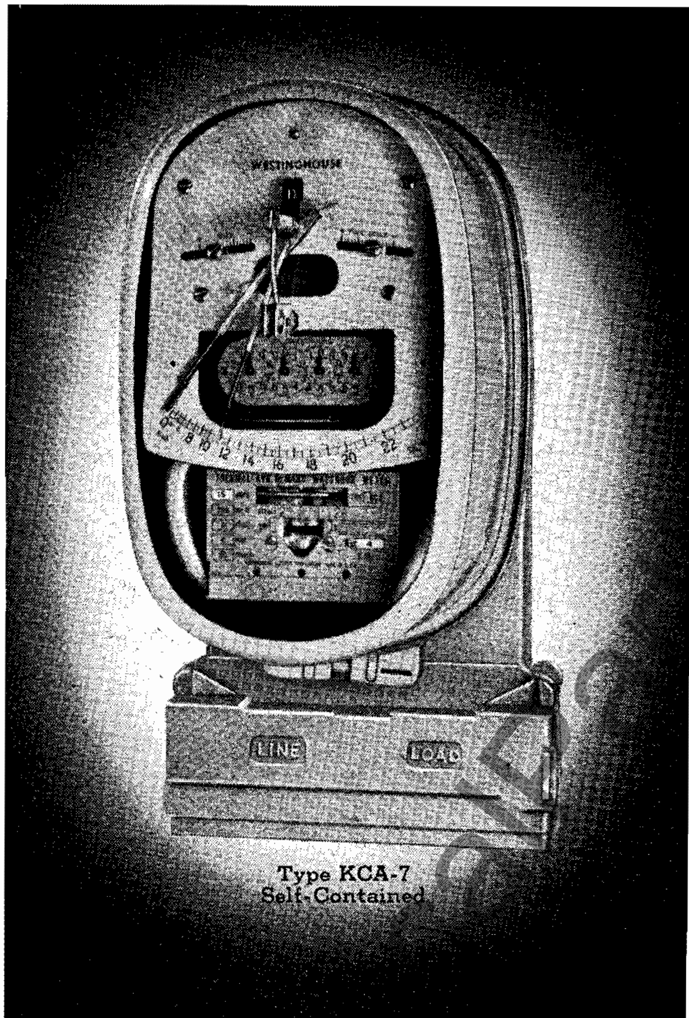
POLYPHASE KVA DEMAND METERS
COMBINATION WATTHOUR AND THERMAL
TYPES KCA-2, KCA-5, KCA-7, KCA-8

SELF-CONTAINED AND TRANSFORMER TYPES • 3-PHASE • 3- AND 4-WIRE



Type KCA-7
Self-Contained

TYPE KCA POLYPHASE WATTHOUR AND THERMAL KVA DEMAND METER is a combination of the Type CA polyphase meter and a thermal KVA demand meter in one unit. The meter measures both kilowatt hours and maximum KVA demand.

The KVA demand unit consists of both a current thermal element and a voltage thermal element. An indicating pointer is geared to the shaft of the current element which is connected, through a linkage, to the shaft of the voltage element. A pointer deflection, caused by the current element, is modified through the linkage by the voltage element to give a reading of KVA demand on the logarithmic principle.

The thermal KVA demand unit and two-element polyphase watthour meter are both mounted in a standard three-element base. Overall dimensions are the same as for the Type CA-3 meter except for an increased overall depth due to the demand type cover. The meter terminal block connections for all types are the same as for the corresponding standard watthour meters.

WESTINGHOUSE SPECIAL FEATURES

1 **UNIQUE IN DESIGN**—A very simple method of measuring KVA demand with a meter having a minimum of movable parts and a wide operating range.

2 **SIMPLIFIED INSTALLATION**—One mounting for both watthour and KVA demand meter. This eliminates one of the major problems in applying thermal demand meters.

3 **LOW MAINTENANCE**—The characteristics of the thermal meter make it more nearly approach the low maintenance of the standard watthour meter. Test schedules can be arranged on the same basis as for separate watthour meters.

4 **MINIMUM SIZE**—Overall dimensions are the same as for a three-element watthour meter except for the increased depth of the demand type cover.

New Information
E43-1, 2, 3, 5B; D65-1, 2, 3, 5B; C29-1, 2, 3, 5J
Classified File

EFFECTIVE AUGUST 4, 1950

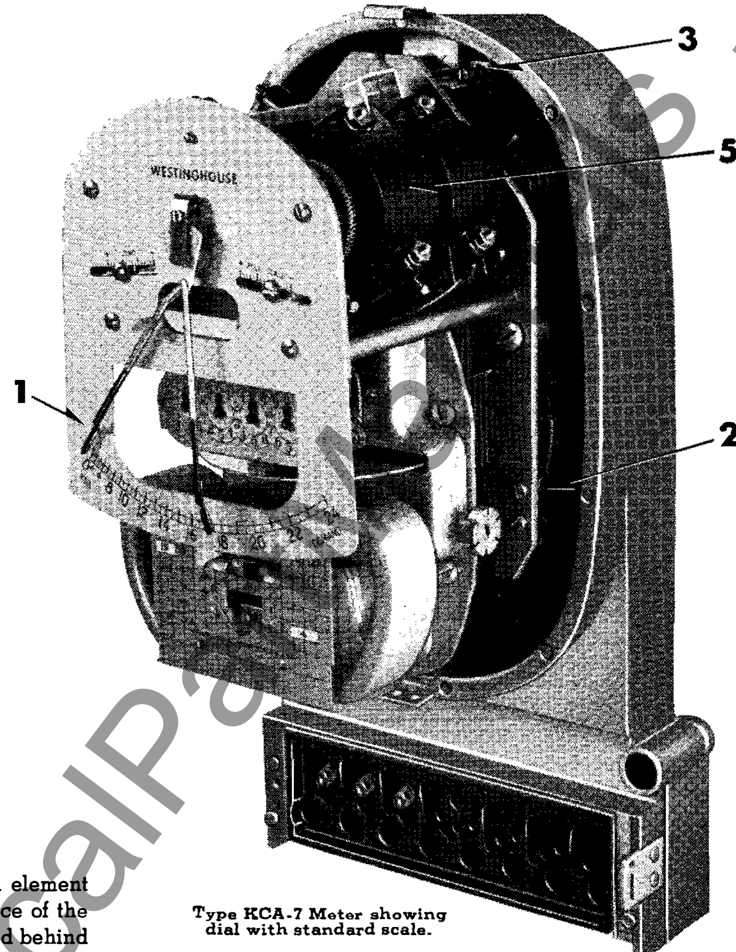
CONSTRUCTION

A polyphase watthour meter and a polyphase thermal KVA demand meter are both mounted on a standard three-element base. The meters are separate and neither interferes with the operation of the other.

The watthour meter consists of an electromagnet, frame, moving element, bearings, permanent magnet and register.

1. POINTERS do not interfere with the reading or accessibility of the watthour meter register. The demand scale is at the bottom of the dial. Two demand pointers are provided; one operates as a pusher and the other indicates maximum demand. They are returned to zero by means of a manually operated reset device in the glass cover.

2. INTERNAL CURRENT TRANSFORMERS are mounted at the rear on each side of the watthour meter frame. They are used to reduce the line current to a value which when dissipated in the thermal heater circuit will not raise the ambient temperature of the meter, and are an integral part of the phase shifting network required for correct operation of the demand element.



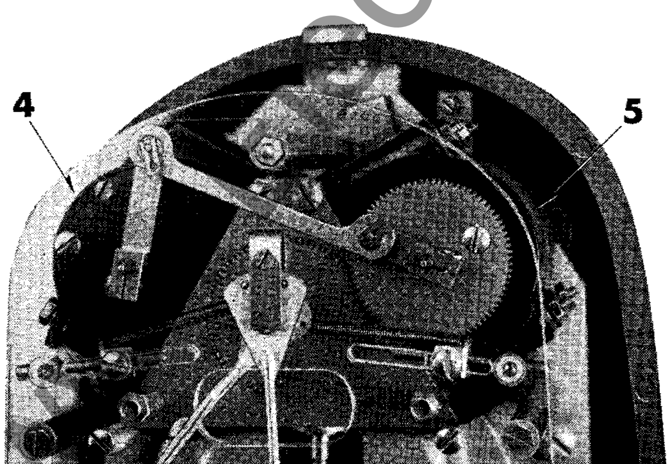
Type KCA-7 Meter showing dial with standard scale.

3. THE MUTUAL REACTOR of the current thermal element is mounted at the top of the meter. The resistance of the current thermal circuit is the spool of wire mounted behind the current thermal unit. Separate heaters are used to heat the rear spring of the thermal bimetallic shaft. The front spring acts as a compensator for ambient temperature changes.

4. THE VOLTAGE ELEMENT operates from a small transformer mounted in the rear of the meter above the electromagnets. The secondary is connected to the rear spring of the thermal element bimetallic shaft assembly.

5. THE CURRENT ELEMENT is linked to the voltage element and the pointer is geared to the current element shaft. The connecting link is easily removed for calibration purposes.

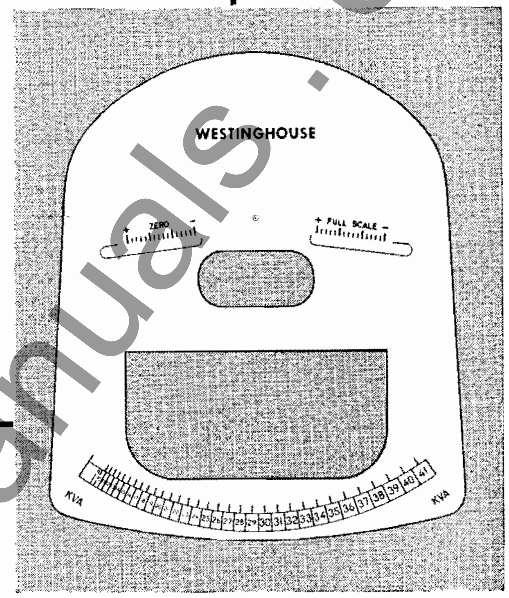
ADJUSTMENTS—The watthour meter elements have standard adjustments for full load, light load, balance and power factor. The thermal elements have adjustments for the position of the pusher pointer at zero and full scale. The thermal elements also have adjustments for mutual reactor and linkage mechanism.



Close-up view of thermal elements and linkage mechanism.

DEMAND DIALS

Demand dials are direct reading to suit the meter capacity and require no multiplier on the demand scale. They are available with either the standard scale or block type of scale marking.



Dial showing block type of scale marking.

APPLICATION

Heretofore, the relatively expensive initial cost and maintenance of KVA demand metering equipment has discouraged its use on smaller loads. The thermal KVA demand meter, with its low maintenance requirements, provides an economical means of measuring KVA demand on loads which have been too small to justify that type of metering.

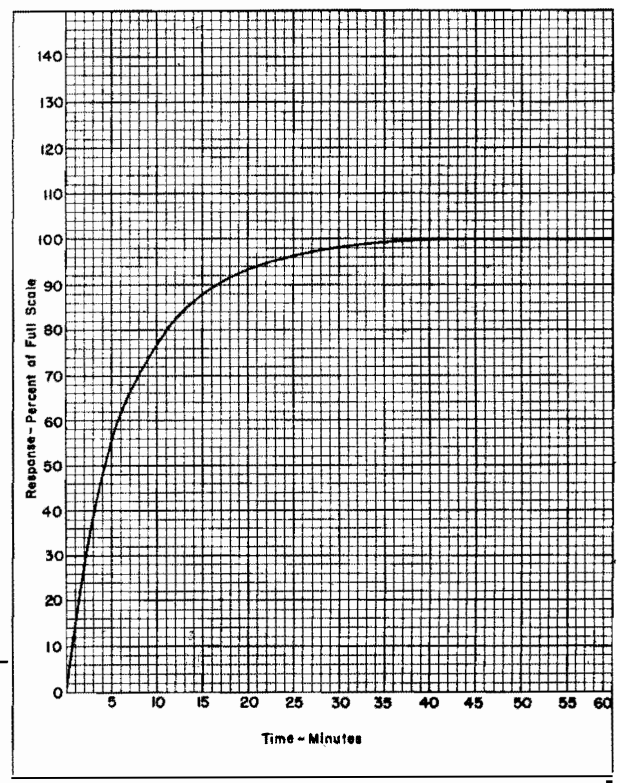
Self-Contained and Transformer Type Meters— For Use On:

Type KCA-2 . . . . 3-phase 3-wire service

Type KCA-5 . . . . 3-wire network systems

Type KCA-7 . . . . . . 3-phase 4-wire delta service

Type KCA-8 . . . . . . 3-phase 4-wire wye systems



TIME RESPONSE CURVE

Thermal demand meters have no definite time interval such as determined by timing devices in block interval demand meters. The time interval of a thermal meter is the time required for the meter to read 90 percent of the applied load, as shown on the curve.

PRINCIPLE OF OPERATION

The watthour meter proper operates on the induction principle entirely independent of, and unaffected by, the associated KVA thermal element.

TWO ELEMENTS—The KVA demand unit is comprised of two distinct elements—current and voltage. Separate thermal elements respond to current and voltage changes in the circuit. There is a leverage arm on each of the shafts and these are coupled by a movable link. The indicating pointer is geared to these linked shafts. The meter is basically a polyphase ampere demand meter whose reading is modified by voltage changes (acting through the voltage element) to give KVA.

PHASE SHIFTING—In the determination of polyphase ampere demand no measurements of the ampere demands of the individual phases give a true picture of the demand of the entire circuit. It is necessary to:

1. Employ a method of properly shifting the phase of voltages derived from the individual currents (these voltages proportional in magnitude to the magnitude of the currents).
2. Obtain their vector sum.
3. Apply this sum to a demand device.

No combination of the algebraic sums or differences of the currents will accomplish this.

The basis of the method of phase shifting is the fact that a given current flowing through a resistance will produce a voltage drop in phase with the current, while the same current flowing through the primary winding of a mutual inductance will produce an induced voltage in the secondary, which is ninety degrees out of phase with the current. The illustration at the right shows the basic circuit and vector diagrams for use on a three-phase, three-wire system.

The principles shown here are applicable to other polyphase circuits. "M" is a mutual inductance, "R" a resistor, "R_H" the heater resistor in the current thermal unit, and "N" the ratio of the current transformers.

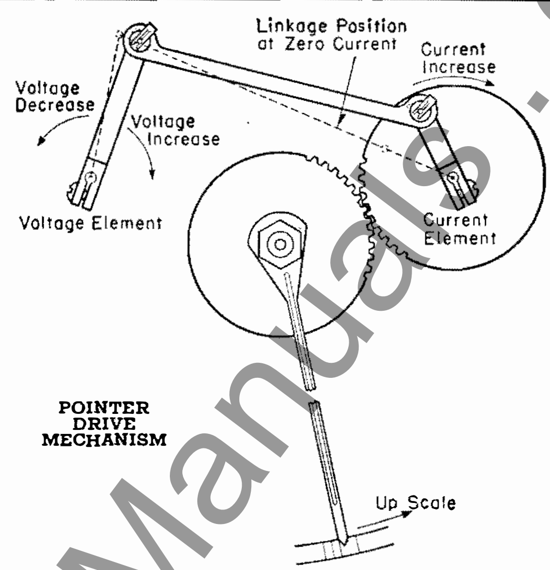
CIRCUIT KVA—For visualization of the operation the following assumptions can be made:

1. Balanced load of 5 amperes.
2. $R = \sqrt{3}$
3. $\omega M = 1$
4. N = 1 to 1; 2N = 2 to 1
5. The heater is open circuited.

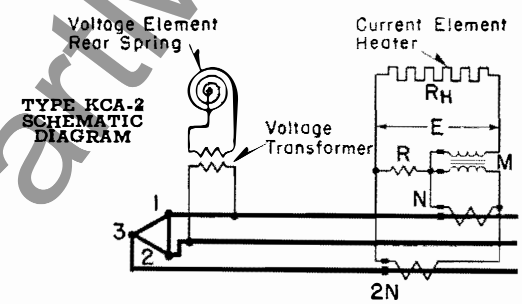
The current (5A) in line 3 (I_3) goes through the 2N transformer and a secondary current of 2.5 amperes flows through R and the mutual reactor primary in series. This results in drops of $2.5\sqrt{3}$ volts (across the resistor in phase with I_3) and 2.5 volts (across the mutual reactor secondary leading I_3 by 90°). These two add to give 5 volts which is the net voltage from I_3.

The current in line (I_1) goes through the N transformer and 5 amperes secondary current flows through the primary of the mutual reactor only. This causes a secondary voltage of 5 volts leading I_1 by 90°. The total voltage E is $5\sqrt{3}$ which is $\sqrt{3}$ times the voltage drop caused by either phase current. This is a correct measure of the KVA of the circuit which equals $\sqrt{3}$ VI or $\sqrt{3}$ times the KVA of one phase alone.

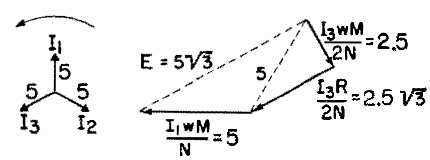
Now if the heater circuit is closed, a current will flow in R_H directly proportional to E. Heat produced in R_H activates the current element bimetal shaft. Currents of any magnitude



POINTER DRIVE MECHANISM



TYPE KCA-2 SCHEMATIC DIAGRAM



TYPE KCA-2 VECTOR DIAGRAMS

or power factor will cause a current in the heater proportional to the total volt amperes.

THE VOLTAGE DEMAND UNIT uses a direct heated bimetallic spring. A small transformer has its primary connected across one of the phases and its secondary connected directly to one of the bimetallic springs on a thermal shaft assembly. An arm on this shaft is coupled to an arm on the current element shaft by a movable link.

The mechanism is so arranged that when there is no load on the meter the link and the arm (on the current element shaft) are in line. Therefore, under these conditions, voltage variations do not cause any motion of the pointer. As soon as the load causes the current element to move the pointer off zero, variations in voltage affect the reading. The two thermal units and the linkage mechanism are so designed as to give a correct indication of KVA over a wide variation of voltage and currents. The meter takes into account individual magnitude variations of the currents and assumes that the voltages are balanced as it measures the variations of only one of the phases.

LIST PRICES—TYPE KCA TWO-ELEMENT METERS

METER TYPE	APPLICATION	VOLTS	AMPERES	FULL SCALE KVA	FULL SCALE AMPERES	STYLE NUMBER STANDARD SCALE	STYLE NUMBER BLOCK TYPE SCALE	LIST PRICE DISCOUNT SYMBOL B
TYPE KCA-2 3-Phase 3-Wire Service	**Self-Contained***	240	15	14.4	34.7	1543 783	1543 788	**$124.00**
		240	15	24.0	57.7	1542 933	1543 789	**124.00**
		240	50	41.6	100.0	1543 784	1543 790	**133.00**
		480	15	28.8	34.7	1543 785	1543 791	**132.00**
		480	15	48.0	57.7	1543 786	1543 792	**132.00**
		480	50	83.2	100.0	1543 787	1543 793	**141.00**
	For Use With Transformers†	120	2.5	1.2	5.77	1543 794	1543 800	**123.00**
		120	5.0	2.0	9.66	1543 795	1543 801	**123.00**
		240	2.5	2.4	5.77	1543 796	1543 802	**125.00**
		240	5.0	4.0	9.66	1543 797	1543 803	**125.00**
		480	2.5	4.8	5.77	1543 798	1543 804	**133.00**
		480	5.0	8.0	9.66	1543 799	1543 805	**133.00**
TYPE KCA-5 3-Wire Network Service	**Self-Contained***	120	15	7.2	30.0	1543 806	1543 808	**120.00**
		120	15	12.0	50.0	1542 934	1543 809	**120.00**
		120	50	24.0	100.0	1543 807	1543 810	**131.00**
	For Use With Transformers†	120	2.5	1.2	5.0	1543 811	1543 813	**121.00**
		120	5.0	2.0	8.33	1543 812	1543 814	**121.00**
TYPE KCA-7 3-Phase 4-Wire Delta Service	**Self-Contained***	240	15	14.4	34.7	1543 815	1543 817	**129.00**
		240	15	24.0	57.7	1542 935	1543 818	**129.00**
		240	50	41.6	100.0	1543 816	1542 400	**136.00**
	For Use With Three 2-Wire Current Transformers of Equal Ratio† (Not Suitable for Use With Both Current and Potential Transformers)§							
		240	2.5	2.4	5.77	1543 819	1543 821	**130.00**
		240	5.0	4.0	9.66	1543 820	1543 822	**130.00**
TYPE KCA-8 3 Current and 2 Potential Coils 3-Phase 4-Wire Wye Service	**Self-Contained***	120/208	15	10.8	30.0	1543 823	1543 828	**131.00**
		120/208	15	18.0	50.0	1542 936	1543 829	**131.00**
		120/208	50	36.0	100.0	1543 824	1543 830	**136.00**
		277/480	15	21.6	30.0	1543 825	1543 831	**134.00**
		277/480	15	36.0	50.0	1543 826	1543 832	**134.00**
		277/480	50	72.0	100.0	1543 827	1543 833	**139.00**
	For Use With Transformers†	120/208	2.5	1.8	5.0	1543 834	1543 838	**132.00**
		120/208	5.0	3.0	8.33	1543 835	1543 839	**132.00**
		277/480	2.5	3.6	5.0	1543 836	1543 840	**135.00**
		277/480	5.0	6.0	8.33	1543 837	1543 841	**135.00**

* Style number and list price for self-contained meters include meter complete with glass cover, but do not include potential indicating lamps. If potential indicating lamps are required add **$1.00 net** to net price of meter and suffix "PI" to style number.

These self-contained meters have six current terminals only and are not suitable for 2-phase, 4-wire service. When meters with eight current terminals for 2-phase, 4-wire service are desired, refer inquiry to Meter Division.

† Style number and list price for transformer type meters include potential indicating lamps. There will be no reduction in price should the meters be required without potential indicating lamps.

These meters are supplied with registers corresponding to their KW capacity without transformers. When used with transformers, the reading must be multiplied by the ratio of the transformers.

They can also be supplied with the register arranged to correspond to the transformer ratios and a multiple of 10 multiplier marked on the register dial, at an extra charge of **$1.30 list.** 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.

Standard ratchet attachments can be supplied at a net additional charge of **$1.00 each.**

Five dial registers are available on some of the above meters at no additional charge. Cyclometer registers can be supplied at an extra charge of **$0.45 list.**

§ Meters with 120 volt potential coils for use with both current and potential transformers can be supplied upon request.

Ordering Information

WHEN ORDERING—Specify the type, style number and complete meter rating. This will include the frequency, the voltage and ampere ratings, the demand scale required and the type service to which the meter will be applied. Inquiries for ratings other than those listed should be referred to the nearest District Office.

Prices Subject to Change Without Notice

POLYPHASE KVA DEMAND METERS

COMBINATION WATTHOUR AND THERMAL

TYPES KCA-2, KCA-5, KCA-7, KCA-8

WIRING DIAGRAMS—Front View

TYPE KCA-2: 3-PHASE, 3-WIRE

Fig. 1—Self-Contained

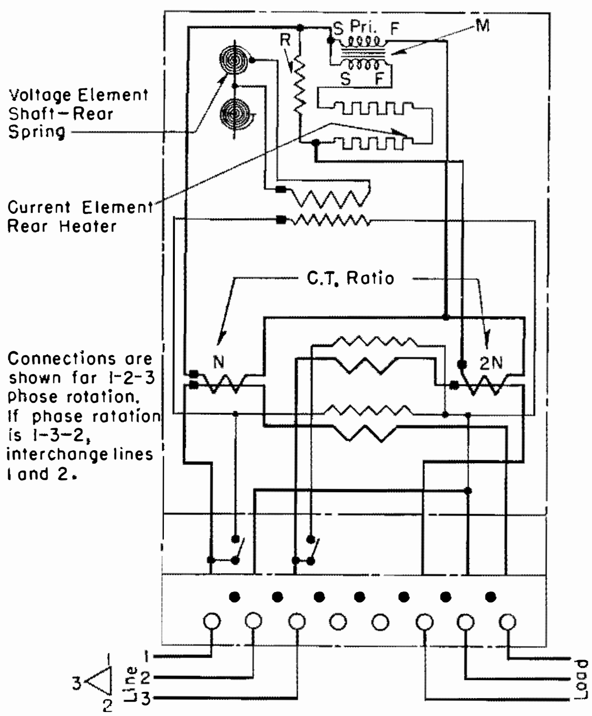
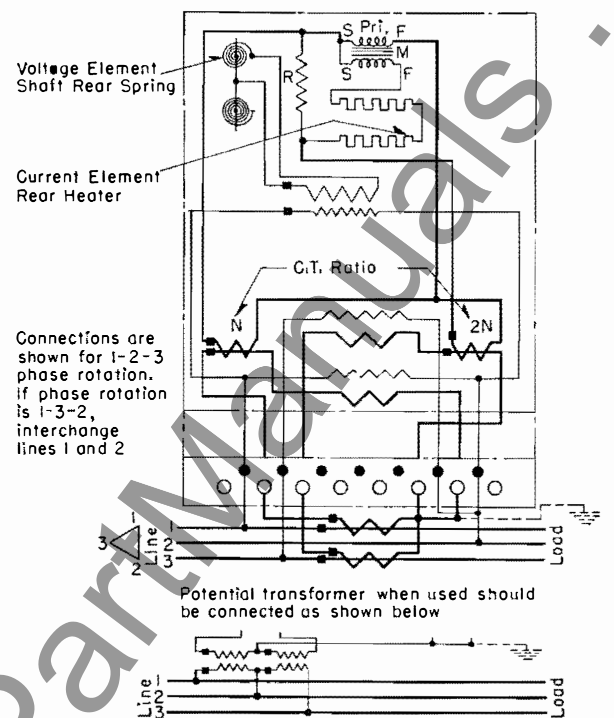


Fig. 2—Transformer Type



TYPE KCA-5: 3-WIRE, NETWORK

Fig. 3—Self-Contained

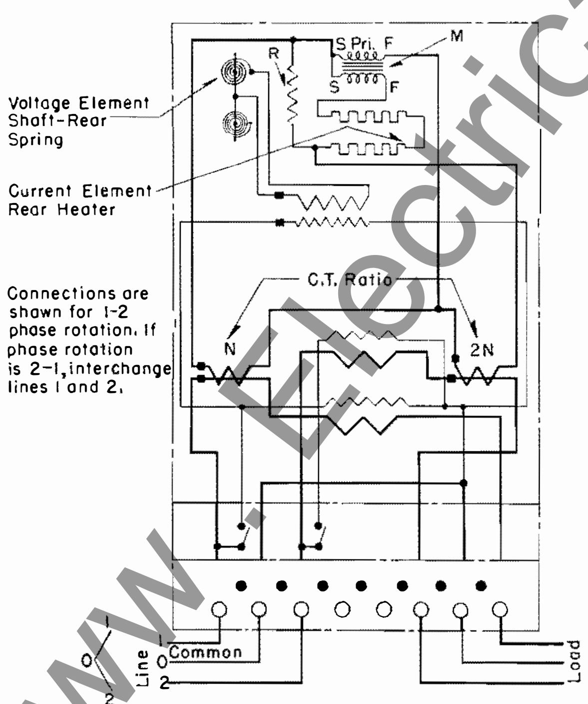
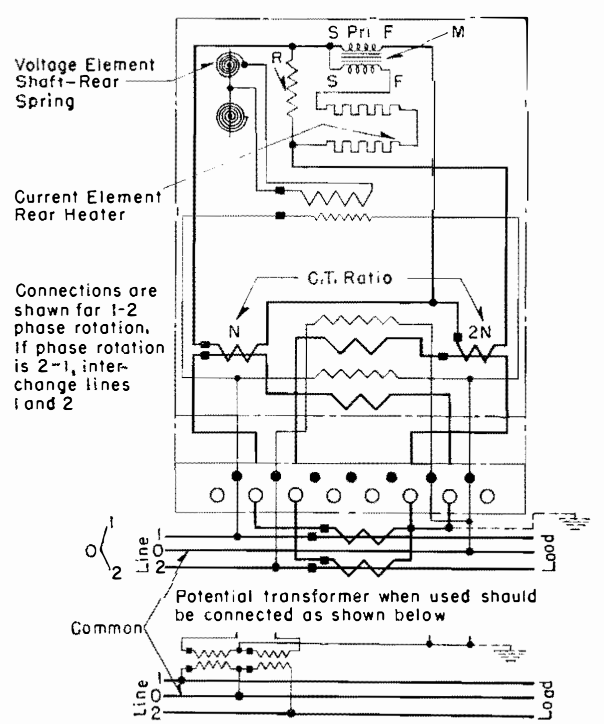


Fig. 4—Transformer Type



WIRING DIAGRAMS—Front View (Continued)

TYPE KCA-7: 3-PHASE, 4-WIRE, DELTA

Fig. 5—Self-Contained

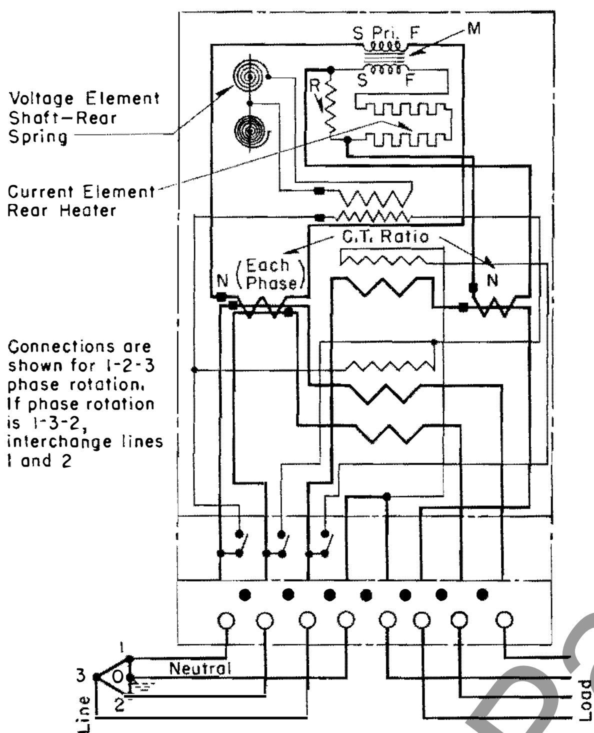
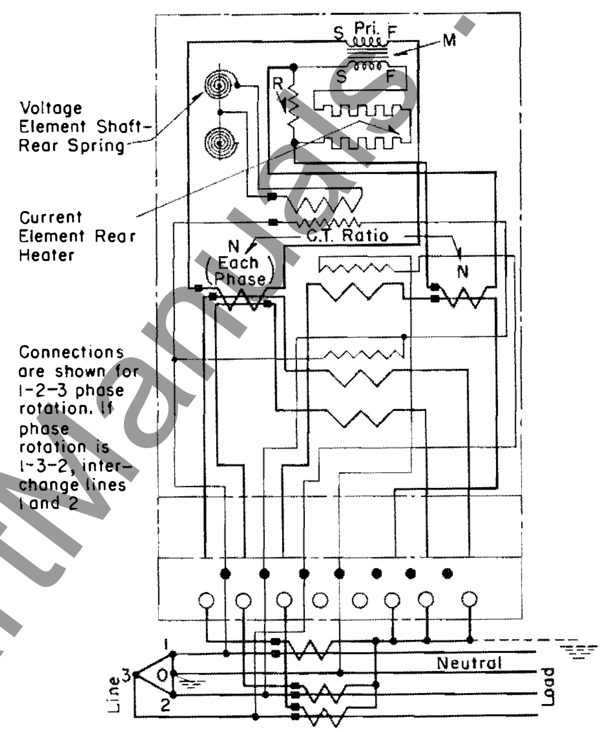


Fig. 6—Transformer Type



TYPE KCA-8: 3-PHASE, 4-WIRE, WYE

Fig. 7—Self-Contained

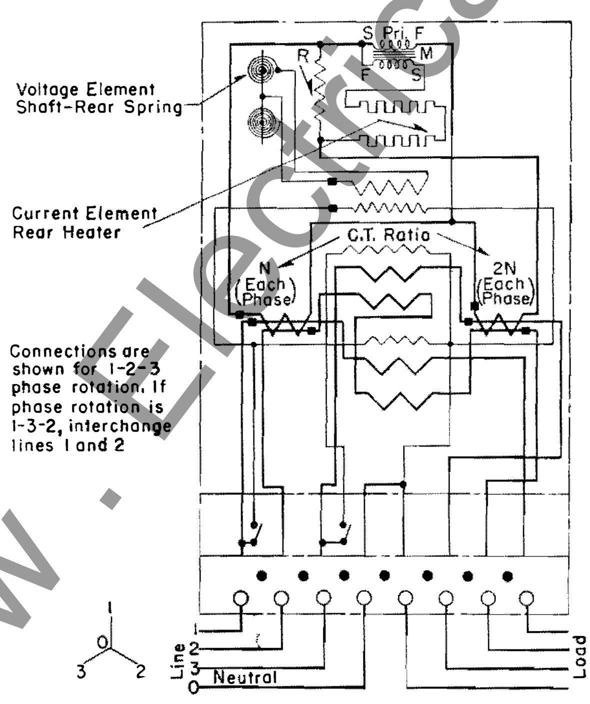
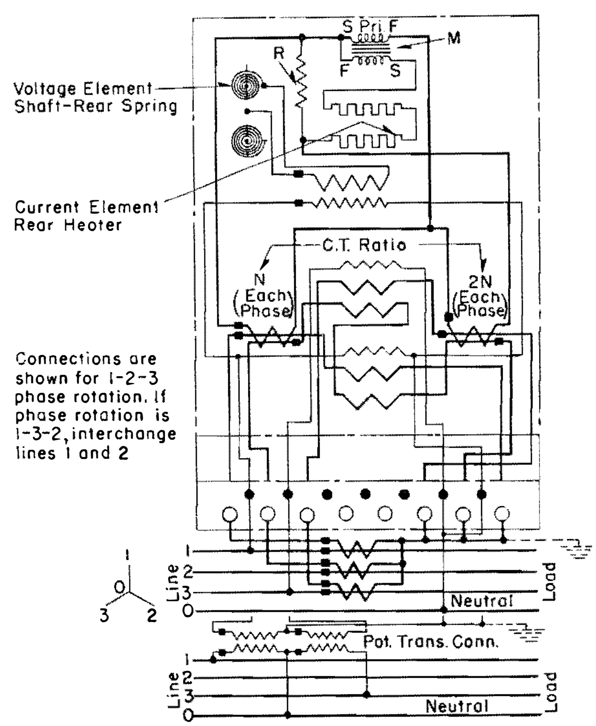


Fig. 8—Transformer Type



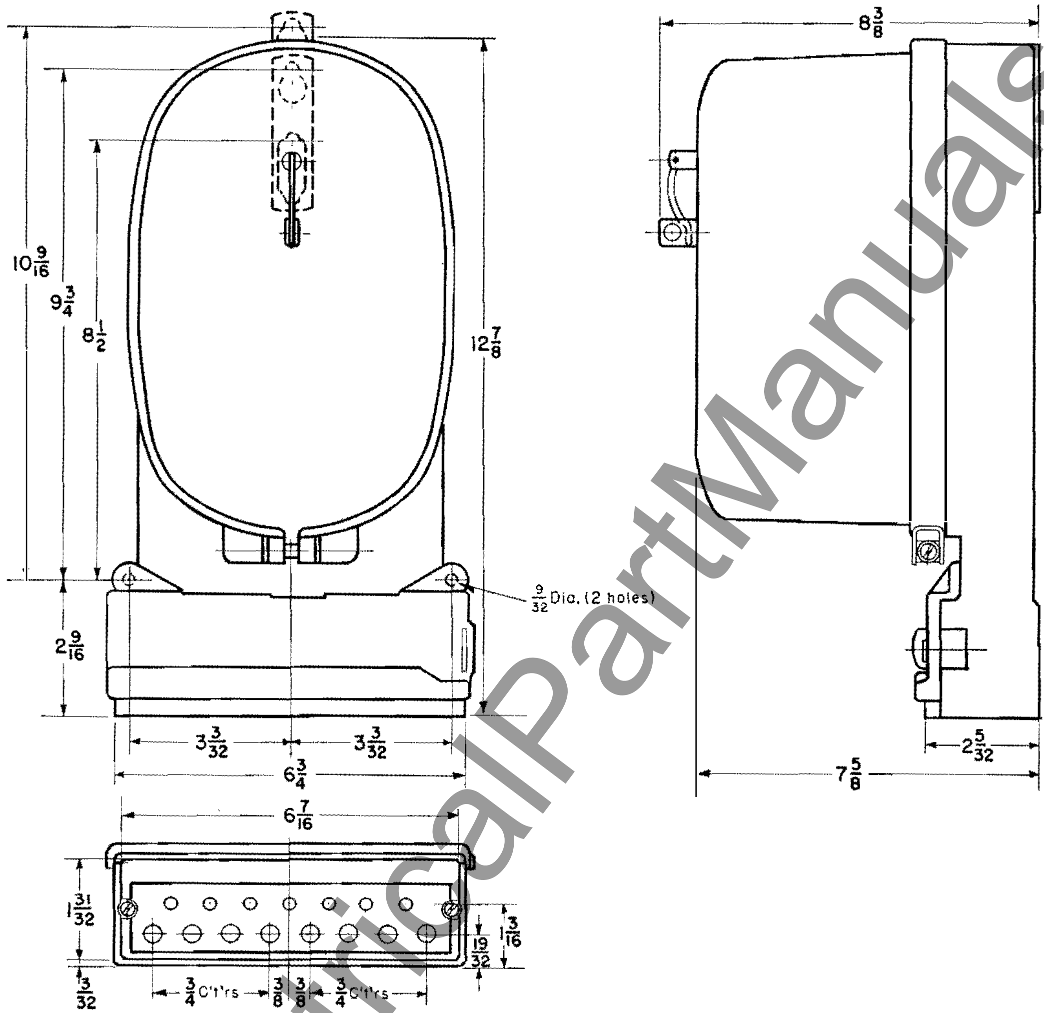
POLYPHASE KVA DEMAND METERS

COMBINATION WATTHOUR AND THERMAL

TYPES KCA-2, KCA-5, KCA-7, KCA-8

OUTLINE DIMENSIONS IN INCHES

Dimensions Approximate Only. Do Not Use for Construction Purposes.



NET WEIGHT IN POUNDS

METER	NO. OF UNITS	DOMESTIC NET	DOMESTIC SHIPPING	EXPORT NET	EXPORT GROSS	EXPORT LEGAL
Types KCA-2, KCA-5 KCA-7, KCA-8	1	18	22	18	45	19

LITERATURE REFERENCE

Instruction Leaflet 42-340

WESTINGHOUSE ELECTRIC CORPORATION

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