with a clock tripped by a solenoid. The contact-making clock is a standard clock except that it is equipped with a contact that is closed at the time of tripping. The solenoid-tripping clock has a motor to wind up the spring for tripping the pen and advancing the paper but it is tripped by the solenoid.

The solenoid is in series with the contact on the other clock and with a source of voltage. If the meter circuit of the clock with contacts is interrupted thereby stopping the tripping of the solenoid operated clock, a slip clutch in the spring drive of the solenoid-operated clock prevents its spring from being overstressed by the motor.

Phase-Shifting Transformers

Phase-shifting transformers are used to convert the meters to reactive volt-ampere demand meters. They consist of small auto transformers which are tapped so as to shift the voltage applied to the meter potential coils by 90 degrees.

When it is desired to measure reactive power on two-phase circuts, no phase-shifting transformers are necessary. It is only necessary to interchange the voltage connections. Internal and external wiring of the phase-shifting transformers are shown in detail in the various diagrams, Fig. 16 to Fig. 36.

Ratchets

Ratchets may be used to prevent reverse rotation on reversal of power. They may also be used to prevent rotation on leading power factor of meters wired for reactive power measurement. The new No. 1 shaft is put in the register and the pawl assembly fastened to the register frame at its right.

REPLACEMENT PARTS AND REPAIRS

When facilities are limited or where only a small number of meters are used, it is recommended that the meters be returned to the factory for repairs. When returning a meter for repairs, obtain a Returned Material Tag from the District Office so as to avoid delay in identifying the shipment.

When ordering renewal parts, give the entire nameplate reading. Always give the name of the part wanted. Check Renewal Parts Data 42-413 for aid in identifying parts.

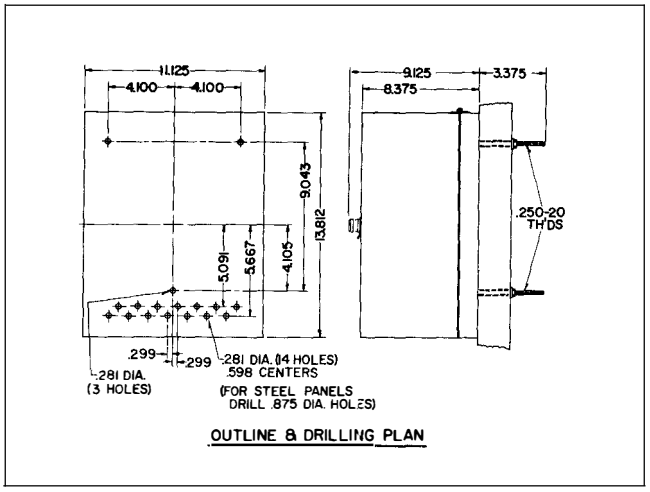


Fig. 2 — Types R-2, 7, -8 Meters with Hinge and Stud Covers

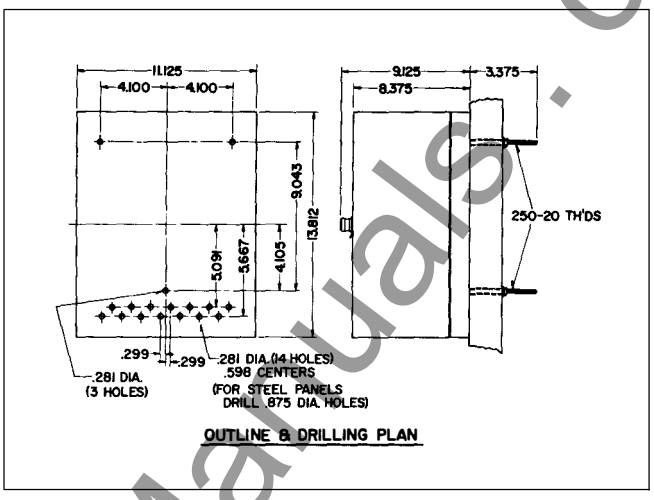


Fig. 3 — Types R-2, -7, -8 Meters with Stud Covers

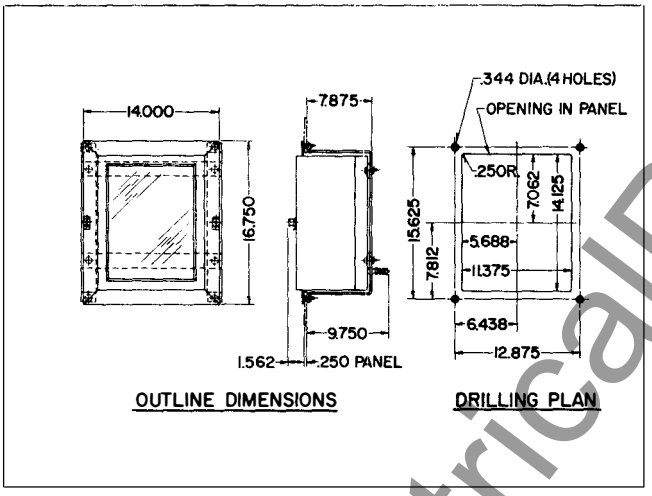


Fig. 4 — Types R-2, -7, -8 Meters, Flush Type

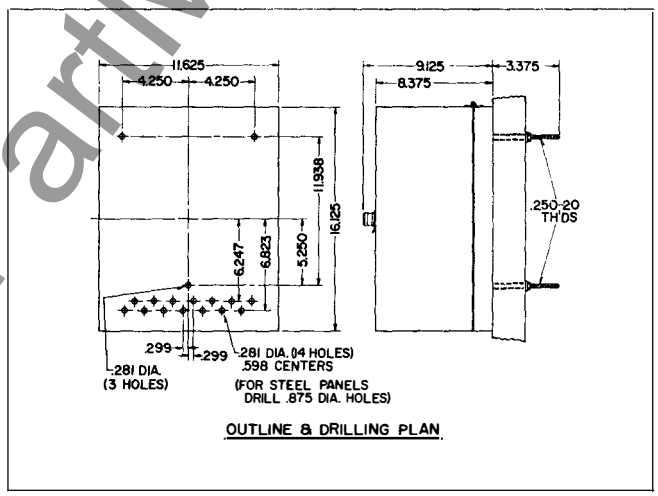


Fig. 5 — Types R-3, -32, -38 Meters with Hinge and Stud Covers

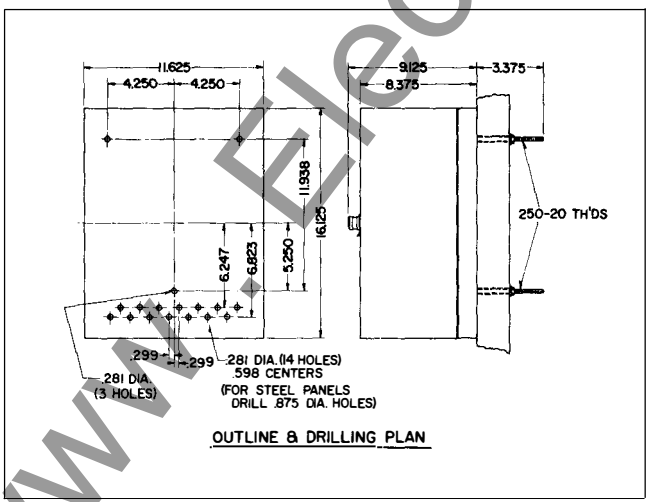


Fig. 6 — Types R-3, -32, -38 Meters with Stud Covers

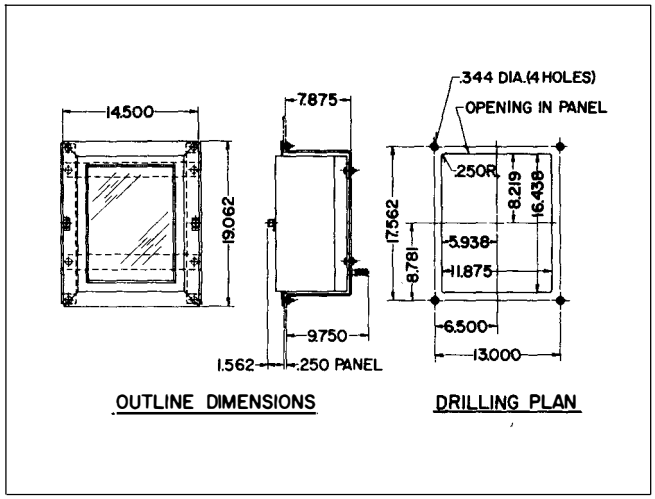


Fig. 7 — Types R-3, -32, -38 Meters, Flush Type

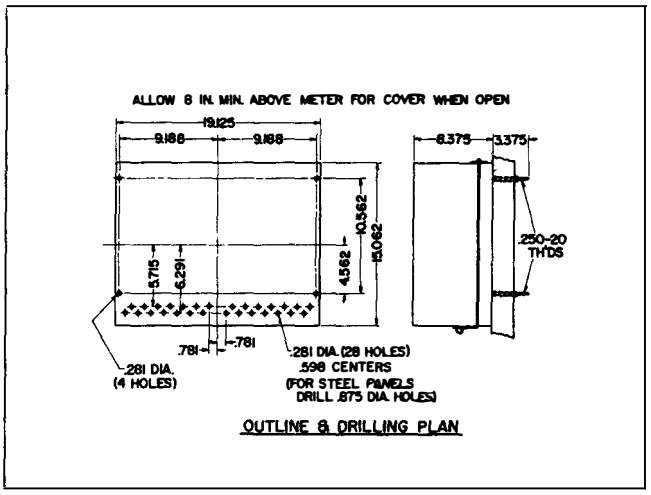


Fig. 8 — Types R-22, -27, -28 Meters with Hinge Covers

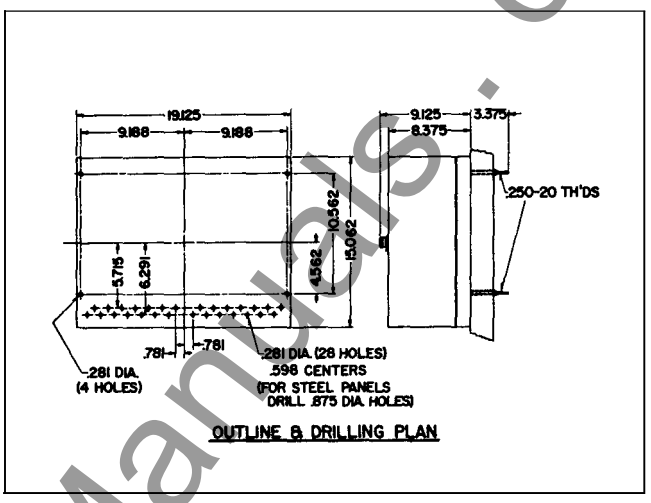


Fig. 9 — Types R-22, -27, -28 Meters with Stud Covers

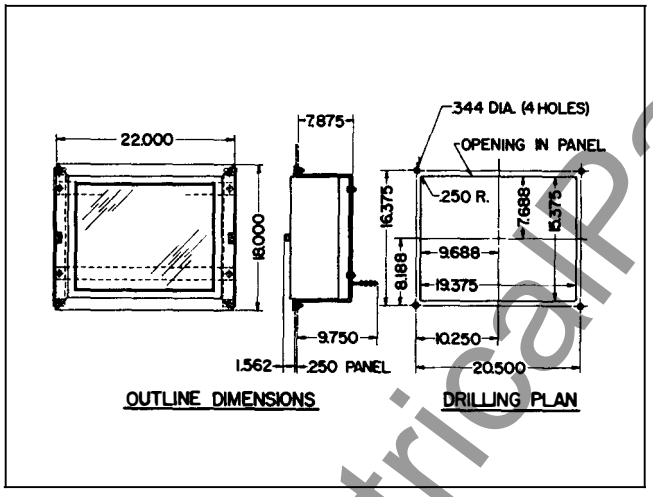


Fig. 10 — Types R-22, -27, -28 Meters, Flush Type

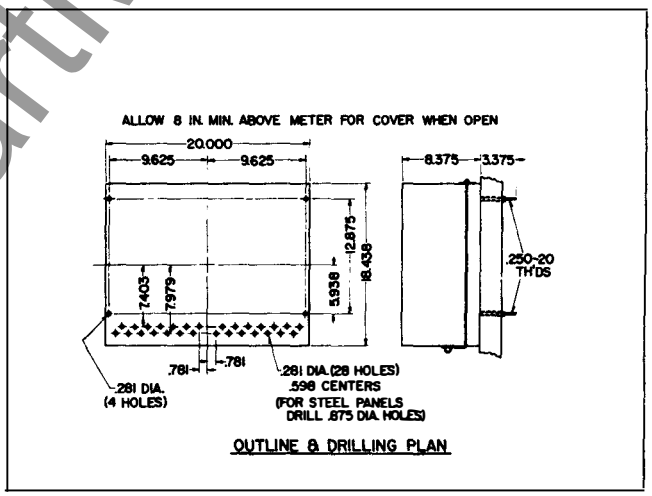


Fig. 11 — Type R-23 Meters with Hinge Covers

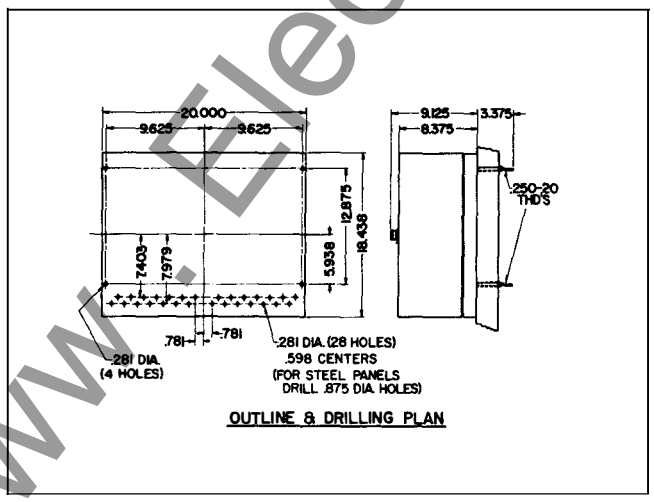


Fig. 12 — Type R-23 Meters with Stud Covers

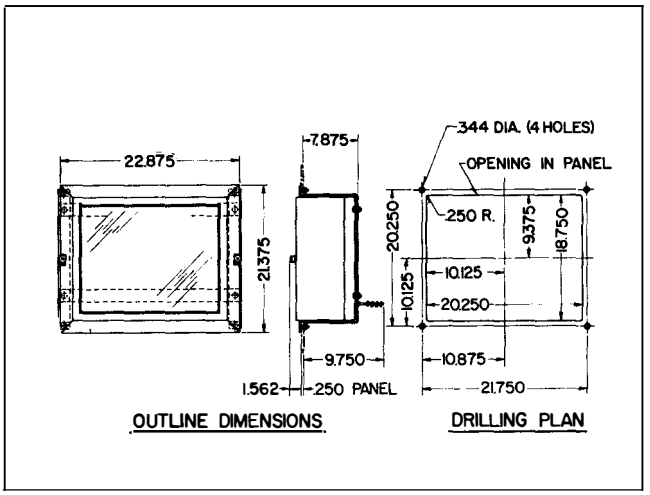


Fig. 13 — Type R-23 Meters, Flush Type

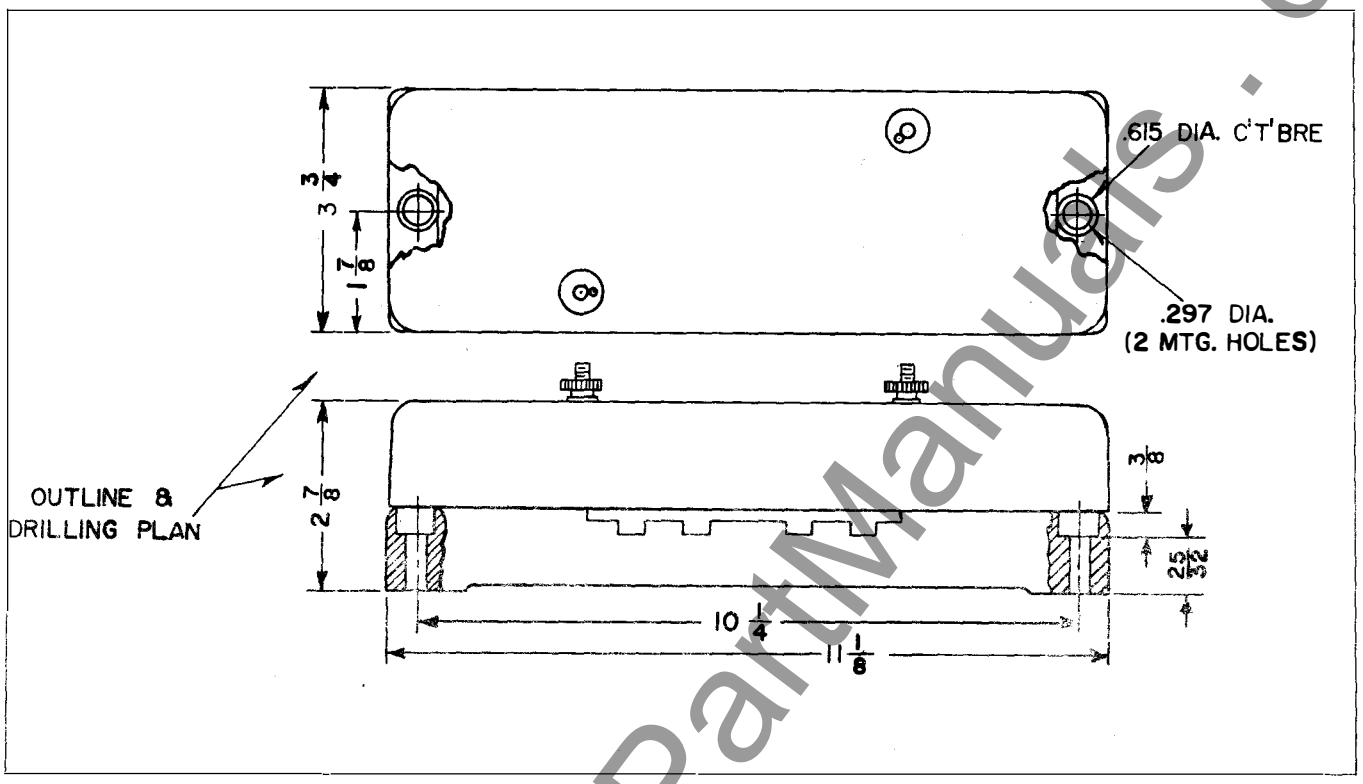


Fig. 14 — Types PS-2, -7, -8 Phase-Shifting Transformer

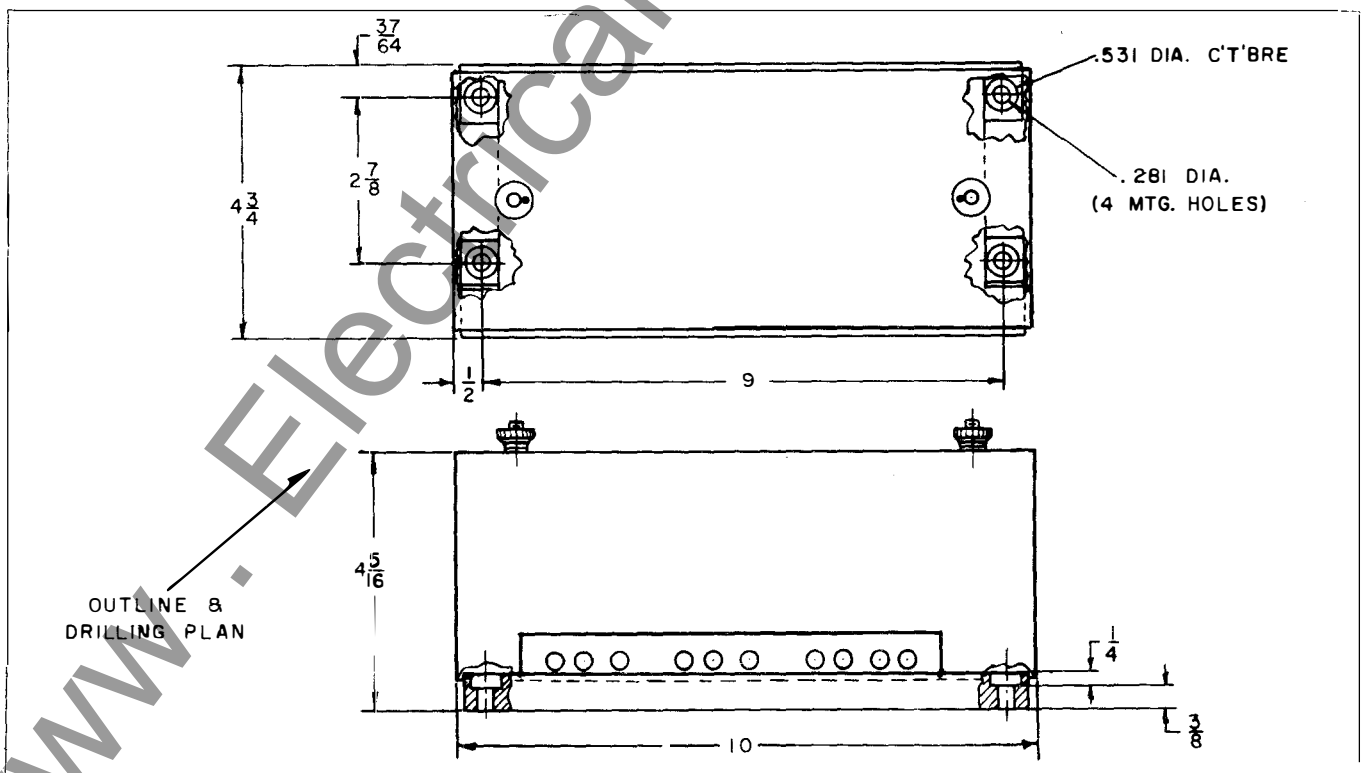


Fig. 15 — Types PS-3, -9 Phase-Shifting Transformer

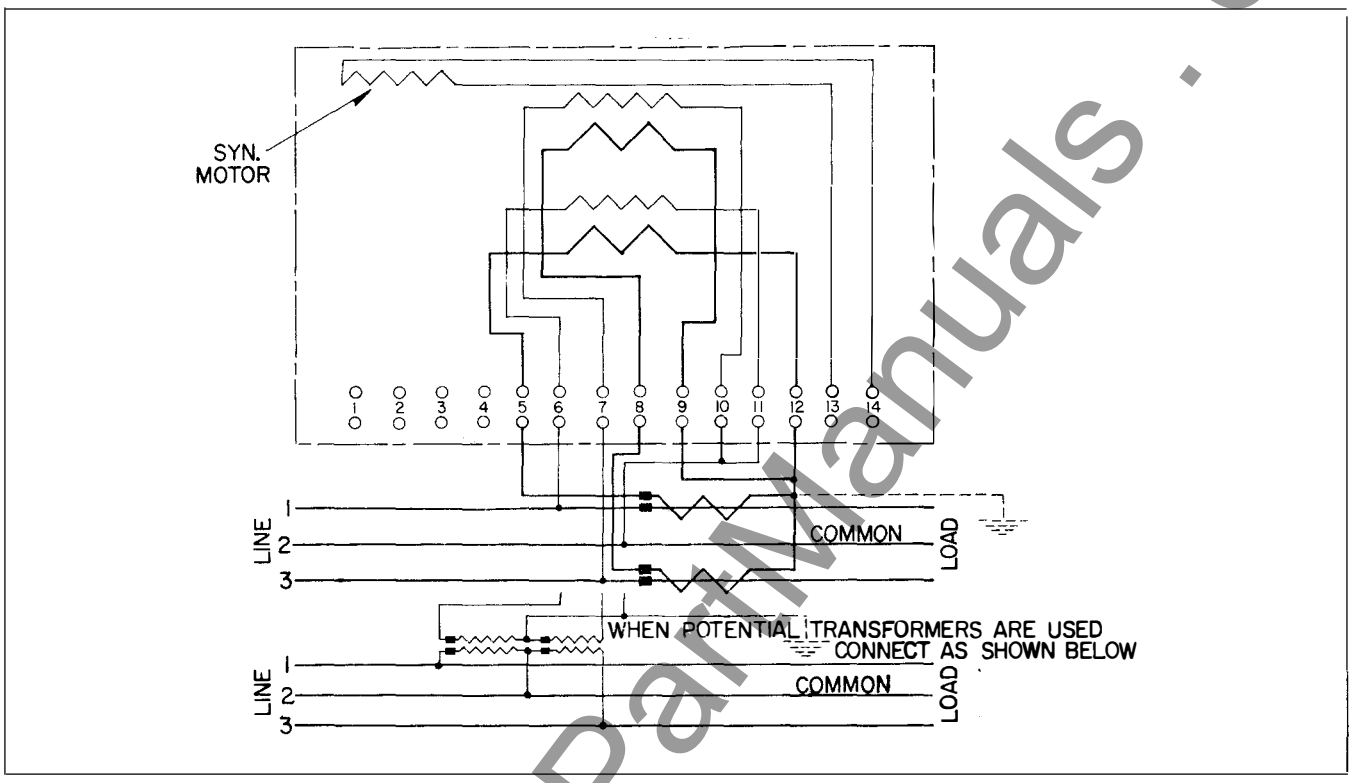


Fig. 16 — Type R-2, 2- or 3-Phase, 3-Wire

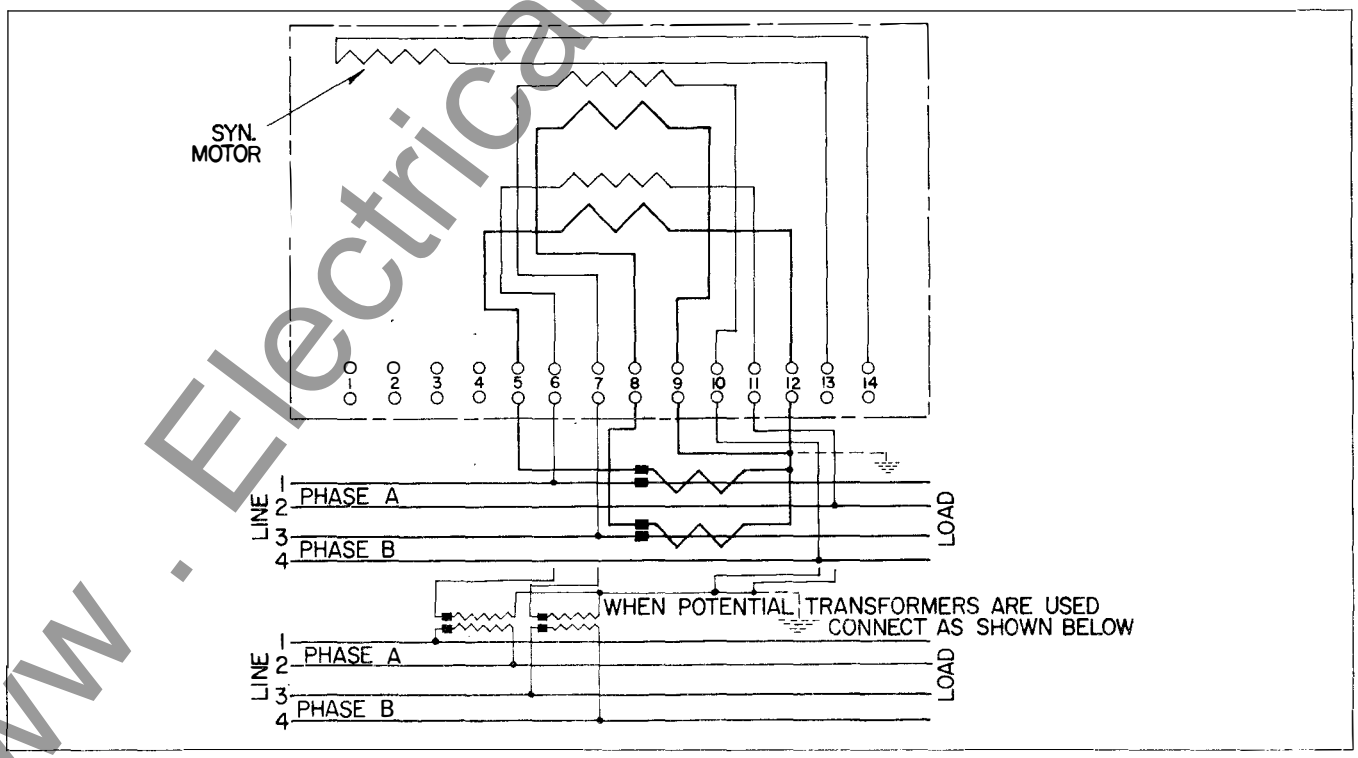


Fig. 17 — Type R-2, 2-Phase, 4-Wire

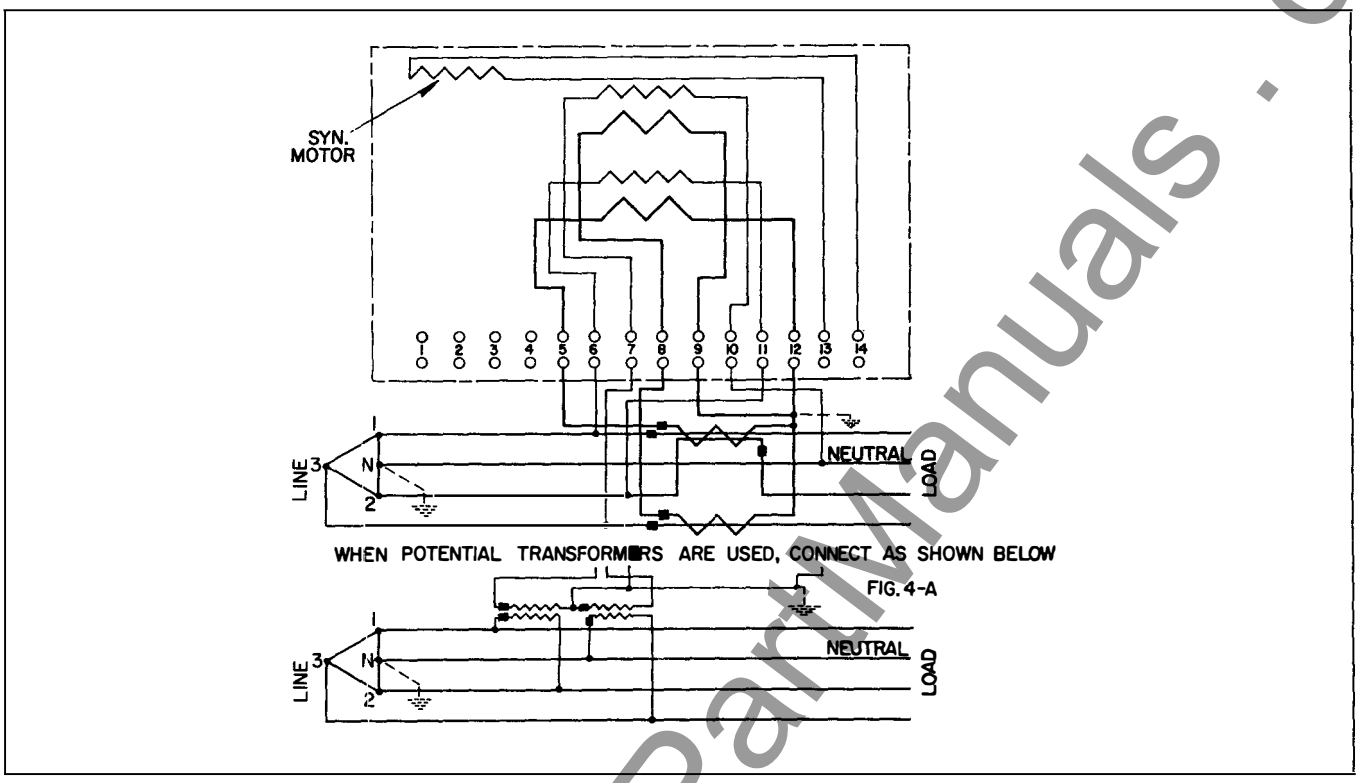


Fig. 18 — Type R-2, 3-Phase, 4-Wire, Delta, Using One 2-Wire and one 3-Wire Current Transformer

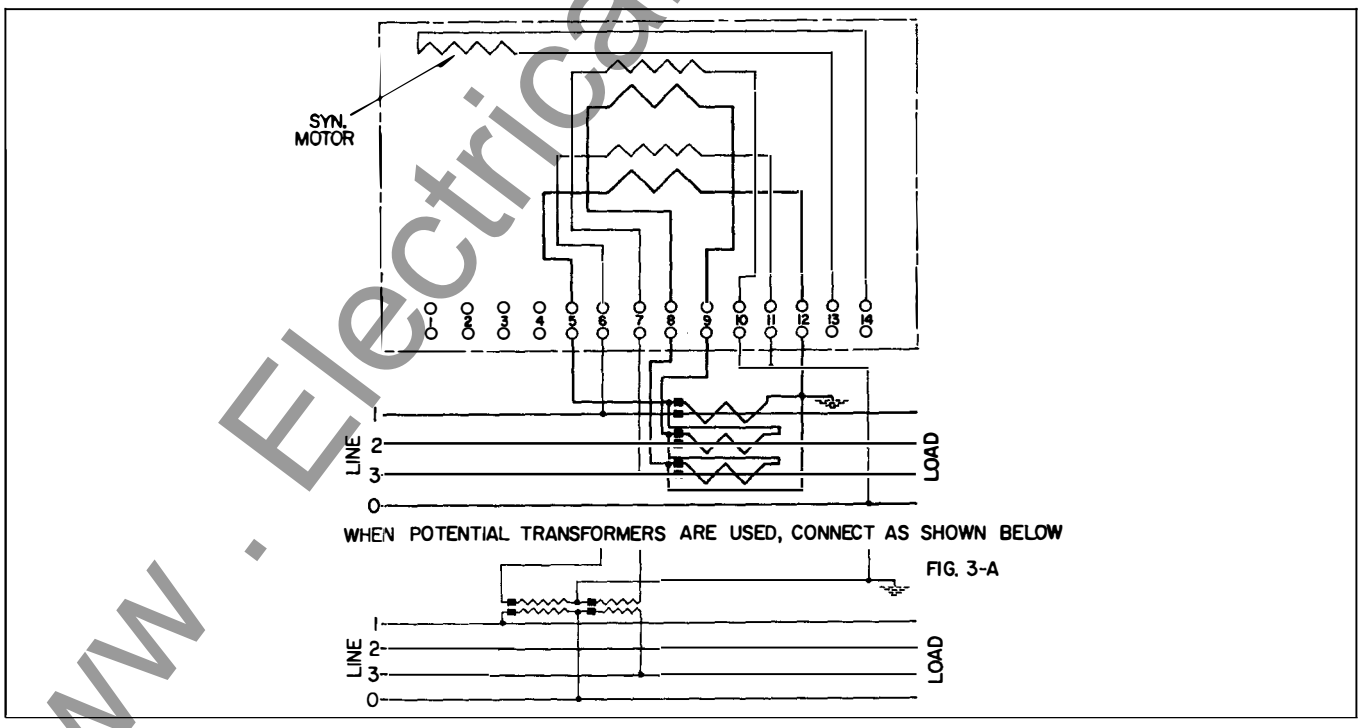


Fig. 19 — Type R-2, 3-Phase, 4-Wire, "Y" Using Three 2-Wire Current Transformers

	ACCESSORIES	TERMINALS USED	MARKING	WIRING CHANGES
1	SOLENOID TRIP	1-2		
2	CLOCK CONTACTS	1-2		
3	HEATER	1-2 OR 7-10		
4	MECHANICAL CONTACTS	1-2-3	K-Y-Z	
5	ELECTRONIC INITIATOR	1-2-3	7B-6C-8A	
6	ALARM CONTACTS-ONE	3-4	(#4)C	
7	ALARM CONTACTS-TWO	2-3-4	(#4)C	
8	ALARM CONTACTS-THREE	1-2-3-4	(#4)C	
9	SOLENOID TRIP OR CLOCK CONTACTS & HEATER	1-2 3-4		
10	SOLENOID TRIP OR CLOCK CONTACTS OR HEATER & MECHANICAL CONTACTS	1-3 2-3-4	K-Y-Z	
11	SOLENOID TRIP OR CLOCK CONTACTS OR HEATER & ELECTRONIC INITIATOR	13-14 1-2-3	7B-6C-8A	SEE NOTE "A"
12	SOLENOID TRIP OR CLOCK CONTACTS & HEATER & MECHANICAL CONTACTS	4-13 4-14 1-2-3	" K-Y-Z	SEE NOTE "A"
13	SOLENOID TRIP OR CLOCK CONTACTS & HEATER & ELECTRONIC INITIATOR	4-13 4-14 1-2-3	7B-6C-8A	SEE NOTE "A"
14	SOLENOID TRIP & ONE ALARM CONTACT	1-2 3-4	(#4)C	
15	SOLENOID TRIP & TWO ALARM CONTACTS	1-4 2-3-4	(#4)C	
16	SOLENOID TRIP & THREE ALARM CONTACTS	13-14 1-2-3-4	(#4)C	SEE NOTE "A"

WHEN USING THERMOSTAT WITH HEATER WIRE IN SERIES AS SHOWN

CONNECT LEADS TO DESIGNATED TERMINALS

A=CHANGE MOTOR LEADS FROM TERMINALS 13-14 TO 6-11

Fig. 20 — Accessory Wiring Table for R-2 Meter

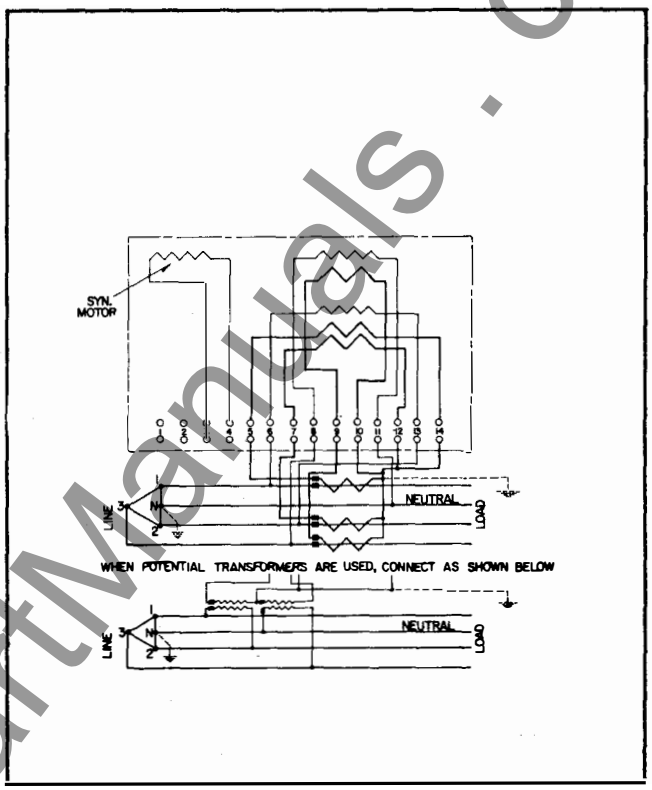


Fig. 21 — Type R-7, 3-Phase, 4-Wire Delta

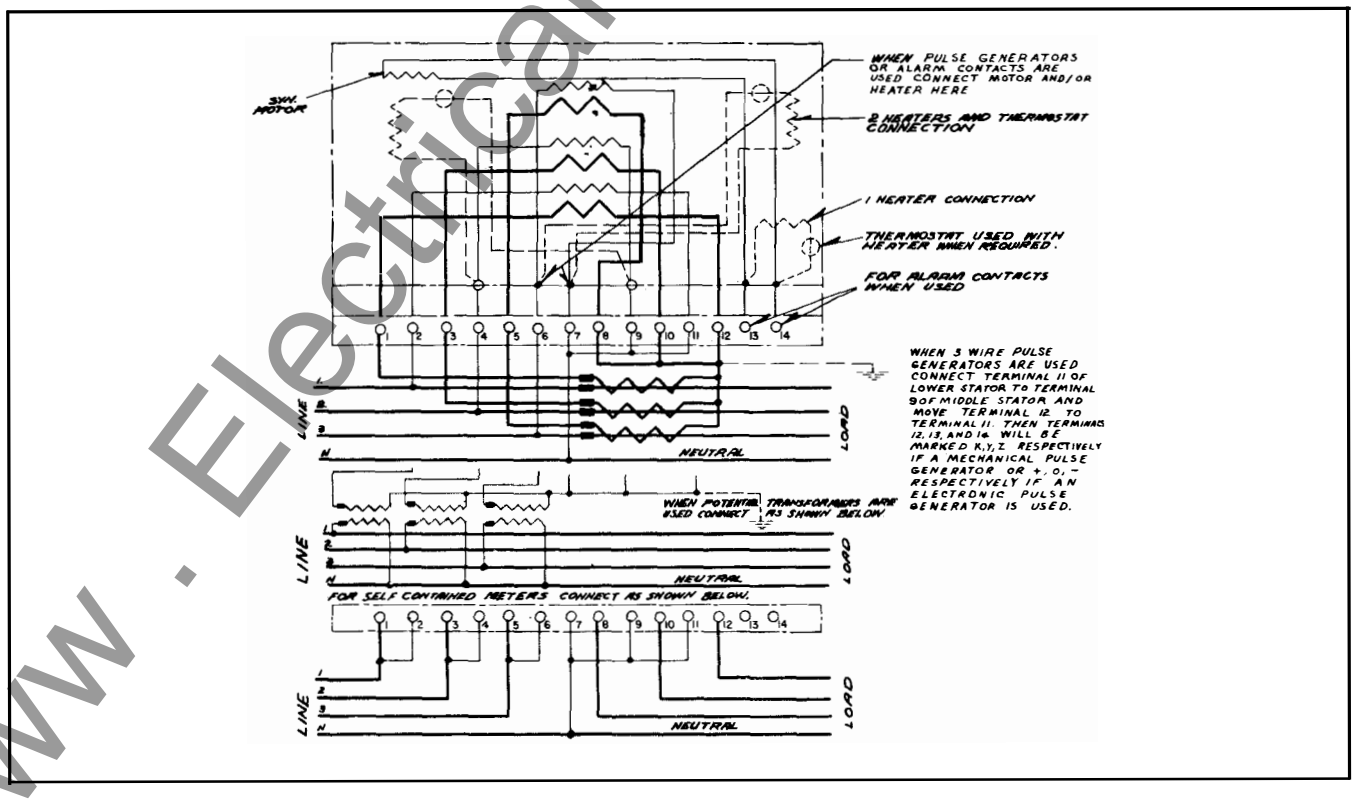


Fig. 22 — Type R-3, 3-Phase, 4-Wire "Y"

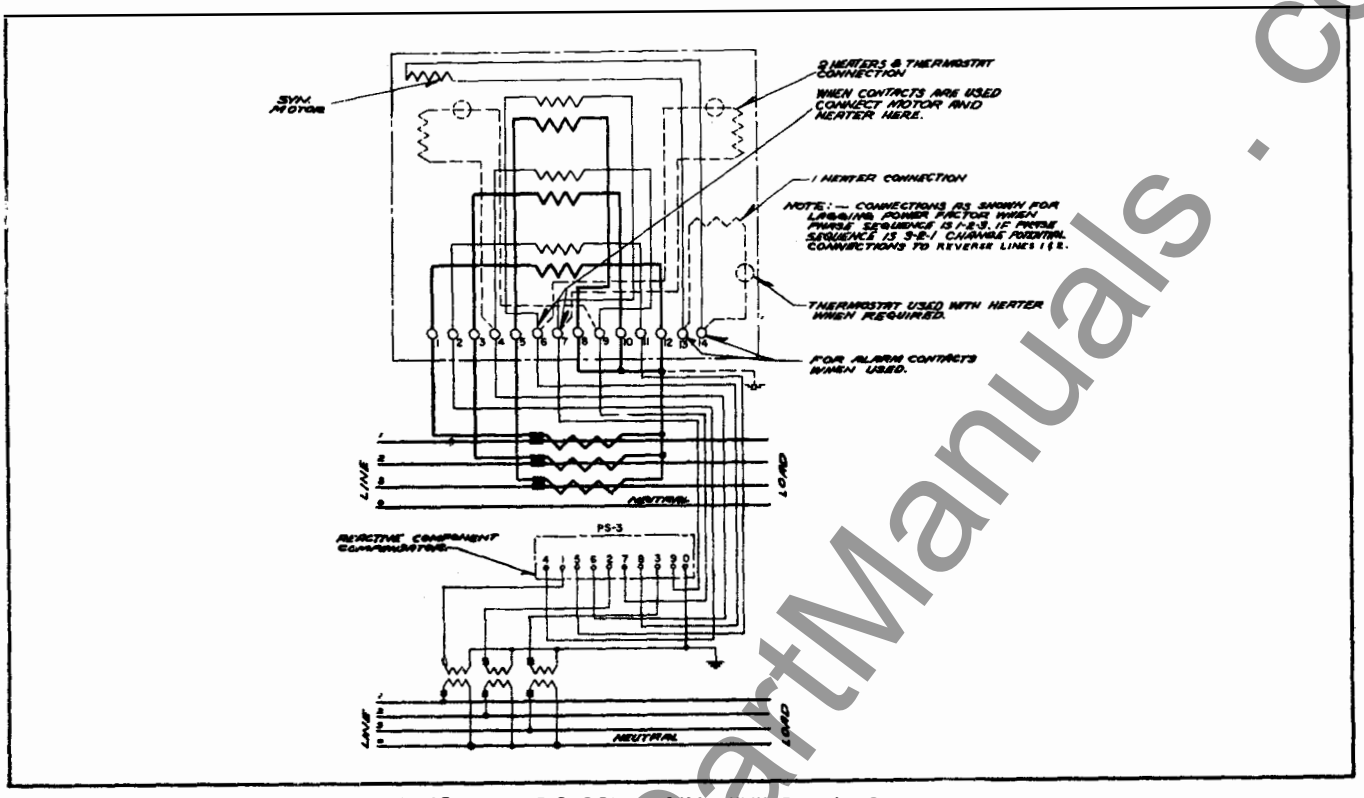


Fig. 23 — Type R-3, 3-Phase, 4-Wire "Y", Reactive Connections Using PS-3 Phase-Shifting Transformers

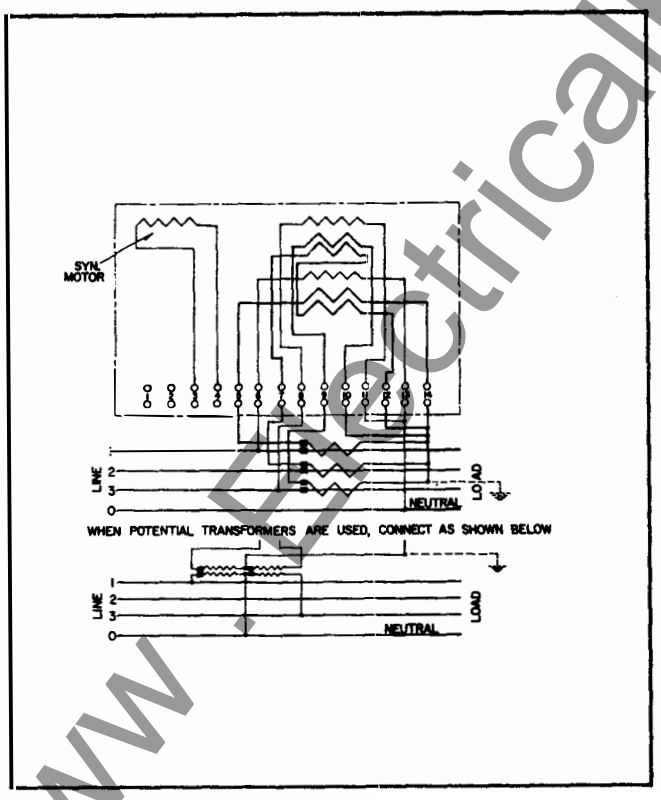


Fig. 24 — Type R-8, 3-Phase, 4-Wire, "Y"

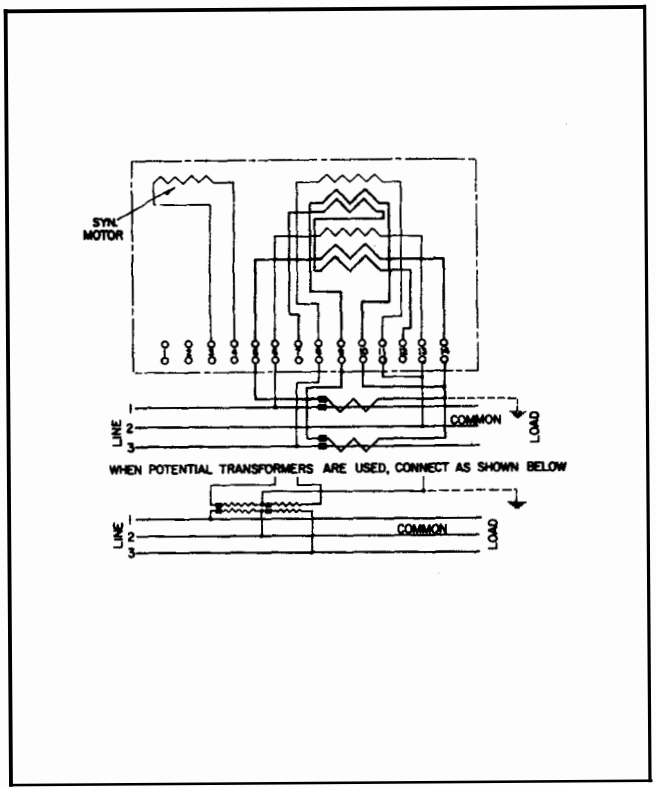


Fig. 25 — Type R-8, 3-Phase, 3-Wire

	ACCESSORIES	TERMINALS USED	MARKING	WIRING CHANGES
1	SOLENOID TRIP	1-2		
2	CLOCK CONTACT	1-2		
3	HEATER	1-2 OR 8-11		
4	MECHANICAL CONTACTS	1-2-3	K-Y-Z	SEE NOTE 'A'
5	ELECTRONIC INITIATOR	1-2-3	7B-6C-8A	SEE NOTE 'A'
6	ALARM CONTACTS-ONE	1-2	(*1)C	
7	ALARM CONTACTS-TWO	1-2-3	(*1)C	SEE NOTE 'A'
8	ALARM CONTACTS-THREE	1-2-3-4	(*1)C	SEE NOTE 'A'
9	SOLENOID TRIP OR CLOCK CONTACTS & HEATER	1-2		SEE NOTE 'A'
		3-4		
10	SOLENOID TRIP OR CLOCK CONTACTS OR HEATER & MECHANICAL CONTACTS	1-3		SEE NOTE 'A'
		2-3-4	K-Y-Z	
11	SOLENOID TRIP & ONE ALARM CONTACTS	1-2		SEE NOTE 'A'
		3-4	(*4)C	
12	SOLENOID TRIP & TWO ALARM CONTACTS	1-4		SEE NOTE 'A'
		2-3-4	(*4)C	

WHEN USING THERMOSTAT WITH HEATER WIRE IN SERIES AS SHOWN — THERMOSTAT — HEATER — CONNECT LEADS TO DESIGNATED TERMINALS

A=CHANGE MOTOR LEADS FROM TERMINALS 3-4 TO 6-13 WHEN REQUIRED

Fig. 26 — Accessory Wiring Table for R-7, -8 Meters

	ACCESSORIES	TERMINALS USED	MARKING	WIRING CHANGES
1	SOLENOID TRIP	23-24		SEE NOTE 'A'
2	CLOCK CONTACTS	23-24		SEE NOTE 'A'
3	HEATERS	23-24		SEE NOTE 'A'
4	MECHANICAL CONTACTS (R.H. SIDE)	26-27-28	K-Y-Z	
5	MECHANICAL CONTACTS (L.H. SIDE)	12-13-14		
6	ELECTRONIC INITIATOR (R.H. SIDE)	26-27-28	7B-6C-8A	
7	ELECTRONIC INITIATOR (L.H. SIDE)	12-13-14		
8	ALARM CONTACTS-ONE (R.H. SIDE)	27-28	(*28)C	
9	ALARM CONTACTS-ONE (L.H. SIDE)	13-14	(*14)C	
10	ALARM CONTACTS-TWO (R.H. SIDE)	26-27-28	(*28)C	
11	ALARM CONTACTS-TWO (L.H. SIDE)	12-13-14	(*14)C	
12	ALARM CONTACTS-THREE (R.H. SIDE)	25-26-27-28	(*28)C	
13	ALARM CONTACTS-THREE (L.H. SIDE)	11-12-13-14	(*14)C	

WHEN USING THERMOSTAT WITH HEATER CONNECT IN SERIES AS SHOWN — THERMOSTAT — HEATER — CONNECT LEADS TO DESIGNATED TERMINALS

A=WHEN NO TERMINALS ARE AVAILABLE CHANGE MOTOR LEADS TO TERMINALS 2 & 7 & USE TERMINALS 9 & 10

Fig. 27 — Accessory Wiring Table for R-22 Meters

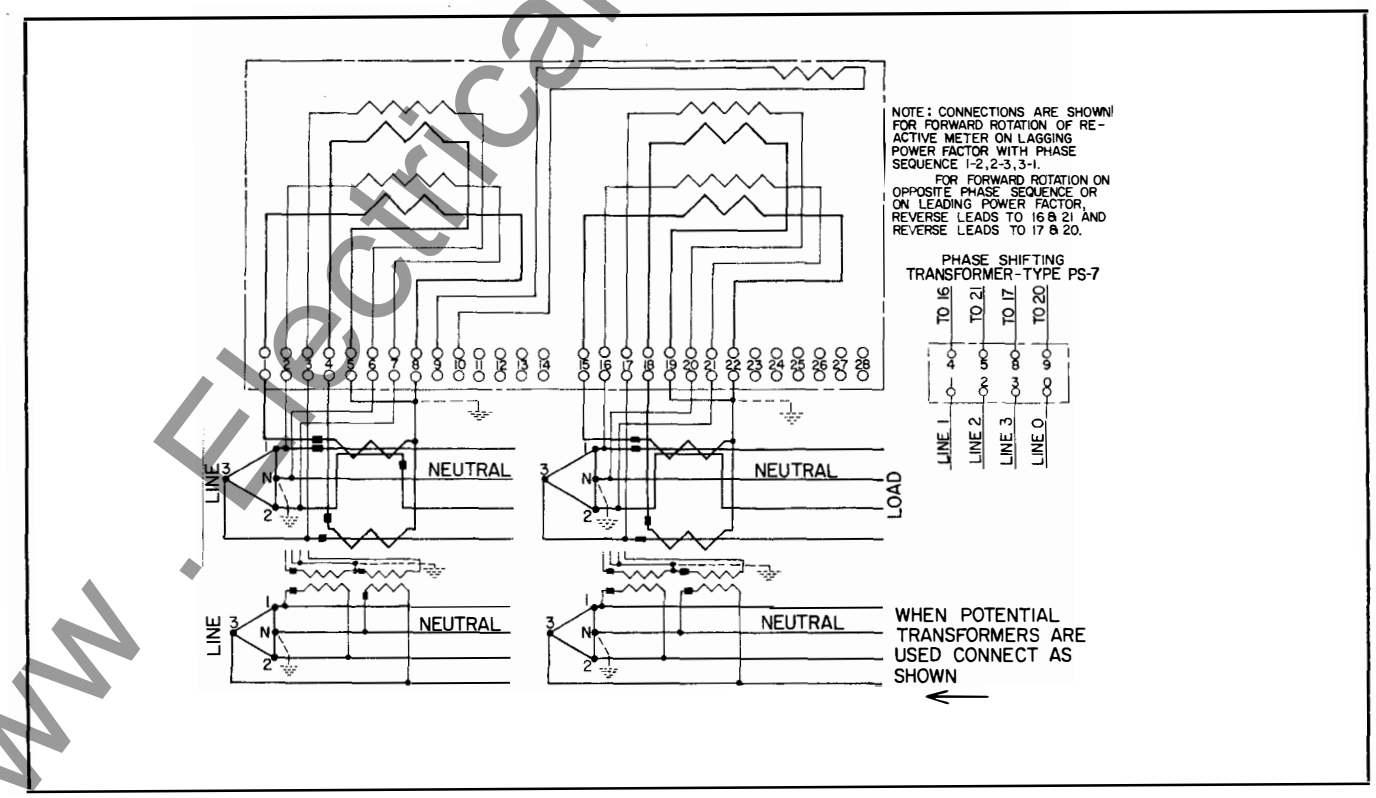


Fig. 28 — Type R-22, Duplex, 3-Phase, 4-Wire Delta

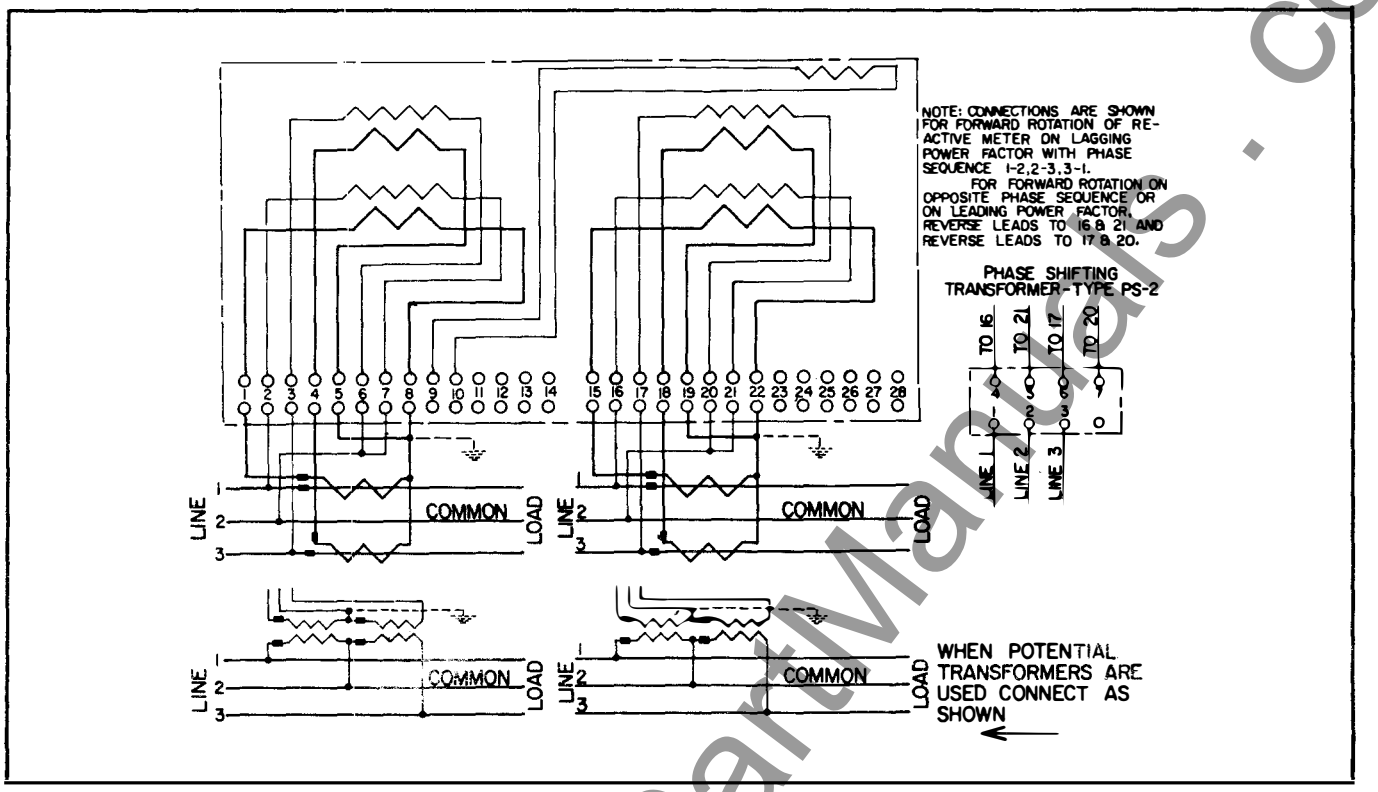


Fig. 29 — Type R-22, Duplex, 3-Phase, 3-Wire

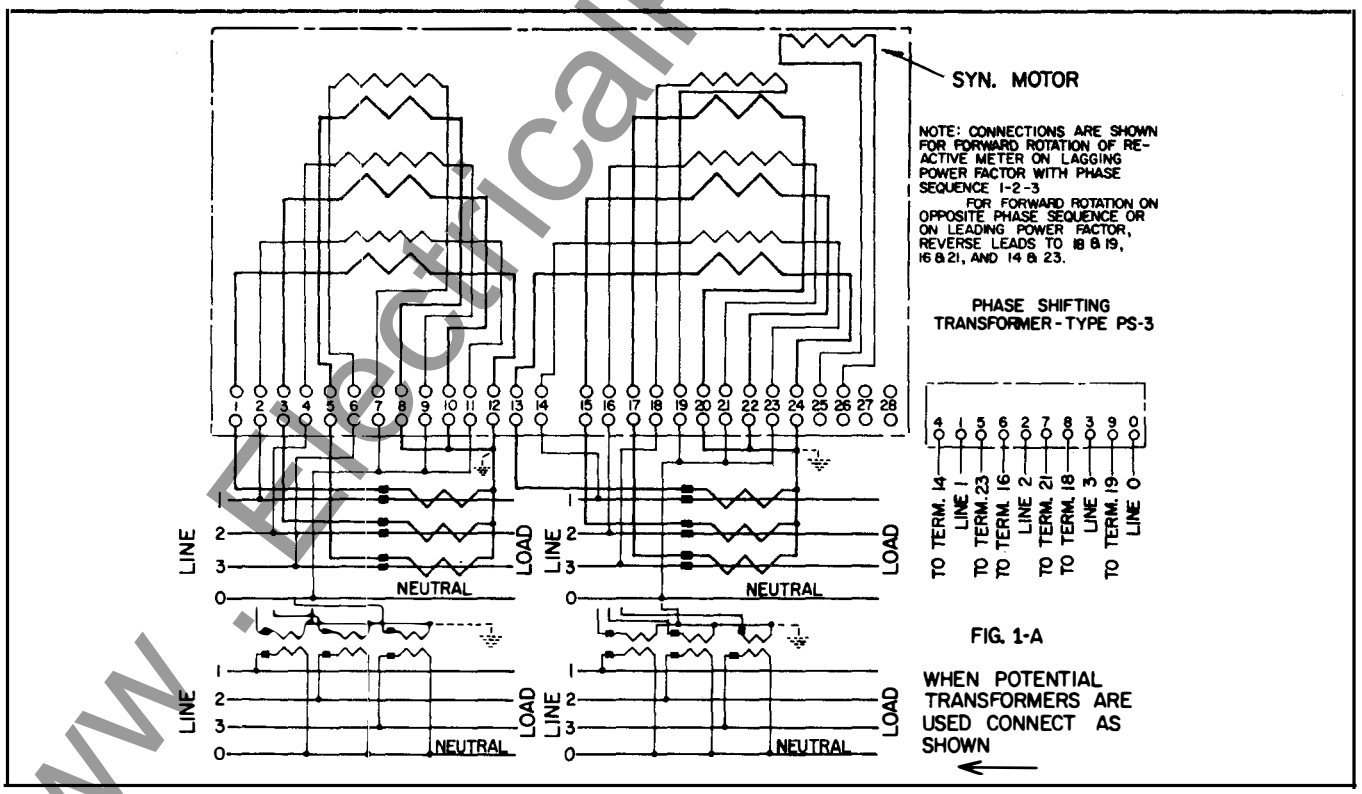
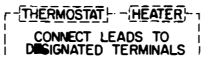


Fig. 30 — Type R-23, Duplex, 3-Phase, 4-Wire "Y"

	ACCESSORIES	TERMINALS USED "A"	MARKING	ALTERNATE WIRING
1	SOLENOID TRIP	27-28		* 25-26
2	CLOCK CONTACTS	27-28		* 25-26
3	HEATERS	27-28		*25-26 OR 4-9
4	MECHANICAL CONTACTS	*26-27-28	K-Y-Z	
5	ELECTRONIC INITIATOR	*26-27-28	7B-6C-8A	
6	ALARM CONTACTS-ONE	27-28	(*28)C	
7	ALARM CONTACTS-TWO	*26-27-28	(*28)C	
8	ALARM CONTACTS-THREE	*25-26-27-28	(*28)C	

WHEN USING THERMOSTAT WITH HEATER CONNECT IN SERIES AS SHOWN



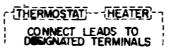
*=WHEN TERMINALS 25-26 ARE NEEDED MOVE MOTOR LEADS TO TERMINALS 6-7.

A=WHEN A COMBINATION OF ACCESSORIES ARE USED THAT REQUIRE THE SAME TERMINALS SEE ALTERNATE WIRING COLUMN.

Fig. 31 — Accessory Wiring Table for R-23 Meters

	ACCESSORIES	TERMINALS USED "A"	MARKING	ALTERNATE WIRING
1	SOLENOID TRIP	25-26		* 11-12
2	CLOCK CONTACTS	25-26		* 11-12
3	HEATERS	25-26		*11-12 OR 18-21
4	MECHANICAL CONTACTS (R.H. SIDE)	26-27-28	K-Y-Z	
5	MECHANICAL CONTACTS (L.H. SIDE)	* 12-13-14		
6	ELECTRONIC INITIATOR (R.H. SIDE)	26-27-28	7B-6C-8A	
7	ELECTRONIC INITIATOR (L.H. SIDE)	* 12-13-14		
8	ALARM CONTACTS-ONE (R.H. SIDE)	27-28	(*28)C	
9	ALARM CONTACTS-ONE (L.H. SIDE)	13-14	(*14)C	
10	ALARM CONTACTS-TWO (R.H. SIDE)	26-27-28	(*28)C	
11	ALARM CONTACTS-TWO (L.H. SIDE)	* 12-13-14	(*14)C	
12	ALARM CONTACTS-THREE (R.H. SIDE)	25-26-27-28	(*28)C	
13	ALARM CONTACTS-THREE (L.H. SIDE)	*11-12-13-14	(*14)C	

WHEN USING THERMOSTAT WITH HEATER CONNECT IN SERIES AS SHOWN



*=WHEN TERMINALS 11-12 ARE NEEDED MOVE MOTOR LEADS TO TERMINALS 4-7.

A=WHEN A COMBINATION OF ACCESSORIES ARE USED THAT REQUIRE THE SAME TERMINALS SEE ALTERNATE WIRING COLUMN

Fig. 32 — Accessory Wiring Table for R-27, -28 Meters

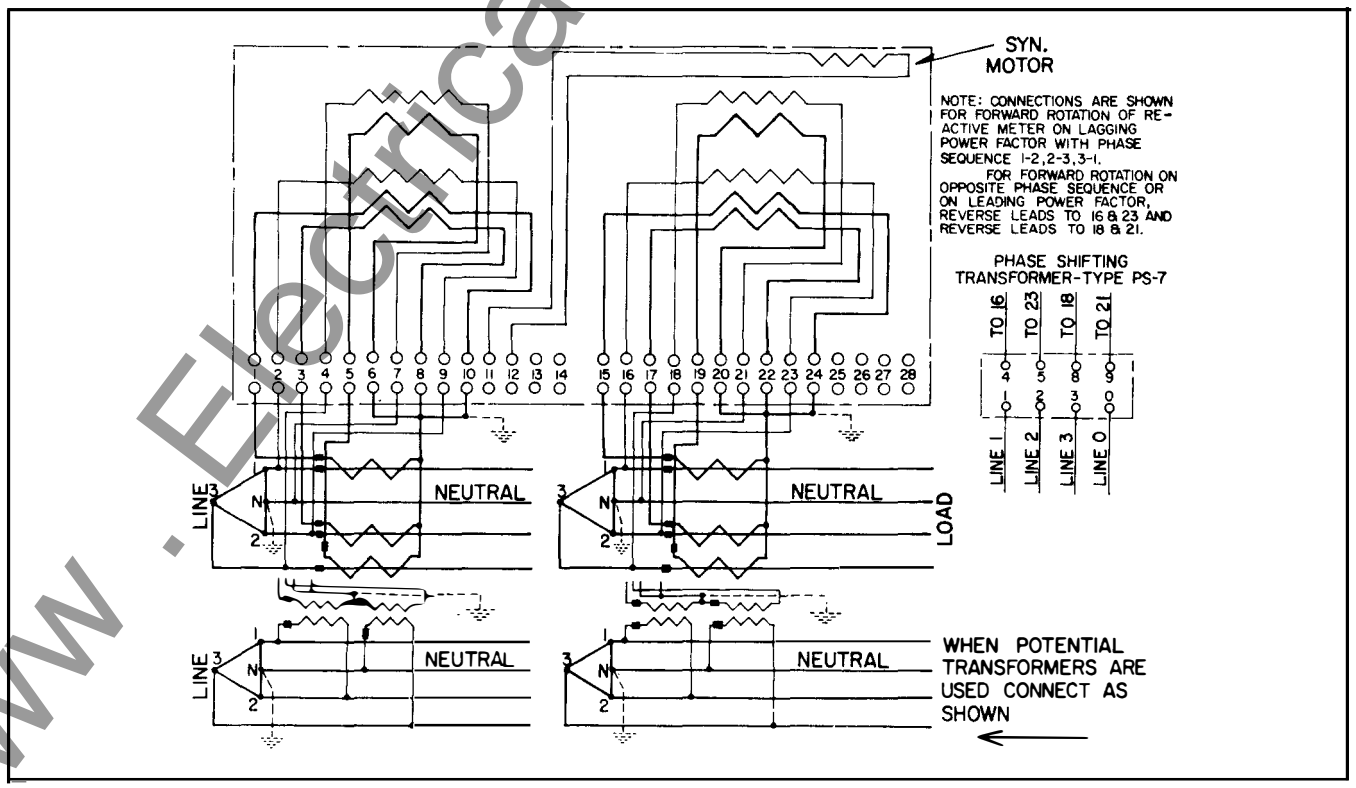


Fig. 33 — Type R-27, Duplex, 3-Phase, 4-Wire Delta

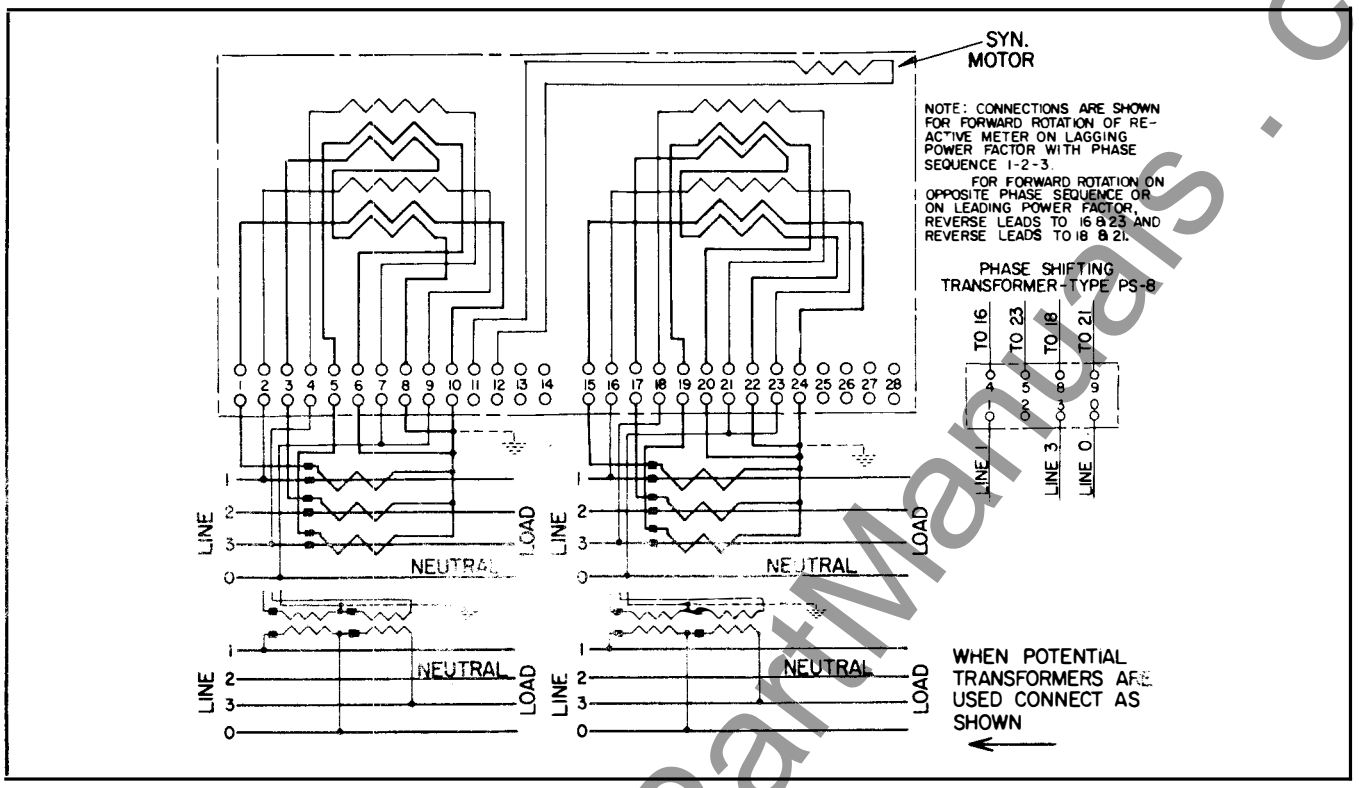


Fig. 34 — Type R-28, Duplex, 3-Phase, 4-Wire "Y"

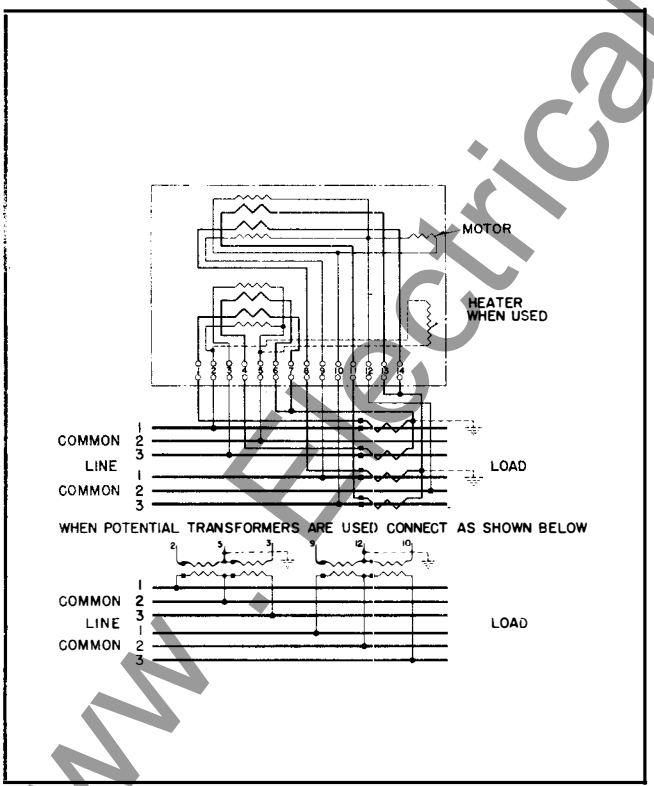


Fig. 35 — Type R-32, Totalizing, Two 3-Phase, 3-Wire Circuits

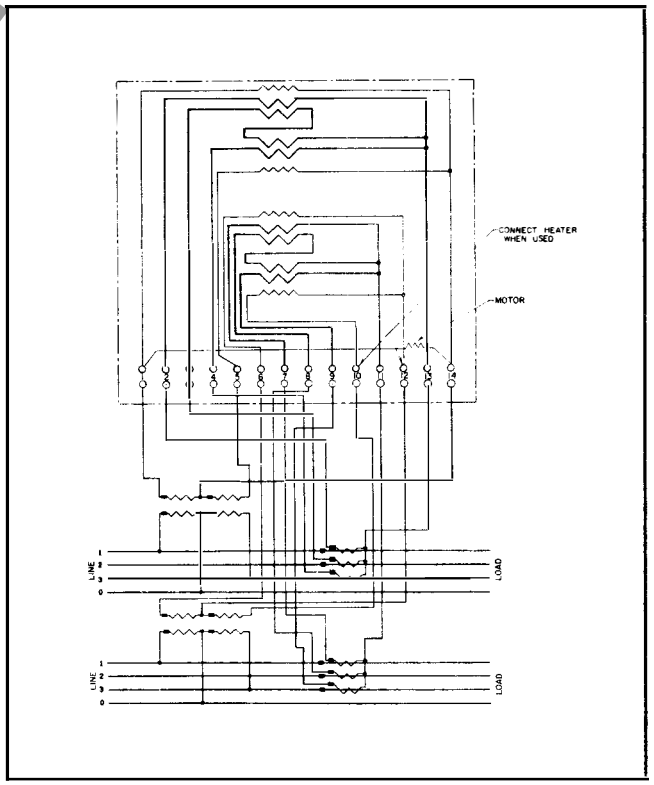


Fig. 36 — Type R-38, Totalizing, Two 3-Phase, 4-Wire "Y" Circuits

NOTES

WESTINGHOUSE ELECTRIC CORPORATION
METER DIVISION • **RALEIGH, N. C.**
Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

RECORDING WATT DEMAND METERS

(Types R-2, R-3, R-4, R-6, R-7, R-8, R-9, R-10, R-22, R-23, R-27, R-28, R-29, R-32, R-42, R-43, R-52)

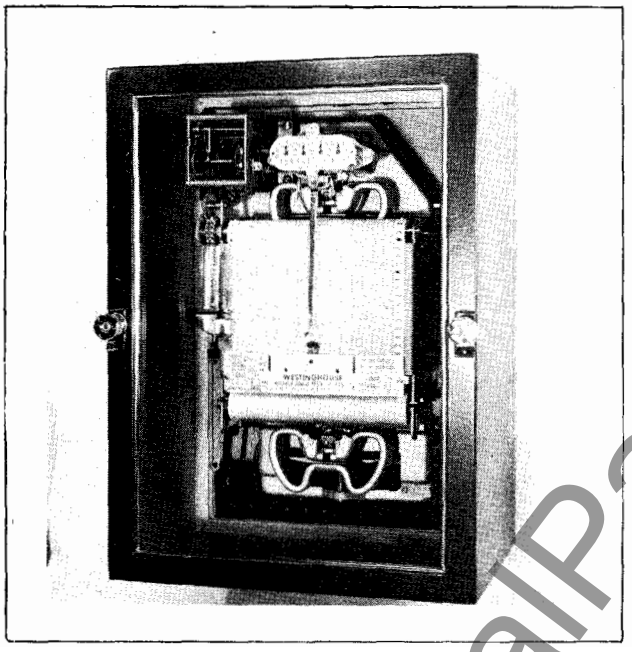


Fig. 1—Type R-3 Recording Demand Meter.

INTRODUCTION

The Type R recording demand meters provide readings of KWH and a chart record of KW demand. The KW demand Record is made on the chart by a pen which is driven from the meter shaft. At the end of the time interval the pen is tripped by a synchronous motor operated timing mechanism and returns by gravity action to zero. As the paper begins to move before the pen is tripped a distinct vertical mark is made at the maximum demand point.

The paper mechanism is arranged so that the preceding demand record for a number of hours is visible. This complete mechanism may be removed as a unit or swung to one side on a hinge when the meter element is being inspected or adjusted.

The meters are furnished with 5, 10, 15, 30 or 60 minute intervals. Current capacities of 2.5 and 5 amperes and voltage rating of 120, 240, 480 and 600 volts are furnished. The meter may be supplied to have chart full scale equal to either 150% or 100% nominal full load. The 2.5 and 5 ampere meters have direct reading charts and registers but a multiplier must be used for all indications on higher rating meters.

The meter is manufactured in the types described in the table on page 2.

The duplex meters, Types R-22, -23, -27, -28 and -29 consist of two identical independent meter elements mounted side by side in one case. The separate demand charts are operated by the same timing mechanism. One element may be connected through external phase shifting transformers to measure KVAR hours and KVAR demand.

The Type R-32 totalizing meter consists of two independent 2-element polyphase meters mounted one above the other on the same shaft. It has one integrating register and makes only a totalized demand record.

The Type R-52 duplex totalizing meter consists of two meters similar to the R-32 mounted in one case.

The Types R-42 and R-43 meters are duplex meters with a differential totalizing register. The KWH of the circuits connected to the right hand meter element is read directly on the right hand register. A differential mechanism totalizes the demand (recorded on the chart) and the KWH (left hand register). The KWH for the left hand meter element may be computed by subtracting the register readings.

APPLICATION CHART

Type	Number of Elements	Circuit Application
R-2	2	3-phase, 3-wire or 2-phase 3 or 4 wire
R-3	3	3-phase, 4-wire wye
R-4	3-Totalizing	1-phase, 2-wire and 3-phase, 3-wire
R-6	3-Totalizing	1-phase, 3-wire and 3-phase, 3-wire
R-7	2	3-phase, 4-wire delta
R-8	2-Split Coil	3-phase, 4-wire wye
R-9	3	3-phase, 4-wire delta
R-10	2	2-phase, 5-wire
R-22	2-Duplex	3-phase, 3-wire or 2-phase, 3 or 4 wire
R-23	2-Duplex	3-phase, 4-wire, wye
R-27	2-Duplex	3-phase, 4-wire delta
R-28	2-Duplex split coil	3-phase, 4-wire wye
R-29	3-Duplex	3-phase, 4-wire delta
R-32	4-Totalizing	3-phase, 3-wire or 2-phase, 3 or 4 wire.
R-42	2-Duplex differential totalizing	3-phase, 3-wire or 2-phase 3 or 4 wire
R-43	3-Duplex differential totalizing	3-phase, 4-wire wye
R-52	4-Duplex totalizing	3-phase, 3-wire or 2-phase 3 or 4 wire.

These meters may be supplied with a register which gives the KW demand of the circuits connected to the right hand elements as well as the total demand. In this case the right hand elements drive a "stop" and at the end of the time interval the pen is disengaged from the totalizing KW demand gearing and falls back until arrested by this "stop". It pauses momentarily and then is reset to zero. As the paper chart is moving during this resetting period, distinct vertical marks are made at both the total KW demand point and at the right hand element demand point. The demand for the left hand elements may then be computed by subtraction.

INSTALLATION AND OPERATION

These meters are designed to be either front or rear connected. As received, it is adapted for front connection. However, brass studs are included, which when screwed into the terminals on the back of the meter, convert it into a rear connected meter suitable for mounting on a switchboard or any panel where the wiring is from the rear. Outline and drilling plans are shown in Figs. 7 to 19. Mount the meter taking care to have it level. Connect according to the appropriate diagram of Fig. 20 to 40.

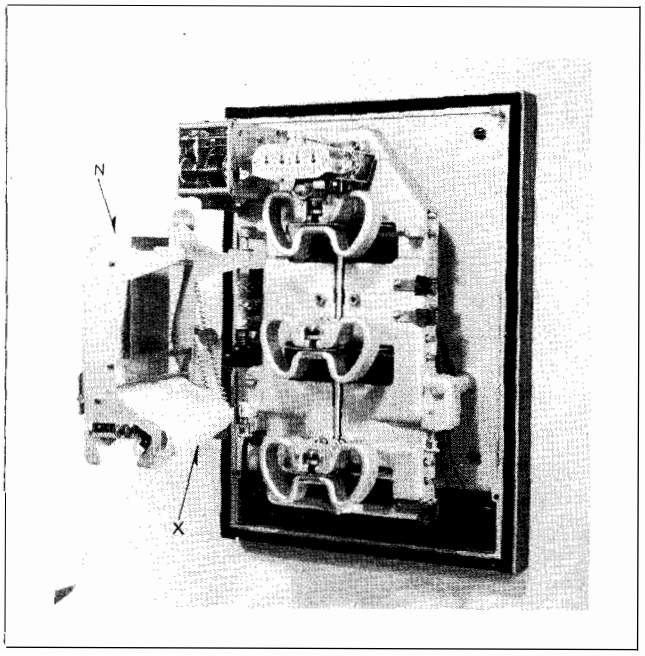


Fig. 2—Type R-3 Meter with Chart Mechanism Swung to One Side.

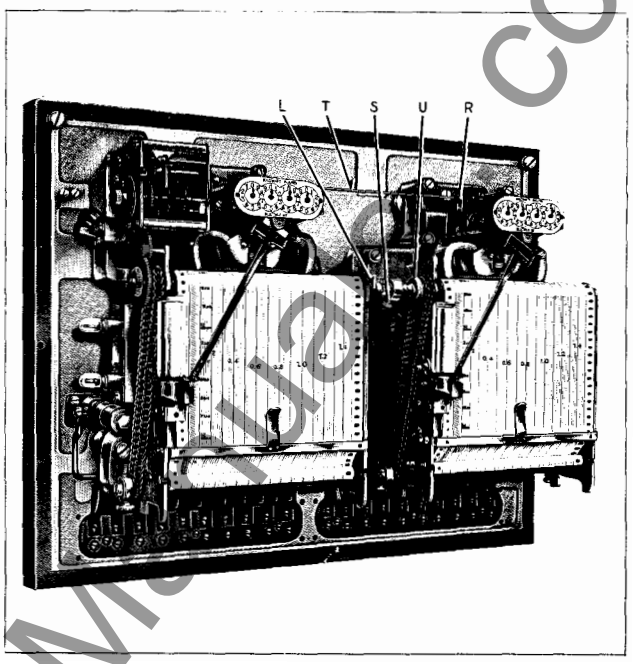


Fig. 3—Type R-22 Duplex Recording Demand Meter.

Remove the cord and paper used to secure the pen, inkwell and discs.

Check the clock operation as follows: Spring "C" on shaft "1" (Fig. 6) should have one and one-half turns tension just after tripping. If this condition has been disturbed, restore it as follows before putting the meter in operation. Pull the latch arm "G" forward and allow the spring to run down. Turn the knob "N" slowly until the pin on the gear "H" is in a neutral position just below the trip latch. Then hold gear "H" and turn knob "N" 1 1/2 turns. Release gear "H" so that the pin is held by the latch arm. Reset pointer on zero and turn the knob "N" one revolution to check operation.

To facilitate adjustment of the paper mechanism and the insertion of new charts the paper mechanism can be swung to one side. (Fig. 2). Loosen the two thumb screws at the bottom of the movement frame until the large gear on the left side of the paper roll drum clears the pinion in the reset mechanism and until the post on the upper right-hand side of the paper mechanism clears the movement frame.

Before inserting a new roll of paper cut the end as per Fig. 4 and swing the mechanism to one side as above. Slide the roll endwise over the spindle "X", Fig. 2 and bring the end under the guide and over the roll "N". Slide the end of the paper into the slot in spool "X" and take several turns on this spool. See that the edges of the paper do not bind under the guides nor rub against the sides of the frame holding the spool and that the pins of the roll "N" fit into perforations along the edge of the paper without tearing. The paper must lie tight against the roll.

In duplex meters the connecting device between the two paper mechanisms may be disengaged to allow individual adjustment. To accomplish this loosen the thumb screw "S", Fig. 3 and slide the link out of the slot in the left hand driving drum shaft.

Remove small ink bottle and well. Fill bottle with ink supplied. Other inks may evaporate too quickly and clog the pen.

Fill the pen and start the ink flowing through the tube by moving the fine wire back and forth through it until ink appears on the wire. The wire must be removed during normal operations. Flow is best started in a "V"

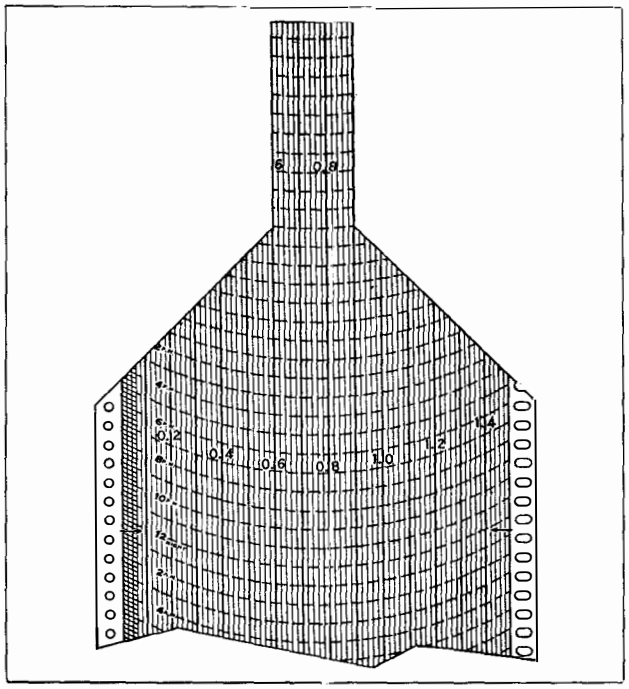


Fig. 4—Suggested Method for Trimming Leading End of Paper Chart when Starting.

type pen by inserting a razor blade in the "V" and drawing it back and forth until flow is started.

Check zero as follows: Trip the clock and see that the worm wheel on shaft "4" (Fig. 5) is completely demeshed from the worm on shaft "2". If not, move collar "M" out on rod "F" and lock in place. If the pen does not return to zero but can be moved there by hand move weight "B" futher out on the cross arm. This weight should be set to make the pen return to zero even if the deflection was small. on the other hand, it should not be set in such a way that the pen returns with excessive speed from large deflections.

Turn the worm BD so that the pen rests on zero. Check this setting by running the meter enough revolutions to bring the pen up to the first fine line on the chart. This is equal to 1/5 of the revolutions as determined in "Checking Correct Demand Registration" Section on page 5. Loosen the thumb nut "U" and move the chart slightly to draw a line. If the pen is not exactly on chart line turn worm BD until this is accomplished. Recheck by tripping the pen and running the required number of revolutions again.

It may be observed that there is a slight variation in the zero setting on successive resets. The amount of the variations depends on the capacity and interval of the meter and is unavoidable since on re-engagement, the worm wheel does not mesh in exactly the same way with the worm on each reset. By making several checks the best compromise can be established.

Check that the pen makes distinct vertical marks at the end of the pen stroke. Hold the trip rod in and move the pen to a point near full scale. Then trip the clock and observe the action. If unsatisfactory, turn the worm "P" on the clock mechanism tripping wheel "K" until the arm has just passed over the tripping stud when the wheel is at rest. Recheck the operation.

Calibration Adjustments - Two and Three Element Meters.

Full Load - Moving iron discs above disc gap to the left increases meter speed and vice versa.

Light Load - Moving the screw to the left of the frame and below the disc in the clockwise direction increases meter speed and vice-versa. (F in label indicates fast).

Phase Balance - Turning the screw at the left of the frame and above the disc, moves the balance plate in or out of the electromagnet. Moving the plate out decreases torque.

Power Factor - Increasing the resistance of the loop mounted beside each electromagnet increases speed and vice versa. The loop is closed with a soldered joint and resistance is increased by closing the loop closer to the end of the wire.

Calibration Adjustments - Four Element Meters

On Four element meters the adjustments are the same as two and three element meters except for the following:

Full Load - The keeper is located below the disc gap and must be turned to the right to increase speed.

Light Load - The adjustment screws are similar to those of the two and three element meters but are located alternately to the right and to the left of the frame. Those on the right are turned counterclockwise and those on the left are turned clockwise to increase speed.

Phase Balance - The phase balance adjusters are accessible from the front of the meters. Turning them counterclockwise increases speed.

Checking Correct Demand Registration of All Scale Points.

The demand indication may be checked by noting the advancement of the pen for a definite number of disc revolutions. By means of the following formula the number of disc revolutions between main chart division lines (.1, .2, etc.) can be computed.

$$\text{KW Disc Revs Between Main Chart Lines} = \frac{25 \times (\text{Interval in minutes} - 15, 30, \text{etc.})}{\text{Number of Main Division Lines to Full Load.}}$$

For example the R-2, 120 volt, 5 ampere, 15 minute interval, full scale equal to 150% of full load meter, has a chart with full scale equal to 1.5 Kw and 15 main division lines (at .1, .2, .3, etc. to 1.5). The number of main division lines to full load (1.0 Kw) is 10.

Using the above formula:

$$\text{Kw Disc Revs Between Main Chart Lines} = \frac{25 \times 15}{10} = 37.5$$

37.5 would also be the correct number for a similar meter in which full scale equals full load since there would still be 10 main division lines to full load. For easy reference full load is always marked on the nameplate. This formula is applicable to all meters.

Placing Chart in Synchronism

To set the chart in synchronism with actual time, turn the pointer knob "N" until the escapement is released, allowing the chart to advance and the pen to trip. Then stop the discs of the meter and the motor. Loosen thumb nut "U" on the chart mechanism and rotate the chart until the pen is at the point where the present interval should have started and tighten the thumb nut. Set the pointer on the time dial to the number of minutes which have elapsed since the time indicated on the chart. Then allow the timing motor and meter discs to operate.

An example may make this clearer. Suppose the meter has a 15 minute interval and that it is 10:20 a.m. It is desired to start the next time interval at 10:30 a.m. First, the pen is tripped as described. Then the timing motor and meter discs are stopped. Next, the chart is advanced as described, so that the pen rests on the 10:15 a.m.point. The pointer is then set to indicate 6 minutes if the time is 10:21 (10:21 - 10:15): 7 minutes if it is 10:22 ....etc. and the meter discs and motor allowed to start.

MAINTENANCE

General

All recording demand meters should be given a periodic cleaning and lubrication. The frequency of the service varies according to the conditions to which the device is subjected.

It is not possible to specify in a general instruction leaflet any rigid rules to govern time intervals between servicing or inspections. The conditions in applications are so variable that dependence must be placed upon the experience and judgement of the local operators. Some operating companies consider that the registers should be serviced once every two and a half or three years or more frequently if installed where subject to high temperatures or unusual environments.

The register and the clock mechanism should be removed from the meter and the motor disassembled from the clock assembly. The register gearing should be cleaned with a good grade of clock cleaning fluid. Rinse and dry the register thoroughly after cleaning.

The meter elements are serviced in the usual manner for watthour meters.

Lubrication

The motor and clock gearing are the only parts of the meter which need lubrication.

A. Lubrication - Gear Case Motors

These motors operate a one rpm output shaft through an oil immersed gear train. Under normal operating conditions the motor should be oiled every 2-1/2 years and completely dismantled and cleaned every 5 years. For motors operating at high temperatures, these times should be 1 year and 3 years respectively. Oil is added through the breather hole in the bottom of the case. After adding oil, turn motor right side up and remove any oil that may adhere to the inside of the breather hole by cleaning it with a good grade of pipe cleaner. Cut cleaner in short pieces and remove fuzz by hand-rubbing. Cleaners should be changed often to do a satisfactory job.

When dismantling motor, the following procedure should be followed:

1. Remove cover from motor assembly. Use sharp gas flame or a soldering iron to soften yellow lacquer on screw heads and the shellac on the threads. Remove screws while hot.

2. Remove motor gear train.

3. Clean shellac from frame. Do not get cleaning fluid in motor oil.

4. Clean rotor shaft assembly and add trace of oil.

5. Dismantle motor gear train.

6. Clean shaft assemblies and plates with a good clock cleaning fluid.

7. Apply thin coat of shellac P.D. 1154-5 around the matching surfaces of both motor frame and cover. Be sure to apply the shellac on all surfaces around the holes. Allow shellac to dry a few minutes before assembly.

8. Put cover on frame and tighten all screws.

9. Seal screw heads and the joint between cover and case with lacquer P.D. #7241 using artist brush.

10. After allowing shellac to dry one day add 1-1/3 C.C. of oil S#935736 through breather hole. A combination oil gauge and filler S#1340461 is recommended for adding oil to the gear case.

11. After adding oil, remove any excess that may adhere to inside of breather hole by cleaning same with a pipe cleaner soaked in thinner. Then paint the inside of the hole with solution P.D. 9289-1. This will prevent oil from creeping over the surface out of the hole.

12. Re-date motor whenever it is reoiled.

B. Lubrication - Open Gearing Motors

These motors should be lubricated about every 2 1/2 years under normal conditions and every year if they have been subjected to high temperatures. Remove the cap and saturate the wool batting with oil S#1275575. The gasket in the cap should be replaced with a new one S#1336744. Replace cap and screw on tightly.

The shaft next to the motor has the same kind of bearing as the motor and lubrication should follow that of the above paragraph.

C. Clock Gearing Lubrication

Add a trace of oil S#935736 to the shaft bearings in the clock.

Changing Interval of Meter

Both the clock and the register must be changed in changing the interval of a meter. Five minute clocks may be converted to 10

minute clocks by removal of two studs (180 degrees apart) from the tripping wheel. The paper advances every 5 minutes for both 5 and 10 minute interval meters. Similarly 15 minute clocks may be converted to 30 minute clocks by removal of two studs (180 degrees apart) and to 60 minute clocks by removal of three studs. The paper advances every 15 minutes for 15, 30- and 60 minute interval meters. A change in register gearing is involved in all interval changes.

PRINCIPLE OF OPERATION

General

A. Register Mechanism

The meter measures demand by the block interval principle. Details of the register operation may be understood from Fig. 5. The disc shaft drives the watthour register through shaft assemblies 1,3, 7 and 8. At the same time the pen shaft (6) is driven through shaft assemblies 1,2,4,5. At the end of the time interval the tripping rod "F" pushed by the trip arm on the clock mechanism disengages the worm wheel on shaft 4 from the worm on shaft 2.

The weight "N" and the adjustable weights "B" counterbalance the pen and pen arm. When falling to zero the worm on shaft 4 moves the sector "H" against the stop pin "I" on worm wheel "S" thus determining the zero position of the pen. Spring "O" remeshes the pen gearing.

Jamming of the meter due to overloads is prevented by the arm "P" on the pen shaft (6) hitting the arm "R" and demeshing the gearing whenever the pen goes above full scale. The kilowatthours are still registered as this gearing is not disturbed.

Adjustment screw "K" regulates the mesh between the worm on the "2" shaft and the worm wheel "S". Screw "BC" adjusts the overload trip-out point.

B. Clock Mechanism

The clock mechanism is shown in Fig. 6. The motor "B" drives shaft assemblies 9,8,7, and shaft 1 through ratchet "B" on gear "A". Spring "C" is wound from shaft 1 and shaft 2 is also driven. At the end of the time interval the cam "E" trips the latch arm "G" and it allows shaft 1A (held in tension by spring "C") to revolve. This drives through 4A to 4 which has the paper mechanism pinion and the tripping wheel "K". Its speed is controlled by the governor "L" driven from the 1A shaft through 5 and 3. Manual tripping is possible through turning the knob "N" one revolution which turns the #1 shaft and the above sequence is followed. The set screw "O" controls the position of the latch arm "G" with respect to the pin on gear "H" (shaft 1-A).

The clock with the open gearing motor is similar to that in Fig. 6 except for the motor drive.

Details of Operation

Types R-22,R-23,R-27,R-28,R-29 Duplex Meters

The principles of operation of these meters is the same as that outlined above. Certain modifications are made as follows:

The tripping of both registers simultaneously is accomplished by the trip rod "T" (Fig. 3) held by a support on each register. The trip arms "R" are fastened to "T" by set screws. They should be adjusted so as to allow the same time of disengagement for both registers.

The paper mechanism of the right hand meter is operated by means of the connecting device between the upper paper rolls. It may be disconnected by loosening the thumb screw "S" and sliding the link out of the left hand drum shaft.

Types R-42, R-43 Duplex Differential Totalizing Meters.

These meters have one chart mechanism and a differential totalizing register. It provides

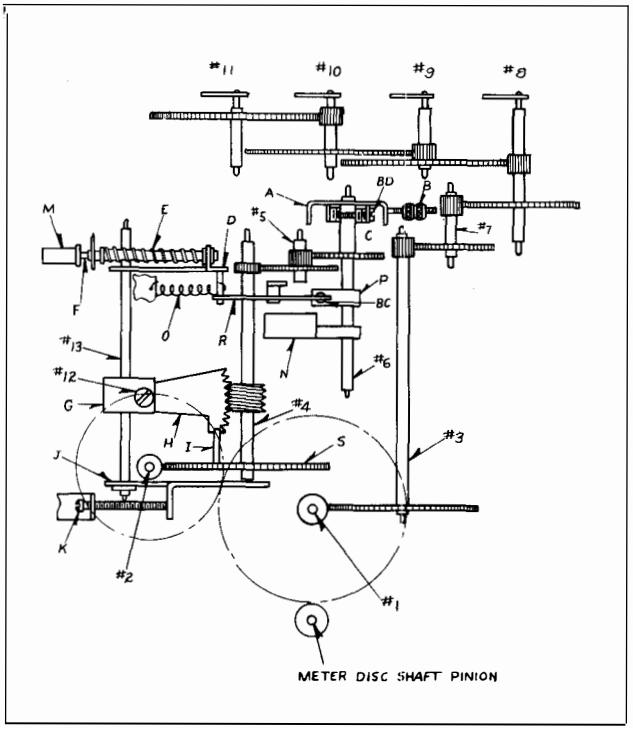


Fig. 5—Schematic Diagram of Register Mechanism.

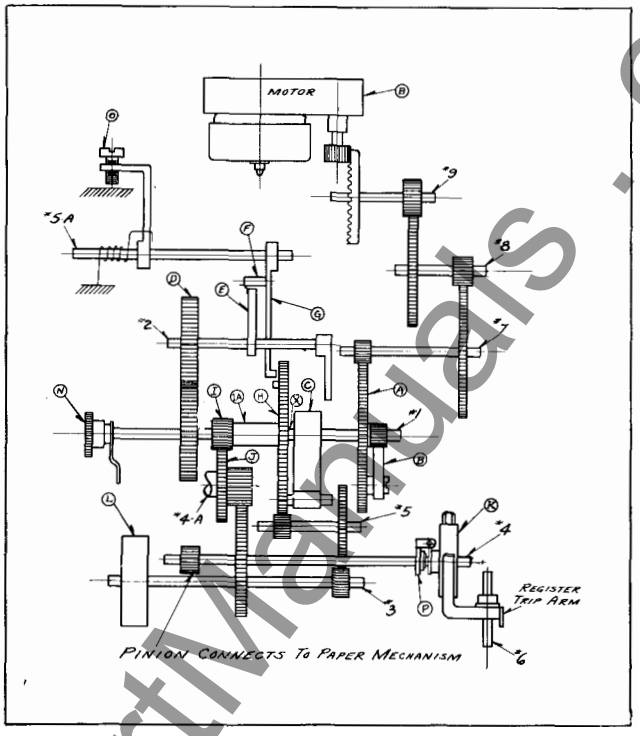


Fig. 6—Schematic Diagram of Clock Mechanism.

a totalized KW demand record, the KWH (right hand register) directly driven off the circuit connected to the right hand meter element and the total KWH (left hand register) of both circuits. The meter may be provided to give a record of the demand of the circuits connected to the right hand elements. The clock mechanism has a synchronous motor to determine the time interval and a separate spring operated mechanism to trip the pen and advance the paper. The synchronous motor requires the same maintenance as outlined on page 6.

The differential totalizing mechanism in the center of the register operates as follows. Each disc shaft drives a horizontal shaft which releases an escapement pawl. Each escapement controls the motion of one side gear of the differential. The center gear of the differential is held in tension by a torque motor and it turns as the side gears are released. Its motion is transmitted through a set of gears to the pen and to the left hand register. The load of the differential gearing is thus removed from the meter elements and falls on the torque motor.

Type R-32 Totalizing Meter and Type R-52 Duplex Totalizing Meter.

These meters are of the four element type totalizing two polyphase circuits. The R-52 is a duplex meter. The clock mechanism has a synchronous motor to determine the time interval and a separate spring operated mechanism to trip the pen and advance the paper. This synchronous motor requires the same maintenance as outlined on page 6.

The type R-52 is different from other duplex meters in that the current circuits of the two meters are internally connected in series. This makes it readily adaptable by the use of phase shifting transformers to the measurement of KVARH and KVAH along with KVAR and KW demand. It also may be used with ratchets to measure the "In" and "Out" power of a circuit or with all elements connected through phase shifting transformers to measure KVARH and KVAR demand under both leading and lagging power factor conditions.

ACCESSORIES

Alarm Contacts

Alarm contacts are provided for operating a

signaling device whenever a predetermined value of demand is reached. One, two or three contacts may be provided. These will operate up to three alarm devices at different scale points. The alarm devices do not affect the meter operation and it will continue up scale after the contacts have been closed. The assembly is mounted on the right hand side of the register and the sector meshes with the gear on the pen shaft. The alarm point may be set anywhere desired by turning the adjusting screws on the cam shaft. Reconnect the motor to the meter potential terminals if necessary in order to procure adequate terminals.

Heaters

Heaters are provided for operation under low termperature conditions. Bases are drilled for the mounting of these units and they are wired as shown in the connection diagrams.

Contact Clock and Solenoid Tripping for Simultaneous Demand

When it is desirable to obtain simultaneous tripping of two demand meters, one meter is equipped with a contact making clock and the other is equipped with a clock tripped by a solenoid. The contact making clock is a standard clock except that it is equipped with a contact that is closed at the time of tripping. The solenoid tripping clock has a motor to wind up the spring for tripping the pen and advancing the paper but it is tripped by the solenoid.

The solenoid is in series with the contact on the other clock and with a source of voltage. If the meter circuit of the clock with contacts is interrupted thereby stopping the tripping of the solenoid operated clock, a slip clutch in the spring drive of the solenoid operated clock prevents its spring from being overstressed by the motor.

Phase Shifting Transformers

Phase shifting transformers are used to convert the meters to reactive volt-ampere demand meters. They consist of small auto transformers which are tapped so as to shift the voltage applied to the meter potential coils by 90 degrees.

When it is desired to measure reactive power on two-phase circuits no phase shifting transformers are necessary. It is only necessary to interchange the voltage connections. Internal and external wiring of the phase shifting transformers are shown in detail in the various diagrams, Fig. 20 to Fig. 40.

Ratchets

Ratchets may be used to prevent reverse rotation on reversal of power. They may also be used to prevent rotation on leading power factor of meters wired for reactive power measurement. The new #1 shaft is put in the register and the pawl assembly fastened to the register frame at its right.

REPLACEMENT PARTS AND REPAIRS

When facilities are limited or where only a small number of meters are used, it is recommended that the meters be returned to the factory for repairs. When returning a meter for repairs, obtain a Returned Material Tag from the District Office so as to avoid delay in identifying the shipment.

When ordering renewal parts, give the entire nameplate reading. Always give the name of the part wanted. Check Renewal Parts Data 42-413 for aid in identifying parts.

OUTLINE DIMENSIONS

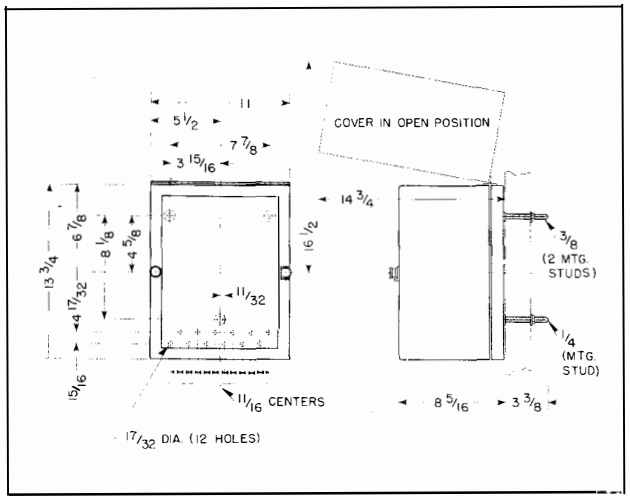


Fig. 7—Types R-2, -7, -8, -10 Meters with Hinge and Stud Covers.

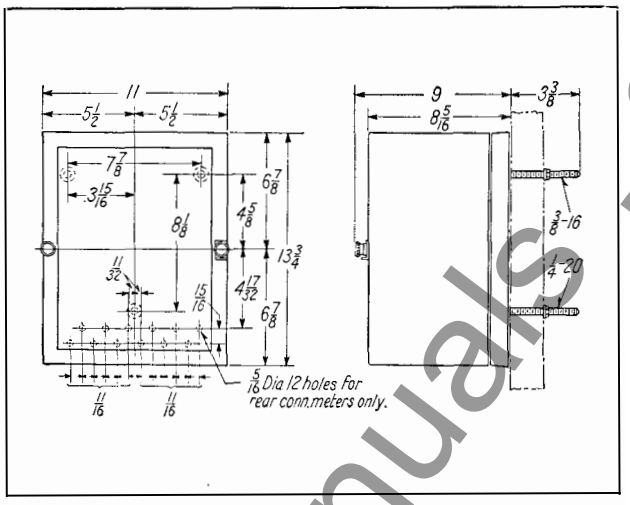


Fig. 8—Types R-2, -7, -8, -10 Meters with Stud Covers.

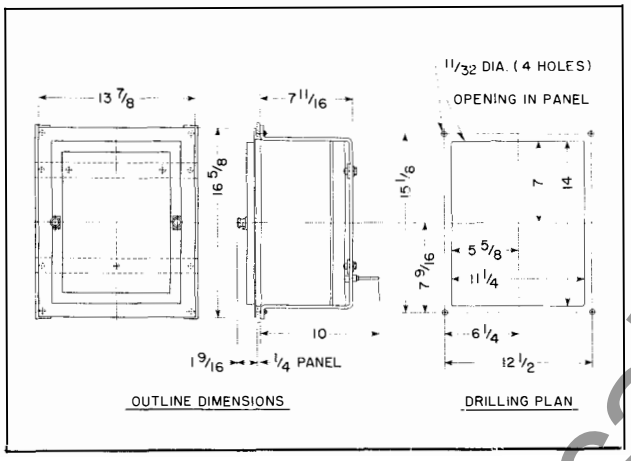


Fig. 9—Types R-2, -7, -8, -10 Meters, Flush Type.

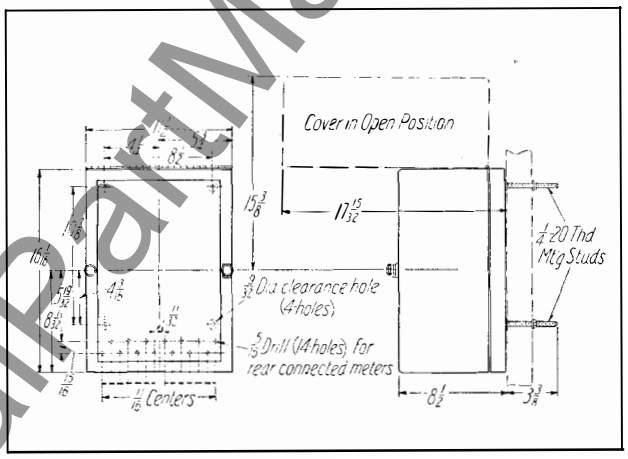


Fig. 10—Types R-3, -4, -6, -9, -32 Meters with Hinge and Stud Covers.

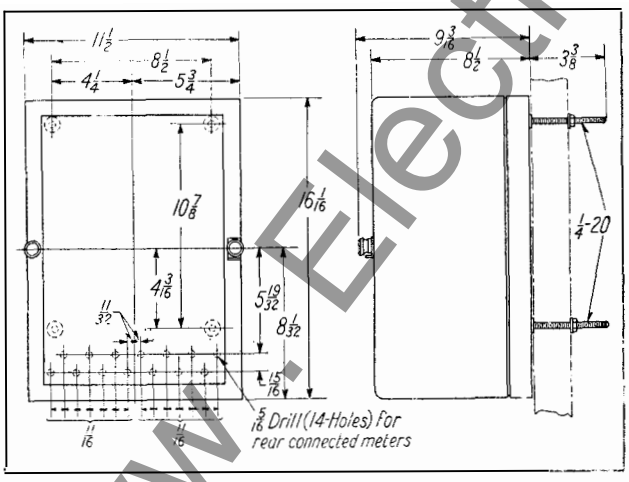


Fig. 11—Types R-3, -4, -6, -9, -32 Meters with Stud Covers.

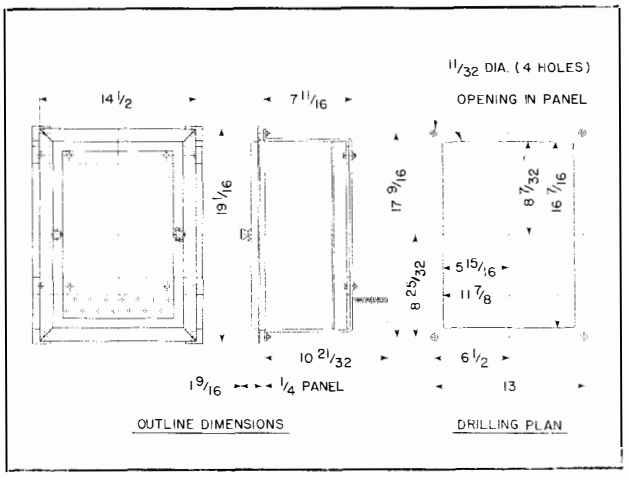


Fig. 12—Types R-3, -4, -6, -9, -32 Meters, Flush Type.

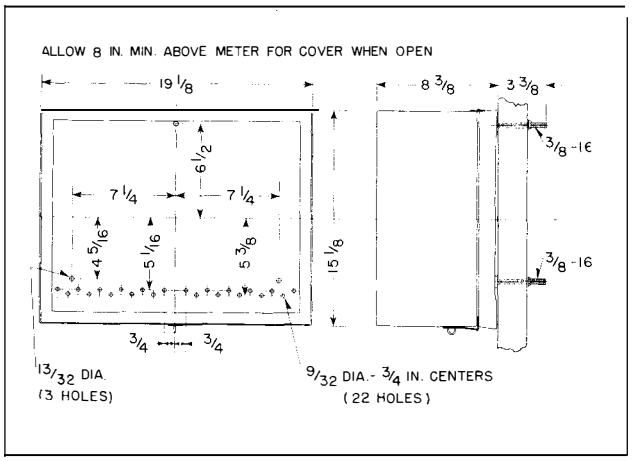


Fig. 13—Types R-22, -27, -28, -42 Meters with Hinge Covers.

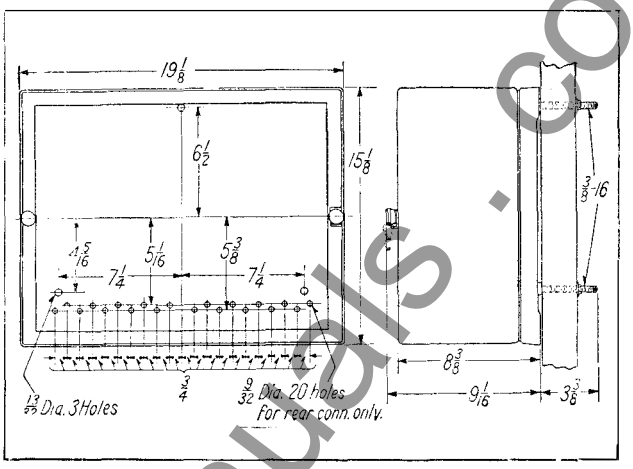


Fig. 14—Types R-22, -27, -28, -42 Meters with Stud Covers.

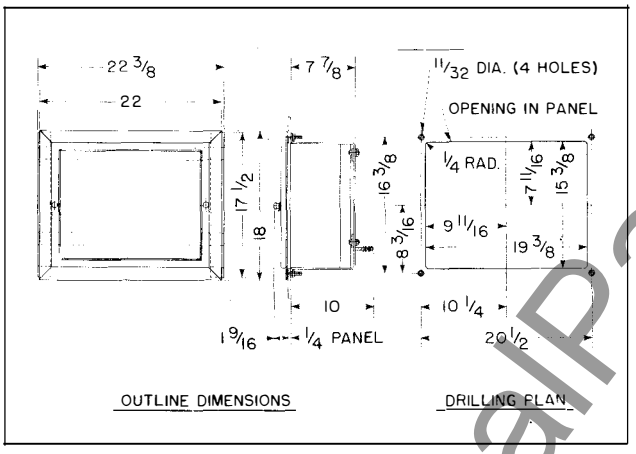


Fig. 15—Types R-22, -27, -28, -42 Meters, Flush Type.

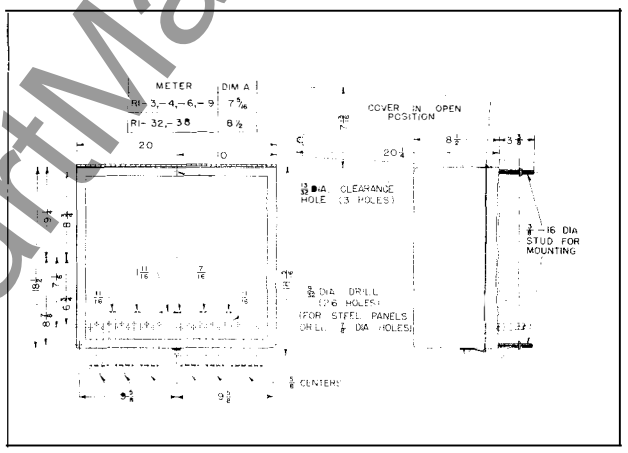


Fig. 16—Types R-23, -29, -43, -52 Meters with Hinge Covers.

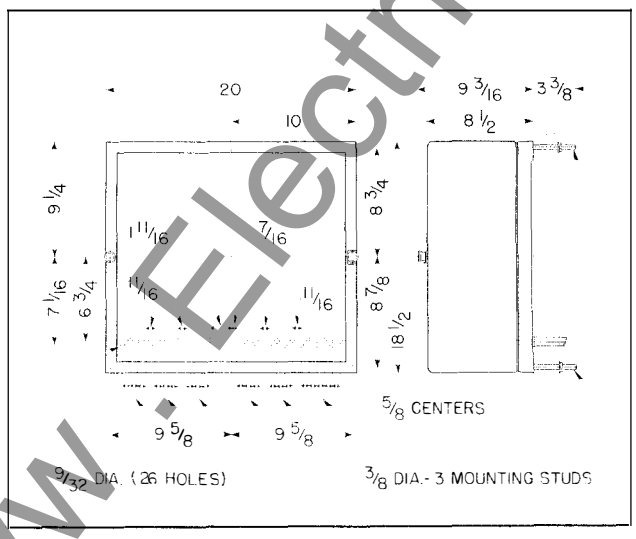


Fig. 17—Types R-23, -29, -42, -52 Meters with Stud Covers.

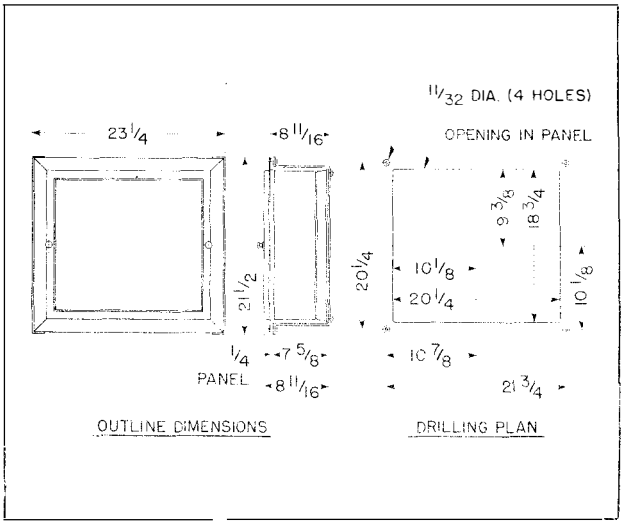


Fig. 18—Types R-23, -29, -43, -52 Meters, Flush Type.

OUTLINE DIMENSIONS

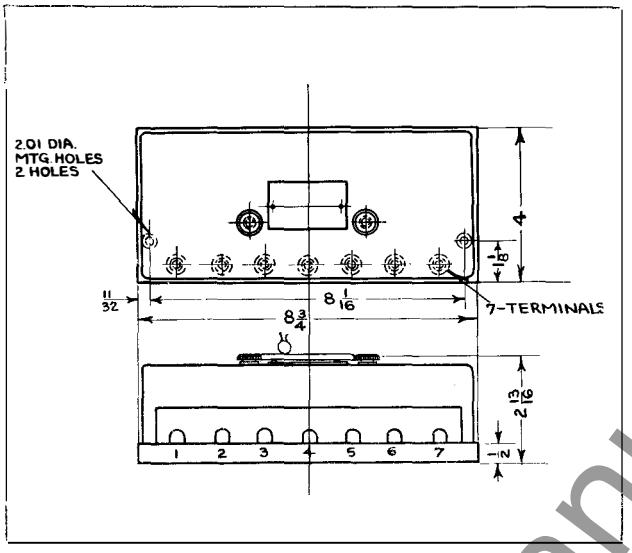


Fig. 19—Types K-1, -3, -4, -5, -7, -9 Phase Shifting Transformers.

CONNECTION DIAGRAMS—FRONT VIEW

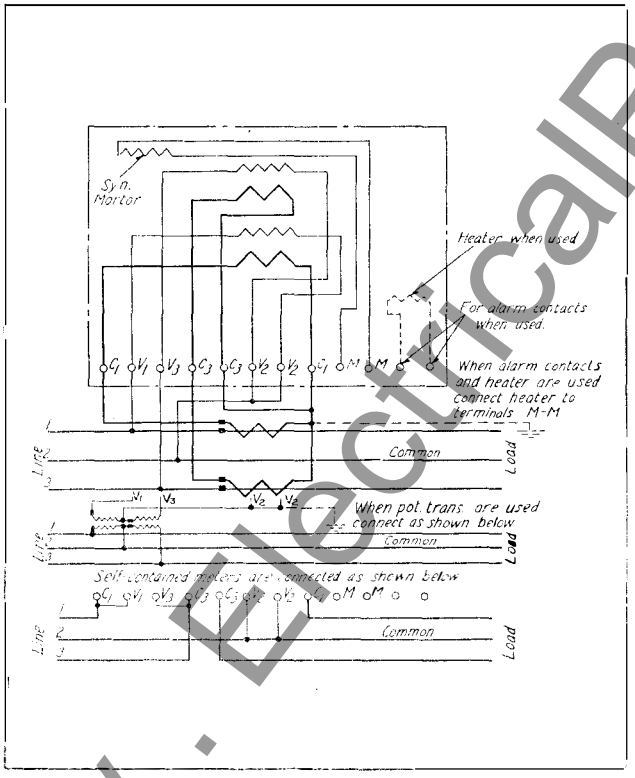


Fig. 20—Type R-2, 2- or 3-Phase, 3-Wire.

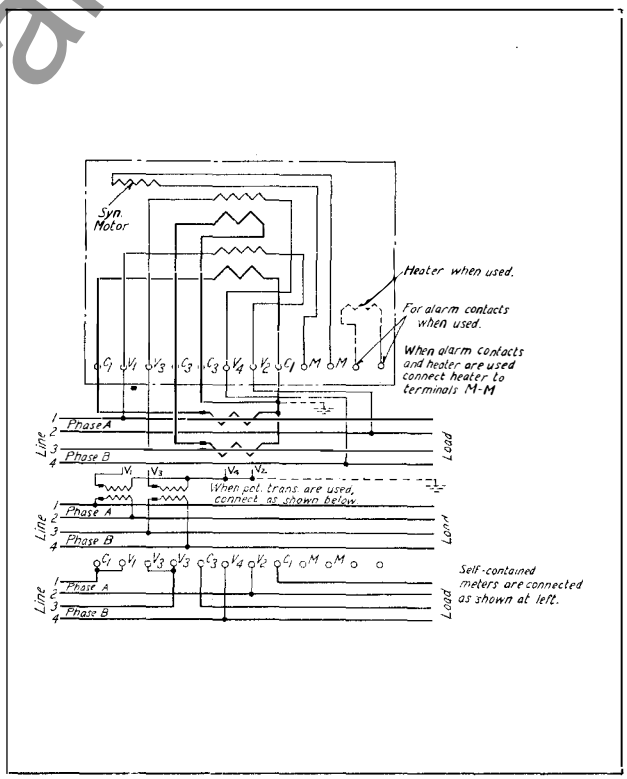


Fig. 21—Type R-2, 2-Phase, 4-Wire.

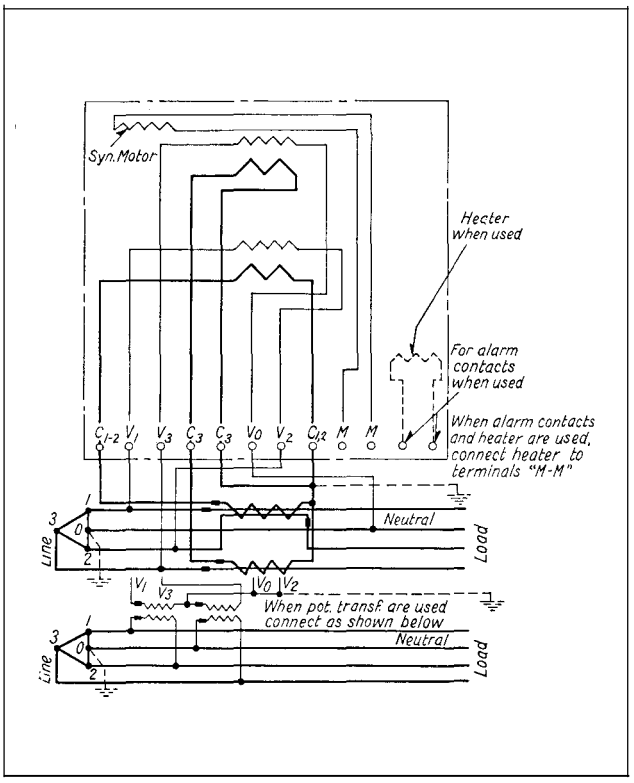


Fig. 22—Type R-2, 3-Phase, 4-Wire, Delta, Using One 2-Wire and One 3-Wire Current Transformer.

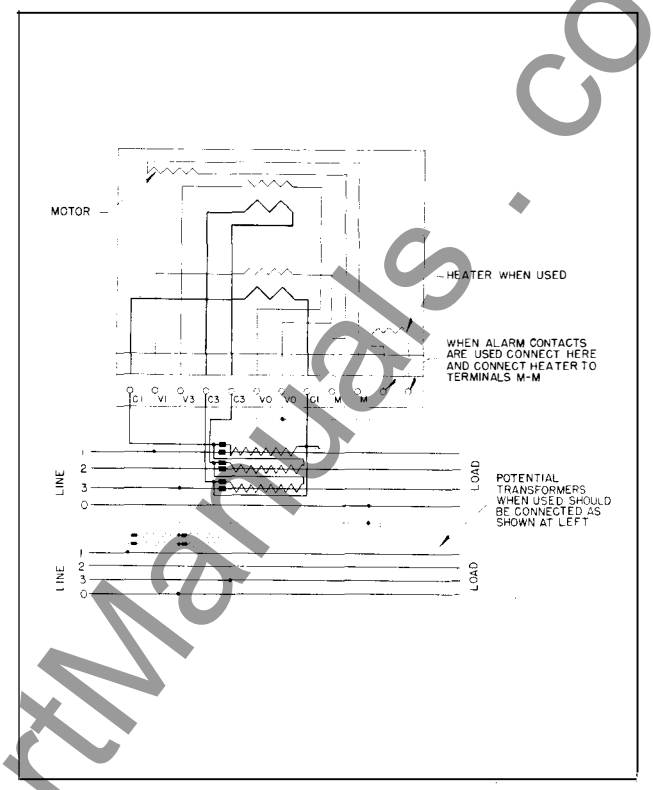


Fig. 23—Type R-2, 3-Phase, 4-Wire, "Y" Using Three 2-Wire Current Transformers.

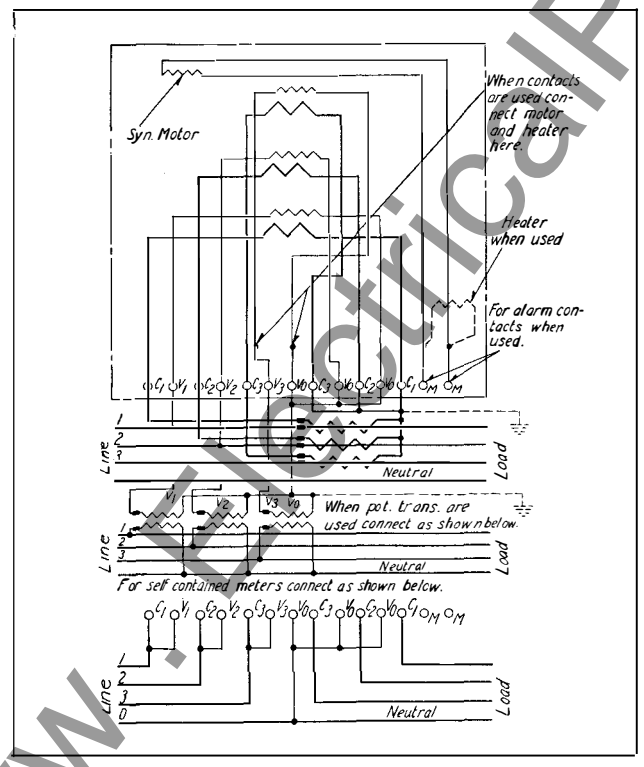


Fig. 24—Type R-3, 3-Phase, 4-Wire, "Y".

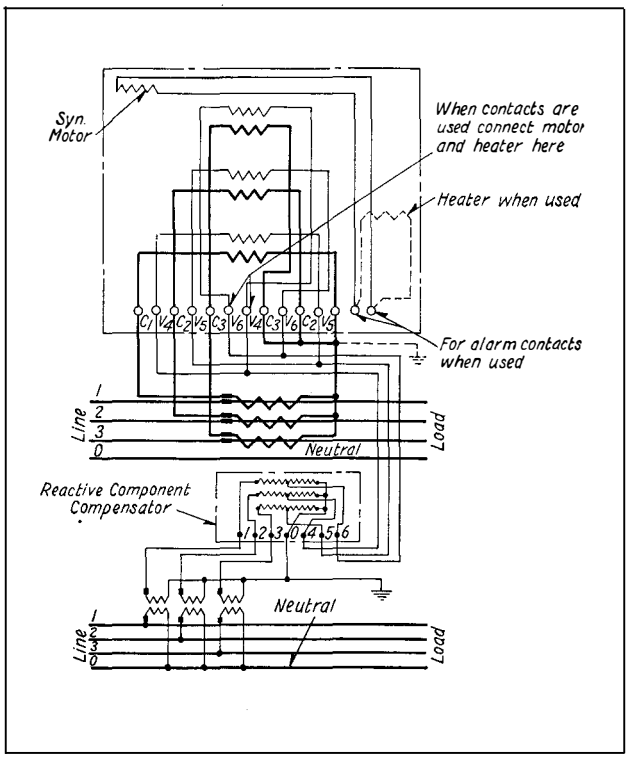


Fig. 25—Type R-3, 3-Phase, 4-Wire, "Y", Reactive Connections Using K-4 Phase Shifting Transformers.

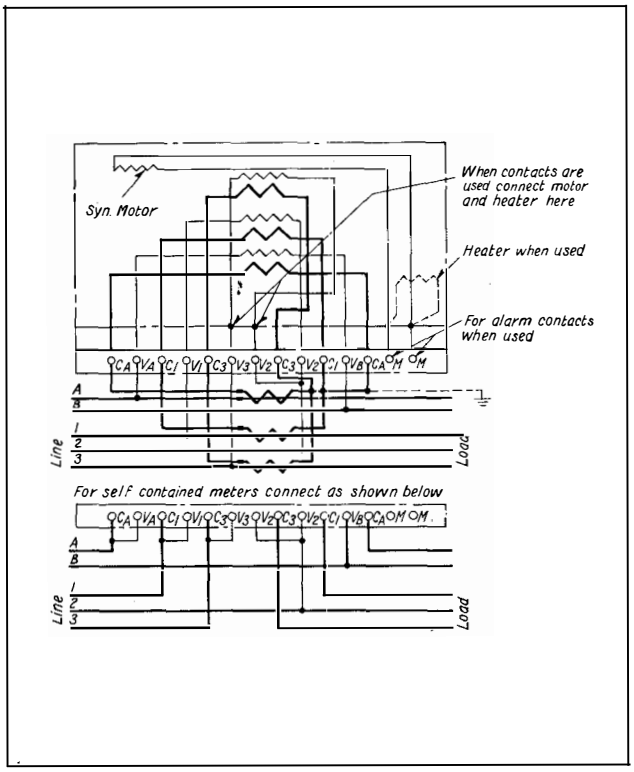


Fig. 26—Type R-4, Totalizing, 3-Phase, 3-Wire and Single-phase 2-Wire.

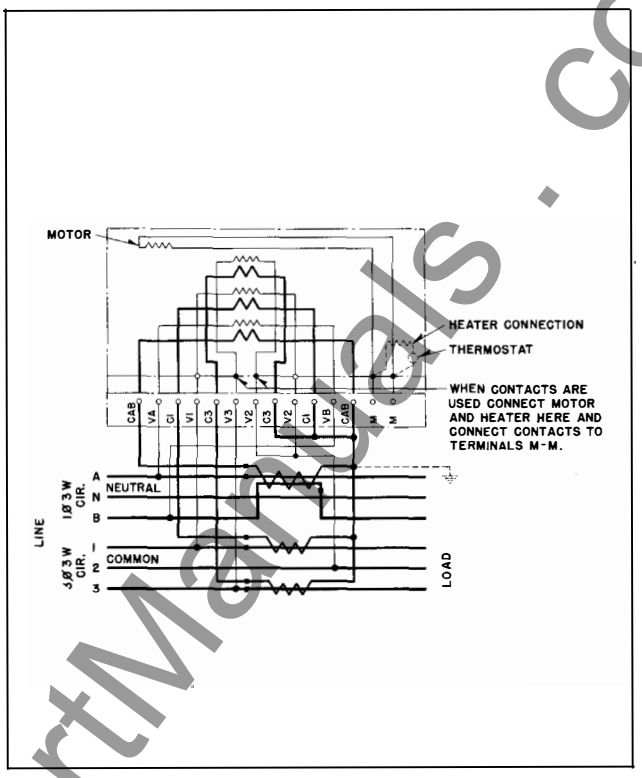


Fig. 27—Type R-4, Totalizing, 3-Phase, 3-Wire and Single-phase 3-Wire, Using One 3-Wire Current Transformer (Singlephase Circuit).

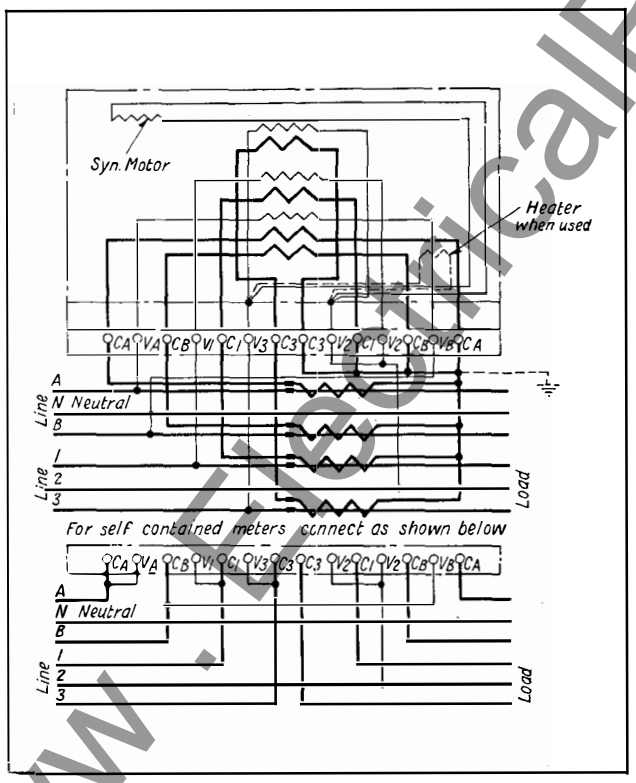


Fig. 28—Type R-6, Totalizing, 3-Phase, 3-Wire and Single-phase 3-Wire.

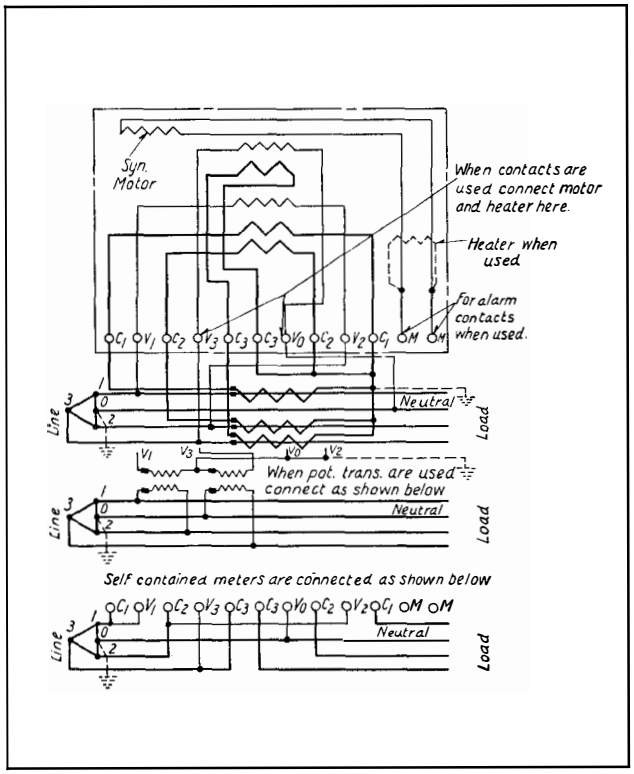


Fig. 29—Type R-7, 3-Phase, 4-Wire Delta.

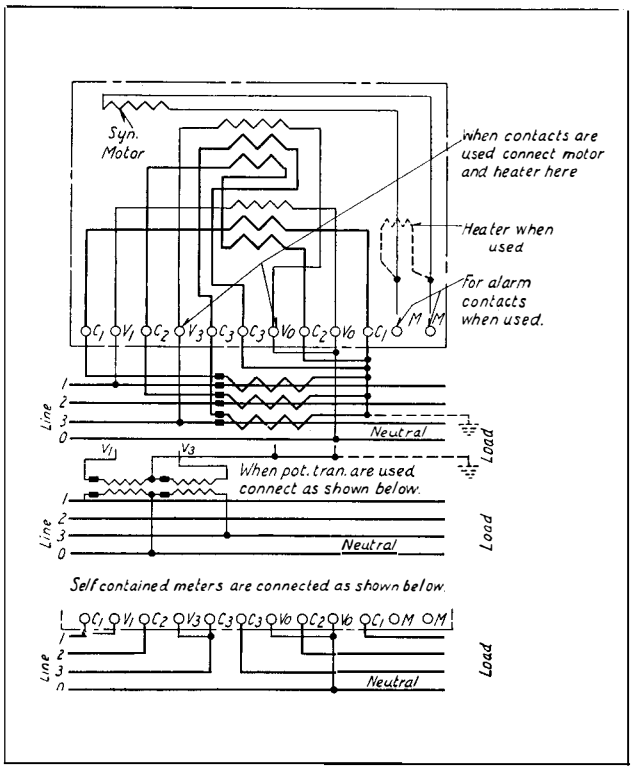


Fig. 30—Type R-8, 3-Phase, 4-Wire "Y".

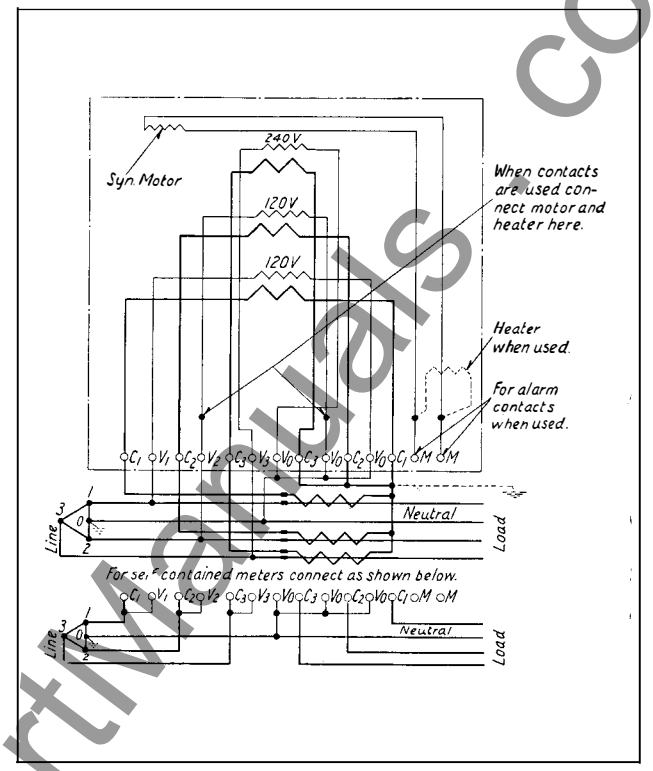


Fig. 31—Type R-9, 3-Phase, 4-Wire Delta.

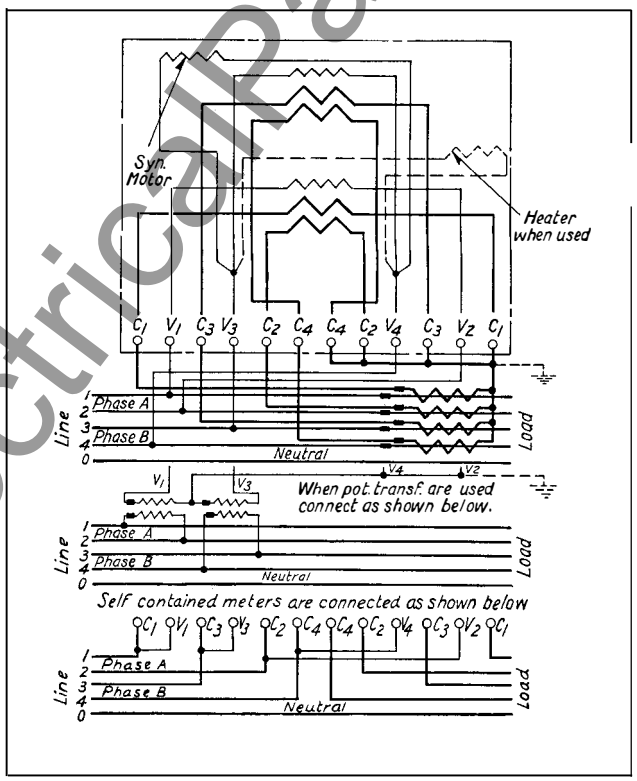
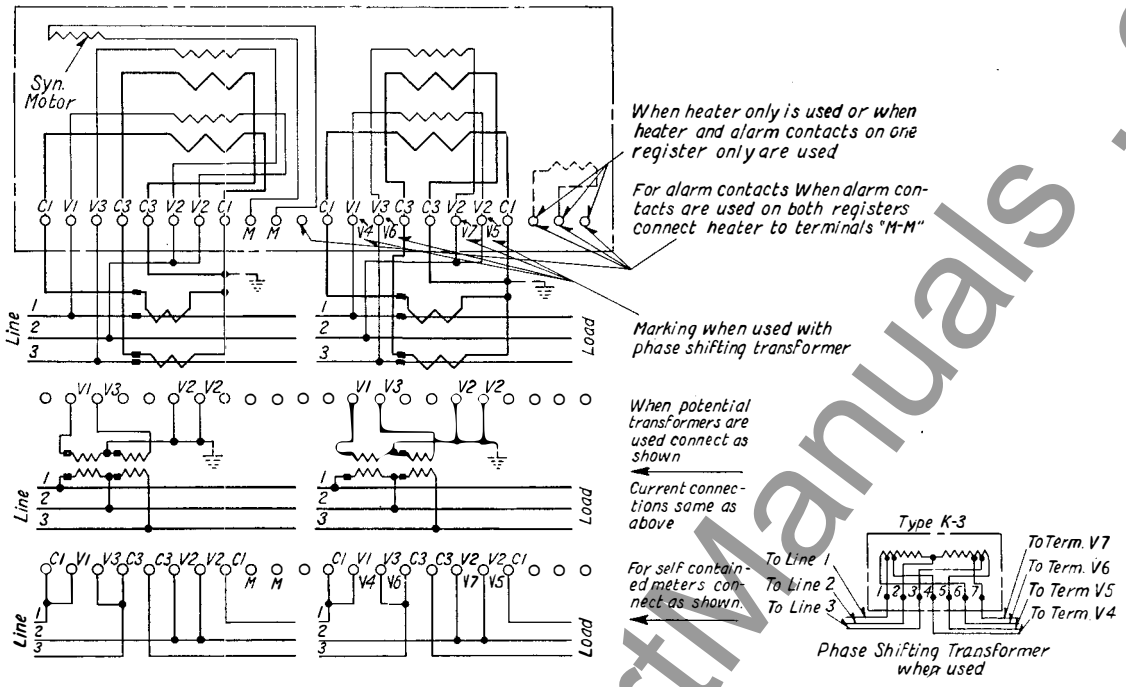
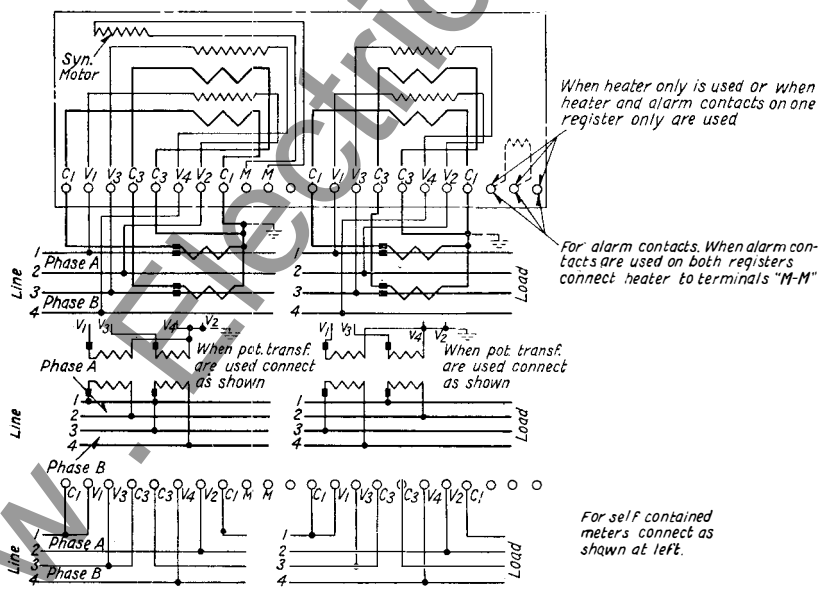


Fig. 32—Type R-10, 2-Phase, 5-Wire.



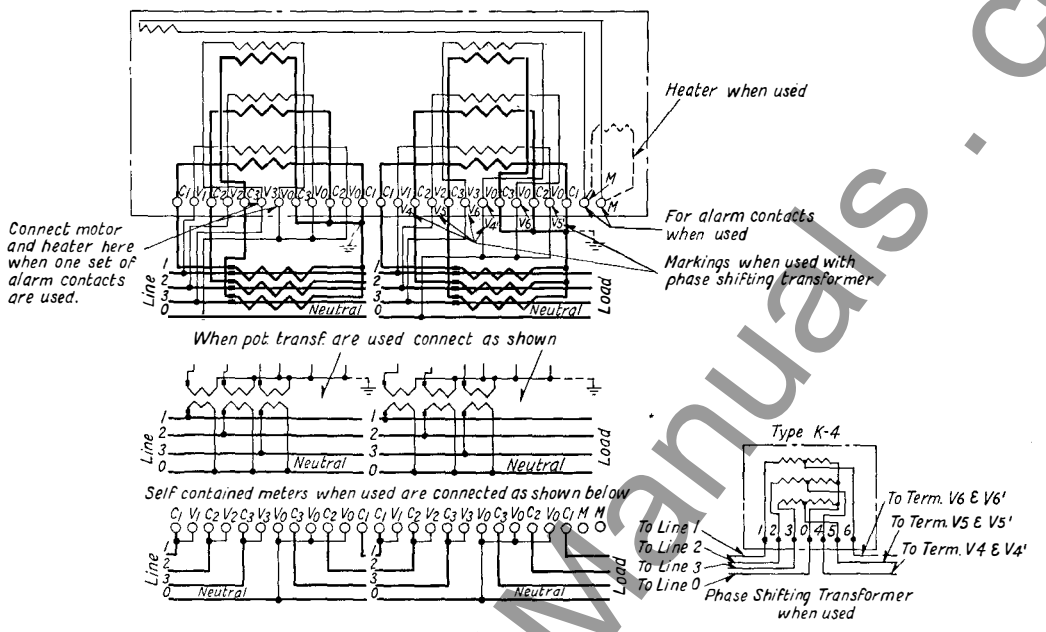
NOTE: When the Phase Shifting Transformer is Connected as Shown Above for Measuring Reactive Kv-a., Voltage 4-5 is 90° from Voltage 1-2, Voltage 6-7 is 90° from Voltage 3-2.
Connections are Made for Forward Rotation of Reactive Component Meter when Power Factor is Lagging Phase Rotation is 1-2, 2-3 and 3-1.
If Phase Rotation is Reversed Leads 4-5 Must be Reversed at Reactive Component Meter or at the Transformer, Also Leads 6-7 Must be Reversed.
If it is Desired to Use Meter on Leading Power Factors Leads 4-5 Must be Reversed; Also Leads 6-7.
If it is Desired to Prevent Reversal of Rotation when Power Factor Changes from Lag to Lead or Vice Versa, the Reactive Component Meter Must be Equipped with a Ratchet.

Fig. 33—Types R-22, -42, Duplex 2- or 3-Phase, 3-Wire.



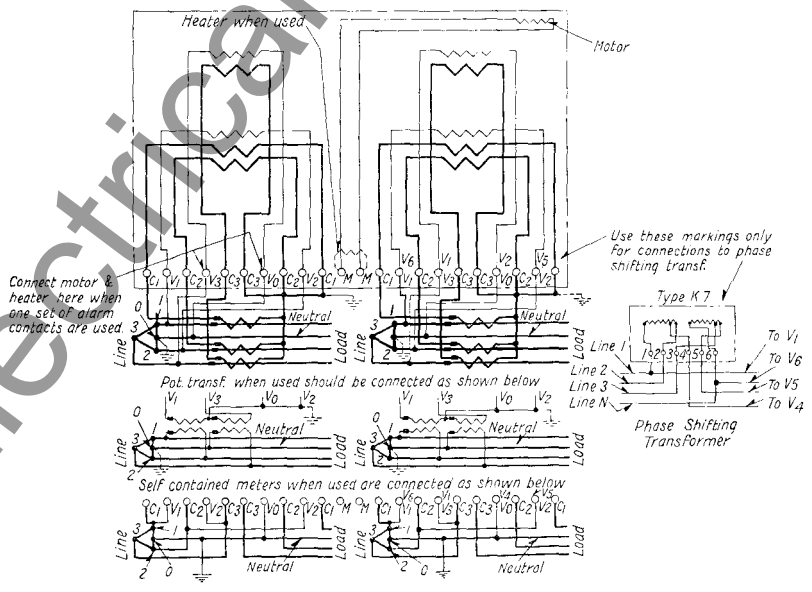
NOTE: A Phase Shifting Transformer is Not Required for Measuring Reactive Kv-a. on 2-Phase Circuits. The Potential Coils of "A" Phase and the Current Coils of "B" Phase are Connected to the Same Reactive Element. Similarly the Potential Coils of "B" and the Current Coils of "A" are Connected to the Other Reactive Element.

Fig. 34—Types R-22, -42, Duplex, 2-Phase, 4-Wire.



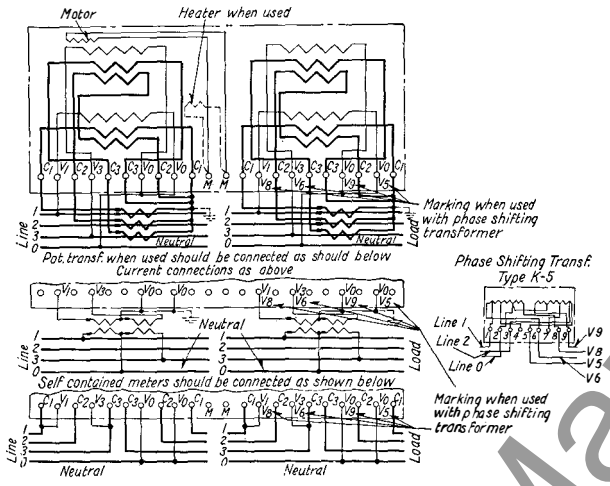
NOTE: CONNECTIONS ARE SHOWN FOR FORWARD ROTATION ON LAGGING POWER FACTOR WHEN PHASE SEQUENCE IS 1-2-3. IF PHASE SEQUENCE IS 3-2-1 REVERSE LEADS V6 AND V4', V5 AND V6', V4 AND V5'. IF FORWARD ROTATION ON LEADING POWER FACTOR IS DESIRED REVERSE LEADS AS ABOVE.

Fig. 35—Types R-23, -43, Duplex, 3-Phase, 4-Wire, "Y".



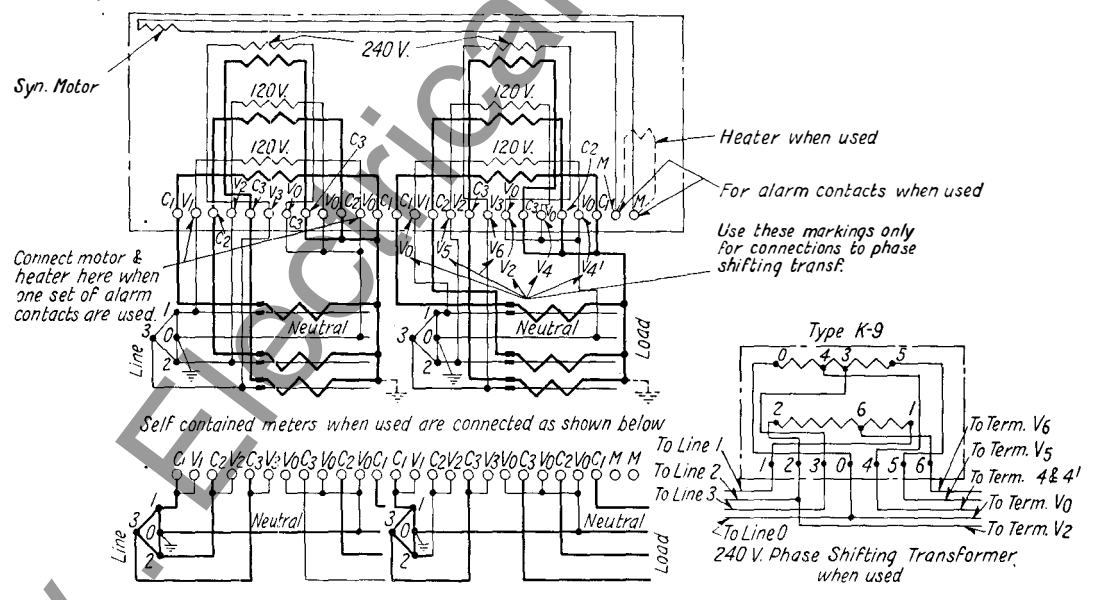
NOTE: CONNECTIONS ARE SHOWN FOR FORWARD ROTATION OF REACTIVE METER ON LAGGING POWER FACTOR WITH PHASE SEQUENCE 1-2, 2-3, 3-1. FOR FORWARD ROTATION ON OPPOSITE PHASE SEQUENCE OR ON LEADING POWER FACTOR REVERSE LEADS TO V6 AND V5 AND REVERSE LEADS TO V1 AND V4.

Fig. 36—Type R-27, Duplex, 3-Phase, 4-Wire, Delta.



NOTE: When the Phase Shifting Transformer is Connected as Shown Above for Measuring Reactive Kv-a., Voltage 8-5 is 90° from Voltage 1-2, Voltage 6-9 is 90° from Voltage 3-2.
Connections are Made for Forward Rotation of Reactive Component Meter when Power Factor is lagging and Phase Rotation is 1-2, 2-3 and 3-1.
If Phase Rotation is Reversed leads 8-5 Must be Reversed at Reactive Component Meter or at the Transformer Also leads 6-9 Must be Reversed.
If it is Desired to Use Meter on Leading Power Factors Leads 8-5 Must be Reversed; Also Leads 6-9.
If it is Desired to Prevent Reversal of Rotation when Power Factor Changes from Lag to lead or Vice Versa, the Reactive Component Meter Must be Equipped with Ratchet.

Fig. 37—Type R-28, Duplex, 3-Phase, 4-Wire, "Y".



NOTE: CONNECTIONS ARE SHOWN FOR FORWARD ROTATION ON LAGGING POWER FACTOR WHEN PHASE SEQUENCE IS 1-2, 2-3, 3-1.
WHEN PHASE SEQUENCE IS 3-2, 2-1, 1-3 REVERSE LEADS V0 AND V4', V5 AND V4, V6 AND V2.
IF FORWARD ROTATION IS DESIRED ON LEADING POWER FACTOR REVERSE LEADS AS ABOVE.

Fig. 38—Type R-29, Duplex, 3-Phase, 4-Wire, Delta.

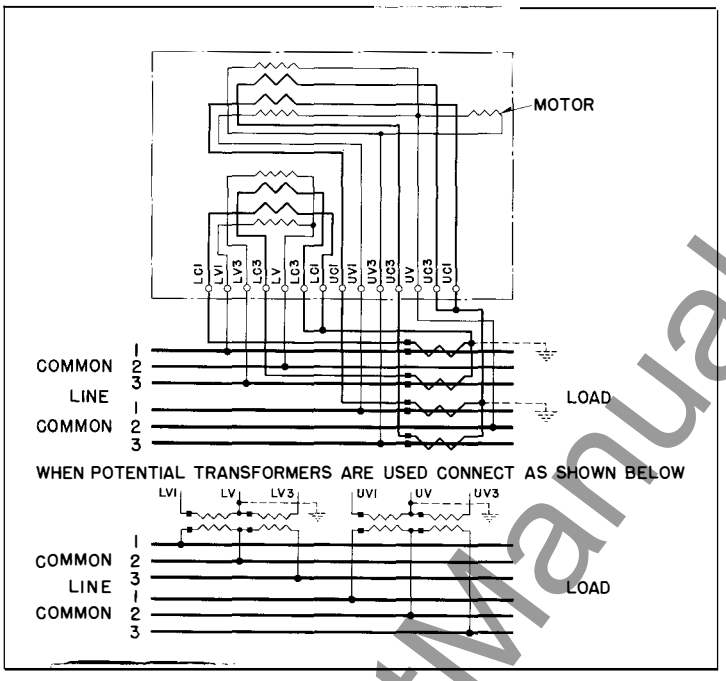


Fig. 39—Type R-32. Totalizing, Two 3-Phase, 3-Wire Circuits.

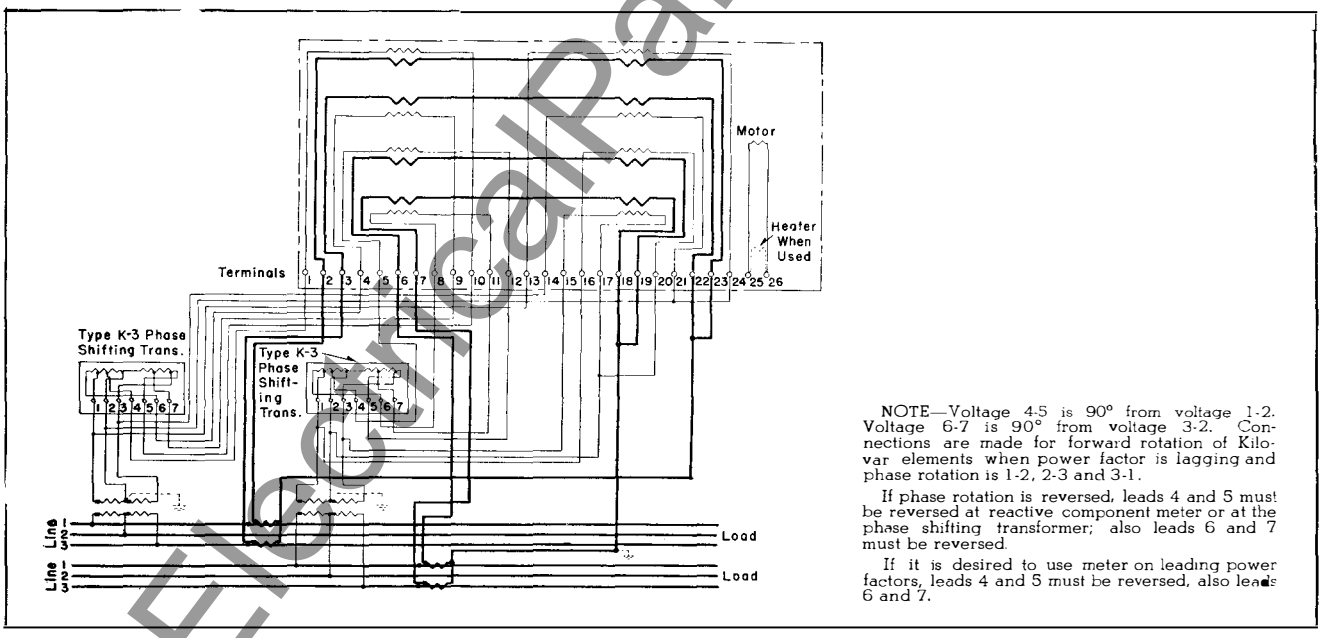


Fig. 40—Types R-52. Duplex Totalizing Two 3-Phase, 3-Wire Circuits.

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