RECORDING DEMAND WATTHOUR METERS

WITH SYNCHRONOUS MOTOR CLOCKS

Two- and Three-Element Types R-2, R-3, R-7, R-8, R-9 and R-10
Two- and Three-Element Duplex Types R-22, R-23, and R-28

AND

REACTIVE COMPONENT COMPENSATORS FOR REACTIVE KVA METERING

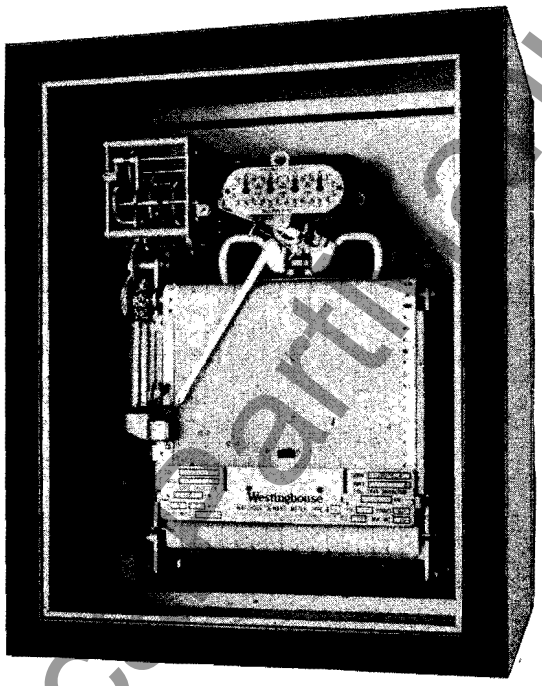


FIG. 1—TYPE R-2 TWO-ELEMENT RECORDING DEMAND METER—HINGED COVER

General

These Recording Demand Watthour meters measure both the kilowatt hours consumed and the integrated block interval demand. The kilowatt hours are indicated on a four-counter dial and the integrated block interval demand is recorded on a chart. They require no additional apparatus or wiring and may be installed as ordinary watthour meters. Their simplicity makes them reliable for determining the block interval demand of power installations, particularly where a permanent record of the demand involving the time and length of occurrence is desired.

A small hysteresis type synchronous motor serves both to determine the time intervals and to furnish power for advancing the chart at the end of the time interval. The chart 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, Figure 5, when the meter element is being inspected or adjusted.

The chart re-roll is chain driven, Figure 4, with a clutch mechanism to maintain even tension on the chart when it is advanced. This clutch requires no adjustment. The chart record is made by an ink-carrying pen fed by a large capacity reservoir. The ink reservoir is designed to permit the use of a quick drying ink, thus assuring legible charts under extreme atmospheric conditions.

These meters can be supplied with either stud mounted or hinged covers with fabricated metal sides and full glass front.

Application

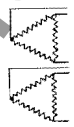
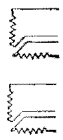
The tabulation on page 2 gives the class of service for which each type of meter listed is suitable and reference to the connection diagram which applies to the application.

When the type R-2 and type R-22 meters are used for measuring 3 phase 4-wire delta service using one 2-wire and one 3-wire current transformers of equal ratio, the 3 phase 3-wire power load will be measured accurately under all conditions. The single phase 3-wire load will be measured under the same conditions as when a 3-wire current transformer is used with a single phase 2-wire meter.

RECORDING DEMAND WATTHOUR METERS—Continued

APPLICATION CHART

KW Demand Meters

APPLICATION	TYPE R RECORDING KW DEMAND	ELEMENTS
1 Phase 2- or 3-Wire 	Type R-2*	1
3-Wire Network 	Type R-2*	2
3 Phase 3-Wire 	Type R-2	2
2 Phase 4-Wire 	Type R-2	2
2 Phase 5-Wire 	Type R-10	2
3 Phase 4-Wire Y 	Type R-8 Type R-3	2 3
3 Phase 4-Wire Delta 	Type R-7 Type R-9	2 3
DUPLEX KW DEMAND METERS		
3-Phase, 3-Wire and 3-Phase, 3-Wire 	Type R-22	2
2-Phase, 4-Wire and 2-Phase, 4-Wire 	Type R-22	2
3-Phase, 4-Wire "Y" and 3-Phase, 4-Wire "Y" 	Type R-28 Type R-23	2½ 3

*Order "Similar to" Styles listed and give complete description of service to be metered.

RECORDING DEMAND WATTHOUR METERS—Continued

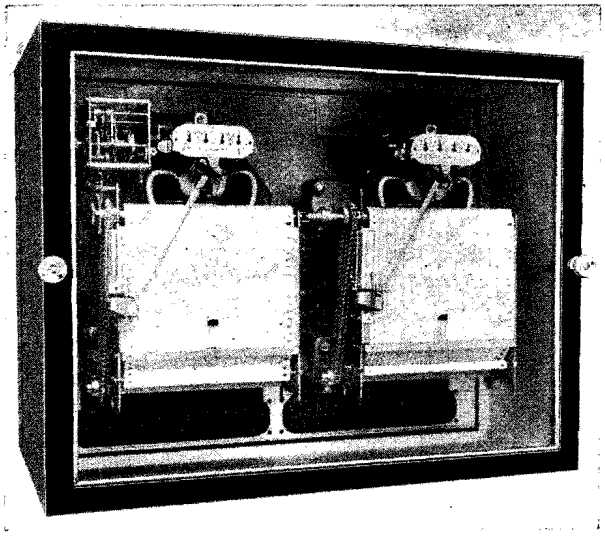


FIG. 2—TYPE R-22 DUPLEX TWO-ELEMENT RECORDING DEMAND METER

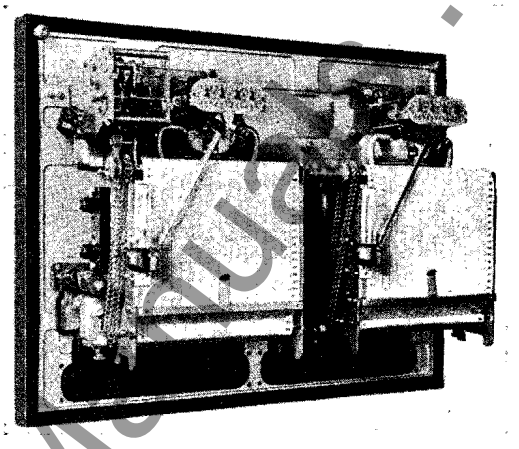


FIG. 3—TYPE R-22 DUPLEX TWO-ELEMENT RECORDING DEMAND METER—COVER REMOVED

The type R-7 meter will measure 3 phase 3-wire power load accurately for all conditions. The single phase 3-wire load will be measured under the same conditions as when a single phase 3-wire meter is used with two 2-wire current transformers.

The type R-8 meters and the type R-28 duplex meters are commonly known as two and one-half element meters, having 3 current coils and 2 potential coils. These meters will measure the load correctly regardless of current unbalance or power factor. For 3 phase 4-wire installations where there is a possibility of badly unbalanced voltages, it is sometimes desirable to use the three-element meters, types R-3 and R-23, which measure the load correctly regardless of voltage unbalance.

All other types of these meters measure accurately under all conditions the services for which they are listed.

Duplex Meters—Types R-22, R-23 and R-28—These duplex meters, Figures 2 and 3, may be used with reactive component compensators for obtaining simultaneous kw demand and reactive kva demand. From these two quantities, the kva demand and so called "average" power factor can be determined. In addition to the demand records, the dials of the registers indicate the total kilowatt hours and the total reactive kva hours consumed.

The types K-3 and K-4 reactive component compensators listed on page 10 are for use with these meters for obtaining the reactive kva

The duplex meters may also be used for checking the simultaneous registration and demand on primary and secondary power loads.

Distinctive Features

1. These recording demand watthour meters are installed as ordinary watthour meters, requiring no additional apparatus or wiring not normally used with an ordinary watthour meter.

2. Measuring and recording elements are interconnected mechanically.

3. The synchronous motor timing permits obtaining simultaneous demand on two or more meters at widely separated points without the necessity of interconnecting tripping facilities.

4. The timing device and the chart mechanism are both driven by a small synchronous motor eliminating the use of hand-wound spring motors.

5. The terminals are arranged so that the meter may be connected either from the front or rear making the meter suitable for wall or switchboard mounting.

6. Stud mounted covers are available for use where space limitations will not permit the use of hinged covers.

7. Potential indicating lamps are standard equipment.

8. The demand chart is of sufficient length and the ink reservoir provides sufficient ink for at least one month's operation, thus reducing the maintenance cost.

9. The metal cover with full glass front adds to the appearance of the meters and makes them thoroughly dustproof.

Operation and Construction

In these meters, the watthour meter element advances the kilowatt hour counters the same as in an ordinary watthour meter. Simultaneously, through a gear train, the pen is advanced across the chart. The pen advances a distance proportional to the kilowatt hours consumed during the demand interval. For example, suppose that during a certain 15 minute interval one kilowatt hour was consumed. At the end of this interval, the pen on the demand chart would indicate 4 kw. which is the average kilowatt load that occurred during the 15 minute interval.

At the end of the pre-determined time interval, a stud on the reset wheel releases the gears of the pen from mesh and a balancing weight returns the pen to zero where it is again meshed with the gear train ready to repeat the advance during the next time interval.

Just before the pen is released, the record paper is advanced one-sixteenth of an inch by the operating spring so

RECORDING DEMAND WATTHOUR METERS—Continued

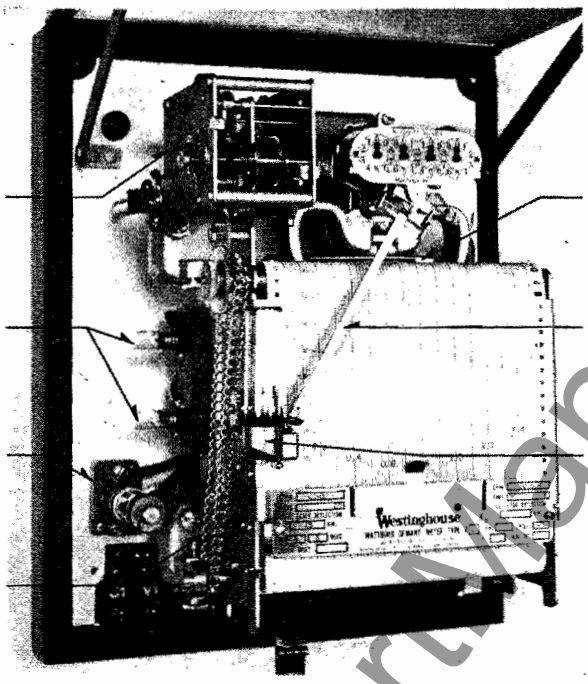


FIG. 4—TYPE R-2 TWO-ELEMENT RECORDING DEMAND METER—COVER RAISED

that the pen makes a distinct and readily observed record of the maximum pen travel.

The paper-driving mechanism is a metal drum with pins that engage in perforations in the record paper, driven through gearing by the operating spring. The paper is held on a spindle and is wound off this on to a drum by the driving mechanism.

Demand Scale and Charts—The demand recording mechanism of all meters for which styles are listed is designed to advance the pen ⅔ of full scale for the nominal kw rating of the meter. Full scale deflection represents 1½ the nominal kw rating of the meter. The kw markings on the charts conform to the kw values represented by the deflection of the pen. For example, the nominal kw rating of a 120 volt 5 ampere type R-2 meter is 1 kw. The charts supplied for these meters, Figure 8, will be marked 1 kw for ⅔ full scale deflection and 1½ kw for full scale deflection. When the meter is operating at its nominal kw capacity, the pen will be advanced to the 1 kw marking on the chart during the demand time interval for which the meter is intended.

When it is not expected that the meters will be operated at their nominal kw. capacity, it is sometimes desirable to obtain a pen deflection greater than ⅔ full scale for the nominal kw. rating of the meter. In this case, meters can be supplied for which the pen deflection will be equal to full scale on the chart for the nominal kw rating of the meter. Meters with demand recording mechanisms of this type should be ordered "similar to the styles listed for the standard meters except full load pen deflection to equal full scale." The charts for meters in which full load pen deflection equals full scale of the chart are listed, in addition to the standard charts.

Demand Chart Mechanism

The demand chart mechanism is arranged so that the preceding demand record for a number of hours is visible Figure 1. This complete mechanism may be removed as a unit or swung to one side on a special hinge when the meter is being inspected or adjusted, Figure 5.

Demand Recording Pen—The pen is of the platinum tube "V" type familiar to operators of recording demand watthour meters. The self-inking device will hold a supply of ink sufficient to last for at least 35 days.

The pen is inked intermittently by dipper action as the pen returns to the zero position.

The inking mechanism consists of a reservoir kept supplied with ink directly from a small bottle. The ink is supplied in liquid form in 2 ounce bottles ready to use.

Register—The register contains the gearing both for the four integrating dials and for driving the pen. Should the pen reach full scale before the end of the time interval due to heavy overload or other causes, it is automatically retained in the full scale position until the end of the time interval when it is returned to the zero position in the normal way.

Clock—The timing device and the chart driving mechanism are combined so that a small synchronous motor serves both to determine the time intervals and to furnish the power for advancing the paper. During the interval, the motor stores energy in a spring which, at the end of the time interval, is released causing the chart to be advanced and the pen to be reset to zero. The paper is advanced just before the pen is released leaving a distinct record of the maximum pen travel.

RECORDING DEMAND WATTHOUR METERS—Continued

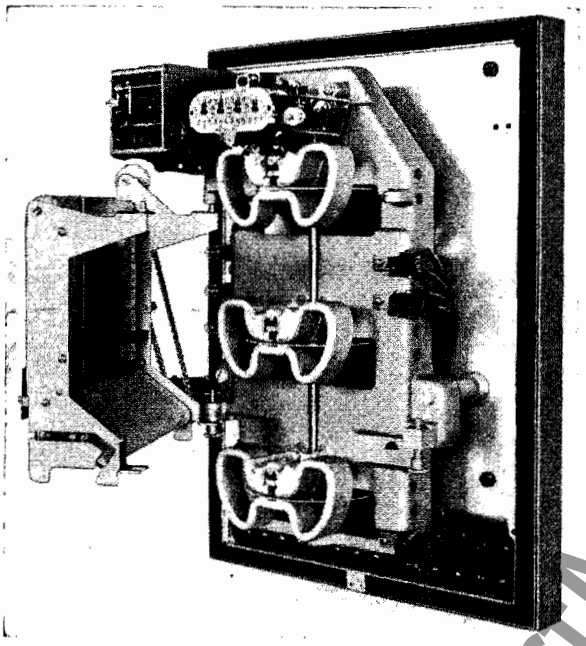


FIG. 5—TYPE R-3 METER WITH CHART MECHANISM SWUNG TO ONE SIDE FOR INSPECTION OF THE METER ELEMENT OR INSERTION OF THE DEMAND CHART

The combination timing device and chart driving mechanism eliminates the use of a hand-wound spring for driving the demand chart, thus making the timing and chart mechanism function automatically with the exception of chart and ink replacements.

Base—The base is made of cast iron with terminals arranged in a moulded terminal block so that the meter may be connected either from the front or the rear. Studs for rear connection on switchboards up to two inches thick are supplied on all meters. These studs can be removed if it is desired to connect the meter from the front.

Cover—The covers for both the single meters and the duplex meters have metal sides with a full glass front. All types of meters can be supplied with either the stud mounted or the hinge mounted cover.

Electromagnets—The electromagnets are made up of one-piece laminations, with the potential pole above the disc and the current poles below. The laminations are held together by eyelet rivets which also serve as bushings for the screws that fix the electromagnet to the grid. All of the adjustment devices are integral parts of the electromagnet assemblies. All electromagnets are temperature compensated for inductive (class 2) errors.

The Light Load adjustment consists of an alloy plate which is moved across the current poles by means of a micrometer screw. The frame which supports this plate and adjusting screw is fixed to the current pole laminations by two studs which pass through the pole pieces. These studs also serve to clamp the current pole laminations securely together. A circular arrow indicates the direction which the adjusting screw should be turned to increase the meter speed.

The Full Load adjustment is obtained by adjusting the position of an iron disc with respect to the air gaps of the permanent magnet. The iron disc is fastened to a screw which is threaded into the permanent magnet supporting casting. The periphery of the disc is provided with slots to facilitate turning from the front. A small set screw locks the adjuster in position.

The Torque Balance between elements is obtained by moving, in a radial direction, a soft iron plate mounted beneath the voltage pole of the electromagnet. The micrometer screw used for adjusting the position of the soft iron plate is fixed to the face of the potential pole.

The Power Factor adjustment is obtained by adjusting a resistance in series with a closed winding on the series poles.

Permanent Magnets—The permanent magnets are made of high quality magnet steel properly heat treated and aged to assure permanency of calibration. The magnet consists of two C-shaped pieces permanently fastened together by a non-ferrous alloy casting. This casting also serves to support the full load adjustment and for fastening the magnet assembly to the meter frame.

Temperature compensation at unity power factor (class I) is obtained by the use of a compensating material which is fastened across the air gap of the permanent magnets under the discs.

Moving Elements—The discs are pressed on the shaft and definitely located without set screws. The pinion for driving the register is cut directly on the disc shaft.

A highly polished and hardened steel ball revolves between two cup-shaped sapphire jewels to form the bottom shaft bearing. **This bearing requires no lubrication whatever either for protection to the parts or to reduce normal friction.**

The top, or guide bearing, consists of a polished steel pin which fits into a ring jewel bearing in the top of the disc shaft. Sealed in the disc shaft is a lubricant which continuously oils the pin.

Duplex Meter

The duplex meters consist of 2 single meters mounted in a single case with the 2 chart-advancing drums mechanically connected together and the tripping mechanism arranged to trip both the pens to zero at the same instant.

Detail Principle of Operation

The details of operation may be understood by reference to Figures 6 and 7. Under load the disc-shaft **L** integrates watthours on the register through the gearing of shaft assemblies **#1, #3, #7,** and **#8.** At the same time the pen is advanced through shaft assemblies **#1.**

RECORDING DEMAND WATTHOUR METERS—Continued

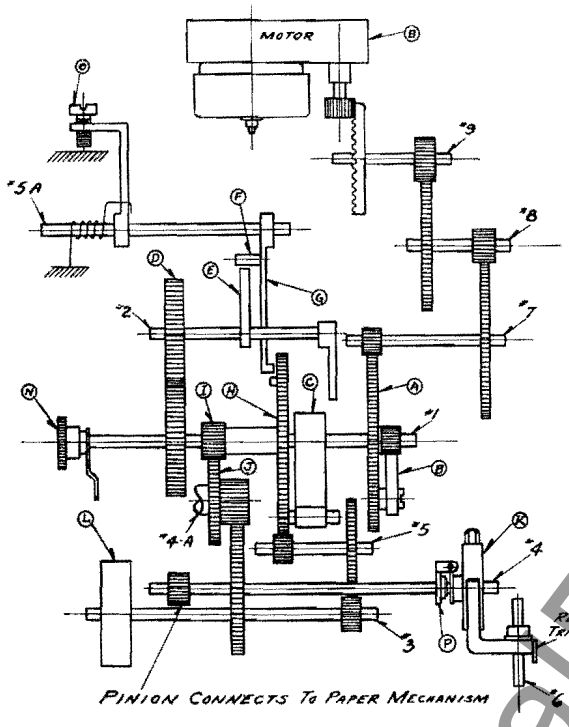


FIG. 6—SCHEMATIC DIAGRAM OF TRIPPING MECHANISM

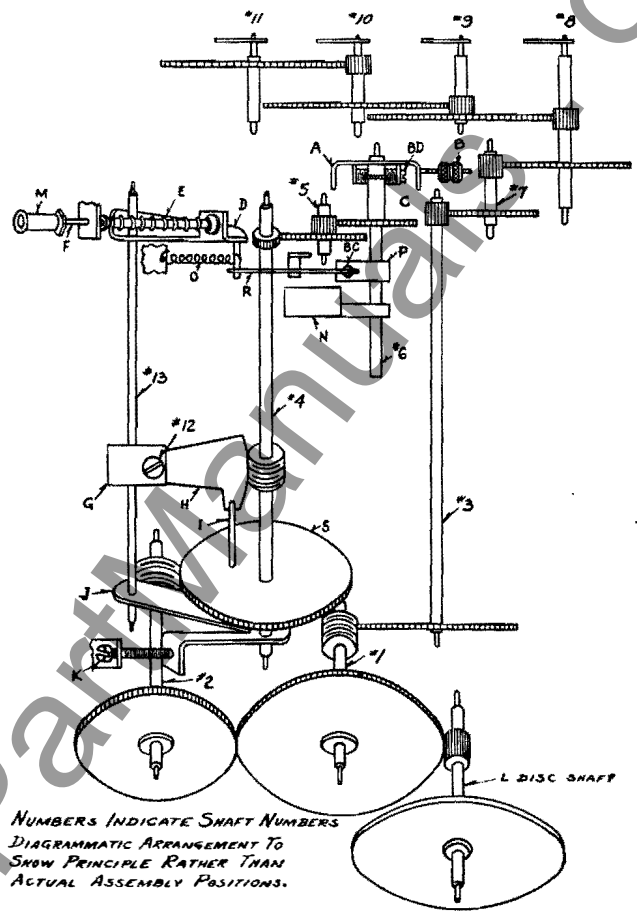


FIG. 7—SCHEMATIC DIAGRAM OF REGISTER MECHANISM

#2, #4, #5, and #6. At the end of the time interval the tripping arm #6, Figure 6, pushes against rod **F**, disengaging the worm wheel on shaft #4 from worm on shaft #2, Figure 7.

The weight of the pen and the pen arm is counterbalanced by weight **N**, and the adjustable weights **B** are so placed as to cause the pen to immediately swing to the zero position when its driving gears are disengaged. When falling to the zero position, the rotation of the worm on shaft #4 moves the swinging section **H** against the stop **I** on worm wheel **S**, thus determining the zero position of the pen. When pressure on rod **F** is relieved, the spring **O** returns the pen gearing into mesh.

When for any reason the pen reaches full scale, arm **P** on shaft #6 pushes against arm **R** on bracket mounted on shaft **14**. This causes worm wheel **S** on #4 shaft to disengage with worm **T** on shaft #2. This throws the pen gearing out of mesh but allows the K.W.H. gearing to go undisturbed.

Adjustment screw **K** is to adjust the mesh between the pen worm and worm wheel **S**. This is adjusted at the factory and should require no attention. Screw **BC** adjusts the full scale tripping point, screw **BD** is to adjust the pen to zero position.

The time interval is determined by the synchronous motor **B**, Figure 6 driving shaft #4 through shafts #9 #8, #7, #1, and #4-A. Gear **A** is loose on shaft #1 and drives shaft #1 through ratchet **B**. This winds up spring **C** and at the same time turns gear **D** on shaft #2 to operate cam **E**. When shaft #2 makes one revolution the cam raises pin **F** on arm **G** and releases gear **H** on shaft **1** to which the other end of spring **C** is attached. Pinion **I** on shaft **1** drives gear **J** on shaft #4-A, causing the reset wheel **K** to force register reset arm against trip rod **M** in Figure 7, allowing the pen to reset to zero and also advancing the paper the correct amount. The torque of the mechanism is held constant during the reset period by spring governor **L** on #3 shaft. Gear **A** is made to drive shaft #1 through a ratchet **B** so that by turning knob **N** manually one revolution, the mechanism can be made to trip the pen gearing and reset the pen to zero.

RECORDING DEMAND WATTHOUR METERS—Continued

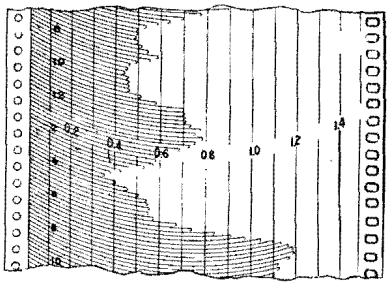


FIG. 8—CHART MADE BY A 15 MINUTE INTERVAL METER—1 KW. FULL LOAD 1.5 KW FULL SCALE

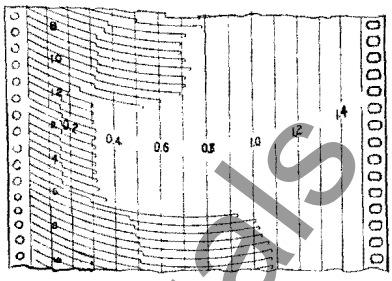


FIG. 9—CHART MADE BY A 30 MINUTE INTERVAL METER—1.0 KW. FULL LOAD 1.5 KW FULL SCALE

LIST PRICES

Style Number and List Price include meter as listed **complete with potential indicating lamps,** two rolls of Demand Chart and one 2-ounce bottle of red ink.

When meters are required without potential indicating lamps, there will be no reduction in price for their omission. Instrument Transformers are not included.

TYPE R-2
TWO-ELEMENT METERS FOR 2- OR 3-PHASE, 3-WIRE SERVICE WITH SYNCHRONOUS MOTOR CLOCK

Volts	Amps.	Nom. Kw	Meter with Hinged Cover—Styles: 5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	Meter with Stud Cover—Styles: 5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	①List Price
60 CYCLES													
120	2.5	.5†	1054 160	1054 168	1054 176	1054 184	....	1054 200	1054 208	1054 216	1054 224	....	$189 00
240	2.5	1.0†	1054 161	1054 169	1054 177	1054 185	....	1054 201	1054 209	1054 217	1054 225	....	193 00
480	2.5	2.0†	1054 162	1054 170	1054 178	1054 186	....	1054 202	1054 210	1054 218	1054 226	....	202 00
600	2.5	2.5†	1054 163	1054 171	1054 179	1054 187	....	1054 203	1054 211	1054 219	1054 227	....	202 00
120	5.0	1.0†	1054 164	1054 172	1054 180	1054 188	1054 196	1054 204	1054 212	1054 220	1054 228	1054 236	189 00
240	5.0	2.0†	1054 165	1054 173	1054 181	1054 189	1054 197	1054 205	1054 213	1054 221	1054 229	1054 237	193 00
480	5.0	4.0†	1054 166	1054 174	1054 182	1054 190	1054 198	1054 206	1054 214	1054 222	1054 230	1054 238	202 00
600	5.0	5.0†	1054 167	1054 175	1054 183	1054 191	1054 199	1054 207	1054 215	1054 223	1054 231	1054 239	202 00

TYPE R-3
THREE-ELEMENT METERS FOR 3-PHASE, 4-WIRE "Y" SERVICE WITH SYNCHRONOUS MOTOR CLOCK

Volts	Amps.	Nom. Kw	*Meter with Stud Cover—Styles: 5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	①List Price
60 CYCLES								
120/208Y	2.5	.75†	1054 280	1054 284	1054 288	1054 292	....	$253 00
277/480Y	2.5	1.5 †	1054 281	1054 285	1054 289	1054 293	....	260 00
120/208Y	5.0	1.5 †	1054 282	1054 286	1054 290	1054 294	1054 298	253 00
277/480Y	5.0	3.0 †	1054 283	1054 287	1054 291	1054 295	1054 299	260 00

† The meters for which styles are listed are supplied with registers corresponding to their nominal kw. rating. When transformers are used, a multiplier, determined by the transformer ratios, must be applied to both the kilowatt-hour and kilowatt demand readings.

These meters can also be supplied with the register (but not the demand chart) arranged to correspond to the transformer ratios and a multiple of 10 multiplier marked on the kilowatt-hour dial, at an extra charge of $1.30 List. The marking of the demand chart for these meters will correspond to their nominal kw. rating, but a multiplier corresponding to the transformer ratios will be specified on the nameplate of the meter. They will be non-standard and will not be carried in stock. Order, "similar to" the style listed "except for use with transformers" and specify the ratio of the transformers.

* Type R-3 meters can be supplied with hinged covers, at no additional charge, if specified on order.

① **Changed since previous issue.**

Order by Style Number

RECORDING DEMAND WATTHOUR METERS—Continued

LIST PRICES—Continued

TYPE R-7

TWO-ELEMENT METERS FOR 3-PHASE, 4-WIRE DELTA SERVICE WITH SYNCHRONOUS MOTOR CLOCK

Volts	Amps.	Nom. Kw	Meter with Hinged Cover—Styles: 5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	Meter with Stud Cover—Styles: 5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	①List Price
60 CYCLES													
240	2.5	1.0†	1054 340	1054 342	1054 344	1054 346	....	1054 350	1054 352	1054 354	1054 356	....	$218 00
240	5.0	2.0†	1054 341	1054 343	1054 345	1054 347	1054 349	1054 351	1054 353	1054 355	1054 357	1054 359	218 00

TYPE R-8

TWO-ELEMENT (THREE CURRENT AND TWO POTENTIAL COIL) METERS FOR 3-PHASE, 4-WIRE "Y" SERVICE WITH SYNCHRONOUS MOTOR CLOCK

Volts	Amps.	Nom. Kw	Meter with Hinged Cover—Styles: 5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	Meter with Stud Cover—Styles: 5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	①List Price
60 CYCLES													
120/208Y	2.5	.75†	1054 440	1054 444	1054 448	1054 452	....	1054 460	1054 464	1054 468	1054 472	....	$194 00
277/480Y	2.5	1.5†	1054 441	1054 445	1054 449	1054 453	....	1054 461	1054 465	1054 469	1054 473	....	202 00
120/208Y	5.0	1.5†	1054 442	1054 446	1054 450	1054 454	1054 458	1054 462	1054 466	1054 470	1054 474	1054 478	194 00
277/480Y	5.0	3.0†	1054 443	1054 447	1054 451	1054 455	1054 459	1054 463	1054 467	1054 471	1054 475	1054 479	202 00

TYPE R-9

THREE-ELEMENT METERS FOR 3-PHASE, 4-WIRE DELTA SERVICE WITH SYNCHRONOUS MOTOR CLOCK

Volts#	Amps.	Nom. Kw	*Meter with Stud Cover—Styles: 5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	①List Price
60 CYCLES								
240	2.5	1.5†	1054 500	1054 502	1054 504	1054 506	....	$278 00
240	5.0	3.0†	1054 501	1054 503	1054 505	1054 507	1054 509	278 00

TYPE R-10

TWO-ELEMENT METERS FOR 2-PHASE, 5-WIRE SERVICE WITH SYNCHRONOUS MOTOR CLOCK

Volts	Amps.	Nom. Kw	Meter with Hinged Cover—Styles: 5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	Meter with Stud Cover—Styles: 5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	①List Price
60 CYCLES													
240	2.5	1.0†	1054 550	1054 552	1054 554	1054 556	....	1054 560	1054 562	1054 564	1054 566	....	$242 00
240	5.0	2.0†	1054 551	1054 553	1054 555	1054 557	1054 559	1054 561	1054 563	1054 565	1054 567	1054 569	242 00

① **Changed since previous issue.**

The ratings of these meters are based on the 3-phase, 3-wire delta power circuit.

* Type R-9 meters can be supplied with hinged covers, at no additional charge, if specified on order. They will not, however, be carried in stock.

† The meters for which styles are listed are supplied with registers corresponding to their nominal kw. rating. When transformers are used, a multiplier, determined by the transformer ratios, must be applied to both the kilowatt-hour and kilowatt demand readings.

These meters can also be supplied with the register (but not the demand chart) arranged to correspond to the transformer ratios and a multiple of 10 multiplier marked on the kilowatt-hour dial at an extra charge of **$1.30** list. The marking of the demand chart for these meters will correspond to their nominal kw. rating, but a multiplier corresponding to the transformer ratios will be specified on the nameplate of the meter. They will be non-standard and will not be carried in stock. Order, "similar to" the style listed "except for use with transformers" and specify the ratio of the transformers.

Order by Style Number

RECORDING DEMAND WATTHOUR METERS—Continued

LIST PRICES—Continued

TYPE R-22

TWO-ELEMENT DUPLEX METERS FOR 2- OR 3-PHASE, 3-WIRE SERVICE WITH SYNCHRONOUS MOTOR CLOCK

			Meter with Hinged Cover—Styles					Meter with Stud Cover—Styles					
	Amps.	Nom. Kw	5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	List Price
60 CYCLES													
120	2.5	.5†	1054 730	1054 738	1054 746	1054 754	....	1054 770	1054 778	1054 786	1054 794	....	$300 00
240	2.5	1.0†	1054 731	1054 739	1054 747	1054 755	....	1054 771	1054 779	1054 787	1054 795	....	310 00
480	2.5	2.0†	1054 732	1054 740	1054 748	1054 756	....	1054 772	1054 780	1054 788	1054 796	....	325 00
600	2.5	2.5†	1054 733	1054 741	1054 749	1054 757	....	1054 773	1054 781	1054 789	1054 797	....	325 00
120	5.0	1.0†	1054 734	1054 742	1054 750	1054 758	1054 766	1054 774	1054 782	1054 790	1054 798	1054 806	300 00
240	5.0	2.0†	1054 735	1054 743	1054 751	1054 759	1054 767	1054 775	1054 783	1054 791	1054 799	1054 807	310 00
480	5.0	4.0†	1054 736	1054 744	1054 752	1054 760	1054 768	1054 776	1054 784	1054 792	1054 800	1054 808	325 00
600	5.0	5.0†	1054 737	1054 745	1054 753	1054 761	1054 769	1054 777	1054 785	1054 793	1054 801	101 809	325 00

TYPE R-23

THREE-ELEMENT DUPLEX METERS FOR 3-PHASE, 4-WIRE "Y" SERVICE WITH SYNCHRONOUS MOTOR CLOCK

			*Meter with Stud Cover—Styles					
Volts	Amps.	Nom. Kw	5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	①60 Min. Interval	List Price
60 CYCLES								
120/208Y	2.5	.75†	1054 850	1054 854	1054 858	1054 862	....	$400 00
277/480Y	2.5	1.5†	1054 851	1054 855	1054 859	1054 863	....	410 00
120/208Y	5.0	1.5†	1054 852	1054 856	1054 860	1054 864	1054 868	400 00
277/480Y	5.0	3.0†	1054 853	1054 857	1054 861	1054 865	1054 869	410 00

TYPE R-28

TWO-ELEMENT (THREE-CURRENT AND TWO POTENTIAL COIL) DUPLEX METERS FOR 3-PHASE, 4-WIRE "Y" SERVICE WITH SYNCHRONOUS MOTOR CLOCK

			*Meter with Stud Cover—Styles					
Volts	Amps.	Nom. Kw	5 Min. Interval	10 Min. Interval	15 Min. Interval	30 Min. Interval	60 Min. Interval	List Price
60 CYCLES								
120/208Y	2.5	.75†	1054 910	1054 914	1054 918	1054 922	1054 926	$310 00
277/480Y	2.5	1.5†	1054 911	1054 915	1054 919	1054 923	1054 927	325 00
120/208Y	5.0	1.5†	1054 912	1054 916	1054 920	1054 924	1054 928	310 00
277/480Y	5.0	3.0†	1054 913	1054 917	1054 921	1054 925	1054 929	325 00

① **Changed since previous issue.**

* Types R-23 and R-28 meters can be supplied with hinged covers, at no additional charge, if specified on order. They will not, however, be carried in stock.

† The meters for which styles are listed are supplied with registers corresponding to their nominal kw. rating. When transformers are used a multiplier, determined by the transformer ratios, must be applied to both the kilowatt-hour and kilowatt demand readings.

These meters can also be supplied with the register (but not the demand chart) arranged to correspond to the transformer ratios and a multiple of 10 multiplier marked on the kilowatt-hour dial at an extra charge of $1.30 list. The marking of the demand chart for these meters will correspond to their nominal kw. rating, but a multiplier corresponding to the transformer ratios will be specified on the nameplate of the meter. They will be non-standard and will not be carried in stock. Order, "similar to" the style listed "except for use with transformers" and specify the ratio of the transformers.

Order by Style Number

RECORDING DEMAND WATTHOUR METERS—Continued

ACCESSORIES

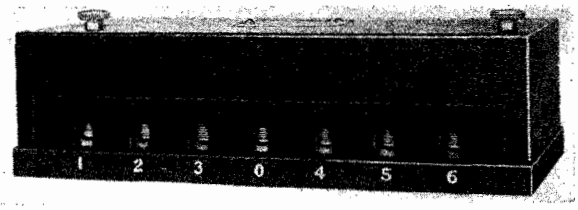


FIG. 10—PHASE SHIFTING TRANSFORMER—COVER ON

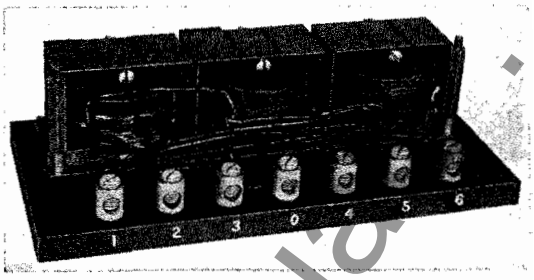


FIG. 11—PHASE SHIFTING TRANSFORMER—COVER OFF

Ink

The ink listed below is "quick drying" and should be used with the meters listed in this catalog.

The bottles in which this ink is supplied are furnished with droppers for filling the ink reservoir on the meter.

LIST PRICES

Two Ounce Bottle	①Style No.	List Price
Red Ink	256 332	$ 0 35
Green Ink	1003 720	0 35
Blue-Print Ink	1003 719	0 35

Ratchets

The Phase Shifting Transformers listed, Figures 10 and 11, may be for preventing reversed rotation on reversal of power. When a ratchet attachment is to be supplied on single meters or on only one register of Duplex Meters add **$1.00 net** to the net price of the meter or when supplied on both registers of a Duplex Meter add **$2.00 net.**

Phase Shifting Transformers

The Phase Shifting Transformers listed, Figures 10 and 11, may be used with single meters for measuring reactive kilovolt ampere demand or with duplex meters for measuring both the reactive kva and the kw demand. They may also be used with conventional polyphase watthour meters for measuring Reactive Kilovolt ampere hours, provided the potential terminals of the watthour meter are independent of the current terminals.

These transformers consist of a suitable number of small tapped coils mounted on a common base, provided with terminals so that they can be connected to the meters with which they are used. The permanent taps on the coils are internally connected so that when connected to the metering element it will cause the meter to correctly measure the sine instead of the cosine component of Kv-a.

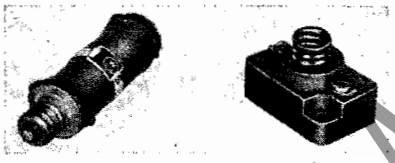


FIG. 12—HEATER AND RECEPTACLE

The types K-3, K-4, K-7, and K-9 are connected for specific circuit applications as indicated in the application chart.

The type K-5 transformers are basically three-wire transformers with additional taps and terminals to make them suitable for services other than three-phase three-wire, as indicated in the application chart.

The various types of transformers are applicable as follows:

Service	Meter	Type	Transformer Connections
3 wire network	2 element	K-5	Line-to-common
3 phase 3 wire Delta	2 element	K-3	Line-to-line
3 phase 4 wire "Y"	3 element	K-4	Line-to-neutral
		K-5	Line-to-neutral
	2½ element self-contained or two potential transformers.	K-5	Line-to-neutral
	2½ element self-contained or three potential transformers	K-4	Line-to-neutral
3 phase 4 wire Delta	2	K-7	Line-to-line*
	2	K-5	Line-to-line*
	3	K-9	Line-to-line*
		K-5	Line-to-line*

* Polyphase circuit.

①LIST PRICES

Phase Shifting Transformers

Volts	Cycles	Style No.	List Price
TYPE K-3 (3-WIRE)			
120	60	938 636	$15 00
240	60	938 637	15 00
480	60	938 638	15 00
600	60	938 639	15 00
TYPE K-4 (4-WIRE)			
120	60	938 646	18 00
240	60	938 647	18 00
480	60	938 648	18 00
600	60	938 649	18 00
TYPE K-5			
120	60	1 155 763	18 00
240	60	1 155 764	18 00
TYPE K-7			
120	60	1 094 969	15 00
240	60	1 094 970	15 00
480	60	1 094 971	15 00
TYPE K-9			
240	60	1 094 974	18 00
480	60	1 094 975	18 00

①Alarm Contacts

Any of the meters listed can be supplied with adjustable contacts for one, two or three positions for operating a signal lamp or sounding an alarm whenever a predetermined value of demand has been reached. The contacts are designed to carry up to approximately 25 watts inductive load.

This device is designed so as not to have any perceptible effect upon the meter accuracy and it does not interrupt the demand record even though it continues to increase after the contacts have been closed.

When alarm contacts are to be supplied with single meters, or on one register of a Duplex meter, add the following list prices of **$40.00** for single position, **$45.00** for two position, and **$50.00** for three position to the list price of the meter. When they are to be supplied on both registers of Duplex meters, add twice the list price of the contact to the list price of the meter.

When meters are required with alarm contacts, they should be ordered, "Simi-

① Changed since previous issue.

RECORDING DEMAND WATTHOUR METERS—Continued

ACCESSORIES—Continued

lar to the style listed for the meter, except with alarm contacts."

①Heaters

When demand meters are mounted in outdoor meter houses in cold climates or in other locations of low temperature it is desirable to install a small heater inside the meter case.

The heaters listed consist of a small resistance unit of approximately 30-watt consumption. The candelabra base listed consists of a moulded base to which is attached a socket for the heater unit. The bases of all meters listed are drilled and tapped for mounting the heater receptacle below the clock.

Any of the Type R meters listed can be supplied with Thermostat for heater control at **$11.00 List**, additional to the list price of the meter.

Heater Units Only

Volts	Style No.	①List Price
115	332 977	$2 80
230	363 445	3 50
460	363 446	5 00
575	363 447	5 50

①Heater Receptacle

	Style No.	List Price
All Voltages	332 947	$0 60

The same list price applies whether heaters and bases are ordered on new meters or on separate order for installation in meters already installed.

①CONTACT CLOCK AND SOLENOID TRIPPING FEATURE FOR SIMULTANEOUSLY TRIPPING TWO OR MORE METERS

When it is desirable for any reason, to obtain duplicate readings on two or more meters measuring the same service or to obtain a comparison of the demand of two or more services it is essential that all meters involved be tripped simultaneously. For example, a power consumer may desire, for demand control purposes, to install a duplicate meter at a point from which the power he is using may be controlled.

If the power user's meter is to provide a duplicate record of the power supplier's meter at all times, both meters must be tripped simultaneously.

To assure simultaneous tripping it is recommended that one of the meters be provided with a contact on the tripping mechanism which will operate at the instant of tripping to energize a solenoid tripping device on the other meter.

When any of the meters listed are to be supplied with a contact device on the tripping mechanism, **$10.00 list** should be added to the list price of the meter.

When any of the meters listed are to be supplied with a solenoid operated tripping mechanism, **$5.00 list** should be added to the list price of the meter.

Except when otherwise specified on the order, the contact device and solenoid device will be supplied for operation from a single phase, 115 volt, 60 cycle power source. Only approximately 25 milliamperes at 115 volts, 60 cycles is required for operating the solenoid. A two conductor telephone cable with #19 wire provides an excellent transmission channel provided the distance between meters does not exceed approximately 1500 feet. If the meters are located so far apart as to warrant the use of a leased telephone line, rectox rectifier and insulating units designed for this purpose can be supplied upon request.

Demand Charts

The demand charts listed are accurately ruled and have the hours stamped on the zero margin with the space between the hour markings sub-divided with light lines to conform to the demand interval for which they are intended.

When ordering demand charts care should be taken to select the style of chart for which the full load and full scale Kw. markings conform to the Kw. values for full load and full scale deflections of the pen. The table of styles and list prices for demand charts is arranged to serve as a guide in the proper selection of demand charts for the various types and ratings of meters listed. The length of the charts and the number of days for which they are suitable are included in this table.

The meters listed for 2½ amperes are intended for use with 5 ampere secondary current transformers. When these meters are operated on 5 ampere secondary current transformers, the moving element rotates at double the speed of the 5 ampere meters for the same primary load but the registers are designed to give equal pen deflections on the chart. Therefore, the kw capacity of the chart should be based on the nominal kw capacity of the 5 ampere meters.

LIST PRICES—DEMAND CHARTS

For Meters Types R-2, R-22, R-7 and R-10—2½ and 5 Ampere

Demand Inter. in Min.	Length in Ft.	Capacity in Days*	120 VOLTS			240 VOLTS			480 VOLTS			600 VOLTS			List Price Per Roll
			CAPACITY IN KW		Style	CAPACITY IN KW		Style	CAPACITY IN KW		Style	CAPACITY IN KW		Style	
			F.L.	F.S.		F.L.	F.S.		F.L.	F.S.		F.L.	F.S.		
5	20	12	1.0	1.0	838 444	2.0	2.0	838 445	4.0	4.0	838 446	5.0	5.0	838 447	$0 35
5	20	12	1.0	1.5	286 931	2.0	3.0	286 932	4.0	6.0	286 933	5.0	7.5	375 087	35
5	56	36	1.0	1.5	818 236	2.0	3.0	818 237	4.0	6.0	....	5.0	7.0	....	1 25
10	27	32	1.0	1.0	280 501	2.0	2.0	280 502	4.0	4.0	280 503	5.0	5.0	838 449	60
10	27	32	1.0	1.5	375 344	2.0	3.0	375 345	4.0	6.0	375 346	5.0	7.5	375 347	60
15–30–60	20	36	1.0	1.0	277 633	2.0	2.0	277 634	4.0	4.0	277 635	5.0	5.0	838 451	35
15–30–60	20	36	1.0	1.5	237 204	2.0	3.0	263 096	4.0	6.0	263 097	5.0	7.5	357 263	35

* The length of these charts is sufficient to provide a record for the number of days indicated with an additional length of at least two feet for inserting the chart into the meter.

① Changed since previous issue.

(Continued on next page)

RECORDING DEMAND WATTHOUR METERS—Continued

LIST PRICES—DEMAND CHARTS—Continued

For Meters Types R-3, R-23, R-8, R-28 and R-9—2½ and 5 Ampere

Demand Inter. in Min.	Length in Ft.	Capacity in Days*	120 VOLTS			240 VOLTS			480 VOLTS			600 VOLTS			List Price Per Roll
			CAPACITY IN KW		Style	CAPACITY IN KW		Style	CAPACITY IN KW		Style	CAPACITY IN KW		Style	
			F.L.	F.S.		F.L.	F.S.		F.L.	F.S.		F.L.	F.S.		
5	20	12	1.5	1.5	286 931	3.0	3.0	286 932	6.0	6.0	286 933	7.5	7.5	375 087	35
5	56	36	1.5	1.5	818 236	3.0	3.0	818 237	6.0	6.0	....	7.5	7.5	....	1 25
5	20	12	1.5	2.25	375 078	3.0	4.5	375 079	6.0	9.0	375 080	7.5	11.25	375 081	35
10	27	32	1.5	1.5	375 344	3.0	3.0	375 345	6.0	6.0	375 346	7.5	7.5	375 347	60
10	27	32	1.5	2.25	838 456	3.0	4.5	838 457	6.0	9.0	838 458	7.5	11.25	838 459	60
15-30-60	20	36	1.5	1.5	237 204	3.0	3.0	263 096	6.0	6.0	263 097	7.5	7.5	357 263	35
15-30-60	20	36	1.5	2.25	280 943	3.0	4.5	282 214	6.0	9.0	282 215	7.5	11.25	375 082	35

* The length of these charts is sufficient to provide a record for the number of days indicated with an additional length of at least two feet for inserting the chart into the meter.

APPROXIMATE WEIGHTS

Apparatus	Quantity	Packing for Domestic Shipments: Net Weight in Pounds	Packing for Domestic Shipments: Shipping Weight in Pounds	Packing for Export Shipments (Ocean): Net Weight in Pounds	Packing for Export Shipments (Ocean): Legal Weight in Pounds	Packing for Export Shipments (Ocean): Gross Weight in Pounds
Types R-2, R-7, R-8 and R-10 meters	1	34	48	34	48	78
Types R-3 and R-9 meters	1	44	121	44	121	121
Types R-22 and R-28 meters	1	71	105	71	105	238
Type R-23 meter	1	67	109	67	109	241
Type K-3 reactive compensator	1	6	12	6	12	35
Type K-4 reactive compensator	1	8	14	8	14	37
DEMAND CHARTS						
20 ft. rolls	10	...	...	...	...	...
27 ft. rolls	10	...	...	...	...	...
56 ft. rolls	10	...	...	...	...	...
INK						
2-oz. bottle	4	1½	4	1½	4	15

APPROXIMATE DIMENSIONS IN INCHES OF SHIPPING CASES FOR EXPORT PACKING

Apparatus	Quantity	Dimensions
Types R-2, R-7, R-8 and R-10 meters	1	26 x 21 x 23
Types R-3 and R-9 meters	1	23 x 23 x 19
Types R-22 and R-28 meters	1	35 x 29 x 34
Type R-23 meters	1	35 x 29 x 34
Type K-3 reactive compensator	1	15 x 10 x 6
Type K-4 reactive compensator	1	15 x 10 x 6
DEMAND CHARTS		
20 or 27 ft. rolls	10	.....
56 ft. rolls	10	.....
INK		
2-oz. bottles	4	12 x 10 x 6

TYPICAL PERFORMANCE CURVES

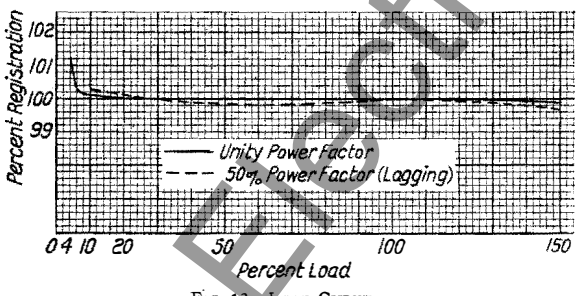


FIG. 13—LOAD CURVE

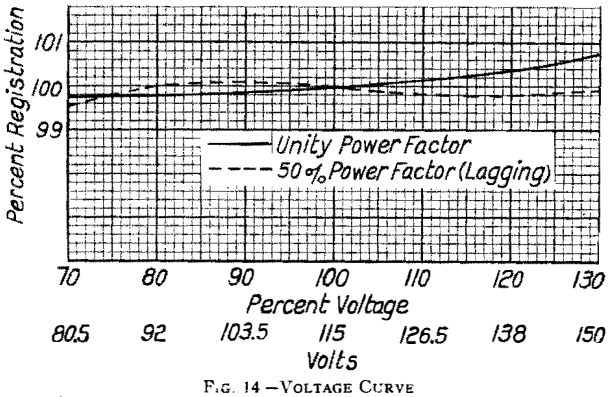


FIG. 14—VOLTAGE CURVE

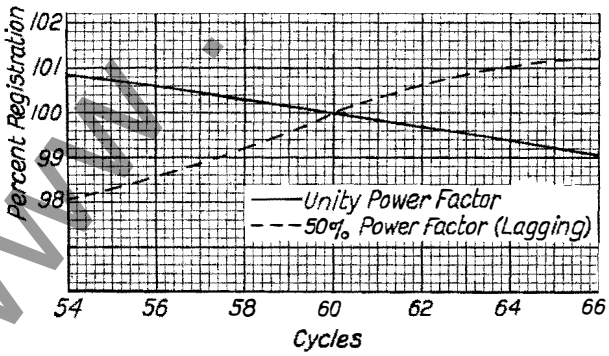


FIG. 15—FREQUENCY CURVE

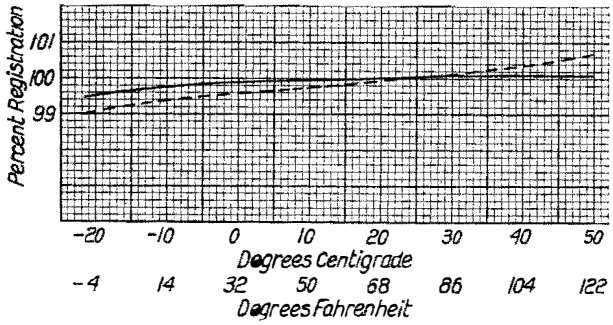


FIG. 16—TEMPERATURE CURVE

RECORDING DEMAND WATTHOUR METERS—Continued

CONNECTION DIAGRAMS—SINGLE METERS

(Front Views)

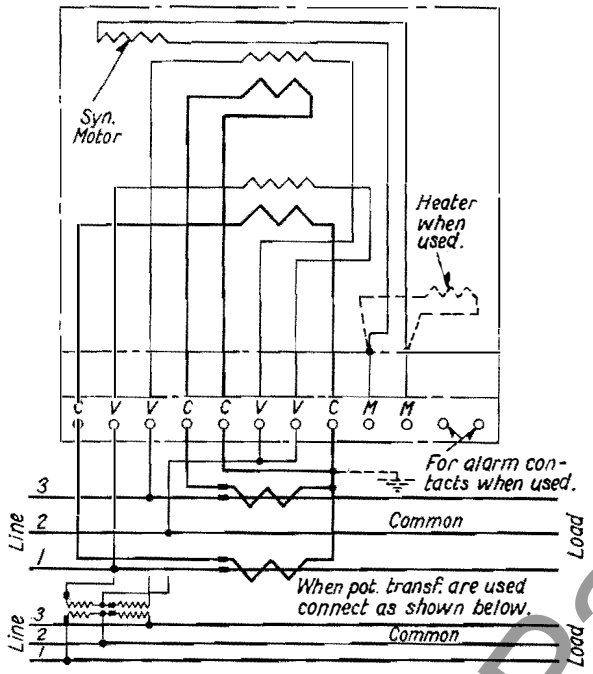


FIG. 17—TYPE R-2 TWO OR THREE PHASE THREE-WIRE WITH TRANSFORMERS

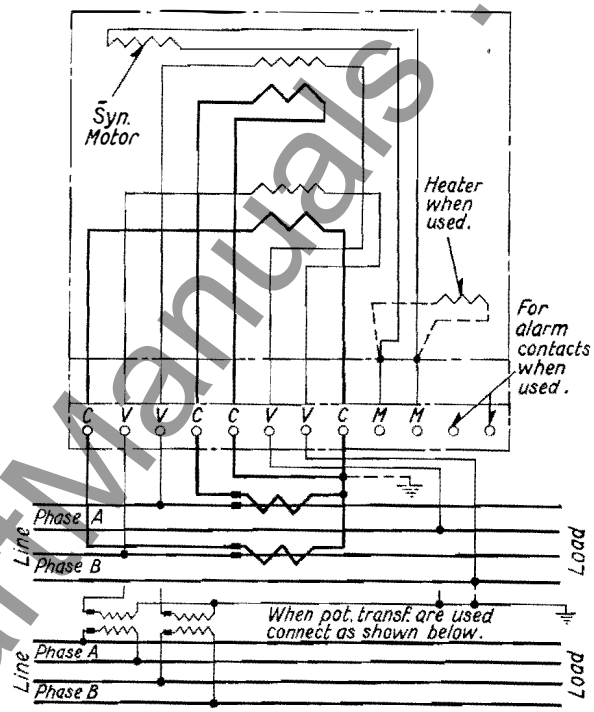


FIG. 18—TYPE R-2 TWO PHASE FOUR-WIRE WITH TRANSFORMERS

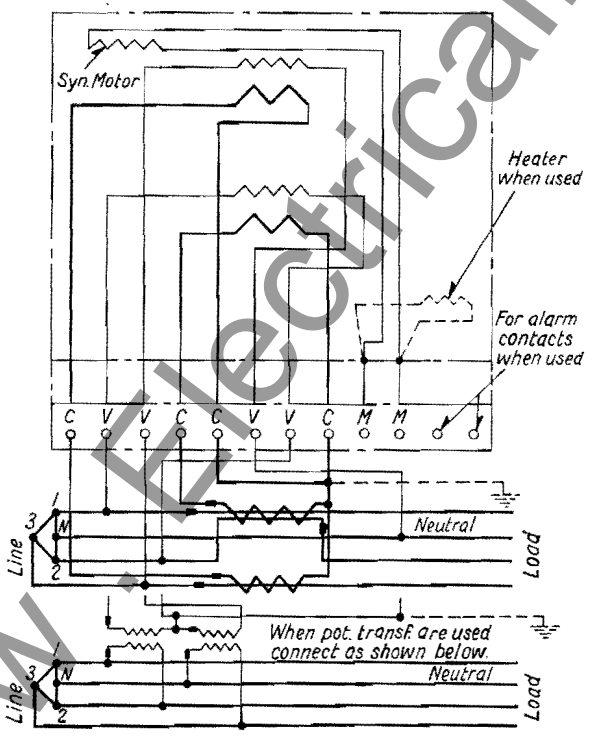


FIG. 19—TYPE R-2 THREE PHASE FOUR-WIRE DELTA USING ONE TWO-WIRE AND ONE THREE-WIRE CURRENT TRANSFORMER OF EQUAL RATIO

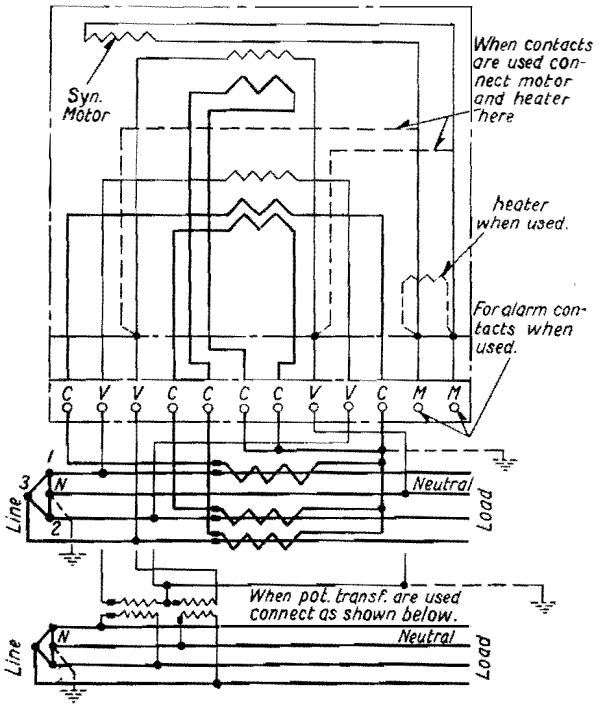


FIG. 20—TYPE R-7 THREE PHASE FOUR-WIRE DELTA USING THREE TWO-WIRE CURRENT TRANSFORMERS OF EQUAL RATIO

RECORDING DEMAND WATTHOUR METERS—Continued

CONNECTION DIAGRAMS—SINGLE METERS—Continued

(Front Views)

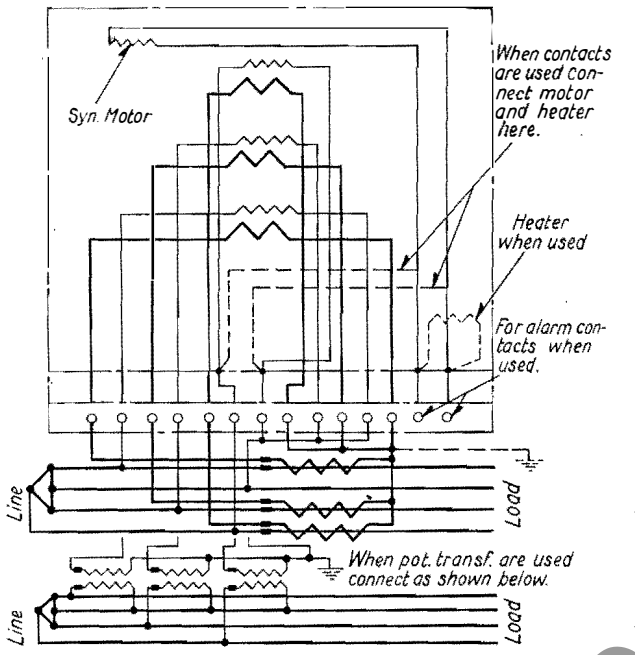


FIG. 21—TYPE R-9 THREE PHASE FOUR-WIRE DELTA USING THREE TWO-WIRE CURRENT TRANSFORMERS OF EQUAL RATIO

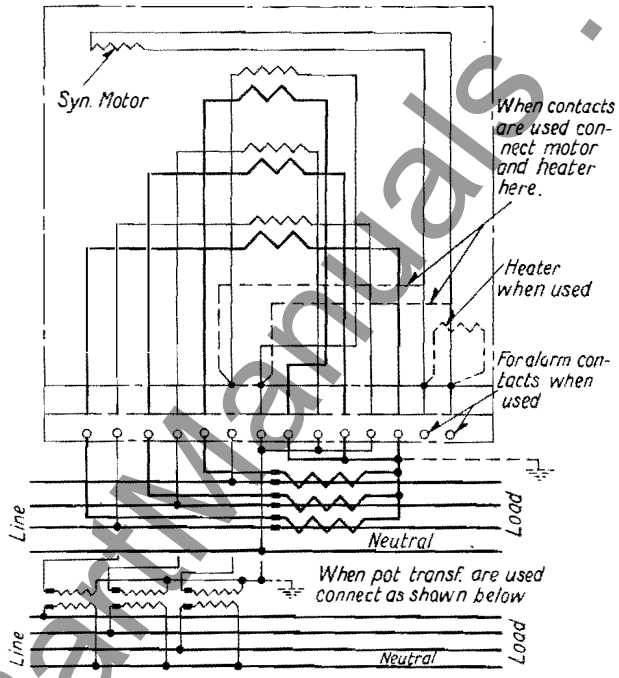


FIG. 22—TYPE R-3 THREE PHASE FOUR-WIRE "Y" WITH TRANSFORMERS

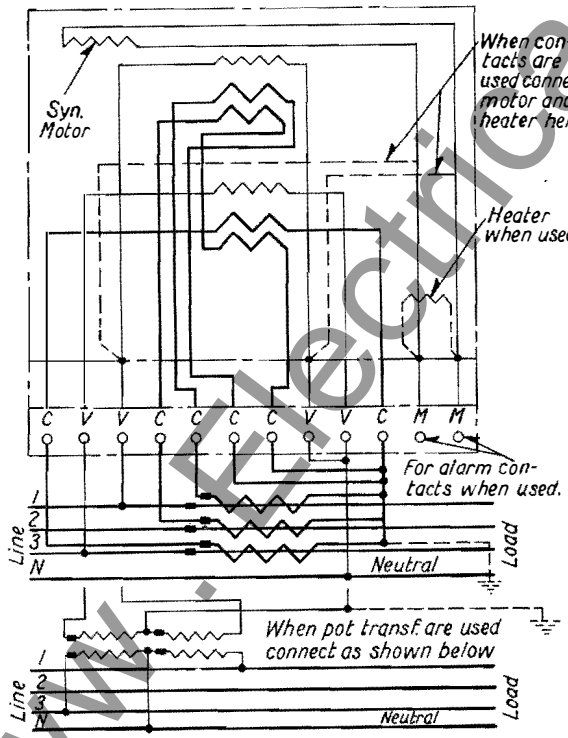


FIG. 23—TYPE R-8 THREE PHASE FOUR-WIRE "Y" WITH TRANSFORMERS

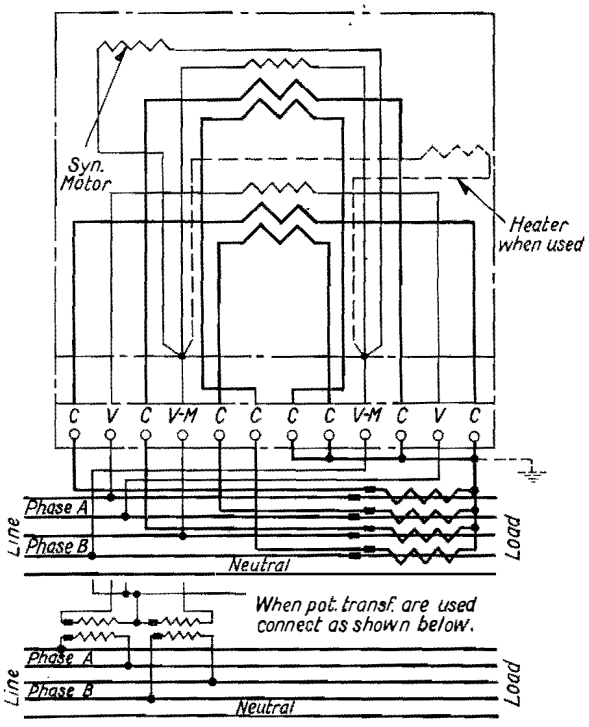


FIG. 24—TYPE R-10 TWO PHASE FIVE-WIRE WITH TRANSFORMERS

RECORDING DEMAND WATTHOUR METERS—Continued

CONNECTION DIAGRAMS—DUPLEX METERS

(Front Views)

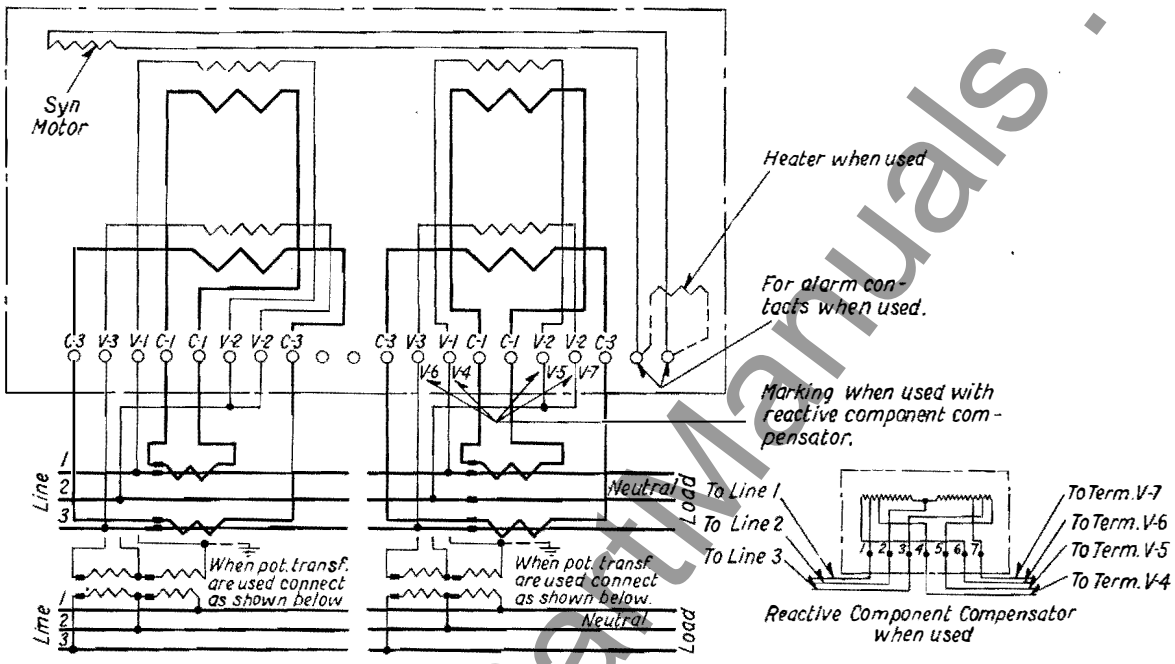


FIG. 25—TYPE R-22 DUPLEX TWO OR THREE PHASE THREE-WIRE WITH TRANSFORMERS

• ①NOTE: WHEN THE REACTIVE COMPONENT COMPENSATOR IS CONNECTED AS SHOWN ABOVE FOR MEASURING REACTIVE KV-A,, VOLTAGE 4-5 IS 90° FROM VOLTAGE 1-2. VOLTAGE 5-6 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 4-5 MUST BE REVERSED AT REACTIVE COMPONENT METER OR AT THE COMPENSATOR, 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 RATCHET.

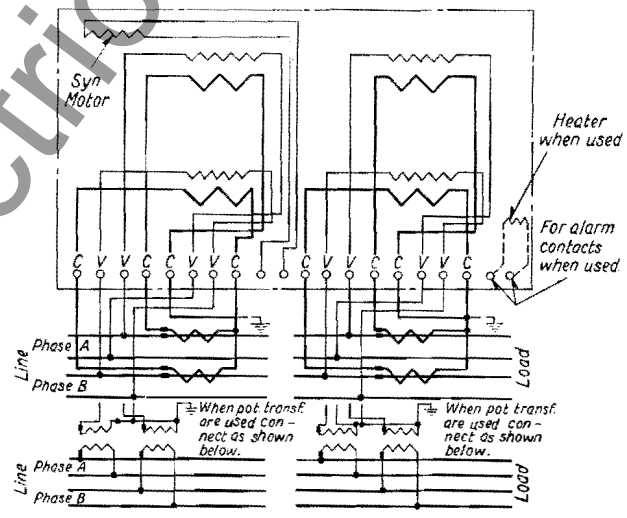


FIG. 26—TYPE R-22 DUPLEX TWO PHASE FOUR-WIRE WITH TRANSFORMERS

NOTE: A REACTIVE COMPONENT COMPENSATOR 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.

① Changed since previous issue.

RECORDING DEMAND WATTHOUR METERS—Continued

CONNECTION DIAGRAMS—DUPLEX METERS—Continued

(Front Views)

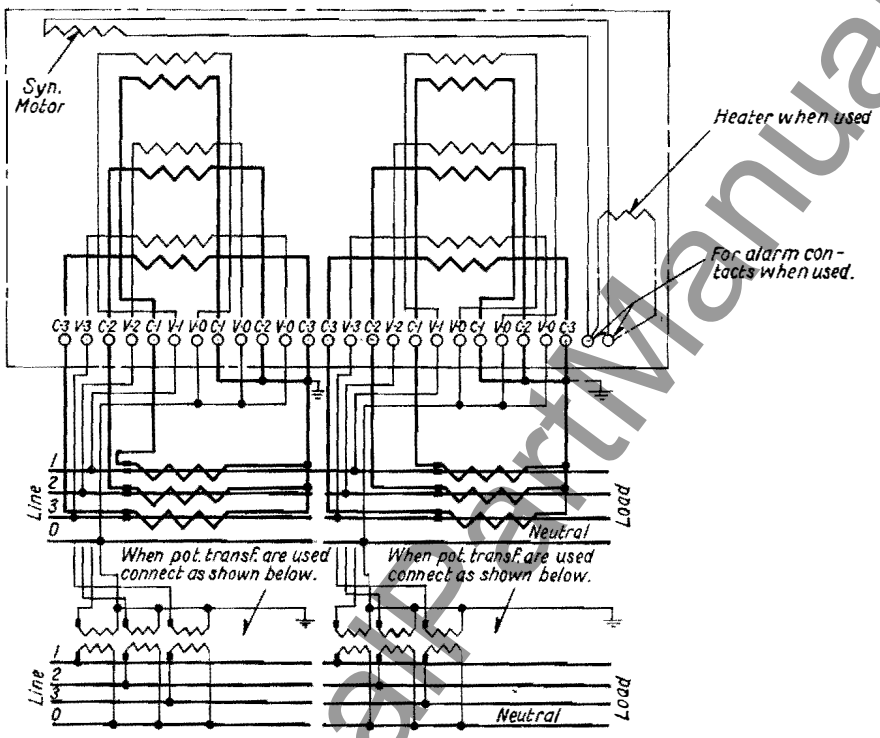
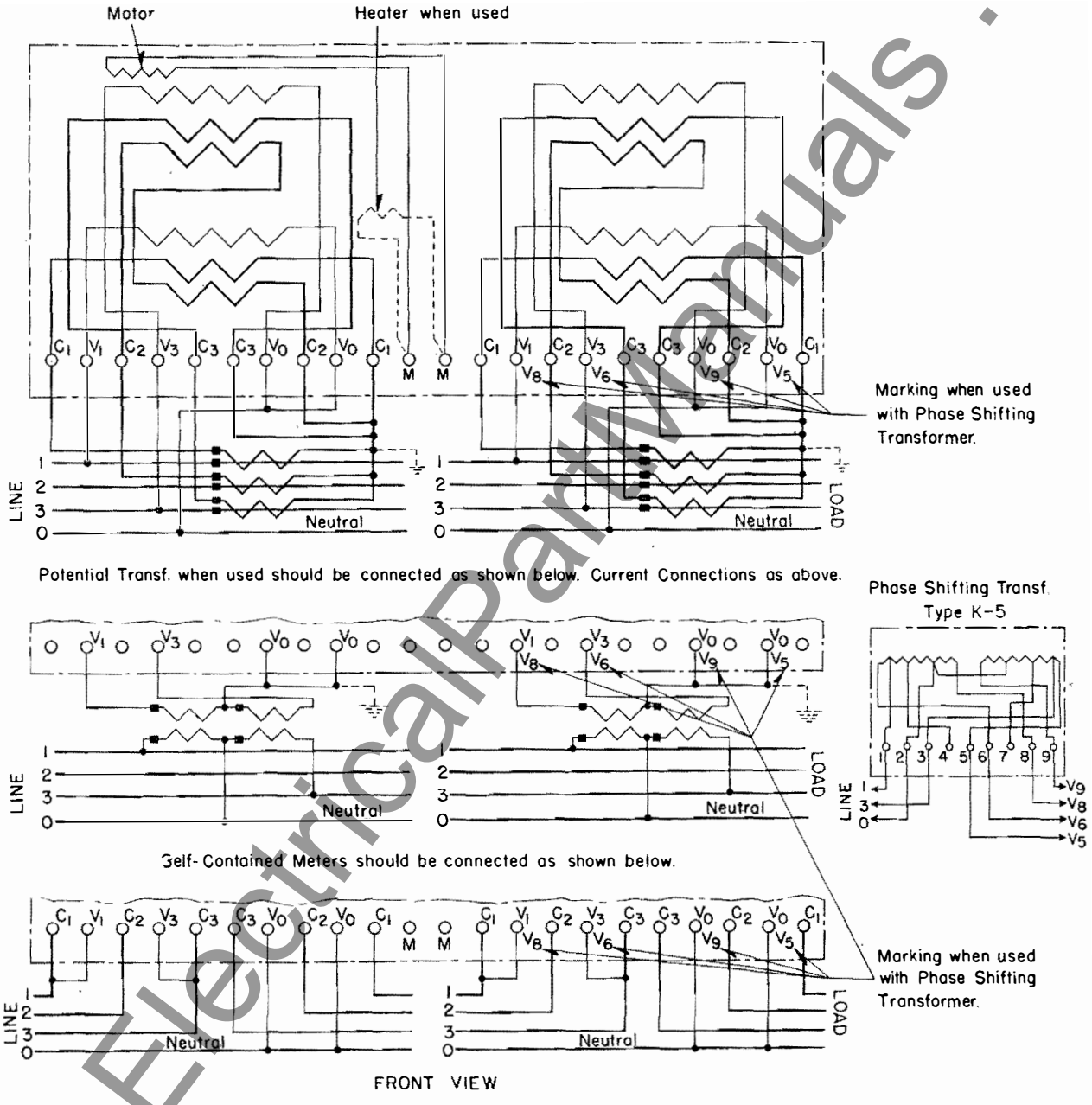


FIG. 27—TYPE R-23 THREE PHASE FOUR-WIRE "Y" WITH TRANSFORMERS

RECORDING DEMAND WATTHOUR METERS—Continued

CONNECTION DIAGRAMS—DUPLEX METERS—Continued

(Front Views)



(1) FIG. 28—TYPE R-28 THREE PHASE FOUR-WIRE WITH K-5 COMPENSATOR WHEN USED

NOTE: VOLTAGE 8-5 IS 90° FROM VOLTAGE 1-2, VOLTAGE 6-9 IS 90° FROM VOLTAGE 8-2.

CONNECTIONS ARE MADE FOR FORWARD ROTATION OF REACTIVE COMPONENT METER WHEN POWER FACTOR IS LAGGING AND PHASE ROTATION IS 1-2-3.

IF PHASE ROTATION IS REVERSED, LEADS 8-5 MUST BE REVERSED AT REATIVE COMPONENT METER OR AT THE TRAMSFORMER, 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 ROATION WHEN POWER FACTOR CHANGES FROM LAG TO LEAD, OR VICE VERSA, THE REACTIVE COMPONENT METER MUST BE EQUIPPED WITH A RATCHET.

(1) Changed since previous issue.

RECORDING DEMAND WATTHOUR METERS—Continued

OUTLINE DIMENSIONS IN INCHES

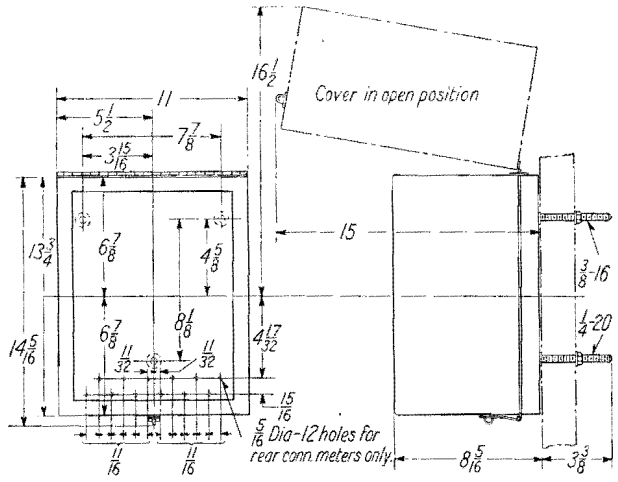


FIG. 29—TYPES R-2, R-7, R-8 AND R-10—HINGED COVER

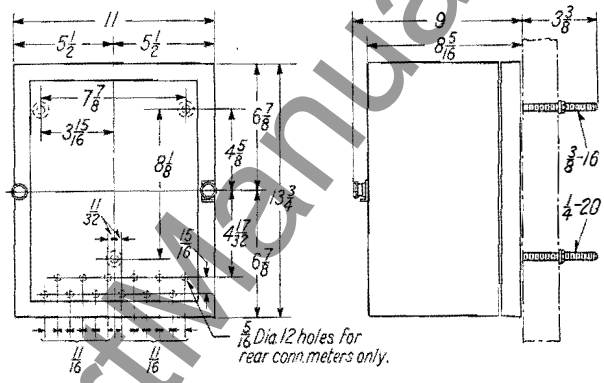


FIG. 30—TYPES R-2, R-7, R-8 AND R-10—STUD COVER

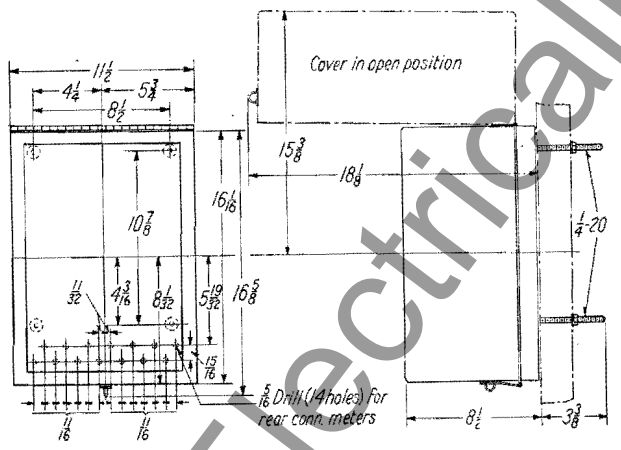


FIG. 31—TYPES R-3 AND R-9—HINGED COVER

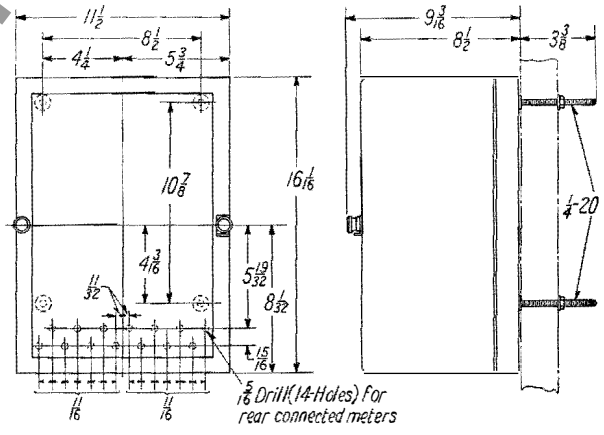


FIG. 32—TYPES R-3 AND R-9—STUD COVER

RECORDING DEMAND WATTHOUR METERS—Continued

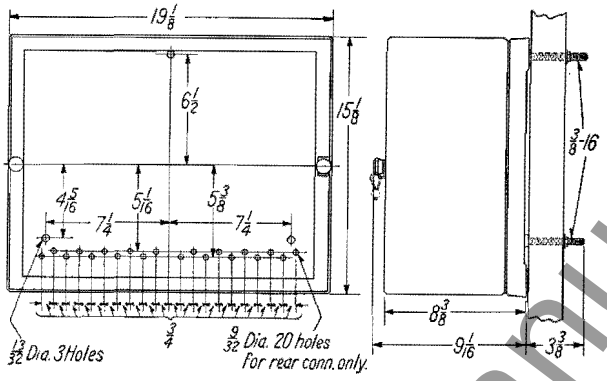


FIG. 33—TYPES R-22 AND R-28—STUD COVER

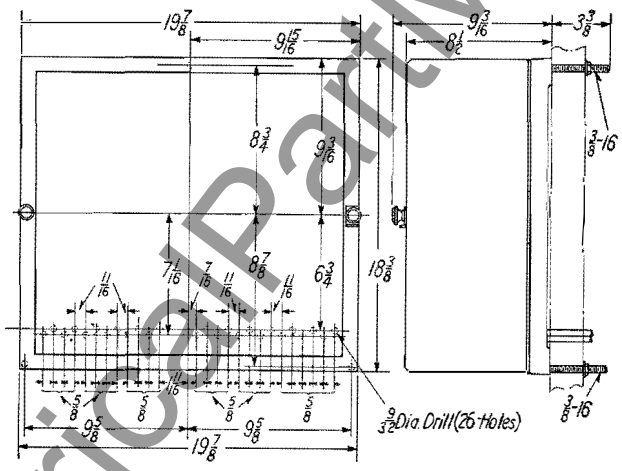


FIG. 34—TYPE R-23—STUD COVER

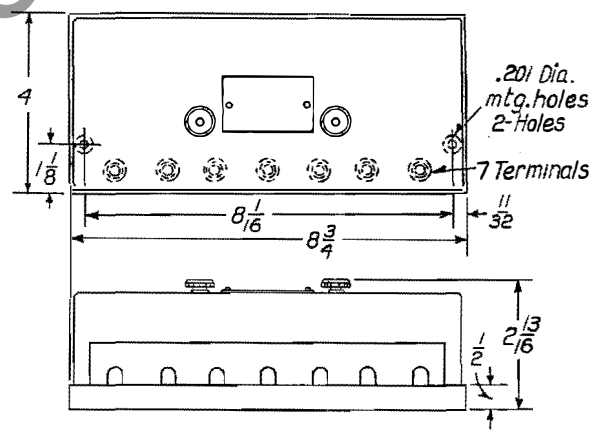


FIG. 35—TYPES K-3, K-4, K-5, K-7 AND K-9 PHASE SHIFTING TRANSFORMERS

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