WESTINGHOUSE INSTRUMENTS

PORTABLE

PRECISION

PANEL

RECORDING

TELEMETERING

OSCILLOGRAPHS

BOILER ROOM AND CLASSROOM INDICATORS

A-C. TACHOMETERS

ELECTRONIC DEVICES

CATALOG 43

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
NEWARK WORKS NEWARK, N. J.

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* These are narrow Flange Instruments. For Wide Flange Instruments add prefix "W" to the Style Number.

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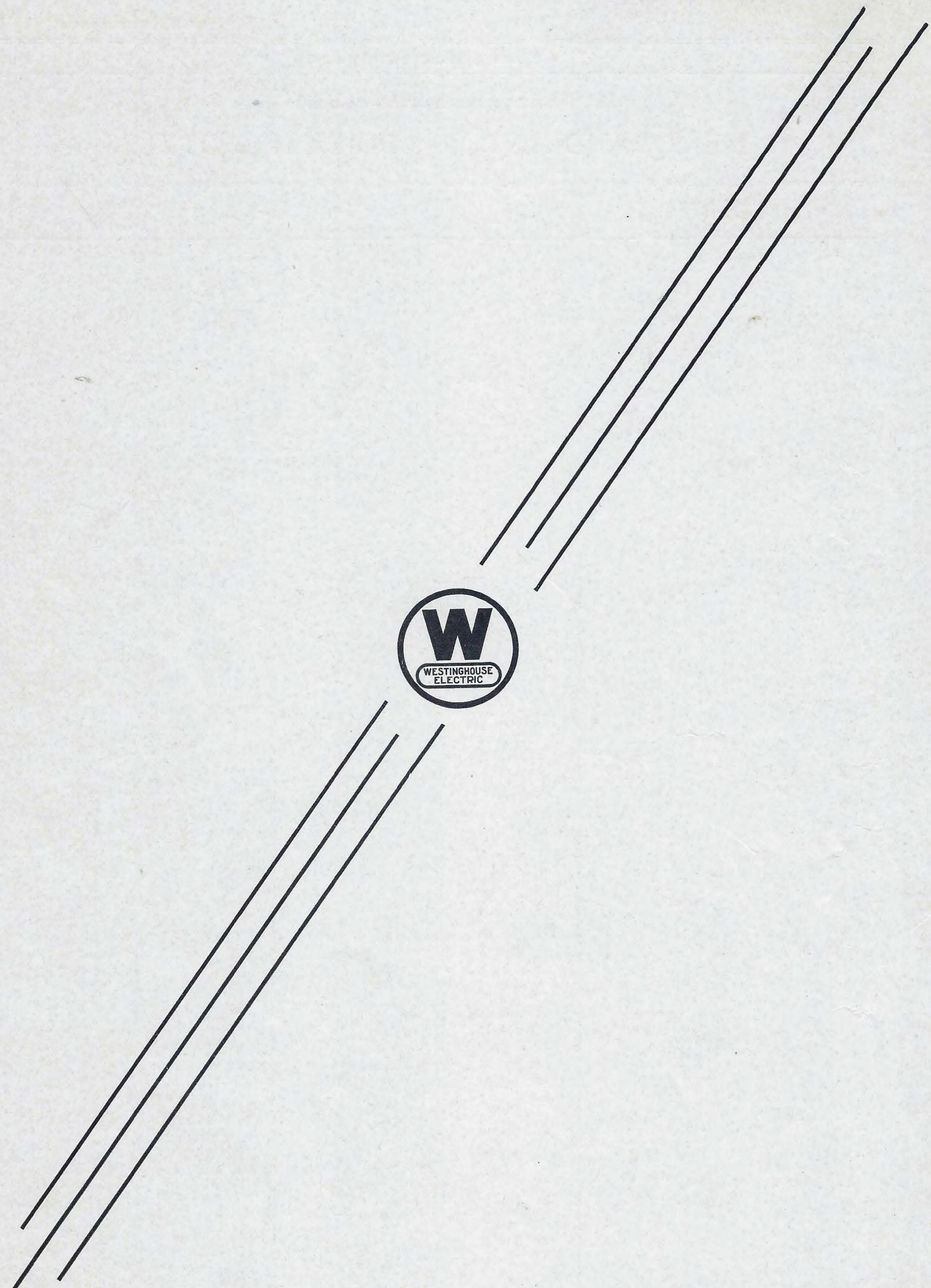

EVERY HOUSE NEEDS WESTINGHOUSE

ORDERING INSTRUCTIONS

To avoid delays and misunderstandings, note carefully the following general instructions.

1. Send all *correspondence* and *orders* to the nearest office of the Company or the nearest agent-jobber.

2. When ordering *give* complete description. If modification of standard apparatus is desired, order "Similar to S. O. . . . . except (state modification)."

3. In *ordering duplicate* of apparatus, order by S. O. number marked on the apparatus. Also give the *serial number* and full description.

4. In ordering *parts*, give style number complete description, and serial number of the apparatus for which the part is required.

5. State whether *shipment* is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

6. Present all *claims for breakage* to the carrier, as we are not responsible for damage to apparatus after delivery to the carrier. If we are notified of such claims, however, we shall gladly lend assistance to secure adjustment.

7. Make *claims for shortage* within five days after receipt of shipment; otherwise they will not be considered.

8. Do not *return apparatus* to us for credit or exchange without first obtaining written approval with shipping instructions from the sales office through which the order was placed. Notifications of such shipment, with copy of shipping receipt, must be sent to the sales office. Shipment must bear the name and address of the sender, otherwise, we cannot accept responsibility for credit.

9. *In communicating with us regarding an order*, always mention the number and date of your purchase order, also give our G. O. number when available.

10. *Terms* are such as the Company may extend to the purchaser, not to exceed net in thirty days from date of invoice.

11. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

12. The Company will not be responsible or liable for any loss, damage, detention or delay caused by fire, strike, civil or military authority, or by insurrection or riot, or by any other cause which is unavoidable or beyond its reasonable control; nor in any event for consequential damages.

Prices are furnished on request by nearest representive. See list on the last page of this catalog.

We are users of L-CODE, the Electrical Industry Telegraph Code.

PORTABLE INSTRUMENTS—TYPE PY-5

Alternating Current

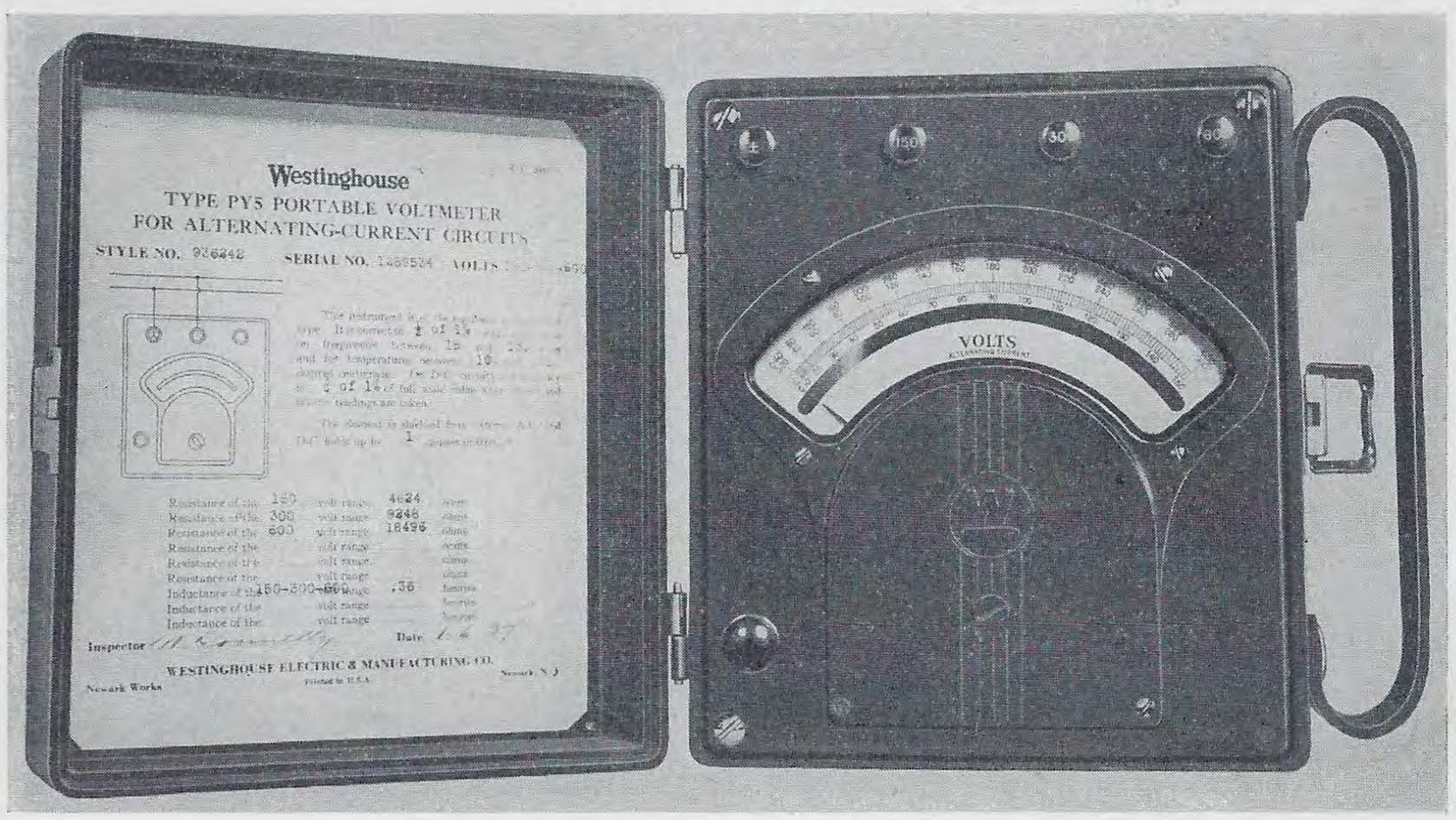

FIG. 1—TYPE PY-5 TRIPLE RANGE VOLTMETER

DATA

CASE SIZE	7¼" x 8 1/16" x 4"
SCALE LENGTH	5"
ACCURACY	WITHIN ½% ON A-C.
MOVEMENTS	AMMETERS AND VOLTMETERS: REPULSION IRON VANE; WATTMETERS: ELECTRODYNAMOMETER
SHIELDING	SHIELDED FROM EXTERNAL MAGNETIC FIELDS
CASE	MOLDARTA
WEIGHT	WITH COVER; SIX POUNDS, NET; NINE POUNDS, SHIPPING

General

Type PY-5 portable instruments are the latest developments of Westinghouse engineering and research in the field of reliable and accurate portable electrical instruments. New movements have been designed for the highest accuracy to withstand severe portable service. The cases are of Moldarta, artistically proportioned, convenient to carry, and sturdy.

Detailed parts; such as, terminals, hardware, and leather handle, have been selected for the greatest convenience in use. These new instruments are listed in a large number of capacities to completely meet the requirements for all general testing, laboratory, or research requirements.

Application

PY-5 instruments are for portable service. They will measure over a wide variety of ranges the usual electrical quantities such as volts, amperes and watts.

These instruments are suitable for all general testing in central station operation, industrial plants, educational institution laboratories, manufacturers electrical laboratories, and electrical research.

Operation and Construction

The case of PY-5 instruments is molded in two parts of strong Moldarta that does not warp nor split with age. All outside metal parts are polished nickel, making an artistic contrast. The cover is hinged on the left side, and is removable by sliding it forward, the hinges separating in the center. A large leather handle is securely fastened on the right side of the case which is provided with rubber feet to protect the instrument from shock and to prevent slipping on table tops.

All voltmeter and wattmeter cases are ventilated for protection of resistance cards.

The movement complete with shield, top-cover plate, terminals, and resistance cards are mounted on the molded face plate. This face plate with the mechanism complete can be removed from the case as a unit, thereby simplifying the wiring and arrangement of parts. The magnetic shield is fastened

PORTABLE INSTRUMENTS—TYPE PY-5—Continued

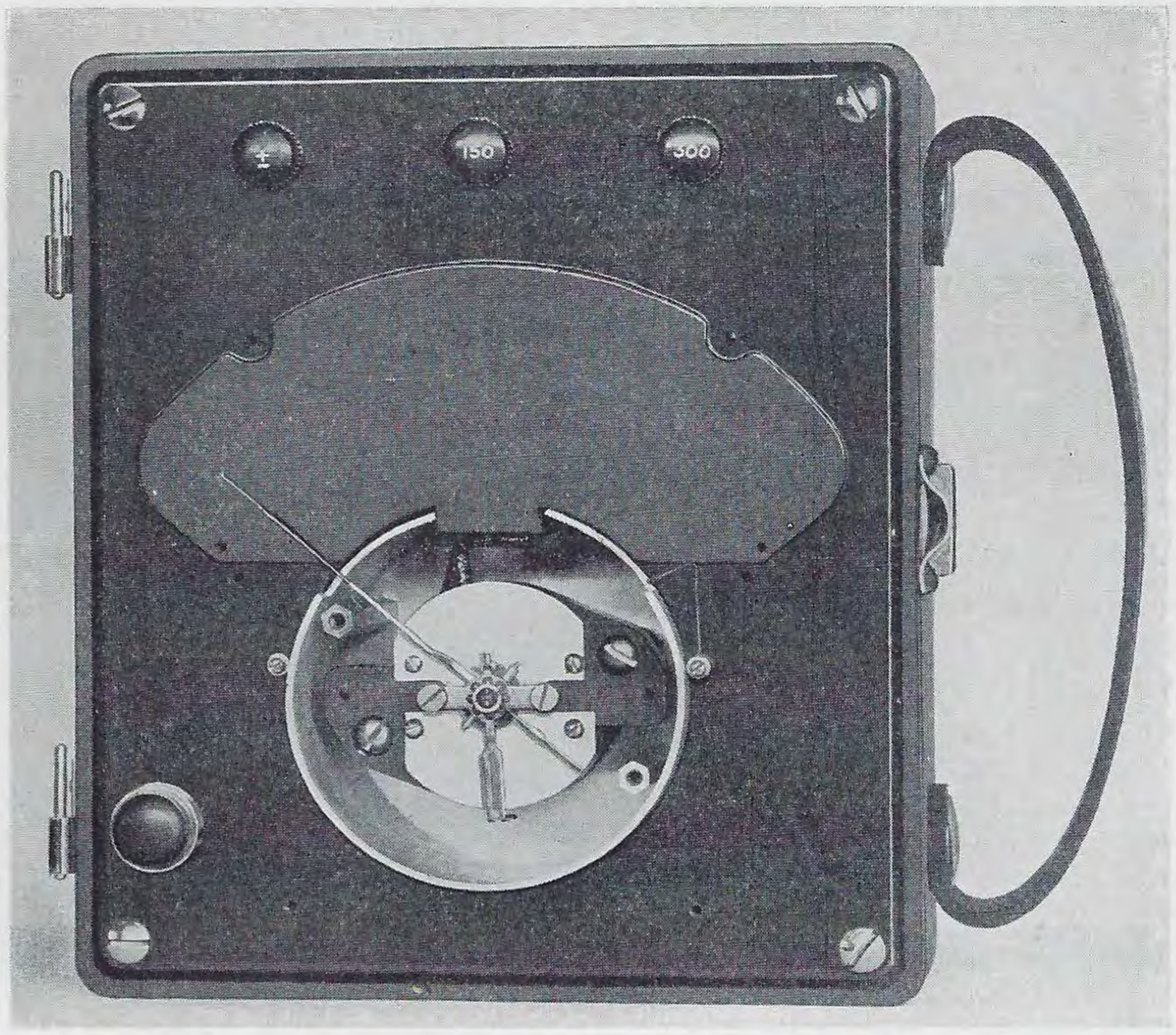

Fig. 2—Top View with the Top Cover Plate Removed, Showing the Mechanism, Pointer, and Shielding

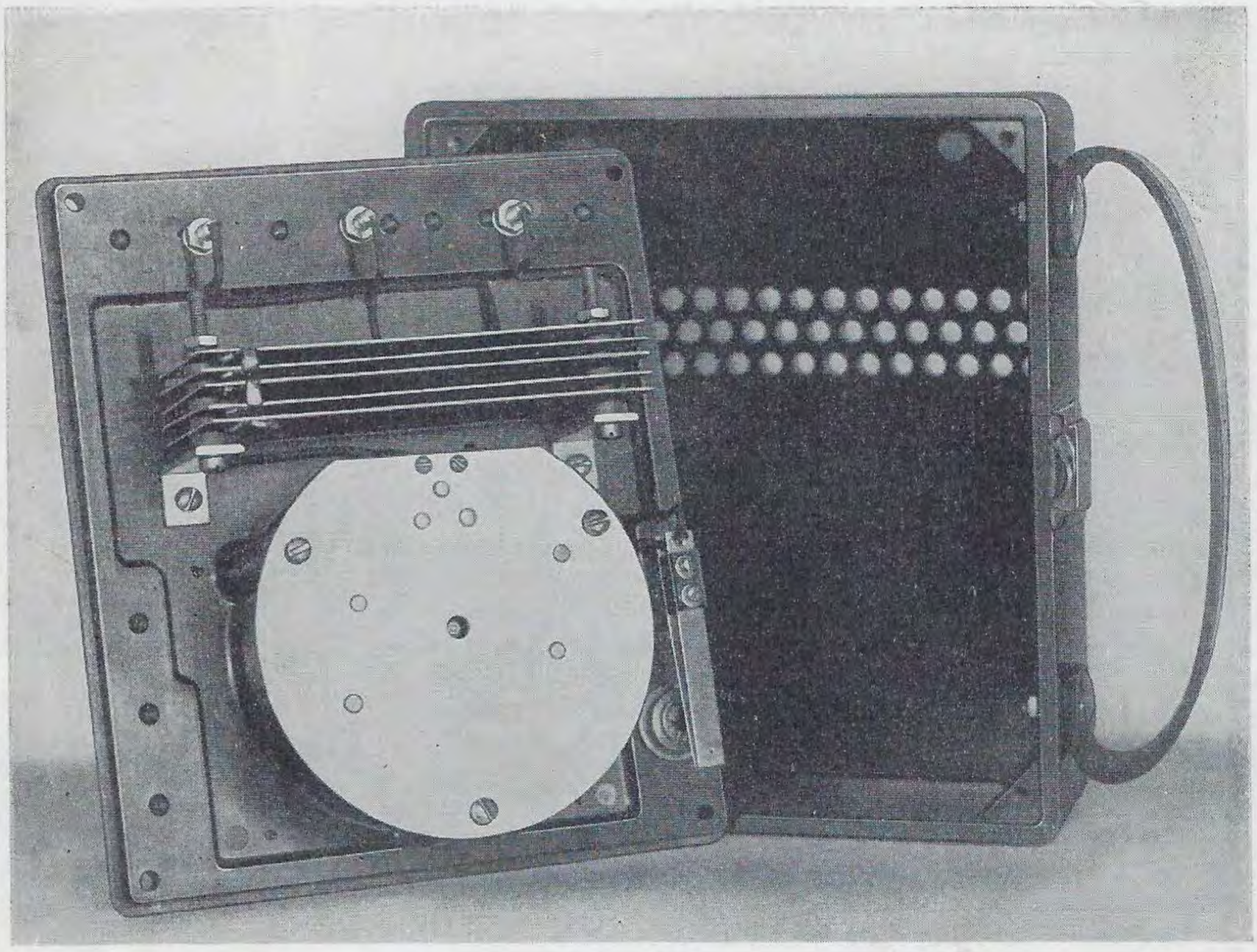

Fig. 3—Back View of Cover Plate Showing Resistance Cards, Switch and Magnetic Shielding. The Entire Instrument Mechanism is Mounted on the Cover Plate

PORTABLE INSTRUMENTS—TYPE PY-5—Continued

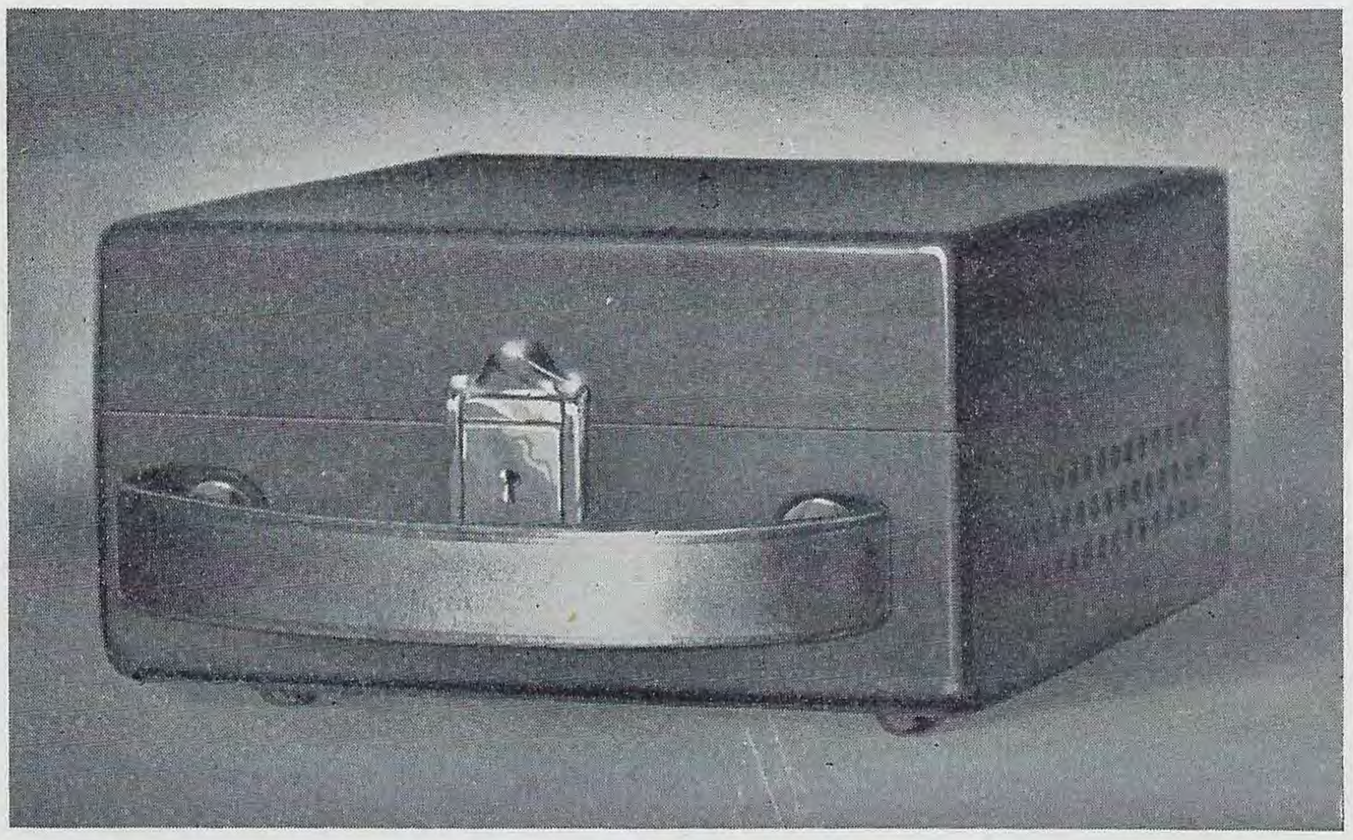

FIG. 4—CLOSED POSITION, SHOWING CLASP AND CARRYING HANDLE

by screws to a molded depression in the face plate, sealing the element in a dust-proof chamber. This eliminates the use of dust-proofing gaskets around the edge of the face plate where it joins the case. This feature provides a better dust-proofing construction.

A molded cover plate encloses the upper part of the movement and the pointer. This has an opening for the dial. This cover plate is fastened to the face plate by six screws removable from the top. It also carries the external zero adjuster.

Dial and Mirror—The dial is made of paper, firmly cemented to a highly-polished metal plate. A slot in the paper dial exposes the polished plate to provide a mirror for the knife-edge pointer.

Binding Posts—All binding posts are molded with brass-screw inserts provided with stops so that they cannot be removed from the lower threaded section. The upper part can be unscrewed sufficiently for inserting terminals or wire ends, but cannot be removed and lost.

Movements—PY-5 ammeters, milliammeters and voltmeters have a repulsion iron vane movement. Damping is obtained by a double vane operating in a molded chamber. The vanes are shaped to obtain the greatest effective air damping. The moving element is mounted in the operating coil, and it can be removed from the coil and the rest of the instrument, without disturbing any of the wiring.

The wattmeters have a standard electrodynamometer movement with air damping.

Damping—Damping according to A.I.E.E. rules is 14 for voltmeters and 12 for ammeters, milliammeters and wattmeters. This is defined as the ratio of overswing to underswing.

Scales—The length of the scale arc is 5 inches. It is divided into 100, 120, 125 or 150 divisions depending upon full-scale value.

The wattmeter scale is practically uniform with slight compression at either end. The voltmeter, ammeter and milliammeter have practically uniform scales over $\frac{4}{5}$ of the length, and reliable readings can be taken down to $\frac{1}{25}$ of full-scale value.

FIG. 5—TEST LEADS, STYLE NO. 818183

Accuracy—Accuracy is within $\frac{1}{2}\%$ of full-scale value for all instruments.

The accuracy on direct current is 1% for voltmeters, ammeters, milliammeters, and $\frac{1}{2}\%$ for wattmeters.

Temperature—All standard-range instruments will indicate within the Guaranteed Limits of Accuracy between temperatures of 10 and 35 degrees Centigrade.

Frequency Range—PY-5 instruments unless otherwise noted, are accurate on frequencies between 15 and 135 cycles. Ammeters and Milliammeters carrying rated current through the actuating coils are good for frequencies of 15 to 500 cycles with but little change in accuracy. Transformer Type Ammeters are capable of operation over the range of 25 to 135 cycles.

Double range ammeters are arranged for series paralleling the element coils by means of terminals and links.

Transformer type ammeters have self-contained multi-range transformers and are arranged for selection of range by selecting terminals. Where the high range is 50 amperes or less these ammeters may be supplied with rotary switch for selection of ranges at an additional price as shown on page 4.

Ratings Available on Special Order

Voltmeters—Single and multi-range from 1 to 1000 volts. Any instrument having two or more ranges where one range is more than five times the other will have two or more scale arcs.

Low-Power-Factor Wattmeters—Available with full-scale watts not less than 25% of the rated current times the rated voltage.

The leads illustrated are available for use with all Westinghouse portable instruments. They are used as test leads for connection between the instrument and the circuit being tested.

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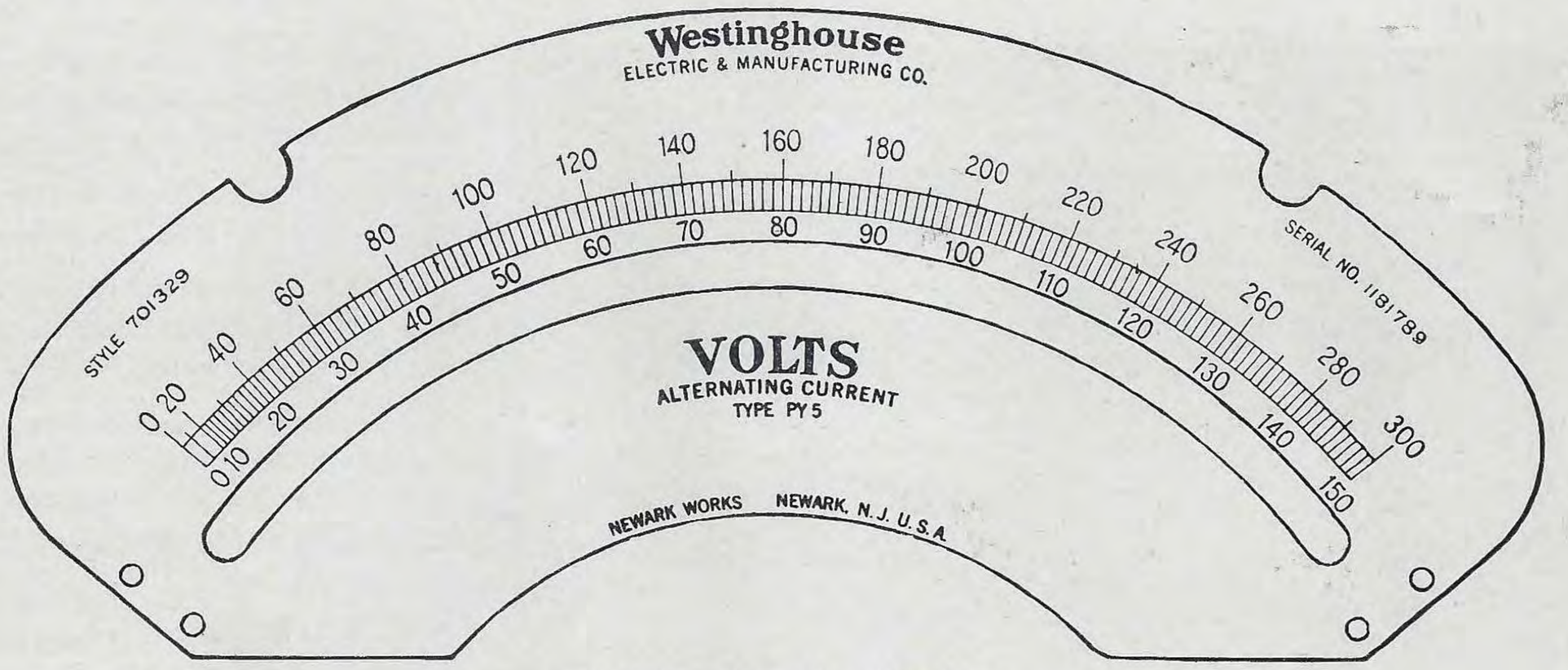


FIG. 6—VOLTMETER DIAL, FULL SIZE

LIST PRICES

MILLIAMMETERS
For Frequencies of 15 to 135 Cycles

Rating	Scale Divisions	Resistance Approximate Ohms	Burden Full Scale Volt-Amperes	Style No.	List Price Discount Symbol BC
Single Range—Self Contained					
10	100	3900	.53	701 335	$56 00
25	125	580	.53	701 336	56 00
50	100	142	.53	701 337	56 00
75	150	62	.53	936 227	56 00
100	100	37	.53	701 338	56 00
150	150	15.4	.53	936 228	56 00
250	125	5.8	.53	701 339	56 00
500	100	2.3	.53	701 340	56 00
750	150	1.1	.53	701 341	56 00
Double Range—Self Contained					
20–40	100–100	556–410	.53–.68	701 342	71 00
50–150	100–150	117–32	.53–.68	701 343	71 00
250–750	125–150	6.91–1.26	.53–.68	701 344	71 00

AMMETERS
For Frequencies of 15 to 135 Cycles

Single Range—Self Contained					
1	100	.35	.53	701 345	56 00
2.5	125	.058	.53	701 346	56 00
3	150	.0635	.53	936 229	56 00
5	100	.0162	.53	701 347	56 00
10	100	.0052	.53	701 348	56 00
15	150	.0017	.53	701 349	60 00
25	125	.00065	.6	701 350	60 00
50	100	.00044	1.0	701 351	62 00
75	150	.0002	1.3	930 603	62 00
100	100	.00022	2.2	701 352	65 00
150	150	.00009	3.0	936 230	68 00
200	100	.00005	3.0	936 231	71 00
300	150	.000065	6.0	877 182	77 00
Double Range—Self Contained					
.5–1	100	1.5–.75	.53–1.1	936 232	71 00
1–2	100	.36–.18	.53–1.1	936 233	71 00
2.5–5	100	.058–.029	.53–1.1	936 234	71 00
5–10	100	.0172–.0073	.53–.81	701 354	71 00
25–50	100–100	.0006–.0003	.53–1.1	936 235	75 00
40–80	100–80	.00033–.00017	.8–1.64	936 236	77 00
50–100	100–100	.0003–.00015	1.1–2.2	936 237	80 00

TRANSFORMER TYPE AMMETERS
For Frequencies of 25 to 135 Cycles

Rating	Scale Divisions	Burden Full Scale Volt-Amperes at 60 Cycles	Style No.	List Price Discount Symbol BC
Single Range—Self Contained				
400	100	3	1 008 500	$85 00
500	100	3	1 008 501	85 00
Four Range—Self Contained				
1–2–5–10*	100	3	1 008 493	100 00
1.5–3–7.5–15*	150	3	1 008 494	100 00
2–5–10–20*	100	3	1 008 495	100 00
3–7.5–15–30*	150	3	1 008 496	100 00
5–10–20–50*	100	3	1 008 497	100 00
Five Range—Self Contained				
5–10–20–50–100	100	3	1 008 498	102 00
Seven Range—Self Contained				
2–5–10–20–50–100–200	100	3	1 008 499	115 00

* These capacities may be supplied with range changing rotary switch at $10.00 additional list.

NOTE: All Transformer Type Ammeters are supplied with Terminals for selecting Ranges unless otherwise ordered with Rotary Switches. Switches may be supplied where the high Range is fifty amperes or less at increased prices.

Order by Style Number

PORTABLE INSTRUMENTS—TYPE PY-5—Continued

LIST PRICES—Continued

VOLTMETERS

For Frequencies of 15 to 135 Cycles

Rating	Scale Divisions	Resistance Approximate Ohms	Burden Full Scale Volt-Amperes	Style No.	List Price Discount Symbol BC
Single Range—Self Contained					
15	150	45	5.0	701 321	$58 00
30	150	175	5.0	701 322	58 00
75	150	1100	5.0	701 323	58 00
125	125	3120	5.0	936 238	58 00
150	150	4400	5.0	701 324	58 00
250	125	12500	5.0	936 239	61 00
300	150	17500	5.0	701 325	62 00
500	100	40000	6.25	936 240	67 00
600	120	47000	7.50	701 326	70 00
750	150	75000	10.00	701 327	74 00
Double Range—Self Contained					
75–150	150	1130–2200	5–10	701 328	63 00
150–300	150	4400–8800	5–10	701 329	67 00
150–600	150	4400–17600	5–20	701 330	75 00
300–600	150	17500–35000	5–10	701 331	75 00
150–750	150	4400–22000	5–25	936 241	79 00
300–750	150	17500–63000	5–12.5	701 332	79 00

Dynamometer Voltmeters may be Supplied on Special Order at $20 .00 List Additional

Triple Range—Self Contained					
150–300–600	150	4400–8700–17600	5–10–20	936 242	80 00
75–150–300	150	1100–2200–4500	5–10–20	701 334	73 00
150–300–750	150	4400–8700–24000	5–10–25	701 333	84 00
Six Range—Self Contained					
3–15–75 / 150–300–750 *	150	6–30–800 / 1600–13000–32000	1.5, 7.5, 7.0, / 14.0, 6.9, 17.2	936 243	115 00

* Frequency Range 15 to 70 Cycles.

VOLT-AMMETERS

Self Contained

Rating	Scale Divisions	Resistance Approx. Ohms	Burden Full Scale Volt-Amperes	Style No.	List Price Discount Symbol BC
75 volts	150	1130	5	877 057	$80 00
150 volts	150	2260	10		
1 amp.	100	.6	.67		
5 amp.	100	.02	.69		
75 volts	150	1130	5	877 058	80 00
150 volts	150	2260	10		
5 amp.	100	.02	.55		
10 amp.	100	.01	1.1		
75 volts	150	1130	5	877 059	84 00
150 volts	150	2260	10		
5 amp.	100	.015	.41		
25 amp.	100	.0014	.96		
150 volts	150	4400	5	877 060	84 00
300 volts	150	8800	10		
1 amp.	100	.60	.67		
5 amp.	100	.021	.69		
150 volts	150	4400	5	877 061	84 00
300 volts	150	8800	10		
5 amp.	100	.020	.55		
10 amp.	100	.010	1.1		
150 volts	150	4400	5	877 062	88 00
300 volts	150	8800	10		
5 amp.	100	.015	.41		
25 amp.	100	.0014	.96		
150 volts	150	4400	5	877 063	96 00
750 volts	150	22000	25		
1 amp.	100	.6	.67		
5 amp.	100	.020	.69		
150 volts	150	4400	5	877 064	96 00
750 volts	150	22000	25		
5 amp.	100	.020	.55		
10 amp.	100	.010	1.1		
150 volts	150	4400	5	877 065	100 00
750 volts	150	22000	25		
5 amp.	100	.015	.41		
25 amp.	100	.0014	.96		

Order by Style Number

PORTABLE INSTRUMENTS—TYPE PY-5 —Continued

LIST PRICES—Continued

SINGLE-PHASE WATTMETERS

Rating Volts	Rating Amperes	Scale Divisions	Watt Range	Resistance Approx. Ohms Potential Circuit Low Range	Resistance Approx. Ohms Potential Circuit High Range	Burden Full Scale Voltage Circuit Watts Low Range	Burden Full Scale Voltage Circuit Watts High Range	Burden Full Scale Current Circuit Volt-Amperes at 60 Cycles	Style No.	List Price Discount Symbol BC
Double-Voltage, Single-Current Ranges Self Contained										
20–40*	1	100	20/40	260	520	1.5	3	1.1	701 403	$ 85 00
20–40*	2.5	100	50/100	260	520	1.5	3	1.1	701 407	85 00
20–40*	5	100	100/200	260	520	1.5	3	1.1	701 408	85 00
20–40*	10	100	200/400	260	520	1.5	3	1.1	701 409	85 00
20–40*	25	100	500/1000	260	520	1.5	3	1.2	701 410	85 00
20–40*	50	100	1000/2000	260	520	1.5	3	1.3	701 411	85 00
50–100*	1	100	50/100	1650	3300	1.5	3	1.1	701 412	85 00
50–100*	2.5	125	125/250	1650	3300	1.5	3	1.1	701 413	85 00
50–100*	5	125	250/500	1650	3300	1.5	3	1.1	701 414	85 00
50–100*	10	100	500/1000	1650	3300	1.5	3	1.1	701 415	85 00
50–100*	25	125	1250/2500	1650	3300	1.5	3	1.2	701 416	85 00
50–100*	50	125	2.5/5 Kw.	1650	3300	1.5	3	1.3	701 417	85 00
100–200*	1	100	100/200	6500	13000	1.5	3	1.1	701 418	85 00
100–200*	2.5	125	250/500	6500	13000	1.5	3	1.1	701 419	85 00
100–200*	5	100	500/1000	6500	13000	1.5	3	1.1	701 420	85 00
100–200*	10	100	1000/2000	6500	13000	1.5	3	1.1	701 421	85 00
100–200*	25	125	2.5/5 Kw.	6500	13000	1.5	3	1.2	701 422	85 00
100–200*	50	100	5/10 Kw.	6500	13000	1.5	3	1.3	701 423	85 00
100–500*	1	100	100/500	8650	43747	1.5	7.5	1.1	704 061	95 00
100–500*	2.5	125	250/1250	8650	43747	1.5	7.5	1.1	704 062	95 00
100–500*	5	100	500/2500	8650	43747	1.5	7.5	1.1	704 063	95 00
100–500*	10	100	1/5 Kw.	8650	43747	1.5	7.5	1.1	704 064	95 00
100–500*	25	125	2.5/12.5 Kw.	8650	43747	1.5	7.5	1.2	704 065	95 00
100–500*	50	100	5/25 Kw.	8650	43747	1.5	7.5	1.3	704 066	95 00

Rating Volts	Rating Amperes	Scale Divisions	Scale Range	Resistance Approx. Ohms Potential Circuit Low Range	Resistance Approx. Ohms Potential Circuit High Range	Burden Full Scale Voltage Circuit Watts Low Range	Burden Full Scale Voltage Circuit Watts High Range	Burden Full Scale Current Circuit Volt-Amperes at 60 Cycles Low Range	Burden Full Scale Current Circuit Volt-Amperes at 60 Cycles High Range	Style No.	List Price Discount Symbol BC
Double-Voltage, Double-Current Ranges Self Contained											
50–100*	.5–1	100	50	1650	3300	1.5	3	1.1	1.1	839 677	$110 00
50–100*	1–2	100	100	1650	3300	1.5	3	1.1	1.1	839 678	110 00
50–100*	2.5–5	125	250	1650	3300	1.5	3	1.1	1.1	839 679	110 00
50–100*	5–10	100	500	1650	3300	1.5	3	1.1	1.1	839 680	110 00
50–100*	10–20	100	1000	1650	3300	1.5	3	1.2	1.2	839 681	110 00
50–100*	15–30	150	1500	1650	3300	1.5	3	1.2	1.2	839 682	110 00
50–100*	30–60	150	3000	1650	3300	1.5	3	1.3	1.3	839 683	110 00
100–200*	.5–1	100	100	6500	13000	1.5	3	1.1	1.1	839 684	110 00
100–200*	1–2	100	200	6500	13000	1.5	3	1.1	1.1	839 685	110 00
100–200*	2.5–5	100	500	6500	13000	1.5	3	1.1	1.1	839 686	110 00
100–200*	5–10	100	1000	6500	13000	1.5	3	1.1	1.1	839 687	110 00
100–200*	10–20	100	2000	6500	13000	1.5	3	1.2	1.2	839 688	110 00
100–200*	15–30	150	3000	6500	13000	1.5	3	1.2	1.2	839 689	110 00
100–200*	30–60	150	6 Kw.	6500	13000	1.5	3	1.3	1.3	839 690	110 00
100–500*	.5–1	100	50	8500	42500	1.2	6	1.1	1.1	839 691	120 00
100–500*	1–2	100	100	8500	42500	1.2	6	1.1	1.1	839 692	120 00
100–500*	2.5–5	125	250	8500	42500	1.2	6	1.1	1.1	839 693	120 00
100–500*	5–10	100	500	8500	42500	1.2	6	1.1	1.1	839 694	120 00
100–500*	10–20	100	1000	8500	42500	1.2	6	1.2	1.2	839 695	120 00
100–500*	15–30	150	1500	8500	42500	1.2	6	1.2	1.2	839 696	120 00
100–500*	30–60	150	3000	8500	42500	1.2	6	1.3	1.3	839 697	120 00

*Current and voltage ratings listed are normal, and instruments are suitable for continuous use at 50% above normal voltage. Full-scale value in watts is product of normal current and voltage rating.

PY-5 VOLTMETER FOR RAILWAY SERVICE
For Alternating Current Only

This special instrument is for the measurement of alternating-current circuits where direct-current is also present as in railway and subway tracks. The movement is repulsion vane type and a self-contained transformer is used to block out the direct-current. The indications on this scale are not appreciably affected where the direct-current voltage is not more than 50% of the full-scale value of the instrument. The weight is approximately 7½ lbs. Instruments for other than 25 cycles, refer to headquarters.

Rating Volts Full Scale	Frequency Cycles	Scale Divisions	Resistance Approx. Ohms Low Range	Resistance Approx. Ohms High Range	Burden Full Scale Low Range	Burden Full Scale High Range	Style No.	List Price Discount Symbol BC
10–100	25	100	165	1200	4	6.5	930 429	$69 00

LEADS

Description	Style No.	List Price Discount Symbol BC
Test Leads, 36 inches long (1 pair)	818 183	$ 2 00

CARRYING CASE

Leather Carrying Case	820 995	11 00

Order by Style Number

TYPE PY-4 PORTABLE INSTRUMENTS

Alternating Current

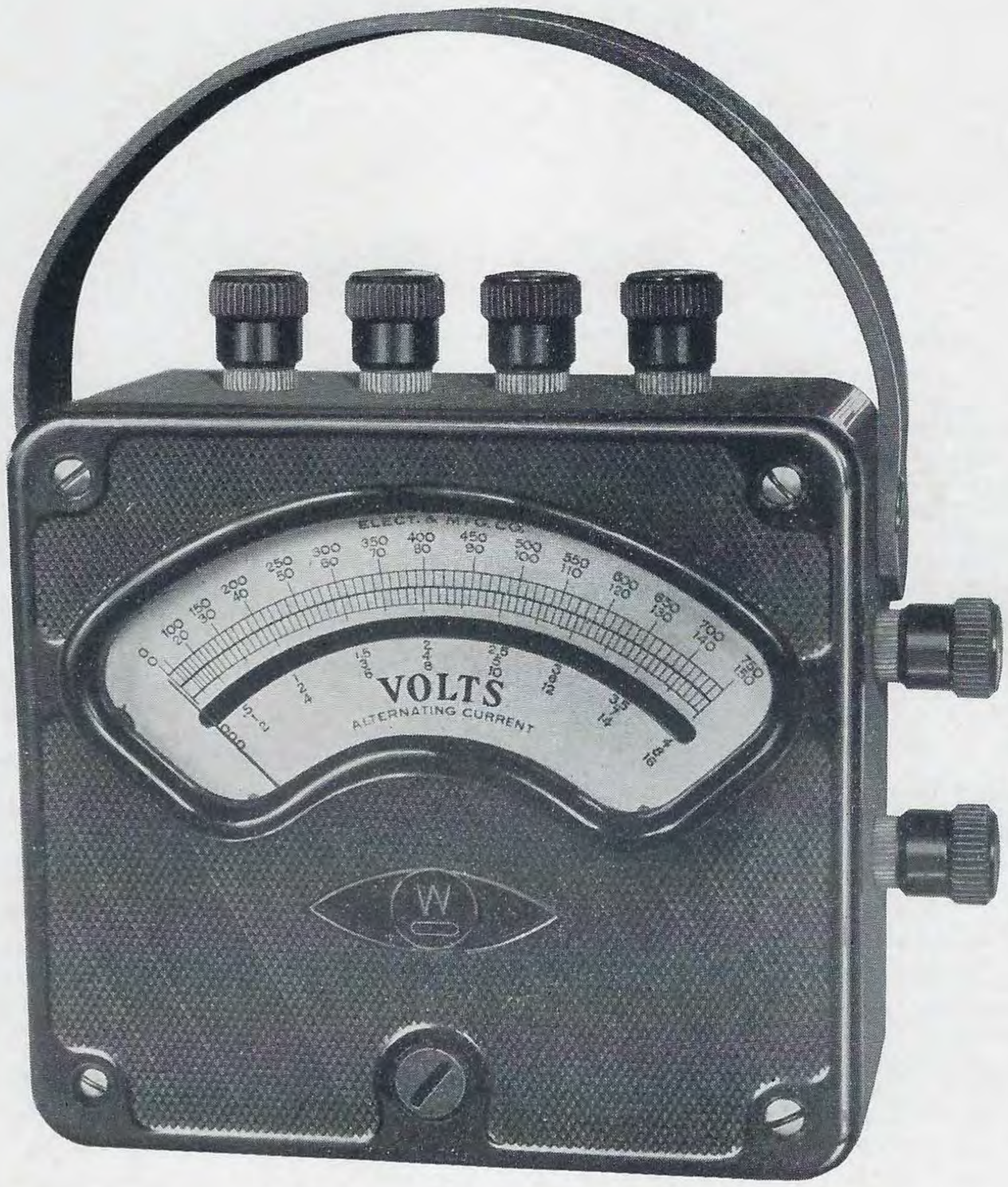


FIG. 1—TYPE PY-4 FIVE RANGE VOLTMETER

DATA

CASE SIZE	4½" x 4½" x 2"
SCALE LENGTH	3.2"
ACCURACY	WITHIN ¾ % ON A-C.
MOVEMENT	REPULSION IRON VANE
SHIELDING	SHIELDED FROM EXTERNAL MAGNETIC FIELDS
CASE	MOLDARTA
WEIGHT	NET: 2 POUNDS; SHIPPING: 3 POUNDS.

Application

Type PY-4 portable instruments are intended for general testing purposes where a small size, alternating-current instrument, easy to carry, is desired. They are provided with Moldarta cases, are neat appearing, and of a convenient size which can be easily slipped into the pocket. They are available in a wide range of capacities to cover every need for voltmeters, ammeters and milliammeters.

Construction and Operation

Type PY-4 instrument elements are mounted on a Moldarta plate which carries all resistance spools and shunts. This plate also serves as a support for all strap connections to the terminals. The plate carries the entire mechanism and accessories, and is removable from the front of the case by removing the cover plate which is fastened to the case by four screws. This type of construction makes easy removal of the instrument mechanism for repair or recalibration.

Terminals are provided with non-removable nuts which are insulated, and which will clamp almost any kind

TYPE PY-4 PORTABLE INSTRUMENTS—Continued

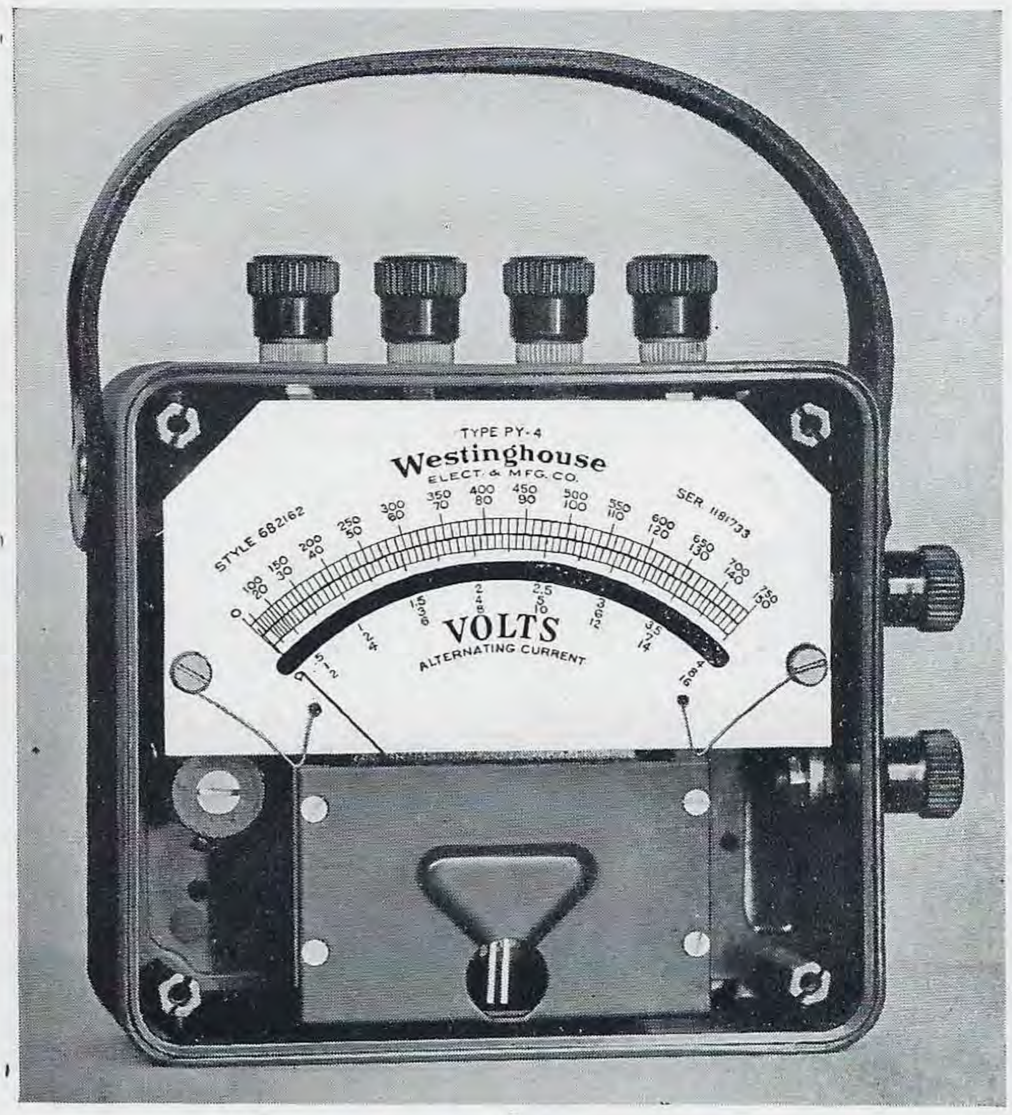


FIG. 2—TYPE PY-4 PORTABLE INSTRUMENT WITH COVER OF CASE REMOVED

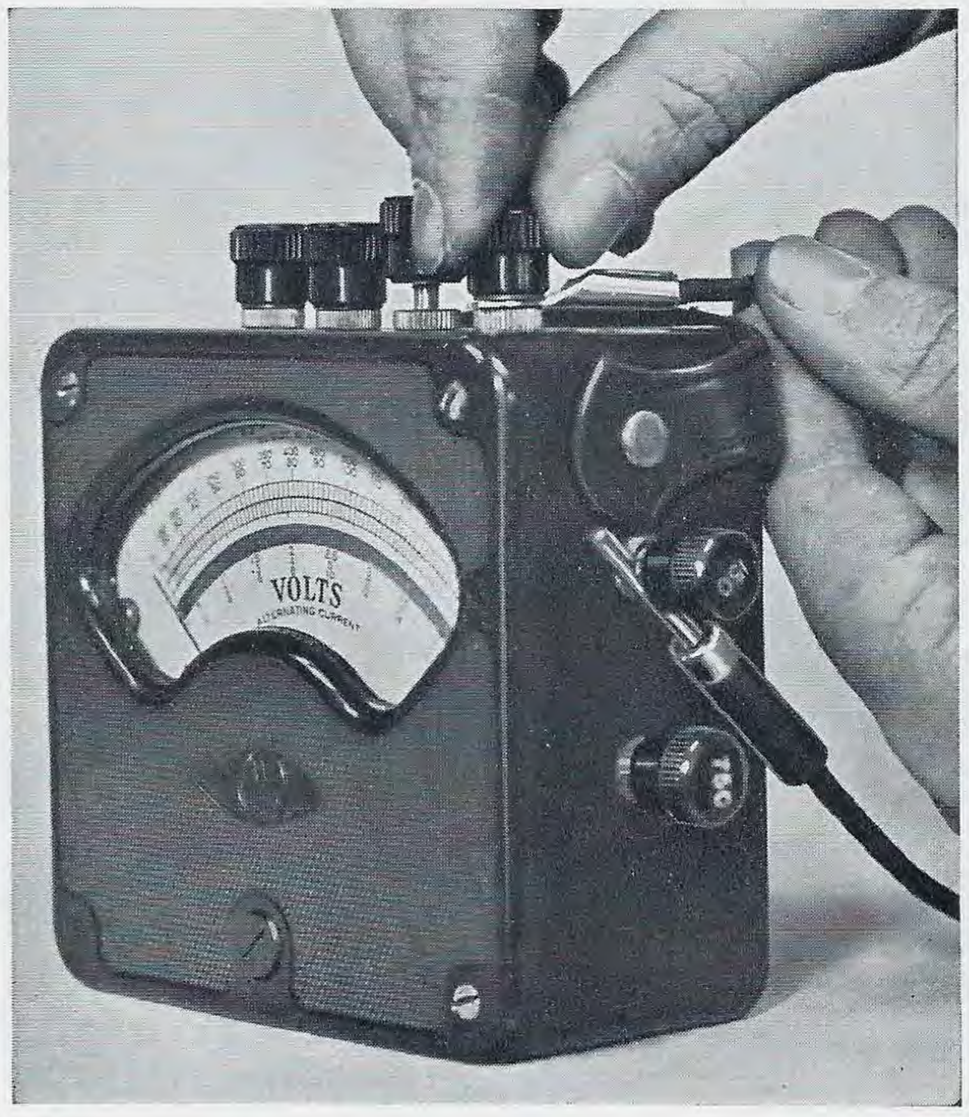


FIG. 3—THE TERMINALS OF THE TYPE PY-4 PORTABLE INSTRUMENT HAVE NON-REMOVABLE NUTS WHICH ARE INSULATED. THEY WILL CLAMP ALMOST ANY TEST WIRE OR LEAD

of test wires or leads. The instrument is available with a leather carrying case, if desired. A large leather handle with ample room for the hand is provided.

Dials—A white lithographed metal dial with black figures is used. It is provided with a mirror scale for use with the knife-edge pointer. Scales are exceptionally uniform in distribution. The figures and sub-divisions are selected for greatest ease in reading. Sufficient room is available for multi-scale arcs without any crowding of arcs or figures.

Pointer—The pointer is made of aluminum tubing flattened to a knife edge at the upper end. The upper edge of the flat section is colored red to facilitate reading. Readings can be taken easily to within ¾ percent at any point on the scale with the knife-edge pointer and mirror dial.

Zero Adjuster—An external, insulated zero adjuster is standard on all PY-4 portable instruments.

Movements—The movement used in the PY-4 instrument is the repulsion iron-vane type, with air damper and magnetic shield. This movement is also suitable for use on direct-current with lower accuracy, but for direct-current measurements, the d'Arsonval type of movement should be used because of its higher accuracy and lower-energy consumption.

The repulsion vane mechanism used in PY-4 portable instruments is a new development, embodying many refinements such as Hipernik iron vanes and uniform deflection throughout practically the entire scale arc, providing an almost uniform scale distribution. The energy consumption has been reduced thus making possible the building of self-contained instruments for higher ranges and with multi-ranges.

Damping—Damping according to A. I.E.E. rules is 3.7 for voltmeters, ammeters, and milliammeters. This is defined as the ratio of over-swing to under-swing from steady deflection at ⅔ scale deflection.

Scales—The length of the scale arc is 3.2 inches. It is divided into subdivisions which give the greatest ease in reading. Special design and material in the repulsion vanes give unusually uniform scales for alternating-current instruments.

Accuracy—Accuracy is within ¾ percent of full-scale value for all instruments on a-c. The accuracy on direct-current is within 1¼% for all instruments.

Temperature—All standard-range instruments will indicate correctly between temperatures of 10 and 35 degrees Centigrade.

Frequency Range—Type PY-4 instruments unless otherwise noted are accurate on frequencies between 15 and 200 cycles. They may be used on frequencies up to 500 cycles except voltmeters and multi-range ammeters with little change in accuracy.

The leads illustrated are available for use with all Westinghouse portable instruments. They are used as test leads for connection between the instrument and the circuit being tested. The leads are flexible and are 3 feet long. Style Number and List Price cover one pair.

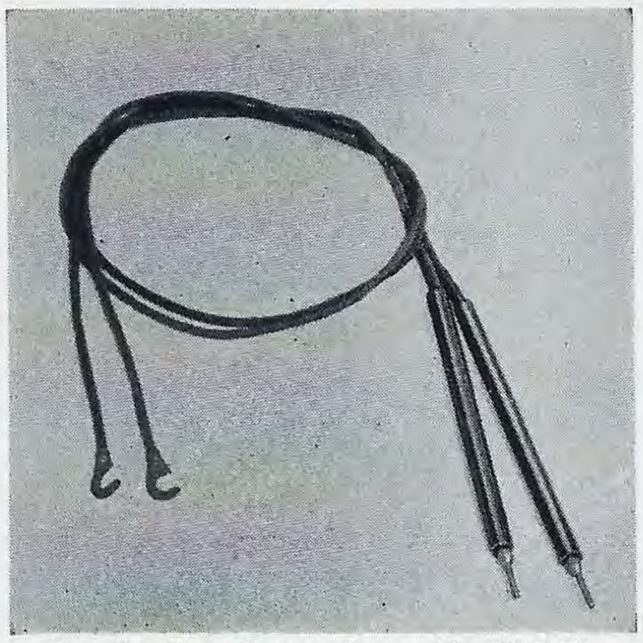


FIG. 4—TEST LEADS, STYLE NO. 818183

TYPE PY-4 PORTABLE INSTRUMENTS—Continued

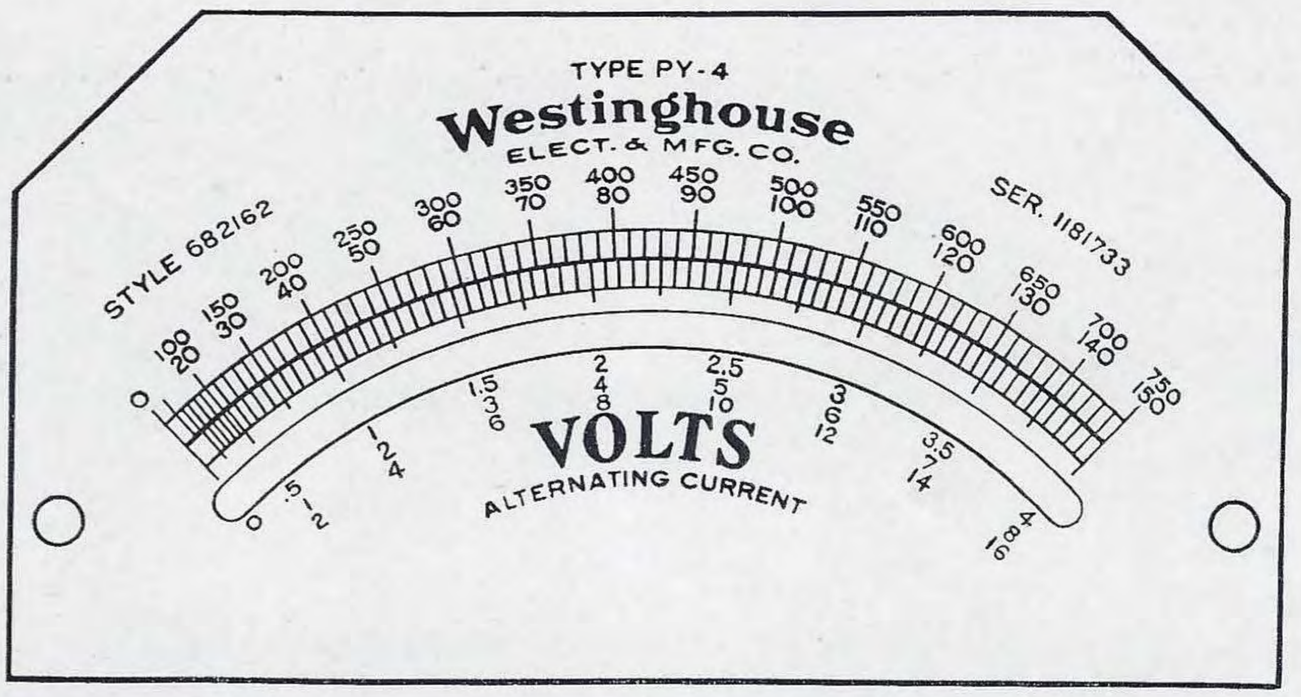


FIG. 5—THE SCALE SHOWN IS APPROXIMATELY ACTUAL SIZE. AN UNUSUALLY UNIFORM SCALE IS ASSURED THE TYPE PY-4 PORTABLE INSTRUMENT BY SPECIAL DESIGN AND MATERIAL IN THE ACTUATING VANES OF THE INSTRUMENT.

LIST PRICES

Rating	Approximate Resistance Ohms	Scale Division	Style No.	List Price Discount Symbol BC
		AMMETERS		
		For Frequencies of 15 to 500 Cycles		
		Single-Range		
1	.12	100	701 306	$30 00
1.5	.1	75	936 857	30 00
2	.04	100	936 858	30 00
2.5	.017	125	701 307	30 00
3	.015	75	936 859	30 00
5	.011	100	701 308	30 00
7.5	.008	75	701 309	30 00
10	.0014	100	701 310	30 00
15	.0010	75	701 311	30 00
25	.0006	125	701 312	30 00
30	.0005	60	936 860	30 00
50*	.0003	100	701 313	30 00

* For frequencies of 15 to 133 cycles.
Any of the above capacities may be supplied with follow up pointer for measurement of starting current at $40.00 list.

		Double-Range		
		For Frequencies of 15 to 200 Cycles		
1	.14	100	682 166	35 00
5	.008	100		
5	.008	100	682 167	35 00
10	.0036	100		
10	.0036	100	682 168	35 00
30	.0009	60		

These instruments have two separate scale arcs.

		MILLIAMMETERS		
		For Frequencies of 15 to 500 Cycles		
		Single-Range		
5	3850	100	682 169	35 00
10	730	100	701 314	30 00
15	250	75	936 861	30 00
25	115	125	701 315	30 00
30	90	75	936 862	30 00
50	29	100	701 316	30 00
75	15	75	936 863	30 00
100	7.2	100	701 317	30 00
150	3.0	75	936 864	30 00
200	1.5	100	936 865	30 00
250	1.1	125	701 318	30 00

Prices are subject to change without notice

TYPE PY-4 PORTABLE INSTRUMENTS—Continued

MILLIAMMETERS—Continued

Rating	Approximate Resistance Ohms	Scale Division	Style No.	List Price Symbol BC
300	.9	75	936 866	$30 00
400	.5	80	936 867	30 00
500	.25	100	701 319	30 00
600	.2	60	936 868	30 00
750	.15	75	701 320	30 00

Double-Range

For Frequencies of 15 to 200 Cycles

10 30	2500 275	100 60	682 170	35 00
50 150	100 11	100 75	682 171	35 00
250 750	2.5 3	125 75	682 172	35 00

VOLTMETERS

For Frequencies of 15 to 200 Cycles

Single-Range

1	1.75	100	701 296	30 00
3	19	60	701 297	30 00
7.5	75	75	701 298	30 00
10	100	100	936 360	30 00
15	300	75	701 299	30 00
20	400	100	936 869	30 00
30	1200	60	701 300	30 00
50	2000	100	936 361	30 00
60	2880	60	936 870	30 00
75	6000	75	701 301	30 00
100	8700	100	936 362	31 00
125	12500	125	936 871	31 00
150	19000	75	701 302	32 00
250	28000	125	936 872	35 00
300	38000	60	701 303	37 50
600	120000	60	701 304	41 00
750	150000	75	701 305	44 50

Double-Range

5–10	28–56	100	936 363	35 00
10–20	100–200	100	936 364	35 00
15–30	300–600	75	936 365	35 00
30–60	1200–2400	60	936 366	35 00
15–150	460–4600	75	682 164	37 00
75–150	6000–12000	75	936 367	40 00
150–300	21600–43200	150	820 036	42 50
150–300	45000–90000	150	703 872	46 00
150–600	21600–86400	75	682 165	46 00

Triple-Range

4– 8–150	18– 36–16900	80–75	682 163	$42 00
150–300–450	21600–43200–64800	75	936 368	48 00
150–300–600	21600–43200–86400	75	936 369	51 00
150–300–750	21600–43200–108000	75	936 370	54 00

These instruments have two separate scale arcs.

Five-Range

4–8–16 150–750	18– 36–72 16900–84500	80 75	682 162	60 00

This instrument has two separate scale arcs.

Leads

Description	Style No.	List Price Discount Symbol BC
Test Leads (one pair)	818 183	$2 00

Carrying Cases

Leather Carrying Case for one PY-4 Instrument	525 431	7 00
Leather Carrying Case for two PY-4 Instruments	495 932	7 50
Leather Carrying Case for three PY-4 Instruments	628 048	7 50

Prices are subject to change without notice.

Order by Style Number

Printed in U.S.A.

TYPE PX-5 PORTABLE INSTRUMENTS

Direct Current

FIG. 1—TYPE PX-5 DOUBLE RANGE AMMETER

DATA

		WEIGHTS
CASE SIZE	7¼" x 8 1/16" x 4"	WITH TUNGSTEN MAGNETS
SCALE LENGTH	5"	6 LB. 4 OZ.—NET
ACCURACY	WITHIN ½%	9 LB.—SHIPPING
MOVEMENT	d'ARSONVAL	WITH COBALT MAGNETS
CASE	MOLDARTA	8 LB.—NET
SHIELDED FROM MAGNETIC FIELDS		9 LB.—SHIPPING

General

Type PX-5 portable instruments are the latest developments of engineering and research by the Westinghouse Company in the field of reliable and accurate portable electrical instruments. New movements have been designed for the highest accuracy to withstand severe portable service. The cases are Moldarta, artistically proportioned, convenient to carry and sturdy. Detailed parts, such as terminals, hardware and leather handle have been selected for the greatest convenience in use. These new instruments are listed in a large number of capacities to completely meet the requirements for all general testing, laboratory or research

Application

The PX-5 instruments are for portable d-c. service. They will measure over a wide variety of ranges the usual electrical quantities such as volts, amperes, milliamperes, microamperes and when equipped with high sensitivity movements using Cobalt steel magnets the energy consumption is reduced for special measurements.

Construction

The case is molded in two parts of strong Moldarta that is durable and does not warp or split with age. All outside metal parts are polished nickel, making an artistic contrast with the molded parts. The cover is hinged on the left side and is removable by sliding it forward, the hinge separating in the center. A large leather handle is securely fastened on the right side. The case is provided with rubber feet to protect the instrument from shock and to prevent slipping on table tops.

The movement complete with shield, dial, terminals, resistance spools and shunts is mounted on a molded face plate. This plate with the mechanism complete can be removed from the case in one unit. This construction greatly simplifies the wiring and arrangement of parts in the case and facilitates repairs or dismantling for inspection. The bottom magnetic shield is made in cup form, and when fastened in place makes the element dust-proof. This eliminates the use of dust-proofing gaskets around the edge of the case.

A molded cover plate encloses the upper part of the movement and the pointer. This is provided with an opening for the dial. The cover plate is fastened to the face plate by six screws removable from the top. It also carries the external zero adjuster.

Dial and Mirror

The dial is made of paper, firmly cemented to a highly polished metal plate. A slot in the paper dial exposes the polished plate to provide a mirror for the knife-edge pointer. The length of the scale arc is 5 inches. It is uniformly divided into 100, 120, 125 or 150 divisions, depending on the range.

TYPE PX-5 PORTABLE INSTRUMENTS—Continued

FIG. 2—TOP VIEW WITH THE COVER PLATE REMOVED, SHOWING DIAL, POINTER, AND SHIELDING.

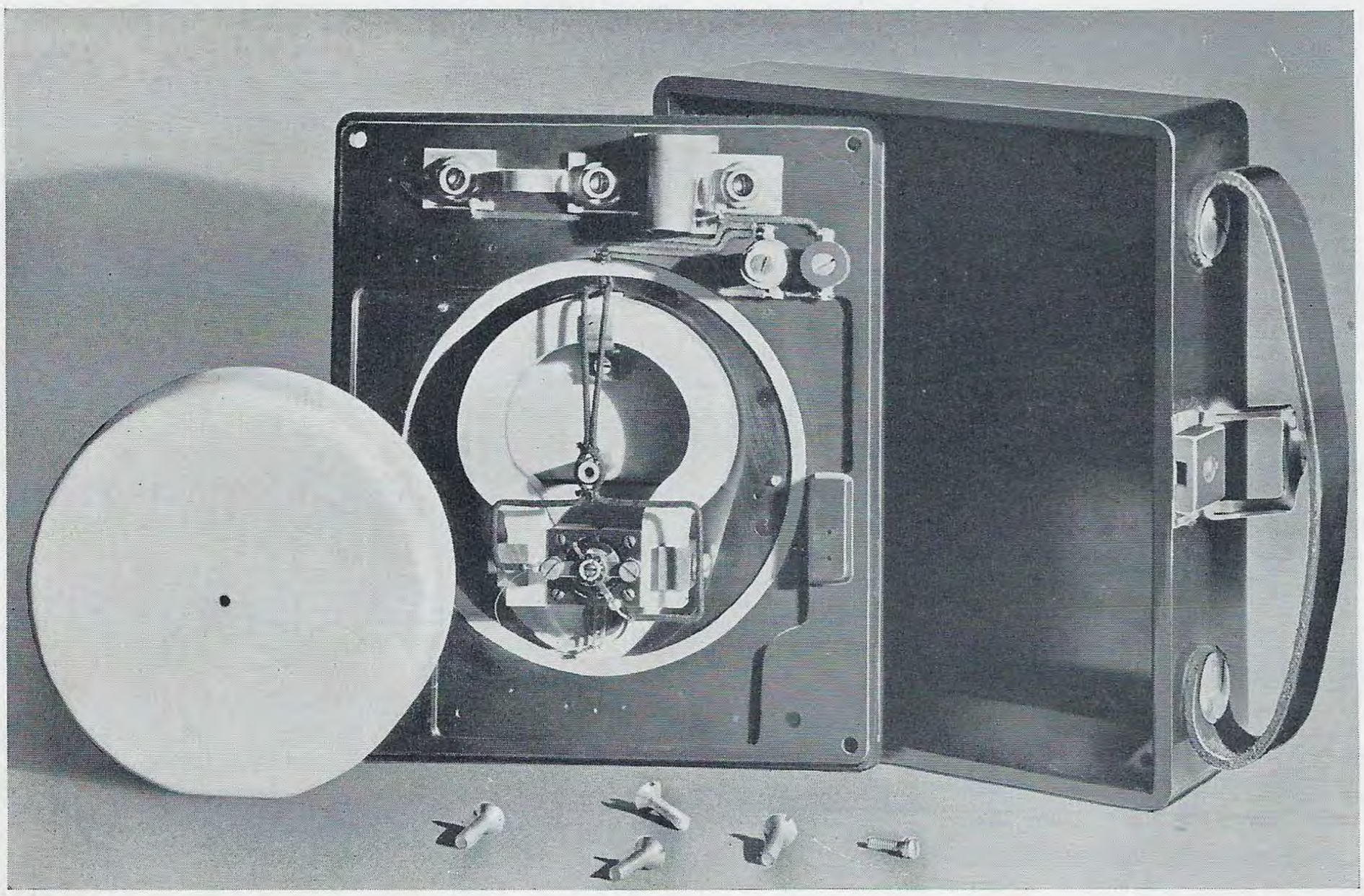


FIG. 3—SHIELD REMOVED TO SHOW MOVEMENT, PERMANENT MAGNET AND GASKET WHICH MAKES THE INSTRUMENT DUST PROOF

TYPE PX-5 PORTABLE INSTRUMENTS—Continued

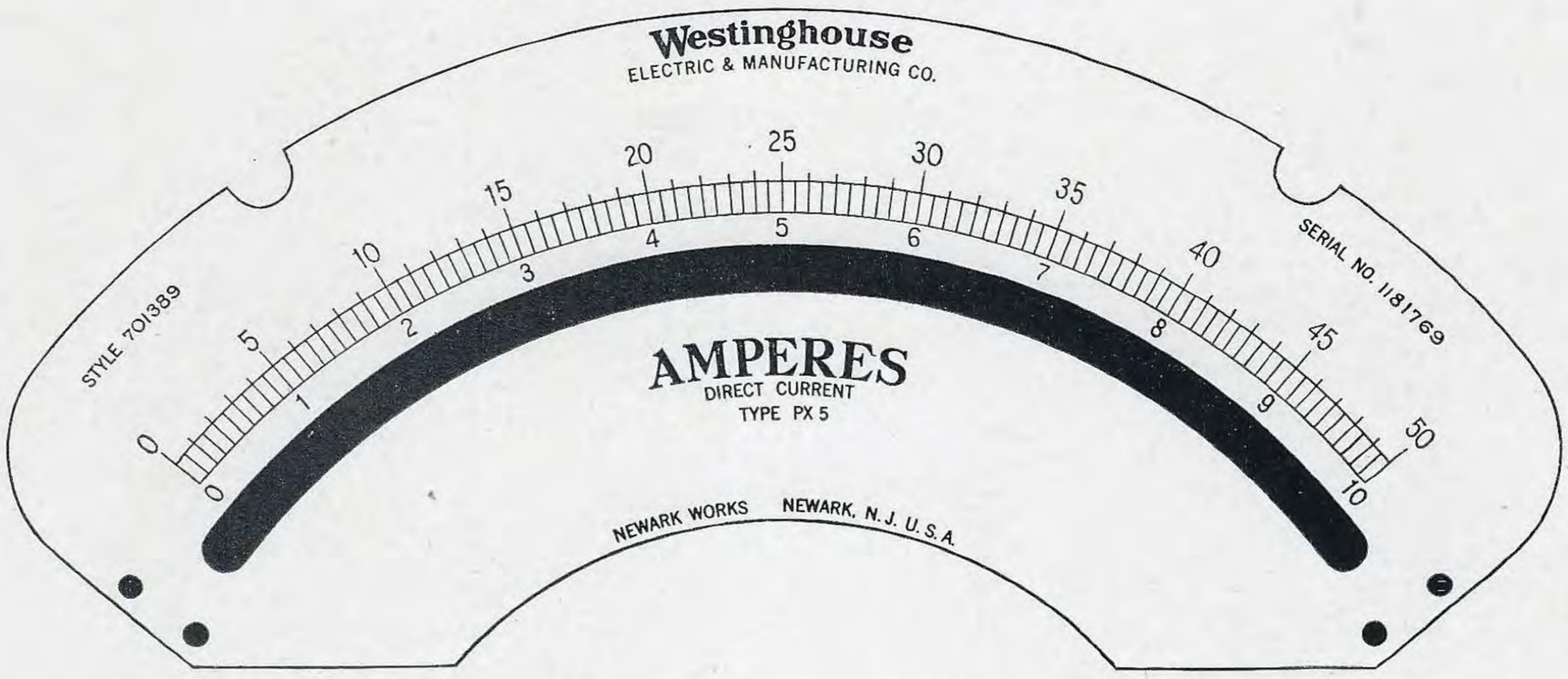


FIG. 4—FULL SIZE REPRODUCTION OF THE PX-5 SCALE

Operation

Movements—The movement is the d'Arsonval type having a permanent magnet and moving coil. The jeweled bearings are sapphire and the pivots are highly polished hard steel. The movement can be inspected or removed by removing the bottom magnet shield.

Highest grade materials and the finest of workmanship go to make this the highest grade instrument movement obtainable. It has all of the worthwhile features developed by years of experience in designing and building high grade electrical instruments.

All binding posts are molded with brass screw inserts.

They are provided with stops so that they cannot be removed from the lower threaded section and lost.

Damping—The damping according to A.I.E.E. rules is 22 for voltmeters, and milliammeters, and 13 for ammeters and millivoltmeters. Microammeters have a damping ratio of 20 or more depending on the scale range.

The above figures are the ratio of overswing to underswing from steady deflection at ⅔ scale deflection.

Scales—The length of the scale arc is 5 inches. It is divided into 100, 120, 125 or 150 divisions depending on the full scale value. Scales are uniform and figures are arranged for the best possible readability. The fine line divisions with a knife-edge pointer make possible the highest accuracy in reading.

Accuracy—The accuracy of all ranges listed is within ½ of one percent of full scale value and applies to the entire scale.

Responsiveness—The time for the pointer to come to rest at ⅔ scale is 1.2 seconds for voltmeters and milliammeters, and 1.5 seconds for ammeters and millivoltmeters.

Temperature—All listed instruments will indicate correctly between temperatures of 10 and 35 degrees centigrade.

INSTRUMENT LEADS

FIG. 5—SHUNT LEADS, STYLE NO. 819344

Leads illustrated are available for use with all Westinghouse portable instruments.

The leads in Figs. 5 and 6 are flexible, 3 feet long, and of fixed resistance to be used as connectors between shunts and portable instruments. The resistance of the pair of leads combined is .017 ohms, for either Style No. 819344 shown in Fig. 5, or Style No. 818183 shown in Fig. 6.

FIG. 6—TEST LEADS, STYLE NO. 818183

TYPE PX-5 PORTABLE INSTRUMENTS—Continued

LIST PRICES

MILLIAMMETERS

Range	Approx. Resistance Ohms	Scale Div.	Style No.	List Price Discount Symbol BC
		Single Range		
1	194	100	701 390	$ 61 00
1.5	109	150	936 244	61 00
2.5	68	125	701 391	61 00
3	25	150	936 245	61 00
5	7	100	701 392	61 00
7.5	6	150	936 246	60 00
10	4.4	100	701 393	60 00
15	2.0	150	936 247	60 00
25	1.1	125	701 394	60 00
30	.7	150	936 248	60 00
50	.55	100	701 395	60 00
75	.39	150	936 249	60 00
100	.27	100	701 396	60 00
150	.18	150	936 250	60 00
250	.11	125	701 397	60 00
300	.11	150	936 251	60 00
500	.10	100	701 398	60 00
750	.066	150	701 399	62 50
1000	.050	100	936 252	67 00
1500	.033	150	936 253	67 00
		Double Range		
15–150	2.5–.36	150	701 400	65 00
100–500	.55–.11	100	701 401	72 00
150–750	.36–.07	150	701 402	72 00
		Triple Range		
.03–.3–3	4160–1300–250	150	936 254	97 00
.15–1.5–15	325– 160– 16	150	936 255	80 00
3–7.5–30	21– 5.7–2.3	150	936 256	80 00
.15–15–150	325– 15 –1.7	150	936 257	80 00
7.5–30–150	22 – 6 –1.2	150	936 258	80 00
15–150–1500	12 – 1.2– .13	150	936 259	87 00
30–300–3000	1.66– .16– .016	150	936 260	87 00
150–750–3000	.33–.066– .016	150	936 261	87 00

MICROAMMETERS

Range	Approx. Resistance Ohms	Scale Div.	Style No.	List Price Discount Symbol BC
30	4500	150	936 262	$ 71 00
50	4500	100	838 215	71 00
100	580	100	838 216	71 00
250	215	125	838 217	66 00
500	55	100	838 218	66 00
750	37	150	838 219	66 00

For instruments of higher sensitivities, see high sensitivity instruments.

AMMETERS

Self Contained

Range	Approx. Resistance Ohms	Scale Div.	Style No.	List Price Discount Symbol BC
		Single Range		
1	.05	100	701 379	$ 67 00
1.5	.033	150	936 263	67 00
2.5	.02	125	701 380	67 00
3	.016	150	936 264	67 00
5	.01	100	701 381	67 00
7.5	.006	150	936 265	67 00
10	.005	100	701 382	67 00
15	.0033	150	701 383	67 00
25	.002	125	701 384	67 00
30	.0016	150	936 266	67 00
50	.001	100	701 385	67 00
		Double Range		
1–5	.05 –.01	100	701 386	72 00
1–10	.05 –.005	100	701 387	72 00
6–30	.0083–.0016	150	701 388	72 00
10–50	.005 –.001	100	701 389	72 00

Order by Style Number

Prices and discounts are subject to change without notice

TYPE PX-5 PORTABLE INSTRUMENTS—Continued

LIST PRICES—Continued

AMMETERS—Continued

Self Contained

Range	Scale Div.	Style No.	List Price Discount Symbol BC
Triple Range			
.05–.5–5	100	936 267	$ 77 00
.5–2.5–5	100	936 268	77 00
.1–1–10	100	936 269	77 00
1–2.5–10	100	936 270	77 00
1–5–10	100	936 271	77 00
.15–3–15	150	936 272	77 00
1.5–3–15	150	936 273	77 00
.5–2.5–25	100	936 274	77 00
2.5–5–25	100	936 275	77 00
2.5–10–25	100	936 276	77 00
5–10–25	100	936 277	77 00
1.5–3–30	150	936 278	77 00
3–6–30	150	936 279	77 00
3–15–30	150	936 280	77 00
.5–5–50	100	936 281	77 00
2–10–50	100	936 282	77 00
5–20–50	100	936 283	77 00
10–25–50	100	936 284	77 00

The above instruments are shunted internally and have a voltage drop of 50 millivolts ± 10%.

VOLT-AMMETERS

Self Contained

Resistance 100 Ohms per Volt

Volts	Amperes	Scale Div.	Style No.	List Price Discount Symbol BC
3–30*	.03–.3–3–30	150	936 285	$ 105 00
3–15–150*	.15–1.5–15	150	936 286	105 00

* Conforms with ARA Specifications.

MILLIVOLTMETERS

Range	Approx. Resistance Ohms	Scale Div.	Style No.	List Price Discount Symbol BC
Single Range				
50†	5	100–150	936 496	$ 63 00
50	5	100	701 360	60 00
100	10	100	701 361	60 00
Double Range				
50–100	5–10	100	701 362	65 00

Style No. and list price of Millivoltmeters include one pair of leads Style No. 819344. Resistance of leads, 0.017 ohms total, is included in above resistance values. For Millivoltmeters of higher sensitivity see high sensitivity instruments.

† This instrument has an additional scale arc with 150 divisions to facilitate its use with shunts of 1.5 amperes capacity and multiples thereof.

VOLTMETERS

Self Contained

Resistance 200 Ohms per Volt

Range	Scale Div.	Style No.	List Price Discount Symbol BC
Single Range			
1	100	701 363	$ 60 00
1.5	150	936 287	60 00
2.5	125	701 364	60 00
3	150	936 288	60 00
5	100	701 365	60 00
15	150	701 366	60 00
150	150	701 367	60 00
300	150	701 368	64 00
600	150	701 369	72 00
750	150	701 370	76 00
Double Range			
3–15	150	701 371	65 00
3–150	150	701 372	65 00
15–150	150	701 373	65 00
75–150	150	701 374	65 00
150–300	150	820 178	69 00
300–600	150	701 375	77 00
150–750	150	701 376	81 00
Triple Range			
1.5–15–150	150	701 378	70 00
3–15–150	150	936 289	70 00
3–150–300	150	936 290	74 00
150–300–750	150	701 377	86 00

Order by Style Number

Prices and discounts are subject to change without notice

TYPE PX-5 PORTABLE INSTRUMENTS—Continued

LIST PRICES—Continued

VOLTMETERS

Self Contained

Resistance 1000 Ohms per Volt

Range	Scale Div.	Style No.	List Price Discount Symbol BC
		Single Range	
1	100	838 220	$ 70 00
1.5	150	936 291	70 00
2.5	125	838 221	70 00
3	150	936 292	70 00
5	100	838 222	70 00
15	150	838 223	70 00
150	150	838 224	70 00
300	150	838 225	74 00
600	150	838 226	82 00
750	150	838 227	86 00
		Double Range	
3–15	150	838 228	75 00
3–150	150	838 229	75 00
15–150	150	838 230	75 00
75–150	150	936 293	75 00
150–300	150	838 231	79 00
300–600	150	838 232	87 00
		Triple Range	
1.5–15–150	150	936 294	80 00
3–15–150	150	936 295	80 00
3–150–300	150	936 296	84 00
150–300–750	150	936 297	96 00

HIGH SENSITIVITY INSTRUMENTS

With Cobalt Steel Magnets

MILLIVOLTMETERS

Range	Approx. Resistance Ohms	Scale Div.	Style No.	List Price Discount Symbol BC
		Single Range		
2	5	100	837 648	$ 100 00
3	7.5	150	936 298	100 00
5	12.5	100	837 649	100 00
7.5	30	150	936 299	100 00
10	50	100	837 650	100 00
15	150	150	936 300	100 00
20	200	100	837 651	100 00
30	300	150	936 301	100 00
50	1000	100	837 652	100 00
75	1500	150	936 302	100 00
100	5000	100	936 303	100 00
150	7500	150	936 304	100 00
200	10000	100	936 305	100 00
250	12500	125	936 306	100 00
300	15000	150	936 307	100 00
500	25000	100	936 308	100 00
		Double Range		
2–8	5–20	80	936 309	110 00
5–10	12.5–25	100	936 310	110 00
2–20	5–50	100	837 653	110 00
10–50	50–250	100	837 654	110 00
20–50	200–500	100	837 655	110 00
		Triple Range		
2–10–50	5–25–125	100	837 656	120 00
		Four Range		
2–5–10–20	5–12.5–25–50	100	936 311	130 00
2–5–20–50	5–12.5–50–125	100	837 657	115 00
2–10–50–250	5–25–125–625	100	837 658	130 00
2–20–200–2000	5–50–500–5000	100	936 312	130 00

Style No. and list price of Millivoltmeters include one pair of leads Style No. 819344. Resistance of leads, 0.017 ohms, total, is included in above resistance values.

Order by Style Number

Prices and discounts are subject to change without notice

TYPE PX-5 PORTABLE INSTRUMENTS—Continued

LIST PRICES—Continued

HIGH SENSITIVITY INSTRUMENTS—Continued

With Cobalt Steel Magnets

MICROAMMETERS

Single Range

Range	Approx. Resistance Ohms	Scale Div.	Style No.	List Price Discount Symbol BC
10	2800	100	936 313	$ 125 00
15	1800	150	936 314	120 00
20	700	100	936 315	110 00
25	368	125	837 659	105 00
30	300	150	936 316	105 00
50	146	100	837 660	100 00
100	37	100	837 661	100 00
150	15	150	936 317	100 00
200	9	100	936 318	100 00
250	7	125	837 662	100 00
300	3.7	150	936 319	100 00
500	2.9	100	837 663	100 00
750	.6	150	936 320	100 00

LEADS

Description	Style No.	List Price Discount Symbol BC
Shunt leads, three feet long (one pair)	819 344	$ 2 00
Test leads, three feet long (one pair)	818 183	2 00

CARRYING CASE

Leather carrying case for one PX-5 instrument	820 995	11 00

Order by Style Number

Prices and discounts are subject to change without notice

Printed in U.S.A.

TYPE PX-4 PORTABLE INSTRUMENTS

Direct Current, Radio-Frequency and Rectox Types

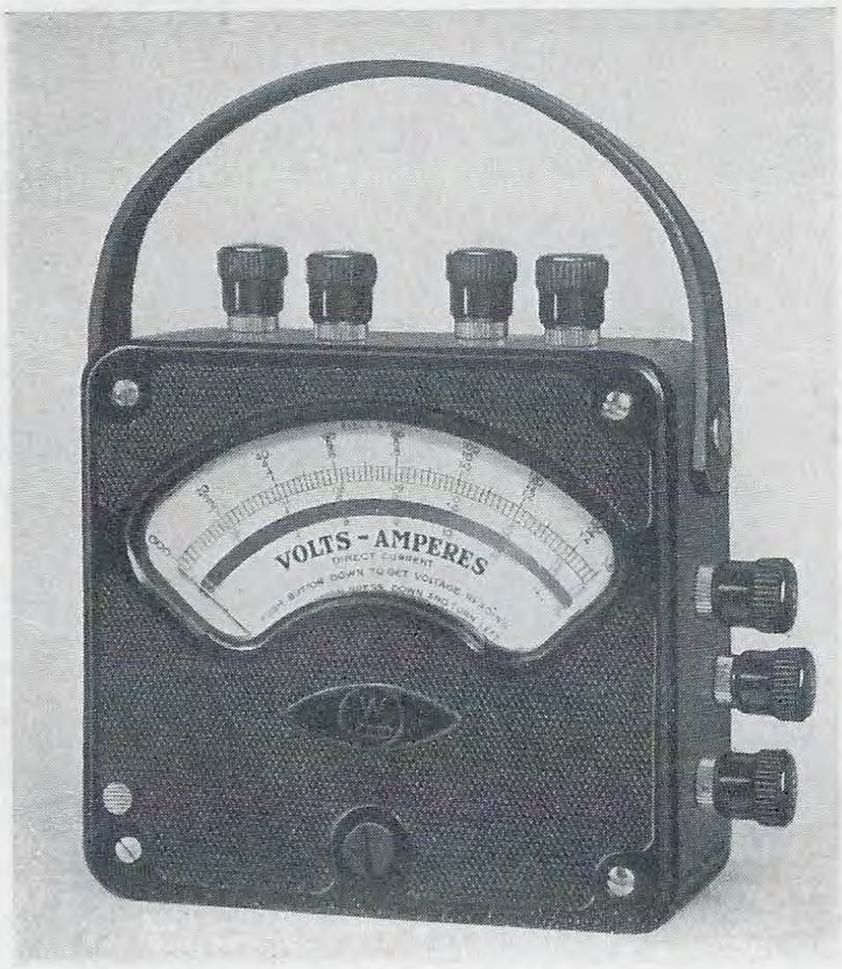


FIG. 1—TYPE PX-4 SIX RANGE VOLT-AMMETER

DATA

CASE SIZE.....4½" x 4½" x 2"
SCALE LENGTH.....3.5"
ACCURACY.....DIRECT CURRENT WITHIN ¾%
RADIO-FREQUENCY WITHIN 2%
RECTOX WITHIN 5%
MOVEMENTS.....DIRECT CURRENT —D'ARSONVAL
RADIO-FREQUENCY—D'ARSONVAL WITH THERMO-COUPLE
RECTOX —D'ARSONVAL WITH RECTOX RECTIFIER
SHIELDING.....NOT SHIELDED FROM EXTERNAL MAGNETIC FIELDS
CASE.....MOLDARTA
WEIGHTS.....NET 3 POUNDS—SHIPPING 5½ POUNDS
COBALT MAGNET TYPES
NET 4 POUNDS—SHIPPING 6½ POUNDS

Application

The PX-4 portable instruments are intended for general testing purposes where a small size, direct-current instrument, easily carried is desired. They are provided with Moldarta cases, neat appearing and of a convenient size which can be easily slipped into the pocket. PX-4 portables are available in a wide range of capacities to cover every direct current need.

Construction and Operation

The PX-4 instrument elements are mounted on a Moldarta plate which supports all resistance spools and shunts. This plate with the mechanism and accessories is removable from the front of the case by removing the molded cover plate, which is fastened to the case by four screws. This type of construction makes easy removal of the instrument mechanism for repair or recalibration.

All terminals are provided with non-removable nuts which are insulated, and which will clamp almost any kind of test wires or leads. The terminals are located on the sides of the case and properly spaced to give ample room for test leads or wires. Each terminal is plainly marked with the capacity range and is also securely anchored in the case so that it will not loosen with use.

The top is also Moldarta. It is arranged with an artistic semi-circular opening for the dial. This opening is closed with a glass window which is held to the cover plate with clamps and made entirely dust-proof. The front cover plate is fitted with a molded zero adjuster.

TYPE PX-4 PORTABLE INSTRUMENTS—Continued

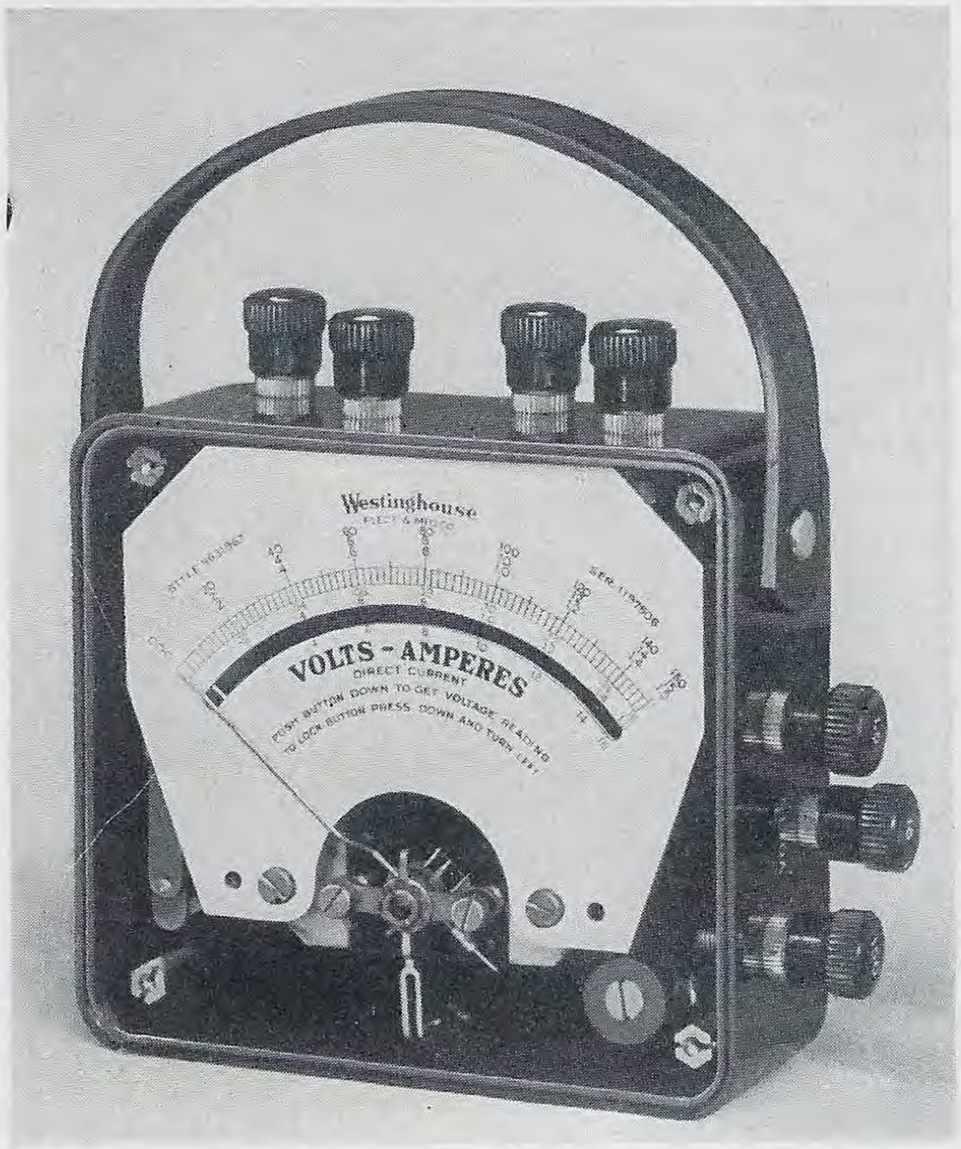


FIG. 2—PX-4 VOLT-AMMETER WITH COVER REMOVED SHOWING SCALE, POINTER AND MOVEMENT

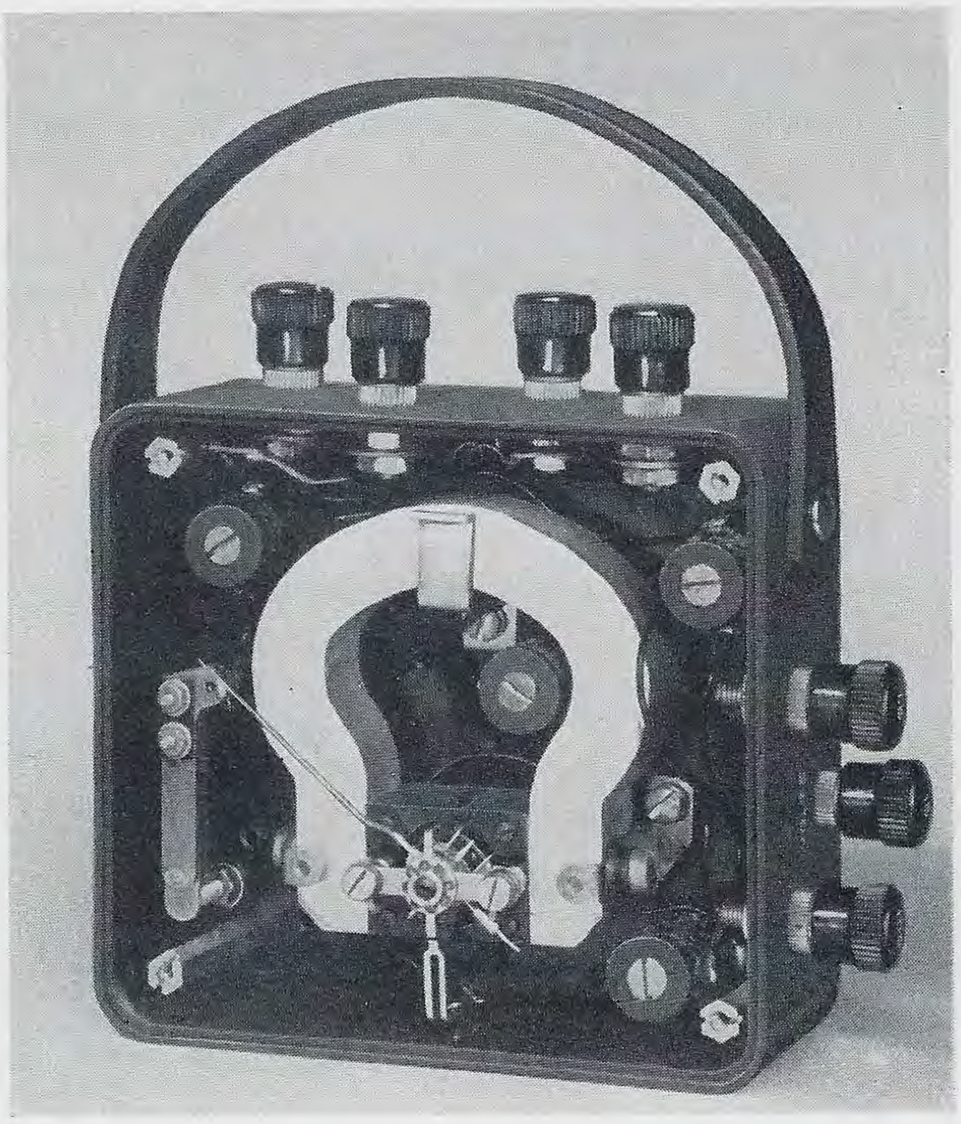


FIG. 3—THIS VIEW SHOWS THE PERMANENT MAGNET, RESISTORS, MOVEMENT AND SWITCH

All PX-4 portables are provided with leather carrying handles which are unusually large with ample room for the hand without interfering with the terminals on the top side of the case. Leather carrying cases for either one, two or three PX-4 instruments are available.

Dials—A white lithographed metal dial with black figures is used. It is equipped with a mirror dial to avoid parallax in reading. Scales are 3.5 inches long and are uniform in distribution except on the radio-frequency ammeters and Rectox types. The figures and subdivisions are selected to make the value of the smallest divisions easy to determine. Sufficient scale area is available to prevent crowding of arcs on multi-range instruments.

Pointer—The pointer is made of aluminum tubing flattened to a knife edge at the upper end. The upper edge of the flat section is colored red to facilitate reading. Readings can be taken to well within the rated accuracy with the knife-edge pointer and mirror scale.

Zero Adjuster—An external, insulated zero adjuster is standard on the PX-4 portable instruments.

Movements—The movement used in the PX-4 portables is the well-known d'Arsonval type, consisting of a permanent magnet and moving coil. This movement has been constantly improved and the latest design as used in the PX-4 instruments represents the ultimate in accuracy and reliability. Proper heat treatment and aging of the permanent magnets together with sturdy coil construction and highly polished genuine sapphire jewels, assure high accuracy over long periods of time. The pivots are made by a new process which guarantees sufficient hardness to withstand severe portable service.

A cobalt steel magnet is used on all PX-4 portable instruments when low energy consumption is essential. The moving coils are wound on aluminum frames except for the low energy instruments where they are wound self-supporting.

For measurement of radio frequency, this movement is equipped with a compensated thermo-couple. Rectifier instruments for measurement of alternating current are available with full-wave Rectox units. By rectification of the a-c. and then measuring the average value of the wave with the PX-4 d'Arsonval element a very sensitive a-c. instrument is provided.

Damping Factor — Damping is obtained by the currents generated in the aluminum frame of the coil. Self-supporting coils are damped by resistance in the external circuit.

Damping factor according to A.I.E.E. rules for all aluminum frame coils is as follows:

Voltmeters —20
Ammeters —20
Milliammeters—20

This is a ratio of over-swing to under-swing from steady deflection at $\frac{2}{3}$ scale deflection.

Temperature—All standard range instruments will indicate correctly between temperatures of 10 and 35 degrees Centigrade.

TYPE PX-4 PORTABLE INSTRUMENTS—Continued

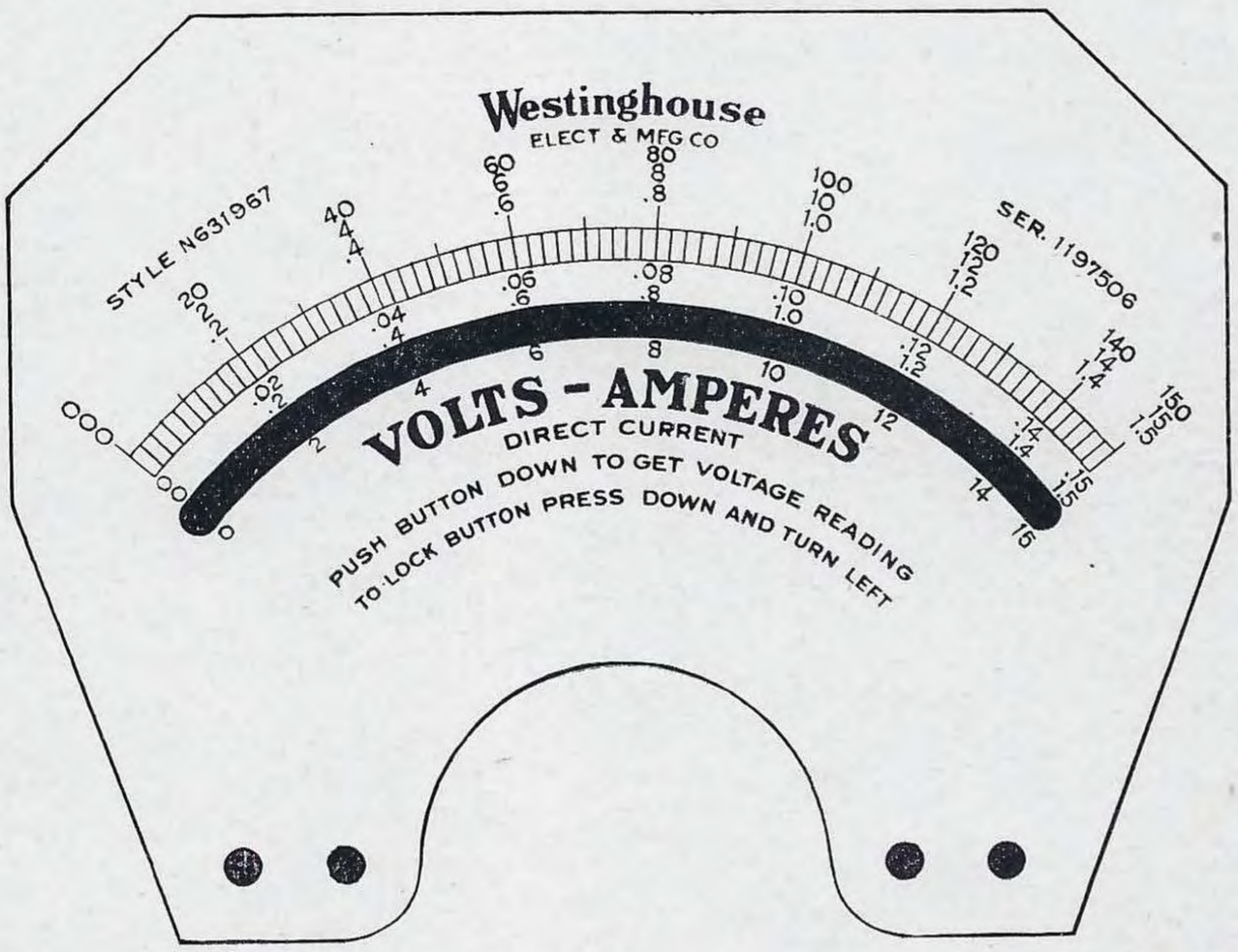


FIG. 4—FULL SIZE SCALE OF PX-4 VOLT-AMMETER

FIG. 5—SHUNT LEADS, STYLE NO. 819344

The leads illustrated are available for use with all Westinghouse portable instruments.

The leads in Figs. 5 and 6 are flexible, 3 feet long, and of fixed resistance to be used as connectors between shunts and portable instruments. The resistance of the pair of leads combined is .017 ohms, for either Style No. 819344 shown in Fig. 5, or Style No. 818183 shown in Fig. 6. The **Style Number** and **List Price** covers one pair of leads. The only difference between these two styles of leads is in the hardware furnished on the ends as is shown in the illustrations.

FIG.6—SHUNT LEADS STYLE NO. 818183

TYPE PX-4 PORTABLE INSTRUMENTS—Continued

LIST PRICES

AMMETERS

Self-Contained

Capacity	Scale Divisions	Style	List Price Discount Symbol BC
Single Range			
1	100	838 273	$30 00
2.5	50	838 274	30 00
5	100	838 275	30 00
10	100	838 276	30 00
15	75	838 277	30 00
25	50	838 278	30 00
50	100	838 279	30 00
Double Range			
.25–2.5	50	423 266	35 00
.5–5	100	423 267	35 00
1–5	100	423 268	35 00
1–10	100	423 269	35 00
2–10	100	423 270	35 00
1.5–15	75	423 271	35 00
2–20	100	423 272	35 00
4–20	40	423 273	35 00
6–30	60	423 274	35 00
10–50	100	838 280	35 00

These Instruments Are Shunted Internally and Have a Drop of 50 M.V. ± 10%.

Triple Range With Portable Combination Shunts

5–20–200	100	424 396	55 00
3–30–300	60	424 397	55 00

The Shunts and Instruments in this Group have 50 M.V. Drops.
Style and List Price Include Shunt and Leads.

MILLIAMMETERS

Self-Contained

Capacity	Scale Divisions	Approx. Resistance Ohms	Style	List Price Discount Symbol BC
Single Range				
1	100	109	836 818	$31 00
2	100	28	423 258	31 00
5	100	5	423 259	30 00
10	100	2.6	423 260	30 00
25	50	.708	423 261	30 00
50	100	1.	423 262	30 00
100	100	.5	423 263	30 00
150	75	.33	423 264	30 00
250	50	.2	423 265	30 00
500	100	.1	836 819	30 00
750	75	.066	836 820	30 00
1000	100	.05	936 371	30 00
1500	75	.033	936 372	30 00
Double Range				
1–10	100	140 –14	838 281	36 00
15–150	75	3.5 – .35	838 282	35 00
100–500	100	.5 – .1	838 283	35 00
150–750	75	.33– .066	838 284	35 00
Triple Range				
3–7.5–30	75	21. –5.7 –2.3	936 374	40 00
1.5– 15–150	75	280 –31 –3.1	936 375	40 00
75– 30–150	75	22.5 –6.2 –1.2	936 376	40 00
15–150–1500	75	12 –1.2 –.12	936 377	40 00
30–300–3000	75	1.66– .16 –.016	936 378	40 00
150–750–3000	75	.33– .066–.016	936 379	40 00

TYPE PX-4 PORTABLE INSTRUMENTS—Continued

LIST PRICES—Continued

MICROAMMETERS

Single Range

Capacity	Scale Divisions	Approx. Resistance Ohms	Style	List Price Discount Symbol BC
300	60	63	423 255	$35 00
500	100	38	423 256	35 00
1000	100	13	423 257	31 00

For Microammeters of Higher Sensitivity, See High Sensitivity Instruments.

MILLIVOLTMETERS

Capacity	Scale Divisions	Approx. Resistance Ohms	Style	List Price Discount Symbol BC
Single Range				
50†	75–100	2.1	936 508	$33 00
50	100	2.1	423 276	30 00
100	100	4.2	423 277	30 00
Double Range				
25–100	50	1–4	463 239	35 00
25–100	50	105–420	423 275	45 00
50–100	100	2–4	626 869	35 00

Style and List Price Include One Pair of Leads, Style 819344.
Resistance of Leads 0.017 Ohms is Included in Above Resistance Values.
†This Instrument Has an Additional Scale Arc with 75 Divisions to Facilitate its Use with Shunts of 1.5 Ampere Capacity and Multiples Thereof.
For Millivoltmeters of Higher Sensitivity, See High Sensitivity Instruments.

VOLTMETERS

Resistance 1000 Ohms per Volt—Self Contained

Capacity	Scale Divisions	Style	List Price Discount Symbol BC
Single Range			
1	100	936 380	$31 00
2.5	50	936 381	31 00
5	100	936 382	32 00
15	75	936 383	32 00
50	100	936 384	33 00
150	75	936 385	35 00
300	75	936 386	37 00
600	60	936 387	42 00
750	75	936 388	46 00
Double Range			
2.5–10	100	936 391	37 00
3–15	60	936 389	37 00
10– 50	100	936 392	38 00
3–150	60	936 390	40 00
8–200	80	512 824	40 00
10–100	100	936 393	39 00
15–150	75	516 629	40 00
75–150	75	936 394	40 00
50–250	50	516 583	42 00
150–300	75	936 395	42 00
75–750	75	936 396	51 00
300–600	60	936 397	47 00
150–750	75	936 398	51 00
Triple Range			
1.5– 15–150	75	936 399	45 00
3–7.5– 30	75	936 400	43 00
3– 15–150	60	936 401	45 00
3–150–300	60	936 402	47 00
7.5– 30– 75	75	936 403	43 00
7.5–300–750	75	936 404	56 00
50–250–750	50	838 272	56 00
75–300–750	75	936 405	56 00
150–300–750	75	936 406	56 00

TYPE PX-4 PORTABLE INSTRUMENTS—Continued

LIST PRICES—Continued

GALVANOMETERS

Capacity	Scale Divisions	Approx. Resistance Ohms	Style	List Price Discount Symbol BC
		Direct Current		
40–0–40 microamperes	10–0–10	18	423 298	$35 00
		Alternating Current Thermocouple Type		
100 milliamperes	100 equal spaced	7	445 864	45 00

ELECTROLYSIS VOLTMETER

Capacity	Scale Divisions	Approx. Resistance Ohms	Style	List Price Discount Symbol BC
.05–0–.05 .5–0–.5 5–0–5 50–0–50	100	20 200 2000 20000	423 291	$45 00

CADMIUM TEST VOLTMETERS

Capacity	Style	List Price Discount Symbol BC
.3–0–2.8	423 278	$50 00
.3–0–2.8 3–0–28	423 279	55 00

Style numbers and List Prices include Set of Leads and Cadmium Test Electrodes.

CODED CURRENT MILLIAMMETER

Capacity	Scale Divisions	Style	List Price Discount Symbol BC
150†	75	930 732	$55 00

†This Instrument has a Highly Damped Movement for Measurement of Discontinuous Signal Currents.

VOLT-AMMETERS

Self-Contained

Resistance 100 Ohms Per Volt for Voltage Ranges

Capacity: Volts	Capacity: Amperes	Scale Divisions	Style	List Price Discount Symbol BC
		Single Range		
50	50	100	936 407	$40 00
		Double Range		
15–150	7.5–30	75	936 408	50 00
3–15	1.5–15	75	936 409	50 00
10–50	.25–2.5	100	936 410	50 00
3–30	.3–6	60	936 411	50 00
30–60	30–60	60	936 412	50 00
		Triple Range		
1.5– 3–30	1.5– 3–30	60	936 413	60 00
3–15–30	3–15–30	60	936 414	60 00
3–15–150	.15–1.5–15	75	936 415	60 00
1.5–15–150	.15–1.5–15	75	936 416	60 00
1.5–15–30	.3– 3–30	60	936 417	60 00

TYPE PX-4 PORTABLE INSTRUMENTS—Continued

LIST PRICES—Continued

Self-Contained

Capacity	Scale Divisions	Style	List Price Discount Symbol BC
RADIO-FREQUENCY AMMETERS			
.5	100	936 418	$37 00
1	100	423 292	37 00
2.5	50	423 293	37 00
3	60	936 419	37 00
5	100	423 294	37 00
10	100	423 295	37 00
15	75	423 296	37 00
20	100	423 297	37 00
RADIO-FREQUENCY MILLIAMMETERS			
Self-Contained			
75	75	838 702	39 00
100	100	838 703	39 00
150	75	838 704	39 00
200	100	838 705	39 00
250	50	838 706	39 00
300	60	838 707	39 00
400	80	838 708	39 01
500	100	838 719	39 00
600	60	838 710	37 00
800	80	838 711	37 00
RECTOX MILLIAMMETERS			
Alternating Current			
1.5	75	722 461	35 00
5	100	722 462	35 00
10	100	722 463	35 00
20	100	722 464	35 00
RECTOX MICROAMMETERS			
Alternating Current			
500	100	722 465	40 00
RECTOX VOLTMETERS			
Alternating Current			
Resistance 1000 Ohms Per Volt			
1	100	722 466	35 00
3	60	722 467	35 00
5	100	722 468	35 00
15	75	722 469	35 00
150	75	722 470	35 00
Alternating Current			
Resistance 2000 Ohms Per Volt			
1.5	75	838 712	38 00
2	100	838 713	38 00
2.5	50	838 714	38 00
3	60	838 715	38 00
Alternating Current			
Resistance 5000 Ohms Per Volt			
	100	838 716	38 00
1.5	100	838 717	38 00

TYPE PX-4 PORTABLE INSTRUMENTS—Continued

LIST PRICES—Continued

HIGH SENSITIVITY INSTRUMENTS

WITH COBALT MAGNETS

MILLIVOLTMETERS

Single Range

Capacity	Approx. Resistance Ohms	Scale Divisions	Style	List Price Discount Symbol BC
2	5.	100	838 718	$50 00
5	12.5	100	838 719	50 00
10	50	100	838 720	50 00
20	200	100	838 721	50 00
50	1000	100	838 722	50 00

Double Range

2–20	5–50	100	838 723	55 00
10–50	50–250	100	838 724	55 00
20–50	200–500	100	838 725	55 00

Style Numbers and List Prices Include One Pair of Leads, Style No. 819344. Above Resistance Values Include Resistance of Leads, 0.017 Ohms.

MICROAMMETERS

25	368	50	838 726	50 00
50	146	100	838 727	47 00
100	37	100	838 728	45 00
250	7	50	838 729	43 00
500	2.9	100	838 730	40 00

LEADS

Description	Style	List Price Discount Symbol BC
Shunt Leads (one pair)	819 344	$2 00
Test Leads (one pair)	818 183	2 00

CARRYING CASES

Description	Style	List Price Discount Symbol BC
Leather Carrying Case for One PX-4 Inst.	525 431	$7 00
Leather Carrying Case for Two PX-4 Inst.	595 932	7 50
Leather Carrying Case for Three PX-4 Inst.	628 048	7 50

Printed in U.S.A.

PORTABLE TRANSFORMERS

CURRENT TRANSFORMERS

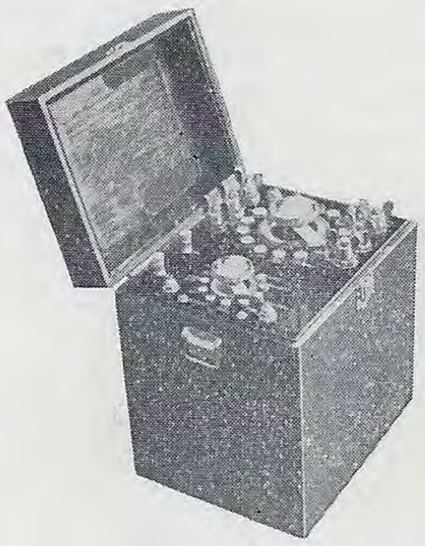


FIG. 1—MULTI-RANGE TYPE

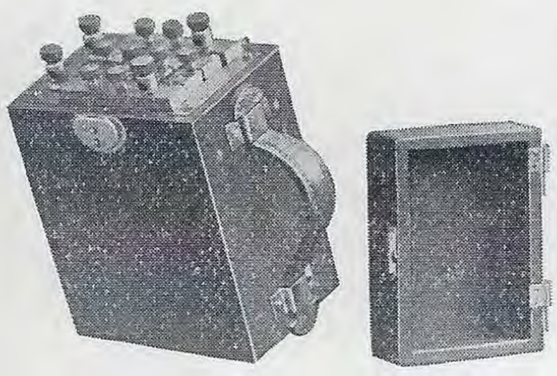


FIG. 2—PLUG-TYPE

FIG. 3—THROUGH-TYPE

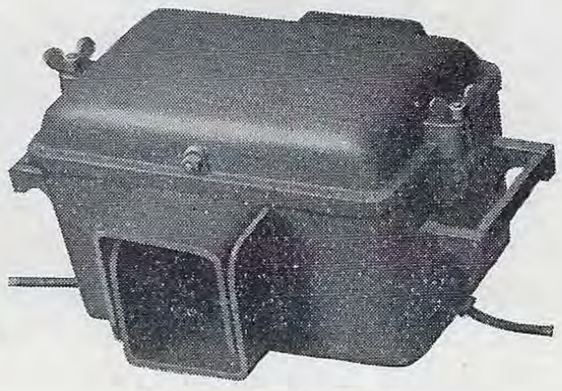


FIG. 4—SPLIT-TYPE

General

Accuracy—Portable current transformers are generally used for emergency tests in the field and are therefore made smaller in size and lighter in weight than the switchboard instrument transformers in order to facilitate their portability. It is therefore necessary to work the material in these at a somewhat higher density than in the case of switchboard transformers, so that the error in ratio will be somewhat greater than for switchboard-type transformers.

Capacity—These current transformers are rated at a current which gives 5 amperes secondary. Since 5 amperes represents the full scale rating of most instruments, the transformers are usually applied to a circuit whose full-load rating is about 65 per cent of the rating of the transformer. They therefore should not be used for continuous operation on a load greater than 65 per cent of their rated primary current, and for not more than two hours at full primary capacity, but can be used for short periods on loads of 150 per cent rated primary current.

Plug-Type

Construction—The coils of the primary can be connected either in series, in series-parallel, or in parallel, by means of connecting plugs to obtain a suitable ratio.

Accuracy—The ratio accuracy of the plug-type transformers is guaranteed to be within one per cent at the full-current rating with each ratio setting when used with a load of 12½ volt-amperes on the secondary.

Multi-Range Type

Rating—Two styles of this transformer are available, one style has 21 ratios as follows:
5 – 10 – 15 – 20 – 25 – 30 – 40 – 50 – 60 – 75 – 80 – 100 – 120 – 125 – 150 – 160 – 200 – 250 – 300 – 400 – 500/5 amperes.

The other style has 23 ratios as follows: 5 – 10 – 15 – 20 – 25 – 30 – 40 – 50 – 60 – 75 – 80 – 100 – 120 – 125 – 150 – 160 – 200 – 250 – 300 – 400 – 500 – 600 – 800/5 amperes.

These Transformers are rated at 600 volts maximum line voltage; capacity, 50 volt amperes; and are compensated for 2½ volt amperes for use on 25 – 60 cycle circuits. They have a continuous current rating of one hour.

Accuracy—Multi-range transformers have a very high degree of accuracy, being designed primarily as laboratory standards. The accuracy is the same for each of the various ratios thus making necessary only one calibration curve. The error of these transformers at low burdens is negligible. Typical ratio curves do not vary more than .2 of 1% from true ratio with a burden of 2½ volt amperes at 90% power factor, 60 cycles. Typical phase angle curves do not vary more than three minutes from zero phase angle at 2½ volt amperes 90% power factor, 60 cycles. Individual calibration curve for ratio and phase angle will be furnished at a moderate additional charge.

Construction—This transformer is mounted in a polished wood case with a removable cover and handles for carrying. A shoulder strap may be used by passing it through the handles.

The transformer is suspended from a panel on which is mounted the binding posts and the dial switches for selecting the desired ratio. All exposed metal parts are nickel-plated. The magnetic circuit is made of Hypernik.

Through-Type

Construction—The through-type transformer is constructed so that the conductor of the circuit to be measured forms the primary winding. The conductor is passed through the hole in the case once for the highest rating, twice for the middle rating, and four times for the low rating.

Accuracy—The ratio accuracy of the through-type transformers is guaranteed to be within one per cent at the full current rating with each ratio setting when used with the secondary load for which it is compensated.

Split-Type

Application—These transformers are used for making measurements of current in circuits that it would be inconvenient or impossible to open, in stations or on large systems.

They may be used without special calibration with any standard ammeters having 5-ampere coils.

Construction—The iron core of the split-type transformer is built in the shape of a rectangle with an opening through its center, the opening varying in size according to the capacity of the transformer.

Each transformer is suitable for only one primary current, but can be used for one-half or one-quarter normal current by passing the conductor two or four times through the opening. It is mounted in a metal case with metal handle cast on the case.

Accuracy—The ratio accuracy of the split-type transformer is guaranteed to be within two per cent at the full current

PORTABLE TRANSFORMERS—Continued

rating when used with a load of 12½ volt-amperes on the secondary.

In a split-type transformer the phase displacement is high, because the magnetic circuit is broken by two small air gaps. It is also a variable quantity as the contact will vary every time the transformer is opened and closed. The effect of phase displacement is to make a watthour meter or wattmeter read high, especially at low line power factor. This error varies roughly from ½ to 1½ per cent at 90 per cent line power factor to 3 to 8 per cent at 50 per cent line power factor. For this reason the split-type current transformer is not suitable for use with wattmeters or watthour meters.

POTENTIAL TRANSFORMERS

Construction—These voltage transformers are of the improved-core type mounted in wood cases with a leather handle. They have insulated binding posts for the secondary connections and uninsulated binding posts for the primary. The primary binding posts are left uninsulated because it is impossible to insulate them sufficiently for perfect safety under all conditions, and a partly insulated terminal is considered to be more dangerous than a bare one.

Insulation—For 575 and 2300-volt transformers the primary winding will stand a test of 10,000 volts. For 460-volt transformers the primary winding will stand a test of 5000 volts. The secondary winding in all cases is tested at 2000 volts.

Accuracy—The ratio accuracy of these transformers is guaranteed to be within ½ per cent of the full voltage rating when used with a burden of 20 volt-amperes on the secondary. They will carry a load of 100 volt-amperes continuously.

Secondary Capacity—All portable voltage transformers listed are compensated for 20 volt-amperes at 115 volts secondary. Without appreciable change in accuracy, the 25-cycle transformers may be used on 60 cycles and the 60-cycle transformers on 133 cycles.

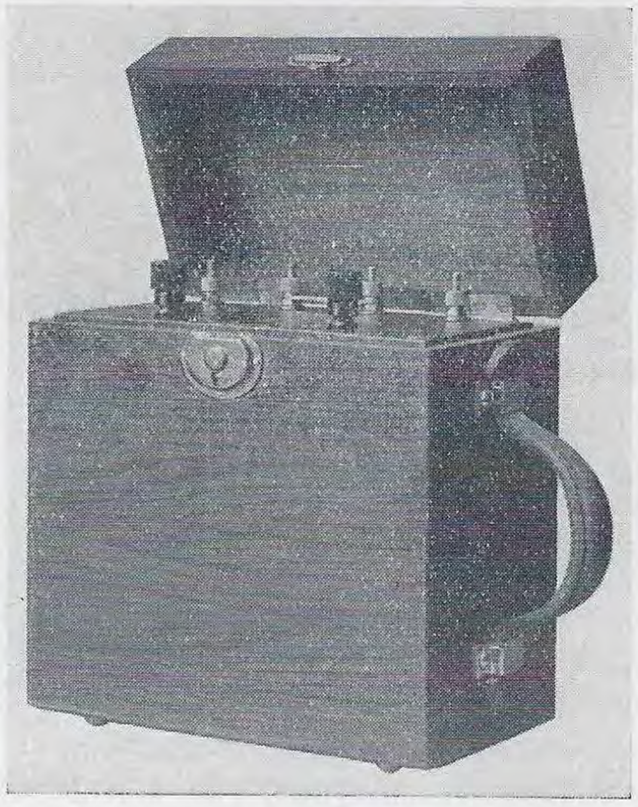


FIG. 5—PORTABLE VOLTAGE TRANSFORMER

LIST PRICES

Prices are F. O. B. Sharon Works.

CURRENT TRANSFORMERS

Primary Amperes at 5 Amp. Secondary	Insulation Rating	Secondary Volt Ampere Burden	Secondary Volt Ampere Comp.	Frequency Cycles	Dimensions, Inches: Approx. Overall	Dimensions, Inches: Opening for Primary Conductor	Approx. Wt., Lb.: Net	Approx. Wt., Lb.: Shipping	Style No.	List Price Discount Symbol BC
Plug-Type										
10– 20– 40	2300	.....	12½	25–60	6¼x10½x4½	.....	15	35	706 835	$118 00
25– 50– 100	2300	.....	12½	25–60	6¼x10½x4½	.....	15	35	706 834	118 00
Multi-Range Type										
5–500	1000	50	2½	25–60	15x13½x10½	.....	60	85	582 905	500 00
5–800	1000	50	2½	25–60	15x13½x12½	.....	70	95	986 983	635 00
Through-Type										
100–200– 400	2500	.....	5–10	25–60	7x7x4½	2 (dia.)	15	35	443 953	62 50
400–800–1600	600	.....	12½	25–60	8½x7⅝x5	2 x4	20	40	443 954	68 50
Split-Type										
250	2300	.....	12½	60	.....	1¼x1⅜	19½	35	456 058	80 00
500 750 1000 1500	2300	.....	12½	25–60	11½x10x7⅜	1⅞x3¼	35	50	305 248 305 249 108 145 305 250	75 00 77 50 80 00 82 50
1000 1500 2000	2300	.....	12½	25-60	12¾x10½x7	2½x3⅜	40	65	305 251 305 252 108 149	82 50 85 00 90 00
2000	2300	.....	12½	25–60	13¾x13¼x9	2x5	45	70	1023 751	125 00
2000 2500 3000	2300	.....	12½	25–60	11x12⅞x6⅞	3½x3⅛	45	70	108 150 305 253 108 152	90 00 95 00 100 00

POTENTIAL TRANSFORMERS

Primary Volts at 115 Volts Secondary	Test Voltage	Secondary Volt Ampere Comp.	Frequency Cycles	Approx. Overall Dimensions Inches	Approx. Wt., Lb.: Net	Approx. Wt., Lb.: Shipping	Style No.	List Price Discount Symbol BC
460– 230 575– 287½ 2300–1150	5000 10000 10000	20	25	10x5¾x10⅛	27	48	215 976 370 009 190 797	$ 90 00 95 00 100 00
460– 230 575– 287½ 2300–1150	5000 10000 10000	20	60	9 7/16 x5 1/16 x8¾	18½	33	215 978 370 008 190 798	65 00 70 00 75 00

Dimensions are for reference only. For official dimensions apply to the nearest district office.

Prices and discounts subject to change without notice.

Printed in U.S.A.

Order by Style Number

PORTABLE VOLTAGE INSTRUMENTS—TYPE PV-130—Continued

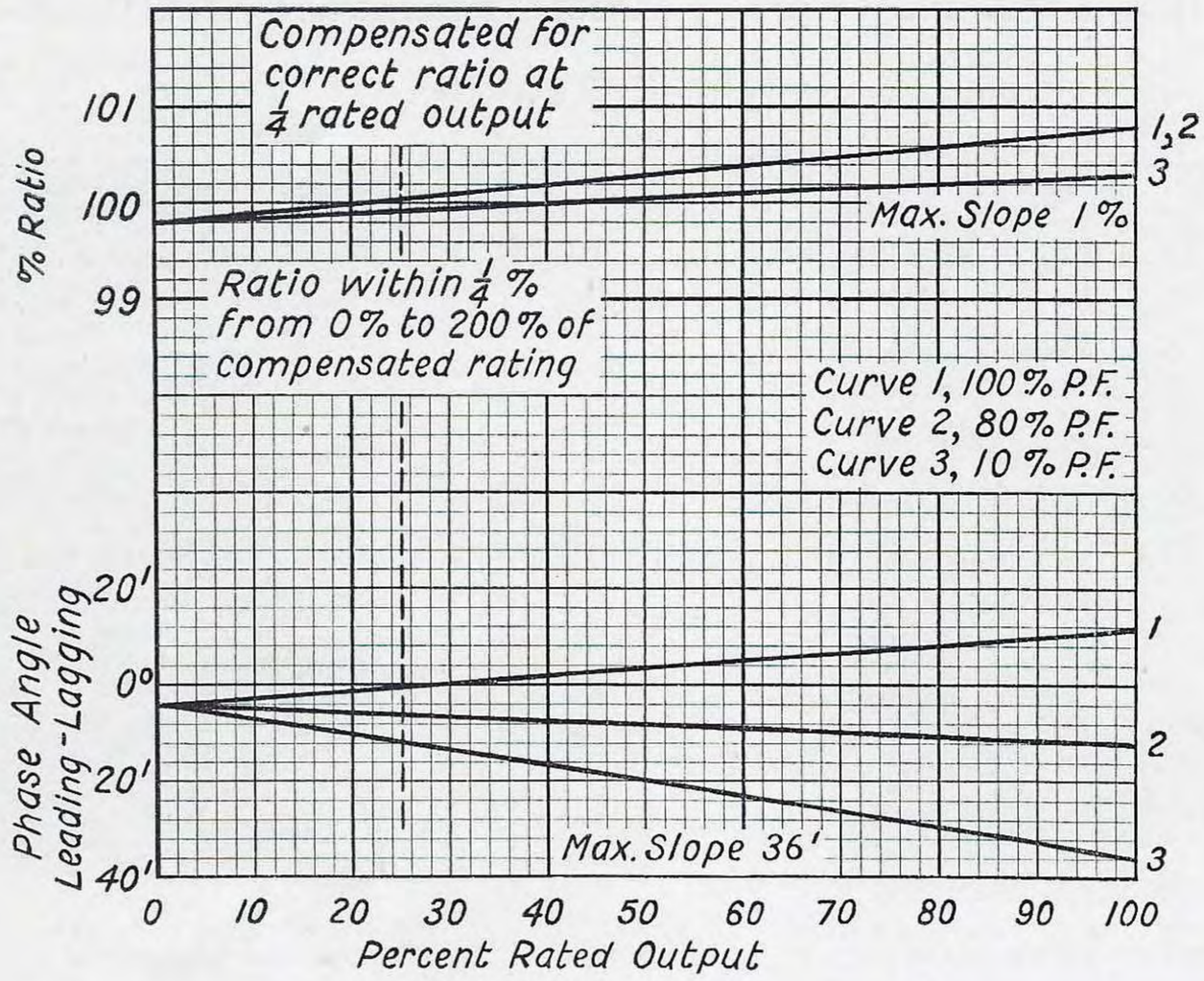


FIG. 2—TYPICAL RATIO AND PHASE ANGLE CURVES
TYPE PV-130 VOLTAGE TRANSFORMERS

LIST PRICES

Furnished in line with standard ratio and phase angle curves unless special ratio and phase angle tests are ordered.

Primary Rating at 115 V. Sec.	Cycles	Case Size	Volt-Ampere Capacity Max.	Volt-Ampere Capacity Comp.	Test Voltage	Style No.	Additional List Price for Special Ratio & Phase Angle Test Discount Sym. BC	List Price Discount Symbol BC
230			100	25				
460	60	S	100	25	4000	1 055 985	$34.50	$ 88.00
575			120	30				
230			12.5	3				
460	25	S	12.5	3	4000	1 055 989	34.50	88.00
575			20	5				
575			20	5				
1150	60	S	75	18	10000	1 055 986	34.50	105.00
2300			75	18				
575			7	2				
1150	25	L	25	6	10000	1 055 990	34.50	105.00
2300			25	6				
1150			25	6				
2300	60	L	100	25	10200	1 055 987	34.50	127.50
4600			100	25				
1725			40	10				
3450	60	L	150	35	14800	1 055 988	34.50	132.00
6900			150	35				

Prices and discounts subject to change without notice.

PORTABLE CURRENT TRANSFORMER

TYPE PC-137

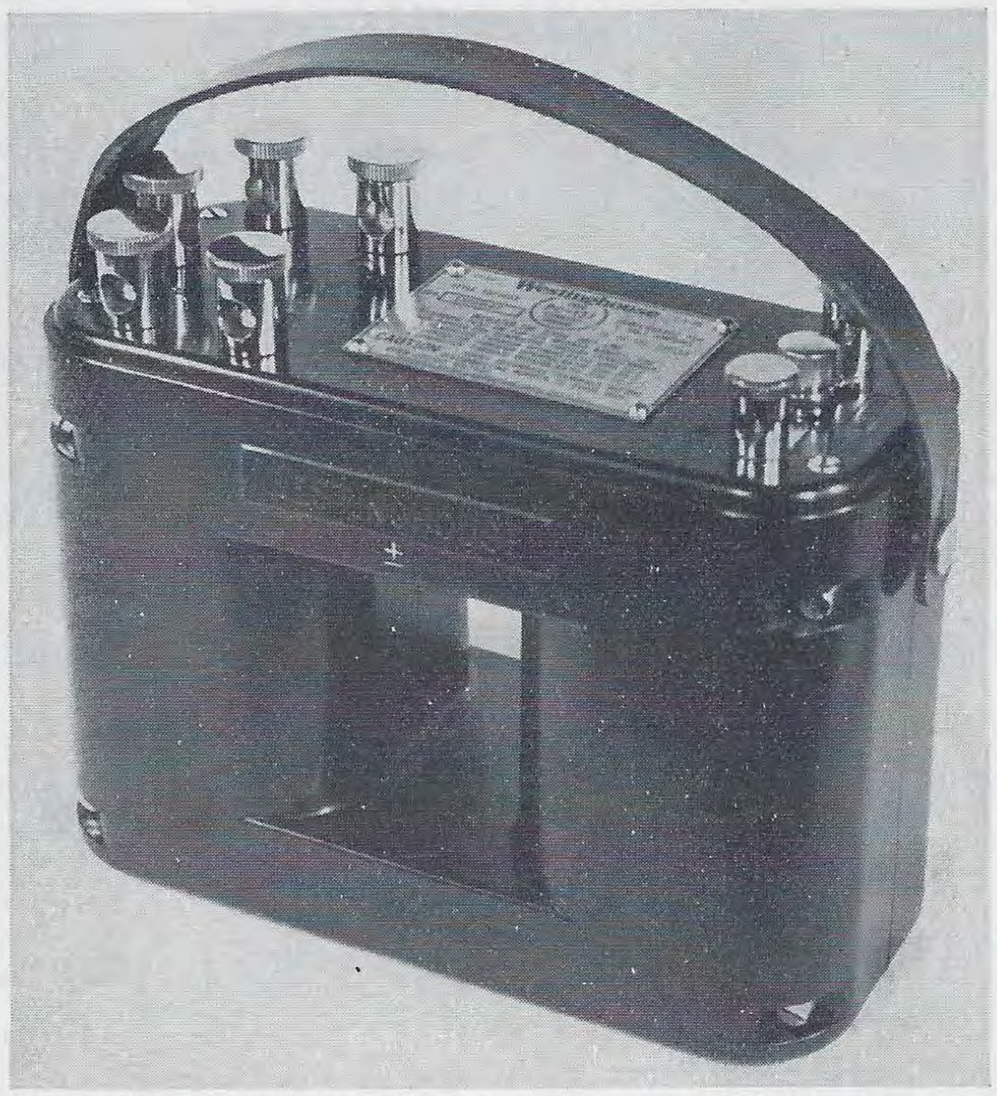


FIG. 1—TYPE PC-137 PORTABLE MULTI-RANGE CURRENT TRANSFORMER

DATA

Type	Combination "Through" and "Tap."
Housing	Moldarta, Maroon with nickel trimmings.
Size	8½" x 4" x 7" high.
Size of opening	1⅝" x 3".
Current rating	Primary 1000, 500, 250, 100, 50, 25, 10 amperes. Secondary 5 amperes.
Frequency rating	25 to 133 cycles.
Arrangement	Through type for 1000, 500 and 250 amperes. Tap type for 100, 50, 25 and 10 amperes.
Insulation rating	2300 volts.
Burden	25 V.A.
Compensation	5 V.A.
Accuracy	¼% from 50% to 200% current rating at compensated rating.
Net weight	Approximately 10½ lbs.
Shipping weight	Approximately 17 lbs.

General

The type PC-137 embodies careful layout and design features which assure high accuracy and provide broader operating ranges. When used with a Westinghouse type PY-5 triple range ammeter of 2—5—10 amperes capacity, currents from 20 amperes to 2000 amperes may be measured with a single hook-up.

Application

For general portable service where the maximum in accuracy and breadth of operating range are required.

Construction—Operation

The PC-137 is of the combination "through" and "tapped" construction. Its broad range of service has not detracted from neatness and compactness. Housed in high quality moldarta with attractive maroon and nickel finish, its appearance is second only to its high standard of performance. High grade low loss "Hypernik" is used in the core construction. Windings are thoroughly insulated and rigidly fixed in relation one to the other and to the iron core.

"Through" capacities of 1000, 500 and 250 are obtained by passing the conductor through the opening provided. Capacities of 100, 50, 25 and 10 are provided with terminals mounted on top of the case. The secondary terminals are distinctly marked and provided with a short circuiting switch for greater safety and convenience.

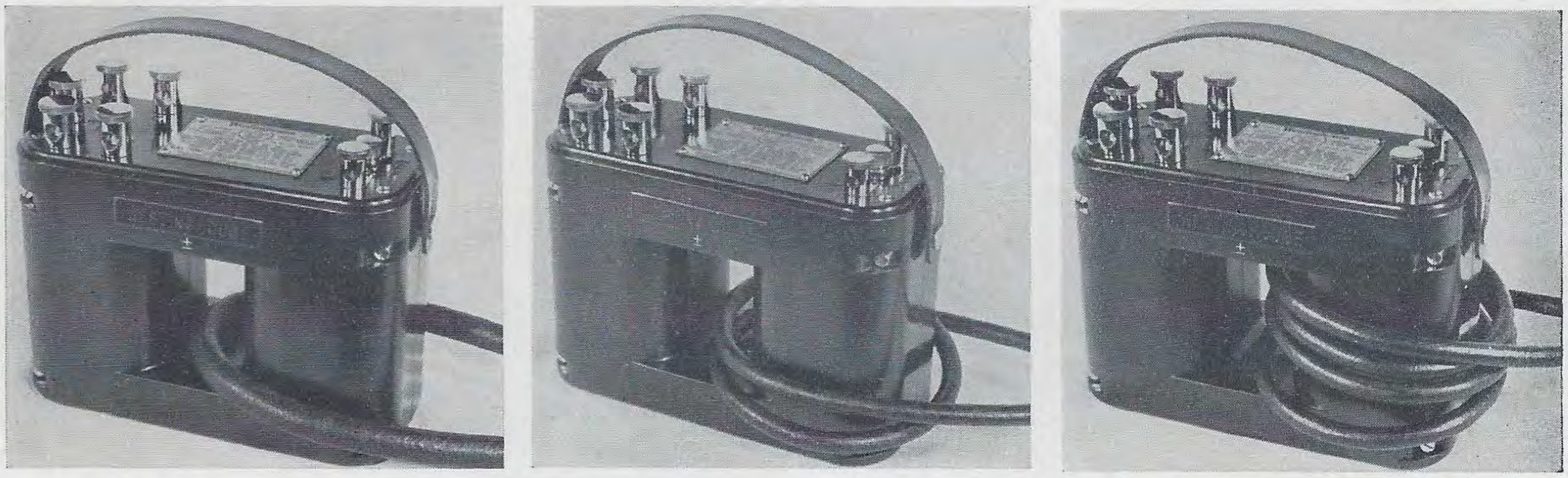
Westinghouse Electric & Manufacturing Company

Newark Works **Newark, N. J.**

Printed in U. S. A.

E-4, AJ-1, C-I, C. F.

TYPE PC-137 PORTABLE CURRENT TRANSFORMER—Continued



(A) ONE TURN, 1000/5 RATIO (B) TWO TURNS, 500/5 RATIO (C) FOUR TURNS, 250/5 RATIO

FIG. 2—SHOWING METHOD OF INTRODUCING TURNS IN PC-137 CURRENT TRANSFORMER WHEN USED AS THROUGH TYPE

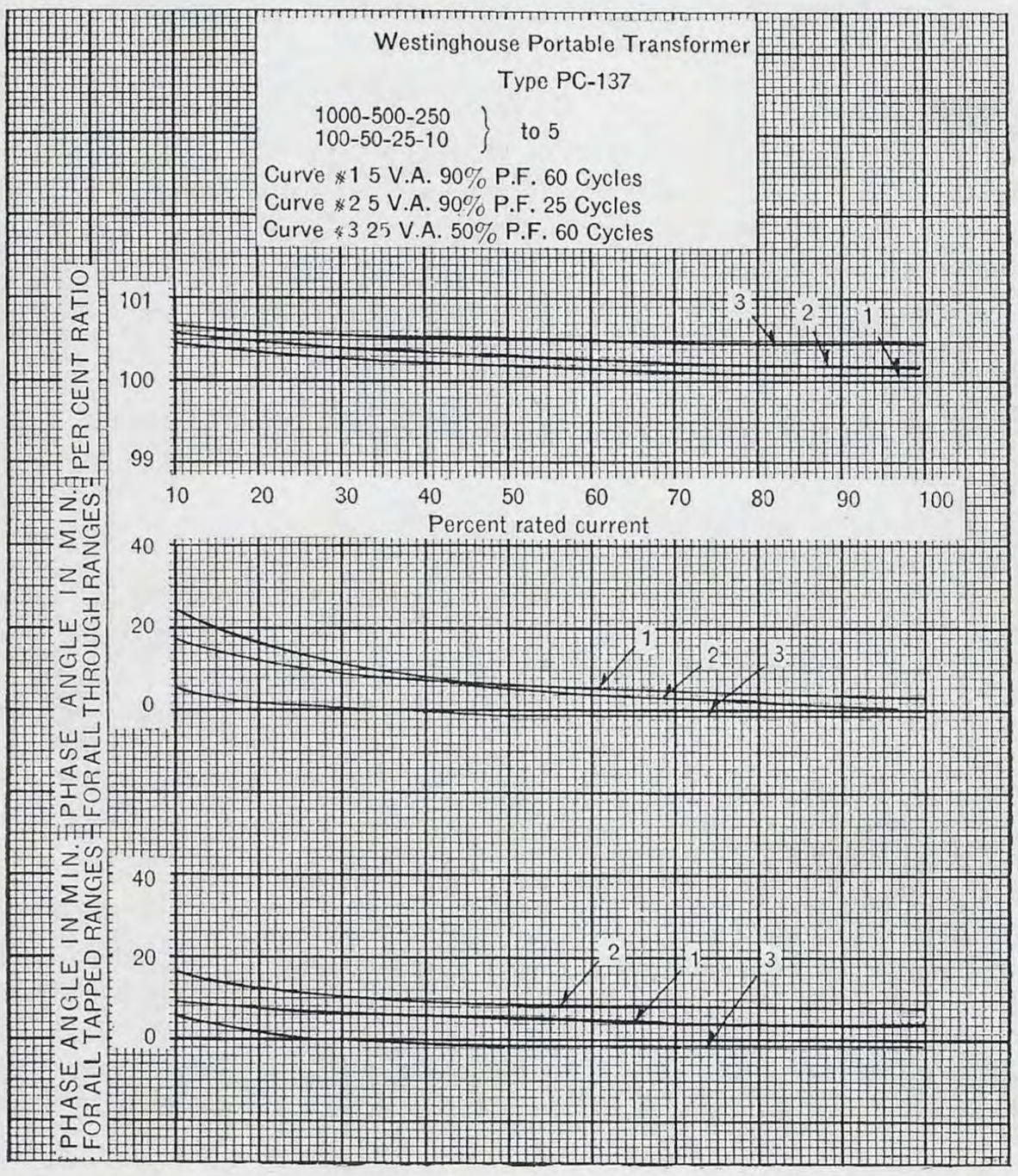


FIG. 3—CHARACTERISTIC RATIO AND PHASE ANGLE CURVES OF THE PC-137 CURRENT TRANSFORMER

TYPE PC-137 PORTABLE CURRENT TRANSFORMER—Continued

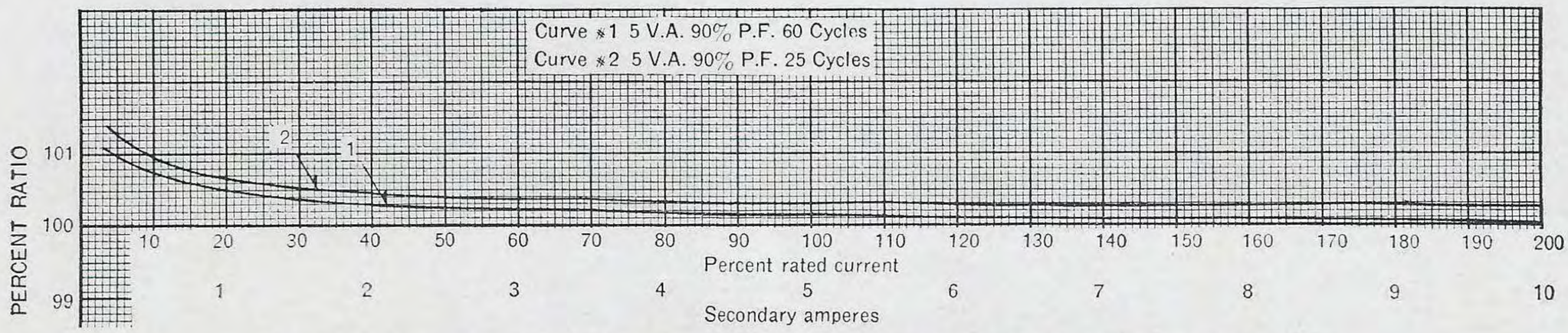


FIG. 4—CHARACTERISTIC RATIO CURVES OF THE PC-137 CURRENT TRANSFORMER SHOWING PERFORMANCE UP TO 200% OF RATED CURRENT

The specific compensated rating of the PC-137 is 5 volt amperes, 60 cycles, 90-100% power factor.

LIST PRICE
TYPE PC-137 PORTABLE CURRENT TRANSFORMERS

Furnished with standard ratio and phase angle curves unless special ratio and phase angle tests are ordered.*

Primary Rating at 5A. Secondary	Volt-Ampere Burden	Voltampere Compensation	Insulation Rating	Style No.	Additional List * Price for Special Ratios and Phase Angle Test. Disc. Symbol BC	List Price Discount Symbol BC
1000, 500, 250 100, 50, 25, 10	25	5	2300	1 001 033	$26 00	$140 00

* Special ratio and phase angle tests are made at one frequency and one burden (preferably 2.5, 5, 15 or 25 V.A.) and one power factor (90% or 50%). The values to be stated on the order.
For test at each additional frequency add one half the listed test price.
For test at each additional burden add one half the listed test price.

Prices and discounts subject to change without notice.

Supersedes
Edition dated Nov. 4, 1935 and Supplement 43-141
Dated Nov. 13, 1935

PORTABLE TEST UNITS

Type PX-25 Ohmmeters
Type PX-26 Volt Ohmmeter
Type PX-37 D-C. Test Unit
Type PM-32 A-C. and D-C. Test Unit

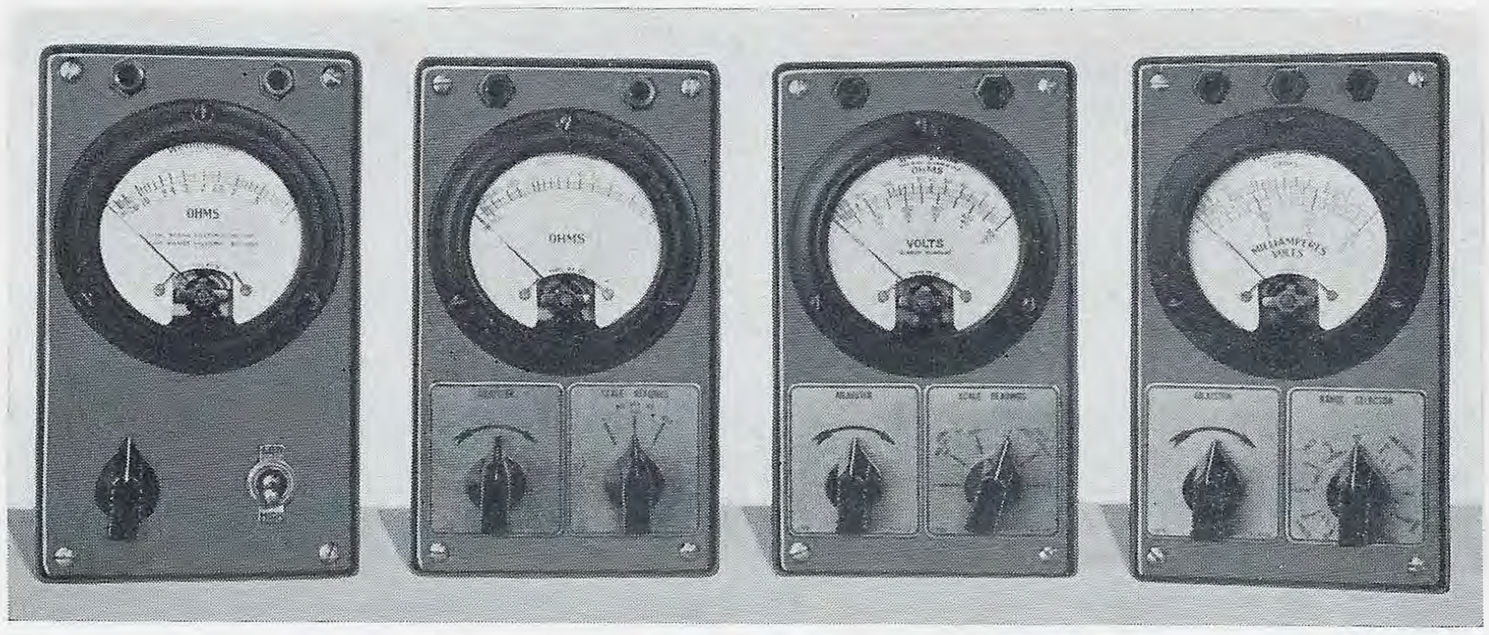


Fig. 1—Portable Volt-Ohmmeters and Test Units

Case Size 7" x 4" x 3¼"

Scale Length 2.4"

Movements—d'Arsonval

Case—Moldarta

Weights—3 Lbs. Approx.

General

Westinghouse portable volt-ohmmeters and test units cover a broad field of application and meet many diverse requirements in general testing, laboratory and radio work. They represent the most recent developments in their class and have been designed with the maximum of accuracy, flexibility of application, and convenience as the prime objective. Selector switches are employed for range selection which reduce the circuit switching and range changing operations to the simplest form.

These instruments embody the new Type NX d'Arsonval movement which has a one piece welded magnet assembly free from derangement under the most severe condition of use.

The cases are of moldarta artistically and sturdily designed, and convenient to carry.

Terminals, leads and switches are arranged for greatest convenience. Scales are selected to give greatest definition consistent with best readability and freedom from error.

Application

The ohmmeters are designed primarily for circuit resistance, continuity and insulation testing in assembled apparatus. They are sufficiently accurate however for resistor classification and leakage limit testing of condensers. The volt-ohmmeters go a step further in that they provide for measurement also of voltage A-C. and D-C. and currents depending upon the ranges selected. Volt-ohmmeters constitute the most useful tool for exploration and trouble shooting in complex circuits such as radios, public speech amplifiers, signal systems, talking movie sets, control systems, and other applications where detailed knowledge of circuit conditions and values must be obtained.

Construction and Operation

The units are individually mounted in convenient moldarta cases 7" x 4" x 3¼" in size. They are made up of a Type NX instrument mounted on a moldarta plate which forms the cover of the unit. Selector switch, battery, adjuster, terminal and circuit details are mounted on the cover plate easily accessible for inspection and replacement of batteries. Pin jacks provide convenient means of connection to external circuits. Leads are provided with prod terminals.

Batteries

A battery adjustor is conveniently mounted on the front of the instrument panel in all types. For maximum accuracy in resistance measurements the instrument should be checked frequently on 0 ohms by shorting the ohmmeter terminals and changing the adjustor if necessary. Standard Burgess or Eveready batteries of 1½ and 4½ volts are used. These may be purchased on the open market. Batteries should be replaced when it is no longer possible to obtain 0 ohms deflection with the adjustor

Scales and Pointers

Markings are in accord with regular portable instrument practice. The pointers are knife edge which makes correct readings easier to obtain. The instrument may be readily removed from the test unit case for inspection and repair if this becomes necessary.

Selector Switches

In the double range ohmmeters the ranges are selected by means of toggle selector switches. In multirange ohmmeters and test units a rotary type switch is provided for the purpose and suitably indexed on engraved switch plate.

PORTABLE TEST UNITS—Continued

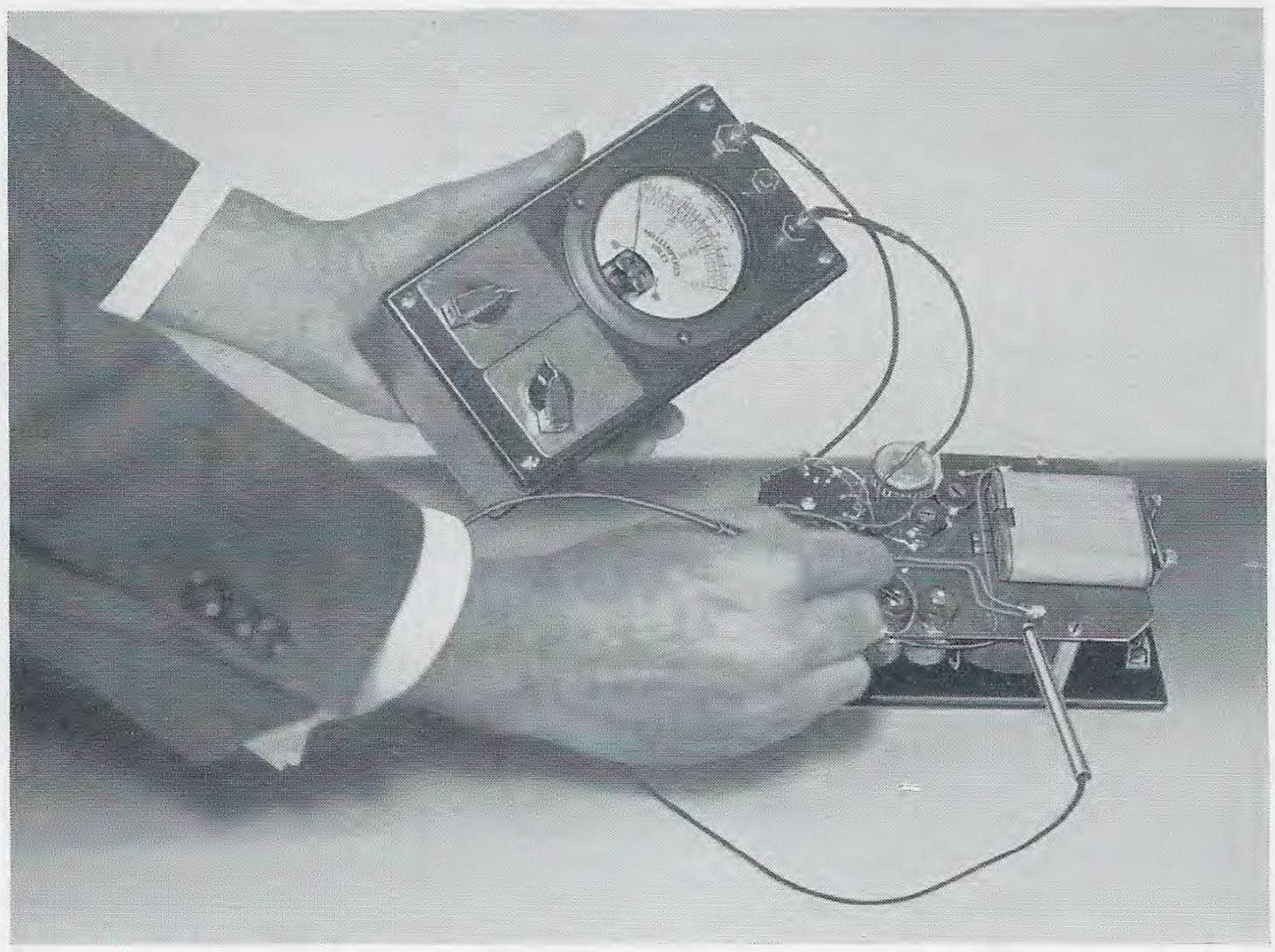


FIG. 2—TYPE PM-32 A-C. and D-C. VOLT OHMMETER IN USE SHOWING CONVENIENCE OF HANDLING.

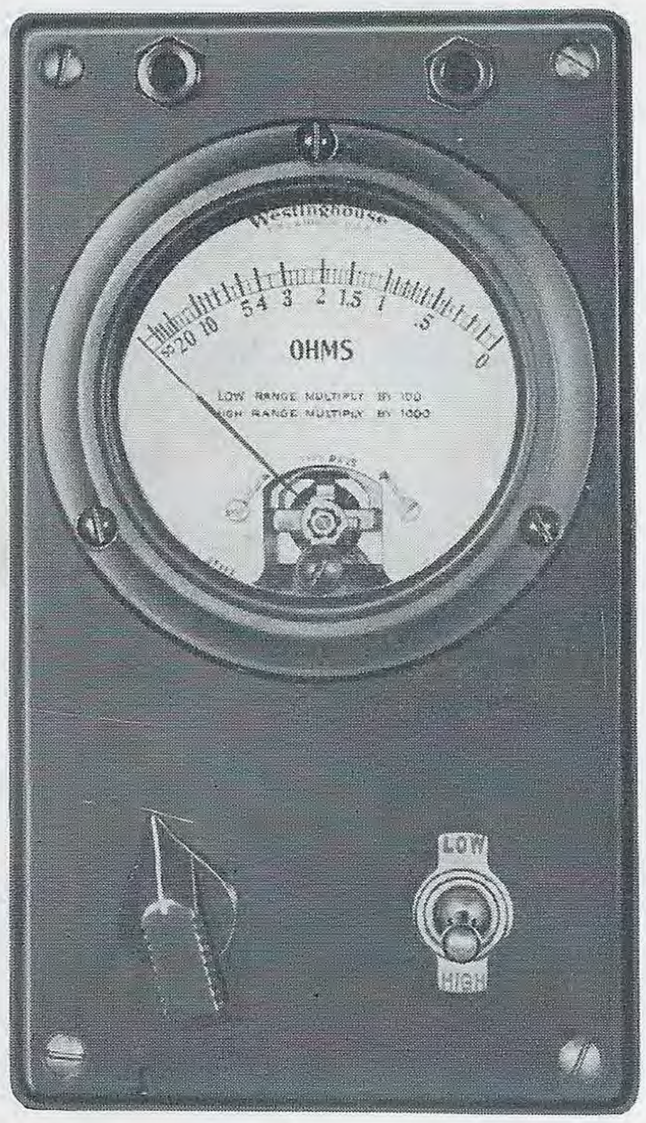


FIG. 3—TYPE PX-25 DOUBLE RANGE OHMMETER

Types

Type PX-25 ohmmeters are available in various ratings from 10 ohms to 100,000 ohms as shown in the price list. These are adequate both as to accuracy and ranges available to cover a very broad field of application. Ohmmeters are particularly useful for continuity testing in complex circuits and also for rough classification work in connection with manufacture and sorting of resistors.

Up to 200,000 ohms the Type PX-25 ohmmeters employ a one cell battery of 1½ volts. Toggle switches are of course supplied only on the double range instruments for range selection.

The triple range Type PX-25 is available with a resistance range from 1,000 to 1,000,000 ohms. The exact specification of this style is given in the price list. A rotary selector switch is used instead of the toggle type for range selection. Two batteries are used in this model, one of 1½ volts and one of 4½ volts. Both of these batteries are available on the open market.

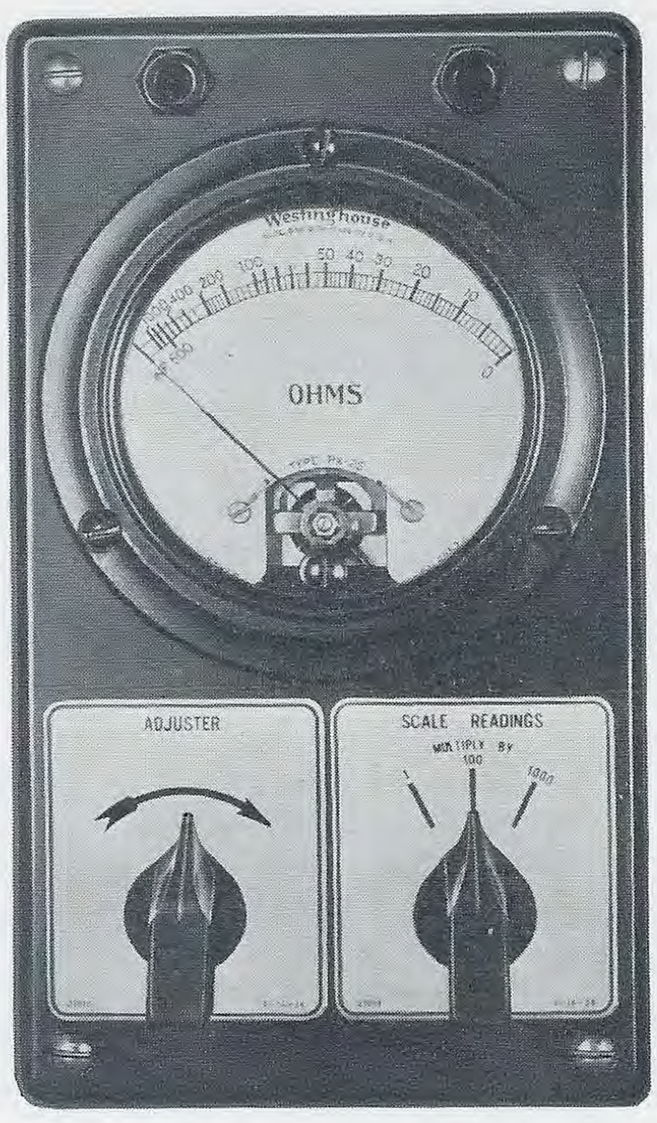


FIG. 4—TYPE PX-25 TRIPLE RANGE OHMMETER

PORTABLE TEST UNITS—Continued

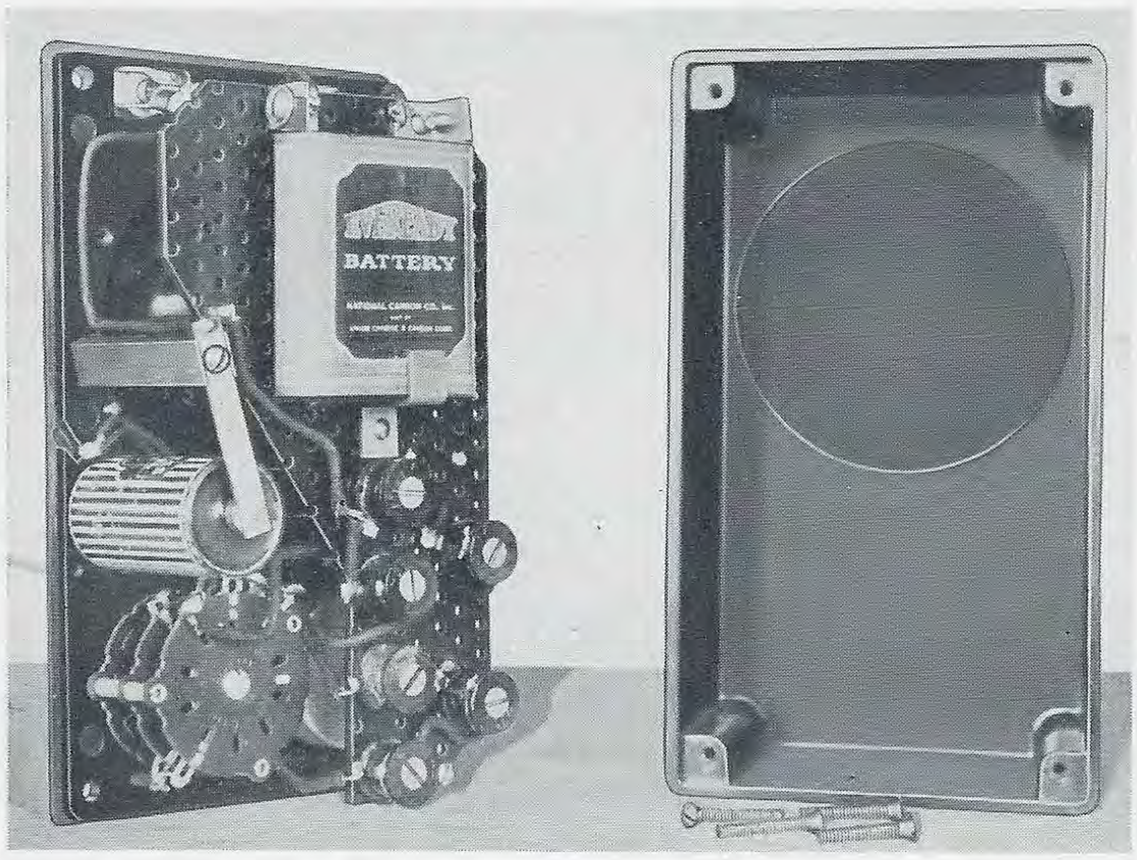


FIG. 5—TYPE PX-25 TRIPLE RANGE OHMMETER CASE REMOVED

Type PX-26 volt ohmmeter covers in addition to the ohm range of 1000 to 1,000,000 ohms, a voltage range of from 5 to 500 volts. The volt ranges have a resistance of 1000 ohms per volt. The selector switch and adjuster arrangement is similar to that used in the PX-25. The exact ranges covered are given in the price list.

Type PM-32, A-C.—D-C. test unit is available with 11 or 14 ranges. These are indicated in the price list. It may be used in addition to these ranges, as an audio voltage output indicator on the 15 volt A-C. voltage range.

Type PX-37 is a multi-range D-C. test unit with ranges indicated in the price list. It has a battery arrangement similar to the PX-25 and 26 employing one battery of 1½ volts and one of 4½ volts. The resistance range on this instrument is from 200 to 10,000,000 ohms. The voltage range covered is from 2½ volts to 1000 volts D-C. It also has a D-C. milliampere range from 1 to 100 milliamps. in convenient steps. This is a very broad combination which covers practically everything imaginable in this type of test unit.

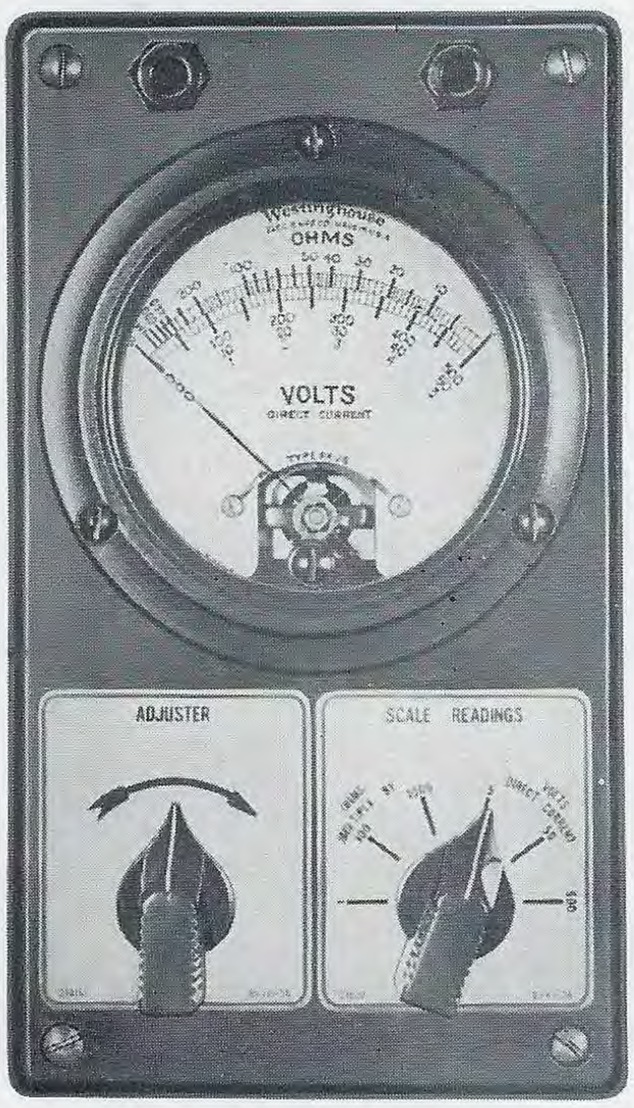


FIG. 6—TYPE PX-26 D-C. VOLT OHMMETER

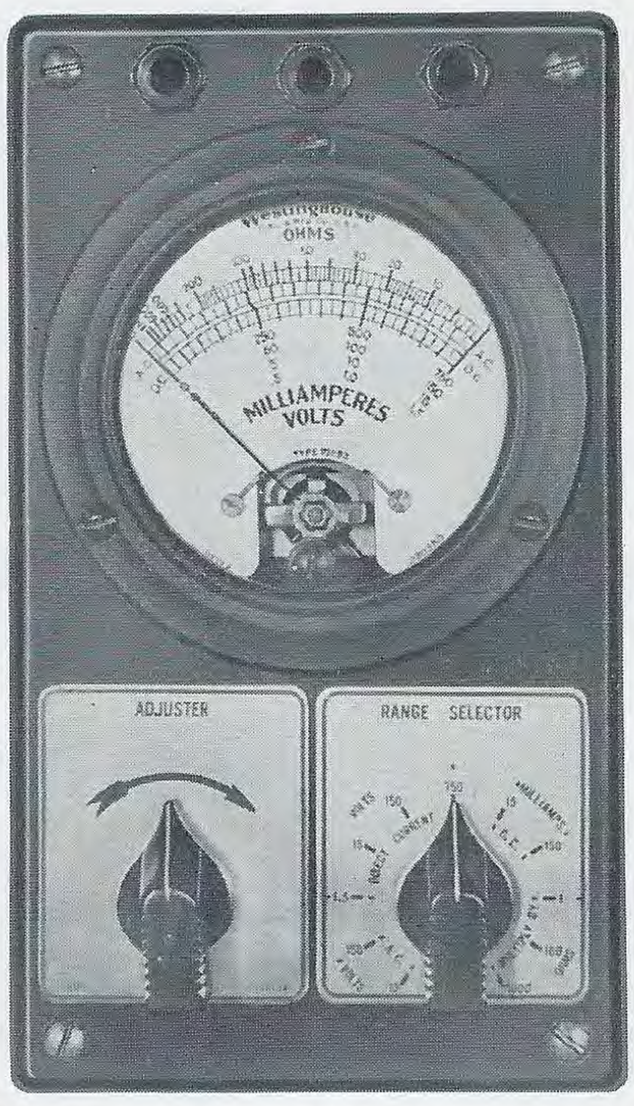


FIG. 7—TYPE PM-2 A-C. AND D-C. TEST UNIT

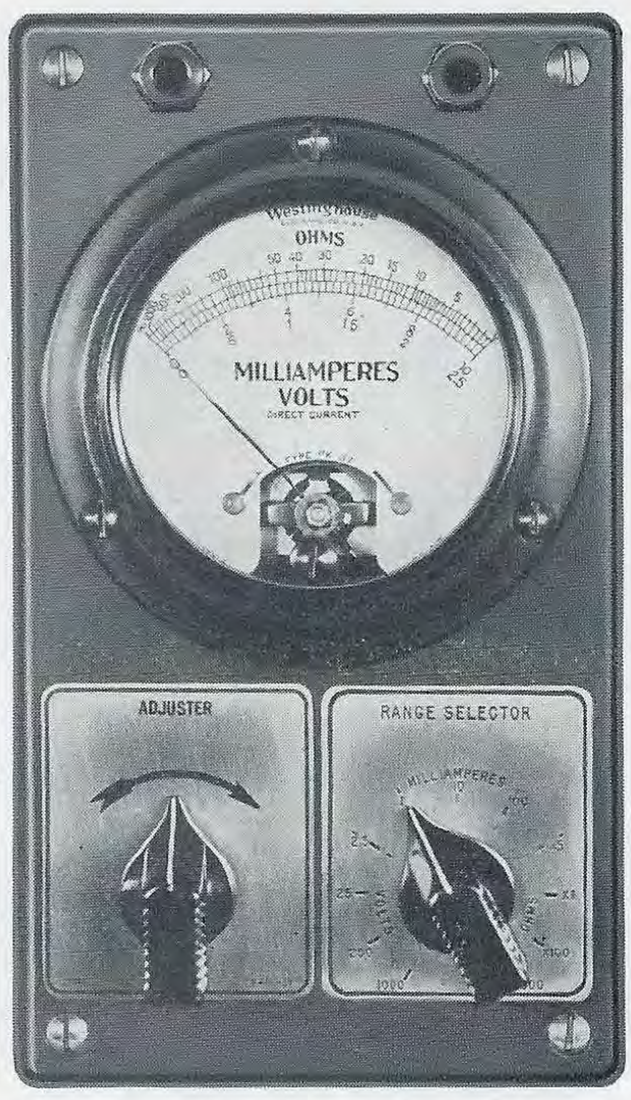


FIG. 8—TYPE PX-37 D-C. VOLT OHMMETER

PORTABLE TEST UNITS—Continued

LIST PRICES

OHMMETERS

DOUBLE RANGE

Type	Ohms Full Scale	Ohms Mid-Scale	Style	List Price Discount Symbol AC
PX-25	10–1000	2–50	931 318	$25 00
	5000–50000	200–2000	930 067	22 50
	1000–100000	50–500	931 319	22 50

TRIPLE RANGE

Type	Ohms Full Scale	Ohms Mid-Scale	Style	List Price Discount Symbol AC
PX-25	1000 100000 1000000	50 5000 50000	876 813	$30 00

D-C. VOLT OHMMETER

Type	Ohms Full Scale	Ohms Mid-Scale	Volts D-C.	Ohms Per Volt	Style	List Price Discount Symbol AC
PX-26	1000	50	5	1000	876 814	$32 50
	100000	5000	50	1000		
	1000000	50000	500	1000		

TEST UNITS

D-C. TEST UNIT

Type	Ohms Full Scale	Ohms Mid-Scale	Volts D-C.	Milli-amps D-C.	Ohms Per Volt	Style	List Price Discount Symbol AC
PX-37	200	6	2.5	1	1000	931 317	$ 55 00
	1000	30	25	10	1000		
	100000	3000	250	100	1000		
	10000000	300000	1000	...	1000		

A-C.—D-C. TEST UNIT

Type	Ohms Full Scale	Ohms Mid-Scale	Volts D-C.	Volts A-C.	Milli-amps D-C.	Ohms Per Volt	Style No.	List Price Discount Symbol AC
PM-32	1000	50	1.5	15	15	1000	930 380	$60 00
	100000	5000	15	150	150	1000		
	1000000	50000	150	...	...	1000		
			750	...	...	1000		
PM-32	1000	50	1.5	1.5	1.5	1000	936 991	65 00
	100000	5000	15	15	15	1000		
	1000000	50000	150	150	150	1000		
			750	750	...	1000		

Single Unit Leather Carrying Case for any of the above..... 931 331 5 00

Prices are subject to change without notice.

Order by Style Number

Printed in U.S.A.

INDUSTRIAL ANALYZER—TYPE TA

A Complete Portable Test Set for A-C. Power

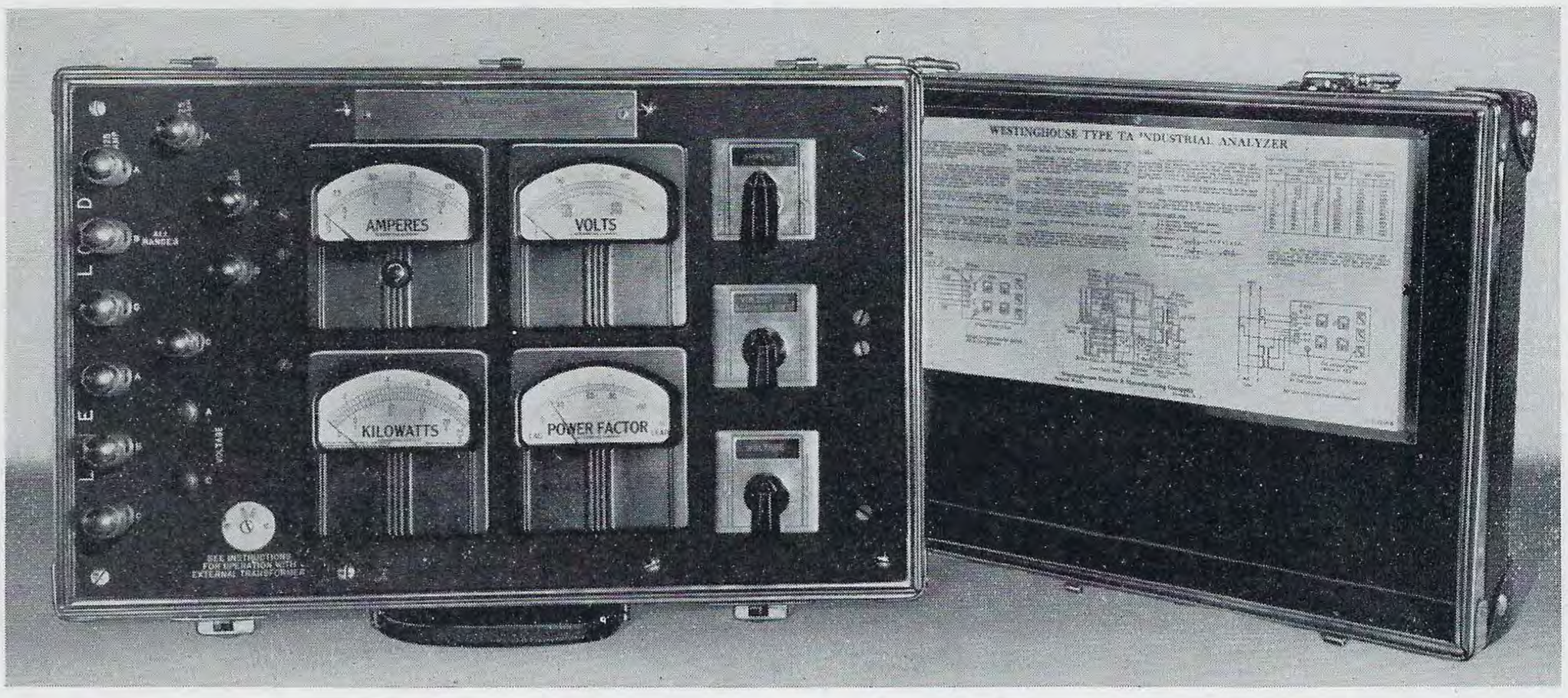


FIG. 1—A CAREFULLY PLANNED, COMPLETE SET OF A-C. INSTRUMENTS, IN A COMPACT PORTABLE CASE, FOR TESTING A-C. MOTORS AND CIRCUITS

Data

ACCURACY—AMMETER AND VOLTMETER ..... WITHIN 1%
ACCURACY—WATTMETER ..... WITHIN 2%
INSTRUMENT SCALE LENGTHS ..... 3½"
RATINGS ..... 5, 25, 125 AMPS.; 150, 300, 600 VOLTS; 25–133 CYCLES.
BURDEN ..... { CURRENT, 13.5 VOLT-AMPERES PER PHASE AT 5 AMPERES
VOLTAGE, 5.6 VOLT-AMPERES PER PHASE AT 115 VOLTS.
WEIGHT ..... 35½ LB.
DIMENSIONS ..... 9¼" x 13¼" x 18⅝"

MEASURES AMPERES, VOLTS, WATTS, AND POWER FACTOR, POLYPHASE; AND AMPERES, VOLTS AND WATTS, SINGLE-PHASE.

General

The engineer responsible for the maintenance of electrical apparatus, motors, etc., in industrial plants requires an adequate equipment of testing instruments. Measurement is the fundamental requirement in all engineering work.

Portable testing instrument equipment is generally found to be incomplete or uncoordinated, or fragmentary, having been collected without any particular planning. Consequently the engineer often struggles along the best way he can with his facilities.

The industrial analyzer is a complete portable test set for a-c. circuits, designed to solve the problem of standardizing the requirements andc ollecting in common and coordinated form all the instruments necessary for alternating-current testing, checking, and installation work. The analyzer may be used on single-phase, two-phase, and three-phase circuits, as shown in the connection diagrams on pages 7 and 8.

It is convenient, compact, lightweight, rugged, and easily carried. It includes all necessary elements to make complete a-c. circuit tests up to 125 amperes, 600 volts.

Application

The electrical industry has long felt the need for a convenient, compact, lightweight, rugged, portable alternating current test set. Service men and "trouble shooters" going out "on a job" are forced to carry a half dozen or more

INDUSTRIAL ANALYZER—TYPE TA—Continued

portable instruments and, often several instrument transformers as well. Each job means a new and separate set up, making and checking connections with the ever present danger of an error in wiring or the inconvenience of not having the proper instrument.

The new portable set, known as the Industrial Analyzer, has been designed to overcome these conditions and fulfill the requirements in as broad a manner as possible.

The instrument finds innumerable applications among service men, trouble shooters, plant maintenance, layout and, efficiency men, electrical dealers, and in fact, anyone having occasion to do any alternating-current testing, checking, or installation work.

A few of the many uses:

1. Testing three-phase induction motors up to 25 horsepower, 115 volts; 50 horsepower, 230 volts; and 100 horsepower, 575 volts.
2. Trouble shooting, checking and testing of all kinds of alternating-current circuits up to 125 amperes, 575 volts.
3. Plant layout, analysis and efficiency tests. Many dollars can be saved by simple quick checks, which can be easily made on various motors and circuits to determine whether motors are properly loaded, load balanced, etc. Often it will be discovered that relocating motors, changing location of transformers or swapping motors on different jobs will save many dollars in power bills and give better performance.
4. Testing and checking of household appliances, refrigerators, etc.

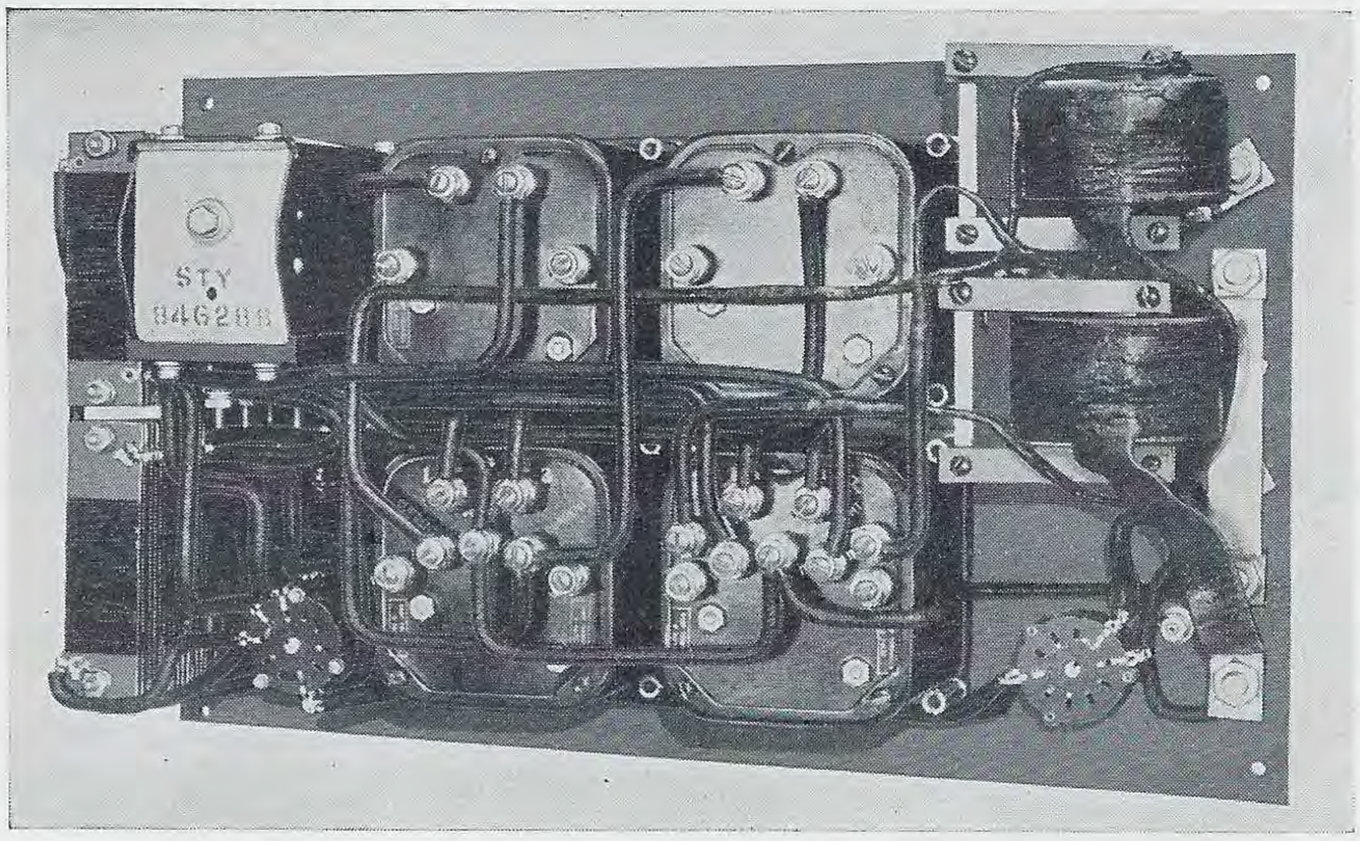


FIG. 2—VIEW OF REAR OF PANEL, SHOWING ARRANGEMENT OF INSTRUMENTS, SWITCHES, RESISTORS AND TRANSFORMERS

This portable test set does the work ordinarily performed by the following apparatus:

1. Portable ammeter—5-ampere coil.
2. Portable voltmeter—150, 300, and 600-volt scales.
3. Portable polyphase wattmeter—5-ampere coil, 115, 230, and 575 volts.
4. Portable polyphase power factor meter—5-ampere coil, 115, 230, and 575 volts.
5. Two 125/5 ratio current transformers.
6. Two 25/5 ratio current transformers.
7. Voltage transformers.

Current coils are 5 amperes. Although special instruments can be built for 125 amperes, self-contained, it is less expensive to use current transformers and this is standard practice, especially for portable wattmeters and power factor meters above 20 amperes.

If instruments are not self-contained for three voltage ranges, it is necessary to use an external multiplier or voltage transformers.

APPLICATION ILLUSTRATED

Greater appreciation of the convenience of this industrial analyzer is obtained from an examination of the illustrations, Fig. 3, 4 and 5 on page 3.

Fig. 3—This illustrates the many disadvantages encountered with the ordinary means of circuit testing as enumerated below.

(a) One of the most obvious but necessary evils of testing with a group of instruments is the great amount of wiring required. At best, this tends to be confusing.

(b) The instruments are usually so far apart that reading all at the same time is very difficult.

(c) Aside from this fact, instruments of the correct ratings must be first located, and then be properly connected for each test. This takes time, especially if the tester is not an expert, and has to reconnect instruments, and occasionolly make a long trip back to a stock room for additional equipment.

(d) Either because proper instruments are not always available, or because it is inconvenient to obtain them, important data is often neglected when a test is made. Of course, when complete test data is not obtained, the results are practically worthless.

(e) Another factor which detracts from test results, is the lack of confidence in ability to connect a group of instruments properly. Consequently, confidence in the test data is also lacking.

(f) Difficulties, and lack of time, cause necessary tests to either be delayed or omitted, and faults continue uncorrected, which of course, also means a monetary loss.

Fig. 4—An examination of the type "TA" Industrial Analyzer will show that all of the difficulties found in testing with a group of instruments have been eliminated.

(a) All connections, except of course those to the source of power and to the load, have been made within the

INDUSTRIAL ANALYZER—TYPE TA—Continued

FIG. 3

analyzer case, thus materially reducing the amount of wiring required.

(b) Because the instruments are grouped closely together, test readings can be obtained simultaneously and accurately.

(c) No time is lost reconnecting instruments for readings of different values.

(d) The industrial analyzer being self-contained for most motors and voltages normally found in industrial work, makes an ideal outfit to obtain really complete test data, accurately and quickly. For motors and voltages beyond the range of the analyzer, external current and potential transformers may be used.

(e) Full confidence in test results is assured with the "Industrial Analyzer" because no connections are necessary except those to load and power source.

(f) Testing is encouraged with the Analyzer because it makes testing a fairly simple procedure. It takes less time to make tests, consequently, more tests can be made in a given time and more faults corrected and more money saved.

Fig. 5—This illustration of the two testing equipments emphasizes the compactness, simplicity, and convenience of the Industrial Analyzer. An interesting fact about this remarkable outfit is that it costs less than half as much as the equivalent group of meters, and is much more desirable.

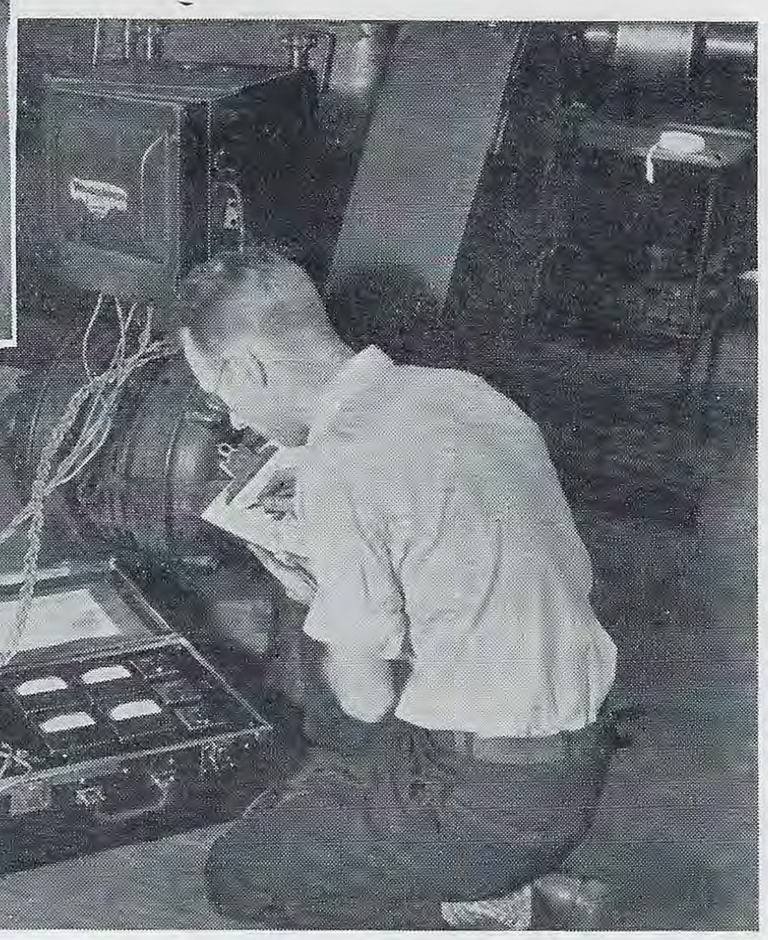


FIG. 4

FIG. 5

INDUSTRIAL ANALYZER—TYPE TA—Continued

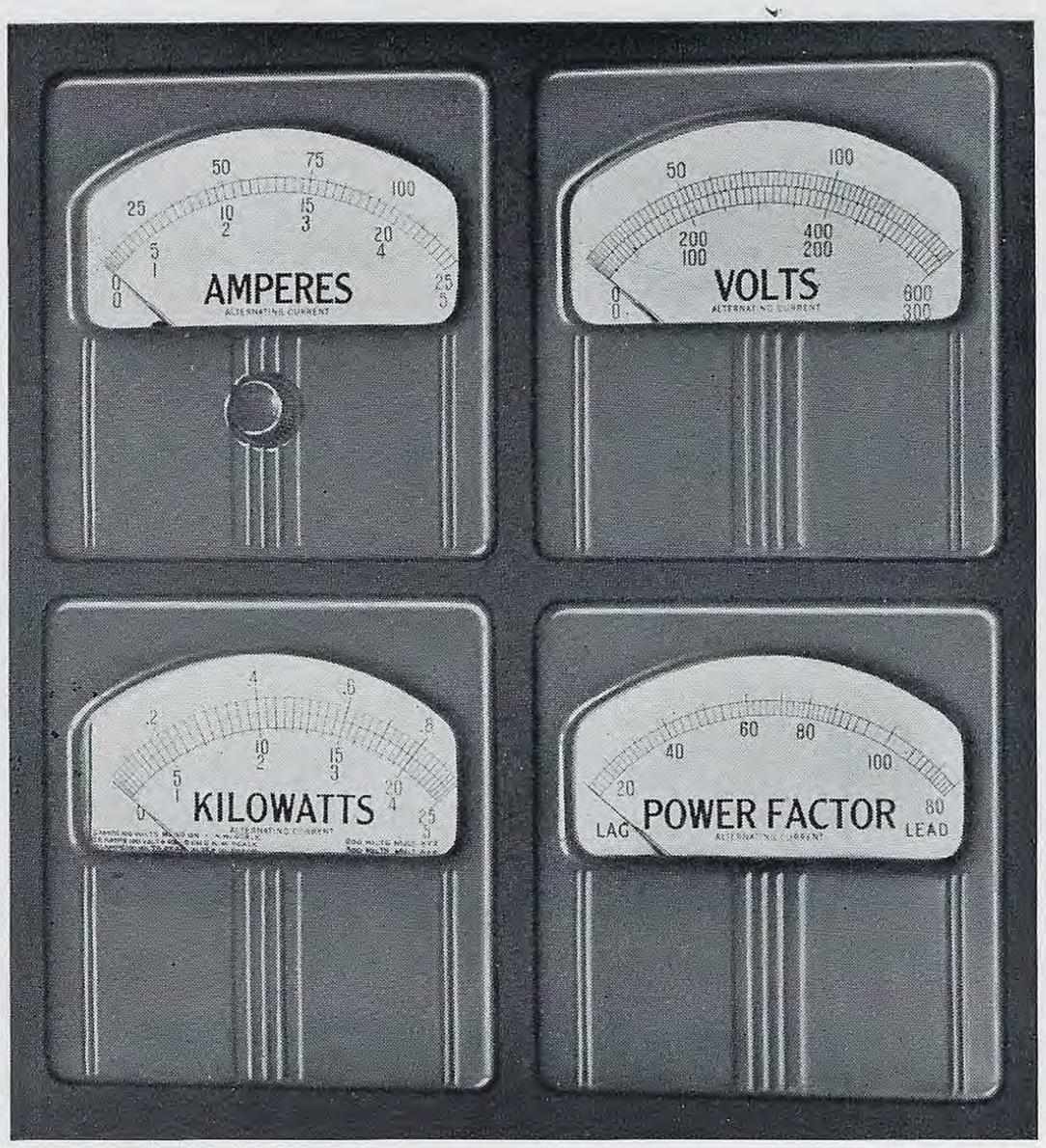


Fig. 6—The Instruments Used in the TA Industrial Analyzer

Distinctive Features

1. Alternating-current circuit analysis and testing—three-phase, two-phase and single-phase.

2. Light weight—weighs 35½ pounds.

3. Compact—case dimensions 9¼" x 13¼" x 18⅝", made possible by use of type K instruments, Minatrol switches, and special lightweight current transformers with Hipernik core.

4. High capacity—self-contained up to 125 amperes and 575 volts.

5. Ammeter may be switched under load to any one of the three phases to determine load balance—made possible by use of Westinghouse Minatrol switch.

6. Follow-up pointer on ammeter to assist the operator to determine the starting current of the motor.

7. Voltmeter may be switched under load across any phase to determine voltage balance.

8. Low burden instruments.

9. Good accuracy—consistent with size and weight. The overall accuracy is within 1% for the ammeter and voltmeter and 2% for the wattmeter when used on sinusoidal wave forms between 25 and 133 cycles and at temperatures between 15 and 35 degrees centigrade.

10. Convenient—easily portable, completely wired, external connections easily and quickly made, scales have excellent readability.

11. Good appearance—modernistic instruments and switches, with external, molded connection terminals. Rugged and durable carrying case with strong leather handle, high grade lock, and rubber cushioning feet.

Construction and Operation

The Analyzer is, in reality, a miniature portable three-phase switchboard panel in a carrying case complete with all necessary switching equipment, transformers, and resistors. The unit contains a triple scale ammeter 0-5, 0-25, and 0-125 amperes, a triple range voltmeter 0-150, 0-300, and 0-600 volts, a polyphase wattmeter with three scales for the above voltage and current ranges, and a polyphase power-factor meter with 10-100-80 scale to operate on the above voltages and currents. The instruments are of the newly designed miniature type with standard size mechanisms having high overload capacity and low energy consumption. The scales of the instruments are 3½ inches long.

Two special lightweight current transformers with Hipernik cores and with primary windings tapped for 5, 25, and 125 amperes are connected into the circuit in the conventional three-phase wiring scheme to provide the multiple current ranges. The various voltage ranges are obtained by switching tapped resistors in the potential circuits.

A Minatrol three-phase ammeter switch is provided to switch the ammeter to read current in any of the three-phase lines and a switch is provided to connect the voltmeter across any two lines. This switching may be performed under load and provides a quick method of checking load balance and voltage balance on three-phase circuits.

Three-phase, two-phase and single-phase motors and other apparatus may

INDUSTRIAL ANALYZER—TYPE TA—Continued

be tested and checked by connecting the Analyzer to the line at the fuse clips, junction box or terminals and connecting the outgoing terminals to the load.

Two-phase, three-wire circuits may be tested by connecting the common wire to terminal B and outside wires to terminals A and C. Ammeter readings give phase currents when set to A or C. Phase voltages may be read by setting the voltage switch to AB or BC.

Four-phase, five-wire circuits (or two-phase, 5-wire) may be considered as 2, two-phase, three-wire circuits. If the two circuits are balanced, readings may be obtained by connecting to one of the two-phase, three-wire circuits and multiplying the readings by two.

Two-phase, four-wire circuits may be tested, by using external transformers, as shown in Fig. 18 on page 8. The various diagrams shown on pages 7 and 8 give a complete outline of the connections to the TA analyzer when using the instrument on all types of circuits.

The power-factor meter being of the polyphase type will give meaningless indications on single-phase and two-phase circuits. For such cases, it is easy to derive power factor from the other instrument readings as follows:

I = Current (amperes)
E = Terminal voltage
P.F. = Power factor
W = Watts

$$P.F. = \frac{W}{E \times I}$$

The Analyzer may be used on circuits with voltages higher than 575, or currents greater than 125 amperes by the use of extra current and voltage transformers as shown in Fig. 13, 15, 17, 18 and 19.

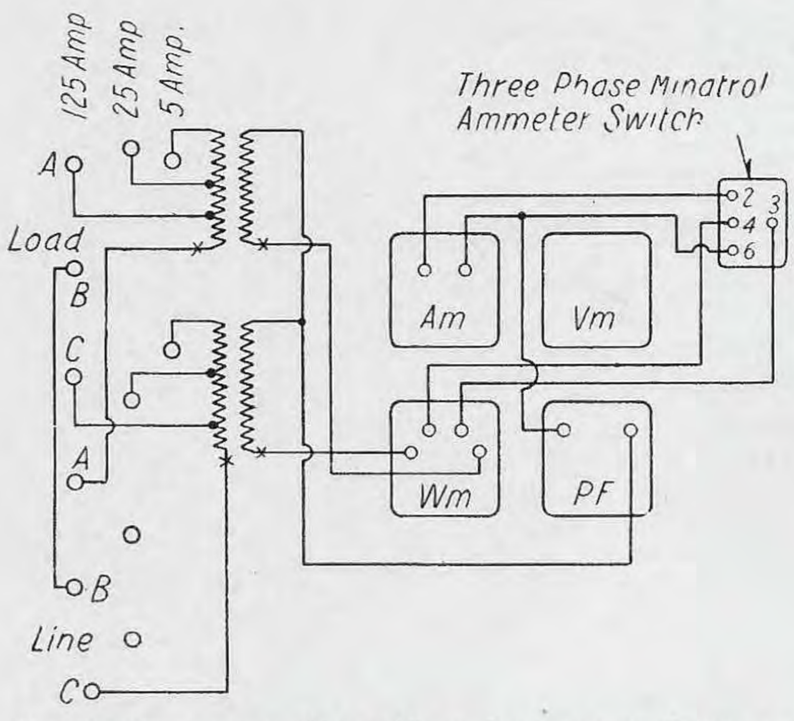


FIG. 7—SCHEMATIC, FRONT VIEW DIAGRAM OF CURRENT CIRCUIT OF THE TYPE TA INDUSTRIAL ANALYZER

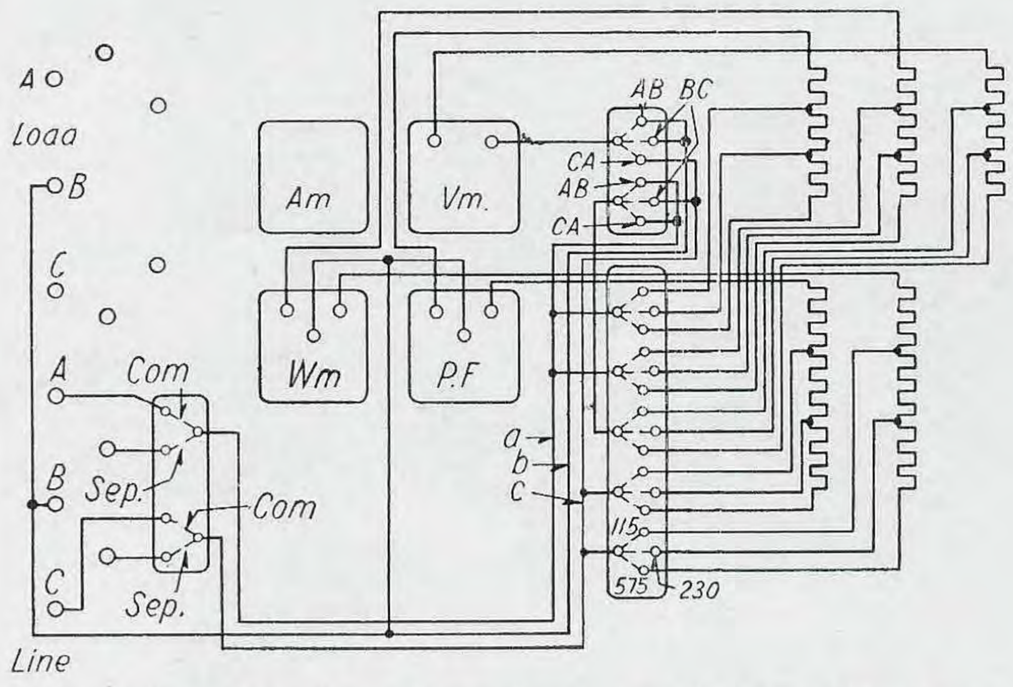


FIG. 8—SCHEMATIC, FRONT VIEW DIAGRAM OF VOLTAGE CIRCUIT OF TYPE TA INDUSTRIAL ANALYZER

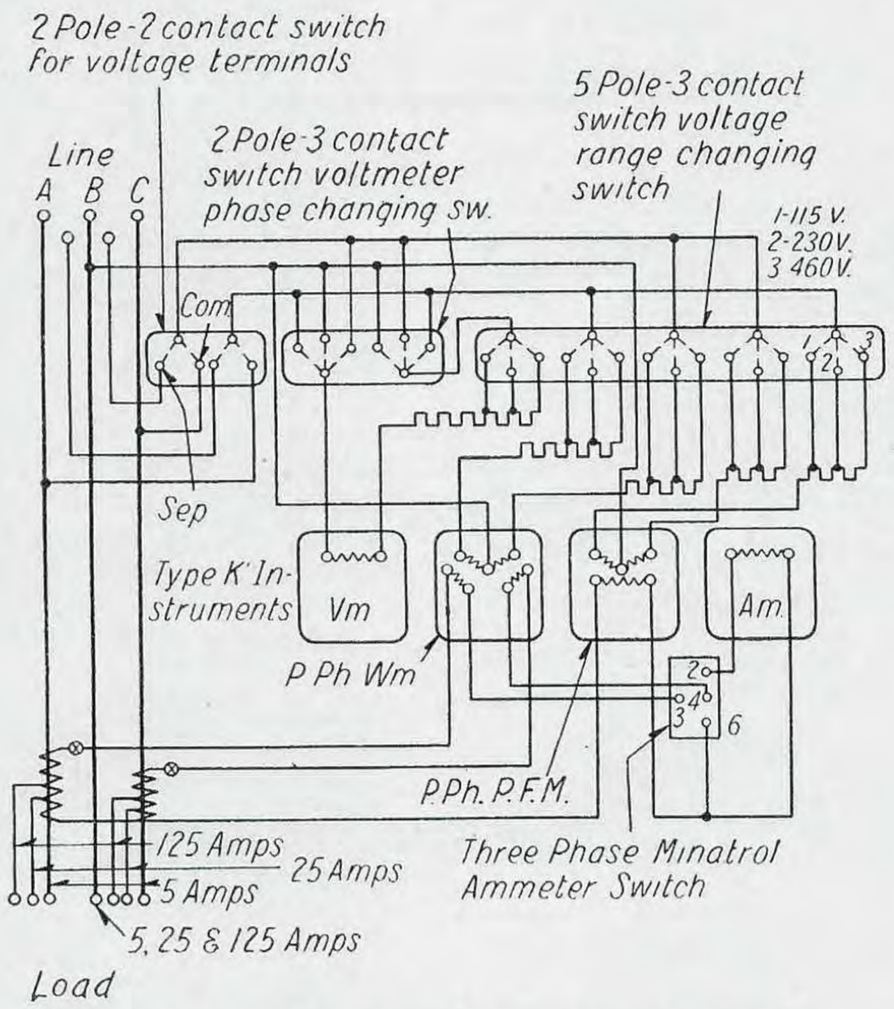


FIG. 9—SCHEMATIC DIAGRAM OF INTERNAL CIRCUIT OF THE TYPE TA INDUSTRIAL ANALYZER

INDUSTRIAL ANALYZER—TYPE TA—Continued

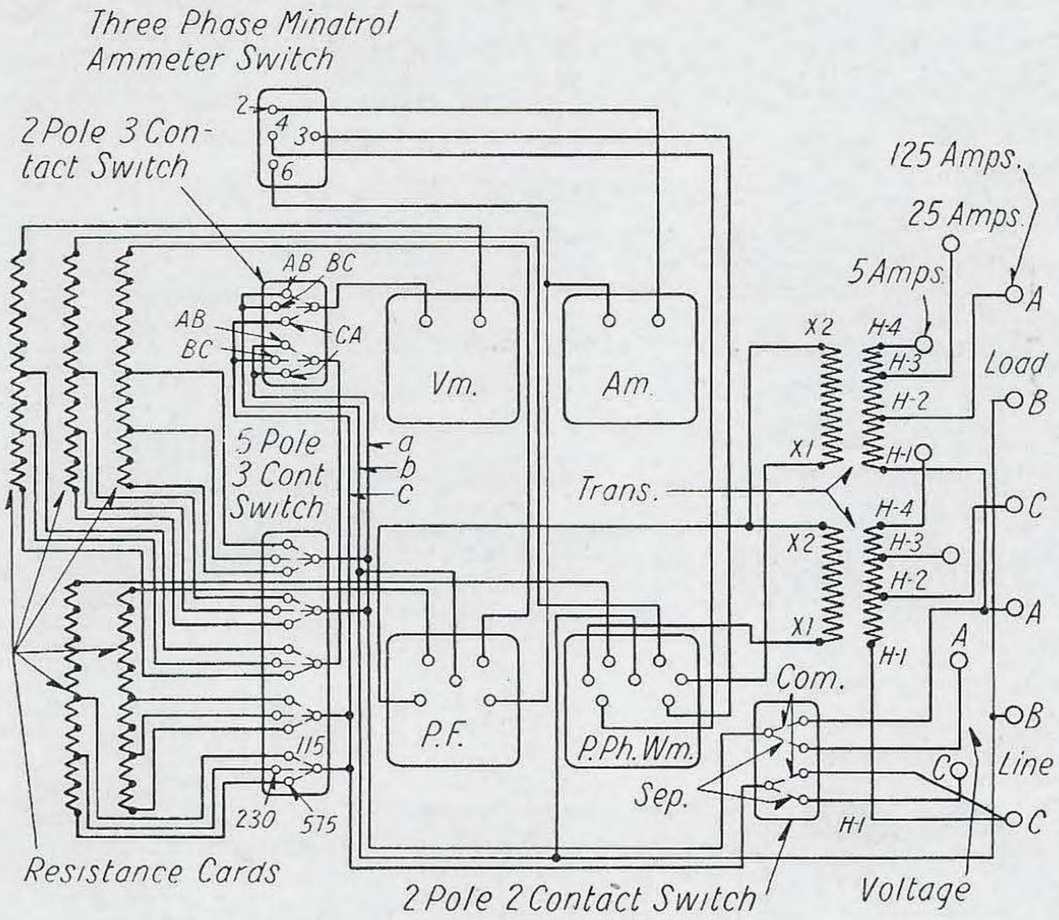


FIG. 10—COMPLETE WIRING DIAGRAM OF THE TYPE TA INDUSTRIAL ANALYZER

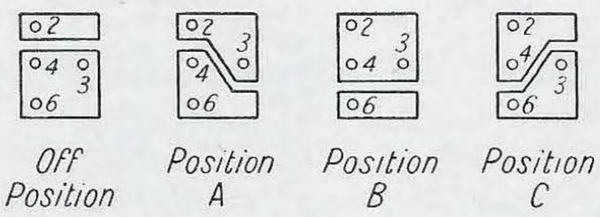


FIG. 11—DRUM DEVELOPMENT OF THREE-PHASE MINATROL AMMETER SWITCH

LIST PRICE

Description	Style No.	Approx. Wt., Lb. Net	Ship.	List Price Discount Symbol BC
Type TA Industrial Analyzer	836 800	35½	47	$400 00
Transformer for 2-phase, 4-wire, primary 115–230–575 volts, secondary 115 volts (see Fig. 18) 1 required	876 141	7	10	40 00

Prices are subject to change without notice.

Order by Style Number

INDUSTRIAL ANALYZER—TYPE TA—Continued

CONNECTION DIAGRAMS

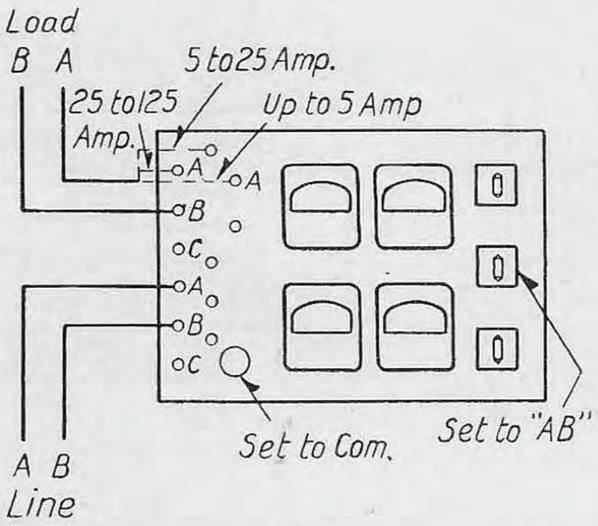


FIG. 12—CONNECTION DIAGRAM FOR SINGLE-PHASE CIRCUIT BELOW 125 AMPERES AND 575 VOLTS

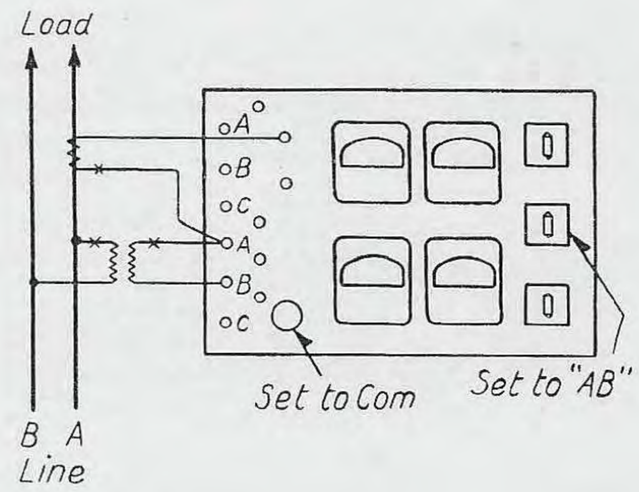


FIG. 13—CONNECTION DIAGRAM FOR SINGLE-PHASE CIRCUIT WITH EXTERNAL CURRENT OR POTENTIAL TRANSFORMERS (OR BOTH) FOR CIRCUITS ABOVE 125 AMPERES, 575 VOLTS

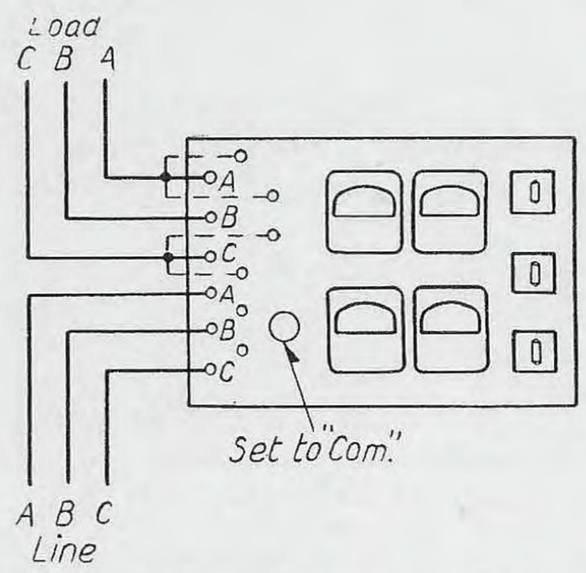


FIG. 14—CONNECTION DIAGRAM FOR 3-PHASE, 3-WIRE CIRCUIT BELOW 125 AMPERES, 575 VOLTS

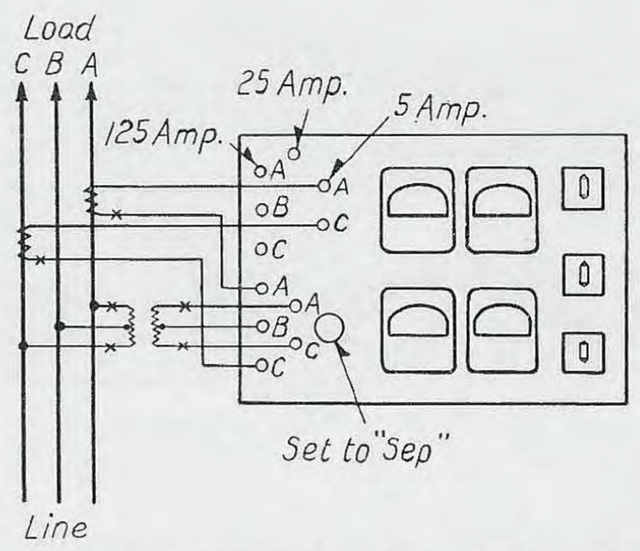


FIG. 15—CONNECTION DIAGRAM FOR 3-PHASE, 3-WIRE CIRCUIT WITH EXTERNAL CURRENT OR POTENTIAL TRANSFORMERS (OR BOTH) FOR CIRCUITS ABOVE 125 AMPERES, 575 VOLTS

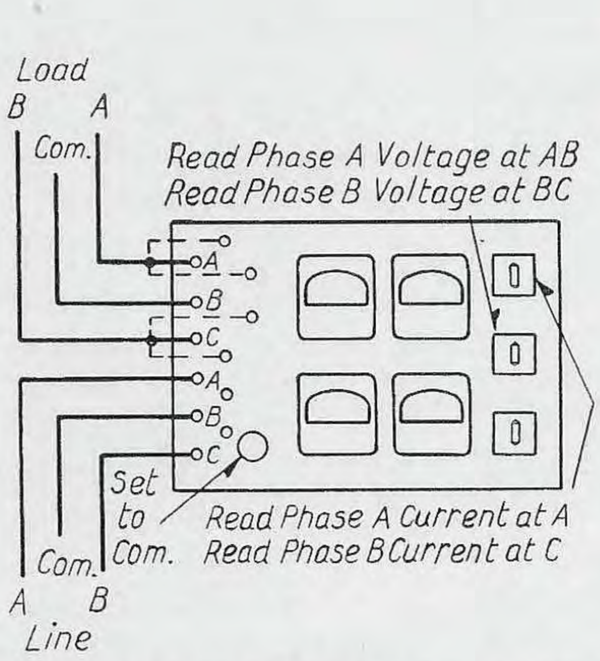


FIG. 16—CONNECTION DIAGRAM FOR 2-PHASE, 3-WIRE CIRCUIT BELOW 125 AMPERES, 575 VOLTS

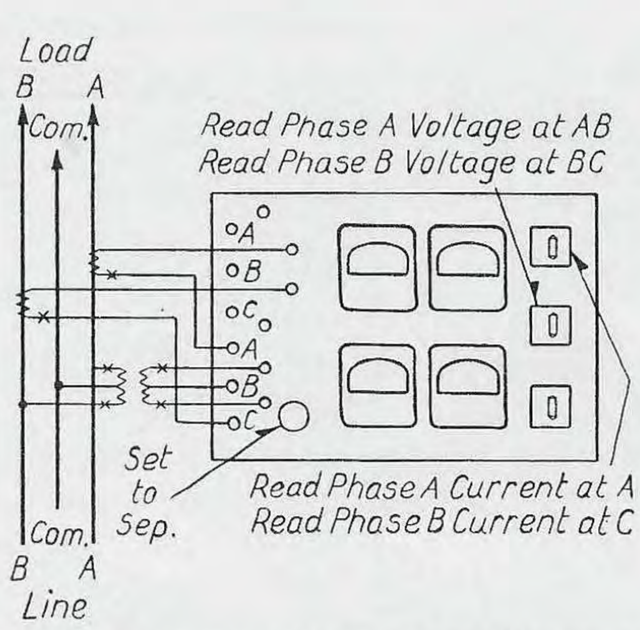


FIG. 17—CONNECTION DIAGRAM FOR 2-PHASE, 3-WIRE CIRCUIT WITH EXTERNAL CURRENT OR POTENTIAL TRANSFORMERS (OR BOTH) FOR CIRCUITS ABOVE 125 AMPERES, 575 VOLTS

NOTE:—Two-phase, 5-wire (4-phase, 5-wire) balanced circuits may be considered as two, 2-phase, 3-wire circuits. Connect as per Fig. 16 or 17 and multiply wattmeter readings by 2 for total circuit power or take readings of both halves of the 5-wire circuit according to Fig. 16 or 17 and add wattmeter readings for total power.

INDUSTRIAL ANALYZER—TYPE TA—Continued

CONNECTION DIAGRAMS—Continued

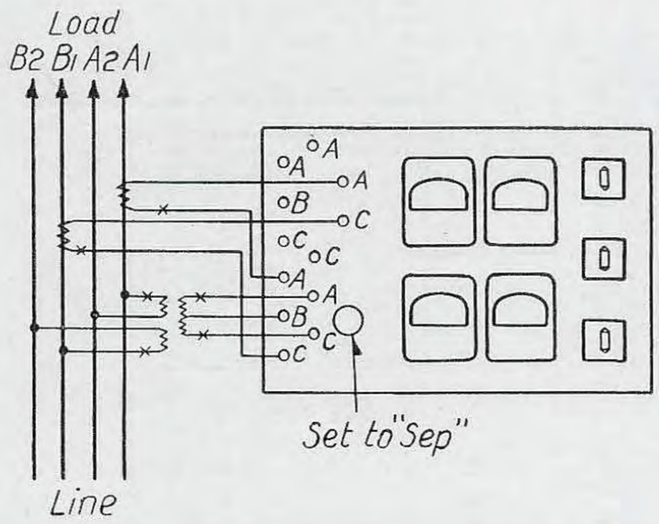


FIG. 18—CONNECTION DIAGRAM FOR 2-PHASE, 4-WIRE CIRCUITS, EXTERNAL POTENTIAL TRANSFORMER MUST ALWAYS BE USED

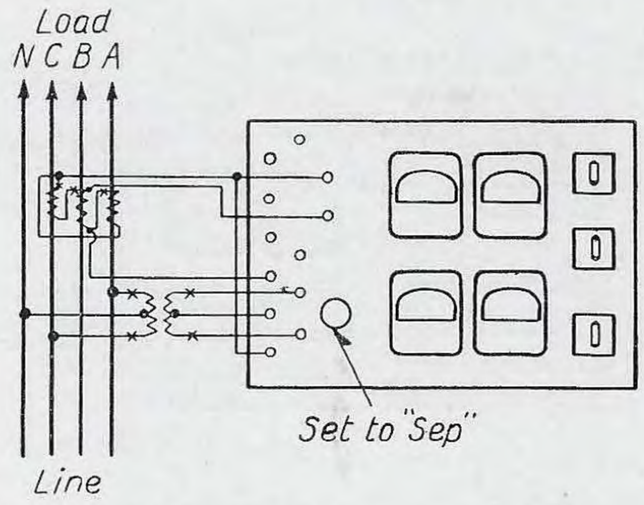


FIG. 19—CONNECTION DIAGRAM FOR 3-PHASE, 4-WIRE CIRCUITS, DELTA-CONNECTED CURRENT TRANSFORMERS MUST ALWAYS BE USED. VOLTAGE TRANSFORMERS MUST BE USED ABOVE 575 VOLTS

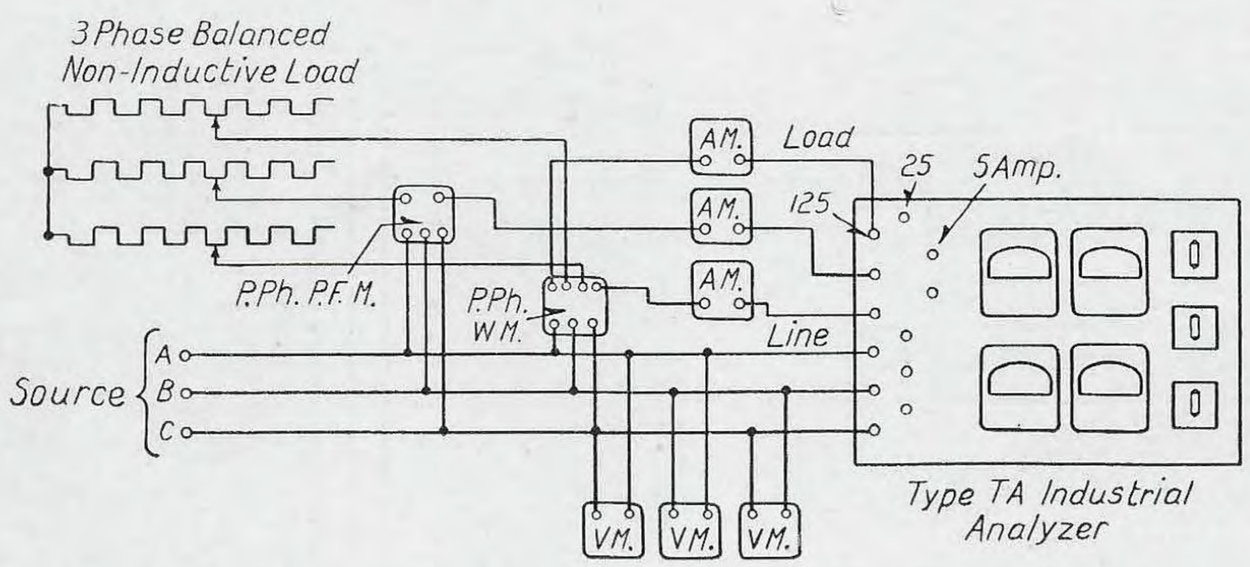


FIG. 20—CONNECTION DIAGRAM FOR CHECKING CALIBRATION OF ANALYZER WITH PORTABLE STANDARDS. CONNECT INSTRUMENTS AS SHOWN SO THAT INTERNAL LOSSES OF ANALYZER WILL NOT ENTER CALIBRATION READINGS

APPROXIMATE AMPERES PER TERMINAL FOR SQUIRREL CAGE INDUCTION MOTOR

	220 VOLTS			220 VOLTS	
Hp. of Motor	2-Phase	3-Phase	Hp. of Motor	2-Phase	3-Phase
.5	1.7	2.0	50	180	125
1	3.0	3.5	60	130	150
2	5.5	6.4	75	160	185
3	8.0	9.2	100	215	250
5	13	15	125	260	300
7.5	19	22	150	320	370
10	24	28	175	360	420
15	35	40	200	415	480
20	45	52	225	460	530
25	56	65	250	520	600
30	66	76	275	570	660
40	87	100	300	620	720

NOTE—For 110 volts, double these values; for 440 volts, use ½; for 550 volts, use ⅖; for 1100 volts, use ⅕; and for 2200 volts, use 1/10 the above values.

For single-phase motors use twice the value of two-phase motors.

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PORTABLE DIRECT CURRENT INDUSTRIAL ANALYZER

Type TX

FIG. 1—TYPE-TX D-C. ANALYZER, A CONVENIENT AND COMPACT ASSEMBLY OF MEASURING INSTRUMENTS FOR D-C. MOTOR AND CONTROL TESTING

DATA

RANGES SELF CONTAINED
- 15–150–300–750 VOLTS.
- 7.5–75–750 AMPS.
- 200–20,000 OHMS (5–500) MID SCALE.

SENSITIVITY...VOLTAGE RANGES 200 OHMS PER VOLT.
ACCURACY.....VOLTS AND AMPS. WITHIN 1%.
CASE SIZE.....7½" x 10¾" x 13".
WEIGHT.....18 LBS. NET. 40 LBS. SHIPPING.

General

All measuring elements usually required in industrial testing of D-c. motors and control are conveniently and economically combined in the D-c. analyzer. It consists of an ammeter and a volt-ohmmeter with suitable shunts, multipliers and range changing switches all mounted in a compact case ready for use.

This outfit eliminates the necessity of the service engineer carrying a large assortment of miscellaneous instruments, multipliers and shunts,

Application

Voltage, current and resistance measurements are prime measurements in D-c. machines and control. If complete information is available on these three quantities in connection with D-c. apparatus or control, there is but little other operating information to be had outside of bare fundamentals. Thus, while the D-c. analyzer cannot directly indicate the trouble, it affords an infallible means of making the prime measurements required to determine and correct trouble, and to check motor applications.

Some of the many uses of the D-c. analyzer are as follows:

1. Testing D-c. motors of 150 volts to 750 volts and of 4 amperes to 750 amperes. A horsepower range of ½ hp. to 600 hp.
2. Motor application checking and determination from ½ hp. to 600 hp.
3. Trouble shooting in motors, control apparatus, elevators, mine locomotives and D-c. power generating and distribution apparatus.

Some specific advantages in the use of the D-c. analyzer over using individual instruments and shunts, are as follows:

1. It eliminates a great volume of wiring thus greatly simplifying the test setup.
2. Liability of error and injury to apparatus and operator is reduced.
3. Greater dependence may be placed in results obtained due to elimination of confusion.
4. Simultaneous readings of the various quantities involved may be more accurately obtained due to the compact arrangement giving close proximity of the instruments.
5. The measuring elements are compactly mounted in one case, thus improving portability and eliminating confusion in assembling the various instruments and shunts which would otherwise be necessary.

PORTABLE DIRECT CURRENT INDUSTRIAL ANALYZER—Continued

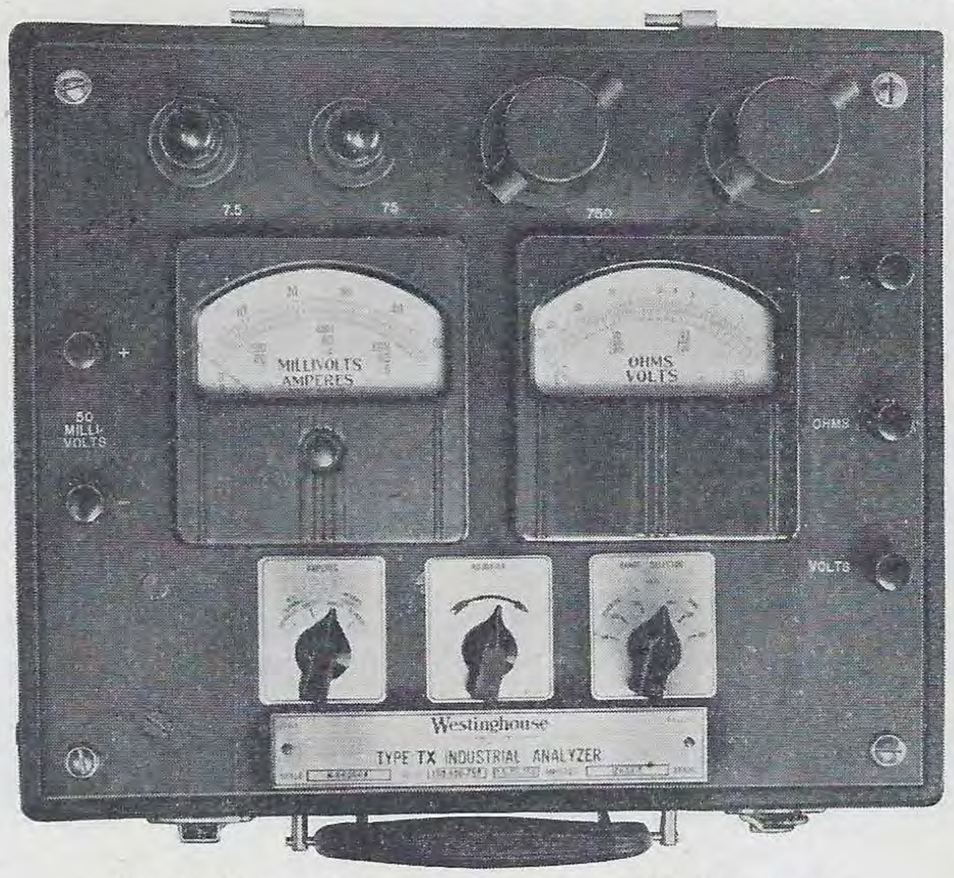

FIG. 2—FRONT PANEL OF THE TYPE "TX" ANALYZER SHOWING CONVENIENT RANGE CHANGING SWITCHES

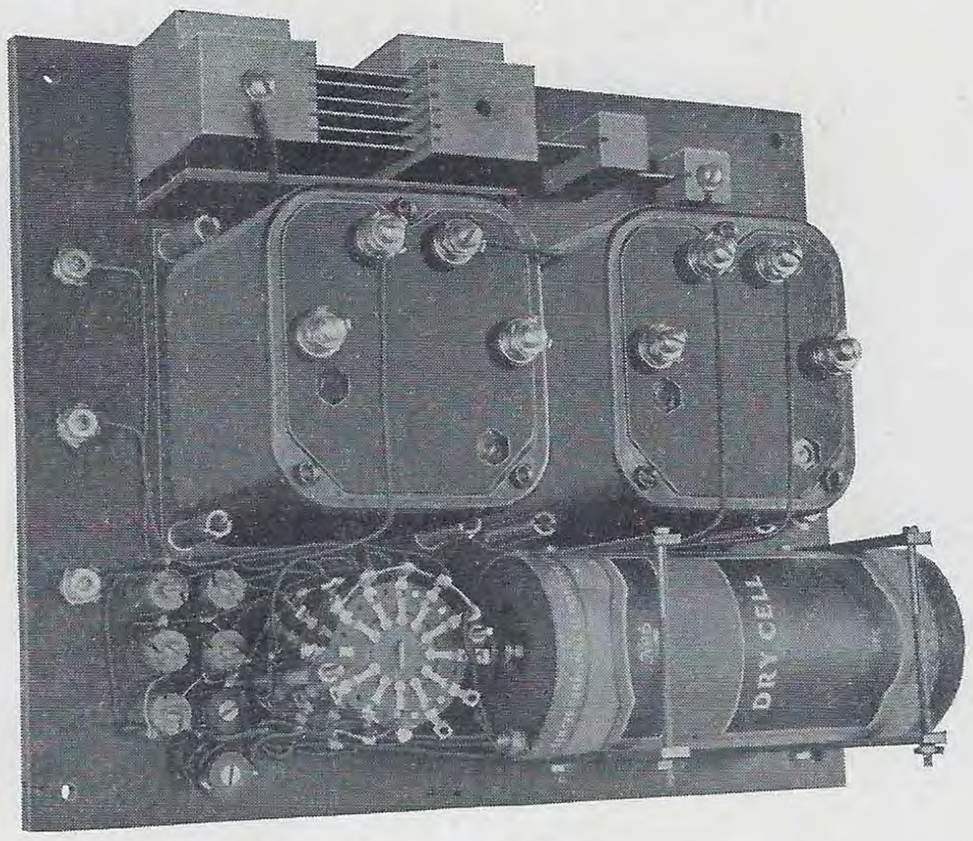

FIG. 3—REAR VIEW OF FRONT PANEL, TYPE "TX" ANALYZER

Construction

Two type-K instruments comprise the measuring elements of the D-c. analyzer. Three shunts, built in the case enable the operator to obtain current ranges of 7.5-75-750 amperes.

Self-contained resistors extend the voltage range from 0 to 750 volts. The ohm ranges are 0-200 and 0-20,000. Suitable selector switches are provided for convenient selection of ranges. A standard No. 6 dry cell is employed to energize the ohmmeter circuit.

The 50 millivolt terminals of the ammeter are brought out to binding posts on the front panel for use with external shunts when capacities other than those built in the unit are required. The ammeter is equipped with a follow-up pointer for measuring motor starting currents. A pair of eight foot shunt leads is supplied.

The unit is mounted in an attractive fabricoid case with nickel trimmings. A Micarta front panel, which carries all measuring elements and details, comprises the mounting plate. The entire assembly may be removed from the case for inspection by removing four screws.

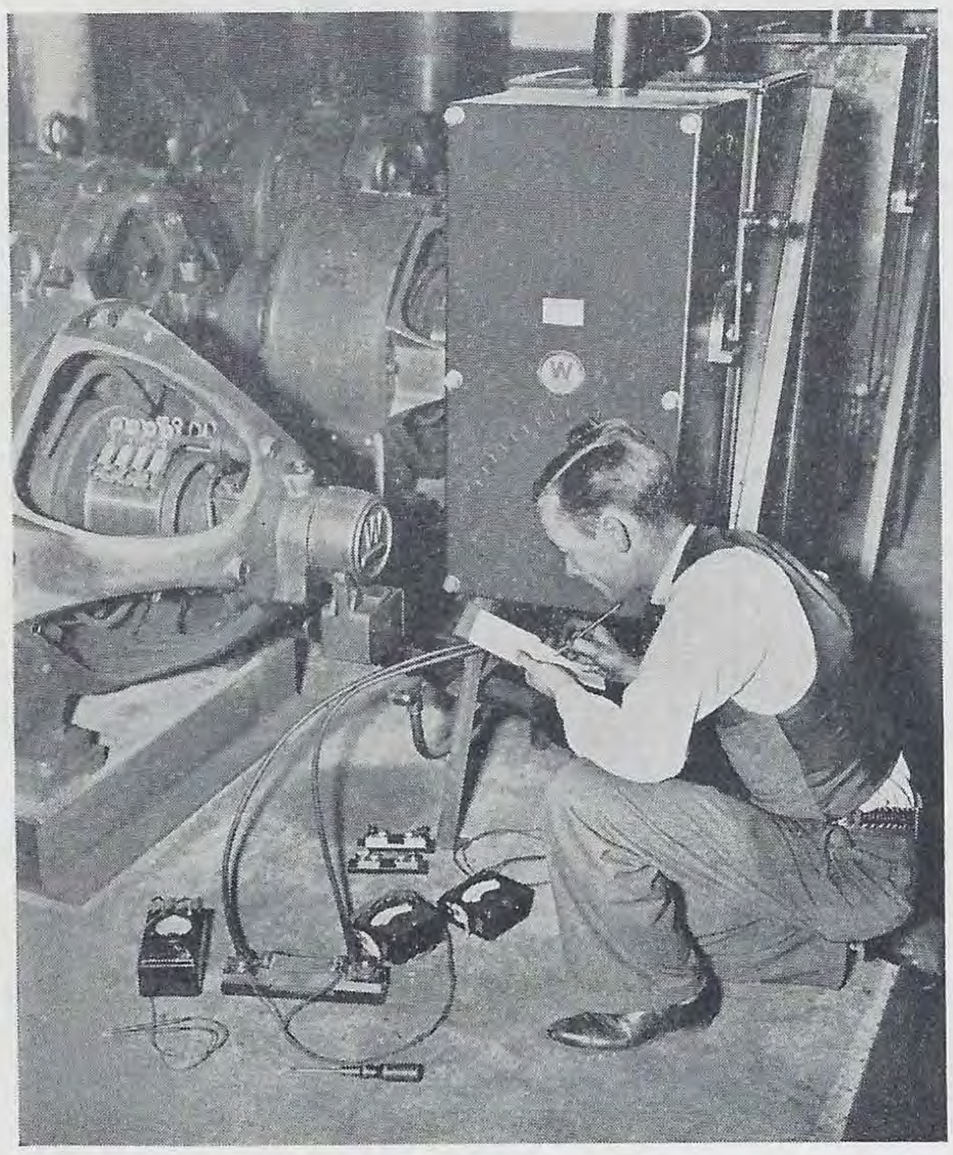

FIG. 4—D-C. GENERATOR LOAD TEST SETUP, THE OLD WAY, USING AN ASSORTMENT OF PORTABLE INSTRUMENTS, SHUNTS AND WIRING

FIG. 5—TYPICAL TEST SETUP EMPLOYING THE TYPE "TX" D-C. ANALYZER

PORTABLE DIRECT CURRENT INDUSTRIAL ANALYZER—Continued

LIST PRICES

Description	Style	Approx. Wt. Lbs. Net	Approx. Wt. Lbs. Shipping	List Price BC Discount
Type TX Direct Current Industrial Analyzer 15-150-300-750 Volts 7.5-75-750 Amperes 200-20,000 Ohms	931 602	.....	.....	$200 00

WIRING DIAGRAMS

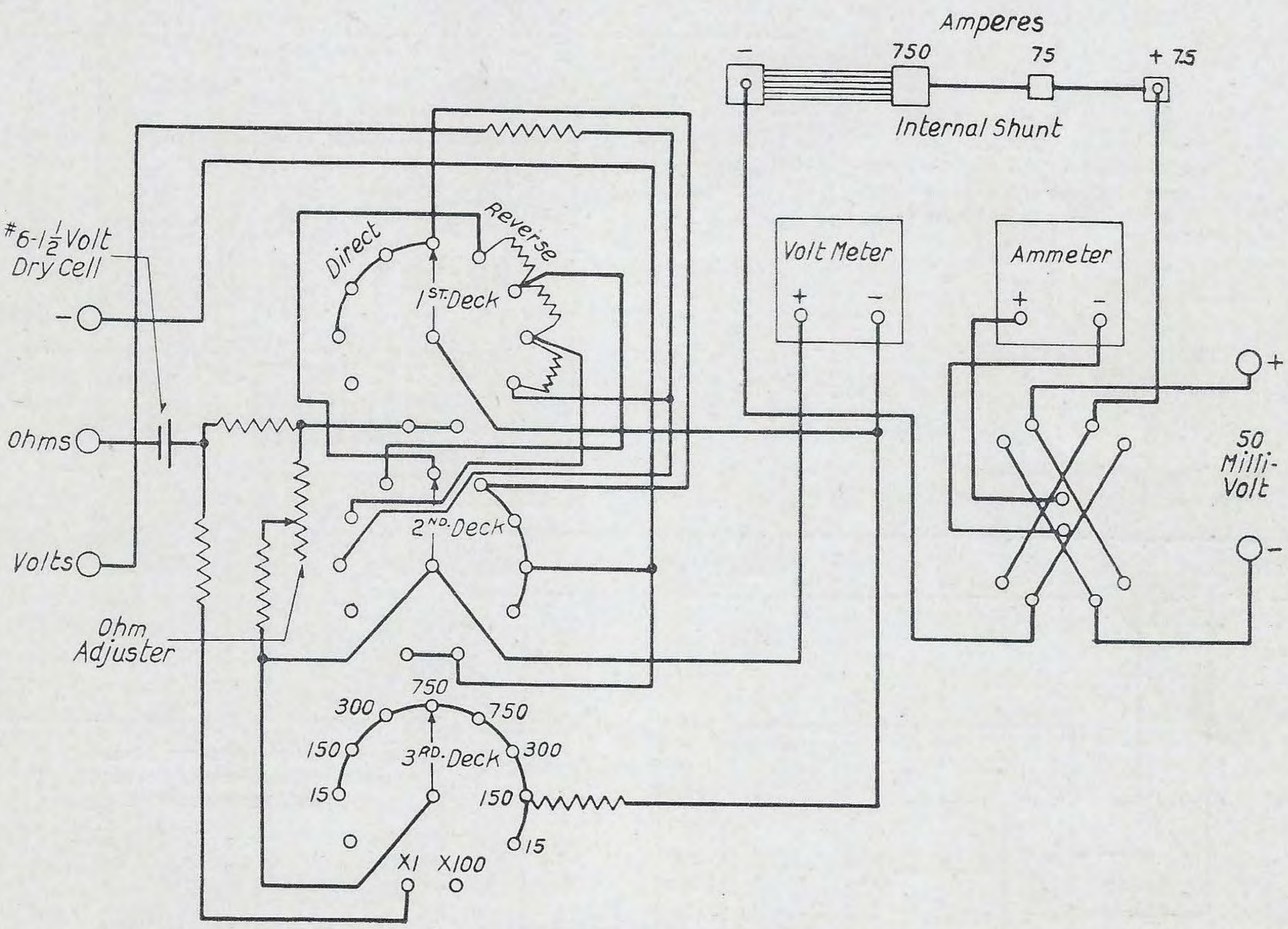

FIG. 6—INTERNAL WIRING DIAGRAM, REAR VIEW

PORTABLE DIRECT CURRENT INDUSTRIAL ANALYZER—Continued

WIRING DIAGRAMS—Continued

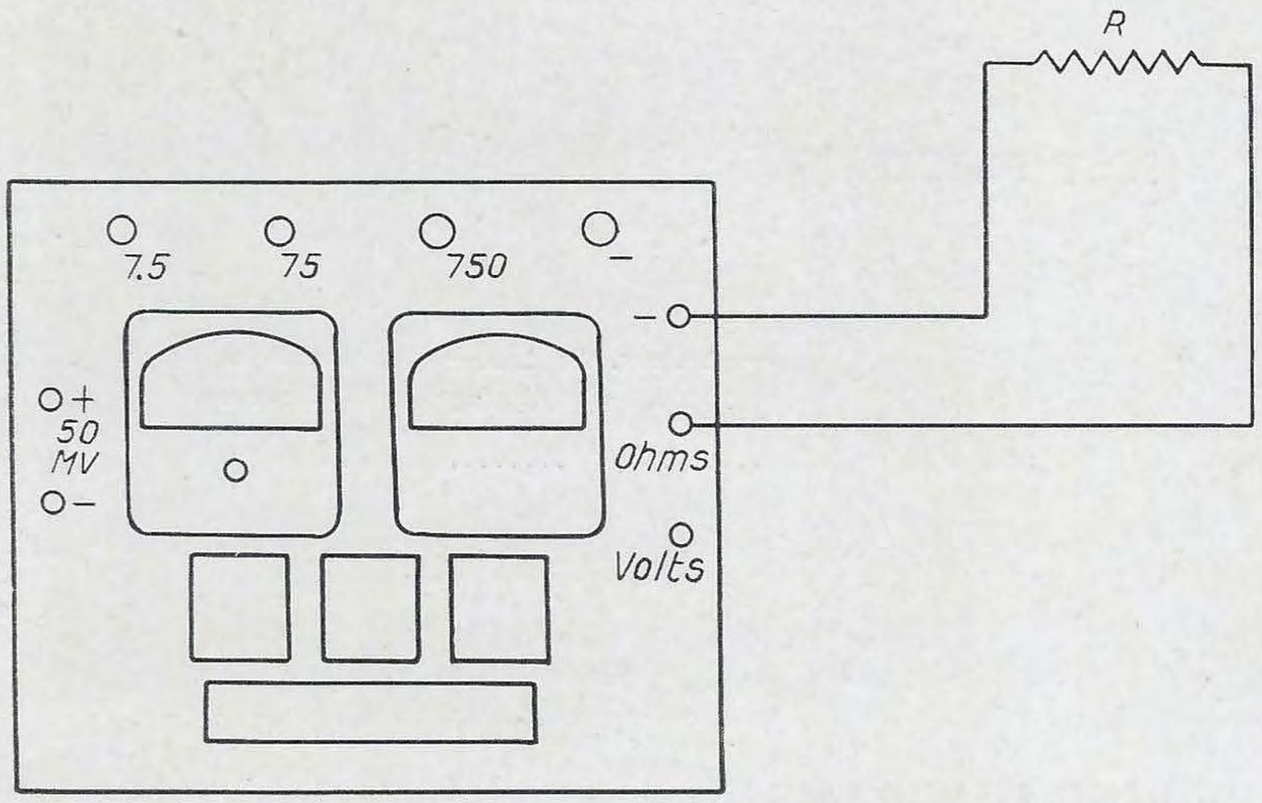

FIG. 7—CONNECTIONS FOR RESISTANCE MEASUREMENT.

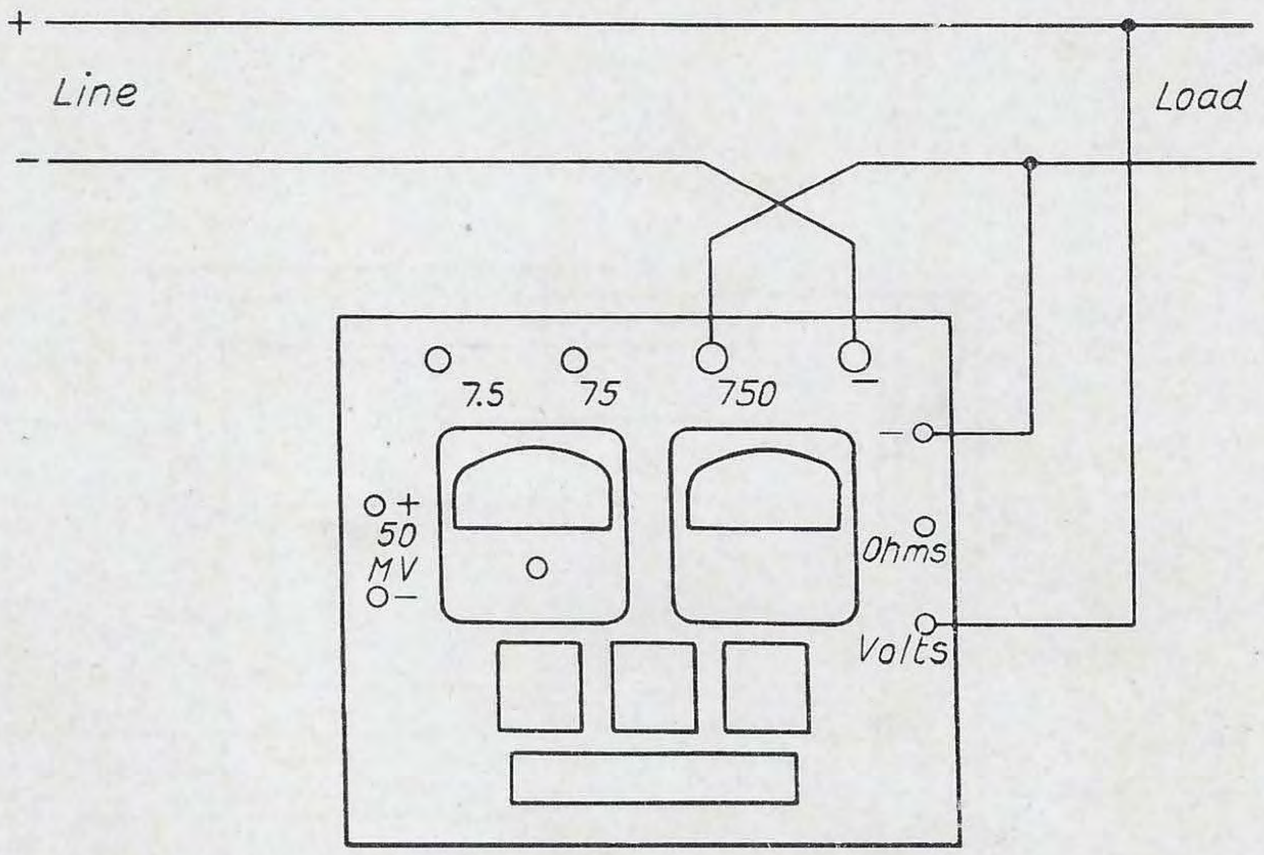

FIG. 8—CONNECTIONS FOR MEASUREMENT OF CURRENT AND VOLTAGE. SHUNT IS SHOWN IN NEGATIVE LEAD.

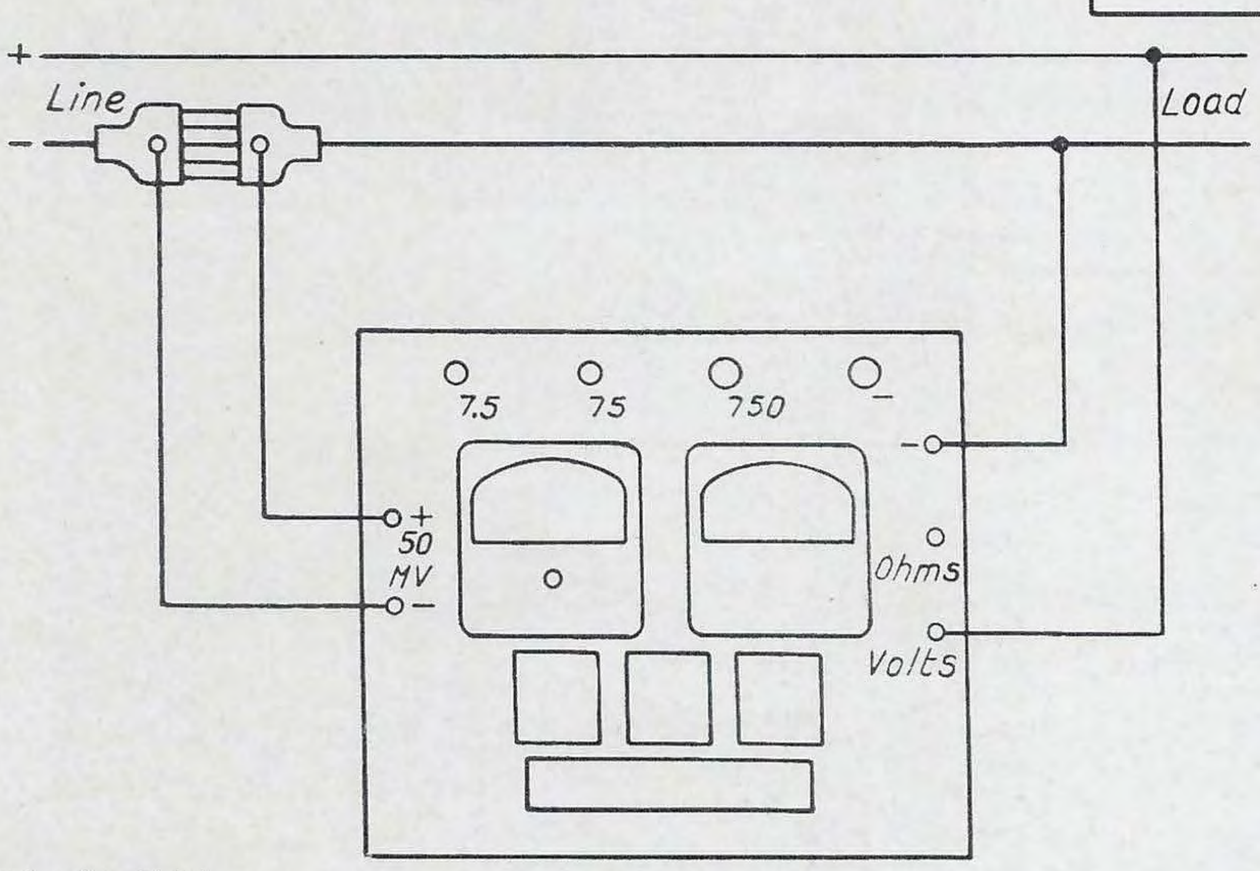

FIG. 9—CONNECTIONS FOR MEASUREMENT OF CURRENT AND VOLTAGE, USING EXTERNAL SHUNT.

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TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS

Flush and Projection Mounting

A-c. and D-c., Radio-Frequency, and Rectox Types

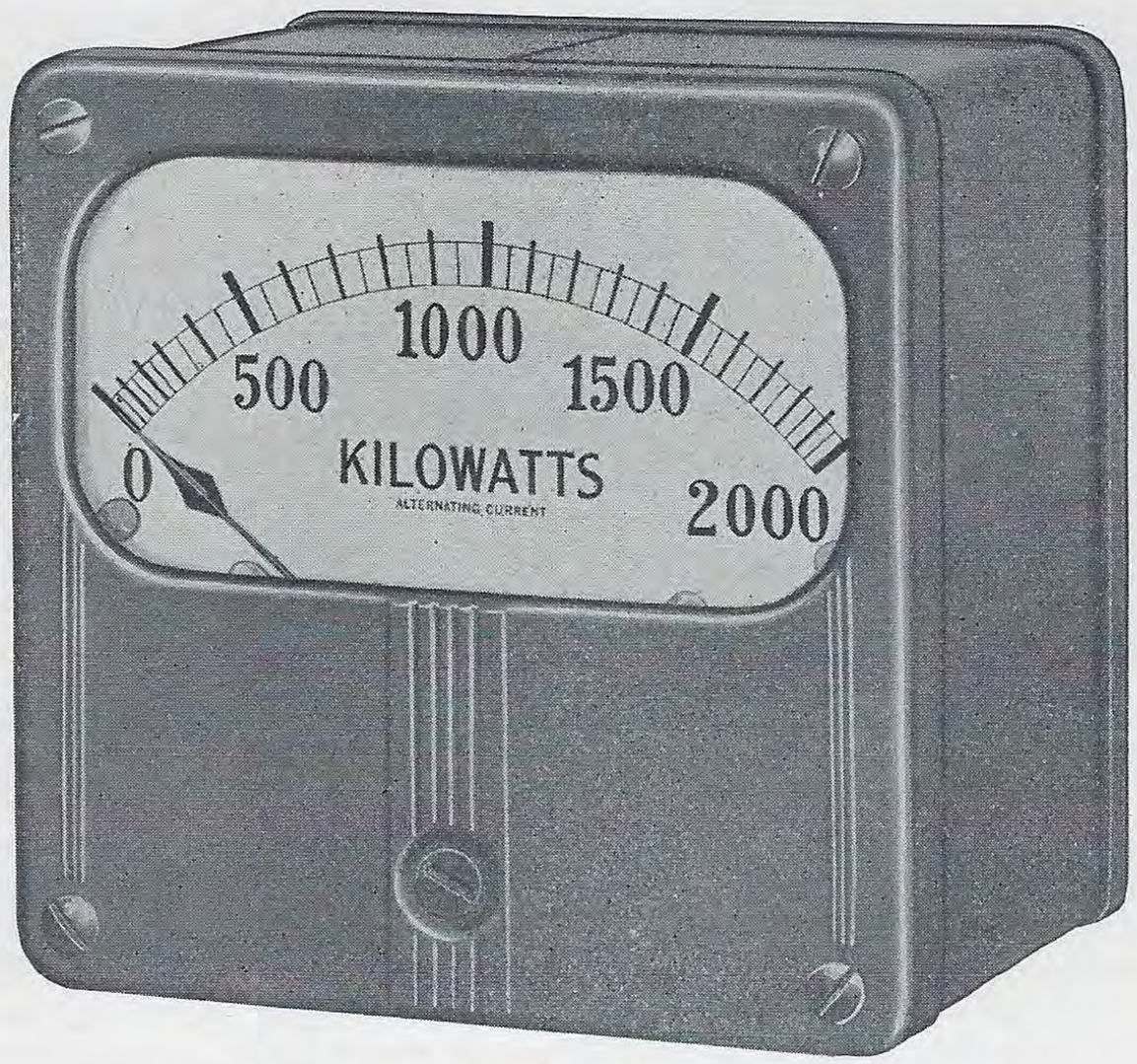


FIG. 1—TYPE H PROJECTION-MOUNTED WATTMETER.

DATA

CASE SIZE.....5½" SQUARE BY 4 1/16" DEEP
SCALE LENGTH.....5"
ACCURACY.....WITHIN 1%

ALTERNATING CURRENT MOVEMENTS—
AMMETER, VOLTMETERS.....REPULSION IRON VANE
WATTMETERS, POWER FACTOR METERS AND FREQUENCY METERS.....ELECTRO-DYNAMOMETER
SYNCHROSCOPE.....MOVING IRON

*DIRECT CURRENT MOVEMENTS.....D'ARSONVAL
WEIGHTS—
HX AMMETER AND VOLTMETER.....NET: 5½ LBS.; SHIPPING; 7 LBS.
HA AMMETER AND VOLTMETER.....NET: 4 LBS.; SHIPPING: 6 LBS.
HA AMMETER AND VOLTMETER, TRIPLEX.....NET: 9 LBS.; SHIPPING: 13 LBS.
HY WATTMETER POLYPHASE.....NET: 4 LBS.; SHIPPING: 6 LBS.
HY POWER FACTOR.....NET: 4½ LBS.; SHIPPING: 7 LBS.
HY WATTMETER SINGLE PHASE.....NET: 4 LBS.; SHIPPING: 6 LBS.

* Weights are approximate and do not include external resistors and reactors.

Application

The type H line of instruments, consists of ammeters, milliammeters, voltmeters, millivoltmeters, single and polyphase wattmeters, single and polyphase power factor meters, frequency meters, synchroscopes and Rectox types. Both a-c. and d-c. instruments are for service on large switchboards made of steel, ebony asbestos, or slate. In addition, radio-frequency types are available for radio applications.

These instruments are especially well suited for applications requiring instruments which have long scales that can be read at considerable distances, and which are distinctive in appearance and quality.

Distinctive Characteristics

Distinguishing the type H line of instruments are the following outstanding characteristics.

1) Improved Movements—While retaining the fundamentals of design used in the previous Westinghouse round-type instruments such as the SX and SY, the designers of the square-case type H line have attained greater overload capacity in the instruments to better withstand the severe stresses of short circuits.

2) Better Readability—Reading type H instruments from points rather far away or under unfavorable conditions is easy because of the long scales and the very clear scale markings. These easy-to-read scales are the result of proper size figures and the right number of scale divisions for each capacity.

3) Save Switchboard Space—Measuring only 5½ inches square, type H projection instruments can be mounted 3 in a row on a 20-inch panel or 4 in a row on a 24-inch panel.

4) One-Size Case—Only the one size of case (5½ inches square by 4 1/16 inches deep) is used for all type H instruments. Thus, different kinds of type H instruments mounted side by side present a pleasing appearance.

5) Distinctive Case—Designed by an artist especially for switchboard appli-

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

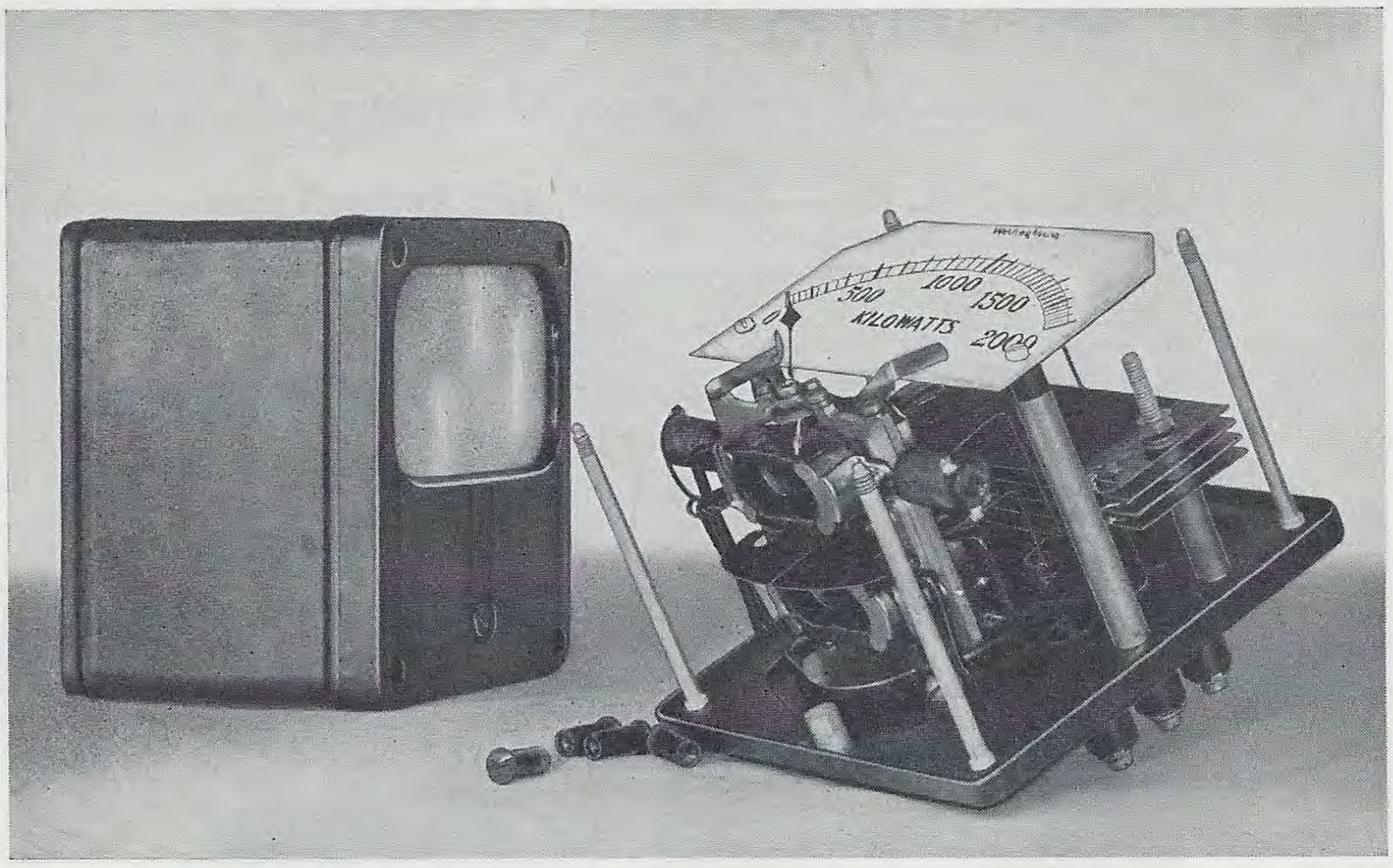


FIG. 2—TYPE HY ELECTRO-DYNAMOMETER WATTMETERS ARE FREE FROM FREQUENCY, VOLTAGE, AND WAVE FORM ERRORS OVER WIDE RANGES

cation, the general proportions of the type H case with the decorative front give a balanced, pleasing appearance with either a single instrument or with groups on a switchboard.

6) Uniform Scale—Special shapes and careful arrangement of the initial position of the vanes in the repulsion-vane movement assure a practically uniform scale even down to seven percent of full scale.

Construction

The same size case is used for all forms of type H instruments. It is square and arranged for flush or projection mounting. The base is made of heavy-gauge, drawn steel provided with knock-outs for insertion of terminals. (See Fig. 3). The cover plate is also of drawn steel, and the sides are of sheet steel folded up and spot welded together and to the cover plate. Polyphase wattmeter movements mount in this case without the use of cup projections on the base. This feature reduces the number of holes required in the panels for mounting.

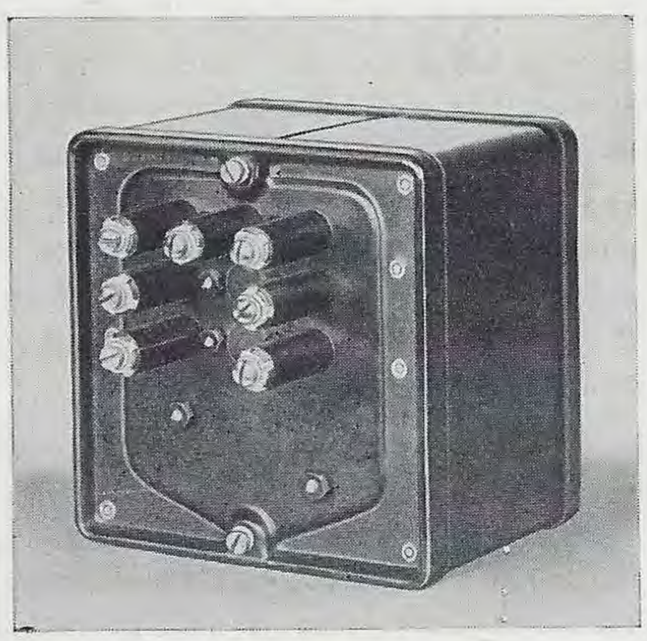


FIG. 3—NOTICE THAT ALL THE CONNECTION TERMINALS ARE LOCATED WITHIN A RECTANGLE PLACED ON THE VERTICAL CENTER LINE OF THE INSTRUMENT TO SIMPLIFY MOUNTING

All current-carrying terminals are moulded with threaded inserts for 10-32 terminals up to 20 amperes and for all voltmeters. A long stud is provided to be screwed into this terminal for thick panels and machine screws for steel panels. All connection terminals are located within a rectangle placed on the vertical center line with uniform distances between terminals both horizontally and vertically. By placing all terminals near the vertical center line, type H instruments may be mounted near the edge of the panel without interference between terminals and the panel-supporting posts on the back of the switchboard. Instruments are held to the panel by two mounting studs placed on the vertical center line.

An unusually high ratio between mounting space and scale length has been attained in the type H instruments. The actual scale length is 5 inches and the dimensions of the case are 5½ inches x 5½ inches.

High torque to weight ratios are maintained in the movements throughout the line. This insures long life and freedom from frictional errors. Sturdy construction resulting from years of experience insures permanent accuracy.

Threaded balance nuts are used throughout the line for balancing the movements.

The ends of the movement shaft carry highly polished and hardened steel pivots which operate in polished sapphire jewels. The jewel mounts are provided with suitable adjustment for end play of the shaft.

Scales—The scales and markings of all type H instruments have been carefully selected for beauty of appearance and ease in reading. The number of subdivisions has been reduced to a minimum to reduce possibility of confusion when reading at long distances. The size and style of figures is such as to greatly facilitate readability as well as to give an artistic appearance. Standard scales are: 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7.5, and 8 with multiples of 10, 100 and 1000. When the range is greater than 5000 the next larger unit of the quantity measured is used, as kilowatts, megawatts, kilovolts.

External Resistors—Voltmeters are self-contained to and including 300 volts a-c. and 800 volts d-c. Ammeters are

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

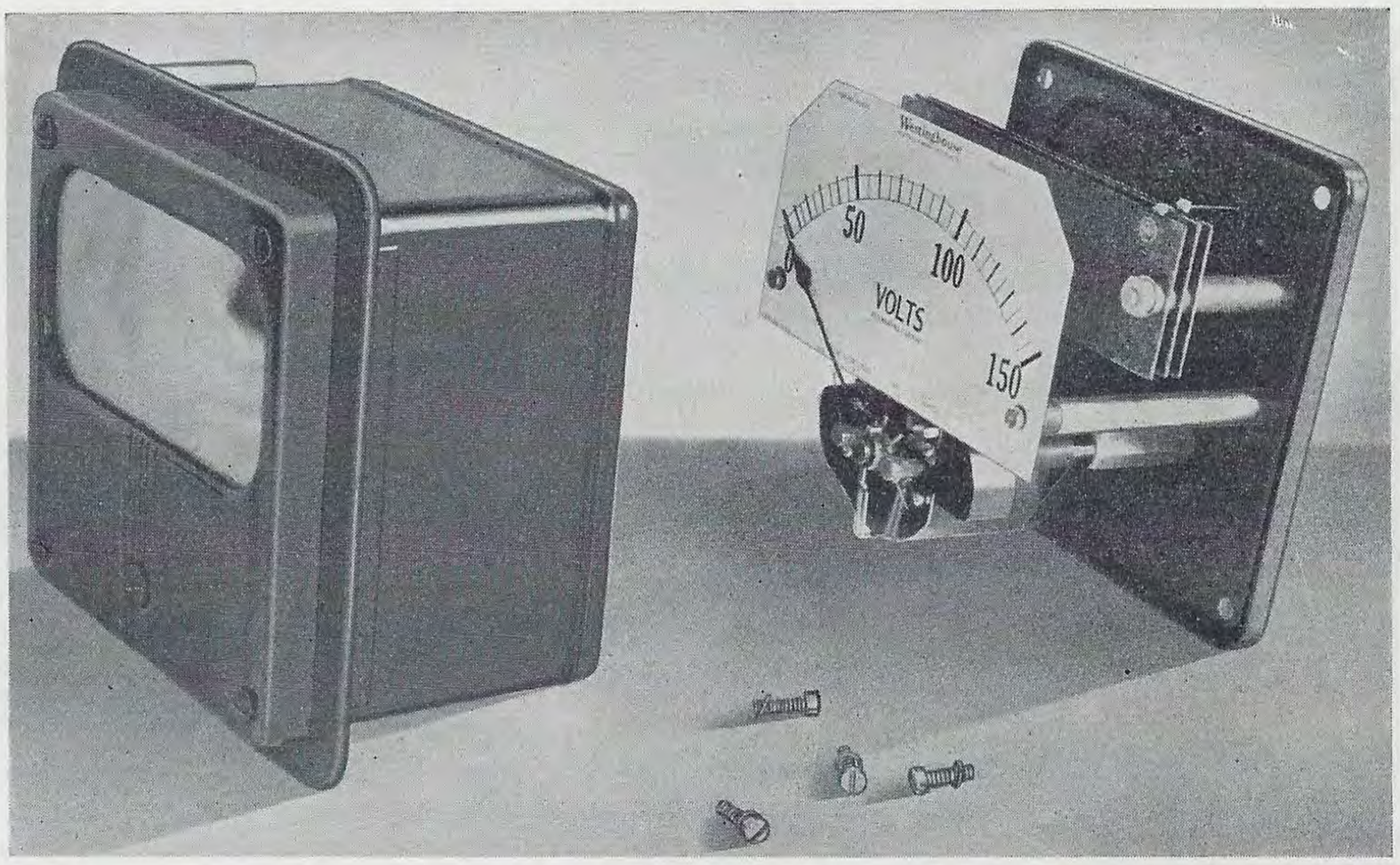


FIG. 4—TYPE HA FLUSH-MOUNTED VOLTMETER, BASE AND MECHANISM REMOVED

self-contained to and including 75 amperes a-c. and 60 amperes d-c.

Wattmeters are self-contained to and including 150 volts and 20 amperes.

Polyphase power factor meters are self-contained to and including 150 volts.

Single-phase power factor meters have external reactors for all ranges.

Frequency meters are provided with external reactors for all ranges.

Synchroscopes are provided with external reactors.

When the rating of the circuit to which the instrument is connected exceeds the self-contained rating available, current and voltage transformers should be used for a-c. circuits and shunts for d-c. circuits.

Reactive Component Compensators

Reactive compensators are small phase shifting transformers which are used to obtain quadrature voltages in connection with Varmeters (reactive volt-ampere meters). They are used on three phase, three wire and three phase, four wire circuits.

On two phase, four wire circuits a compensator is not employed. It is only necessary in this case to interchange the current coils of the Varmeter from the standard wattmeter connections.

Operation

The following types of movements are used in type H instruments.

Alternating Current

Ammeters—repulsion vane.
Voltmeters—repulsion vane.
Wattmeters—electro-dynamometer.
Power Factor Meters—electro-dynamometer and moving iron.
Frequency Meters—electro-dynamometer.
Synchroscopes—moving iron.

Direct Current

All instruments—permanent magnet moving coil.

Repulsion Vane Movement—This movement is reasonably free from wave form and frequency errors and can be used on both a-c. and d-c. with little change in accuracy. However, direct-current measurements should be made with permanent magnet moving coil instruments because of the lower-energy consumption and more uniform scale.

The current to be measured flows through a circular coil. Within the coil are positioned a stationary iron vane and a movable iron vane. The movable iron vane is securely fastened to the pointer shaft. Both vanes being polarized by the same current, are of the same polarity and therefore repel each other. The torque of the movement is controlled by a spiral phosphor-bronze spring which allows the pointer to rotate through an arc of 100 degrees. This pointer indicates the value of the current measured in reference to a suitably calibrated scale.

The mechanism is specially constructed to withstand heavy overloads. The

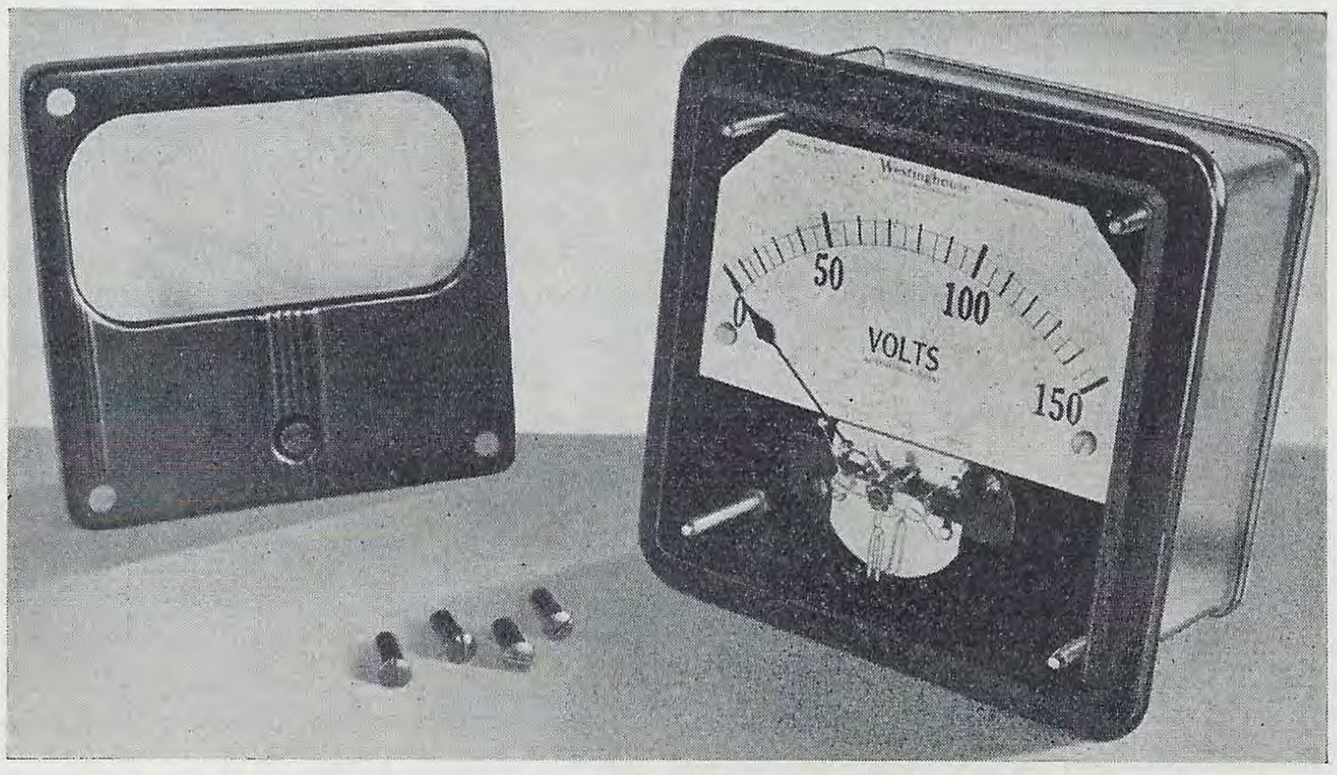


FIG. 5—TYPE HA FLUSH-MOUNTED VOLTMETER, COVER REMOVED

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

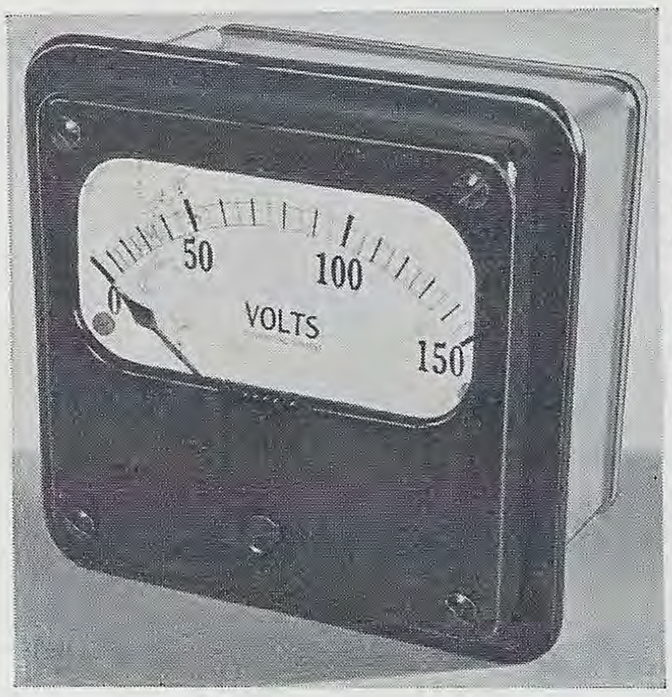


FIG. 6—TYPE HA FLUSH-MOUNTED VOLTMETER

pointer and moving vane are securely fastened to the shaft. This construction together with the tubular pointer provides a very sturdy movement.

Damping is obtained by two properly shaped aluminum vanes operating in closed air chambers.

A decided improvement has been made in the scale distribution of all instruments using the repulsion vane movement. By special shapes and careful arrangement of the initial position of the vanes, a practically uniform scale is obtained even down to 7 percent of full scale. This makes it unnecessary to provide double range coils, switching arrangements, etc. to keep the indications of the instrument well up scale under changing load conditions.

Electro-Dynamometer Movement for Wattmeters—The electro-dynamometer principle of operation is the most direct method for measuring currents in their relations to one another. It is used exclusively in type HY wattmeters, power factor meters, and frequency meters. One of the principal advantages of the dynamometer movement is its freedom from frequency, voltage, and wave form errors over a wide range of application.

The electro-dynamometer movement consists of a system of coils, both stationary and movable, placed in fixed relation to each other and wound without iron in the magnetic circuits. The movable coils are wound for voltage and fixed to the shaft. The current coils are stationary and secured to the frame of the movement. When currents flow in both the stationary and movable coils, the interaction of the magnetic fields tend to cause the axis of the coils to line up. This force is proportional to the product of the strengths of the two fields at any instant. Therefore, the torque is proportional to the product of the current and voltage and the cosine of the phase angle between them. Thus, it is proportional to the power. The pointer indicates in reference to a suitably calibrated scale the power in the circuit. The movements are air damped.

Varmeters—(Reactive volt ampere meters) employ electro-dynamometer movements. They operate similar to polyphase wattmeters except quadrature voltages are applied to the voltage coils through reactive component compensators. They indicate reactive component instead of power.

Electro-Dynamometer Movement for Power Factor Meters—The power-factor meter movements are similar in construction to the wattmeters, except that there are two movable coils placed at right angles to each other, and the current is brought in by means of conducting strips having very low torque. Power-factor meters operate under the influence of electrical torques without any mechanical controlling forces. The movable coils are connected to the voltage of the circuit and the current coils are connected to carry the current of the same circuit. The movable coils take up a position dependent upon the phase angle between the current and voltage. The scale is calibrated in terms of the cosine of the angle or power factor. Air damping is employed.

Electro-Dynamometer Movement for Frequency Meters—Frequency meters employ the same type of dynamometer movement as the power factor meters except that all coils are wound for voltage. A condenser reactor circuit is employed. A resonant type of circuit is used producing considerable torque and a wide open scale. This type of circuit produces an instrument which can accurately indicate small frequency variations and is free from temperature and voltage errors. Air damping is employed.

Moving-Iron Movement for Synchroscope—The synchroscope operates on the moving-iron vane principle. The shaft carries iron vanes which are magnetized by a coil connected to one of the circuits to be synchronized. Another group of coils are so positioned and connected that a rotating field is set up which encircles the movable vanes.

FIG. 7—THE TYPE H SYNCHROSCOPE EMPLOYS THE MOVING-IRON MOVEMENT. ITS SCALE IS A FULL 360° AND IS MARKED TO SHOW THE SYNCHRONISM POINT AND WHETHER OR NOT THE INCOMING CIRCUIT IS FAST OR SLOW

This set of coils is connected to the other circuit to be synchronized. The movable vanes take up a position so that when the field in the vanes reaches its maximum during a cycle, the axis of the vanes will coincide with the axis of the rotating field at that particular instant. The pointer thus indicates in reference to a scale the angular displacement of the two circuits. The scale is a full 360° and is marked to show synchronism point and whether the incoming circuit is fast or slow. This is determined by direction of rotation of the pointer. The pointer will rotate up to a maximum of approximately 4 cycles difference in frequency between the two circuits. Damping is obtained by an aluminum disc attached to the pointer shaft and rotating in the field of a permanent magnet. The movement is adjusted to prevent rotation when potential is accidentally lost from either circuit to avoid incorrect synchronizing under this condition.

This mechanism can be supplied to obtain 360-degree scale power factor meters. It also is used in position indicators.

Type HZ D-C. Wattmeters—Are essentially iron core dynamometers in which the moving coil is energized from an ammeter shunt. The field is produced by a coil connected across the D-C. circuit. This coil with the associated magnetic circuit forms the potential element of the wattmeter, replacing the permanent magnet in the conventional d'Arsonval instrument. The magnetic circuit is designed to practically eliminate residual errors due to hysteresis, thus providing good performance under voltage variations.

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

POWER CONSUMPTION

	Rating	25 CYCLES V.A.	25 CYCLES Watts	25 CYCLES Vars	25 CYCLES % P.F.	60 CYCLES V.A.	60 CYCLES Watts	60 CYCLES Vars	60 CYCLES % P.F.
Ammeters			**Burden on Current Transformers at 5 Amperes***						
Type HA	5-amp.	.45	.41	.184	93	.59	.42	.415	71
Wattmeters									
Type HY	5-amp.	1.94	1.93	0.12	99+	1.95	1.93	0.29	99
Polyphase Power Factor Meters									
Type HY	5-amp.	1.94	1.93	0.12	99+	1.95	1.93	0.29	99
			Burden on Voltage Transformers at 115 Volts*						
Voltmeters									
Type HA	150-volt	3.51	3.51	0.023	99+	3.51	3.51	0.023	99+
Wattmeters									
Single-Phase Type HY	115-volt	3.27	3.27	0	100	3.27	3.27	0	100
Polyphase Type HY	115-volt	2.88	2.88	0	100	2.88	2.88	0	100
Kilovar Meters									
Polyphase Type HY									
1–2 Phase	115	7.45	5.73	4.75	77 lag	7.45	5.73	4.75	77 lag
2–3 Phase	115	3.57	2.27	2.75	63 lead	3.57	2.27	2.75	63 lead
Frequency Meters									
	115-volt	3.5	3.5	0.13	99+	3.5	3.5	0.13	99+
Polyphase Power Factor Meter									
Type HY 50-100-50	115-volt	3.7	3.7	0	100	3.7	3.7	0	100
Type HY 10-100-80	115-volt	3.2	3.2	—	—	3.2	3.2	—	—
Single-Phase Power Factor Meter									
Type HY	115-volt	6.0	13.9	11.1	78	17.8	13.9	11.1	78
Synchroscope									
Type HA	115-volt		Circuit No. 1, For running machine			3.24	2.11	2.4	65.
			Circuit No. 2, For incoming machine			2.88	1.81	2.2	63.

*Values given are for a single element. Polyphase wattmeters have two elements.

LIST PRICES

Black dials can be supplied on all types on special order at $5.00 each additional list. Internal illumination (6 volt) can be supplied on all types, except Synchroscopes, 360° Power Factor Meters and Position Indicators, at $7.50 each additional list price ($15.00 for Triplex Instruments). When ordering, use Style Numbers below and specify "Black Dial" or "Illumination."

TYPE HX—DIRECT CURRENT

AMMETERS—SELF-CONTAINED

Capacity	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price	Flush Mounting Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price	Projection Mounting Discount Symbol BC
1	50	931 857	$48	50	721 982	$44	50
2	40	931 859	48	50	721 984	44	50
3	30	931 861	48	50	721 986	44	50
5	50	931 863	48	50	721 988	44	50
10	50	931 866	48	50	721 991	44	50
15	30	931 867	48	50	721 992	44	50
25	50	931 869	48	50	721 994	44	50
30	30	931 870	48	50	931 614	44	50
40	40	931 871	48	50	931 615	44	50
50	50	931 872	48	50	931 616	44	50
60	30	931 873	48	50	931 617	44	50

AMMETER FOR USE WITH EXTERNAL SHUNT

Same Capacity as Shunt		931 832	43	00	818 170	39 00

Price includes 8-foot leads but not the shunt. When ordering, include item for leads, 8-foot length, Style No. 680730.

MILLIAMMETERS

Capacity	Approx. Resistance-ohms	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price	Flush Mounting Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price	Projection Mounting Discount Symbol BC
0.5	470	50	931 889	$45	00	721 995	$41	00
1	193	50	931 890	45	00	721 996	41	00
5	10.8	50	931 896	43	00	722 002	39	00
10	5.9	50	931 899	43	00	722 005	39	00
50	1.	50	931 905	43	00	722 011	39	00
100	.5	50	931 908	43	00	722 014	39	00
500	.1	50	931 914	43	00	722 020	39	00

VOLTMETERS—SELF-CONTAINED

Resistance—200 Ohms Per Volt

1	50	931 961	43	00	722 045	39 00
8	40	931 969	43	00	722 053	39 00
15	30	931 971	43	00	722 055	39 00
30	30	931 974	43	00	722 058	39 00
100	50	931 979	43	00	722 063	39 00
150	30	931 980	43	00	722 064	39 00
300	30	931 983	47	00	722 067	43 00
500	50	931 985	50	00	722 069	46 00
600	30	931 986	55	00	722 070	51 00
800	40	931 987	59	00	722 071	55 00
150-0-150*	30	931 875	43	00	722 112	39 00
300-0-300*	30	931 874	47	00	722 111	43 00

* Ground detector voltmeters.

Prices and discounts subject to change without notice

Order by Style Number

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE HX DIRECT CURRENT—Continued

VOLTMETERS—WITH EXTERNAL RESISTORS

Resistance—200 Ohms Per Volt

Capacity	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
1000	50	1 009 038	$ 64 50	1 009 026	$ 60 50
1500	30	1 009 039	72 50	1 009 027	68 50
2000	40	1 009 040	81 00	1 009 028	77 00
2500	50	1 009 041	89 00	1 009 029	85 00
3000	30	1 009 042	97 00	1 009 030	93 00
4000	40	1 009 043	170 00	1 009 031	166 00
5000	50	1 009 044	193 00	1 009 032	189 00
10000*	50	1 009 045	293 00	1 009 033	289 00
15000*	30	1 009 046	403 00	1 009 034	399 00
20000*	40	1 009 047	493 00	1 009 035	489 00
25000*	50	1 009 048	593 00	1 009 036	589 00
30000*	30	1 009 049	693 00	1 009 037	689 00

* These capacities have a series parallel resistor taking .05 amperes. from the line. The instrument takes .02 amperes.
Dials are marked in kilovolts.

TYPE HX RADIO FREQUENCY

d'Arsonval Movement with Copper-Oxide Rectifier for Low Energy A-C. Measurements

Capacity	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
MILLIAMMETERS—SELF-CONTAINED					
100	50	931 952	$53 00	722 023	$49 00
300	30	931 956	53 00	722 027	49 00
800	40	931 960	53 00	722 031	49 00
AMMETERS—SELF-CONTAINED					
1	50	931 940	51 00	722 033	47 00
3	30	931 944	51 00	722 037	47 00
10	50	931 949	51 00	722 042	47 00
20	40	931 993	51 00	722 044	47 00

TYPE HX RECTOX TYPES

d'Arsonval Movement with Copper-Oxide Rectifier for Low Energy A-C. Measurements

MILLIAMMETERS

Capacity	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
0.5	50	931 876	$50 00	722 073	$46 00
1	50	931 877	50 00	722 074	46 00
2	40	931 879	50 00	722 076	46 00
5	50	931 883	48 00	722 080	44 00
10	50	931 886	48 00	722 083	44 00
VOLTMETERS					
1000 Ohms Per Volt					
4	40	931 922	52 00	722 089	48 00
10	50	931 926	52 00	722 093	48 00
150	30	931 936	54 00	722 103	50 00
300	30	931 939	58 00	722 106	54 00
2000 Ohms Per Volt					
1	50	931 917	54 00	722 084	50 00
1.5	30	931 918	54 00	722 085	50 00
2	40	931 919	54 00	722 086	50 00
3	30	931 921	54 00	722 088	50 00

TYPE HZ DIRECT CURRENT WATTMETERS

For use with 50 M.V. External Shunts

Capacity Volts	Capacity M.V.	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
115	50*	1 056 972	$154	1 056 973	$150
230	50*	1 056 974	164	1 056 975	160

* Calibrated for use with external shunt. Specify shunt as separate item not included in above styles. Full scale capacity should be selected to facilitate scale marking. Capacities of 1, 1.5, 2, 3, 4, 5, 6, 7.5, 8 and multiples thereof should be used.

RADIO FREQUENCY AMMETERS

Calibrated for Use with External Thermo-Couple

Radio frequency ammeters are available with external thermo-couples in all ranges from 1 to 50 amperes, inclusive. When long leads are used between the instrument and the thermo-couple it is usually necessary to place proper by-pass condensers and radio-frequency chokes in the circuit at the thermo-couple to prevent damage to the thermo-couple by radio-frequency in the instrument leads. Additional information will be furnished on request.

Rating	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
Same as couple*	931 951	$45 00	722 032	$41 00

*List price includes the ammeter calibrated but not the thermo-couple.

Prices and discounts subject to change without notice

Order by Style Number

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE HA ALTERNATING CURRENT

AMMETERS—SELF-CONTAINED

Capacity	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Triplex Flush Mounting Style No.	Triplex Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC	Triplex Projection Mounting Style No.	Triplex Projection Mounting List Price Discount Symbol BC
5	50	931 739	$39 00	1 094 871	$112 00	724 200	$35 00	1 059 735	$100 00
10	50	931 740	39 00	1 094 872	112 00	721 733	35 00	1 059 736	100 00
15	30	931 741	43 00	1 094 873	124 00	721 734	39 00	1 059 737	112 00
25	50	931 742	43 00	1 094 874	124 00	721 735	39 00	1 059 738	112 00
30	30	931 743	43 00	1 094 875	124 00	721 736	39 00	1 059 739	112 00
40	40	931 744	45 00	1 094 876	130 00	721 737	41 00	1 059 740	118 00
50	50	931 745	45 00	1 094 877	130 00	721 738	41 00	1 059 741	118 00
60	30	931 746	45 00	1 094 878	130 00	721 739	41 00	1 059 742	118 00
75	75	931 747	45 00	1 094 879	130 00	721 740	41 00	1 059 743	118 00

A-C. ammeters can be supplied on order as low as ten milliamperes full scale.

AMMETERS—FIVE AMPERE COILS
Calibrated for Use with Transformers

Capacity	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Triplex Flush Mounting Style No.	Triplex Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC	Triplex Projection Mounting Style No.	Triplex Projection Mounting List Price Discount Symbol BC
10	50	931 748	$39 00	1 094 880	$112 00	724 201	$35 00	1 059 744	$100 00
15	30	931 749	39 00	1 094 881	112 00	724 202	35 00	1 059 745	100 00
20	40	931 750	39 00	1 094 882	112 00	724 203	35 00	1 059 746	100 00
25	50	931 751	39 00	1 094 883	112 00	724 204	35 00	1 059 747	100 00
30	30	931 752	39 00	1 094 884	112 00	724 205	35 00	1 059 748	100 00
40	40	931 753	39 00	1 094 885	112 00	724 206	35 00	1 059 749	100 00
50	50	931 754	39 00	1 094 886	112 00	724 207	35 00	1 059 750	100 00
60	30	931 755	39 00	1 094 887	112 00	724 208	35 00	1 059 751	100 00
75	75	931 756	39 00	1 094 888	112 00	724 209	35 00	1 059 752	100 00
80	40	931 757	39 00	1 094 889	112 00	724 210	35 00	1 059 753	100 00
100	50	931 758	39 00	1 094 890	112 00	724 211	35 00	1 059 754	100 00
150	30	931 759	39 00	1 094 891	112 00	724 212	35 00	1 059 755	100 00
200	40	931 760	39 00	1 094 892	112 00	724 213	35 00	1 059 756	100 00
250	50	931 761	39 00	1 094 893	112 00	724 214	35 00	1 059 757	100 00
300	30	931 762	39 00	1 094 894	112 00	724 215	35 00	1 059 758	100 00
400	40	931 763	39 00	1 094 895	112 00	724 216	35 00	1 059 759	100 00
500	50	931 764	39 00	1 094 896	112 00	724 217	35 00	1 059 760	100 00
600	30	931 765	39 00	1 094 897	112 00	724 218	35 00	1 059 761	100 00
800	40	931 766	39 00	1 094 898	112 00	724 219	35 00	1 059 762	100 00
1000	50	931 767	39 00	1 094 899	112 00	724 220	35 00	1 059 763	100 00
1500	30	931 768	39 00	1 094 900	112 00	724 221	35 00	1 059 764	100 00
2000	40	931 769	39 00	1 094 901	112 00	724 222	35 00	1 059 765	100 00
3000	30	931 770	39 00	1 094 902	112 00	724 223	35 00	1 059 766	100 00
4000	40	931 771	39 00	1 094 903	112 00	724 224	35 00	1 059 767	100 00
5000	50	931 772	39 00	1 094 904	112 00	724 225	35 00	1 059 768	100 00

AMMETERS
For Use with Transformers
Calibrated as Required for Capacities Not Listed Above

Capacity	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Triplex Flush Mounting Style No.	Triplex Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC	Triplex Projection Mounting Style No.	Triplex Projection Mounting List Price Discount Symbol BC
.1	..	1 059 786	$44 00	1 094 905	$127 00	1 059 787	$40 00	1 059 769	$115 00
2.5*	..	931 773	39 00	1 094 906	112 00	721 726	35 00	1 059 770	100 00
3*	..	931 774	39 00	1 094 907	112 00	721 727	35 00	1 059 771	100 00
4*	..	931 775	39 00	1 094 908	112 00	721 728	35 00	1 059 772	100 00
5*	..	931 776	39 00	1 094 909	112 00	721 729	35 00	1 059 773	100 00
6*	..	931 777	39 00	1 094 910	112 00	721 730	35 00	1 059 774	100 00
7.5*	..	931 778	39 00	1 094 911	112 00	721 731	35 00	1 059 775	100 00
10*	..	931 779	39 00	1 094 912	112 00	721 732	35 00	1 059 776	100 00

* Specify transformer ratio and scale desired.

Prices and discounts are subject to change without notice.

Order by Style Number

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE HA ALTERNATING CURRENT—Continued

VOLTMETERS—SELF-CONTAINED

Capacity	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Triplex Flush Mounting Style No.	Triplex Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC	Triplex Projection Mounting Style No.	Triplex Projection Mounting List Price Discount Symbol BC
150	30	931 780	$41 00	1 094 913	$118 00	721 721	$37 00	1 059 777	$106 00
300	30	931 781	45 00	1 094 914	130 00	721 723	41 00	1 059 778	118 00
600†	30	931 782	53 00	1 094 915	154 00	721 724	49 00	1 059 779	142 00
750†	75	931 783	57 00	1 094 916	166 00	721 725	53 00	1 059 780	154 00

† Supplied with external resistor.

VOLTMETERS—150 VOLT COILS
Calibrated for Use with Transformers

3000	30	931 784	41 00	1 094 917	118 00	797 174	37 00	1 059 781	106 00
6000§∅	30	1 059 788	41 00	1 094 918	118 00	1 059 790	37 00	1 059 782	106 00
7500	75	931 785	41 00	1 094 919	118 00	931 737	37 00	1 059 783	106 00
9000§	45	1 059 789	41 00	1 094 920	118 00	1 059 791	37 00	1 059 784	106 00

§ Scales marked in kilovolts.
∅ 125 volt coil.

VOLTMETERS—150 VOLT COILS
For Use with Transformers
Calibrated as Required for Capacities Not Listed Above

150‡	..	931 786	41 00	1 094 921	118 00	721 720	37 00	1 059 785	106 00

‡ Specify transformer ratios and scales desired.
Prices are subject to change without notice.

TYPE HY ALTERNATING CURRENT

SINGLE PHASE WATTMETERS

Amperes	Volts	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
5*	115	931 787	$64 00	721 741	$60 00
5*	230†	931 788	68 00	721 742	64 00
5*	460†	931 789	73 00	721 743	69 00
10*	115	931 790	64 00	721 744	60 00
10*	230†	931 791	68 00	721 745	64 00
10*	460†	931 792	73 00	721 746	69 00

* Calibrated as desired for use with transformers. Specify scales and transformer ratios.
† Supplied with external resistor.
Above instruments available with current coils from 0.1 ampere to 20 amperes.

POLYPHASE WATTMETERS
With Two Current Coils and Two Voltage Coils
2-Phase, 4-Wire—2-Phase, 3-Wire—3-Phase, 3-Wire

4	115	931 793	$ 94 00	721 747	$ 90 00
5	115	931 794	94 00	721 748	90 00
7.5	115	931 795	94 00	721 749	90 00
10	115	931 796	94 00	721 750	90 00
5	230‡	931 797	102 00	721 751	98 00
7.5	230‡	931 798	102 00	721 752	98 00
10	230‡	931 799	102 00	721 753	98 00
5	460‡	931 800	112 00	721 755	108 00
7.5	460‡	931 801	112 00	721 756	108 00
10	460‡	931 802	112 00	721 757	108 00
5	575‡	931 803	118 00	721 758	114 00
7.5	575‡	931 804	118 00	721 759	114 00
10	575‡	931 805	118 00	721 760	114 00

Calibrated as desired for use with transformers. Specify scales and transformer ratios.
‡ Supplied with external resistor.
Above instruments available with current coils from 0.1 ampere to 20 amperes.

POLYPHASE WATTMETERS
With Three Current Coils and Two Voltage Coils
3-Phase, 4-Wire

Amperes	Volts	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
4	115	931 806	$104 00	797 870	$100 00

Specify scales and transformer ratios and provide connection diagram.

POLYPHASE VARMETERS (Reactive Volt Amperes)
With Two Current Coils and Two Voltage Coils
3-Phase, 3-Wire

Amps.	Volts	Frequency	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
4x	115	60	931 807	$114 00	721 761	$110 00
5x	115	60	931 808	114 00	721 762	110 00

x Style number and list price includes compensator. Specify scales and transformer ratios. Compensator is external. These instruments are center zero Lag-O-Lead. Left zero-lag scale can be supplied on order at same prices.

With Three Current Coils and Two Voltage Coils
3-Phase, 4-Wire

5§	115	60	931 809	$124 00	931 738	$120 00

§ Style number and list price includes compensator. Specify scale and transformer ratios. Compensator is external. These instruments are center zero Lag-O-Lead. Left zero-lag scales can be supplied on order at same prices.

Prices and discounts subject to change without notice

Order by Style Number

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE HY ALTERNATING CURRENT—Continued

RESONANT CIRCUIT FREQUENCY METERS

Volts	Frequency	Scale	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
115¶	25	20–30	50	931 810	$119 00	721 763	$115 00
115¶	60	50–70	40	931 811	119 00	721 764	115 00
115¶	25	23–27	40	931 812	139 00	721 765	135 00
115¶	60	58–62	40	931 813	139 00	721 766	135 00

¶Supplied with external resistor.
Instruments for other frequencies can be supplied on order.
Instruments for 230 volts can be supplied on order at $10.00 each additional list.

POWER FACTOR METERS WITH 100-DEGREE SCALES, TWO QUADRANT

Phase	Amperes	Volts	Frequency	Scale	Scale Divisions	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
1**	5	115	25	50–100–50	50	931 814	$99 00	721 767	$95 00
1**	5	115	60	50–100–50	50	931 815	99 00	721 780	95 00
3	5	115	25/60	50–100–50	50	931 816	79 00	721 781	75 00
3	5	115	25/60	10–100–80	55	931 817	79 00	721 782	75 00
3††	5	230	25/60	50–100–50	50	931 818	83 00	721 783	79 00
3††	5	230	25/60	10–100–80	55	931 819	83 00	721 784	79 00
3††	5	460	25/60	50–100–50	55	931 820	88 00	721 785	84 00
3††	5	460	25/60	10–100–80	55	931 821	88 00	721 786	84 00

**Supplied with external reactor.
††Supplied with external resistor.
Above instruments available with current coils from 0.1 ampere to 20 amperes.

TYPE HA POWER FACTOR METERS WITH 360-DEGREE SCALES, FOUR QUADRANT

1	5	115	60	100–0–100	40	931 822	119 00	818 650	115 00
1	5	115	25	100–0–100	40	931 823	119 00	818 649	115 00
3	5	115	25/60	100–0–100	40	931 824	99 00	818 652	95 00
3	5	230	25/60	100–0–100	40	931 825	109 00	818 653	105 00
3	5	460	25/60	100–0–100	40	931 826	119 00	818 654	115 00
3	5	575	25/60	100–0–100	40	931 827	129 00	818 655	125 00

Above instruments available with current coils from 0.020 amperes to 10 amperes.

TYPE HA SYNCHROSCOPE

Volts	Frequency	Flush Mounting Style No.	Flush Mounting List Price Discount Symbol BC	Projection Mounting Style No.	Projection Mounting List Price Discount Symbol BC
115	25	931 828	$119 00	818 648	$115 00
115	60	931 829	119 00	818 154	115 00
230	25	931 830	139 00	820 810	135 00
230	60	931 831	139 00	820 809	135 00

TYPE HA POSITION INDICATORS

See Catalog on Position Indicators

REACTIVE COMPONENT COMPENSATORS

For Use with Varmeters with Two Current Coils and Two Voltage Coils, 3-Phase, 3-Wire

Volts	Frequency	Style No.	List Price Discount Symbol BC
115	25	445 956	$20 00
115	60	445 955	20 00

For Use with Varmeters with Three Current Coils and Two Voltage Coils, 3-Phase, 4-Wire

115	60	931 732	30 00

NO. 46 MAZDA LAMP

For Use in Type H Instruments

6.3 Volts—0.25 Amperes

Style No.	List Price
1 001 663	$0 14

TYPE MT TRANSFORMERS

For Supplying Type H Illumination

Style No.	Voltage	Frequency	Volt-Ampere Capacity	List Price Discount Symbol BC
971 456*	115/6.3	50/60	100	$10 00

* Will supply lights of 30 (max.) Type H instruments.

Prices and discounts subject to change without notice

Order by Style Number

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

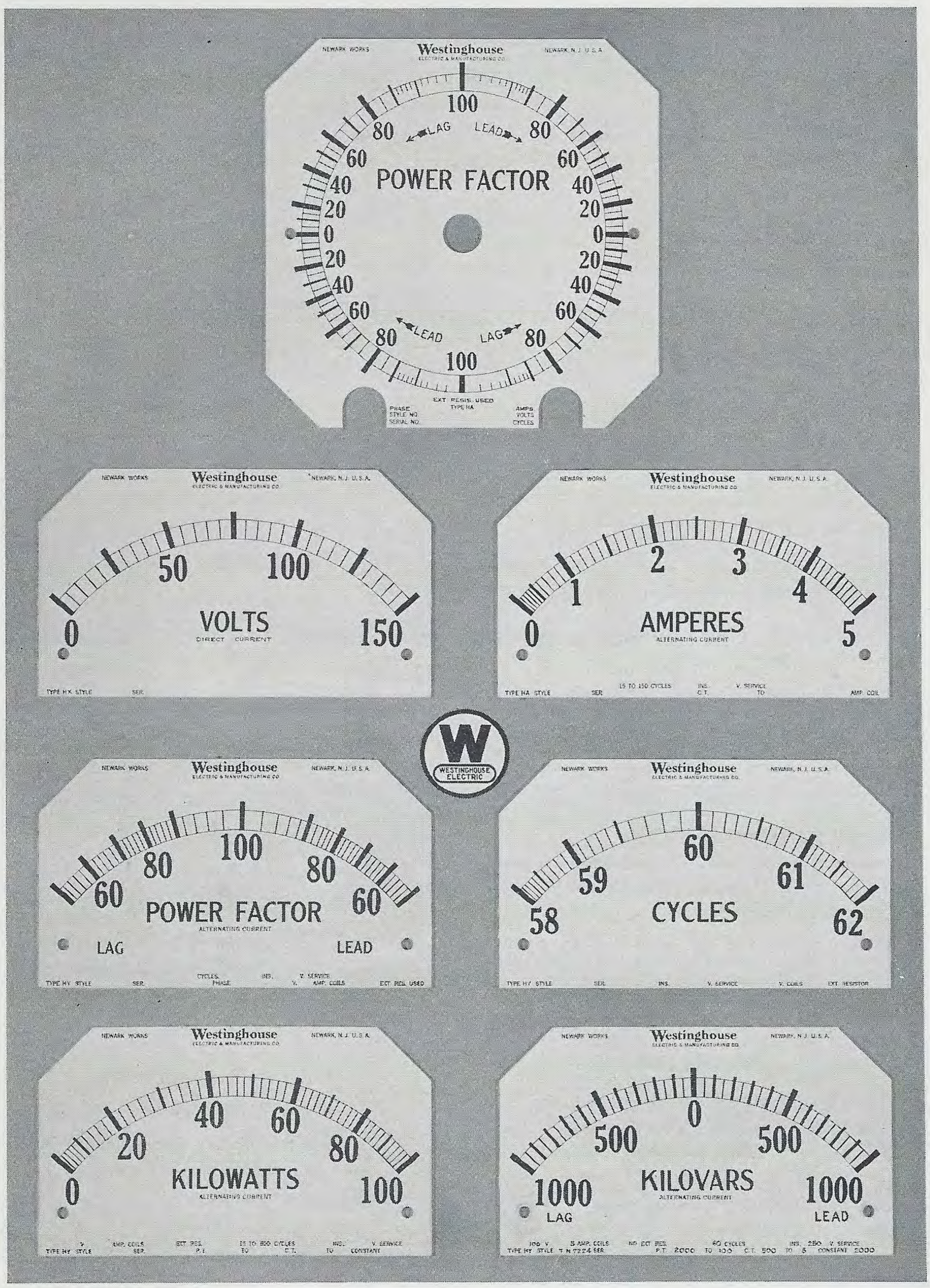


FIG. 8—READING TYPE H INSTRUMENTS FROM POINTS RATHER FAR AWAY OR UNDER UNFAVORABLE CONDITIONS IS EASY BECAUSE OF THE LONG SCALES AND THE VERY CLEAR SCALE MARKINGS. THESE EASY-TO-READ SCALES ARE THE RESULT OF GREAT ATTENTION TO DETAIL AND PROPER SELECTION OF FIGURE SIZES AND NUMBER OF SCALE DIVISIONS. NOTE THE PRACTICALLY UNIFORM SCALE DISTRIBUTION FOR THE A-C. AMMETER.

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

FIG. 9—TYPICAL INSTALLATION OF TYPE H FLUSH INSTRUMENTS ON LATEST SECTIONAL BENCH BOARD TYPE CONTROL DESK

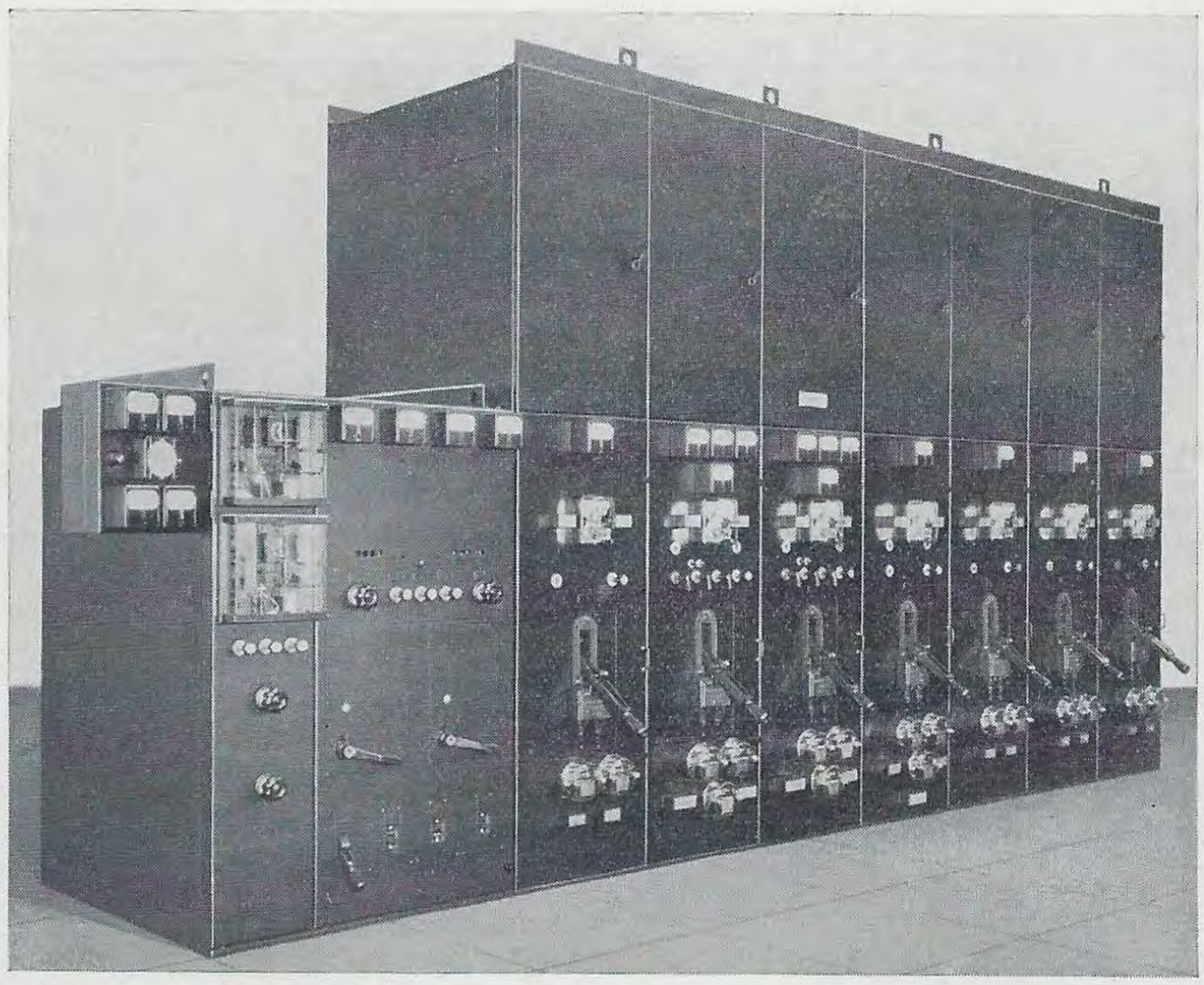


FIG. 10—METAL ENCLOSED CUBICLE TYPE SWITCHGEAR INSTALLATION WITH TYPE H PROJECTION INSTRUMENTS

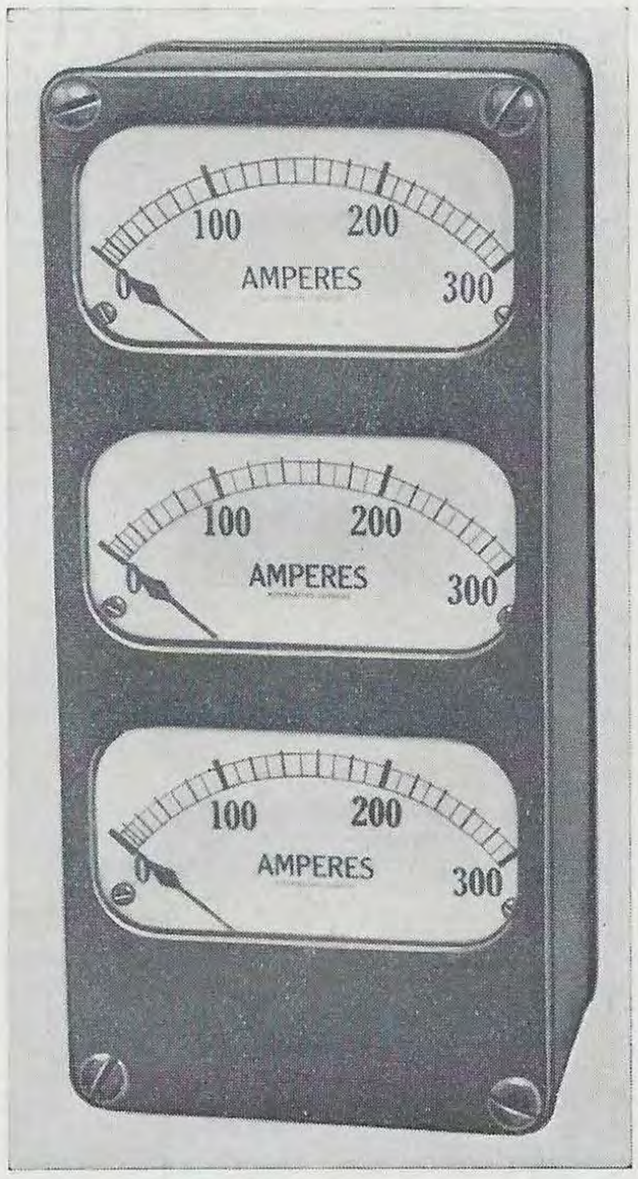
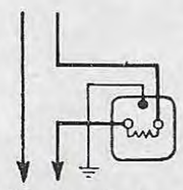


FIG. 11—TYPE HA TRIPLEX AMMETER

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

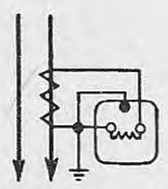
WIRING DIAGRAMS

Fig. 1



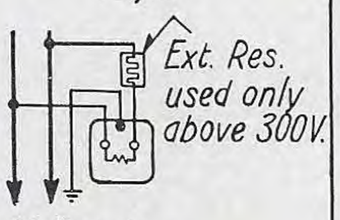
Self Contained Ammeter

Fig. 2



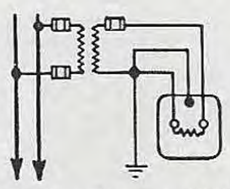
Ammeter with Current Trans.

Fig. 3



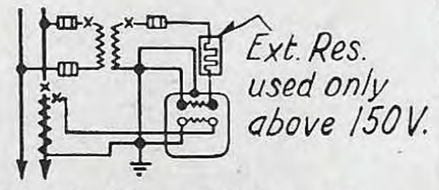
Voltmeter

Fig. 4



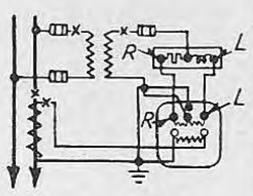
Voltmeter with Potential Trans.

Fig. 5



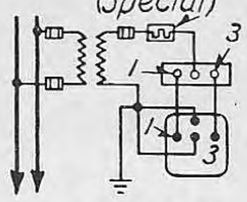
Single Phase Wattmeter on Single Phase Line

Fig. 6



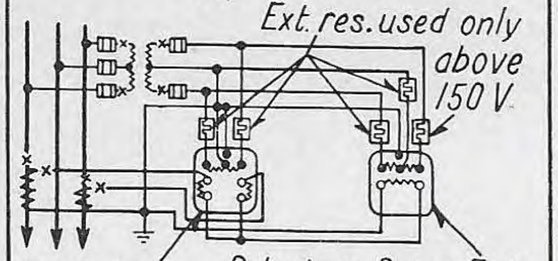
Single Phase Power Factor Meter

Fig. 7



Resonant Type Freq. Meter (Complete conn. #1 & #3 before connecting to line)

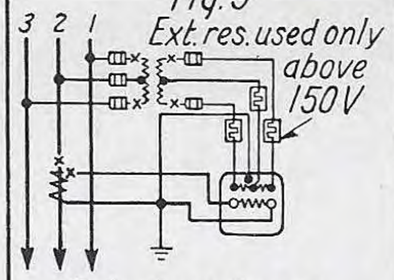
Fig. 8



Std. Polyphase Wattmeter

Polyphase Power Factor Meter when used with 2 current transformers as shown.

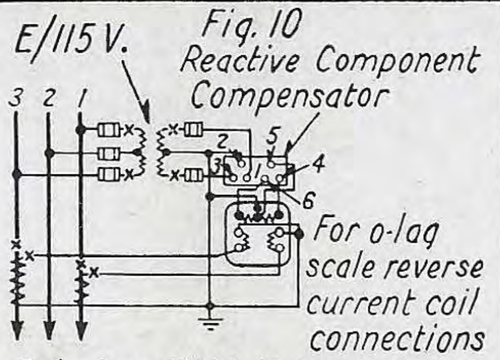
Fig. 9



Polyphase Power Factor Meter

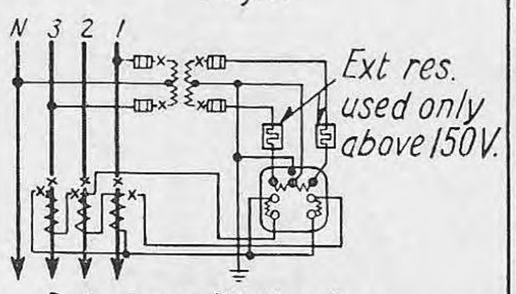
E/115 V.

Fig. 10



Polyphase R.V.A. Meter with Reactive Component Compensator (Std. Watt Meter Calibration)

Fig. 11

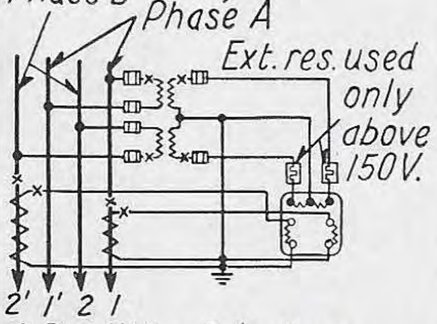


Polyphase Wattmeter (Delta Conn. C.T.)

Phase B

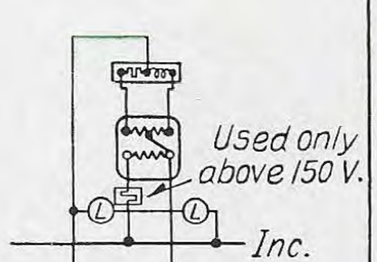
Fig. 12

Phase A



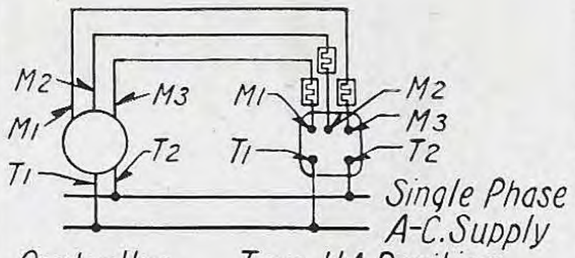
2 Ph. 4 Wire Polyphase Wattmeter

Fig. 13



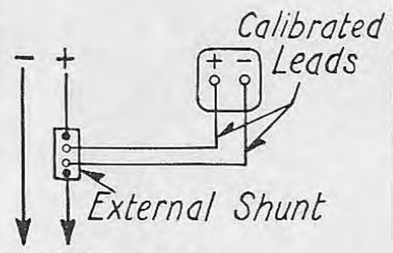
Synchroscope

Fig. 14



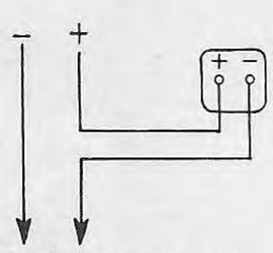
Controller Type HA Position Indicator

Fig. 15



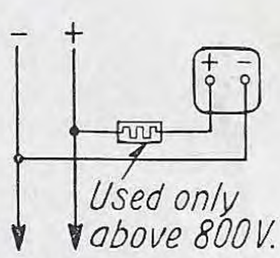
D-C. Ammeter (External Shunt)

Fig. 16



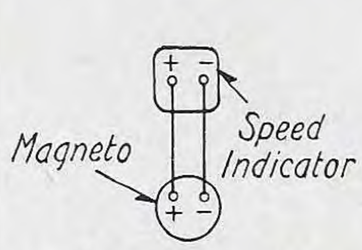
D-C. Ammeter or Milliameter (Self Contained)

Fig. 17



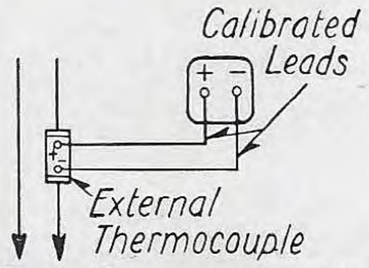
D-C. Voltmeter (Self Contained)

Fig. 18



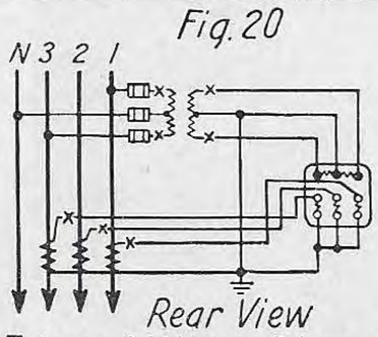
Speed Indicator

Fig. 19



Radio Frequency Ammeter (External Themocouple)

Fig. 20



Rear View
External Wiring Diagram
3 Cur. coil polyphase wattmeter

Fig. 21

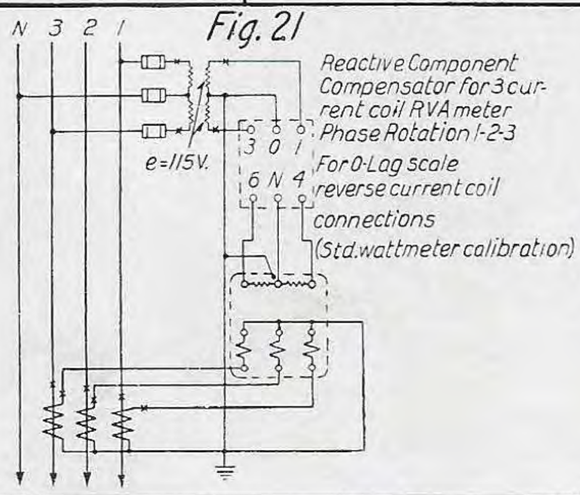


FIG. 12—WIRING DIAGRAMS FOR VARIOUS TYPE H SWITCHBOARD INSTRUMENTS

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

WIRING DIAGRAMS—Continued

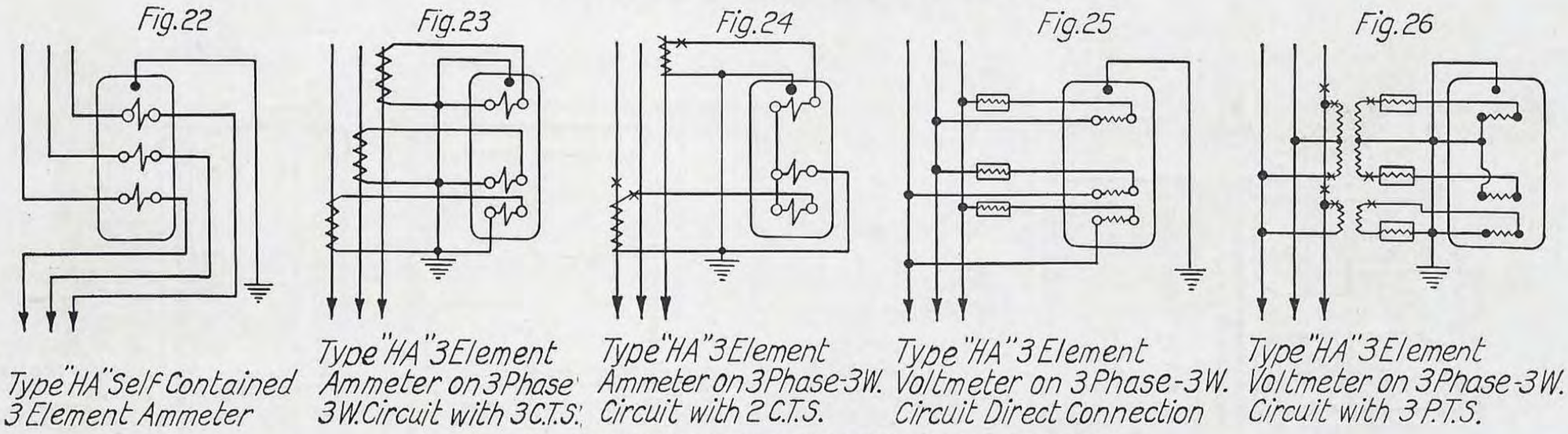


FIG. 13—WIRING DIAGRAMS OF TYPE HA TRIPLEX INSTRUMENTS

OUTLINE DIMENSIONS IN INCHES

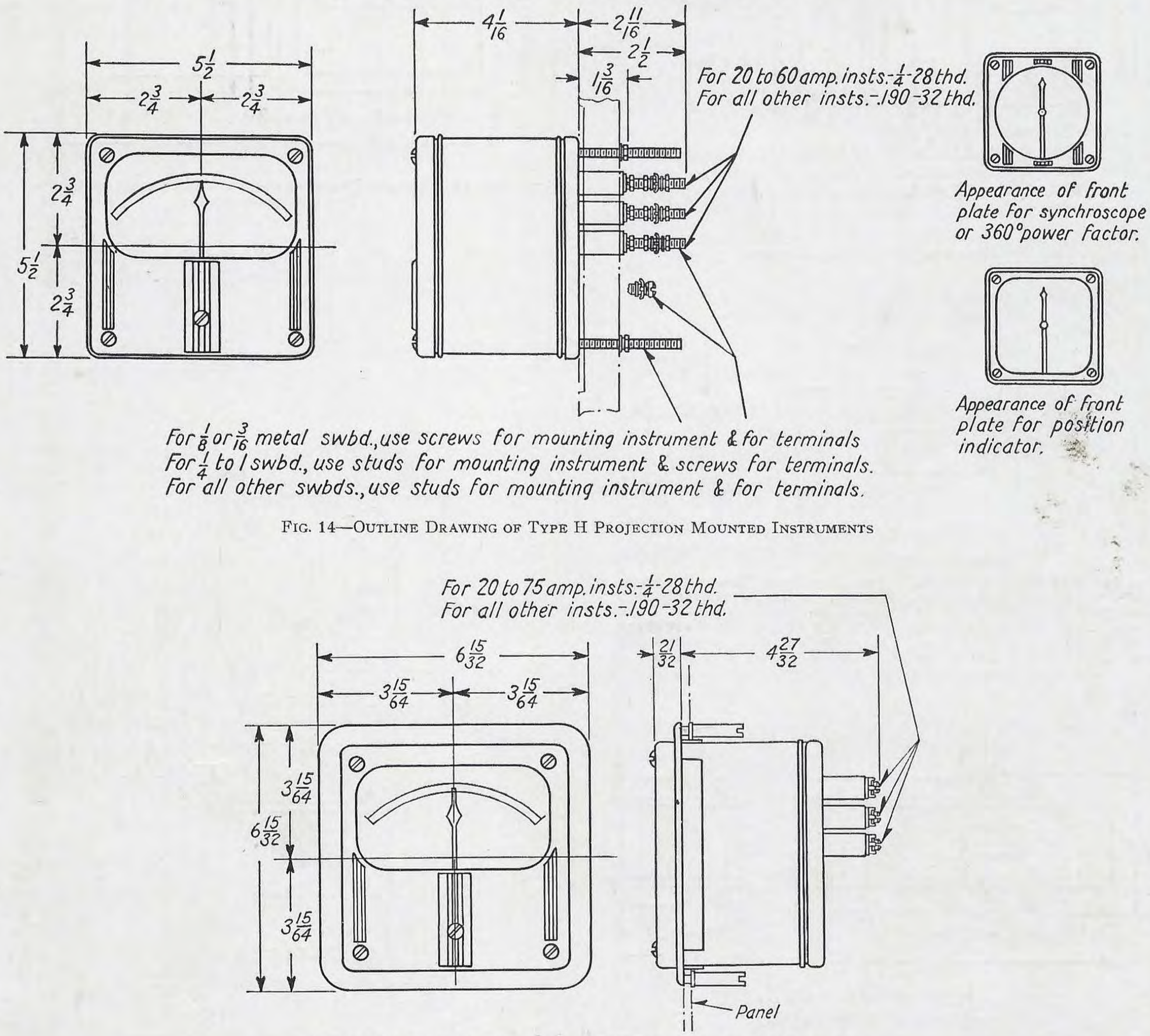


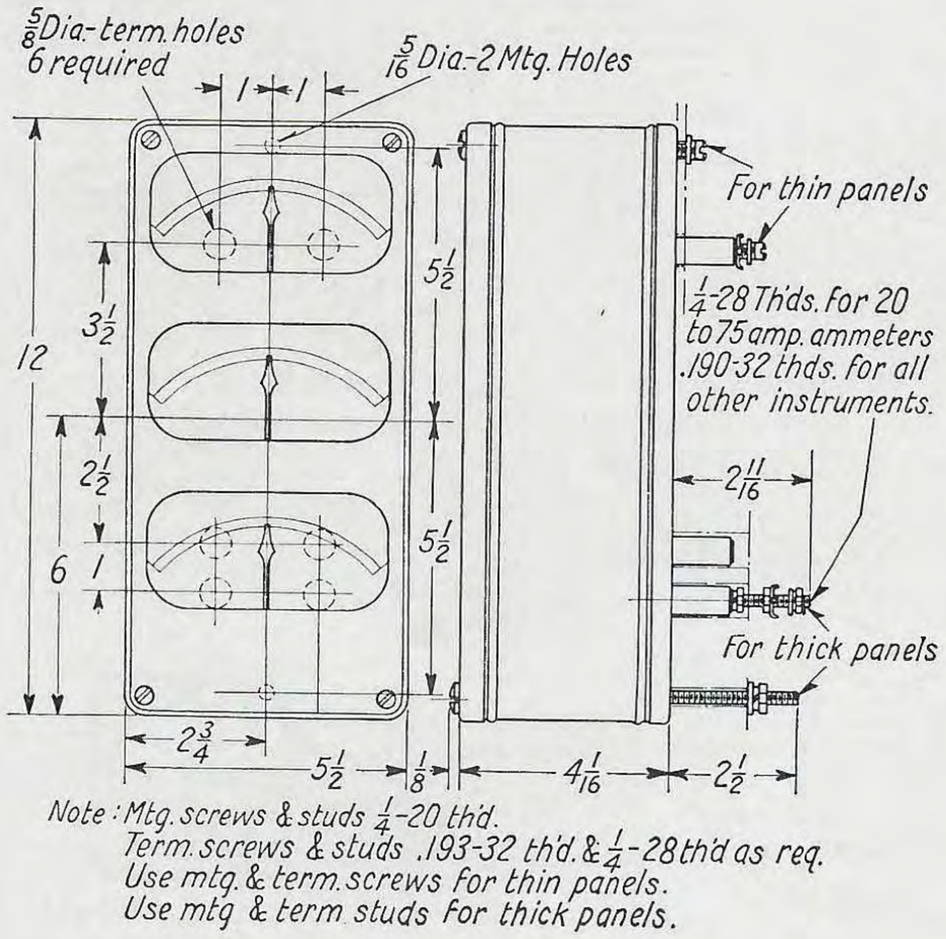
FIG. 14—OUTLINE DRAWING OF TYPE H PROJECTION MOUNTED INSTRUMENTS

FIG. 15—OUTLINE DRAWING FOR TYPE H FLUSH MOUNTED INSTRUMENTS

Dimensions are for reference only. For official dimensions apply to nearest district office.

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued



Note: Mtg. screws & studs 1/4-20 th'd.
Term. screws & studs .193-32 th'd. & 1/4-28 th'd as req.
Use mtg. & term. screws for thin panels.
Use mtg & term. studs for thick panels.

FIG. 16—OUTLINE DRAWING FOR TYPE HA PROJECTION MOUNTED TRIPLEX INSTRUMENTS

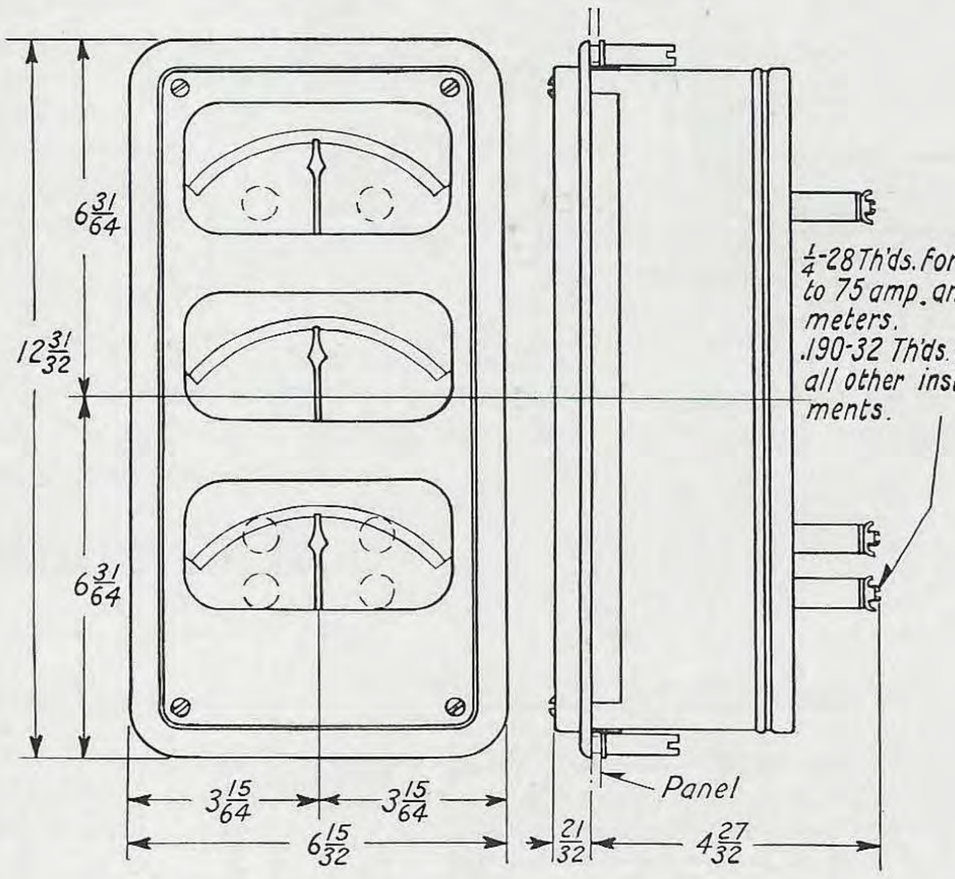


FIG. 17—OUTLINE DRAWING FOR TYPE HA FLUSH MOUNTED TRIPLEX INSTRUMENTS

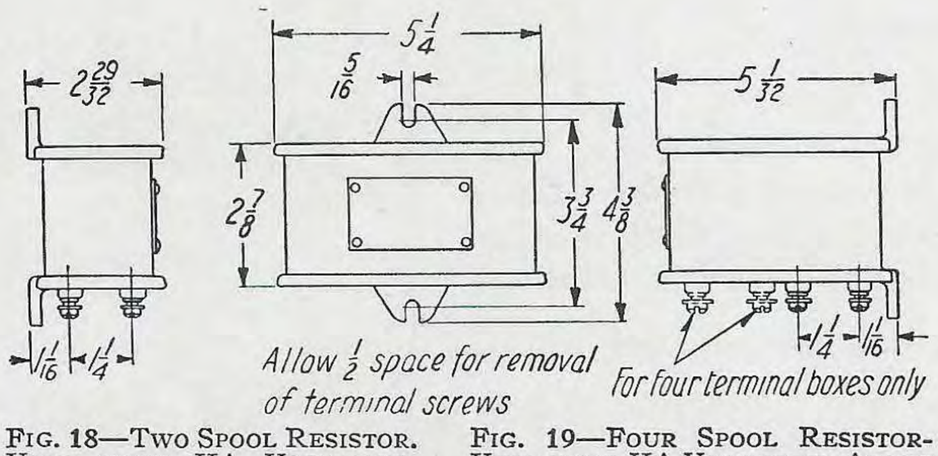


FIG. 18—TWO SPOOL RESISTOR. USED WITH HA VOLTMETER ABOVE 300 V. TO 500 V. (1 REQ.) USED WITH HY POLYPHASE WATTMETER AND POWER FACTOR METER ABOVE 150 V. TO 250 V. (2 REQ.)

FIG. 19—FOUR SPOOL RESISTOR-USED WITH HA VOLTMETER ABOVE 500 V. TO 750 V. (1 REQ.) USED WITH HY POLYPHASE WATTMETER AND POWER FACTOR METER ABOVE 250 V. TO 575 V. (2 REQ.)

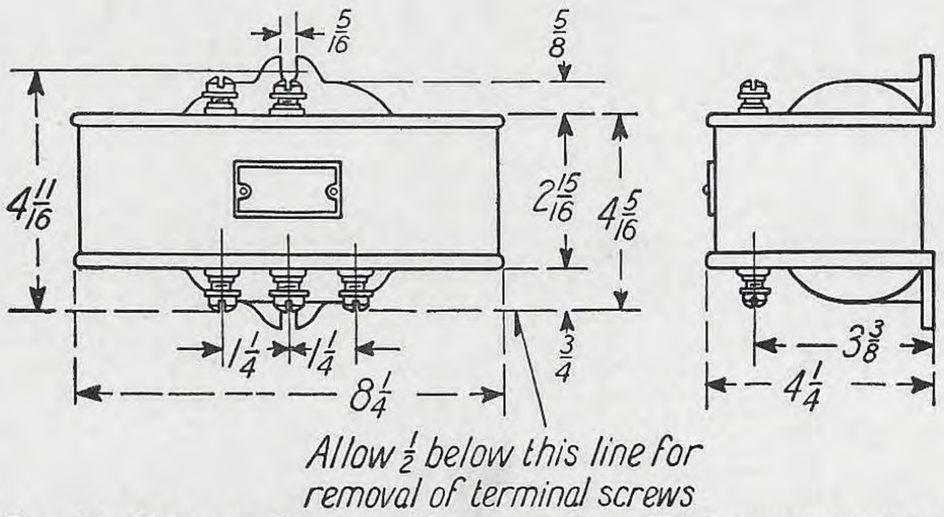


FIG. 20—REACTOR RESISTOR USED WITH TYPE HA SYNCHROSCOPE AND TYPE HA 360° SINGLE PHASE POWER FACTOR METER

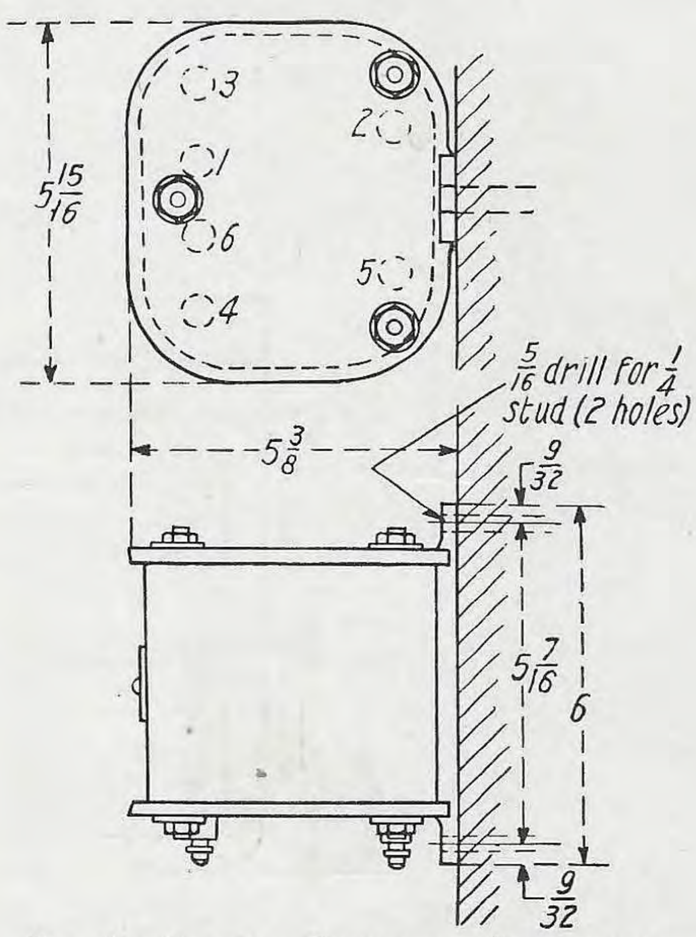


FIG. 21—REACTIVE COMPONENT COMPENSATOR USED WITH 3-PHASE, 3-WIRE VARMETER

Dimensions are for reference only. For official dimensions apply to nearest district office.

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

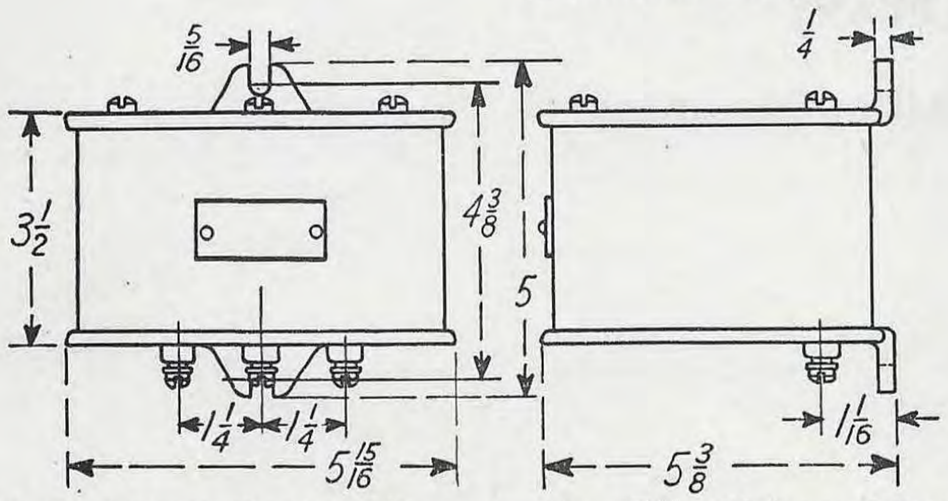


FIG. 22—REACTOR RESISTOR, USED WITH TYPE HY, 100° SINGLE PHASE POWER FACTOR METER

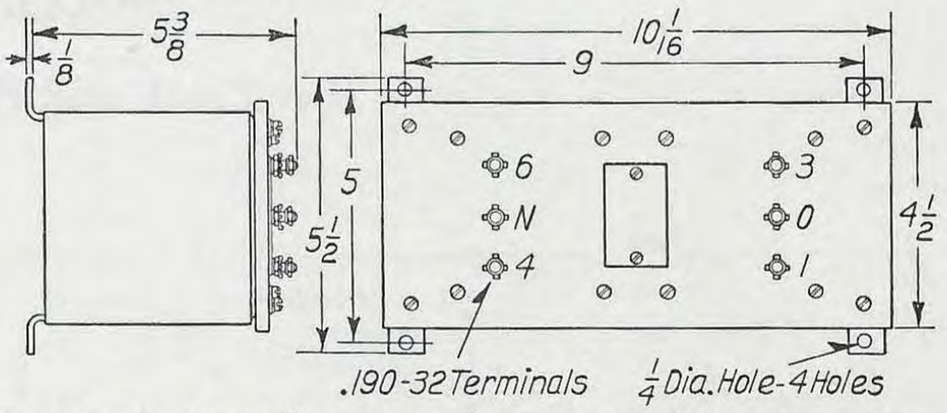


FIG. 23—REACTIVE COMPONENT COMPENSATOR, USED WITH 3-PHASE, 4-WIRE (3 CURRENT COIL) VARMETER

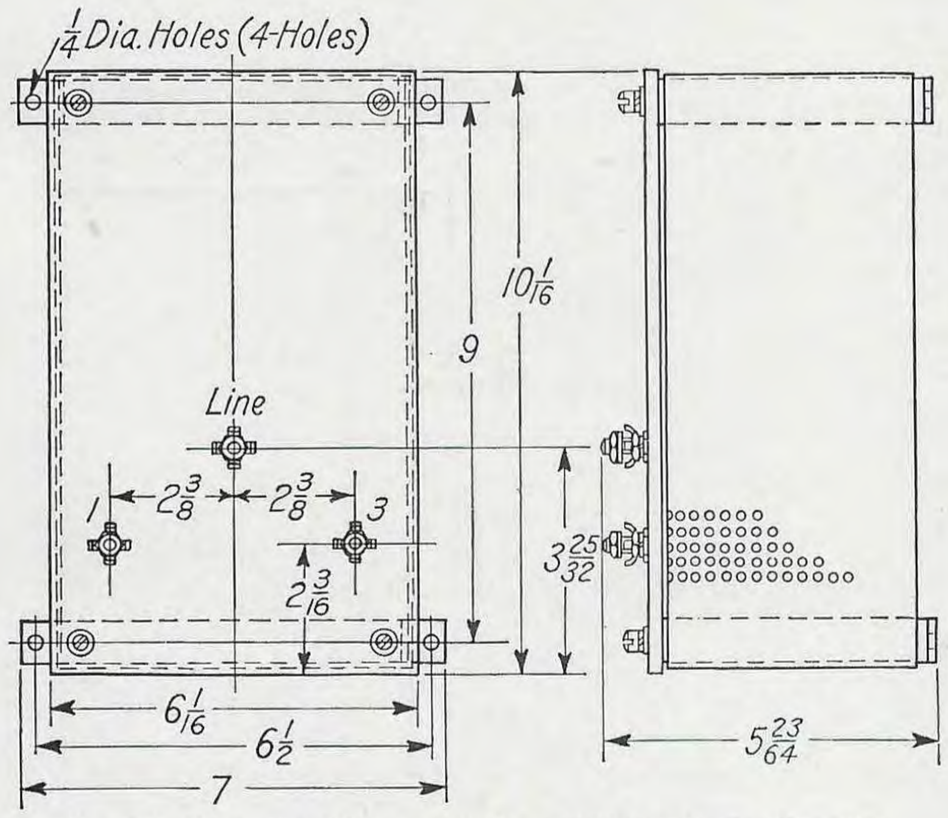


FIG. 24—REACTOR, USED WITH TYPE HY RESONANT CIRCUIT FREQUENCY METER

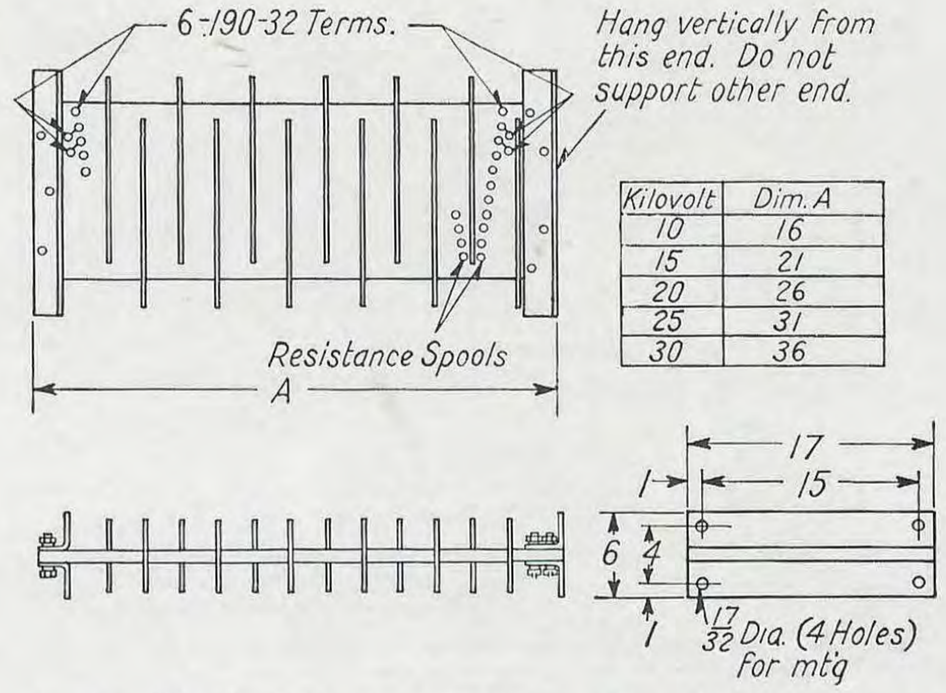


FIG. 25—TYPE R-31 RESISTOR, USED WITH TYPE HX VOLTMETER—RANGES 10 KV. TO 30 KV. INC.

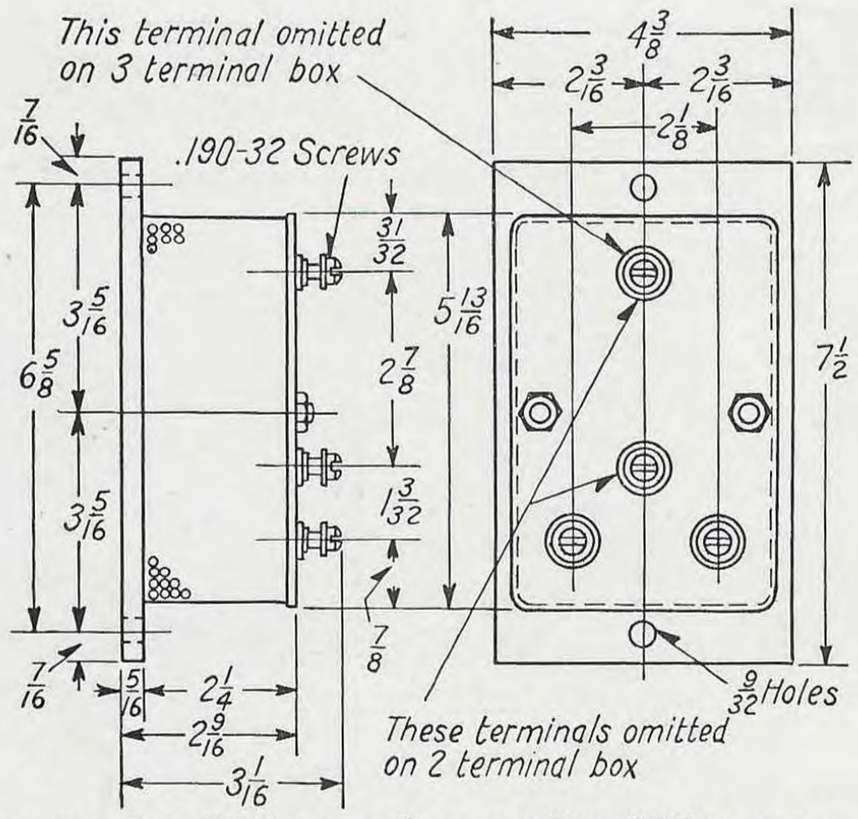


FIG. 26—TYPE R-3 RESISTOR, USED WITH TYPE HX VOLTMETER—RANGES 1500 V. TO 3000 V. INC.

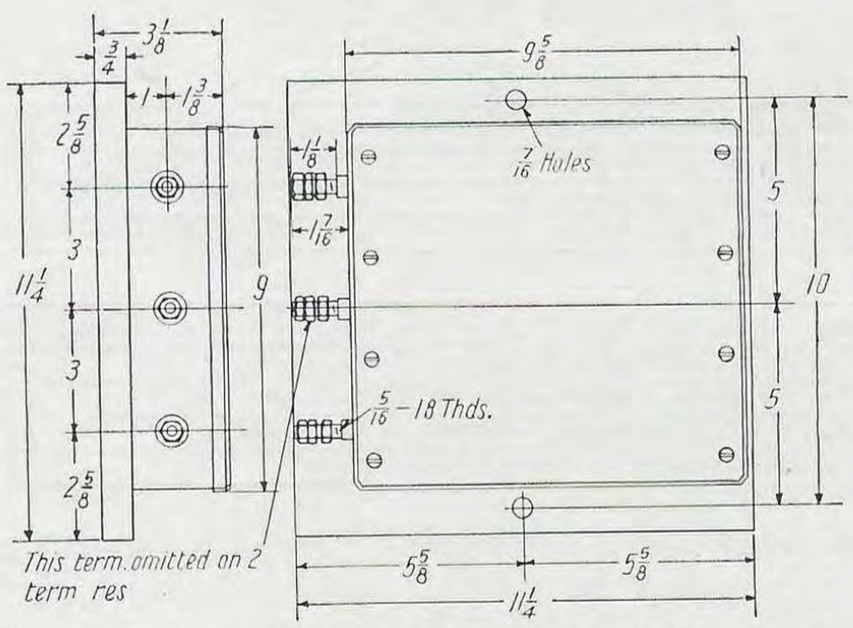


FIG. 27—TYPE R-4 RESISTOR, USED WITH TYPE HX VOLTMETER—RANGES 4000 AND 5000 VOLTS

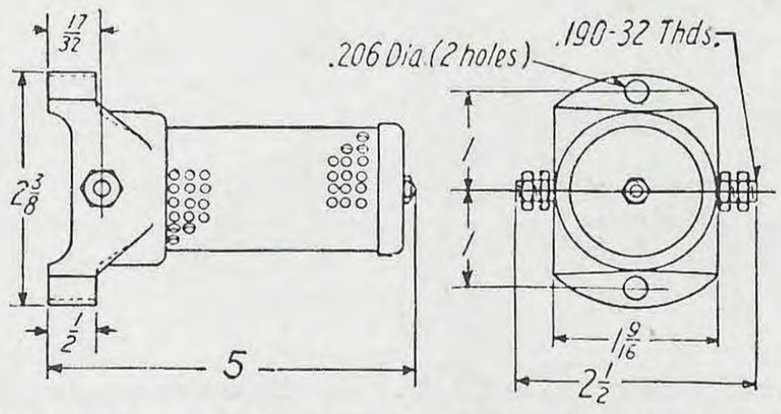


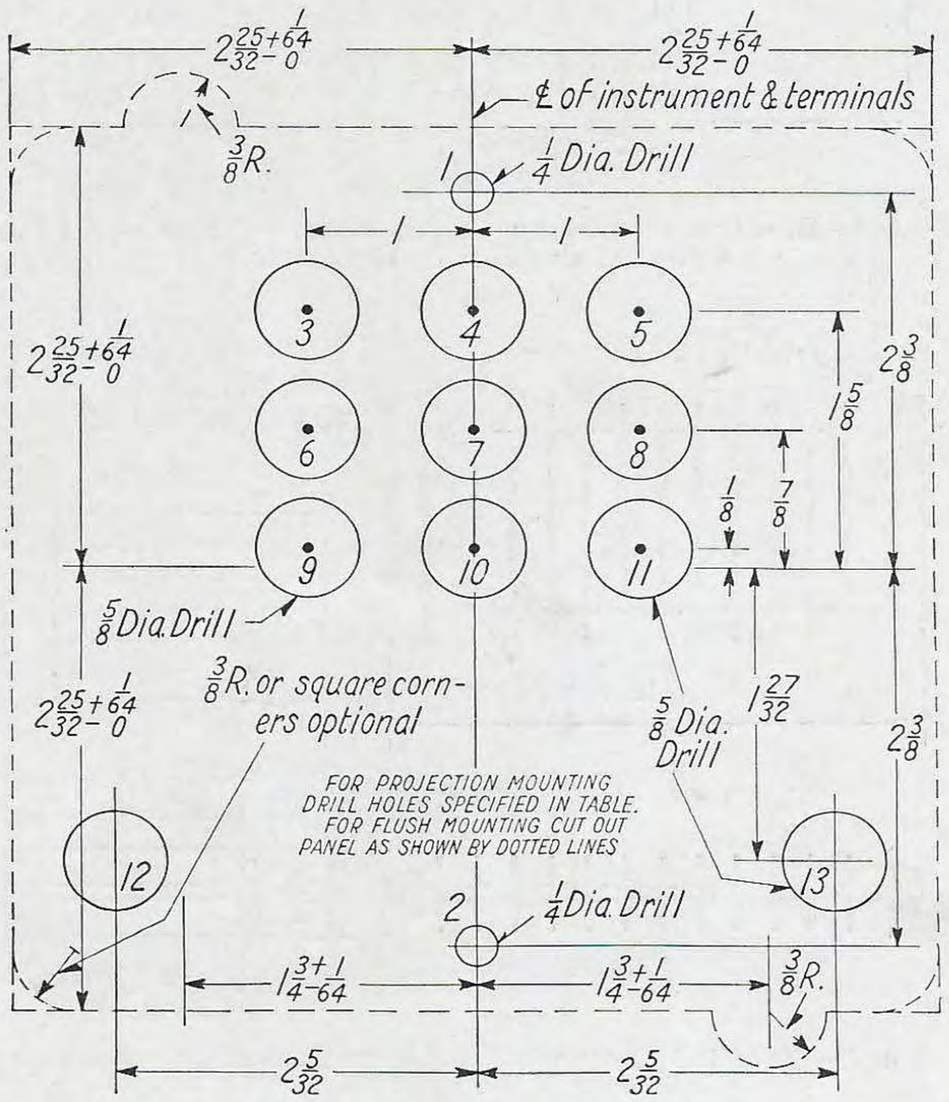
FIG. 28—TYPE RO RESISTOR, USED WITH 1000 V. TYPE HX VOLTMETER

Dimensions are for reference only. For official dimensions apply to nearest district office.

TYPES HA, HX, HY AND HZ SWITCHBOARD INSTRUMENTS—Continued

DRILLING PLANS

For Flush and Projection Mounting



DRILLING PLAN—FRONT VIEW

For A-C. or D-C. Ammeter or Voltmeter	*Drill Holes 1-2-6-8*
For Frequency Meter	*" " 1-2-6-7-8*
For Single Phase Wattmeter	*" " 1-2-3-5-6-8*
For Power Factor Meter	*" " 1-2-3-4-5-6-8*

For Synch., 360° Scale P. F. or Pos. Ind.	*Drill Holes 1-2-3-4-5-6-8*
For Polyphase Watt or Varmeters, 3 Pot. Terms.	*" " 1-2-3-4-5-6-8-9-11*
For Polyphase Watt or Varmeters, 4 Pot. Terms.	*" " 1-2-3-4-5-6-7-8-9-11*
For 3 C.C. P'-ph. Watt or Varmet., 3 Pot. Terms.	*" " 1-2-3-4-5-6-7-8-9-10-11*
For Instruments with Internal Illumination	*" " 12 and 13*

FIG. 29—DRILLING PLAN FOR TYPE H FLUSH OR PROJECTION MOUNTED INSTRUMENTS

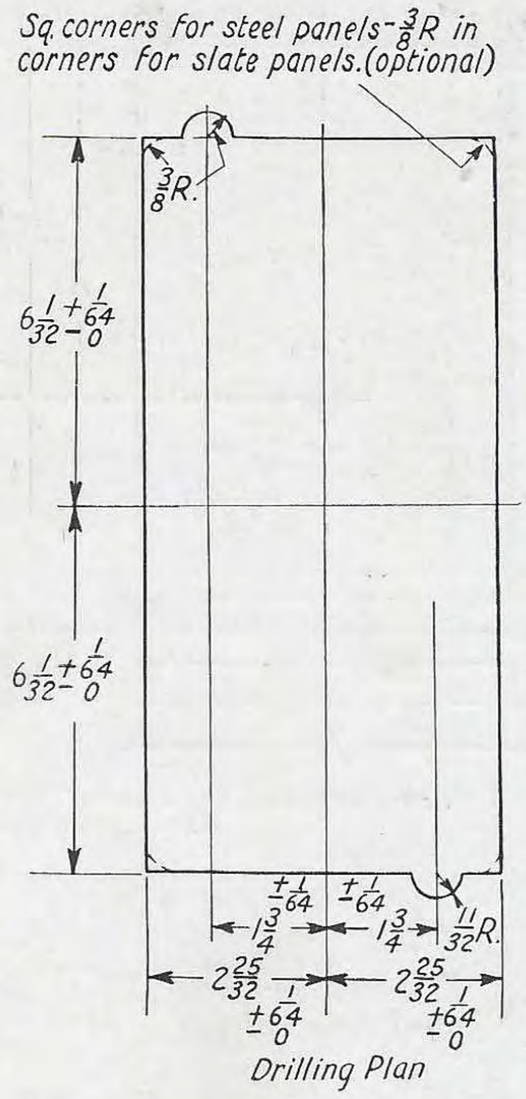


FIG. 30—DRILLING PLAN FOR TYPE H FLUSH MOUNTED TRIPLEX INSTRUMENTS

Dimensions are for reference only. For official dimensions apply to nearest district office.

Printed in U. S. A.

TEMPERATURE INDICATORS

Exploring Coil and Thermocouple Types

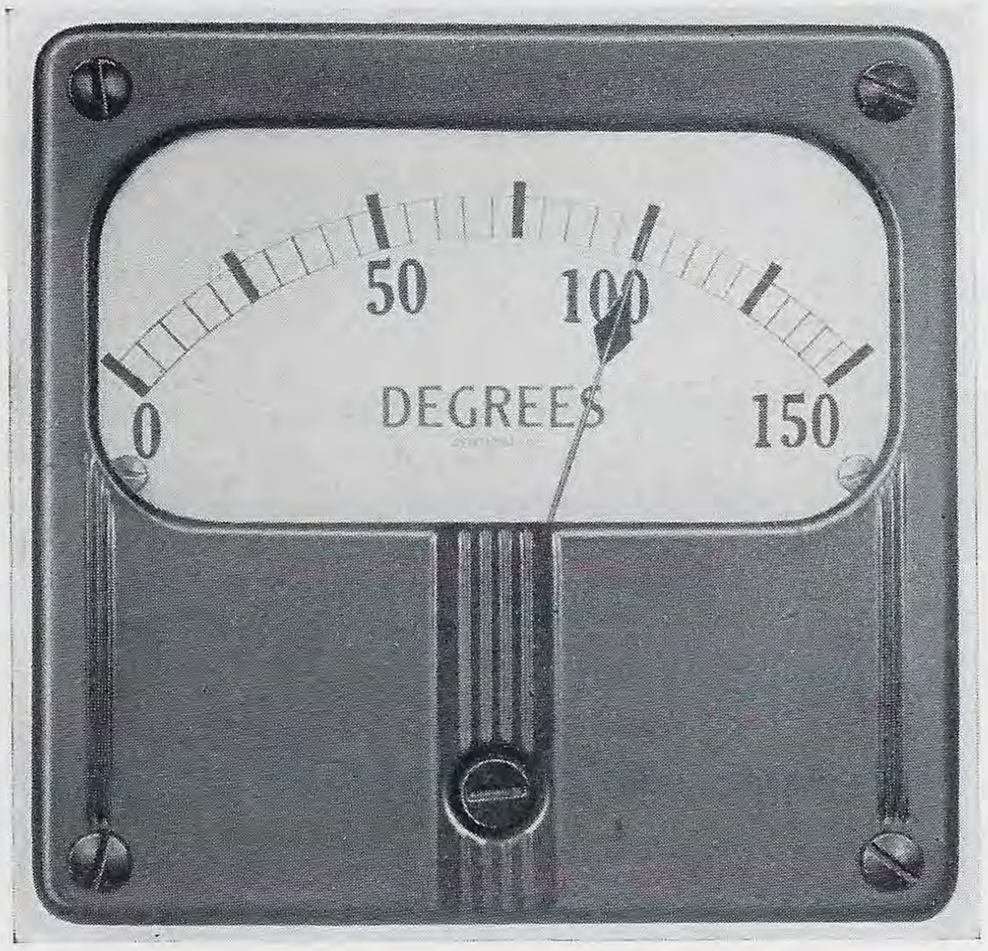


FIG. 1—TYPE HX TEMPERATURE INDICATOR FOR USE WITH EXPLORING COILS

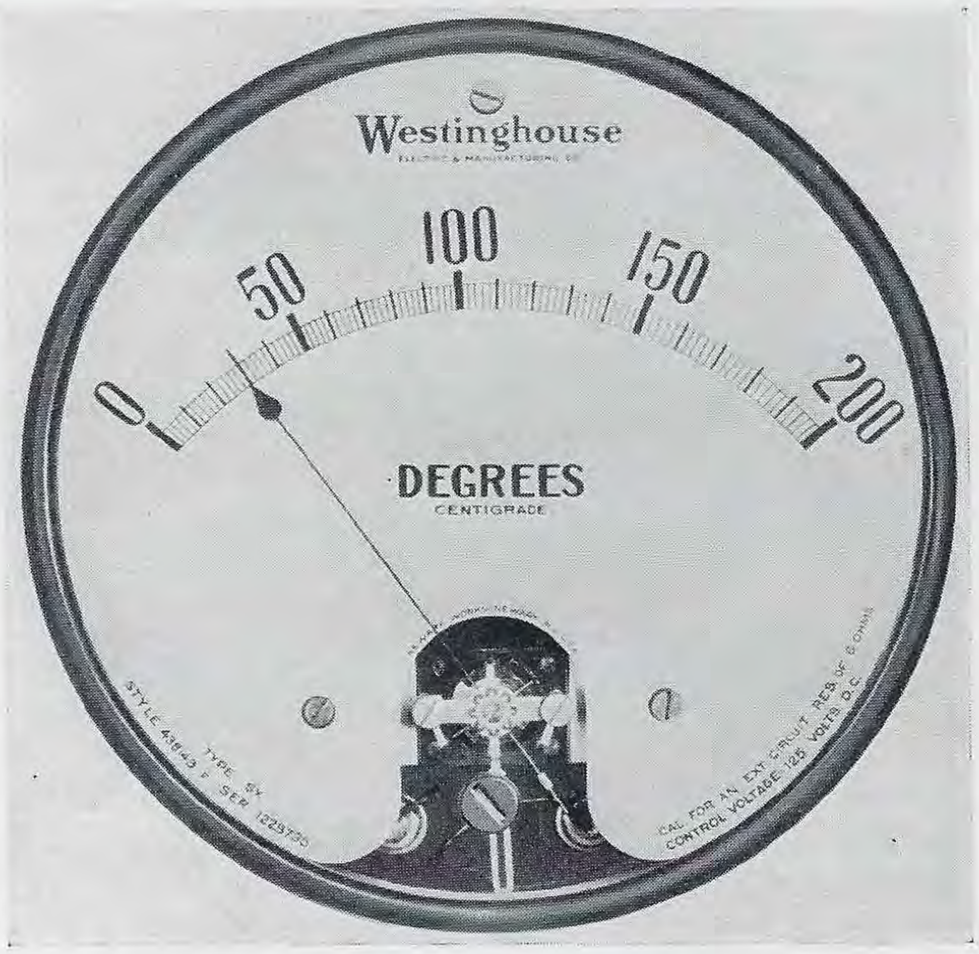


FIG. 2—TYPE SX TEMPERATURE INDICATOR FOR USE WITH THERMOCOUPLES

General

Maintenance of safe temperature in the windings of electrical apparatus such as motors, generators, transformers and other electrical equipment is especially desirable to safeguard the insulation during periods of overload. A continuous check of actual temperature conditions at all times prevents costly shut-downs by detecting dangerous conditions before damage is done to the equipment.

Since heating is closely associated with the operating condition of all electrical apparatus, a reliable means of detecting its presence and evaluating it into measured units is indispensable to safe operation. For this purpose, Westinghouse has available a complete line of indicating instruments and accessories.

Principles of Operation

There are two types of equipment available to be used depending upon the types of detectors embedded in the machine windings. They are first the exploring coil type and second the thermocouple type.

In the first scheme copper coils are embedded in the winding and the resistance of the copper is measured by the instrument. In the second scheme thermocouples are embedded and the e.m.f. of the couple is measured by the instrument.

The selection of equipment depends entirely upon the type of detectors with which the apparatus is equipped.

Exploring Coil Type—The exploring coil is built into the apparatus with the windings and the leads are brought out for circuit connections. The coil is wound with copper wire and adjusted to have a resistance of 10 ohms at 25 degrees Centigrade. Since the resistance of copper changes with the temperature, the coil will have a resistance which varies with the temperature of the winding surrounding it. The resistance of the exploring coil is measured by a Wheatstone Bridge made up of three legs of fixed resistance which do not change with temperature and a fourth leg which is the embedded exploring coil.

The instrument is connected across the bridge as a detector of potential difference and its scale is calibrated in degrees Centigrade. When the exploring coil is at a predetermined temperature the bridge is in balance and no potential exists on the instrument. This point is called the balance temperature and is selected depending upon the scale range of the instrument.

With the exploring coil at any other temperature there will be an unbalance of the bridge resulting in a potential difference which is measured by the instrument. This potential difference is directly proportional to the resistance of the exploring coil and thus the scale can be calibrated in temperature of the coil.

The balance point is selected at the temperature at which the greatest accuracy is desired. At this temperature the indications will be independent of control circuit voltage. This point is marked by a red line on the indicator scale.

Thermocouple Type—Thermocouples of standard copper-advance wire are installed in the windings when the equipment is built. In the thermocouple system there are two junctions of the dissimilar metals, one called the hot junction

TEMPERATURE INDICATORS—Continued

FIG. 3—RECTOX TRICKLE CHARGER USED FOR SUPPLYING D-C. FROM 115 V. A-C. LINE, FOR USE WITH TEMPERATURE INDICATOR WHERE D-C. IS NOT AVAILABLE FOR CONTROL CIRCUIT

which is in the machine windings and the other a cold junction which is outside of the machine.

In any thermocouple system there will always be two junctions of the dissimilar metals when the circuit is closed. If there is a difference of temperature between these two junctions a voltage is generated which is proportional to the temperature difference.

The instrument is connected to measure this potential difference and is calibrated in terms of the hot junction temperature.

Cold Junction Compensation—Since the indicator measures the difference in voltage between the hot and cold junctions some form of compensation is necessary to correct the indications for changes in cold junction ambient temperature, so that the indications will be proportional to hot junction temperatures only. This is accomplished by a Wheatstone Bridge to which is applied a d-c. voltage.

The cold junction of the circuit is thermally and electrically connected to this bridge. Two legs of the bridge are of constant resistance and the other two vary in resistance with ambient temperature. Thus a potential exists across the bridge, depending on the cold junction temperature, which is added to or subtracted from the total circuit e.m.f.

The indicator is thereby corrected for cold junction temperature changes. The bridge is adjusted for a balance or e.m.f. of zero at 30° Centigrade. This is called the balance temperature and at this point the indications are independent of control circuit voltage applied to the compensator.

Installation

Exploring Coil Types

Two schemes of wiring are used with exploring coil installations depending upon location of the coils and degree of accuracy required. Fig. 12 shows a simplified hookup for moderate accuracy using grouped exploring coils and short leads. Fig. 13 shows the preferred wiring diagram for greatest accuracy using scattered exploring coils with long leads of variable length.

The circuits shown in Fig. 12 and 13 automatically compensate for the amount of resistance in the exploring coil leads L_2 and L_4, provided these two leads are of equal resistance for each exploring coil. If exploring coils are widely scattered, as in Fig. 13, instead of being grouped as in Fig. 12, it is advisable to run an individual lead L_2 from each exploring coil to the bridge box.

Selector Switch—A single-pole selector switch is permissible if all exploring coils are located close together and if L_2 and L_4 are of identical resistance for all exploring coils.

If coils are scattered or if lead resistance of circuits is variable, the two-pole selector switch or its equivalent should be used.

Test Resistor—The test resistor is desirable whenever control voltage is subject to variations or when recalibrating the instrument after a change of control source. It can be eliminated if control voltage is known to be always steady at the value for which the indicator is calibrated.

The test resistor has a constant resistance of 9.037 ohms which is equivalent to the resistance of a 10-ohm exploring coil at 0 degrees Centigrade. Thus with the test resistor connected in place of the exploring coils, the instrument should read zero on the scale.

Panel Mounted Rheostat—The panel mounted rheostat is desirable when line voltage fluctuates, or when extreme accuracy with ease of adjustment is required. This rheostat serves to adjust the potential applied to the bridge, and by adjustment of this rheostat the instrument can be made to read correctly for reasonable charges in control voltage.

A-C. Control Circuits—It is necessary to have d-c. potential on the bridge, which may be obtained from a battery or if preferred, from a Rectox rectifier supplied from 115 volts a-c. line. Fig. 12 and 13 show a Rectox trickle charger used for this purpose.

Thermocouple Types

Fig. 11 shows a typical wiring diagram for a thermocouple installation. The cold junction compensator box should be mounted as near to the thermocouples as possible. This distance should not exceed 30 feet.

Two conductor thermocouple cables should be used between the couples and the cold junction compensator.

Lead Resistance Compensator—A lead resistance compensator is supplied with all thermocouple temperature indicators. It is used to adjust the resistance of all leads to the same value so that the instrument will have the same calibration for all thermocouples which may be located at scattered points.

The total circuit resistance external to the instrument should not be greater than 6 ohms.

TEMPERATURE INDICATORS—Continued

LIST PRICES

EXPLORING COIL TYPES

Style number includes the instrument complete with bridge box and calibrated for the range and control circuit voltage indicated in the tables. Instrument calibrated for 10 ohms exploring coils.

Scale Range * Degrees Centigrade	Balance Temp. (Red Line on Dial) Degrees Centigrade	Control Circuit Volts D-C.	Style No.	List Price Disc. Symbol BC
		Type SX Instrument		
0–150	100	20	304 682†	$80 00
0–150	100	125	304 683	80 00
0–150	100	250	304 684	80 00
		Type HX Instrument		
0–150	100	20	722 108†	80 00
0–150	100	125	722 109	80 00
0–150	100	250	722 110	80 00
		Type KX Instrument		
0–150	100	20	821 523†	80 00
0–150	100	125	724 591	80 00
0–150	100	250	821 524	80 00
		Type DX Instrument		
0–150	100	20	304 691†	80 00
0–150	100	125	304 692	80 00
0–150	100	250	304 693	80 00

*Ranges of 0-100 or 0-200 degrees Centigrade can be furnished special at same prices.
†This style should be selected when control circuit is to be supplied from Rectox trickle charger.

ACCESSORIES
(Not Included With Above Styles)

Description	Style No.	List Price Disc. Symbol BC
Rectox trickle charger 115 volts, 60 cycles a-c. 24 volts d-c. with rheostat adjustment	708 947	**
Double-pole selector switch	895 355	††
Single-pole selector switch	940 082	††
Test resistor	724 093	$4 50
Panel mounting rheostat for 20 volt control	839 963	3 50
Panel mounting rheostat for 125 volt control	1 001 806	3 50
Panel mounting rheostat for 250 volt control	1 001 807	3 50

** Refer to Industrial Department, East Pittsburgh.
†† Refer to Switchboard Department, East Pittsburgh.

THERMOCOUPLE TYPES

Style number includes instrument complete with cold junction compensating box and lead resistance compensator for six thermocouples. Instrument is calibrated for range shown and is for use with copper—advance thermocouples.

Scale Range Degrees Centigrade	Control Circuit Volts D-C. * For Cold Junction Compensation	Style No.	List Price Disc. Symbol BC
	Type SX Instrument		
0–200	20†	930 631	$147 00
0–200	125	438 149	147 00
	Type HX Instrument		
0–200	20†	930 632	147 00
0–200	125	722 107	147 00
	Type KX Instrument		
0–200	20†	930 633	147 00
0–200	125	930 634	147 00

*Instruments can also be furnished for 250 volts d-c. control at same price.
†This style should be ordered if Rectox trickle charger is to be used for supplying d-c. for cold junction compensator from 115 volts a-c. line.

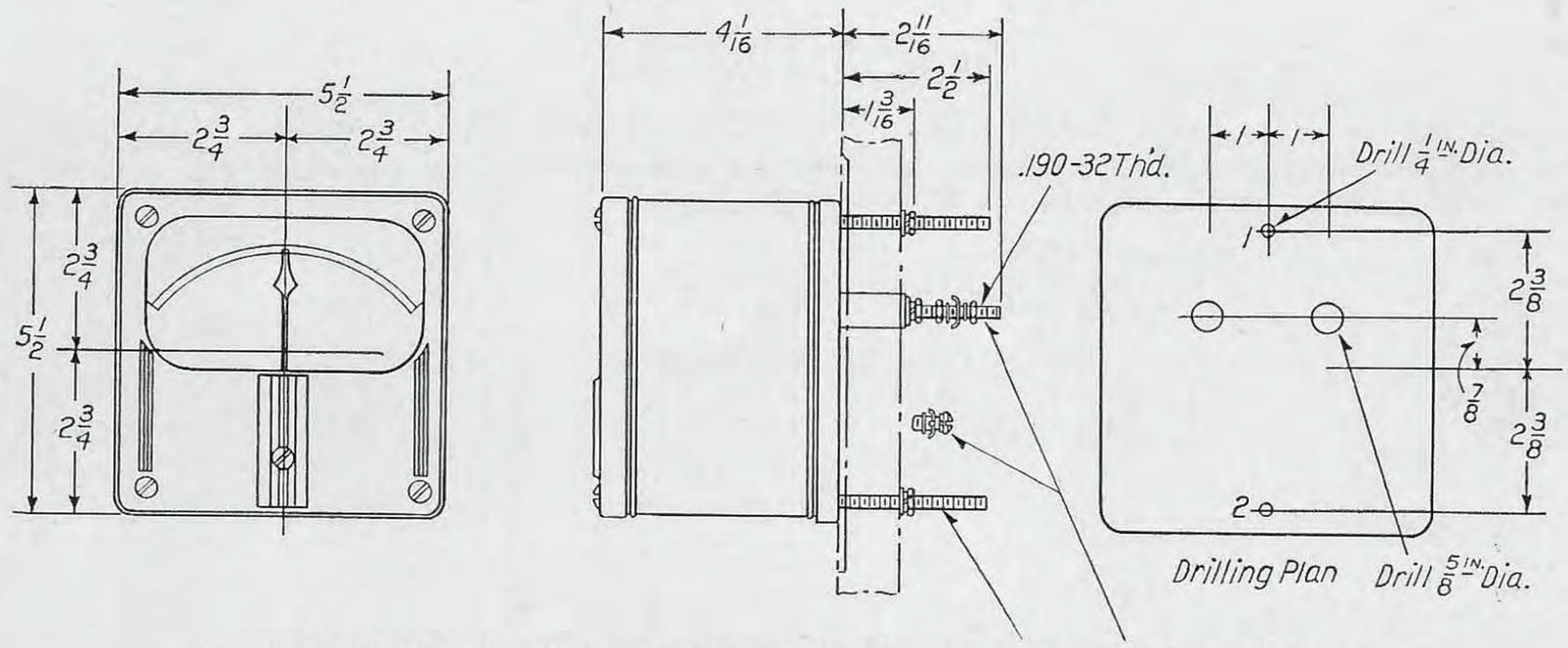
ACCESSORIES
(Not Included With Above Styles)

Description	Style No.	List Price Disc. Symbol BC
Two conductor cable (1 advance, 1 copper-lead)	P. D. 2561	$ 0 50 per foot
Eight conductor copper cable (19 of .0226, 9700 circular mills)	P. D. 2463‡	1 00 per foot
Lead resistance compensator (for 6 thermocouples)	477 866††	45 00
Selector switch, single pole	940 082	**
Rectox Trickle Charger 115 volts, 60 cycles A-C., 24 volts D-C. with rheostat adjustment	708 947	‡‡

‡ Contains one more conductor to that shown in Fig. 11.
†† To be ordered separately in case there are more than 6 thermocouples.
** Refer to Switchboard Department, East Pittsburgh.
‡‡ Refer to Industrial Department, East Pittsburgh.

Prices are subject to change without notice. *Order by Style Number*

TEMPERATURE INDICATORS—Continued



For ⅛″ or 3/16″ Metal Switchboard, use Screws for Mounting Instruments & for Terminals
For ¼″ to 1″ Switchboard, use Studs for Mounting Instruments & Screws for Terminals
For all other Switchboards, use Studs for Mounting Instruments & for Terminals.

Fig. 4—Outline Dimensions and Drilling Plan for Type HX Temperature Indicator

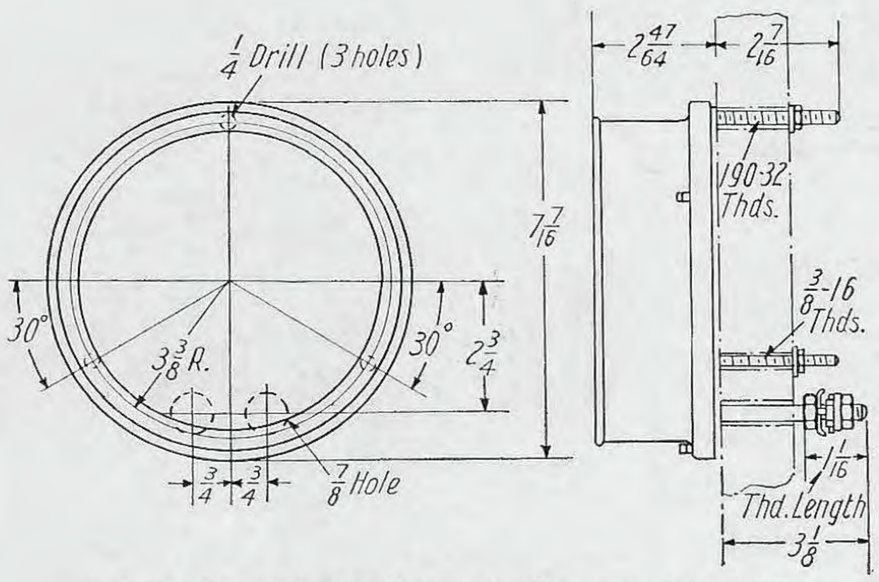


Fig. 5—Outline and Drilling Plan for Type SX Temperature Indicator

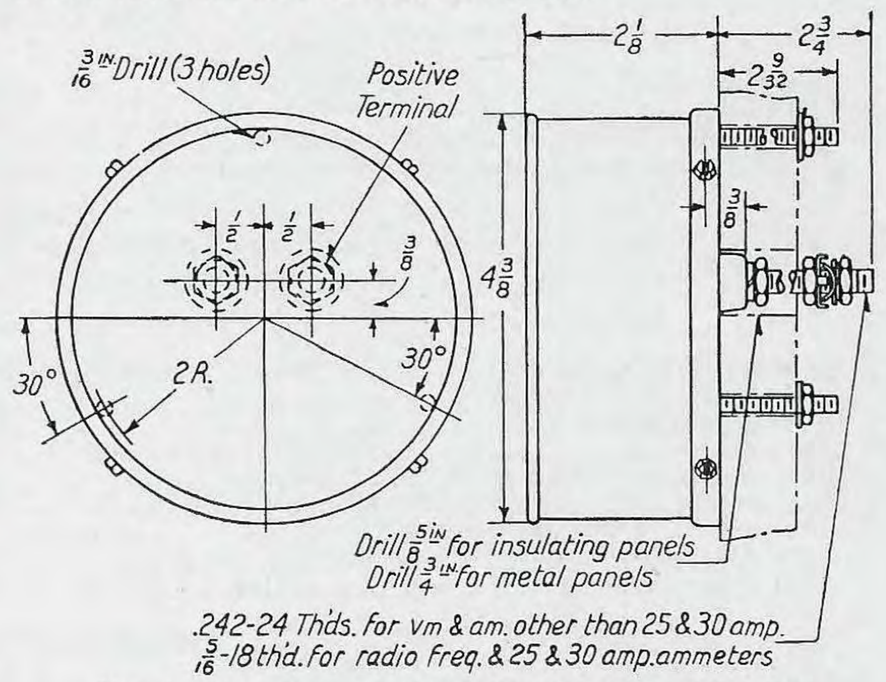


Fig. 6—Outline and Drilling Plan for Type DX Temperature Indicator

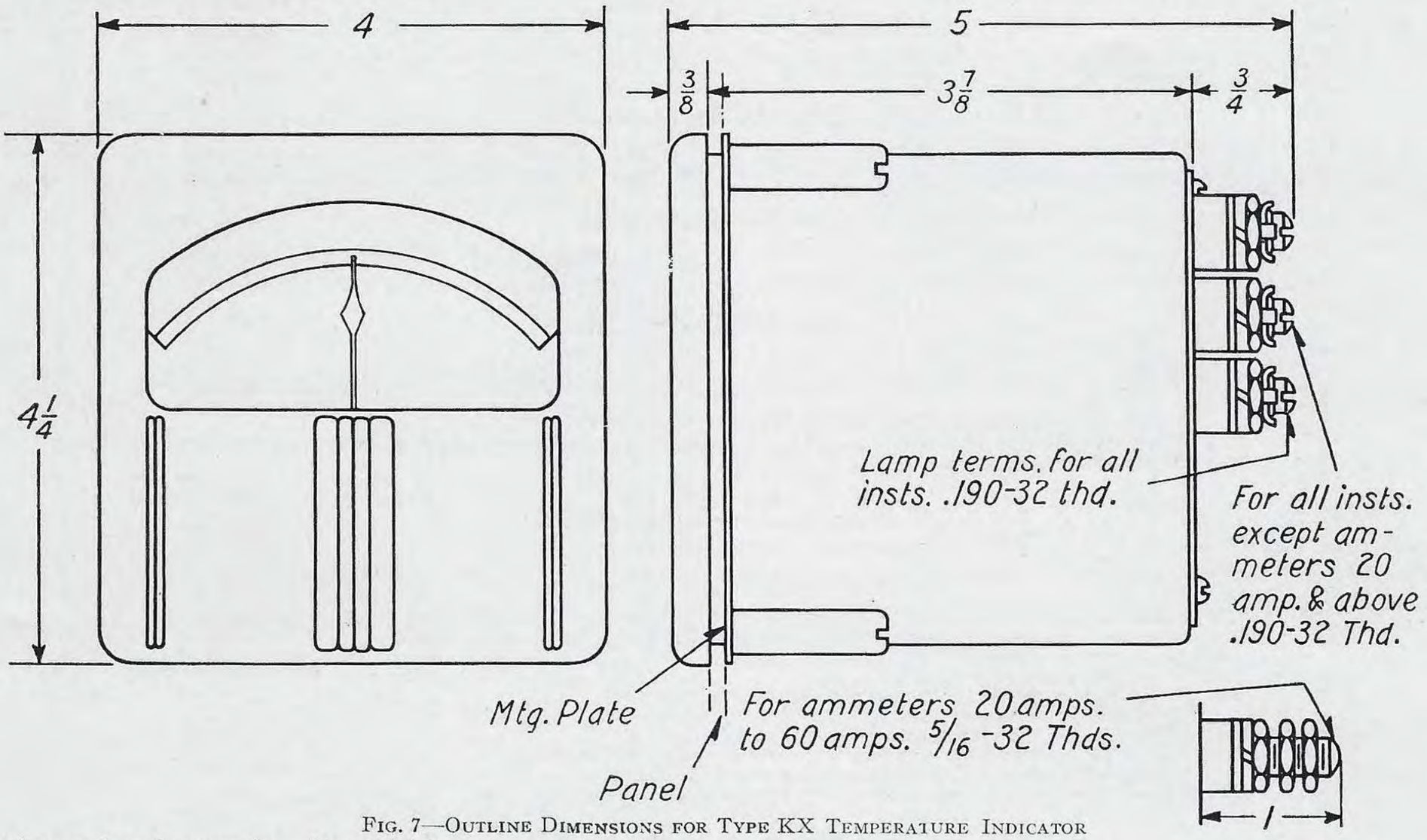


Fig. 7—Outline Dimensions for Type KX Temperature Indicator

Dimensions are for reference only. For official dimensions, apply to the nearest district office.

TEMPERATURE INDICATORS—Continued

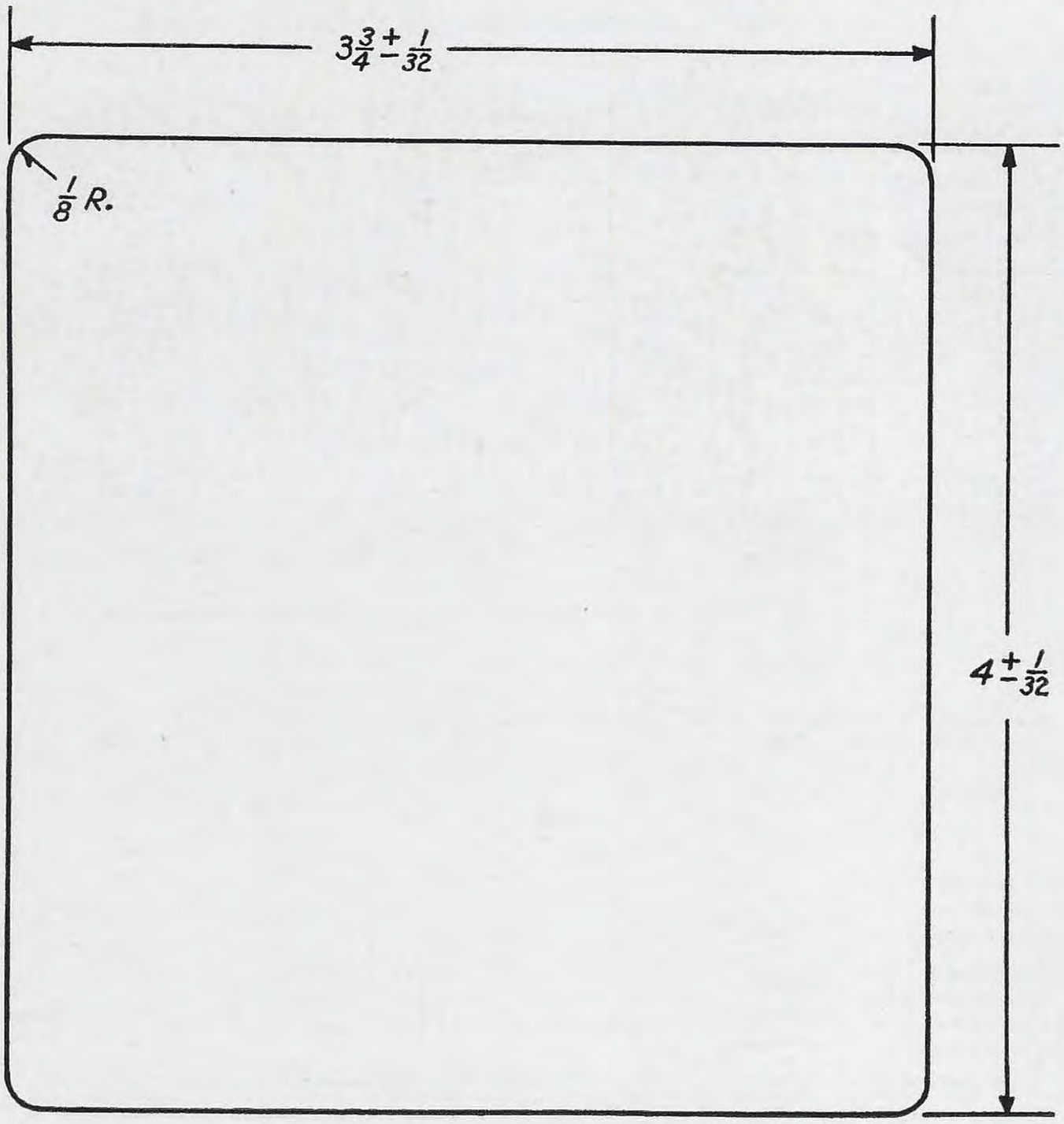


FIG. 8—DRILLING PLAN FOR TYPE KX TEMPERATURE INDICATOR

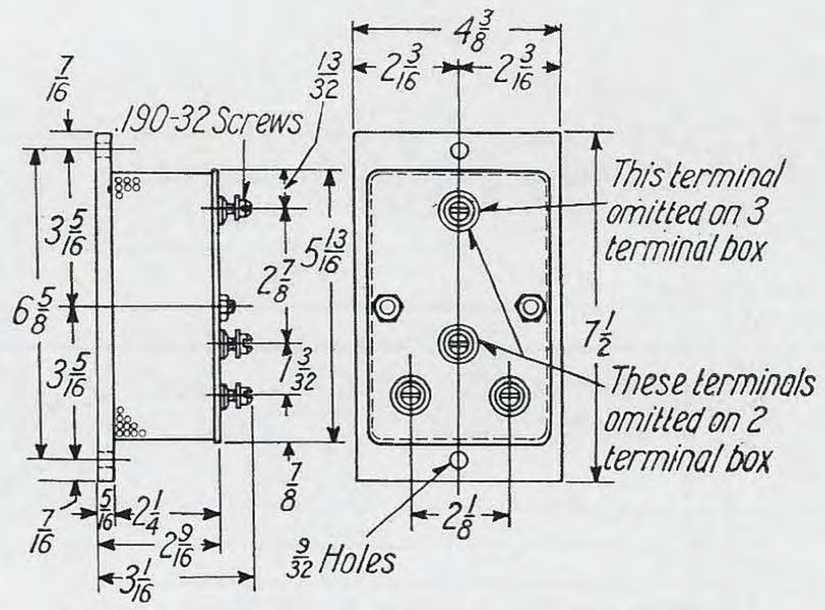


FIG. 9—OUTLINE DIMENSIONS FOR COLD JUNCTION COMPENSATOR USED WITH DIRECT-READING THERMOCOUPLE TEMPERATURE INDICATORS

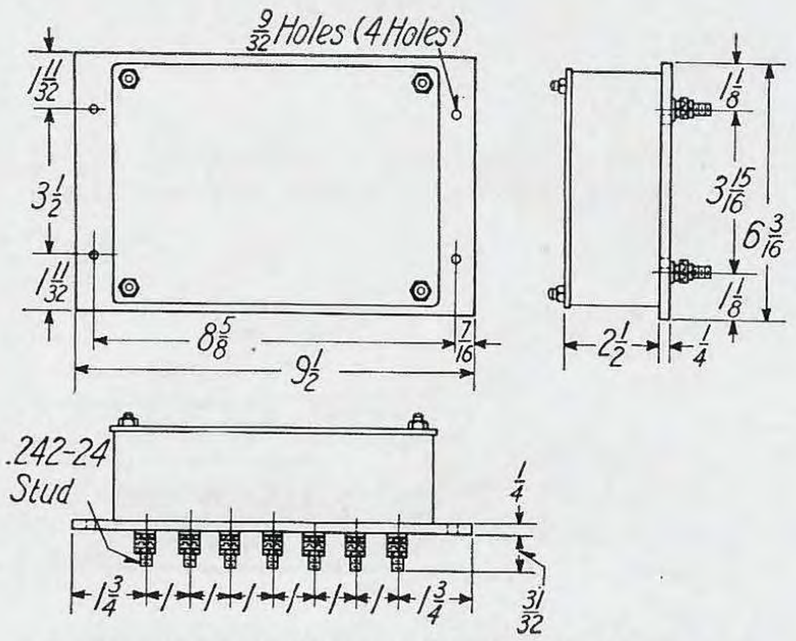


FIG. 10—OUTLINE DIMENSIONS FOR LEAD RESISTANCE COMPENSATOR USED WITH DIRECT-READING THERMOCOUPLE TEMPERATURE INDICATOR FOR A GROUP OF SIX THERMOCOUPLES

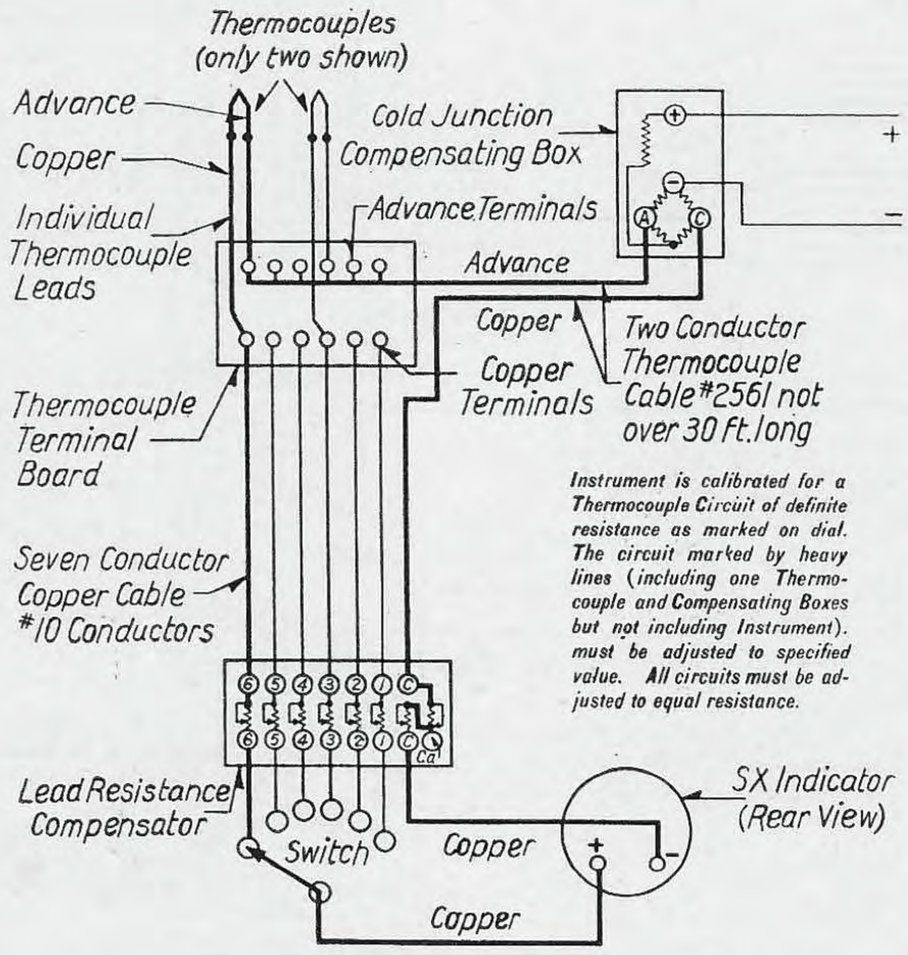


FIG. 11—CONNECTION DIAGRAM FOR THERMOCOUPLE INSTALLATION

Dimensions are for reference only. For official dimensions, apply to the nearest district office.

TEMPERATURE INDICATORS—Continued

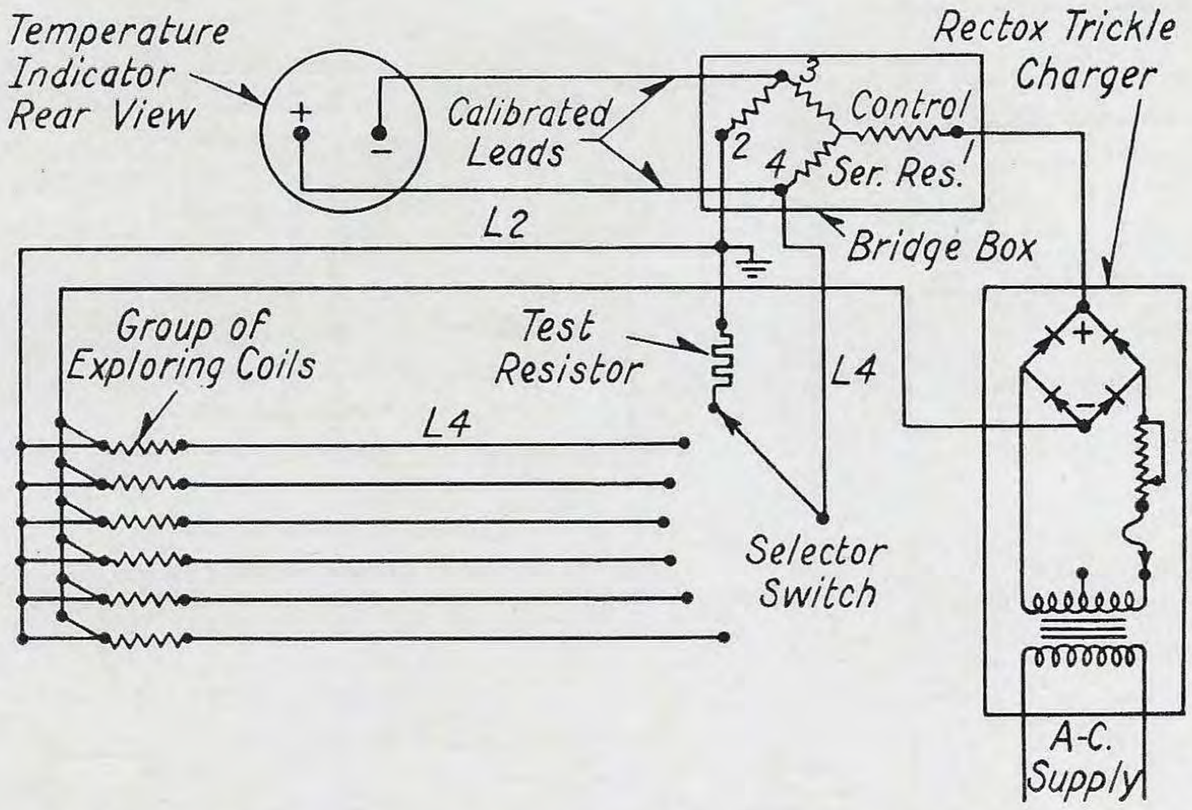


Fig. 12—Simplified Wiring Diagram for Exploring Coil Type Moderate Accuracy Using Grounded Exploring Coils and Relatively Short Leads

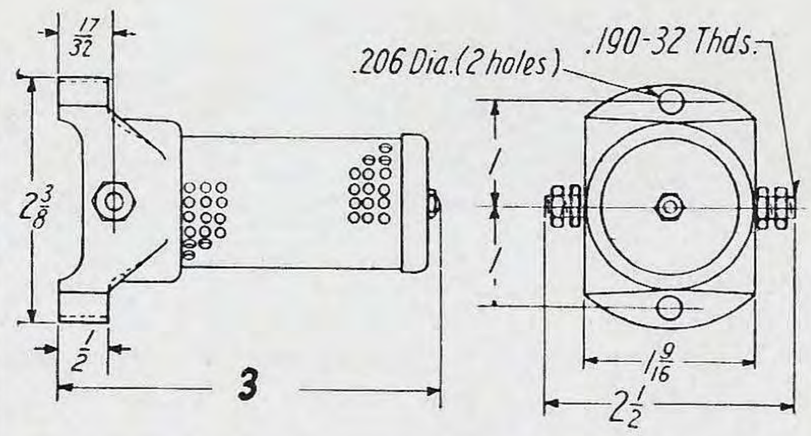


Fig. 14—Test Resistor Outline Dimensions

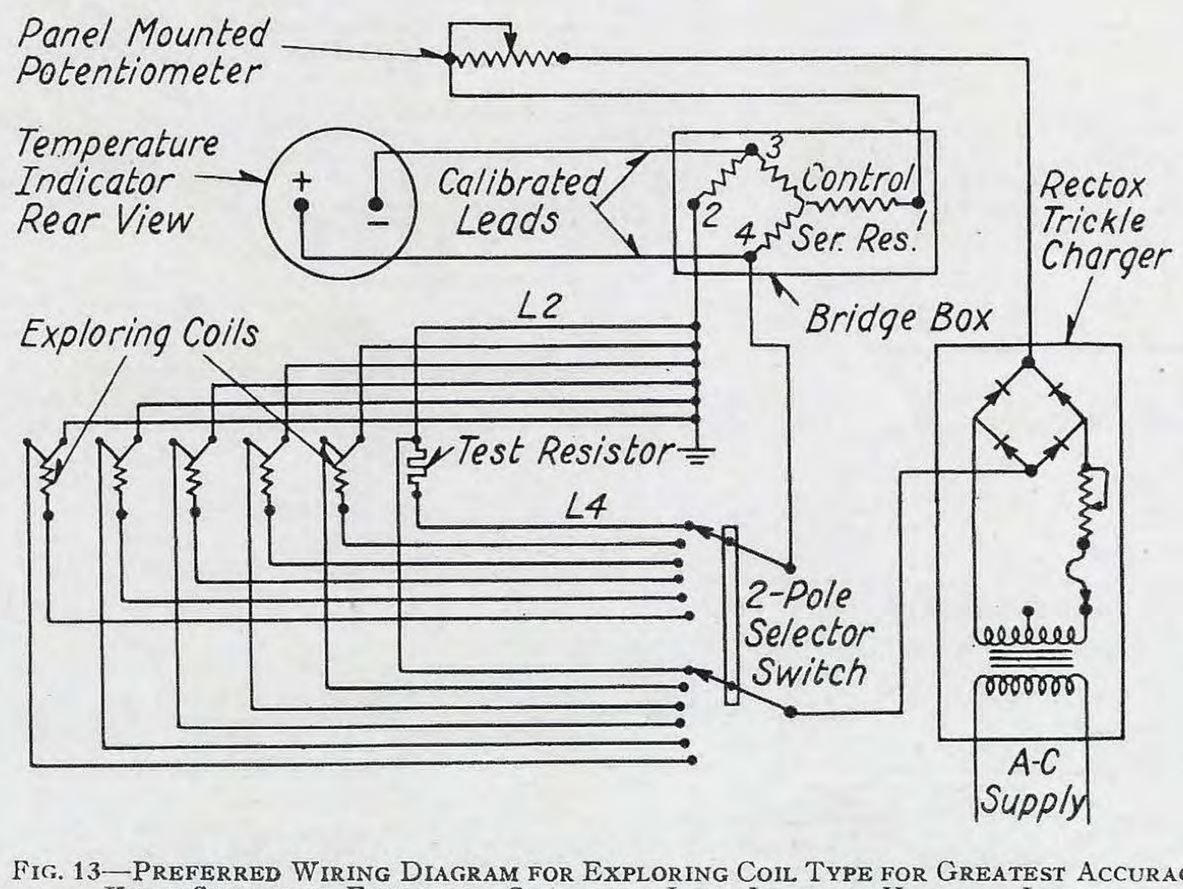


Fig. 13—Preferred Wiring Diagram for Exploring Coil Type for Greatest Accuracy Using Scattered Exploring Coils with Long Leads of Variable Length

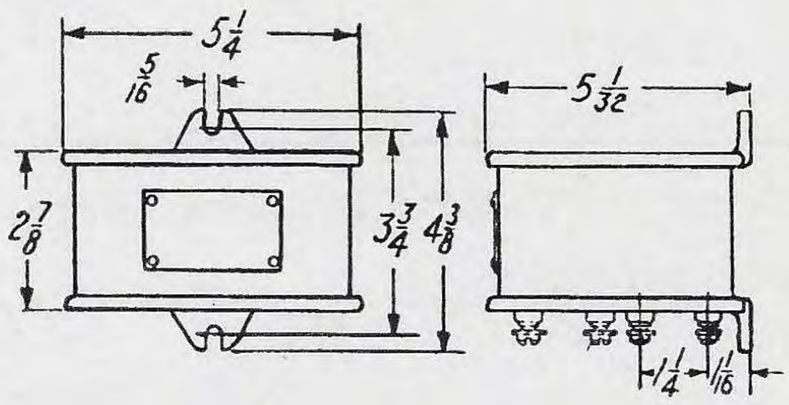


Fig. 15—Outline Dimensions of Bridge Box for Exploring Coil Type Temperature Indicator

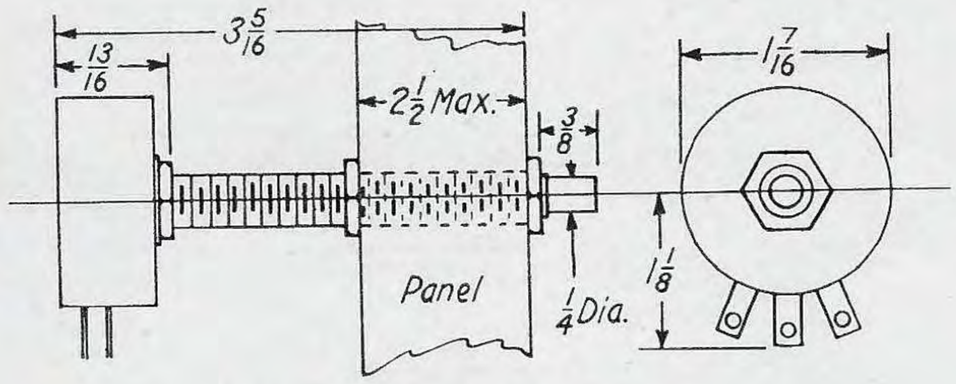


Fig. 16—Panel Rheostat Outline Dimensions

Dimensions are for reference only. For official dimensions, apply to the nearest district office.

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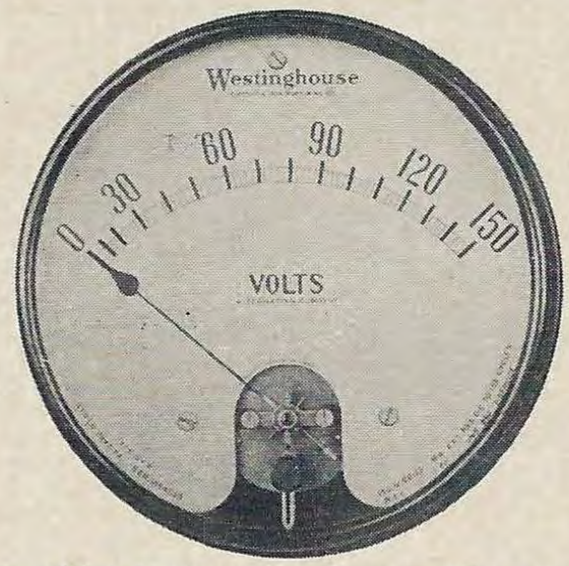
TYPES SY, SY-2, ST AND SX SWITCHBOARD INSTRUMENTS

Projection Mounting

A-C., D-C., Radio-Frequency and Rectox Types



TYPE SY-2 ALTERNATING CURRENT VOLTMETER

DATA

CASE SIZE.....7 3/16" DIAMETER
SCALE LENGTH.....5 1/4"
ACCURACY.....WITHIN ±1%
INSULATION RATING.....750 VOLTS
ALTERNATING CURRENT MOVEMENTS—
AMMETERS, VOLTMETERS.....REPULSION VANE
WATTMETER, POWER FACTOR METERS AND FREQUENCY METERS..ELECTRO-DYNAMOMETER
SYNCHROSCOPE.....MOVING IRON

DIRECT CURRENT MOVEMENTS.....PERMANENT MAGNET MOVING COIL

WEIGHTS:

SX AMMETER AND VOLTMETER ....NET: 6 LBS.; SHIPPING: 7 LBS.
SY WATTMETER POLYPHASE.....NET: 5½ LBS.; SHIPPING: 6½ LBS.
SY POWER FACTOR METER AND SINGLE PHASE WATTMETER.....NET: 5 LBS.; SHIPPING: 6 LBS.

Application

The type S line of instruments, consists of ammeters, milliammeters, voltmeters, single and polyphase wattmeters, single and polyphase power factor meters, frequency meters, synchroscopes and Rectox types. Both a-c. and d-c. instruments are for service on large switchboards made of steel, ebony asbestos, or slate. In addition, radio-frequency types are available for radio applications.

These instruments are well suited to applications requiring round type cases. They have the latest type mechanisms and are capable of the same accuracies obtainable in the more recent type H line of switchboard instruments.

Alternating Current Instruments

Type SY-2 Ammeters and Voltmeters operate on the repulsion iron vane principle. Two flat hipernick iron vanes, one on a stationary bracket and one on the moving element are mounted axially within the coil and are magnetized with like polarities. The resulting force of repulsion between the like poles causes the moving element to move the pointer up scale until the force is balanced by the spring torque.

Type SY Wattmeters are of the electro-dynamometer type.

The electro-dynamometer principle of operation is the most direct method for measuring currents in their relations to one another. It is used exclusively in type SY wattmeters, power factor meters, and frequency meters. One of the principal advantages of the dynamometer movement is its freedom from frequency, voltage, and wave form errors over a wide range of application.

Var Meters—(Reactive volt ampere meters) employ electro-dynamometer movements. They operate similar to polyphase wattmeters except quadrature voltages are applied to the voltage coils through reactive component compensators. They indicate reactive component instead of power.

Electro-Dynamometer Movement for Frequency Meters—Frequency meters employ the same type of dynamometer movement as the power factor meters except that all coils are wound for voltage. A condenser reactor circuit is employed. A resonant type of circuit is used producing considerable torque and a wide open scale. This type of circuit produces an instrument which can accurately indicate small frequency variations and is free from temperature and voltage errors. Air damping is employed.

Moving-Iron Movement for Synchroscope—The synchroscope operates on the moving-iron vane principle. The shaft carries iron vanes which are magnetized by a coil connected to one of the circuits to be synchronized. Another group of coils are so positioned and connected that a rotating field is set up which encircles the movable vanes. This set of coils is connected to the other circuit to be synchronized. The movable vanes take up a position so that when the field in the vanes reaches its maximum during a cycle, the axis of the vanes will coincide with the axis of the rotating field at that particular instant. The pointer thus indicates in reference to a scale the angular displacement of the two circuits. The scale is a full 360° and is marked to show synchronism

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TYPES SY, SY-2, ST AND SX SWITCHBOARD INSTRUMENTS—Continued

point and whether the incoming circuit is fast or slow. This is determined by direction of rotation of the pointer. The pointer will rotate up to a maximum of approximately 4 cycles difference in frequency between the two circuits. Damping is obtained by an aluminum disc attached to the pointer shaft and rotating in the field of a permanent magnet. The movement is adjusted to prevent rotation when potential is accidentally lost from either circuit to avoid incorrect synchronizing under this condition.

Moving-Iron Movement Used in 360° Power Factor Meter—360° Type SY Power Factor Meters use the synchroscope movement described above.

Type SY Position Indicators are similar in mechanical construction to the Type SY synchroscope.

Direct Current Instruments

Permanent Magnet Moving Coi Movements are used in all direct current instruments and in radio frequency and rectox types.

POWER CONSUMPTION—ALTERNATING CURRENT INSTRUMENTS

	Rating	25 Cycles V.A.	25 Cycles Watts	25 Cycles Vars	25 Cycles %P.F.	60 Cycles V.A.	60 Cycles Watts	60 Cycles Vars	60 Cycles %P.F
Ammeters		**Burden on Current Transformers at 5 Amperes***							
Type SY-2	5-amp.	.453	.43	.142	95	.545	.43	.336	79
Wattmeters									
Type SY	5-amp.	1.94	1.93	0.12	99+	1.95	1.93	0.29	99
Polyphase Power Factor Meters									
Type SY	5-amp.	1.94	1.93	0.12	99+	1.95	1.93	0.29	99
Voltmeters		**Burden on Voltage Transformers at 115 Volts***							
Type SY-2	150-volt	3.52	3.52	.01	100	3.52	3.52	0.01	100
Wattmeters									
Single-Phase Type SY	115-volt	11.6	11.6	0	100	11.6	11.6	0	100
Polyphase Type SY	115-volt	8.3	8.3	0	100	8.3	8.3	0	100
Kilovar Meters									
Polyphase Type SY									
1–2 Phase	115	16.7	11.83	—11.77	71 lag	16.7	11.83	—11.77	71 lag
2–3 Phase	115	12.87	8.37	+ 9.77	65 lead	12.87	8.36	+ 9.77	65 lead
Frequency Meters Resonant Type									
Type SY	115-volt	3.49	3.49	.13	99+	3.49	3.49	0.24	99+
Frequency Meters Reactor Type									
Type SY	115-volt	16.35	13.95	8.5	85	16.35	13.95	8.5	85
Polyphase Power Factor Meter 50-100-50									
Type SY	115-volt	12.2	12.2	0	100	12.2	12.2	0	100
Single-Phase Power Factor Meter									
Type SY	115-volt	17.8	13.9	1.11	78	17.8	13.9	1.11	78
Synchroscope									
Type SY	115-volt		Circuit No. 1, for running machine						
		10.9	10.	4.25	92	10.9	10.	4.2	92
			Circuit No. 2, for incoming machine						
		12.2	12.2	.25	100	12.2	12.2	.25	100

*Values given are for a single element; polyphase wattmeters have two elements.

TYPES SY, SY-2, ST AND SX SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES

Types HX, HA, and HY instruments listed in Catalog 43-205 are recommended for new and modern installations. The following listings are for match-up and other special requirements.

TYPE SX—DIRECT CURRENT

***Projection Mounting °White Dials**
Rear Connected

AMMETERS—SELF-CONTAINED

Capacity	Style No.	List Price Discount Symbol BC
2	420 431	$44 50
5	393 189	44 50
10	393 190	44 50
15	393 191	44 50
25	393 192	44 50
50	393 193	44 50

AMMETER FOR USE WITH EXTERNAL SHUNT

Style No. 464412..... 39 00
Price includes 8 foot leads but not the shunt. When ordering, specify shunt capacity.

VOLTMETERS

Full-scale Current—5 MA.
Resistance—200 Ohms Per Volt

Capacity	Style No.	List Price Discount Symbol BC
150	293 402	39 00
300	293 403	43 00
600	293 404	51 00
750	293 405	55 00

MILLIAMMETERS

Capacity	Style No.	List Price Discount Symbol BC
100	422 676	$39 00
150	422 677	39 00
250	422 678	39 00
400	628 500	39 00
500	539 630	39 00
750	539 632	39 00

MOLDED CASE VOLTMETERS

Voltmeters will be furnished with molded cases for insulation rating of 4000 volts. Prices on request. State capacity and application.

TYPE SX RADIO FREQUENCY

***Projection Mounting °White Dials**
Rear Connected

AMMETERS—SELF-CONTAINED

Capacity	Style No.	List Price Discount Symbol BC
6	306 227	$47 00
8	306 228	47 00
10	306 229	47 00
15	306 230	47 00
20	306 231	47 00

Radio frequency ammeters calibrated for external thermo-couple.

Radio frequency ammeters are available with external thermo-couples in ranges from 1 to 50 amperes inclusive.

When long leads are used between the instrument and the thermocouple, it is usually necessary to place proper by-pass condensers and radio-frequency chokes in the circuit at the thermo-couple to prevent damage to the thermo-couple by radio frequency in the instrument leads. Additional information will be furnished on request.

Capacity	Style No.	List Price Discount Symbol BC
....	627 266	$41 00

List price includes the ammeter calibrated but not the thermocouple.

TYPE SY-2—ALTERNATING CURRENT

***Protection Mounting °White Dials**
Rear Connected

AMMETERS—SELF-CONTAINED

Capacity	Style No.	List Price Discount Symbol BC
10	701 013	$35 00
15	701 014	39 00
20	701 015	39 00
25	701 016	39 00
30	701 017	39 00
40	701 018	41 00
50	701 019	$41 00
60	701 020	41 00
75	701 021	41 00
100	701 022	44 00
150	701 023	47 00
200	701 024	50 00
300	701 025	56 00

* Flush mounting type will be furnished at $4.00 list additional.
° Black dials will be furnished at $5.00 list additional.

Order by Style Number

Prices and Discounts subject to change without notice.

TYPES SY, SY-2, ST AND SX SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE SY-2 ALTERNATING CURRENT—Continued

AMMETERS—FIVE AMPERE COILS
Calibrated for Use with Transformers

Scale Capacity	Style No.	List Price Discount Symbol BC	Scale Capacity	Style No.	List Price Discount Symbol BC
5	701 026	$35 00	200	701 039	$35 00
10	701 027	35 00	300	701 040	35 00
15	701 028	35 00	400	701 041	35 00
20	701 029	35 00	500	701 042	35 00
25	701 030	35 00	600	701 043	35 00
30	701 031	35 00	800	701 044	35 00
40	701 032	35 00	1000	701 045	35 00
50	701 033	35 00	1500	701 046	35 00
60	701 034	35 00	2000	701 047	35 00
75	701 035	35 00	3000	701 048	35 00
80	701 036	35 00	4000	701 049	35 00
100	701 037	35 00	5000	701 050	35 00
150	701 038	35 00			

AMMETERS
For Use with Transformers†
Calibrated as Required for Capacities Not Listed Above

Coil Capacity	Style No.	List Price Discount Symbol BC	Coil Capacity	Style No.	List Price Discount Symbol BC
2.5	701 006	$35 00	6	701 010	$35 00
3	701 007	35 00	7.5	701 011	35 00
4	701 008	35 00	10	701 012	35 00
5	701 009	35 00			

† Specify transformer ratio and scales desired.

VOLTMETERS

Capacity	Style No.	List Price Discount Symbol BC	Coil Capacity	Style No.	List Price Discount Symbol BC
150	701 001	$37 00	‡150-volt	701 000	$37 00
300	701 003	41 00			
600§	701 004	49 00			
750§	701 005	53 00			

§ Supplied with external resistor.
‡ Calibrated as desired for use with transformers. Specify transformer ratio and scale desired.

TYPE SY ALTERNATING CURRENT
***Projection Mounting °White Dials**
Rear Connected

SINGLE PHASE WATTMETERS‡

Amps.	Volts	Style No.	List Price Discount Symbol BC	Amps.	Volts	Style No.	List Price Discount Symbol BC
5	115	363 659	$60 00	10	115	363 662	$60 00
5	230	363 660	64 00	10	230	363 663	64 00
5	460	363 661	69 00	10	460	363 664	69 00

‡ Calibrated as desired for use with transformers. Specify transformer ratios and scales desired.

POLYPHASE WATTMETERS‡
2 Phase, 2 Wire; 2 Phase, 3 Wire; 3 Phase, 3 Wire

4	115	363 665	$90 00	4	460	363 673	$108 00
5	115	363 666	90 00	5	460	363 674	108 00
7.5	115	363 667	90 00	7.5	460	363 675	108 00
10	115	363 668	90 00	10	460	363 676	108 00
4	230	363 669	98 00	4	575	363 677	114 00
5	230	363 670	98 00	5	575	363 678	114 00
7.5	230	363 671	98 00	7.5	575	363 679	114 00
10	230	363 672	98 00	10	575	363 680	114 00

* Flush mounting type will be furnished at $4.00 list additional.
° Black dials will be furnished at $5.00 list additional.

‡ Calibrated as desired for use with transformers. Specify transformer ratios and scales desired.

Order by Style Number

Prices and Discounts subject to change without notice.

TYPES SY, SY-2, ST AND SX SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE SY ALTERNATING CURRENT—Continued

THREE-PHASE FOUR-WIRE WATTMETERS
With Three Current Coils and Two Potential Coils

Amps.	Volts	Frequency	Style No.	List Price Discount Symbol BC
5	115	25–60	838 409	$100 00

Specify scales and transformer ratios and provide connection diagram.

THREE-PHASE THREE-WIRE REACTIVE VOLT-AMPERE METERS
With Two Current Coils and Two Voltage Coils

5	115	25	478 024	110 00
5	115	60	478 022	110 00

Style number and list price includes compensator.
Specify scale and transformer ratios.
For three-phase four-wire, add $10.00 list.

FREQUENCY METERS

Volts	Frequency	Scale	Style No.	List Price Discount Symbol BC
115	25	20–30	363 683	$115 00
115	60	50–70	363 684	115 00
115	60	55–65	563 394	115 00
115	60	58–62	704 027	135 00

POWER FACTOR METERS

Volts	Cycles	Scale	Phase	Style No.	List Price Discount Symbol BC
115	25	50–100–50	1	363 681	$95 00
115	25	10–100–80	1	372 243	95 00
115	60	50–100–50	1	372 244	95 00
115	60	10–100–80	1	372 245	95 00
115	25–60	50–100–50	3	363 682	75 00
115	25–60	10–100–80	3	372 246	75 00
230	25–60	50–100–50	3	478 032	79 00
230	25–60	10–100–80	3	478 030	79 00
460	25–60	50–100–50	3	478 036	84 00
460	25–60	10–100–80	3	478 034	84 00

TYPE SY SYNCHROSCOPE

Volts	Frequency	Style No.	List Price Discount Symbol BC
115	25	370 900	$115 00
115	60	370 902	115 00

TYPE ST TRIPLEX
***Projection Mounting °White Dials**
Rear Connected

AMMETERS

Rating	Style No.	List Price Discount Symbol BC
5‡	505 796	$55 00

* Flush mounting type will be furnished at $4.00 list additional.
° Black dials will be furnished at $5.00 list additional.

VOLTMETERS

Rating	Style No.	List Price Discount Symbol BC
150‡§	544 485	$62 00
250§	544 487	65 00
500§	544 489	70 00

‡ Calibrated as desired for use with transformers. Specify transformer ratios and scales desired.
§ Furnished with external resistors (3 reqd.)

OUTLINE DIMENSIONS IN INCHES AND DRILLING PLANS

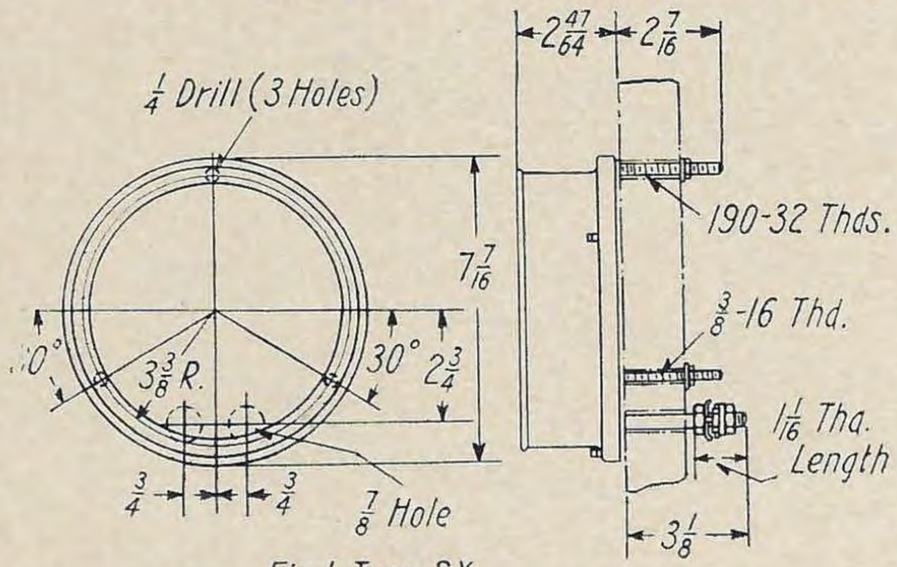


Fig. 1 Type SX

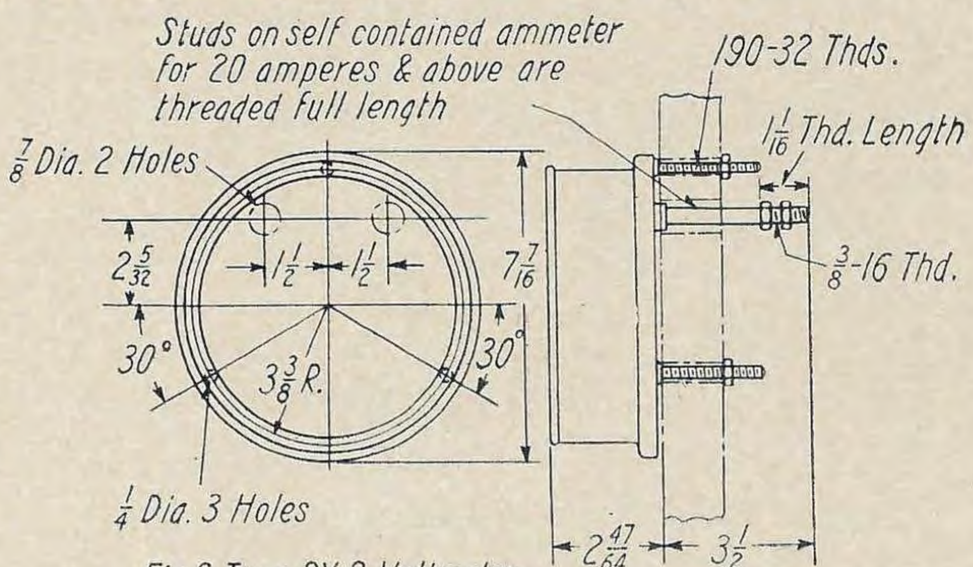


Fig. 2 Type SY-2 Voltmeter and Ammeter up to 80 Amp.

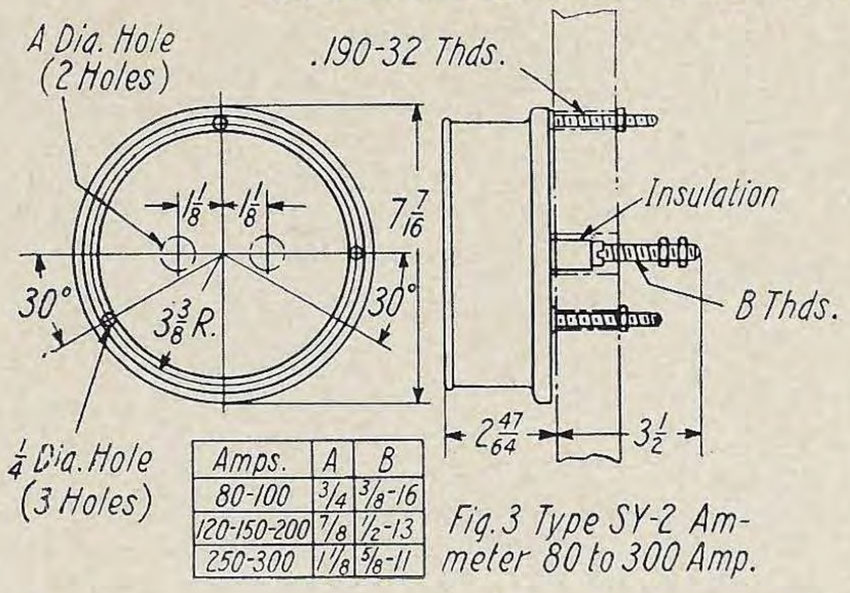
Dimensions are for Reference Only. For Official Dimensions Refer to Nearest Westinghouse Sales Office.

Order by Style Number

Prices and Discounts subject to change without notice.

TYPES SY, SY-2, ST AND SX SWITCHBOARD INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES AND DRILLING PLANS—Continued



Amps.	A	B
80-100	3/4	3/8-16
120-150-200	7/8	1/2-13
250-300	1 1/8	5/8-11

Fig. 3 Type SY-2 Ammeter 80 to 300 Amp.

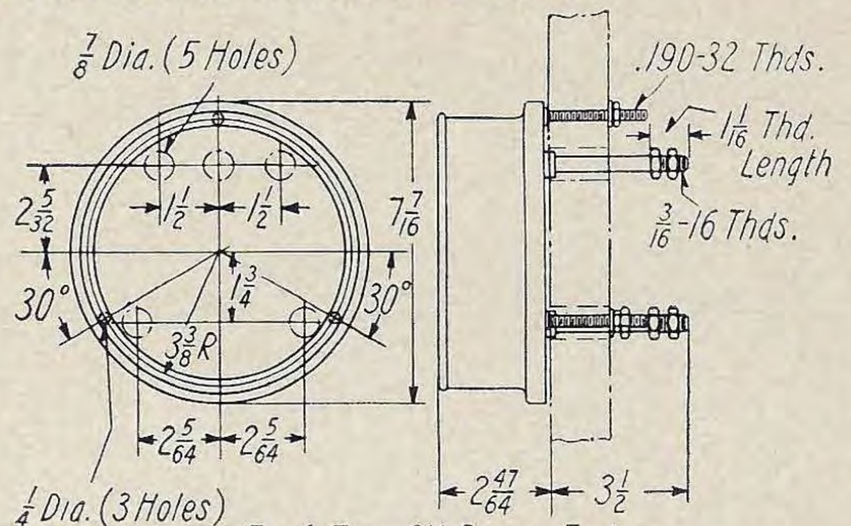


Fig. 4 Type SY Power Factor Meter (100° Scale)

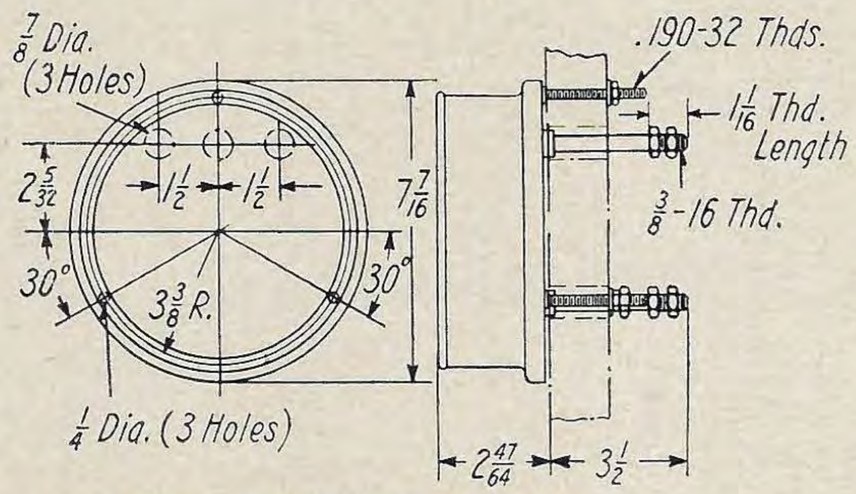


Fig. 5 Type SY Frequency Meter

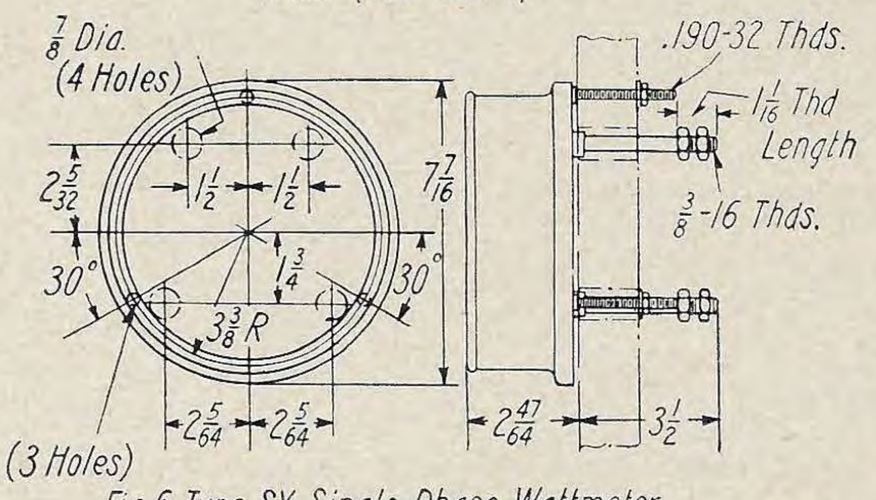


Fig. 6 Type SY Single Phase Wattmeter

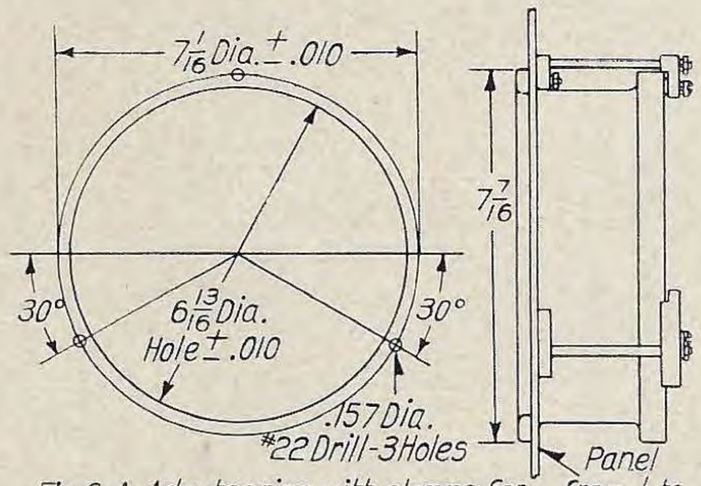


Fig. 6-A Adapter ring with clamps, for flush mtg. SX, SY and SY-2 Instruments

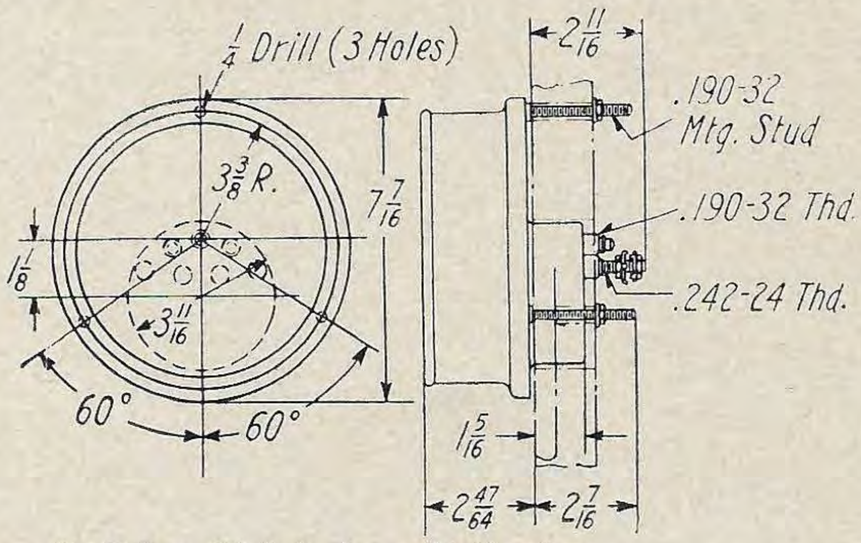


Fig. 7 Type SY Polyphase Wattmeter

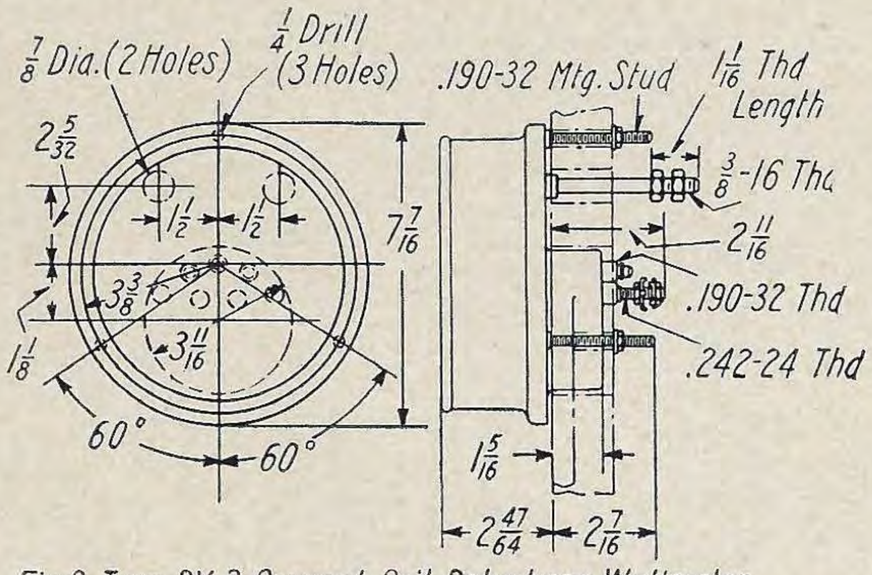


Fig. 8 Type SY 3 Current Coil Polyphase Wattmeter

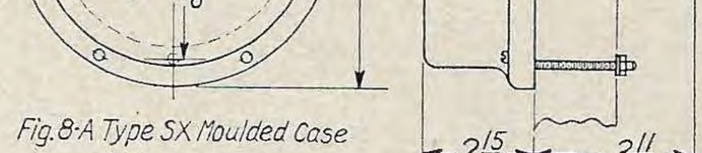


Fig. 8-A Type SX Moulded Case

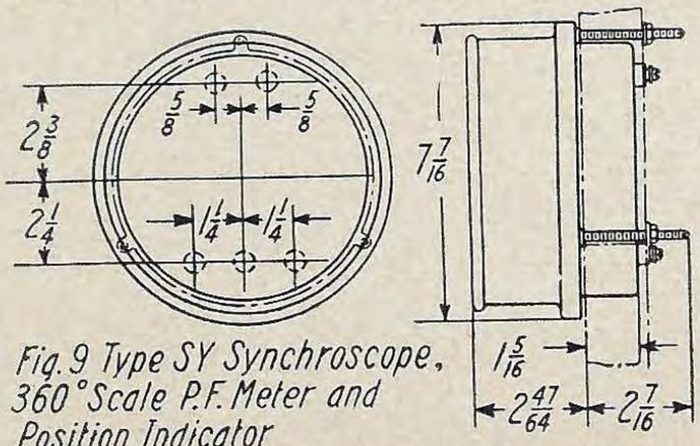


Fig. 9 Type SY Synchroscope, 360° Scale P.F. Meter and Position Indicator

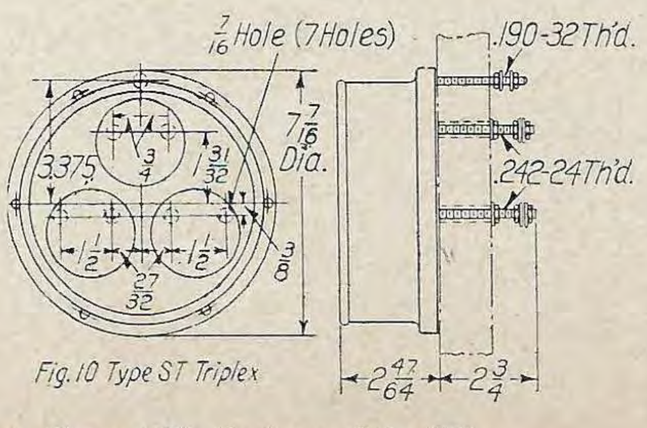


Fig. 10 Type ST Triplex

Dimensions are for Reference Only. For Official Dimensions Refer to Nearest Westinghouse Sales Office.

TYPES SY, SY-2, ST AND SX SWITCHBOARD INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

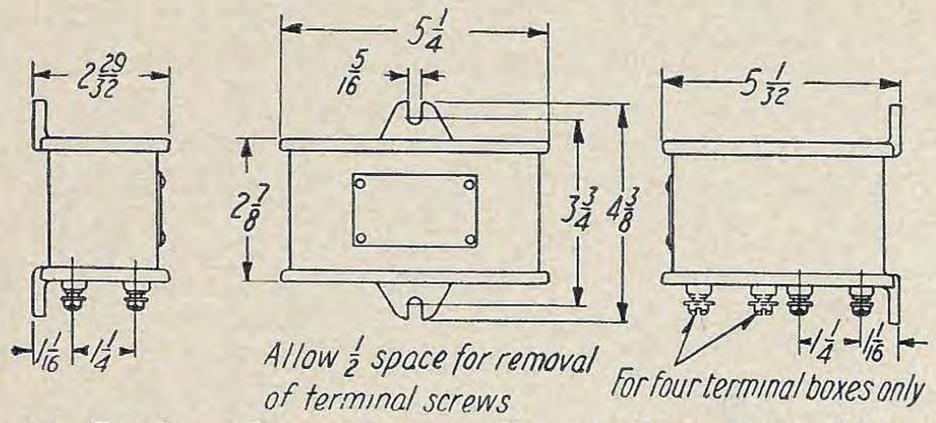


FIG. 11—TWO SPOOL RESISTOR, USED WITH SY-2 VOLTMETER ABOVE 300 V. TO 500 V. (1 REQ.) USED WITH SY SINGLE PHASE AND POLYPHASE WATTMETER AND POLYPHASE POWER FACTOR METER TO 150 V, (2 REQ.)

FIG. 12—FOUR SPOOL RESISTOR. USED WITH SY-2 VOLTMETER ABOVE 500 V. TO 750 V. (1 REQ.) USED WITH SY, SINGLE PHASE AND POLYPHASE WATTMETER AND POLYPHASE POWER FACTOR METER ABOVE 150 V. TO 575 V. (2 REQ.)

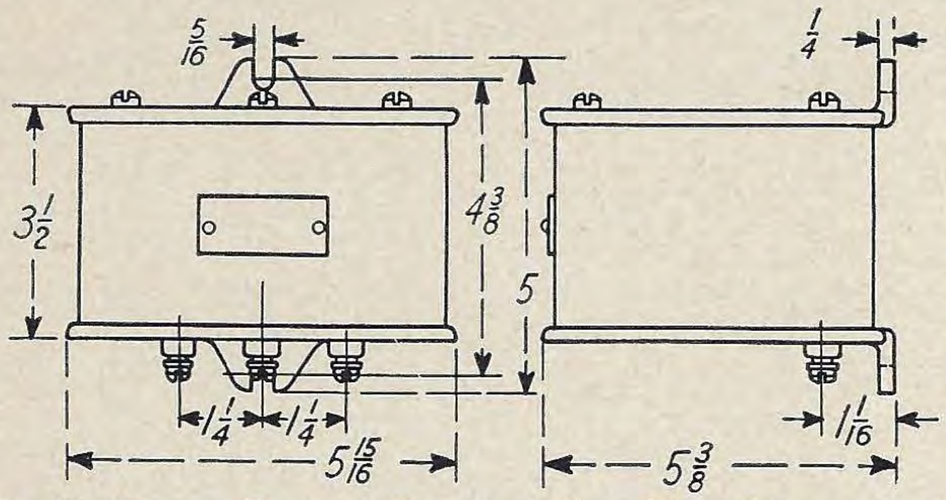


FIG. 13—REACTOR RESISTOR, USED WITH TYPE SY, 100° SINGLE PHASE POWER FACTOR METER. TYPE SY SYNCHROSCOPE AND TYPE SY 360° SCALE SINGLE PHASE POWER FACTOR METER

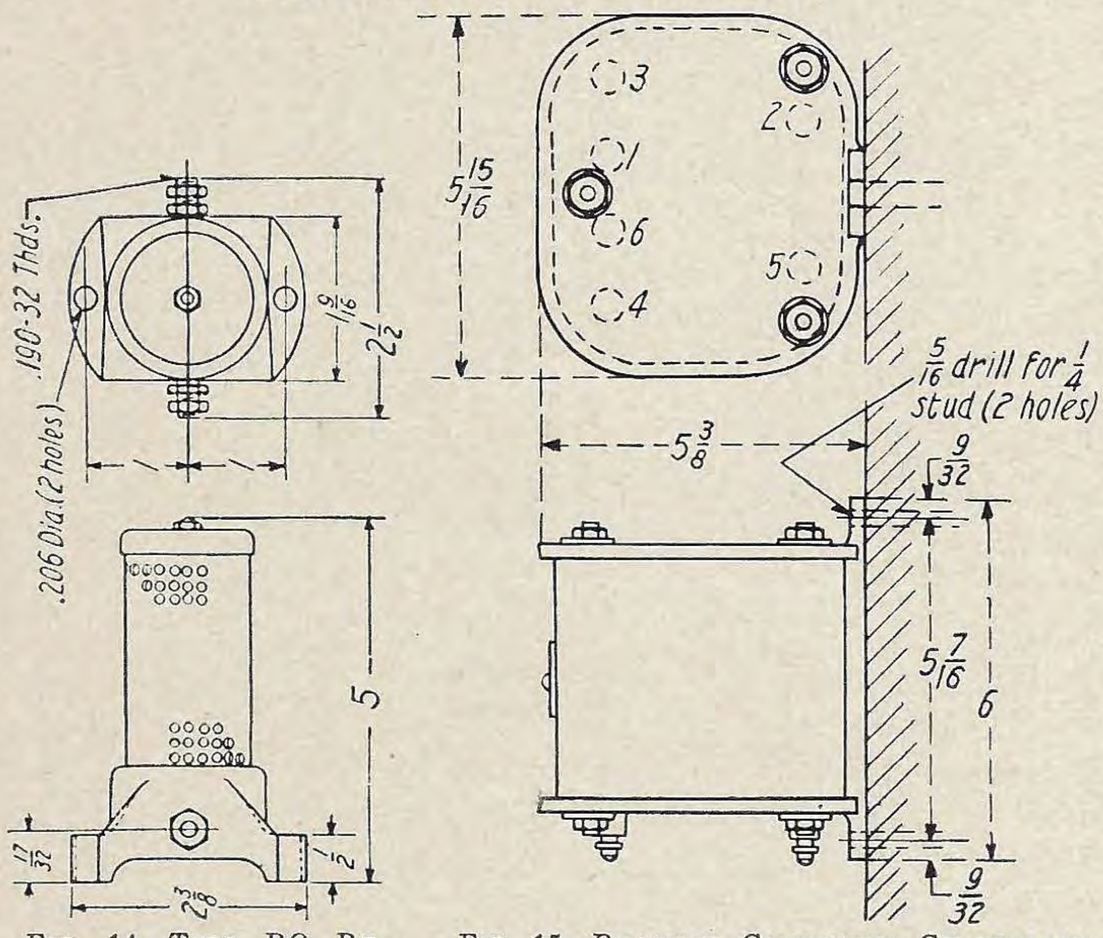


FIG. 14—TYPE RO RESISTOR, USED WITH 800 V. AND 1000 V. TYPE SX VOLTMETER

FIG. 15—REACTIVE COMPONENT COMPENSATOR USED WITH 3-PHASE, 3-WIRE VAR METER

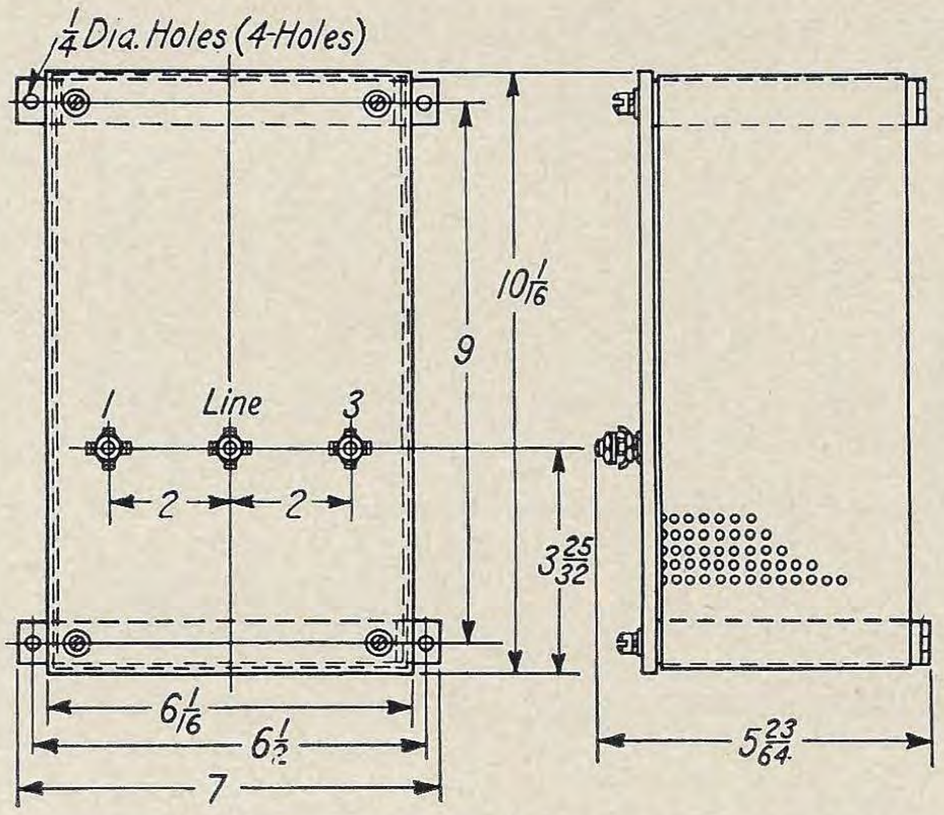


FIG. 17—REACTOR, USED WITH TYPE SY RESONANT CIRCUIT NARROW RANGE FREQUENCY METER. (55-65 CY., 58-62 CY., 23-27 CY.)

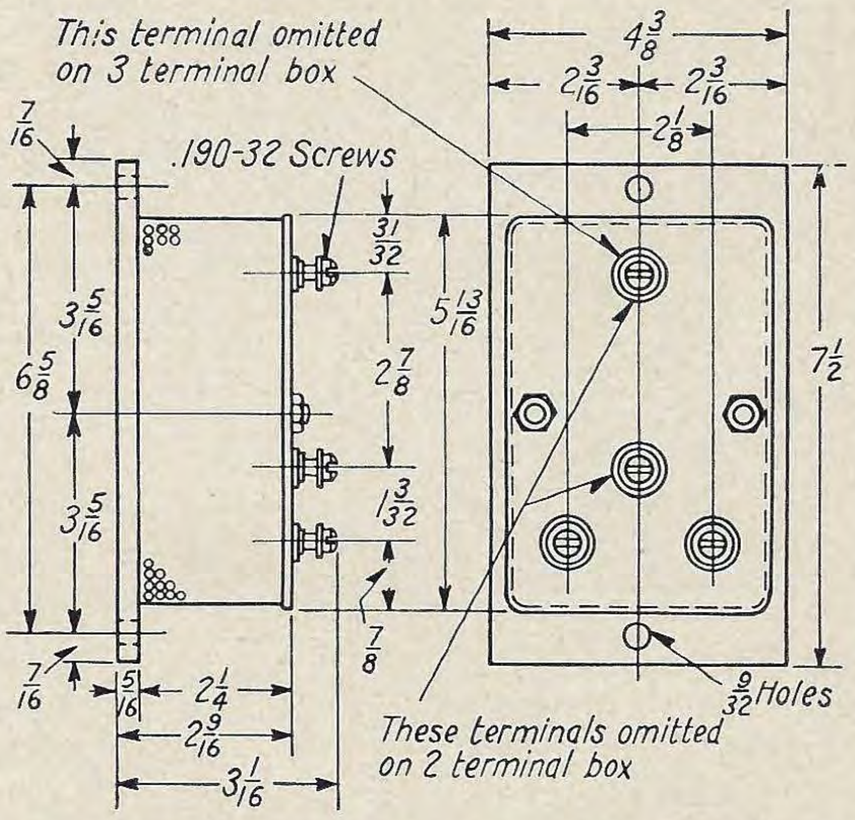


FIG. 18—TYPE R-3 RESISTOR, USED WITH TYPE SX VOLTMETER—RANGES 1500 V. TO 3000 V. INC.

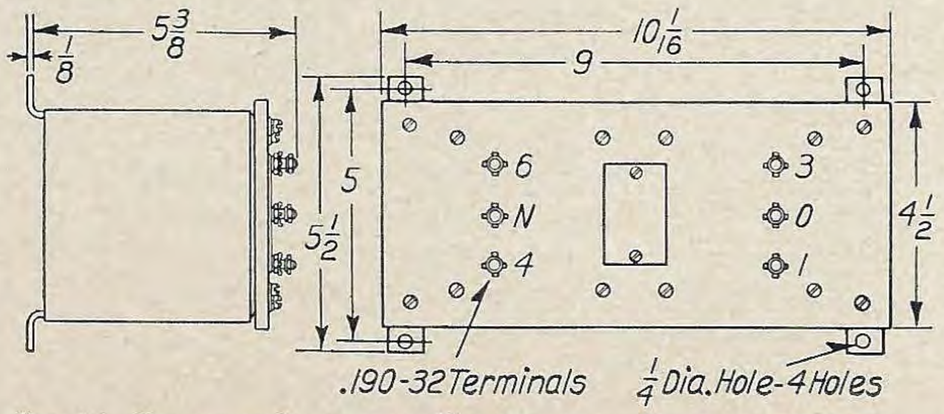


FIG. 16—REACTIVE COMPONENT COMPENSATOR, USED WITH 3-PHASE, 4-WIRE (3 CURRENT COIL) VAR METER

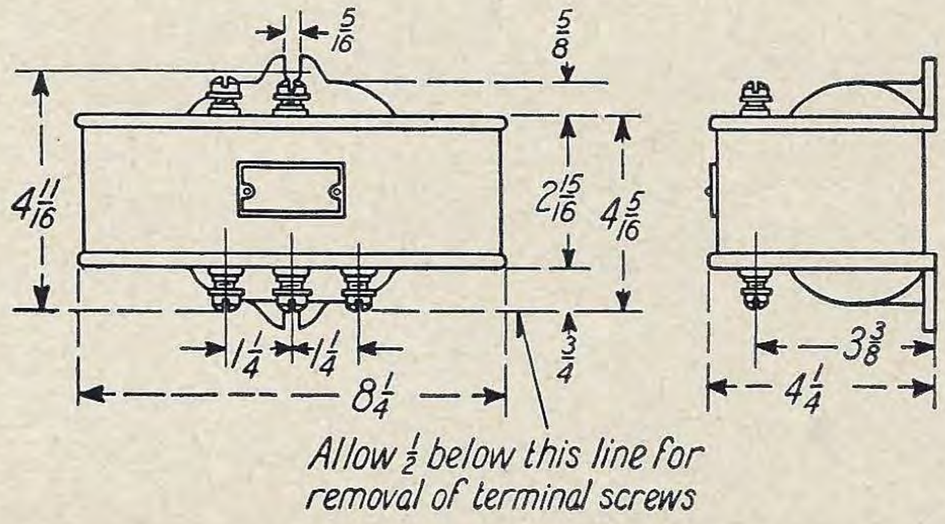


FIG. 19—REACTOR RESISTOR USED WITH TYPE SY BROAD RANGE FREQUENCY METER. (20-30 CY., 50-70 CY.)

TYPES SY, SY-2, ST AND SX SWITCHBOARD INSTRUMENTS—Continued

WIRING DIAGRAMS

Rear Views

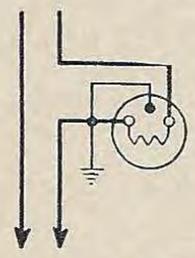


Fig. 1 SY-2 Self Contained Ammeter

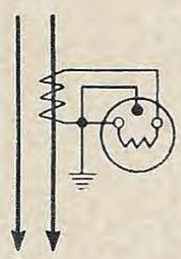


Fig. 2 SY-2 Ammeter with current trans.

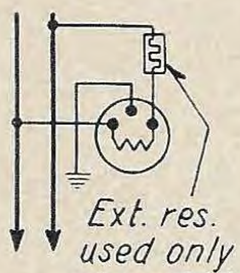


Fig. 3 SY-2 Voltmeter

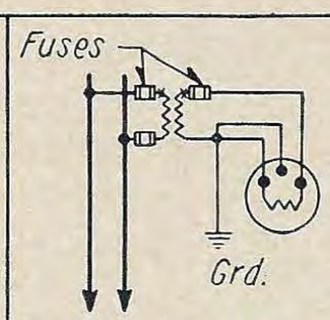


Fig. 4 SY-2 Voltmeter with voltage trans.

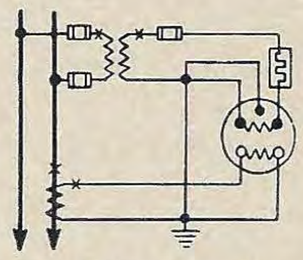


Fig. 5 SY Single phase wattmeter on single phase line

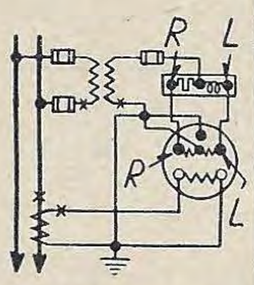


Fig. 6 SY Single phase power factor meter

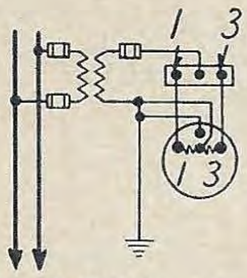
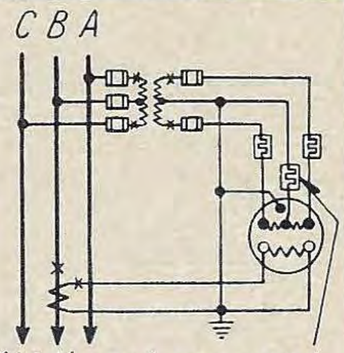


Fig. 7 SY Resonant type freq. meter (Complete conn. 1&3 before connecting to line)



Middle ext. res. used only above 150 V.

Fig. 8 SY Polyphase power factor meter 100° scale

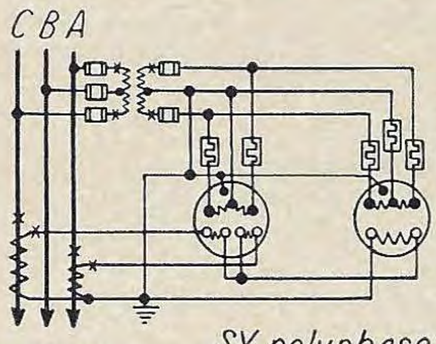


Fig. 9 SY Polyphase Wattmeter

SY polyphase power factor meter with 2 current trans. as shown

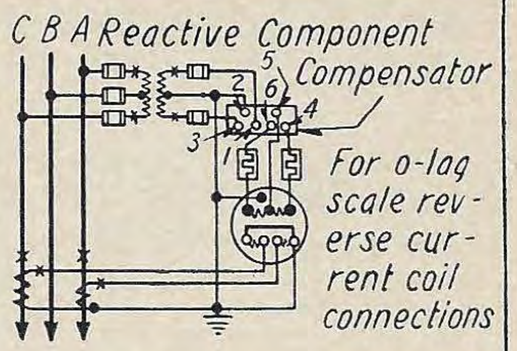


Fig. 10 SY Polyphase R.V.A. meter with compensator (Std. Wattmeter Calibration) Lag-0-Lead Scale

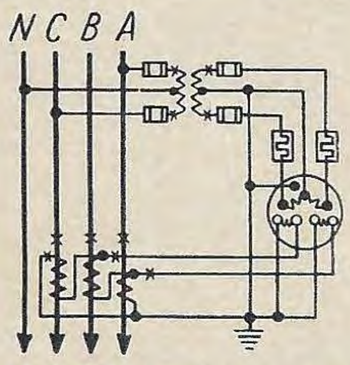


Fig. 11 SY Polyphase wattmeter (Delta Connected C.T.)

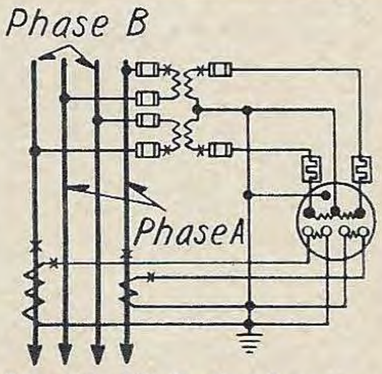


Fig. 12 SY Polyphase wattmeter on 2Ph 4 wire circuit

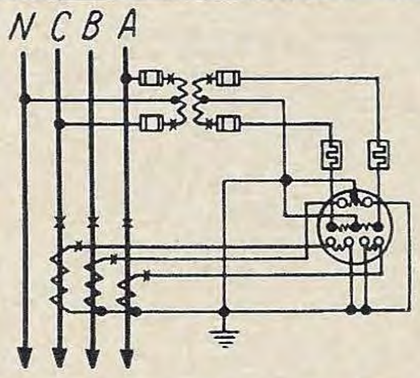


Fig. 13 SY 3 Current Coil Polyphase Wattmeter

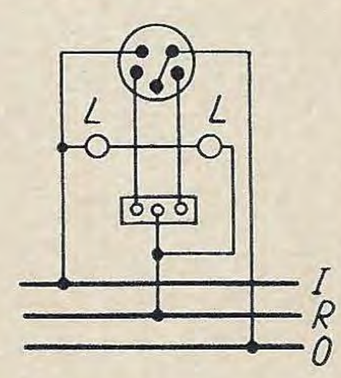
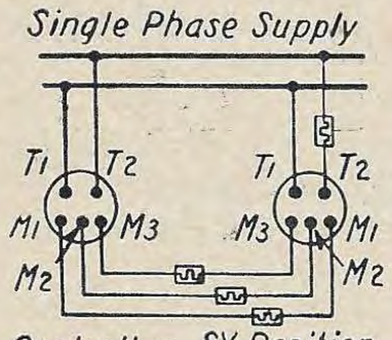


Fig. 14 SY Synchroscope



Controller SY Position Indicator

Fig. 15 Position Indicator System

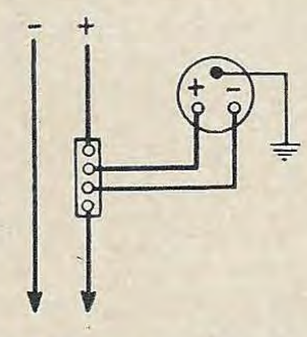


Fig. 16 SX Ammeter (External Shunt)

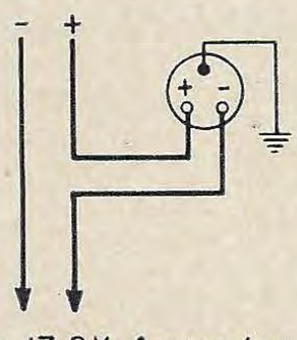


Fig. 17 SX Ammeter or Milliammeter (Self Contained)

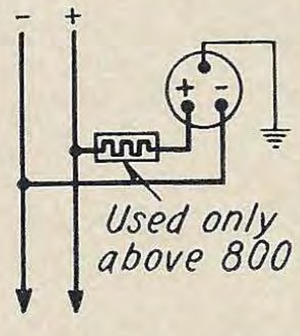


Fig. 18 SX Voltmeter

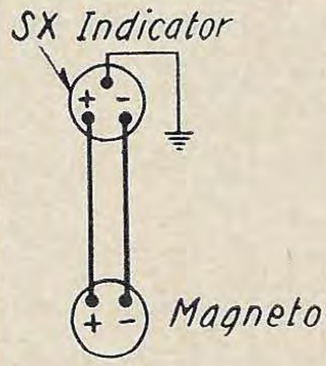


Fig. 19 Speed Indicating System

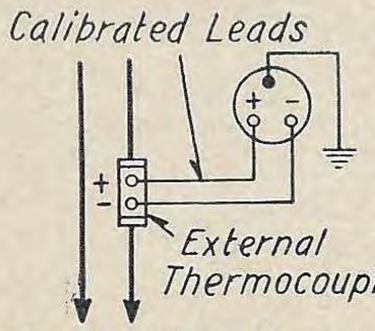


Fig. 20 SX Radio Freq. Ammeter (External Thermocouple)

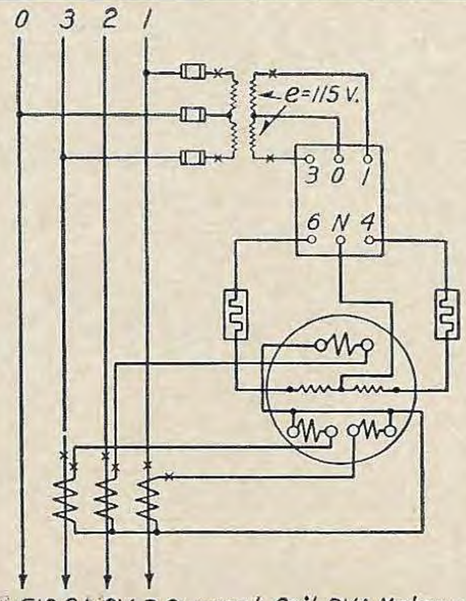


FIG. 21 SY 3 Current Coil RVA Meter with Reactive Component Compensator. (Std. 3 current Coil Wattmeter Calibration) For 0-Lag scale reverse current coil connections

Wiring diagrams are for reference only. For official diagrams refer to nearest Westinghouse Sales Office.

TYPE TG ELECTROSTATIC GROUND DETECTORS

For Alternating Current

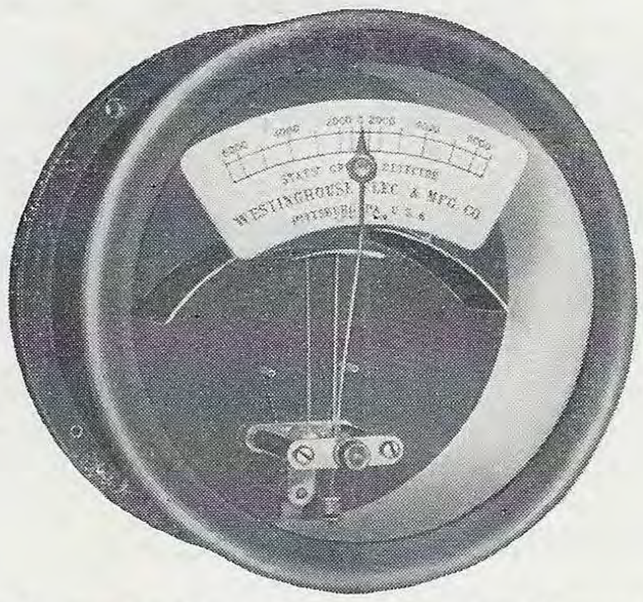


FIG. 1—SINGLE-PHASE TYPE TG GROUND DETECTOR

FIG. 2—THREE-PHASE TYPE TG GROUND DETECTOR

DATA

CASE.....ROUND METAL WITH GLASS FRONT
CASE DIMENSIONS.....9⅝" DIA., 5½" DEEP
MOUNTING.....PROJECTION

WEIGHT—INSTRUMENT.....12 LBS. NET, 32 LBS SHIPPING
WEIGHT—CONDENSERS..... 5 LBS. NET, 11 LBS. SHIPPING
POWER CONSUMPTION.....NEGLIGIBLE

Application

Ground detectors are desirable on some alternating-current transmission or distributing systems to indicate a ground before it has developed to any serious extent. On a system in which one conductor might become grounded without tripping the circuit-breakers or a similar result, ground detectors are recommended. On high-voltage circuits no other than the electrostatic type of ground detector is practicable.

Limitations—The practical application of ground detectors is limited to overhead lines without a grounded neutral and on which the normal charging current passing into a ground is insufficient to trip a breaker, and to small underground systems.

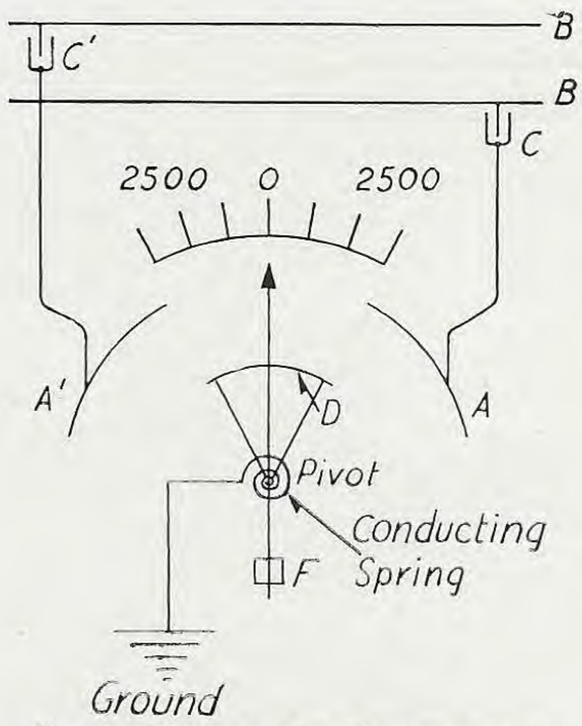


FIG. 3—DIAGRAM AND CONNECTIONS OF SINGLE-PHASE GROUND DETECTOR

Operation

The type TG ground detectors are connected to the circuit through condensers, so that the potential at the switchboard is low and safe.

The single-phase ground detector indicates a ground on either side of the system by the movement of a pointer. It is intended for use on a single-phase system or in pairs on a two-phase system. Two single-phase instruments can be used on a three-phase system, and the grounded line determined by a comparison of the indications. The moving vane moves away from the fixed vane connected with the line on which a ground occurs.

The three-phase ground detector indicates a ground in any phase, and which phase is grounded. The movable-indicating vane moves away from the fixed vane connected with the grounded line.

Construction

The instruments are designed for switchboard mounting and are enclosed in metal cases with glass fronts. The case depth is 5½".

Ground detector movements are essentially electrostatic voltmeters. The control forces in single phase detectors are supplied partly by gravity, hence they must be operated only in the vertical position. The movements in three phase detectors are spring controlled.

Condensers—The condenser consists of a brass tube covered with a layer of insulating material and a copper sheath. The inner tube is connected to the line and the outer sheath to a fixed vane of the ground detector. The condenser insulates the instrument from the line but the leads connecting the instrument and condensers must be treated as high-voltage conductors to avoid a disturbance of their electrostatic charge. They cannot be enclosed in metal conduits.

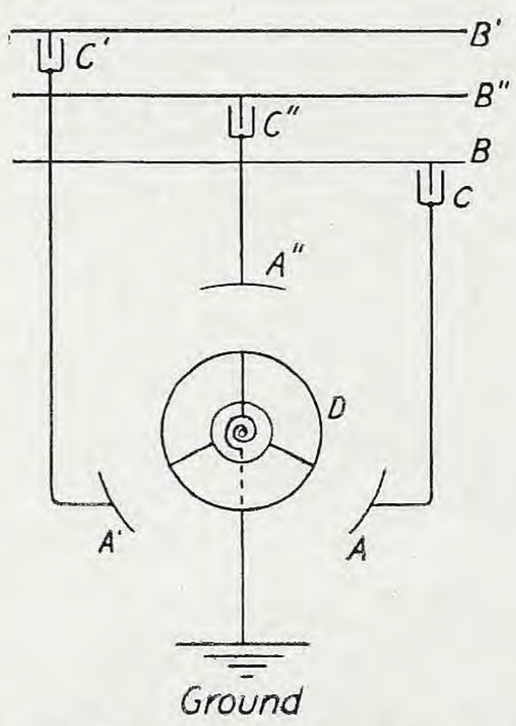


FIG. 4—DIAGRAM AND CONNECTIONS OF THREE-PHASE GROUND DETECTOR

TYPE TG ELECTROSTATIC GROUND DETECTORS—Continued

LIST PRICES

TYPE TG GROUND DETECTORS

Single-Phase

Volts	No. of Condensers	Style	List Price Discount Symbol BC
2200	2	15 803	$120 00
3500	2	183 616	120 00
6600	2	15 804	125 00
11000	2	15 805	125 00
22000	2	15 806	127 00

Three-Phase

Volts	No. of Condensers	Style	List Price Discount Symbol BC
2200	3	35 586	$127 00
3500	3	183 615	130 00
6600	3	35 587	135 00
11000	3	35 588	140 00
22000	3	35 589	145 00

Style number and list price include instrument complete with condensers for voltage listed. For higher voltages, prices will be furnished on request.

REPLACEMENT CONDENSERS

For use with Ground Detectors

Volts	Style	List Price Discount Symbol BC
2200	29 897	$14 00
3500	163 699	16 00
6600	29 898	18 00
11000	29 899	20 00
22000	29 900	24 00

Style number includes one condenser. Two required for single phase instruments. Three required for three phase instruments.

OUTLINE AND DRILLING DIMENSIONS IN INCHES

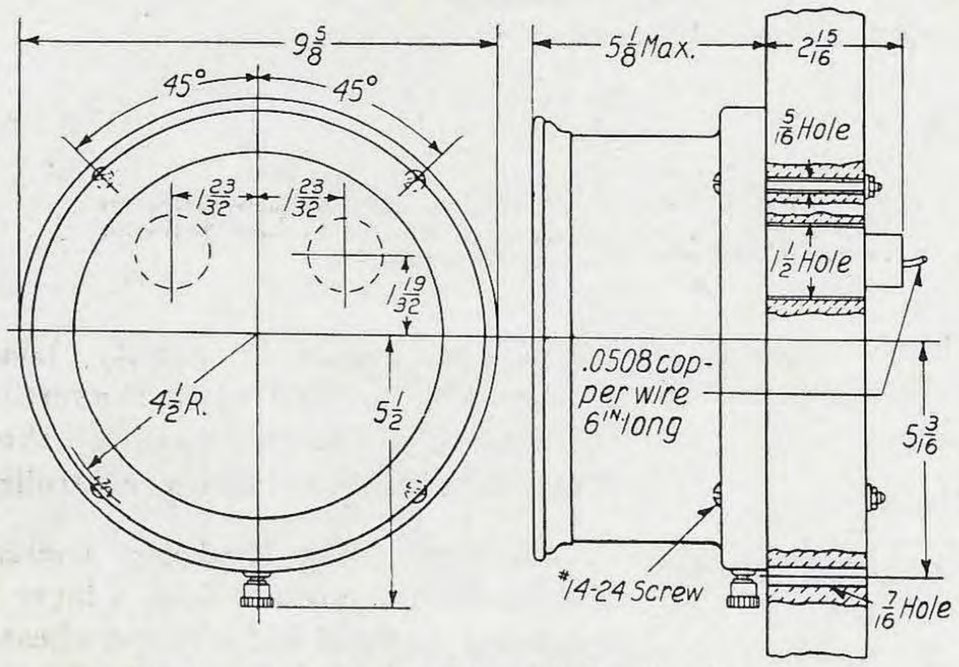


FIG. 5—SINGLE-PHASE TYPE TG GROUND DETECTOR

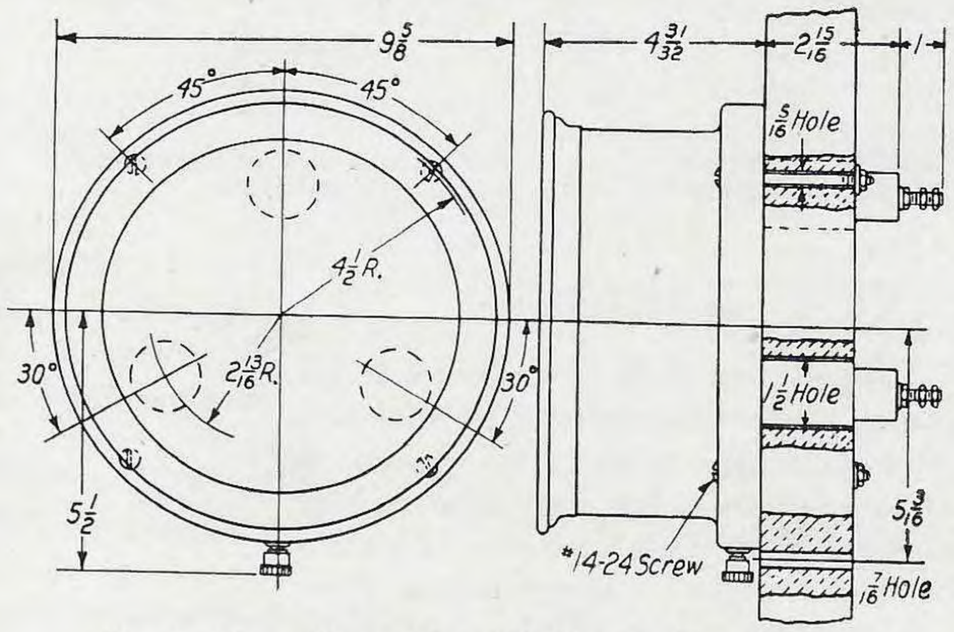


FIG. 6—THREE-PHASE TYPE TG GROUND DETECTOR

Voltage	F	C
2200	2¾	10
3500	2⅞	12
6600	3	16½
11000	2⅞	19¾
22000	3¼	24¼

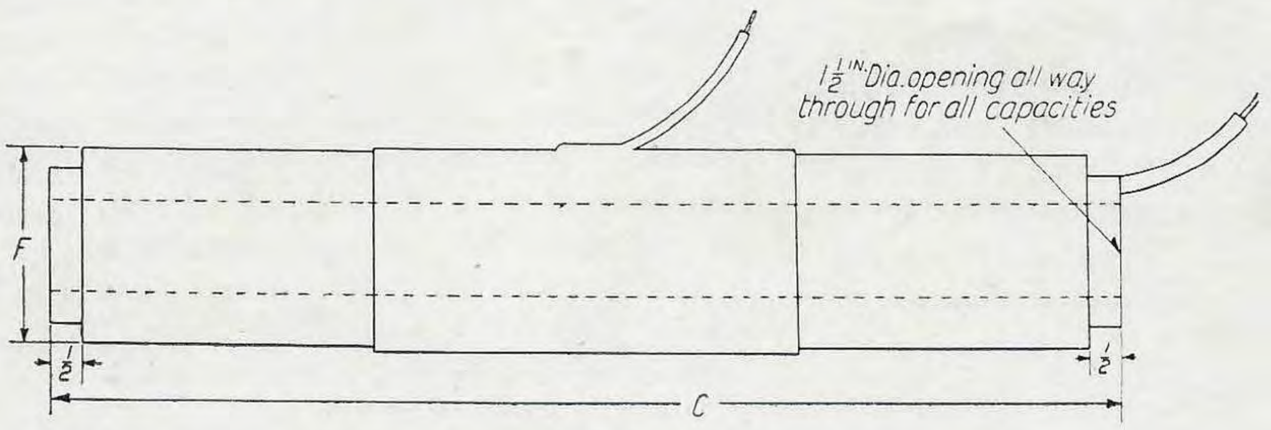


FIG. 7—CONDENSER FOR USE WITH TYPE TG GROUND DETECTOR

Prices are subject to change without notice.
Dimensions are for reference only. For official dimensions refer to nearest district office.

Order by Style Number

TYPES KA, KX, AND KY SWITCHBOARD INSTRUMENTS

A-C., D-C., Radio-Frequency, and Rectox Types

FIG. 1

DATA

CASE SIZE OVER FLANGE	4" x 4¼"
BODY SIZE	3¾" x 4"
SCALE LENGTH	3½"
ACCURACY	
D-C. AND A-C.	WITHIN 1%
RADIO-FREQUENCY	WITHIN 2%
RECTOX	WITHIN 5%
MOUNTING	FLUSH
DIAL	ILLUMINATED
CASE	STEEL

WEIGHTS:	NET	SHIPPING
TYPE KA AMMETERS AND VOLTMETERS	2 LB. 7 OZ.	4 LB.
TYPE KX AMMETERS AND VOLTMETERS	2 LB. 12 OZ.	4 LB.
TYPE KY SINGLE-PHASE WATTMETERS, POWER-FACTOR METERS, AND REACTIVE KV-A. METERS WITH EXTERNAL RESISTORS	4 LB.	6 LB.
TYPE KY POLYPHASE WATTMETERS, POWER-FACTOR METERS, AND REACTIVE KV-A. METERS WITH EXTERNAL RESISTORS	6 LB.	8 LB.

Application

Type K switchboard instruments are especially suited for power station miniature switchboards and for industrial panels where space and mounting arrangements require medium-sized instruments. They may be used also for radio transmitter panels where they add considerable to the finished appearance of a transmitter because of their neatly arranged scales and flush-mounting details. Six-volt lamps for dial illumination increases the readability in locations where the illumination is below 5 foot-candles. A complete line is available including ammeters, voltmeters, wattmeters, power-factor meters, frequency meters, radio frequency ammeters, and Rectox types. The cases are arranged for flush mounting only and the outside flange dimensions are 4 inches wide by 4¼ inches high.

Construction and Operation

Cases—All cases are of the same size, and are made of heavy-gauge steel drawn into rectangular cup shapes. An opening is provided at the bottom for the molded base and the top is flanged to provide a support for the instrument case against the panel. The Moldarta base supports the movement. The entire mechanism and base is assembled into the case from the front and held in place by three screws on the back of the case. The mechanism may therefore be removed from the front of the case while mounted on the panel, by disconnecting the external wiring and removing three screws at the rear.

All type K instruments are flush mounted only. Standard mounting details consist of a metal trim which slips over the body of the instrument and four studs on the back of the flange. This trim rests against the back of the panel and is held in place by special nuts screwed on the flange studs. The studs are of sufficient length to fit panels up to one inch in thickness and the special nuts are threaded so that they are also suitable for thin panels such as steel.

The flange studs are located on the four corners of the flange and clear the edges of the flange. Interference with the case body is prevented by the rounded corners on the case. This makes it

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Newark Works, Newark, N. J.

Printed in U.S.A.
Reprit (12-37)

TYPES KA, KX AND KY SWITCHBOARD INSTRUMENTS--Continued

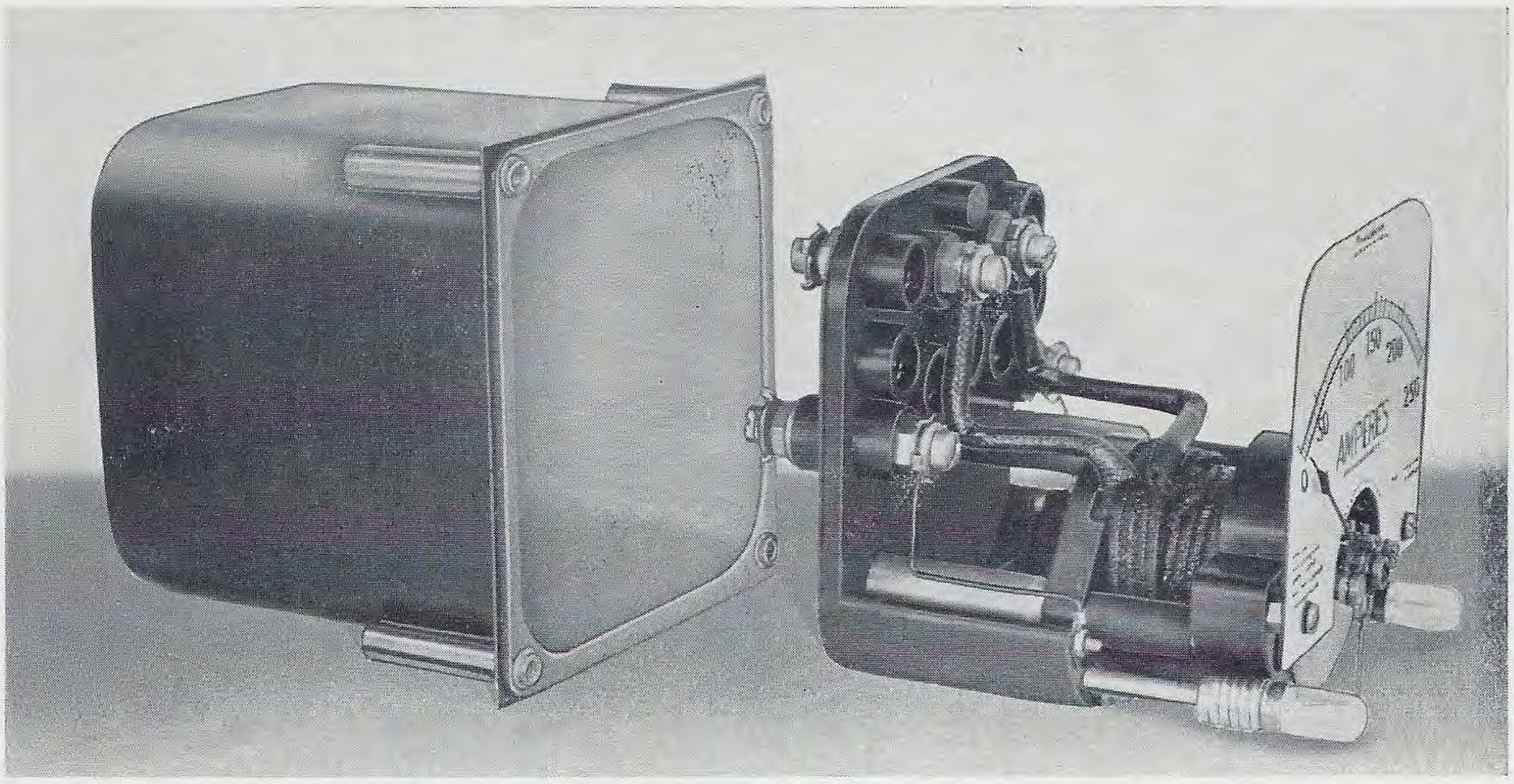


FIG. 2—TYPE KA AMMETER, SHOWING INTERNAL CONSTRUCTION, AND CASE WITH MOUNTING NUTS. NOTICE THE DIAL LAMPS WITH THE BAYONET BASES

possible to substitute for the panel a lattice frame-work built up from narrow steel strips leaving spaces 3¾" wide x 4" high to mount the instruments. When so mounted, the case flanges of all instruments will be adjacent with practically no clearance and make an almost solid front of instruments on the panel.spacing to make wiring easy. They are This permits the instruments to bethreaded to receive a 10-32 screw for mounted with the greatest space econ-ratings up to and including 20 amperes omy and avoids the cutting of holes in aand $\frac{5}{16}$-32 screw for more than 20 am-panel for the cases. peres. All current carrying terminals are

Terminals—The terminals are mount-designed for high mechanical strength ed in the Moldarta base with sufficientand are well insulated from the case.

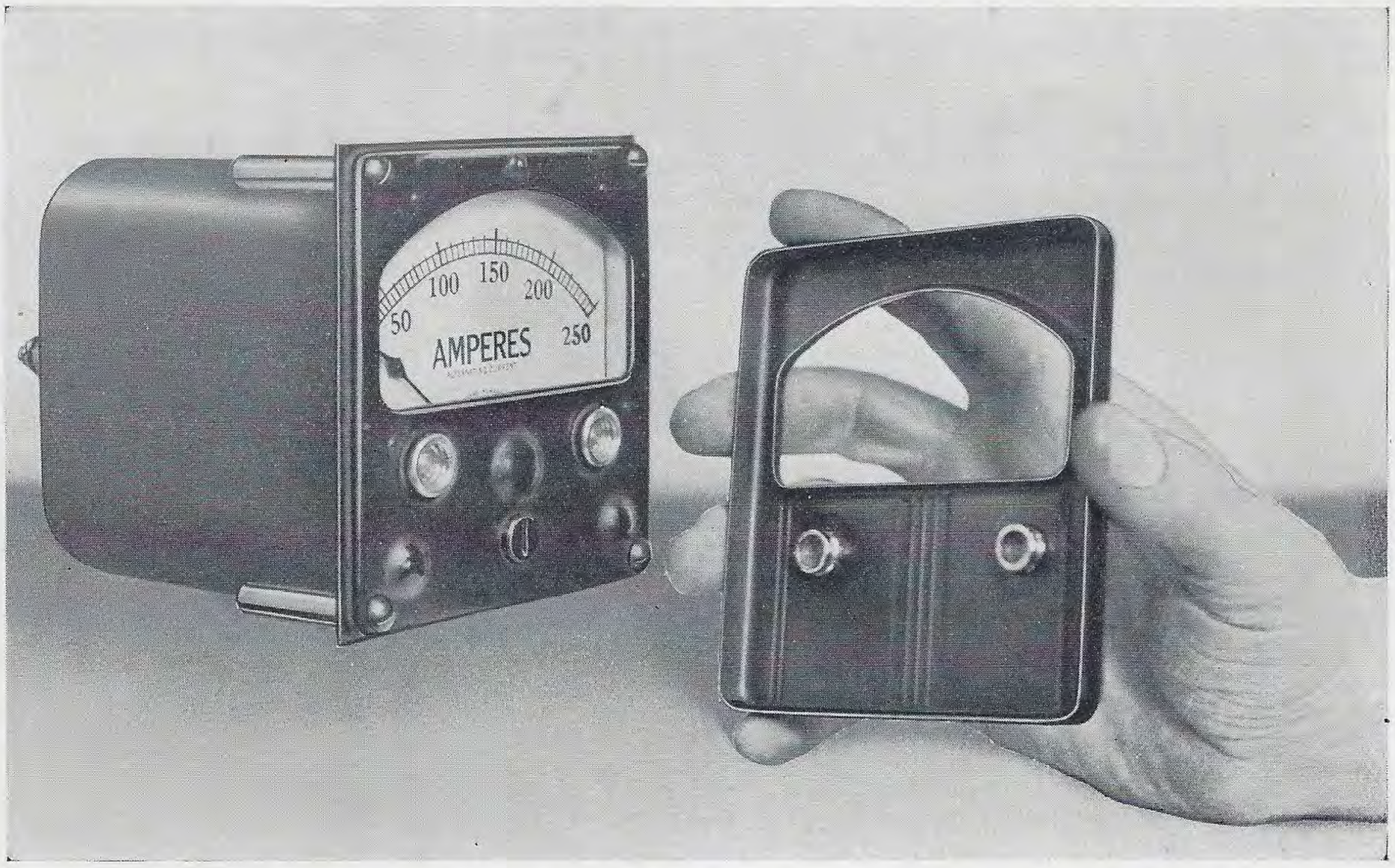


FIG. 3—TYPE KA AMMETER SHOWING THE GASKETED INSIDE COVER PLATE AND THE SNAP-ON SCREWLESS COVER PLATE

TYPES KA, KX AND KY SWITCHBOARD INSTRUMENTS—Continued

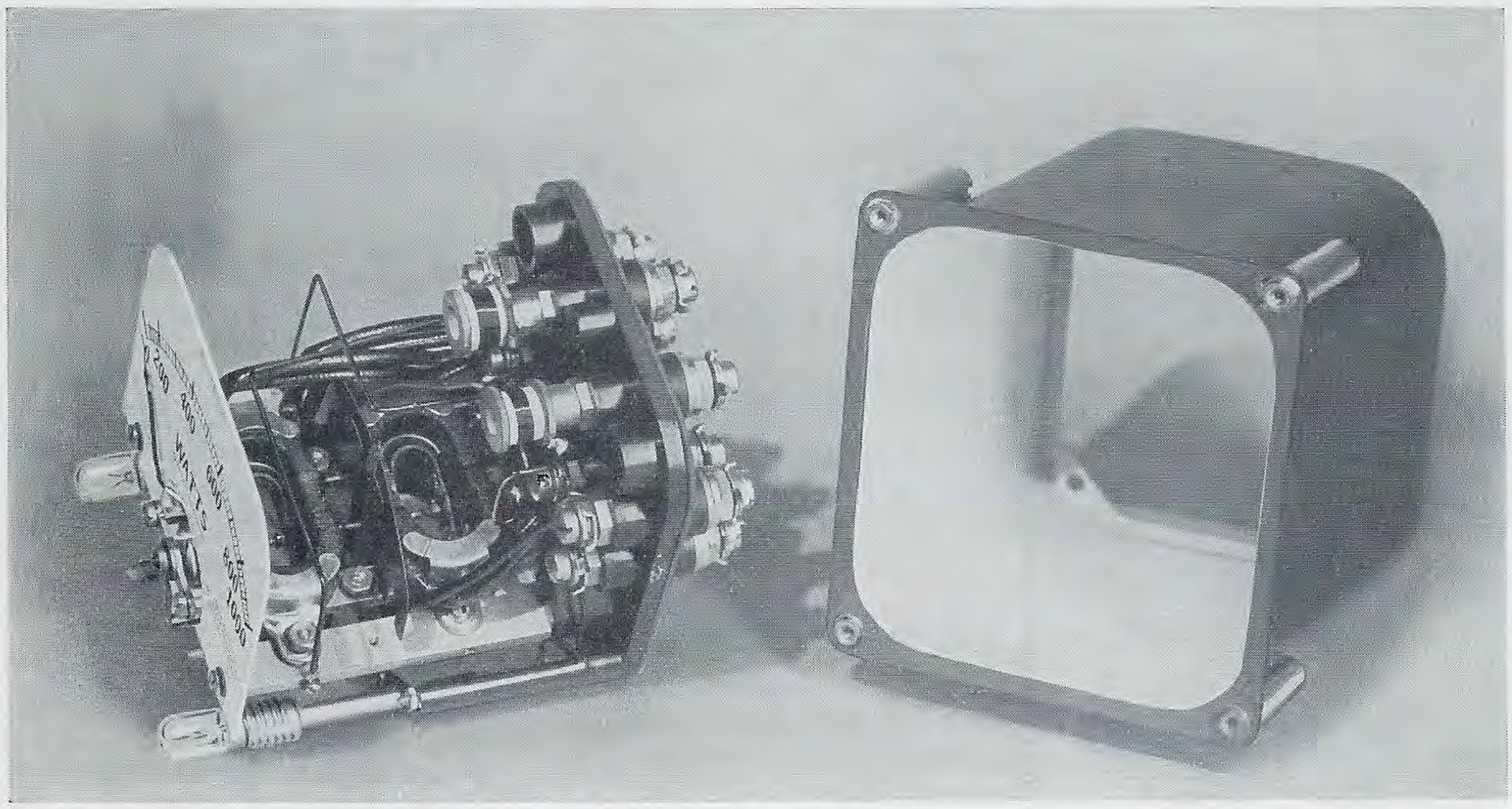


FIG. 4—TYPE KY POLYPHASE WATTMETER, SHOWING THE COMPACT CONSTRUCTION. THESE WATTMETERS ARE FREE FROM FREQUENCY, VOLTAGE AND WAVE FORM ERRORS OVER A WIDE RANGE

Screwless Cover—The fronts of type K instruments are decorated with a screwless cover plate which is held in place by spring snaps. This plate may be easily removed for zero adjustment. The instrument is made dust-proof by means of a second inside cover plate which holds the glass front and is secured to the case by four screws. A gasket between this plate and the case makes the case entirely dust-proof. The inside cover plate is concealed by the snap-on decorative cover.

Dials—All type K dials are made of metal to prevent warping or discoloration with age. The scales and figures are arranged for easy reading. A new type of target on the pointer gives an artistic appearance to the entire scale and dial arrangement and also aids in accurate readings of the scale. Small clearance between the scale and pointer reduces parallax.

The dials are illuminated by two 6-volt lamps mounted below the dial on removable studs improving the readability considerably, especially where the outside illumination is below 5 foot-candles. The lamps are wired to two extra terminals on the base and they can

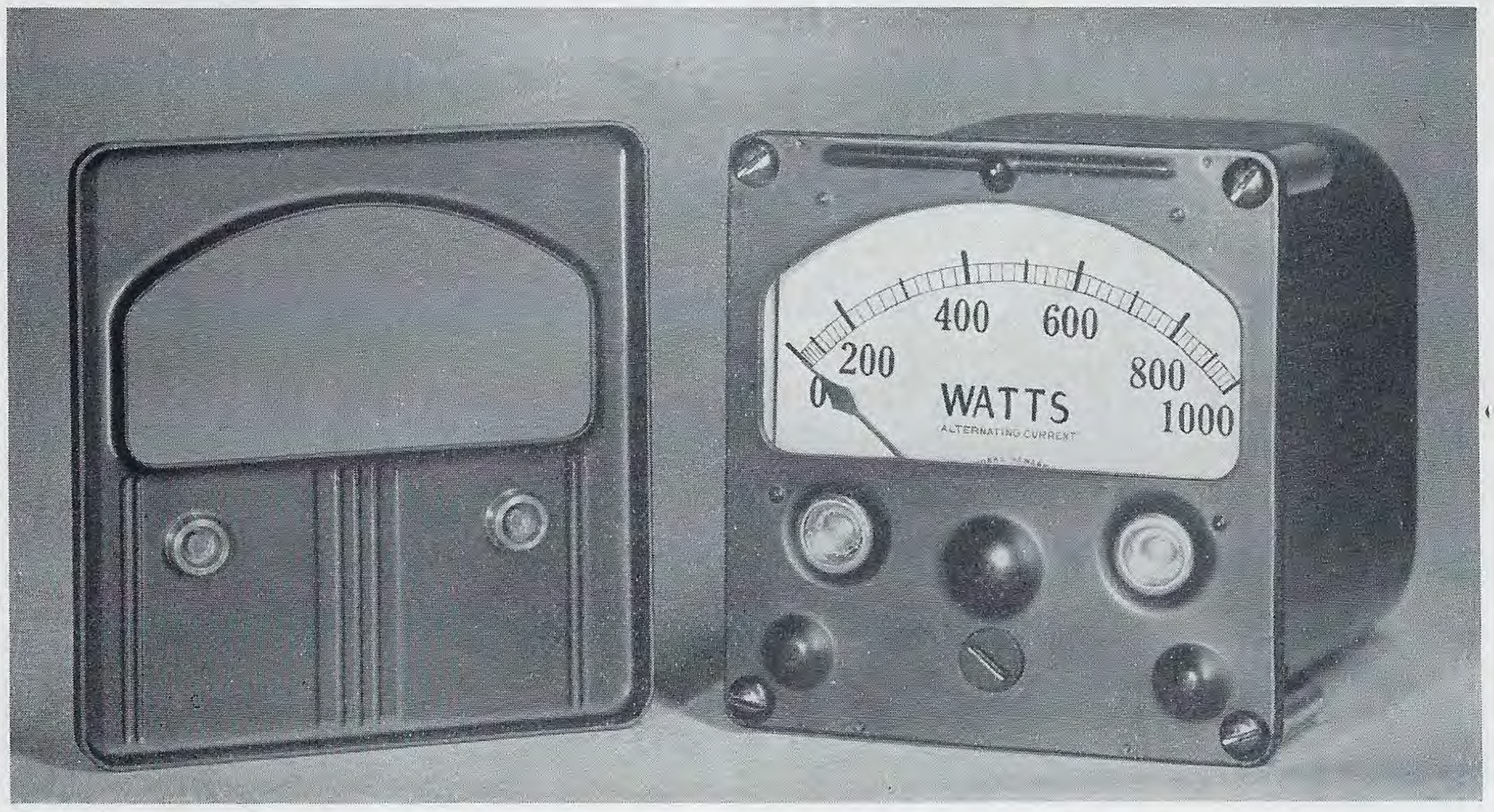


FIG. 5—TYPE KY POLYPHASE WATTMETER WITH DECORATIVE COVER PLATE REMOVED TO SHOW ZERO ADJUSTER, MOUNTING STUDS, AND COVER SNAP-ON BUTTONS

TYPES KA, KX AND KY SWITCHBOARD INSTRUMENTS—Continued

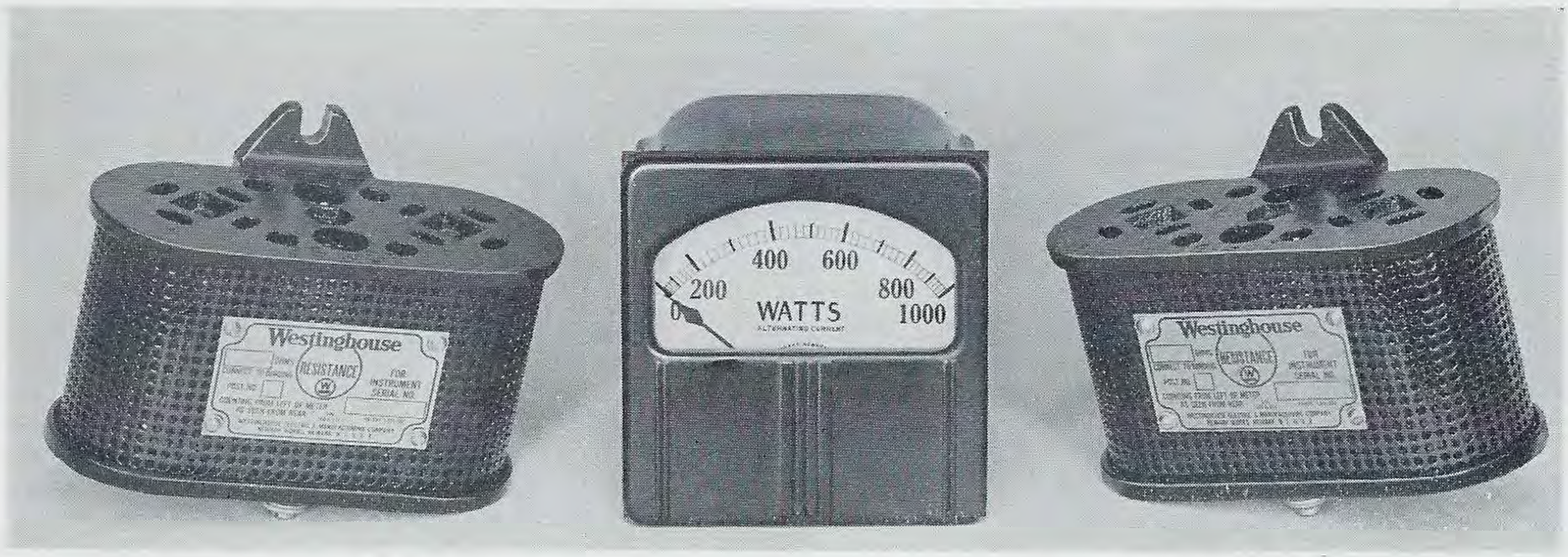


FIG. 6—TYPE KY POLYPHASE WATTMETER WITH EXTERNAL RESISTANCE BOXES

be replaced by removing the front cover plates.

Movements—The following types of movements are used in type K instruments:

For Alternating Current—

Ammeters—Repulsion iron vane

Voltmeters—Repulsion iron vane

Wattmeters—Electro-dynamometer

Power Factor Meters—Electro-dynamometer

Frequency Meters—Electro-dynamometer

Rectox types—d'Arsonval with Rectox rectifier

Radio-Frequency types—d'Arsonval with thermocouple.

For Direct Current—

All instruments—d'Arsonval

Performance Characteristics

Accuracy and Permanence of Calibration—All movements used in this line of instruments are time-tried and proven by years of service in other Westinghouse switchboard instruments. They embody the highest grade workmanship and the best of instrument design practice. The control springs are the result of years of experience in the art of aging and heat treatment and are made of the finest materials. Permanent magnets are high grade tungsten steels properly aged and heat treated. Pivots have a very high degree of polish to resist corrosion and are made from special composition steels properly treated to give long life and resist the wearing forces of vibration. All moving and stationary coils are carefully wound to obtain proper performance, and provide an adequate margin on insulation. On all these fundamental parts depend the accuracy and permanency of calibration and the utmost care is given to their design and manufacture.

Torque-Weight Ratio—The torque-weight ratio is a measure of the ability of the instrument to give accurate indications and overcome frictional forces. Torque-weight ratios are kept high by use of special light-weight parts and adequate torques in all moving elements.

Damping—All electro-dynamometer and repulsion iron vane type K instruments are air damped by means of special-shaped light-weight vanes operating in closed dustproof chambers. Adequate damping is obtained by this system and practically any degree of damping is easily obtained, with a minimum of parts and simple construction. All d'Arsonval instruments are damped by eddy currents in the moving coil frame.

Responsiveness—All type K instrument movements are designed to give a quick acting pointer with minimum time to come to rest at the desired reading.

Rectox Movements—For measurement of alternating currents where low energy consumption is necessary, the Rectox type of movement should be used. This consists of a copper-oxide rectifier and a d'Arsonval instrument. The alternating current is rectified and measured on the d-c. movement which is calibrated in terms of effective value of the a-c. wave. This makes it possible to take advantage of the high sensitivity of the d'Arsonval movement to measure a-c. Very sensitive a-c. instruments are available in type K with the Rectox rectifier.

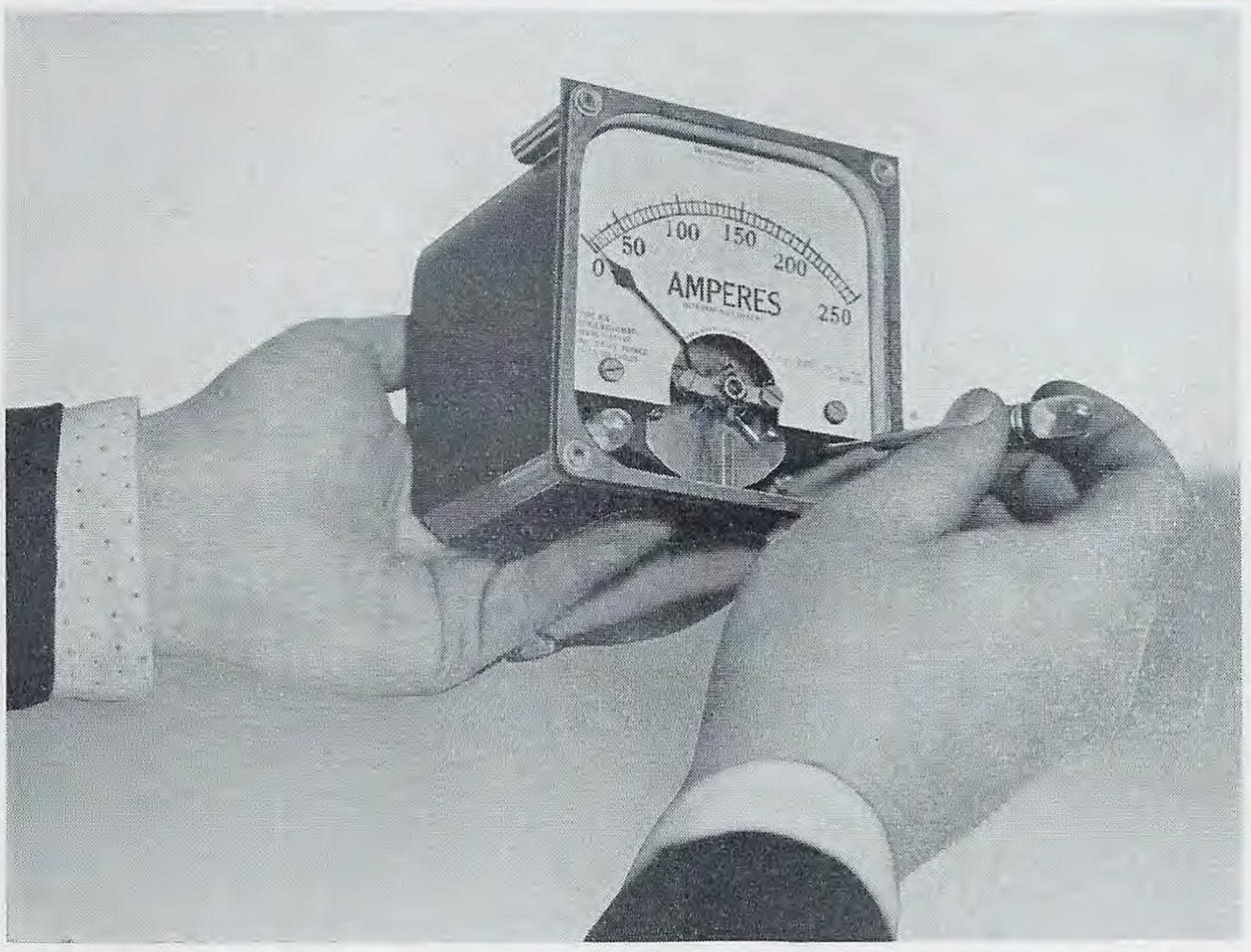


FIG. 7—THE DIAL LAMPS ARE EASILY REPLACED FROM THE FRONT OF THE INSTRUMENT BY REMOVING THE TWO COVER PLATES. BAYONET CONTACTS ARE USED

TYPES KA, KX AND KY SWITCHBOARD INSTRUMENTS—Continued

FIG. 8—TYPE KA A-C. AMMETER

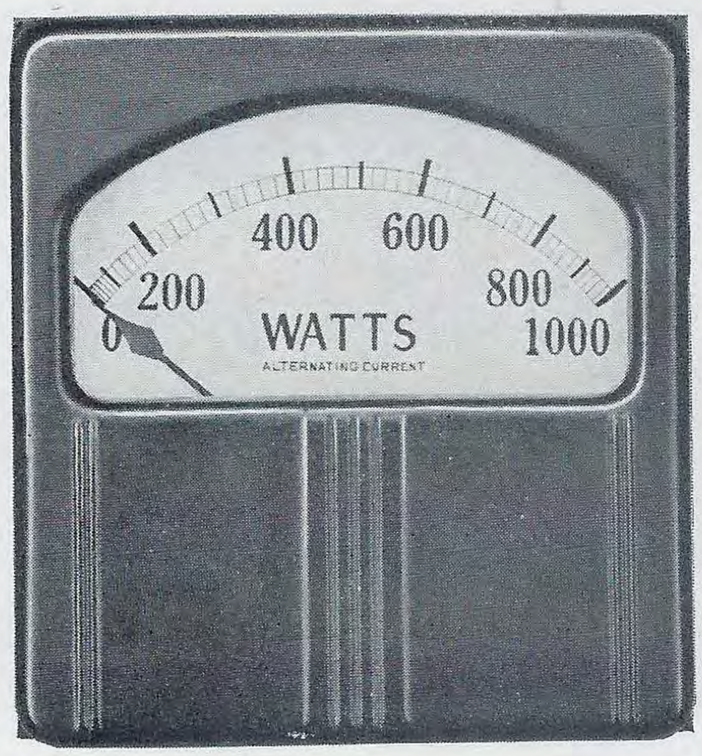


FIG. 9—TYPE KY POLYPHASE WATTMETER

POWER CONSUMPTION

BURDEN ON CURRENT TRANSFORMER AT 5 AMPERES

	Cycles	V. A.	Watts	Reactive Component	Per Cent. P. F.
Type KA Ammeter	25	.45	.43	.14	95
Type KA Ammeter	60	.54	.43	.34	79
Type KY Wattmeters*	25	1.94	1.93	.12	99 plus
Type KY Wattmeters*	60	1.95	1.93	.29	99
Type KY Power Factor Meter	25	1.94	1.93	.12	99 plus
Type KY Power Factor Meter	60	1.95	1.93	.29	99

BURDEN ON VOLTAGE TRANSFORMER AT 115 VOLTS

Type KA Voltmeter	25	3.52	3.52	.023	99 plus
Type KA Voltmeter	60	3.52	3.52	.055	99 plus
Type KY Single-Phase Wattmeter	25	3.27	3.27	0	100
Type KY Single-Phase Wattmeter	60	3.27	3.27	0	100
Type KY Polyphase Wattmeter*	25	2.88	2.88	0	100
Type KY Polyphase Wattmeter*	60	2.88	2.88	0	100
Type KY Frequency Meter	25	3.5	3.5	.13	99 plus
Type KY Frequency Meter	60	3.5	3.5	.24	99 plus
Type KY Polyphase Power Factor Meter	25	3.7	3.7	0	100
Type KY Polyphase Power Factor Meter	60	3.7	3.7	0	100
Type KY Single-Phase Power Factor Meter	25	17.8	13.9	11.1	78
Type KY Single-Phase Power Factor Meter	60	17.8	13.9	11.1	78

*Values given are for single element. Polyphase wattmeters have two elements.

LIST PRICES

TYPE KX AMMETERS

Direct Current

Calibrated for Use with 50 Millivolt Shunts

Specify Shunt Rating

Rating	Style No.	List Price Discount Symbol BC
Same as shunt†	724585	$39 00

†Style No. and List Price include leads.

TYPE KX AMMETERS—SELF CONTAINED

Direct Current

Rating	Scale Divisions	Style No.	List Price Discount Symbol BC
1	50	724586	$44 50
2.5	50	821401	44 50
5	50	821404	44 50
8	40	821406	44 50
10	50	821407	44 50
15	30	821408	44 50
25	50	821410	44 50

Order by Style Number

Prices and discounts subject to change without notice.

TYPES KA, KX AND KY SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE KX VOLTMETERS

Direct Current

Resistance—200 Ohms per Volt

Rating	Scale Divisions	Style No.	List Price Discount Symbol BC
1	50	821497	$39 00
2.5	50	821500	39 00
5	50	821503	39 00
8	40	821505	39 00
10	50	821506	39 00
15	30	821507	39 00
25	50	821509	39 00
50	50	821512	39 00
100	50	821515	39 00
150	30	724588	39 00
250	50	821517	43 00
300	30	821518	43 00
400	40	821519	45 00
500	50	821520	46 00
600	30	821521	51 00
800	40	821522	55 00

TYPE KX MILLIAMMETERS

Direct Current

Rating	Approx. Resistance in ohms.	Scale Divisions	Style No.	List Price Discount Symbol BC
.5	308	50	821436	$41 00
1	200	50	724587	41 00
2.5	67	50	821439	41 00
5	10	50	821442	39 00
8	6	40	821444	39 00
10	5	30	821445	39 00
15	3	30	821446	39 00
25	1	50	821448	39 00
50	1	50	821451	39 00
100	.5	50	821454	39 00
150	.33	30	821455	39 00
250	.20	50	821457	39 00
300	.17	30	821458	39 00
400	.12	40	821459	39 00
500	.10	50	821460	39 00
600	.083	30	821461	40 00
800	.062	40	821462	42 00

TYPE KX RECTOX VOLTMETERS

Alternating Current

Resistance—1000 Ohms per Volt

Rating	Scale Divisions	Style No.	List Price Discount Symbol BC
5	50	821467	$48 00
8	40	821469	48 00
10	50	821470	48 00
15	30	821471	48 00
25	50	821473	48 00
50	50	821476	48 00
80	40	821478	48 00
100	50	821479	48 00
150	30	821480	50 00
200	40	821481	50 00
250	50	821482	52 50
300	30	821483	54 00

Resistance—2000 Ohms per Volt

2.5	50	821456	48 00

Resistance—5000 Ohms per Volt

1	50	724589	48 00

Order by Style Number

Prices and discounts subject to change without notice.

TYPES KA, KX AND KY SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE KX RECTOX MILLIAMMETERS

Alternating Current

Rating	Scale Divisions	Style No.	List Price Discount Symbol BC
.5	50	821484	$46 00
1	50	821485	46 00
2.5	30	821488	46 00
5	50	821491	44 00
8	40	821493	44 00
10	50	821494	44 00

TYPE KX RADIO FREQUENCY AMMETER

For Use with External Thermocouple

Rating	Style No.	List Price Discount Symbol BC
Uncal.*	821495	$41 00

Radio frequency ammeters are available with external thermocouples in all ranges from 1 to 50 amperes inclusive. When long leads are used between the instrument and the thermocouple, it is usually necessary to place proper by-pass condensers and radio-frequency chokes in the circuit at the thermocouple to prevent damage to the thermocouple by radio-frequency current in the instrument leads. Additional information on this subject will be furnished upon request.

*List price includes the ammeter calibrated but not the thermocouple.

TYPE KA AMMETERS

Alternating Current

Rating	Scale Divisions	Style No.	List Price Discount Symbol BC
Transformer Types			
.1*†	50	724574	$37 00
1*	50	724575	35 00
5*	50	724576	35 00

*Calibrated as desired for use with current transformers, specify transformer ratio.
†Special for 0.1-amp. secondary transformers.

Self-Contained			
5	50	836405	35 00
10	50	836396	35 00
15	30	836397	39 00
25	50	836398	39 00
30	30	836399	39 00
40	40	836400	41 00
50	50	836401	41 00
60	30	836402	41 00

TYPE KA VOLTMETERS

Alternating Current

Rating	Scale Divisions	Style Number	List Price Discount Symbol BC
150†	30	837556	$40 00
150‡	30	724572	37 00
150	30	724573	37 00
300	30	836494	41 00
600	30	836495	49 00
750	75	836496	53 00

†Special low-burden of 1.75 watts at 115 volts for use with condenser bushing potential device.
‡Transformer rated—specify transformer ratio.

Order by Style Number

Prices and discounts subject to change without notice.

TYPES KA, KX AND KY SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE KY WATTMETERS

When ordered for use with transformers, specify transformer ratio.

Single-Phase

Rating Amps.	Volts	Style No.	List Price Discount Symbol BC
.1*	115	724577	$62 00
.1*	230	836461	66 00
.1*	460	736462	71 00
5	115	724578	60 00
5	230	836457	64 00
5	460	836458	69 00
10	115	837231	60 00
10	230	836459	64 00
10	460	836460	69 00

Polyphase

When ordered for use with transformers, specify transformer ratio.

.1*	115	724579	92 00
.1*	230	836473	100 00
.1*	460	836474	110 00
5	115	724580	90 00
5	230	836466	98 00
5	460	836470	108 00
10	115	836465	90 00
10	230	836468	98 00
10	460	836472	108 00

Polyphase with Three Current Coils for Three Phase 4-Wire Circuits

When ordered for use with transformers, specify transformer ratio.

.1*	115	836480	102 00
5	115	837232	100 00

*Special for 0.1-amp. secondary transformer

POLYPHASE REACTIVE VOLT-AMPERE METERS

Zero-Center Scales

Amps.	Volts	Frequency	Style No.	List Price Discount Symbol BC
4†	115	60	836475	$ 110 00
5†	115	60	836476	110 00
.1*†	115	60	837233	112 00
4†	115	25	837234	110 00
5†	115	25	837235	110 00
.1*†	115	25	837236	112 00

*Special for 0.1-amp. secondary transformer
†Style Number and List Price includes compensator.
†For Three Phase Four Wire Circuits Add $10 00 List.

FREQUENCY METERS

Rating Volts	Rating Frequency	Scale Divisions	Style No.	List Price Discount Symbol BC
115	23–27	40	836501	$135 00
115	20–30	50	836491	115 00
115	58–62	40	836502	135 00
115	50–70	40	836492	115 00

POWER FACTOR METERS

Single-Phase

Amps.	Volts	Frequency	Scale	Scale Divisions	Style No.	List Price Discount Symbol BC
.1*	115	25	50–100–50	50	836477	$97 00
.1*	115	60	50–100–50	50	724583	97 00
5	115	25	50–100–50	50	836479	95 00
5	115	60	50–100–50	50	836478	85 00

Polyphase

.1*	115	25/60	50–100–50	50	836481	77 00
5	115	25/60	50–100–50	50	836483	75 00
5	230	25/60	50–100–50	50	836485	79 00
5	460	25/60	50–100–50	50	836490	84 00
.1*	115	25/60	10–100–80	55	836482	77 00
5	115	25/60	10–100–80	55	836484	75 00
5	230	25/60	10–100–80	55	836486	79 00
5	460	25/60	10–100–80	55	836487	84 00

*Special for 0.1-amp. secondary transformer

Order by Style Number

Prices and discounts subject to change without notice.

TYPES KA, KX AND KY SWITCHBOARD INSTRUMENTS—Continued

LIST PRICES—Continued

No. 40 MAZDA LAMP

T 3—¼ MIN. SCREW BASE (6.3 V.—0.15A.)

Style	List Price
717744	Refer to Price List 120

TYPE MT TRANSFORMER

FOR SUPPLYING TYPE K ILLUMINATION

Style	Voltage	Frequency	Voltage-Amperes Capacity	List Price Discount Symbol BC
971456	115/6.3	50/60	100	$10 00

Order by Style Number

Prices and discounts subject to change without notice.

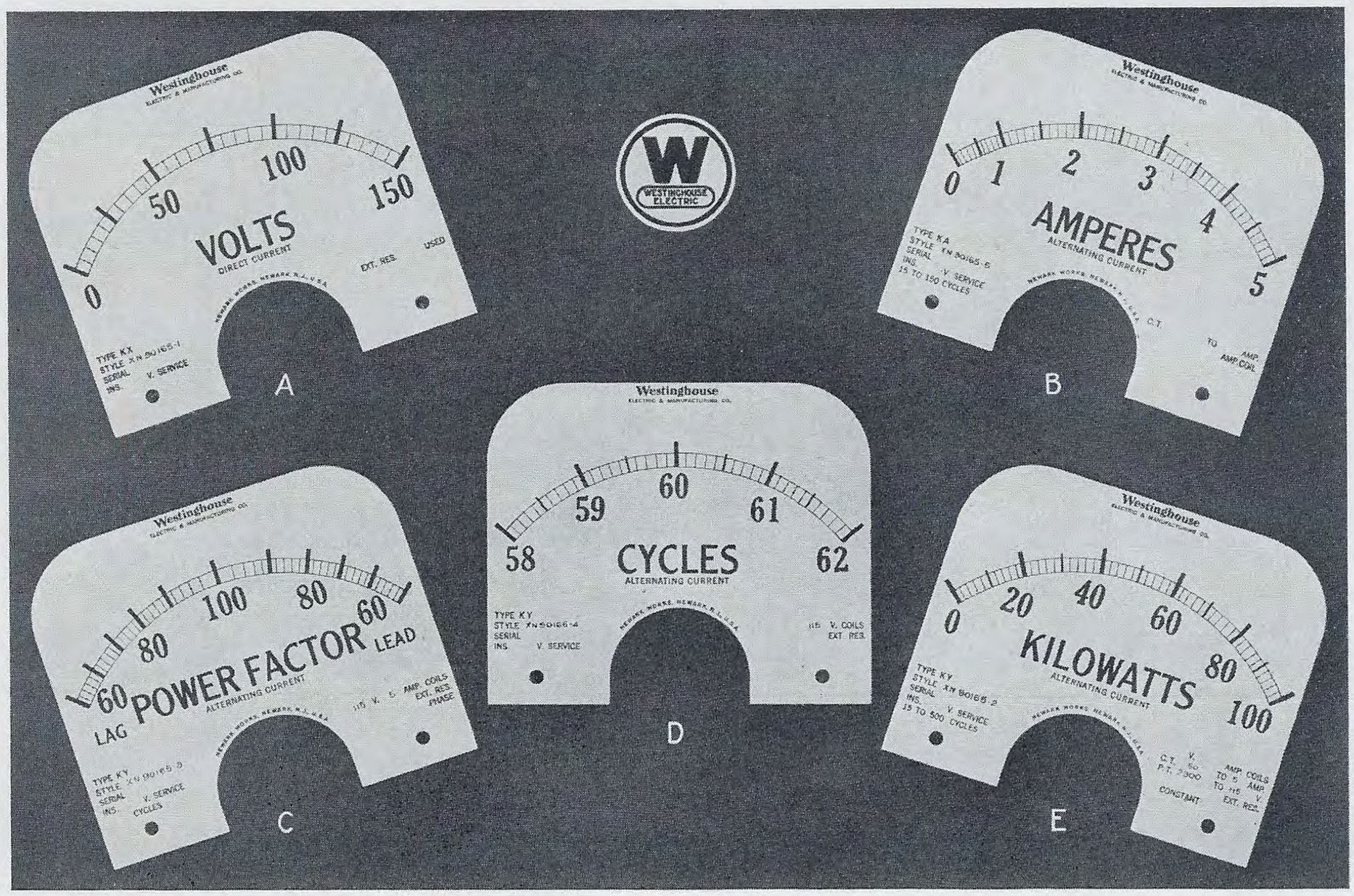


FIG. 10—LONG SCALES AND VERY CLEAR SCALE MARKINGS CHARACTERIZE TYPE K INSTRUMENTS.

TYPES KA, KX AND KY SWITCHBOARD INSTRUMENTS—Continued

EXTERNAL WIRING DIAGRAMS

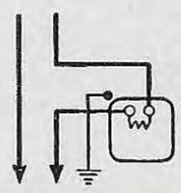


Fig.1 Self Contained Ammeter

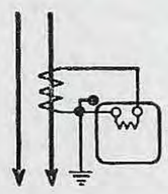


Fig. 2 Ammeter with Current Trans.

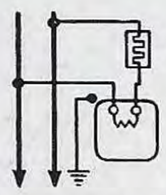


Fig.3 Voltmeter

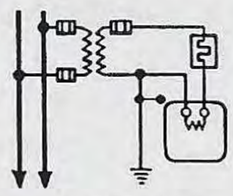


Fig. 4 Voltmeter with Potential Trans.

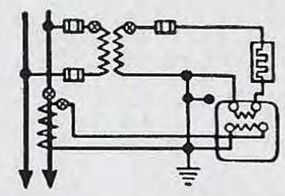


Fig.5 Single Phase Wattmeter on Single Phase Line

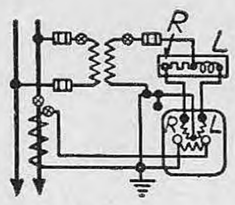


Fig. 6 Single Phase Power Factor Motor

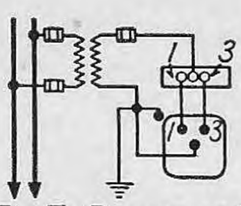


Fig. 7 Resonant Type Freq. Motor (Complete conn. 1 & 3 before connecting to line)

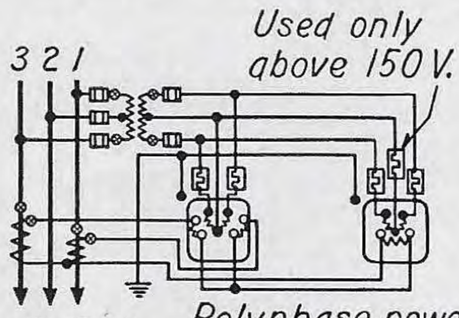


Fig. 8 Std. Polyphase Wattmeter

Polyphase power factor meter when used with 2 current trans. as shown

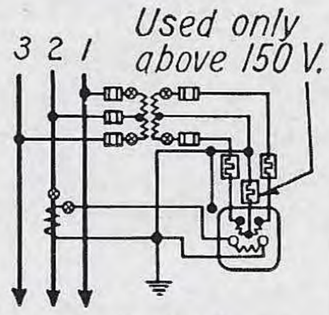


Fig. 9 Polyphase Power Factor Meter

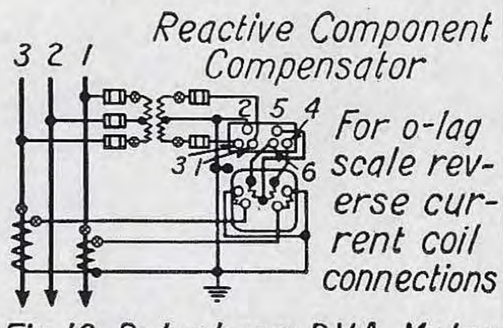


Fig. 10 Polyphase R.V.A. Meter with Reactive Component Compensator (Std. Wattmeter Calibration)

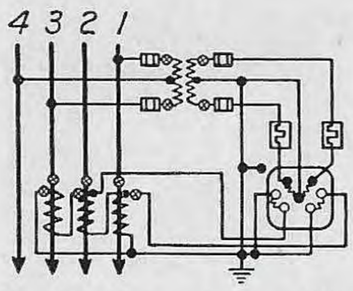


Fig. 11 Polyphase Wattmeter (Delta Conn. C.T.)

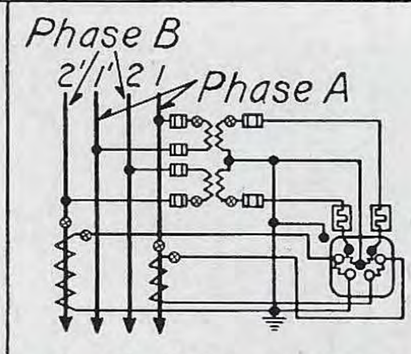


Fig. 12 2 Ph. 4 Wire Polyphase Wattmeter

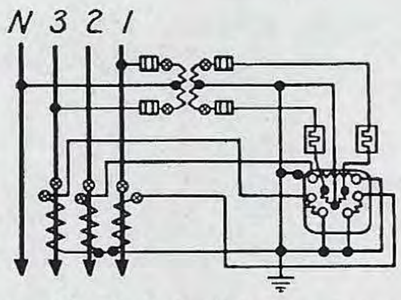


Fig. 13 3 C.C. Wattmeter

Fig. 14 For all Insts. with Illumination

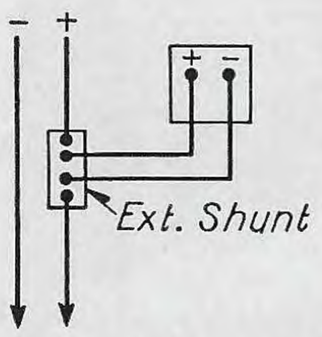


Fig. 15 D-C. Ammeter Ext. Shunt

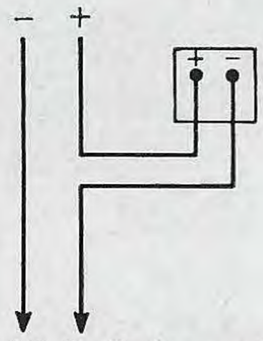


Fig. 16 D-C. Ammeter & Milliammeter Self Contained

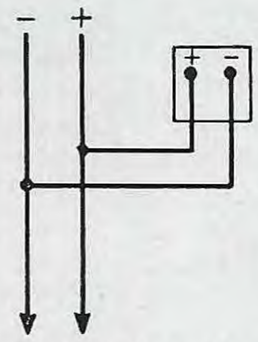


Fig. 17 D-C. Voltmeter Self Contained

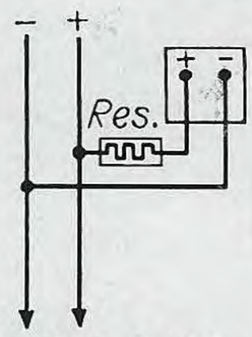


Fig. 18 D-C. Voltmeter with Ext. Res. above 500 V.

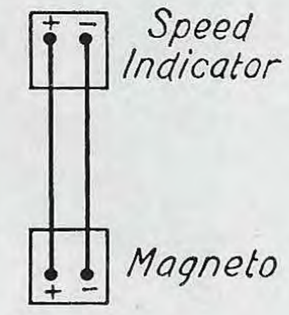


Fig. 19

FIG, 11--EXTERNAL WIRING DIAGRAMS FOR TYPE K INSTRUMENTS.

Diagrams are for reference only. For official diagrams apply to nearest Westinghouse Sales Office.

TYPES KA, KX AND KY SWITCHBOARD INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES

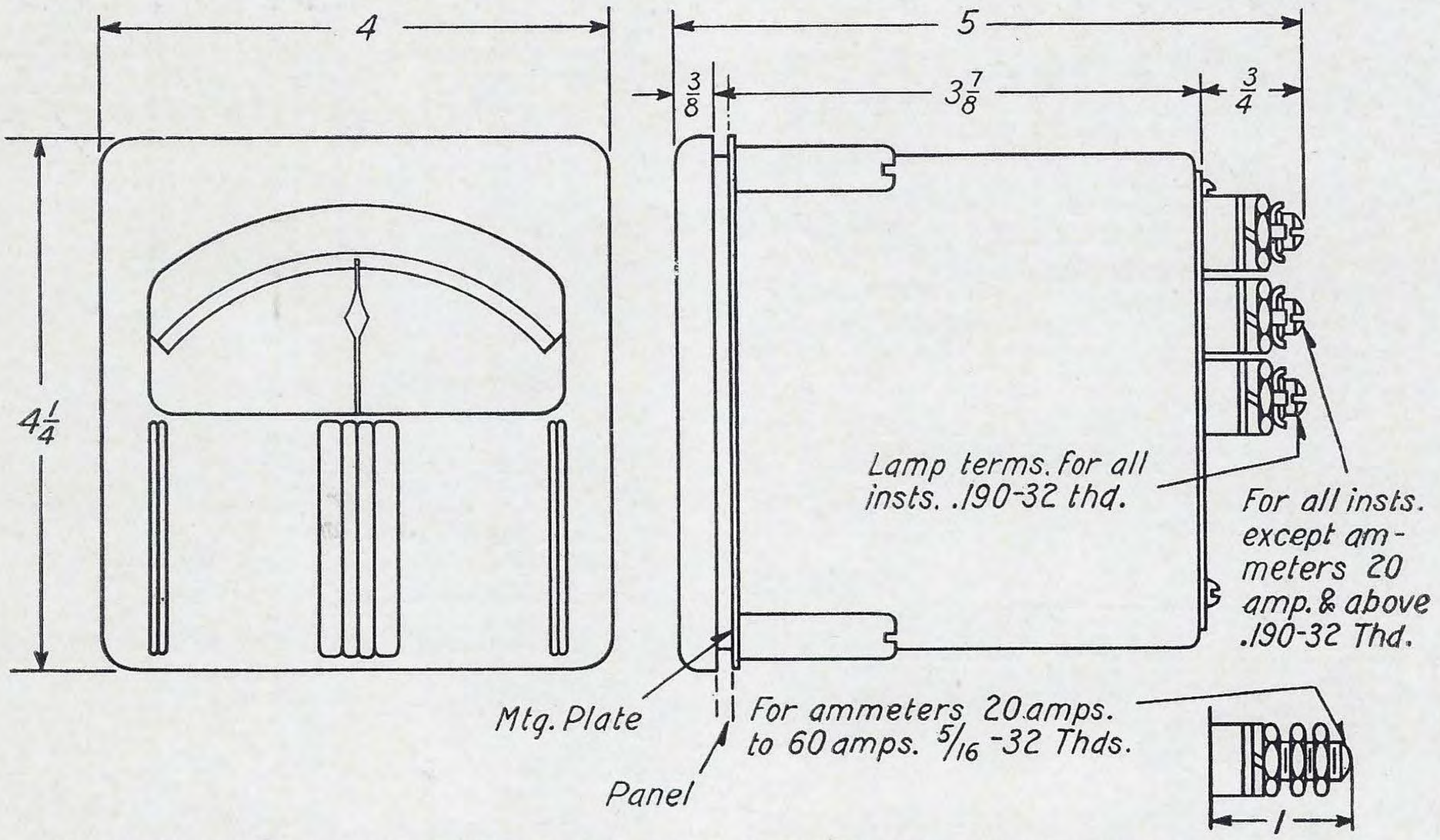


FIG. 12—OUTLINE DIMENSIONS OF THE STANDARD TYPE K CASE. THIS STANDARD CASE IS USED FOR ALL TYPE K INSTRUMENTS

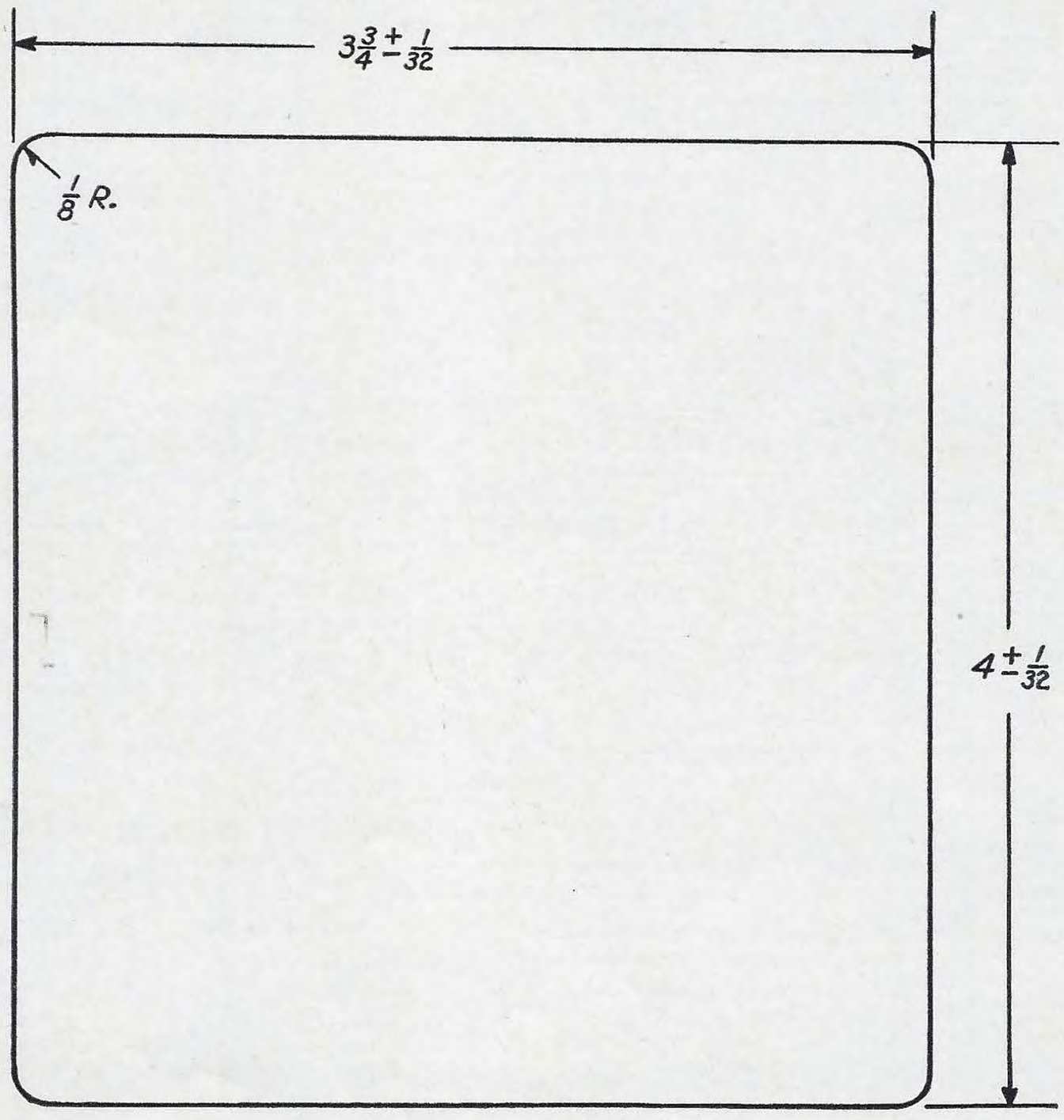


FIG. 13—DRILLING PLAN OF TYPE K INSTRUMENTS

Dimensions are for reference only. For official dimensions refer to nearest Westinghouse Sales Office.

TYPES KX, KA AND KY SWITCHBOARD INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

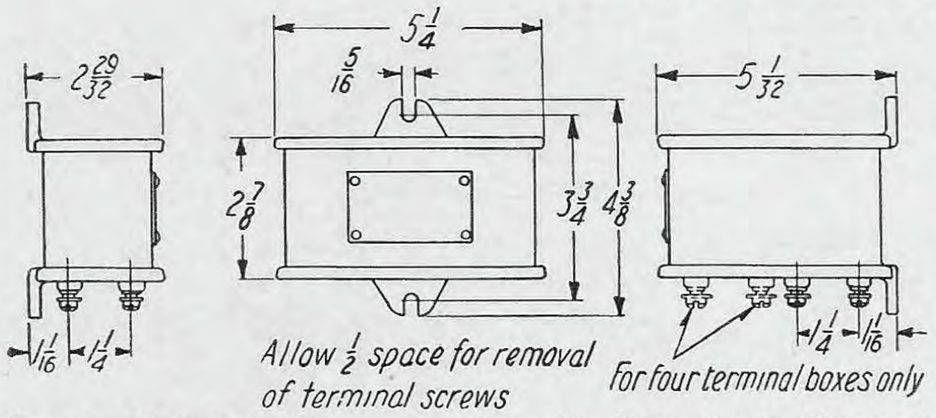


FIG. 14—TWO SPOOL RESISTOR USED WITH KA VOLTMETER TO 250 V. (1 REQ.) USED WITH KY SINGLE PHASE WATTMETER TO 300 V. (1 REQ.) USED WITH KY POLYPHASE WATTMETER AND 3 PHASE POWER FACTOR METER TO 250 V. (2 REQ.) ONE ADDITIONAL 2 SPOOL RESISTOR IS USED IN MIDDLE LINE OF 3 PHASE POWER FACTOR METERS ABOVE 150 V.

FIG. 15—FOUR SPOOL RESISTOR USED WITH KA VOLTMETER ABOVE 250 V. TO 750 V. (1 REQ.) USED WITH KY SINGLE PHASE WATTMETER ABOVE 300 V. TO 750 V. (1 REQ.) USED WITH KY POLYPHASE WATTMETER AND 3 PHASE POWER FACTOR METER ABOVE 250 V. TO 575 V. (2 REQ.)

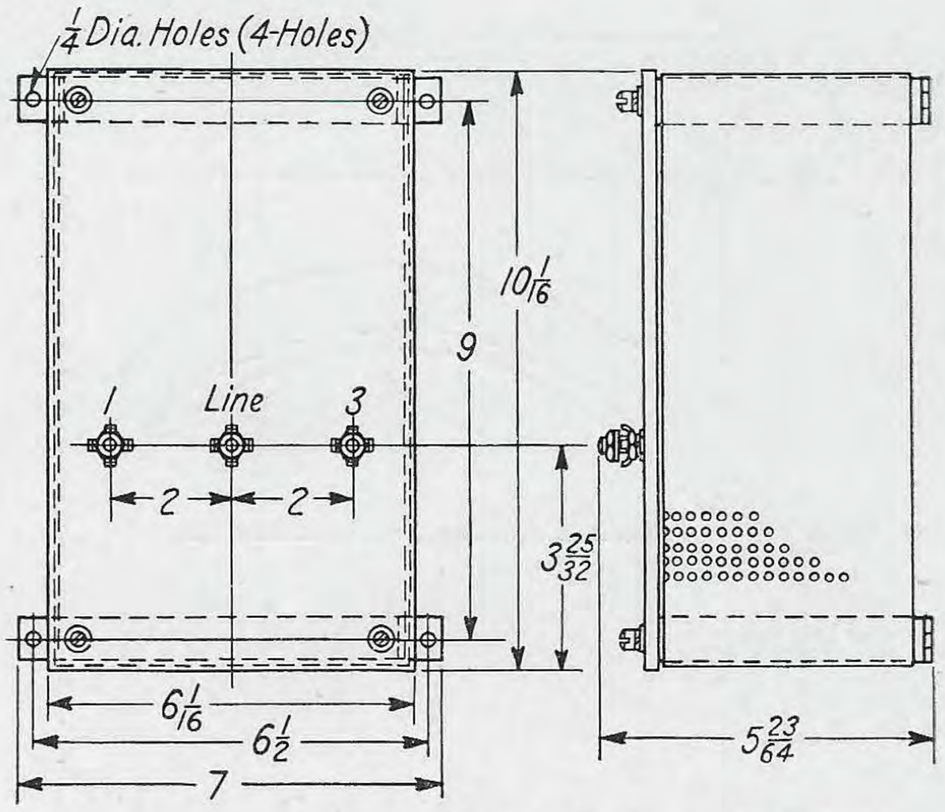


FIG. 20—REACTOR, USED WITH TYPE KY RESONANT CIRCUIT FREQUENCY METER ALL RANGES

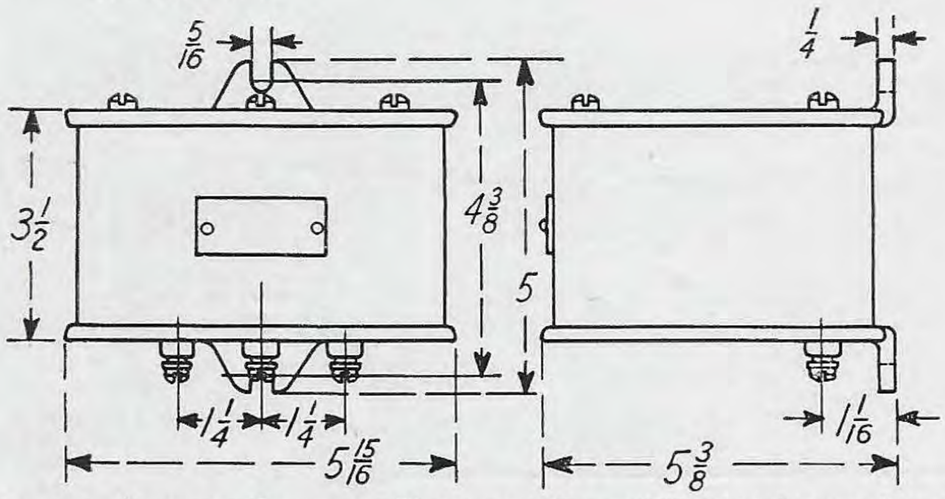


FIG. 16—REACTOR RESISTOR, USED WITH TYPE KY, 100° SINGLE PHASE POWER FACTOR METER

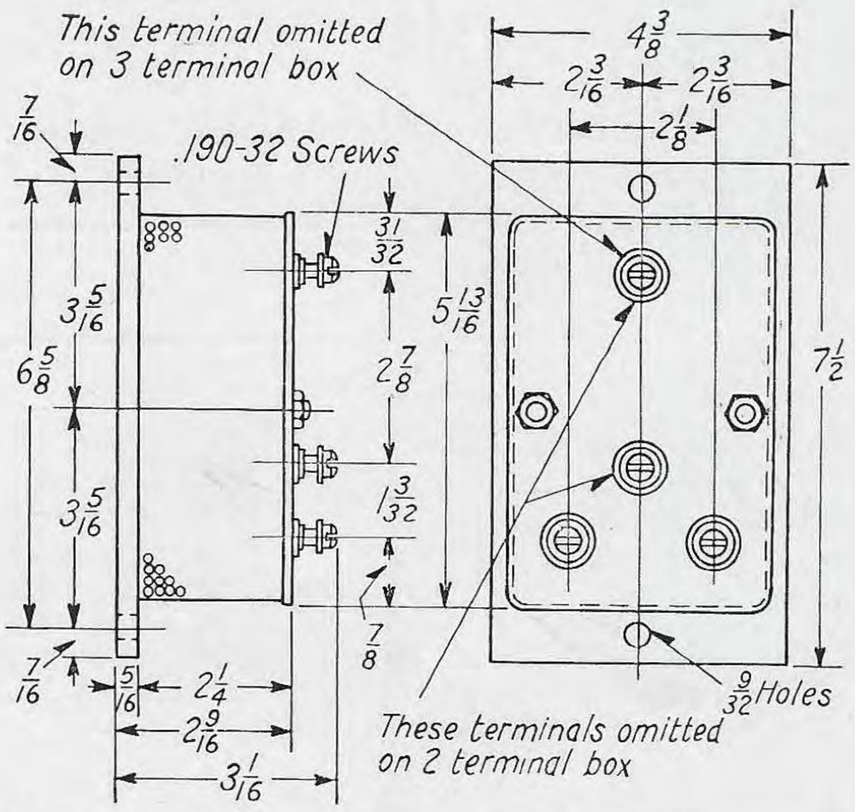


FIG. 21—TYPE R-3 RESISTOR, USED WITH TYPE KX VOLTMETER—RANGES 1500 V. TO 3000 V. INC.

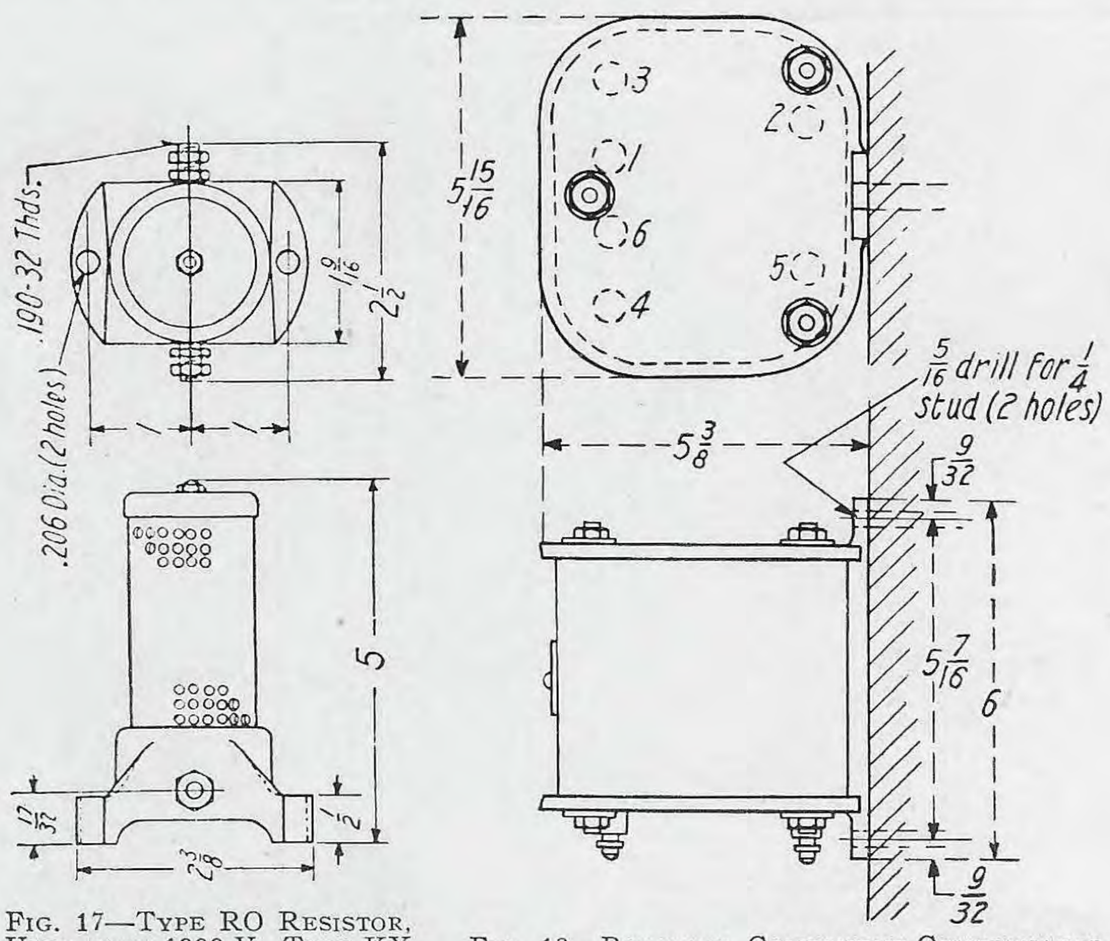
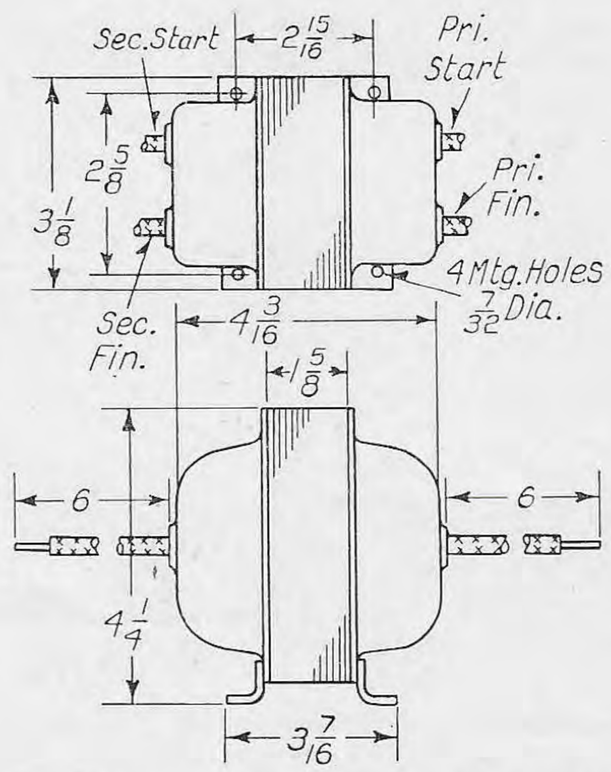


FIG. 17—TYPE RO RESISTOR, USED WITH 1000 V. TYPE KX VOLTMETER

FIG. 18—REACTIVE COMPONENT COMPENSATOR USED WITH 3-PHASE, 3-WIRE VAR METER



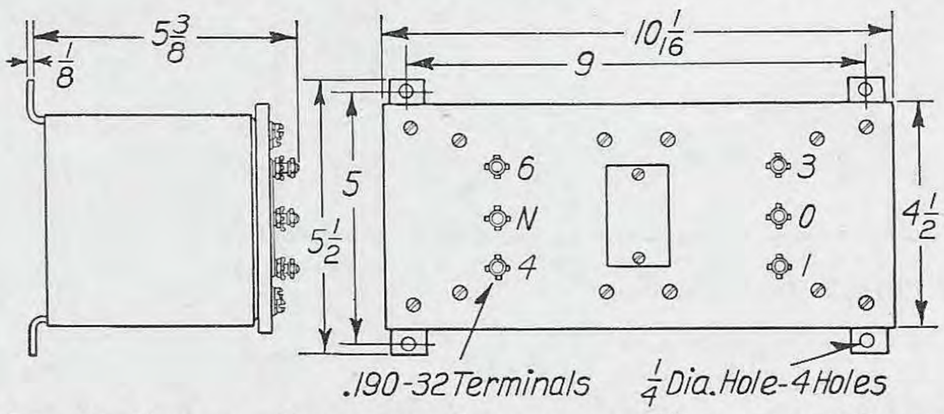


FIG. 19—REACTIVE COMPONENT COMPENSATOR, USED WITH 3-PHASE, 4-WIRE (3 CURRENT COIL) VAR METER

FIG. 22—TYPE MT TRANSFORMER, 100 VOLT AMPERES CAPACITY

Dimensions are for reference only. For official dimensions **apply** to nearest Westinghouse Sales Office.

SYNCHROTIE EQUIPMENT
FOR
REMOTE INDICATING AND RECORDING

Type ADS Synchrotie Position Indicators
Type SY Position Indicators
Type HA Position Indicators
Type HB Boiler Room Indicators
Type GH Position Recorder
Type TS Water Level Indicators
Type R Position Indicator Attachment

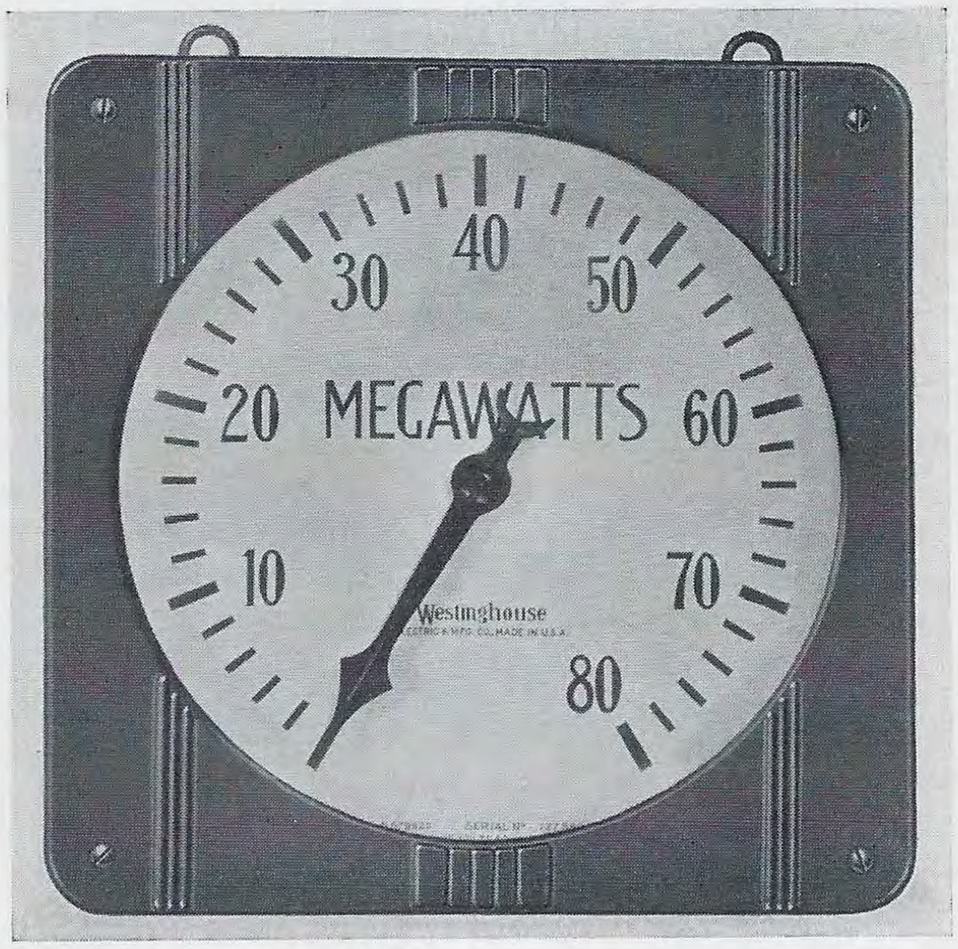


FIG. 1—TYPE HB BOILER ROOM INDICATOR 25 INCH DIAL

DATA—TYPE ADS SYNCHROTIE MOTORS

Rating	115 or 230 volts 25 or 60 cycles
Volt-ampere Consumption	75 V. A. 18 Watts per motor.
Receiver lag	1° at 0.3 oz. inches
Accuracy ADS Motors only	1% overall for one Transmitter and one Indicating Receiver. 2% overall for recording.
Weight ADS Motors only	4 lbs. 10 oz. net. 6.5 lbs. shipping.

General

Synchrotie position indicators are constructed similar to small polyphase induction motors. The stator is wound for single-phase and the rotor is three-phase. In a position indicator system two motors are used, one as a transmitter and one as a receiver. The rotors are connected together and the stators are connected to a single-phase source of power. When so connected the rotor of the receiver will follow the movement of the rotor of the transmitter and thus provide a very accurate signal system which can be operated at considerable distances between the sender and receiver.

Application

In every industry there are innumerable uses for position indicators. Many problems of remote signaling, control or indication can be solved with synchrotie position indicators. The following list gives some of the many possible uses:

Signaling Systems

Grain elevator distribution systems
Switchboard to generator room
Steel mills furnace to blower room
Marine signals between engine room and bridge

Indicating Positions Of

Generator rheostats
Waterwheel governors
Steam turbine governors
Water reservoir levels

Westinghouse Electric & Manufacturing Company
Newark Works, Newark, N. J.

Printed in U.S.A.

EVERY HOUSE NEEDS WESTINGHOUSE

SYNCHROTIE EQUIPMENT—Continued

FIG. 2—TYPE ADS MOTOR COMPLETE

Lift bridges
Swing bridges
Turntables
Transformer tap connections
Gates or valves
Voltage regulator rotors
Frequency-changer stators

Construction and Operation

The transmitter and receiver motors are identical in size. The construction is quite similar to an ordinary polyphase induction motor. The stators have definite poles and the rotors are wound three-phase. The stators are connected to a single-phase source of power and the rotors are connected together by three wires. When the stator excitation circuit is closed, an alternating current voltage is impressed on the rotors of both the transmitter and receiver. Since the receiver rotor is free to turn, it assumes a position similar to that of the transmitter. As the transmitter rotor is turned, the receiver rotor follows at the same speed and in the same direction.

The synchronous action is due to voltages induced in the three legs of the rotor by single-phase current in the stator windings. These voltages are unequal in magnitude and vary with the position of the rotor. When the two rotors are in exactly corresponding positions, the voltages induced in the transmitter rotor are equal and opposite to those induced in the receiver rotor. They are balanced so that no current flows in the windings of either.

When the transmitter rotor is moved from the original position, the induced voltages are no longer equal and opposite and current flows in the rotor windings. This current sets up torques in both rotors, but since the transmitter rotor is held in position and the receiver is free to move, the receiver rotor turns until the rotor voltages balance. This corresponds to the new position of the transmitter.

If the transmitter rotor is moved either manually or automatically, the receiver rotor immediately assumes the same position.

Damping

Position motors are equipped with mechanical inertia type dampers to prevent oscillating or hunting upon being energized.

Characteristics

The angle between the transmitter and receiver when they are in other than their normal balanced position is termed the angle of coercion. This angle must be kept low by not overloading or unbalancing the rotors because the motors will overheat if the angle is greater than 5 degrees for any length of time. If overloaded beyond a certain point, the motors will pull out of step.

A number of receivers may be operated from a single transmitter with reduced receiver torque. In the formula:—

$$TR = \frac{2}{N + 1}$$

TR is the torque of each receiver when N receivers are operated from a single transmitter. Thus with two receivers, each receiver has ⅔ normal torque; with three receivers, each receiver has ½ normal torque, etc.

Burden

The burden per motor on single-phase at 115 volts, 60 cycles is 72.7 volt-amperes, 17.5 watts, and 24.1 per cent power factor.

FIG. 3—TYPE ADS MOTOR PARTS INCLUDING ROTOR BRUSH MECHANISM AND FRAME

SYNCHROTIE EQUIPMENT—Continued

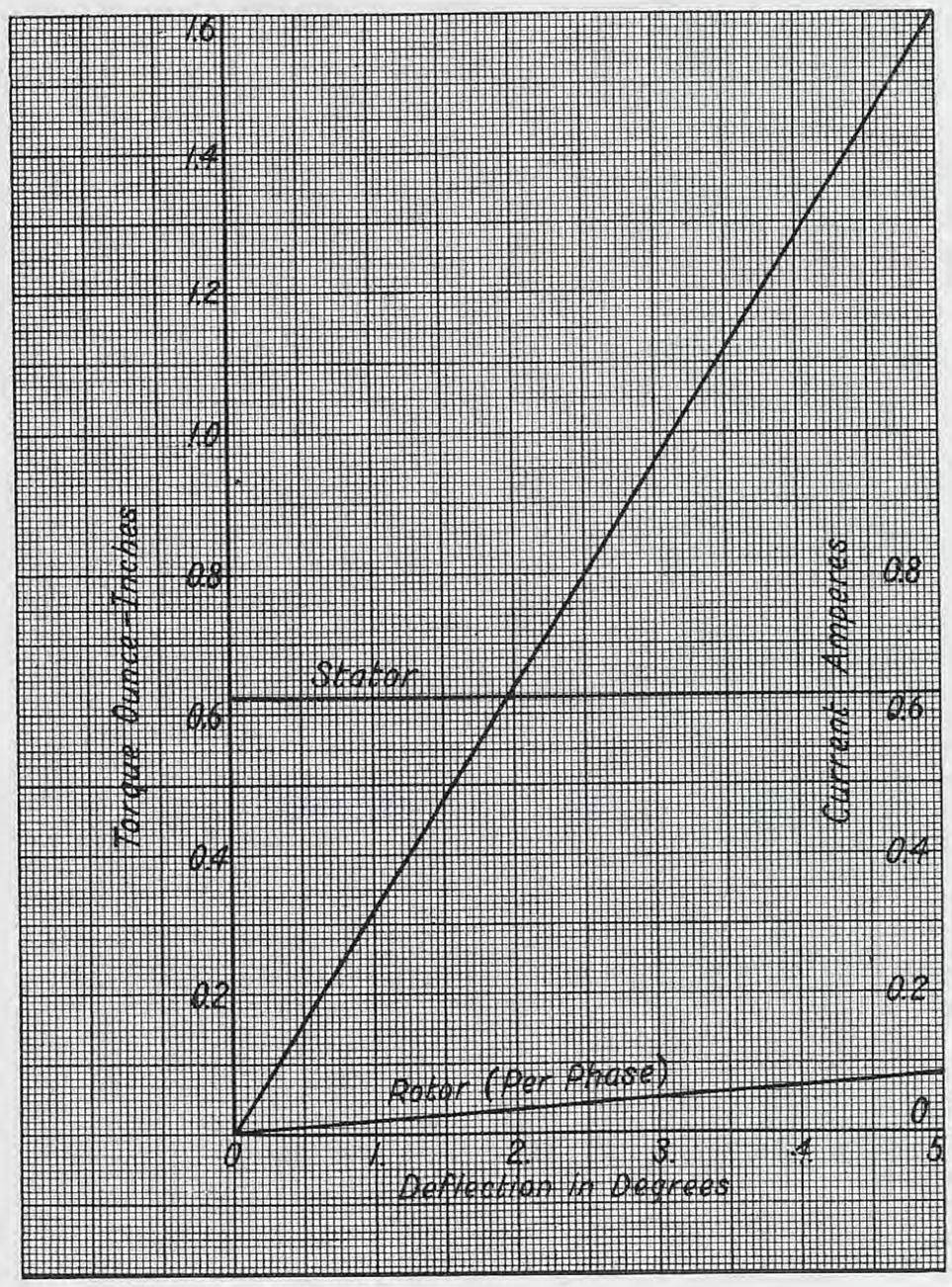


FIG. 4—TORQUE DEFLECTION CHARACTERISTICS

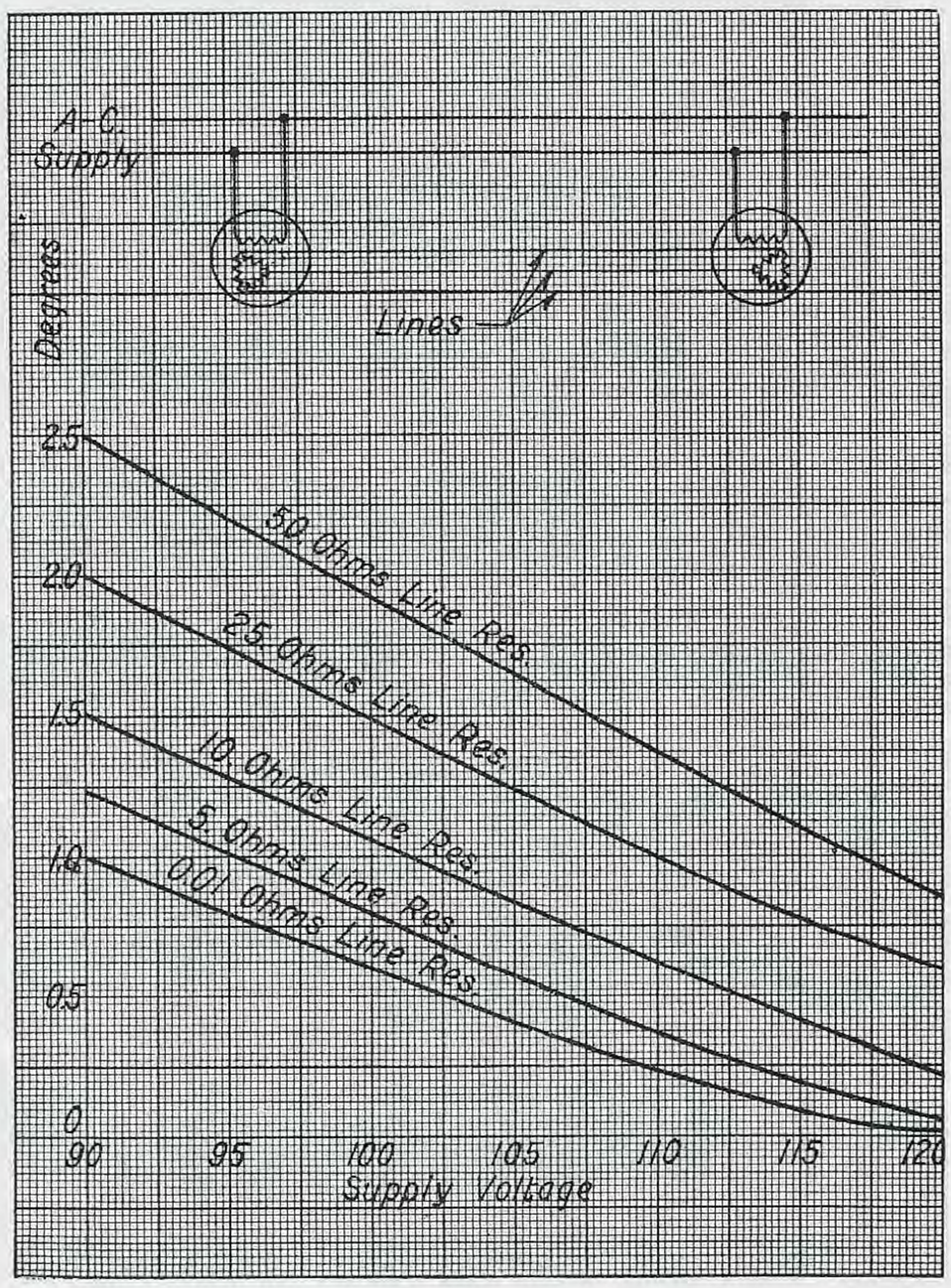


FIG. 5—RECEIVER LAG IN DEGREES WITH SUPPLY VOLTAGE VARIATION FOR VARIOUS LINE RESISTANCES

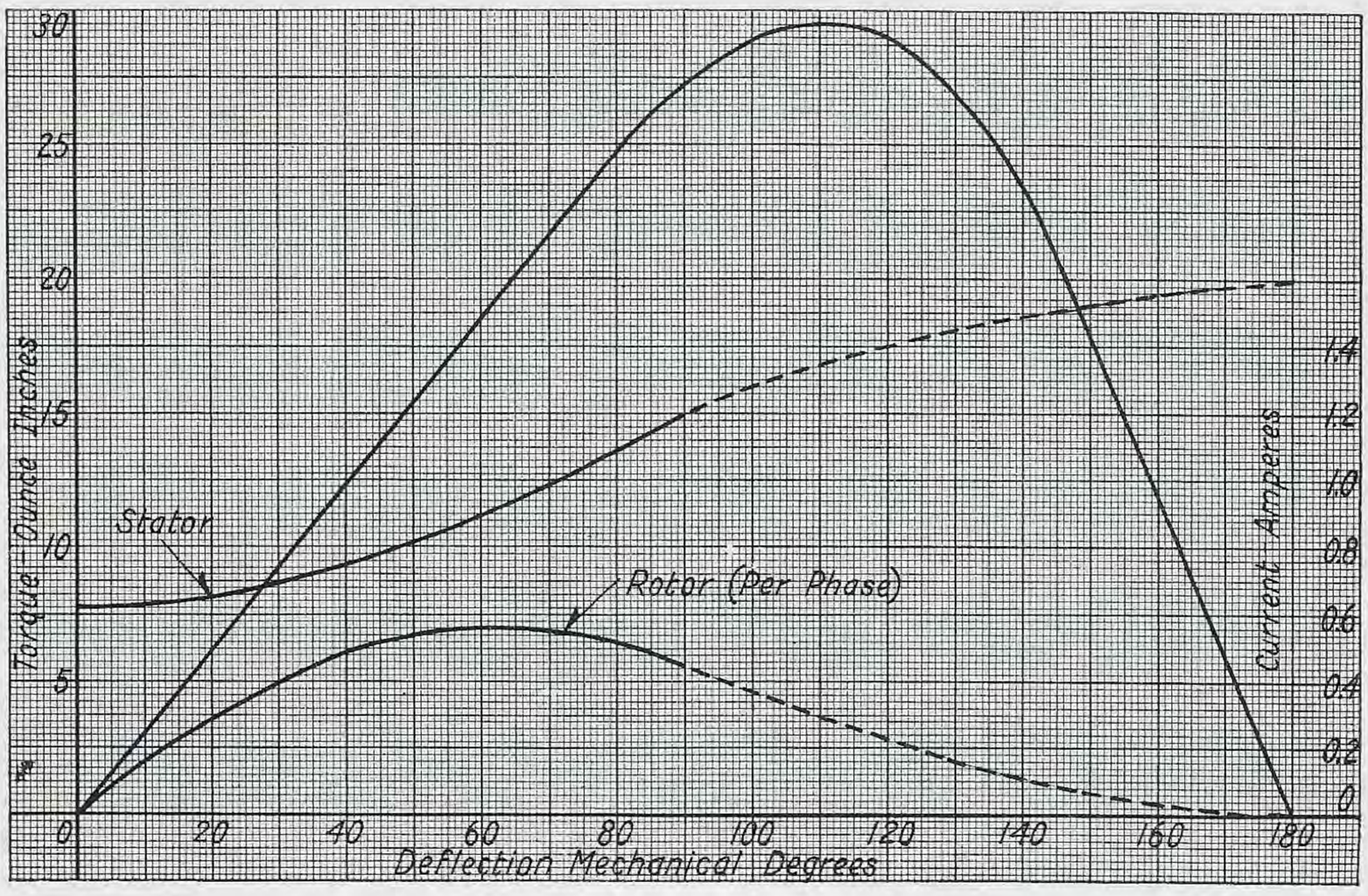


FIG. 6—TYPE ADS POSITION INDICATOR MOTOR FRAME 24-A TORQUE DISPLACEMENT CHARACTERISTICS

SYNCHROTIE EQUIPMENT—Continued

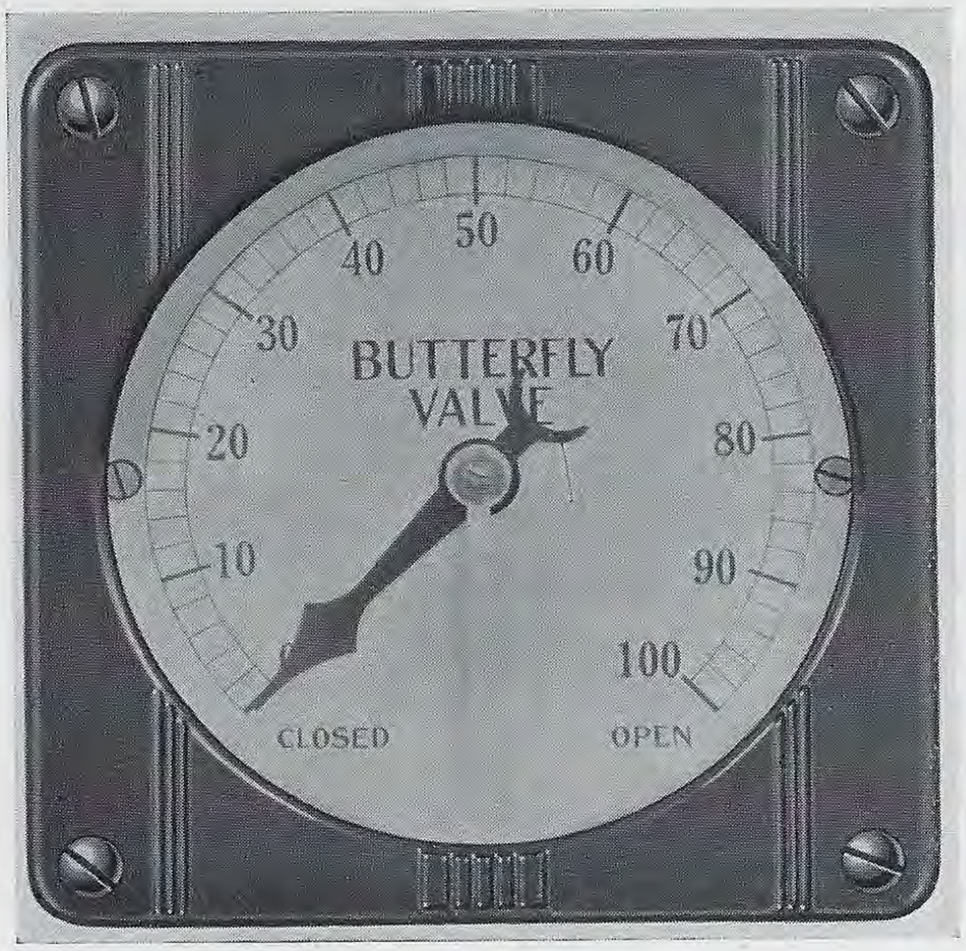


Fig. 7—Type HA Position Indicator

Fig. 8—Type HB Large Size Indicator Operated by ADS Motor

Bearings and Slip Rings

High-grade anti-friction ball bearings are used. Bearings are sealed against dirt. Silver is used in the slip rings for good electrical contact.

Accuracy

With negligible line resistance between the sender and receiver motors, it is only necessary to have a displacement between the sender and receiver rotors of approximately .1 degree to overcome the receiver rotor friction. From this, it is obvious that the receiver will follow very closely the sender. Taking into effect variables, such as slot variances, dial markings, etc., there will not be more than 1% error in indication throughout the full 360° of rotation. This does not include errors in the transmitting device which drives the transmitter motor.

The errors of indication are correspondingly increased with addition of line resistance between the sender and receiver rotors as shown by Fig. 5.

Bracket and Face Plate for Switchboards

Fig. 17 shows the layout of a mounting bracket and face-plate for mounting the position motor on the back of a switchboard for manual signal sending. This unit may be used with the HB indicator for signaling from switchboards to generator or boiler rooms.

Synchroscope Receivers

Either a type SY or HA synchroscope indicating instrument may be used in place of an ADS motor as a receiver when provided with suitable windings. Since indicating instrument movements have much less friction than the position motor bearings, a much higher degree of accuracy can be maintained between sender and receiver when a synchroscope receiver is used. They may also be operated with several miles of line between the sender and receiver. However, long lines having considerable capacity or inductance should be given special consideration to take account of any phase shift which may alter the true indications.

Large Boiler Room Receivers

The Type HB Boiler Room Receiver is furnished in a square cast case having round dials, 10, 15, 25 and 40 inches in diameter. The pointer of these instruments is operated by a position motor mounted in the case. They are available in single face and double face forms. Both forms may be supplied with anticipating pointers.

The Type HB Indicators are intended for applications where a large dial is essential such as boiler rooms where the dial must be visible at considerable distance from the indicator. They are used extensively for signaling between the operating room and boiler room in power stations.

Water Level Transmitter

The Type TS Water Level Transmitter is shown in Fig. 9. This unit consists of a brass float, chain, counterweight, sprocket and transmitter housing containing suitable gearing and a type ADS position motor. The position motor is rotated by the action of the float and assumes a position proportionate to water level. The unit is housed in a durable aluminum alloy case with suitable moisture proof cover and conduit outlets. This transmitter may be used in conjunction with type HA or SY synchroscope receivers or with the type GH Position Recorder.

Type GH Position Recorder

A continuous record of water level or position may be had by means of the type GH Position Recorder which is shown in Fig. 10. The pen is driven by a type ADS synchrotie motor. The chart is 4″ wide and is driven by a hand wound clock. Chart speeds of ¾,

SYNCHROTIE EQUIPMENT—Continued

1½ or 3 inches per hour may be used by changing gears furnished with the recorder.

Type ADS Synchrotie Transmitter Attachment

Type R Recording Wattmeters and type R Recording Totalizing Wattmeters may be supplied with ADS Synchrotie Transmitter Attachments. This attachment permits indicating at remote points on type SY or HA Position Indicators or type HB Boiler Room Indicators, the load on type R Recorders or Totalizers. The ADS motor is mounted on rear of the switchboard panel and driven by a shaft connecting with the pen carriage driving worm of the Type R.

This attachment cannot be supplied for recorders already in service because of the necessity of drilling the shaft clearance hole in the recorder base and other specialties required in the pen carriage driving worm. The recorder and ADS transmitting attachment should be ordered together.

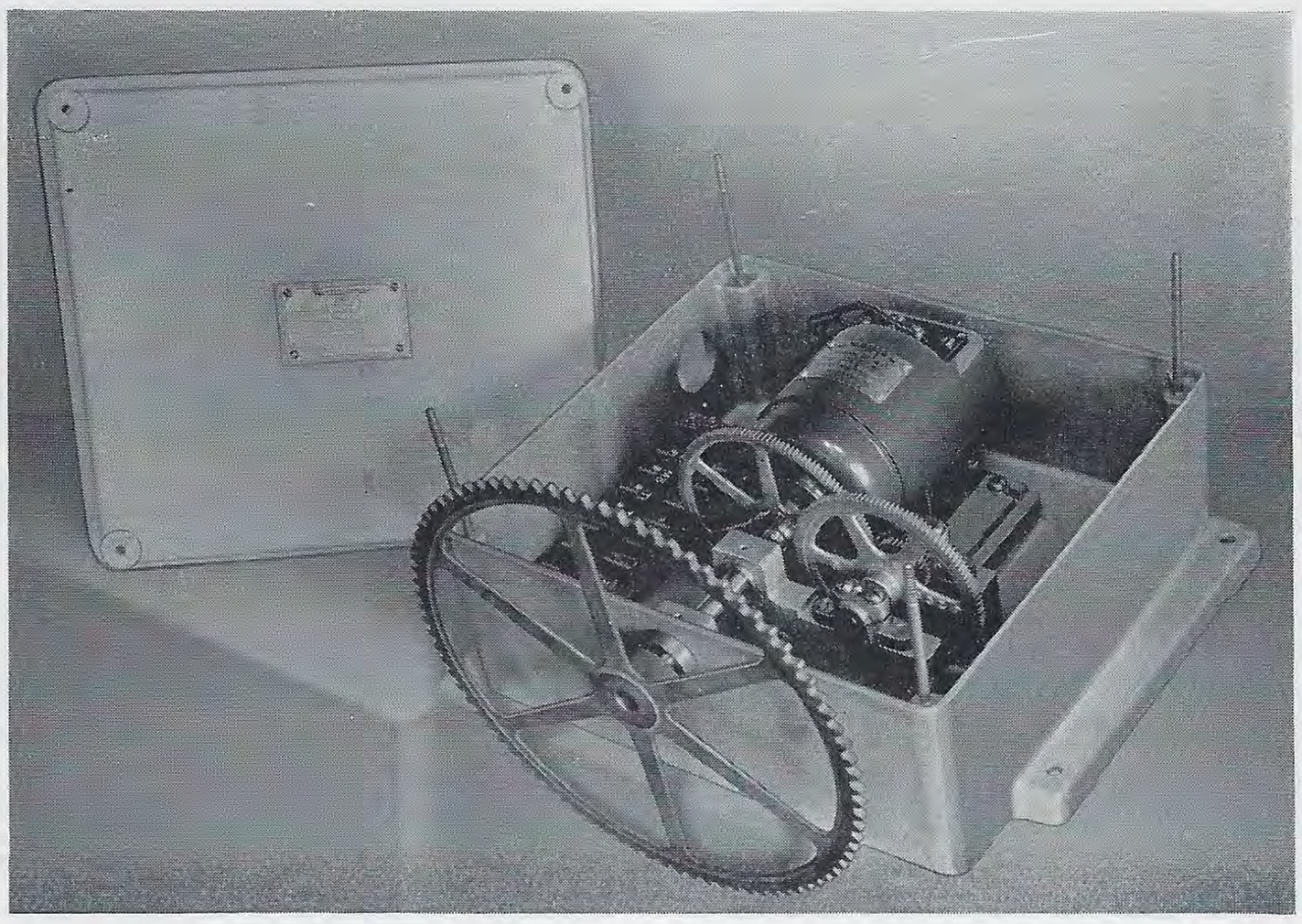


FIG. 9—WATER LEVEL TRANSMITTER EQUIPPED WITH TYPE ADS POSITION MOTOR

FIG. 10—TYPE GH RECORDING INSTRUMENT OPERATED BY ADS POSITION MOTOR

SYNCHROTIE EQUIPMENT—Continued

FIG. 11—TYPE R RECORDER EQUIPPED WITH TYPE ADS POSITION TRANSMITTER

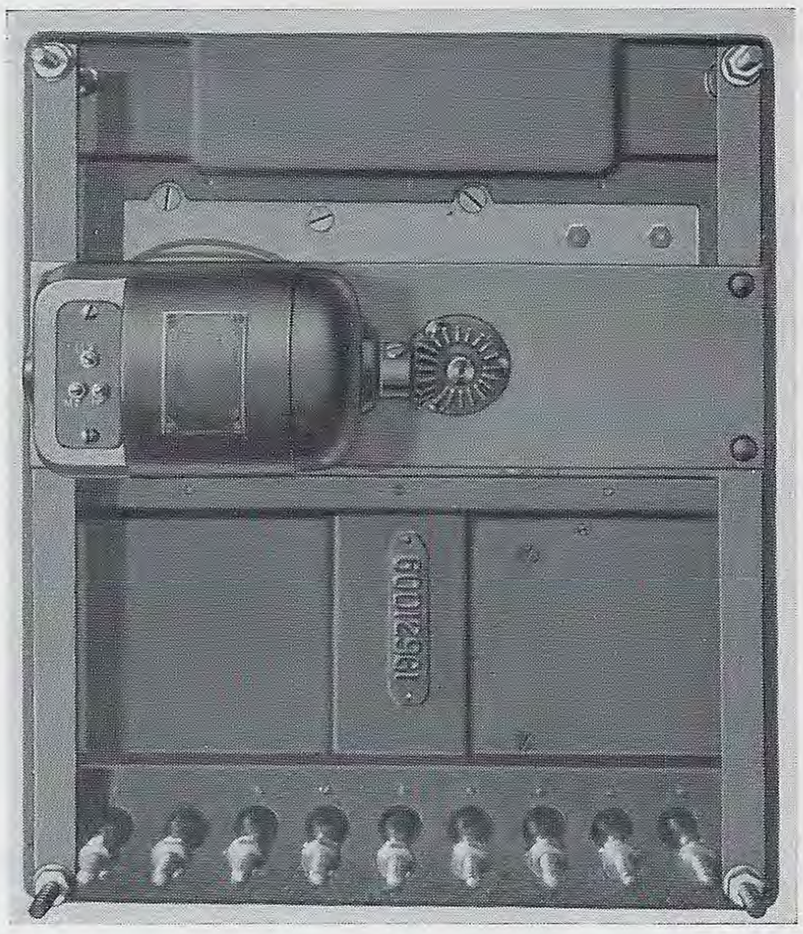


FIG. 12—REAR VIEW OF TYPE R RECORDER SHOWING TYPE ADS POSITION TRANSMITTER MOTOR

LIST PRICES

Type ADS Synchrotie Position Indicator Transmitter with Bracket, Face Plate and Handwheel for Switchboard Mounting

RATING Volts	Cycles	APPROX. WT.—LBS. Net	Shipping	Style No.	List Price Discount Symbol BC
115	60	8	10	1 009 938	$ 75 00
230	60	8	10	1 009 939	85 00
115	25	8	10	1 009 940	80 00
230	25	8	10	1 009 941	90 00

Type SY and HA Position Indicators

Projection Mounting

RATING Type	Volts	Cycles	APPROX. WT.—LBS. Net	Shipping	Style No.	List Price Discount Symbol BC
SY	115	60	8	10	438 309	$115 00
SY	230	60	8	10	877 613	125 00
HA	115	60	8	10	818 651	115 00
HA	230	60	8	10	839 633	125 00

For flush mounting add **$4.00** list. Also available for 25 cycles at same prices.

Type GH Position Recorder

Projection Mounting

RATING Volts	Cycles	APPROX. WT.—LBS. Net	Shipping	Style No.	List Price Discount Symbol BC
*115	60	15	25	1 009 954	$400 00

*Also available for 230 volts, 60 cycles and 115 and 230 volts, 25 cycles at same price.

Type TS Water Level Transmitter

*115	60	18	30	1 009 955	400 00

*Also available for 230 volts, 60 cycles and 115 and 230 volts, 25 cycles at same price. Style number includes transmitter with float, counterweight and chain.

Type R Recorder and Totalizer Position Indicator Attachment

Volts	Cycles			Style No.	List Price Discount Symbol BC
*115	60	..	..	1 009 956	$150 00

*Also available for 230 volts, 60 cycles and 115 and 230 volts, 25 cycles at same price. This attachment must be ordered with recorder or totalizer with which used. For information recorders and totalizers see Catalog 43-410.

Type HB Boiler Room Indicators

Description	RATING Volts	Cycles	Style No.	List Price Discount Symbol BC
With Ten Inch Dials				
*Single face, single pointer	115	60	1 009 942	$ 358 00
*Double face, single pointer	115	60	1 009 943	530 00
*Single face, double pointer	115	60	1 009 944	410 00
*Double face, double pointer	115	60	1 009 945	625 00
With Fifteen Inch Dials				
*Single face, single pointer	115	60	1 009 946	482 00
*Double face, single pointer	115	60	1 009 947	660 00
*Single face, double pointer	115	60	1 009 948	536 00
*Double face, double pointer	115	60	1 009 949	750 00
With Twenty-Five Inch Dials				
*Single face, single pointer	115	60	1 009 950	715 00
*Double face, single pointer	115	60	1 009 951	890 00
*Single face, double pointer	115	60	1 009 952	768 00
*Double face, double pointer	115	60	1 009 953	985 00
With Forty Inch Dials†				
*Single face, single pointer	115	60	.....	1 070 00
*Double face, single pointer	115	60	.....	1 250 00
*Single face, double pointer	115	60	.....	1 140 00
*Double face, double pointer	115	60	.....	1 340 00

*Also available for 230 volts, 60 cycle and 115 and 230 volts, 25 cycle at same prices. †Indicators with forty-inch dials will be supplied on special order.

Order by Style Number

Prices and discounts subject to change without notice.

SYNCHROTIE EQUIPMENT—Continued

WIRING DIAGRAMS

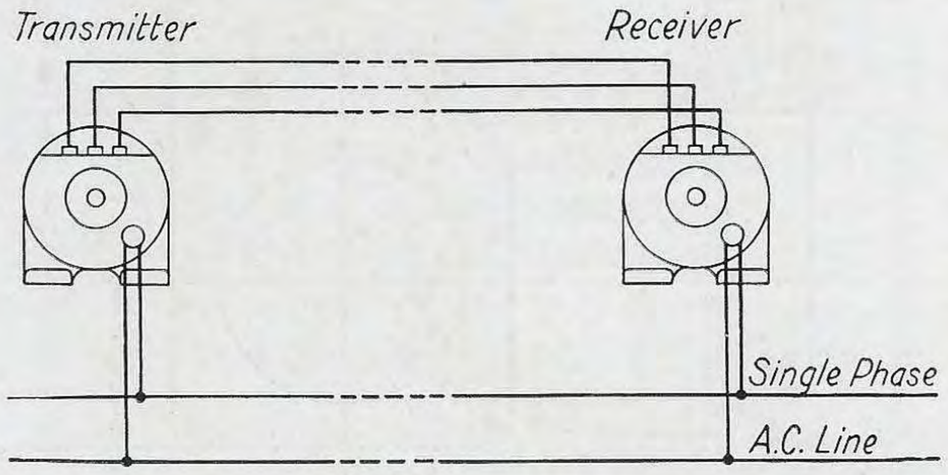


FIG. 13—EXTERNAL WIRING DIAGRAM FOR POSITION INDICATOR MOTOR

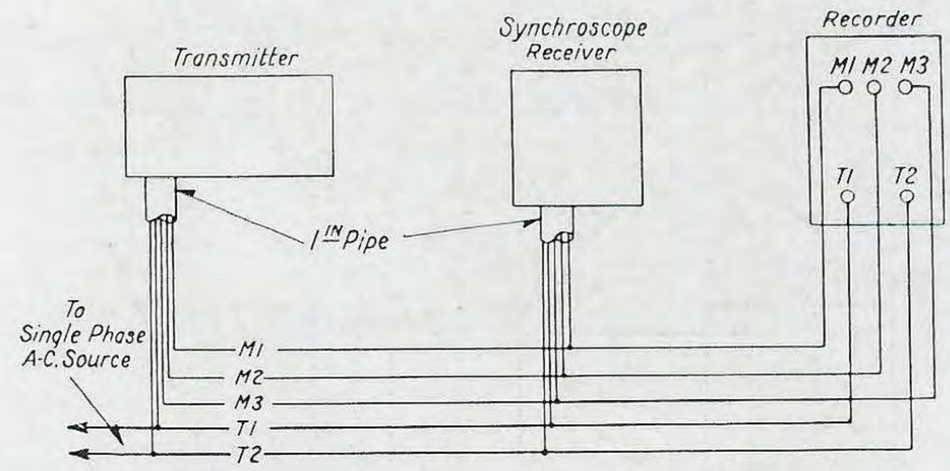


FIG. 14—EXTERNAL WIRING DIAGRAM FOR TYPE TS WATER LEVEL TRANSMITTER AND TYPE GH POSITION RECORDER

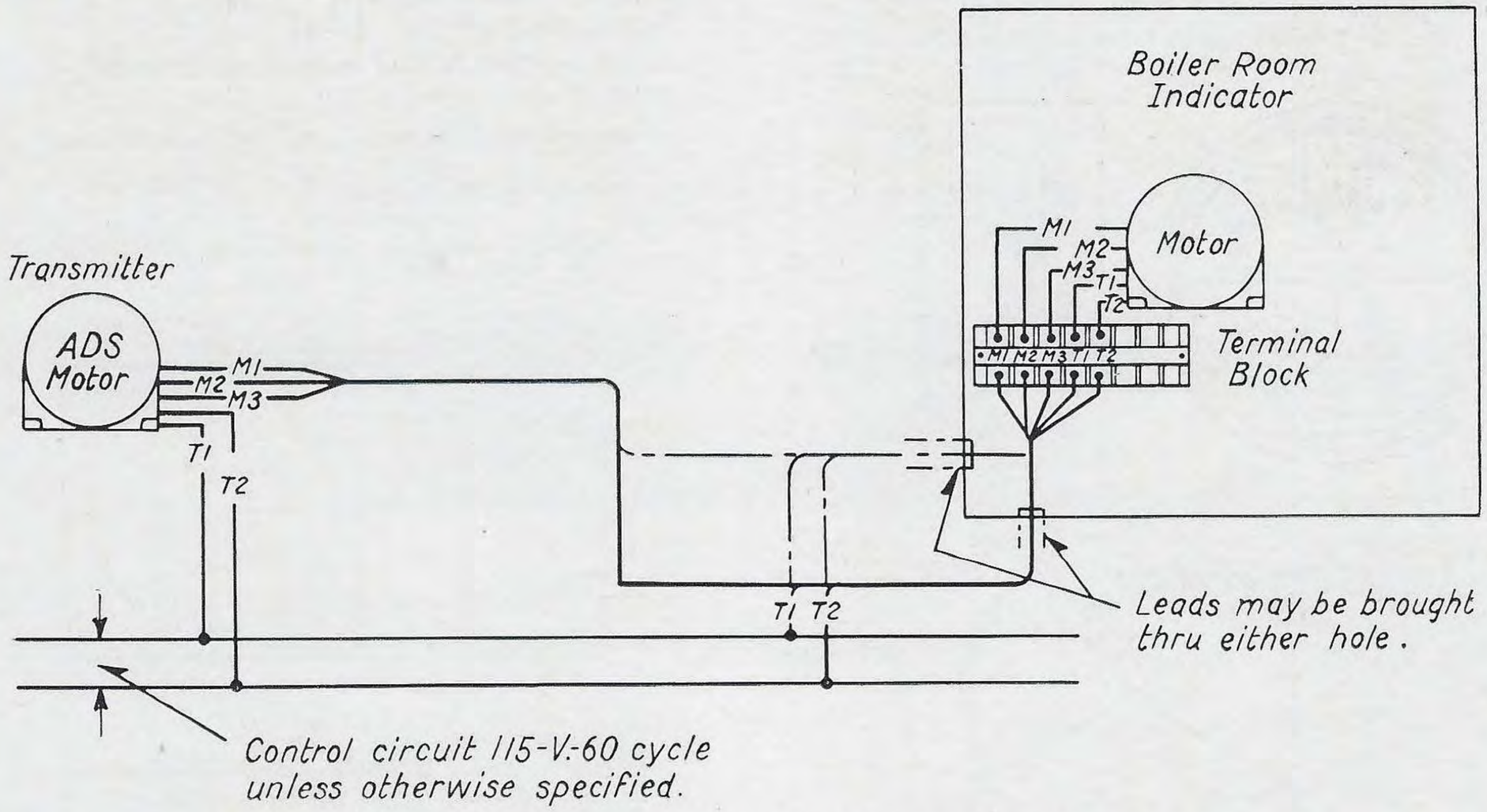


FIG. 15—EXTERNAL WIRING DIAGRAM FOR TYPE HB BOILER ROOM INDICATOR

OUTLINE DIMENSIONS IN INCHES

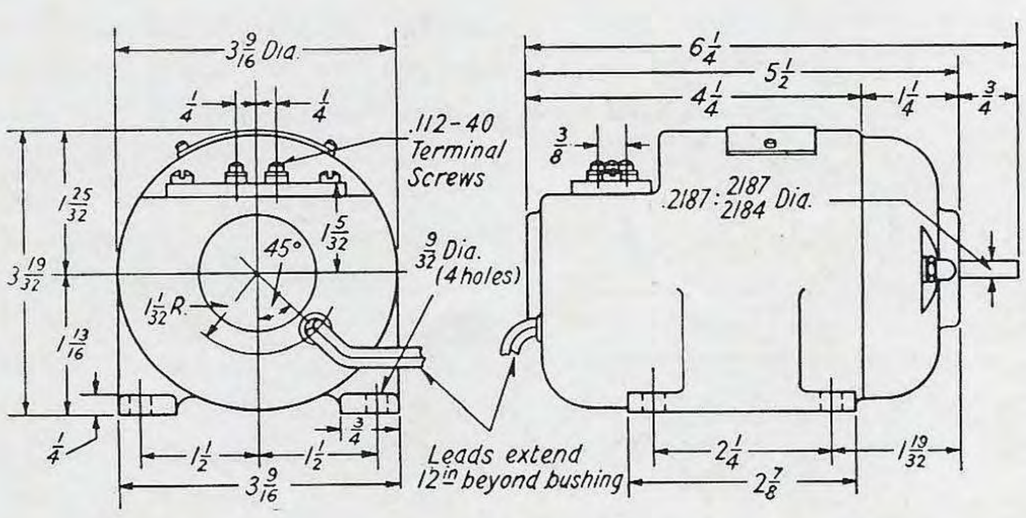


FIG. 16—OUTLINE AND DRILLING PLAN FOR TYPE ADS POSITION INDICATOR MOTOR

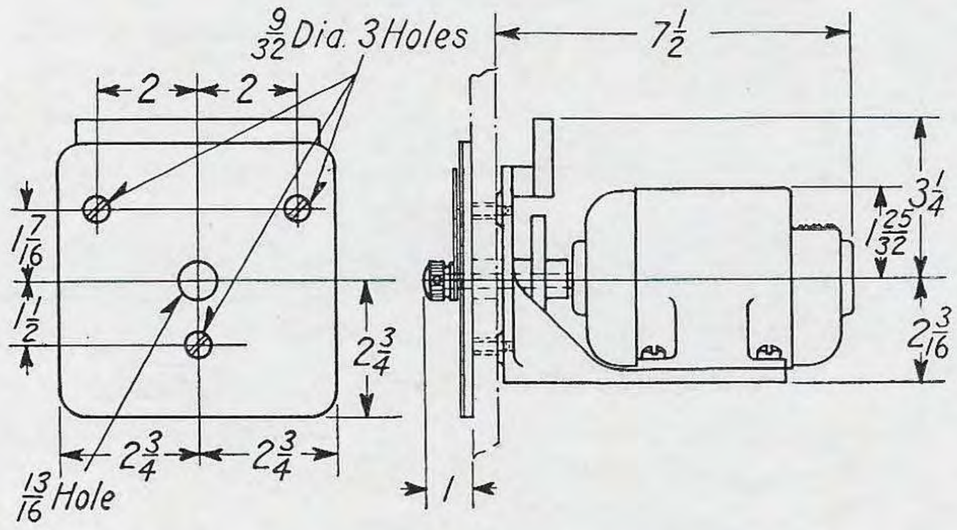


FIG. 17—OUTLINE FOR BRACKET FOR SWITCHBOARD MOUNTING

SYNCHROTIE EQUIPMENT—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

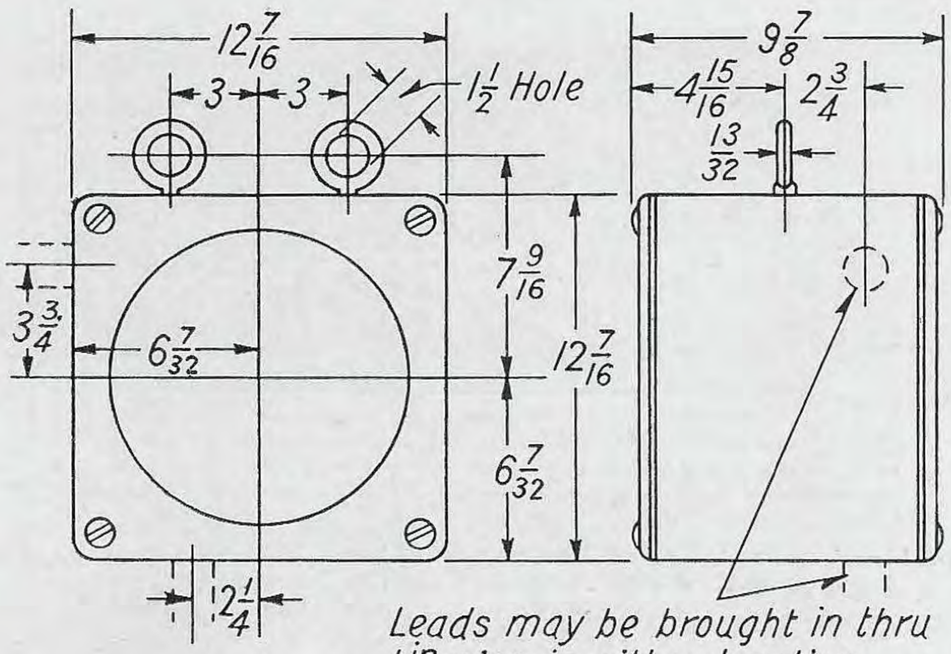


FIG. 18—TYPE HB BOILER ROOM INDICATOR 10" DIAL

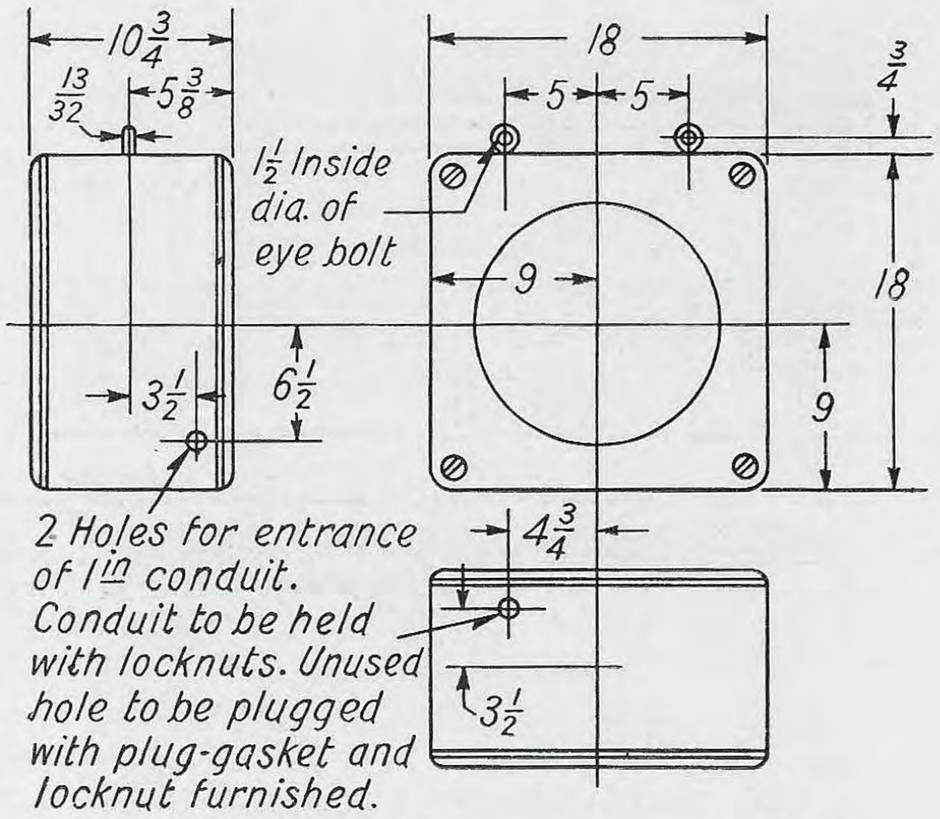


FIG. 19—TYPE HB BOILER ROOM INDICATOR, 15" DIAL

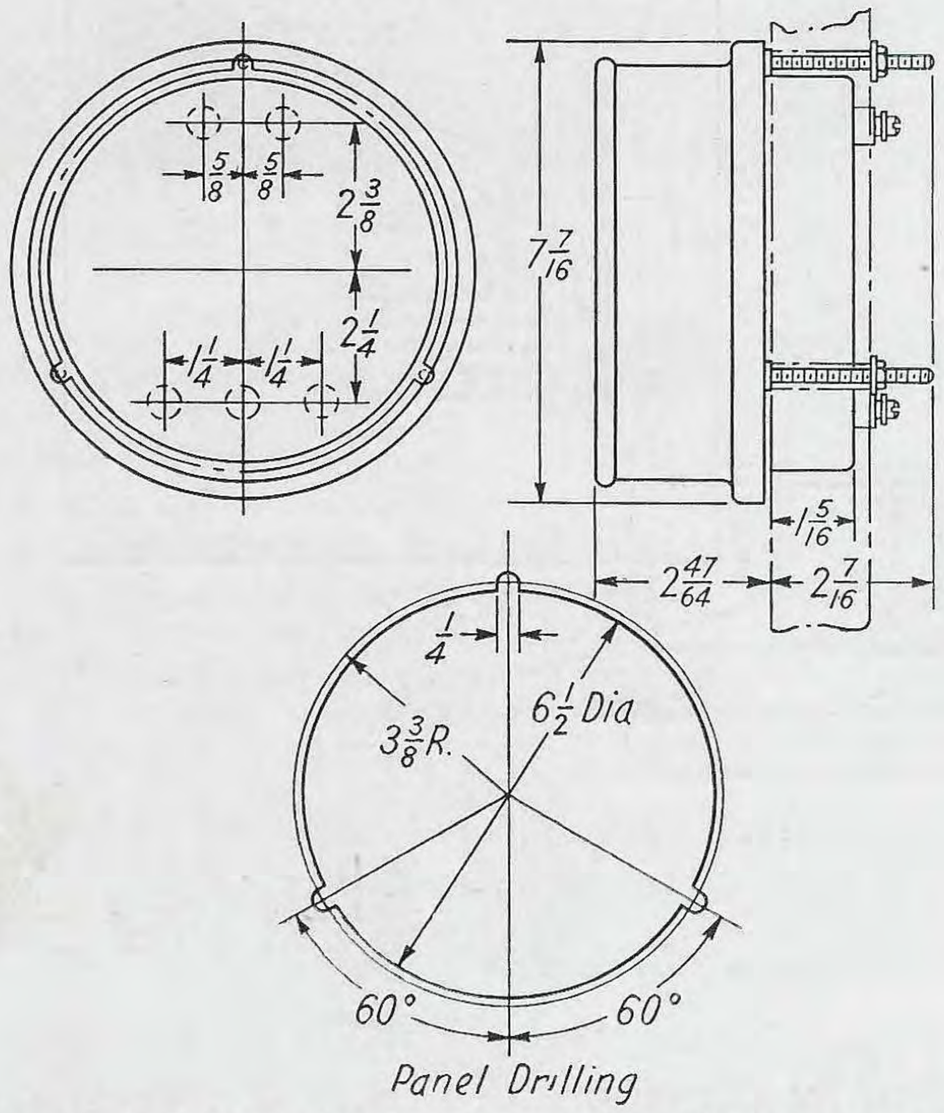


FIG. 20—OUTLINE AND DRILLING PLAN FOR TYPE SY SYNCHRONOSCOPE

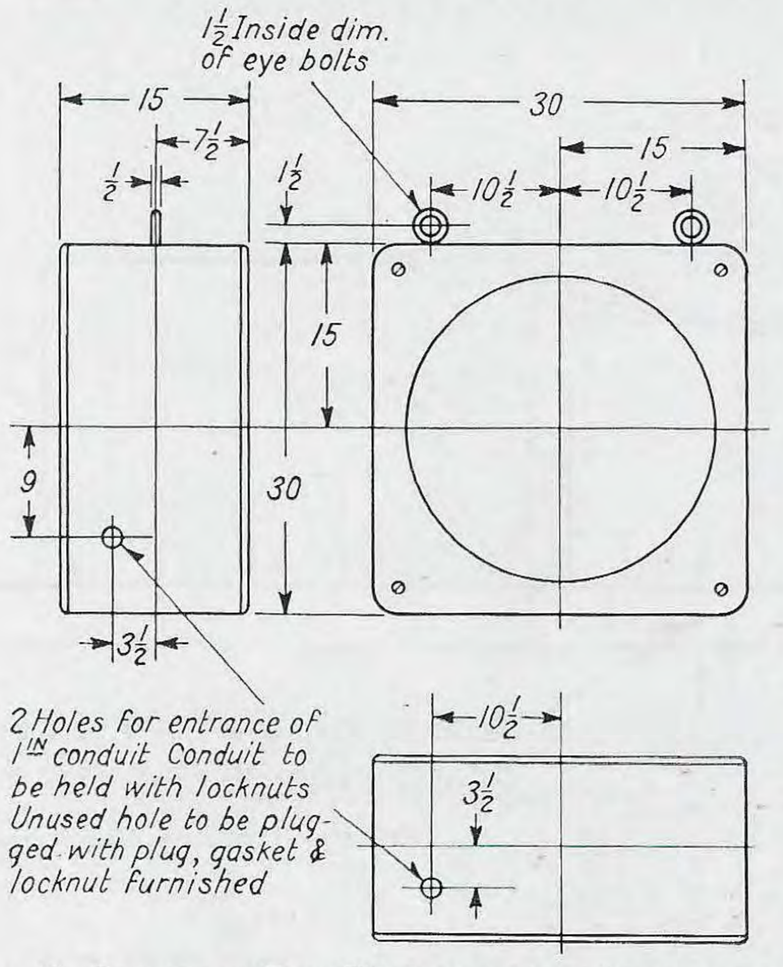


FIG. 21—OUTLINE OF TYPE HB BOILER ROOM INDICATOR WITH 25 INCH DIAL

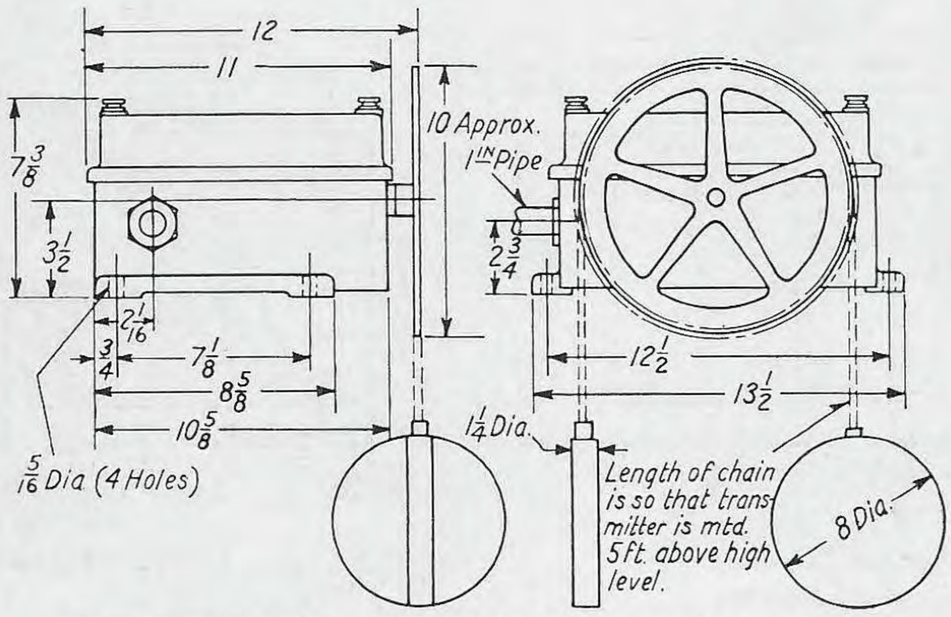


FIG. 22—OUTLINE OF TYPE TS WATER LEVEL TRANSMITTER

Dimensions shown are approximate only. For official dimensions apply to the nearest Westinghouse Sales office.

SHUNTS FOR D-C. AMMETERS—TYPE G

Switchboard and Portable Types

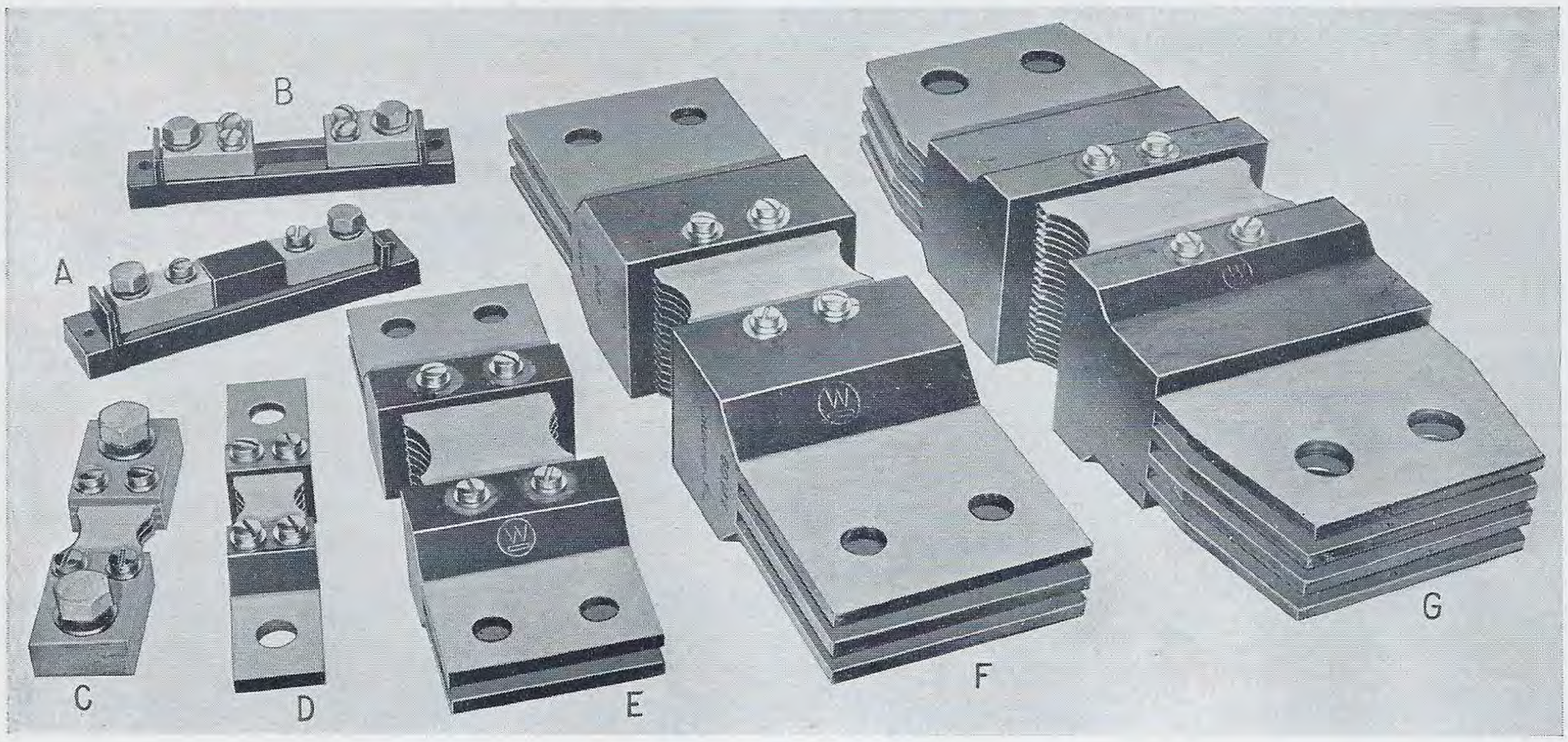


FIG. 1—TYPE G SWITCHBOARD SHUNTS

Application

Type G shunts are used for the measurement of large, direct currents. They are also used for applications where it is not practical to carry the full current of the circuit through the instrument. Shunts are convenient where it is desired to use a single millivoltmeter for a number of ranges.

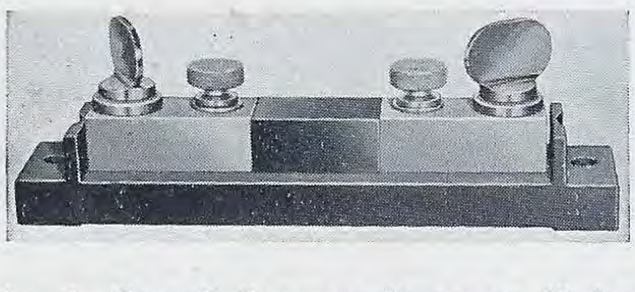


FIG. 2—TYPE G PORTABLE SHUNT OF 20 AMPERES CAPACITY

Direct-current instruments are usually available self-contained up to and including 50 amperes. Currents larger than this value are measured by means of a type G shunt designed to carry the main current of the circuit, giving a definite millivolt drop across its terminals. The instrument is connected across the terminals of the shunt and its scale is calibrated in terms of the current flowing in the shunt.

Construction

Type G shunts are designed for mounting in bus bars. The terminal castings above 300 amperes are slotted to receive one one-quarter inch bar per slot. The sizes ranging from 5 to 200 amperes, inclusive, are mounted on a Moldarta base which takes all strain that may arise from bus bar distortion. The terminal lugs are made of large section copper to give adequate heat dissipation and sufficient ridgity for support of the unit. The resistance strips are made of manganin and have a negligible temperature co-efficient and thermo-electromotive force, thus avoiding errors due to heating.

Operation

Temperature Rise—Type G shunts operate at a temperature rise not in excess of 80 degrees Centigrade when carrying their rated current, which corresponds to A.I.E.E. standards. In order that this temperature rise will not be exceeded, it is necessary to take certain precautions in their application. Most of the heat is dissipated by conduction through the bus bars and connected apparatus. The bus bar size and position will have very much influence on the temperature rise of the shunt. The entire installation should be such that adequate sized bus bars are used and ventilation conditions are favorable.

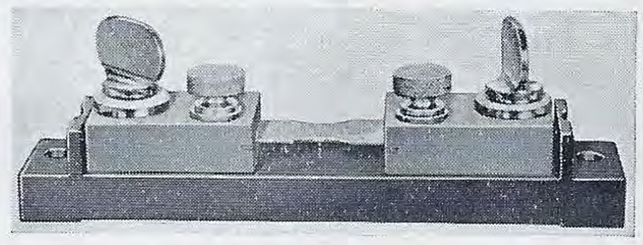


FIG. 3—TYPE G PORTABLE SHUNT OF 25 AMPERES CAPACITY

Millivolt Drop

Standard type G shunts are adjusted to give a drop of 50 millivolts across their terminals when carrying full-rated current. This value is adjusted at the factory to within $\pm \frac{1}{10}$ of 1%. Shunts for capacities of ten amperes and less must be calibrated with instruments with which used.

Special type shunts are available having a millivolt drop of 100 across terminals at full load. These shunts are not recommended except where extreme accuracy is required.

Westinghouse Electric & Manufacturing Company
Newark Works, Newark, N. J.

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EVERY HOUSE NEEDS WESTINGHOUSE

SHUNTS FOR D-C. AMMETERS—TYPE G—Continued

Shunts having 100-millivolt drop are larger and have more manganin resistance material and thus are higher priced than 50-millivolt types. One hundred millivolt shunts are identified as type GG.

Selection of Capacity

Shunts should be chosen in general so that their rating is 25% higher than the value of the full-load current of the circuit. This allows for overloads by keeping the ammeter indications on the scale of the instrument and also prevents excessive heating of the shunt during overload periods. The ammeter full-scale value is usually selected to agree with the capacity rating of the shunt.

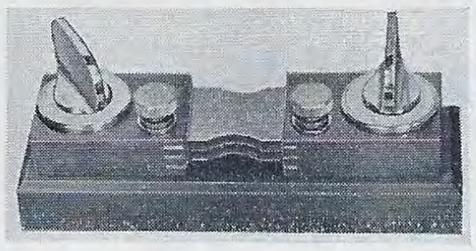


FIG. 4—TYPE G PORTABLE SHUNT. CONSTRUCTION USED FOR CAPACITIES OF 250 TO 300 AMPERES

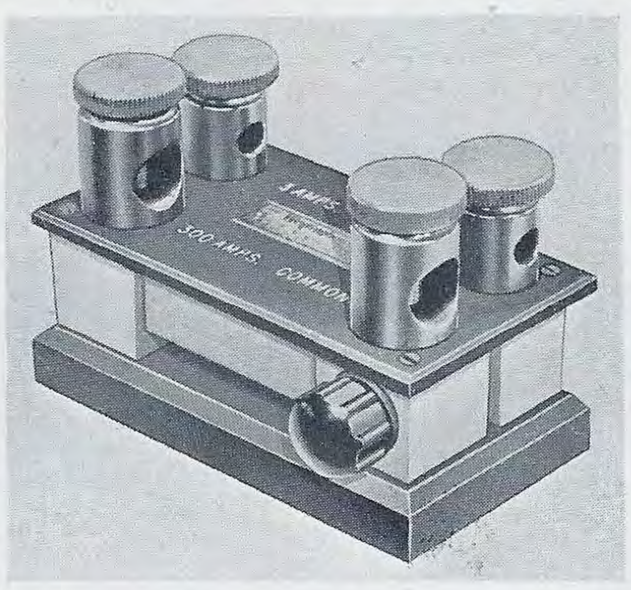


FIG. 5—TYPE G PORTABLE COMBINATION SHUNT. 3–30–300 AMPERE CAPACITY

Type G shunts are listed in this catalog up to and including 20000 amperes. Should it be necessary to have capacities greater than 20000 amperes, it is recommended that the proper number of shunts of rating of 20000 or less be connected in parallel, each shunt being provided with separate leads to the ammeter terminals. For example, use three 10000-ampere shunts for a capacity of 30000 amperes. This arrangement will be found less expensive, more accurate and more desirable from an operating viewpoint than using a single 30000-ampere shunt.

Portable Shunts

Type G shunts are also available for use with portable instruments. They are similar to switchboard types except that screw or bolt terminals have been replaced with thumb screws. The millivolt drop is 50 millivolts for portable types, the same as for switchboard types. Portable type shunts are available with special hardware as above up to and including 750 amperes. Beyond this capacity standard switchboard types are recommended for use with portable instruments.

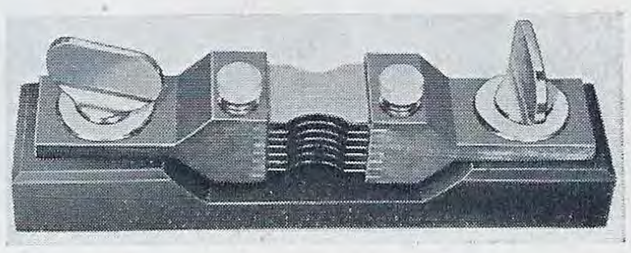


FIG. 6—TYPE G PORTABLE SHUNT. CONSTRUCTION USED FOR CAPACITIES OF 400 TO 750 AMPERES

LIST PRICES

Switchboard Type G Shunts—50 Millivolt Drop

Capacity Amperes	Figure	Weight Net	Weight Shipping	Style Number	List Price Discount Symbol BC
1 §	1-A	10 oz.	2 lb.	936 938	$ 5 50
1.5§	1-A	10 oz.	2 lb.	936 939	5 50
2§	1-A	10 oz.	2 lb.	936 940	5 50
3§	1-A	10 oz.	2 lb.	936 941	5 50
5§	1-A	10 oz.	2 lb.	724 755	5 50
7.5§	1-A	10 oz.	2 lb.	936 942	5 50
10§	1-A	10 oz.	2 lb.	724 756	5 50
15§	1-A	10 oz.	2 lb.	724 757	5 50
20§	1-A	10 oz.	2 lb.	936 943	5 50
25§	1-B	14 oz.	2 lb.	703 927	5 50
30	1-B	14 oz.	2 lb.	936 944	5 50
50	1-B	14 oz.	2 lb.	703 928	5 50
75	1-B	14 oz.	2 lb.	703 929	5 50
100	1-B	14 oz.	2 lb.	703 930	5 50
150	1-B	14 oz.	2 lb.	703 931	5 50
200	1-B	14 oz.	2 lb.	703 932	5 50
250	1-C	1 lb., 5 oz.	3 lb.	703 933	5 50
300	1-C	1 lb., 5 oz.	3 lb.	703 934	6 25
400	1-D	1 lb., 5 oz.	3 lb.	282 639	8 00
500	1-D	1 lb., 5 oz.	3 lb.	282 640	9 75
600	1-D	1 lb., 10 oz.	4 lb.	282 641	11 50
750	1-D	1 lb., 10 oz.	4 lb.	936 931	14 00
800	1-D	1 lb., 10 oz.	4 lb.	282 642	15 00
1000	1-E	1 lb., 10 oz.	4 lb.	282 643	20 00
1200	1-E	6 lb., 5 oz.	10 lb.	282 644	23 00
1500	1-F	9 lb., 10 oz.	12 lb.	282 645	29 00
2000	1-F	13 lb.	15 lb.	282 646	33 00
2500	1-F	25 lb.	28 lb.	282 647	42 00
3000	1-F	30 lb.	34 lb.	282 648	50 00
3500	1-F	30 lb.	34 lb.	936 932	67 00
4000	1-G	36 lb.	40 lb.	282 649	85 00
4500	1-G	36 lb.	40 lb.	936 933	92 00
5000	1-G	44 lb.	48 lb.	282 650	100 00
6000	1-G	56 lb.	68 lb.	282 651	117 00
7500	1-G	60 lb.	75 lb.	936 934	140 00
8000	1-G	74 lb.	88 lb.	282 652	150 00
10000	1-G	92 lb.	110 lb.	306 209	200 00
12000	1-G	114 lb.	135 lb.	931 117	250 00
15000	1-G	119 lb.	140 lb.	936 935	325 00
18000	1-G	170 lb.	200 lb.	936 936	400 00
20000	1-G	171 lb.	200 lb.	936 937	450 00

§ Shunts of 25 ampere capacity and less must be calibrated with the instruments with which they are used.
SPECIAL NOTE—Shunts with 100-millivolt drop are available on special order. Refer to Headquarters.
Prices are subject to change without notice.

Order by Style Number

SHUNTS FOR D-C. AMMETERS—TYPE G—Continued

LIST PRICES—Continued

Portable Type G Shunts—50 Millivolt Drop

Capacity Amperes	Figure	Weight Net	Weight Shipping	Style Number	List Price Discount Symbol BC
1 §	2	10 oz.	2 lb.	936 945	$ 7 00
1.5†§	2	10 oz.	2 lb.	936 946	7 00
2 §	2	10 oz.	2 lb.	936 947	7 00
3 †§	2	10 oz.	2 lb.	936 948	7 00
5 §	2	10 oz.	2 lb.	724 732	7 00
7.5†§	2	10 oz.	2 lb.	936 949	7 00
10 §	2	10 oz.	2 lb.	724 733	7 00
15 †	2	10 oz.	2 lb.	724 734	7 00
20	3	10 oz.	2 lb.	936 950	7 00
25	3	14 oz.	2 lb.	724 735	7 00
30 †	3	14 oz.	2 lb.	936 951	7 00
50	3	14 oz.	2 lb.	724 736	7 00
75 †	3	14 oz.	2 lb.	724 737	7 00
100	3	14 oz.	2 lb.	724 738	7 00
150 †	3	14 oz.	2 lb.	724 739	7 00
200	3	14 oz.	2 lb.	724 740	7 00
250	4	14 oz.	2 lb.	724 741	7 00
300 †	4	1 lb., 12 oz.	4 lb.	724 742	8 25
400	6	1 lb., 14 oz.	4 lb.	724 753	10 00
500	6	2 lb.	4 lb.	724 754	11 75
750 †	6	2 lb., 12 oz.	4 lb.	936 952	14 00

NOTE—Above 750 amperes, standard switchboard shunts may be used.
† Shunts of these capacities require instruments having scales of 75 or 150 divisions for greatest convenience.
§ Shunts of 10 amperes capacity and less must be calibrated with the instruments with which they are used.
SPECIAL NOTE—Shunts with 100-millivolt drop are available on special order. Refer to Headquarters

Portable Combination Type G Shunts—50 Millivolt Drop

Triple Range

Cepacity Amperes	Figure	Weight Net	Weight Shipping	Style Number	List Price Discount Symbol BC
5-20-200 ‡	5	1 lb., 4 oz.	4 lb.	186 871	$25 00
3-30-300†‡	5	1 lb., 4 oz.	4 lb.	197 040	25 00

† Shunts of these capacities require instruments having scales of 75 or 150 divisions for greatest convenience.
‡ These shunts are calibrated for use with 50 millivolt instruments having 5 ohms resistance unless otherwise ordered.

Leads for Switchboard Ammeters

(Shunt Leads)

Length in Feet Between Ammeter and Shunt	Covering	Style Number	List Price Per Pair Discount Symbol BC
8*	Weatherproof	680 730	$ 2 00
All Other Lengths 10 to 170 Incl.	Weatherproof	Order by Length	$2.00 for the First Eight Feet Plus $0.40 Per Foot Per Pair Additional

* Standard 8 foot leads have a resistance of 0.0276 ohms per pair.

Standard 8 foot leads should be used wherever possible to make use of stock deliveries and to avoid instruments having odd calibration characteristics.

For distances of less than 8 feet the standard 8 foot leads should be used and the excess cable coiled up in back of the switchboard.

Leads 8 feet in length and longer may be supplied at prices given above. Leads in excess of 8 feet long must be ordered and calibrated with the instrument with which they are used.

Where an ammeter is to be used in conjunction with a switch and two or more shunts, a pair of switch leads will be required in addition to one pair of shunt leads for each shunt. When these combinations are ordered, distances from each shunt to the switch and from switch to instrument should be given. Switch leads 8 feet long are supplied at no increase in price when ammeter and shunts are ordered together. Leads for individual shunts will be furnished at prices given above.

Standard 8 foot leads are included in the price of ammeters for use with shunts and are listed in the various catalog sections covering instruments. If special leads, longer than 8 feet, are required they are furnished at the above prices. If the instrument is to be furnished without leads there will be a deduction of $2.00 list for the 8 foot leads ordinarily included.

SHUNTS FOR D-C. AMMETERS—TYPE G—Continued

OUTLINE DIMENSIONS IN INCHES

Switchboard Shunts

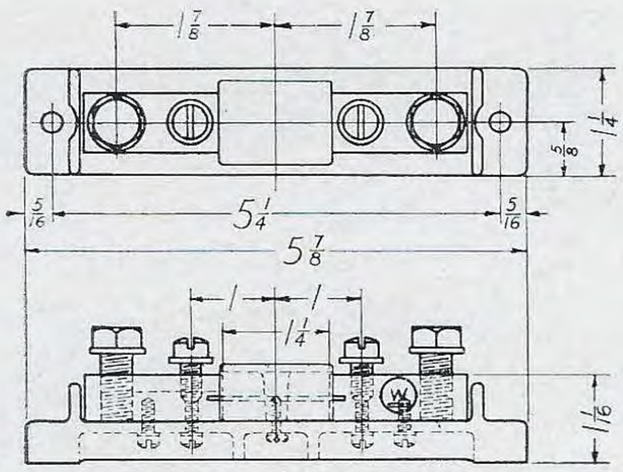


FIG. 7—1 TO 20 AMP. INCL.

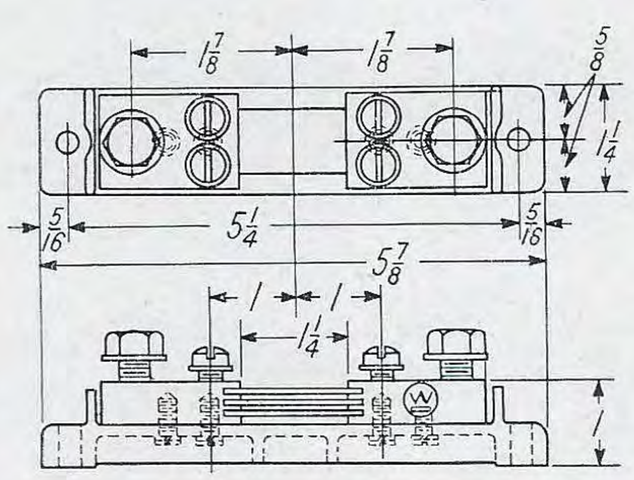


FIG. 8—25 TO 200 AMP. INCL.

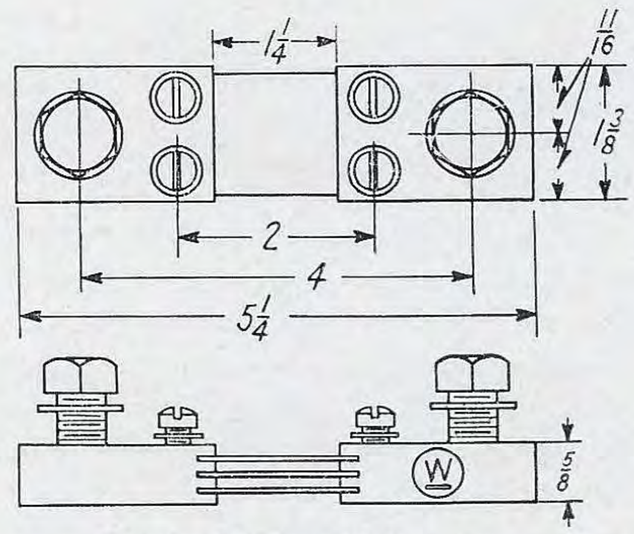


FIG. 9—250 AND 300 AMP. INCL.

Style No.	Amps.	Fig. No.	No. of Strips
936 938	1	7	1
936 939	1.5	7	1
936 940	2	7	1
936 941	3	7	1
724 755	5	7	1
936 942	7.5	7	1

Style No.	Amps.	Fig. No.	No. of Strips
724 756	10	7	1
724 757	15	7	1
936 943	20	7	1
703 927	25	8	1
936 944	30	8	1
703 928	50	8	1

Style No.	Amps.	Fig. No.	No. of Strips
703 929	75	8	1
703 930	100	8	2
703 931	150	8	3
703 932	200	8	4
703 933	250	9	3
703 934	300	9	4

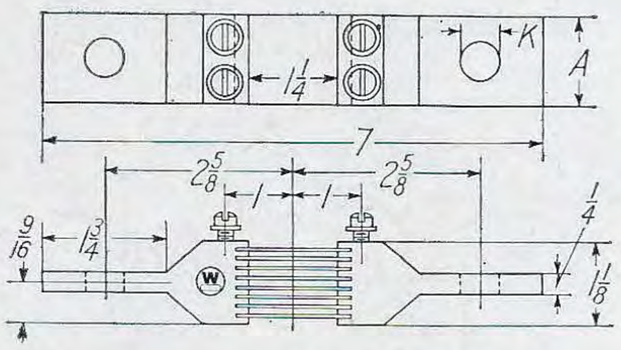


FIG. 10—400 TO 800 AMP. INCL.

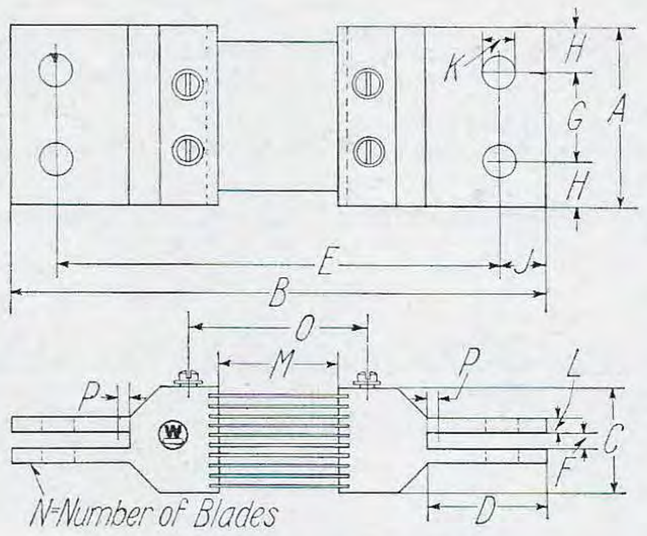


FIG. 11—1000 TO 3500 AMP. INCL.

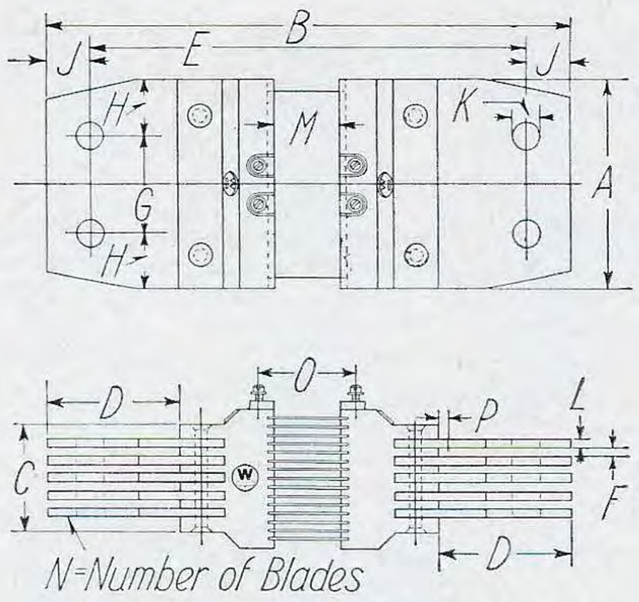


FIG. 12—4000 TO 20000 AMP. INCL.

			DIMENSIONS IN INCHES CORRESPONDING TO LETTERS SHOWN IN OUTLINE VIEWS														
Style No.	Amps.	Fig.	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P
282 639	400	10	1¼	....	....	....	....	....	....	....	....	17/32	....	....	....	....	....
282 640	500	10	1¼	....	....	....	....	....	....	....	....	17/32	....	....	....	....	....
282 641	600	10	1½	....	....	....	....	....	....	....	....	17/32	....	....	....	....	....
936 931	750	10	2	....	....	....	....	....	....	....	....	21/32	....	....	....	....	....
282 642	800	10	2	....	....	....	....	....	....	....	....	21/32	....	....	....	....	....
282 643	1000	11	3	9	1¾	2	7½	¼	1½	¾	¾	17/32	¼	2	2	3	3/16
282 644	1200	11	3	9	1¾	2	7½	¼	1½	¾	¾	17/32	¼	2	2	3	3/16
282 645	1500	11	3	9	2¼	2	7½	¼	1½	¾	¾	17/32	¼	2	3	3	3/16
282 646	2000	11	4	9	2¼	2	7½	¼	2	1	¾	17/32	¼	2	3	3	3/16
282 647	2500	11	4	14⅜	2⅝	3½	11⅞	¼	2	1	1¼	21/32	¼	1⅞	3	2⅞	3/16
282 648	3000	11	4	14⅜	3	3½	11⅞	¼	2	1	1¼	21/32	¼	1⅞	4	2⅞	3/16
936 932	3500	11	4	14⅜	3⅝	3½	11⅞	¼	2	1	1¼	21/32	¼	1⅞	4	2⅞	¼
282 649	4000	12	5	14⅜	3¼	3½	11⅞	¼	2	1½	1¼	13/16	¼	1⅞	4	2⅞	¼
936 933	4500	12	5	14⅜	3⅝	3½	11⅞	¼	2	1½	1¼	13/16	¼	1⅞	....	2⅞	¼
282 650	5000	12	5	14⅜	4	3½	11⅞	¼	2	1½	1¼	13/16	¼	1⅞	5	2⅞	¼
282 651	6000	12	6	14⅞	4	3¾	12⅜	¼	2¾	1⅝	1¼	13/16	¼	1⅞	5	2¾	¼
936 934	7500	12	6	14⅞	5¼	3¾	12⅜	¼	2¾	1⅝	1¼	13/16	¼	1⅞	....	2¾	¼
282 652	8000	12	6	14⅞	5¼	3¾	12⅜	¼	2¾	1⅝	1¼	13/16	¼	1⅞	6	2¾	¼
306 209	10000	12	8	15⅞	5	4¼	12⅞	¼	2¾	2¼	1¼	13/16	¼	1⅞	6	2¾	¼
931 117	12000	12	8	15⅞	6	4¼	12⅞	¼	3½	2¼	1½	1 1/16	¼	1⅞	7	2¾	¼
936 935	15000	12	8	15⅞	7	4¼	12⅞	¼	3½	2¼	1½	1 1/16	¼	1⅞	9	2⅞	¼
936 936	18000	12	10	15⅞	7⅝	4¼	12⅞	¼	4½	2¾	1½	1 1/16	¼	1⅞	9	2⅞	¼
936 937	20000	12	10	15⅞	7⅝	4¼	12⅞	¼	4½	2¾	1½	1 1/16	¼	1⅞	9	2⅞	¼

TYPE JS TACHOMETER

Axle Mounting for Railway Service

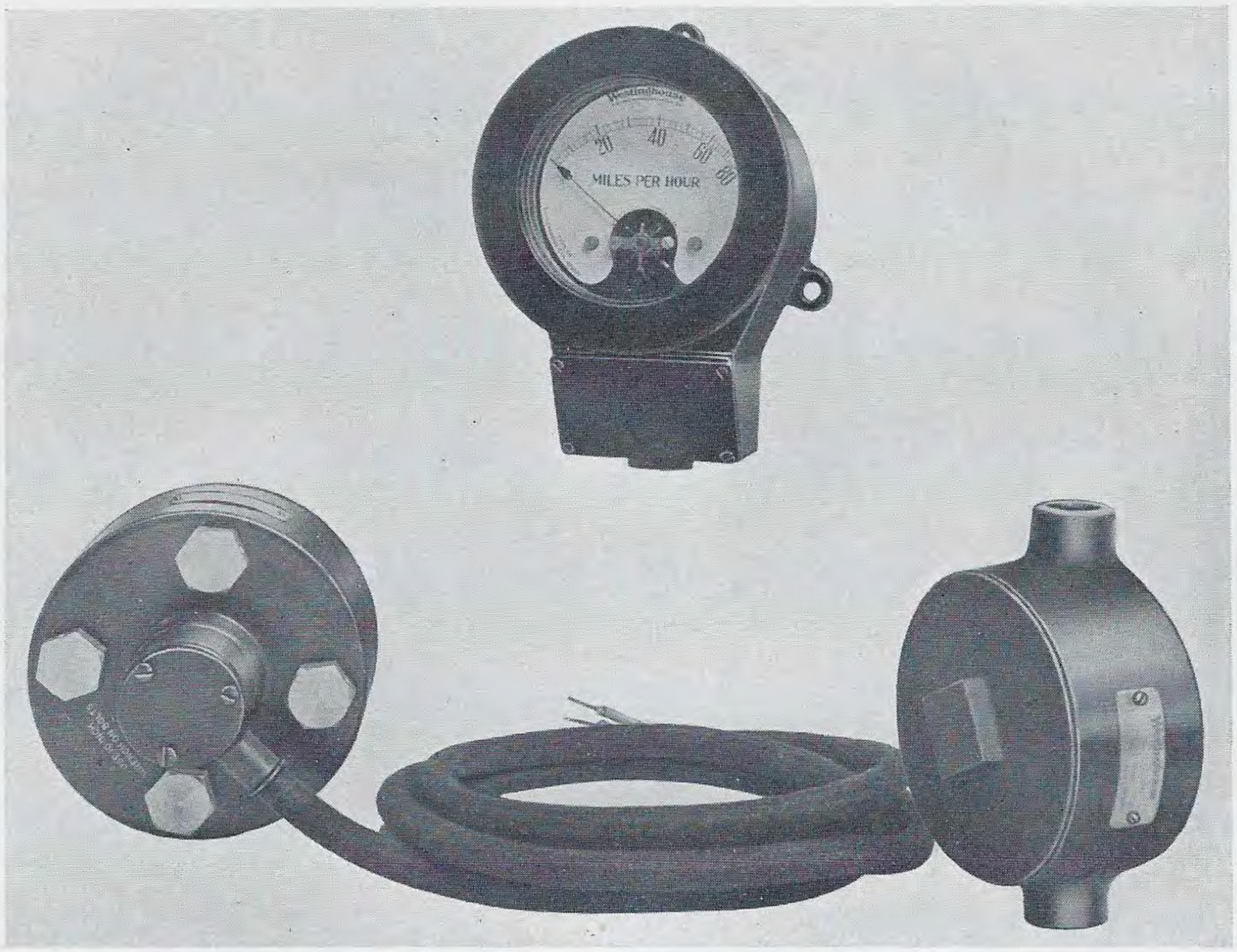


FIG. 1—TYPE JS TACHOMETER SHOWING TYPE JS GENERATOR, TYPE DXA INDICATOR, CABLE TERMINAL JUNCTION BOX AND JUNCTION BOX WITH ADJUSTING RHEOSTAT.

DATA

GENERATOR	ALTERNATING CURRENT, SATURATED INDUCTOR TYPE.		
MOUNTING	AXLE MOUNTED, MINIMUM AXLE DIAMETER 5½"		
INDICATOR	TYPE DXA PERMANENT MAGNET MOVING COIL, RECTOX TYPE.		
ACCURACY	WITHIN ±3%		
WEIGHT APPROX	TYPE JS GENERATOR	NET 13 LBS.	SHIP. 17 LBS.
	TYPE DXA INDICATOR	NET 12 LBS.	SHIP. 16 LBS.
	JUNCTION BOX	NET 5 LBS.	SHIP. 10 LBS.

General

The type JS axle mounted Railway Tachometer is an unusually rugged speed indicator specially designed for heavy traction railway service. By mounting the generator directly on the pony truck axle, auxiliary mounting details are not necessary. The use of belts and pulleys is also eliminated. The complete tachometer consists of only three items, i.e., Generator, Junction Box and Indicator.

The tachometer operates on the principle of an electric generator which has an output proportional to speed. This output is an alternating current which is transmitted through a flexible cable and suitable conduit wiring, to the indicator in the locomotive cab. It is rectified by a rectox rectifier before being applied to the moving coil of the type DXA indicator. The rectifiers used are specially aged and compensated for railway service. The indicator is calibrated in miles per hour.

Construction

Commutator, brushes and drive belt are eliminated from the generator and its drive by means of the axle mounting arrangement. The generator housing, mounted on the axle, revolves with the wheel. The permanent magnet field revolves with the housing. The armature remains stationary, the winding being brought out directly through the flexible lead. This lead also serves to prevent the armature from turning.

The generator permanent magnets are thoroughly aged and even if they should weaken slightly due to severe shock or heat or vibration, the error in reading would not be noticeable. This is due to a saturated section in the magnetic circuit so that with a large change of magneto-motive force the change in reading is unnoticeable. The generator bearings are sealed in and need no attention, except to be refilled with grease every 5 years.

The "DXA" instrument has a high torque d-c. movement which has large pivots and jewels, and is especially designed for railway service. A small rectox is included within the meter case

TYPE JS TACHOMETER—Continued

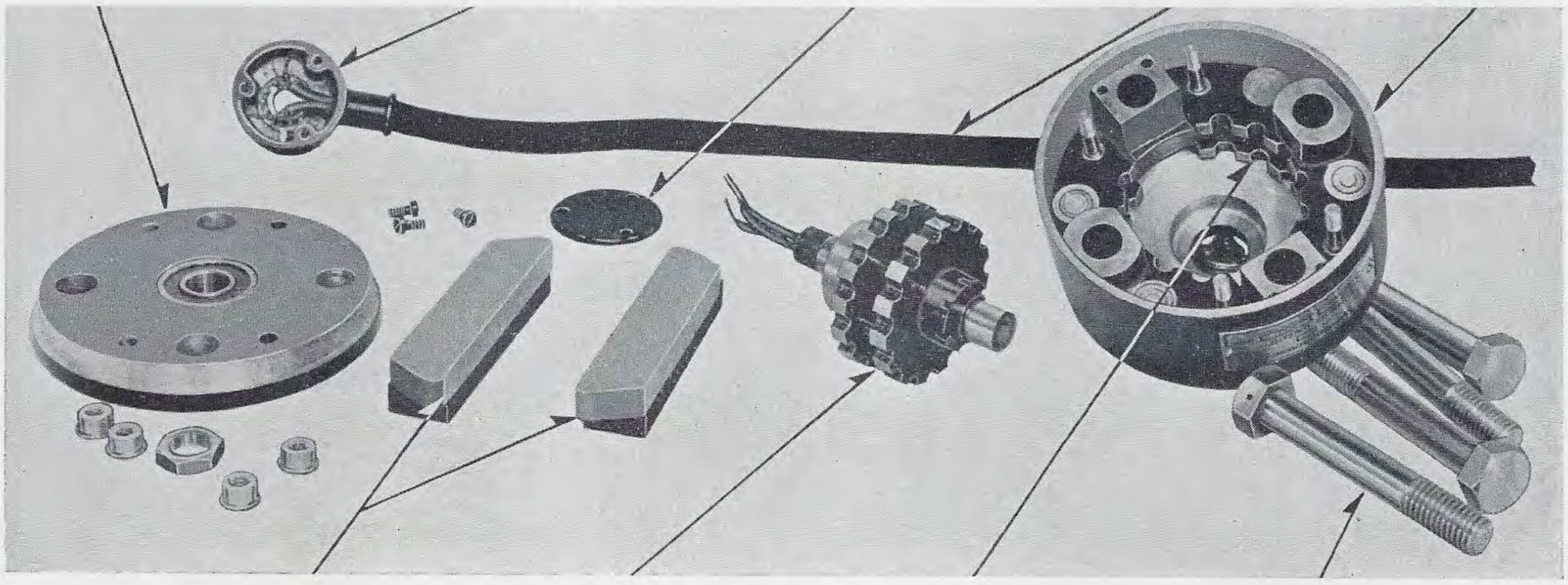


FIG. 2—EXPLODED VIEW, TYPE JS TACHOMETER GENERATOR.

which rectifies the alternating current from the inductor generator. The circuit is so proportioned that the scale is uniform even at the low end.

Compensation for changes in wheel diameter is made by means of a compensating rheostat mounted in the Junction Box.

Application

Steam Railway Service

Type JS Tachometers are specially designed for use in Heavy Traction steam railway service. The axle mounted form is particularly convenient in this field because of the accessibility of pony truck axles where the Type JS Generator may be conveniently mounted by drilling and tapping four holes.

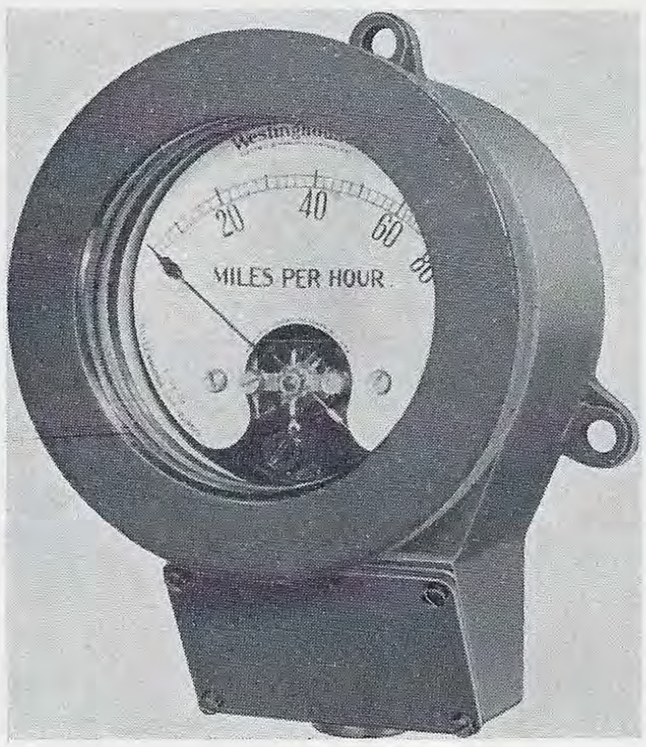


FIG. 3—TYPE "DXA" INDICATOR

Electric Railway Service

This equipment may be adapted to electric traction service but usually requires special mounting provisions to suit the outboard bearing arrangement generally employed on electric locomotives. Negotiations in this field are invited. Inquiries should be accompanied with drawings of the journal box, bearing and axle where the tachometer generator is to be mounted.

In ordering, the full scale speed and wheel diameter should be specified. Standard outfits are arranged for wheel diameter as ordered. The compensating rheostat is calibrated to accommodate wheels of specified maximum diameter and may be adjusted in operation to take care of diameters down to two inches less to compensate for wear.

LIST PRICES

Type JS Tachometer

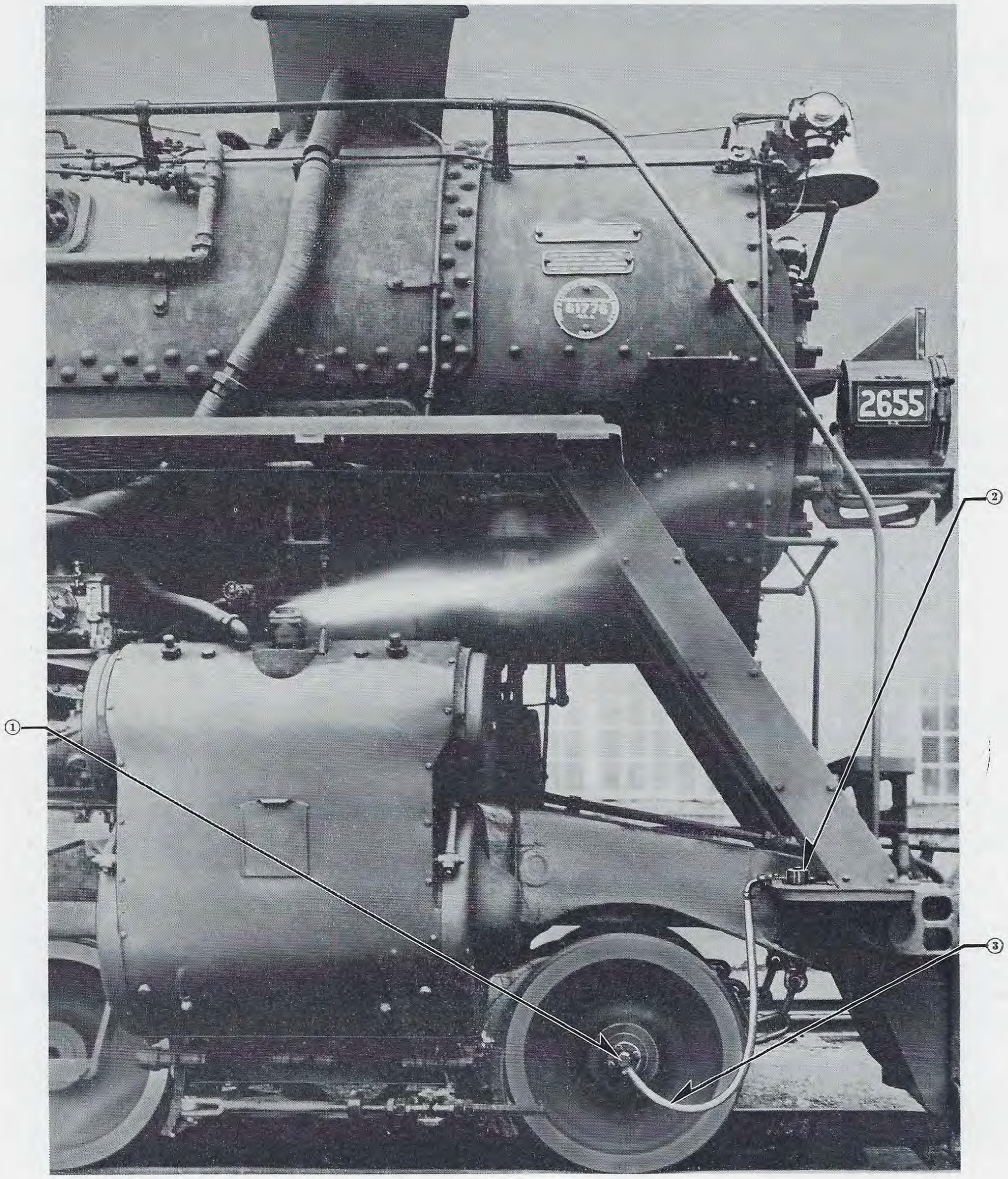
Description	Style No.	List Price Discount Symbol BC
Type JS Tachometer Outfit Complete with Generator, Indicator, Junction Box with Calibrating Rheostat, and Cable Terminal Junction Box	1 009 989	$400 00

Order by Style Number

Prices and discounts are subject to change without notice.

TYPE JS TACHOMETER—Continued

OUTLINE DIMENSIONS IN INCHES



1—TYPE JS TACHOMETER GENERATOR

2—CABLE TERMINAL JUNCTION BOX

3—FLEXIBLE CABLE CONNECTOR

FIG. 4—TYPE JS TACHOMETER INSTALLATION ON PONY WHEEL OF STEAM LOCOMOTIVE

TYPE JS TACHOMETER—Continued

TYPICAL WIRING DIAGRAM

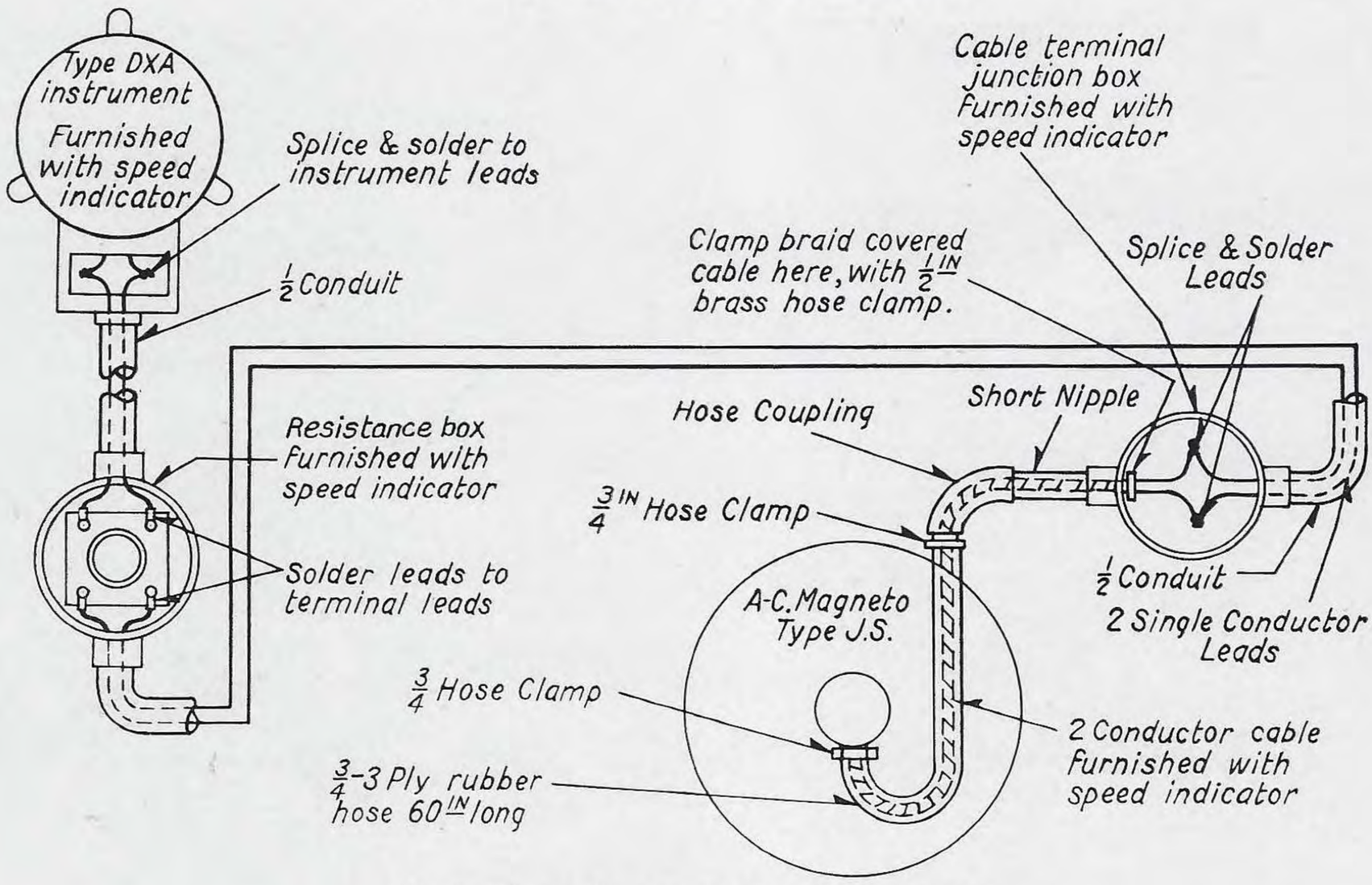


FIG. 5—TYPICAL DIAGRAM FOR TYPE JS TACHOMETER

OUTLINE DIMENSIONS IN INCHES

Dimensions are for reference only. For official dimensions refer to nearest Westinghouse Sales Office.

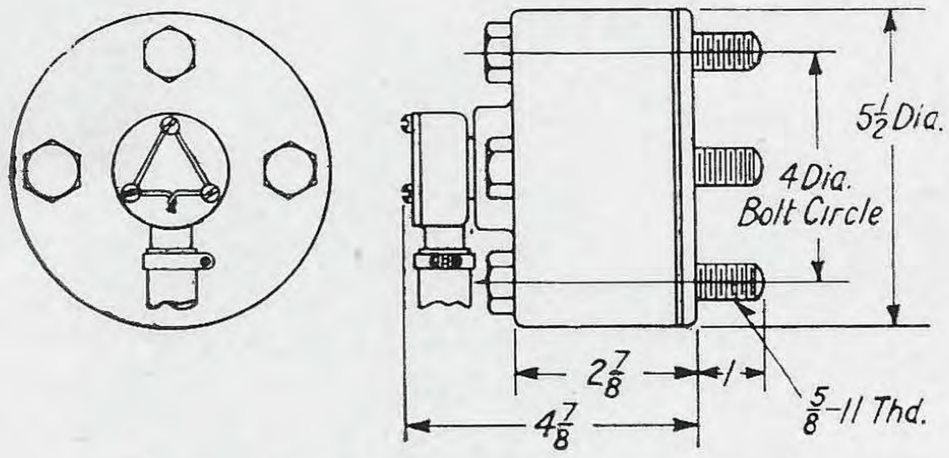


FIG. 6—OUTLINE AND DRILLING PLAN, TYPE JS TACHOMETER GENERATOR

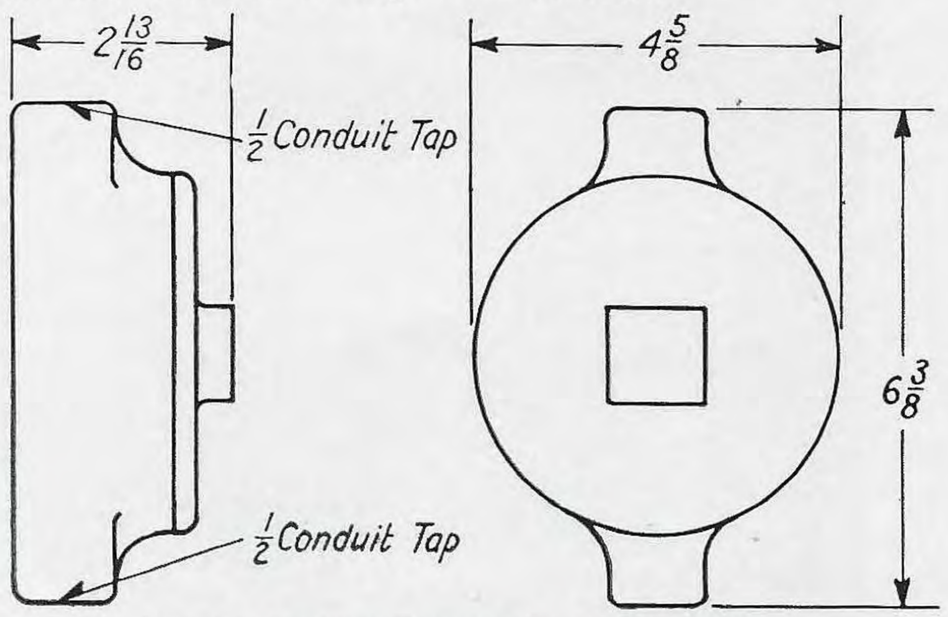


FIG. 7—JUNCTION BOX FOR ADJUSTING RHEOSTAT AND CABLE TERMINAL

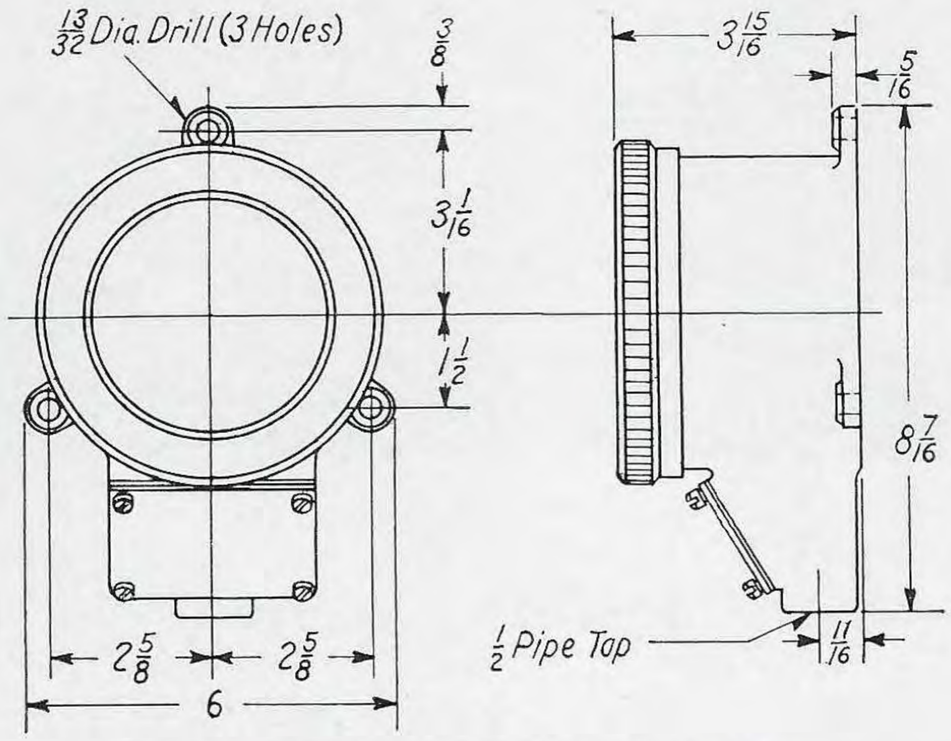


FIG. 8—OUTLINE AND DRILLING PLAN, TYPE DXA SHOCK PROOF INDICATOR

MINIATURE PANEL INSTRUMENTS

TWO-INCH CLASSIFICATION

Types MX, MC, MT and MA

Direct Current, Rectox, Radio Frequency and Alternating Current Types

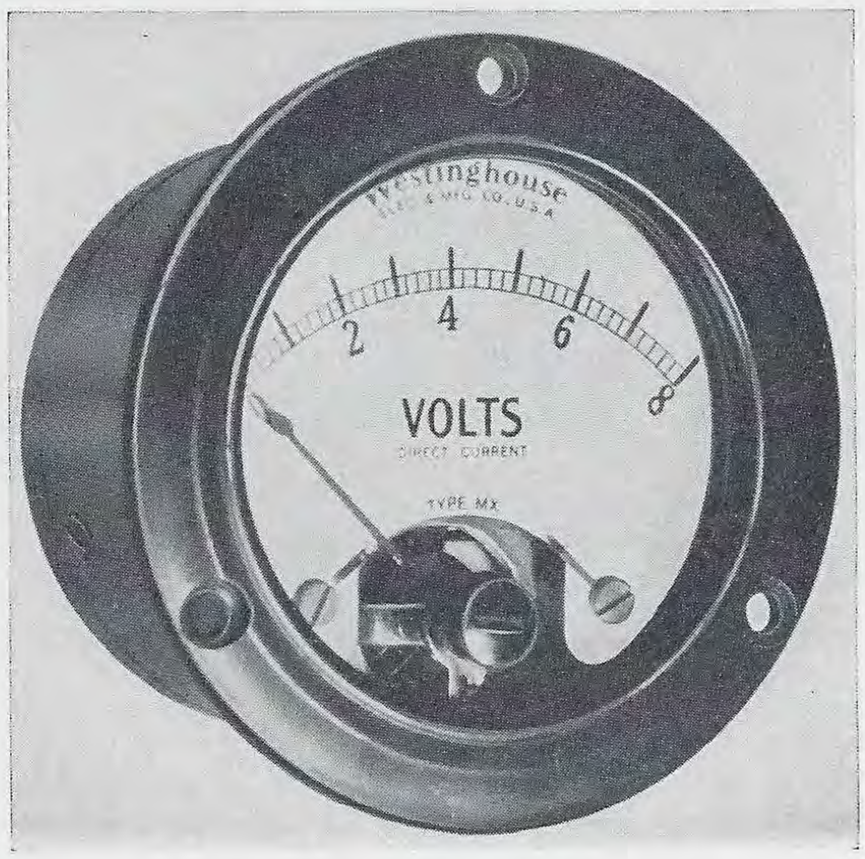


FIG. 1-A—WIDE FLANGE INSTRUMENT

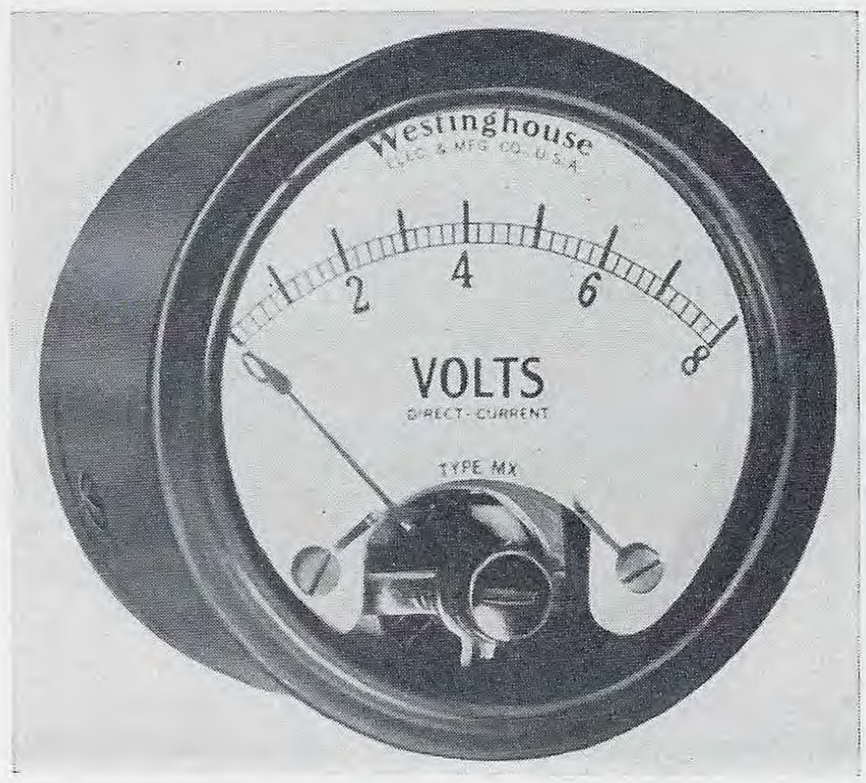


FIG. 1-B—NARROW FLANGE INSTRUMENT

FIG. 1—ILLUSTRATING CASE FORMS USED IN THE "M" LINE OF MINIATURE PANEL INSTRUMENTS

DATA

	ROUND FLUSH MOUNTING NARROW FLANGE	ROUND FLUSH MOUNTING WIDE FLANGE
‡ D-C. Types	MX	MX
Rectox Types	MC	MC
Radio Frequency Types	MT	MT
** A-C. Types	MA	MA
Case Material	Moldarta	Moldarta
Mounting	Flush	Flush
	Clamped	Bolted
Body Diameter	2 1/16"	2 1/16"
Front Flange	2 1/4"	2 9/16"
D-C. Scale Length	1.8"	1.8"
A-C. Scale Length	1 1/2"	1 1/2"
Insulation Rating	500 V.	500 V.
* Accuracy	± 2%	± 2%
† Net Wt. A-C. Types	5 1/4 oz.	5 1/4 oz.
† Net Wt. D-C. Types	8 oz.	8 oz.
† Net Wt. Cobalt Magnet D-C. Types	10 oz.	10 oz.

‡ Permanent Magnet Moving Coil (D-C.) Types have electromagnetic damping.
** Repulsion Vane (A-C.) Types are air damped.
* Accuracy Rectox Types, 5%. Repulsion Vane Types when used on D-C. 3%.
† Weights are approximate and do not include shunts, resistors, etc.

General

The Westinghouse line of Miniature Panel Instruments is available as a complete line covering all industrial and radio applications in a variety of forms. All forms are available with alternating current or direct current movements. The ratings cover the broadest possible field consistent with prevailing requirements for instruments of this class. The line provides for the measurement of Direct Current: volts, amperes, milliamperes, microamperes; Rectox Types: power level, output; Thermocouple Types: radio frequency amperes and milliamperes; Alternating Current: volts, amperes and milliamperes.

The entire line of miniature panel instruments employs but two types of mechanisms. This contributes to interchangeability of parts and permits of short delivery schedules on special and semi-standard forms. The cases are interchangeable between narrow flange and wide flange forms.

Mechanisms are of the latest improved design having higher torque-weight ratios and low volt-ampere burdens. Capacities as low as 20 microamperes are available in moving coil types. Self-contained ammeters of 50 amperes and voltmeters of 200 volts are available, thus providing the economical maximum in variety of ratings with a minimum of external accessories.

Westinghouse Electric & Manufacturing Company
Newark Works, Newark, N. J.

EVERY HOUSE NEEDS WESTINGHOUSE

MINIATURE PANEL INSTRUMENTS—Continued

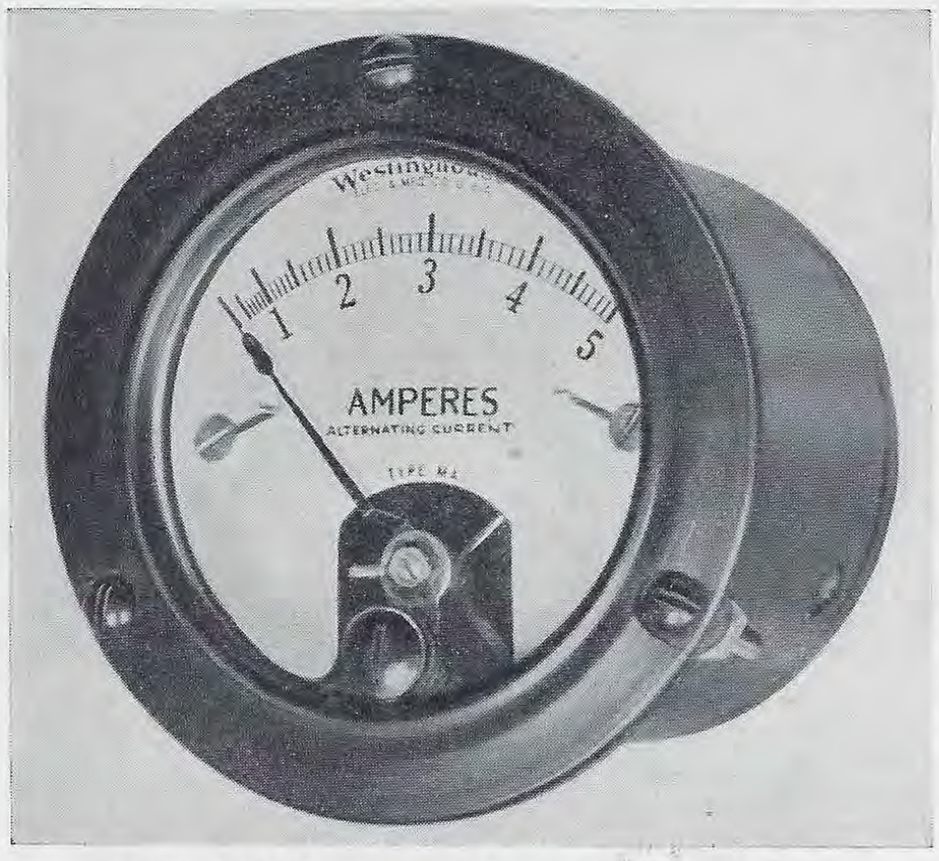


FIG. 2—TYPE MA AMMETER WITH WIDE FLANGE CASE

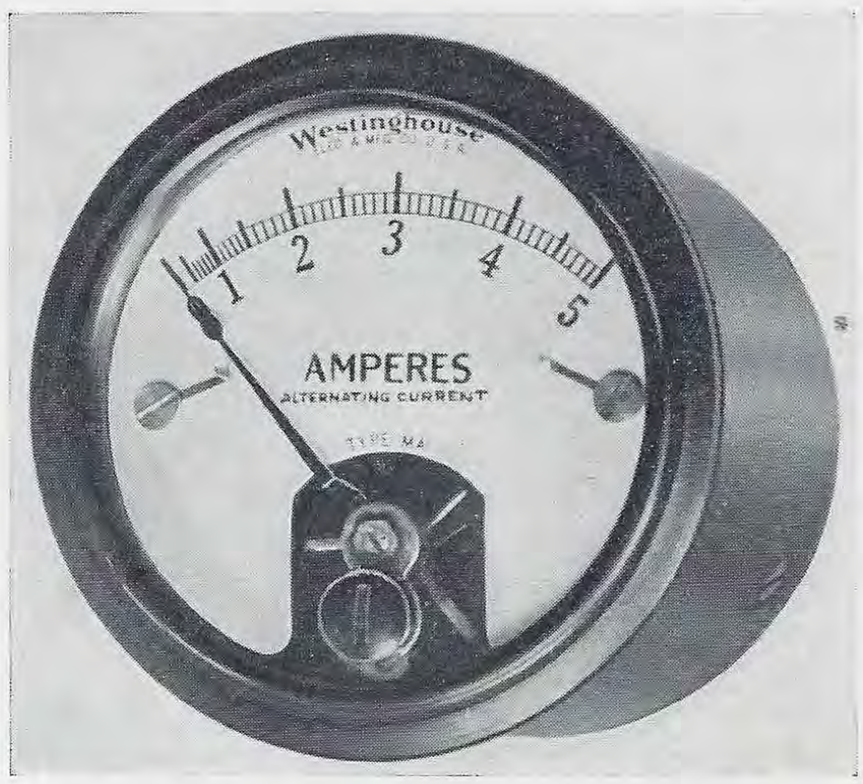


FIG. 3—TYPE MA AMMETER WITH NARROW FLANGE CASE

Application

A broad field of applications is covered by the Westinghouse line of miniature panel instruments. Some of these applications are briefly as follows:

1. Industrial Test Units for production testing of electrical apparatus.
2. Automotive Analyzers for testing electrical characteristics encountered in ignition, lighting and starting systems.
3. Battery Testers and Battery Chargers.
4. Radio Tube Testers and Set Analyzers.
5. Radio Transmitters, for plate and filament currents and voltages, output, distortion factor modulation and grid currents.
6. Radio experimenters and amateurs for general use in radio circuits.
7. Aircraft, for indication of battery currents, voltages, etc.
8. Arc Welding Outfits.
9. Motion Picture Arc Lamp Control Panels.
10. Sound Movie equipment for measuring electrical circuit characteristics.
11. Electrical Laboratories for general test work.
12. Ohmmeters for measuring resistance.

In application of miniature panel instruments the influence of steel panels as well as the influence of one instrument upon the other and the influence of current carrying leads upon instrument indication must be considered. When mounted on insulated panels the panel influence need not be considered. When mounted on steel panels all miniature instruments must be so calibrated.

As a general rule the moving coil type of instruments must be at least 5″ apart between center lines and 8″ when one or more of the instruments have cobalt magnets.

The effect of one "A-35" repulsion vane instrument on another is negligible. Repulsion vane instruments should not be less than 6″ from leads carrying currents of the order of 50 amperes. This minimum distance increases or decreases with the current level in direct proportion.

If the above precautions are taken the influence between instruments, and of current carrying leads will be less than ½ of 1%. When the above spacings are impractical, smaller spacings may be used but the instruments must be so calibrated.

Operation and Construction

PERMANENT MAGNET MOVING COIL TYPES FOR DIRECT CURRENT CIRCUITS AND FOR RECTOX AND THERMAL TYPES

Operation—The d'Arsonval, or permanent-magnet moving-coil principle of operation is used. Numerous refinements in the design of this movement have been made; such as, soft iron pole tips welded to the permanent magnet in accurately aligned fixtures; improved springs; and an entirely new method of supporting the iron core in a one piece bracket which also supports the jewel bearings in perfect alignment. Provision is made for the use of extremely strong cobalt-steel magnets for super-sensitive microammeters.

Construction—The cases are round with full open face.

Movements—The permanent magnets are made of high-quality tungsten steel or cobalt steel, properly heat-treated and aged. The soft-iron pole tips are accurately aligned and fastened to the permanent magnet by an electrical welding process, thus assuring perfect alignment and uniform air gap for the moving coil. The iron core is accurately aligned by a one piece bracket which supports the sapphire jewel bearings. These features of construction assure extremely accurate air gaps with the convenience of removal of the element from the pole pieces as a complete unit for easy repairing. This provides also uniform flux distribution and reduces the amount of energy consumed by the movement, making possible a super-sensitive instrument in the miniature size.

Springs—The control springs used are the result of years of research into the behavior of spring materials. Special alloys together with proper heat treatment and aging have resulted in a spring having negligible fatigue or set.

Dials—Standard dials are finished in matte silver, with black figures. The number of scale divisions and the size of

MINIATURE PANEL INSTRUMENTS—Continued

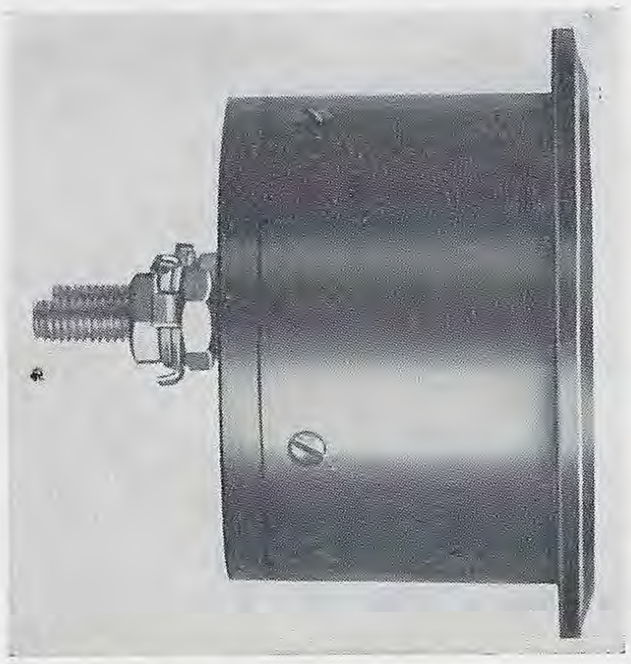


FIG. 4—CASE FORM OF WIDE FLANGE INSTRUMENTS

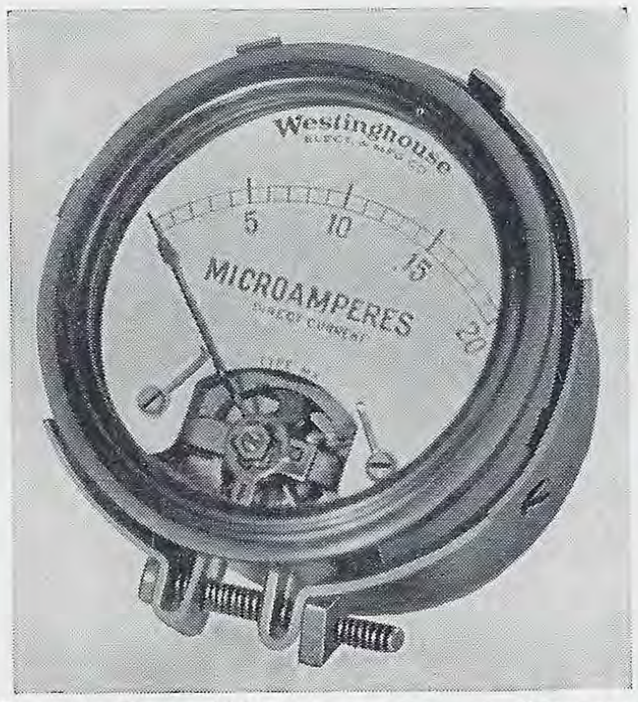


FIG. 5—TYPE MX MICROAMMETER SHOWING THE REAR CLAMP FOR MOUNTING

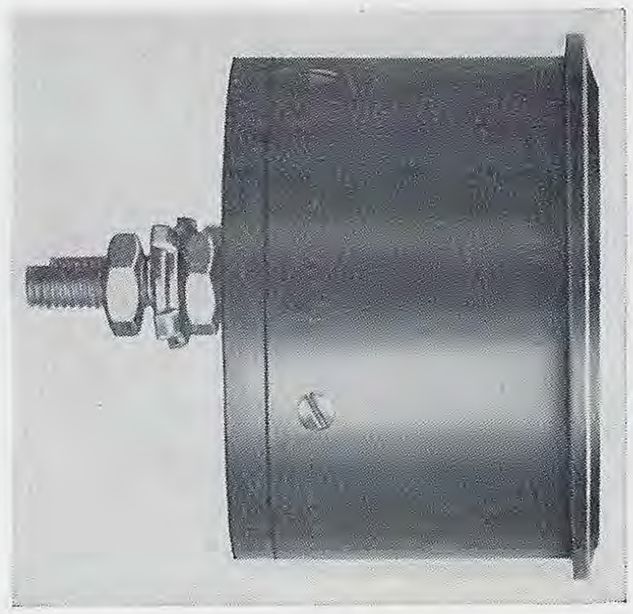


FIG. 6—CASE FORM OF NARROW FLANGE INSTRUMENTS

the figures have been selected for greatest ease of reading and best appearance. Provision is made for multi-scale markings where necessary.

Rectox Types—Rectox instruments are used for the measurement of alternating currents when low energy consumption is necessary. A copper-oxide, full-wave rectifier is mounted inside the instrument case, and connected to supply full-wave rectified current to the moving coil. The d'Arsonval instrument element deflects in proportion to the average value of the rectified wave. The dial is calibrated in terms of effective or root-mean-square values. A sensitivity of from 1000 to 10,000 ohms per volt can be obtained with rectifier-type instruments.

Zero Adjusters — Standard instruments are provided with external zero adjusters.

Pointers—The pointer and cross arms are made from strong aluminum alloy, resulting in minimum weight and maximum strength.

Pointer Stops—Pointer stops for both zero and full scale are standard equipment.

Removable Mechanism—All element parts are assembled on a one-piece frame which can be lifted readily from the instrument for inspection or replacement.

Insulation—The two-inch classification miniature panel instruments are rated at 500 volts which corresponds to a test of 2000 volts between terminals and the panel.

Modifications Available—Special capacities and special dial markings not listed herein may be supplied to meet specific applications. Negotiations on instruments of this class are invited.

Operation and Construction

REPULSION VANE TYPES FOR A-C. CIRCUITS

Operation—The repulsion iron vane principle of operation is used. This movement is reasonably free from wave form and frequency errors. The current to be measured flows through a stationary coil. A molded chamber containing a stationary iron vane and a movable iron vane is placed within the stationary coil. The molded chamber acts as a support for the stationary vane, also for the bearings and shaft. The pointer is securely fastened to the shaft. Both vanes are of the same polarity at any instant and being polarized by the one stationary coil, repel each other. The movable vane thus moves away from the stationary vane against the torque of a phosphor-bronze control spring. For any given current in the coil an equilibrium point is reached when the forces of repulsion in the vanes just balance the torque of the control spring. The pointer indicates with reference to a scale calibrated in terms of the current or voltage applied to the instrument. Since the force of repulsion in the vanes is a function of the current in the coil, the instrument can be calibrated in terms of the current.

Construction—The cases are round with full open face.

Movements—A new repulsion vane mechanism is used having a very sturdy construction, and incorporating an easy and reliable means of calibration. The entire movement may be removed for inspection without disconnecting leads or control springs. Calibration is effected by means of a screw which is accessible on the rear of the case. The new repulsion vane movement has been designed to give an unusually good scale distribution. Scale divisions are practically uniform from 10% scale deflection to full scale.

Springs—The control springs used are the result of years of research into the behavior of spring materials. Special alloys together with proper heat treatment and aging have resulted in a spring having negligible fatigue or set.

Bearings and Pivots—Genuine sapphire jewels are used. They are ground and highly polished and checked for contour and dimensions by a special process.

Pivots are made of high-grade steel specially treated and polished. Radius and polish are also checked by special processes developed from years of experience in instrument manufacture.

Dials—Standard dials are finished in matte silver, with black figures. The number of scale divisions and the size of the figures have been selected for the greatest ease in reading and best appearance. Provision is made for multi-scale markings where necessary.

Zero Adjusters—All instruments are provided with external zero adjusters.

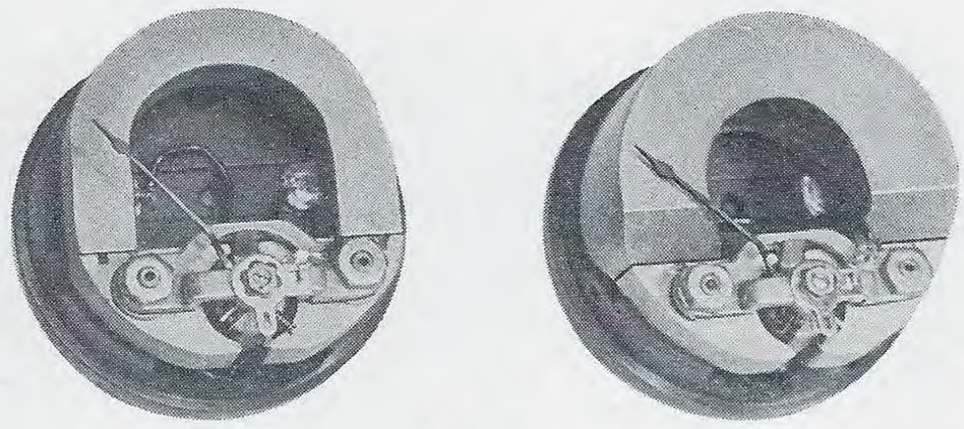
Pointers—The pointer is equipped with cross arms to receive special coiled wire balance weights which are easily adjusted and are self-locking. The pointers are of aluminum alloy.

Removable Mechanism—All moving element parts are assembled to a one-piece molded chamber which can easily be removed as a unit for inspection or repair.

Insulation—The two-inch classification miniature panel instruments are rated at 500 volts which corresponds to a test of 2000 volts between terminals and panel.

Modifications Available—Special capacities and special dial markings, not listed herein, may be supplied to meet specific applications. Negotiations on instruments of this class are invited.

MINIATURE PANEL INSTRUMENTS—Continued



A B

FIG. 7
A—STANDARD MX MOVEMENT WITH A TUNGSTEN MAGNET
B—STANDARD MX MOVEMENT WITH A COBALT MAGNET FOR LOW-RANGE, HIGH-SENSITIVITY MICROAMMETERS

LIST PRICES

DIRECT-CURRENT INSTRUMENTS
TYPE MX

All instruments listed below are calibrated for use on non-magnetic panels. When ordering for use on steel panels, panel thickness must be specified.

D-C. AMMETERS
Calibrated for 50-Mv. External Shunts

	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
Left Zero*†	818 486	W-818 486	$7 50
Center Zero*†	818 487	W-818 487	7 50

* The above styles of d-c. ammeters can be calibrated for any external shunt from 5 to 10,000 amperes, and for standard or special length leads.
† Specify rating of shunt required. List price includes leads, but not the shunt.
When ordering specify Style No. 553583 leads for type MX.

D-C. AMMETERS
Self-Contained
Approximately 50-Mv. Drop Across Terminals

Rating	Scale Div.	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
1§	20	818 488	W-818 488	$7 50
1.5§	30	818 489	W-818 489	7 50
2§	40	818 490	W-818 490	7 50
3§	30	818 492	W-818 492	7 50
5§	50	724 654	W-724 654	7 50
10§	20	818 497	W-818 497	7 50
15§	30	818 498	W-818 498	7 50
20§	40	818 499	W-818 499	7 50
30§	30	818 501	W-818 501	7 50
50§	50	818 503	W-818 503	7 50

§ Any of these ammeters can be furnished with a center zero at the same price.

D-C. MILLIAMMETERS
Self-Contained
Double Range with Three Binding Posts

Rating	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
15—150	836 110	W-836 110	$14 00
30—150	836 111	W-836 111	14 00

D-C. MILLIAMMETERS
Self-Contained

Rating	Scale Div.	Resistance Approx. Ohms	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
1¶	20	110	818 504	W-818 504	$8 50
1.5¶	30	61	818 505	W-818 505	8 50
2¶	40	46	818 506	W-818 506	8 50
3¶	30	16.2	818 508	W-818 508	8 50
5¶	50	10.1	818 510	W-818 510	7 50
10¶	20	2.37	724 652	W-724 652	7 50
15¶	30	2.44	818 514	W-818 514	7 50
20¶	40	1.68	818 515	W-818 515	7 50
30¶	30	1.67	818 517	W-818 517	7 50
50¶	50	1.	818 519	W-818 519	7 50
100¶	20	.50	818 522	W-818 522	7 50
150¶	30	.33	818 523	W-818 523	7 50
200¶	40	.25	818 524	W-818 524	7 50
300¶	30	.17	818 525	W-818 525	7 50
500¶	50	.10	818 527	W-818 527	7 50
800¶	40	.062	818 529	W-818 529	7 50

¶ For special requirements, it is usually possible to make milliammeters of lower resistance than the values shown here.

D-C. MICROAMMETERS*
Self-Contained

Rating	Scale Div.	Resistance Approx. Ohms	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
20	40	2180	820 159	W-820 159	$24 50
50	50	456	836 169	W-836 169	22 00
80	40	183	820 964	W-820 964	22 00
100	20	121	818 530	W-818 530	19 50
150	30	340	818 531	W-818 531	16 50
200	40	154	818 532	W-818 532	12 75
250	25	121	818 533	W-818 533	12 75
300	30	154	818 534	W-818 534	12 75
400	40	97	818 535	W-818 535	12 75
500	50	110	818 536	W-818 536	12 75
600	30	93	818 537	W-818 537	12 75
800	40	61	818 538	W-818 538	12 75

* Microammeters below 500 microamperes depend upon the external circuit for damping.

Prices and Discounts subject to change without notice

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

DIRECT-CURRENT INSTRUMENTS, TYPE MX—Continued

D-C. VOLTMETERS
Self-Contained

Resistance—200 Ohms per Volt

Rating	Scale Div.	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
1	20	818 539	W-818 539	$7 50
1.5	30	818 540	W-818 540	7 50
2	40	818 541	W-818 541	7 50
3	30	818 543	W-818 543	7 50
5	50	818 545	W-818 545	7 50
8	40	818 547	W-818 547	7 50
10	20	818 548	W-818 548	7 50
15	30	818 549	W-818 549	7 50
20	40	818 550	W-818 550	7 50
25	25	818 551	W-818 551	7 50
30	30	818 552	W-818 552	7 50
50	50	818 554	W-818 554	7 50
80	40	818 556	W-818 556	7 50
100	20	818 557	W-818 557	8 50
150	30	724 653	W-724 653	9 75
200	40	818 559	W-818 559	11 50

For higher ratings see table following.

Resistance—1000 Ohms per Volt

Rating	Scale Div.	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
1	20	821 583	W-821 583	$10 50
2	40	821 584	W-821 584	10 50
5	50	821 588	W-821 588	10 50
8	40	821 590	W-821 590	10 50
10	20	821 591	W 821 591	10 50
15	30	821 592	W-821 592	10 50
25	25	821 594	W-821 594	10 50
50	50	821 597	W-821 597	10 50
80	40	821 599	W-821 599	10 50
100	20	821 600	W-821 600	11 00
150	30	821 601	W-821 601	11 75
200	40	821 602	W-821 602	12 50
250*	25	821 603	W-821 603	13 00
300*	30	821 604	W-821 604	13 50
500*	50	821 606	W-821 606	15 75
800*	40	821 608	W-821 608	21 00
1000*	20	821 609	W-821 609	24 50

* Supplied with external resistor. When an external resistor is required, the voltmeter is made self-contained for 150 volts (150,000 ohms) and the balance of the resistance is external.

RECTOX INSTRUMENTS
TYPE MC

All instruments listed below are calibrated for use on non-magnetic panels. When ordering for use on steel panels, panel thickness must be specified.

RECTOX MILLIAMMETERS
Self-Contained

Rating	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
1	818 595	W-818 595	$13 50
2	818 596	W-818 596	13 50
5	818 597	W-818 597	12 50
10	818 598	W-818 598	12 50

RECTOX MICROAMMETERS
Self-Contained

Rating	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
80*	....	....	.....
200	818 593	W-818 593	$17 75
500	818 594	W-818 594	17 75

* This range is particularly suited for use as an a-c. galvanometer.

RECTOX VOLTMETERS
Self-Contained

Rating	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
Resistance—1000 Ohms per Volt			
4†	724 655	W-724 655	$15 50
5†	818 600	W-818 600	15 50
10†	818 601	W-818 601	15 50
50†	818 602	W-818 602	15 50
150†	818 603	W-818 603	17 50

† Below 4 volts, Rectox voltmeters should have a resistance of 2000 or 5000 ohms per volt.

Resistance—2000 Ohms per Volt			
1.5	818 604	W-818 604	17 75
2	818 605	W-818 605	17 75
2.5	818 606	W-818 606	17 75
3	818 607	W-818 607	17 75
Resistance—5000 Ohms per Volt			
0.5	818 608	W-818 608	17 75
1	818 609	W-818 609	17 75

Prices and Discounts subject to change without notice

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

RADIO FREQUENCY INSTRUMENTS
TYPE MT

All instruments listed below are calibrated for use on non-magnetic panels. When ordering for use on steel panels, panel thickness must be specified.

RADIO-FREQUENCY AMMETERS
Self-Contained

Rating	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
1	818 572	W-818 572	$14 50
1.5	818 573	W-818 573	14 50
2	818 574	W-818 574	14 50
3	818 576	W-818 576	14 50
5	724 656	W-724 656	14 50
6	818 579	W-818 579	14 50
8	818 580	W-818 580	14 50
10	818 581	W-818 581	14 50
15	818 582	W-818 582	14 50
20	818 583	W-818 583	14 50

RADIO-FREQUENCY MILLIAMMETERS
Self-Contained

Rating	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
100	724 657	W-724 657	$16 50
150	818 585	W-818 585	16 50
200	818 586	W-818 586	16 50
250	818 587	W-818 587	16 50
300	818 588	W-818 588	16 50
400	818 589	W-818 589	16 50
500	818 590	W-818 590	16 50
600	818 591	W-818 591	14 50
800	818 592	W-818 592	14 50

RADIO-FREQUENCY AMMETER
Calibrated for Use With External Thermocouple

Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
818 558	W-818 558	$8 50

EXTERNAL THERMOCOUPLES
For Radio Frequency Ammeters
Air Type

Rating	Narrow Flange Style No.	List Price Discount Symbol AC
1	878 638	$12 00
1.5	878 639	12 00
2	878 640	12 00
2.5	878 641	12 00
3	878 642	12 00
4	878 643	12 00
5	878 644	12 00
6	878 645	12 00
8	878 646	12 00
10	878 647	12 00
15	878 648	12 00
20	878 649	12 00
25	878 650	12 00
30	878 651	14 50
35	878 652	14 50
40	878 653	14 50
50	878 654	14 50

* List price includes the ammeter calibrated with four foot leads, but not the thermocouple. Radio-frequency ammeters are available with external thermocouples in all ranges from 1 to 50 amperes, inclusive. When long leads are used between the instrument and the thermocouple, it is usually necessary to place proper by-pass condensers and radio-frequency chokes in the circuit at the thermocouple to prevent damage to the thermocouple by radio-frequency in the instrument leads. Additional information on this subject will be furnished on request.

External thermocouples may be used with radio-frequency ammeters designed for the purpose and listed with the various types of instruments. Each instrument and thermocouple must be calibrated together.

ALTERNATING CURRENT INSTRUMENTS
TYPE MA

All instruments listed below are calibrated for use on non-magnetic panels. When ordering for use on steel panels, panel thickness must be specified.

AMMETERS
Self-Contained

Rating	Scale Div.	F.S. Burden V.A. @ 60 Cy.	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
1	20	.1	937 530	W-937 530	$7 50
2.5	25	.025	937 531	W-937 531	7 50
5	25	.006	937 532	W-937 532	7 50
10	20	.0025	937 533	W-937 533	7 50
15	30	.0015	937 534	W-937 534	7 50
25	25	.0006	937 535	W-937 535	7 50
50	25	.0003	937 536	W-937 536	7 50

MILLIAMMETERS
Self-Contained

Rating	Scale Div.	F.S. Burden V.A. @ 60 Cy.	Inductance Henrys	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
5	25	.17	4.8	937 537	W-937 537	$7 50
10	20	.17	1.2	937 538	W-937 538	7 50
15	30	.15	.52	937 539	W-937 539	7 50
25	25	.14	.187	937 540	W-937 540	7 50
50	25	.14	.047	937 541	W-937 541	7 50
100	20	.15	.012	937 542	W-937 542	7 50
250	25	.17	.002	937 543	W-937 543	7 50
500	25	.17	.0005	937 544	W-937 544	7 50

VOLTMETERS
Self-Contained

Rating	Scale Div.	F.S. Burden V.A. @ 60 Cy.	Resistance Approx. Ohms	Narrow Flange Style No.	Wide Flange Style No.	List Price Discount Symbol AC
1.5	30	.75	3	937 518	W-937 518	$7 50
2	20	1.00	4	937 519	W-937 519	7 50
3	30	.75	12	937 520	W-937 520	7 50
5	25	1.25	20	937 521	W-937 521	7 50
7.5	37.5	.75	75	937 522	W-937 522	7 50
10	20	1.00	100	937 523	W-937 523	7 50
15	30	1.50	150	937 524	W-937 524	7 50
25	25	1.25	500	937 525	W-937 525	7 50
50	25	1.25	2000	937 526	W-937 526	7 50
75	37.5	1.12	5000	937 527	W-937 527	7 50
150	30	1.50	15000	937 528	W-937 528	9 75
250	25	1.25	50000	937 529	W-937 529	13 00

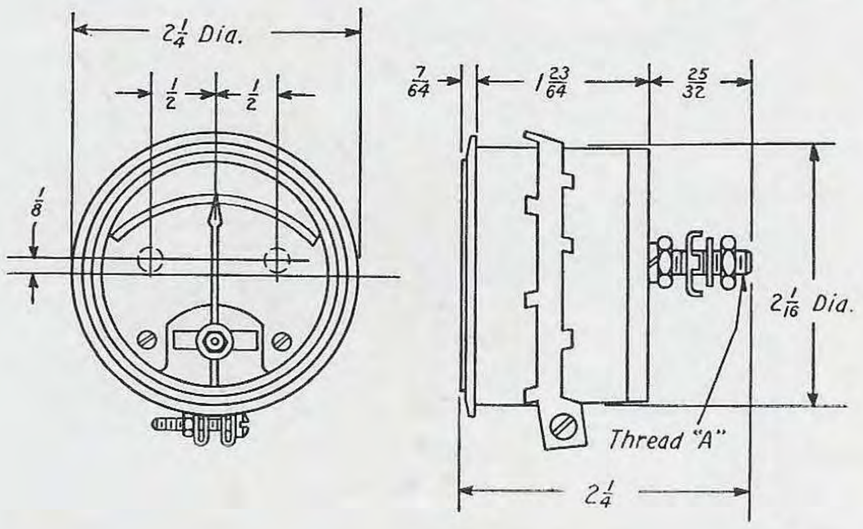
Prices and Discounts subject to change without notice

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

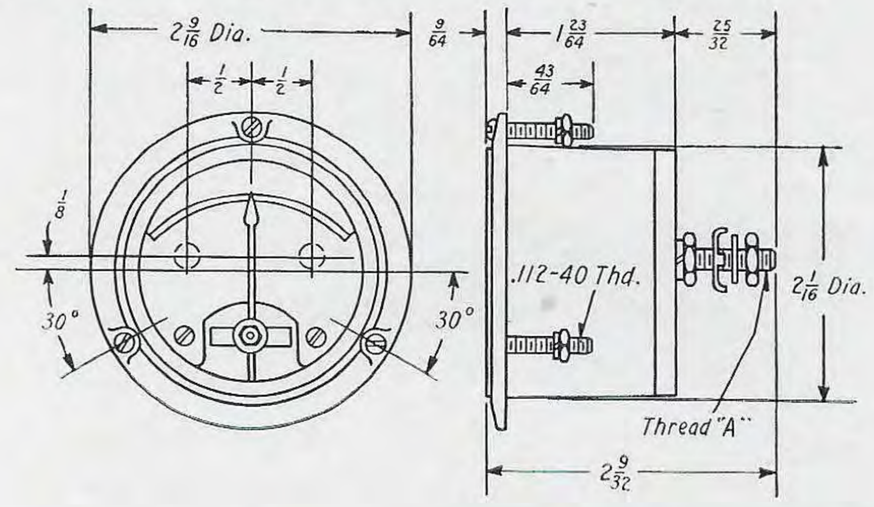
OUTLINE DIMENSIONS IN INCHES

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.



Type of Instrument	Thread "A"
D-C. Ammeter 20 Amps. & Up	1/4 - 28
R.F. Ammeter	1/4 - 28
All other Instruments	.190-32

FIG. 8—TYPES MX, MC AND MT WITH NARROW FLANGE



Type of Instrument	Thread "A"
D-C. Ammeter 20 Amps. & Up	1/4 - 28
R.F. Ammeter	1/4 - 28
All other Instruments	.190-32

FIG. 9—TYPES MX, MC AND MT WITH WIDE FLANGE

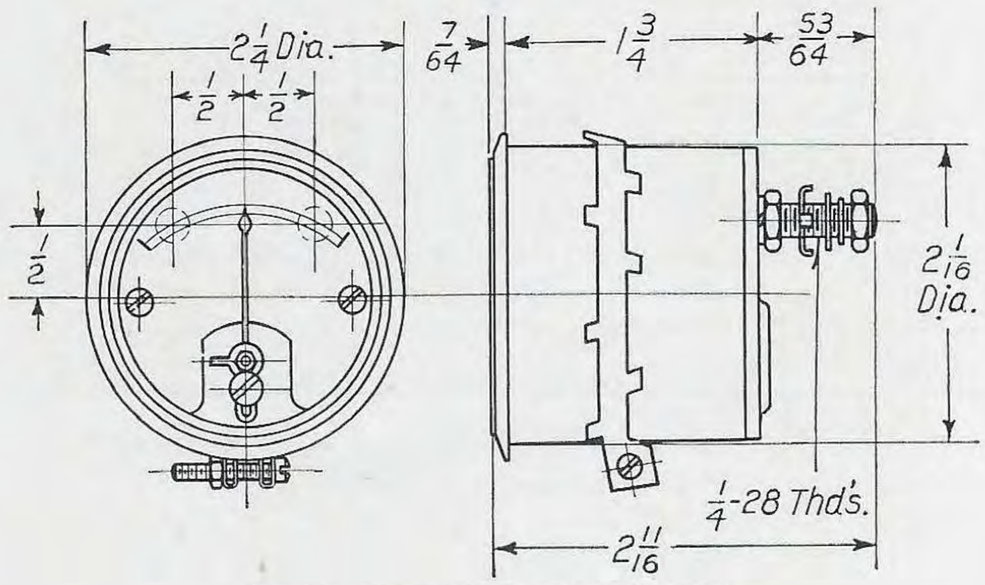


FIG. 10—TYPE MA NARROW FLANGE

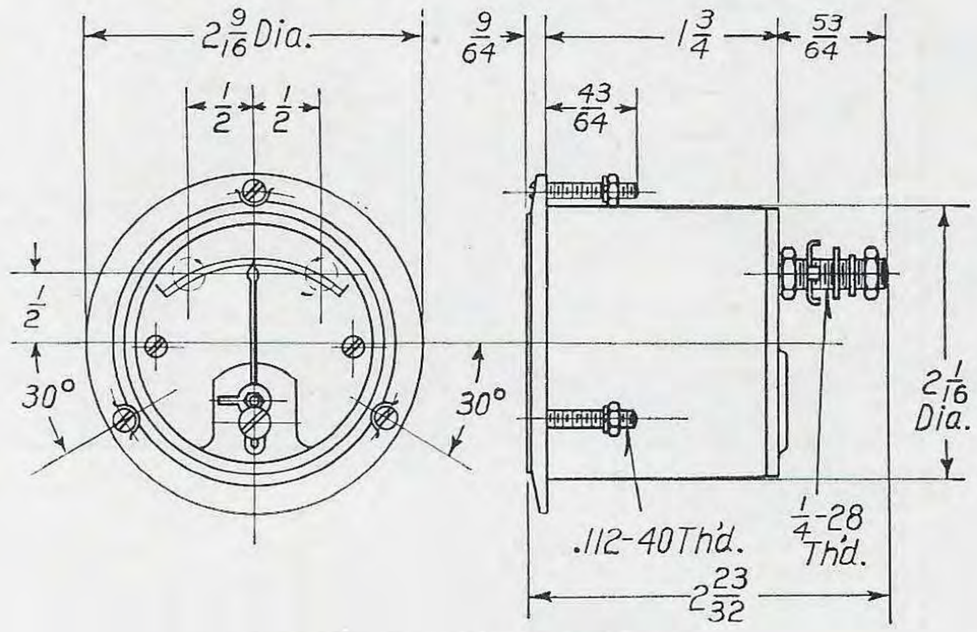


FIG. 11—TYPE MA WIDE FLANGE

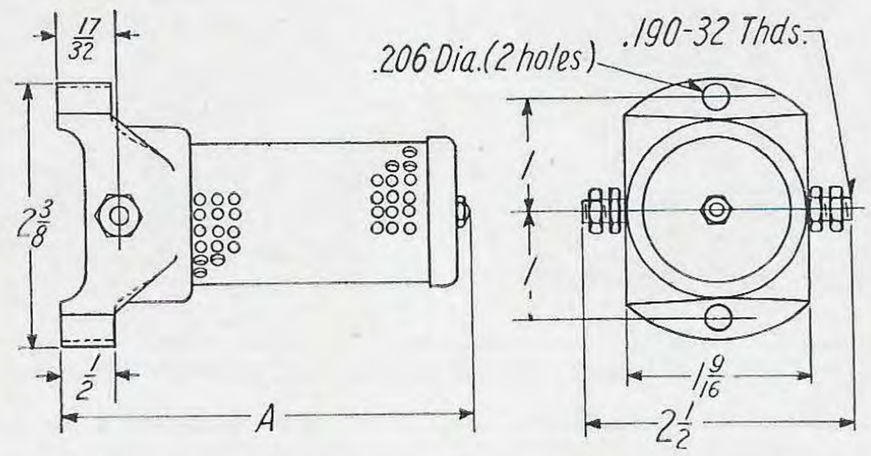
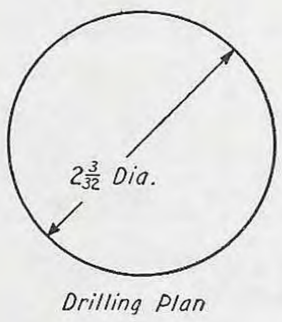
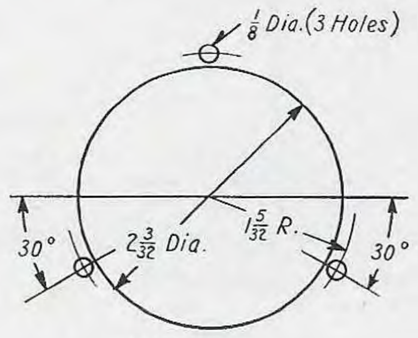


FIG. 12—TYPE RO EXTERNAL RESISTOR FOR VOLTMETERS UP TO AND INCLUDING 1000 VOLTS. Dimension A is three inches up to and including 750 volts; five inches for 1000 volts.



Drilling Plan

FIG. 13—TYPES MX, MC, MT AND MA NARROW FLANGE



Drilling Plan

FIG. 14—TYPES MX, MC, MT AND MA WIDE FLANGE

Dimensions are for reference only. For official dimensions refer to nearest Westinghouse Sales Office.

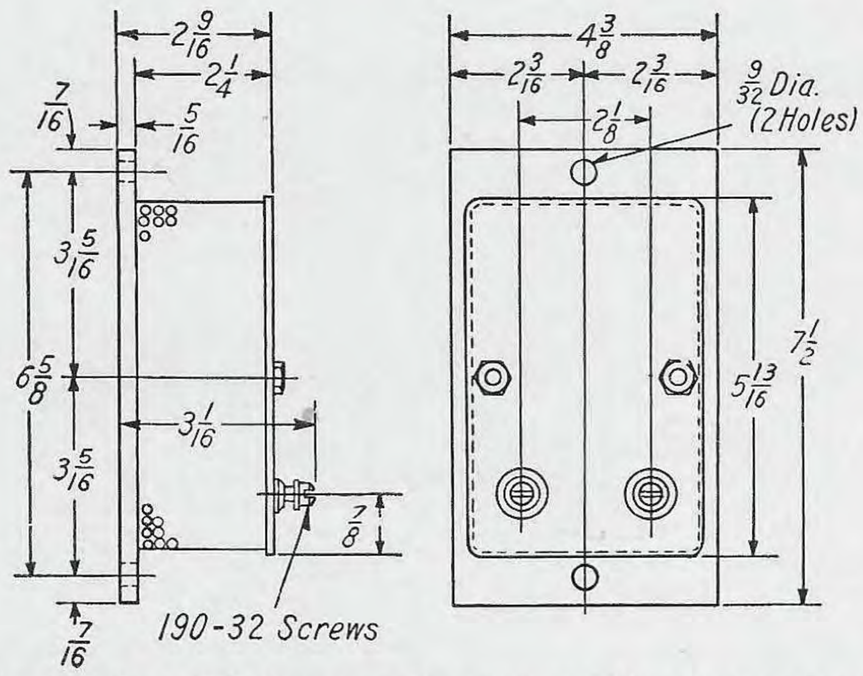


FIG. 15—TYPE R-3 EXTERNAL RESISTOR FOR VOLTMETERS FROM 1500 TO AND INCLUDING 3000 VOLTS FULL-SCALE

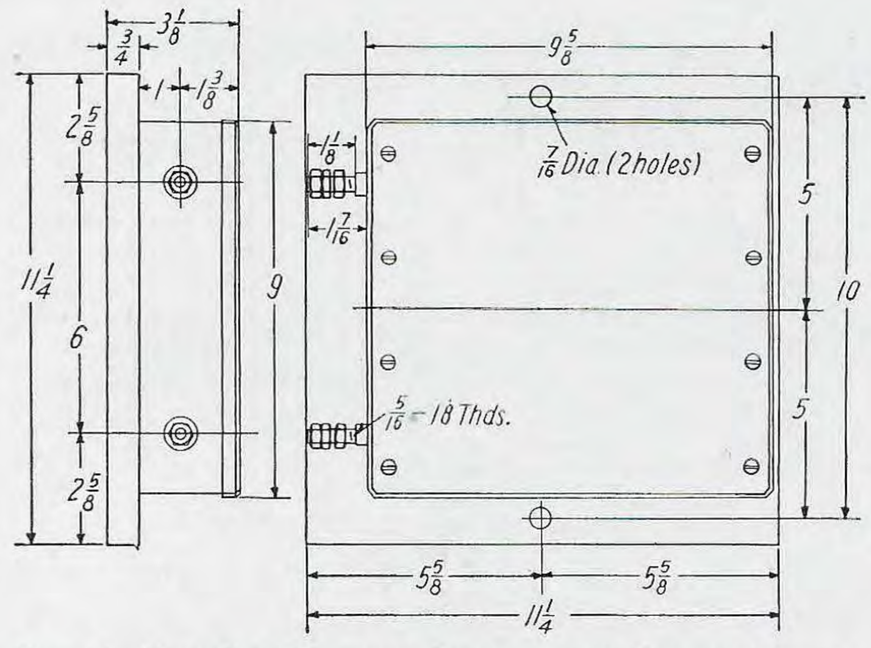


FIG. 16—TYPE R-4 EXTERNAL RESISTOR FOR VOLTMETERS OF 5000 VOLTS FULL-SCALE

EXTERNAL WIRING DIAGRAMS (REAR VIEW)

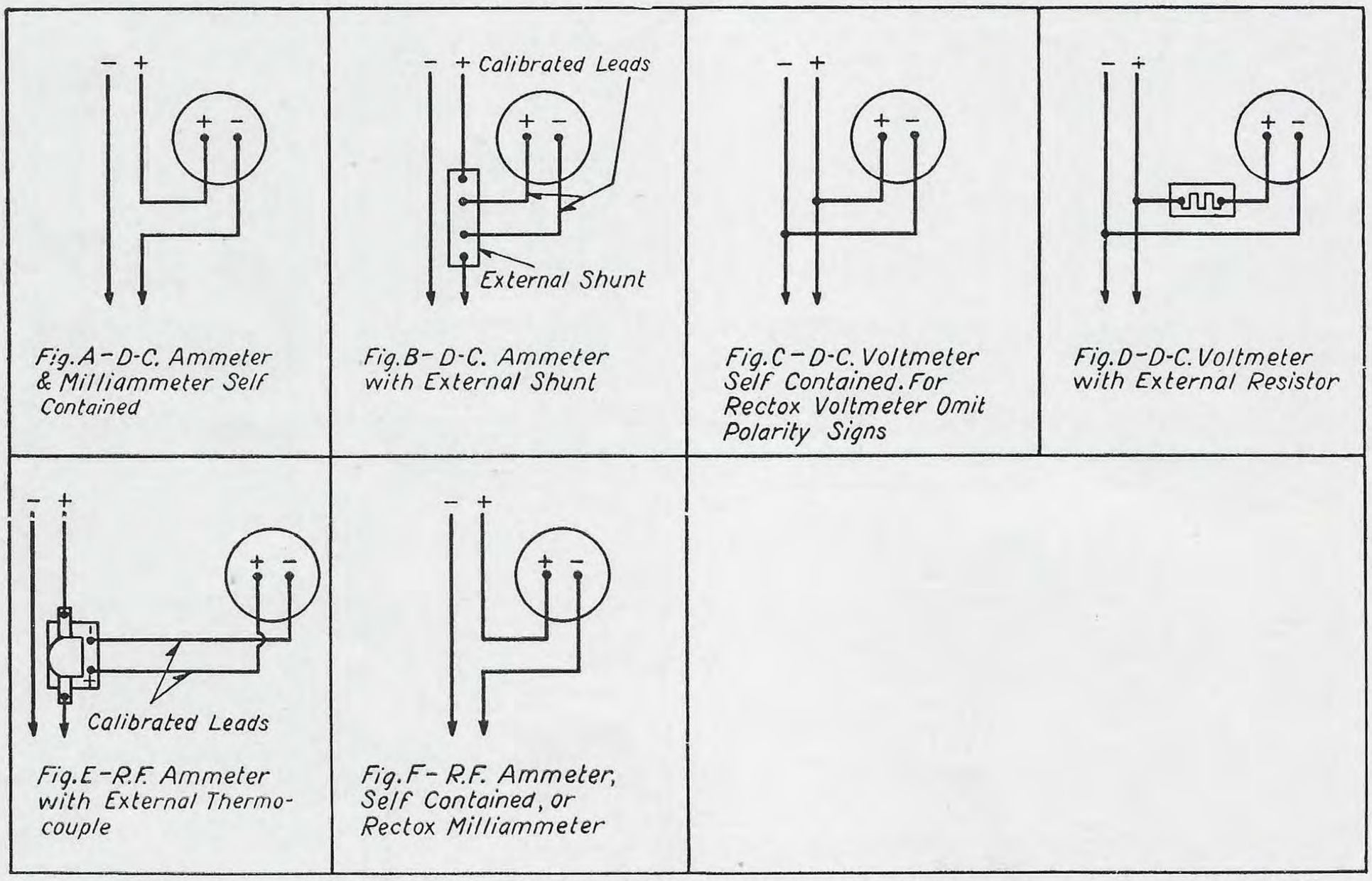


FIG. 17—DIRECT CURRENT, RECTOX AND RADIO FREQUENCY INSTRUMENTS

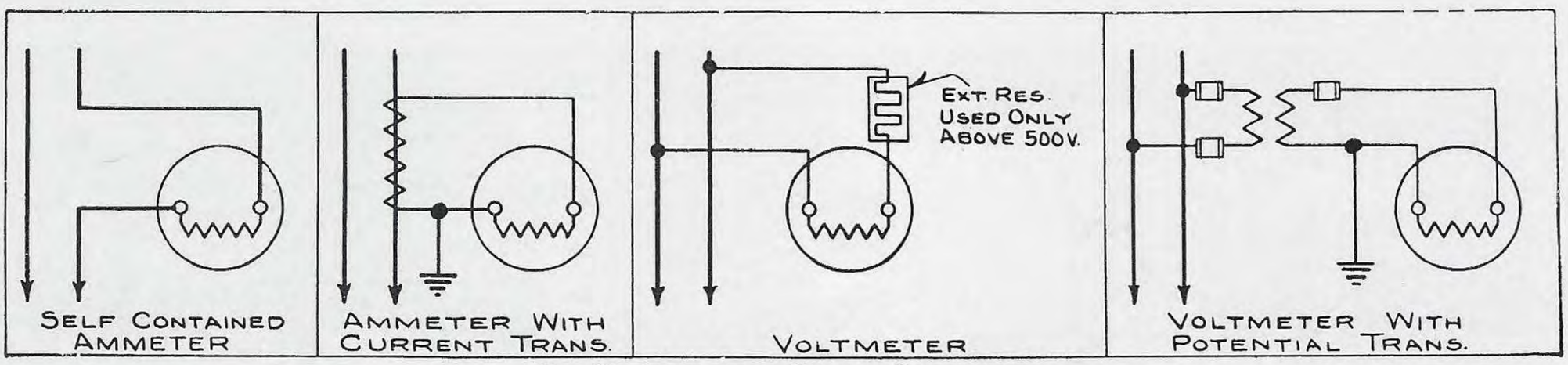


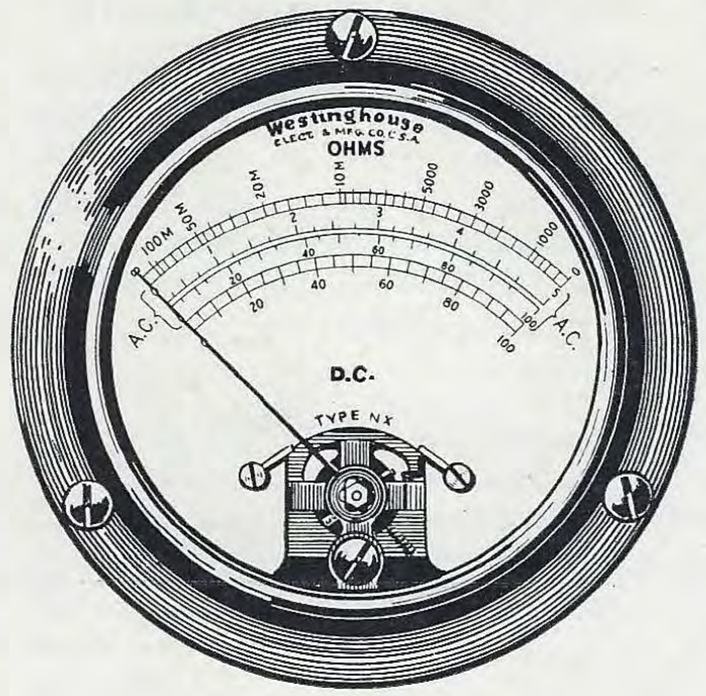
FIG. 18—ALTERNATING CURRENT INSTRUMENTS

For official diagrams and CIRCUIT PRECAUTIONS see instruction leaflet packed with the instrument.

Printed in U.S.A.

TYPE NX UNIVERSAL RECTOX INSTRUMENT

For A-C., D-C., and Resistance Measurements



DATA

BODY DIAMETER	2¾"
FLANGE DIAMETER	3½"
SCALE LENGTH	2.4"
ACCURACY—D-C	WITHIN 2%
ACCURACY RECTOX	WITHIN 5%
CASE	MOLDARTA
MOUNTING	FLUSH WITH BOLTS THROUGH FLANGE
POINTER	KNIFE EDGE

Application

The NX Universal Rectox Instrument was developed specifically for radio service work. The instrument has a built-in Rectox unit that makes it suitable for a-c. as well as d-c. For special uses a group of special resistances and shunts are available that give a wide range of measurements. All readings are obtained from the regular scales of the instrument by using simple multipliers.

Practically all voltage and current measurements needed to check receiving set operation can be made with the Universal Rectox Instrument. In addition the ohmmeter is available for resistance measurements; for locating open circuits, short circuits, and grounds.

Construction

In the NX Universal Rectox Instrument the d'Arsonval, or permanent-magnet moving-coil principle of operation is used. Numerous refinements in the design of this movement have been made; such as, soft iron pole tips welded to the permanent magnet in accurately aligned fixtures; improved springs; and an entirely new method of supporting the iron core in a die-cast bracket which also supports the jewel bearings in perfect alignment.

Cases and Mountings—Cases are of the full, open-face type made of Moldarta provided with narrow flanges with three bolts through the flange for mounting on a panel. These instruments are available only for flush mounting. They are suitable for either steel, ebony-asbestos, or slate panels.

Movements—The permanent magnets are made of high-quality tungsten steel properly heat-treated and aged. The soft-iron pole tips are accurately aligned and fastened to the permanent magnet by an electrical welding process, thus assuring perfect alignment and uniform air gap for the moving coil. The iron core is accurately aligned by a die-cast bracket which supports the sapphire jewel bearings. These features of construction assure extremely accurate air gaps with the convenience of removal of the moving element from the pole pieces as a complete unit for easy repairing.

Springs—The springs used are the result of years of research into the behavior of spring materials. Special alloys together with proper heat treatment and ageing, have resulted in a spring having negligible fatigue or set.

Dial—Standard dial is finished in matte silver, with black figures for d-c. and ohms and red figures for a-c. The number of scale divisions and the size of the figures have been selected for greatest ease in reading and best appearance.

Rectox Unit—A copper-oxide, full-wave rectifier is mounted inside the instrument case, and connected to feed full-wave rectified current to the moving coil. The d'Arsonval instrument element deflects proportional to the average value of the rectified wave. The dial is calibrated in terms of effective or root-mean-square values.

Zero Adjuster—The instrument is provided with an external zero adjuster.

Pointer—The knife-edge pointer is made from strong aluminum alloy, resulting in minimum weight and maximum strength.

Pointer Stops—Pointer stops for both zero and full scale are standard equipment.

Removable Mechanism—All moving element parts are assembled on a one-piece, die-cast frame which can be lifted readily from the instrument for inspection or replacement.

Insulation—The type NX universal instrument has an insulation rating of 1000 volts which corresponds to a test of 3000 volts between terminals and the panel.

Reprinted (5-37)

TYPE NX UNIVERSAL RECTOX INSTRUMENT—Continued

Operation

The instrument is self-contained for the following ranges:

0—1 milliampere, d-c. (resistance 100 ohms)

0—1 milliampere, a-c. (resistance 5000 ohms)

0–100 millivolts, d-c. (resistance 100 ohms)

0—5 volts, a-c. (resistance 5000 ohms)

Four terminals are provided on this instrument, two for d-c., and two for a-c. No shunt or special connection is required when changing from a-c. to d-c. Simply use the d-c. terminals for d-c., and the a-c. terminals for a-c.

The instrument only for self-contained ranges is Style No. 836736.

Accessories

The following additional ranges can be obtained by the use of accessories which are ordered separately.

Volts, d-c.—0-1-5-10-50-100-200-500-1000

Volts, a-c.—0-10-50-100-200-500-1000

Ohms—0-1000-10,000-100,000

Milliamps., d-c.—0-5-10-50-100-500

Amperes, d-c —0-1-5-10-50

Milliamps., a-c.—0-5-10-50-100

Following are the accessories which are used to give these ranges.

For Voltage Measurements

Resistor Unit—The same resistances can be used for d-c. volts or a-c. volts above 5 volts. Style No. 837435 covers the complete set of resistance spools for all a-c. and d-c. voltmeter ranges listed below. The resistance spools are mounted on a Micarta strip with proper taps and terminals.

Separate Resistor Spools—The following separate resistor spools are available to make various voltage ranges in case it is not desired to use the complete resistor unit. For any of the voltage ranges, order the following resistors to total 1000 ohms per volt including the resistance of the instrument, which is 100 ohms for d-c., and 5000 ohms for a-c. See diagrams, Fig. 3 and 4, page 3 for a-c. and d-c. voltage measurement.

Rating Ohms	Style No.
900	837411
4000	837412
5000	838151
40,000	836938
50,000	836934
100,000	836183
300,000	837413
500,000	837414

For Current Measurements

Milliamperes, D-C.—Style No. 837436 is a combination shunt for ranges 0-5-10-50-100-500 milliamperes, d-c. All shunt units are mounted on a Micarta strip with proper terminals. For connections see Fig. 5, page 3.

Milliamperes, A-C.—Style No. 837437 is a combination shunt for ranges 0-5-10-50-100 milliamperes, a-c. All shunt units are mounted on a Micarta strip with proper terminals. For connections see Fig. 6, page 4.

Amperes, D-C.—Style No. 837438 is a combination shunt for ranges 0-5-10-50 amperes, d-c. All shunt units are mounted on a Micarta strip with proper terminals. For connections see Fig. 7, page 4.

For Resistance Measurement

For ohmmeter connections see Fig. 8, page 4.

For all Ranges—Style No. 837429 is a 2916-ohm resistance spool and Style No. 837439 is a 500-ohm potentiometer rheostat. Both of these are needed for all ranges of the ohmmeter.

For 0-10,000 Ohm Range—Style No. 548425 is a 333.3 ohm resistance spool for the 0-10,000 range only.

For 0-1000 Ohm Range—Style No. 837425 is a 30.3-ohm resistance spool for the 0-1000-ohm range only.

LIST PRICES

TYPE NX UNIVERSAL RECTOX INSTRUMENT

For A-C., D-C., and Resistance Measurements
Supplied with knife-edge pointer

Instrument is calibrated for use on non-magnetic panels. If it is to be used on steel panel, specify panel thickness on order.

Four terminals are provided, two for d-c., and two for a-c. No shunt or special connection is required when changing from a-c. to d-c. Simply use the d-c. terminals for d-c., and the a-c. terminals for a-c.

Description	Style No.	List Price Discount Symbol A-C
Type NX Instrument only for self-contained ranges*	836736	$19 00

*Dial markings consist of 4 scales 0-100 d-c.; 0-100 a-c.; 0-5 a-c.; and 0-100,000 ohms. The instrument is self-contained for 0-1 milliamp., d-c.; 0-1 milliamp., a-c.; 0-100 millivolts, d-c.; and 0-5 volts, a-c. The resistances of the instrument are 100 ohms on d-c., and 5000 ohms on a-c.

RESISTORS FOR VOLTAGE MEASUREMENTS

Description	Style No.	List Price Discount Symbol AC
Complete set of resistance spools on Micarta strip with taps, to obtain 0-1-5-10-50-100-200-500-1000 volts, d-c., and 0-10-50-100-200-500-1000 volts, ac.	837435	$ 11 00
900-ohm resistance spool	837411	62
4000-ohm resistance spool	837412	71
5000-ohm resistance spool	838151	75
40,000-ohm resistance spool	836938	86
50,000-ohm resistance spool	836934	97
100,000-ohm resistance spool	836183	1 07
300,000-ohm resistance spool	837413	2 16
500,000-ohm resistance spool	837414	2 16

Prices are subject to change without notice.

Order by Style Number

TYPE NX UNIVERSAL RECTOX INSTRUMENT—Continued

LIST PRICES—Continued

COMBINATION SHUNTS FOR CURRENT MEASUREMENTS

For Ranges	Style No.	List Price Discount Symbol AC
0-5-10-50-100-500 milliamperes, d-c.*	837436	$ 5 00
0-5-10-50-100 milliamperes, a-c.*	837437	5 00
0-1-5-10-50 amperes, d-c.*	837438	5 00

*These shunts are mounted on a Micarta strip with suitable terminals.

RESISTANCES FOR OHMMETER

Description	Style No.	List Price Discount Symbol AC
Ohmmeter resistance spool, 2916 ohms required for all ranges of ohmmeter	837429	$ 0 67
Potentiometer rheostat, 500 ohms, required for all ranges of ohmmeter	837439	75
Ohmmeter resistance spool, 333.3 ohms, for range 0-10,000 ohms	548425	60
Ohmmeter resistance spool, 30.3 ohms, for range 0-1000 ohms	837425	60

Prices are subject to change without notice.

CONNECTION DIAGRAMS

Diagram	Range	Read on Scale	Multiplier
A-C. + A-C. −	0-1 Mil. Amps. D-C.	0-100 D-C.	.01
	0-100 Mil. Volts D-C.	0-100 D-C.	1

FIG. 1—D-C. MILLIAMMETER OR MILLIVOLTMETER

Diagram	Range	Read on Scale	Multiplier
A-C. + A-C. −	0-1 Mil. Amps. A-C.	0-100 D-C.	.01
	0-5 Volts A-C.	0-5 A-C.	1

FIG. 2—A-C. MILLIAMMETER OR VOLTMETER

Diagram	Range	Read on Scale	Multiplier
A-C. + A-C. −	900 Ohms		
	4000 Ohms		
	5000 Ohms	1 Volt D-C.	0-100 D-C. .01
	40000 Ohms	5 Volts D-C.	0-100 D-C. .05
	50000 Ohms	10 Volts D-C.	0-100 D-C. .1
	100000 Ohms	50 Volts D-C.	0-100 D-C. .5
	300000 Ohms	100 Volts D-C.	0-100 D-C. 1
	500000 Ohms	200 Volts D-C.	0-100 D-C. 2
	1000 Volts D-C.	500 Volts D-C.	0-100 D-C. 5
		1000 Volts D-C.	0-100 D-C. 10

FIG. 3—D-C. VOLTMETER. USE RESISTANCE UNIT STYLE NO. 837435. RESISTANCES CAN BE CONNECTED IN "PLUS" LEAD INSTEAD OF "MINUS" IF DESIRED.

Diagram	Range	Read on Scale	Multiplier
A-C. + A-C. −	900 Ohms		
	4000 Ohms	These two resistances not used for A-C.	
	5000 Ohms	5 Volts A-C.	0-5 A-C. 1
	40000 Ohms	10 Volts A-C.	0-5 A-C. 2
	50000 Ohms	50 Volts A-C.	0-100 A-C. .5
	100000 Ohms	100 Volts A-C.	0-100 A-C. 1
	300000 Ohms	200 Volts A-C.	0-100 A-C. 2
	500000 Ohms	500 Volts A-C	0-100 A-C. 5
	1000 Volts A-C.	1000 Volts A-C.	0-100 A-C. 10

FIG. 4—A-C. VOLTMETER. USE RESISTANCE UNIT STYLE NO. 837435 OR COMPONENT PARTS.

Diagram	Range	Read on Scale	Multiplier
A-C. + A-C. −	12.5 Ohms	5 Mil. Amps. D-C.	0-100 D-C. 05
	10 Ohms	10 Mil. Amps. D-C.	0-100 D-C. .1
	1.25 Ohms	50 Mil. Amps. D-C.	0-100 D-C. .5
	1.00 Ohm	100 Mil. Amps. D-C.	0-100 D-C. 1
	.25 Ohm	500 Mil. Amps. D-C.	0-100 D-C. 5
	Line +		

FIG. 5—D-C. MILLIAMMETER. USE COMBINATION SHUNT STYLE NO. 837436.

TYPE NX UNIVERSAL RECTOX INSTRUMENT—Continued

CONNECTION DIAGRAMS—Continued

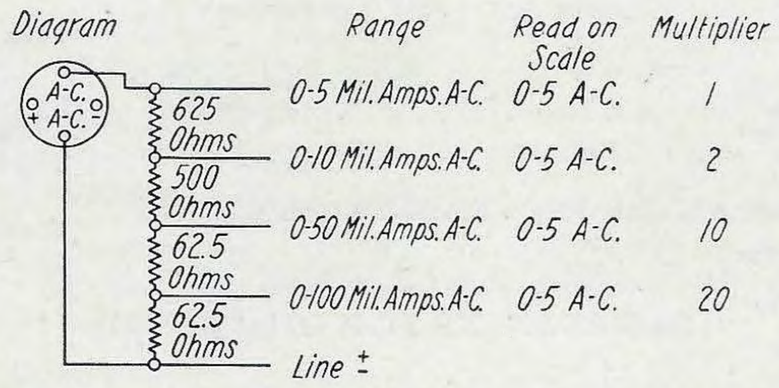


FIG. 6—A-C. MILLIAMMETER. USE COMBINATION SHUNT STYLE NO. 837437.

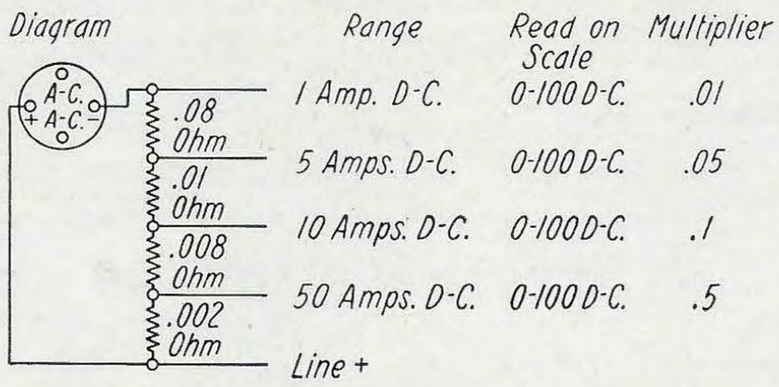


FIG. 7—D-C. AMMETER. USE COMBINATION SHUNT STYLE NO. 837438.

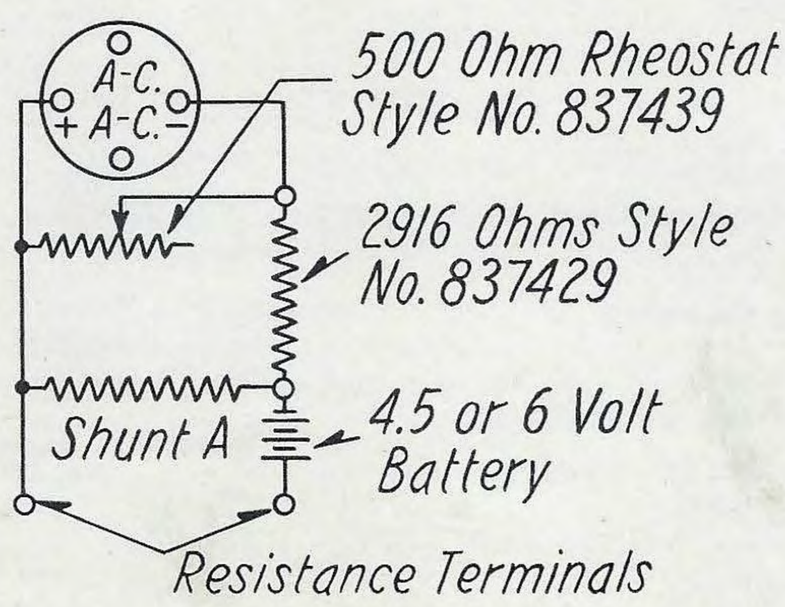


FIG. 8—OHMMETER.

Range		Read on Scale	Multiplier
0-100,000 ohms—omit shunt A		0-100,000	1
0-10,000 ohms—	Shunt A = 333.3 ohms Style No. 548425	0-100,000	.1
0-1,000 ohms—	Shunt A = 30.3 ohms Style No. 837425	0-100,000	.01

Short circuit the resistance terminals and adjust rheostat until instrument reads zero ohms. Then connect unknown across resistance terminals and read resistance directly.

Printed in U.S.A.

TYPE NX MULTI-RANGE, RADIO-FREQUENCY AMMETER

FIG. 1—THE TYPE NX MULTI-RANGE RADIO-FREQUENCY AMMETER

DATA

BODY DIAMETER	2¾ INCHES
FLANGE DIAMETER	3½ INCHES
SCALE LENGTH	2.4 INCHES
ACCURACY WITHIN	2%
CASE	MOLDARTA
MOUNTING	FLUSH WITH BOLTS THROUGH FLANGE
POINTER	KNIFE EDGE
TERMINALS	THREE
SCALE MARKING	0–10 UNIFORM FOR DIRECT CURRENT 0–10 SQUARE LAW FOR RADIO FREQUENCY
FULL SCALE CURRENT	1 MILLIAMPERE
INTERNAL RESISTANCE	10 OHMS

Application

This instrument is designed for the accurate determination of radio frequency currents of various values. Also, it can be used to measure in several steps, voltages from 10 millivolts up to 1000 volts d-c., or d-c. milliamperes from 1 to 500, or d-c. amperes from 1 to 50 by addition of accessories which are furnished separately.

The instrument is for panel-mounting and matches in appearance and mounting other well-known Westinghouse Type NX panel instruments. Manufacturers of test equipments or radio amateurs and experimenters will find hundreds of applications for this instrument because it can measure a large number of different values with simple changes in connections.

Operation

The instrument is a three-terminal millivoltmeter having a full-scale current of one milliampere and an internal resistance of ten ohms. Two terminals are used for electrical connections to the element, and the third terminal is connected to the frame, magnet and dial and is used for connecting these parts electrically to the radio-frequency circuit, thereby eliminating dangerous electrostatic fields around the instrument coil and keeping capacity currents out of the windings.

By use of the accessories furnished as separate units the following measurements may be made:

1—Multi-range thermo-couple Style No. 837674 for 0.5-1-2-5-10 amperes radio frequency.

2—Resistance spool Style No. 837673 for 0-100 millivolts d-c.

3—Resistance spool Style No. 837673 and multiplier Style No. 837435 for 0-.01-.1-1-5-10-50-100-200-500-1000 volts d-c.

4—Resistance spool Style No. 837673 and combination shunt Style No. 837436 for 0-1-5-10-50-100-500 milliamperes d-c.

5—Resistance spool Style No. 837673 and combination shunt Style No. 837438 for 0-1-5-10-20-50 amperes d-c.

The instrument is furnished with a pair of calibrated leads which must always be used in making connections to the multi-range thermo-couple or when measuring millivolts.

Reprint (11-37)

TYPE NX MULTI-RANGE, RADIO-FREQUENCY AMMETER—Continued

Construction

In the type NX multi-range radio-frequency ammeter, which is in reality a millivoltmeter, the d'Arsonval, or permanent-magnet moving-coil principle of operation is used. Numerous refinements in the design of this movement have been made; such as, soft iron pole tips welded to the permanent magnet in accurately aligned fixtures; improved springs; and an entirely new method of supporting the iron core in a die-cast bracket which also supports the jewel bearings in perfect alignment.

Cases and Mountings—Cases are of the full, open-face type made of Moldarta provided with flanges with three bolts through the flange for mounting on a panel. These instruments are available only for flush mounting. They are suitable for either steel, ebony-asbestos, or slate panels. Where the instrument is to be used on a steel panel, the panel thickness must be specified on the order so that proper calibration of the instrument can be made.

Movements—The permanent magnets are made of high-quality tungsten steel properly heat-treated and aged. The soft-iron pole tips are accurately aligned and fastened to the permanent magnet by an electrical welding process, thus assuring perfect alignment and uniform air gap for the moving coil. The iron core is accurately aligned by a die-cast bracket which supports the sapphire jewel bearings. These features of construction assure extremely accurate air gaps with the convenience of removal of the moving element from the pole pieces as a complete unit for easy repairing.

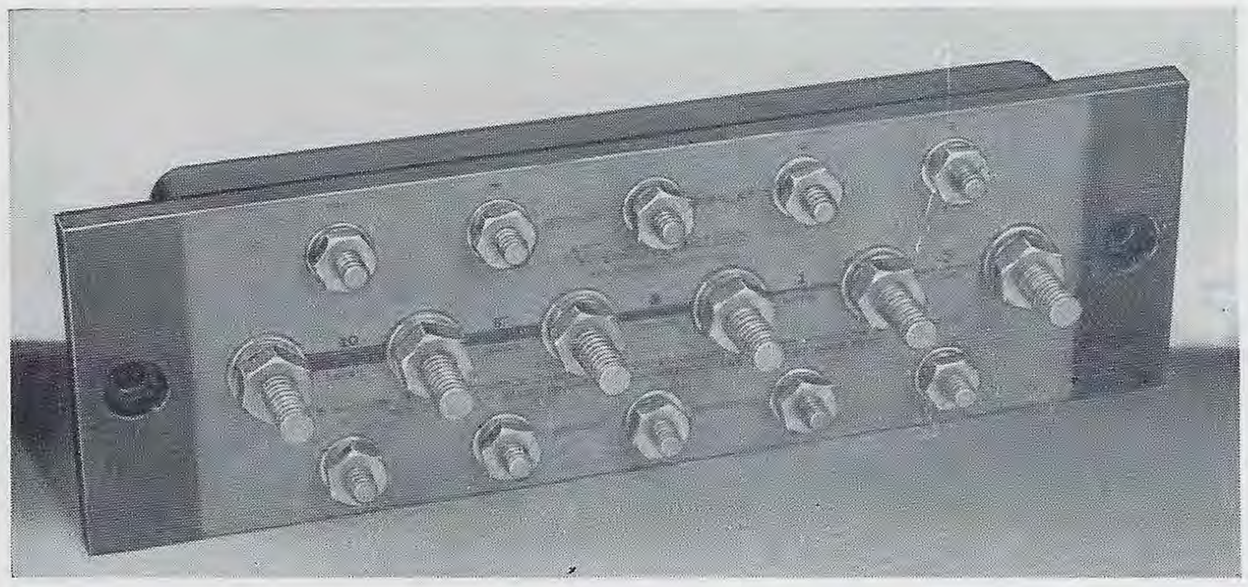


FIG. 2—MULTI-RANGE THERMO-COUPLE FOR USE WITH NX RADIO FREQUENCY AMMETERS

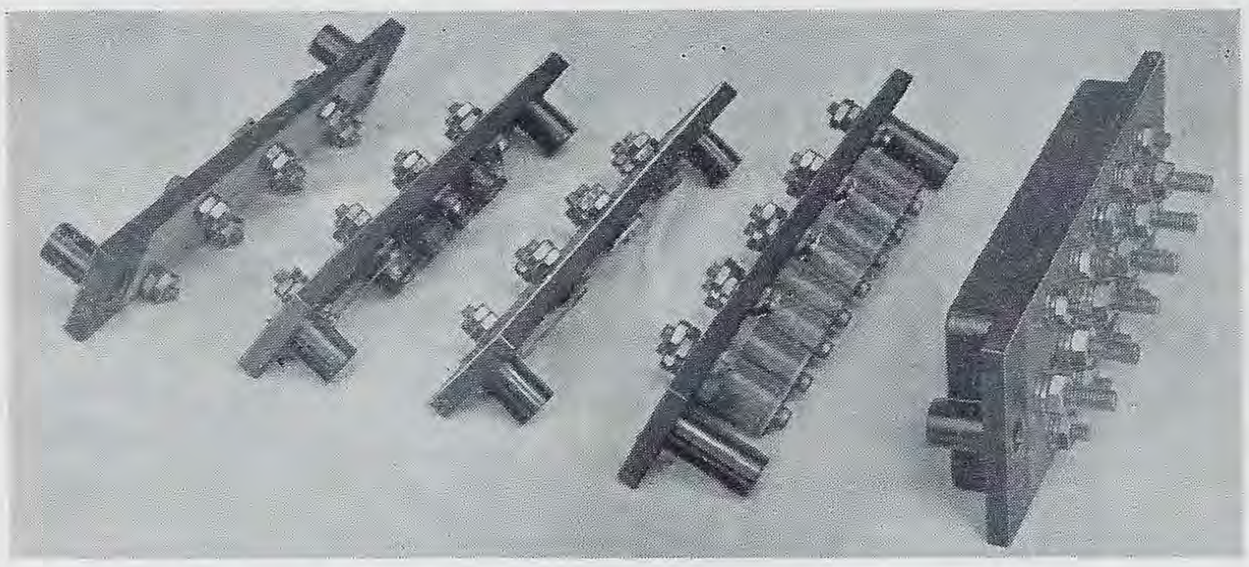


FIG. 3—MULTIPLIERS AND SHUNTS FOR USE WITH NX RADIO-FREQUENCY AMMETER

Springs—The springs used are the result of years of research into the behavior of spring materials. Special alloys together with proper heat treatment and ageing, have resulted in a spring having negligible fatigue or set.

Dial—The standard dial is finished in matte silver, with black figures and two scales. The number of scale divisions and the size of the figures have been selected for greatest ease in reading and best appearance.

Zero Adjuster—The instrument is provided with an external zero adjuster.

Pointer—The knife-edge pointer is made from strong aluminum alloy, resulting in minimum weight and maximum strength.

Pointer Stops—Pointer stops for both zero and full scale are standard equipment.

Removable Mechanism—All moving element parts are assembled on a one-piece, die-cast frame which can be lifted readily from the instrument for inspection or replacement.

Insulation—This instrument has an insulation rating of 750 volts which corresponds to a test of 2500 volts between terminals and the panel.

Accessories

Multi-Range Thermo-couple—The external thermo-couple unit consists of a Micarta strip upon which are mounted five radio frequency thermo-couples in capacities of 0.5-1-2-5 and 10 amperes. The unit has six current terminals and 5 pairs of potential terminals, one pair for each of the five thermo-couples. In use, the heater of desired rating is connected in series in the line and the instrument is connected across the corresponding potential terminals by means of calibrated leads furnished with the instrument. The use of leads differing in resistance from those furnished will affect the calibration both as a millivoltmeter and radio-frequency ammeter. Longer leads of larger cross section, giving the same resistance, can be used.

In mounting the instrument for radio-frequency measurements care should be taken to keep both instrument and leads at the same radio-frequency potential as the thermo-couple. Otherwise, radio-frequency current may flow through the leads and instrument to ground resulting in a burned out thermo-couple or instrument windings. For example, it would be dangerous to mount the instrument or leads near a grounded frame if the thermo-couple is connected in the circuit at some distance from a ground. The capacity between the instrument or leads and ground would permit radio-frequency leakage to ground which might be destructive. If the leads are to be shielded

TYPE NX MULTI-RANGE, RADIO-FREQUENCY AMMETER—Continued

the shield should be connected to a radio frequency terminal of the thermo-couple, and should **not** be grounded.

A third terminal marked "L" is provided on the instrument, and is used to connect the instrument parts such as frame dial and magnet to the radio-frequency circuit to eliminate electro-static fields. This terminal is not used for d-c. measurements.

Multipliers and Shunts—The multipliers and shunts consist of proper values of resistance mounted on a Micarta strip and provided with connection terminals.

The separate resistance spool Style No. 837673 is unmounted.

LIST PRICES

TYPE NX RADIO-FREQUENCY AMMETER

Description	Style No	List Price Discount Symbol AC
Type NX instrument only, self-contained for 0–10 millivolts and 0–1 milliampere. Resistance 10 ohms. Scale marked 0–10 uniform divisions for d-c. and 0–10 square law for radio frequency. Supplied with one pair of calibrated leads	837675	$12 00

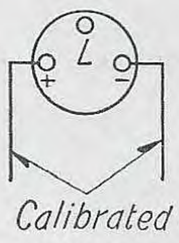
ACCESSORIES

Multi-Range thermo-couple for 0.5–1–2–5–10 amperes radio-frequency	837674	30 00
Combination shunt for 5–10–50–100–500 milliamperes d-c.	837436*	5 00
Combination shunt for 1–5–10–50 amperes d-c.	837438*	5 00
Resistance unit for 1–5–10–50–100–200–500–1000 volts d-c.	837435*	11 00
Resistance spool, 90 ohms for 100 millivolts	837673	60

*Same shunt is used with the Universal Rectox Instrument, Style No. 836736. This shunt is mounted on a Micarta strip with suitable terminals.

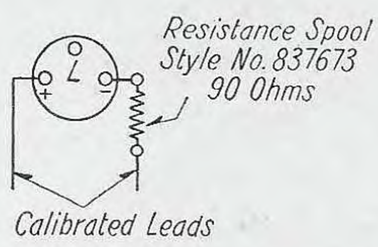
Prices are subject to change without notice.

DIAGRAMS OF CONNECTIONS



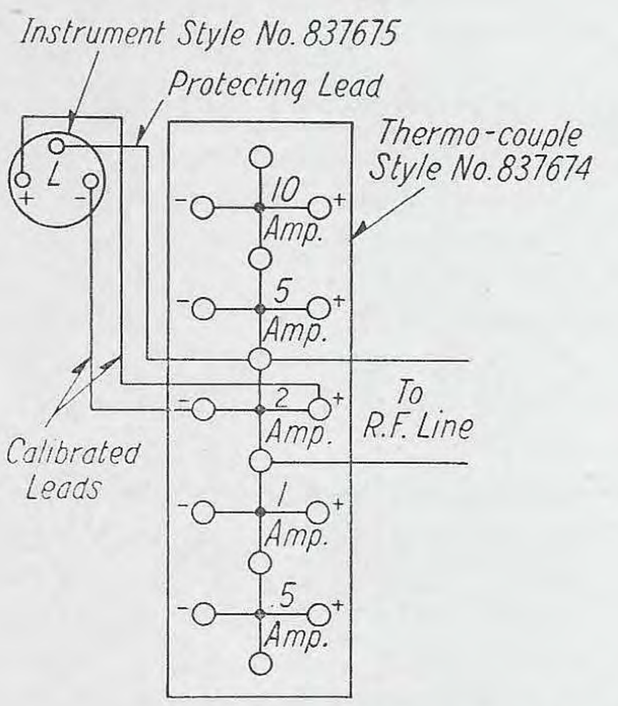
Millivolts Range	Read on Uniform Scale	Multiplier
0–10	0–10	1

FIG. 4—CONNECTIONS AS A D-C. MILLIVOLTMETER 0–10 MILLIVOLTS



Millivolts Range	Read on Uniform Scale	Multiplier
0–100	0–10	10

FIG. 5—CONNECTIONS TO EXTEND RANGE AS A D-C. MILLIVOLTMETER TO 0–100 MILLIVOLTS



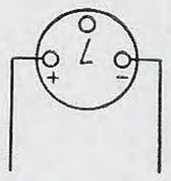
Amperes Range	Read on Uniform Scale R.F. or Current Squared	Multipliers
0–5	0–10	1/20
0–1	0–10	1/10
0–2	0–10	1/5
0–5	0–10	1/2
0–10	0–10	1

FIG. 6—CONNECTIONS AS A 2-AMPERE RANGE RADIO FREQUENCY AMMETER

Order by Style Number

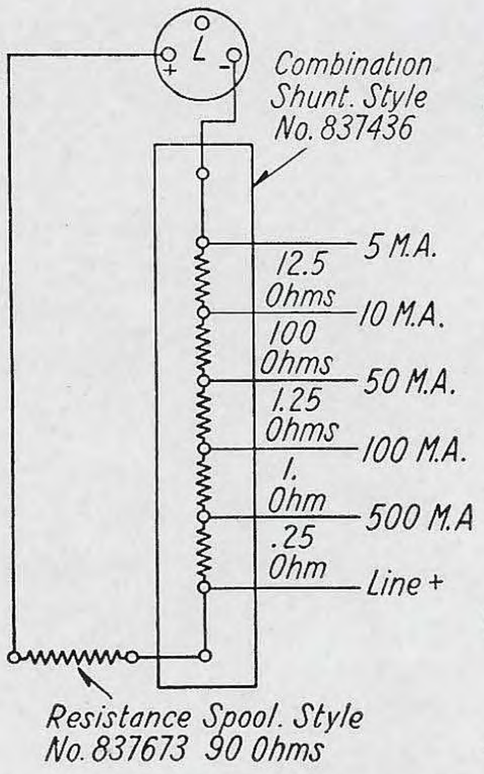
TYPE NX MULTI-RANGE, RADIO-FREQUENCY AMMETER—Continued

DIAGRAMS OF CONNECTIONS—Continued



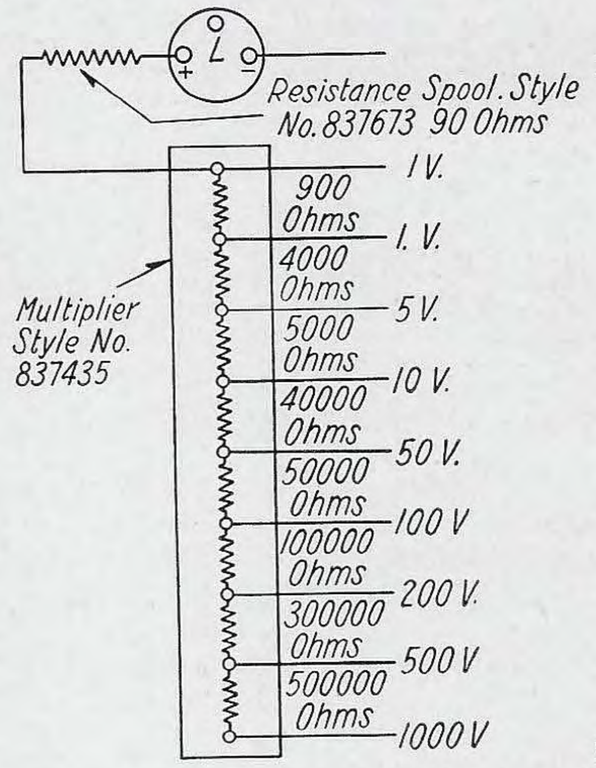
Milliamperes Range	Read on Uniform Scale	Multiplier
0–1	0–10	1/10

FIG. 7—CONNECTIONS AS 0–1 D-C. MILLIAMMETER



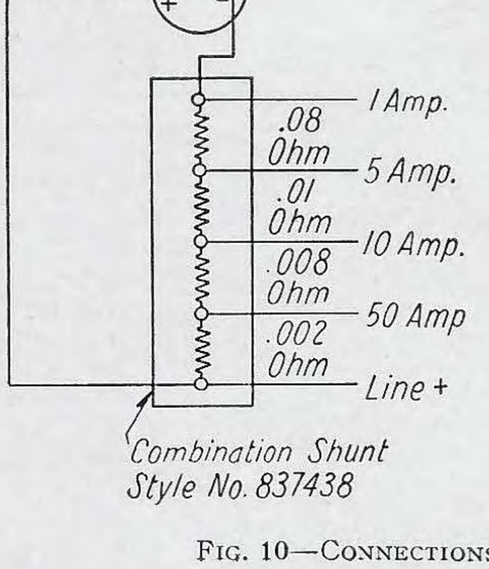
Milli-amperes Range	Read on Uniform Scale	Multipliers
0–5	0–10	1/2
0–10	0–10	1
0–50	0–10	5
0–100	0–10	10
0–500	0–10	50

FIG. 8—CONNECTIONS AS A MULTI-RANGE D-C. MILLIAMMETER



Volts Range	Read on Uniform Scale	Multipliers
0–.1	0–10	1/100
0–1	0–10	1/10
0–5	0–10	1/2
0–10	0–10	1
0–50	0–10	5
0–100	0–10	10
0–200	0–10	20
0–500	0–10	50
0–1000	0–10	100

FIG. 9—CONNECTIONS AS A MULTI-RANGE D-C. VOLTMETER



Amperes Range	Read on Uniform Scale	Multipliers
0–1	0–10	1/10
0–5	0–10	1/2
0–10	0–10	1
0–50	0–10	5

FIG. 10—CONNECTIONS AS A MULTI-RANGE D-C. AMMETER

Printed in U.S.A

TYPE RX MINIATURE RECTANGULAR INSTRUMENTS

Direct Current, Radio Frequency and Rectox Types

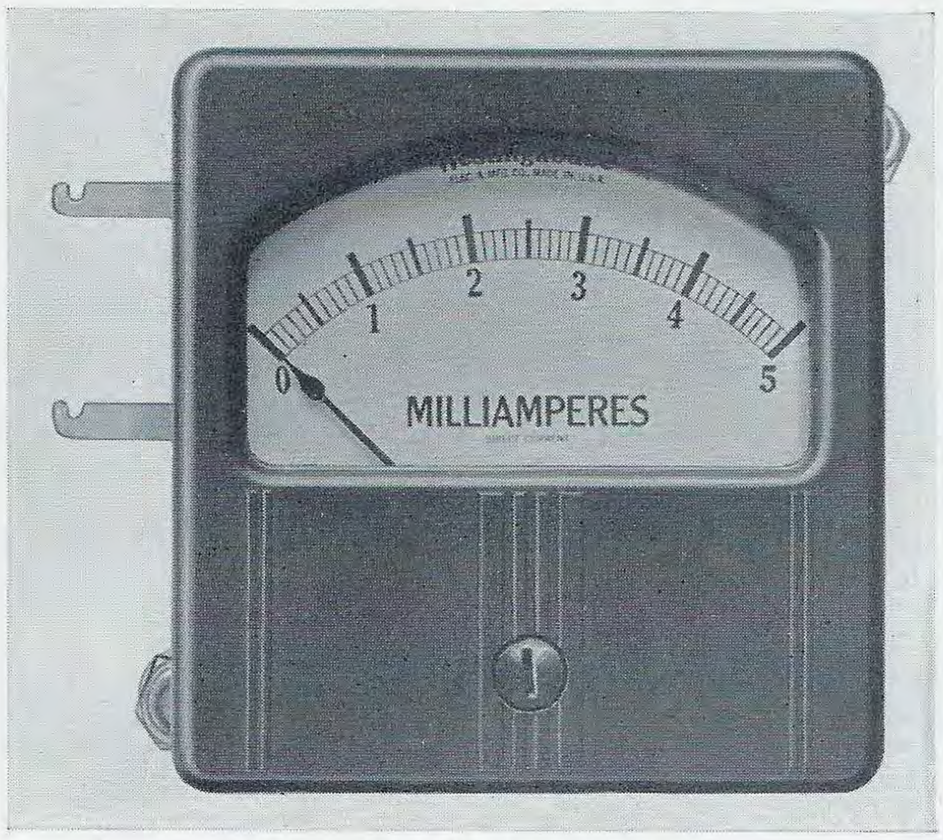


FIG. 1—TYPE RX MILLIAMMETER

General Data

FLANGE DIMENSIONS.....3″x3 1/8″
BODY DIMENSIONS.....2 25/32″x2 29/32″
SCALE LENGTH.....2.4″
ACCURACY WITHIN.....2%
ACCURACY RECTOX TYPES WITHIN.....5%
DECORATIVE RECTANGULAR MOLDARTA CASE.
FLUSH MOUNTING WITH CLAMPS.
WEIGHTS—NET 11 OZ.....SHIPPING 1½ LB.
INSULATION—FOR 1000-VOLT CIRCUITS

General

The Type RX instruments have been designed to fill the need for a line of miniature panel instruments having appearance features in keeping with the modern trend in instruments for radio and communication equipment. The cases are rectangular in shape and made of Moldarta. The front cover has a distinctive artistic appearance with vertical decorative lines on the lower section. The dial opening in the cover is also of a special shape to harmonize with the general appearance. Solder type terminals are standard, eliminating the inconvenience of connections to ordinary stud type terminals and providing a positive connection. Special self-locking clamps are supplied to secure instruments in the panels. The mechanisms used in Type RX instruments are the same as those used in the Type NX 3½″ round lines.

Application

The Type RX instruments are especially suited for communication electrical equipment such as radio transmitting and receiving equipment for broadcasting and communication purposes. They may be used wherever the round type 3½″ instruments have been applied and a more decorative appearance is desired on the instrument equipment.

The general industrial and radio applications of miniature panel instruments can be most completely filled by this line of rectangular instruments. A complete line of capacities, including radio-frequency and rectox types, is available.

Operation

The d'Arsonval, or permanent-magnet moving-coil principle of operation is used. Numerous refinements in the design of this movement have been made; such as, soft iron pole tips welded to the permanent magnet in accurately aligned fixtures; improved springs; and an entirely new method of supporting the iron core in a die-cast bracket which also supports the jewel bearings in perfect alignment. Provision is made for the use of extremely strong cobalt-steel magnets for super-sensitive microammeters.

Construction

Cases and Mountings

All cases are of the rectangular type made of Moldarta with dull matte

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TYPE RX MINIATURE RECTANGULAR INSTRUMENTS—Continued

finish. The front cover has decorative lines and an opening for the dial of distinctive lines and appearance. By the use of special self-locking clamps for support of the instruments in the panel, no holes or screw heads are necessary on the front flange, making an especially clean-cut front cover.

Movements

The permanent magnets are made of high-quality tungsten steel or cobalt steel, properly heat-treated and aged. The soft-iron pole tips are accurately aligned and fastened to the permanent magnet by an electrical welding process, thus assuring perfect alignment and uniform air gap for the moving coil. The iron core is accurately aligned by a die-cast bracket which assures a uniform air gap with the convenience of removal of the moving element from the pole pieces as a complete unit for easy repairing. This provides uniform scale distribution except when used with thermo-couples or rectox units and reduces the amount of energy consumed by the movement, making possible a super-sensitive instrument in the miniature size.

Springs

The springs used in Type RX instruments are the result of years of research into the behavior of spring materials. Special alloys together with proper heat treatment and aging, have resulted in a spring having negligible fatigue or set.

Dials

Standard dials are finished in matte silver, with black figures. The number of scale divisions and the size of the figures have been selected for greatest ease in reading and best appearance. Provision is made for multi-scale markings where necessary.

Rectox Types

Rectox instruments are used for the measurement of alternating currents when low-energy consumption is necessary. A copper-oxide, full-wave rectifier is mounted inside the instrument case, and connected to feed full-wave rectified current to the moving coil. The d'Arsonval instrument element deflects proportional to the average value of the rectified wave. The dial is calibrated in terms of effective or root-mean-square values. A sensitivity of from 1000 to 5000 ohms per volt can be obtained with rectifier-type instruments.

Zero Adjusters

All standard RX instruments have external insulated zero adjusters made of Moldarta

Pointers

The pointer and cross arms are made from strong aluminum alloy, resulting in minimum weight and maximum strength.

Pointer Stops

Pointer stops for both zero and full scale are standard equipment.

Removable Mechanism

All moving element parts are assembled on a one-piece, die-cast frame which can be lifted readily from the instrument for inspection or replacement.

Insulation

Type RX instruments have an insulation rating of 1000 volts which corresponds to a test of 3000 volts between terminals and panel.

Terminals

All standard RX instruments are furnished with a new type solder terminal. A notch is provided to wrap the wire around the terminal. The connection is then soldered. These solder clips project straight out the side of the base and are made of flat brass. This makes possible the mounting of instruments in shields, close to the base without interference with connections to the terminals. If desired the solder clips may be bent straight back from the base for convenience in wiring.

Type RX instruments can be furnished special with stud type terminals, same as supplied on round miniature panel instruments.

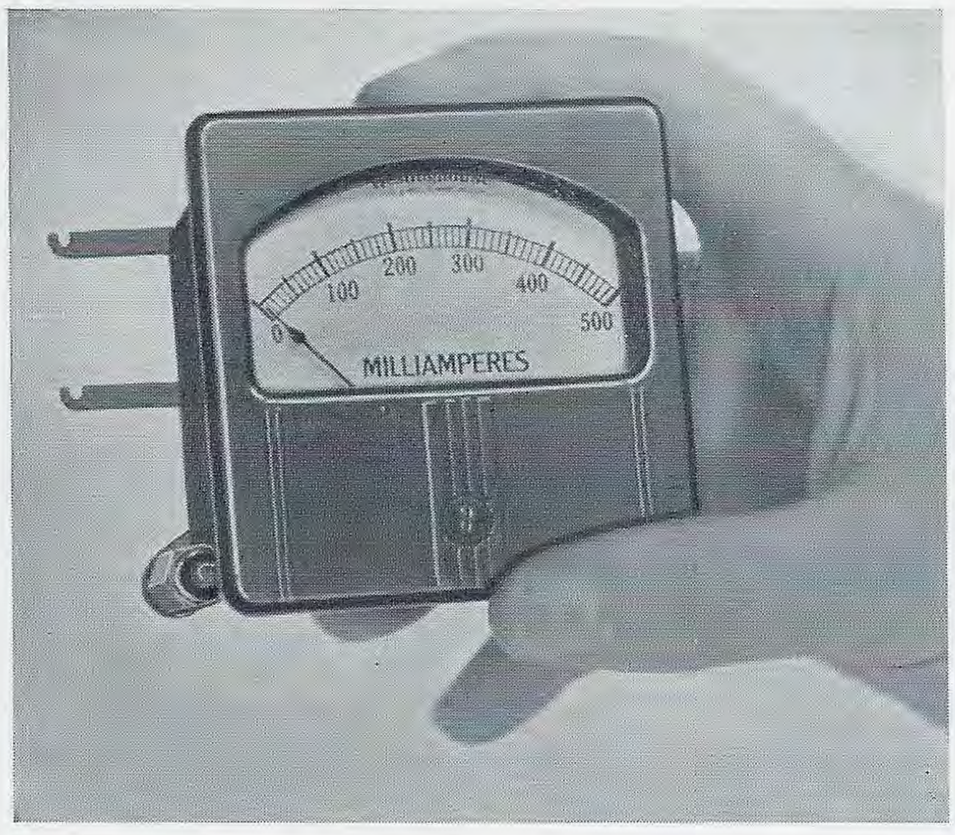


FIG. 2—THE SMALL SIZE OF TYPE RX INSTRUMENTS MAKES THEM IDEALLY SUITED FOR RADIO AND COMMUNICATION EQUIPMENT

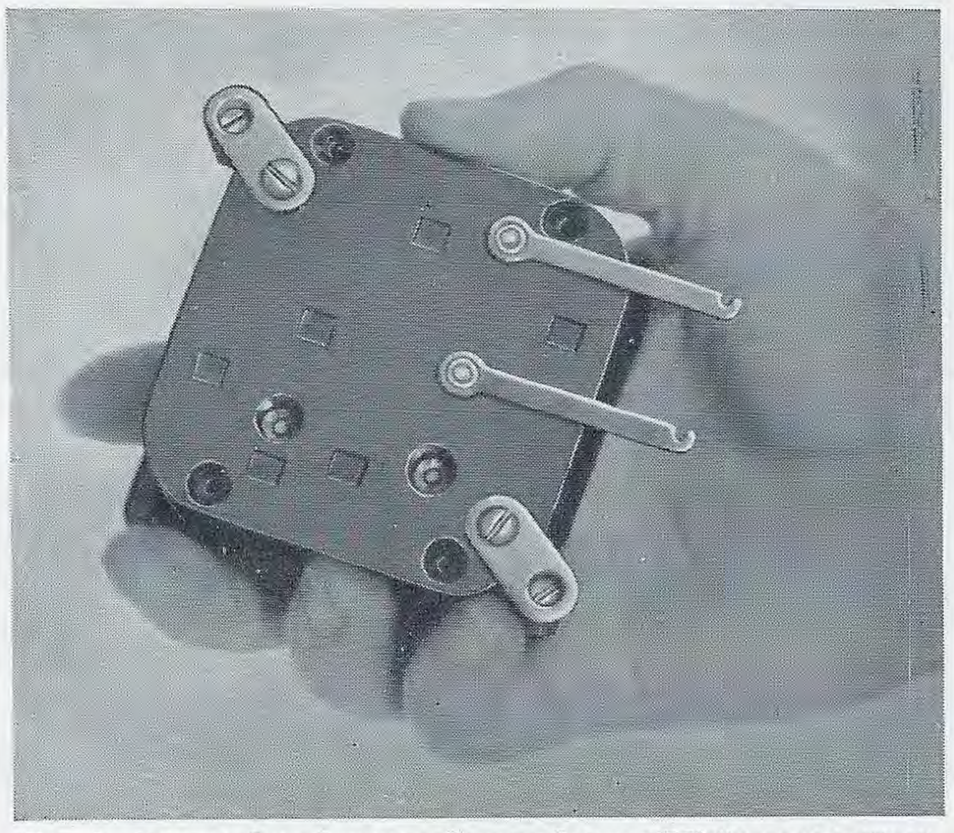


FIG. 3—SPECIAL SELF-LOCKING CLAMPS SECURE RX INSTRUMENTS IN PANELS. RX INSTRUMENTS CAN BE FURNISHED WITH NEW TYPE SOLDER TERMINALS AS SHOWN OR WITH CONVENTIONAL STUD TERMINALS

TYPE RX MINIATURE RECTANGULAR INSTRUMENTS—Continued

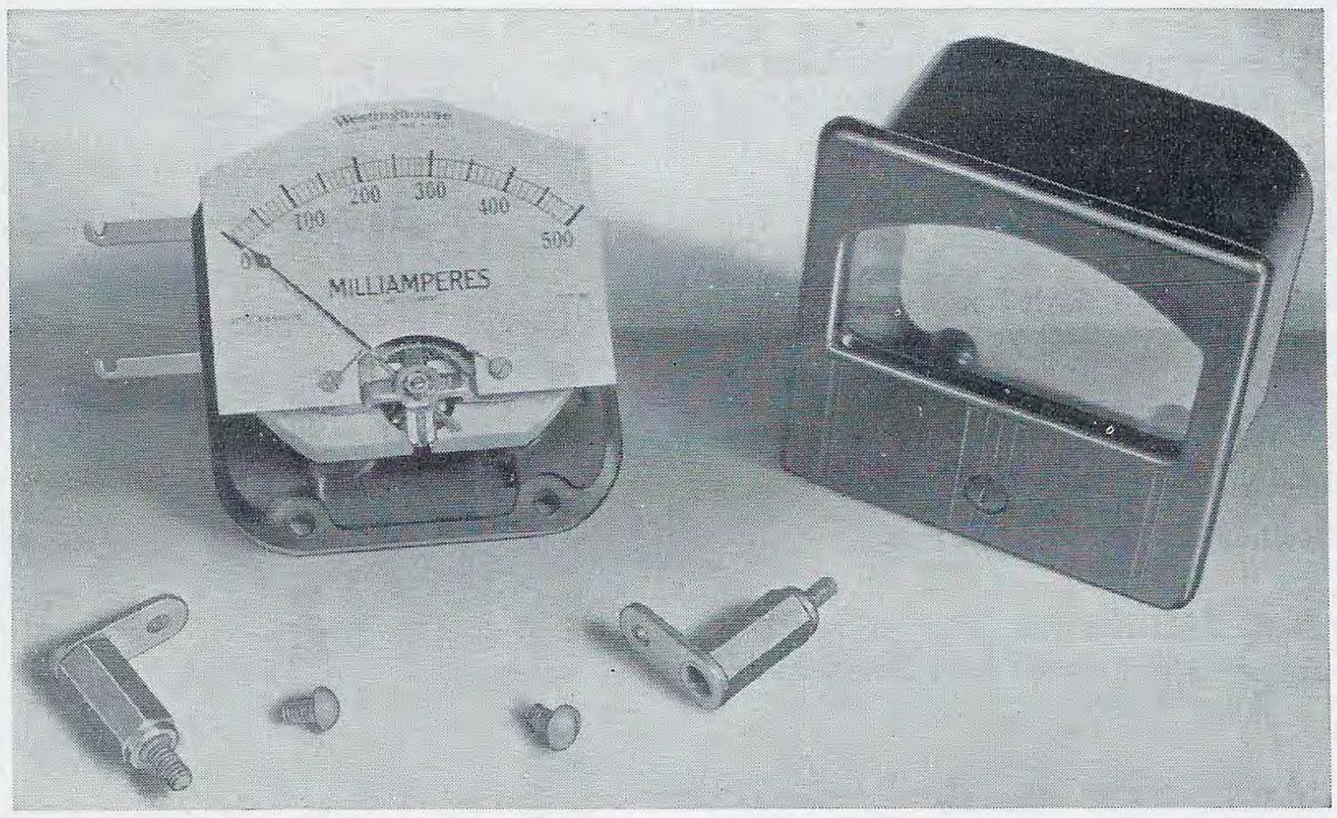


FIG. 4—TYPE RX MILLIAMMETER WITH COVER AND SELF-LOCKING MOUNTING CLAMPS REMOVED

WIRING DIAGRAMS AND MOUNTING TEMPLATE

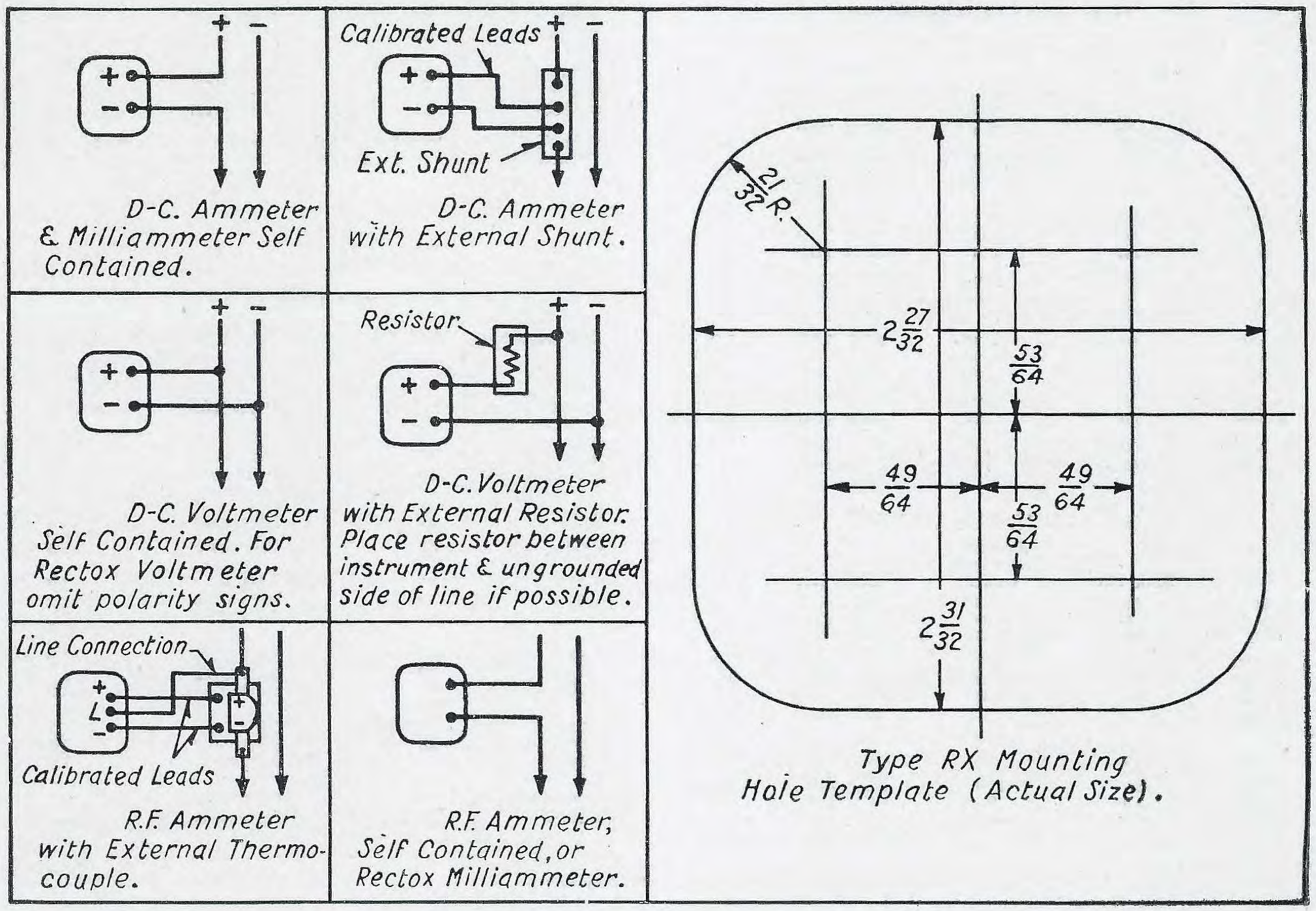


FIG. 5—EXTERNAL WIRING DIAGRAMS AND MOUNTING HOLE TEMPLATE

TYPE RX MINIATURE RECTANGULAR INSTRUMENTS—Continued

LIST PRICES

All standard RX instruments are calibrated for use on non-magnetic panels. If they are to be used on steel panels, please specify panel thickness on order.

D-C. AMMETERS

Calibrated for 50 Mv. External Shunts

Capacity	Scale Div.	Style No.	List Price Discount Symbol AC
Left Zero *†	..	839 728	$10 00
Center Zero *†	..	839 729	10 00

*The above styles of d-c. ammeters can be calibrated for any external shunt from 5 to 10,000 amperes, and with standard or special length leads.
†Specify rating of shunt required. List Price includes leads, but not the shunt.
When ordering specify leads S#839730, 4 feet long.

D-C. AMMETER

Self-contained. Approximately 50 Mv. Drop Across Terminals

Capacity	Scale Div.	Style No.	List Price Discount Symbol AC
0–1	50	839 731	$10 00
0–1.5	30	839 732	10 00
0–2	40	839 733	10 00
0–3	30	839 735	10 00
0–4	40	839 736	10 00
0–5	50	839 737	10 00
0–8	40	839 739	10 00

Ratings higher than 8 and up to 50 amperes can be furnished with stud-type terminals at same price.

D-C. MILLIAMMETERS

Capacity	Scale Div.	Approx. Resistance Ohms	Style No.	List Price Discount Symbol AC
0–1	50	57.2	839 740	$11 00
0–1.5	30	38.6	839 741	11 00
0–2	40	15.1	839 742	11 00
0–3	30	10.4	839 744	11 00
0–5	50	3.7	839 746	10 00
0–8	40	3.9	839 748	10 00
0–10	50	2.1	839 749	10 00
0–15	30	1.5	839 750	10 00
0–20	40	2.5	839 751	10 00
0–25	25	2.0	839 752	10 00
0–30	30	1.67	839 753	10 00
0–50	50	1.	839 755	10 00
0–100	50	.50	839 758	10 00
0–150	30	.33	839 759	10 00
0–200	40	.25	839 760	10 00
0–250	25	.20	839 761	10 00
0–300	30	.17	839 762	10 00
0–500	50	.10	839 764	10 00
0–800	40	.062	839 766	10 00

D-C. MICROAMMETERS

Capacity	Scale Div.	Approx. Resistance Ohms	Style No.	List Price Discount Symbol AC
0–20*	40	2180	839 767	$27 00
0–50*	50	426	839 771	24 50
0–80*	40	183	839 773	24 50
0–100*	50	71	839 774	22 00
0–150*	30	340	839 775	19 00
0–200*	40	154	839 776	15 25
0–250*	25	121	839 777	15 25
0–300*	30	154	839 778	15 25
0–400*	40	97	839 779	15 25
0–500*	50	110	839 780	15 25
0–600*	30	93	839 781	15 25
0–800*	40	61	839 782	15 25

* Microammeters below 500 microamperes depend upon the external circuit for damping.

D-C. VOLTMETERS

Resistance—200 Ohms per Volt

Capacity	Scale Div.	Style No.	List Price Discount Symbol AC
0–1	50	839 783	$ 10 00
0–1.5	30	839 784	10 00
0–2	40	839 785	10 00
0–3	30	839 787	10 00
0–5	50	839 789	10 00
0–6	30	839 790	10 00
0–8	40	839 791	10 00
0–10	50	839 792	10 00
0–15	30	839 793	10 00
0–20	40	839 794	10 00
0–25	25	839 795	10 00
0–30	30	839 796	10 00
0–50	50	839 798	10 00
0–80	40	839 800	10 00
0–100	50	839 801	11 00
0–150	30	839 802	12 25
0–200	40	839 803	14 00
0–250	25	839 804	15 50
0–300	30	839 805	17 50
0–500	50	839 807	20 50
0–800*	40	839 809	25 00
0–1000*	50	839 810	29 50
0–1500*	30	839 811	37 50
0–2000*	40	839 812	46 00
0–2500*	25	839 813	54 00
0–3000*	30	839 814	62 00
0–5000*	50	839 816	94 00

*Supplied with external resistor. The voltmeter is made self-contained for 150 volts and the balance of the resistance is external.

D-C. VOLTMETERS

Resistance—1000 Ohms per Volt self-contained

Capacity	Scale Div.	Style No.	List Price Discount Symbol AC
0–1	50	839 818	$13 00
0–2	40	839 820	13 00
0–5	50	839 824	13 00
0–8	40	839 826	13 00
0–10	50	839 827	13 00
0–15	30	839 828	13 00
0–25	25	839 830	13 00
0–50	50	839 833	13 00
0–80	40	839 835	13 00
0–100	50	839 836	13 50
0–150	30	839 837	14 25
0–200	40	839 838	15 00
0–250	25	839 839	15 50
0–300	30	839 840	16 00
0–500	50	839 842	18 25
0–800	40	839 844	20 25
0–1000	50	839 845	22 00

Order by Style Number

Prices and Discounts subject to change without notice.

TYPE RX MINIATURE RECTANGULAR INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES

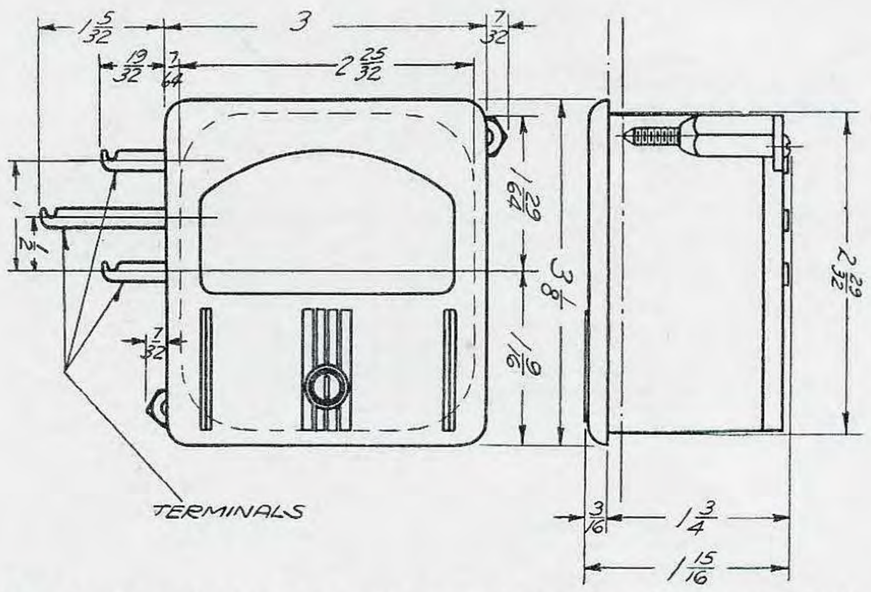


FIG. 6—TYPE RX INSTRUMENT WITH SOLDERING TERMINALS USED UP TO 5 AMPERES

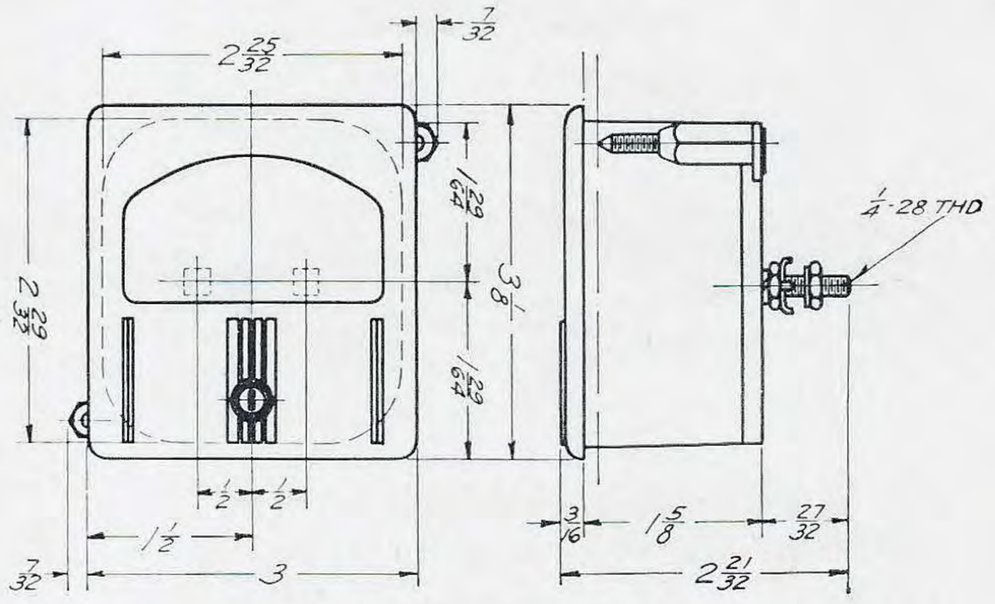


FIG. 7—TYPE RX INSTRUMENT WITH STUD TERMINALS USED FOR 10 AMPERES AND UP

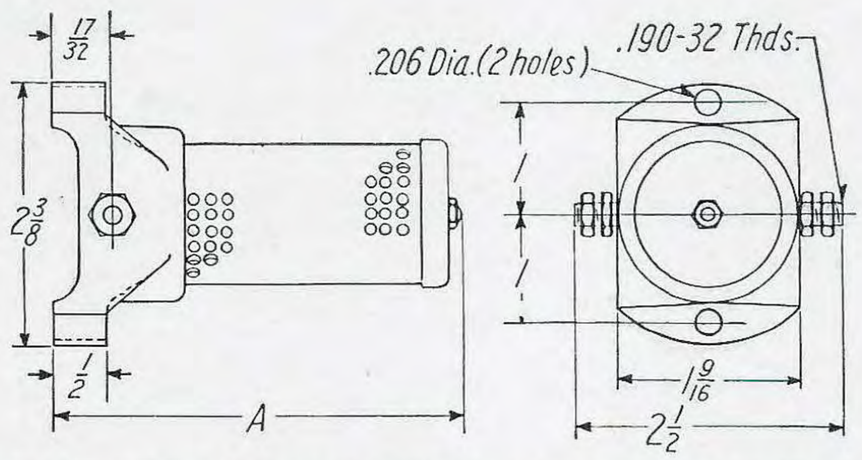


FIG. 8—TYPE RO EXTERNAL RESISTOR FOR VOLTMETERS UP TO AND INCLUDING 1000 VOLTS FULL-SCALE. DIMENSION A IS FOUR INCHES FOR 800 VOLTS. FIVE INCHES FOR 1000 VOLTS

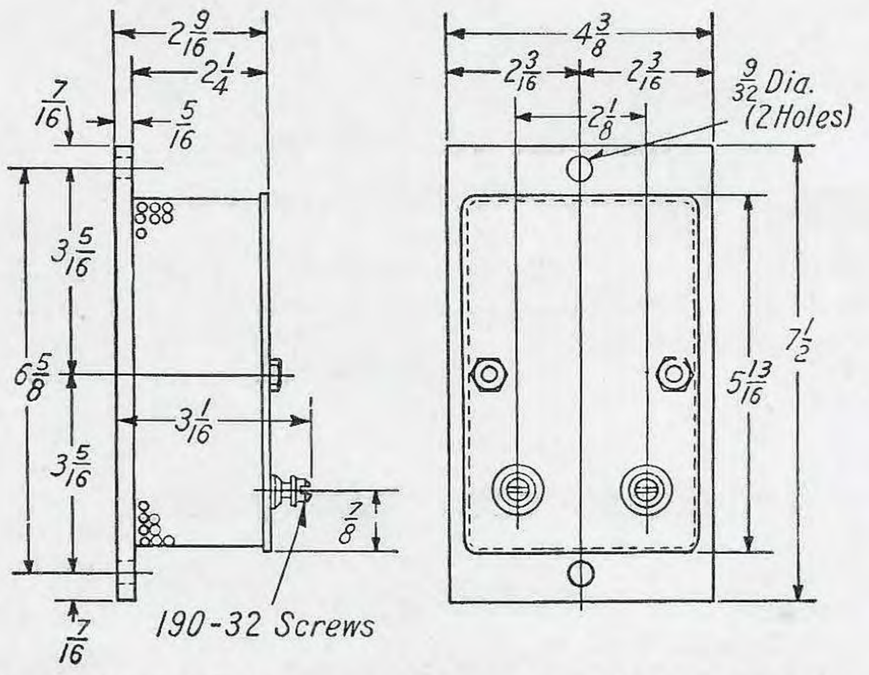


FIG. 9—TYPE R-3 EXTERNAL RESISTOR FOR VOLTMETERS FROM 1500 VOLTS UP TO AND INCLUDING 3000 VOLTS FULL-SCALE

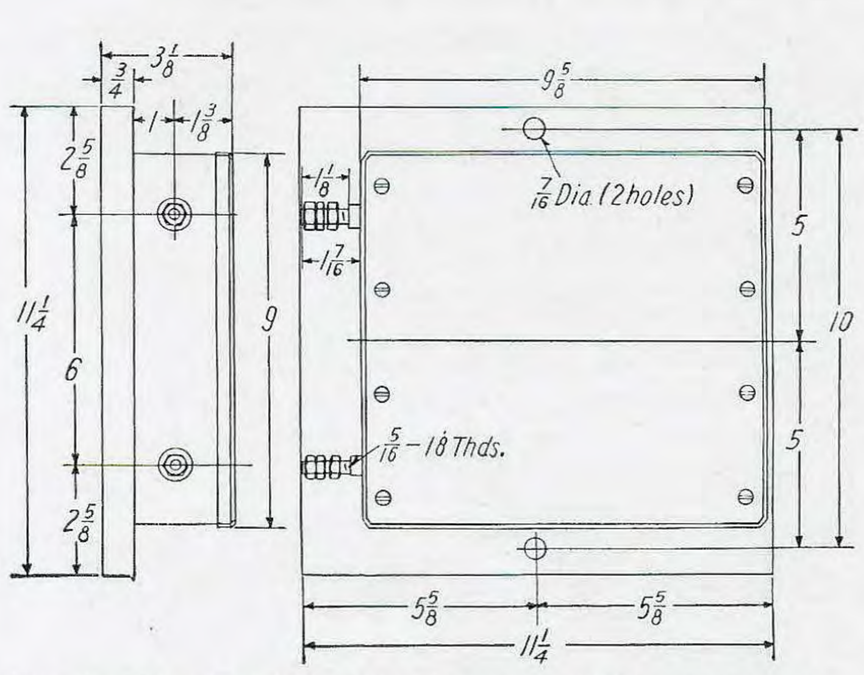


FIG. 10—TYPE R-4 EXTERNAL RESISTOR FOR VOLTMETERS OF 5000 VOLTS FULL-SCALE

Dimensions are for reference only. For official dimensions apply to the nearest Westinghouse Sales Office.

Supersedes
Issue
Dated June 28, 1937

CATALOG SECTION 43-347

FEB. 28, 1938 WESTINGHOUSE INSTRUMENTS

TYPES AX AND BX AIRCRAFT INSTRUMENTS

Ammeters, Voltmeters and Volt-Ammeters

FIG. 1—TYPE BX AIRCRAFT VOLT-AMMETER

FIG. 2—TYPE AX AIRCRAFT VOLT-AMMETER

DATA

	Type BX	Type AX
Case Material	Metal	Moldarta
Mounting	Flush	Flush
Body Diameter	2⅛″	2¼″
Flange Diameter	2⅜″	.....
Scale Length	1.8″	1.8″
Insulation Rating	500 V.	500 V.
Accuracy	± 2%	± 2%
Net Weight	8 oz.	10 oz.

Types Available

Westinghouse aircraft battery instruments are furnished in two types, namely, AX and BX.

The type AX is furnished in a standard 2¼″ Moldarta aircraft case and provided with a black dial with white scale and figures, either with or without luminous paint as desired. The instrument is listed with and without static and magnetic shields for protecting the compass and radio equipment. It is available in several ranges including a volt-ammeter to be used with an external shunt-resistor unit for measuring volts and amperes on one instrument with a selector switch.

The type BX is provided in a standard 2″ round metal case for flush panel mounting. Several ranges of ammeters and voltmeters are available, including a volt-ammeter with built-in push button switch for changing from amperes to volts. The instrument is magnetically shielded and also has an internal static shield for protection against radio interference.

Application

Most aircraft are equipped with batteries and equipment for keeping these batteries charged. In order to be sure of the battery condition, it is essential to use instruments indicating charging or discharging rates and battery or generator voltage. The two types of instruments developed for this application have been designed especially for aircraft service. Such details as mounting, shielding, and accessories have been provided to take care of most every application. In addition the instruments are equipped with moving elements having specially treated parts to withstand severe vibration.

Construction

Cases—Two types of cases are provided. The type BX has a standard round metal case for flush panel mounting. The instrument is secured to the panel by three bolts through the flange.

The type AX has a standard 2¼″ Moldarta Aircraft case which is fastened to the panel by bolts through four lugs on the front.

Both types of cases have a full open glass front exposing the entire dial and pointer.

Shielding—Type BX cases are shielded magnetically by an iron enclosure

Westinghouse Electric & Manufacturing Company

Printed in U.S.A.

Newark Works, Newark, N. J.

TYPES AX AND BX AIRCRAFT INSTRUMENTS—Continued

around the side and permanently attached to the case. This instrument also has an internal static shield which forms suitable contact between the dial and inside of the case. All shields are protected against corrosion.

Type AX cases are available with both magnetic and static shields. These are separate parts which fit over the back of the Moldarta case and are easily removable for terminals and connections. The static shield is provided with cable connectors suitable for use with "Breeze" or similar cable shielding. The static shield is equipped with shielded cable connector. All shields are electro-plated or made of materials which resist corrosion and effectively prevent interference with the compass or radio equipment when properly installed.

FIG. 4—TYPE AX AIRCRAFT AMMETER

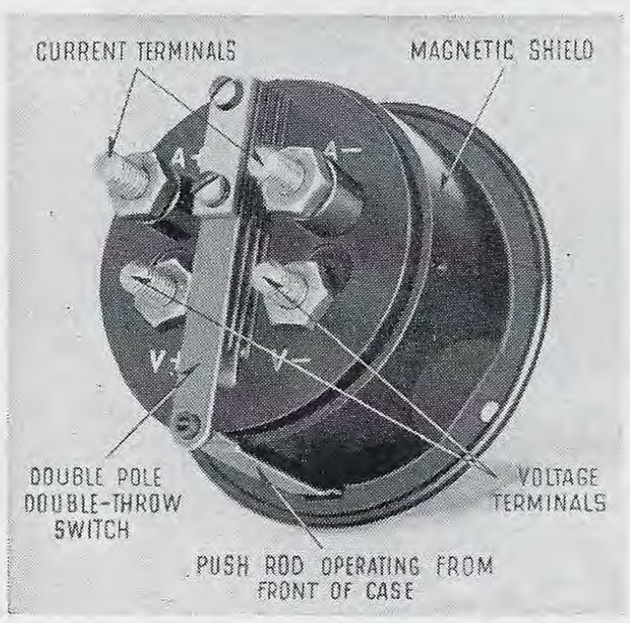


FIG. 3—REAR VIEW OF BX VOLT-AMMETER

The magnetic shield is made of iron cadium plated and the static shield of aluminum with special treatment to prevent corrosion. The static shield is provided with a terminal cover which is removable from the rear affording easy access to the terminal block.

Movements—The d'Arsonval principle of operation is used in both BX and AX instruments. The movements are equipped with pointers having wide section to make reading easy. The permanent magnets are of large size to give an unusually strong field to provide extra damping and torque. Special pivots and jewels are used to withstand severe vibrations. An unusually sturdy construction is used throughout the entire assembly.

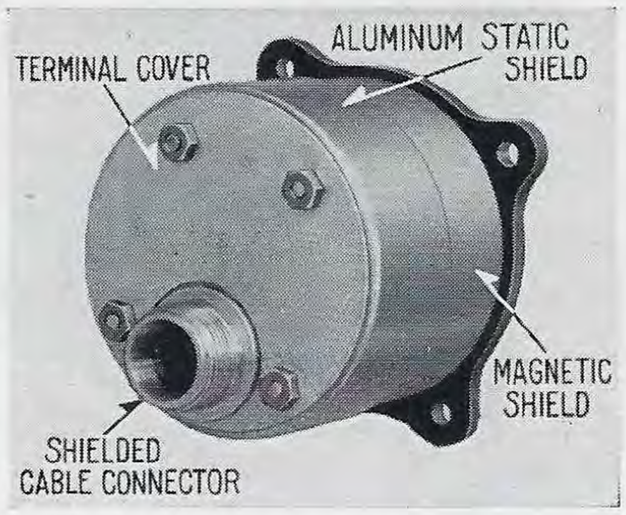


FIG. 6—REAR VIEW, TYPE AX INSTRUMENT, SHOWING SHIELDING DETAILS ASSEMBLED ON CASE

Volt-Ammeters Type BX

The BX Volt-Ammeters are equipped

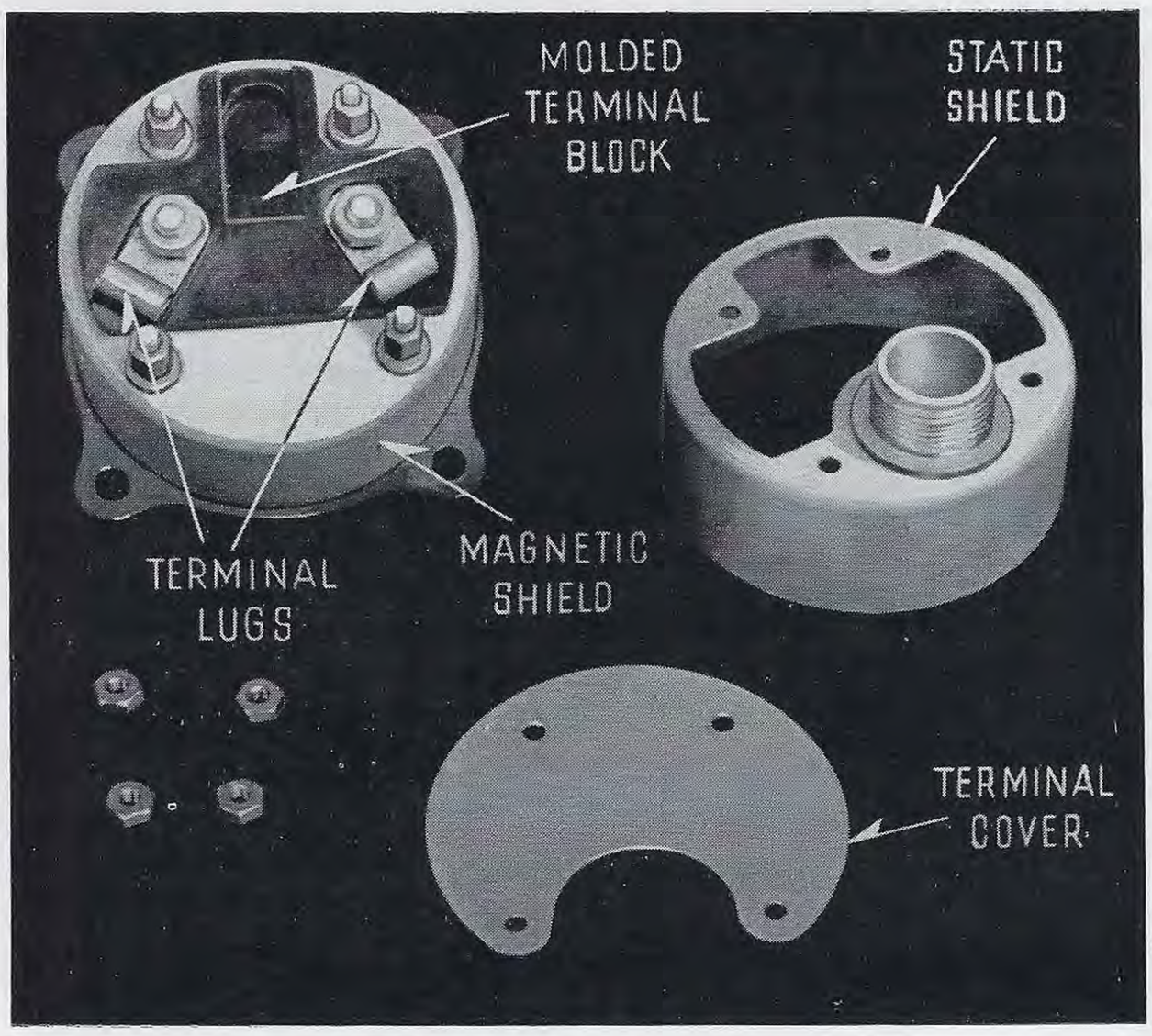


FIG. 5—TYPE AX SHIELDING DETAILS

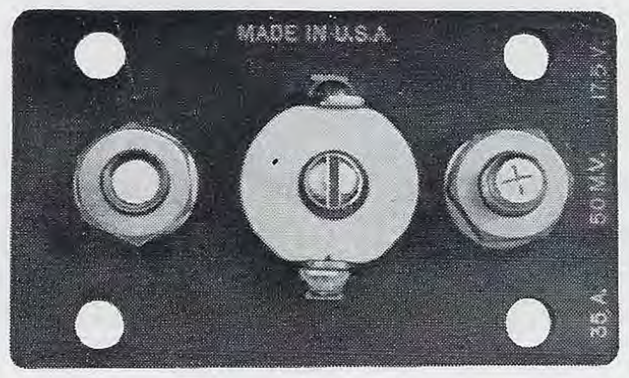


FIG. 7—FRONT VIEW SHUNT-RESISTOR UNIT FOR TYPE AX VOLT-AMMETER

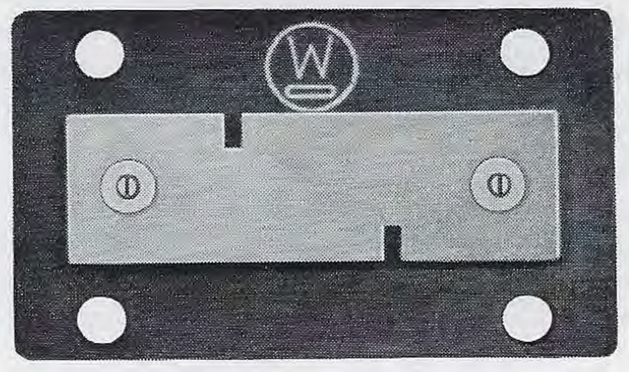


FIG. 8—REAR VIEW SHUNT-RESISTOR UNIT FOR TYPE AX VOLT-AMMETER

TYPES AX AND BX AIRCRAFT INSTRUMENTS—Continued

with a double-pole, double-throw switch built on the base of the instrument. This switch is operated from the front of the case by means of a push rod. Closing the switch in one direction connects the mechanism internally through a resistor to measure volts applied to one set of terminals. The switch normally is closed in the opposite direction and connects the mechanism as a millivoltmeter, measuring the drop across an internal shunt which is connected to another set of terminals to measure amperes. Two scale ranges are marked on the dial, one in volts and the other in amperes. This style is used to give an indication of battery or generator voltage as well as charge or discharge rate on one instrument, thus keeping down the weight of instrument equipment without sacrifice of complete information.

Volt-Ammeters Type AX

The type AX Volt-Ammeter has an external shunt-resistor unit which is to be mounted separately from the instrument and wired through a separate selector switch. The selector switch is not furnished with the instrument. This instrument otherwise is applied the same as the type BX described above. The separate switch and shunt-resistor unit are more flexible in application to individual instrument board requirements than would be the self-contained type BX volt-ammeter.

LIST PRICES

TYPE BX VOLT-AMMETER

Four Terminal

With built-in double pole-double throw push button switch. Style number covers instrument complete with magnetic shield and internal static shield. Supplied with black dial and luminous pointer and scale.

Rating	Style	Weight Net	Weight Shipping	List Price Disc. Symbol AC
10–0–50 amperes } 4–0–20 volts }	931 578	8 oz.	1½ lbs.	$22 00

TYPE BX AMMETER

Style number covers instrument complete with magnetic shield and internal static shield. Supplied with black dial and luminous pointer and scale.

10–0–50 amperes	931 579	7 oz.	1½ lbs.	15 00

TYPE BX VOLTMETER

Style number covers instrument complete with magnetic shield and internal static shield. Supplied with black dial and luminous pointer and scale.

0–20 volts	931 580	7 oz.	1½ lbs.	15 00

TYPE AX VOLT-AMMETER*†

Style number covers instrument complete with static and magnetic shields and shunt-resistor unit.

				List Price Disc. Symbol BC
0–17.5 volts } 0–35 amperes }	931 581	1 lb.	2½ lbs.	$ 21 50

TYPE AX VOLTMETER*†

Style number covers instrument complete with static and magnetic shields.

Rating	Style	Weight Net	Weight Shipping	List Price Disc. Symbol BC
0–17.5 volts	931 582	12 oz.	2½ lbs.	$17 00

TYPE AX AMMETERS*†

Style number covers instrument complete with static and magnetic shields.

30–0–30 amperes	931 583	12 oz.	2½ lbs.	17 00
0–35 amperes	931 584	12 oz.	2½ lbs.	17 00

TYPE AX VOLT-AMMETER*

Style number covers instrument complete with shunt and resistor unit but without either static or magnetic shields.

0–17.5 volts } 0–35 amperes }	931 585	12 oz.	2½ lbs.	18 50

TYPE AX VOLTMETER*

Style number covers instrument without either static or magnetic shields.

0–17.5 volts	931 586	8 oz.	1½ lbs.	14 00

TYPE AX AMMETERS*

Style number covers instrument without either static or magnetic shields.

30–0–30 amperes	931 587	8 oz.	1½ lbs.	14 00
0–35 amperes	931 588	8 oz.	1½ lbs.	14 00

SPARE SHUNT-RESISTOR UNIT FOR TYPE AX VOLT-AMMETER

0–17.5 volts } 0–35 amperes }	931 590	4 oz.	1 lb.	4 50

* All standard listed Type AX instruments are supplied with black **dials** having white pointer and scale. They can be furnished with luminous pointer and scale at a price addition of **$2.50** list.

† If instrument is to be furnished with magnetic shield only, deduct **$2.00 list.** If instrument is to be furnished without magnetic or static shields deduct **$3.00 list.**

Order by Style Number

Prices and discounts are subject to change without notice.

TYPES AX AND BX AIRCRAFT INSTRUMENTS—Continued

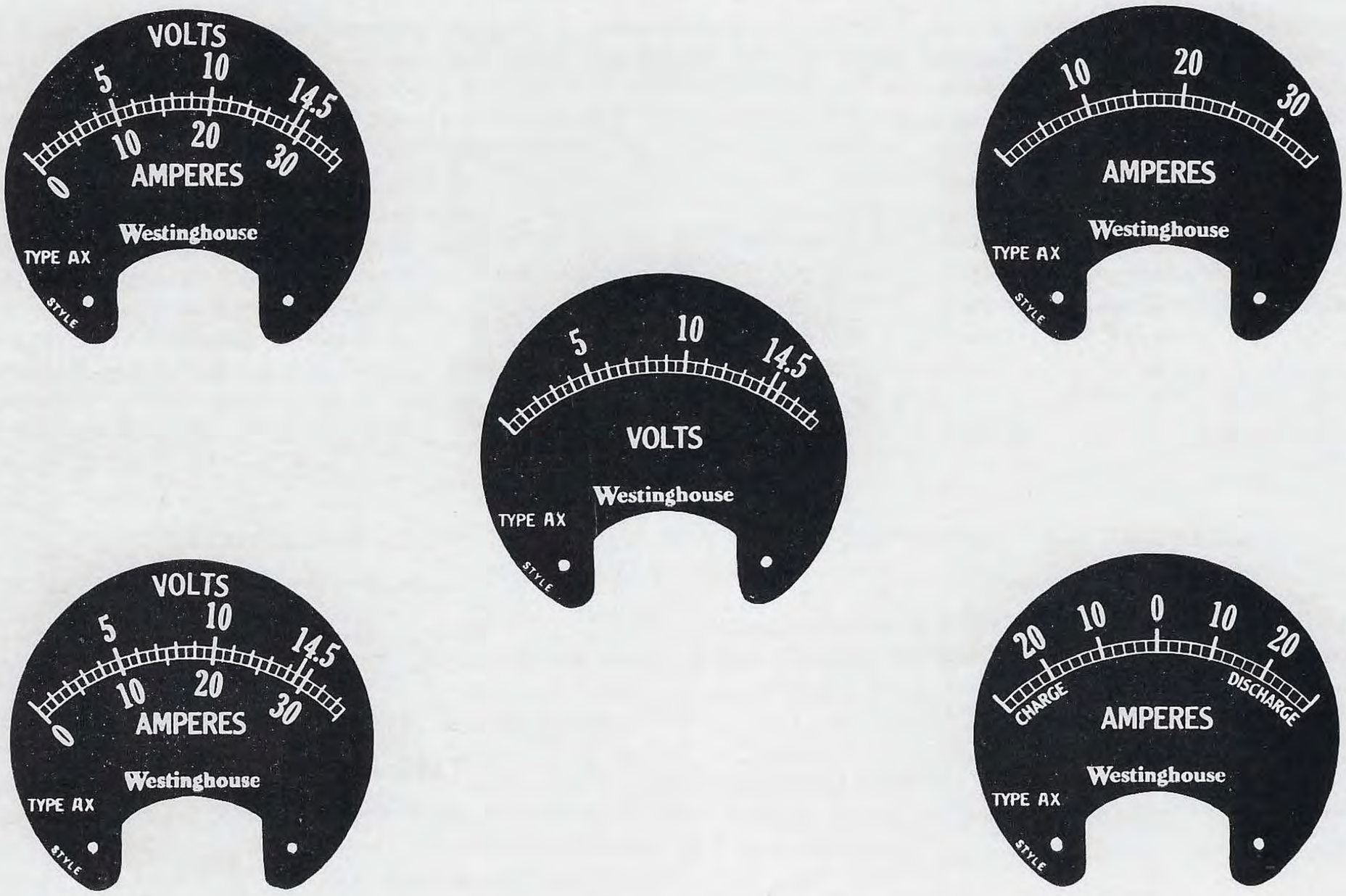


FIG. 9—DIAL MARKINGS OF STANDARD TYPE AX AVIATION INSTRUMENTS

OUTLINE DIMENSIONS IN INCHES

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse sales office.

FIG. 10—OUTLINE AND DRILLING PLAN FOR TYPE BX VOLT-AMMETER

TYPES AX AND BX AIRCRAFT INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse sales office.

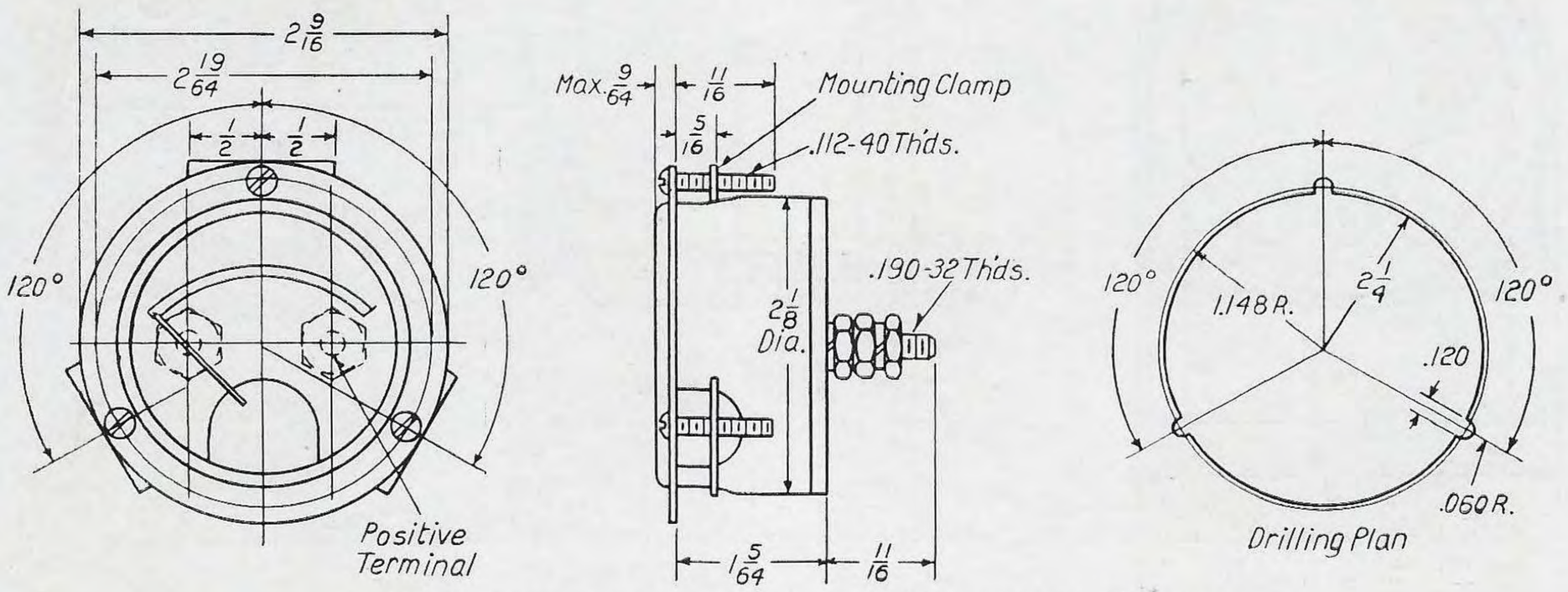


FIG. 11—OUTLINE AND DRILLING PLAN FOR TYPE BX AMMETER AND VOLTMETER

FIG. 12—OUTLINE AND DRILLING PLAN FOR TYPE AX AIRCRAFT INSTRUMENTS WITHOUT SHIELDING DETAILS

TYPES AX AND BX AIRCRAFT INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

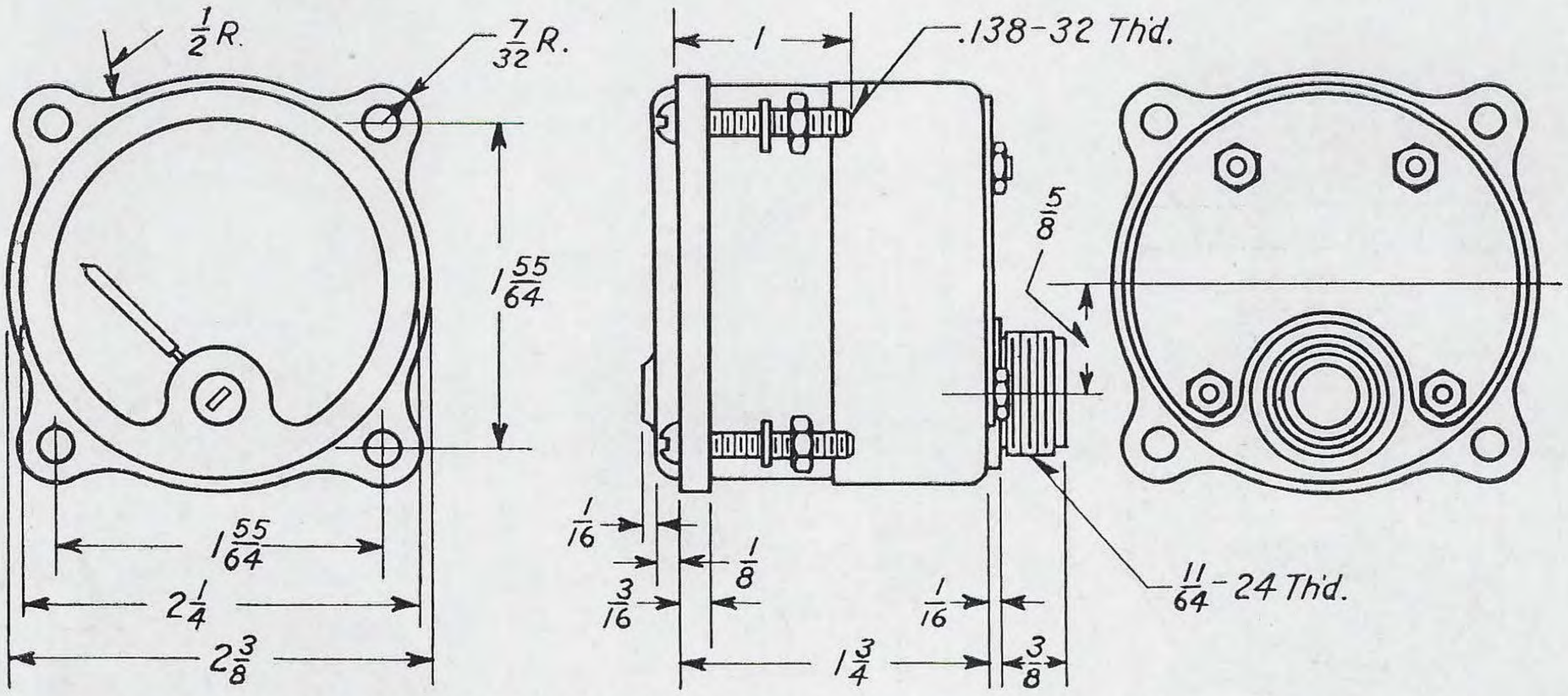


FIG. 13—OUTLINE AND DRILLING PLAN FOR TYPE AX AIRCRAFT INSTRUMENTS WITH STATIC AND MAGNETIC SHIELDING DETAILS

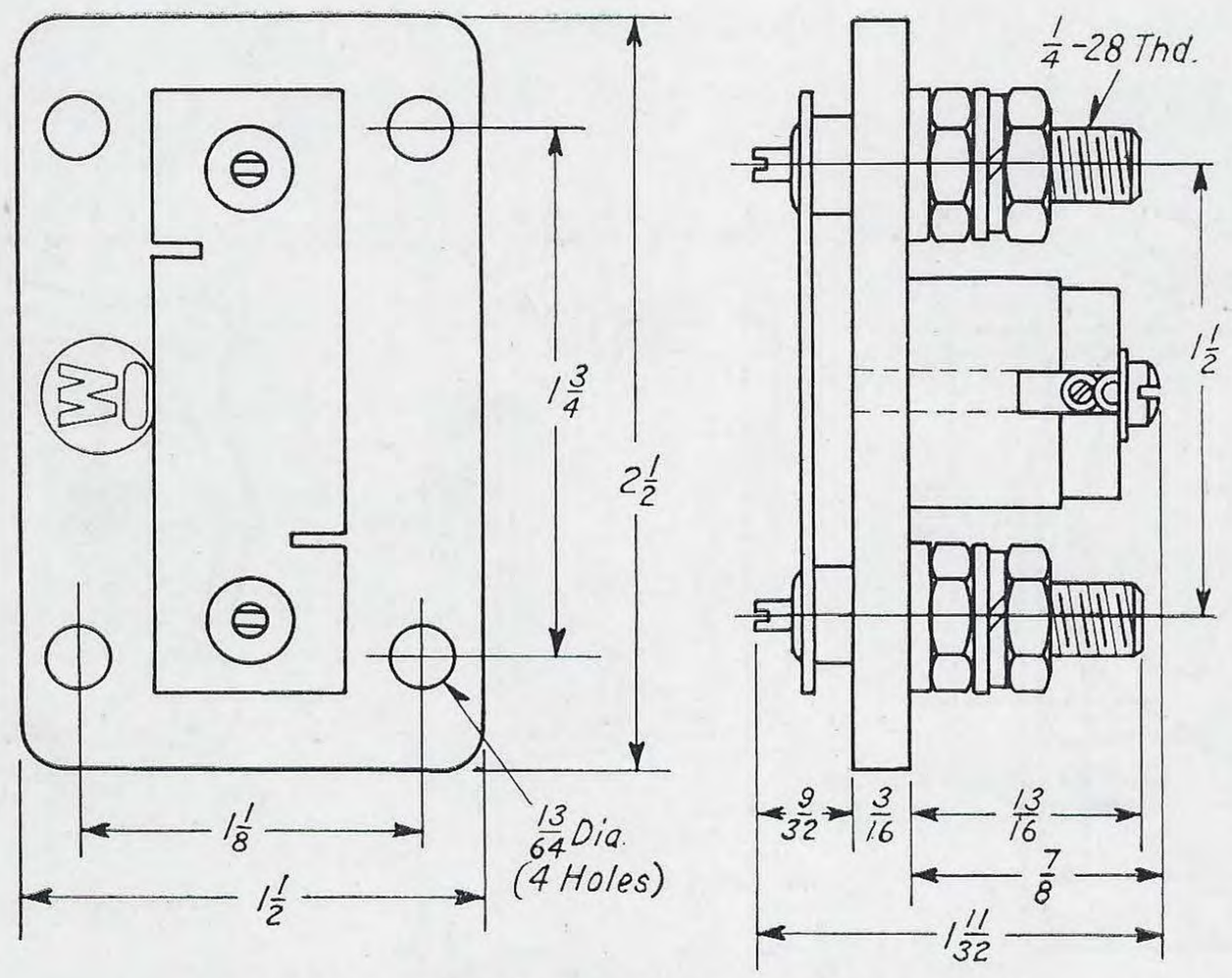


FIG. 14—OUTLINE AND DRILLING PLAN FOR SHUNT-RESISTOR UNIT FOR TYPE AX VOLT-AMMETER

TYPES AX AND BX AIRCRAFT INSTRUMENTS—Continued

WIRING DIAGRAM

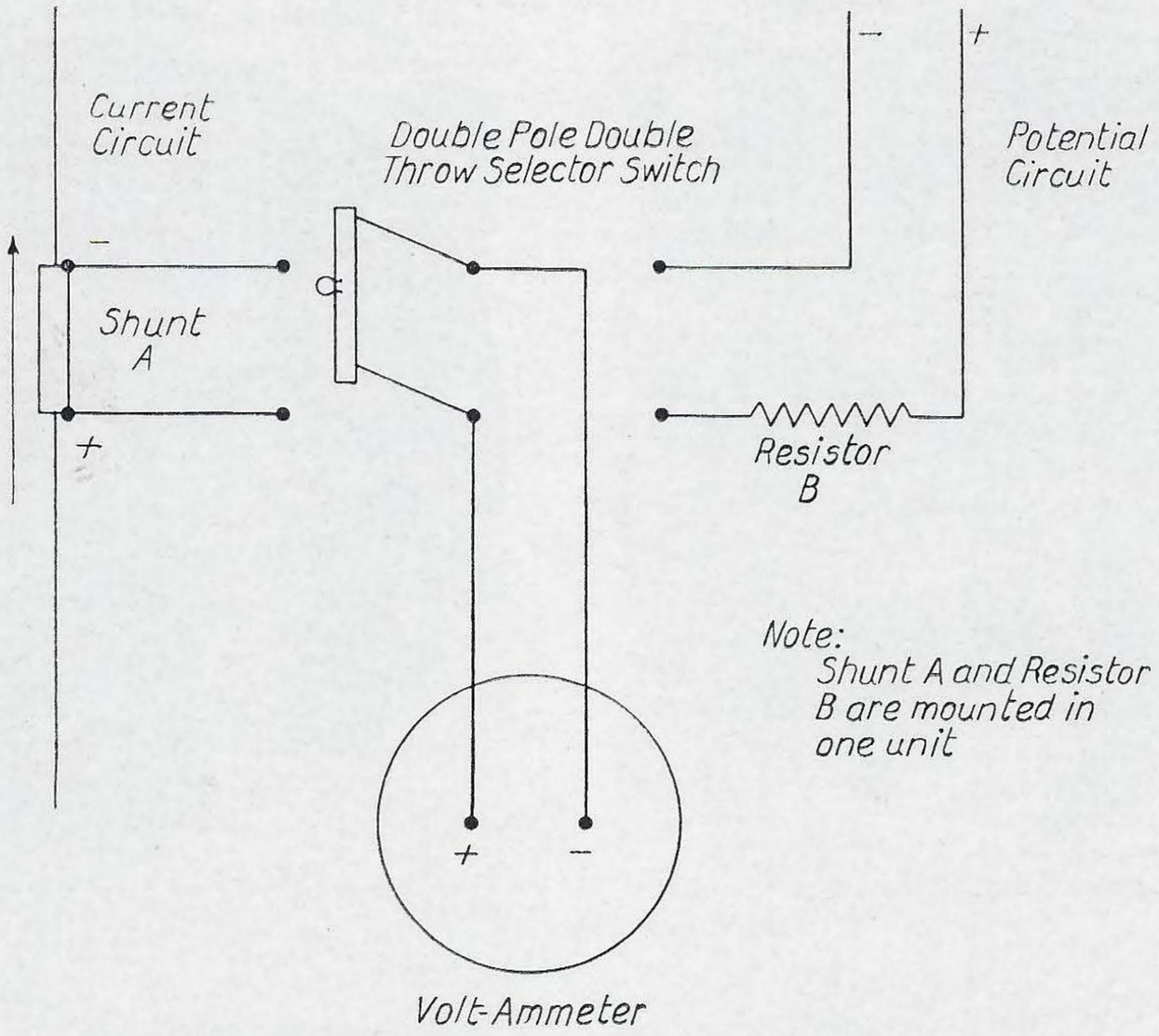


FIG. 15—SCHEMATIC CONNECTIONS OF TYPE AX VOLT-AMMETER WITH EXTERNAL SHUNT AND RESISTOR UNIT

MINIATURE PANEL INSTRUMENTS

THREE-INCH CLASSIFICATION

Alternating Current, Direct Current, Rectox and Radio Frequency Types

Fig. 1-A—Types NX, NC, NT and NA, 3½-Inch Round, Flush Mounting

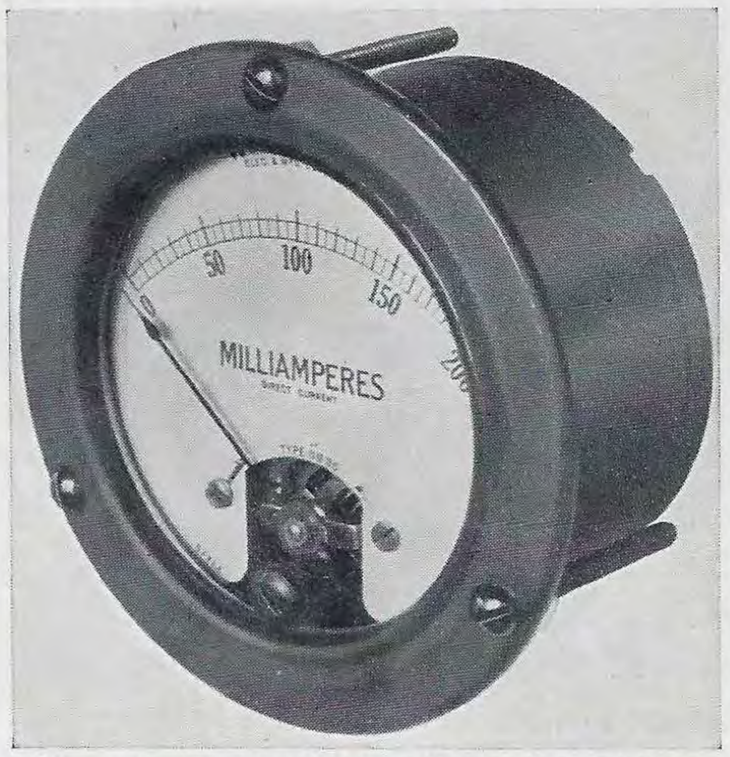


Fig. 1-B—Types VX, VC, VT and VA, 3⅜-Inch Round, Flush Mounting

Fig. 1-C—Types RX, RC, RT and RA Rectangular Flush Mounting

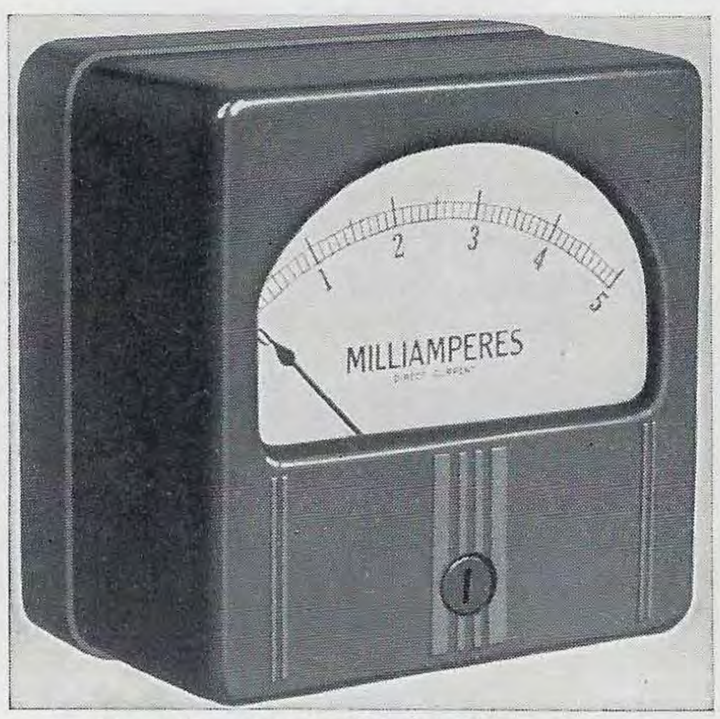


Fig. 1-D—Types UX, UC, UT and UA Rectangular Projection Mounting

Fig. 1—Illustrating Case Forms Used in the "35" Line of Miniature Panel Instruments

DATA

	ROUND FLUSH MOUNTING	ROUND FLUSH MOUNTING	RECTANGULAR FLUSH MOUNTING	RECTANGULAR PROJECTION MOUNTING
‡ D-C. Types	NX-35	VX-35	RX-35	UX-35
Rectox Types	NC-35	VC-35	RC-35	UC-35
Radio Frequency Types	NT-35	VT-35	RT-35	UT-35
** A-C. Types	NA-35	VA-35	RA-35	UA-35
Case Material	Moldarta	Moldarta	Moldarta	Moldarta
Mounting	Flush or Bolted	Flush or Bolted	Flush or Bolted	Projection Bolted
Body Diameter	2.8″	2¾″	2¾″	3″ x 3⅛″
Front Flange	3½″	3⅜″	3″ x 3⅛″	3″ x 3⅛″
D-C. Scale Length	2.4″	2.4″	2.4″	2.4″
A-C. Scale Length	2 1/16″	2 1/16″	2 1/16″	2 1/16″
Insulation Rating	750-V.	750-V.	750-V.	750-V.
* Accuracy	±2%	±2%	±2%	±2%
† Net Wt. A-C. Types	7 oz.	7 oz.	8 oz.	10 oz.
† Net Wt. D-C. Types	10 oz.	10 oz.	11 oz.	13 oz.
† Net Wt. Cobalt Magnet D-C. Types	15 oz.	15 oz.	16 oz.	18 oz.

‡ Permanent Magnet Moving Coil (D-C.) Types have electromagnetic damping.
** Repulsion Vane (A-C.) Types are air damped.
* Accuracy Rectox Types, 5%. Repulsion Vane Types when used on D-C. 3%.
† Weights are approximate and do not include shunts, resistors, etc.

MINIATURE PANEL INSTRUMENTS—Continued

FIG. 2—TYPE NX-35 MILLIAMMETER

General

The Westinghouse 35 line of Miniature Panel Instruments is available as a complete line covering all industrial and radio applications in a variety of forms. All forms are available with alternating current or direct current movements. The ratings cover the broadest possible field consistent with prevailing requirements for instruments of this class. The line provides for the measurement of Direct Current: volts, amperes, milliamperes, microamperes; Rectox Types: power level, output; Thermocouple Types: radio frequency amperes and milliamperes; Alternating Current: volts, amperes and milliamperes.

The entire line of miniature panel instruments employs but two types of mechanisms. This contributes to interchangeability of parts and permits of short delivery schedules on special and semi-standard forms. The cases are uniformly interchangeable for all forms, hence a round flush instrument may be converted to projection rectangular or to flush rectangular front by changing the case only.

Mechanisms are of the latest improved design having higher torque-weight ratios and low volt-ampere burdens. Capacities as low as 20 microamperes are available in moving coil types. Self-contained ammeters of 50 amperes and voltmeters of 200 volts are available, thus providing the economical maximum in variety of ratings with a minimum of external accessories.

Application

A broad field of applications is covered by the Westinghouse line of miniature panel instruments. Some of these applications are briefly as follows:

1. Industrial Test Units for production testing of electrical apparatus.
2. Automotive Analyzers for testing electrical characteristics encountered in ignition, lighting and starting systems.
3. Battery Testers and Battery Chargers.
4. Radio Tube Testers and Set Analyzers.
5. Radio Transmitters, for plate and filament currents and voltages, output, distortion factor modulation and grid currents.
6. Radio experimenters and amateurs for general use in radio circuits.
7. Aircraft, for indication of battery currents, voltages, etc.
8. Arc Welding Outfits.
9. Motion Picture Arc Lamp Control Panels.
10. Sound Movie equipment for measuring electrical circuit characteristics.
11. Electrical Laboratories for general test work.
12. Ohmmeters for measuring resistance.

In application of miniature panel instruments the influence of steel panels as well as the influence of one instrument upon the other and the influence of current carrying leads upon instrument indication must be considered. When mounted on insulated panels the panel influence need not be considered. When mounted on steel panels all miniature instruments must be so calibrated.

As a general rule the moving coil type of instruments must be at least 5″ apart between center lines and 8″ when one or more of the instruments have cobalt magnets.

Theeffect of one "A-35" repulsion vane instrument on another is negligible. Repulsion vane instruments should not be less than 6″ from leads carrying currents of the order of 50 amperes. This minimum distance increases or decreases with the current level in direct proportion.

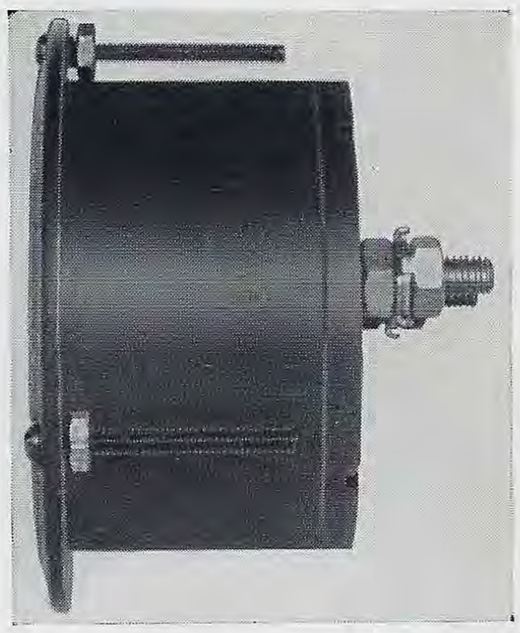


FIG. 3—SHOWING CASE FORM OF ROUND FLUSH INSTRUMENTS

If the above precautions are taken the influence between instruments, and of current carrying leads will be less than ½ of 1%. When the above spacings are impractical, smaller spacings may be used but the instruments must be so calibrated.

Operation and Construction

PERMANENT MAGNET MOVING COIL TYPES FOR DIRECT CURRENT CIRCUITS AND FOR RECTOX AND THERMAL TYPES

Operation—The d'Arsonval, or permanent-magnet moving-coil principle of operation is used. Numerous refinements in the design of this movement have been made; such as, soft iron pole tips welded to the permanent magnet in accurately aligned fixtures; improved springs; and an entirely new method of supporting the iron core in a one piece bracket which also supports the jewel bearings in perfect alignment. Provision is made for the use of extremely strong cobalt-steel magnets for super-sensitive microammeters.

Construction—A complete line of cases in round and rectangular forms are now standard as shown on Page 1. The round form cases are full open face. The rectangular forms have partially open faces with attractive decorative fronts. No mounting screws are visible from the front on the latter forms.

Movements—The permanent magnets are made of high-quality tungsten steel or cobalt steel, properly heat-treated and aged. The soft-iron pole tips are accurately aligned and fastened to the permanent magnet by an electrical welding process, thus assuring perfect alignment and uniform air gap for the moving coil

MINIATURE PANEL INSTRUMENTS—Continued

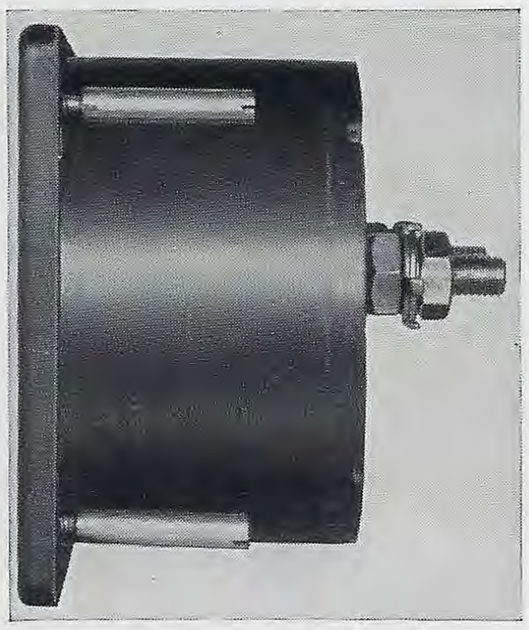


FIG. 4—CASE FORM OF RECTANGULAR FRONT ROUND CASE INSTRUMENTS

FIG. 5—THIS ATTRACTIVE FRONT IS USED ON ALL TYPES OF RECTANGULAR FRONT AND RECTANGULAR CASE INSTRUMENTS OF THE "35" LINE

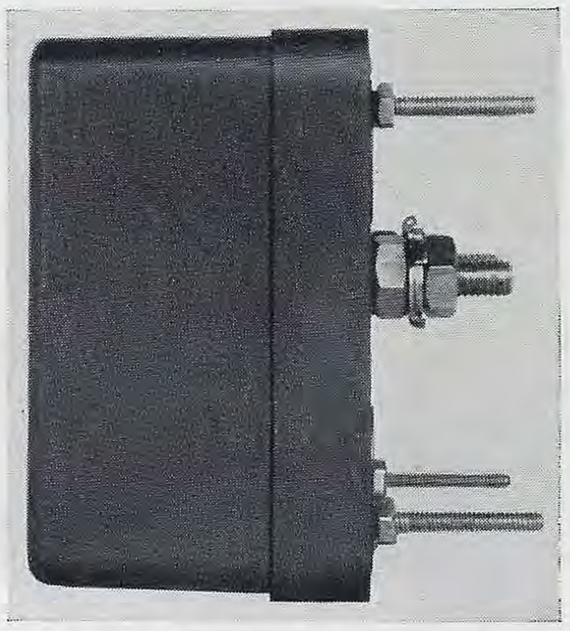


FIG. 6—CASE FORM OF RECTANGULAR PROJECTION INSTRUMENTS

The iron core is accurately aligned by a one piece bracket which supports the sapphire jewel bearings. These features of construction assure extremely accurate air gaps with the convenience of removal of the element from the pole pieces as a complete unit for easy repairing. This provides also uniform flux distribution and reduces the amount of energy consumed by the movement, making possible a super-sensitive instrument in the miniature size.

Springs—The control springs used are the result of years of research into the behavior of spring materials. Special alloys together with proper heat treatment and aging have resulted in a spring having negligible fatigue or set.

Dials—Standard dials are finished in matte silver, with black figures. The number of scale divisions and the size of the figures have been selected for greatest ease of reading and best appearance. Provision is made for multiscale markings where necessary.

Rectox Types—Rectox instruments are used for the measurement of alternating currents when low energy consumption is necessary. A copper-oxide, full-wave rectifier is mounted inside the instrument case, and connected to supply full-wave rectified current to the moving coil. The d'Arsonval instrument element deflects in proportion to the average value of the rectified wave. The dial is calibrated in terms of effective or root-mean-square values. A sensitivity of from 1000 to 10,000 ohms per volt can be obtained with rectifier-type instruments.

Zero Adjusters — Standard instruments are provided with external zero adjusters.

Pointers—The pointer and cross arms are made from strong aluminum alloy, resulting in minimum weight and maximum strength.

Pointer Stops—Pointer stops for both zero and full scale are standard equipment.

Removable Mechanism—All element parts are assembled on a one-piece frame which can be lifted readily from the instrument for inspection or replacement.

Insulation—The "35" line of miniature panel instruments are rated at 750 volts which corresponds to a test of 2500 volts between terminals and the panel.

Modifications Available—Special capacities and special dial markings not listed herein may be supplied to meet specific applications. Negotiations on instruments of this class are invited.

Operation and Construction

REPULSION VANE TYPES FOR A-C. CIRCUITS

Operation—The repulsion iron vane principle of operation is used. This movement is reasonably free from wave form and frequency errors. The current to be measured flows through a stationary coil. A molded chamber containing a stationary iron vane and a movable iron vane is placed within the stationary coil. The molded chamber acts as a support for the stationary vane, also for the bearings and shaft. The pointer is securely fastened to the shaft. Both vanes are of the same polarity at any instant and being polarized by the one stationary coil, repel each other. The movable vane thus moves away from the stationary vane against the torque of a phosphor-bronze control spring. For any given current in the coil an equilibrium point is reached when the forces of repulsion in the vanes just balance the torque of the control spring. The pointer indicates with reference to a scale calibrated in terms of the current or voltage applied to the instrument. Since the force of repulsion in the vanes is a function of the current in the coil, the instrument can be calibrated in terms of the current.

Construction—This movement is available in both round and rectangular forms as shown on Page 1. The round forms are full open face, rectangular forms are partially open face with attractive fronts which mounting screws have been eliminated. Decorative stripes are employed on the rectangular fronts to give a pleasing appearance.

Movements—A new repulsion vane mechanism is used having a very sturdy construction, and incorporating an easy and reliable means of calibration. The entire movement may be removed for inspection without disconnecting leads or control springs. Calibration is effected by means of a screw which is accessible on the rear of the case. The new repulsion vane movement has been designed to give an unusually good scale distribution. Scale divisions are practically uniform from 10% scale deflection to full scale.

Springs—The control springs used are the result of years of research into the behavior of spring materials. Special alloys together with proper heat treatment and aging have resulted in a spring having negligible fatigue or set.

MINIATURE PANEL INSTRUMENTS—Continued

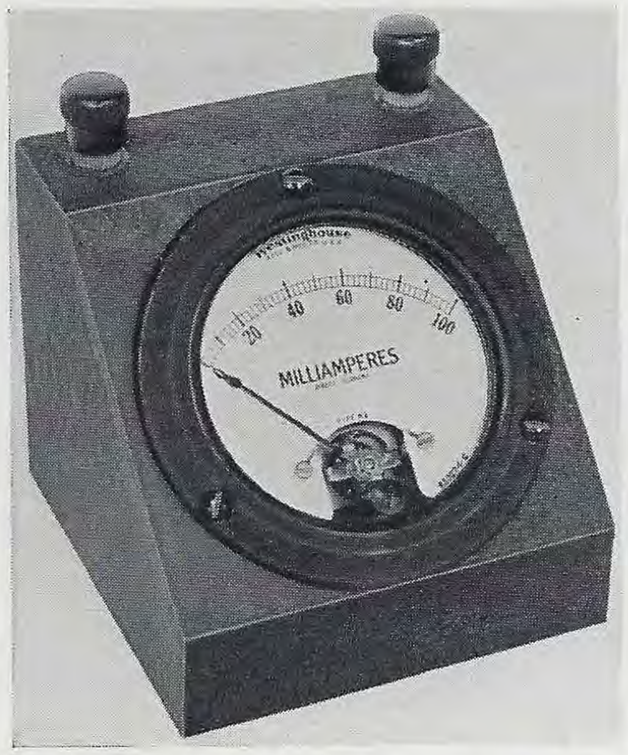


FIG. 7—TYPE NX-35 INSTRUMENT MOUNTED IN A PORTABLE HOUSING

Bearings and Pivots—Genuine sapphire jewels are used. They are ground and highly polished and checked for contour and dimensions by a special process.

Pivots are made of high-grade steel specially treated and polished. Radius and polish are also checked by special processes developed from years of experience in instrument manufacture.

Dials—Standard dials are finished in matte silver, with black figures. The number of scale divisions and the size of the figures have been selected for the greatest ease in reading and best appearance. Provision is made for multi-scale markings where necessary.

Zero Adjusters—All instruments are provided with external zero adjusters.

Pointers—The pointer is equipped with cross arms to receive special coiled wire balance weights which are easily adjusted and are self-locking. The pointers are of aluminum alloy.

Removable Mechanism—All moving element parts are assembled to a one-piece molded chamber which can easily be removed as a unit for inspection or repair.

Insulation—The "35" line of miniature panel instruments are rated at 750 volts which corresponds to a test of 2500 volts between terminals and panel.

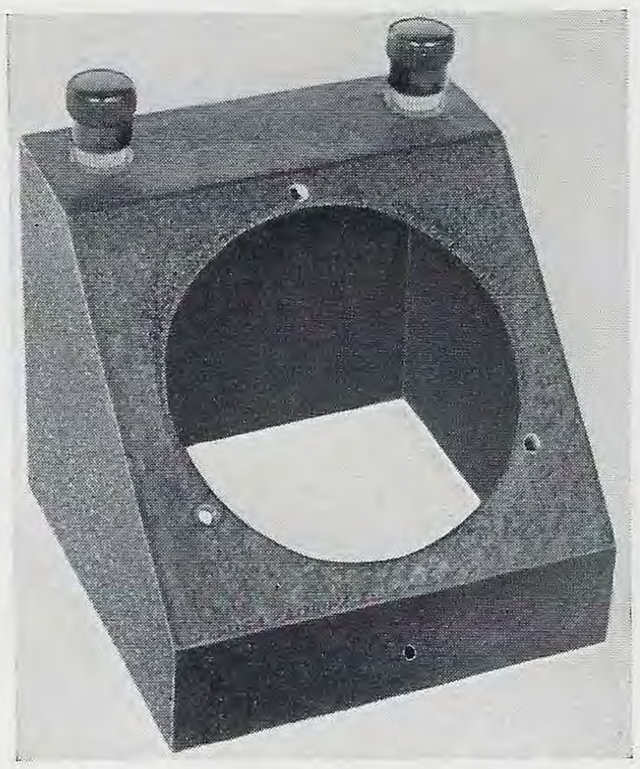


FIG. 8—PORTABLE HOUSING FOR USE WITH TYPES NX-35, NC-35, NT-35 AND NA-35 INSTRUMENTS

Modifications Available—Special capacities and special dial markings, not listed herein, may be supplied to meet specific applications. Negotiations on instruments of this class are invited.

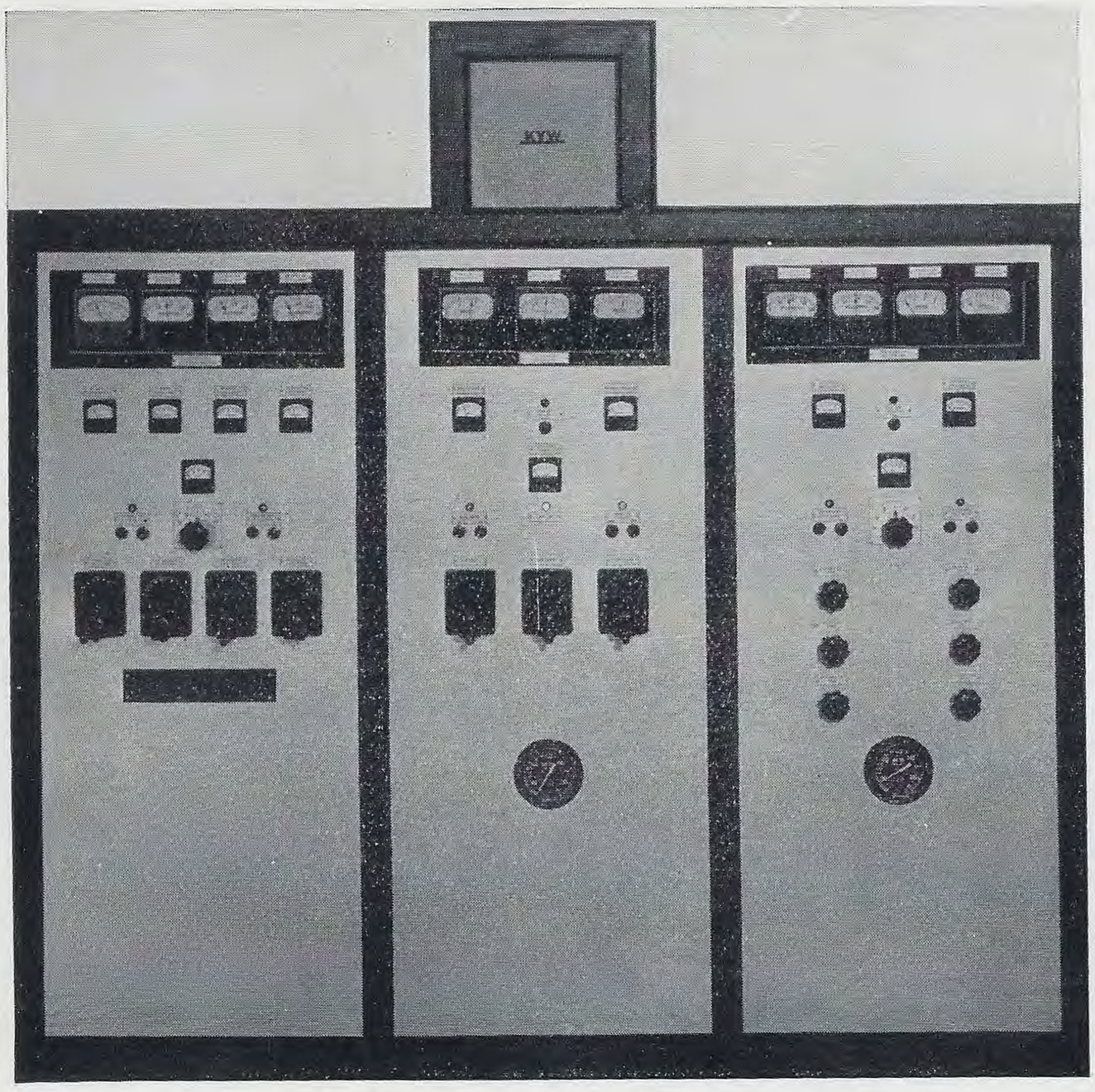


FIG. 9—TYPICAL ARRANGEMENT OF INSTRUMENTS ON A SECTION OF RADIO STATION K Y W TRANSMITTER PANEL.

MINIATURE PANEL INSTRUMENTS—Continued

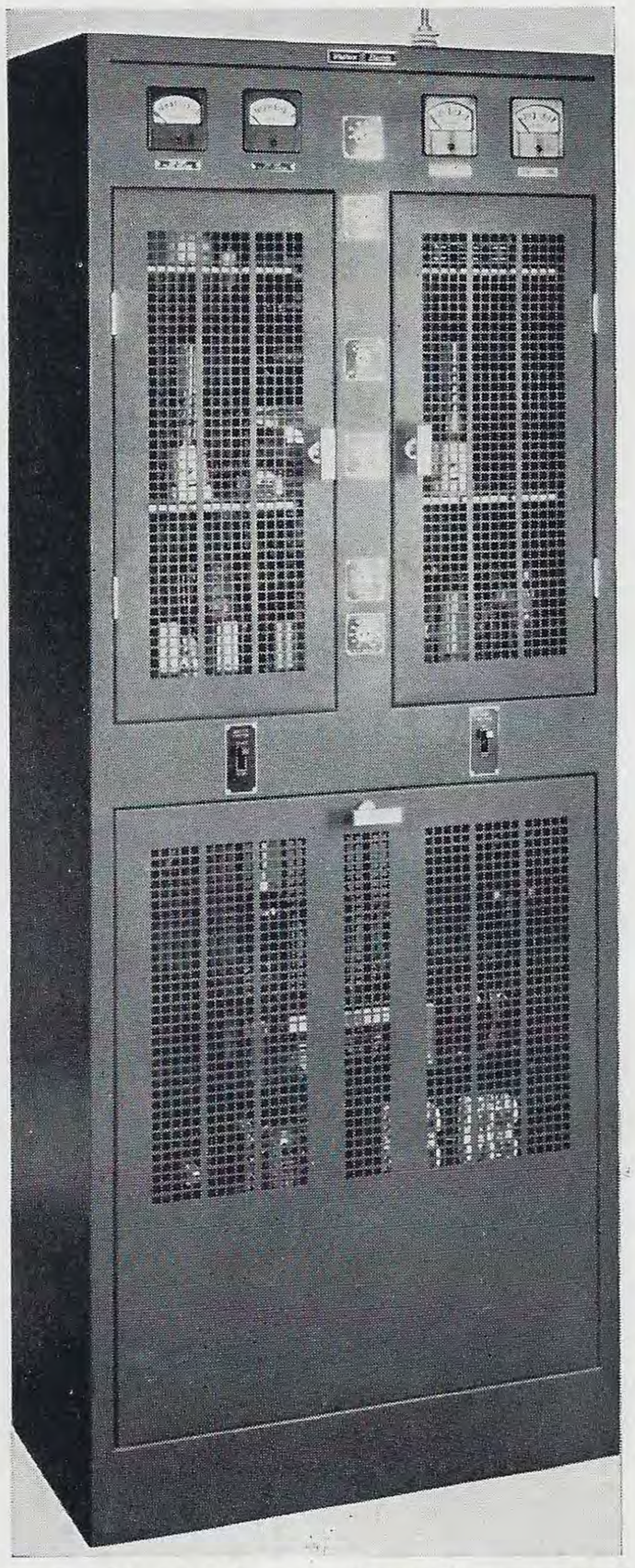


FIG. 10—TYPICAL MEDIUM CAPACITY RADIO TRANSMITTER EQUIPPED WITH WESTINGHOUSE RECTANGULAR INSTRUMENTS

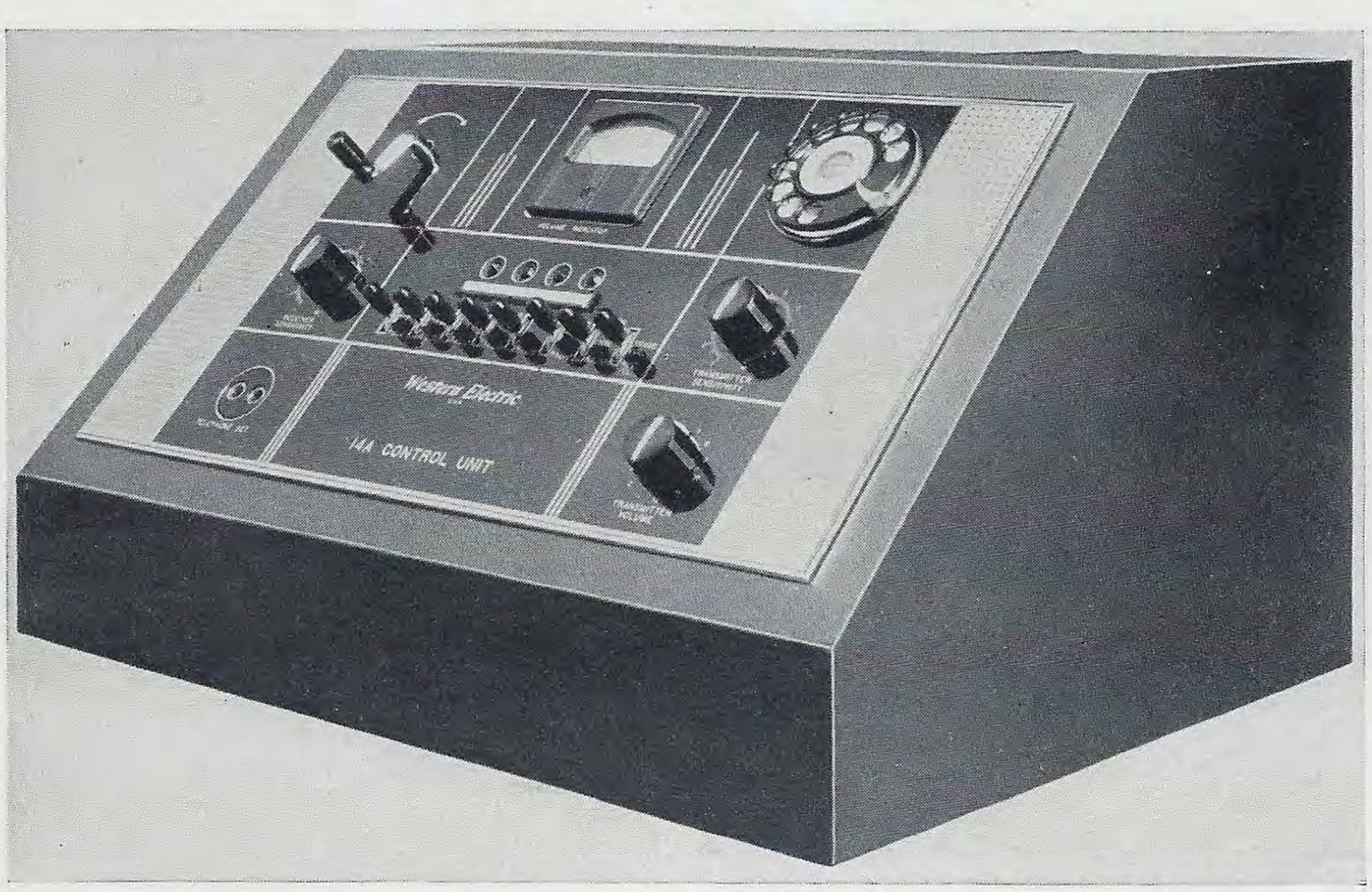


FIG. 11—REMOTE CONTROL CABINET EQUIPPED WITH WESTINGHOUSE RECTANGULAR INSTRUMENTS

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES

DIRECT CURRENT INSTRUMENTS
TYPES NX-35, VX-35, RX-35, UX-35

All instruments listed below are calibrated for use on non-magnetic panels. When ordering for use on steel panels, panel thickness must be specified.

D-C. AMMETERS
Calibrated for 50 M.V. External Shunts

Rating	Scale Div.	Approx. Resist.	NX-35 Style	VX-35 Style	RX-35 Style	UX-35 Style	List Price Discount Symbol AC
50 M.V.	**To suit	....	1 007 000	1 007 057	1 007 019	1 007 038	$ 9 00

** Above styles are for left zero. Center zero instruments are furnished at same price. Instrument may be calibrated for shunts from 5 to 20,000 amps. Above styles cover instrument and leads only.

D-C. AMMETERS
Self-Contained

1	50	....	1 007 002	1 007 059	1 007 021	1 007 040	9 00
1.5	75	....	1 007 003	1 007 060	1 007 022	1 007 041	9 00
2	40	....	1 007 004	1 007 061	1 007 023	1 007 042	9 00
3	60	....	1 007 006	1 007 063	1 007 025	1 007 044	9 00
4	40	....	1 007 007	1 007 064	1 007 026	1 007 045	9 00
5	50	....	1 007 008	1 007 065	1 007 027	1 007 046	9 00
8	40	....	1 007 010	1 007 067	1 007 029	1 007 048	9 00
10	50	....	1 007 011	1 007 068	1 007 030	1 007 049	9 00
15	75	....	1 007 012	1 007 069	1 007 031	1 007 050	9 00
20	40	....	1 007 013	1 007 070	1 007 032	1 007 051	9 00
30	60	....	1 007 015	1 007 072	1 007 034	1 007 053	9 00
50	50	....	1 007 017	1 007 074	1 007 036	1 007 055	9 00

Instruments in this group are shunted internally and have a drop of 50 milli-volts ±10%.

D-C. MILLI-AMMETERS
Self-Contained

1	50	57.2	1 007 076	1 007 110	1 007 087	1 007 098	10 00
1.5	75	38.6	1 007 077	1 007 111	1 007 088	1 007 099	10 00
2	40	15.1	1 007 078	1 007 112	1 007 089	1 007 100	10 00
3	60	10.4	1 007 080	1 007 114	1 007 091	1 007 103	10 00
5	50	3.7	1 007 082	1 007 115	1 007 093	1 007 105	9 00
10	50	2.1	1 007 085	1 007 119	1 007 096	1 007 108	9 00
15	75	1.5	1 007 086	1 007 120	1 007 097	1 007 109	9 00
20	40	....	1 007 121	1 007 172	1 007 138	1 007 155	9 00
25	50	....	1 007 122	1 007 173	1 007 139	1 007 156	9 00
30	60	....	1 007 123	1 007 174	1 007 140	1 007 157	9 00
50	50	....	1 007 125	1 007 176	1 007 142	1 007 159	9 00
100	50	....	1 007 128	1 007 179	1 007 145	1 007 162	9 00
150	75	....	1 007 129	1 007 180	1 007 146	1 007 163	9 00
200	40	....	1 007 130	1 007 181	1 007 147	1 007 164	9 00
250	50	....	1 007 131	1 007 182	1 007 148	1 007 165	9 00
300	60	....	1 007 132	1 007 183	1 007 149	1 007 166	9 00
500	50	....	1 007 134	1 007 185	1 007 151	1 007 168	9 00
800	40	....	1 007 136	1 007 187	1 007 153	1 007 170	9 00
1000	50	....	1 007 137	1 007 188	1 007 154	1 007 171	9 00

Milli-ammeters of ratings of 20 and above are shunted internally and have a drop of 50 M.V. ±10%. Center zero milli-ammeters are furnished at same prices.

D-C. MILLI-AMMETERS
Double Ranges, Three Terminals
Self-Contained

15–150*	75	....	1 007 189	1 007 195	1 007 191	1 007 193	14 00
30–150*	75	....	1 007 190	1 007 196	1 007 192	1 007 194	14 00

* Other ratings may be furnished on special order.

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

DIRECT CURRENT INSTRUMENTS—TYPES NX-35, VX-35, RX-35, UX-35—Continued

Rating	Scale Div.	Approx. Resist.	NX-35 Style	VX-35 Style	RX-35 Style	UX-35 Style	List Price Discount Symbol AC
			D-C. MICROAMMETERS* Self-Contained**				
20	40	2180	1 007 197	1 007 221	1 007 205	1 007 213	$26 00
50	50	426	1 007 201	1 007 225	1 007 209	1 007 217	23 50
80	40	183	1 007 203	1 007 227	1 007 211	1 007 219	23 50
100	50	71	1 007 204	1 007 228	1 007 212	1 007 220	21 00
150	75	340	1 007 229	1 007 252	1 007 237	1 007 101	18 00
200	40	154	1 007 230	1 007 253	1 007 238	1 007 245	16 50
250	50	121	1 007 231	1 007 254	1 007 239	1 007 246	16 50
300	60	154	1 007 232	1 007 255	1 007 240	1 007 247	16 50
400	40	97	1 007 233	1 007 256	1 007 241	1 007 248	16 50
500	50	110	1 007 234	1 007 257	1 007 242	1 007 249	16 50
600	60	93	1 007 235	1 007 258	1 007 243	1 007 250	16 50
800	40	61	1 007 236	1 007 259	1 007 244	1 007 251	16 50

*** Microammeters below 500 microamperes depend upon the external circuit for damping. Ratings of 100 and lower have cobalt magnets.

D-C. VOLTMETERS
Self-Contained
Resistance 200 Ohms per Volt
Single Range

1	50	....	1 007 261	1 007 327	1 007 283	1 007 305	9 00
1.5	75	....	1 007 262	1 007 328	1 007 284	1 007 306	9 00
2	40	....	1 007 263	1 007 329	1 007 285	1 007 307	9 00
3	60	....	1 007 265	1 007 331	1 007 287	1 007 309	9 00
5	50	....	1 007 267	1 007 333	1 007 289	1 007 311	9 00
8	40	....	1 007 269	1 007 335	1 007 291	1 007 313	9 00
10	50	....	1 007 270	1 007 336	1 007 292	1 007 314	9 00
15	75	....	1 007 271	1 007 337	1 007 293	1 007 315	9 00
20	40	....	1 007 272	1 007 338	1 007 294	1 007 316	9 00
25	50	....	1 007 273	1 007 339	1 007 295	1 007 317	9 00
30	60	....	1 007 274	1 007 340	1 007 296	1 007 318	9 00
50	50	....	1 007 276	1 007 342	1 007 298	1 007 320	9 00
80	40	....	1 007 278	1 007 344	1 007 300	1 007 322	9 00
100	50	....	1 007 279	1 007 345	1 007 301	1 007 323	10 00
150	75	....	1 007 280	1 007 346	1 007 302	1 007 324	11 25
200	40	....	1 007 281	1 007 347	1 007 303	1 007 325	13 00

FOR HIGHER RATINGS SEE TABLE FOLLOWING

D-C. VOLTMETERS
Resistance 1000 Ohms per Volt
Single Range

1	50	....	1 007 400	1 007 463	1 007 421	1 007 442	12 00
1.5	75	....	1 007 401	1 007 464	1 007 422	1 007 443	12 00
2	40	....	1 007 402	1 007 465	1 007 423	1 007 444	12 00
3	60	....	1 007 404	1 007 467	1 007 425	1 007 446	12 00
5	50	....	1 007 406	1 007 469	1 007 427	1 007 448	12 00
8	40	....	1 007 408	1 007 471	1 007 429	1 007 450	12 00
10	50	....	1 007 409	1 007 472	1 007 430	1 007 451	12 00
15	75	....	1 007 410	1 007 473	1 007 431	1 007 452	12 00
20	40	....	1 007 411	1 007 474	1 007 432	1 007 453	12 00
25	50	....	1 007 412	1 007 475	1 007 433	1 007 454	12 00
30	60	....	1 007 413	1 007 476	1 007 434	1 007 455	12 00
50	50	....	1 007 415	1 007 478	1 007 436	1 007 457	12 00
80	40	....	1 007 417	1 007 480	1 007 438	1 007 459	12 00
100	50	....	1 007 418	1 007 481	1 007 439	1 007 460	12 50
150	75	....	1 007 419	1 007 482	1 007 440	1 007 461	13 25
200	40	....	1 007 420	1 007 483	1 007 441	1 007 462	14 00
250*	50	....	1 007 484	1 007 520	1 007 496	1 007 508	14 50
300*	60	....	1 007 485	1 007 521	1 007 497	1 007 509	15 00
500*	50	....	1 007 487	1 007 523	1 007 499	1 007 511	17 25
800*	40	....	1 007 489	1 007 525	1 007 501	1 007 513	19 25
1000*	50	....	1 007 490	1 007 526	1 007 502	1 007 514	21 00
1500*	75	....	1 007 491	1 007 527	1 007 503	1 007 515	36 50
2000*	40	....	1 007 492	1 007 528	1 007 504	1 007 516	45 00
2500*	50	....	1 007 493	1 007 529	1 007 505	1 007 517	53 00
3000*	60	....	1 007 494	1 007 530	1 007 506	1 007 518	61 00
5000*	50	....	1 007 495	1 007 531	1 007 507	1 007 519	93 00

* Supplied with external resistor. The instruments are self-contained for 150 volts (150,000 ohms). The balance of the resistance is external.

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

DIRECT CURRENT INSTRUMENTS—TYPES NX-35, VX-35, RX-35, UX-35—Continued

D-C. VOLTMETERS
Resistance 1000 Ohms Per Volt
Double Range, Three Terminal, Self-Contained

Rating	Scale Div.	F.S. Burden V.A. @ 60 Cycles	NX-35 Style	VX-35 Style	RX-35 Style	UX-35 Style	List Price Discount Symbol AC
8–200	40	....	1 007 532	1 007 541	1 007 535	1 007 538	$15 00
30–150	75	....	1 007 533	1 007 542	1 007 536	1 007 539	15 00
50–250	50	....	1 007 534	1 007 543	1 007 537	1 007 540	15 00

D-C. VOLTMETERS*
Resistance 1000 Ohms Per Volt
Four Range
Two Terminal

5–25 100–500*	50	....	1 007 544	1 007 550	1 007 546	1 007 548	19 25
10–50 250–1000*	50	....	1 007 545	1 007 551	1 007 547	1 007 549	25 00

* Supplied with external resistor. self-contained for lowest range.

D-C. MILLIVOLTMETERS
Self-Contained

5‡	50	15.	1 007 584	1 007 593	1 007 587	1 007 590	23 00
6‡	60	14.	1 007 585	1 007 594	1 007 588	1 007 591	23 50
8‡	40	13.	1 007 586	1 007 595	1 007 589	1 007 592	23 50
10	50	3.7	1 007 596	1 007 623	1 007 605	1 007 614	21 00
15	75	5.5	1 007 597	1 007 624	1 007 606	1 007 615	21 00
20	40	6.	1 007 598	1 007 625	1 007 607	1 007 616	21 00
25	50	4.6	1 007 599	1 007 626	1 007 608	1 007 617	21 00
30	60	5.5	1 007 600	1 007 627	1 007 609	1 007 618	21 00
40	40	5.6	1 007 601	1 007 628	1 007 610	1 007 619	21 00
50	50	3.4	1 007 602	1 007 629	1 007 611	1 007 620	21 00
100	50	6.9	1 007 603	1 007 630	1 007 612	1 007 621	21 00
500	50	34.5	1 007 604	1 007 631	1 007 613	1 007 622	18 00

‡ Ratings of 8 millivolts and lower have cobalt magnets.

D-C. VOLT-OHMMETERS
Three Terminal

Volts	Ohms	NX-35 Style	VX-35 Style	RX-35 Style	UX-35 Style	List Price Discount Symbol AC
1.5	1000*	1 007 553	1 007 577	1 007 561	1 007 569	$10 50
1.5	3000*	1 007 554	1 007 578	1 007 562	1 007 570	10 50
4.5	10000*	1 007 555	1 007 579	1 007 563	1 007 571	10 50
4.5	30000*	1 007 556	1 007 580	1 007 564	1 007 572	11 50
4.5	100,000*	1 007 557	1 007 581	1 007 565	1 007 573	13 50
15	500,000*	1 007 558	1 007 582	1 007 566	1 007 574	13 50
90	2,000,000*	1 007 559	1 007 583	1 007 567	1 007 575	15 00

* Ohmmeters require an external D.C. source for operation. The voltage should be equal to the voltage rating of the particular instrument.

PORTABLE HOUSING†

For Types NX-35, NC-35, NT-35 and NA-35 Instruments

Description	Style	List Price Discount Symbol AC
2 Terminals	837 456	$2 00
3 Terminals	837 457	2 50
4 Terminals	837 458	2 75

† This is a compact mounting fixture which mounts one Type NX-35, NC-35, NT-35 or NA-35 instrument. It adapts the instrument to use on work bench, table, or desk as a utility portable. See Figures 7 and 8.

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

RECTOX INSTRUMENTS
TYPES NC-35, VC-35, RC-35, UC-35

All instruments listed below are calibrated for use on non-magnetic panels. When ordering for use on steel panels, panel thickness must be specified.

Rating	Scale Div.	NC-35 Style	VC-35 Style	RC-35 Style	UC-35 Style	List Price Discount Symbol A.C.
RECTOX MILLIAMMETERS Self-Contained						
1	50	1 007 732	1 007 747	1 007 737	1 007 742	$15 00
2	40	1 007 733	1 007 748	1 007 738	1 007 743	15 00
5	50	1 007 734	1 007 749	1 007 739	1 007 744	14 00
10	50	1 007 735	1 007 750	1 007 740	1 007 745	14 00
15	75	1 007 736	1 007 751	1 007 741	1 007 746	14 00
RECTOX MICROAMMETERS Self-Contained						
80†	40	1 007 720	1 007 729	1 007 723	1 007 726	30 00
200	40	1 007 721	1 007 730	1 007 724	1 007 727	19 25
500	50	1 007 722	1 007 731	1 007 725	1 007 728	19 25
RECTOX VOLTMETERS※ Resistance 1000 Ohms Per Volt Single Range, Self-Contained						
4※	40	1 007 760	1 007 784	1 007 768	1 007 776	17 00
5	50	1 007 761	1 007 785	1 007 769	1 007 777	17 00
10	50	1 007 762	1 007 786	1 007 770	1 007 778	17 00
50	50	1 007 764	1 007 788	1 007 772	1 007 780	17 00
100	50	1 007 765	1 007 789	1 007 773	1 007 781	17 50
150	75	1 007 766	1 007 790	1 007 774	1 007 782	19 00
300	60	1 007 767	1 007 791	1 007 775	1 007 783	20 00
RECTOX VOLTMETERS※ Resistance 1000 Ohms Per Volt Multi-Range, Two Terminal						
5–10 / 200–1000*※	50	1 007 552	1 007 576	1 007 560	1 007 568	30 00
RECTOX VOLTMETERS Resistance 2000 Ohms Per Volt Self-Contained						
1	50					
1.5	75	1 007 792	1 007 825	1 007 803	1 007 814	19 25
2	40	1 007 793	1 007 826	1 007 804	1 007 815	19 25
2.5	50	1 007 794	1 007 827	1 007 805	1 007 816	19 25
3	60	1 007 795	1 007 828	1 007 806	1 007 817	19 25
5	50	1 007 796	1 007 829	1 007 807	1 007 818	19 25
10	50	1 007 797	1 007 830	1 007 808	1 007 819	19 25
15	75	1 007 798	1 007 831	1 007 809	1 007 820	19 25
50	50	1 007 799	1 007 832	1 007 810	1 007 821	19 75
100	50	1 007 800	1 007 833	1 007 811	1 007 822	21 50
150	75	1 007 801	1 007 834	1 007 812	1 007 823	21 50
300	60	1 007 802	1 007 835	1 007 813	1 007 824	23 00
RECTOX VOLTMETERS Resistance 5000 Ohms Per Volt Self-Contained						
0.5	50	1 007 836	1 007 842	1 007 838	1 007 840	19 25
1	50	1 007 837	1 007 843	1 007 839	1 007 841	19 25

† This range has expanded lower scale and is particularly suited for use as an A.C. Galvanometer.

※ Below 4 volts Rectox Voltmeters should have a resistance of 2000 or 5000 ohms per volt.

*External resistor is used, low range is self-contained.
※Below 4 volts, Rectox Voltmeters should have a resistance of 2000 or 5000 ohms per volt.

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

RADIO FREQUENCY INSTRUMENTS
TYPES NT-35, VT-35, RT-35, UT-35

All instruments listed below are calibrated for use on non-magnetic panels. When ordering for use on steel panels, panel thickness must be specified.

Rating	NT-35 Style	VT-35 Style	RT-35 Style	UT-35 Style	List Price Discount Symbol AC
		RADIO FREQUENCY AMMETERS†			
		Self-Contained			
1	1 007 636	1 007 672	1 007 648	1 007 660	$16 00
1.5	1 007 637	1 007 673	1 007 649	1 007 661	16 00
2	1 007 638	1 007 674	1 007 650	1 007 662	16 00
2.5	1 007 639	1 007 675	1 007 651	1 007 663	16 00
3	1 007 640	1 007 676	1 007 652	1 007 664	16 00
4	1 007 641	1 007 677	1 007 653	1 007 665	16 00
5	1 007 642	1 007 678	1 007 654	1 007 666	16 00
6	1 007 643	1 007 679	1 007 655	1 007 667	16 00
8	1 007 644	1 007 680	1 007 656	1 007 668	16 00
10	1 007 645	1 007 681	1 007 657	1 007 669	16 00
15	1 077 646	1 007 682	1 007 658	1 007 670	16 00
20	1 007 647	1 007 683	1 007 659	1 007 671	16 00
		RADIO FREQUENCY MILLIAMMETERS†			
		Self-Contained			
100	1 007 684	1 007 711	1 007 693	1 007 702	18 00
150	1 007 685	1 007 712	1 007 694	1 007 703	18 00
200	1 007 686	1 007 713	1 007 695	1 007 704	18 00
250	1 007 687	1 007 714	1 007 696	1 007 705	18 00
300	1 007 688	1 007 715	1 007 697	1 007 706	18 00
400	1 007 689	1 007 716	1 007 698	1 007 707	18 00
500	1 007 690	1 007 717	1 007 699	1 007 708	18 00
600	1 007 691	1 007 718	1 007 700	1 007 709	16 00
800	1 007 692	1 007 719	1 007 701	1 007 710	16 00

† Standard Radio Frequency instruments are suitable for frequencies up to and including six megacycles. Low loss instruments are furnished in all self-contained ratings at $5.00 additional list.

		RADIO FREQUENCY AMMETER			
		Calibrated for Use with External Thermocouple			
*To Suit Thermo-couple	1 007 632	1 007 635	1 007 633	1 007 634	10 00

* List price includes the ammeter calibrated with four foot leads, but not the thermocouple. Radio-frequency ammeters are available with external thermocouples in all ranges from 1 to 50 amperes, inclusive. When long leads are used between the instrument and the thermocouple, it is usually necessary to place proper by-pass condensers and radio-frequency chokes in the circuit at the thermocouple to prevent damage to the thermocouple by radio-frequency in the instrument leads. Additional information on this subject will be furnished on request.

EXTERNAL THERMOCOUPLES
For Radio Frequency Ammeters
Air Type

Rating	Style	List Price Discount Symbol AC
1	878 638	$12 00
1.5	878 639	12 00
2	878 640	12 00
2.5	878 641	12 00
3	878 642	12 00
4	878 643	12 00
5	878 644	12 00
6	878 645	12 00
8	878 646	12 00
10	878 647	12 00
15	878 648	12 00
20	878 649	12 00
25	878 650	12 00
30	878 651	14 50
35	878 652	14 50
40	878 653	14 50
50	878 654	14 50

External thermocouples may be used with radio-frequency ammeters designed for the purpose and listed with the various types of instruments. Each instrument and thermocouple must be calibrated together.

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

ALTERNATING CURRENT INSTRUMENTS
TYPES NA-35, VA-35, RA-35, UA-35

All instruments listed below are calibrated for use on non-magnetic panels. When ordering for use on steel panels, panel thickness must be specified.

Rating	Scale Div.	F.S. Burden V.A. @ 60 Cy.	NA-35 Style	VA-35 Style	RA-35 Style	UA-35 Style	List Price Discount Symbol AC
A-C. AMMETERS Self-Contained For Frequencies of 15 to 500 Cycles							
1	50	.17	1 007 994	1 006 993	1 006 979	1 006 986	$ 9 00
2.5	50	.25	1 007 995	1 006 994	1 006 980	1 006 987	9 00
5	50	.25	1 007 996	1 006 995	1 006 981	1 006 988	9 00
10	50	.50	1 007 997	1 006 996	1 006 982	1 006 989	9 00
15	75	.50	1 007 998	1 006 997	1 006 983	1 006 990	9 00
25	50	.65	1 007 999	1 006 998	1 006 984	1 006 991	9 00
50	50	.75	1 006 978	1 006 999	1 006 985	1 006 992	9 00
A-C. MILLIAMMETERS Self-Contained For Frequencies of 15 to 500 Cycles							
5	50	.17	1 007 844	1 007 986	1 007 852	1 007 860	10 00
10	50	.17	1 007 845	1 007 987	1 007 853	1 007 979	9 00
15	75	.15	1 007 846	1 007 988	1 007 854	1 007 980	9 00
25	50	.14	1 007 847	1 007 989	1 007 855	1 007 981	9 00
50	50	.14	1 007 848	1 007 990	1 007 856	1 007 982	9 00
100	50	.15	1 007 849	1 007 991	1 007 857	1 007 983	9 00
250	50	.17	1 007 850	1 007 992	1 007 858	1 007 984	9 00
500	50	.17	1 007 851	1 007 993	1 007 859	1 007 985	9 00
A-C. VOLTMETERS Single Range For Frequencies of 25-200 Cycles*							
1.5	75	.75	1 007 899	1 007 950	1 007 916	1 007 933	9 00
2	40	1.	1 007 900	1 007 951	1 007 917	1 007 934	9 00
3	60	.75	1 007 901	1 007 952	1 007 918	1 007 935	9 00
5	50	1.25	1 007 902	1 007 953	1 007 919	1 007 936	9 00
10	50	1.	1 007 904	1 007 955	1 007 921	1 007 938	9 00
15	75	1.5	1 007 905	1 007 956	1 007 922	1 007 939	9 00
25	50	1.25	1 007 906	1 007 957	1 007 923	1 007 940	9 00
50	50	1.25	1 007 907	1 007 958	1 007 924	1 007 941	9 00
75	75	1.12	1 007 908	1 007 959	1 007 925	1 007 942	9 00
150	75	1.50	1 007 909	1 007 960	1 007 926	1 007 943	11 25
250	50	1.25	1 007 910	1 007 961	1 007 927	1 007 944	14 50
350	70	1.75	1 007 911	1 007 962	1 007 928	1 007 945	17 50
500	50	2.50	1 007 912	1 007 963	1 007 929	1 007 946	19 50
600†	60	3.00	1 007 913	1 007 964	1 007 930	1 007 947	21 50
750†	75	3.75	1 007 914	1 007 965	1 007 931	1 007 948	23 50
1000†	50	5.00	1 007 915	1 007 966	1 007 932	1 007 949	28 00

† Self-contained up to and including 500 volts. Higher ratings have external resistors.
* Voltmeters for use on frequencies of 200-600 cycles can be furnished at same prices.

A-C. VOLTMETERS Triple Range Self Contained—Four Terminal							
4–8–150	40–75	....	1 007 967	1 007 976	1 007 970	1 007 973	15 50
3–15–150	60–75	....	1 007 968	1 007 977	1 007 971	1 007 974	15 50
4–8–300	40–60	....	1 007 969	1 007 978	1 007 972	1 007 975	17 50

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

Round Forms

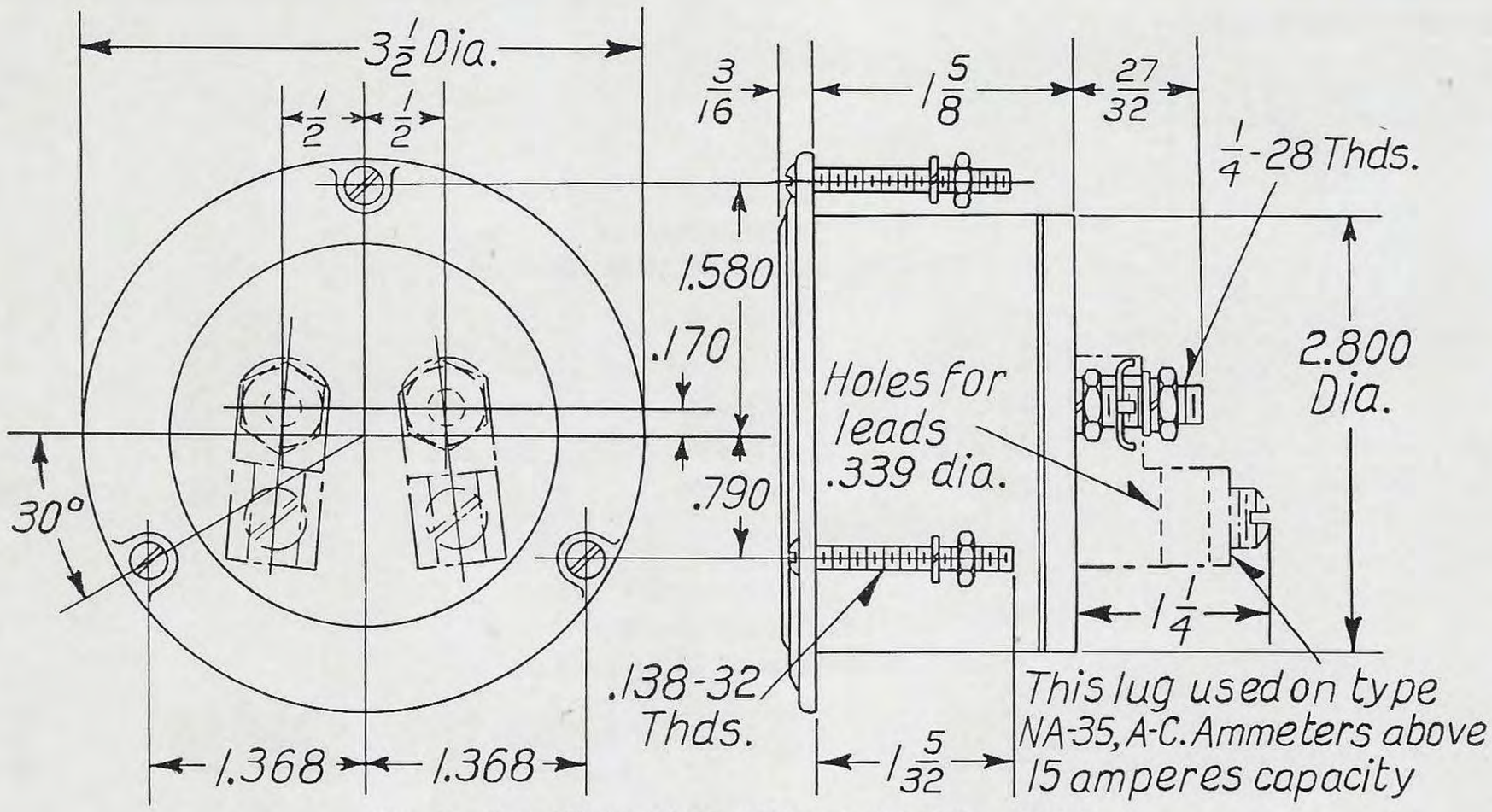


FIG. 12—TYPE NX-35, NC-35, NT-35 AND NA-35 INSTRUMENTS

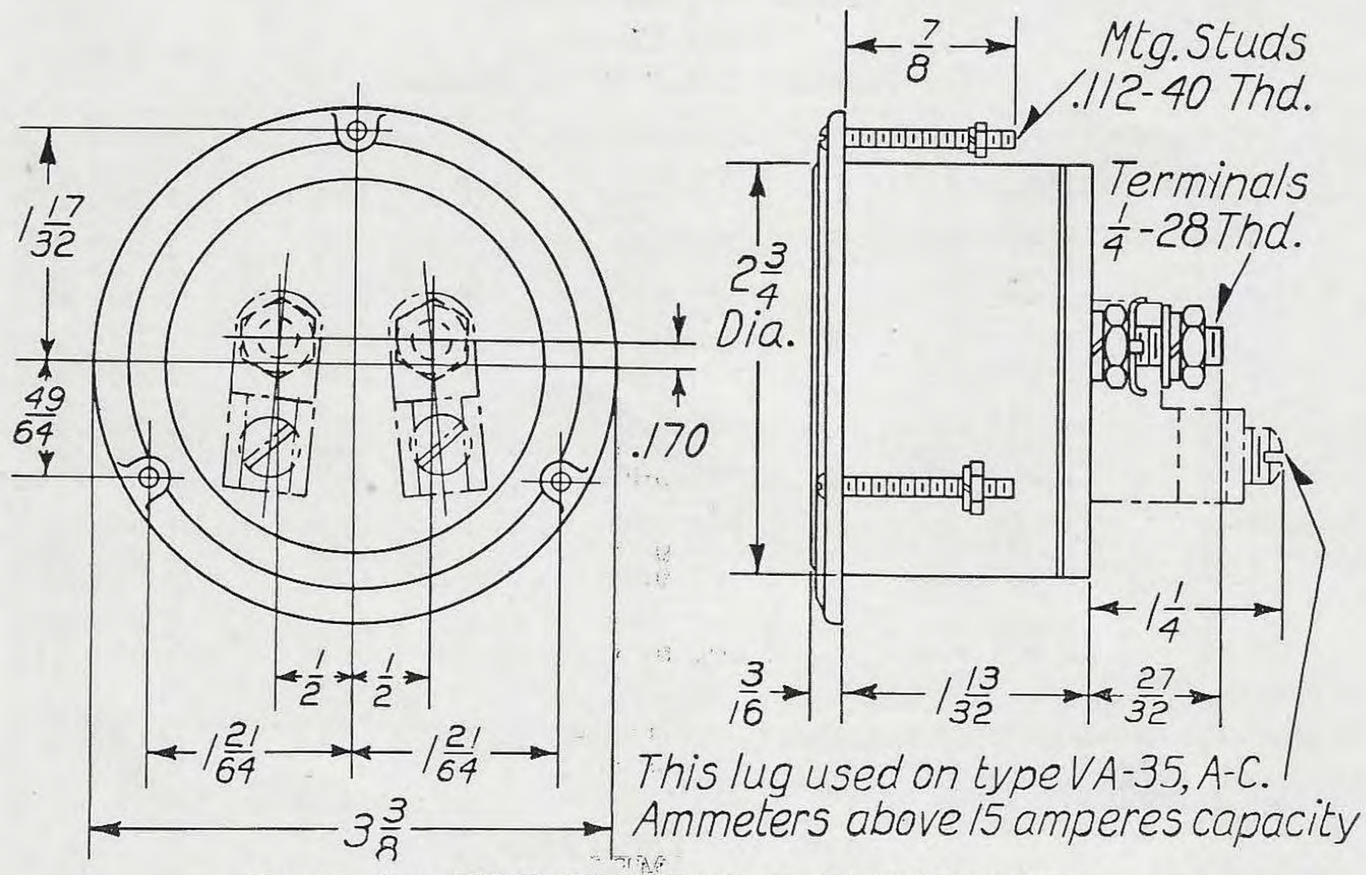


FIG. 13—TYPE VX-35, VC-35, VT-35 AND VA-35 INSTRUMENTS

Note—These outlines are approximately one-half actual size.

MINIATURE PANEL INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

Rectangular Forms

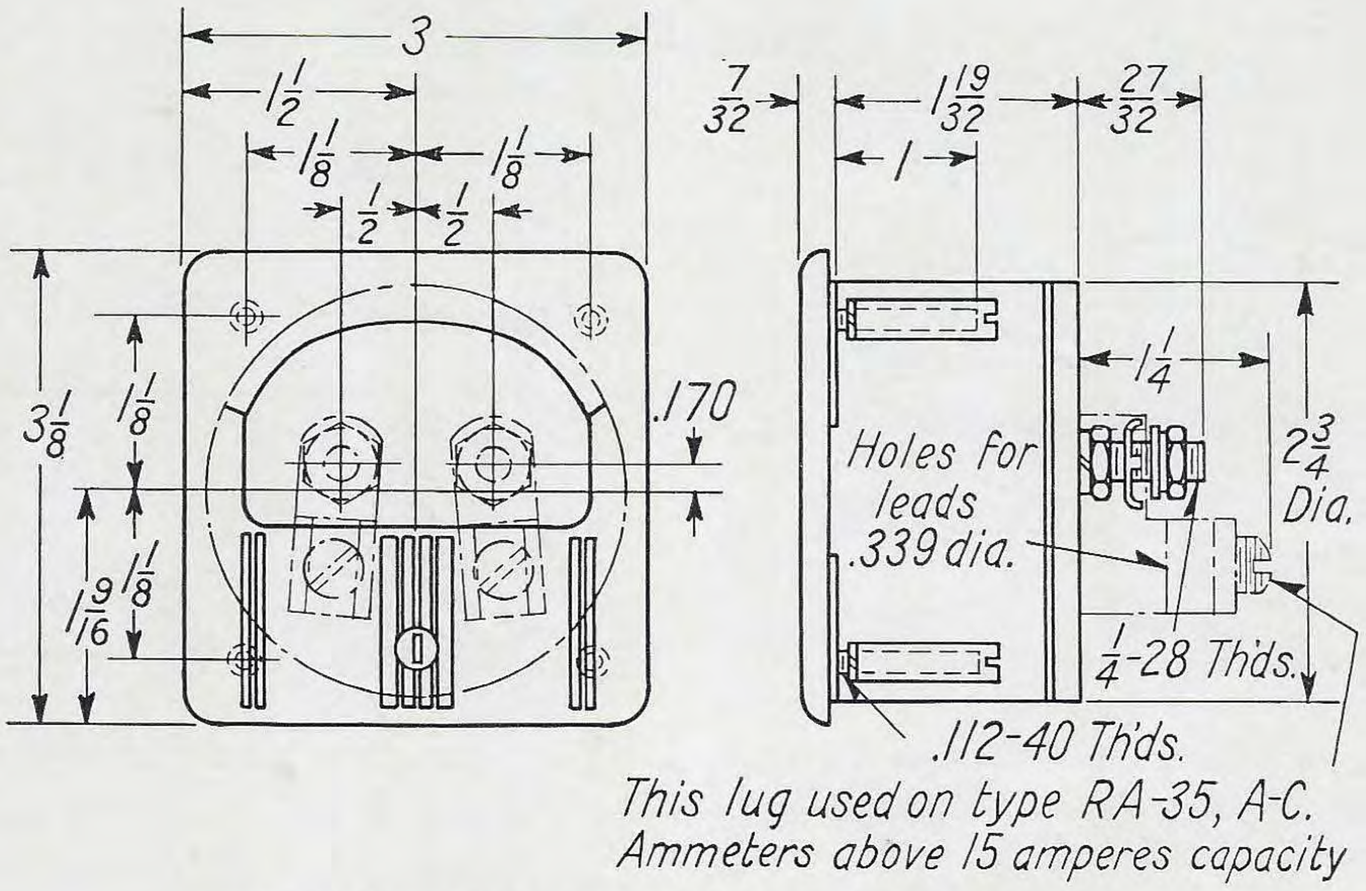


FIG. 14—TYPE RX-35, RC-35, RT-35 AND RA-35 INSTRUMENTS

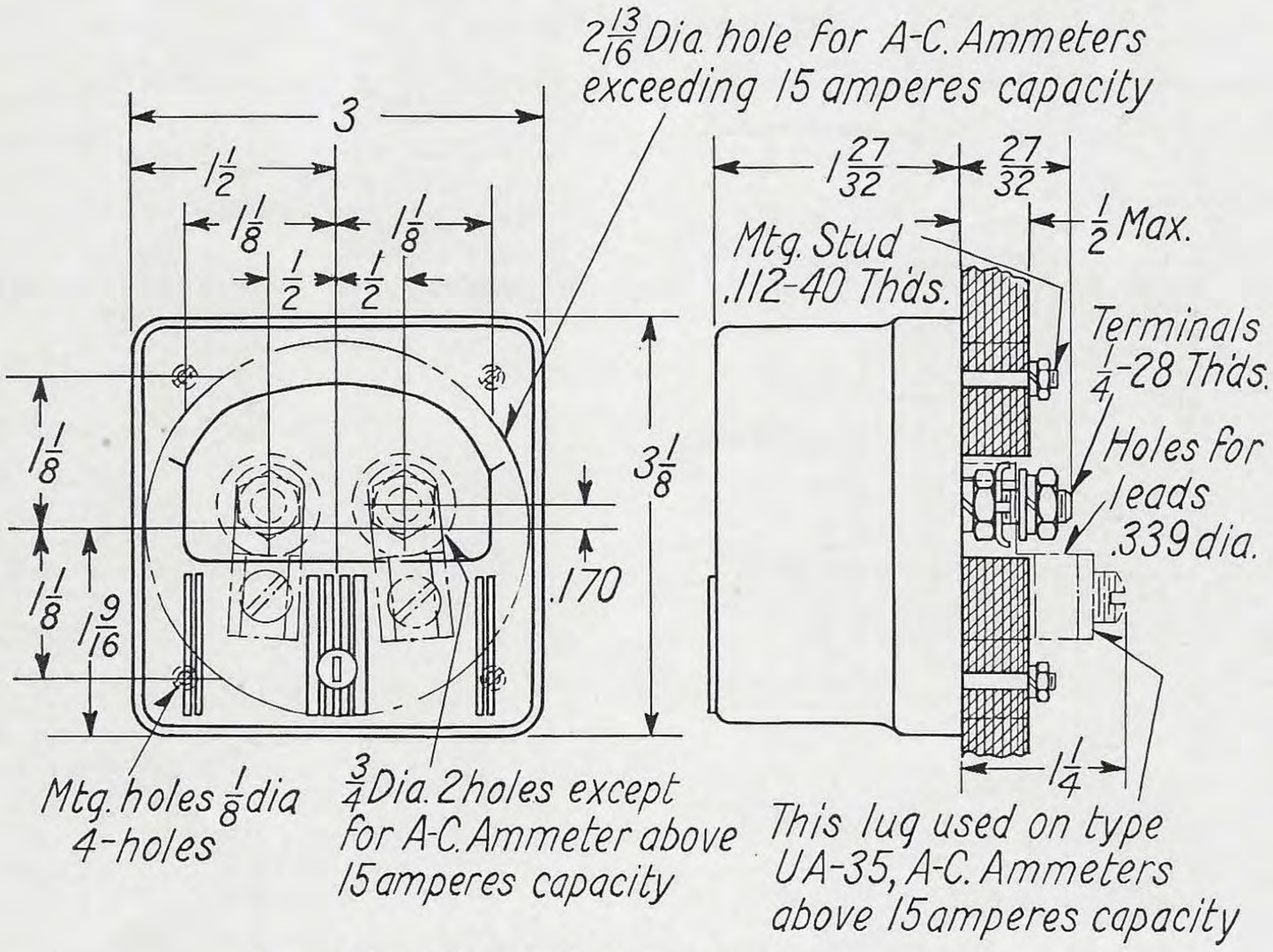


FIG. 15—TYPE UX-35, UC-35, UT-35 AND UA-35 INSTRUMENTS

Note—These outlines are approximately one-half actual size.

MINIATURE PANEL INSTRUMENTS—Continued

DRILLING PLANS

Dimensions in Inches

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

Round Forms

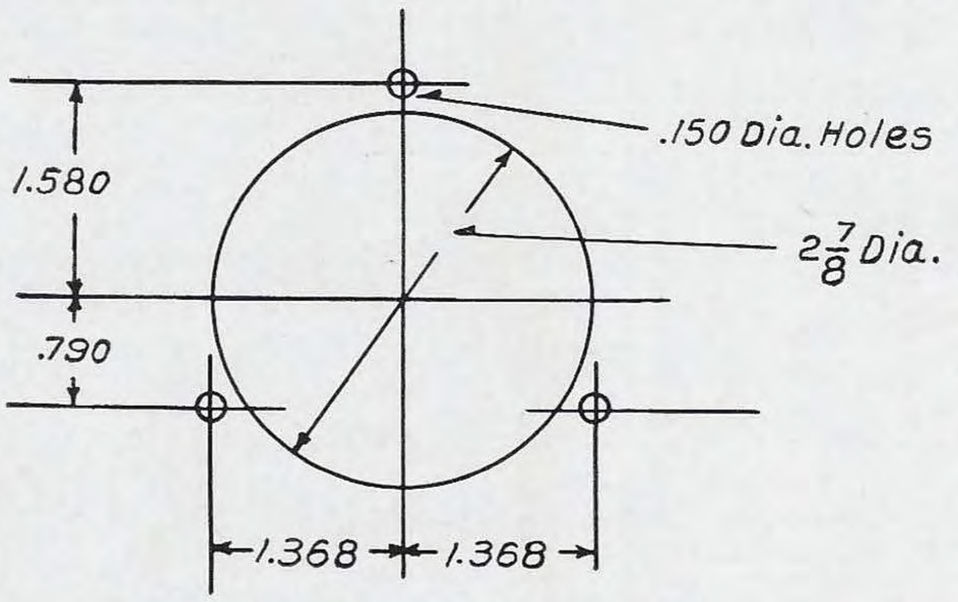


FIG. 16—TYPE NX-35, NC-35, NT-35 AND NA-35 INSTRUMENTS

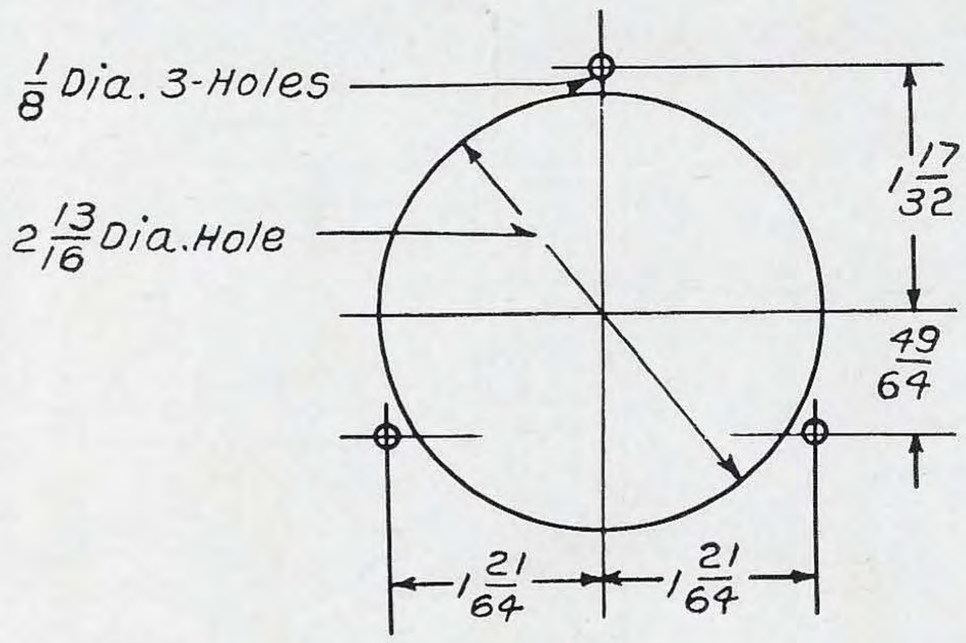


FIG. 17—TYPE VX-35, VC-35, VT-35 AND VA-35 INSTRUMENTS

Rectangular Forms

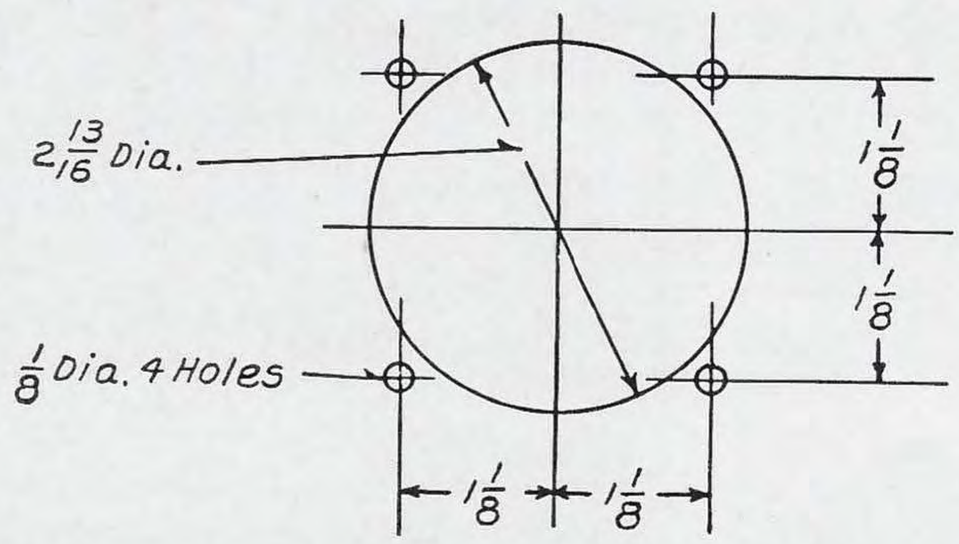


FIG. 18—TYPE RX-35, RC-35, RT-35 AND RA-35 INSTRUMENTS

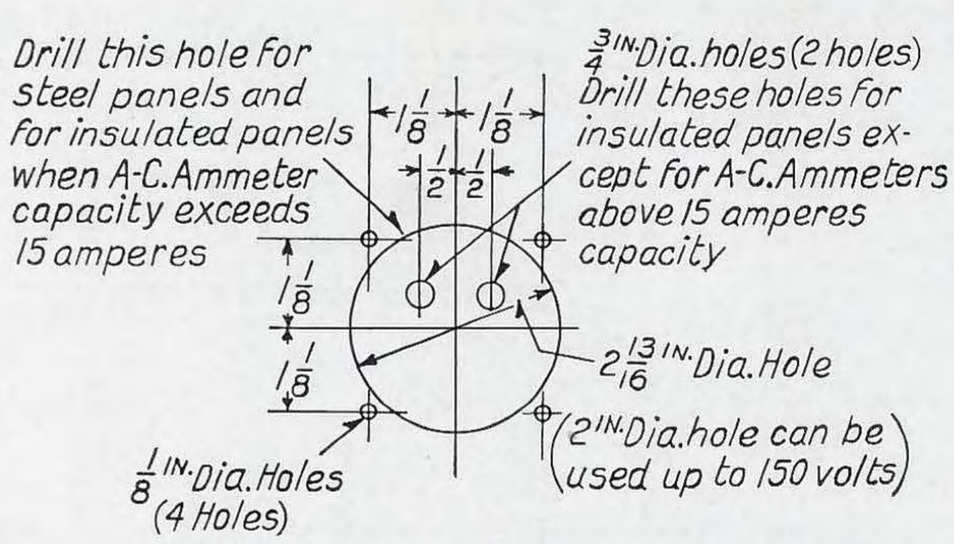


FIG. 19—TYPE UX-35, UC-35, UT-35 AND UA-35 INSTRUMENTS

MINIATURE PANEL INSTRUMENTS—Continued

EXTERNAL WIRING DIAGRAMS

(As seen from the rear of the instrument)

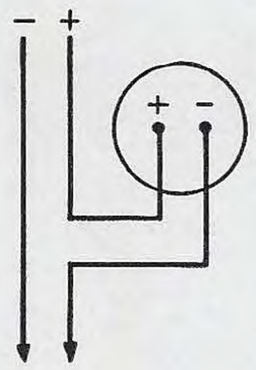


Fig. A – D-C. Ammeter & Milliammeter Self Contained

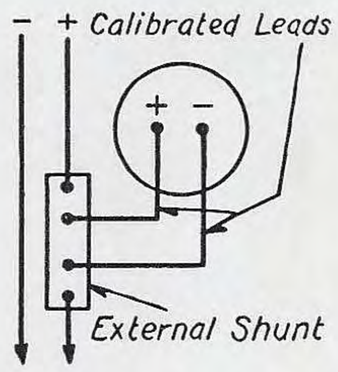


Fig. B – D-C. Ammeter with External Shunt

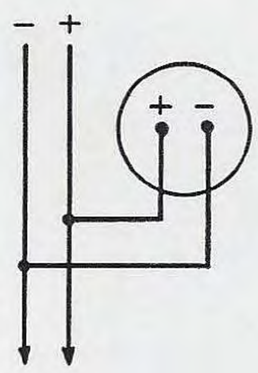


Fig. C – D-C. Voltmeter Self Contained. For Rectox Voltmeter Omit Polarity Signs

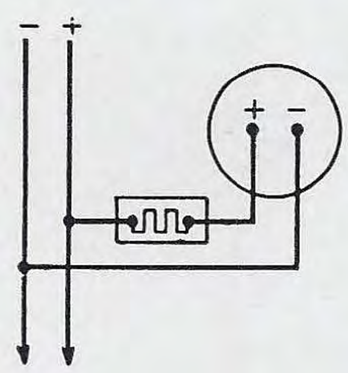


Fig. D – D-C. Voltmeter with External Resistor

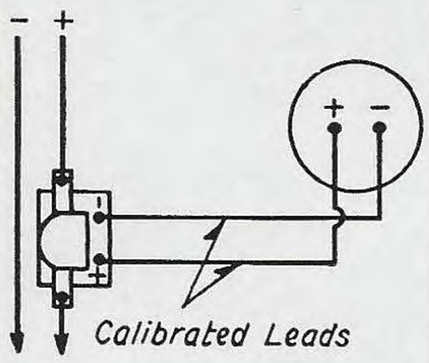


Fig. E – R.F. Ammeter with External Thermo-couple

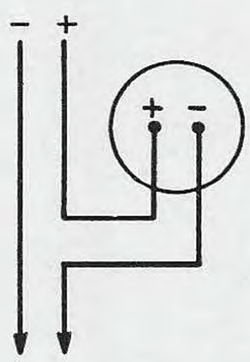


Fig. F – R.F. Ammeter, Self Contained, or Rectox Milliammeter

FIG. 20—DIRECT CURRENT, RECTOX AND RADIO FREQUENCY INSTRUMENTS

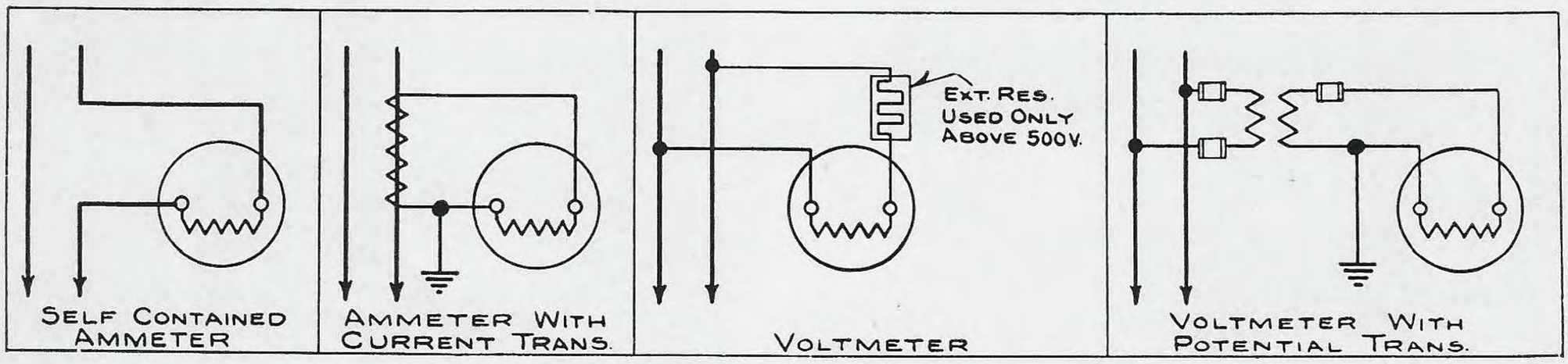


FIG. 21—ALTERNATING CURRENT INSTRUMENTS

For official diagrams and CIRCUIT PRECAUTIONS see the instruction leaflet packed with the instrument.

Printed in U.S.A.

Supersedes
Catalog Section 43-343
Dated June 10, 1935

MINIATURE PANEL INSTRUMENTS

THREE-INCH CLASSIFICATION

Total Hour Meters
Types NH-35, VH-35, RH-35, UH-35

FIG. 1—TYPE NH-35 TOTAL HOUR METER

DATA

Types	NH-35	VH-35	RH-35	UH-35
Case Form	Round	Round	Rectangular	Rectangular
Mounting	Flush	Flush	Flush	Projection
Case Material	Moldarta	Moldarta	Moldarta	Moldarta
Body Diameter	2.8"	2¾"	2¾"	3" x 3⅛"
Front Flange	3½"	3⅜"	3" x 3⅛"	3" x 3⅛"
Insulation Rating	750-V.	750-V.	750-V.	750-V.
*Net Weight	7 oz.	7 oz.	8 oz.	10 oz.

* Weights are approximate and do not include resistors and transformers.

General

The Total Hour Meter is a time integrating device which indicates total hours of operation of the circuit or device to which it is connected. It is driven by an improved hysteresis type synchronous motor which operates the Total Hour indicating dial through a form cut gear train. It is available in any of the case forms of the 35 line of miniature panel instruments which provides for round flush, rectangular flush and rectangular projection mounting.

Elapsed time indications are given in hours and tenths of hours. A five dial counter is used hence indication, in tenths of hours, up to 9999.9 hours are consecutive after which the counter repeats. The tenth hour dial is useful in measuring short time intervals. It also provides a means of verifying that the total hour meter is cunnected to the supply circuit of the apparatus under observation. The motion of the pointer on this dial is readily observed when the motor is running.

Application

The Westinghouse Total Hour Meter may be conveniently employed in application requiring an automatic device for indicating total time of operation. Some of these applications are:

Radio Transmitters
Radio Tubes
Radio Beacons
Airport Lighting
Electrical Appliances
Electrical Signs
Processing Ovens
Time Study
Test Racks
Production Machines
Motors and Blowers
Refrigerators
Oil Burner Tests
Welders
Textile Machinery
Paper Machinery

The use of a small and highly efficient hysteresis motor permits of building the total hour meter in standard X-35 cases. This results in a compact shallow case requiring a minimum of space and utilizing a standard panel drilling.

Construction

The hysteresis motor, gear train and dial assemblies of the total hour meter are shown in Fig. 4. The motor is a true high torque synchronous motor having 12 poles and operating at 600 rpm. on 60 cycles. The compactness of the total hour meter is due to this small and efficient motor.

Gears used in the gear train are machine cut and bearings are of the highest grade to insure frictionless operation over long periods of service.

Westinghouse Electric & Manufacturing Company
Newark Works, Newark, N. J.

Reprint (1-38)
Printed in U.S.A.

EVERY HOUSE NEEDS WESTINGHOUSE

MINIATURE PANEL INSTRUMENTS—TOTAL HOUR METERS—Continued

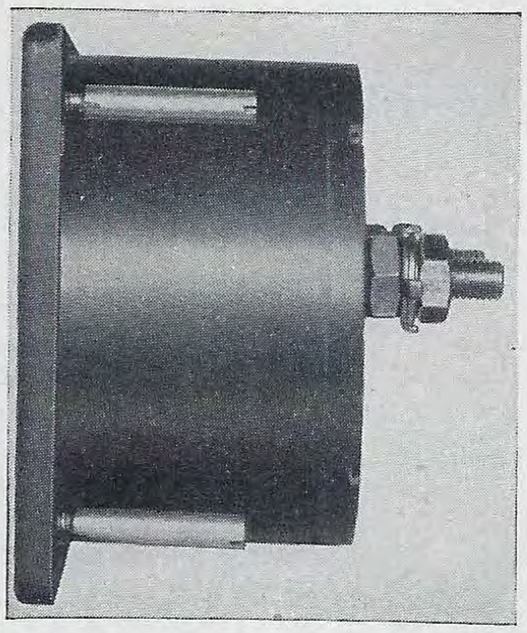


FIG. 3—CASE FORM OF RECTANGULAR FRONT ROUND CASE INSTRUMENTS

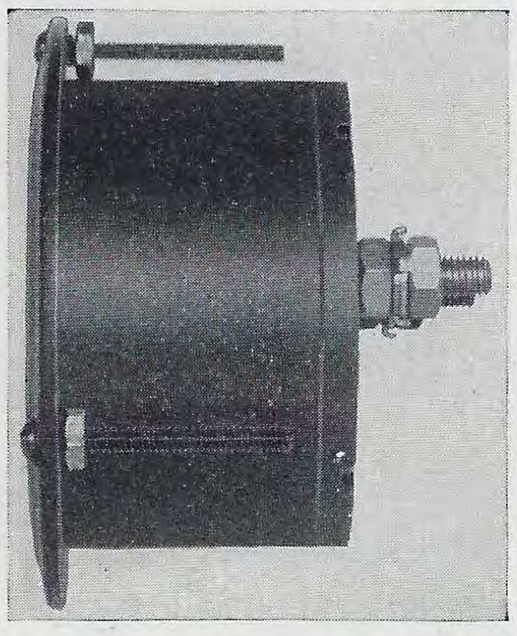


FIG. 2—SHOWING CASE FORM OF ROUND FLUSH INSTRUMENTS

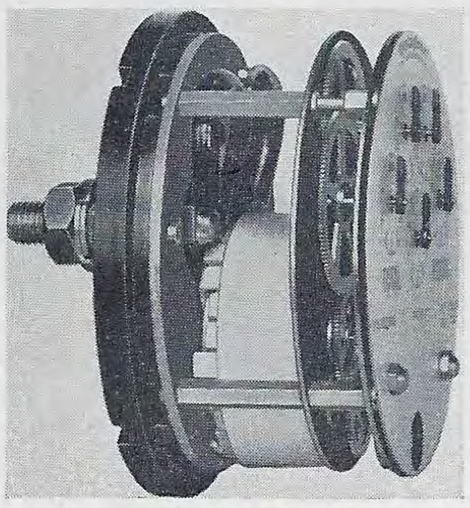


FIG. 4—MECHANISM AND BASE OF TOTAL HOUR METER SHOWING MOTOR GEAR TRAIN AND DIAL

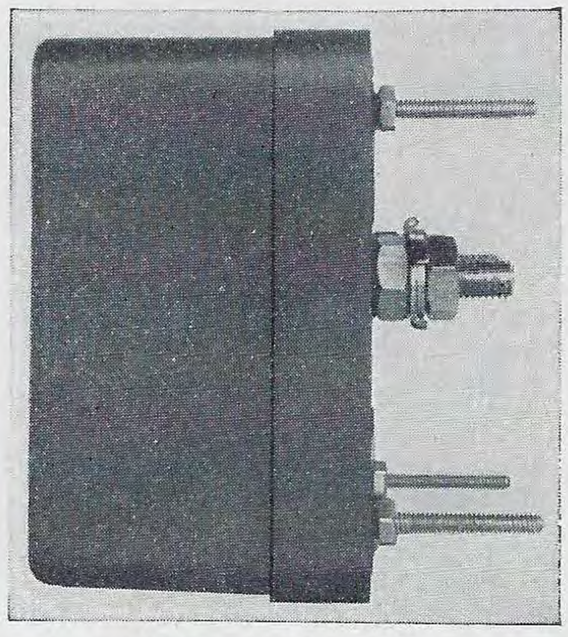


FIG. 5—CASE FORM OF RECTANGULAR PROJECTION INSTRUMENTS

Operation

The Total Hour Meter is suitable for operation on alternating current circuits having regulated frequency. It is connected in parallel with the apparatus of which the total hours of operation are to be indicated. The self starting synchronous driving motor starts and runs continuously while the apparatus is switched on. Voltage variations from 75% to 125% of the rated value will not affect the starting or synchronous operation of the Total Hour Meter. The motor is provided with an oil storage reservoir and will operate from one to two years without attention. When this oil supply is exhausted it is only necessary to clean the motor bearing and replenish the oil supply.

If desired, the Total Hour dials may be set back to zero by resetting the pointers.

VOLT AMPERE BURDENS

Voltage Rating	BURDENS			
	25 Cycle	40 Cycle	50 Cycle	60 Cycle
11	2.5	2.5	2.3	2.2
115	3	2.5	2.3	2.2
230*	4	4	4	4
460‡	3.5	3	3	3
575‡	3.5	3	3	3

* Supplied with external resistor.
‡ Supplied with external transformer.

MINIATURE PANEL INSTRUMENTS—TOTAL HOUR METERS—Continued

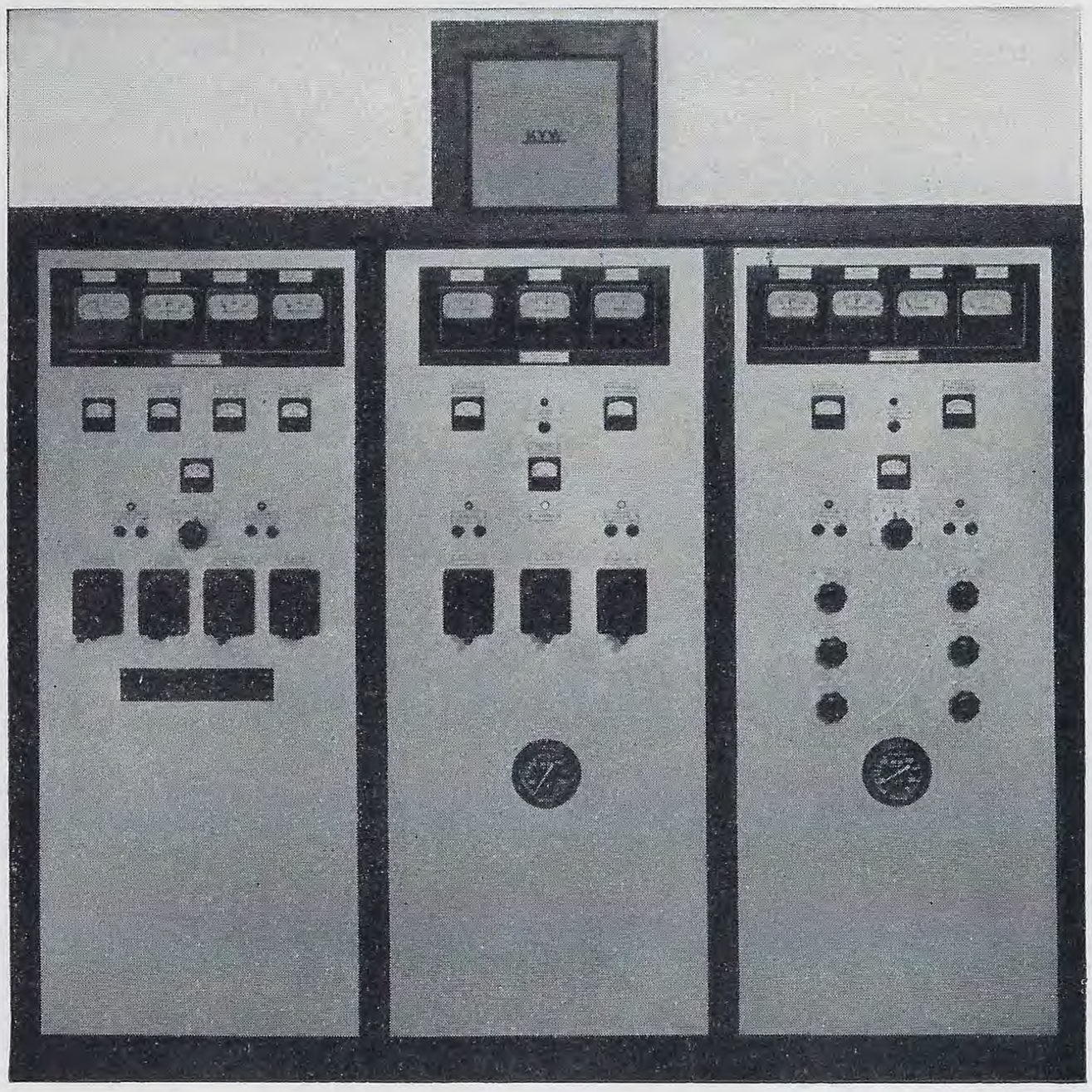


FIG. 6—TYPICAL ARRANGEMENT OF INSTRUMENTS ON A SECTION OF RADIO STATION KYW TRANSMITTER PANEL

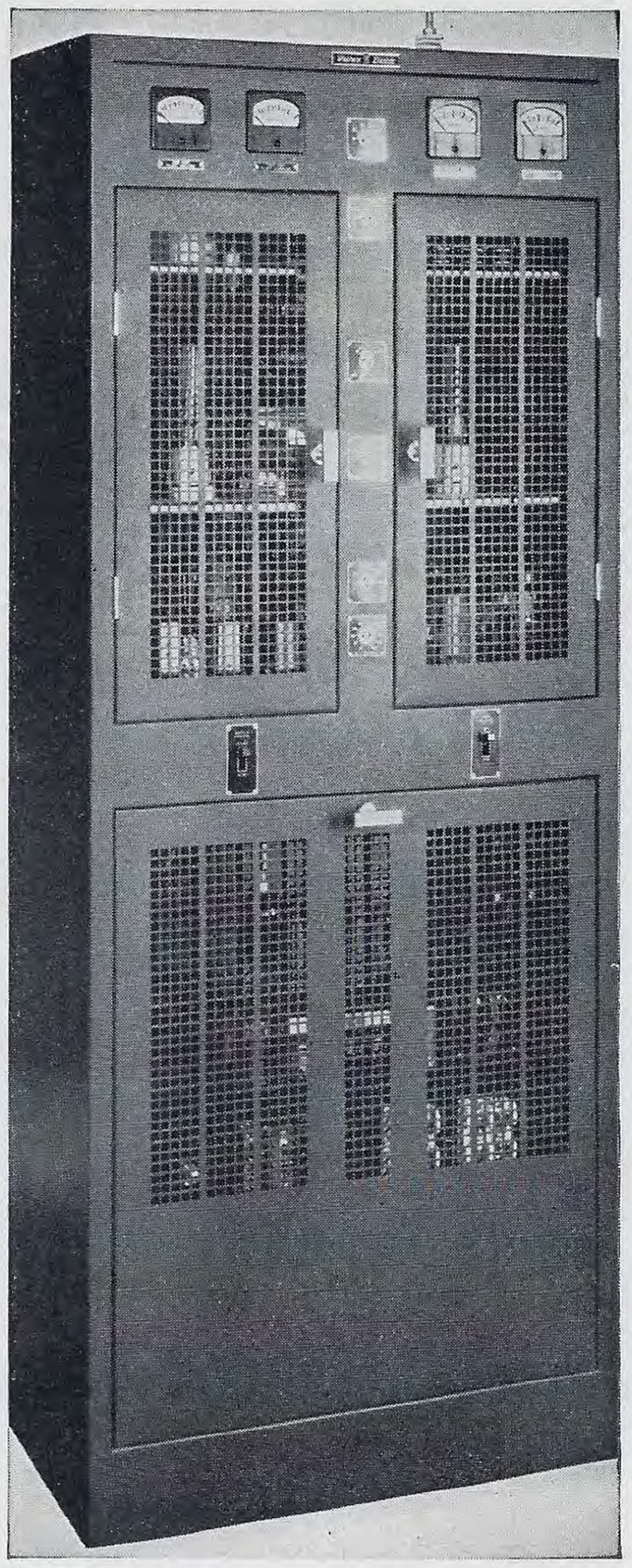


FIG. 7—TYPICAL MEDIUM CAPACITY RADIO TRANSMITTER EQUIPPED WITH WESTINGHOUSE MINIATURE RECTANGULAR INSTRUMENTS

MINIATURE PANEL INSTRUMENTS—TOTAL HOUR METERS—Continued

LIST PRICES

Volts	Rating Frequency	NH-35 Style	VH-35 Style	RH-35 Style	RH-35 Style	List Price Discount Symbol A-C.
11	60	1 001 602	1 001 603	1 001 601	1 001 604	$20 00
115	60	1 001 606	1 001 607	1 001 605	1 001 608	20 00
230*	60	1 001 610	1 001 611	1 001 609	1 001 612	25 00
460‡	60	1 055 415	1 055 416	1 055 414	1 055 417	30 00
575‡	60	1 055 419	1 055 420	1 055 418	1 055 421	30 00
115	25	1 001 614	1 001 615	1 001 613	1 001 616	20 00
115	40	1 001 618	1 001 619	1 001 617	1 001 620	20 00
115	50	1 001 622	1 001 623	1 001 621	1 001 624	20 00
115	80	1 001 626	1 001 627	1 001 625	1 001 628	20 00

* Supplied with external resistors.
‡ Supplied with external transformer.

EXTERNAL WIRING DIAGRAMS

REAR VIEWS

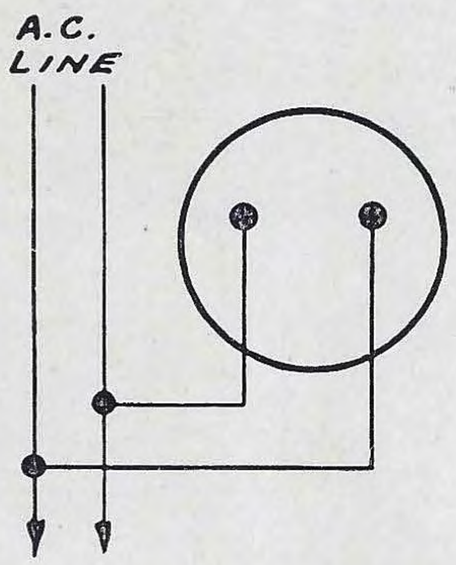


FIG. 8
TOTAL HOUR METER WITHOUT EXTERNAL RESISTOR

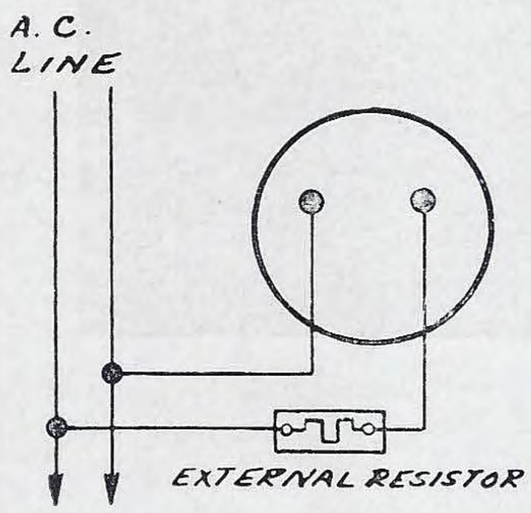


FIG. 9
TOTAL HOUR METER WITH EXTERNAL RESISTOR

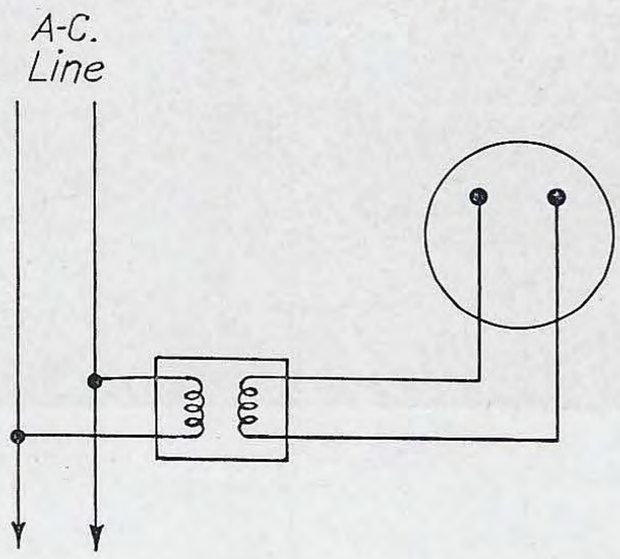


FIG. 10
TOTAL HOUR METER WITH EXTERNAL TRANSFORMER

Diagrams are for reference only, for official diagrams refer to nearest Westinghouse sales office.

Order by Style Number

Prices and discounts are subject to change without notice.

MINIATURE PANEL INSTRUMENTS—TOTAL HOUR METERS—Continued

DRILLING PLANS—DIMENSIONS IN INCHES

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

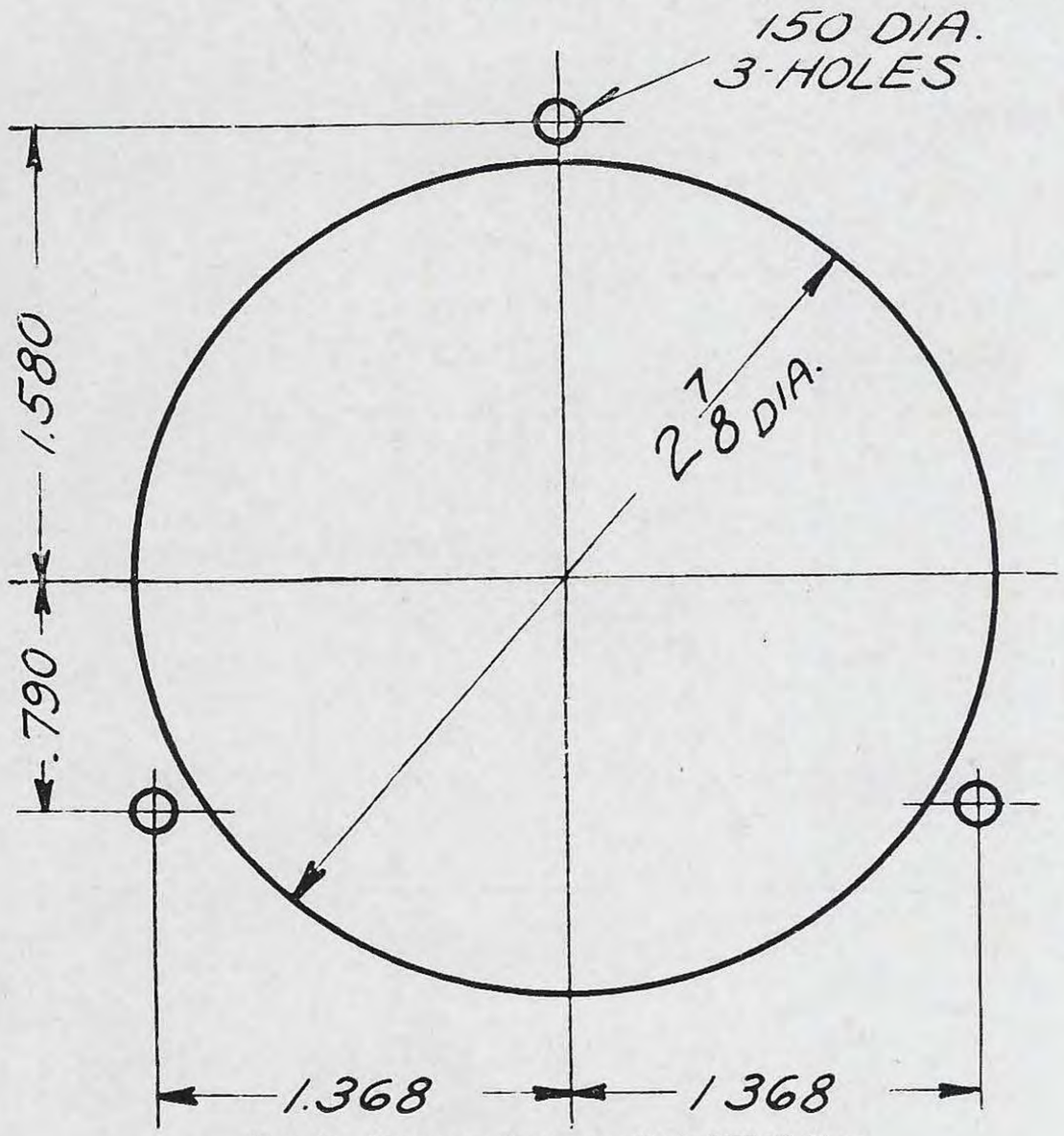


FIG. 11—DRILLING PLAN FOR TYPE NH-35 CASE

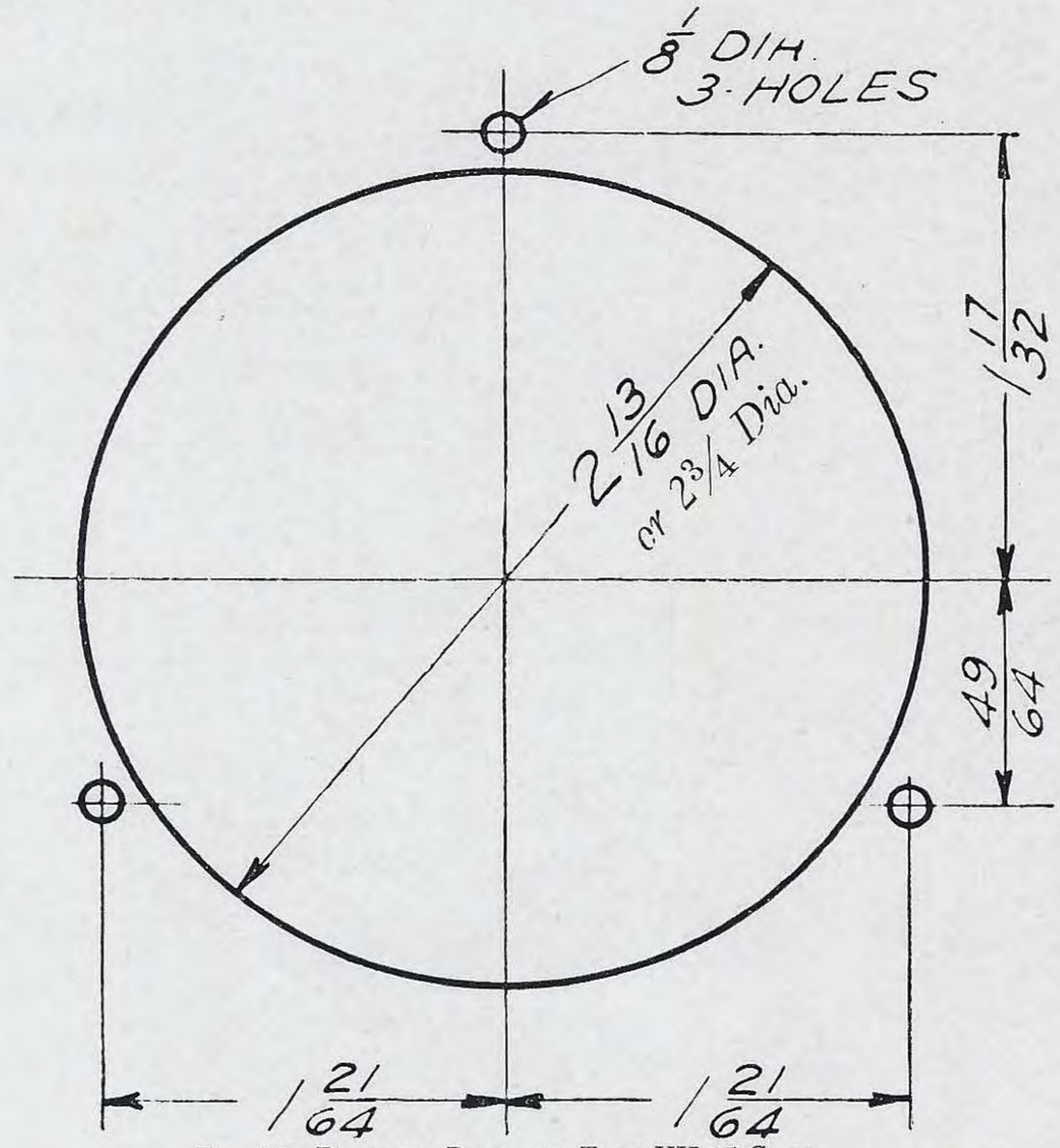


FIG. 12—DRILLING PLAN FOR TYPE VH-35 CASE

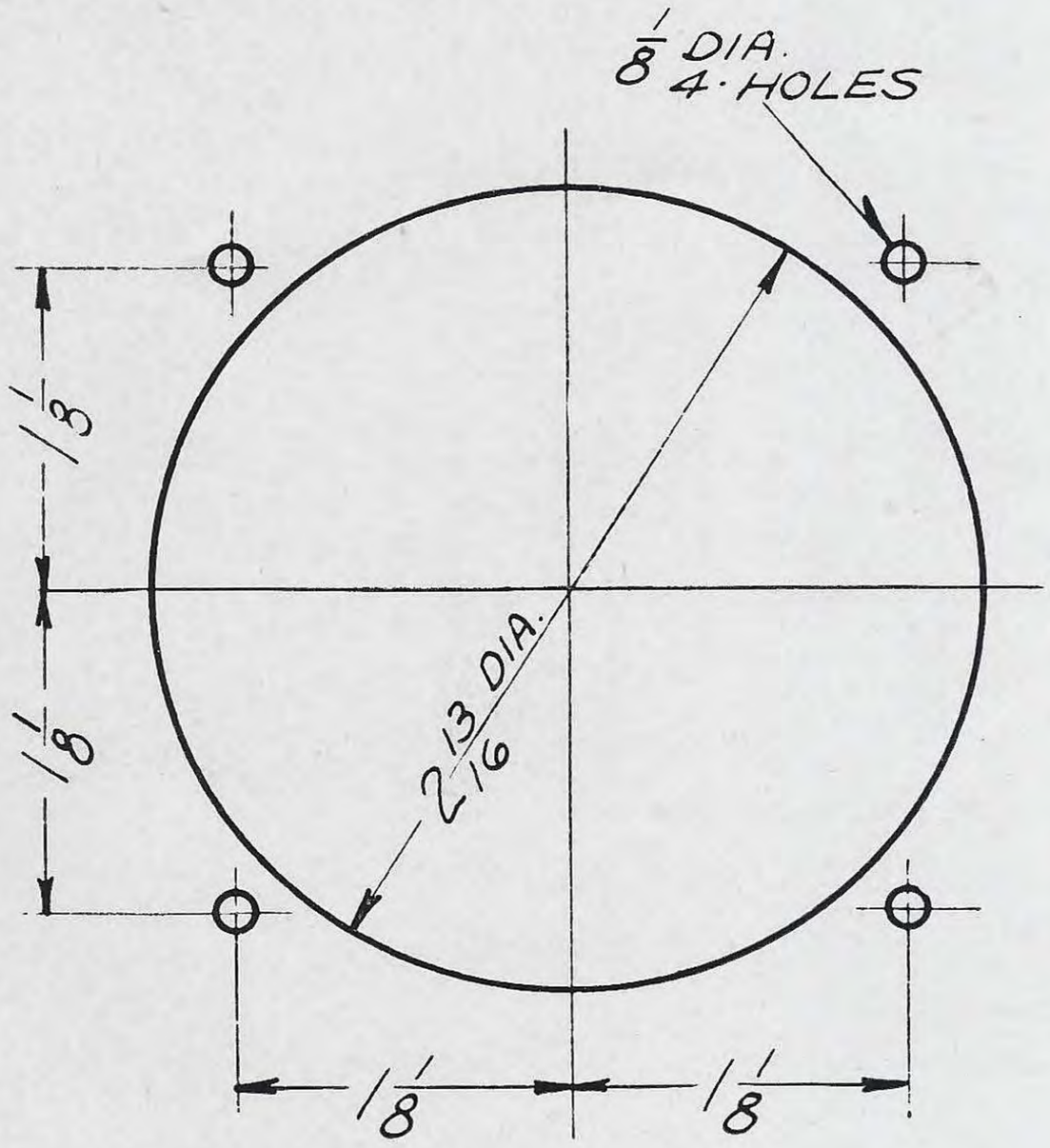
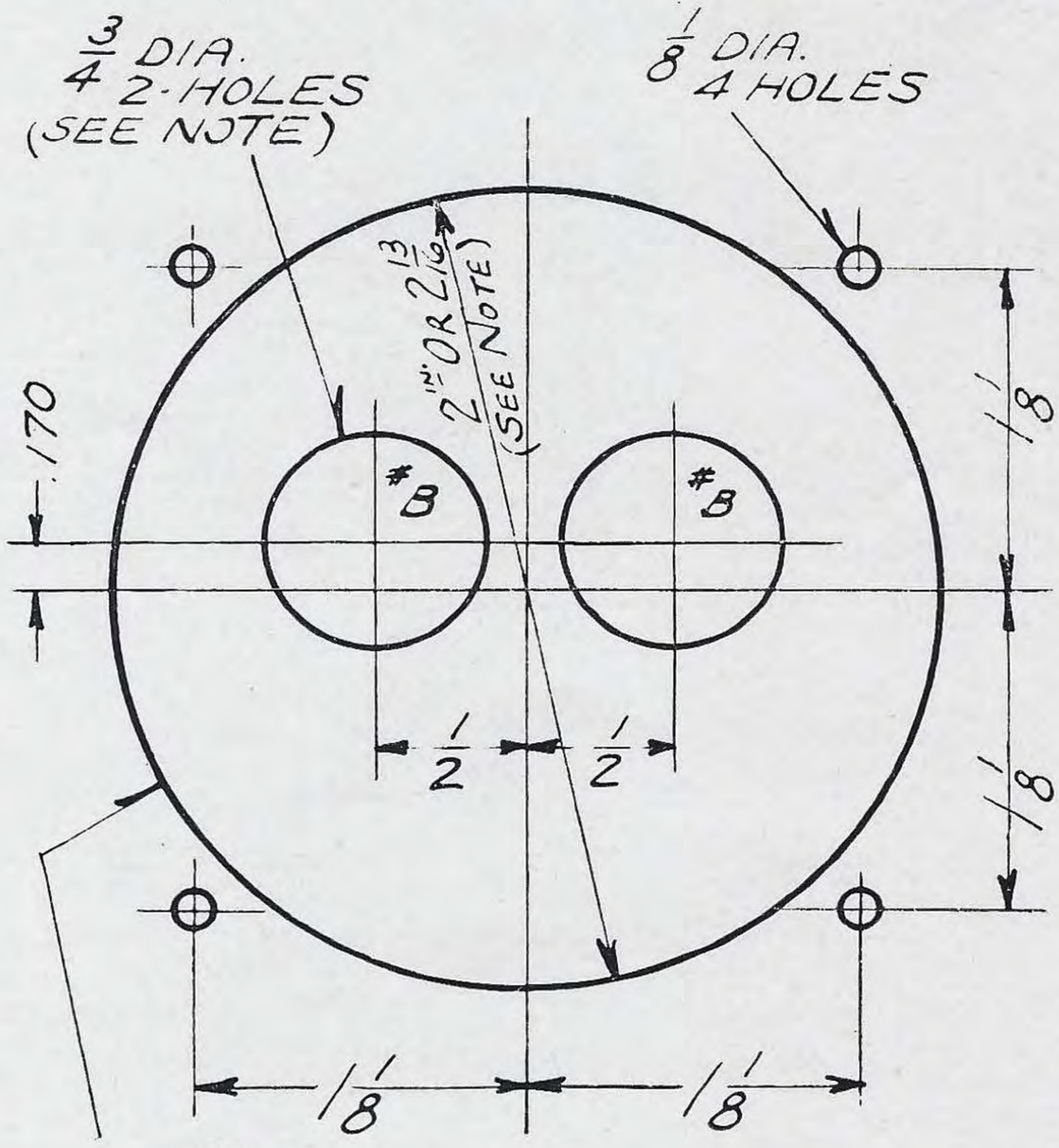


FIG. 13—DRILLING PLAN FOR TYPE RH-35 CASE



Note:—

FOR INSULATING PANELS HOLES #B MAY BE USED.
USE 2-INCH DIA. HOLE UP TO 150 VOLTS.
USE 2 13/16-INCH DIA. HOLE ABOVE 150 VOLTS

FIG. 14—DRILLING PLAN FOR TYPE UH-35 CASE.

MINIATURE PANEL INSTRUMENTS—TOTAL HOUR METERS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

Rectangular Forms

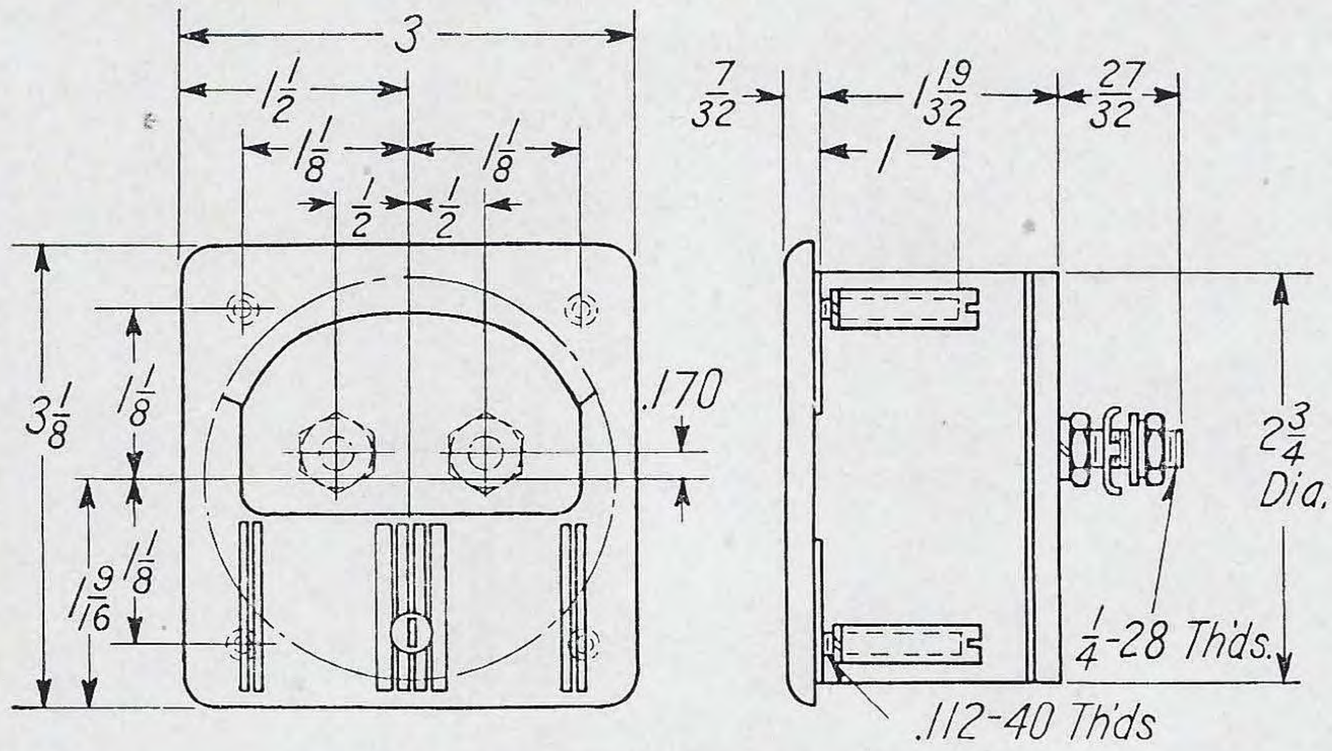


FIG. 17—TYPE HR-35 INSTRUMENTS

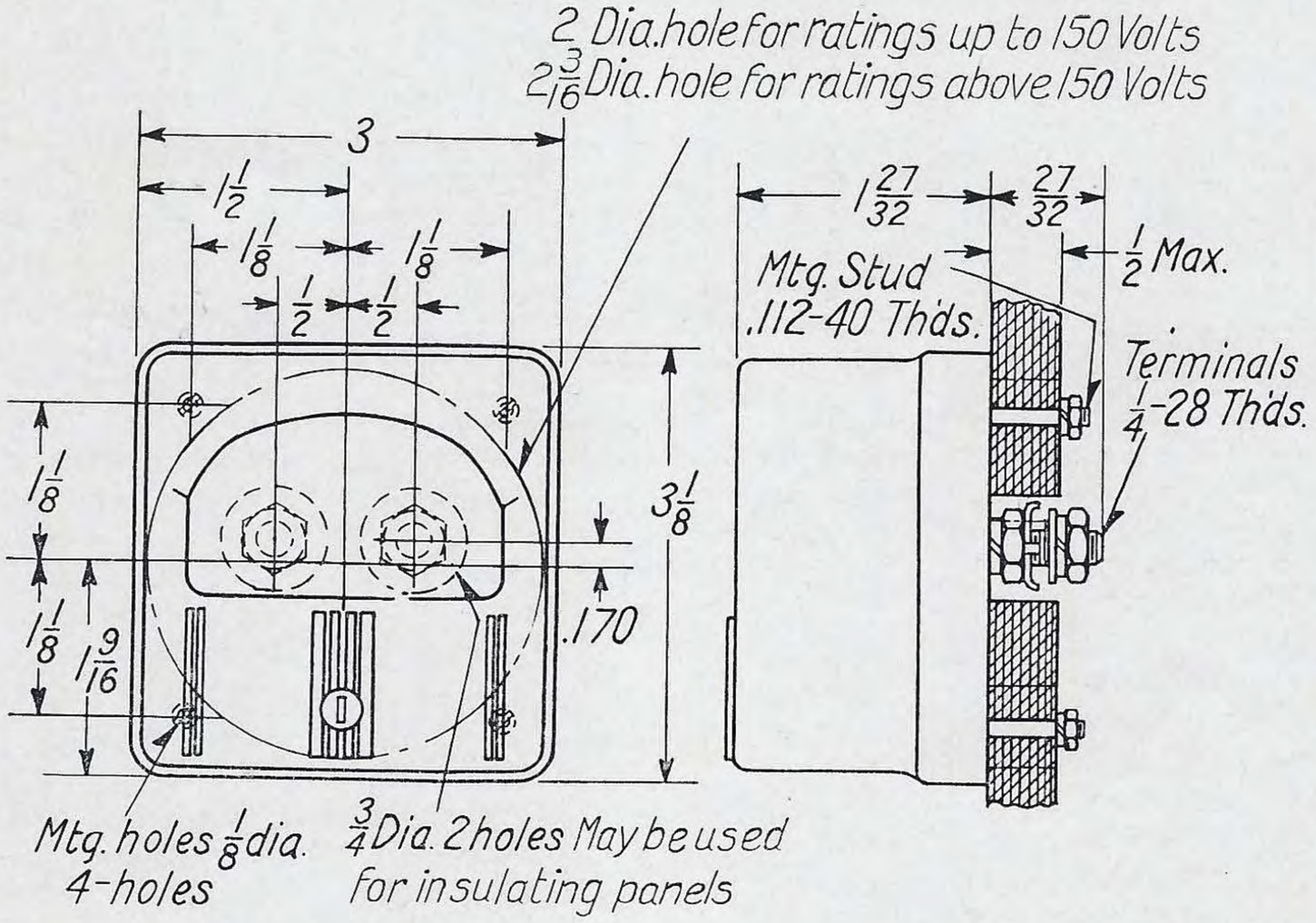


FIG. 18—TYPE UH-35 INSTRUMENTS

Note—These outlines are approximately one-half actual size.

MINIATURE PANEL INSTRUMENTS—TOTAL HOUR METERS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

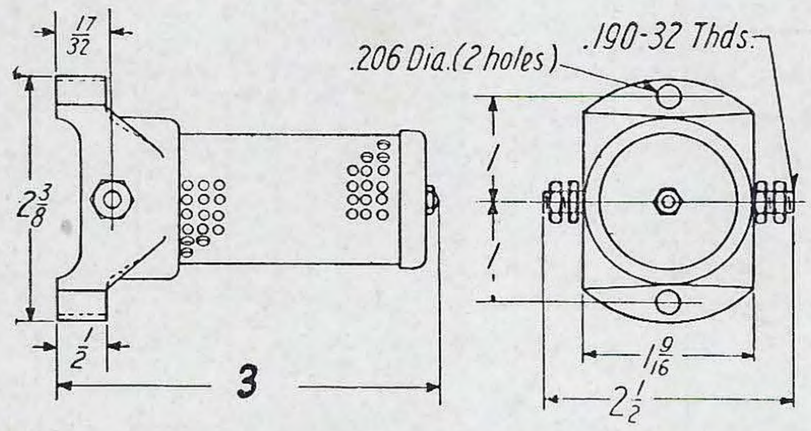


FIG. 19—TYPE RO EXTERNAL RESISTOR USED WITH 230 VOLT TOTAL HOUR METER.

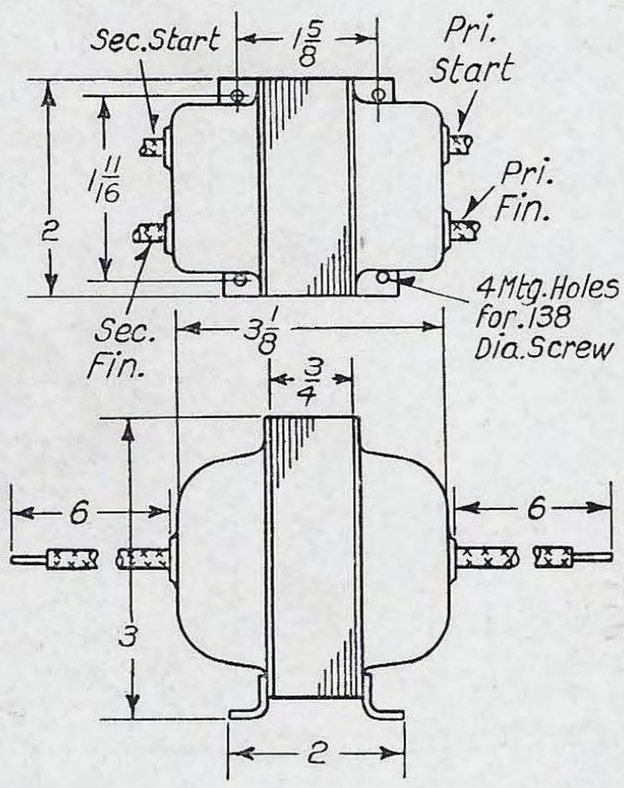


FIG. 20—TYPE MT TRANSFORMER USED WITH 460 AND 575 VOLT TOTAL HOUR METER

MINIATURE PANEL INSTRUMENTS

THREE-INCH CLASSIFICATION
Power Level Indicators
DB (decibel) Meters

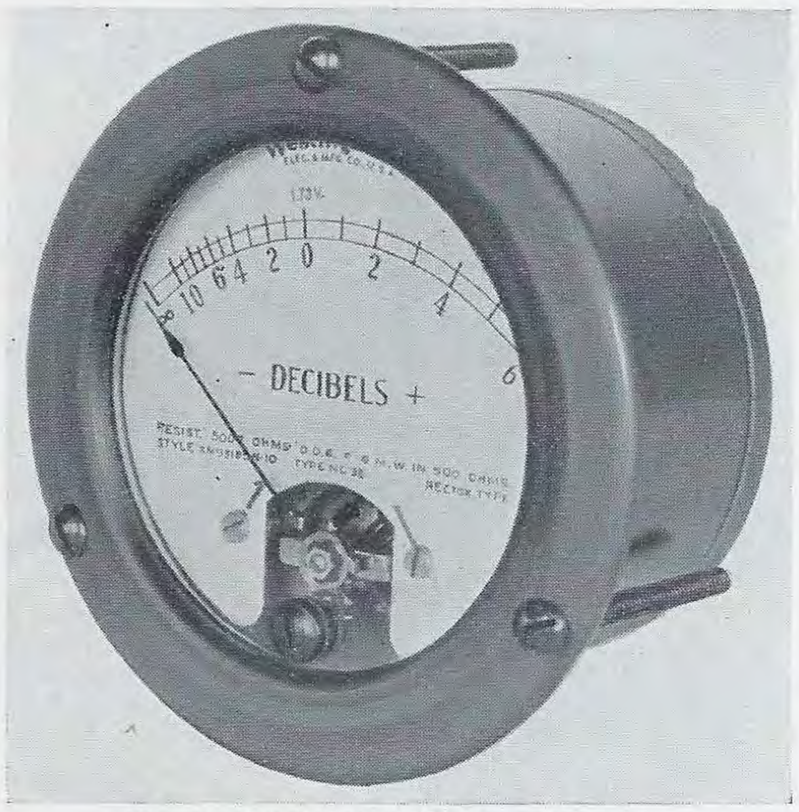


Fig. 1—Type NC-35 Decibel Meter

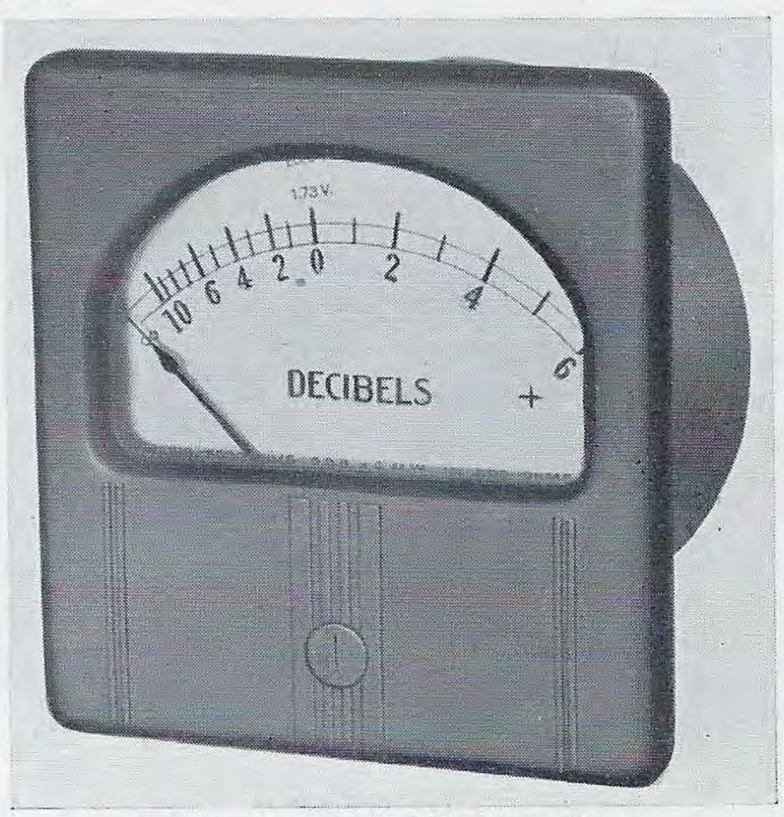


Fig. 2—Type RC-35 Decibel Meter

DATA

	ROUND FLUSH MOUNTING	ROUND FLUSH MOUNTING	RECTANGULAR FLUSH MOUNTING	RECTANGULAR PROJECTION MOUNTING
Types	NC-35	VC-35	RC-35	UC-35
Case Material	Moldarta	Moldarta	Moldarta	Moldarta
Mounting	Flush Bolted	Flush Bolted	Flush Bolted	Projection Bolted
Body Diameter	2.8"	2¾"	2¾"	3" x 3⅛"
Front Flange	3½"	3⅜"	3" x 3⅛"	3" x 3⅛"
Scale Length	2.4"	2.4"	2.4"	2.4"
Insulation Rating	750-V.	750-V.	750-V.	750-V.
Accuracy	±5%	±5%	±5%	±5%
†Net Weight Standard Speed	10 oz.	10 oz.	11 oz.	13 oz.
†Shipping Weight Standard Speed	16 oz.	16 oz.	18 oz.	18 oz.
†Net Weight High Speed	15 oz.	15 oz.	16 oz.	18 oz.
†Shipping Weight High Speed	24 oz.	24 oz.	26 oz.	28 oz.

CHARACTERISTICS

Standard Level	6 Milli W.	6 Milli. W.	6 Milli W.	6 Milli W.
Low Level	0.6 Milli W.	0.6 Milli. W.	0.6 Milli W.	0.6 Milli W.
Standard Line Impedance	500 or 600 Ohms			
Standard Scales	—10/0/+6			

†Weights are approximate and do not include resistors.

General

Power Level Indicators are necessary for the efficient operation of lines and circuits carrying audio frequency currents. Power level indications are useful wherever audio frequency signals are generated, amplified, transmitted, received and utilized.

Operation and Construction

Power Level Indicators are essentially rectox voltmeters. It is customary to provide them with scales marked in decibels. This unit is convenient in measuring levels of audio frequency signals. It is based upon an arbitrary power level (usually 0.006 watts) of a typical line resistance (usually 500 or 600 ohms.) The decibel is a logarithmic unit which is most useful in measurement of power ratios in communication circuits. The overall power gain or loss in a system may be obtained by adding algebraically the "db" gains or losses of the individual devices or lines comprising the entire network.

Modified permanent magnet moving coil instrument mechanisms are used n conjunction with selected rectox rectifiers, in power level indicators. Special attention is given to the control of response and damping characteristics of the movements.

Westinghouse Electric & Manufacturing Company
Newark Works, Newark, N. J.

Printed in U.S.A.
Reprint (8-38)

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MINIATURE PANEL INSTRUMENTS—DB (DECIBEL) METERS—Continued

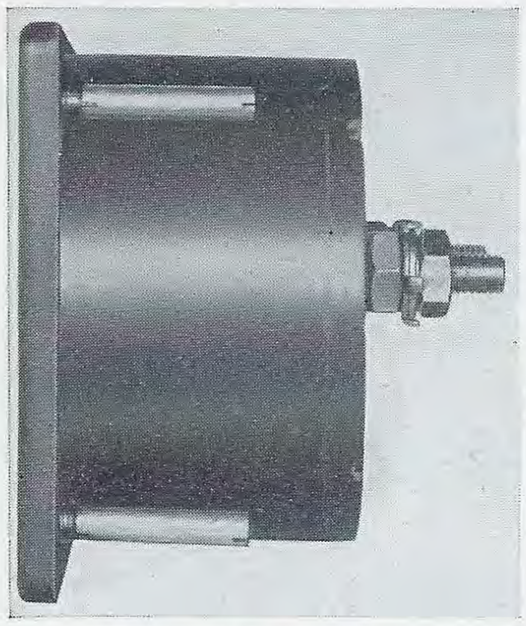


FIG. 4—CASE FORM OF RECTANGULAR FRONT ROUND CASE INSTRUMENTS

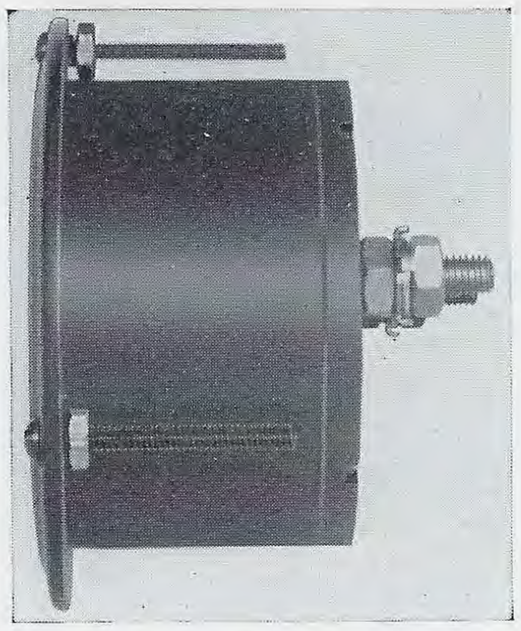


FIG. 3—CASE FORM OF ROUND FLUSH INSTRUMENTS

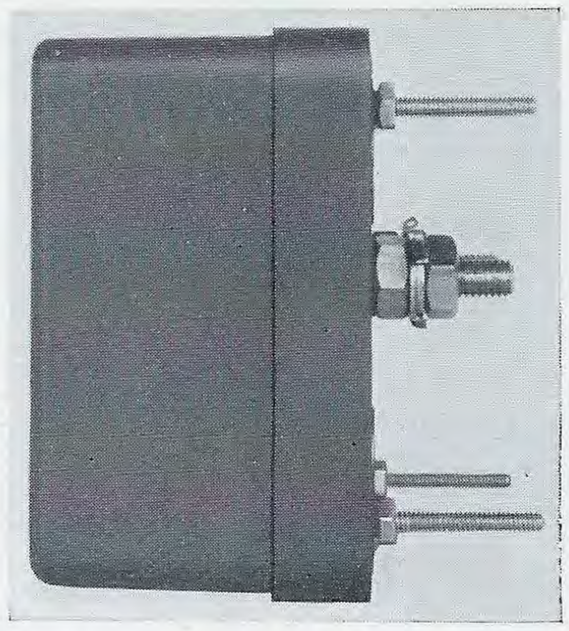


FIG. 5—CASE FORM OF RECTANGULAR PROJECTION INSTRUMENTS

Type X-35 Power Level Indicators—Scale Marking

All standard power level indicators have scales marked —10/0/+6 decibels, unless otherwise specified.

Speed and Response

Standard Power Level Indicators are available in two speeds as follows:

Standard Speed—The standard speed power level indicator has a natural period of approximately .57 second and is not highly damped. The overshoot is approximately 50% and the damping factor is 2.

High Speed—The high speed indicator has a natural period of approximately one-third second, and is highly damped, having an overshoot of approximately 6%, or a damping factor of 16.6. This instrument has a very light moving element, strong control springs, and a strong cobalt steel magnet. The approximate time of respose is .1 second, or the responsiveness is approximately 10 for readings within a fraction of a "db" of the final steady value.

Power Level and Internal Resistance

Self-contained Power Level Indicators are available for two power levels, Standard Level and Low Level. The internal resistance of the indicator depends upon the power level.

Standard Level—The standard power level is 6 milliwatts, and indicators calibrated O DB = .006 watt have an internal resistance of approximately 5000 ohms.

Low Level—The lowest power level for which indicators can be furnished is $\frac{6}{10}$ milliwatt. Indicators calibrated O DB = .0006 watt have an internal resistance of approximately 1581 ohms.

Line Impedance and Voltage

500 Ohm Line—For a 500 ohm line impedance and standard power level of .006 watts, the power level indicator is calibrated O DB = 1.732 volts. For a 500 ohm line and low power level of .0006 watt, the power level indicator is calibrated O DB = .548 volts.

600 Ohm Line—For a line impedance of 600 ohms and standard power level of .006 watt, the power level indicator is calibrated O DB = 1.897 volts. For a 600 ohm line and low power level of .0006 watt, the indicator is calibrated O DB = .6 volts.

Special Features

In general, standard ranges should be used where possible. However, power level indicators can be furnished with special scales, speed, response, and damping, and special calibration to meet any requirements within the possibility of design.

Due to characteristics of the copper oxide rectifier, it is not desirable to make Power Level Indicators for levels lower than O DB = .548 or .6 volts.

Multi-Ranges

Although not generally recommended, multi-ranges can be furnished. Due to fundamental characteristics of the rectox, multi-range instruments are less accurate and single range instruments are therefore to be preferred.

MINIATURE PANEL INSTRUMENTS—DB (DECIBEL) METERS—Continued

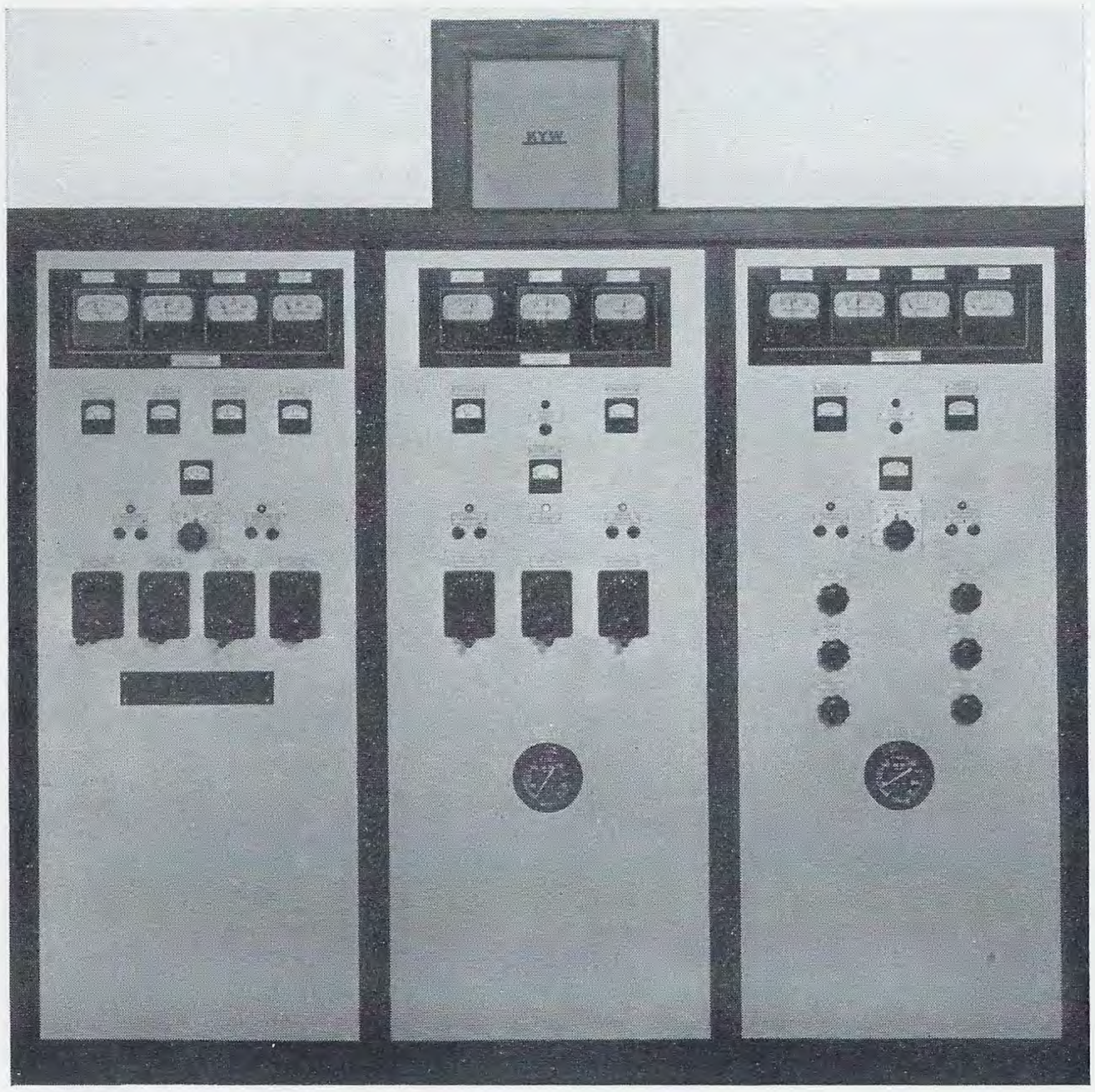


FIG. 6—TYPICAL ARRANGEMENT OF INSTRUMENTS ON A SECTION OF RADIO STATION KYW TRANSMITTER PANEL

FIG. 7—REMOTE CONTROL CABINET EQUIPPED WITH WESTINGHOUSE TYPE RC-35 RECTANGULAR INSTRUMENTS

MINIATURE PANEL INSTRUMENTS—DB (DECIBEL) METERS—Continued

LIST PRICES

All listed styles have standard scales −10/0/+6 Decibels.

Reference Pr. Level at O DB	Ohms Line Impedance	Volts for O DB	Internal Res. Ohms at O DB	Style No. Type * NC-35	Type * VC-35	Type * RC-35	Type * UC-35	List Price Discount Symbol AC
Standard Speed								
.006	500	1.732	5000	1 007 861	1 007 873	1 007 865	1 007 869	$20 00
.006	600	1.897	5000	1 007 862	1 007 874	1 007 866	1 007 870	20 00
.0006	500	.548	1581	1 007 863	1 007 875	1 007 867	1 007 871	20 00
.0006	600	.600	1581	1 007 864	1 007 876	1 007 868	1 007 872	20 00
High Speed								
.006	500	1.732	5000	1 007 877	1 007 889	1 007 881	1 007 885	24 50
.006	600	1.897	5000	1 007 878	1 007 890	1 007 882	1 007 886	24 50
.0006	500	.548	1581	1 007 879	1 007 891	1 007 883	1 007 887	24 50
.0006	600	.600	1581	1 007 880	1 007 892	1 007 884	1 007 888	24 50

* The type RX instrument described in Cat. Sec. 43-344 may be supplied in any of the above capacities at the same prices.
* The type K instrument described in Cat. Sec. 43-230 may be supplied in any of the above capacities at **$44.00** list for high speed and **$38.00** list for standard speed.

RESISTORS

Description	Ohms	Style No.	List Price Discount Symbol AC
To bring low level (.0006 watt) indicator to standard level (.006 watt) and 5000 ohms resistance	3419	1 007 893	$1 50
To bring standard 5000 ohm (.006 watt) indicator to 15811 ohms (.06 watt)	10811	1 007 894	1 50
To raise level from .06 o .6 watt by increasing resistance from 15811 to 50,000 ohms	34189	1 007 895	1 75
To raise level from .6 to 6 watts by increasing resistance from 50,000 to 158110 ohms	108110	1 007 896	2 35
To raise level from 6 to 60 watts by increasing resistance from 158110 ohms to 500,000 ohms	341890	1 007 898 Req. 1 931 344 Req. 1	5 00
To raise level from 60 to 600 watts by increasing resistance from 500,000 to 1,581,000 ohms	1081100	1 007 897 Req. 1 931 516 Req. 1	10 00

The above resistors are unmounted. They are wound on wood spools 1 inch long by ½ inch diameter and may be mounted with No. 6 screws 1¼ inches long.

USEFUL TECHNICAL DB DATA

Power Level DB	Power Ratio to O DB	Power 6 M.W. at O DB Watts	Voltage Ratio to O DB	Volts—Based on 6 M.W. at O DB in 500 Ohms	Volts—Based on 6 M.W. at O DB in 600 Ohms	Voltmeter Resistance 5000 at O DB
−10	0.1000	0.0006000	0.31623	0.5477	.6000	1581
− 9	0.1259	0.0007553	0.35481	0.6145	.6732	1774
− 8	0.1585	0.0009509	0.39811	0.6895	.7554	1991
− 7	0.1995	0.0011972	0.44668	0.7737	.8475	2233
− 6	0.2512	0.0015071	0.50119	0.8681	.9509	2506
− 5	0.3162	0.0018975	0.56234	0.9740	1.0670	2812
− 4	0.3981	0.0023886	0.63096	1.0928	1.1972	3155
− 3	0.5012	0.0030071	0.70795	1.2262	1.3433	3540
− 2	0.6310	0.0037857	0.79433	1.3758	1.5071	3972
− 1	0.7943	0.0047660	0.89125	1.5437	1.6910	4456
0	1.0000	0.0060000	1.00000	1.7321	1.8974	5000
+ 1	1.2589	0.0075535	1.1220	1.9434	2.1289	5610
+ 2	1.5849	0.0095093	1.2589	2.1805	2.3886	6294
+ 3	1.9953	0.0119716	1.4125	2.4466	2.6801	7062
+ 4	2.5110	0.0150713	1.5849	2.7451	3.0071	7924
+ 5	3.1623	0.0189747	1.7783	3.0801	3.3741	8891
+ 6	3.9811	0.0238865	1.9953	3.4559	3.7867	9976
+ 7	5.0119	0.030071	2.2387	3.8776	4.2477	11193
+ 8	6.3096	0.037857	2.5119	4.3507	4.7660	12559
+ 9	7.9433	0.047660	2.8184	4.8816	5.3475	14091
10	10.0000	0.060000	3.1623	5.4772	6.0000	15811
11	12.589	0.075535	3.5481	6.1455	6.7321	17740
12	15.849	0.095093	3.9811	6.8954	7.5536	19905
13	19.953	0.119716	4.4668	7.7368	8.4752	22334
14	25.119	0.150713	5.0119	8.6808	9.5094	25059
15	31.623	0.189747	5.6234	9.7400	10.670	28117
16	39.811	0.238865	6.3096	10.9285	11.972	31548
17	50.119	0.30071	7.0795	12.2620	13.433	35397
18	63.096	0.37857	7.9433	13.7582	15.071	39716
19	79.433	0.47660	8.9125	15.4369	16.910	44562
20	100.000	0.60000	10.0000	17.3205	18.974	50000
21	125.89	0.75535	11.220	19.434	21.289	56105
22	158.49	0.95093	12.589	21.805	23.886	62945
23	199.53	1.19716	14.125	24.466	26.801	70625
24	251.19	1.50713	15.849	27.451	30.071	79240
25	316.23	1.89747	17.783	30.801	33.741	88915
26	398.11	2.38865	19.953	34.559	37.867	99765
27	501.19	3.0071	22.387	38.776	42.477	111935
28	630.96	3.7857	25.119	43.507	47.660	125595
29	794.33	4.7660	28.184	48.816	53.475	140915
0	1000.00	6.0000	31.623	54.772	60.000	158110

Order by Style Number

Prices and discounts are subject to change without notice.

MINIATURE PANEL INSTRUMENTS—DB (DECIBEL) METERS—Continued

OUTLINE DIMENSIONS IN INCHES

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

Round Forms

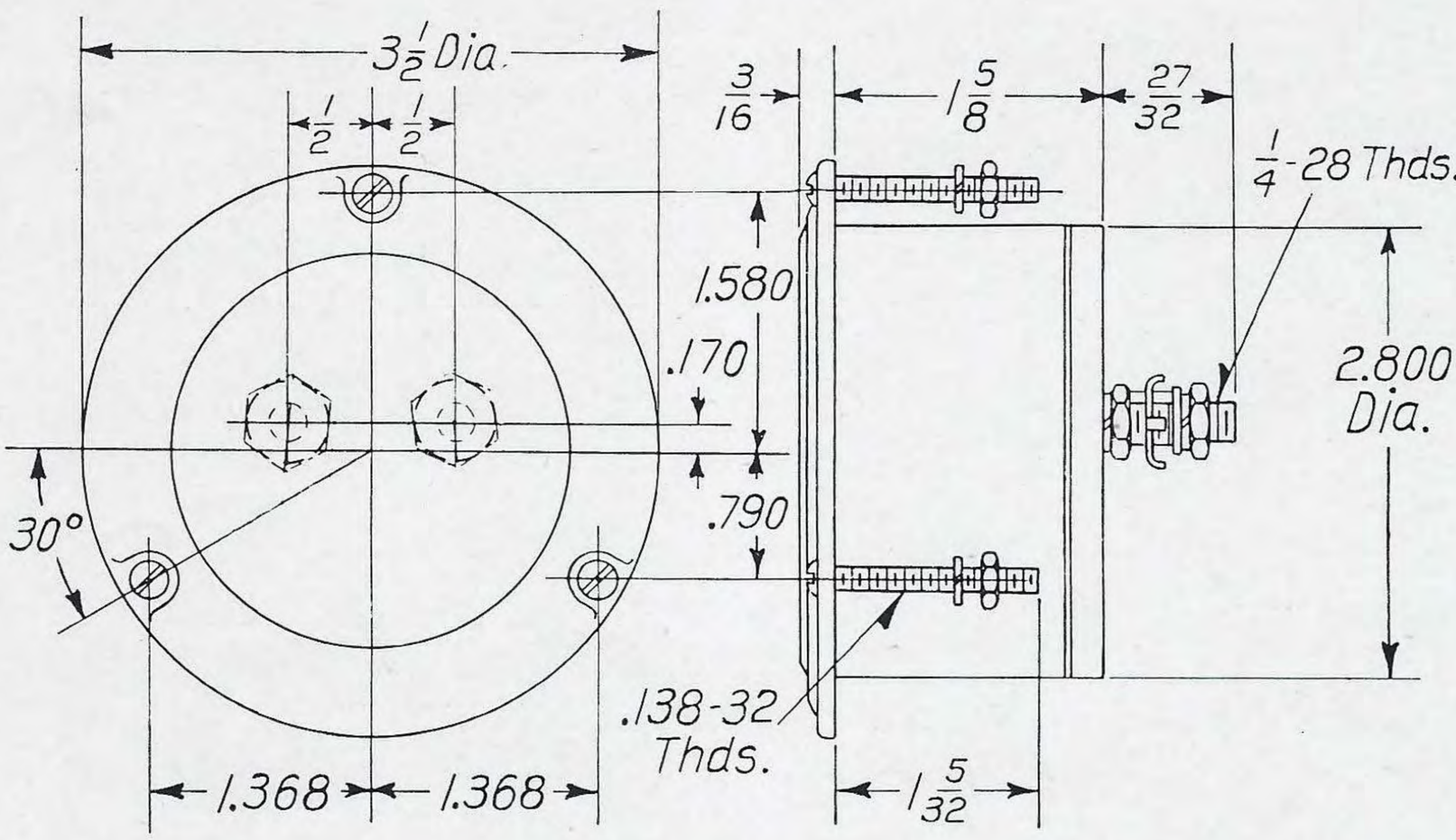


FIG. 8—TYPE NC-35 INSTRUMENTS

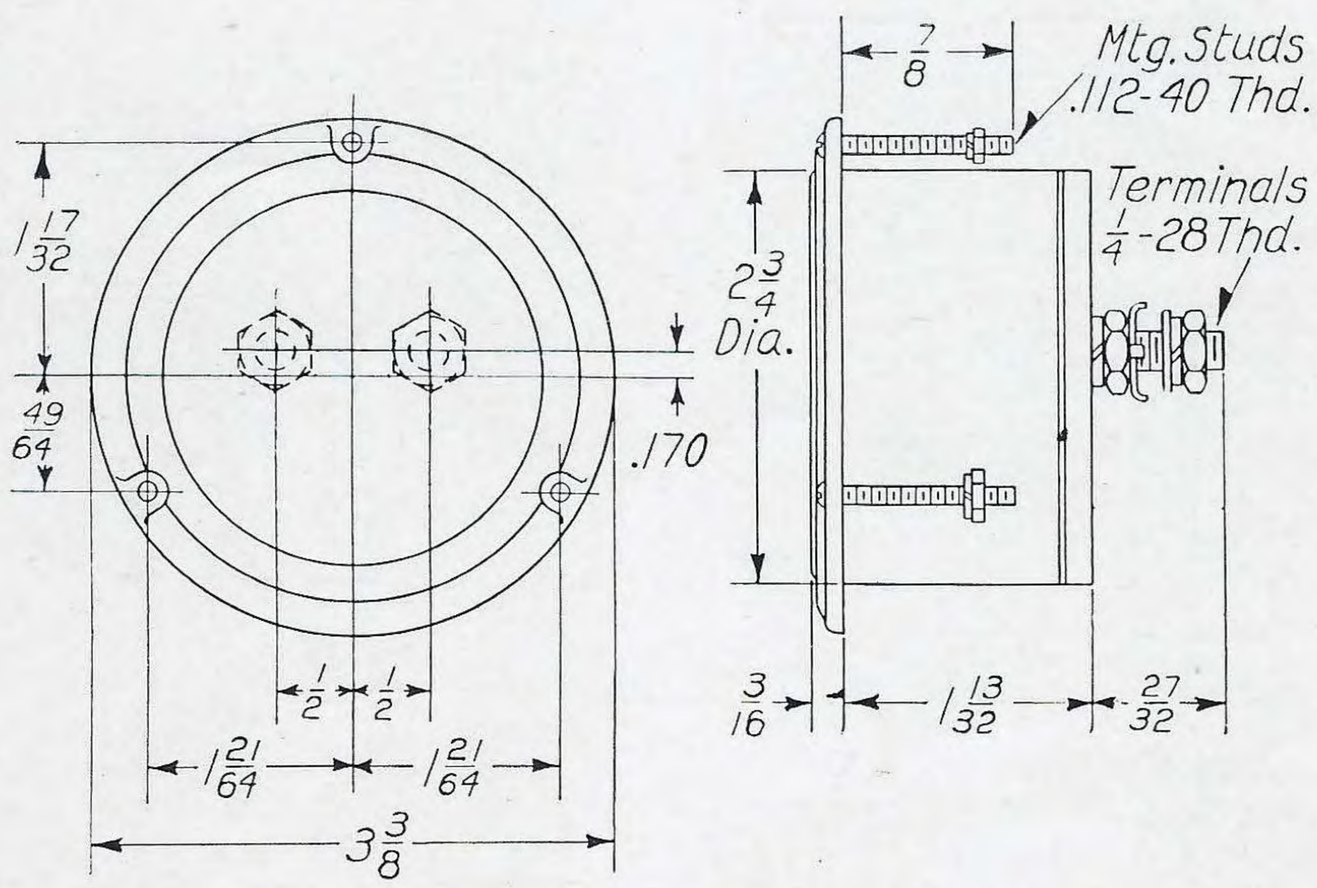


FIG. 9—TYPE VC-35 INSTRUMENTS

Note—These outlines are approximately one-half actual size.

MINIATURE PANEL INSTRUMENTS—DB (DECIBEL) METERS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

Rectangular Forms

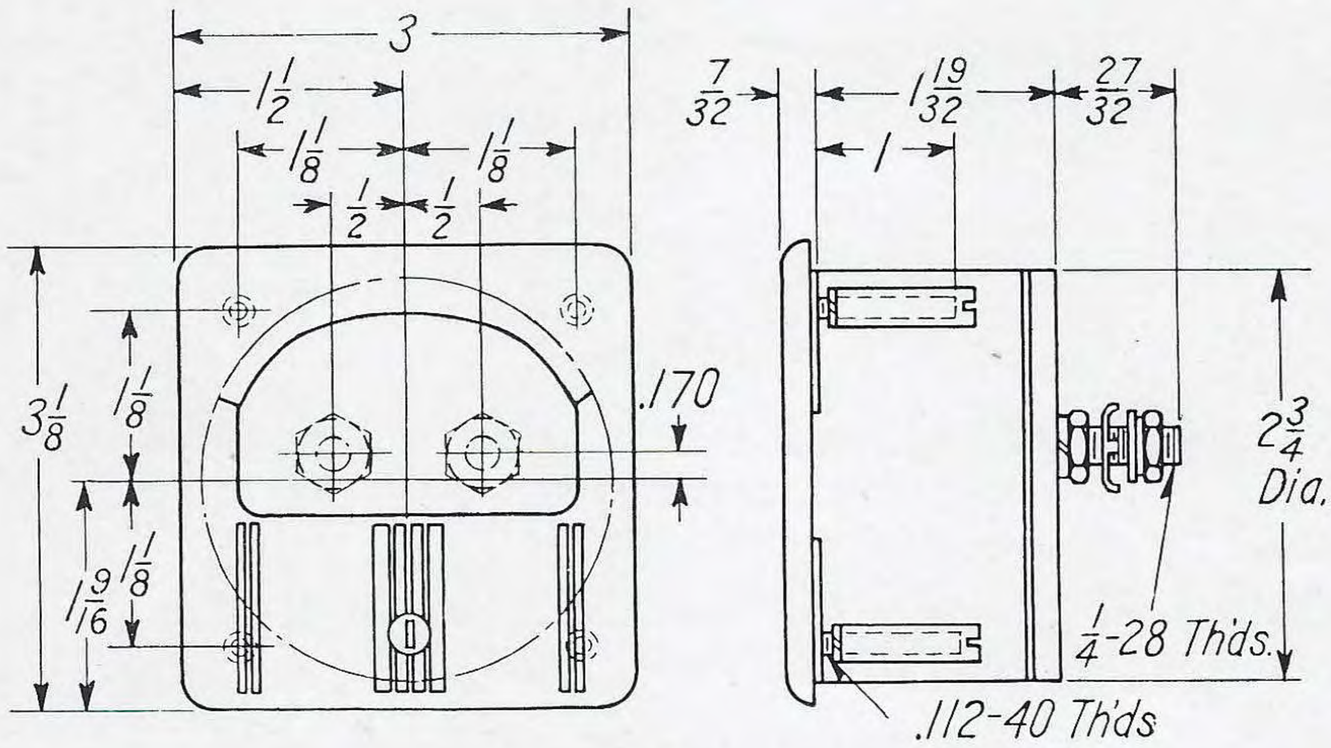


FIG. 10—TYPE RC-35 INSTRUMENTS

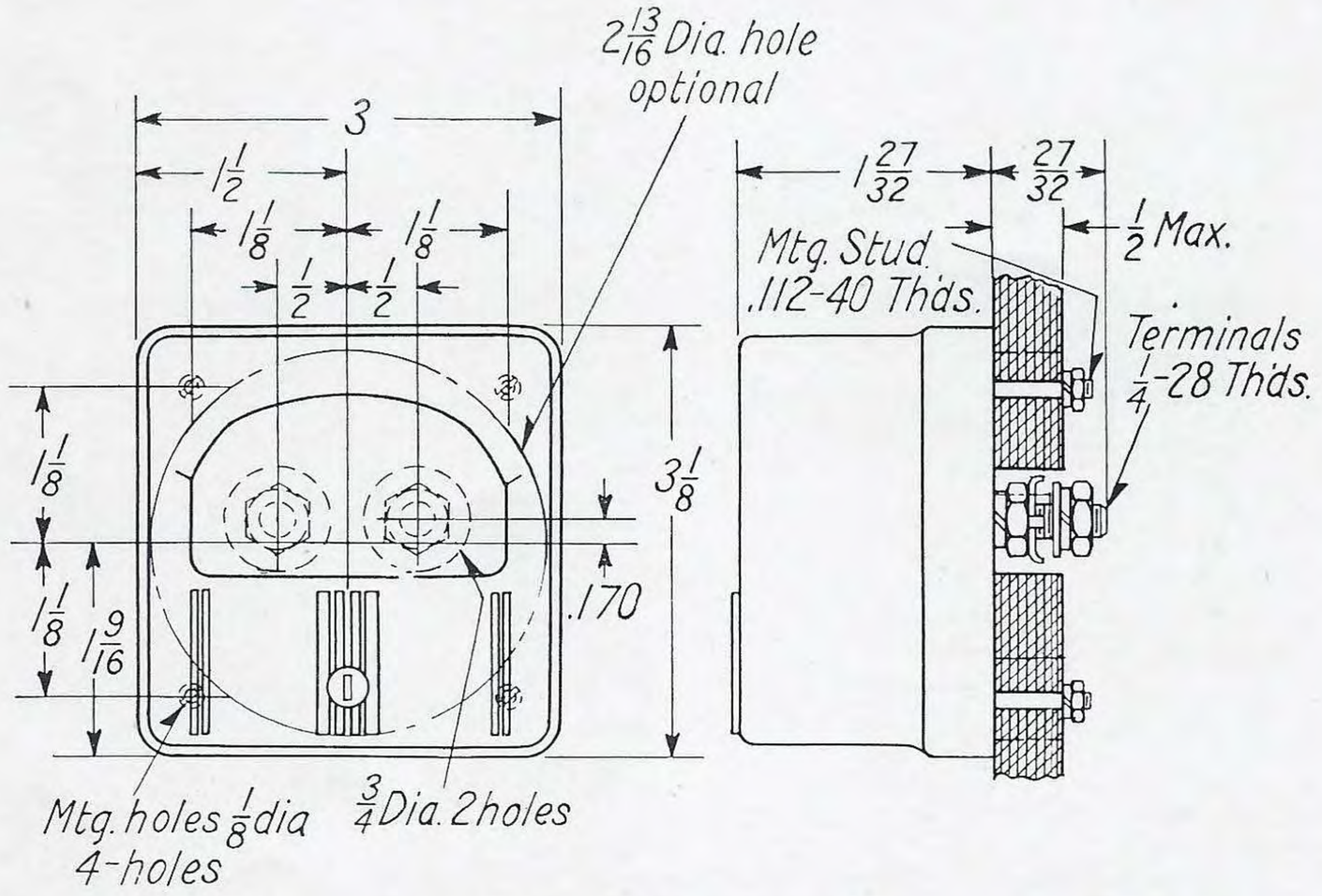


FIG. 11—TYPE UC-35 INSTRUMENTS

Note—These outlines are approximately one-half actual size.

MINIATURE PANEL INSTRUMENTS—DB (DECIBEL) METERS—Continued

DRILLING PLANS

(Front Views)

Dimensions in Inches

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

Round Forms

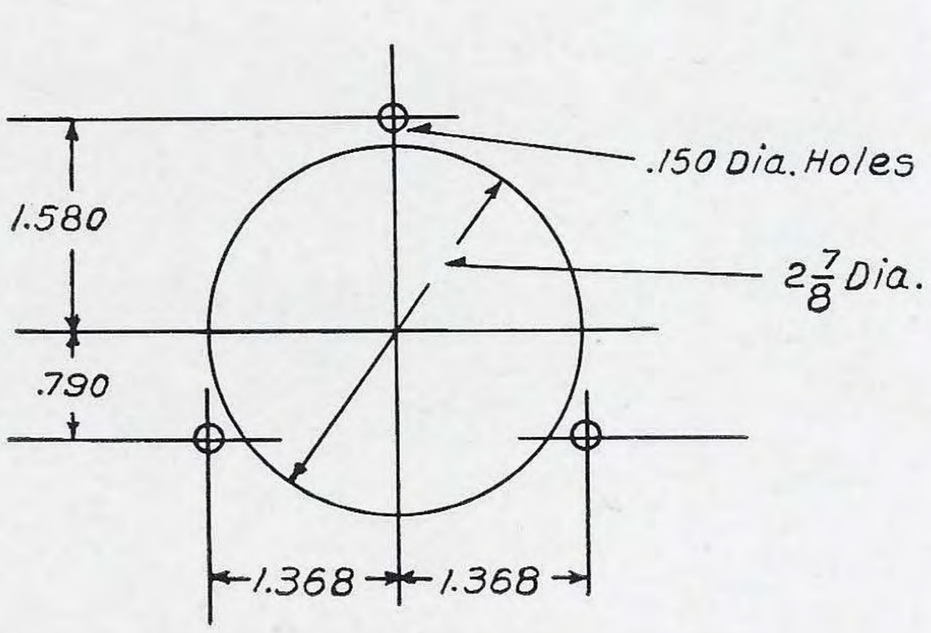


FIG. 12—TYPE NC-35 INSTRUMENTS

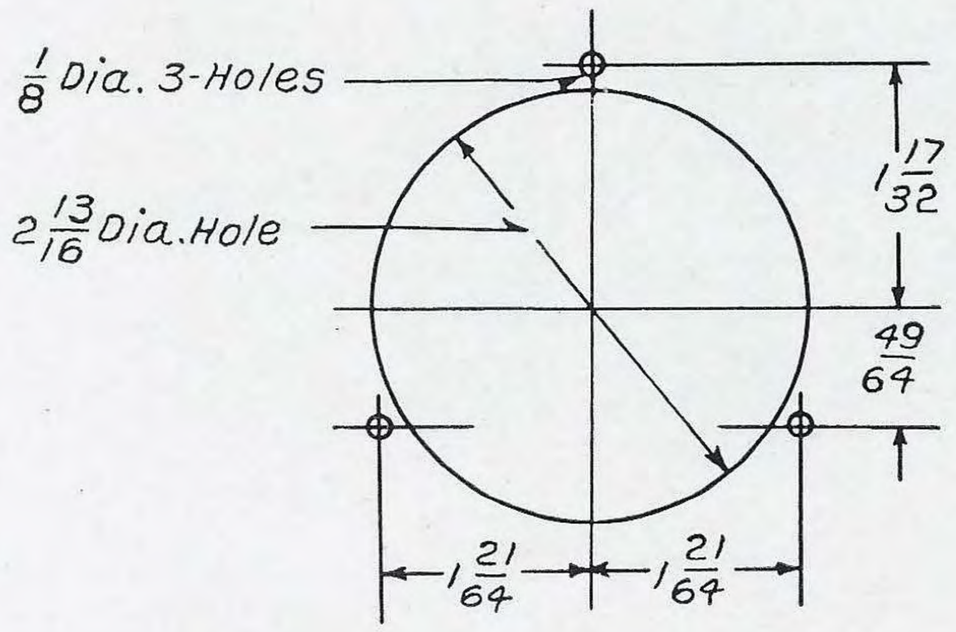


FIG. 13—TYPE VC-35 INSTRUMENTS

Rectangular Forms

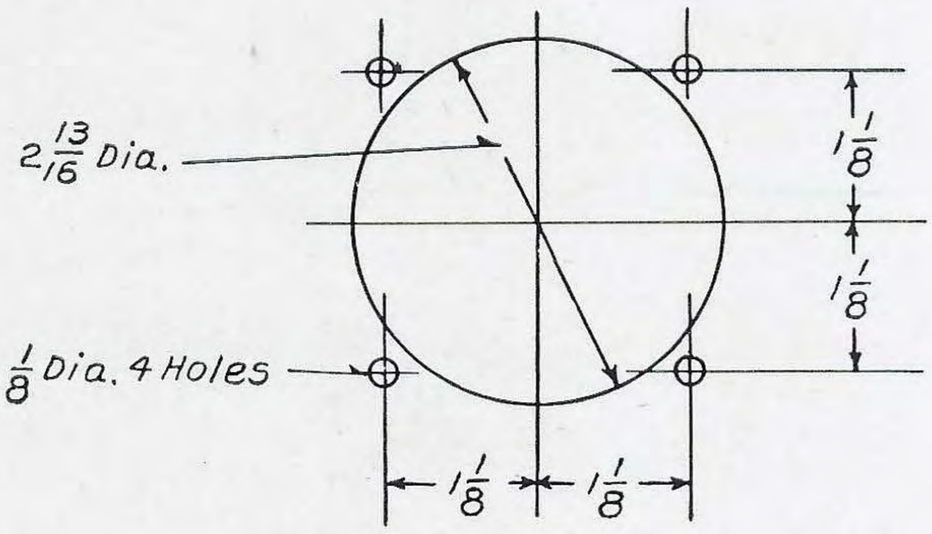


FIG. 14—TYPE RC-35 INSTRUMENTS

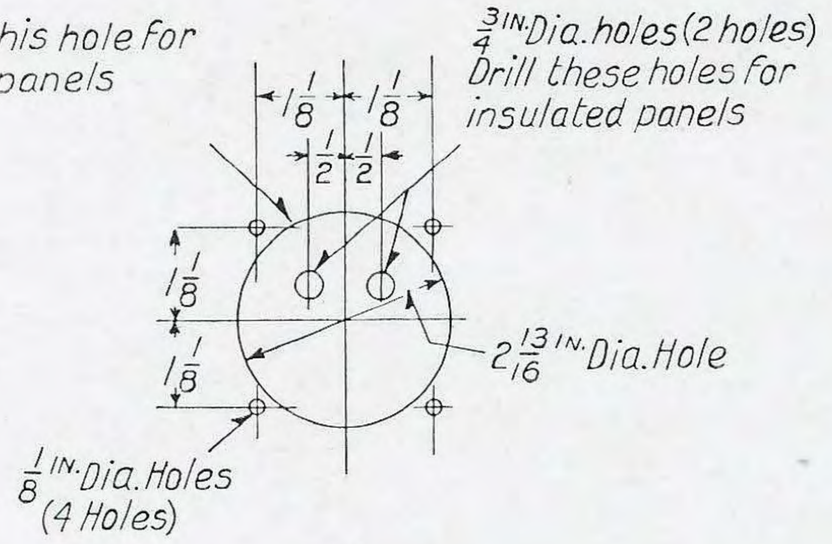


FIG. 15—TYPE UC-35 INSTRUMENTS

MINIATURE PANEL INSTRUMENTS

FOUR-INCH CLASSIFICATION

Alternating Current, Direct Current, Rectox and Radio Frequency Types

Fig. 1-A—Types RX-37, RC-37, RT-37 and RA-37
Rectangular Flush Mounting

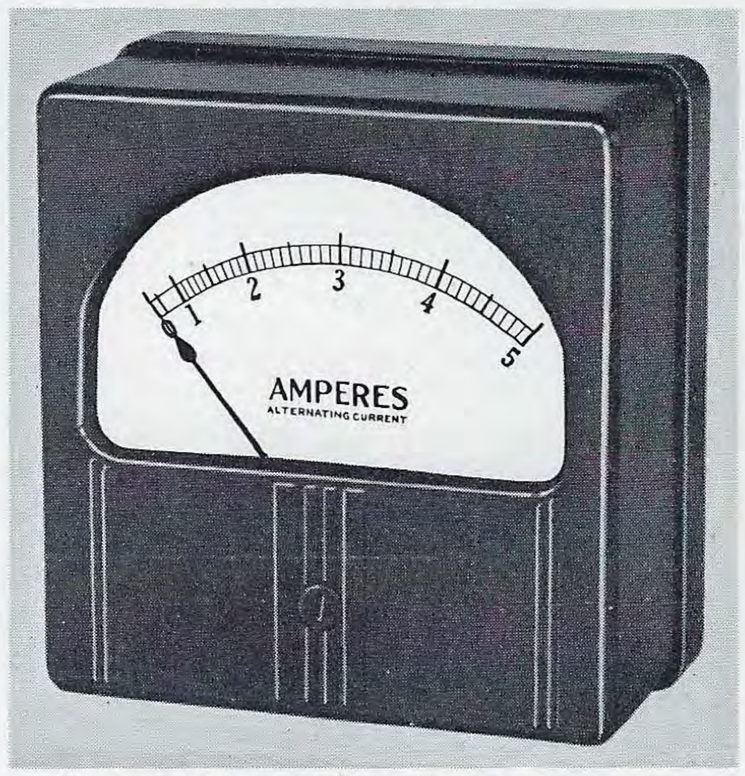


Fig. 1-B—Types UX-37, UC-37, UT-37 and UA-37
Rectangular Projection Mounting

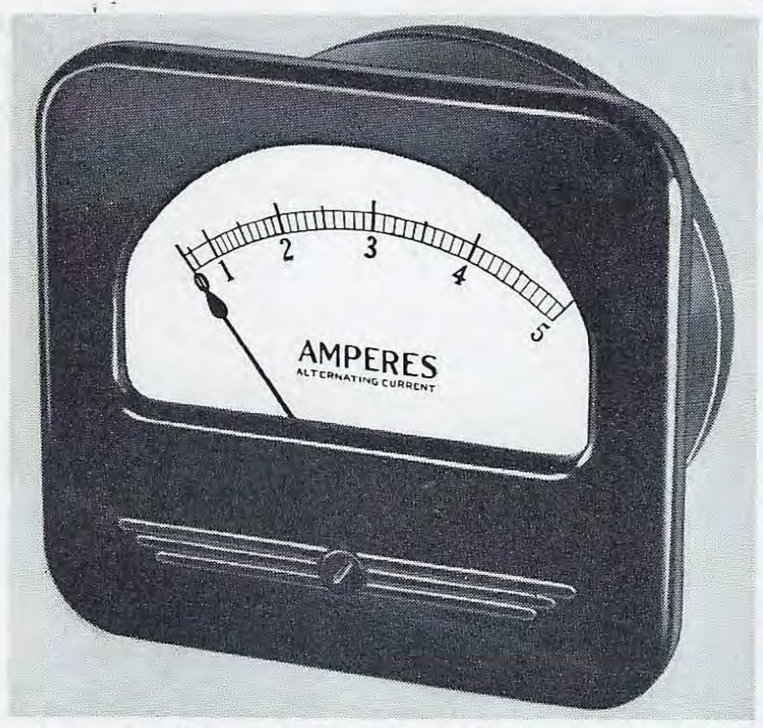


Fig. 1-C—Types QX-37, QC-37, QT-37 and QA-37
Rectangular Flush Mounting

Fig. 1—Illustrating Case Forms Used in the "37" Line of Panel Instruments

DATA

	RECTANGULAR FLUSH MOUNTING	RECTANGULAR PROJECTION MOUNTING	RECTANGULAR FLUSH MOUNTING
‡D-C. Types	RX-37	UX-37	QX-37
Rectox Types	RC-37	UC-37	QC-37
Radio Frequency Types	RT-37	UT-37	QT-37
**A-C. Types	RA-37	UA-37	QA-37
Case Material	Moldarta	Moldarta	Moldarta
Mounting	Flush-Bolted	Projection-Bolted	Flush-Bolted
Body Diameter	$3\frac{3}{4}''$	$3\frac{31}{32}'' \times 4\frac{7}{32}''$	$3\frac{3}{4}''$
Front Flange	$3\frac{31}{32}'' \times 4\frac{7}{32}''$	$3\frac{31}{32}'' \times 4\frac{7}{32}''$	$4\frac{7}{32}'' \times 3\frac{31}{32}''$
D-C. Scale Length	$3''$	$3''$	$3''$
A-C. Scale Length	$2\frac{5}{8}''$	$2\frac{5}{8}''$	$2\frac{5}{8}''$
Insulation Rating	750-V.	750-V.	750-V.
*Accuracy	±2%	±2%	±2%
†Net Wt. A-C. Types	10 oz.	12 oz.	10 oz.
†Net Wt. D-C. Types	15 oz.	17 oz.	15 oz.
†Net Wt. Cobalt Magnet D-C. Types	20 oz.	22 oz.	20 oz.

‡Permanent Magnet Moving Coil (D-C.) Types have electromagnetic damping.
**Repulsion Vane (A-C.) Types are air damped.
*Accuracy Rectox Types, 5%. Repulsion Vane Types when used on D-C., 3%.
†Weights are approximate and do not include shunts, resistors, etc.

Westinghouse Electric & Manufacturing Company
Newark Works, Newark, N. J.

Printed in U. S. A.
E-4, AJ-1, C-1, C.F.

MINIATURE PANEL INSTRUMENTS—Continued

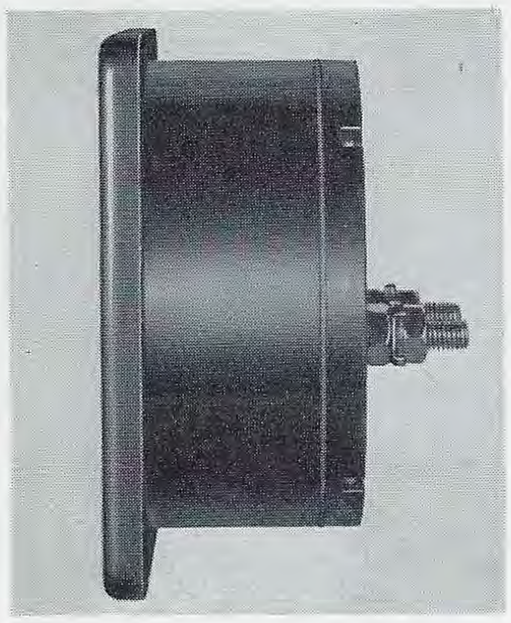


FIG. 2—SHOWING CASE FORM OF RECTANGULAR FLUSH INSTRUMENTS TYPE R-37

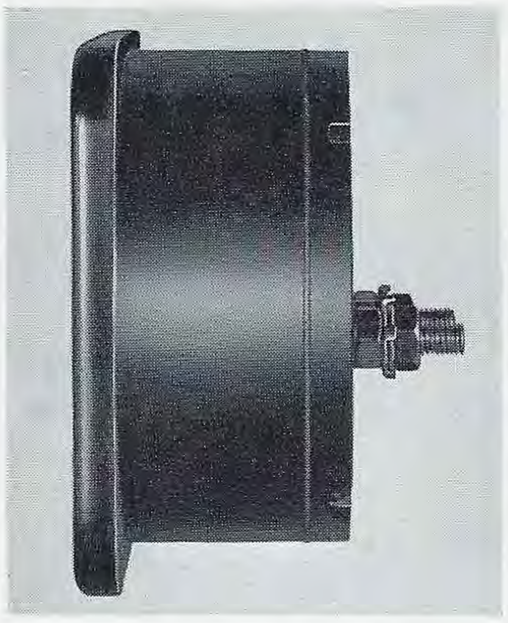


FIG. 3—CASE FORM OF RECTANGULAR FLUSH INSTRUMENTS TYPE Q-37

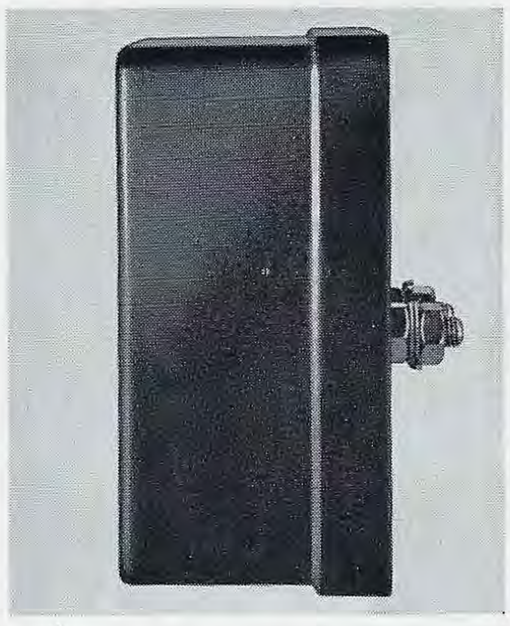


FIG. 4—CASE FORM OF RECTANGULAR PROJECTION INSTRUMENTS TYPE U-37

General

The Westinghouse 37 line of Panel Instruments is available as a complete line covering all industrial and radio applications in a variety of forms. All forms are available with alternating current or direct current movements. The ratings cover the broadest possible field consistent with prevailing requirements for instruments of this class. The line provides for the measurement of Direct Current: volts, amperes, milliamperes, microamperes; Rectox Types: power level, output; Thermocouple Types: radio frequency amperes and milliamperes; Alternating Current: volts, amperes and milliamperes.

The entire line of instruments employs but two types of mechanisms. This contributes to interchangeability of parts and permits of short delivery schedules on special and semi-standard forms. The cases are uniformly interchangeable for all forms, hence a rectangular flush instrument may be converted to projection rectangular by changing the case only.

Mechanisms are of the latest improved design having higher torque-weight ratios and low volt-ampere burdens. Capacities as low as 20 microamperes are available in moving coil types. Self-contained ammeters of 50 amperes and voltmeters of 200 volts are available, thus providing the economical maximum in variety of ratings with a minimum of external accessories.

Application

A broad field of application is covered by the Westinghouse line of 37 panel instruments. Some of these applications are briefly as follows:

1. Industrial Test Units for production testing of electrical apparatus.
2. Automotive Analyzers for testing electrical characteristics encountered in ignition, lighting and starting systems.
3. Battery Testers and Battery Chargers.
4. Radio Tube Testers and Set Analyzers.
5. Radio Transmitters, for plate and filament currents and voltages, output, distortion factor modulation and grid currents.
6. Radio experimenters and amateurs for general use in radio circuits.
7. Arc Welding Outfits.
8. Motion Picture Arc Lamp Control Panels.
9. Sound Movie equipment for measuring electric circuit characteristics.
10. Electrical Laboratories for general test work.
11. Ohmmeters for measuring resistance.

In application of panel instruments the influence of steel panels as well as the influence of one instrument upon the other and the influence of current carrying leads upon instrument indication must be considered. When mounted on insulated panels the panel influence need not be considered. When mounted on steel panels all miniature instruments must be so calibrated.

As a general rule the moving coil type of instruments must be at least 5″ apart between center lines and 8″ when one or more of the instruments have cobalt magnets.

The effect of one "A-37" repulsion vane instrument on another is negligible. Repulsion vane instruments should not be less than 6″ from leads carrying currents of the order of 50 amperes. This minimum distance increases or decreases with the current level in direct proportion.

If the above precautions are taken the influence between instruments, and of current carrying leads will be less than ½ of 1%. When the above spacings are impractical, smaller spacings may be used but the instruments must be so calibrated.

Operation and Construction

PERMANENT MAGNET MOVING COIL TYPES FOR DIRECT CURRENT CIRCUITS AND FOR RECTOX AND THERMAL TYPES

Operation—The d'Arsonval, or permanent-magnet moving-coil principle of operation is used. Numerous refinements in the design of this movement have been made; such as, soft iron pole tips welded to the permanent magnet in accurately aligned fixtures; improved springs; and an entirely new method of supporting the iron core in a one piece bracket which also supports the jewel bearings in perfect alignment. Provision is made for the use of extremely strong cobalt-steel magnets for super-sensitive microammeters.

Construction—A line of cases of flush and projection forms are now standard as shown on Page 1. The cases have partially open faces with attractive decorative fronts. No mounting screws are visible from the front.

Movements—The permanent magnets are made of high-quality tungsten steel or cobalt steel, properly heat-treated and aged. The soft-iron pole tips are accurately aligned and fastened to the permanent magnet by an electrical welding process, thus assuring perfect align-

MINIATURE PANEL INSTRUMENTS—Continued

ment and uniform air gap for the moving coil.

The iron core is accurately aligned by a one-piece bracket which supports the sapphire jewel bearings. These features of construction assure extremely accurate air gaps with the convenience of removal of the element from the pole pieces as a complete unit for easy repairing. This provides also uniform flux distribution and reduces the amount of energy consumed by the movement, making possible a super-sensitive instrument in the minature size.

Springs—The control springs used are the result of years of research into the behavior of spring materials. Special alloys together with proper heat treatment and ageing have resulted in a spring having negligible fatigue or set.

Dials—Standard dials are finished in matte silver, with black figures. The number of scale divisions and the size of the figures have been selected for greatest ease of reading and best appearance. Provision is made for multiscale markings where necessary.

Rectox Types—Rectox instruments are used for the measurement of alternating currents when low energy consumption is necessary. A copper-oxide, full-wave rectifier is mounted inside the instrument case, and connected to supply full-wave rectified current to the moving coil. The d'Arsonval instrument element deflects in proportion to the average value of the rectified wave. The dial is calibrated in terms of effective or root-mean-square values. A sensitivity of from 1000 to 10,000 ohms per volt can be obtained with rectifier-type instruments.

Zero Adjusters—Standard instruments are provided with external zero adjusters.

Pointers—The pointer and cross arms are made from strong aluminum alloy, resulting in minimum weight and maximum strength.

Pointer Stops—Pointer stops for both zero and full scale are standard equipment.

Removable Mechanism—All element parts are assembled on a one-piece frame which can be lifted readily from the instrument for inspection or replacement.

Insulation—The "37" line of miniature panel instruments are rated at 750 volts which corresponds to a test of 2500 volts between terminals and the panel.

Modifications Available—Special capacities and special dial markings not listed herein may be supplied to meet specific applications. Negotiations on instruments of this class are invited.

Operation and Construction

REPULSION VANE TYPES FOR A-C. CIRCUITS

Operation—The repulsion iron vane principle of operation is used. This movement is reasonably free from wave form and frequency errors. The current to be measured flows through a stationary coil. A molded chamber containing a stationary iron vane and a movable iron vane is placed within the stationary coil. The molded chamber acts as a support for the stationary vane, also for the bearings and shaft. The pointer is securely fastened to the shaft. Both

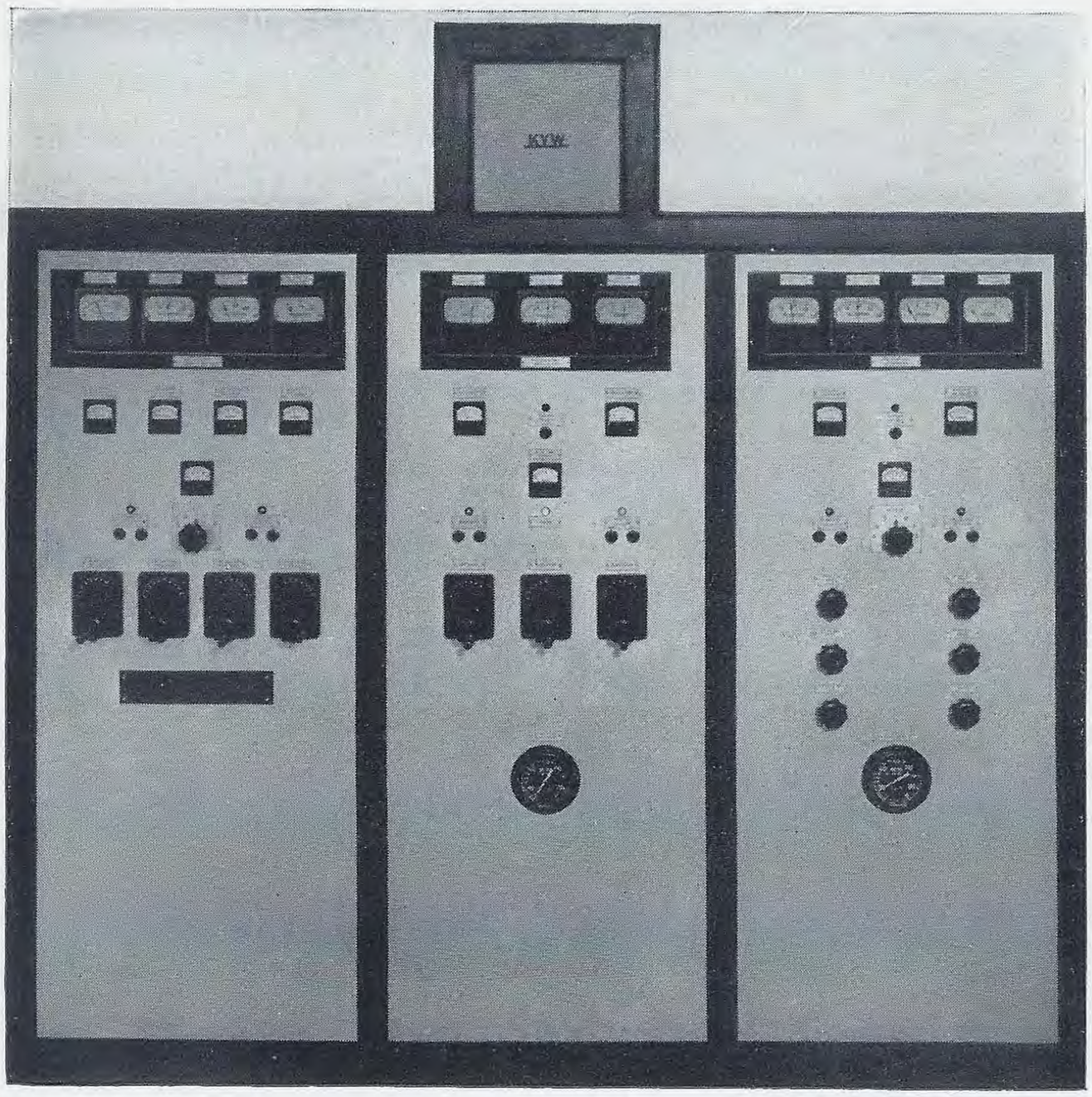


FIG. 5—TYPICAL ARRANGEMENT OF INSTRUMENTS ON A SECTION OF RADIO STATION KYW TRANSMITTER PANEL

MINIATURE PANEL INSTRUMENTS—Continued

vanes are of the same polarity at any instant and being polarized by the one stationary coil, repel each other. The movable vane thus moves away from the stationary vane against the torque of a phosphor-bronze control spring. For any given current in the coil an equilibrium point is reached when the forces of repulsion in the vanes just balance the torque of the control spring. The pointer indicates with reference to a scale calibrated in terms of the current or voltage applied to the instrument. Since the force of repulsion in the vanes is a function of the current in the coil, the instrument can be calibrated in terms of the current.

Construction — This movement is available in both flush and projection rectangular forms as shown on Page 1. The faces are partially open with attractive fronts from which mounting screws have been eliminated. Decorative stripes are employed on the fronts to give a pleasing appearance.

Movements—A new repulsion vane mechanism is used having a very sturdy construction, and incorporating an easy and reliable means of calibration. The entire movement may be removed for inspection without disconnecting leads or control springs. Calibration is effected by means of a screw which is accessible on the rear of the case. The new repulsion vane movement has been designed to give an unusually good scale distribution. Scale divisions are practically uniform from 10% scale deflection to full scale.

Springs—The control springs used are the result of years of research into the behavior of spring materials. Special alloys together with proper heat treatment and ageing have resulted in a spring having negligible fatigue or set.

Bearings and Pivots—Genuine sapphire jewels are used. They are ground and highly polished and checked for contour and dimensions by a special process.

Pivots are made of high-grade steel specially treated and polished. Radius and polish are also checked by special processes developed from years of experience in instrument manufacture.

Dials—Standard dials are finished in matte silver, with black figures. The number of scale divisions and the size of the figures have been selected for the greatest ease in reading and best appearance. Provision is made for multi-scale markings where necessary.

Zero Adjusters—All instruments are provided with external zero adjusters.

Pointers—The pointer is equipped with cross arms to receive special coiled wire balance weights which are easily adjusted and are self-locking. The pointers are of aluminum alloy.

Removable Mechanism—All moving element parts are assembled to a one-piece molded chamber which can easily be removed as a unit for inspection or repair.

Insulation—The "37" line of miniature panel instruments are rated at 750 volts which corresponds to a test of 2500 volts between terminals and panel.

Modifications Available—Special capacities and special dial markings, not listed herein, may be supplied to meet specific applications. Negotiations on instruments of this class are invited.

LIST PRICES
DIRECT CURRENT INSTRUMENTS
TYPES RX-37, UX-37, QX-37

All instruments listed below are calibrated for use on non-magnetic panels. When ordering for use on steel panels, panel thickness must be specified.

D-C. AMMETERS
Calibrated for 50 M.V. External Shunts

Rating	Scale Div.	Approx. Resist.	RX-37 Style No.	UX-37 Style No.	QX-37 Style No.	List Price Discount Symbol AC
50 M.V.	To suit	....	1 058 000	1 058 234	1 058 470	$12 00

Above styles are for left zero. Center zero instruments are furnished at same price. Instruments may be calibrated for shunts from 5 to 20,000 amps. Above styles cover instrument and leads only.

D-C. AMMETERS
Self-Contained

1	50	....	1 058 002	1 058 236	1 058 472	12 00
1.5	75	....	1 058 003	1 058 237	1 058 473	12 00
2	40	....	1 058 004	1 058 238	1 058 474	12 00
2.5	50	....	1 058 005	1 058 239	1 058 475	12 00
3	60	....	1 058 006	1 058 240	1 058 476	12 00
4	40	....	1 058 007	1 058 241	1 058 477	12 00
5	50	....	1 058 008	1 058 242	1 058 478	12 00
6	60	....	1 058 009	1 058 243	1 058 479	12 00
8	40	....	1 058 010	1 058 244	1 058 480	12 00
10	50	....	1 058 011	1 058 245	1 058 481	12 00
15	75	....	1 058 012	1 058 246	1 058 482	12 00
20	40	....	1 058 013	1 058 247	1 058 483	12 00
25	50	....	1 058 014	1 058 248	1 058 484	12 00
30	60	....	1 058 015	1 058 249	1 058 485	12 00
40	40	....	1 058 016	1 058 250	1 058 486	12 00
50	50	....	1 058 017	1 058 251	1 058 487	12 00
60	60	....	1 058 018	1 058 252	1 058 488	12 00

Instruments in this group are shunted internally and have a drop of 50 M.V. ± 10%.

Prices and discounts subject to change without notice.

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

DIRECT CURRENT INSTRUMENTS—TYPES RX-37, UX-37 and QX-37—Continued

D-C. MILLI-AMMETERS
Self-Contained

Rating	Scale Div.	Approx. Resist.	RX-37 Style No.	UX-37 Style No.	QX-37 Style No.	List Price Discount Symbol AC
1	50	57.2	1 058 019	1 058 253	1 058 489	$13 00
1.5	75	38.6	1 058 020	1 058 254	1 058 490	13 00
2	40	15.1	1 058 021	1 058 255	1 058 491	13 00
2.5	50	12.4	1 058 022	1 058 256	1 058 492	13 00
3	60	10.4	1 058 023	1 058 257	1 058 493	13 00
4	40	8.3	1 058 024	1 058 258	1 058 494	13 00
5	50	3.7	1 058 025	1 058 259	1 058 495	12 00
6	60	2.4	1 058 026	1 058 260	1 058 496	12 00
8	40	3.9	1 058 027	1 058 261	1 058 497	12 00
10	50	2.1	1 058 028	1 058 262	1 058 498	12 00
15	75	1.5	1 058 029	1 058 263	1 058 499	12 00
20	40	....	1 058 030	1 058 264	1 058 500	12 00
25	50	....	1 058 031	1 058 265	1 058 501	12 00
30	60	....	1 058 032	1 058 266	1 058 502	12 00
40	40	....	1 058 033	1 058 267	1 058 503	12 00
50	50	....	1 058 034	1 058 268	1 058 504	12 00
60	60	....	1 058 035	1 058 269	1 058 505	12 00
80	40	....	1 058 036	1 058 270	1 058 506	12 00
100	50	....	1 058 037	1 058 271	1 058 507	12 00
150	75	....	1 058 038	1 058 272	1 058 508	12 00
200	40	....	1 058 039	1 058 273	1 058 509	12 00
250	50	....	1 058 040	1 058 274	1 058 510	12 00
300	60	....	1 058 041	1 058 275	1 058 511	12 00
400	40	....	1 058 042	1 058 276	1 058 512	12 00
500	50	....	1 058 043	1 058 277	1 058 513	12 00
600	60	....	1 058 044	1 058 278	1 058 514	12 00
800	40	....	1 058 045	1 058 279	1 058 515	12 00

Milli-ammeters of ratings of 20 and above are shunted internally and have a drop of 50 M.V. ±10%. Center zero milli-ammeters are furnished at same prices.

D-C. MILLI-AMMETERS
Double Range, Three Terminals
Self-Contained

15-150*	75	7.2–1.86	1 058 046	1 058 280	1 058 516	17 00
30-150*	75	9.9–2.52	1 058 047	1 058 281	1 058 517	17 00

* Other ratings may be furnished on special order.

D-C. MICROAMMETERS**
Self-Contained

20	40	2180	1 058 048	1 058 282	1 058 518	29 00
25	50	2180	1 058 049	1 058 283	1 058 519	29 00
30	60	1810	1 058 050	1 058 284	1 058 520	29 00
40	40	885	1 058 051	1 058 285	1 058 521	27 50
50	50	426	1 058 052	1 058 286	1 058 522	26 50
60	60	341	1 058 053	1 058 287	1 058 523	26 50
80	40	183	1 058 054	1 058 288	1 058 524	26 50
100	50	71	1 058 055	1 058 289	1 058 525	24 00
150	75	1450	1 058 056	1 058 290	1 058 526	21 00
200	40	1080	1 058 057	1 058 291	1 058 527	19 50
250	50	560	1 058 058	1 058 292	1 058 528	19 50
300	60	371	1 058 059	1 058 293	1 058 529	19 50
400	40	228	1 058 060	1 058 294	1 058 530	19 50
500	50	110	1 058 061	1 058 295	1 058 531	19 50
600	60	93	1 058 062	1 058 296	1 058 532	19 50
800	40	57	1 058 063	1 058 297	1 058 533	19 50

** Microammeters below 500 microapmeres depend upon the external circuit for damping. Ratings of 100 and lower have cobalt magnets.

Prices and discounts subject to change without notice.

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

DIRECT CURRENT INSTRUMENTS—TYPES RX-37, UX-37 and QX-37—Continued

D-C. VOLTMETERS
Self-Contained
Resistance 200 Ohms per Volt
Single Range

Rating	Scale Div.	Approx. Resist.	RX-37 Style No.	UX-37 Style No.	QX-37 Style No.	List Price Discount Symbol AC
1	50	....	1 058 136	1 058 370	1 058 606	$12 00
1.5	75	....	1 058 137	1 058 371	1 058 607	12 00
2	40	....	1 058 138	1 058 372	1 058 608	12 00
2.5	50	....	1 058 139	1 058 373	1 058 609	12 00
3	60	....	1 058 140	1 058 374	1 058 610	12 00
4	40	....	1 058 141	1 058 375	1 058 611	12 00
5	50	....	1 058 142	1 058 376	1 058 612	12 00
6	60	....	1 058 143	1 058 377	1 058 613	12 00
8	40	....	1 058 144	1 058 378	1 058 614	12 00
10	50	....	1 058 145	1 058 379	1 058 615	12 00
15	75	....	1 058 146	1 058 380	1 058 616	12 00
20	40	....	1 058 147	1 058 381	1 058 617	12 00
25	50	....	1 058 148	1 058 382	1 058 618	12 00
30	60	....	1 058 149	1 058 383	1 058 619	12 00
40	40	....	1 058 150	1 058 384	1 058 620	12 00
50	50	....	1 058 151	1 058 385	1 058 621	12 00
60	60	....	1 058 152	1 058 386	1 058 622	12 00
80	40	....	1 058 153	1 058 387	1 058 623	12 00
100	50	....	1 058 154	1 058 388	1 058 624	13 00
150	75	....	1 058 155	1 058 389	1 058 625	14 25
200	40	....	1 058 156	1 058 390	1 058 626	16 00
250	50	....	1 058 157	1 058 391	1 058 627	17 50
300	60	....	1 058 158	1 058 392	1 058 628	19 50
400	40	....	1 058 159	1 058 393	1 058 629	21 00
500	50	....	1 058 160	1 058 394	1 058 630	22 50

D-C. VOLTMETERS
Self-Contained
Resistance 1000 Ohms per Volt
Single Range

1	50	....	1 058 161	1 058 395	1 058 631	15 00
1.5	75	....	1 058 162	1 058 396	1 058 632	15 00
2	40	....	1 058 163	1 058 397	1 058 633	15 00
2.5	50	....	1 058 164	1 058 398	1 058 634	15 00
3	60	....	1 058 165	1 058 399	1 058 635	15 00
4	40	....	1 058 166	1 058 400	1 058 636	15 00
5	50	....	1 058 167	1 058 401	1 058 637	15 00
6	60	....	1 058 168	1 058 402	1 058 638	15 00
8	40	....	1 058 169	1 058 403	1 058 639	15 00
10	50	....	1 058 170	1 058 404	1 058 640	15 00
15	75	....	1 058 171	1 058 405	1 058 641	15 00
20	40	....	1 058 172	1 058 406	1 058 642	15 00
25	50	....	1 058 173	1 058 407	1 058 643	15 00
30	60	....	1 058 174	1 058 408	1 058 644	15 00
40	40	....	1 058 175	1 058 409	1 058 645	15 00
50	50	....	1 058 176	1 058 410	1 058 646	15 00
60	60	....	1 058 177	1 058 411	1 058 647	15 00
80	40	....	1 058 178	1 058 412	1 058 648	15 00
100	50	....	1 058 179	1 058 413	1 058 649	15 50
150	75	....	1 058 180	1 058 414	1 058 650	16 25
200	40	....	1 058 181	1 058 415	1 058 651	17 00
250	50	....	1 058 182	1 058 416	1 058 652	17 50
300	60	....	1 058 183	1 058 417	1 058 653	18 00
400	40	....	1 058 184	1 058 418	1 058 654	19 00
500	50	....	1 058 185	1 058 419	1 058 655	20 25
600	60	....	1 058 186	1 058 420	1 058 656	21 25
800	40	....	1 058 187	1 058 421	1 058 657	22 25
1000	50	....	1 058 188	1 058 422	1 058 658	24 00
1500*	75	....	1 058 189	1 058 423	1 058 659	39 50
2000*	40	....	1 058 190	1 058 424	1 058 660	48 00
2500*	50	....	1 058 191	1 058 425	1 058 661	56 00
3000*	60	....	1 058 192	1 058 426	1 058 662	64 00
4000*	40	....	1 058 193	1 058 427	1 058 663	80 00
5000*	50	....	1 058 194	1 058 428	1 058 664	96 00

* Supplied with external resistor. The Instruments are self-contained for 150 volts (150,000 ohms). The balance of the resistance is external.

Prices and discounts subject to change without notice.

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

DIRECT CURRENT INSTRUMENTS—TYPES RX-37, UX-37 and QX-37—Continued

D-C. VOLTMETERS
Resistance 1000 Ohms per Volt
Double Range, Three Terminal, Self-Contained

Rating	Scale Div.	Approx. Resist.	RX-37 Style No.	UX-37 Style No.	QX-37 Style No.	List Price Discount Symbol AC
0–8–200	40	....	1 058 195	1 058 429	1 058 665	$18 00
0–30–150	75	....	1 058 196	1 058 430	1 058 666	18 00
0–50–250	50	....	1 058 197	1 058 431	1 058 667	18 00

D-C. VOLTMETERS
Resistance 1000 Ohms per Volt
Four Range—Two Terminal

0–5–25–100–500*	..	....	1 058 198	1 058 432	1 058 668	22 25
0–10–50–250–1000*	..	....	1 058 706	1 058 433	1 058 669	28 00

* Supplied with external resistor, self-contained for lowest range.

D-C. MILLIVOLTMETERS
Self-Contained

5‡	50	15.2	1 058 064	1 058 298	1 058 534	26 50
6‡	60	14.3	1 058 065	1 058 299	1 058 535	26 50
8‡	40	12.9	1 058 066	1 058 300	1 058 536	26 50
10	50	5.4	1 058 067	1 058 301	1 058 537	24 00
15	75	7.35	1 058 068	1 058 302	1 058 538	24 00
20	40	7.15	1 058 069	1 058 303	1 058 539	24 00
25	50	3.13	1 058 070	1 058 304	1 058 540	24 00
30	60	3.75	1 058 071	1 058 305	1 058 541	24 00
40	40	5.	1 058 072	1 058 306	1 058 542	24 00
50	50	3.8	1 058 073	1 058 307	1 058 543	24 00
100	50	7.6	1 058 074	1 058 308	1 058 544	24 00
500	50	37.9	1 058 075	1 058 309	1 058 545	21 00

‡ Ratings of 8 millivolts and lower have cobalt magnets.

RECTOX INSTRUMENTS
TYPES RC-37, UC-37, QC-37

RECTOX MICROAMMETERS
Self-Contained

Rating	Scale Div.	Approx. Resist.	RC-37 Style No.	UC-37 Style No.	QC-37 Style No.	List Price Discount Symbol AC
80†	40	....	1 058 076	1 058 310	1 058 546	$33 00
200	40	....	1 058 077	1 058 311	1 058 547	22 25
500	50	....	1 058 078	1 058 312	1 058 548	22 25

† This range has expanded lower scale and is particularly suited for use as an A-C. Galvanometer.

RECTOX MILLIAMMETERS
Self-Contained

1	50	....	1 058 079	1 058 313	1 058 549	18 00
2	40	....	1 058 080	1 058 314	1 058 550	18 00
5	50	....	1 058 081	1 058 315	1 058 551	17 00
10	50	....	1 058 082	1 058 316	1 058 552	17 00
15	75	....	1 058 083	1 058 317	1 058 553	17 00

RECTOX VOLTMETERS⁂
Resistance 1000 Ohms per Volt
Single Range, Self-Contained

4⁂	40	....	1 058 084	1 058 318	1 058 554	20 00
5	50	....	1 058 085	1 058 319	1 058 555	20 00
10	50	....	1 058 086	1 058 320	1 058 556	20 00
15	75	....	1 058 087	1 058 321	1 058 557	20 00
50	50	....	1 058 088	1 058 322	1 058 558	20 00
100	50	....	1 058 089	1 058 323	1 058 559	20 50
150	75	....	1 058 090	1 058 324	1 058 560	22 00
300	60	....	1 058 091	1 058 325	1 058 561	23 00

⁂ Below 4 volts, Rectox Voltmeters should have a resistance of 2000 or 5000 ohms per volt.

RECTOX VOLTMETERS⁂
Resistance 1000 Ohms per Volt
Multi-Range, Two Terminal

5–10–200–1000⁂*	50	....	1 058 105	1 058 339	1 058 575	33 00

* External resistor is used, low range is self-contained.

⁂ Below 4 volts, Rectox Voltmeters should have a resistance of 2000 or 5000 ohms per volt.

Prices and discounts subject to change without notice.

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

RECTOX INSTRUMENTS—TYPES RC-37, UC-37 and QC-37—Continued

RECTOX VOLTMETERS
Resistance 2000 Ohms per Volt
Self-Contained

Rating	Scale Div.	Approx. Resist.	RC-37 Style No.	UC-37 Style No.	QC-37 Style No.	List Price Discount Symbol AC
1.5	75	....	1 058 092	1 058 326	1 058 562	$22 25
2	40	....	1 058 093	1 058 327	1 058 563	22 25
2.5	50	....	1 058 094	1 058 328	1 058 564	22 25
3	60	....	1 058 095	1 058 329	1 058 565	22 25
5	50	....	1 058 096	1 058 330	1 058 566	22 25
10	50	....	1 058 097	1 058 331	1 058 567	22 25
15	75	....	1 058 098	1 058 332	1 058 568	22 25
50	50	....	1 058 099	1 058 333	1 058 569	22 75
100	50	....	1 058 100	1 058 334	1 058 570	24 50
150	75	....	1 058 101	1 058 335	1 058 571	24 50
300	60	....	1 058 102	1 058 336	1 058 572	26 00

RECTOX VOLTMETERS
Resistance 5000 Ohms per Volt
Self-Contained

0.5	50	....	1 058 103	1 058 337	1 058 573	22 25
1	50	....	1 058 104	1 058 338	1 058 574	22 25

RADIO FREQUENCY INSTRUMENTS
TYPES RT-37, UT-37, QT-37

RADIO FREQUENCY AMMETER
Self-Contained

Rating	Scale Div.	Approx. Resist.	RT-37 Style No.	UT-37 Style No.	QT-37 Style No.	List Price Discount Symbol AC
1	..	....	1 058 114	1 058 348	1 058 584	$19 00
1.5	..	....	1 058 115	1 058 349	1 058 585	19 00
2	..	....	1 058 116	1 058 350	1 058 586	19 00
2.5	..	....	1 058 117	1 058 351	1 058 587	19 00
3	..	....	1 058 118	1 058 352	1 058 588	19 00
4	..	....	1 058 119	1 058 353	1 058 589	19 00
5	..	....	1 058 120	1 058 354	1 058 590	19 00
6	..	....	1 058 121	1 058 355	1 058 591	19 00
8	..	....	1 058 122	1 058 356	1 058 592	19 00
10	..	....	1 058 123	1 058 357	1 058 593	19 00
15	..	....	1 058 124	1 058 358	1 058 594	19 00
20	..	....	1 058 125	1 058 359	1 058 595	19 00

RADIO FREQUENCY MILLIAMMETERS†
Self-Contained

100	..	....	1 058 127	1 058 361	1 058 597	21 00
150	..	....	1 058 128	1 058 362	1 058 598	21 00
200	..	....	1 058 129	1 058 363	1 058 599	21 00
250	..	....	1 058 130	1 058 364	1 058 600	21 00
300	..	....	1 058 131	1 058 365	1 058 601	21 00
400	..	....	1 058 132	1 058 366	1 058 602	21 00
500	..	....	1 058 133	1 058 367	1 058 603	21 00
600	..	....	1 058 134	1 058 368	1 058 604	19 00
800	..	....	1 058 135	1 058 369	1 058 605	19 00

† Standard Radio Frequency instruments are suitable for frequencies up to and including six megacycles. Low loss instruments are furnished in all self-contained ratings at $5.00 additional list.

RADIO FREQUENCY AMMETER
Calibrated for use with External Thermocouple

*To suit Thermo-couple	..	....	1 058 126	1 058 360	1 058 596	13 00

* List price includes the ammeter calibrated with 4 ft. leads, but not the thermocouple. Radio-frequency ammeters are available with external thermocouples in all ranges from 1 to 50 amps. inclusive. When long leads are used between the instrument and the thermocouple, it is usually necessary to place proper by-pass condensers and radio-frequency chokes in the circuit at the thermocouple to prevent damage to the thermocouple by radio-frequency in the instrument leads.

Prices and discounts subject to change without notice.

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

LIST PRICES—Continued

RADIO FREQUENCY INSTRUMENTS—TYPES RT-37, UT-37 and QT-37—Continued

EXTERNAL THERMOCOUPLES
For Radio Frequency Ammeters
Air Type

Rating	Style No.	List Price Discount Symbol AC	Rating	Style No.	List Price Discount Symbol AC
1	878 638	$12 00	10	878 647	$12 00
1.5	878 639	12 00	15	878 648	12 00
2	878 640	12 00	20	878 649	12 00
2.5	878 641	12 00	25	878 650	12 00
3	878 642	12 00	30	878 651	14 50
4	878 643	12 00	35	878 652	14 50
5	878 644	12 00	40	878 653	14 50
6	878 645	12 00	50	878 654	14 50
8	878 646	12 00			

External thermocouples may be used with radio-frequency ammeters designed for the purpose and listed with the various types of instruments. Each instrument and thermocouple must be calibrated together.

ALTERNATING CURRENT INSTRUMENTS
TYPES RA-37, UA-37, QA-37

All instruments listed below are calibrated for use on non-magnetic panels. When ordering for use on steel panels, panel thickness must be specified.

A-C. AMMETERS
Self-Contained
For Frequencies of 15 to 500 Cycles

Rating	Scale Div.	F.S. Burden V.A. at 60 Cy.	RA-37 Style No.	UA-37 Style No.	QA-37 Style No.	List Price Discount Symbol AC
1	50	.17	1 058 199	1 058 434	1 058 670	$12 00
2.5	50	.25	1 058 200	1 058 435	1 058 671	12 00
5	50	.25	1 058 201	1 058 436	1 058 672	12 00
6	60	.25	1 058 202	1 058 437	1 058 673	12 00
10	50	.50	1 058 203	1 058 438	1 058 674	12 00
15	75	.50	1 058 204	1 058 439	1 058 675	12 00
25	50	.65	1 058 205	1 058 440	1 058 676	12 00
50	50	.75	1 058 707	1 058 441	1 058 677	12 00

A-C. MILLIAMMETERS
Self-Contained
For Frequencies of 15 to 500 Cycles

5	50	.17	1 058 223	1 058 459	1 058 695	13 00
10	50	.17	1 058 224	1 058 460	1 058 696	12 00
15	75	.15	1 058 225	1 058 461	1 058 697	12 00
25	50	.14	1 058 226	1 058 462	1 058 698	12 00
50	50	.14	1 058 227	1 058 463	1 058 699	12 00
100	50	.15	1 058 228	1 058 464	1 058 700	12 00
250	50	.17	1 058 229	1 058 465	1 058 701	12 00
500	50	.17	1 058 230	1 058 466	1 058 702	12 00

A-C. VOLTMETERS
Single Range
For Frequencies of 25-200 Cycles*

1.5	75	.75	1 058 206	1 058 442	1 058 678	12 00
2	40	1	1 058 207	1 058 443	1 058 679	12 00
3	60	.75	1 058 208	1 058 444	1 058 680	12 00
5	50	1.25	1 058 209	1 058 445	1 058 681	12 00
7.5	75	.75	1 058 210	1 058 446	1 058 682	12 00
10	50	1	1 058 211	1 058 447	1 058 683	12 00
15	75	1.5	1 058 212	1 058 448	1 058 684	12 00
25	50	1.25	1 058 213	1 058 449	1 058 685	12 00
50	50	1.25	1 058 214	1 058 450	1 058 686	12 00
75	75	1.12	1 058 215	1 058 451	1 058 687	12 00
150	75	1.50	1 058 216	1 058 452	1 058 688	14 25
250	50	1.25	1 058 217	1 058 453	1 058 689	17 50
350	70	1.75	1 058 218	1 058 454	1 058 690	20 50
500	50	2.50	1 058 219	1 058 455	1 058 691	22 50
600†	60	3.00	1 058 220	1 058 456	1 058 692	24 50
750†	75	3.75	1 058 221	1 058 457	1 058 693	26 50
1000†	50	5.00	1 058 222	1 058 458	1 058 694	31 00

* Voltmeters for use on frequencies of 200-600 cycles can be furnished at same prices.
† Self-contained up to and including 500 volts. Higher ratings have external resistors.

A-C. VOLTMETERS
Triple Range, Self-Contained, Four Terminal

4–8–150	40–75	....	1 058 231	1 058 467	1 058 703	18 50
3–15–150	60–75	....	1 058 232	1 058 468	1 058 704	18 50
4–8–300	40–60	....	1 058 233	1 058 469	1 058 705	20 50

Prices and discounts subject to change without notice.

Order by Style Number

MINIATURE PANEL INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

Rectangular Forms

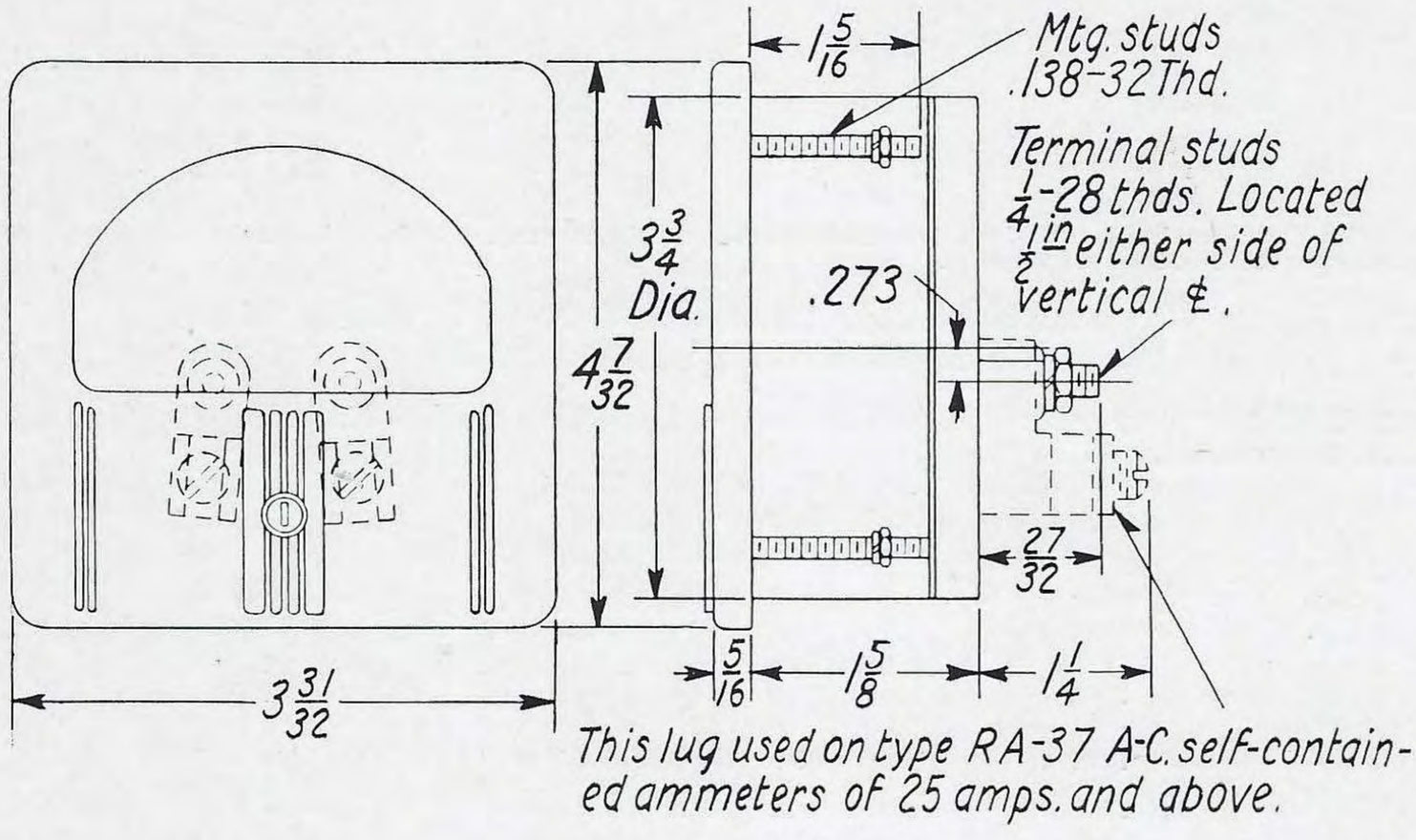


FIG. 6—TYPES RX-37, RC-37, RT-37 AND RA-37 INSTRUMENTS

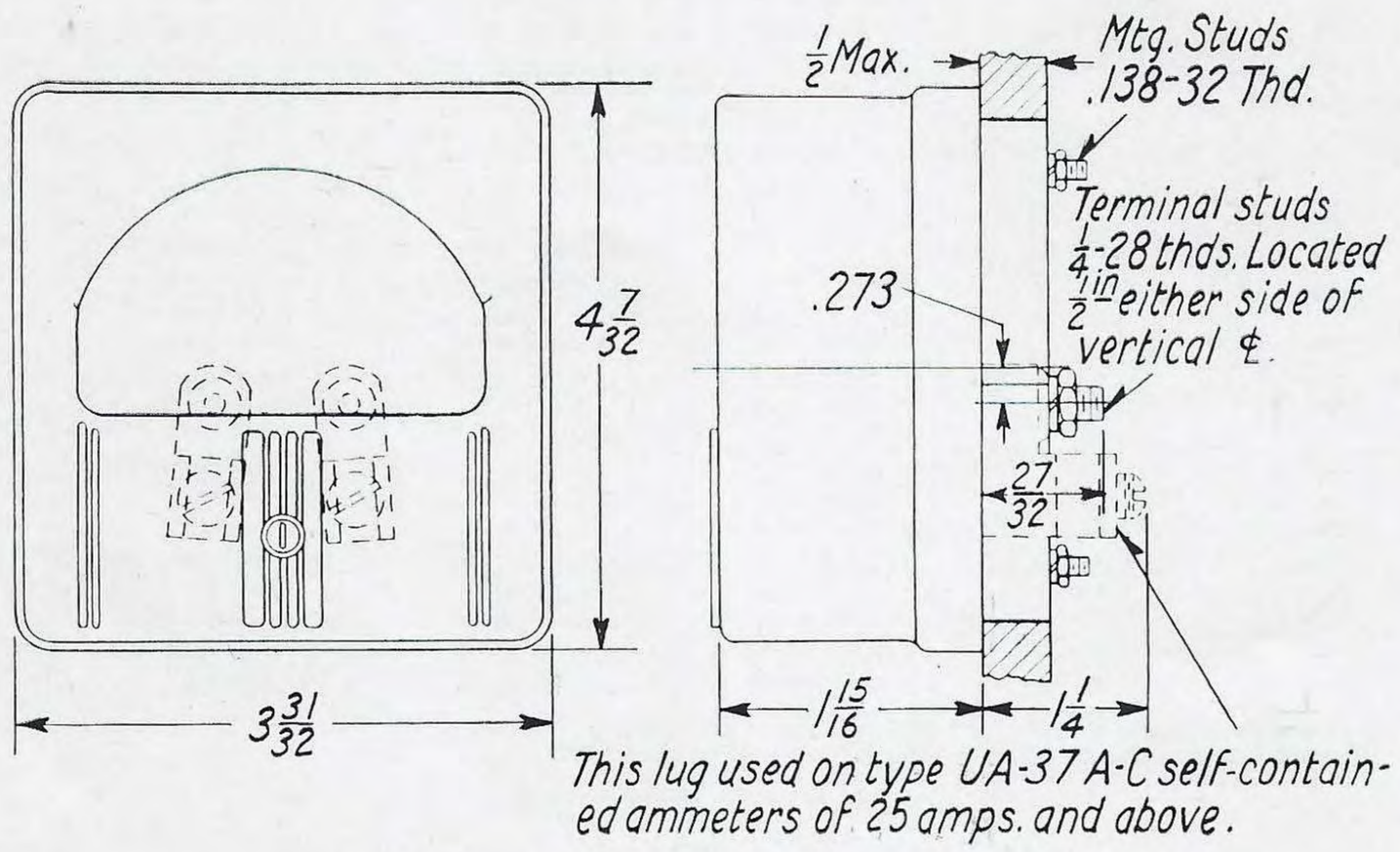


FIG. 7—TYPES UX-37, UC-37, UT-37 AND UA-37 INSTRUMENTS

MINIATURE PANEL INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales Office.

Rectangular Forms—Continued

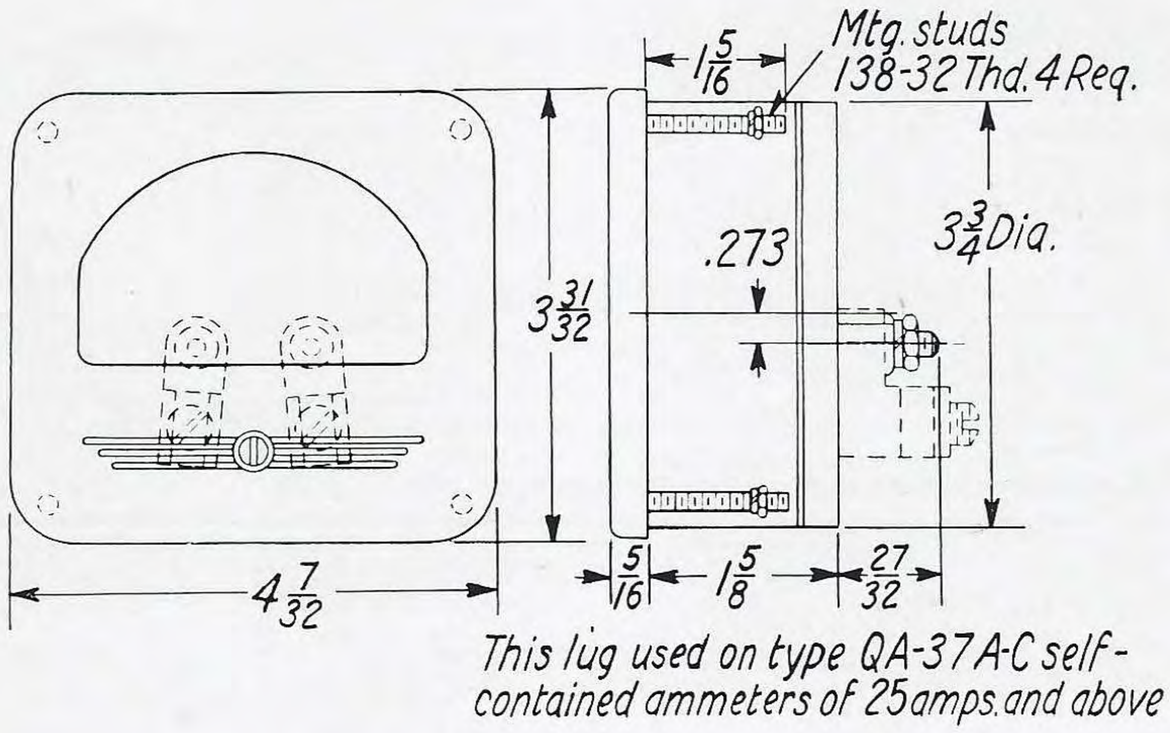
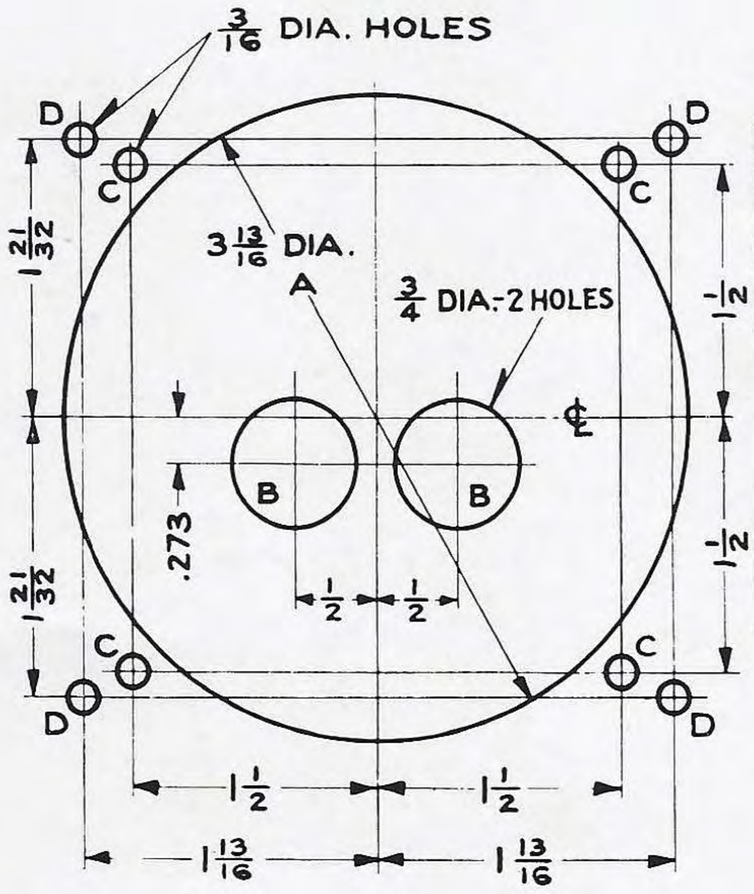


FIG. 8—TYPES QX-37, QC-37, QT-37 AND QA-37 INSTRUMENTS



TYPE	REMARKS	PANEL	HOLES
RX-37	ALL RANGES	ANY	A-C
UX-37	ALL RANGES	INSUL.	B-C
UX-37	ALL RANGES	METAL	A-C
RA-37	ALL RANGES	ANY	A-C
UA-37	BELOW 25 AMP.	INSUL.	B-C
UA-37	25 TO 50 AMP.	INSUL.	A-C
UA-37	BELOW 25 AMP.	METAL	A-C
QA-37	ALL RANGES	ANY	A-D
QX-37	ALL RANGES	ANY	A-D

FIG. 9—TYPE 37 INSTRUMENTS DRILLING PLAN, AS SEEN FROM FRONT OF PANEL, DIMENSIONS IN INCHES

MINIATURE PANEL INSTRUMENTS—Continued

EXTERNAL WIRING DIAGRAMS

(As seen from the rear of the instrument)

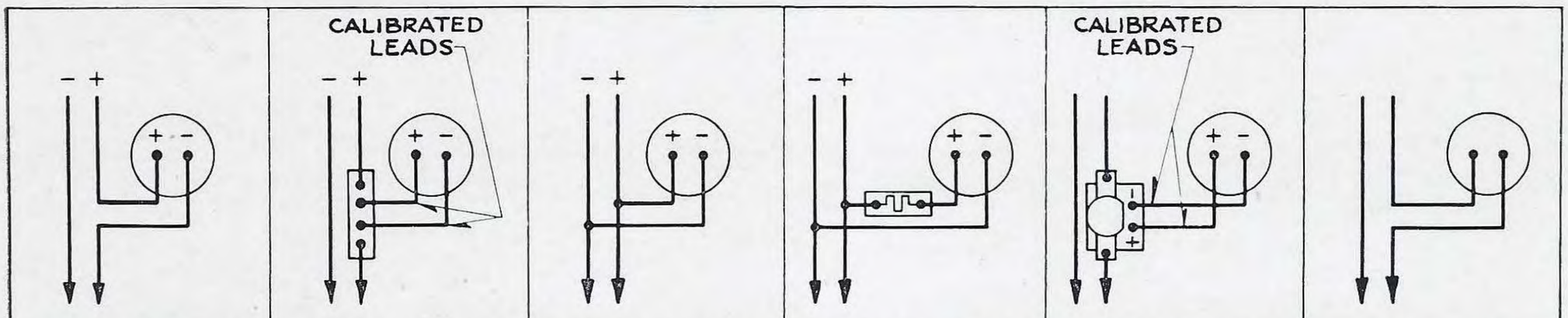


FIG. 1 - X-37 AMMETER OR MILLIAMMETER SELF-CONTAINED.

FIG. 2 - X-37 AMMETER WITH EXTERNAL SHUNT.

FIG. 3 - X-37 VOLTMETER SELF-CONTAINED. FOR C-37 RECTOX VOLTMETER OMIT POLARITY SIGNS.

FIG. 4 - X-37 VOLTMETER WITH EXTERNAL RESISTOR.

FIG. 5 - T-37 AMMETER WITH EXTERNAL THERMOCOUPLE.

FIG. 6 - T-37 AMMETER OR C-37 MILLIAMMETER SELF-CONTAINED.

EXTERNAL WIRING DIAGRAM
X-37 D'ARSONVAL - C-37 RECTOX - T-37 THERMOCOUPLE
LEFT REAR TERMINAL IS GROUNDED TO INSTRUMENT CHASSIS.

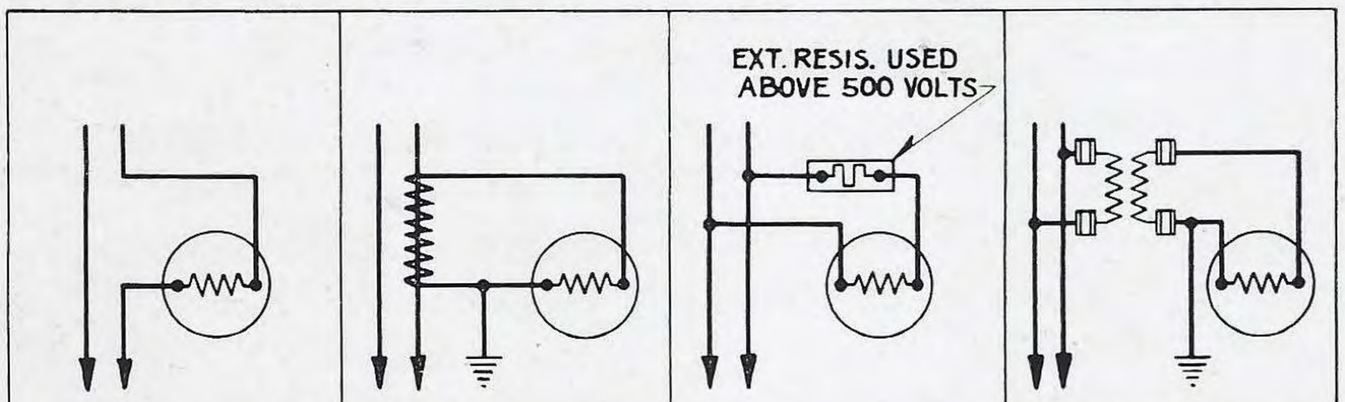


FIG. 7 - A-37 SELF-CONTAINED AMMETER OR MILLIAMMETER.

FIG. 8 - A-37 AMMETER WITH CURRENT TRANSFORMER.

FIG. 9 - A-37 VOLTMETER

FIG. 10 - A-37 VOLTMETER WITH POTENTIAL TRANSFORMER.

EXTERNAL WIRING DIAGRAM
A-37 REPULSION IRON
LEFT REAR TERMINAL IS GROUNDED TO INSTRUMENT CHASSIS.

FIG. 10—TYPE 37 INSTRUMENTS

RECORDING INSTRUMENTS

DIRECT ACTING—STRIP CHART

TYPES GX-40 AND GY-40

Switchboard and Portable Forms
Direct Current and Alternating Current

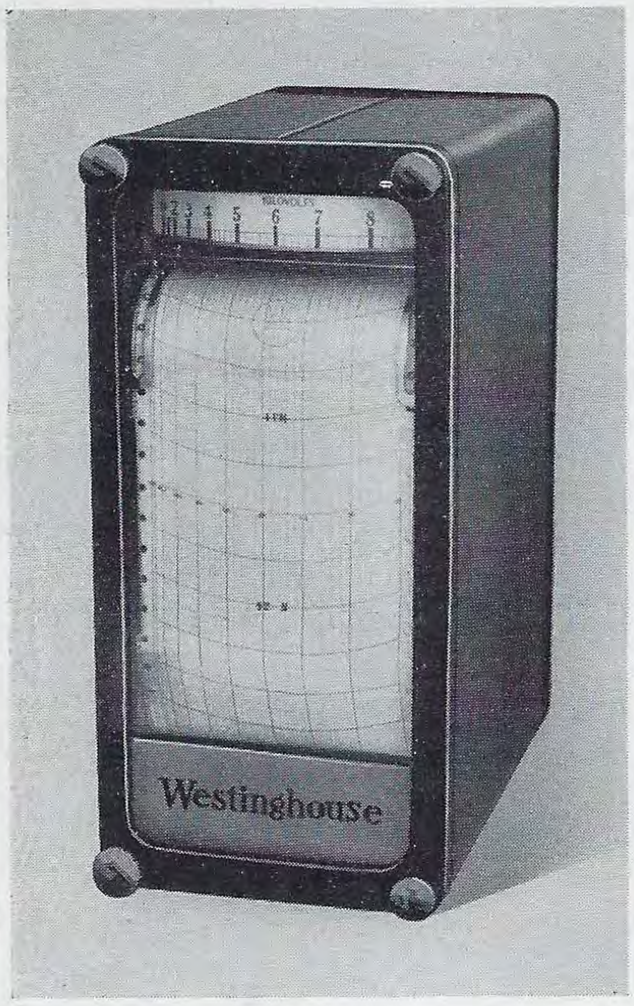


Fig. 1—Type GY-40 Switchboard Recording A-C. Kilovolt Meter

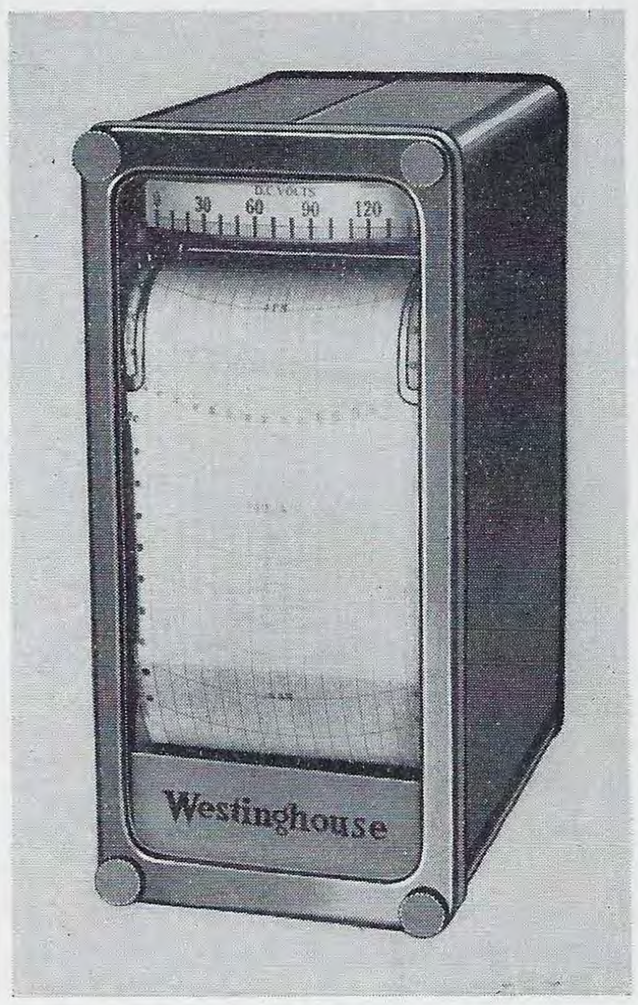


Fig. 2—Type GX-40 Switchboard Recording D-C. Voltmeter

DATA

Mounting	Switchboard (projection) and portable.
Case Material	Pressed steel, black baked enamel finish.
Case Size	5½" wide, 12" high, 9" deep.
Movements Direct Current	Permanent magnet, moving coil TYPE GX-40 for D-C. volts and amperes. Single element, iron core dynamometer TYPE GY-40 for D-C. self-contained watts.
Movements Alternating Current	Single element, iron core dynamometer TYPE GY-40 for A-C. volts, amps. and single phase watts. Double element, iron core dynamometer TYPE GY-40 for A-C. watts, vars, magnetic.
Damping	Critical.
Response	¾ to 1¼ seconds.
Insulation Rating	750 Volts.
Chart	4 7/16" wide, 4" scale, (for length see p.).
Chart Speeds	¾", 1½" (3" standard) and 6" per hour, (and per minute by manual trip.).
Chart Speed Change Gears	Complete set for above speeds furnished with each recorder.
Clocks	Synchronous motor driven. Spring driven, 8 day, handwound.
Shielding	Shielded against external magnetic and static fields.
Accuracy	**Permanent magnet moving coil types:** D-C. self contained ammeters (max. capacity 80 A.)....Within 1%. D-C. shunt operated (100 M.V.) ammeters....Within 1½%. D-C. voltmeters and milliammeters....Within 1%. **Single element Dynamometer types:** A-C. Voltmeters and ammeters....Within 1%. A-C. wattmeters and varmeters....Within 1%. D-C. self contained wattmeters (max. capacity 20 A.)....Within 3%. **Double element Dynamometer types:** A-C. Polyphase wattmeters and varmeters....Within 1%.
Power consumption Weights	See tables on pages 6 and 7.

Printed in U.S.A.
E-4, AJ-1, C-1, C.F.

Westinghouse Electric & Manufacturing Company
Newark Works, Newark, N. J.

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

GENERAL

Experience of many years in design and manufacture of recording instruments, contributes to the high standards of performance, general utility and perfection of detail in the Westinghouse G-40 line of recorders.

Careful design of movements and damping mechanisms provides uniformly consistent performance for all types and capacities. The general utility of the line is broadened by built-in features which provide in each recorder, the selection at will of many operating characteristics which heretofore required a selection at time of ordering and which could not be readily changed in the field. Perfection of detail in chart drive, chart reroll, chart threading means, inking system, etc., has eliminated inconvenience in operating and removed many causes of lost records.

The use of accurate die castings for frame members and other important alignment parts, is standard practice in G-40 recorders. Line reamed sleeve bearings and precision ball bearings minimize friction and contribute to dependable operation of the chart mechanism.

Housings are of sturdy pressed steel fully reinforced and provided with dust and moisture proofing. The convenient size of the G-40 recorder permits of greater panel economy, mounting on 6 inch center lines. With portable features the recorder is as convenient to carry as a brief case.

DISTINCTIVE FEATURES

1. Convenient size for switchboard mounting and for portable service.
2. Complete line of movements, permanent magnet moving coil, single element dynamometer, double element dynamometer, cross coil dynamometer.
3. Structural members of pressed steel, die cast aluminum alloy, hard alloy plate and high strength moldarta assure permanent accuracy.
4. Removable
   - Pen
   - Ink reservoir
   - Chart mechanism
   - Clocks
   - Pivots and bearing screws
   - Bearing bracket
   - Scales
5. Integral movement. All dynamometer movement members, including damping vane, mounted concentric on one piece, rigid bronze alloy shaft.
6. Uniformly good damping and response.
7. High grade high torque clocks. Selection of 4 speeds by selecting one gear. All clocks are furnished standard with high speed feature.
8. Simplified chart mechanism. Only two gear meshes between clocks and chart driving drum thus minimizing backlash and simplifying construction.
9. Two color. Easy to read charts with special sizing to provide better records. No wood pulp paper used.
10. Charts have double perforations for more dependable operation.

APPLICATION

The G-40 Recorder is furnished with a broad line of movements to meet all conventional requirements in central station and industrial fields. Superior construction features and the ultimate in convenience and accuracy make it valuable in general portable service. On this service its ruggedness, accuracy and multiple range combinations place it in a distinctive class. Some of the specific applications covered are as follows:

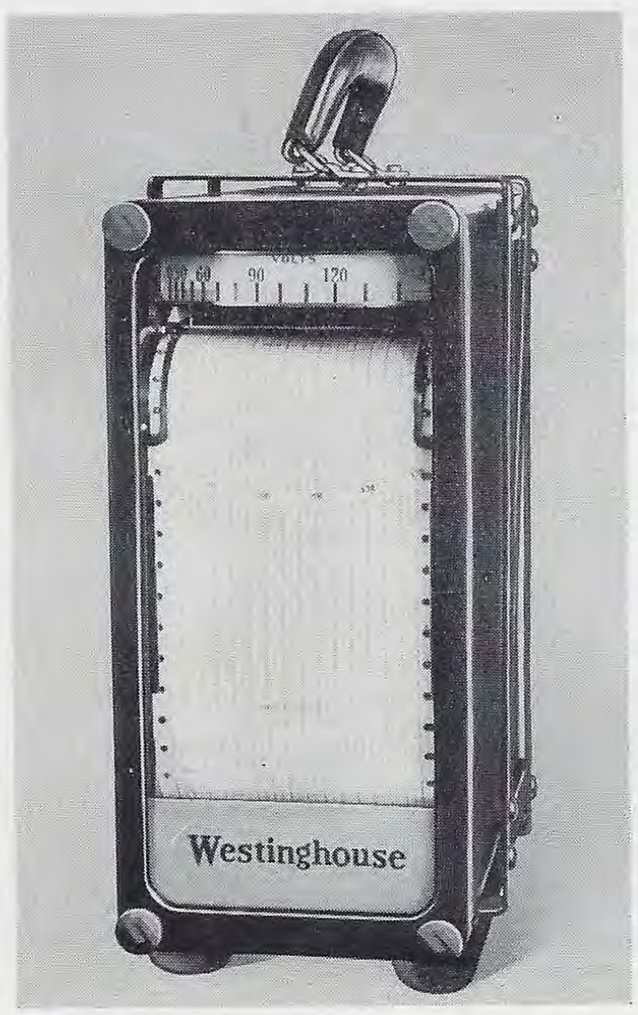


Fig. 3—Portable Type GY-40 Recording A-C. Voltmeter

Fig. 4—Portable Recorder Showing Portable Bracket and Resistor Compartment.

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

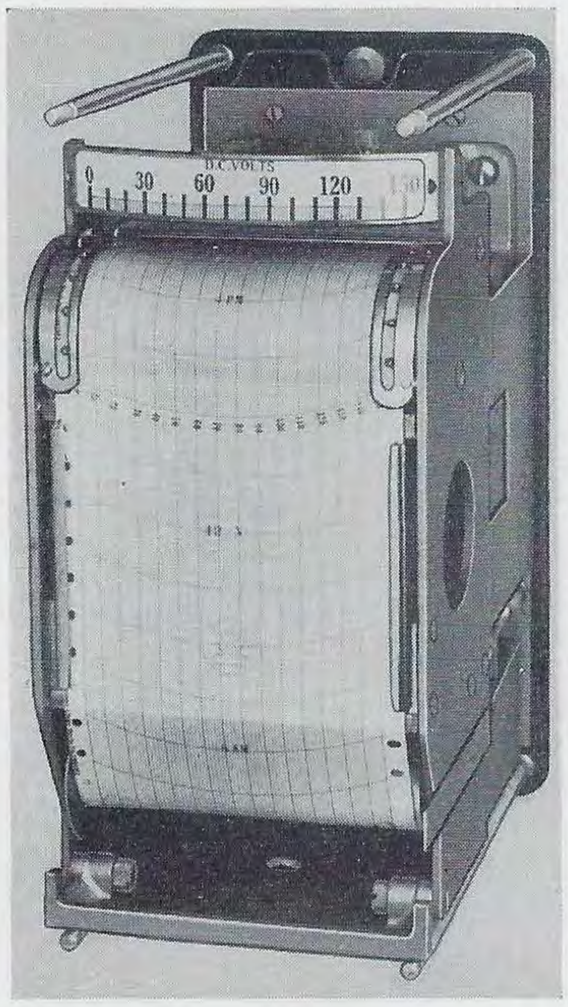


FIG. 5—RECORDING D.C. VOLTMETER TYPE GX-40, COVER REMOVED

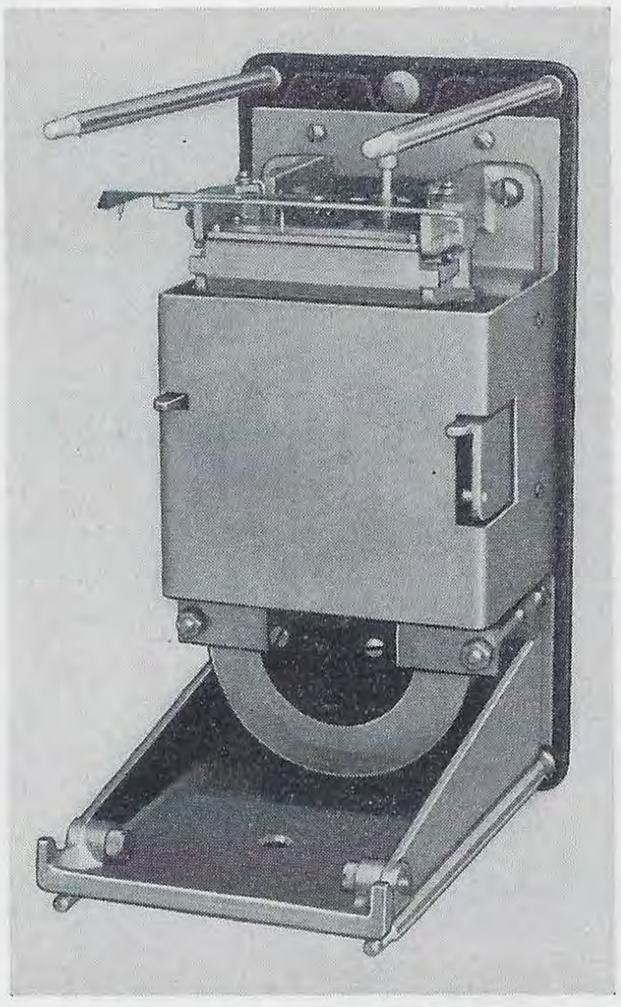


FIG. 6—PERMANENT MAGNET MOVING COIL MECHANISM, USED IN TYPE GX-40 D.C. RECORDER, SHOWN WITH SHIELD AND RECORDER BASE

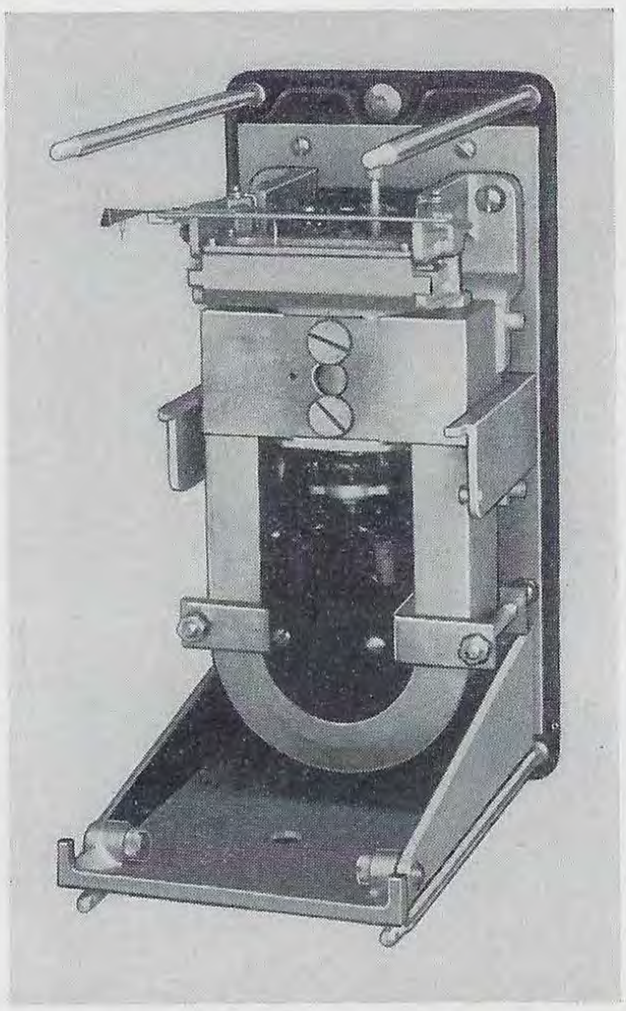


FIG. 7—TYPE GX-40 MECHANISM, SHIELD REMOVED, SHOWN ON RECORDER BASE. THIS CUT ALSO SHOWS THE SIMPLE AND POSITIVE PEN LIFTING MECHANISM

CENTRAL STATION

Power Generating Stations—

Load and voltage in:
- Generator circuit
- Transformer circuit
- Feeder circuit
- Auxiliaries

Telemeter load recording of:
- Station total load
- Transmission load
- Tie line load

Sub Stations—

Load and voltage in:
- Bus circuits
- Feeder circuits
- Tie lines

Operating and Maintenance—

Load and voltage in:
- Feeder circuits
- Transformers
- Consumers loads

Laboratory—

Volts, amperes, milliamperes, and watts, in:
- Test circuits
- Performance tests
- Life tests

INDUSTRIAL

Manufacturing—

Load and voltage:

Factory distribution circuit, Load surveys, motor load surveys.

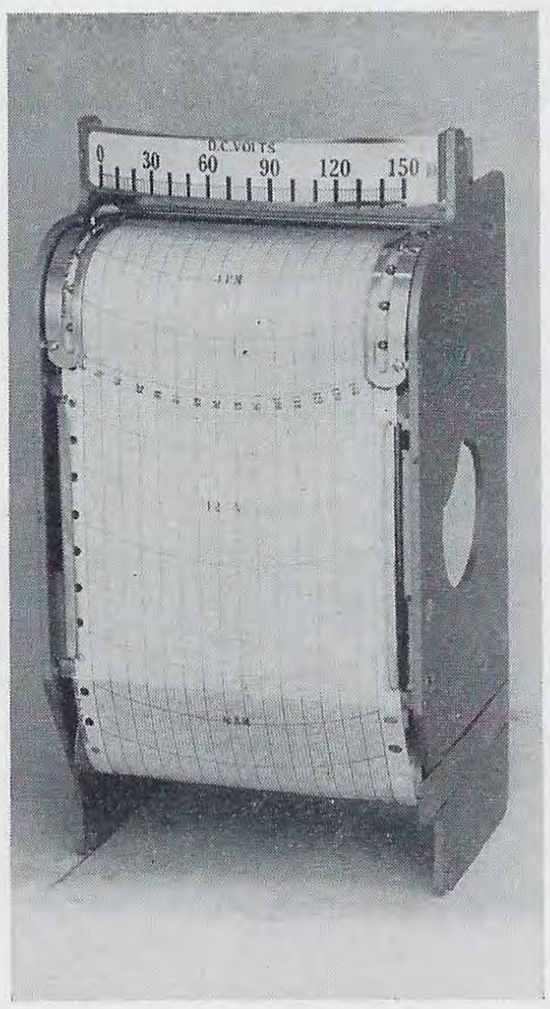


FIG. 8—CHART MECHANISM, FRONT SHOWING UNIT CONSTRUCTION

Machine drive performance (load factor).

Machine performance as indicated by load curves.

Performance of on - off appliances.

Production machinery (load and time) factor.

Maintenance—

Load and voltage:

Periodic records on transformers and motors to forestall shutdowns.

Load cycle and daily cycle records on modified or repaired electric motors, drives and machinery.

Electrical Testing Laboratories—

Watts, volts, amperes, and milliamperes, for:
- Apparatus performance records
- Life test records

Research—

Watts, volts, amperes, and milliamperes:

Performance records of electrical quantities in experimental setups.

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

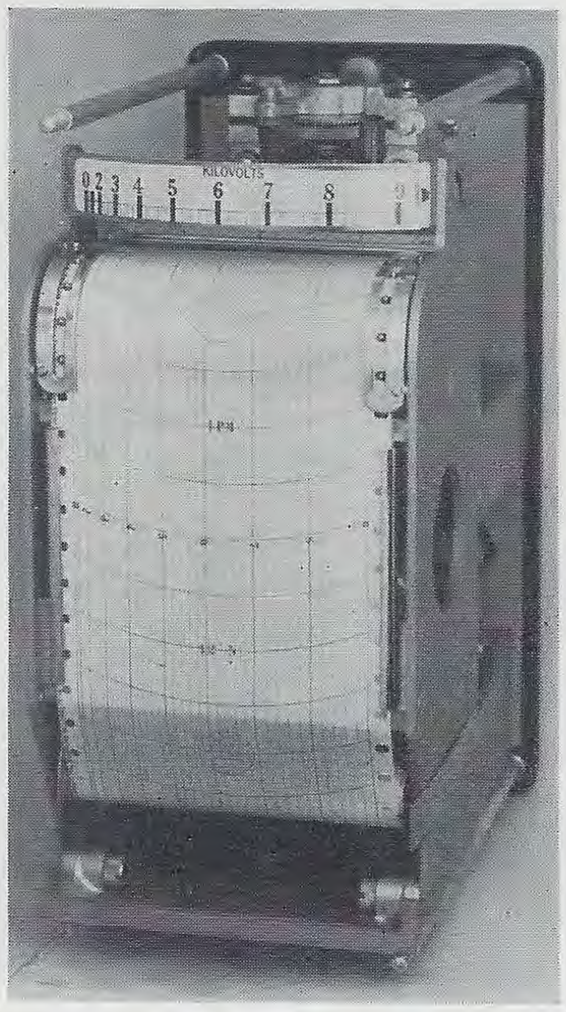


FIG. 9—RECORDING A-C. KILOWATT METER TYPE GY-40 SHOWING SUBSTANTIAL FRAME MEMBERS AND CHART MECHANISM

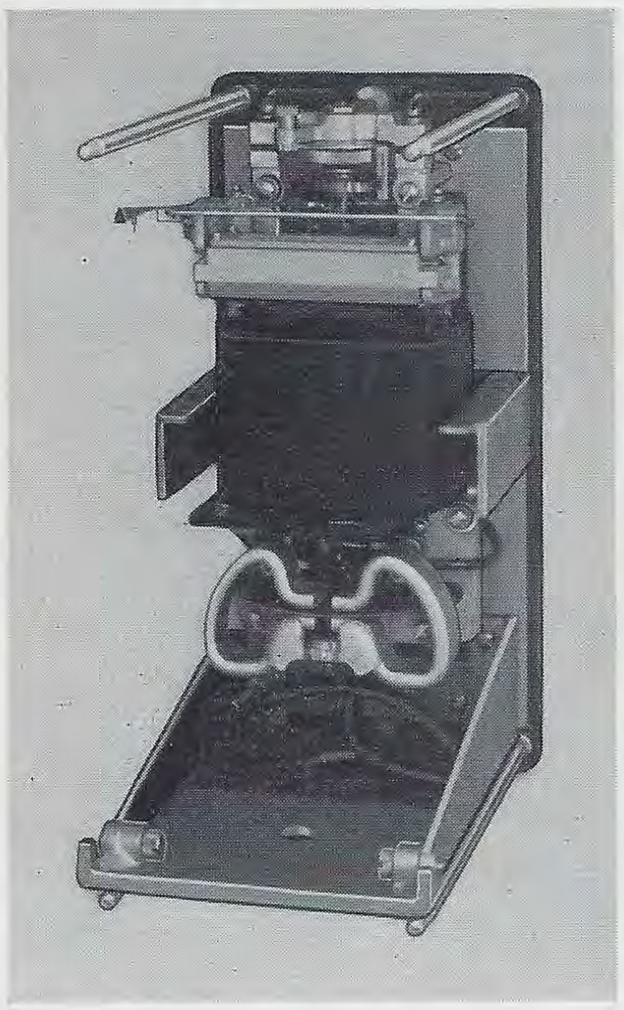


FIG. 10—SINGLE ELEMENT DYNAMOMETER MECHANISM USED IN A-C. AMMETERS, VOLTMETERS AND SINGLE PHASE WATTMETERS. NOTE THE RIGID CONCENTRICALLY MOUNTED DAMPING MECHANISM

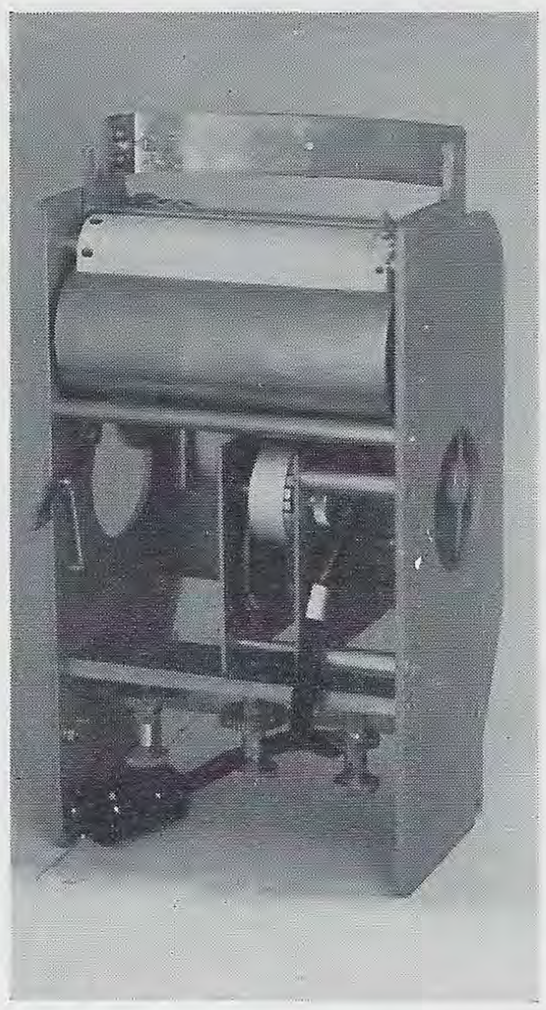


FIG. 11—CHART MECHANISM, REAR. NOTE CLOCK MOUNTING AND CONVENIENT STORAGE POSITION FOR CHART SPEED CHANGE GEARS

CONSTRUCTION

Framework and Housing—Base and frame members are made of heavy gauge pressed steel plate or die castings. Covers are of formed and welded sheet iron.

Measuring Elements—All measuring elements are of integral design, one frame carrying all moving parts including damping mechanisms. This design renders the elements virtually self-contained and independent of alignment of frame and base and eliminates influence of mounting irregularities.

Measuring elements are of the direct acting type. Electromagnetic damping is used throughout the line. The damping discs are concentrically mounted on the moving element shafts thus eliminating possibilities of misalignment. All elements are shielded against interelement and external field influence.

Direct Current Voltmeter, Ammeter, Millivoltmeter and Milliammeter Elements operate on the permanent magnet moving coil principle. The magnetic pole assembly on this movement is one piece, assuring perfect air gap symmetry and permanent calibration. Moving element alignment is maintained by direct support of the bearings from the pole assembly through two concentrically machined bell brackets.

Firm support and excellent damping of the moving element is assured by a special form of movement frame which utilizes a large percentage of the total flux for damping. The cylindrical form of this frame provides a strength factor of 10 to 20 times that of the conventional rectangular form.

Single Phase Wattmeter, Voltmeter and Ammeter Elements are iron clad, iron core, single element dynamometers. These movements have high torque weight ratios, nominal volt-ampere burdens and good frequency performance.

Polyphase Wattmeter and Varmeter Elements. The double element dynamometer principle is used. Varmeters are furnished with phase shifting compensators to provide the necessary quadrature voltages where required.

Chart Mechanism—Close attention to the finest details of construction and operation, characterizes the design of the G-40 chart mechanism. In earlier recording devices, the measuring elements were the principal sources of inaccuracy. The chart mechanisms, however, were responsible for a majority of failures to record. In keeping with the high standard of design and construction of G-40 recorders, the chart mechanism has been given special attention to eliminate lost records.

The assembly of moving parts is rigidly supported between two ⅛" thick brass plates. The entire mechanism is hinged and removable by simply "lifting out" after swinging to the unlock position.

Synchronous and spring driven clocks are interchangeable and may be detached by removing three screws. Paper speeds are changed by substituting one gear. Gears for ¾", 1½", 3", and 6" per hour are furnished and mounted conveniently within the chart mechanism.

To minimize backlash, only one auxiliary gear shaft is used between the paper driving drum and the clock. A friction clutch is provided by means of which the chart timing may be corrected by simply advancing or retarding the chart drive drum.

Threading the chart is accomplished by simple procedure. The chart roll is opened, placed in the roll compartment, fed under pressure roller, fed

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

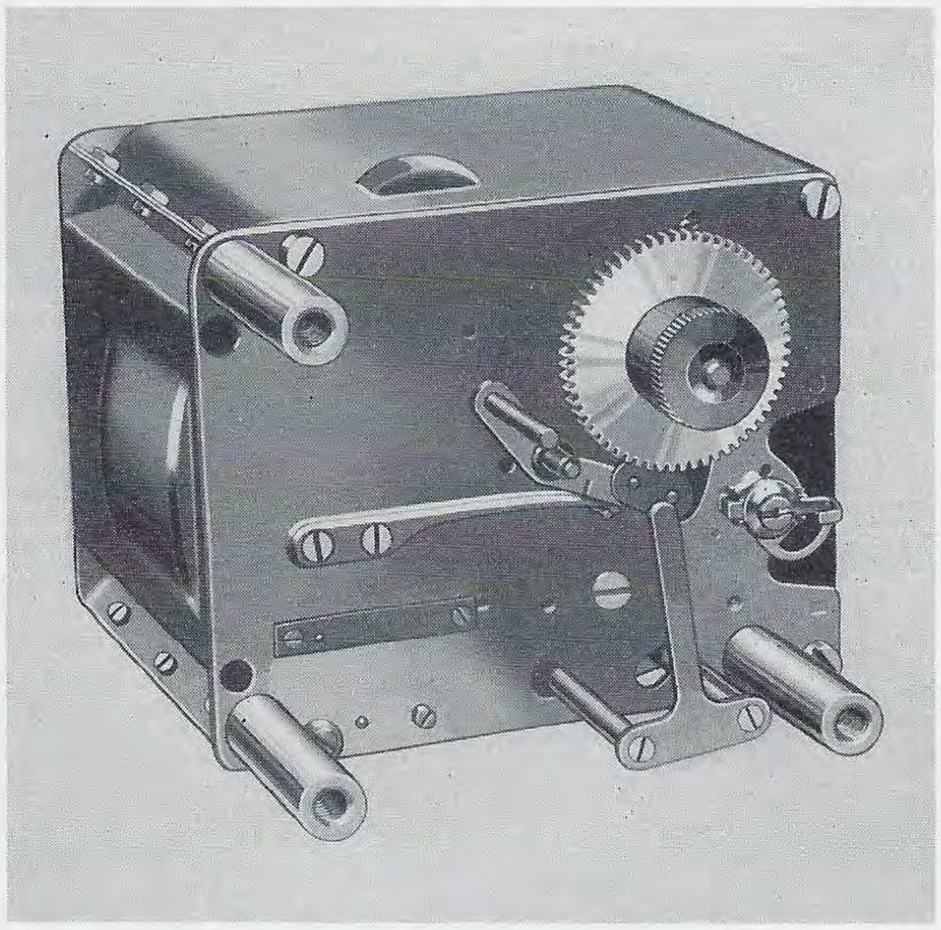


FIG. 12—SPRING DRIVEN HAND WOUND EIGHT-DAY CLOCK

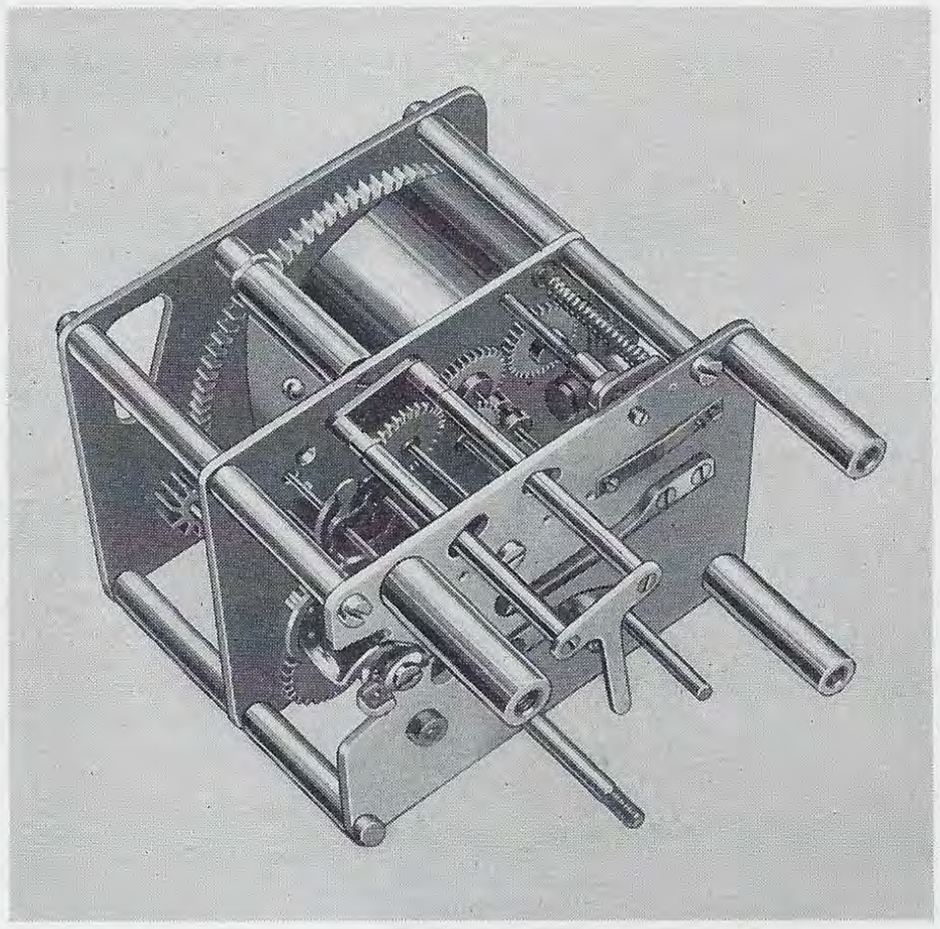


FIG. 13—SPRING DRIVEN HAND WOUND EIGHT-DAY CLOCK. COVER REMOVED

over chart drive drum sprocket, placed in guide plate and threaded on the reroll spool.

Chart rerolling is accomplished by a simple direct drive which is free of gears, clutches and travel restraining devices. This form of reroll is the outcome of extensive test to determine the simplest and most dependable action. The reroll spool drive bearing is a low friction high grade ball bearing. This low friction bearing is an essential requirement of the direct drive reroll.

Mounting and Terminal Hardware—The G-40 line is available in projection mounting housing. Portable carrying details may be added to standard housings. An integral mounted resistor compartment is supplied with portables and is mounted directly on the rear of the standard case and base.

Standardized terminals are furnished with switchboard mounting recorders. These terminals are centralized for maximum convenience in wiring and are universal for panels from $\frac{1}{16}$″ to 2″ in thickness.

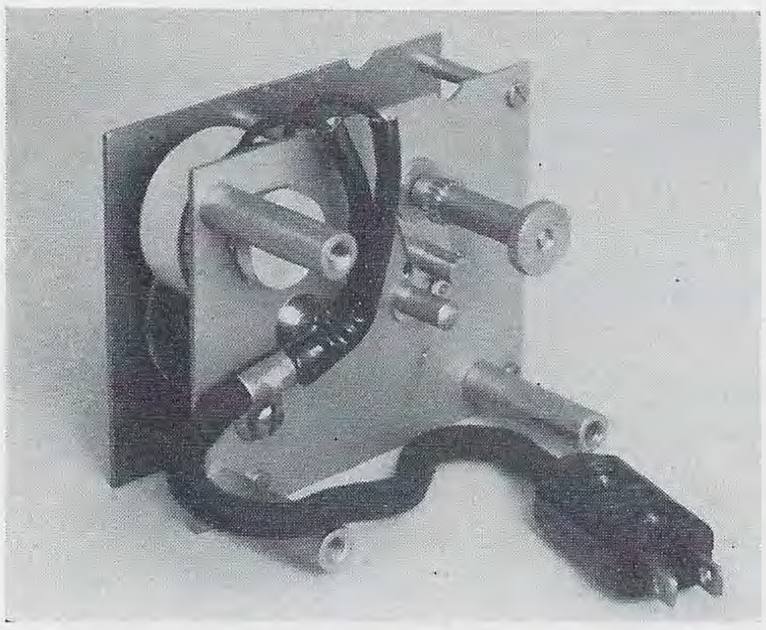


FIG. 14—SYNCHRONOUS MOTOR DRIVEN CLOCK USED IN G-40 RECORDERS. NOTE SIMPLICITY OF MOUNTING AND CONVENIENT PLUG FOR DISCONNECTING WHEN CHART MECHANISM OR CLOCK IS REMOVED

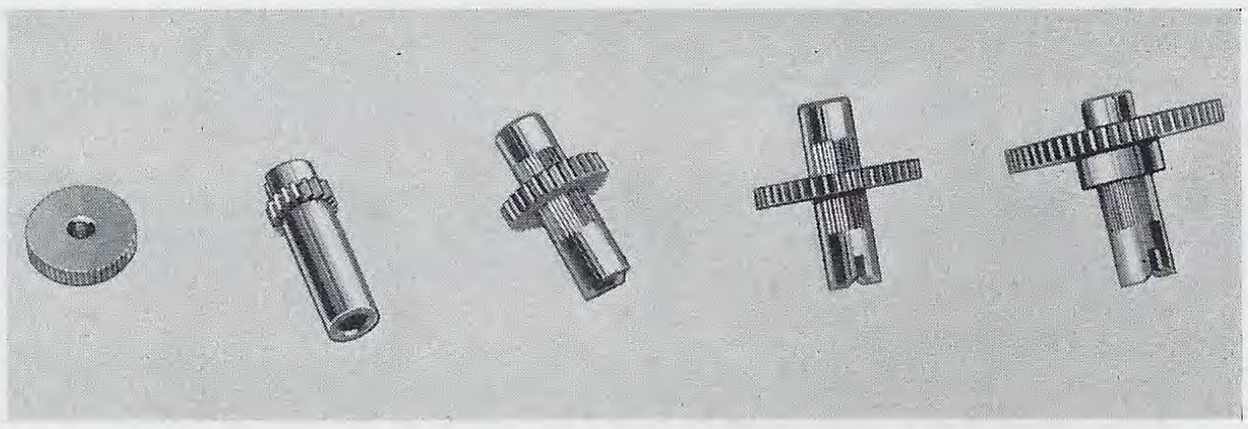


FIG. 15—THUMB NUT, AND CHART—SPEED CHANGE GEARS

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

WEIGHTS

Including External Resistors, Reactors and Compensators When Required

Type	Capacity	Approx. Net Weight Pounds	Approx. Ship. Weight Pounds
TYPE GX-40 DIRECT CURRENT RECORDERS Weight of Shunts Not Included			
Voltmeter	300 volts or less	40	90
Voltmeter	Above 300 volts *	42	95
Ammeter	60 amps. or less	40	90
Ammeter	Above 80 amps. †	40	90
Milliammeter	800 M.A. or less	40	90

* Supplied with external resistor.
† Requires external shunt.

TYPE GY-40 ALTERNATING CURRENT RECORDERS Weight of Instrument Transformer Not Included			
Ammeter	20 amps. or less	34	85
Voltmeter	750 volts or less *	36	90
Single Phase Wattmeter	575 volts or less * / 20 amps. or less	36	95
Polyphase Wattmeter	575 volts or less * / 20 amps. or less	38	100
Polyphase Varmeter	115 volts or less ‡ / 5 amps. / 25-50-60 cycles	50	110

* Supplied with external resistor.
‡ Supplied with external compensator and resistors.

TYPE GX-40 PORTABLE DIRECT CURRENT RECORDERS Self-Contained			
Voltmeter	750 volts or less	45	100
Ammeter	100 amps. or less	45	100
Millivoltmeter	100 M.V.	40	90
Milliammeter	800 M.A. or less	40	90
Volt-Milliammeter	750 V. or less / 500 M.A. or less	45	100
TYPE GY-40 PORTABLE ALTERNATING CURRENT RECORDERS Self-Contained			
Ammeter	20 amps. or less	38	90
Voltmeters	750 volts or less	38	90
Single Phase Wattmeters	300 volts or less / 20 amps. or less	40	90
Polyphase Wattmeters	300 volts or less / 20 amps. or less	45	95

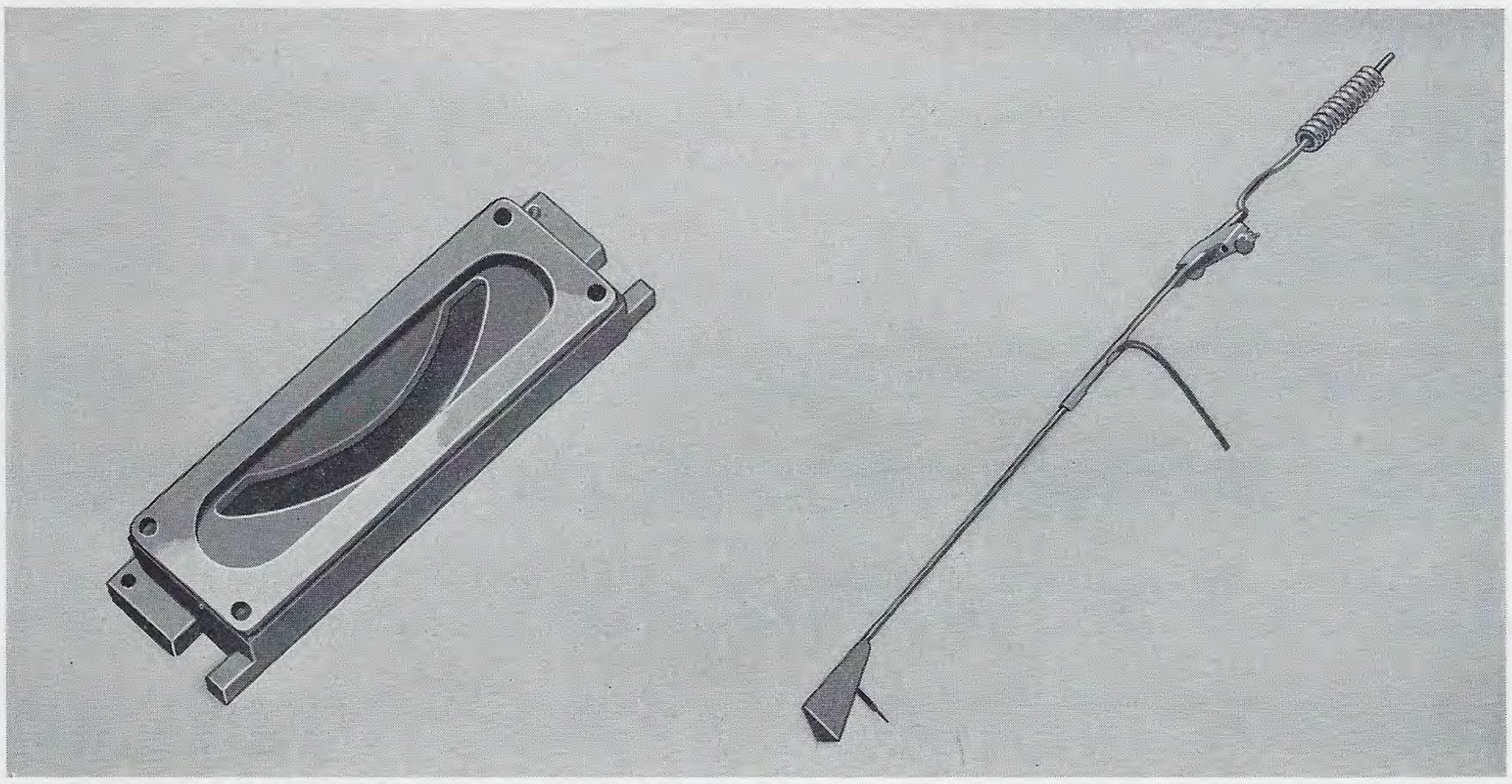


FIG. 16—INK WELL AND PEN. THE PEN IS CONSTRUCTED FROM SILVER TUBING WITH PLATINUM-IRIDIUM POINT

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

POWER CONSUMPTION

Direct Current Recorders

Type	At Rating	Circuit	Watts	Ohms Resistance
GX-40 Millivoltmeter, 0-100 M.V.	100 M.V.	Millivolt	.05	0.2
GX-40 Ammeter, 0-5 A.	5	Current	0.5	.02
GX-40 Voltmeter, 0-150 V.	150	Voltage	3.75	6000

Alternating Current Recorders

Type	At Rating	Circuit	60 Cycle V.A.	Watts	Vars	% P.F.
GY-40 Ammeter, 0-5 A.	5	Current	10	6.25	7.8	62.5
GY-40 Voltmeter, 0-150 V.	115	Voltage	13.3	13.3	0.0	100
GY-40 Single Phase Wattmeter	5	Current	7.05	2.8	6.4	40
	115	Voltage	12.5	12.5	0.0	100
‡GY-40 3 Ph. 3-W Wattmeter, 2 Ph. 4-W Wattmeter	5	Current	6.0	3.3	5.0	55
2 Ph. 4-W Varmeter with Cross Phase Connection. (2 C.C.—2 P.C.)	115	Voltage	12.9	12.9	0.0	100
GY-40 3 Ph. 4-W	5	Current A	3.0	1.7	2.5	55
		Current C	3.0	1.7	2.5	55
		Current B	6.0	3.3	5.0	55
Wattmeter (3 C.C.—2 P.C.)	115	Voltage	12.9	12.9	0.0	100
‡GY-40 3 Ph. 3-W	5	Current	6.0	3.3	5.0	55
Varmeter (2 C.C.—2 P.C.)	115	Voltage A-B	....	7.45	—5.7	...
		Voltage B-C	....	7.45	+1.7	...
		Voltage C-A	....	13.9	—2.0	...

‡ Varmeter voltage circuit burdens include burdens of compensators.

Synchronous Clock Motors

GY-40 Syn. Motor	115	Voltage	3.3	....	.....	...
Driven Clock	230	Voltage	6.	....	.....	...

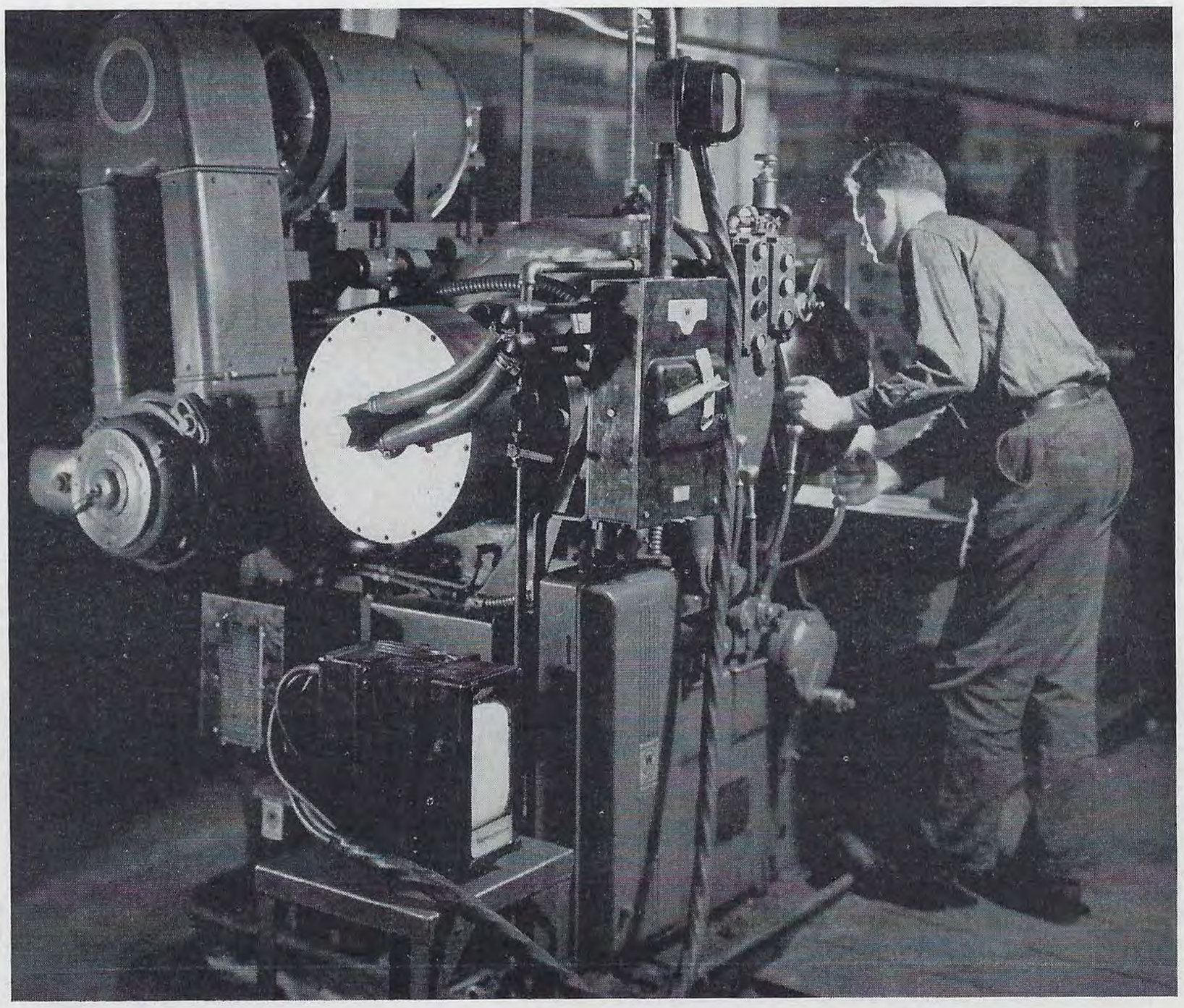


FIG. 17—RECORDING LOAD CYCLE ON HIGH SPEED BORING MACHINE WITH GY-40 POLYPHASE RECORDER, CIRCUIT CONNECTIONS ACCOMPLISHED BY INSERTING ANALYZER JACK INTO TYPE S-5 SOCKET

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

SUPPLIES FURNISHED WITH EACH RECORDER

Quantity	Style	Description
3	....	Chart rolls, 3 inches per hour (supplied for low range when recorder has more than one range, unless otherwise specified on order).
1	108 067	Green ink, 1 oz. bottle, concentrated to make one quart.
1	72 449	Rubber syringe for filling ink well.
1	837 390	Rubber syringe for starting pen.
1 pkg.	837 391	Pen cleaning wires, 1 dozen.
1	876 241	Winding key (furnished with recorders having handwound clocks).
1*	820 502	Change gear for ¾" per hour.
1*	820 488	Change gear for 1½" per hour.
1*	820 486	Change gear for 3" per hour.
1*	820 484	Change gear for 6" per hour.

* Change gears are conveniently mounted in the chart mechanism and may be changed at will. Only one gear need be changed.

LIST PRICES

TYPE GX-40 RECORDERS

SWITCHBOARD TYPE—PROJECTION MOUNTING

D-C. VOLTMETERS

Uniform Scales
40 Ohms per Volt

Capacity	Style No. With 115 Volts, 60 Cycles Synchronous Clock	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
15	1 093 906	$245 00	1 093 907	$255 00
30	1 093 908	245 00	1 093 909	255 00
50	1 093 910	245 00	1 093 911	255 00
100	1 093 912	245 00	1 093 913	255 00
150	1 093 914	245 00	1 093 915	255 00
250	1 093 916	245 00	1 093 917	255 00
300	1 093 918	245 00	1 093 919	255 00
500*	1 093 920	245 00	1 093 921	255 00
600*	1 093 922	250 00	1 093 923	260 00
750*	1 093 924	255 00	1 093 925	265 00

* Capacities above 300 volts are supplied with external resistor. These capacities are self-contained for 150 volts. The remainder of the resistance is external.

D-C. AMMETERS

Uniform Scales
With External Shunts
100 Millivolts
Style and Price Includes 1 Pair of 8 Ft. Leads S# 408886
Resistance .00672 Ohms Total and 1-100 M.V. Type GG Shunt.

Capacity	Style No. With 115 Volts, 60 Cycles Synchronous Clock	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
80x	1 093 948	$251 00	1 093 949	$261 00
100x	1 093 950	251 00	1 093 951	261 00
150x	1 093 952	251 00	1 093 953	261 00
200	1 093 954	251 00	1 093 955	261 00
250	1 093 956	253 00	1 093 957	263 00
300	1 093 958	253 00	1 093 959	263 00
400	1 093 960	254 00	1 093 961	264 00
500	1 093 962	255 00	1 093 963	265 00
600	1 093 964	257 00	1 093 965	267 00
800	1 093 966	260 00	1 093 967	270 00
1000	1 093 968	265 00	1 093 969	275 00
1200	1 093 970	269 00	1 093 971	279 00
1500	1 093 972	274 00	1 093 973	284 00
2000	1 093 974	281 00	1 093 975	294 00
2500	1 093 976	287 00	1 093 977	297 00
3000	1 093 978	295 00	1 093 979	305 00
4000	1 093 980	330 00	1 093 981	340 00
5000	1 093 982	345 00	1 093 983	355 00
6000	1 093 984	362 00	1 093 985	372 00
8000	1 093 986	395 00	1 093 987	405 00

x Capacities below 200 amperes must be calibrated with shunt.

D-C. AMMETERS

Uniform Scales
Self-Contained

Capacity	Style No. With 115 Volts, 60 Cycles Synchronous Clock	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
1	1 093 926	$245 00	1 093 927	$255 00
2	1 093 928	245 00	1 093 929	255 00
5	1 093 930	245 00	1 093 931	255 00
10	1 093 932	245 00	1 093 933	255 00
15	1 093 934	245 00	1 093 935	255 00
20	1 093 936	245 00	1 093 937	255 00
25	1 093 938	245 00	1 093 939	255 00
30	1 093 940	245 00	1 093 941	255 00
40	1 093 942	245 00	1 093 943	255 00
50	1 093 944	245 00	1 093 945	255 00
60	1 093 946	245 00	1 093 947	255 00

All above capacities are shunted internally and have a full scale drop of 100 M.V. ± 10%.

D-C. MILLIAMMETERS

Uniform Scales
Self-Contained

Capacity	Resistance	Style No. With 115 V. 60 Cycles Synchronous Clock	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
5	3890	1 093 988	$265 00	1 093 989	$275 00
10	420	1 093 990	260 00	1 093 991	270 00
15	280	1 093 992	255 00	1 093 993	265 00
20	210	1 093 994	250 00	1 093 995	260 00
25	70	1 093 996	245 00	1 093 997	255 00
30	59	1 093 998	245 00	1 093 999	255 00
40	44	1 094 000	245 00	1 094 001	255 00
50	35	1 094 002	245 00	1 094 003	255 00
60	11	1 094 004	245 00	1 094 005	255 00
80	8.3	1 094 006	245 00	1 094 007	255 00
100	6.6	1 094 008	245 00	1 094 009	255 00
150	4.4	1 094 010	245 00	1 094 011	255 00
200	3.3	1 094 012	245 00	1 094 013	255 00
300	2.2	1 094 014	245 00	1 094 015	255 00
400	1.65	1 094 016	245 00	1 094 017	255 00
500	.08	1 094 018	245 00	1 094 019	255 00
600	.067	1 094 020	245 00	1 094 021	255 00
800	.05	1 094 022	245 00	1 094 023	255 00

List Prices and Discounts subject to change without notice

Order by Style Number

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE GX-40 RECORDERS—Continued

SWITCHBOARD TYPE—PROJECTION MOUNTING—Continued

A-C. AMMETERS

15 to 500 Cycles
Non-Uniform Scales
Self-Contained

Capacity	Style No. With 115 Volts, 60 Cycles Synchronous Clock	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
2.5	1 094 024	$190 00	1 094 025	$200 00
5‡	1 094 026	190 00	1 094 027	200 00
7.5	1 094 028	195 00	1 094 029	205 00
10	1 094 030	195 00	1 094 031	205 00
15	1 094 032	195 00	1 094 033	205 00
20	1 094 034	195 00	1 094 035	205 00

A-C. AMMETERS

15 to 500 Cycles
Non-Uniform Scales
For Use with Current Transformers
5 Ampere Coils

Capacity	Style No. With 115 Volts, 60 Cycles Synchronous Clock	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
25	1 094 036	$190 00	1 094 037	$200 00
30	1 094 038	190 00	1 094 039	200 00
40	1 094 040	190 00	1 094 041	200 00
50	1 094 042	190 00	1 094 043	200 00
60	1 094 044	190 00	1 094 045	200 00
75	1 094 046	190 00	1 094 047	200 00
80	1 094 048	190 00	1 094 049	200 00
100	1 094 050	190 00	1 094 051	200 00
120	1 094 052	190 00	1 094 053	200 00
150	1 094 054	190 00	1 094 055	200 00
200	1 094 056	190 00	1 094 057	200 00
250	1 094 058	190 00	1 094 059	200 00
300	1 094 060	190 00	1 094 061	200 00
400	1 094 062	190 00	1 094 063	200 00
500	1 094 064	190 00	1 094 065	200 00
600	1 094 066	190 00	1 094 067	200 00
800	1 094 068	190 00	1 094 069	200 00
1000	1 094 070	190 00	1 094 071	200 00
1200	1 094 072	190 00	1 094 073	200 00
1500	1 094 074	190 00	1 094 075	200 00
2000	1 094 076	190 00	1 094 077	200 00
2500	1 094 078	190 00	1 094 079	200 00
3000	1 094 080	190 00	1 094 081	200 00
4000	1 094 082	190 00	1 094 083	200 00
5000	1 094 084	190 00	1 094 085	200 00
7500	1 094 086	190 00	1 094 087	200 00

A-C. VOLTMETERS

15 to 75 Cycles
Non-Uniform Scales

Capacity	Style No. With 115 Volts, 60 Cycles Synchronous Clock†	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
100 ∅	1 094 088	$200 00	1 094 089	$210 00
150 ∅**	1 094 090	200 00	1 094 091	210 00
250 ∅	1 094 092	205 00	1 094 093	215 00
300 ∅	1 094 094	205 00	1 094 095	215 00
500 ∅	1 094 096	210 00	1 094 097	220 00
600 ∅	1 094 098	210 00	1 094 099	220 00
750 ∅	1 094 100	215 00	1 094 101	225 00

A-C. SINGLE PHASE WATTMETERS

15 to 75 Cycles
Uniform Scales—Left Zero*
1 Current Coil—1 Potential Coil - 2 Wire

Volts	Capacity Amps.	Capacity Watts	Style No. With 115 V. 60 Cy. Synchronous Clock†	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
∅115	5 Θ	500	1 094 102	$230 00	1 094 103	$240 00
	10	1000	1 094 104	235 00	1 094 105	245 00
	15	1500	1 094 106	235 00	1 094 107	245 00
	20	2000	1 094 108	235 00	1 094 109	245 00
∅230	5 Θ	1000	1 094 110	235 00	1 094 111	245 00
	10	2000	1 094 112	240 00	1 094 113	250 00
	15	3000	1 094 114	240 00	1 094 115	250 00
	20	4000	1 094 116	240 00	1 094 117	250 00
∅460	5 Θ	2000	1 094 118	240 00	1 094 119	250 00
	10	4000	1 094 120	245 00	1 094 121	255 00
	15	6000	1 094 122	245 00	1 094 123	255 00
	20	8000	1 094 124	245 00	1 094 125	255 00
∅575	5 Θ	2500	1 094 126	245 00	1 094 127	255 00
	10	5000	1 094 128	250 00	1 094 129	260 00
	15	7500	1 094 130	250 00	1 094 131	260 00
	20	10 Kw.	1 094 132	250 00	1 094 133	260 00

A-C. POLYPHASE WATTMETERS

15 to 75 Cycles
Uniform Scales—Left Zero*
3 Phase—3 Wire, 2 Phase, 3 Wire
2 Phase—4 Wire, 1 Phase, 3 Wire
2 Current Coils—2 Potential Coils

Volts	Capacity Amps.	Capacity Watts	Style No. With 115 V. 60 Cy. Synchronous Clock†	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
∅115	5 Θ	1000	1 094 134	$230 00	1 094 135	$240 00
	10	2000	1 094 136	235 00	1 094 137	245 00
	15	3000	1 094 138	235 00	1 094 139	245 00
	20	4000	1 094 140	235 00	1 094 141	245 00
∅230	5 Θ	2000	1 094 142	235 00	1 094 143	245 00
	10	4000	1 094 144	240 00	1 094 145	250 00
	15	6000	1 094 146	240 00	1 094 147	250 00
	20	8000	1 094 148	240 00	1 094 149	250 00
∅460	5 Θ	4000	1 094 150	240 00	1 094 151	250 00
	10	8000	1 094 152	245 00	1 094 153	255 00
	15	12 Kw.	1 094 154	245 00	1 094 155	255 00
	20	16 Kw.	1 094 156	245 00	1 094 157	255 00
∅575	5 Θ	5000	1 094 158	245 00	1 094 159	255 00
	10	10 Kw.	1 094 160	250 00	1 094 161	260 00
	15	15 Kw.	1 094 162	250 00	1 094 163	260 00
	20	20 Kw.	1 094 164	250 00	1 094 165	260 00

A-C. POLYPHASE WATTMETERS

15 to 75 Cycles
Uniform Scales—Left Zero*
3 Phase—4 Wire
3 Current Coils—2 Potential Coils

Volts	Capacity Amps.	Capacity Watts	Style No. With 115 V. 60 Cy. Synchronous Clock†	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
115Y	5 Θ	2000	1 094 166	$250 00	1 094 167	$260 00
	10	4000	1 094 168	255 00	1 094 169	265 00
	15	6000	1 094 170	255 00	1 094 171	265 00
	20	8000	1 094 172	255 00	1 094 173	265 00
230Y	5 Θ	4000	1 094 174	255 00	1 094 175	265 00
	10	8000	1 094 176	260 00	1 094 177	270 00
	15	12 Kw.	1 094 178	260 00	1 094 179	270 00
	20	16 Kw.	1 094 180	260 00	1 094 181	270 00

‡ When required for use with current transformers, specify complete transformer rating, thus (1000/5 current) and specify record chart capacity. See record chart list.

∅ Supplied with external resistor.

** When required for use with potential transformer, specify complete transformer rating thus (4600/115 potential) and specify record chart capacity. See record chart list.

† Synchronous motor clocks will be furnished with rating same as voltage circuit of recorder, at same prices when so ordered.

* Center zero scales will be furnished at same prices when so ordered.

Θ When required for use with instrument transformers specify complete transformer ratings, thus (500/5 current, 11,500/115 potential) and specify record chart capacity. See record chart list.

List Prices and Discounts subject to change without notice

Order by Style Number

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

LIST PRICES—Continued

TYPE GY-40 RECORDERS SWITCHBOARD TYPE— PROJECTION MOUNTING

POLYPHASE VARMETERS

Uniform Scales—Center Zero*

3 Phase—3 Wire

2 Current Coils—2 Potential Coils with Compensator

Capacity Volts	Amps.	Vars	Freq.	Style No. With 115 V. Synchronous Clock	List Price Discount Symbol BC	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
115	5 Θ	500	60	1 094 182	$250 00	1 094 183	$260 00
			50	1 094 184	250 00	1 094 185	260 00
			25	1 094 186	250 00	1 094 187	260 00

3 Phase—4 Wire

3 Current Coils—2 Potential Coils with Compensator

For Use with 2 Potential Transformers

Connected Line to Neutral

115	5 Θ	1000	60	1 094 200	270 00	1 094 201	280 00
			50	1 094 202	270 00	1 094 203	280 00
			25	1 094 204	270 00	1 094 205	280 00

2 Phase—3 Wire, 2 Phase—4 Wire

2 Current Coils—2 Potential Coils

No Compensator Required

115	5 Θ	500	60	1 094 188	230 00	1 094 189	240 00
			50	1 094 190	230 00	1 094 189	240 00
			25	1 094 192	230 00	1 094 189	240 00

Θ When required for use with instrument transformers specify complete transformer ratings, thus (500/5 current, 11,500/115 potential) and specify record chart capacity. See record chart list.

* Left zero scales will be supplied at same prices when so ordered.

TYPE GX-40 RECORDERS PORTABLE TYPE

D-C. VOLTMETERS

Uniform Scales
40 Ohms per Volt†
Self-Contained

Capacity	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
150–300 D	1 094 206	$305 00
300–600 D	1 094 207	310 00
150–750 D	1 094 208	310 00
150–300–750 T	1 094 209	320 00

D, T indicates double and triple range.

† Above ranges are supplied 100 ohms per volt on special order at $20.00 list additional, 200 ohms per volt $30.00 list additio nal.

D-C. AMMETERS

Uniform Scales
Self-Contained

1-5 D	1 094 210	$295 00
10–50 D	1 094 211	295 00
5–20–100 (100 M.V.) Q	1 094 212	325 00
1–2–20–100 (100 M.V.) 5R	1 094 213	325 00

D, Q, 5R, Double, Quadruple, five range respectively. 100 M.V. range consumes ½ ampere and should be used with shunts of 200 amperes and above. Self-contained ranges have a drop at terminals of 100 M.V. ± 10%.

Q, 5R furnished with 0-100 charts unless otherwise specified.

D-C. MILLIVOLTMETERS

For Use with External 100 M.V. Shunts
Style and Price Include One Pair of 8 Ft. Leads S# 408886, Resistance .00672 Ohms Total, but no Shunt.

Uniform Scales—Two Wire

100‡	1 094 214	$285 00

‡ Must be calibrated with shunts when capacity is less than 200 amperes. The moving element consumes ½ ampere. Charts 0-100 furnished unless otherwise specified.

TYPE GX-40 RECORDERS PORTABLE TYPE (Continued)

D-C. MILLIAMMETERS

Uniform Scales
Self-Contained

Capacity	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
10–50–500 T	1 094 215	$320 00
5–50–500 T	1 094 216	325 00

T, Triple range.

D-C. UNIVERSAL VOLT-MILLIAMMETER

Uniform Scale
Self-Contained

(150–300–750 V) (5–50–500 M.A.)	6R	1 094 217	$355 00

6R, Six range. Voltage ranges 200 ohms per volt.

TYPE GY-40 RECORDERS PORTABLE TYPE

A-C. AMMETERS

15 to 500 Cycles x
Non-Uniform Scales
Single Range—Self-Contained

Capacity	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
2.5	1 094 218	$230 00
5	1 094 219	230 00
10	1 094 220	235 00
15	1 094 221	235 00
20	1 094 222	235 00

A-C. VOLTMETERS

15 to 75 Cycles x
Non-Uniform Scales
Double and Triple Range—Self-Contained

Capacity	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
150–300	1 094 223	$270 00
150–750	1 094 224	280 00
150–300–750	1 094 225	290 00

A-C. SINGLE PHASE WATTMETERS

15 to 150 Cycles x
Uniform Scales
Self-Contained
1 Current Coil—1 Potential Coil
Double Current—Double Voltage

Capacity Volts	Amps.	Watts	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
150	5 ∅	500	1 094 226	$290 00
300	10 ∅	1000		
		1000		
		2000		

A-C. POLYPHASE WATTMETERS

15 to 150 Cycles x
Uniform Scales
Self-Contained
2 Current Coil—2 Potential Coils
Double Current—Double Voltage

Capacity Volts	Amps.	Watts	Style No. With 8 Day Handwound Clock	List Price Discount Symbol BC
150	5 ∅	1000	1 094 227	$300 00
300	10 ∅	2000		
		2000		
		4000		

∅ Current circuit may be supplied for 10-20 amperes at $10.00 list additional.

x May be used on direct current with an accuracy of ± 2%.

List Prices and Discount subject to change without notice

Order by Style Number

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

SUPPLIES

Description	Style No.	List Price Discount Symbol BC
Green ink (1 oz. btle. concentrated) to make 1 quart	108 067	$ 0 30
Green ink 1 oz.(blue printing) to make 1 quart	680 104	0 30
Pen complete with balancing nut	837 392	6 00
Ink well complete	1 003 925	1 00
Pen starting syringe	837 390	0 25
Ink well filling syringe	72 449	1 00
Pen cleaning wires (style includes 1 doz.)	837 391	0 20
Synchronous motor driven clock 115 volt, 60 cycle	931 211	40 00
Synchronous motor driven clock 115 volt, 50 cycle	....	40 00
Synchronous motor driven clock 115 volt, 25 cycle	....	40 00
Handwound 8-day clock	876 242	50 00
Winding key for handwound clock	876 241	0 50

Description	Style No.	List Price Discount Symbol BC
Change gear for ¾″ per hour	820 502	$0 50
Change gear for 1½″ per hour	820 488	0 50
Change gear for 3″ per hour	820 486	0 50
Change gear for 6″ per hour	820 484	0 50
Thumb nut to hold change gears	820 499	0 20
Chart rewind spring belt (15⅞″ long)	836 127	0 50
Chart rewind spool	836 073	2 00
Bearings for (dynamometer) alternating current recorders.		
Jewel screw	876 914	2 50
Jewel screw lock nut	876 889	0 20
Pivot	876 903	0 50
Bearings for (permanent magnet moving coil) direct current recorders.		
Jewel screw	877 013	1 00
Jewel screw lock nut .190-32 Hex. B.M. Sc. Nut Fin. 2-C	Std. Hdwr.	0 20
Pivot	876 370	0 50

RECORD CHARTS

For
Ammeters Direct Current—Voltmeters Direct Current
Wattmeters Direct Current—Wattmeters Alternating Current
Varmeters Alternating Current

LEFT ZERO UNIFORMLY DIVIDED

Capacity	Chart Divisions Main	Sub.	Total	RECORD CHARTS Chart Speed—Inches Per Hour ¾ Style No.	1½ Style No.	3 Style No.	6 Style No.
1	10	5	50	1 093 141	1 093 142	1 093 143	1 093 144
2	8	5	40	1 093 068	1 093 069	1 093 070	1 093 071
3	6	5	30	1 093 000	1 093 001	1 093 002	1 093 003
4	8	5	40	1 093 072	1 093 073	1 093 074	1 093 075
5	10	5	50	1 093 145	1 093 146	1 093 147	1 093 148
6	12	5	60	1 093 207	1 093 208	1 093 209	1 093 210
7.5	15	5	75	1 059 244	1 059 245	1 059 246	1 059 247
8	8	5	40	1 093 076	1 093 077	1 093 078	1 093 079
10	10	5	50	1 093 149	1 093 150	1 093 151	1 093 152
12	12	5	60	1 093 211	1 093 212	1 093 213	1 093 214
15	15	5	75	1 093 257	1 093 258	1 093 259	1 093 260
16	8	4	32	1 093 020	1 093 021	1 093 022	1 093 023
20	8	5	40	1 093 080	1 093 081	878 231	1 093 082
25	10	5	50	1 093 153	1 093 154	1 093 155	1 093 156
30	6	5	30	1 093 004	1 093 005	1 093 006	1 093 007
32	8	4	32	1 093 024	1 093 025	1 093 026	1 093 027
40	8	5	40	1 093 083	1 093 084	1 093 085	1 093 086
50	10	5	50	1 093 157	1 093 158	1 093 159	1 093 160
60	12	5	60	1 093 215	1 093 216	1 093 217	1 093 218
64	8	4	32	1 093 028	1 093 029	1 093 030	1 093 031
75	15	5	75	1 093 261	1 093 262	1 093 263	1 093 264
80	8	5	40	1 003 639	1 093 087	1 003 591	1 093 088
100	10	5	50	930 186	1 093 161	930 718	838 752
120	12	5	60	1 003 638	1 093 219	1 003 594	1 093 220
150	15	5	75	1 003 392	1 093 265	1 093 266	1 093 267
160	8	4	32	1 093 032	1 093 033	1 093 034	1 093 035
200	8	5	40	1 003 641	1 093 089	1 003 592	1 093 090
250	10	5	50	1 093 162	1 093 163	1 093 164	1 093 165
300	6	5	30	1 093 008	1 093 009	1 093 010	1 093 011
320	8	4	32	1 093 036	1 093 037	1 093 038	1 093 039
400	8	5	40	1 003 640	1 093 091	1 003 593	1 093 092
500	10	5	50	1 093 166	1 093 167	836 812	1 093 168
600	12	5	60	1 093 221	1 093 222	1 093 223	1 093 224
640	8	4	32	1 093 040	1 093 041	1 093 042	1 093 043
750	15	5	75	1 093 268	1 093 269	1 093 270	1 093 271
800	8	5	40	1 093 093	1 093 094	1 093 095	1 093 096
1000	10	5	50	1 003 642	1 093 169	1 002 027	1 093 170
1200	12	5	60	1 093 225	1 093 226	1 093 227	1 093 228
1500	15	5	75	1 093 272	1 093 273	1 093 274	1 093 275
1600	8	4	32	1 093 044	1 093 045	1 093 046	1 093 047
2000	8	5	40	1 093 097	1 093 098	1 093 099	1 093 100
2500	10	5	50	1 093 171	1 093 172	1 093 173	1 093 174
3000	6	5	30	1 093 012	1 093 013	1 093 014	1 093 015

List Prices and Discount subject to change without notice

Order by Style Number

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

RECORD CHARTS—Continued

For

Ammeters Direct Current

Voltmeters Direct Current

Wattmeters Direct Current

Wattmeters Alternating Current

Varmeters Alternating Current

LEFT ZERO UNIFORMLY DIVIDED

	Chart Divisions			Record Charts — Chart Speed—Inches Per Hour			
Capacity	Main	Sub.	Total	¾ Style No.	1½ Style No.	3 Style No.	6 Style No.
4000	8	5	40	1 093 101	1 093 102	1 093 103	1 093 104
5000	10	5	50	1 093 175	1 093 176	1 093 177	1 093 178
6000	12	5	60	1 093 229	1 093 230	1 003 708	1 093 231
7500	15	5	75	1 093 276	1 093 277	1 093 278	1 093 279
8000	8	5	40	1 093 105	1 093 106	1 093 107	1 093 108

For

Ammeters Direct Current

Voltmeters Direct Current

Wattmeters Direct Current

Wattmeters Alternating Current

Varmeters Alternating Current

CENTER ZERO UNIFORMLY DIVIDED

	Chart Divisions			Record Charts — Chart Speed—Inches Per Hour			
Capacity	Main	Sub.	Total	¾ Style No.	1½ Style No.	3 Style No.	6 Style No.
5–0–5	10	5	50	1 093 179	1 093 180	1 093 181	1 093 182
8–0–8	8	4	32	1 093 048	1 093 049	1 093 050	1 093 051
10–0–10	8	5	40	1 093 109	1 093 110	1 093 111	1 093 112
15–0–15	6	5	30	1 059 248	1 059 249	1 059 250	1 059 251
20–0–20	8	5	40	1 093 113	1 093 114	1 093 115	1 093 116
25–0–25	10	5	50	1 093 183	1 093 184	1 093 185	1 093 186
30–0–30	12	5	60	1 093 233	1 093 234	1 093 235	1 093 236
40–0–40	8	5	40	1 093 117	1 093 118	1 093 119	1 093 120
50–0–50	10	5	50	1 093 187	1 093 188	1 093 189	1 093 190
60–0–60	12	5	60	1 093 237	1 093 238	1 093 239	1 093 240
80–0–80	8	4	32	1 093 052	1 093 053	1 093 054	1 093 055
100–0–100	8	5	40	1 093 121	1 093 122	1 093 123	1 093 124
150–0–150	6	5	30	1 059 252	1 059 253	1 059 254	1 059 255
200–0–200	8	4	32	1 093 056	1 093 057	1 093 058	1 093 059
250–0–250	10	5	50	1 093 191	1 093 192	1 093 193	1 093 194
300–0–300	12	5	60	1 093 241	1 093 242	1 093 243	1 093 244
400–0–400	8	5	40	1 093 125	1 093 126	1 093 127	1 093 128
500–0–500	10	5	50	1 093 195	1 093 196	1 093 197	1 093 198
600–0–600	12	5	60	1 093 245	1 093 246	1 093 247	1 093 248
800–0–800	8	4	32	1 093 060	1 093 061	1 093 062	1 093 063
1000–0–1000	8	5	40	1 093 129	1 093 130	1 093 131	1 093 132
1500–0–1500	6	5	30	1 093 016	1 093 017	1 093 018	1 093 019
2000–0–2000	8	5	40	1 093 133	1 093 134	1 093 135	1 093 136
2500–0–2500	10	5	50	1 093 199	1 093 200	1 093 201	1 093 202
3000–0–3000	12	5	60	1 093 249	1 093 250	1 093 251	1 093 252
4000–0–4000	8	5	40	1 093 137	1 093 138	1 093 139	1 093 140
5000–0–5000	10	5	50	1 093 203	1 093 204	1 093 205	1 093 206
6000–0–6000	12	5	60	1 093 253	1 093 254	1 093 255	1 093 256
8000–0–8000	8	4	32	1 093 064	1 093 065	1 093 066	1 093 067

Order by Style Number

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

RECORD CHARTS—Continued

For

Voltmeters Alternating Current

Ammeters Alternating Current

LEFT ZERO NON-UNIFORMLY DIVIDED

Capacity	Chart Divisions Main	Sub.	Total	Record Charts — Chart Speed—Inches Per Hour: ¾ Style No.	1½ Style No.	3 Style No.	6 Style No.
2.5	10	5	50x	1 093 312	1 093 313	1 093 314	1 093 315
5	10	5	50x	1 093 316	1 093 317	1 003 752	1 093 318
6	12	5	60*	1 059 256	1 059 257	1 059 258	1 059 259
7.5	15	5	75 Θ	1 093 382	1 093 383	1 093 384	1 093 385
9	9	5	45x	1 003 386	1 059 260	1 059 261	1 059 262
10	10	5	50x	1 093 319	1 093 320	1 093 321	1 093 322
15	15	5	75 Θ	1 093 386	1 093 387	1 093 388	1 093 389
20	8	5	40x	1 093 280	1 093 281	1 093 282	1 093 283
25	10	5	50x	1 093 323	1 093 324	1 093 325	1 093 326
30	12	5	60*	1 093 355	1 093 356	1 093 357	1 093 358
40	8	5	40x	1 093 284	1 093 285	1 093 286	1 093 287
50	10	5	50x	1 093 327	1 093 328	1 093 329	1 093 330
60	12	5	60*	1 093 359	1 093 360	1 093 361	1 093 362
75	15	5	75 Θ	1 093 390	1 093 391	1 093 392	1 093 393
80	8	5	40x	1 093 288	1 093 289	1 093 290	1 093 291
100	10	5	50x	1 093 331	1 093 332	1 093 333	1 093 334
120	12	5	60*	1 093 363	1 093 364	1 093 365	1 093 366
150	15	5	75 Θ	1 093 394	1 093 395	1 003 385	1 093 396
200	8	5	40x	1 093 292	1 093 293	1 093 294	1 093 295
250	10	5	50x	1 093 335	1 093 336	1 093 337	1 093 338
300	12	5	60*	1 093 367	1 093 368	1 093 369	1 093 370
400	8	5	40x	1 093 296	1 093 297	1 093 298	1 093 299
500	10	5	50x	1 093 339	1 093 340	1 093 341	1 093 342
600	12	5	60*	1 093 371	1 093 372	1 093 373	1 093 232
750	15	5	75 Θ	1 093 397	1 093 398	1 093 399	1 093 400
800	8	5	40x	1 093 300	1 093 301	1 093 302	1 093 303
1000	10	5	50x	1 093 343	1 093 344	1 093 345	1 093 346
1200	12	5	60*	1 093 374	1 093 375	1 093 376	1 093 377
1500	15	5	75 Θ	1 093 401	1 093 402	1 093 403	1 093 404
2000	8	5	40x	1 093 304	1 093 305	1 093 306	1 093 307
2500	10	5	50x	1 093 347	1 093 348	1 093 349	1 093 350
3000	12	5	60*	1 093 378	1 093 379	1 093 380	1 093 381
4000	8	5	40x	1 093 308	1 093 309	1 093 310	1 093 311
5000	10	5	50x	1 093 351	1 093 352	1 093 353	1 093 354

x First ten subdivisions are omitted.
* First fifteen subdivisions are omitted.
Θ First twenty subdivisions are omitted.

RECORD CHART LIST PRICES

Quantity†	List Price Each Discount Symbol BC
1 to 24 inclusive	$1 40
25 to 99 inclusive	1 30
100 or more	1 20

† Record charts of all listed capacities and speeds may be combined on one order to obtain quantity price.

RECORD CHART DATA

Rulings in Black—Time and Capacity Markings in Color.

Speed Inches per Hour	Length of Chart—Feet	Will Run Days	Time Marking	Distance Between Markings: Time	Capacity
¾	54	35	12M-4AM-8AM etc.	3″	12″
1½	54	17	12M-2AM-4AM etc.	3″	12″
3	54	8	12M-1AM-2AM etc.	3″	12″
6	48	3	12M-1AM-2AM etc.	6″	12″

Order by Style Number

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

RECORD CHART DIVISION

UNIFORMLY DIVIDED CHARTS

Cardinal Points are Indicated by Dots.
Capacity Markings are Located at These Points

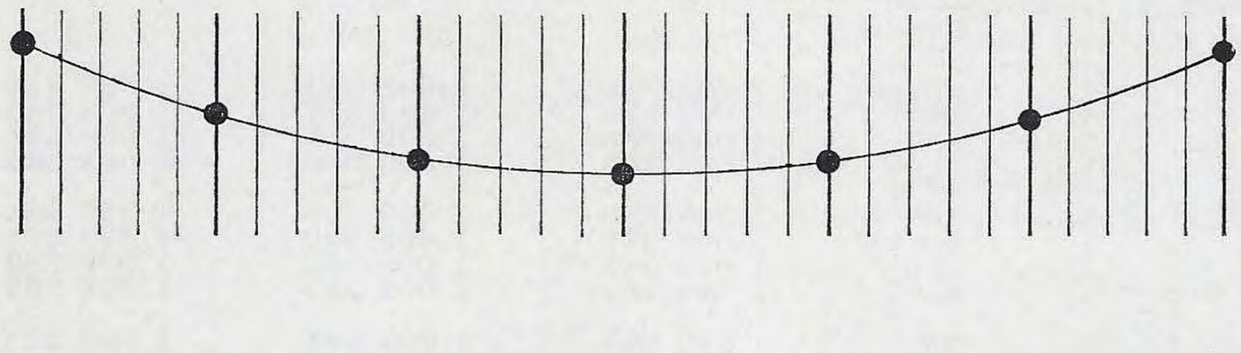
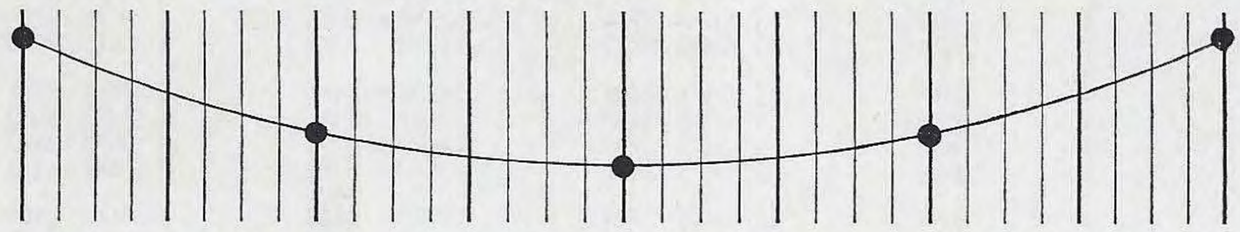
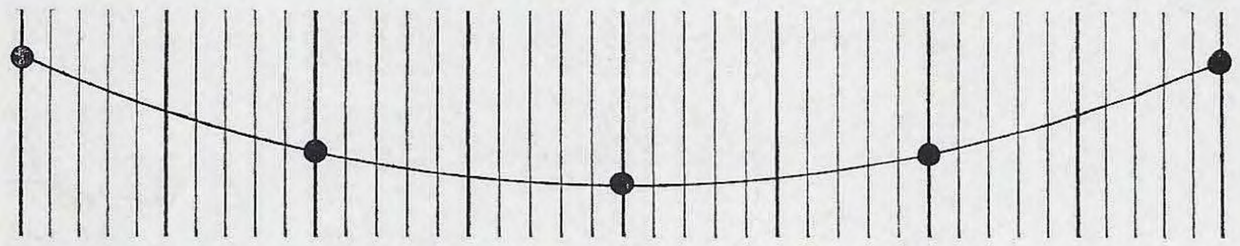
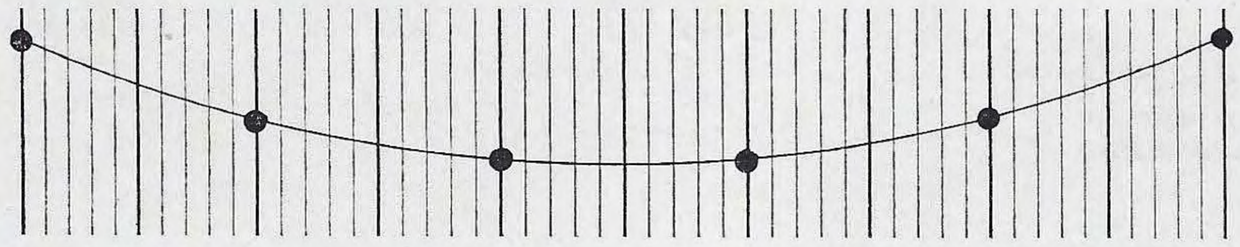
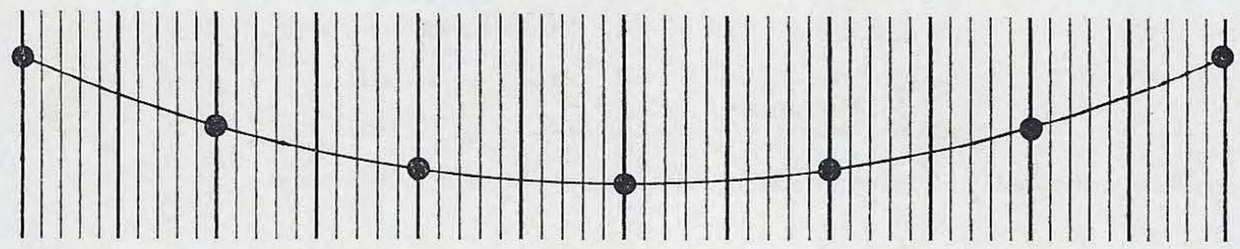
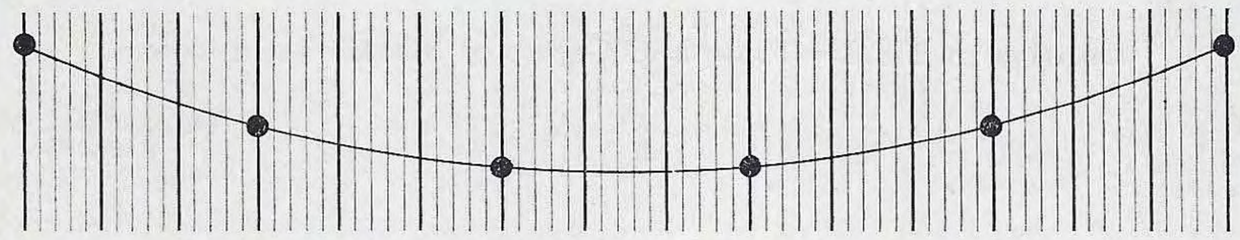
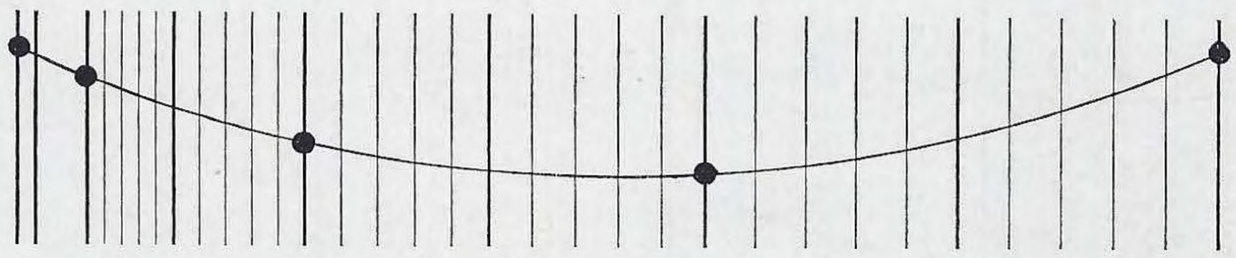
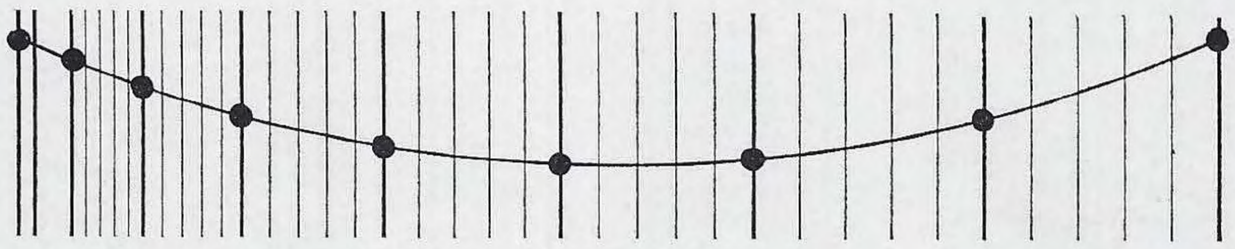
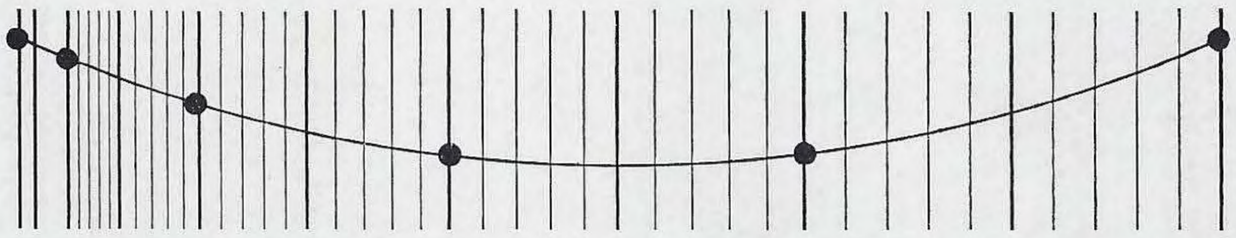
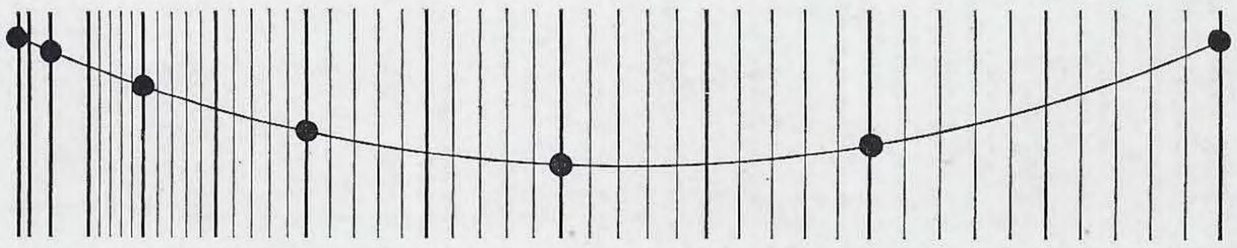
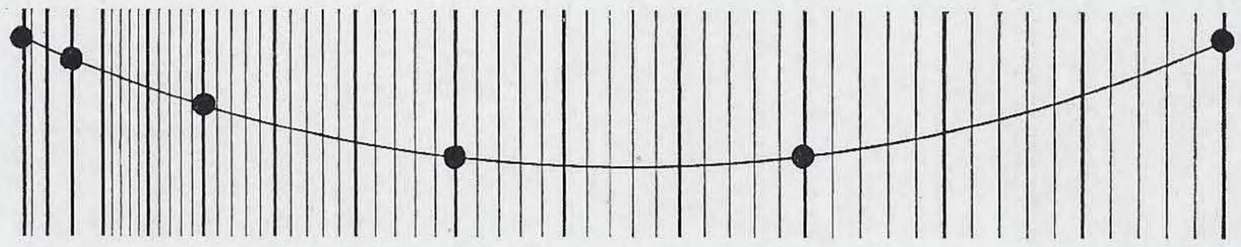
—DIVISION PLAN— Main	Sub.	Total	
6	5	30	
8	4	32	
8	5	40	
10	5	50	
12	5	60	
15	5	75	

FIG. 18—RECORD CHART DIVISION

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

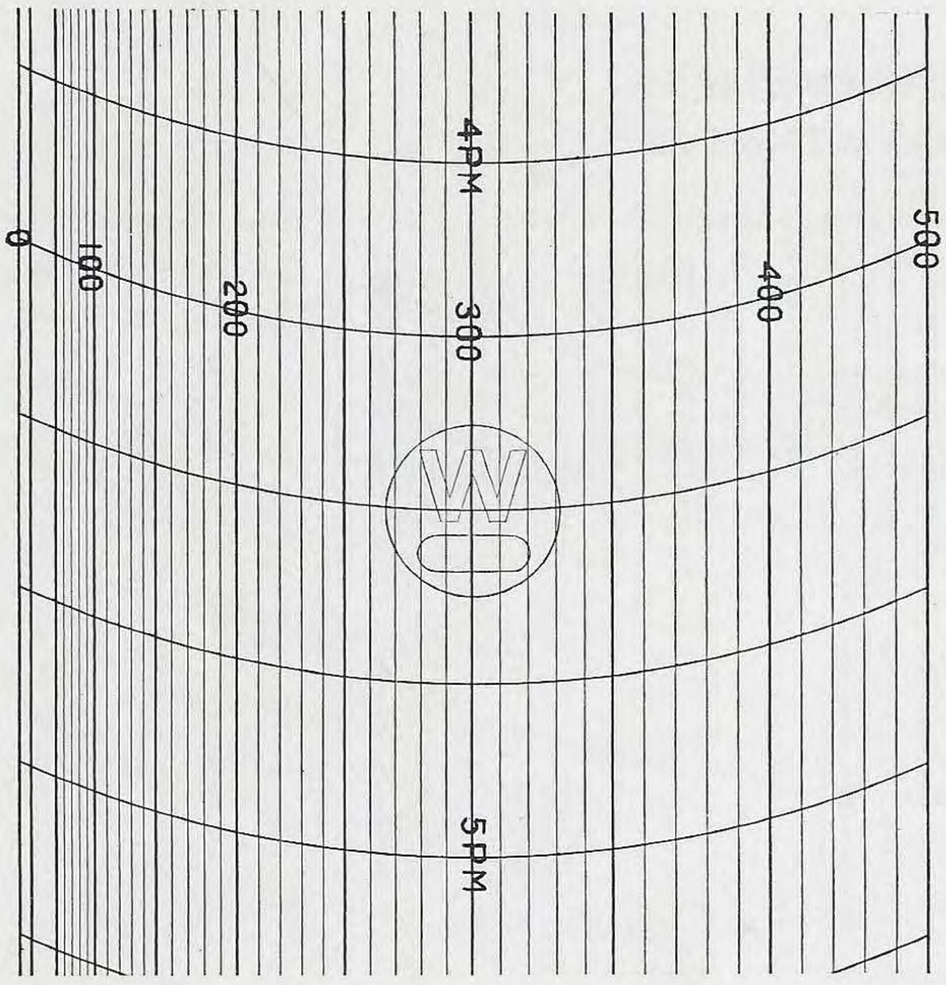
NON-UNIFORMLY DIVIDED CHARTS

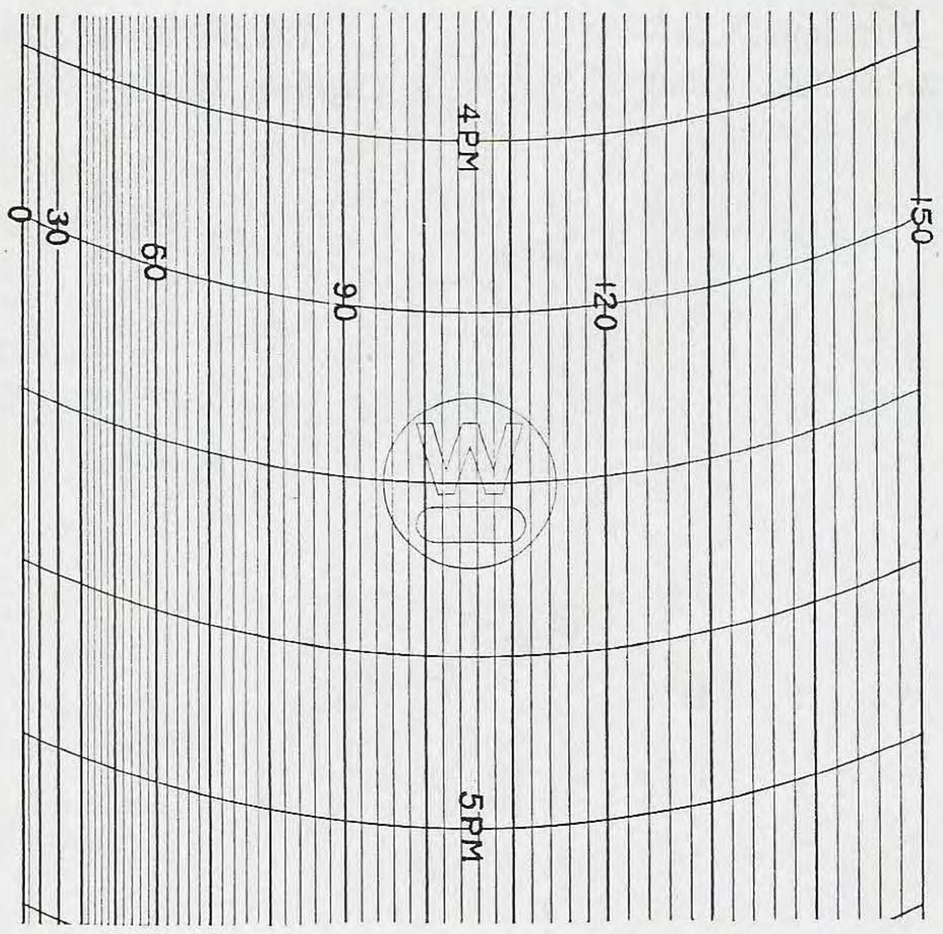
DIVISION PLAN			Cardinal Points are Indicated by Dots. Capacity Markings are Located at These Points.
Main	Sub.	Total	
8	5	40*	
9	5	45*	
10	5	50*	
12	5	60†	
15	5	75‡	

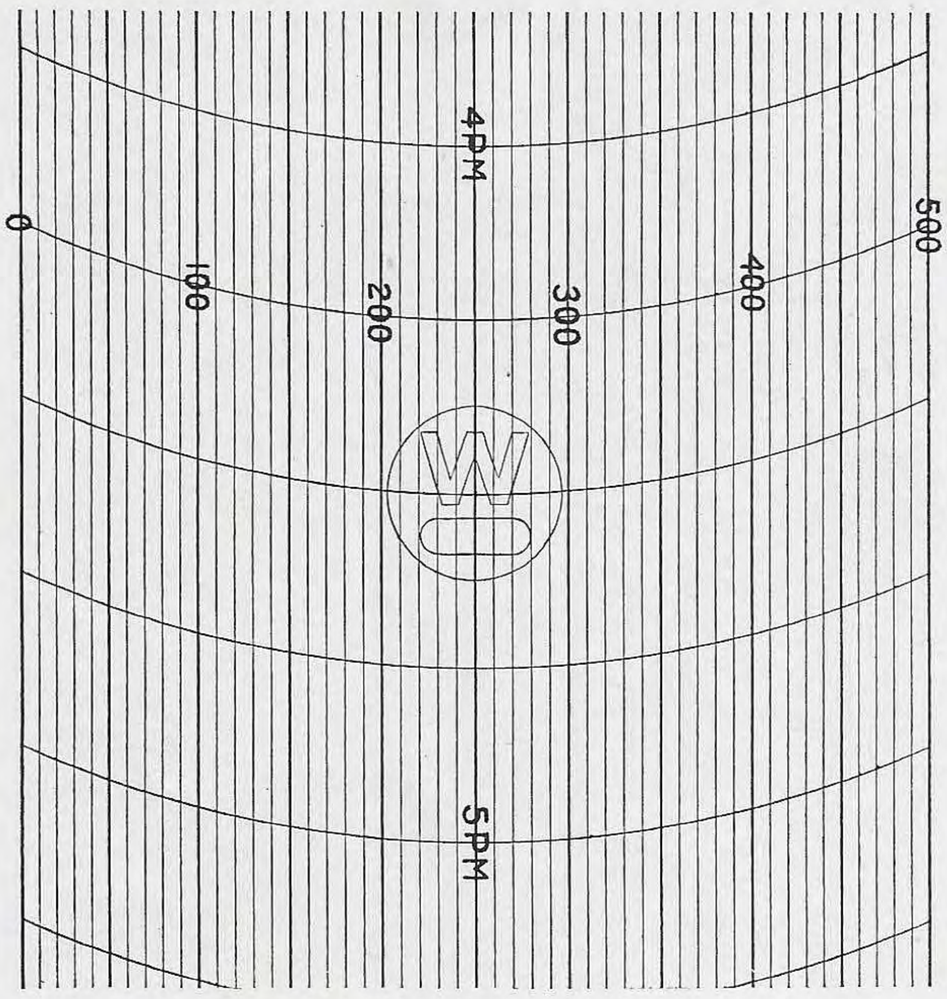
* First ten subdivisions are omitted.
† First fifteen subdivisions are omitted.
‡ First twenty subdivisions are omitted.

FIG. 19—RECORD CHART DIVISION

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued







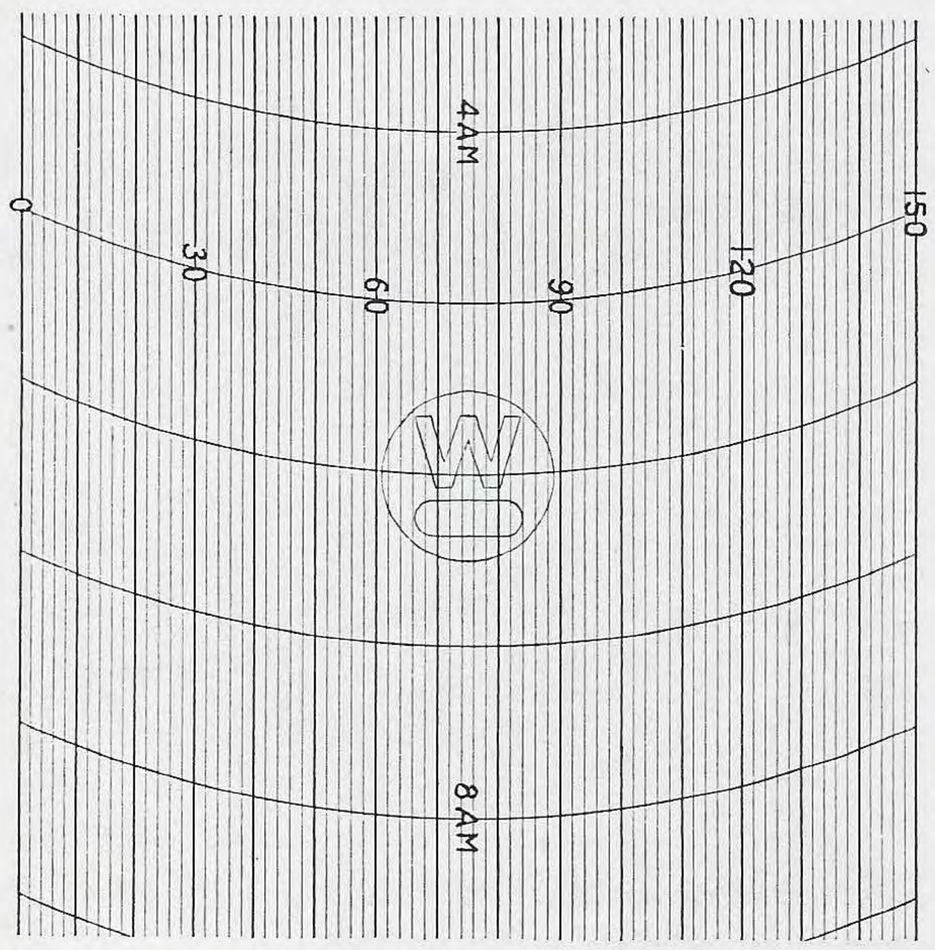
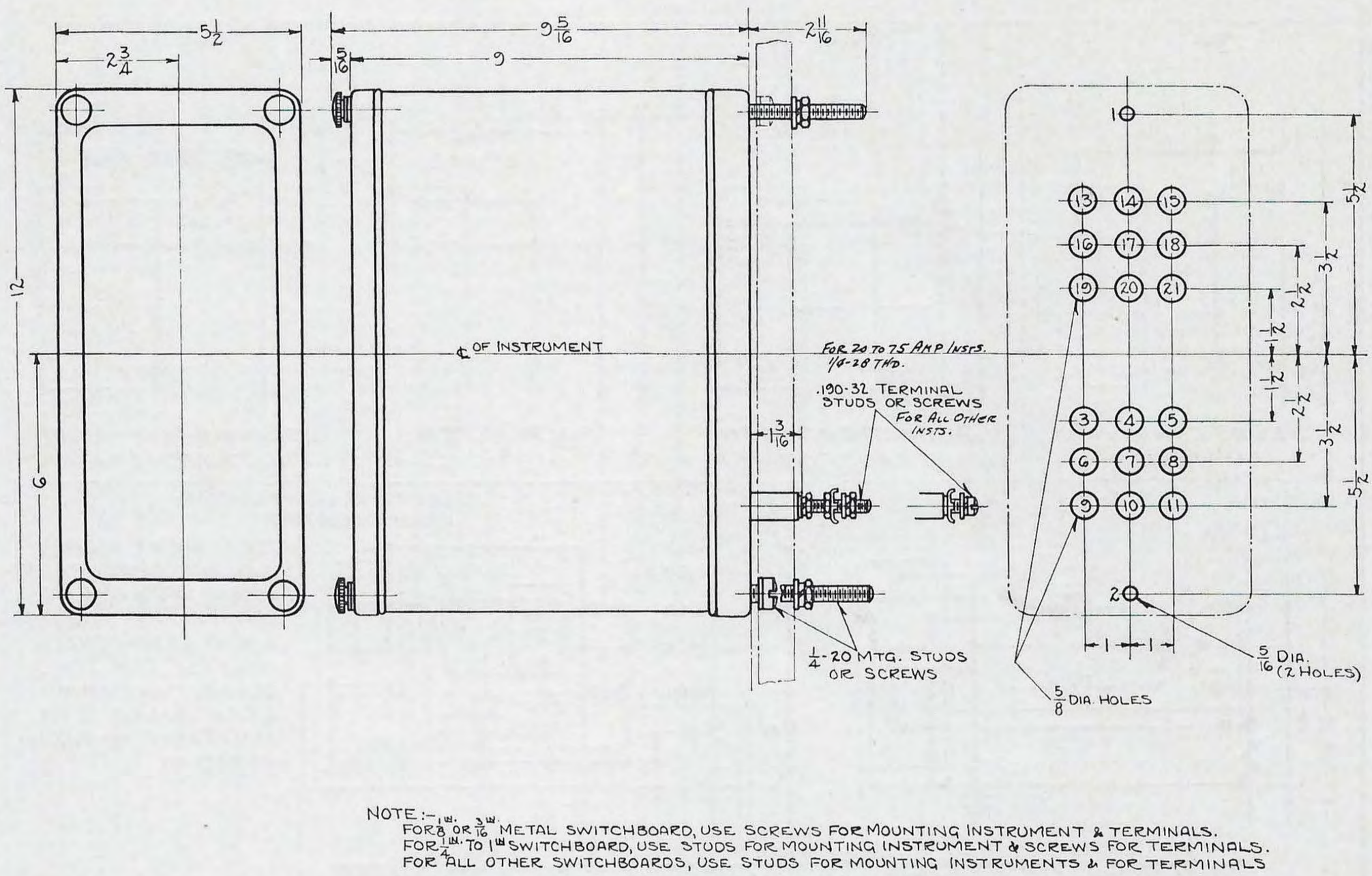


FIG. 20—SAMPLE CHARTS

TYPES GX-40 AND GY-40 RECORDING INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES

Dimensions are for reference only; for Official Dimensions see instructions shipped with Recorders, or apply to the nearest Westinghouse Sales Office.



NOTE:— FOR 1/8 OR 3/16 IN. METAL SWITCHBOARD, USE SCREWS FOR MOUNTING INSTRUMENT & TERMINALS.
FOR 1/4 IN. TO 1 IN. SWITCHBOARD, USE STUDS FOR MOUNTING INSTRUMENT & SCREWS FOR TERMINALS.
FOR ALL OTHER SWITCHBOARDS, USE STUDS FOR MOUNTING INSTRUMENTS & FOR TERMINALS

FIG. 21—OUTLINE AND DRILLING PLAN, TYPE G-40 RECORDERS

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

Business Addresses

Headquarters, Pittsburgh, Pa.

*AKRON, OHIO, 106 South Main St.
*ALBANY, N. Y., 456 No. Pearl St.
§ALEXANDRIA, VA., 121 Frazier Ave.
*ALLENTOWN, PA., 522 Maple St.
*APPLETON, WISC., 1708 N. Drew St., P.O. Box 206
†APPELTON, WISC., 1029 So. Outagamie St.
⁂†*ATLANTA, GA., 426 Marietta St., N. W.
xATTICA, N. Y.
*BAKERSFIELD, CALIF., 2224 San Emedio St.
*BALTIMORE, MD., 118 E. Lombard St.
†BALTIMORE, MD., 501 East Preston Road
§BALTIMORE, MD., 40 S. Calvert St.
*BEAUMONT, TEXAS, 2293 Broadway Ave., P. O. Box 2367
*BINGHAMTON, N. Y., Suite 704, Marine Midland Bldg., 86 Court St.
*BIRMINGHAM, ALA., 2030 Second Ave.
*BLUEFIELD, W. VA., 208 Bluefield Avenue
§BOISE, IDAHO, P. O. Box 1597
*BOSTON, MASS., 10 High St.
†⁂BOSTON, MASS., 12 Farnsworth St.
*†BRIDGEPORT, CONN., Bruce Ave. & Seymour St.
*BUFFALO, N. Y., 814 Ellicott Square Bldg.
†⁂BUFFALO, N. Y., 1132 Seneca St.
*BURLINGTON, IOWA, 1708 River St.
*BURLINGTON, VER., 207 Park Ave.
*BUTTE, MONTANA, 129 West Park St.
⁂BUTTE, MONTANA, 742 Bryant Ave.
①*CANTON, OHIO, 120 W. Tuscarawas St.
*CEDAR RAPIDS, IOWA, 813 18th St., S.E. P. O. Box 148
*† CHARLOTTE, N. C., 210 East Sixth St.
①*⁂CHARLESTON, W. VA., 1415 Oakmont Rd. P. O. Box 865
CHATTANOOGA, TENN., 536 Market St.
*CHICAGO, ILL., 20 N. Wacker Drive
*CHICAGO, ILL., 2211 W. Pershing Road
†⁂CHICOPEE FALLS, MASSACHUSETTS
xCINCINNATI, OHIO, 207 West Third St.
*⁂†⁂CLEVELAND, OHIO, 1216 West Fifty-Eighth St.
†x⁂ COLUMBIA, S. C., 912 Lady St.
§*COLUMBUS, OHIO, 85 E. Gay St.
①*DALLAS, TEXAS, 209 Browder St.
⁂DALLAS, TEXAS, 1712 Carter St.
*DAVENPORT, IOWA, 206 E. Second St.
*DAYTON, OHIO, 30 North Main St.
*DENVER, COLORADO, 910 Fifteenth St.
⁂DENVER, COLORADO, 1700 Sixteenth St.
†DENVER, COLORADO, 988 Cherokee St.
§DENVER, COLORADO, Gas & Elec. Bldg.
xDERRY, PA.
*DES MOINES, IOWA, 523 Sixth Ave.
*†⁂DETROIT, MICH., 5757 Trumbull Ave.
*DULUTH, MINN., 10 East Superior St.
①§EAST PEORIA, ILL., 900 W. Washington St.
x⁂EAST PITTSBURGH, PA.
*EL PASO, TEXAS, Oregon and Mills Sts.
⁂EL PASO, TEXAS, 450 Canal St.
§EL PASO, TEX., % Zork Hdwe. Co., 309 N. El Paso St.
*⁂†EMERYVILLE, CALIF., 1466 Powell St.
xEMERYVILLE, CALIF., 6161 Green St.
*ERIE, PA., 1003 State St.
*EVANSVILLE, IND., 201 N. W. First St.
*†FAIRMONT, W. VA., 602 Cleveland Ave.
§FARGO, N. D., 520—3rd Ave. N
*FORT WAYNE, IND., 1010 Packard Ave.
*FORT WORTH, TEXAS, 501 Jones St.
*FRESNO, CALIF., 872 Peralta Way, P. O. Box 632
*GARY, IND., 701 Washington St.
①*GRAND RAPIDS, MICH., 511 Monroe Ave. N. W.
*GREENSBORO, N. C., 108 S. Park Drive, P. O. Box 1828.
*GREENVILLE, S. C., West Earle St.
*HAMMOND, IND., 235 167th St.
*HARTFORD, CONN., Main & Pearl Sts., P. O. Box 745
*HONOLULU, T. H., Hawaiian Elec. Co. Agt.
*HOUSTON, TEXAS, 1314 Texas Ave.
⁂HOUSTON, TEXAS, 2313 Commerce Ave.
†HOUSTON, TEXAS, 2315 Commerce Ave.
§HOUSTON, TEXAS, 611-15 Petroleum Bldg
①†*⁂HUNTINGTON, W. VA., 1029 Seventh Ave.
*INDIANAPOLIS, IND., 137 S. Penna. Ave.
†INDIANAPOLIS, IND., 551 West Merrill St.
*ISHPEMING, MICH., 433 High St.
*JACKSON, MICH., 212 West Michigan Ave.
①*†JOHNSTOWN, PA., 107 Station St.
*JOPLIN, MO., 420 School St.
*KANSAS CITY, MO., 101 W. Eleventh St.
⁂†KANSAS CITY, MO., 2124 Wyandotte St.
*KNOXVILLE, TENN., Gay & Clinch St.
xLIMA, OHIO
*LITTLE ROCK, ARK., 1115 West 24th St.
§LITTLE ROCK, ARK., % Fones Bros. Hdwe., 2nd & Rock Sts.
*†⁂LOS ANGELES, CALIF., 420 So. San Pedro St.
*LOUISVILLE, KY., 322 West Broadway
*MADISON, WISC., 508 Edgewood Ave.
xMANSFIELD, OHIO, 200 East Fifth St.
*MARSHALL, TEXAS, 504 Nathan St.
*MEMPHIS, TENN., 130 Madison Ave.
*MIAMI, FLA., 1036 N. Miami Ave.
*MILWAUKEE, WISC., 546 North Broadway
†MILWAUKEE, WISC., 1669 N. Water St.
*†⁂MINNEAPOLIS, MINN., 2303 Kennedy St., N. E.
*MONROE, LA., 1301 N. Fourth St.
*NASHVILLE, TENN., 219 Second Ave., N.
*NEWARK, N. J., 1180 Raymond Blvd.
†⁂NEWARK, N. J., Haynes Ave. & Lincoln Highway
xNEWARK, N. J., Plane & Orange St.
①*NEW HAVEN, CONN., 42 Church St., P. O. Box 1718
①*NEW ORLEANS, LA., 333 St. Charles St.
⁂NEW ORLEANS, LA., 527 Poydras St.
*NEW YORK, N. Y., 150 Broadway
†NEW YORK, N. Y., 460 West Thirty-Fourth St
*NIAGARA FALLS, N. Y. 205 Falls St
①*NORFOLK, VA., City Hall Ave. & Bank St.
*OKLAHOMA CITY, OKLA., 120 N. Robinson St.
⁂OKLAHOMA CITY, OKLA., Third & Alie Sts.
*OMAHA, NEB., 409 South Seventeenth St.
§OMAHA, NEB., 117 N. 13th St.
*PEORIA, ILL., 104 E. State St.
*†⁂PHILADELPHIA, PA., 3001 Walnut St.
*PHOENIX, ARIZONA, 11 West Jefferson St.
xPITTSBURGH, PA., Nuttall Works, 200 McCandless Ave.
z*PITTSBURGH, PA., 306 4th Ave., Box 1017
⁂†PITTSBURGH, PA., 543 N. Lang Ave.
*PORTLAND, MAINE, 142 High St.
*PORTLAND, OREGON, 309 S. W. Sixth Ave.
†PORTLAND, OREGON, 2138 N. Interstate Ave.
⁂PORTLAND, OREGON, 720 N. Thompson St.
*†PROVIDENCE, R. I., 16 Elbow St.
①*RALEIGH, N. C., 803 North Person St., P. O. Box 1134
§RALEIGH, N. C., P. O. Box 443.
§READING, PA., 619 Spruce St.
*RICHMOND, VA., Fifth & Byrd
*§ROANOKE, VA., 726 First St., S. E.
*†ROCHESTER, N. Y., 410 Atlantic Ave.
*ROCKFORD, ILL., 130 South Second St.
*SACRAMENTO, CALIF., 1805 20th St.
*SALT LAKE CITY, UTAH, 10 West First South St.
†⁂SALT LAKE CITY, UTAH, 346 A Pierpont Ave.
§SALT LAKE CITY, UTAH, McCormick Bldg.
*SAN ANTONIO, TEXAS, 115 W. Travis St.
§SAN FRANCISCO, CALIF., 1355 Market St.
*SAN FRANCISCO, CALIF., 1 Montgomery St.
*SEATTLE, WASH., 603 Stewart St.
†⁂SEATTLE, WASH., 3451 East Marginal Way
xSHARON, PA., 469 Sharpsville Ave.
*SIOUX CITY, IOWA, 2311 George St.
*SOUTH BEND, IND., 216 East Wayne St.
§SOUTH BEND, IND., 107 E. Jefferson St.
xSOUTH PHILA. WKS., Essington, Pa.
°SOUTH PHILA. WKS., P. O. Box 7348, Philadelphia, Pa.
*SPOKANE, WASH., So. 158 Monroe St.
*SPRINGFIELD, ILL., 601 E. Adams St., Box 37
*†SPRINGFIELD, MASS., 395 Liberty St
xSPRINGFIELD, MASS., 653 Page Boulevard
*ST. LOUIS, MO., 411 North Seventh St.
†⁂ST. LOUIS, MO., 717 South Twelfth St.
*SYRACUSE, N. Y., 420 N. Geddes St.
*TACOMA, WASH., 1023 "A" St.
*TAMPA, FLA., 417 Ellamae Ave., Box 230
*TOLEDO, OHIO, 245 Summit St.
*TULSA, OKLA., 303 East Brady St.
*⁂†UTICA, N. Y., 113 N. Genesee St.
*WASHINGTON, D. C., 1434 New York Ave., N. W.
*WATERLOO, IOWA, 328 Jefferson St., P. O. Box 598.
*WICHITA, KAN., 233 So. St. Francis Ave.
*†WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
*†WORCESTER, MASS., 32 Southbridge St.
*YORK, PA., 143 So. George St.
*YOUNGSTOWN, OHIO, 25 E. Boardman St.

Where address and P. O. box are both given, send mail to P. O. box, telegrams to address indicated.

WESTINGHOUSE ELECTRIC SUPPLY COMPANY

Fully equipped sales offices and warehouses are maintained at all addresses

ALBANY, N. Y., 454 No. Pearl St.
ALLENTOWN, PA., 522 Maple St.
ATLANTA, GA., 96 Poplar St., N. W.
AUGUSTA, MAINE, 90 Water St.
BALTIMORE, MD., 40 South Calvert St.
BANGOR, MAINE, 175 Broad St.
BINGHAMTON, N. Y., 87 Chenango St.
BOSTON, MASS., 76 Pearl St.
BURLINGTON, VT., 208 Flynn Ave.
BUTTE, MONTANA, 50 East Broadway
CHARLOTTE, N. C., 210 East Sixth St.
CHICAGO, ILL., 113 North May St.
CLEVELAND, OHIO, 3950 Prospect Ave.
COLUMBIA, S. C., 915 Lady St.
DALLAS, TEXAS, 409 Browder St.
①DES MOINES, IOWA, 1400 Walnut St.
DETROIT, MICH., 547 Harper Ave.
DULUTH, MINN., 308 W. Michigan St.
EVANSVILLE, IND., 201 N. W. First St.
FLINT, MICH., 1314 N. Saginaw St.
FORT WORTH, TEXAS, 501 Jones St.
①GRAND RAPIDS, MICH., 511 Monroe Ave., N. W.
GREENVILLE, S. C., 200 River St.
HOUSTON, TEXAS, 1903 Ruiz St.
INDIANAPOLIS, IND., 137 S. Pennsylvania St.
JACKSONVILLE, FLA., 37 South Hogan St.
LOS ANGELES, CALIF., 905 East Second St.
MADISON, WISC., 1022 E. Washington Ave.
MIAMI, FLA., 1036 North Miami Ave.
MEMPHIS, TENN., 366 Madison Ave.
MILWAUKEE, WISC., 546 N. Broadway
MINNEAPOLIS, MINN., 215 South Fourth St.
NEWARK, N. J., 49 Liberty St.
NEW HAVEN, CONN., 240 Cedar St.
zNEW YORK, N. Y., 150 Varick St
①NORFOLK, VA., 320 City Hall Ave.
OAKLAND, CALIF., Tenth & Alice Sts.
OKLAHOMA CITY, OKLA., 10 E. California St.
OMAHA, NEB., 117 North Thirteenth St.
PEORIA, ILL., 104 East State St.
PHILADELPHIA, PA., 1101 Race St.
PHOENIX, ARIZONA, 315 West Jackson St.
PORTLAND, OREGON, 134 N.W. Eighth Ave.
PROVIDENCE, R. I., 66 Ship St.
RALEIGH, N. C., 322 S. Harrington St.
READING, PA., 619 Spruce St.
RICHMOND, VA., 301 South Fifth St.
ROANOKE, VA., 726 First St., S. E.
①ROCHESTER, N. Y., 1048 University Ave.
ST. LOUIS, MO., 1011 Spruce St.
ST. PAUL, MINN., 145 East Fifth St.
SACRAMENTO, CALIF., 20th and R Sts.
SALT LAKE CITY, UTAH, 235 West South Temple St.
SAN ANTONIO, TEXAS, 1201 E. Houston St.
SAN FRANCISCO, CALIF., 260 Fifth St.
SEATTLE, WASH., 558 First Ave., South
SIOUX CITY, IOWA, 1005 Dace St.
SPOKANE, WASH., 152 So. Monroe St.
SPRINGFIELD, MASS., 46 Hampden St.
SYRACUSE, N. Y., 961 W. Genesee St.
TAMPA, FLA., 417 Ellamae St.
TOLEDO, OHIO, 812 Lafayette St.
TRENTON, N. J., 245 N. Broad St.
TULSA, OKLA., 303 East Brady St.
UTICA, N. Y., 113 N. Genesee St.
WASHINGTON, D. C., 1216 "K" St., N. W.
WATERLOO, IOWA, 328 Jefferson St.
WICHITA, KANSAS, 233 So. St. Francis Ave.
WILMINGTON, DEL., 216 E. Second St.
WORCESTER, MASS., 24 Southbridge St.
YORK, PA., 143 S. George St.

* Sales Office † Service Shop x Works ⁂ Warehouse °First Class Mail Only § Merchandising Products Only z Headquarters ‡ Apparatus Products Only
①Changed or added since previous issue.

January, 1938

RECORDING AMMETERS AND VOLTMETERS—TYPE U

Switchboard and Portable

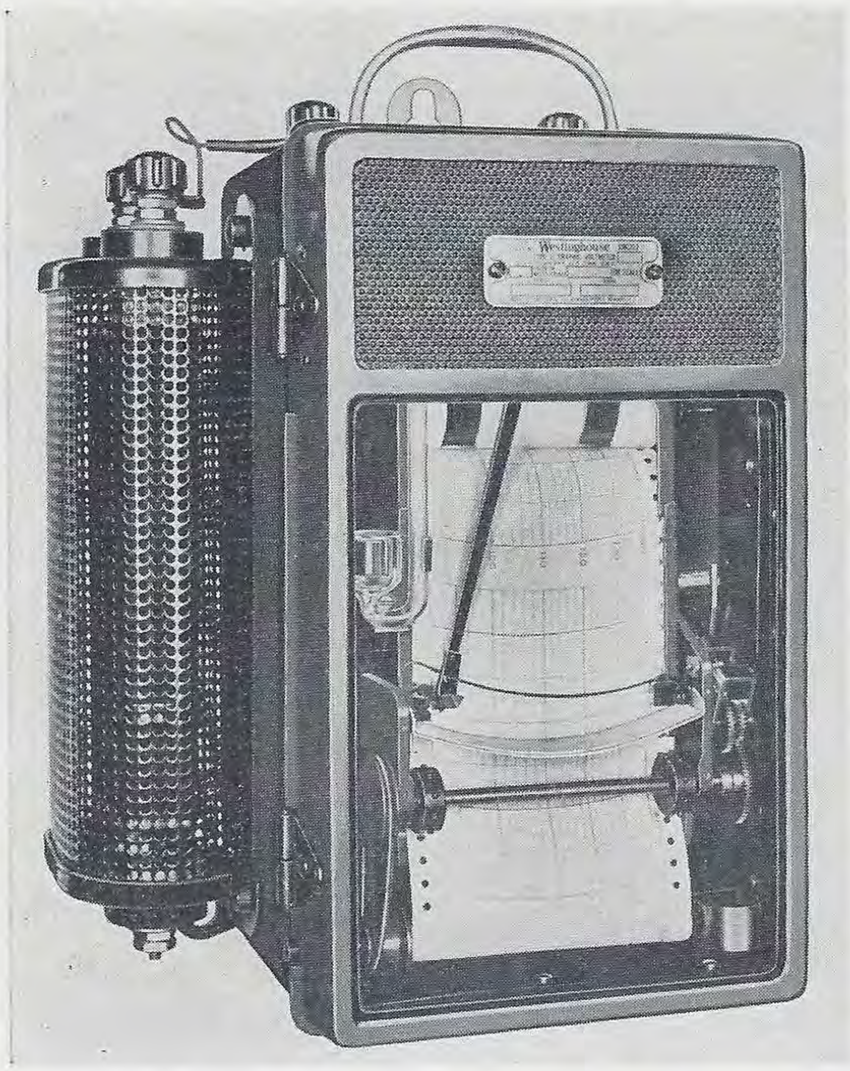


FIG. 1—TYPE U RECORDING VOLTMETER FOR PORTABLE SERVICE

Data

CASE.....METAL WITH GLASS WINDOW

CASE SIZE....HEIGHT —10 INCHES
DEPTH —5½ INCHES
WIDTH —5¾ INCHES WITHOUT RESISTOR
WIDTH —7¾ INCHES WITH RESISTOR

SCALE LENGTH..2½ INCHES

CHART..... 3¼ INCHES WIDE; 16 FEET LONG FOR 1 INCH PER HOUR; 32 FEET LONG FOR 2 INCHES PER HOUR

MOVEMENT... SOLENOID

BURDEN..... 90–140 VM. AT 115 V., 60 CY., 33 VA.; 0–5 AM. AT 5 A., 60 CY., 15 VA.

ACCURACY....3% A-C. AND D-C.

WEIGHT.....VOLTMETER AND RESISTOR
10½ LBS. NET, 13½ LBS. SHIPPING
AMMETERS
9½ LBS. NET, 12½ LBS. SHIPPING

Application

These instruments are intended for purposes where recording instruments that are easily operated, light in weight, comparatively low in price, and reasonably accurate, are required. Type U instruments permit central stations to secure at a reasonable cost, records, which would otherwise not be taken on account of the expense.

Service Voltage—An instrument on the service end of each feeder provides record of actual conditions. The type U voltmeter is light, easily set up, and transferred from one feeder to another, thus furnishing a number of records at minimum expense.

Customers' Load Curves—A type U recording ammeter is the simplest means for obtaining the load curve of a prospect's or customer's plant, from which maximum demand, load factor and diversity factor can be quickly approximated. A type U three-wire ammeter is particularly useful for this purpose on three-wire loads.

Station Curves—Mounted on the station or substation switchboard, type U instruments will give records of the variation in current and voltage.

Settling Disputes — During recent years recording instruments have come into extensive use in settling disputes with customers. The records often disclose the use of power at unexpected hours. The type U instrument, because it can be installed easily and quickly, is particularly adapted for such service.

Other Uses—There are innumerable uses for a recording instrument of this character. Determining most economical hours for operating generators of various sizes, checking up the distribution of load between units, and many other uses will suggest themselves to every central station man.

Construction and Operation

Measuring Element—The measuring element of the voltmeter or ammeter is a solenoid, with a core of soft iron wire which is drawn into the coil with a force dependent upon the current in the coil. Alternating-current ammeters operate with the line connected directly in self-contained types, and on the secondaries of current transformers in the 5-ampere rating. Direct-current measurements are limited to the currents for which the solenoid itself can be wound.

Voltmeters and ammeters both operate on the same principle, the only difference being that the voltmeter is wound for small currents, has a relatively high resistance in series with the coil, and is calibrated to read in terms of the voltage applied instead of in terms of the current in the coil.

Between the main shaft carrying the pen and the iron core of the solenoid there is a lever arm having sufficient resilience to damp out small vibrations such as those set up in the core by alternating currents in the coil. The torque transmitted to the shaft through this arm is opposed by a spiral spring.

Recording Element—The recording element consists of a V-point pen, chart, ink, and a clock, with the necessary details for feeding the chart through the instrument at a uniform rate so that the time indicated by the time scale on the chart for the point where the pen touches the paper always corresponds with the time of day.

RECORDING AMMETERS AND VOLTMETERS—TYPE U—Continued

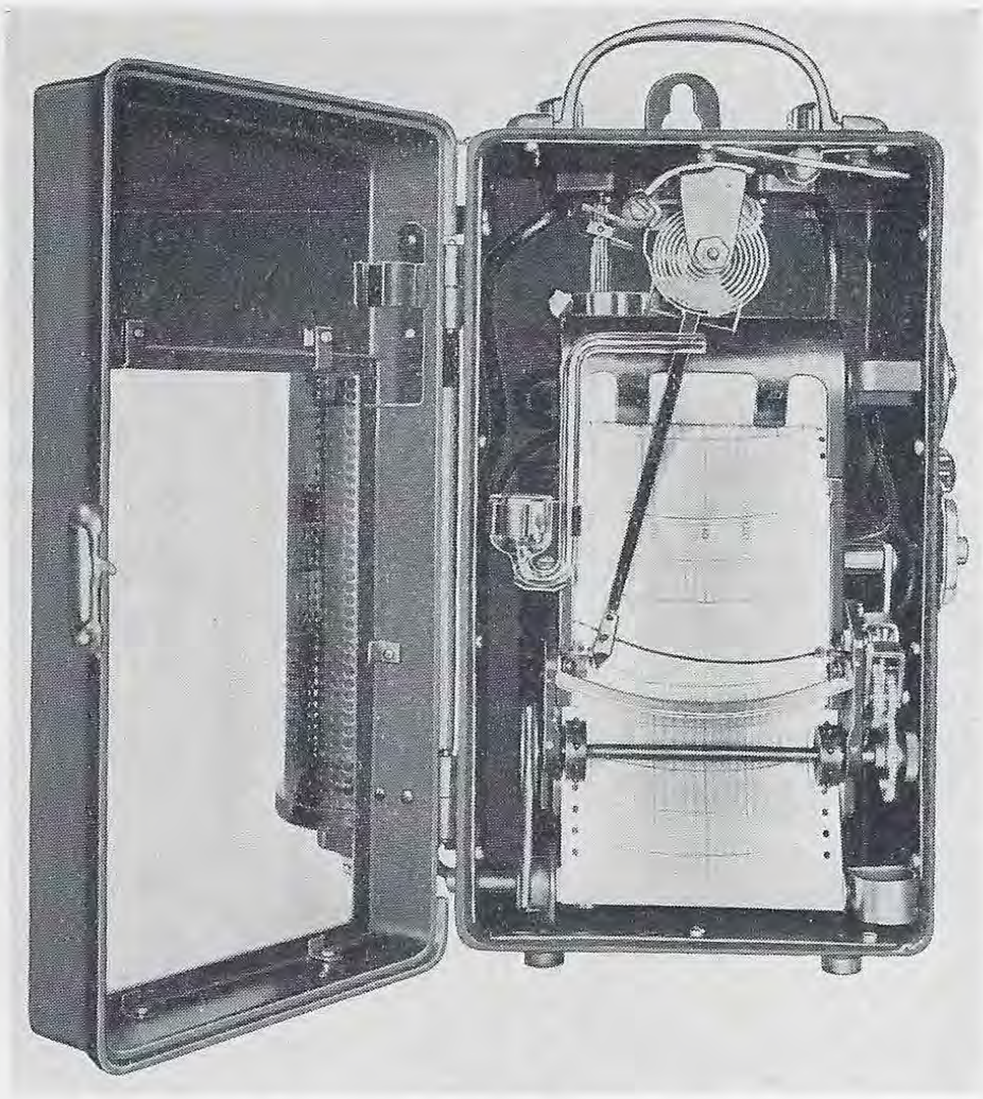


FIG. 2—TYPE U RECORDING INSTRUMENT WITH COVER OPEN

Damping—Damping is obtained by means of an oil dashpot. Damping, other than that inherent in the design of movement is not always necessary or desirable, but if the circuit being metered is very unsteady or is liable to be switched off suddenly at intervals, the oil dashpot should be used.

Case—The instrument is contained in a metal case having a glass window exposing the pen and several inches of chart. The standard instrument is suitable for either switchboard mounting or general portable use. A hinged handle is provided for easy portability. It is also equipped with a lug for hanging the instrument on a wall for temporary testing or while being stored in the instrument room.

Pen—The pen is of the open-top V-point type which has been used in a variety of graphic instruments. This kind of pen has minimum weight and can be kept in good working order with a minimum amount of attention.

The pen and pen arm can be taken off the instrument without disturbing its calibration.

Clock and Chart Drive—The clock is a standard American jeweled movement designed for heavy-duty recorder service. It has an exceptionally strong spring and is substantially built.

The clock is of key-wound type with balance-wheel escapement. Under normal conditions winding once a week is sufficient.

The paper driving mechanism is a pair of sprockets driven through gearing by the standard eight-day clock mechanism.

The standard rate of drive is one inch or two inches per hour.

Instruments with clocks driven by synchronous motor can also be furnished.

Record Paper—The record paper is furnished in 16-foot rolls, ruled for a speed of one inch per hour; and the 32-foot rolls, for a speed of two inches per hour. A roll is sufficient for 8 days' record. The time markings are half inch apart and the capacity markings agree with the calibration of the instrument used. The paper is 3¼ inches wide, scale 2½ inches.

Ink—A glass ink reservoir, which holds a supply of ink sufficient for three weeks or more of ordinary use, feeds the ink into the pen as used, by means of a yarn wick. Ink enough to last 100 hours on the average circuit can be held in the pen without the use of the ink reservoir. The ink is furnished in liquid form, specially prepared for use with the pen and paper supplied. A small bottle of ink is placed in a clip inside the cover of the instrument for convenience.

Types Available

Ammeters are made self-contained up to and including 80 amperes. Direct-current ammeters for higher currents cannot be furnished.

High-Voltage Ammeter—This specially-insulated ammeter is for connection in arc circuits or other high-voltage lines. The case is made of hardwood instead of metal. The cover can be locked to prevent unauthorized persons from opening it. Interior metal parts have standard 600-volt insulation between them and the coil, and should not be handled while the instrument is connected to a high-voltage circuit.

Three-wire ammeters record the total current in both outside wires of a three-wire system. They are useful in obtaining a record of the total load on a three-wire installation, but are recommended for use on direct-current circuits only.

Instruments with Zero Center—As type U instruments are not polarized, it is impossible to furnish them with zero center.

Portable Testing Unit—This unit consists of a portable split-type current transformer, and a 5-ampere type U recording ammeter, and provides a convenient means of measuring currents up to 250 amperes without opening the circuit.

The instrument is calibrated for use with the transformer, and a correction curve is furnished. By the use of this curve an accuracy within five per cent can be obtained.

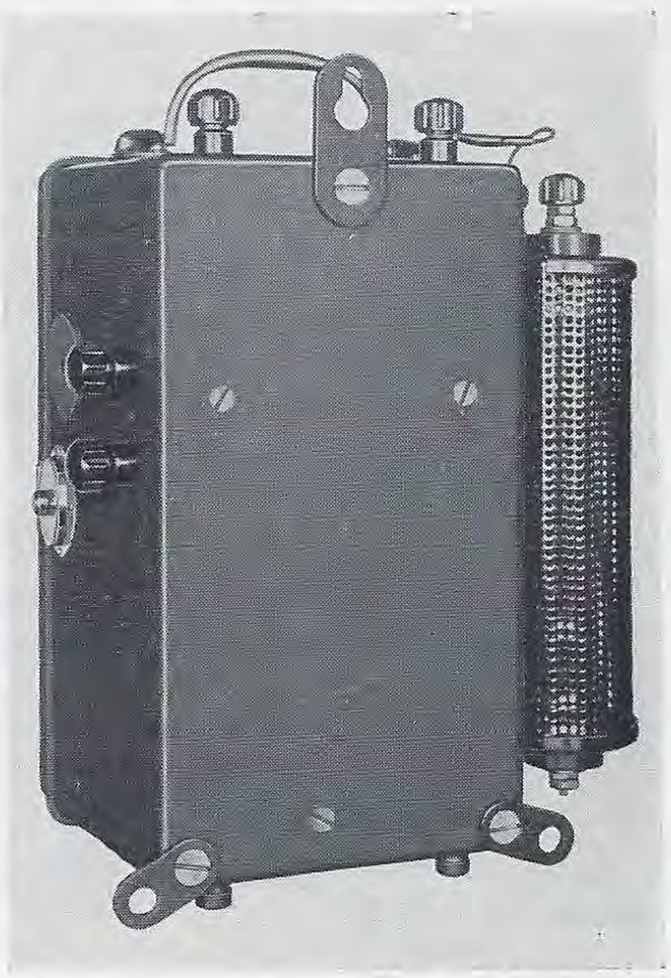


FIG. 3—REAR VIEW OF TYPE U VOLTMETER SHOWING TERMINALS AND MOUNTING LUGS

RECORDING AMMETERS AND VOLTMETERS—TYPE U—Continued

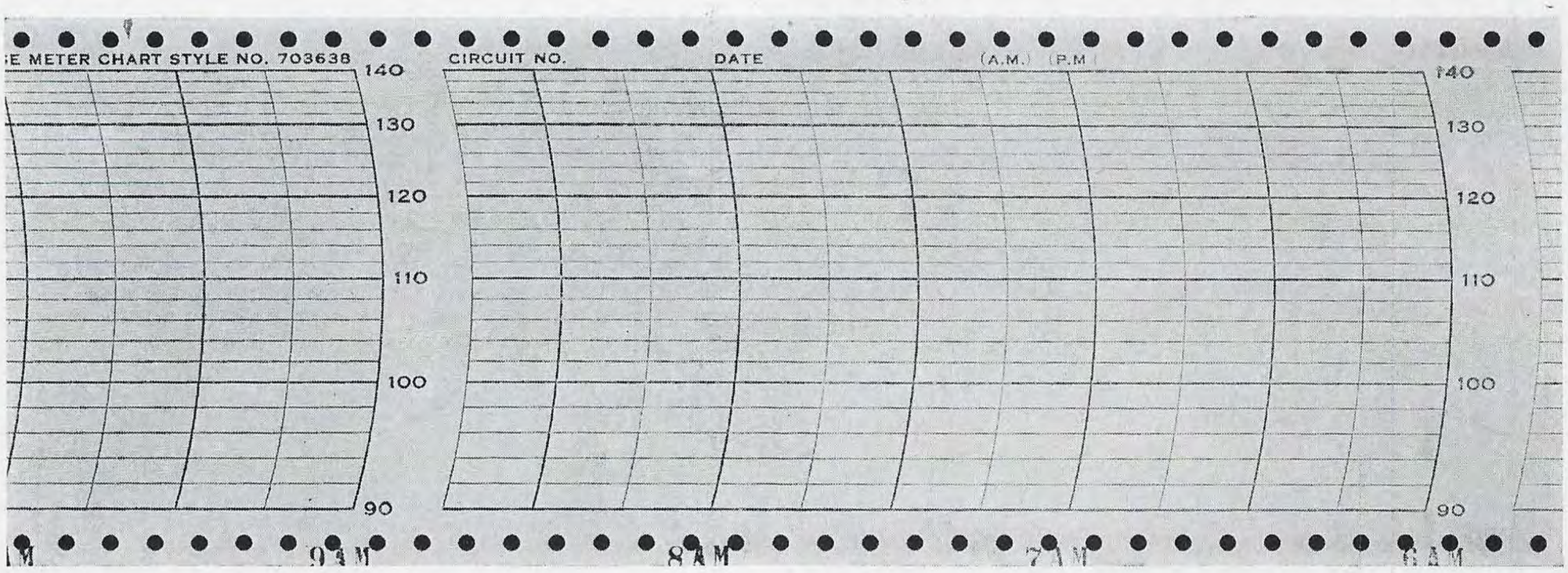


FIG. 4—SAMPLE OF RECORD PAPER FOR 90-140 SCALE VOLTMETER (NOT TO SCALE)

LIST PRICES

Special Note—Style number and list price include instrument complete with five rolls of paper and a two-ounce bottle of ink.

A-C. VOLTMETERS—SUPPLIED WITH EXTERNAL RESISTORS

Suppressed Zero

Single Range

Capacity	Frequency Cycles	One Inch Per Hour: Style No. Synchronous Clock 110 Volts	One Inch Per Hour: Style No. Key-Wound Clock	Two Inches Per Hour: Style No. Synchronous Clock 110 Volts	Two Inches Per Hour: Style No. Key-Wound Clock	List Price Disc. Symbol B C
90–130	60	438 000	190 379	936 427	936 438	$ 96 00
90–140	60	703 906	703 898	936 428	936 439	96 00
120–180	60	936 420	304 800	936 429	936 440	102 00
180–260	60	936 421	190 380	936 430	936 441	102 00
180–280	60	936 422	703 901	936 431	936 442	102 00
240–360	60	936 423	304 802	936 432	936 443	108 00
360–520	60	936 424	198 723	936 433	936 444	108 00
450–650	60	936 425	198 724	936 434	936 445	113 00

Double Range*

Capacity	Frequency Cycles	One Inch Per Hour: Style No. Synchronous Clock 110 Volts	One Inch Per Hour: Style No. Key-Wound Clock	Two Inches Per Hour: Style No. Synchronous Clock 110 Volts	Two Inches Per Hour: Style No. Key-Wound Clock	List Price Disc. Symbol B C
90–130 / 180–260	D-C. and 60	936 882	438 401	936 883	936 884	113 00
90–130 / 180–260	60	561 941**	199 097	936 435**	936 446	108 00
90–140 / 180–280	60	703 907**	703 904	936 436**	936 447	108 00
180–260 / 360–520	60	936 426**	438 400	936 437**	936 448	125 00

* Paper should be used of a voltage range to correspond to the range used. Unless otherwise ordered, three rolls of low-range and three of high-range paper will be supplied with the instrument.

** 110-220-volt clock motor supplied.

A-C. AMMETERS—SELF-CONTAINED

Two-Wire

Capacity	Frequency Cycles	One Inch Per Hour: Style No. Synchronous Clock 110 Volts	One Inch Per Hour: Style Nc. Key-Wound Clock	Two Inches Per Hour: Style No. Synchronous Clock 110 Volts	Two Inches Per Hour: Style No. Key-Wound Clock	List Price Disc. Symbol BC
0–5	60	438 001	190 381	936 449	936 456	$102 00
0–10	60	438 002	190 382	936 450	936 457	102 00
0–15	60	438 003	304 804	936 451	936 458	102 00
0–20	60	438 004	198 715	936 452	936 459	108 00
0–25	60	438 005	304 806	936 453	936 460	108 00
0–40	60	438 006	198 716	936 454	936 461	108 00
0–80	60	438 007	198 717	936 455	936 462	113 00

Order by Style Number

RECORDING AMMETERS AND VOLTMETERS—TYPE U—Continued

LIST PRICES—Continued

D-C. VOLTMETERS—SUPPLIED WITH EXTERNAL RESISTORS

Suppressed Zero

Capacity	Style No. Key-Wound Clock One Inch Per Hour	Style No. Key Wound-Clock Two Inches Per Hour	List Price Disc. Symbol BC
Single Range			
90–130	190 383	936 463	$ 96 00
90–140	703 899	936 464	96 00
120–180	304 799	936 465	102 00
180–260	190 384	936 466	102 00
180–280	703 902	936 467	102 00
240–360	304 801	936 468	108 00
360–520	198 721	936 469	108 00
450–650	198 722	936 470	113 00
Double Range*			
90–130 } 180–260 }	199 098	936 471	108 00
90–140 } 180–280 }	703 905	936 472	108 00
180–260 } 360–520 }	438 399	936 473	125 00

* Paper should be used of a voltage range to correspond to the range used. Unless otherwise ordered, three rolls of low-range and three of high-range paper will be supplied with the instrument.

D-C. AMMETERS—SELF-CONTAINED

Left Zero—Two-Wire

Capacity	Style No Key-Wound Clock One Inch Per Hour	Style No Key-Wound Clock Two Inches Per Hour	List Price Disc. Symbol BC
0–5	190 385	936 474	$102 00
0–10	190 386	936 475	102 00
0–15	304 803	936 476	102 00
0–20	198 718	936 477	108 00
0–25	304 805	936 478	108 00
0–40	198 719	936 479	108 00
0–80	198 720	936 480	113 00

Left Zero—Three-Wire

0–5	179 560	936 481	125 00
0–10	179 561	936 482	125 00

HIGH-VOLTAGE AMMETER

7000 Volts Maximum Circuit Voltage

Capacity Amperes	Style No. Key-Wound Clock One Inch Per Hour Paper	Style No. Key-Wound Clock Two Inches Per Hour Paper	List Price Disc. Symbol BC
0–10	241 314*	936 483*	$125 00

* These styles cover instruments uncalibrated. Specify whether a-c. or d-c. calibration is required.

PORTABLE TESTING SET

Description	Style No. Key-Wound Clock One Inch Per Hour Paper	Style No. Key-Wound Clock Two Inches Per Hour Paper	List Price Disc. Symbol BC
Consists of one 5-ampere recorder with key-wound clock and one split-type transformer Style No. 456058, Ratio 250/5.....	199 363	936 484	$180 00

Order by Style Number

RECORDING AMMETERS AND VOLTMETERS—TYPE U—Continued

LIST PRICES—Continued

RECORD CHARTS

VOLTMETERS			AMMETERS		
Capacity	Style No. 1 Inch Per Hour	Style No. 2 Inches Per Hour	Capacity	Style No. 1 Inch Per Hour	Style No. 2 Inches Per Hour
0–150††	247 562	247 563	0–5	167 817	192 927
90–130	157 916	188 706	5.4–7.8††	269 643	....
90–140	703 637	703 638	0–10	174 415	199 102
100–160††	227 156	289 486	0–15	247 570	247 571
120–180	247 566	247 567	0–20	174 416	199 103
180–260	173 209	199 099	0–25	247 572	247 573
180–280	703 639	703 640	0–30††	247 574	247 575
0–300††	247 564	247 565	0–40	174 417	199 104
240–360	247 568	247 569	0–60††	247 576	247 577
360–520	173 210	199 100			
450–650	173 211	199 101	0–80	174 418	199 105

††Special capacity charts for instruments not listed in this catalog.

No. of Rolls*	List Price Per Roll 1 Inch Per Hour Disc. Symbol BC	List Price Per Roll 2 Inches Per Hour Disc. Symbol BC
1–49	$0 30	$0 35
50–99	0 28	0 33
100–499	0 26	0 31
500 or more	0 25	0 30

NOTE —Record charts are packed in standard cartons of 60 rolls each for 1 inch per hour and 30 rolls each for 2 inches per hour.
*Record charts of all listed capacities and speeds may be combined on one order to obtain quantity price.

SUPPLIES

Description	Style No.	List Price Disc. Symbol BC
¼ oz. bottle red ink	174 005	$ 0 30
2 oz. bottle red ink	256 332	0 35
8 oz. bottle red ink	180 201	1 40
1 pint bottle red ink	180 202	2 75
2 oz. bottle blueprint red ink	321 361	0 35
Ink reservoir	183 081	0 85
Pen complete with pen arm for instruments up to and including sub D styles	180 794	1 00
Pen complete with pen arm for instruments of sub E styles and above	239 347	1 00
Wick yarn for pen feed	....	0 05 per foot
Key wound clock, Waterbury, for instruments up to and including sub E styles	136 905	25 00
Winding key for above	821 920	0 65
Key wound clock, Seth Thomas, for instruments of sub F styles and above	535 156	25 00
Winding key for above	821 858	0 65
Synchronous motor clock complete, 110 volts, 60 cycles	289 701	25 00
Driving belt for paper re-roll	249 323	0 50

GEAR TRAIN FOR PAPER DRIVE MECHANISM

Style number and list price include Gear Train complete ready to install in instrument.

Description	Style No. One Inch Per Hour	Style No. Two Inches Per Hour	List Price Disc. Symbol BC
Gear train for hand-wound clock	180 796	199 210	$2 25
Pinion for hand-wound clock	180 795	199 211	0 35
Gear train for synchronous clock	505 965	505 966	2 25
Pinion for synchronous clock	180 795	199 211	0 35

Order by Style Number

RECORDING AMMETERS AND VOLTMETERS—TYPE U—Continued

OUTLINE DIMENSIONS IN INCHES

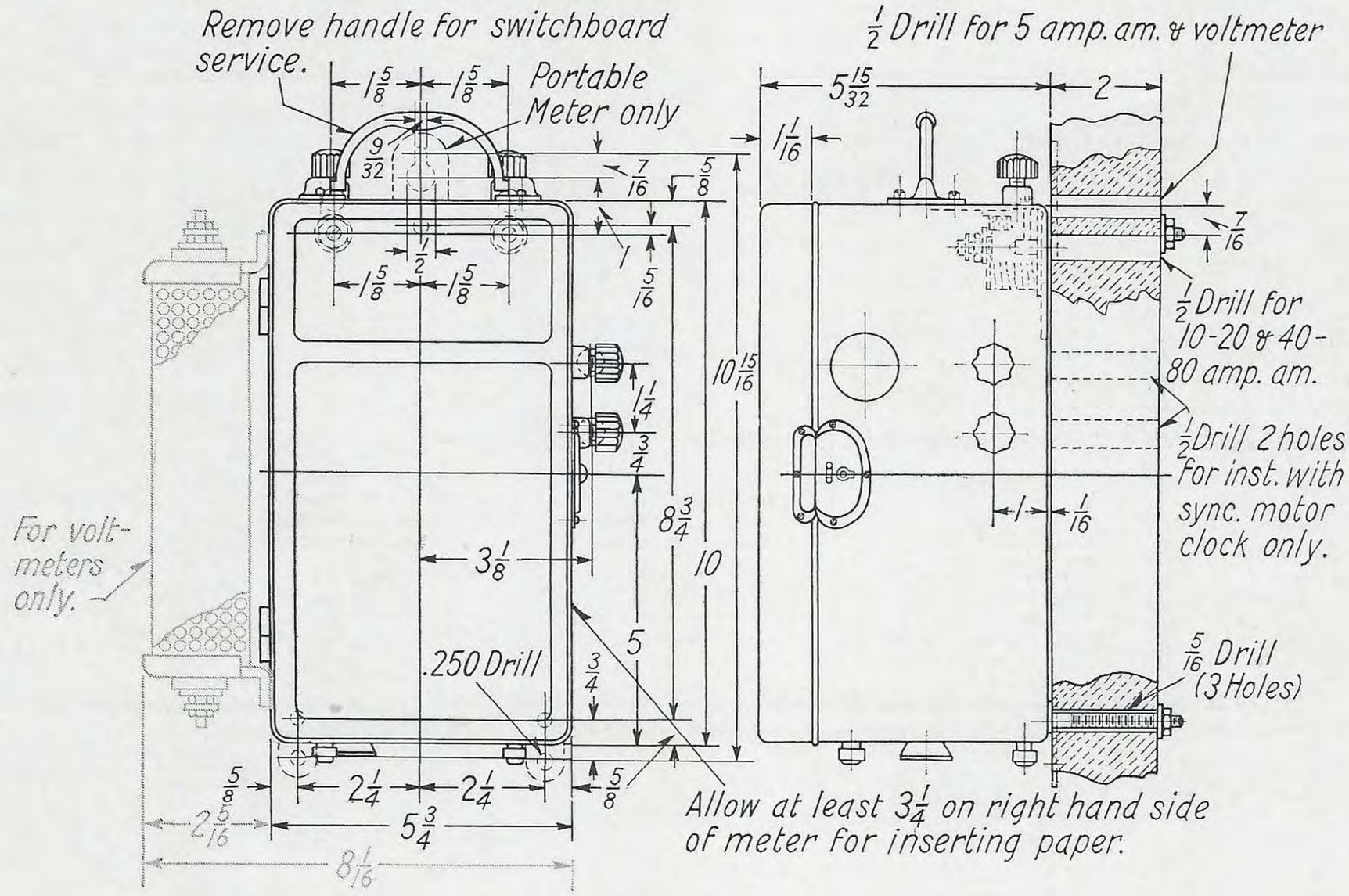
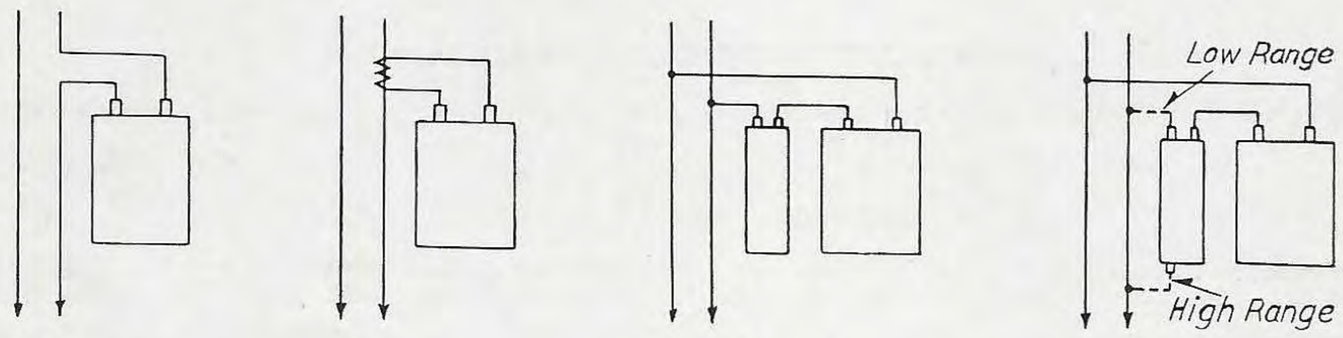


FIG. 5—OUTLINE AND DRILLING PLAN FOR TYPE U RECORDING INSTRUMENT

Dimensions are for reference only. For official dimensions, apply to the nearest district office.

CONNECTION DIAGRAMS



LOW-RANGE SELF-CONTAINED AMMETER

HIGH-RANGE AMMETER WITH TRANSFORMER

LOW-RANGE VOLTMETER FOR VOLTAGE NOT OVER 750 V.

HIGH-RANGE VOLTMETER WITH TRANSFORMER

Order by Style Number

Printed in U.S.A.

TYPE R RECORDERS—TYPE R TOTALIZERS

Relay Type—Motor Actuated
Alternating Current and Direct Current Forms

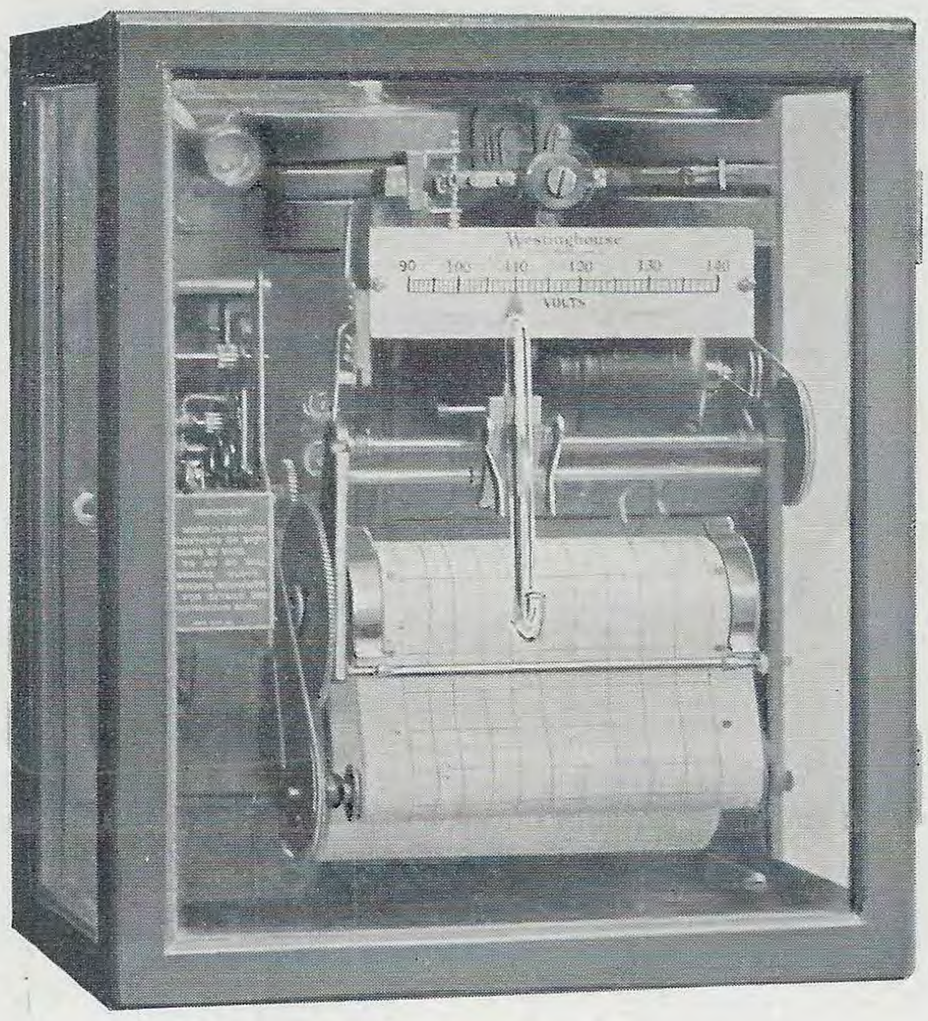


FIG. 1—TYPE R RECORDING VOLTMETER

DATA

Case	Switchboard Types, Wood Frame—Glass Front; Portable Types, Wood—Glass Window
Size	13½" Wide, 16½" High, 9 5/16" Deep
Weight	Net 35 Lbs.; Shipping 170 Lbs.
Chart	6¾" Wide, 5¼" Scale, 260 Feet Long
Chart Speeds	2, 4, 8 Inches per Hour
Clocks	Self Winding—Pendulum, and Synchronous Motor
Movements A-C	Kelvin Balance—Watts, Volts, Amps., Power Factor
Movements D-C	Kelvin Balance—Watts Permanent Magnet Moving Coil—Volts, Amps.
Control Circuit	A-C.—110 V, 25 or 60 Cycles D-C.—125 or 250 V.
Power Consumption	See Tables
Accuracy	Recorders 1½%, Totalizers 2% of Full Scale.

General

Relay type motor actuated recorder and totalizers are particularly useful in circuits where instrument transformer burdens are limited. They are superior to most forms of recorders in quality of records and are particularly valuable where records in true rectangular co-ordinates are required. Pen and inking problems reduce to practically zero in the relay type recorder since the high operating torques permit of an integral ink reservoir and ample pen pressure. Higher operating torques also permit of dependable contact mechanisms which are often valuable in applications requiring control or signaling.

Application

Type R Recording instruments are suitable for applications where accuracy and sensitiveness to small changes, in the quantity measured, is desired. They are used extensively for making records of the electrical quantities involved in power house and substation operation. The load curves recorded by these instruments are used by central station companies for determining the power demands of large power consumers.

All instruments have indicating dials, rendering the use of separate indicating instruments unnecessary, thus resulting in a distinct saving in certain installations. All instruments have paper rerolls.

Operation and Construction

All instruments operate on the relay principle, the measuring element actuating only contacts and not moving the pen directly. In turn, these contacts energize a device arranged to move the pen. The use of resistances prevents harmful sparking at the contacts, which are made of special alloy.

The Control Circuit is generally 110 volts, direct-current, 25 or 60 cycles alternating-current, the allowable temporary variation of voltage being that ordinarily found in practice, but instruments for other control circuits can be supplied on special order. When the direct-current supply is from an exciter circuit controlled by an automatic volt-

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

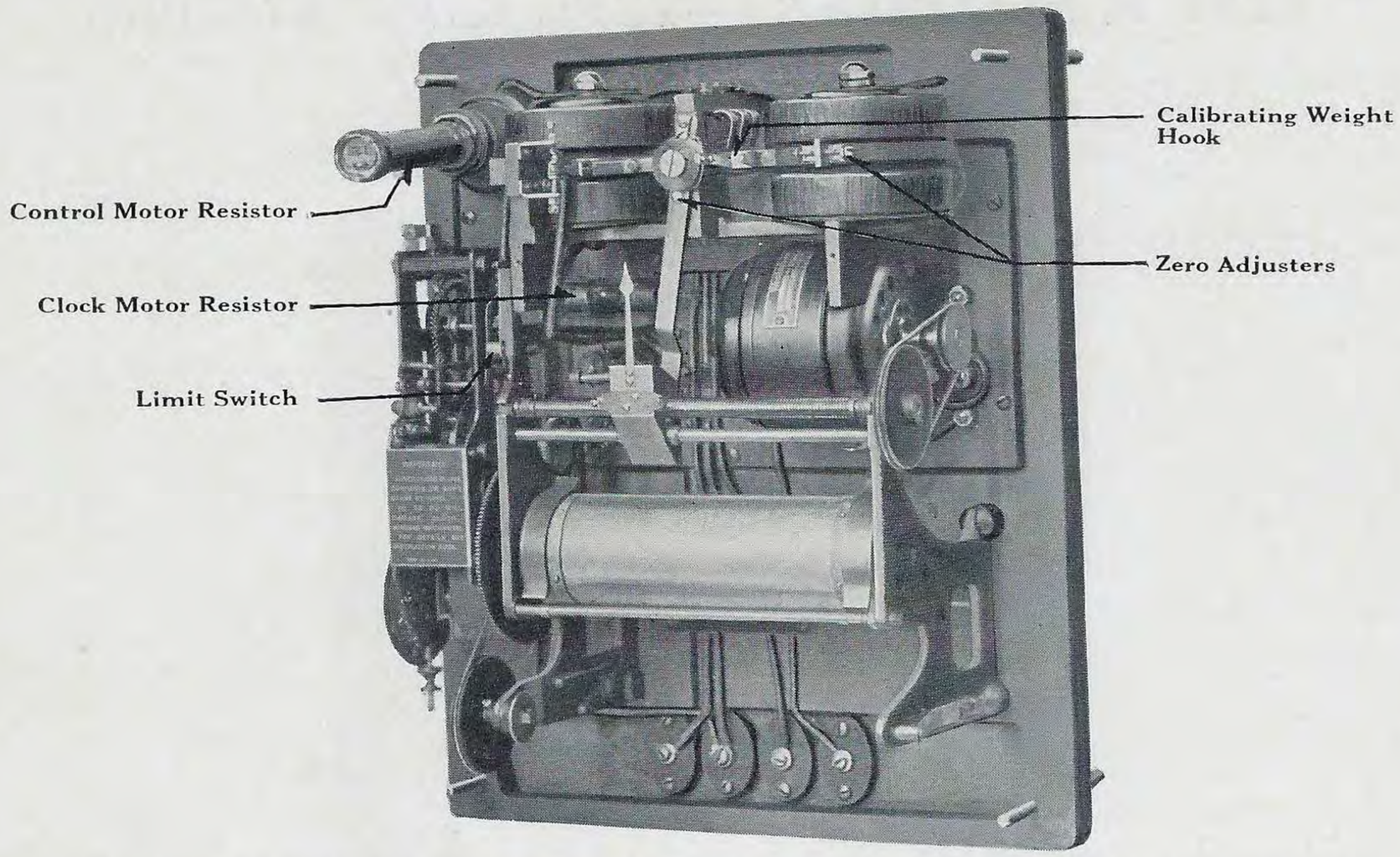


FIG. 2—TYPE R RECORDING VOLTMETER WITHOUT COVER, PAPER ROLL, PEN OR SCALE, SHOWING INTERIOR DETAILS

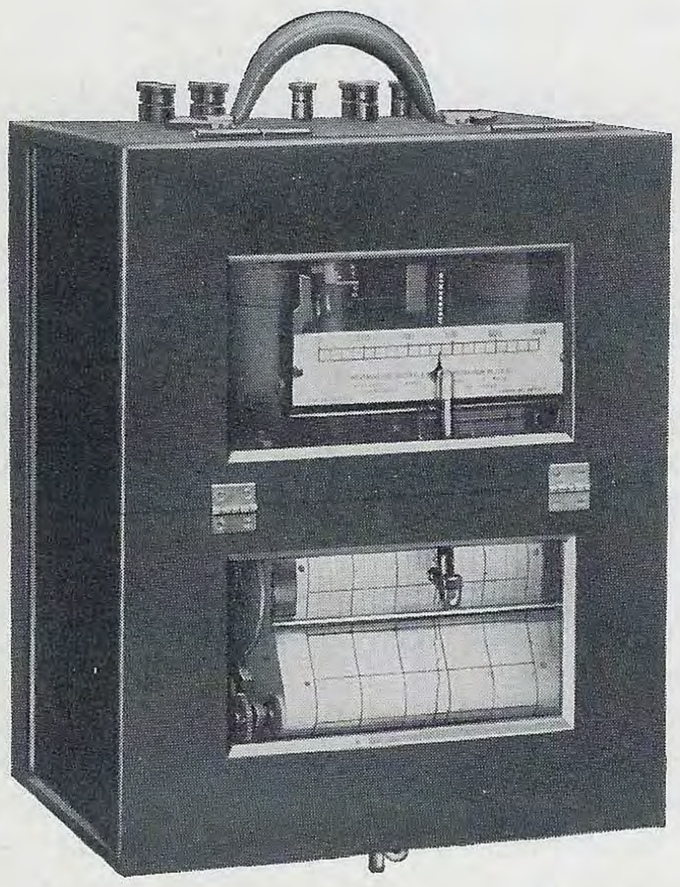


FIG. 3—TYPE R PORTABLE RECORDING WATTMETER

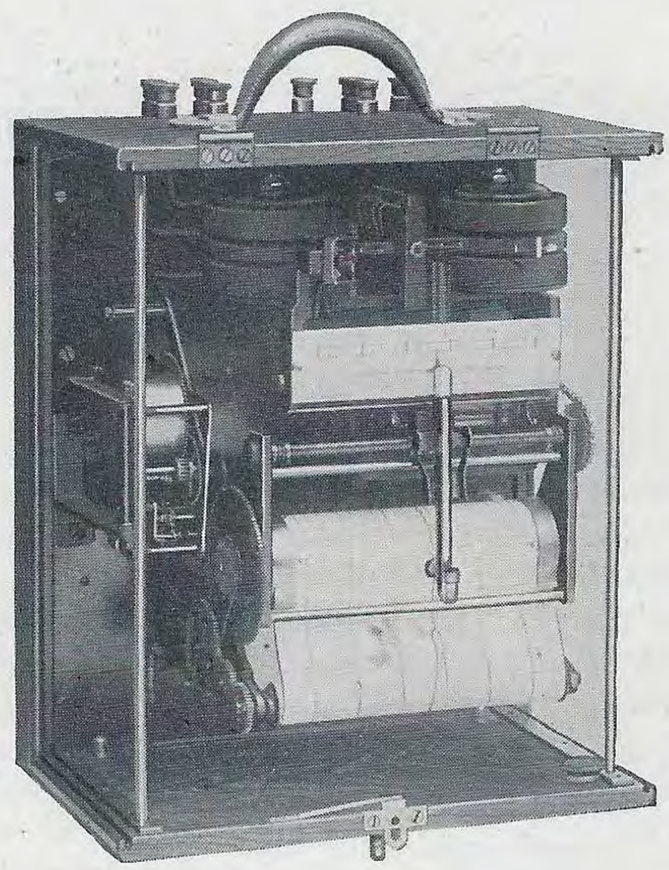


FIG. 4—TYPE R PORTABLE RECORDING WATTMETER WITH COVER REMOVED

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

age regulator causing great fluctuations, alternating-current should be used.

The Record is made by a pen moving in a straight horizontal line at right angles to the motion of the paper, giving a scale having rectangular co-ordinates.

The Pen is self-feeding and will hold one month's supply of ink. The feed is uniform at all temperatures. The writing point is a hard-alloy tube which will not clog, or scratch the paper. A rubber bulb and tube filler are supplied with each instrument.

The sensitiveness of the instrument may be regulated by varying the distance between the contacts. This varies the amount the quantity measured must change, before the recording mechanism is affected by the closing of the contacts.

The speed at which the pen travels across the paper is a function of the adjustment and the control circuit. Being independent of the rate at which the measured circuit changes, the resulting record is much clearer than in the case of direct acting instruments.

The recorders are built on a sturdy cast metal plate and are housed in dust proof cases. The principal parts are: Measuring elements, Pen Mechanism, Chart Mechanism, Pen Drive Motor, Clock Mechanism and Case.

Measuring Elements

The Measuring Elements of all instruments except D-C. Ammeters are of the Kelvin-balance type. They are independent of variations in frequency, external fields, temperature, power factor, or wave form. Polyphase Wattmeters are correct with any degree of unbalancing of phases. **Direct-Current Ammeters** are of the permanent magnet type with moving coils, and operate from shunts.

Direct-Current Wattmeters are similar to the alternating-current wattmeters except that the series coils are designed to carry the total current.

The Type R, Three-Phase Recording Power-Factor meter has the same construction as the polyphase wattmeter, with the addition of a phase shifter, connected mechanically to the recording mechanism. Electrically, this phase shifter is connected to the line voltage on its primary side and to the voltage coil of the wattmeter element on the secondary side. The phase shifter is mounted in the meter and is driven from the worm which moves the pen.

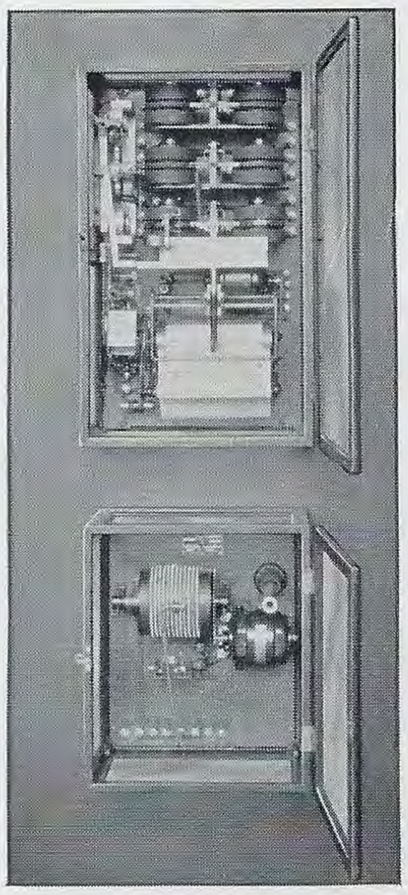


FIG. 5—THREE-ELEMENT TOTALIZER WITH TRANSMITTER

The relation between the pen travel and the phase shifter is such that 120 electrical degrees correspond to 5¼ inches on the chart. The wattmeter element of this meter is balanced mechanically and so closes one contact or the other depending on whether the torque is positive or negative. The current supplied to the element from the phase shifter will lag 90 degrees behind the line voltage at 100 per cent power-factor. The element operates at all times at zero power-factor since the torque is zero. At zero power-factor the current in the element will be 180 degrees from line voltages or 90 degrees behind the position for 100 percent power-factor. For other power-factors, the vectorial mean angle of lag of the current, and the angle through which the phase shifter is turned from its position at 100 per cent power-factor, are the same. Two scales are available 50-100-50 and 10-100-80 and either of these may be used on any meter by re-calibrating.

This instrument has two current coils and reads vectorial power-factor as recognized and defined by the A.I.E.E.

Type R Totalizing Recording Wattmeters are used for measuring the total power in a group of two to twelve independent circuits. It is possible to record on this instrument the total power in several circuits not in synchronism or of different characteristics, such as, frequency, transformer ratio and voltage. These instruments can be made for any capacity and frequency and can be used with instrument transformers in service, even though of different ratios However, an element designed to be operated with certain transformers cannot be used with transformers of other capacities. The calibration is not affected by change of frequency. The measuring elements are all mechanically connected to one set of contacts, so that it is the total pull of all the elements that close and open the contacts. The control element is supplied for operation by either direct-current or by alternating-current, as ordered. The standard instruments are provided with micarta bases 14 inches wide and 1 inch thick.

Telemetering Attachments of the Type S current balance type or the position indicator type may be supplied with Totalizing Wattmeters. Type S current balance Transmitters are used to totalize the load on two or more totalizers and to perform the usual functions of Telemetering. The Type ADS Transmitters are applicable to both Type R recorders and Totalizers. They are generally used in conjunction with boiler room indicators.

Contacts may be furnished on Type R recorders and Totalizers. Two capacities are available, 20 watts and 200 watts.

Either capacity may be furnished single throw or double throw as required. The current rating of either is 1 ampere. The minimum zone of the 200 watt contacts (the intermission between opening of the low contact and closing of the high) is 2 inches on the recorder scale. The contacts may be set to place this zone at any desired position on the scale. The 20 watt contacts have a minimum zone of $\frac{3}{16}$" on the recorder scale. Contacts cannot be furnished as accessories but must be built into the recorders or totalizers.

Recording Mechanism

Pen-Operating Mechanism—The pen is operated by a small motor energized through the relay contacts.

The ink furnished with the instruments is of special grade. It is furnished in concentrated form to be added to distilled water, making a writing fluid containing a minimum of solid matter. The ordinary commercial writing inks are not recommended as they cause the pen point to clog.

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

Chart Mechanisms are of the drum type using strip charts. The drum is readily disengaged from the clock drive system for setting time and for threading the chart. Rerolling action is performed by the clock.

Standard Paper—Recording instrument paper is supplied in rolls of 260 feet. A roll is sufficient for 62 days' record at the rate of 2 inches per hour, 31 days at 4 inches per hour, or 15½ days at 8 inches per hour.

The Pen Driving Motor is universal commutating. A suitable spark absorbing network is used to relieve the contacts of sparking under the motor action. Only a small percentage of the motor energy is handled by the controlling contacts.

Clock Mechanism may be of the pendulum self winding type or synchronous motor actuated. Additional sets of gears may be supplied, at an extra price, to operate at chart speeds other than that for which the recorder is assembled.

Cases are of wood frame with glass windows on switchboard and portable types. Close attention is given to dust proofing. The cases are easily removed for inspection or repair of the mechanisms.

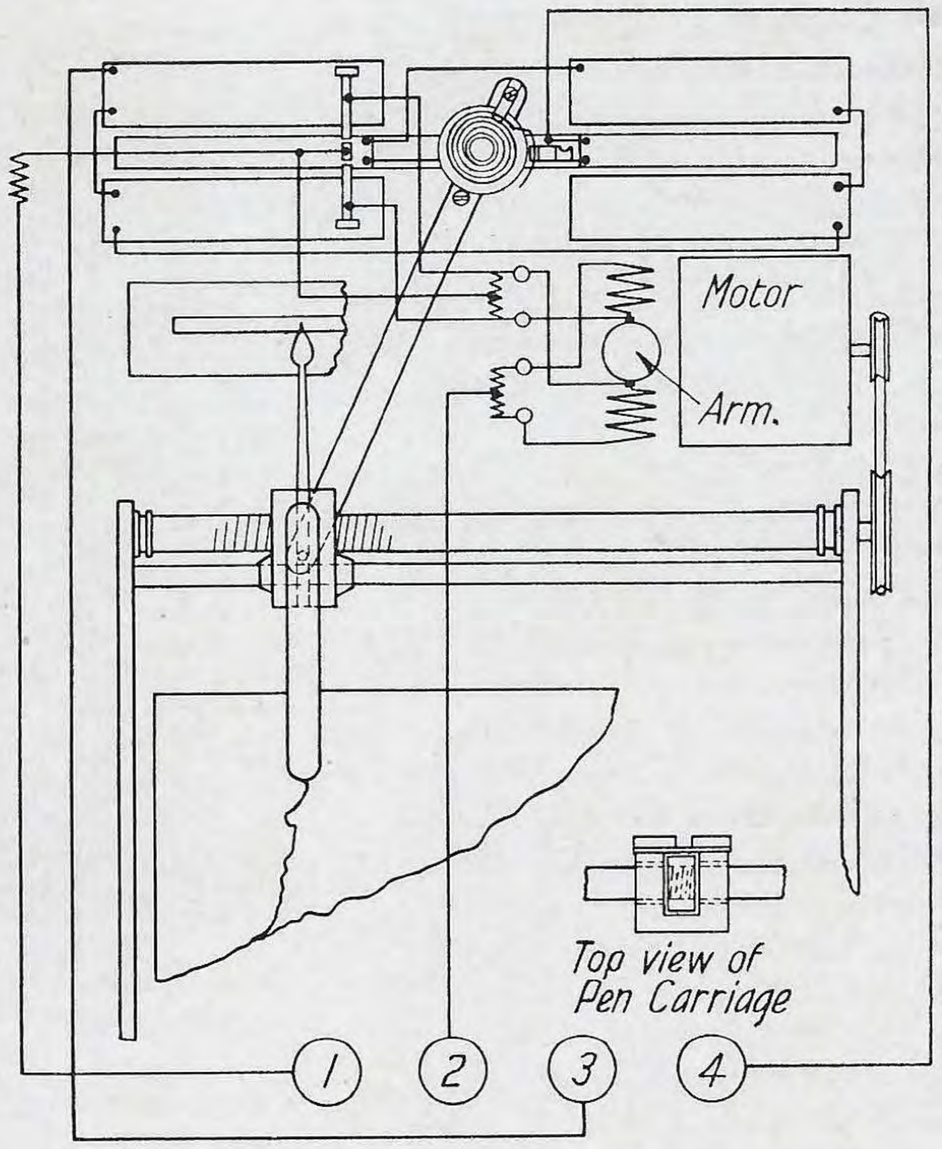


FIG. 6—DIAGRAM OF TYPE R RECORDING VOLTMETER

VOLT AMPERE BURDENS

	25 CYCLES				60 CYCLES			
	VA	Watts	Vars	Per Cent Power Factor	VA	Watts	Vars	Per Cent Power Factor
Current Circuit*								
Wattmeter								
P.P.5 Amp.	4.32	4.12	1.28	95.5	5.37	4.12	3.12	76.6
S.P.5 Amp.	8.64	8.24	2.56	95.5	10.74	8.24	6.24	76.6
P.F. Meter								
Vect. 5 Amp.	4.32	4.12	1.28	95.5	5.37	4.12	3.12	76.6
Ammeter								
5 Ampere	3.78	3.66	0.95	97	3.87	3.3	2.03	85.3
Totalizer	Totalizer burdens are different for each Instrument							
Voltage Circuit*								
Wattmeter								
P.P. 100 V.	10.7	10.7	0.0	100	10.7	10.7	0.0	100
S.P. 100 V.	10.7	10.7	0.0	100	10.7	10.7	0.0	100
P.F. Meter								
Vect. 100 V.	10.7	10.7	0.0	100	10.7	10.7	0.0	100
Voltmeter								
90–140V	13.8	13.8	0.05	100	13.8	13.8	0.5	100
Totalizer	Totalizer burdens are different for each Instrument							

* Values given are for One Element Only. Polyphase Recorders have Two Elements.

Transformers and Shunts

Voltage Transformers should have a secondary voltage of 115 volts at the nominal voltage of the circuit.

Current Transformers should have a secondary current of five amperes nominal.

For suitable voltage and current transformers, see catalog on "Instrument Transformers".

Type G Shunts are suitable for the direct-current graphic ammeters. One shunt will operate both an indicating and a graphic instrument without error. Shunt leads 8 feet in length are regularly supplied with each direct-current ammeter.

Ordering Information

The Style Number and List Price include instrument with one roll of standard paper, two pens, one filler, one bottle of ink, and one indicating dial and pointer, but without shunts or transformers. Ammeter shunts for direct-current ammeters, or current and voltage transformers for alternating-current instruments, in combination with paper of the proper marking, enable any capacity to be obtained.

In Ordering Recorders and Totalizers of all kinds and capacities the following information should be given when not covered by the style number.

(1) Voltage, current and frequency ratings and type of circuit in which instrument is to be used.
(2) Instrument transformer ratios.
(3) Shunt rating (where used).
(4) Preferred full scale calibration (refer to pages 8, 9 and 10 for available charts).
(5) Control circuit voltage and frequency.
(6) Chart speed.
(7) Type of clock desired.
(8) Rear or front connected.

Orders for Totalizers Should Specify:

1. Current and voltage transformer ratios and connections in each circuit to be totalized.
2. Type, capacity and frequency of each circuit.
3. Voltage and frequency of control circuit. The following control circuits are standard.
   110 volt D-C.
   250 volt D-C.
   110 volt 25 cycle
   110 volt 60 cycle.
4. Specify type of clock desired, for example, self winding or synchronous.

Positive Sequence Network

A network is available for supplying positive sequence voltage to recorders of any class having approximately the following characteristics; actuating coil resistance 200 ohms, actuating coil current 0.125 amps., voltage rating 0-150 volts. In ordering, complete specifications of the recorder should be given as follows: actuating coil current, actuating coil resistance, total voltage circuit resistance, full scale voltage.

Positive Sequence Voltage Network Price **$63.50** List Disc. Symbol BC.

If used on secondaries of standard 115 volt open delta potential transformers one reversing transformer is required. Refer to Sharon Works.

Telemetering Transmitters Supplied with Type R Recorders and Totalizing Wattmeters

Current Balance Transmitter Type S

Telemetering transmitter attachment for operation on 110 or 250 volts D-C. complete for recording totalizing watt meter **$475.00** list additional to price of totalizer.

Synchrotie Position Transmitter

Position transmitter attachment for operation on 110 volts, 25 or 60 cycles complete for use with type R recorder or totalizing watt meter $150.00 list additional to price of totalizer or recorder.

Orders Should Specify voltage and frequency of supply circuits. Also distance to telemetering receiver and type of lines used. The above prices do not include receivers. For receivers see Catalog on Position Indicators and Boiler Room Indicators. These attachments are built into the recorders or totalizers and cannot be supplied separate as accessories.

Contacts

Supplied with type R recorders and totalizers. Add to the List Price of each totalizer or recorder:

For Single Throw Contacts. . . . **$25.00**

For Double Throw Contacts. . . **40.00**

These prices apply for 20 watt or 200 watt contacts.

LIST PRICES

A-C. AMMETERS

Kelvin Balance Type (Square Law Scales) Rear Connected, Panel Mounting

Current Circuit Rating	Control Circuit: Volts	Control Circuit: Frequencies	Control Circuit: Clocks	Style No.	List Price Discount Symbol BC
5†	110	D-C.	Self Winding	374 798	$260 00
5†	250	D-C.	Self Winding	374 801	265 00
5†	110	25	Self Winding	374 799	260 00
5†	110	60	Self Winding	374 800	260 00
5†	110	60	Synchronous	437 970	290 00

Orders Should Specify full scale rating desired according to chart selected, and current transformer ratio.

† The 5 ampere full scale rating may be modified within limits of 4.5 to 5.5 amperes to suit current transformer capacities. These instruments cannot be used with shunts.

For D-C. capacities, see D-C. ammeters.

Order by Style Number

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

LIST PRICES—Continued

RECORDING A-C. AND D-C. VOLTMETERS
Kelvin Balance Type
Rear Connected, Panel Mounting

Voltage Circuit Rating	Control Circuit: Volts	Control Circuit: Frequencies	Control Circuit: Clocks	Style No.	List Price Discount Symbol BC
90–140	110	D-C.	Self Winding	374 802	$290 00
90–140	250	D-C.	Self Winding	374 805	300 00
90–140	110	25	Self Winding	374 803	290 00
90–140	110	60	Self Winding	374 804	290 00
90–140	110	60	Synchronous	437 972	320 00
180–280	110	D-C.	Self Winding	374 806	300 00
180–280	250	D-C.	Self Winding	374 809	300 00
180–280	110	25	Self Winding	374 807	300 00
180–280	110	60	Self Winding	374 808	300 00
180–280	110	60	Synchronous	437 974	325 00
250–450	110	D-C.	Self Winding	374 810	300 00
250–450	250	D-C.	Self Winding	374 813	310 00
250–450	110	25	Self Winding	374 811	300 00
250–450	110	60	Self Winding	374 812	300 00
250–450	110	60	Synchronous	437 976	325 00
360–560	110	D-C.	Self Winding	374 814	310 00
360–560	250	D-C.	Self Winding	374 817	320 00
360–560	110	25	Self Winding	374 815	310 00
360–560	110	60	Self Winding	374 816	310 00
360–560	110	60	Synchronous	437 978	340 00
450–700	110	D-C.	Self Winding	374 818	320 00
450–700	250	D-C.	Self Winding	374 821	320 00
450–700	110	25	Self Winding	374 819	320 00
450–700	110	60	Self Winding	374 820	320 00
450–700	110	60	Synchronous	437 980	340 00

Order Should Specify full scale rating desired according to chart selected, and voltage transformer ratio.

Special non-suppressed voltmeters may be supplied on order using any standard ammeter paper listed. This paper is marked "recording meter" and is suitable for use in voltmeters as well as ammeters.

A-C. VOLTMETER
For Positive Sequence Voltage
Kelvin Balance Type (Square Law Scale)
Rear Connected, Panel Mounting

Voltage Circuit Rating	Control Circuit: Volts	Control Circuit: Frequencies	Control Circuit: Clocks	Style No.	List Price Discount Symbol BC
0–150	110	D-C.	Self Winding	935 950	$353 50
0–150	250	D-C.	Self Winding	935 951	363 50
0–150	110	25	Self Winding	935 952	353 50
0–150	110	60	Self Winding	935 953	353 50
0–150	110	60	Synchronous	935 954	383 50

Above recorders are complete with network. If used on secondaries of standard 115 volt open delta potential transformers, one reversing transformer is required. Refer to Sharon Works.

SINGLE PHASE WATTMETERS
Kelvin Balance Type
Rear Connected, Panel Mounting

Inst. Circuit Rating: Volts	Inst. Circuit Rating: Amperes	Control Circuit: Volts	Control Circuit: Frequencies	Control Circuit: Clock	Style No.	List Price Discount Symbol BC
100	5	110	D-C.	Self Winding	374 822	$230 00
100	5	250	D-C.	Self Winding	374 825	235 00
100	5	110	25	Self Winding	374 823	230 00
100	5	110	60	Self Winding	374 824	230 00
100	5	110	60	Synchronous	437 982	260 00
200	5	110	D-C.	Self Winding	374 826	240 00
200	5	250	D-C.	Self Winding	374 829	245 00
200	5	110	25	Self Winding	374 827	240 00
200	5	110	60	Self Winding	374 828	240 00
200	5	110	60	Synchronous	437 984	270 00
400	5	110	D-C.	Self Winding	374 830	245 00
400	5	250	D-C.	Self Winding	374 833	250 00
400	5	110	25	Self Winding	374 831	245 00
400	5	110	60	Self Winding	374 832	245 00
400	5	110	60	Synchronous	437 986	270 00

Orders Should Specify full scale rating desired according to chart selected, and voltage and current transformer ratios where used. The full scale current rating may be modified from 4 to 6 amperes to suit capacities required.

Order by Style Number

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

LIST PRICES—Continued

POLYPHASE WATTMETERS
Kelvin Balance Type
Rear Connected, Panel Mounting
Two Potential Coils—Two Current Coils*
3 Phase 3 Wire, 2 Phase 3 Wire, 2 Phase 4 Wire

Inst. Circuit Rating Volts	Inst. Circuit Rating Amperes	Control Circuit Volts	Control Circuit Frequencies	Control Circuit Clock	Style No.	List Price Discount Symbol BC
100	5	110	D-C.	Self Winding	374 834	$230 00
100	5	250	D-C.	Self Winding	374 837	235 00
100	5	110	25	Self Winding	374 835	230 00
100	5	110	60	Self Winding	374 836	230 00
100	5	110	60	Synchronous	437 988	260 00
200	5	110	D-C.	Self Winding	374 838	240 00
200	5	250	D-C.	Self Winding	374 841	245 00
200	5	110	25	Self Winding	374 839	240 00
200	5	110	60	Self Winding	374 840	240 00
200	5	110	60	Synchronous	437 990	270 00
400	5	110	D-C.	Self Winding	374 842	245 00
400	5	250	D-C.	Self Winding	374 845	250 00
400	5	110	25	Self Winding	374 843	245 00
400	5	110	60	Self Winding	374 844	245 00
400	5	110	60	Synchronous	437 992	270 00

* Any of the above recorders may be supplied with three current coils for use on 3 phase 4 wire circuits at $20 00 additional list.

Orders Should Specify full scale rating desired according to chart selected, and voltage and current transformer ratios and connections where used, and type of circuit.

The full scale current rating may be modified from 4 to 6 amperes to suit capacities required.

VECTORIAL POWER FACTOR METERS
Kelvin Balance Type
For Three Phase Circuits
Rear Connected, Panel Mounting

Inst. Circuit Rating Volts	Inst. Circuit Rating Amperes	Inst. Circuit Rating Frequencies	Control Circuit Volts	Control Circuit Frequencies	Control Circuit Clock	Style No.	List Price Discount Symbol BC
100	5	60	110	D-C.	Self Winding	492 273	$375 00
100	5	60	250	D-C.	Self Winding	492 274	380 00
100	5	60	110	60	Self Winding	492 271	375 00
100	5	60	110	60	Synchronous	492 272	400 00

Orders Should Specify scales desired. 50-100-50 and 10-100-80 scales available. Chart speed should be specified in accordance with chart selected. Recorders for 25 cycle circuits may be supplied at same prices.

D-C. AMMETERS
Permanent Magnet Moving Coil Type
For Use with Type G Shunts

Rear Connected, Panel Mounting

Type of Circuit	Control Circuit	Clock	Style No.	List Price Discount Symbol BC
2 Wire	110 Volts D-C.	Self Winding	372 649	$290 00
2 Wire	250 Volts D-C.	Self Winding	372 650	295 00
3 Wire	110 Volts D-C.	Self Winding	372 651	290 00
3 Wire	250 Volts D-C.	Self Winding	372 652	295 00

Orders Should Specify capacity required in accordance with shunt and recording chart selected.

Recorders are calibrated 50 millivolts for use with type G shunts, require one for 2 wire, two for 3 wire. Shunts are not included in above prices. Eight foot shunt leads are included.

PORTABLE RECORDING INSTRUMENTS
Kelvin Balance Type
A-C. Ammeters

Capacity	Control Circuit Voltage D-C. to 60 Cycle	Clock	Style No.	List Price Discount Symbol BC
5	110	Pendulum	289 426	$380 00

A-C. and D-C. Voltmeters†

90–140 ‡	110	Pendulum	289 428	380 00
180–280	110	Pendulum	289 430	380 00
250–450	110	Pendulum	289 432	380 00
360–560	110	Pendulum	289 434	380 00
450–700	110	Pendulum	289 436	380 00

† Voltmeters may be supplied non-suppressed if desired. Ranges must be selected in accord with standard ammeter paper. List Prices same as above.

‡ 90–140/180–280 Voltmeters may be supplied at $10 00 extra list.

Order by Style Number

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

LIST PRICES—Continued

PORTABLE RECORDING INSTRUMENTS—Continued

SINGLE PHASE AND POLYPHASE WATTMETERS
Kelvin Balance Type
Two Current Coils—Two Potential Coils

Capacity	Control Circuit Voltage D-C. to 60 Cycle	Clock	Style No.	List Price Discount Symbol BC
5–10 A., 110 V.	110	Pendulum	289 438	$380 00
5–10 A., 220 V.	110	Pendulum	289 440	380 00
5–10 A., 550 V.	110	Pendulum	289 442	380 00

Note: On all the above portable recorders synchronous motor clocks are optional. Also 220 volt control circuits and clocks are optional at same price.

RECORDING TOTALIZING WATTMETERS
Kelvin Balance Type
Rear Connected

No. of Circuits	Approx. Dimensions of Panel in Inches	Style No.	List Price Discount Symbol BC
2	19⅜ x 14 x 1	219 302	$1200 00
3	23 x 14 x 1	219 303	1490 00
4	26⅝ x 14 x 1	219 304	1850 00
5	30¼ x 14 x 1	219 305	2060 00
6	34 x 14 x 1	219 306	2260 00
7	37⅝ x 14 x 1	219 307	2520 00
8	41¼ x 14 x 1	219 308	2900 00
9	On Application	219 309	3250 00
10	On Application	219 310	3340 00
11	On Application	219 311	3500 00
12	On Application	219 312	3960 00

RECORD CHARTS

Record Charts—For Use with Types R, M, and Solenoid Recorders and Type R Totalizers

Record Charts are supplied in rolls of 260 feet. A roll is sufficient for 62 days record at the rate of 2 inches per hour, 31 days at 4 inches per hour, or 15½ days at 8 inches per hour. Standard packages contain 10 rolls. These packages insure the charts against injury and orders should, therefore, call for lots of ten or multiples thereof.

Blank charts do not have time or capacity markings. They are otherwise same as standard.

Semi-standard charts are not listed herein but may be supplied on re-orders in capacities for which printing plates are available, at prices indicated for semi-standard paper. All styles not listed below are classed as semi-standard or special. All requirements for this class charts should be negotiated except for re-orders of semi-standard styles.

AMMETER CHARTS A-C.
Voltmeter Charts Left Zero A-C.
For Type R Recorders

Capacity Amperes or Volts	Style No. 2 Inches Per Hour	Style No. 4 Inches Per Hour
5	372 669	372 670
10	372 672	372 673
15	372 675	372 676
25	372 678	372 679
50	372 681	372 682
75	372 684	372 685
100	372 687	372 688
150	372 690	372 691
200	372 693	372 694
300	372 696	372 697
400	372 699	372 700
500	372 702	372 703
750	372 705	372 706
1000	372 708	372 709
1500	372 711	372 712
2000	372 714	372 715
2500	372 717	372 718
3000	372 720	372 721
4000	372 723	372 724

Description	Style No.
Blank 50 Divisions (no time markings)	372 735
Blank 75 Divisions (no time markings)	372 736
Blank 40 Divisions (no time markings)	372 737

VOLTMETER CHARTS A-C.
For Type R Recorders

Capacity Volts	Style No. 2 Inches per Hour	Style No. 4 Inches per Hour
90–140	372 653	372 654
180–280	372 656	372 657
250–450	372 660	372 661
360–560	372 663	372 664
450–700	372 666	372 667

VOLTMETER CHARTS A-C. AND D-C.
For Type M and Solenoid Operated Recorders

Capacity Volts	Style No. 2 Inches Per Hour	Style No. 4 Inches Per Hour
90–140	59 084	84 600
180–280	69 902	84 601
250–450	99 712	99 713
360–560	99 708	99 709
450–700	69 903	84 602

Description	Style No.
Blank 50 divisions (no time markings)	89 596

Order by Style Number

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

RECORD CHARTS—Continued

AMMETER CHARTS A-C.—VOLTMETER CHARTS A-C.

For Type M and Solenoid Operated Recorders

Capacity Amperes	Style No. 2 Inches Per Hour	Style No. 4 Inches Per Hour
5	121 128	....
10	66 298	84 715
20	66 299	....
160	65 768	....
200	66 305	....
800	65 766	....
1000	66 309	....
3000	120 459	....
4000	120 460	....
6000	120 462	....
8000	120 463	120 471

	Description	Style No.
Blank	20 divisions (no time markings)	84 691
Blank	24 divisions (no time markings)	84 692
Blank	32 divisions (no time markings)	84 693

AMMETER CHARTS D-C.—VOLTMETER CHARTS D-C.
WATTMETER CHARTS A-C. AND D-C.
For Types R and M and Solenoid Operated Recorders

Capacity Amp. or Kw.	Style No. 2 Inches Per Hour	Style No. 4 Inches Per Hour	Style No. 8 Inches Per Hour
10	66 276	84 636	84 663
16	66 277	84 637	84 664
20	66 293	84 638	84 665
24	108 058	108 059	108 060
25	216 731	423 815	....
30	120 438	120 444	120 450
32	66 278	84 639	84 666
40	66 279	84 640	84 667
50	66 280	84 641	84 668
60	66 281	84 642	84 669
80	66 282	84 643	84 670
100	66 283	84 644	84 671
120	66 284	84 645	84 672
150	164 352	321 359	....
160	66 285	84 646	84 673
200	66 286	84 647	84 674
240	108 064	108 065	108 066
250	120 441	512 460	120 453
300	120 439	120 445	120 451
320	66 287	84 648	84 675
400	66 288	84 649	84 676
480	127 119	....	....

Capacity Amp. or Kw.	Style No. 2 Inches Per Hour	Style No. 4 Inches Per Hour	Style No. 8 Inches Per Hour
500	66 289	84 650	84 677
600	66 290	84 651	84 678
640	172 696	....	....
700	263 196	....	....
800	63 718	84 652	84 679
1000	66 291	84 653	84 680
1200	66 292	84 654	84 681
1500	120 443	120 449	120 455
1600	63 720	84 655	84 682
2000	59 601	84 656	84 683
2400	66 319	84 793	84 811
2500	120 442	120 448	120 454
3000	120 440	120 446	120 452
3200	63 719	84 657	84 684
4000	66 294	84 658	84 685
5000	66 295	84 659	84 686
6000	65 763	84 660	88 497
6400	172 323	....	....
8000	91 244	91 245	91 246
10000	66 042	84 799	84 817
12000	59 086	84 661	88 498
15000	477 898	....	....

	Style No.
Blank 20 divisions (no time markings)	84 606
Blank 24 divisions (no time markings)	84 607
Blank 32 divisions (no time markings)	84 608
Blank 50 divisions (no time markings)	535 576

AMMETER CHARTS D-C. ZERO CENTER
WATTMETER CHARTS A-C. AND D-C. ZERO CENTER
For Types R and M and Solenoid Operated Recorders

Capacity Amp. or Kw.	Inches Per Hour	Style No.	Capacity Amp. or Kw.	Inches Per Hour	Style No.	Capacity Amp. or Kw.	Inches Per Hour	Style No.
4–0–12	2	209 914	500–0–500	2	153 706	2400–0–2400	2	98 798
10–0–40	2	241 279	1000–0–1000	2	209 837	3200–0–3200	2	104 167
20–0–20	2	477 419	1500–0–1500	2	224 721	4000–0–4000	2	130 623
20–0–20	4	477 443	1500–0–1500	4	247 375	6000–0–6000	2	133 829
						6000–0–12000	2	98 801
50–0–200	2	139 962	1500–0–3000	2	238 127			
60–0–60	4	530 783	2000–0–2000	2	140 086	5000–0–45000	4	242 575
						8000–0–8000	2	162 658
120–0–120	4	201 658	2000–0–2000	8	239 295	8000–0–8000	4	171 187
200–0–600	2	214 978	2000–0–4000	2	533 847			
						10000–0–5000	2	188 175
300–0–300	2	91 331	2000–0–6000	2	258 882	12000–0–12000	2	252 592
400–0–1600	4	173 804	2000–0–6000	4	197 027	40000–0–40000	2	301 855

Note—For higher capacities, use charts graduated in higher units: Thus for 50,000 kilowatts use 50 megawatt chart. For low capacities, use chart listed and read in watts instead of kilowatts; thus, for 5 kilowatts, use 5000 chart, etc.

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

RECORD CHARTS—Continued

FREQUENCY RECORDER CHARTS—TYPE R RECORDERS

Frequency	Style No. 2 Inches Per Hour	Style No. 4 Inches Per Hour
25	372 726	372 727
60	372 729	372 730

	Style No.
Blank (no time markings)	372 734

FREQUENCY RECORDER CHARTS TYPE M AND SOLENOID-OPERATED RECORDERS

Frequency Range Cys.	Style No. 2 Inches Per Hour	Style No. 4 Inches Per Hour
21–29	110 354	110 355
26–34	114 840	114 841
32–48	119 655	119 656
42–58	120 480	120 481
52–68	110 357	110 358

	Style No.
Blank (no time markings)	110 360

POWER FACTOR RECORDER CHARTS—TYPE R RECORDERS

Power Factor Range Per Cent	Feed Rate Inches Per Hour	Style No.
50–100–50	2	446 154
50–100–50	4	446 155
50–100–50	8	446 156
10–100–80	2	446 157
10–100–80	4	446 158
10–100–80	8	446 159

POWER FACTOR RECORDER CHARTS—SOLENOID OPERATED RECORDERS

Power Factor Range Per Cent	Feed Rate Inches Per Hour	Style No.
50–100–50	1	84 687
50–100–50	2	59 083
50–100–50	4	84 688
50–100–50	8	84 689
50–100–50	Blank	84 690
10–100–80	2	119 157
10–100–80	4	119 158
10–100–80	8	119 159
10–100–80	Blank	119 160

PRICES STANDARD CHARTS (As Listed)

Quantity	List Price Discount Symbol BC
In lots of 9 rolls or less, per roll	$4 50
In lots of 10 to 99 rolls, per roll	4 25
In lots of 100 to 499 rolls, per roll	3 40
In lots of 500 to 4999 rolls, per roll	3 15
In lots of 5000 to 9999 rolls, per roll	3 00
In lots of 10000 rolls or over, per roll	2 50

PRICES SEMI-STANDARD CHARTS Applying to Re-Orders (Not Listed)

Quantity	List Price Discount Symbol BC
In lots of 9 rolls or less, per roll	$4 90
In lots of 10 to 99 rolls, per roll	4 60
In lots of 100 to 499 rolls, per roll	3 70
In lots of 500 to 4999 rolls, per roll	3 50
In lots of 5000 to 9999 rolls, per roll	3 30
In lots of 10000 rolls or over, per roll	2 80

SUPPLIES

Description	Style No.	List Price Discount Symbol BC
Capillary reservoir pen	122 429	$2 80
Holder for above pen	122 430	0 30
Rubber pen filler	72 449	0 60
Green ink in concentrated form, to be added to one quart of distilled water	108 067	0 30
Red ink in concentrated form, to be added to one quart of distilled water	324 157	0 30
Blue-print green ink in concentrated form, to be added to one quart of distilled water	680 104	0 30
Blue-print red ink in concentrated form, to be added to one quart of distilled water	321 366	0 30
Pen cleaning wires	219 079	0 10 doz. net

Clock and clock parts for speeds of 1, 2, 4, 8 or 24 inches per hour direct-current or alternating control can be supplied. When requesting quotations, state the present speed and control circuit and new speeds or new control circuit desired, also style number of instrument with which they are to be used

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

EXTERNAL CONNECTION DIAGRAMS—Continued

EXTERNAL CONNECTION DIAGRAMS ARE SHOWN FROM THE REAR
INTERNAL DIAGRAMS ARE SHOWN FROM THE FRONT

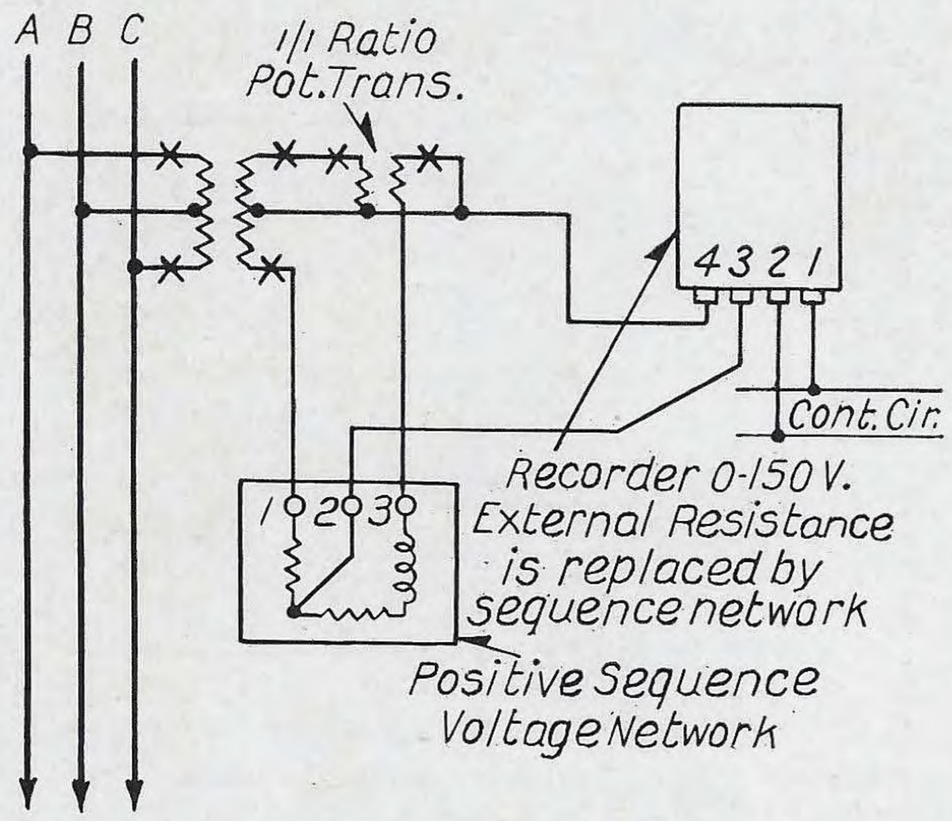


FIG. 11—VOLTMETER WITH NETWORK FOR RECORDING POSITIVE PHASE SEQUENCE VOLTAGE

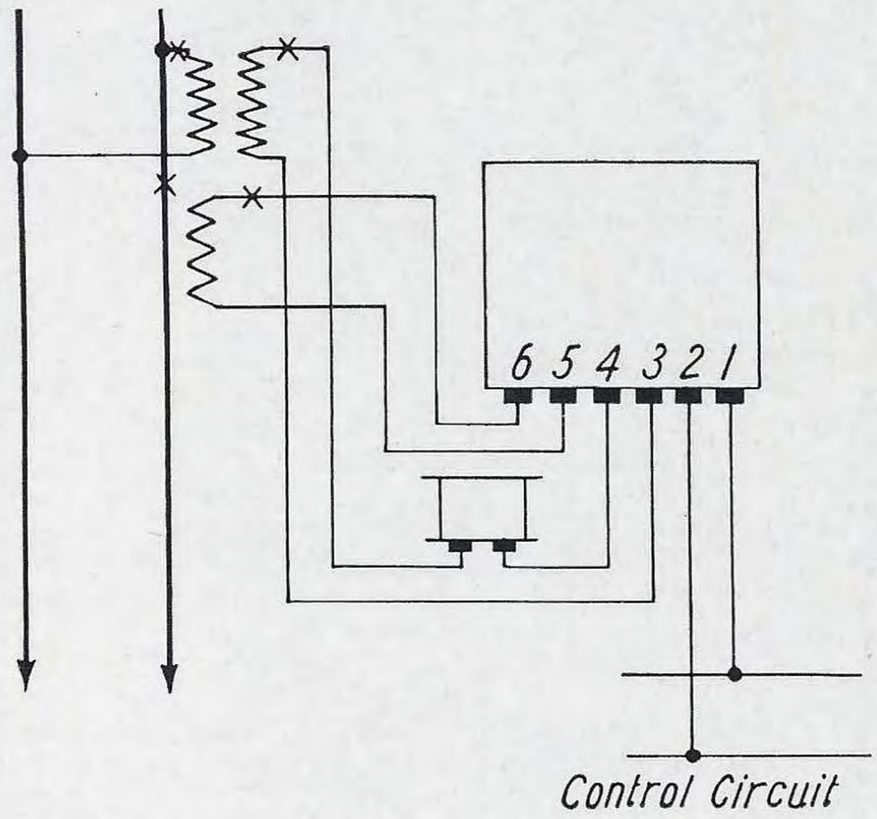


FIG. 12—SINGLE-PHASE WATTMETER

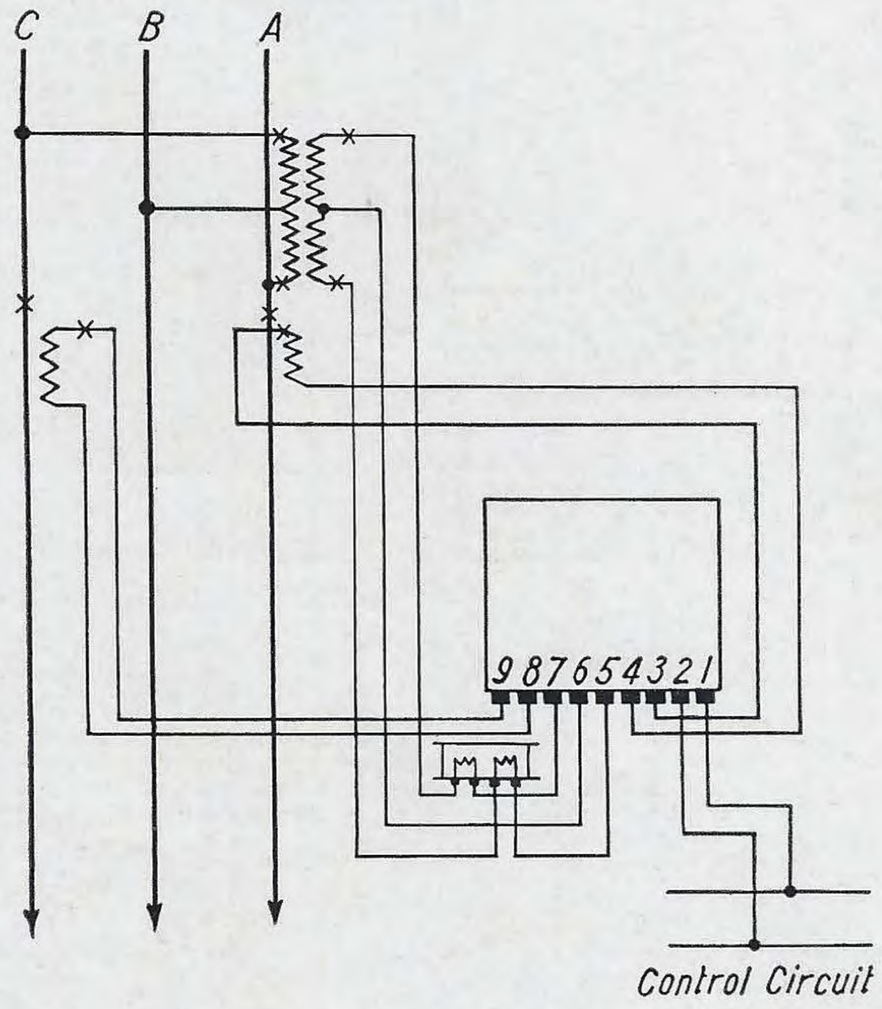


FIG. 13—POLYPHASE WATTMETER FOR THREE-PHASE THREE-WIRE CIRCUIT

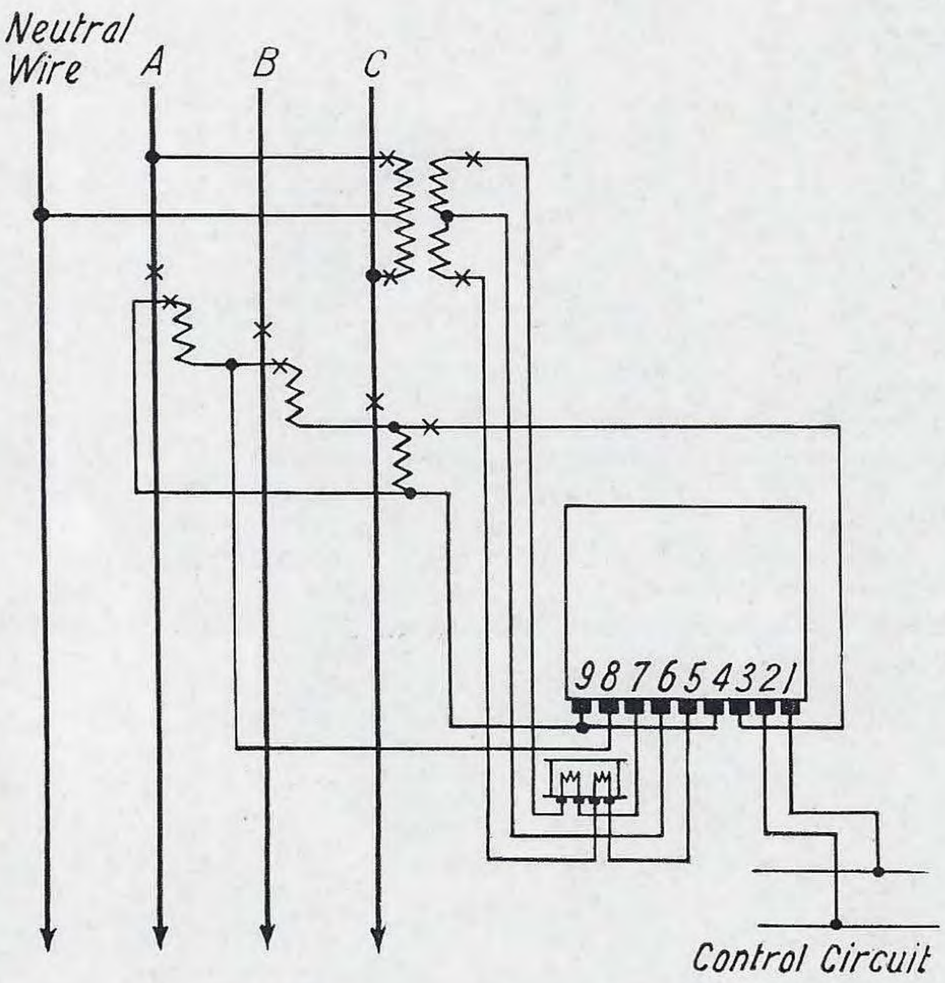


FIG. 14—POLYPHASE WATTMETER FOR THREE-PHASE FOUR-WIRE CIRCUIT

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

EXTERNAL CONNECTION DIAGRAMS—Continued

EXTERNAL CONNECTION DIAGRAMS ARE SHOWN FROM THE REAR
INTERNAL DIAGRAMS ARE SHOWN FROM THE FRONT

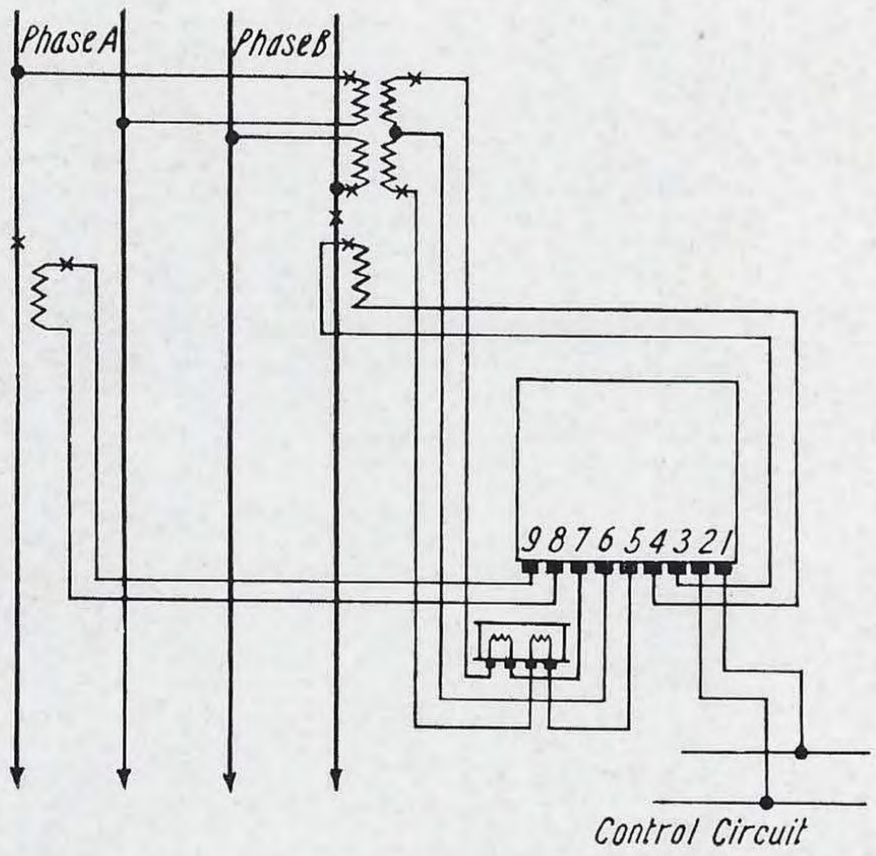


FIG. 15—POLYPHASE WATTMETER FOR TWO-PHASE, FOUR-WIRE CIRCUIT

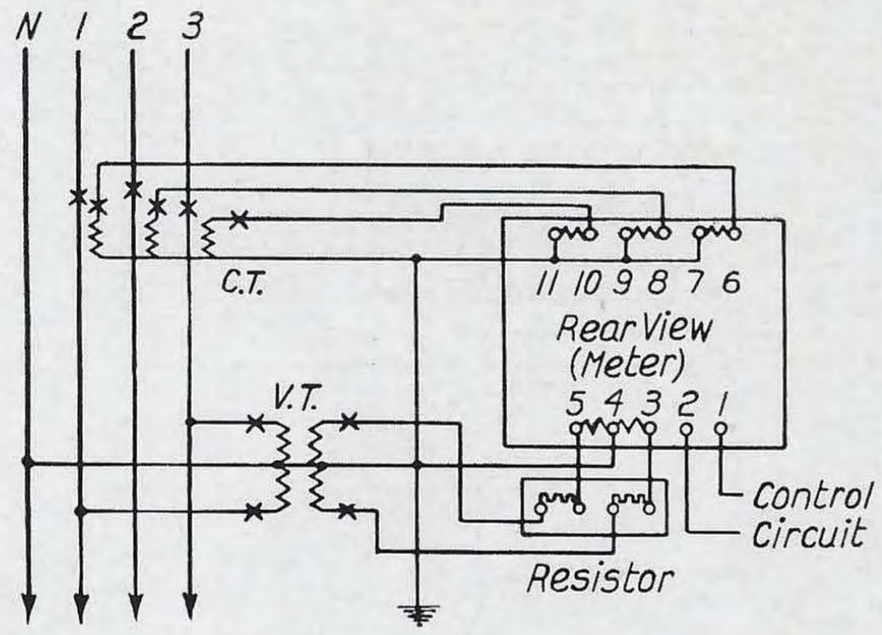


FIG. 16—THREE CURRENT COIL POLYPHASE WATTMETER FOR THREE-PHASE, FOUR-WIRE CIRCUIT

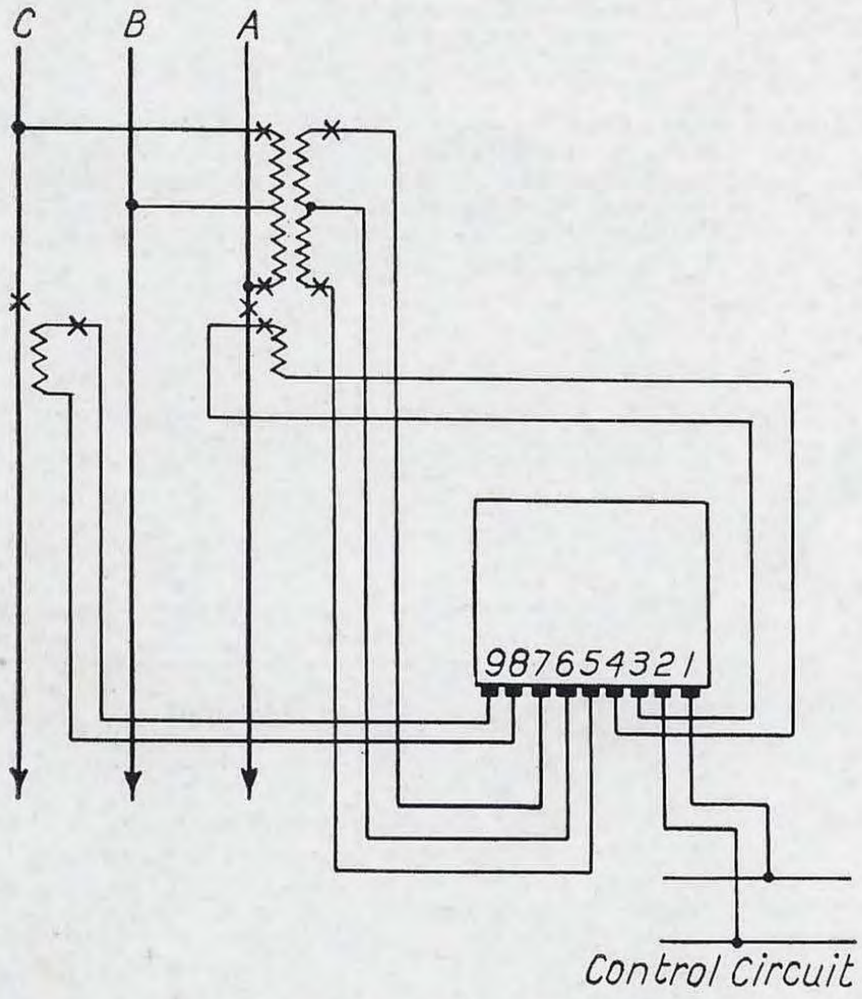


FIG. 17—THREE-PHASE POWER FACTOR METER ON A THREE-PHASE, THREE-WIRE CIRCUIT—PHASE SEQUENCE A, B, C

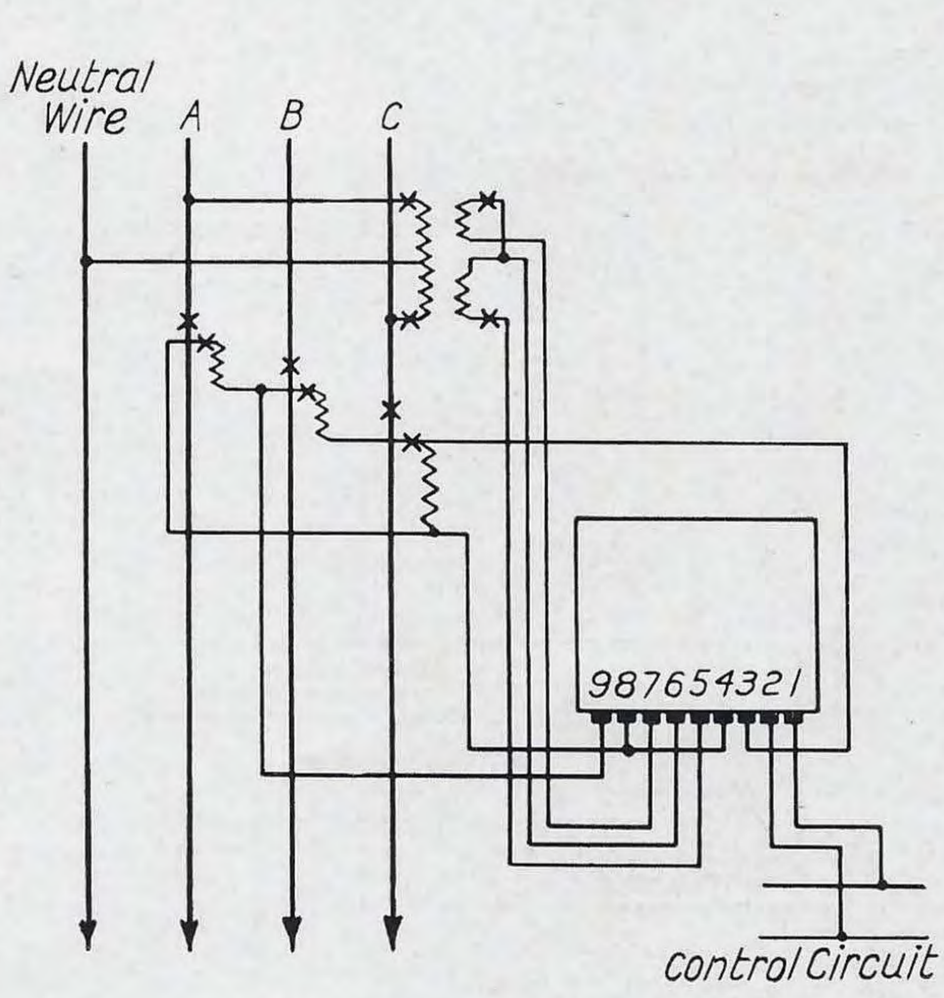


FIG. 18—THREE-PHASE POWER FACTOR METER ON A THREE-PHASE, FOUR-WIRE CIRCUIT—PHASE SEQUENCE A, B, C

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

EXTERNAL CONNECTION DIAGRAMS—Continued

EXTERNAL CONNECTION DIAGRAMS ARE SHOWN FROM THE REAR
INTERNAL DIAGRAMS ARE SHOWN FROM THE FRONT

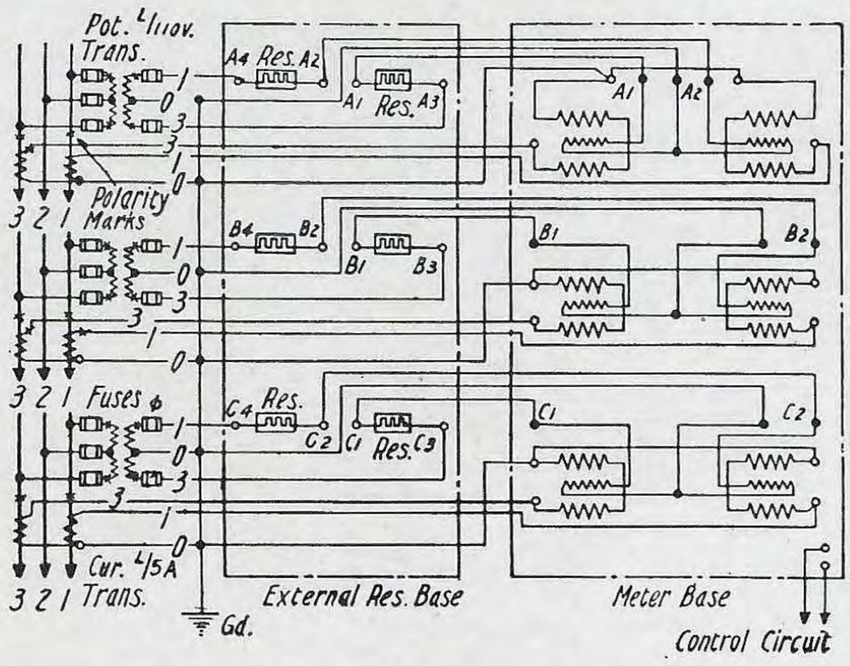


FIG. 19—TOTALIZING WATTMETER

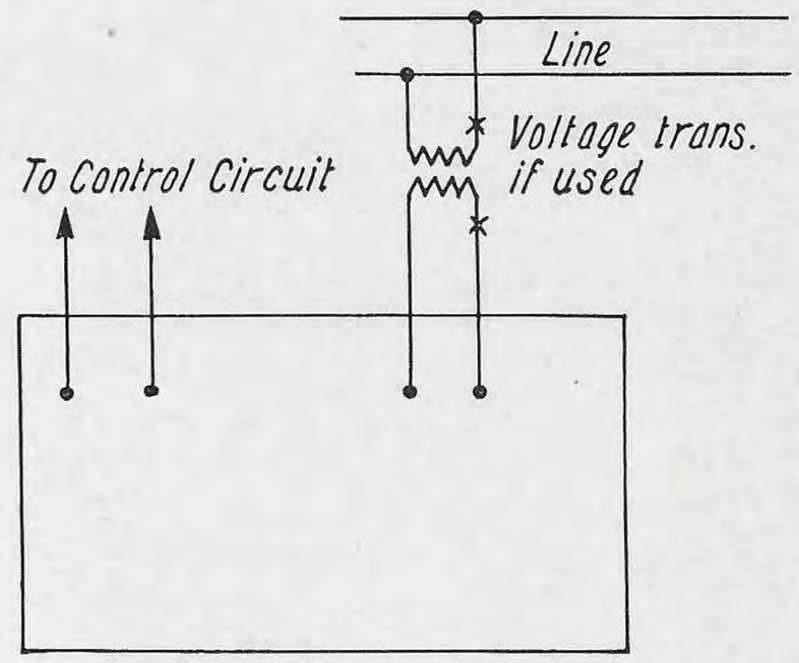


FIG. 20—PORTABLE VOLTMETER

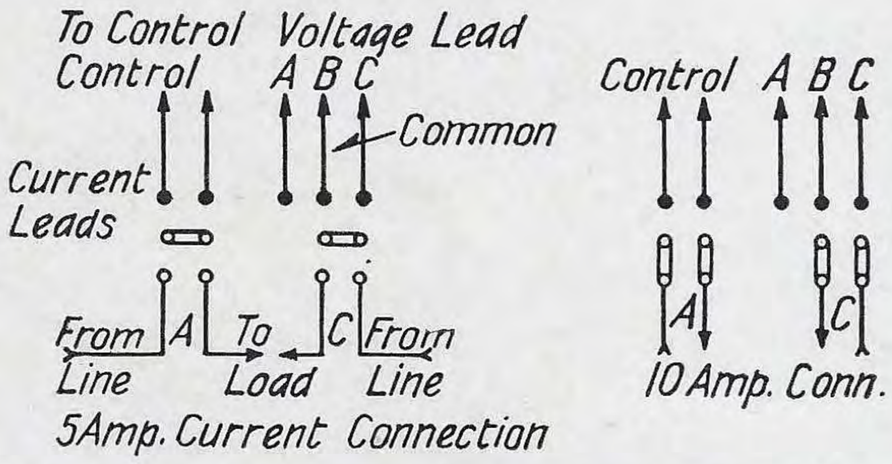
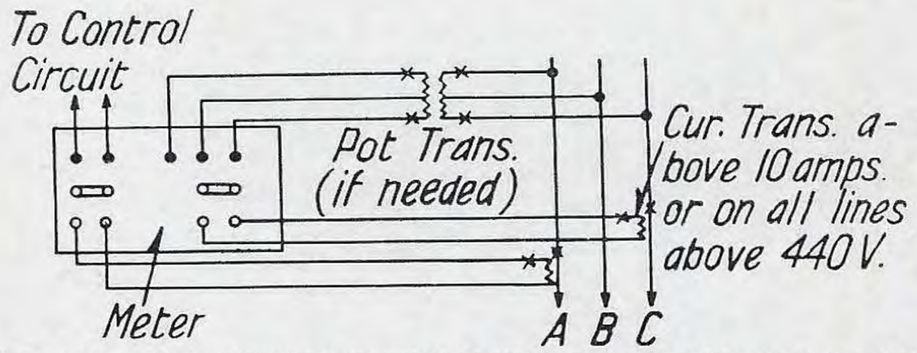
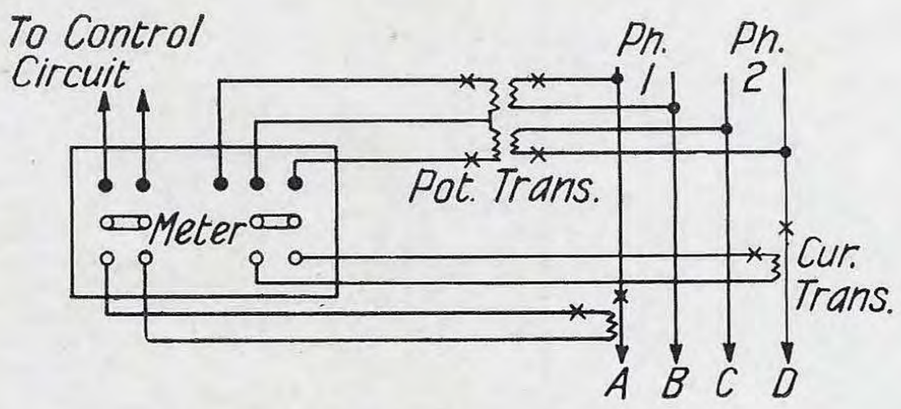


FIG. 21—PORTABLE POLYPHASE WATTMETER OR POLYPHASE POWER FACTOR METER



PORTABLE POLYPHASE WATTMETER OR POLYPHASE POWER FACTOR METER

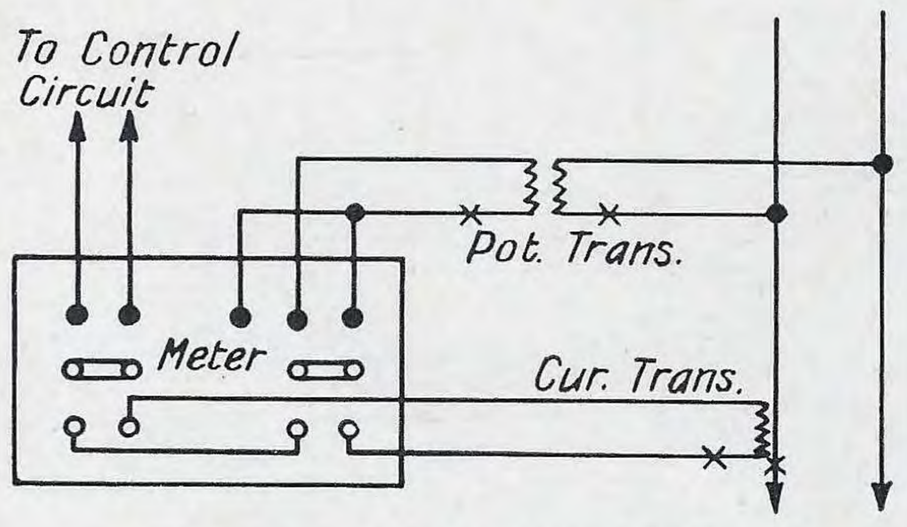
FIG. 22—CONNECTIONS FOR 1, 2, OR 3-PHASE, 3-WIRE CIRCUIT. ON 1-PHASE, B IS NEUTRAL. ON 2-PHASE, 3-WIRE, B IS COMMON WIRE. CROSSES ON TRANSFORMER LEADS INDICATE CORRESPONDING POLARITY.



PORTABLE POLYPHASE WATTMETER

FIG. 23—CONNECTIONS FOR 2-PHASE, 4-WIRE CIRCUIT

Note—Potential Transformers cannot be omitted on low voltage circuits unless B and C can be connected together, forming a 3-Wire system.



PORTABLE POLYPHASE WATTMETER

FIG. 24—CONNECTIONS FOR SINGLE-PHASE CIRCUIT

Note—Meter reads twice actual power, since the current coils are in series.

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

INTERNAL CONNECTION DIAGRAMS

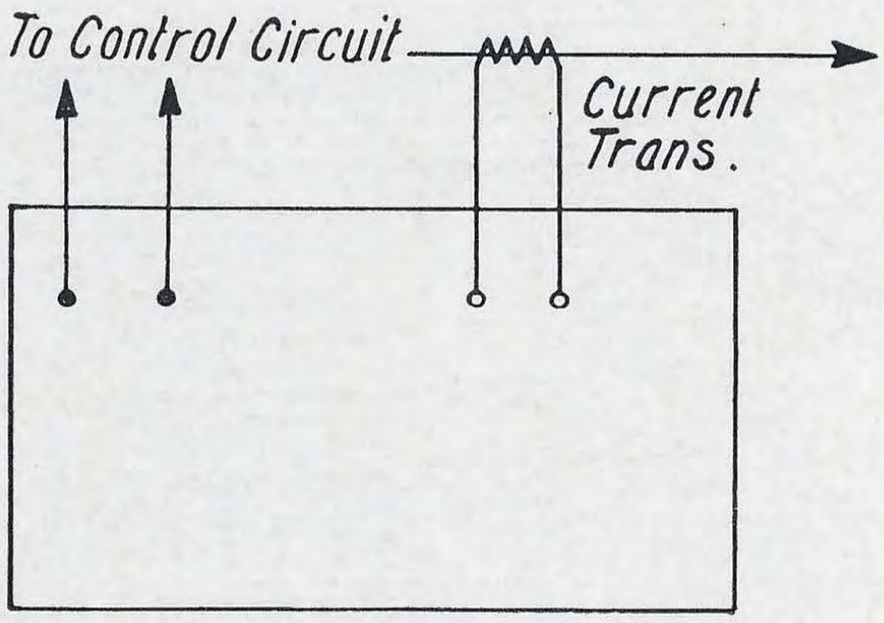


FIG. 25—PORTABLE AMMETER

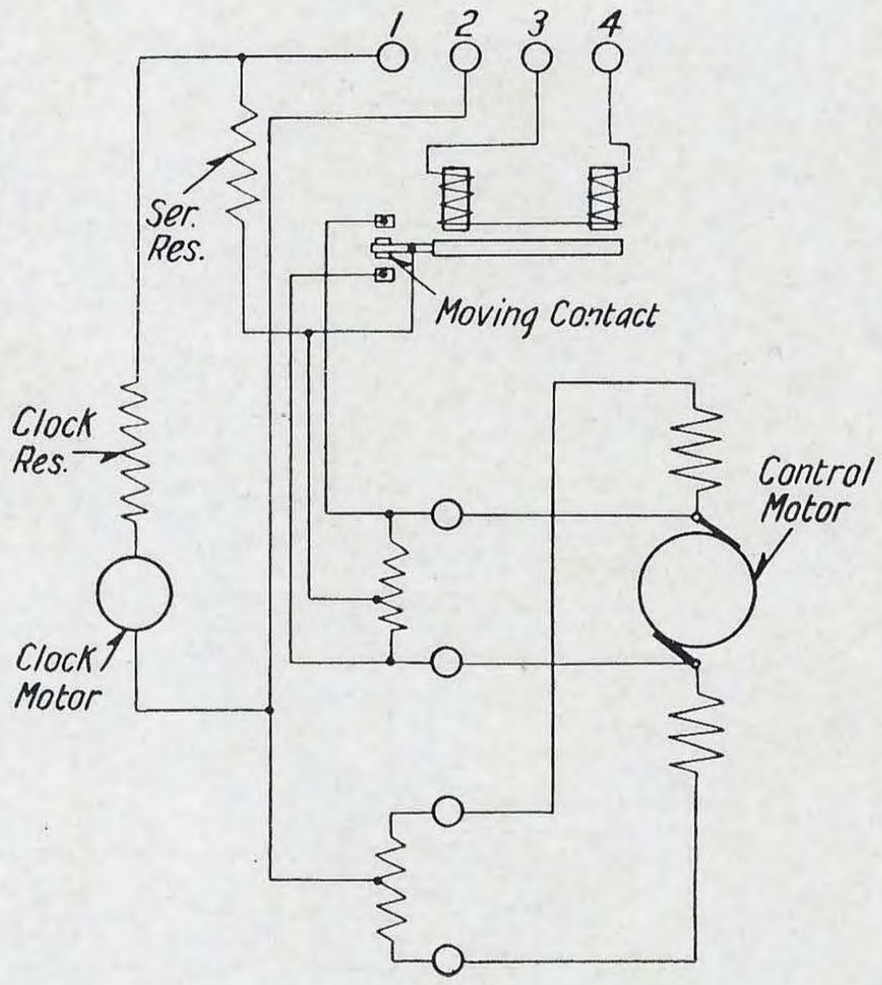


FIG. 26—D-C. AMMETER, TWO-WIRE

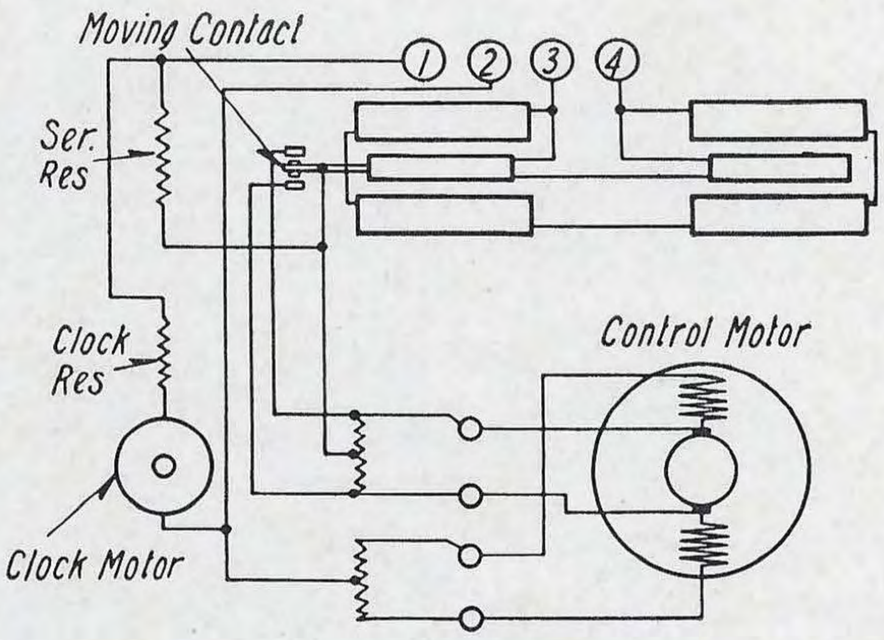


FIG. 27—A-C. AMMETER

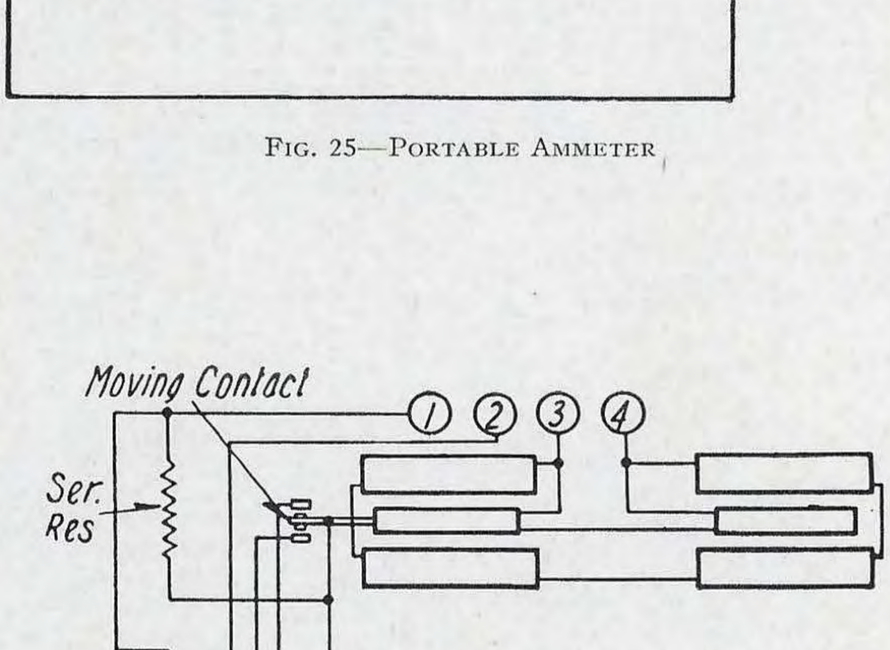


FIG. 28—A-C. OR D-C. VOLTMETER

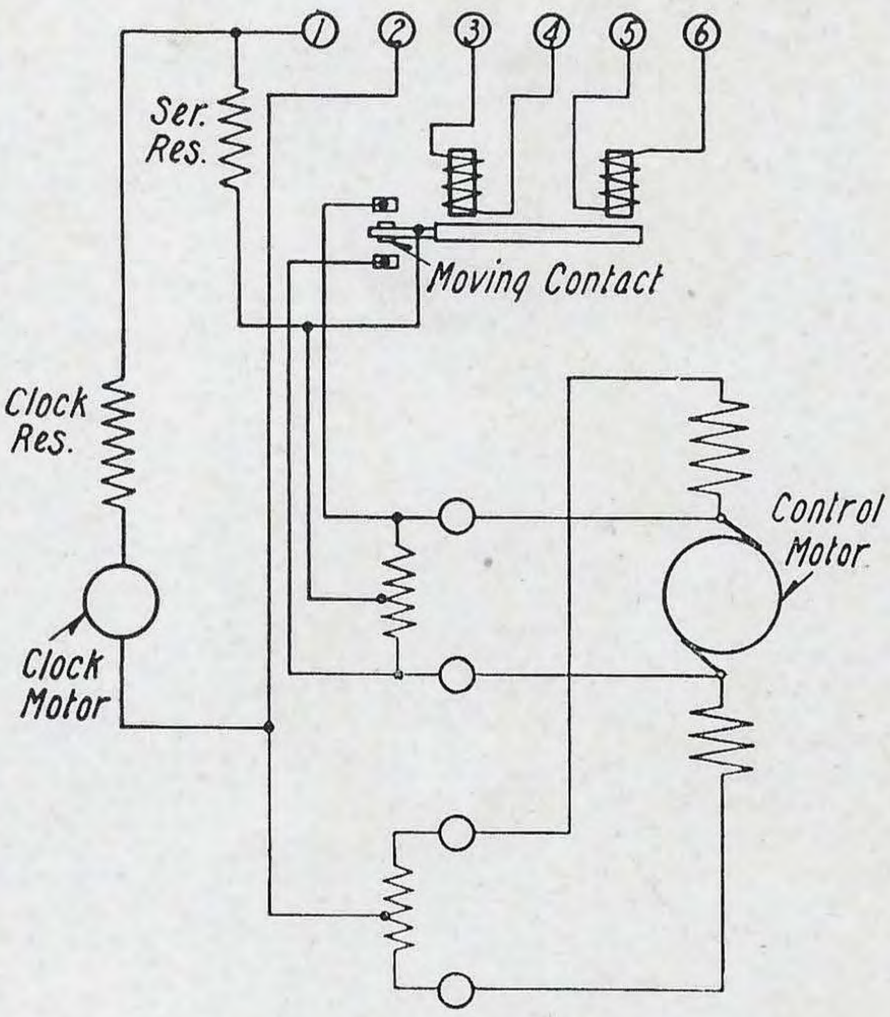


FIG. 29—D-C. AMMETER, THREE-WIRE

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

INTERNAL CONNECTION DIAGRAMS—Continued

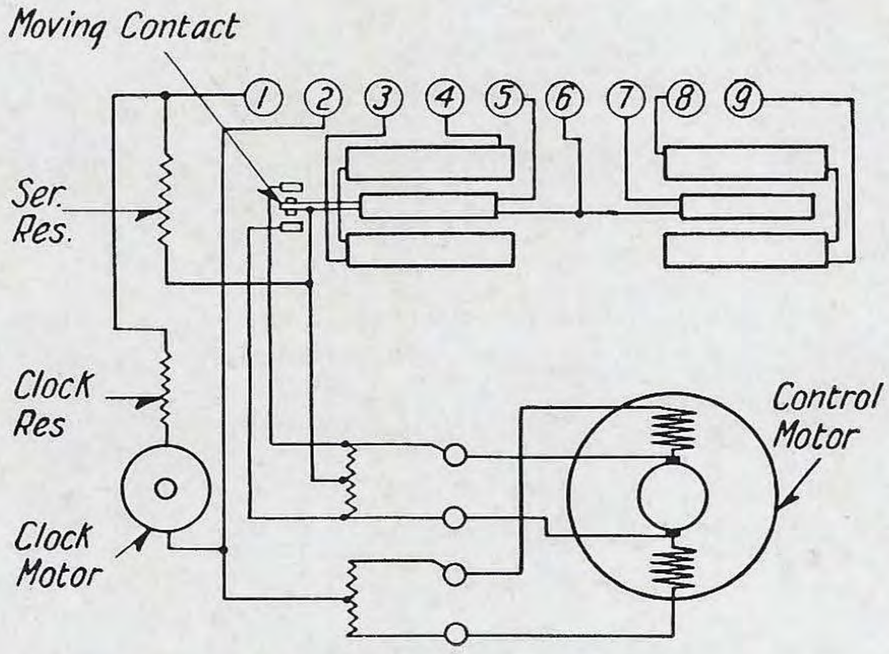


FIG. 30—POLYPHASE WATTMETER

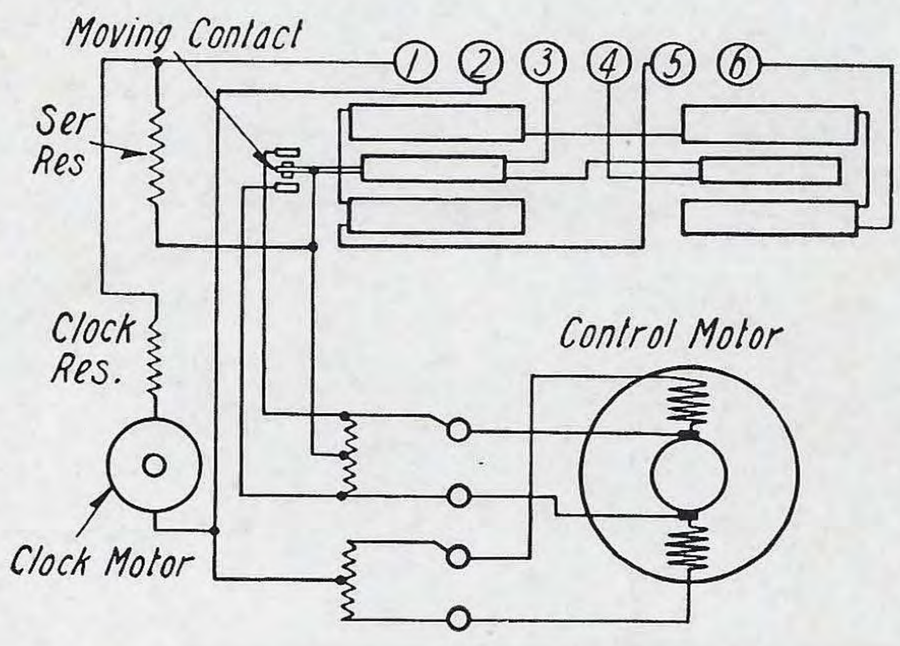


FIG. 31—SINGLE-PHASE WATTMETER

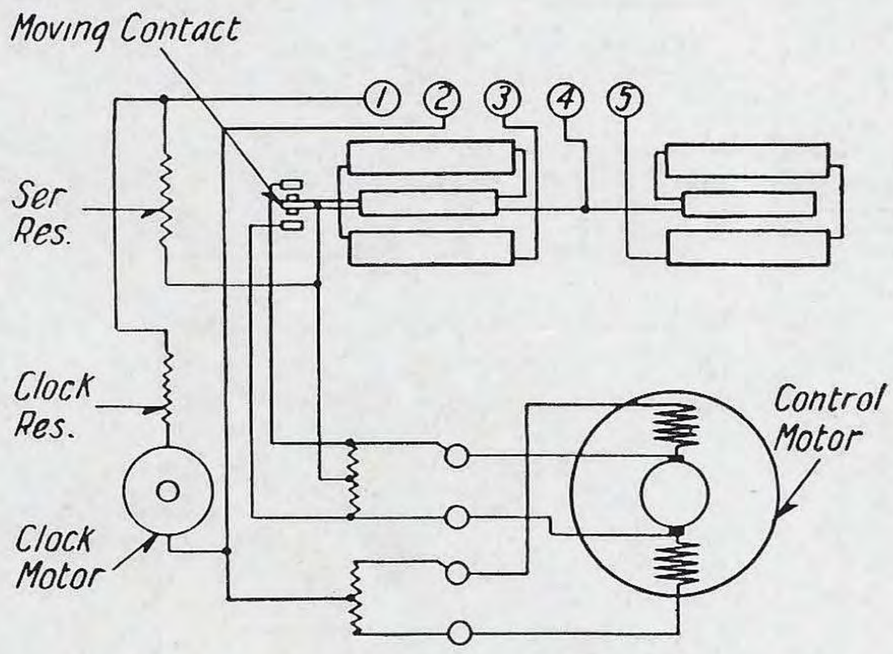


FIG. 32—FREQUENCY METER

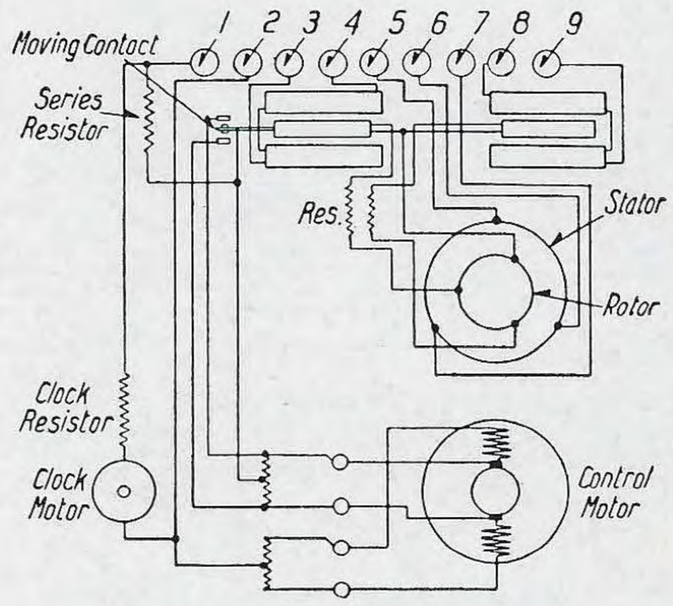


FIG. 33—POWER FACTOR METER

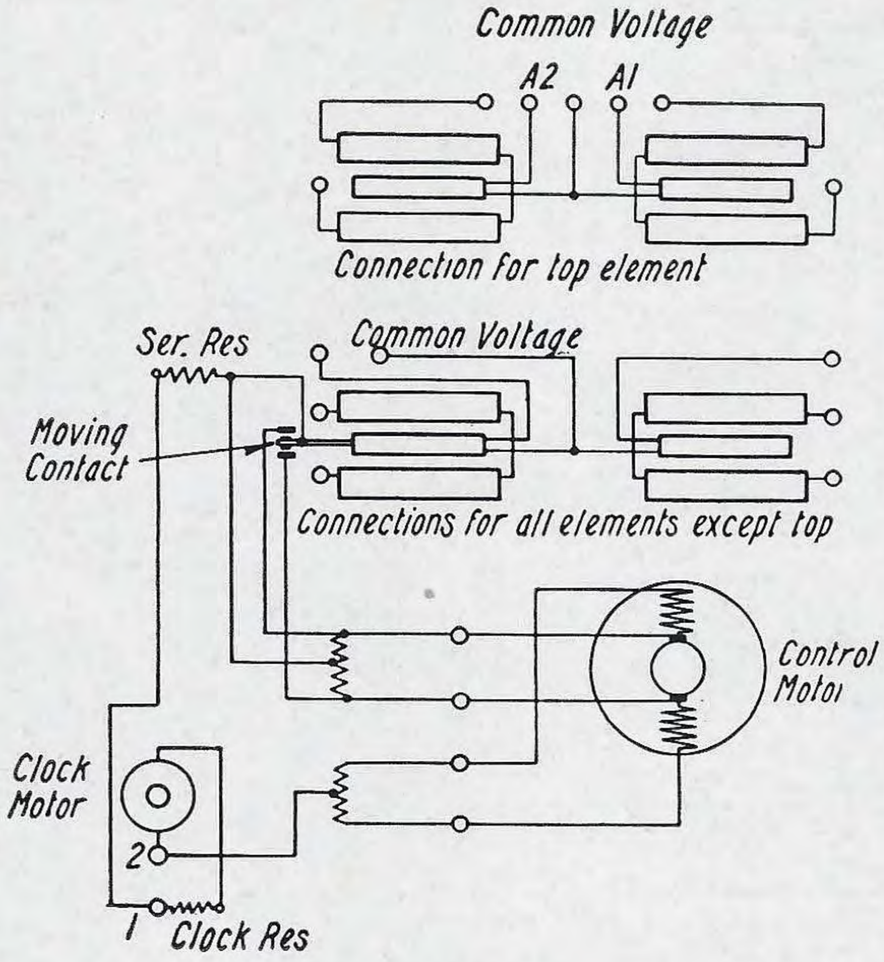


FIG. 34—TOTALIZING WATTMETER

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

OUTLINE DIMENSIONS IN INCHES

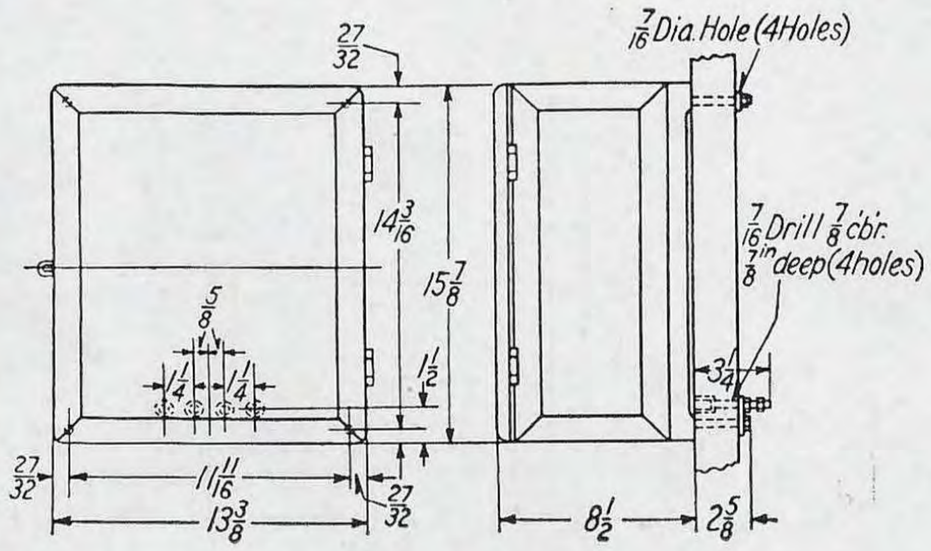


FIG. 35—REAR-CONNECTED A-C. AND D-C. AMMETERS AND VOLTMETERS—OUTLINE

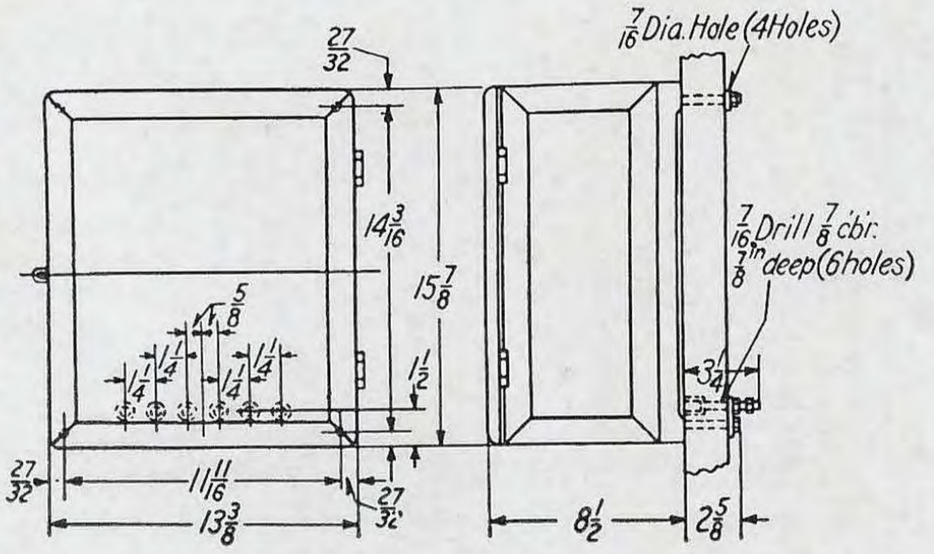


FIG. 36—REAR-CONNECTED, SINGLE-PHASE WATTMETER AND THREE-WIRE D-C. AMMETER—OUTLINE

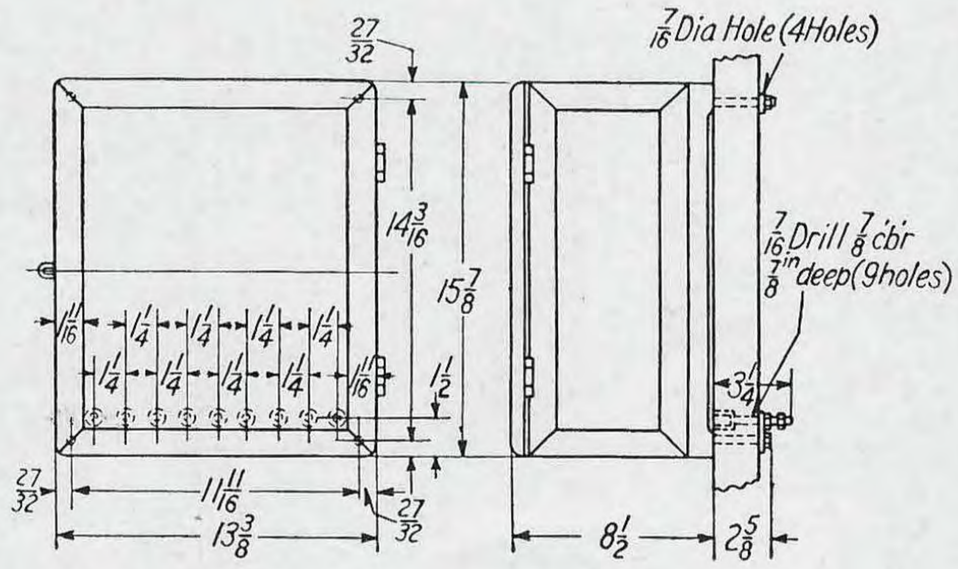


FIG. 37—REAR-CONNECTED, POLYPHASE WATTMETER—OUTLINE

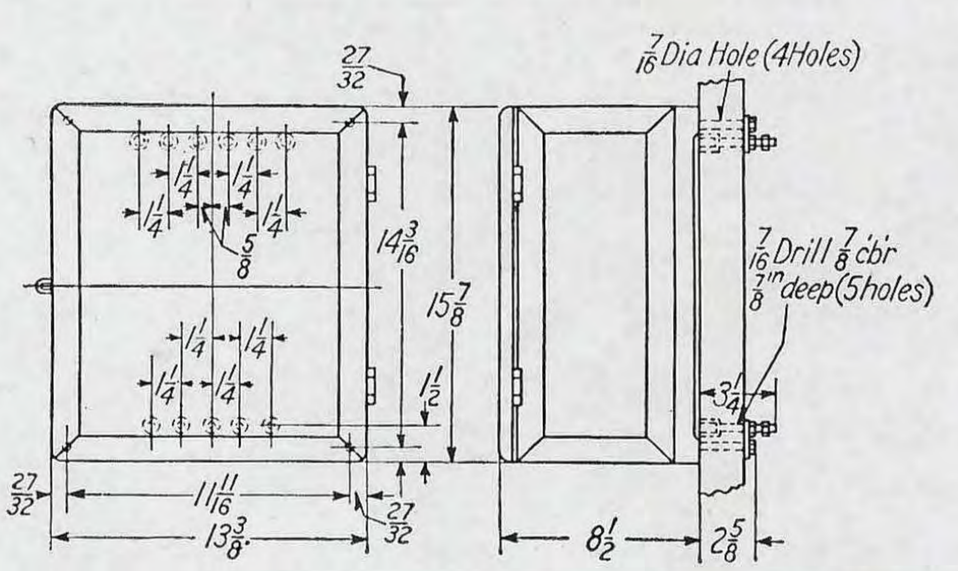


FIG. 38—REAR-CONNECTED, THREE-CURRENT COIL POLYPHASE WATTMETER—OUTLINE

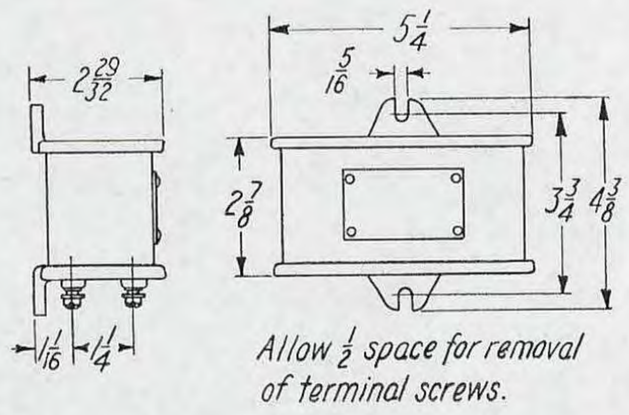


FIG. 39—EXTERNAL RESISTOR USED WITH SINGLE PHASE WATTMETERS AND VOLTMETERS UP TO AND INCLUDING 300 VOLTS.

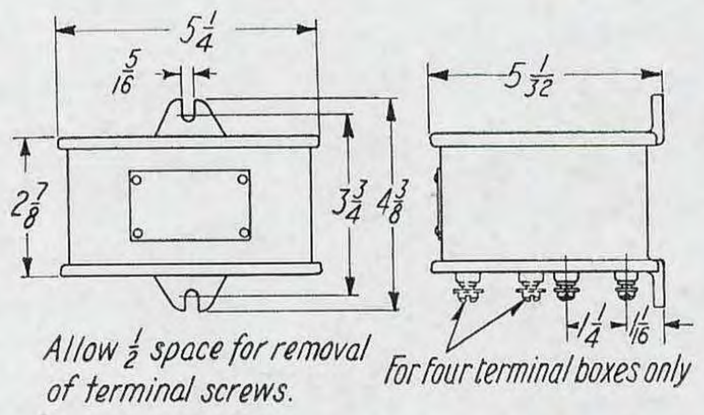


FIG. 40—EXTERNAL RESISTOR USED WITH POLYPHASE WATTMETERS UP TO 300 VOLTS AND SINGLE PHASE WATTMETERS ABOVE 300 VOLTS, POLYPHASE WATTMETERS ABOVE 300 VOLTS USE TWO OF THESE RESISTORS.

Dimensions are for reference only. For official dimensions refer to nearest Westinghouse Sales Office.

TYPE R RECORDERS—TYPE R TOTALIZERS—Continued

OUTLINE DIMENSIONS IN INCHES—Continued

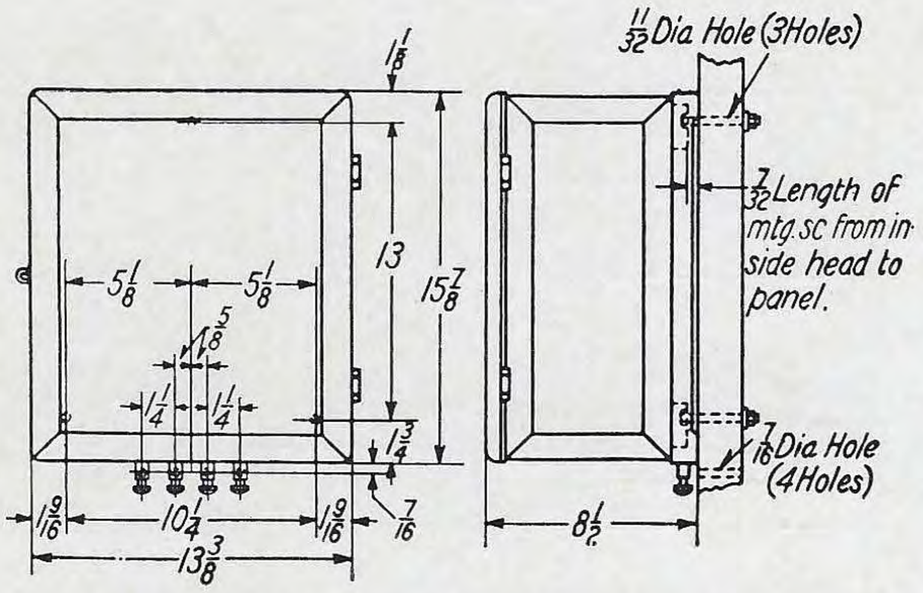


FIG. 41—FRONT-CONNECTED AMMETERS AND VOLTMETERS—OUTLINE

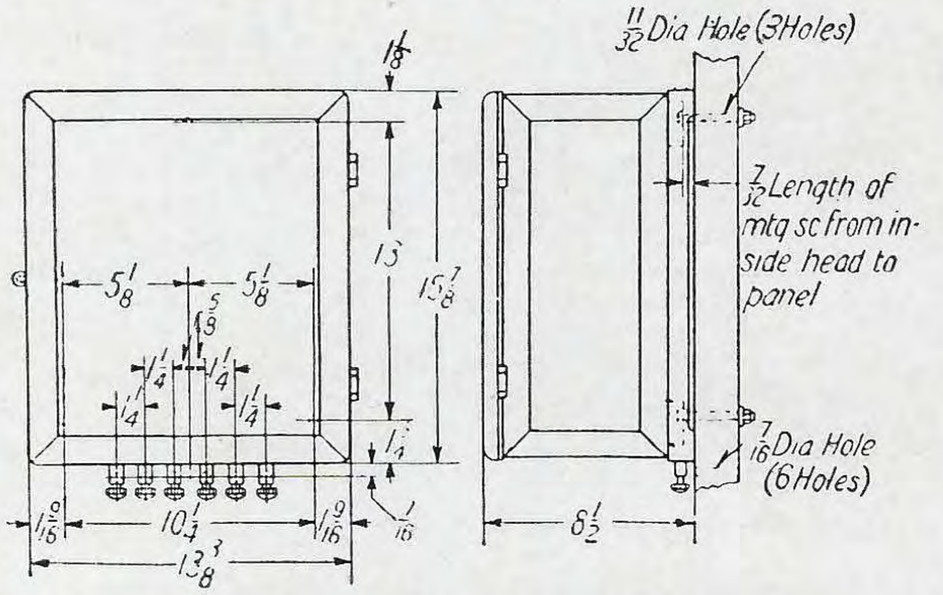


FIG. 42—FRONT-CONNECTED, SINGLE-PHASE WATTMETER AND THREE-WIRE D-C. AMMETER—OUTLINE

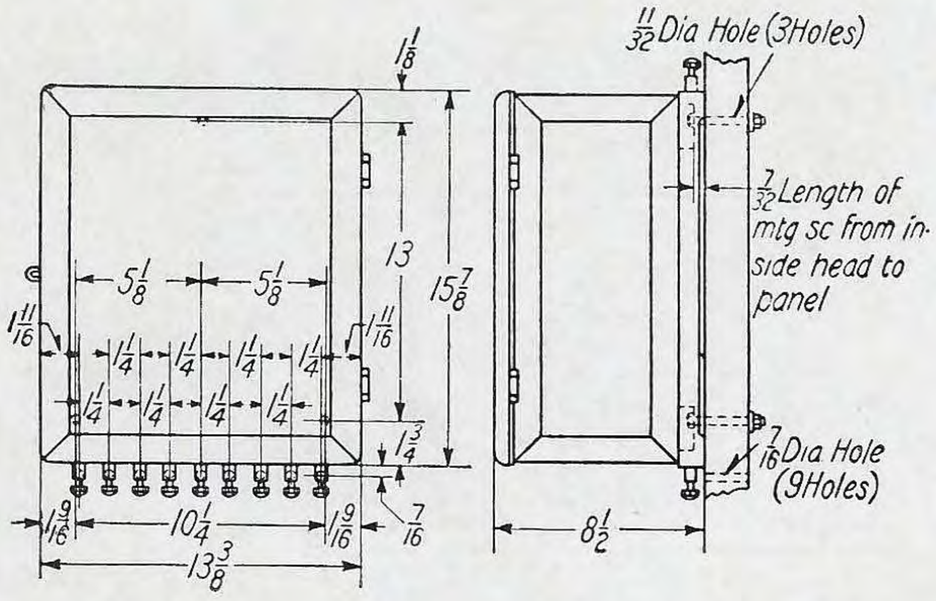


FIG. 43—FRONT-CONNECTED, POLYPHASE WATTMETER—OUTLINE

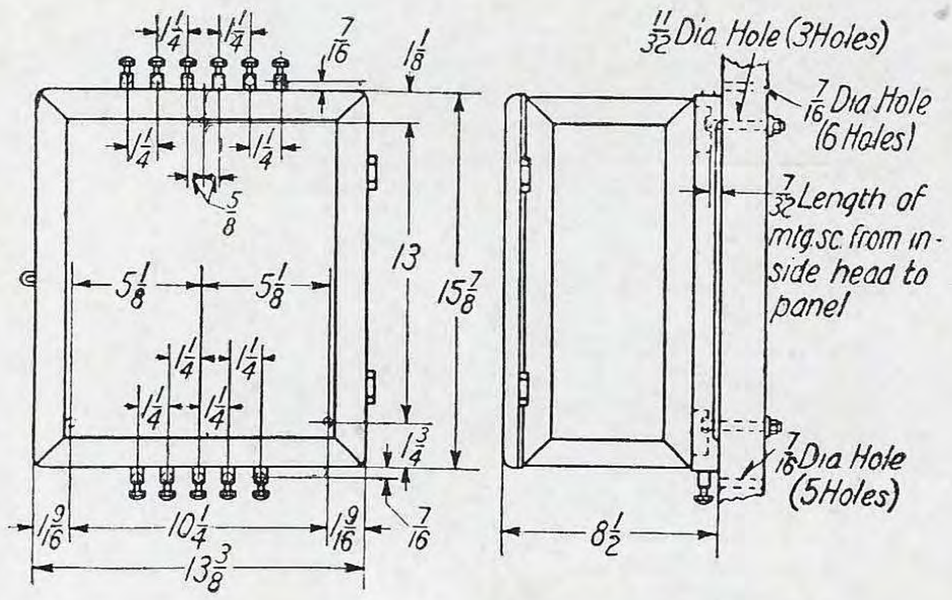


FIG. 44—FRONT-CONNECTED, THREE-CURRENT COIL POLYPHASE WATTMETER—OUTLINE

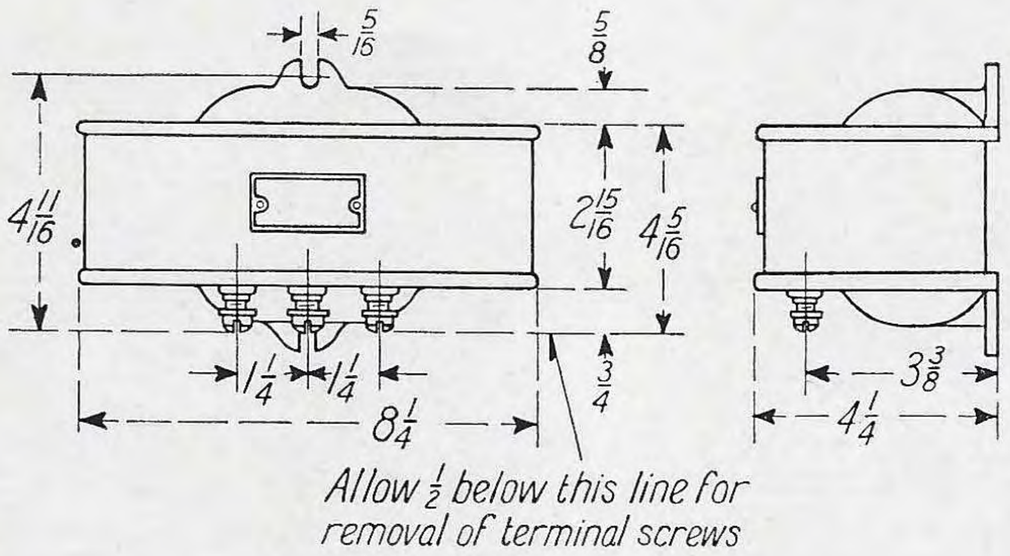


FIG. 45—POSITIVE SEQUENCE VOLTAGE NETWORK

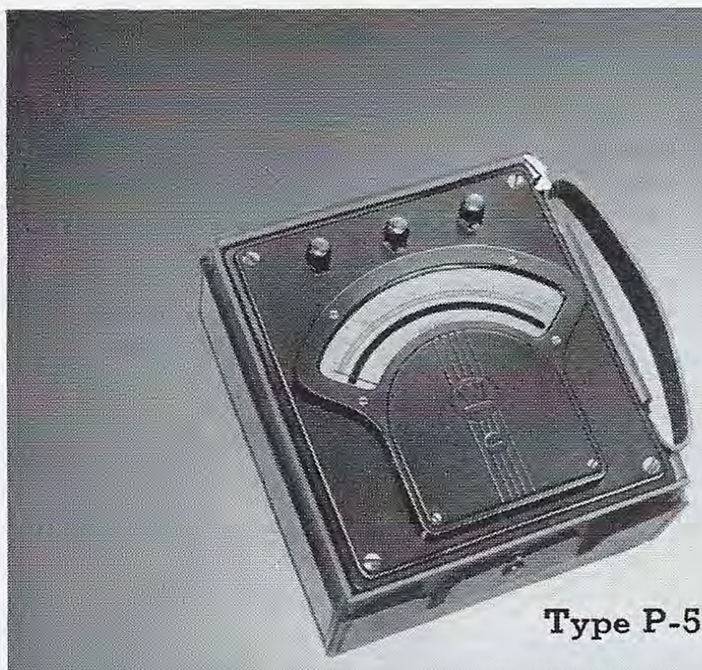
Dimensions are for reference only. For official dimensions refer to nearest Westinghouse Sales Office.

Printed in U.S.A.

A-C AND D-C
PORTABLE INSTRUMENTS

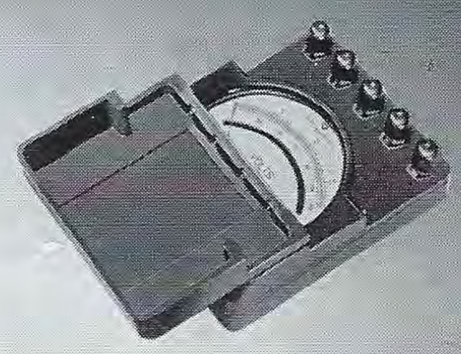
AMMETERS • VOLTMETERS • WATTMETERS • INDUSTRIAL ANALYZERS • TEST SETS

11/1/57

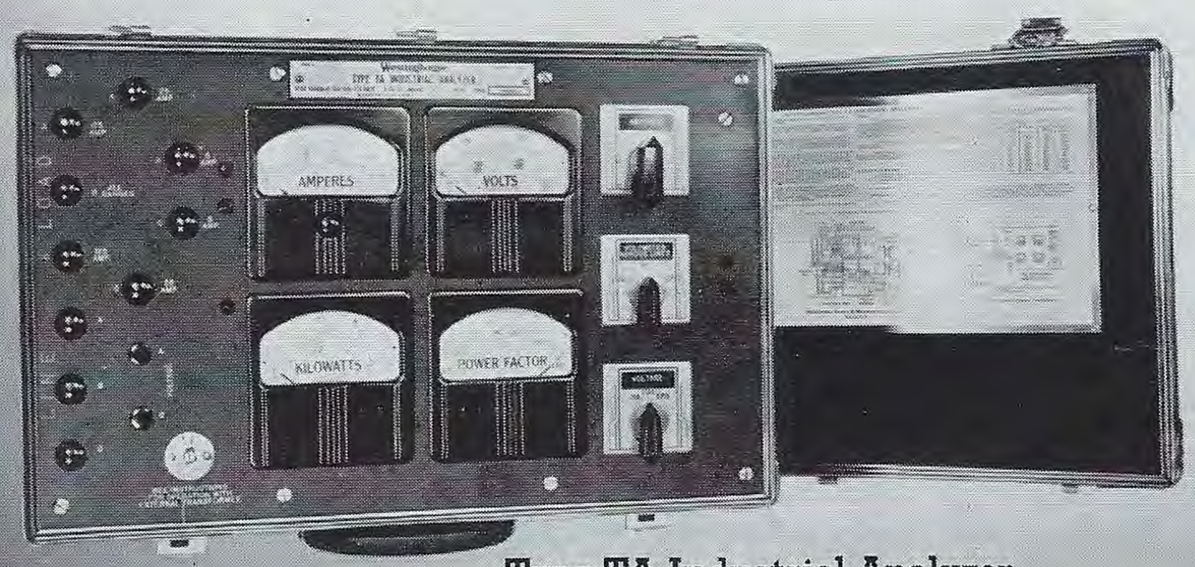


Type P-5

Type P-4



Type P-14



Type TA Industrial Analyzer

Type PM-32
Test Set

WESTINGHOUSE PORTABLE INSTRUMENTS AND TEST SETS meet the highest standards ever established for portable testing in industry . . . as attested by the tens of thousands of these instruments in service in laboratories, aboard ships, in power plants, on production lines and in service establishments.

Because of their broad scope of application, portable instruments are required in a wide variety of ranges, sizes and accuracies. Each type has many different applications, but each application can best be served with a particular instrument as outlined in the table below.

It is the aim of this catalog to help you choose the best instrument for your particular applications.

POINTS TO CONSIDER WHEN SELECTING INSTRUMENTS

1 **ACCURACY**—For general portable applications, the accuracy range is from ½% to 1%.

To check switchboard and panel instruments, an accuracy of ½% in the portable is proper.

To check other electrical equipment such as motors or controls, an accuracy of ½% to 1% in the portable is commonly used.

To check communications and control circuits, an accuracy of 1% to is used.

2 **SCALE RANGE**—For general testing, ranges should be chosen to have the instrument pointer deflect between ⅓ to full scale during normal use.

3 **SINGLE OR MULTIPLE SCALE**—Simplicity is the ideal of any product. Therefore, it follows that a single-range instrument is best suited for testing because it simplifies reading, tends to eliminate inaccuracies and is easy to hook-up. However, since single-range instruments sometimes multiply the number needed, it is often desirable to have multiple-range portables.

The ranges listed in this catalog have been developed to cover the broad field of electrical measurements and to provide scales that may be easily and accurately read.

With these few factors in mind, the index on Page 2 should help you select the correct instrument for any portable testing job.

Supersedes Catalog Section 43-100 dated October 17, 1955
Mailed to: E/332/PL; D65-1, 2, 3, 5C; C29-1, 2, 3, 5N-T

AUGUST 13, 1956

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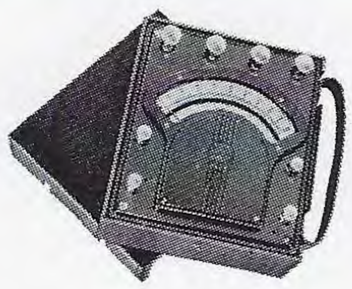
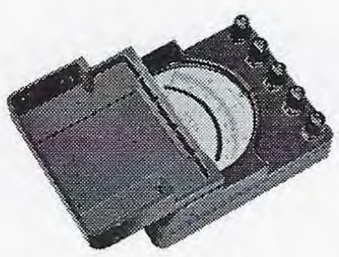


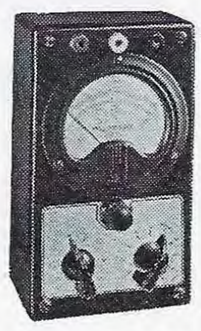
Type P-5

Type P-4

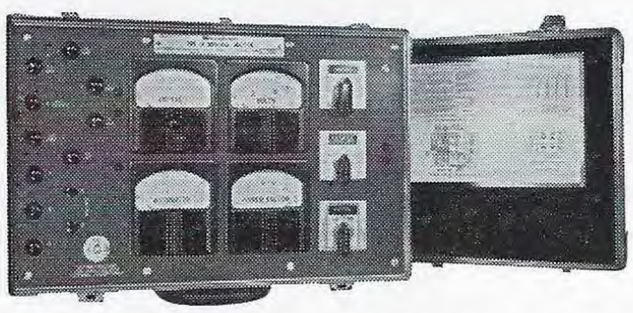


Type P-14
Hinge Cover

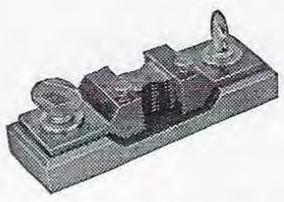
Type P-14
Open Face



Type PM-32
Test Set

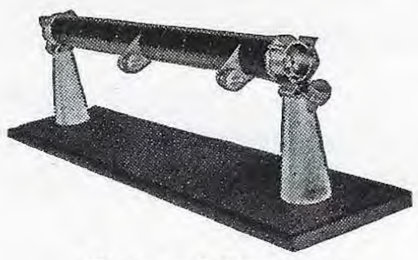


Type TA Industrial Analyzer



External Shunts

Portable Transformers



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INSTRUMENTS • SPECIFICATIONS

SPECIFICATIONS—PORTABLE INSTRUMENTS

	P-5 INSTRUMENTS	P-4 INSTRUMENTS	P-14 INSTRUMENTS	DESIGN FEATURES
TYPE	PX-5 D-C PA-5 A-C PY-5 A-C	PX-4 D-C PY-4 A-C PX-4 RADIO FREQUENCY TYPE PX-4 RECTIFIER TYPE	PX-14 D-C PA-14 A-C PT-14 RADIO FREQUENCY TYPE PC-14 RECTIFIER TYPE	• Permanently White Dials —will not fade, crack or discolor • High Overload Capacity — 35 times full-scale momentary overload on a-c iron vane ammeters • Non - Aging Springs — to insure unchanging calibration throughout instrument life • Linear Scale Distribution on d-c—entire scale length on a-c—upper 90% of scale • Low Friction Pivots—special techniques insure trouble-free operation against pivot "mushrooming" or corrosion • Pre-Aged Magnet — to insure constant flux density
CASE SIZE	7¾" x 8⅝" x 4"	4½" x 4½" x 2"	OPEN FACE: 5¼" x 4¼" x 1¾" for D-C 5¼" x 4¼" x 2 5/16" for A-C HINGE COVER: 5¼" x 4¼" x 2 1/16" for D-C 5¼" x 4¼" x 2⅝" for A-C	
SCALE LENGTH	5.3"	PX-4: 3.5" PY-4: 3.2"	PX-14, PT-14, PC-14: 3.2" PA-14: 2.8"	
ACCURACY	±½%	±¾% (except for the PX-4 Rectifier Type which is 1¾%)	PX-14, PA-14, PT-14: ±1% PC-14: ±2%	
SHIELDING	Magnetically Shielded	PX-4: Not Shielded PY-4: Magnetically Shielded	Magnetically Shielded	
MOVEMENT	PX-5: Permanent Magnet—Moving Coil PA-5: Repulsion Iron Vane PY-5: Dynamometer	PX-4: Permanent Magnet—Moving Coil* PY-4: Repulsion Iron Vane *Plus thermocouple for Thermal Converter Type, and rectifier for Rectifier Type	PX-14: Permanent Magnet—Moving Coil PA-14: Repulsion Iron Vane PT-14: Thermocouple and Permanent Magnet—Moving Coil PC-14: Rectifier and Permanent Magnet—Moving Coil	
NET WEIGHT	6 lbs. to 8 lbs.	2 lbs. to 4 lbs.	1½ lbs. to 2½ lbs.	
SHIPPING WEIGHT	9 lbs. to 10 lbs.	4½ lbs. to 6½ lbs.	4 lbs. to 5 lbs.	

SPECIFICATIONS — TEST SETS, ANALYZERS

	PM-32 PORTABLE TEST SET	TA ANALYZER
TEST SET AND INDUSTRIAL ANALYZER		
CASE SIZE	7" x 4" x 3¼"	9¼" x 13¼" x 18⅝"
SCALE LENGTH	2.4"	3½"
ACCURACY		Ammeter & Voltmeter—1% Wattmeter—2%
SHIELDING	Not Shielded	Magnetically Shielded
MOVEMENT	Permanent Magnet—Moving Coil	Repulsion Iron Vane and Dynamometer
NET WEIGHT	3 lbs.	35½ lbs.
SHIPPING WEIGHT	5 lbs.	47 lbs.

Ordering Information

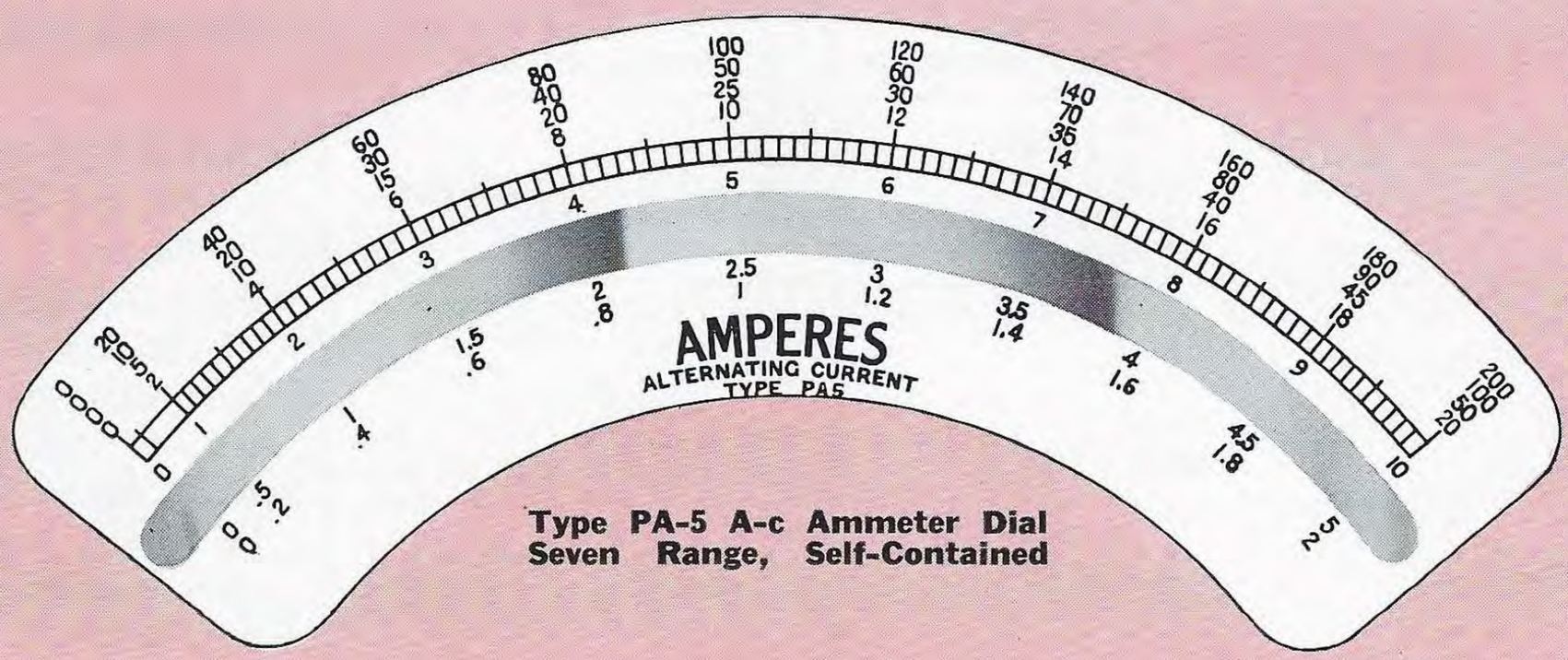
WHEN ORDERING, Specify: Quantity, Style Number, Type and List Price.

SHIPMENT—Any style number which is followed by the letter Ⓢ is normally in stock and will be checked and shipped quickly, subject to prior orders. For schedules on other styles check your nearest Westinghouse district sales office.

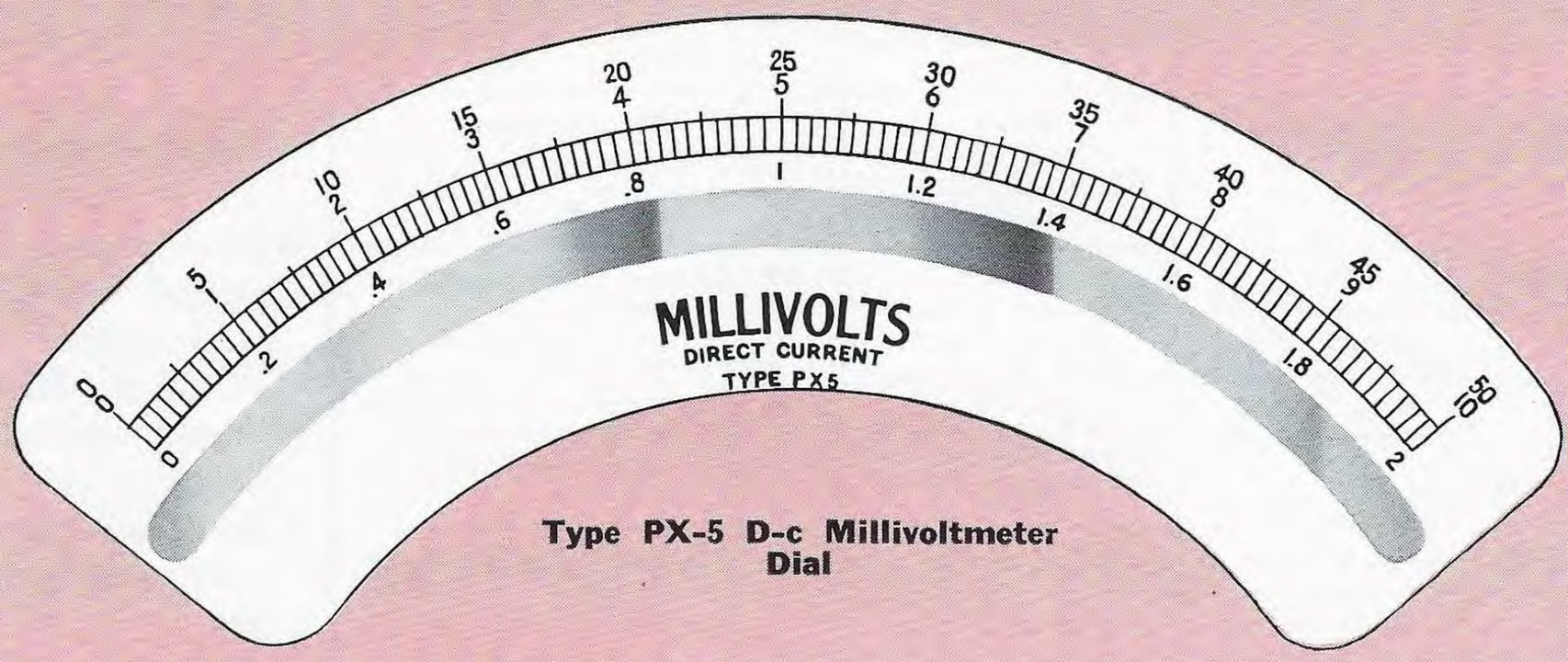
C. S. 43-100

TYPE P-5 INSTRUMENTS

ACCURACY ±½%



Type PA-5 A-c Ammeter Dial Seven Range, Self-Contained



Type PX-5 D-c Millivoltmeter Dial

Type PY-5 Dynamometer Wattmeter. When top half of leather case is removed it will still button to bottom half to provide single unit with instrument.

- Conforms to ASA Standard C-39.1 Military Specification MIL-M-16034A.
- Momentary overload capacity 35 times full scale value for a-c iron vane instruments.
- Provided with mirror dial and knife-edge pointer.
- Self-contained ratings to 200 amperes a-c. See dial above.
- Standard ratings chosen to provide maximum range coverage consistent with good readability.
- Ideal for checking switchboard and panel instrument accuracy.

LIST PRICES • PX-5 D-C INSTRUMENTS

±½% ACCURACY D-C INSTRUMENTS—TYPE PX-5

Type PX-5
D-C Voltmeter

RATING	SCALE DIVISIONS	APPROXIMATE RESISTANCE OHMS	STYLE NUMBER	LIST PRICE↓
D-C AMMETERS				
Single Range				
1	100	.05	1727 647	$164.00
1.5	150	.033	1727 648	164.00
2.5	125	.02	1727 649	164.00
3	150	.016	1727 650	164.00
5	100	.01	1727 651	164.00
7.5	150	.006	1727 652	164.00
10	100	.005	1727 653	164.00
15	150	.0033	1727 654	164.00
25	125	.002	1727 655	164.00
30	150	.0016	1727 656	164.00
50	100	.001	1727 657	164.00
Double Range				
1–5	100	.05 –.01	1727 658	177.00
1–10	100	.05 –.005	1727 659	177.00
6–30	120	.0083–.0016	1727 660	177.00
10–50	100	.005 –.001	1727 661	177.00
Triple Range				
.05–.5–5	100	.....	1727 662	190.00
.5–2.5–5	100	.....	1727 663	190.00
.1–1–10	100	.....	1727 664	190.00
1–2 5–10	100	....	1727 665	190.00
1–5–10	100	.....	1727 666	190.00
.15–3–15	150	.....	1727 667	190.00
1.5–3–15	150	....	1727 668	190.00
.5–2.5–25	100	.....	1727 669	190.00
2.5–5–25	100	...	1727 670	190.00
2.5–10–25	100	...	1727 671	190.00
5–10–25	100	....	1727 672	190.00
1.5–3–30	150	....	1727 673	190.00
3–6–30	120	.....	1727 674	190.00
3–15–30	150	....	1727 675	190.00
.5–5–50	100	.....	1727 676	190.00
2–10–50	100	.....	1727 677	190.00
5–20–50	100	.....	1727 678	190.00
10–25–50	100	.....	1727 679	190.00

The above instruments are shunted internally and have a voltage drop of 50 millivolts at full scale current.

RATING	SCALE DIVISIONS	APPROXIMATE RESISTANCE OHMS	STYLE NUMBER	LIST PRICE↓
D-C MILLIAMMETERS				
Single Range				
1	100	194	1727 680	$160.00
1.5	150	109	1727 681	160.00
2.5	125	68	1727 682	160.00
3	150	25	1727 683	160.00
5	100	7	1727 684	160.00
7.5	150	6	1727 685	160.00
10	100	4.4	1727 686	160.00
15	150	2.0	1727 687	160.00
25	125	1.1	1727 688	160.00
30	150	.7	1727 689	160.00
50	100	.55	1727 690	160.00
75	150	.39	1727 691	160.00
100	100	.27	1727 692	160.00
150	150	.18	1727 693	160.00
250	125	.11	1727 694	160.00
300	150	.11	1727 695	160.00
500	100	.10	1727 696	160.00
750	150	.066	1727 697	160.00
1000	100	.050	1727 698	164.00
1500	150	.033	1727 699	164.00
Double Range				
15–150	150	2.5–.36	1727 700	174.00
100–500	100	.55–.11	1727 701	174.00
150–750	150	.36–.07	1727 702	174.00
Triple Range				
.03–.3–3	150	4160–1300–250	1727 703	188.00
.15–1.5–15	150	325– 160– 16	1727 704	188.00
3–7.5–30	150	21– 5.7– 2.3	1727 705	188.00
.15–15–150	150	325– 15– 1.7	1727 706	188.00
7.5–30–150	150	22– 6– 1.2	1727 707	188.00
15–150–1500	150	12– 1.2– .13	1727 708	190.00
30–300–3000	150	1.66–.16–.016	1727 709	190.00
150–750–3000	150	.33–.066–.016	1727 710	190.00
D-C MICROAMMETERS				
30	150	2140	1727 724	185.00
50	100	1960	1727 725	183.00
100	100	495	1727 726	181.00
250	125	297	1727 727	174.00
500	100	73	1727 728	172.00
750	150	22	1727 729	170.00
HIGH SENSITIVITY D-C MICROAMMETERS With High Coercive Magnets				
Single Range				
10	100	3400	1727 711	245.00
15	150	1450	1727 712	237.00
20	100	865	1727 713	218.00
25	125	550	1727 714	214.00
30	150	475	1727 715	214.00
50	100	136	1727 716	207.00
100	100	35	1727 717	207.00
150	150	20	1727 718	207.00
200	100	9.6	1727 719	207.00
250	125	6.5	1727 720	207.00
300	150	3.8	1727 721	207.00
500	100	2.5	1727 722	207.00
750	150	2.2	1727 723	207.00

LEADS FOR TYPE P-5 INSTRUMENTS

DESCRIPTION	STYLE NUMBER	LIST PRICE
Pair 3-foot test leads, .017 ohms (prongs on one end)	818 183Ⓢ	$3.50
Pair 3-foot shunt leads, .017 ohms (open connectors on both ends)	819 344Ⓢ	3.50

↓ Price includes leather carrying case. These instruments can also be provided without carrying case. Subtract $10.00 list.

Prices Effective August 13, 1956; Subject to Change Without Notice

DISCOUNTS—See Selling Policy 43-000

LIST PRICES • PX-5 D-C INSTRUMENTS

±½% ACCURACY D-C INSTRUMENTS—TYPE PX-5 (Cont'd)

Type PX-5
D-C Voltmeter

D-C MILLIVOLTMETERS*

Single Range

RATING	SCALE DIVISIONS	APPROXIMATE RESISTANCE OHMS	STYLE NUMBER	LIST↓ PRICE
50†	100–150	5	1727 730Ⓢ	$150.00
50	100	5	1727 731Ⓢ	160.00
100	100	10	1727 732	150.00

Double Range

50–100	100	5–10	1727 733Ⓢ	174.00

* Style number and list price of Millivoltmeters include one pair of leads Style Number 819 344. Resistance of leads, 0.017 ohm total, is included in above resistance values.

† This instrument has an additional scale arc with 150 divisions to facilitate its use with shunts of 1.5 amperes capacity and decimal multiples thereof.

HIGH SENSITIVITY D-C MILLIVOLTMETERS‡
With High Coercive Magnets

Single Range

2	100	5	1727 734	207.00
3	150	7.5	1727 735	207.00
5	100	12.5	1727 736	207.00
7.5	150	30	1727 737	207.00
10	100	50	1727 738	207.00
15	150	150	1727 739	207.00
20	100	200	1727 740	207.00
30	150	300	1727 741	207.00
50	100	1000	1727 742	207.00
75	150	1500	1727 743	207.00
100	100	5000	1727 744	207.00
150	150	7500	1727 745	207.00
200	100	10000	1727 746	207.00
250	125	12500	1727 747	207.00
300	150	15000	1727 748	207.00
500	100	25000	1727 749	207.00

Double Range

2–8	100-80	5–20	1727 750	218.00
5–10	100	12.5–25	1727 751	218.00
2–20	100	5–50	1727 752	218.00
10–50	100	50–250	1727 753	218.00
20–50	100	200–500	1727 754	218.00

Triple Range

2–10–50	100	5–25–125	1727 894	229.00

Four Range

2–5–10–20	100	5–12.5–25–50	1727 755	240.00
2–5–20–50	100	5–12.5–50–125	1727 756	240.00
2–10–50–250	100-100	5–25–125–625	1727 757	240.00
2-20-200-2000	100	5–50–500–5000	1727 758	240.00

‡ Style Number and list price include one pair of leads Style Number 819344. Resistance of leads,0.017 ohm total, included in above resistance values.

D-C VOLTMETERS
Resistance 1000 Ohms per Volt

Single Range

RATING	SCALE DIVISIONS	STYLE NUMBER	LIST↓ PRICE
1	100	1727 759	$160.00
1.5	150	1727 760	160.00
2.5	125	1727 761	160.00
3	150	1727 762	160.00
5	100	1727 763	160.00
15	150	1727 764	160.00
150	150	1727 765	160.00
300	150	1727 766	170.00
600	120	1727 767	190.00
750	150	1727 768	200.00

Double Range

3–15	150	1727 769	170.00
3–150	150	1727 770	170.00
15–150	150	1727 771	170.00
75–150	150	1727 772	170.00
150–300	150	1727 773Ⓢ	180.00
300-600	120	1727 774	200.00

Triple Range

1.5–15–150	150	1727 775	182.00
3–15–150	150	1727 776	182.00
3–150–300	150	1727 777	190.00
150–300–750	150	1727 778Ⓢ	216.00

Four Range

75-150-750-1500	150	1727 779Ⓢ	280.00

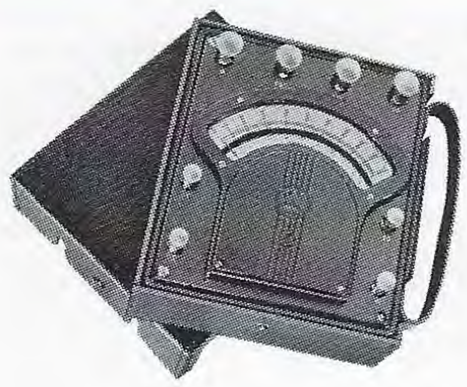
NOTE: For higher ratings, external sectional type resistors may be used. See Catalog Section 43-800 for pricing.

↓ Price includes leather carrying case. These instruments can also be provided without carrying case. Subtract $10.00 list.

Prices Effective August 13, 1956; Subject to Change Without Notice

DISCOUNTS—See Selling Policy 43-000

LIST PRICES • PA-5 A-C INSTRUMENTS



Type PA-5
A-C Ammeter
Seven Range
Self-Contained

±½% ACCURACY A-C INSTRUMENTS—TYPE PA-5

Self-Contained—For Frequencies of 20 to 135 Cycles■

RATING	SCALE DIVISIONS	RESISTANCE APPROXIMATE OHMS	BURDEN FULL SCALE VOLT-AMPS. AT 60 CYCLES	STYLE NUMBER	LIST PRICE↓
A-C AMMETERS					
Single Range					
1	100	.244	.32	1727 780	$134.00
2.5	125	.054	.41	1727 781	134.00
3	150	.035	.375	1727 782	134.00
5	100	.012	.375	1727 783Ⓢ	134.00
10	100	.003	.375	1727 784	134.00
15	150	.0017	.430	1727 785	134.00
25	125	.0019	1.23	1727 786	134.00
50	100	.0005	1.23	1727 787	136.00
Double Range†					
.5–1*	100	1.4–.35	.39	1727 788	159.00
1–2*	100	.33–.08	.365	1727 789	159.00
2.5–5*	125–100	.065–.016	.435	1727 790Ⓢ	159.00
5–10*	100	.012–.003	.375	1727 791Ⓢ	159.00
25–50	100–100	.0019–.0005	1.24	1727 792Ⓢ	161.00
MULTI-RANGE AMMETERS WITH INTERNAL TRANSFORMERS†					
Four Range					
1–2–5–10*	100	.12–.17– .45– .94		1727 793Ⓢ	$227.00
Five Range					
5–10–20–50–100	100	.45–.94– 1.9–5.0–10.3		1727 794Ⓢ	241.00
Seven Range					
2–5–10–20–50–100–200	100	.17–.45–.94–1.9–5.–10.3–22.0		1727 795Ⓢ	272.00

† All multi-range ammeters are supplied with terminals for selecting ranges unless otherwise ordered with rotary switches.
* Switches may be supplied where high range is fifty amperes or less at an additional list price of $36.00.

↓ **Price includes leather carrying case. These instruments can also be provided without carrying case. Subtract $10.00 list.**

RATING	SCALE DIVISIONS	RESISTANCE APPROXIMATE OHMS	BURDEN FULL SCALE VOLT-AMPS. AT 60 CYCLES	STYLE NUMBER	LIST PRICE↓
A-C MILLIAMMETERS					
Single Range					
10	100	3840	.40	1727 796	$136.00
25	125	570	.40	1727 797	136.00
50	100	143	.40	1727 798	136.00
75	150	60	.40	1727 799	136.00
100	100	38	.40	1727 800	136.00
150	150	15.6	.40	1727 801	136.00
250	125	5.1	.40	1727 802	136.00
500	100	1.44	.40	1727 803	136.00
750	150	.52	.40	1727 804	136.00
Double Range					
20–40	100–100	654–228	.40	1727 805	154.00
50–150	100–150	156–14	.40	1727 806	154.00
250–750	125–150	6.5– .6	.40	1727 807	154.00
A-C VOLTMETERS					
Single Range					
15	150	45	5.0	1727 808	138.00
30	150	180	5.0	1727 809	138.00
75	150	1120	5.0	1727 810	138.00
125	125	3120	5.0	1727 811	139.00
150	150	4500	5.0	1727 812	139.00
250	125	12500	5.0	1727 813	141.00
300	150	18000	5.0	1727 814	141.00
500	100	40000	6.25	1727 893	149.00
600	120	48000	7.50	1727 815	150.00
750	150	75000	10.00	1727 816	152.00
Double Range					
75–150	150	1125–2250	5–10	1727 817	152.00
150–300	150	4500–9000	5–10	1727 818Ⓢ	153.00
150–600	150	4500–18000	5–20	1727 819	162.00
300–600	150	18000–36000	5–10	1727 820	162.00
150–750	150	4500–22500	5–25	1727 821	164.00
300–750	150	18000–45000	5–12.5	1727 822	164.00
Triple Range					
150–300–600	150	4500–9000–18000	5–10–20	1727 823Ⓢ	174.00
75–150–300	150	1125–2250–4500	5–10–20	1727 824	165.00
150–300–750	150	4500–9000–22500	5–10–25	1727 825Ⓢ	176.00
Six Range*					
3–15–75 / 150–300 / 750	150	5.56–27.8–715 / 1430–11100 / 27600	1.5– 7.5 / 7.0–14.0 / 6.9–17.2	1727 826Ⓢ **	225.00

* Frequency Range 15 to 70 Cycles.
** Must be used with .017 ohm leads which are supplied with this style.

■ Rectifier type and radio frequency type instruments are available.

Prices Effective August 13, 1956; Subject to Change Without Notice

DISCOUNTS—See Selling Policy 43-000

C. S. 43-100

LIST PRICES • PY-5 A-C INSTRUMENTS

±½% ACCURACY A-C SINGLE-PHASE WATTMETERS—TYPE PY-5

Type PY-5
A-C Wattmeter

Self Contained—For D-C and Frequencies of 20 to 135 Cycles

DOUBLE-VOLTAGE, SINGLE-CURRENT RANGES

RATINGS*		SCALE DIVISIONS	WATT RANGE	RESISTANCE APPROX. OHMS POTENTIAL CIRCUIT		BURDEN FULL SCALE VOLT-AMPS. AT 60 CYCLES			STYLE NO.	LIST PRICE↓
						VOLTAGE CIRCUIT WATTS		CURRENT CIRCUIT		
VOLTS	AMPERES†			LOW RANGE	HIGH RANGE	LOW RANGE	HIGH RANGE	VOLT-AMPS. AT 60 CYCLES		
20-40	1	100-80	20/40	300	600	1.5	3	.60	1727 827	$174.00
20-40	2.5	100	50/100	300	600	1.5	3	.60	1727 828	174.00
20-40	5	100	100/200	300	600	1.5	3	.64	1727 829	174.00
20-40	10	100-80	200/400	300	600	1.5	3	.86	1727 830	174.00
20-40	25	100	500/1000	400	800	1.5	3	1.30	1727 831	174.00
20-40	50	100	1000/2000	260	520	1.5	3	1.30	1727 832	174.00
50-100	1	100	50/100	2000	4000	1.5	3	.60	1727 833	177.00
50-100	2.5	125	125/250	2000	4000	1.5	3	.60	1727 834	177.00
50-100	5	125	250/500	2000	4000	1.5	3	.64	1727 835	177.00
50-100	10	100	500/1000	2000	4000	1.5	3	.86	1727 836	177.00
50-100	25	125	1250/2500	2600	5200	1.5	3	1.30	1727 837	177.00
50-100	50	125	2.5/5 Kw.	1650	3300	1.5	3	1.30	1727 838	177.00
100-200	1	100	100/200	6200	12400	1.5	3	.60	1727 839	178.00
100-200	2.5	125	250/500	7100	14200	1.5	3	.60	1727 840	178.00
100-200	5	100	500/1000	7100	14200	1.5	3	.64	1727 841	178.00
100-200	10	100	1000/2000	6700	13400	1.5	3	.86	1727 842	178.00
100-200	25	125-100	2.5/5 Kw.	8200	16400	1.5	3	1.30	1727 843	178.00
100-200	50	100	5/10 Kw.	6500	13000	1.5	3	1.30	1727 844	178.00
100-500	1	100	100/500	14000	70000	1.5	7.5	1.40	1727 845	184.00
100-500	2.5	125	250/1250	14000	70000	1.5	7.5	1.50	1727 846	184.00
100-500	5	100-125	500/2500	14000	70000	1.5	7.5	1.60	1727 847	184.00
100-500	10	100	1/5 Kw.	11000	55000	1.5	7.5	.64	1727 848	184.00
100-500	25	125	2.5/12.5 Kw.	13000	65000	1.5	7.5	1.32	1727 849	184.00
100-500	50	100-125	5/25 Kw.	8650	43747	1.5	7.5	1.30	1727 850	184.00

DOUBLE-VOLTAGE, DOUBLE-CURRENT RANGES

RATINGS*		SCALE DIVISIONS	WATT RANGE	RESISTANCE APPROX. OHMS POTENTIAL CIRCUIT		BURDEN FULL SCALE VOLT-AMPS. AT 60 CYCLES				STYLE NO.	LIST PRICE
						VOLTAGE CIRCUIT WATTS		CURRENT CIRCUIT VOLT-AMPS. AT 60 CY.			
VOLTS	AMPERES†			LOW RANGE	HIGH RANGE	LOW RANGE	HIGH RANGE	LOW RANGE	HIGH RANGE		
50-100	.5-1	100	50	2000	4000	1.5	3	.60	.60	1727 851	$195.00
50-100	1-2	100	100	2000	4000	1.5	3	.64	.64	1727 852	195.00
50-100	2.5-5	125	250	2100	4200	1.5	3	.64	.64	1727 853	195.00
50-100	5-10	100	500	2000	4000	1.5	3	.86	.86	1727 854	195.00
50-100	10-20	100	1000	2100	4200	1.5	3	.85	.85	1727 855	195.00
50-100	15-30	150	1500	1400	2800	1.5	3	1.10	1.10	1727 856	195.00
50-100	30-60	150	3000	1650	3300	1.5	3	1.3	1.3	1727 857	195.00
100-200	.5-1	100	100	6200	12400	1.5	3	.60	.60	1727 858	195.00
100-200	1-2	100	200	6500	13000	1.5	3	.64	.64	1727 859	195.00
100-200	2.5-5	100	500	7100	14200	1.5	3	.64	.64	1727 860Ⓢ	195.00
100-200	5-10	100	1000	6700	13400	1.5	3	.86	.86	1727 861Ⓢ	195.00
100-200	10-20	100	2000	8200	16400	1.5	3	.85	.85	1727 862	195.00
100-200	15-30	150	3000	6000	12000	1.5	3	1.10	1.10	1727 863	195.00
100-200	30-60	150	3000	6500	13000	1.5	3	1.3	1.3	1727 864	195.00
100-500	.5-1	100	50	14000	28000	1.2	6	1.3	1.3	1727 865	213.00
100-500	1-2	100	100	14000	28000	1.2	6	.82	.82	1727 866	213.00
100-500	2.5-5	125	250	14000	28000	1.2	6	1.60	1.60	1727 867	213.00
100-500	5-10	100	500	11000	22000	1.2	6	.64	.64	1727 868Ⓢ	213.00
100-500	10-20	100	1000	14000	28000	1.2	6	.85	.85	1727 869	213.00
100-500	15-30	150	1500	9000	18000	1.2	6	1.10	1.10	1727 870	213.00
100-500	30-60	150	3000	8500	42500	1.2	6	1.3	1.3	1727 871	213.00

* Current and voltage ratings listed are normal, and instruments are suitable for continuous use at 50% above normal voltage. Full-scale value in watts is product of normal current and voltage rating. Triple voltage wattmeters are available upon request.

† Low power factor wattmeters are available with full scale watts not less than 25% of rated current times rated voltage. Prices available on request.

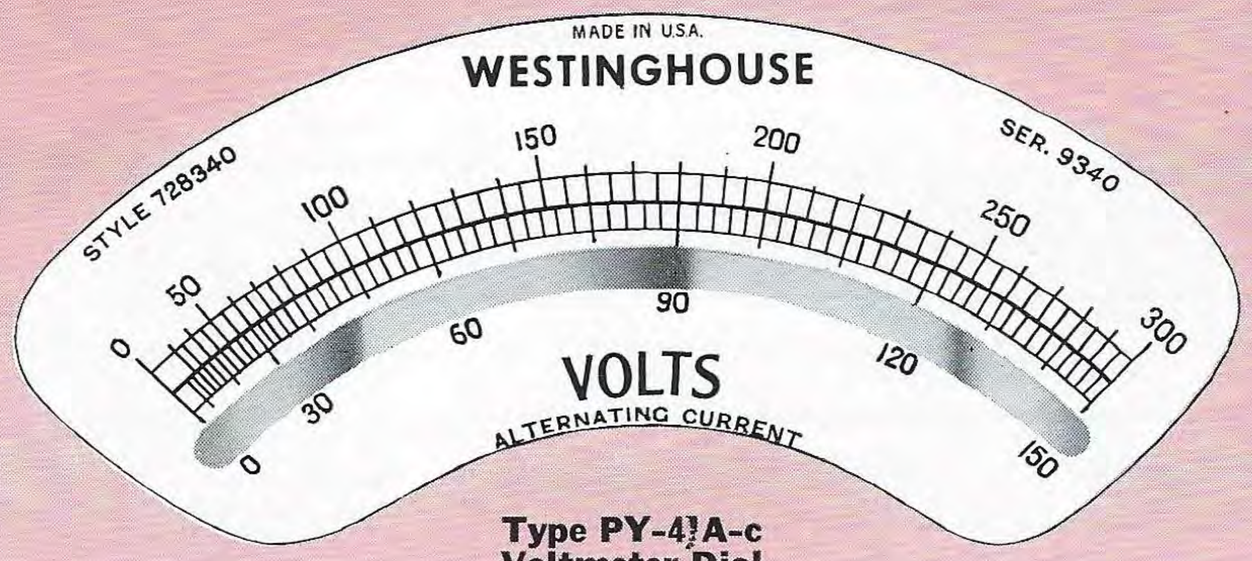
↓ **Price includes leather carrying case. These instruments can also be provided without carrying case. Subtract $10.00 list.**

Prices Effective August 13, 1956; Subject to Change Without Notice

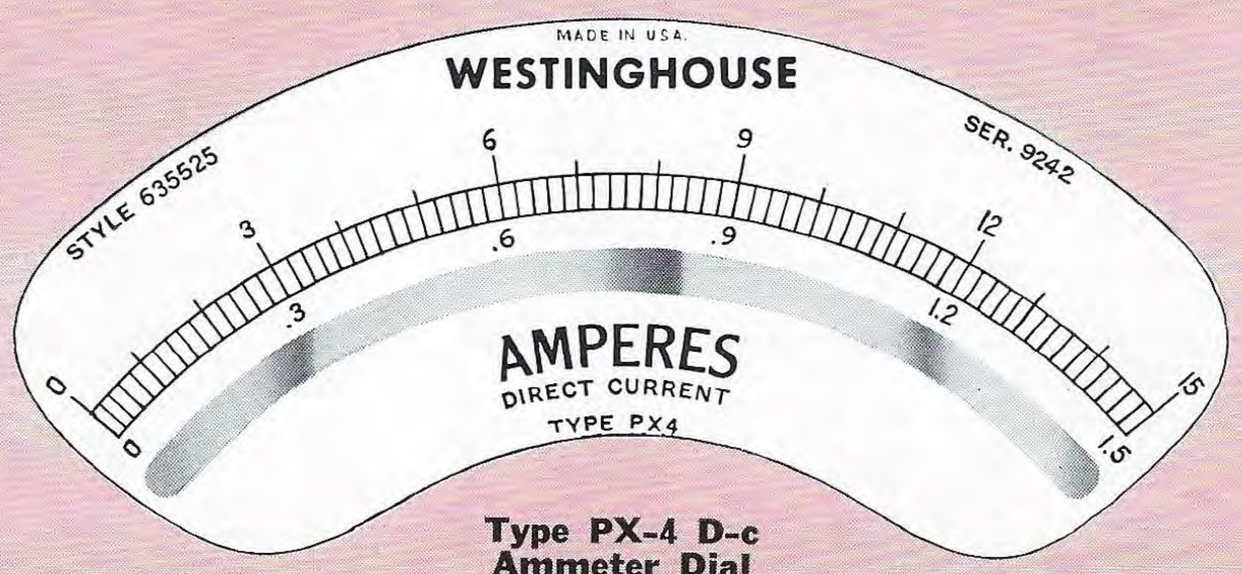
DISCOUNTS—See Selling Policy 43-000

TYPE P-4 INSTRUMENTS

ACCURACY ±¾%



Type PY-4 A-c Voltmeter Dial



Type PX-4 D-c Ammeter Dial

Type PY-4 A-c Voltmeter

- Conforms to ASA Standard C-39.1 Military Specification MIL-M-16034A.
- Momentary overload capacity 35 times full scale value for a-c iron vane instruments.
- Provided with mirror dial and knife-edge pointer.
- Combines ruggedness with high accuracy.
- Especially recommended for survey work and industrial testing.
- Lightweight and compact—easy to carry and use.

LIST PRICES • PX-4 D-C INSTRUMENTS

Type PX-4
D-C Ammeter

±¾% ACCURACY D-C INSTRUMENTS—TYPE PX-4

D-C AMMETERS

CAPACITY	SCALE DIVISIONS	STYLE NO.	LIST PRICE
Single Range*—Self-Contained			
1	100	838 273	$ 69.00
2.5	50	838 274	69.00
5	100	838 275	69.00
10	100	838 276	71.00
15	75	838 277	71.00
25	50	838 278	71.00
50	100	838 279	71.00
Double Range*—Self-Contained			
.25–2.5	50	423 266	80.50
.5–5	100	423 267	80.50
1–5	100-100	423 268	80.50
1–10	100	423 269	82.50
2–10	100	423 270	82.50
1.5–15	75	423 271	82.50
2–20	100	423 272	82.50
4–20	80	423 273	82.50
6–30	60	423 274	82.50
10–50	100-100	838 280	82.50
Triple Range, with Portable Combination Shunts†			
5–20–200	100	424 396	105.50
3–30–300	60	424 397	105.50

* These instruments are shunted internally and have a drop of 50 millivolts at full scale current.

† These instruments have a drop of 100 millivolts at full scale.

D-C MILLIVOLTMETERS

CAPACITY	SCALE DIVISIONS	APPROXIMATE RESISTANCE OHMS	STYLE* NUMBER	LIST PRICE
Single Range				
50†	75–100	2.1	936 508	$ 71.00
50	100	2.1	423 276	64.50
100	100	4.2	423 277	64.50
Double Range				
25–100	100-100	1–4	463 239	82.50
25–100	50	105–420	423 275	82.50
50–100	100-100	2–4	626 869	82.50

For Millivoltmeters of higher sensitivity, see High Sensitivity Instruments.

* Style number and list price include one pair of leads, Style No. 819344. Resistance of leads 0.017 ohms, is included in above resistance values.

† This instrument has an additional scale arc with 75 divisions to facilitate its use with shunts of 1.5 amperes capacity and decimal multiple thereof.

D-C MILLIAMMETERS

Single Range—Self-Contained				
1	100	109	836 818	64.50
2	100	28	423 258	64.50
5	100	5	423 259	64.50
10	100	2.6	423 260	62.50
25	50	.7	423 261	62.50
50	100	1.	423 262	64.50
100	100	.5	423 263	64.50
150	75	.33	423 264	64.50
250	50	.2	423 265	64.50
500	100	.1	836 819	64.50
750	75	.066	836 820	68.50
1000	100	.05	936 371	68.50
1500	75	.033	936 372	68.50
Double Range				
1–10	100	140–26	838 281	82.50
15–150	75-100	3.3–.75	838 282	82.50
100–500	100-100	.5–.126	838 283	82.50
150–750	75	.33–.077	838 284	86.50
Triple Range				
3– 7.5–30	60–75	21–11 –3.1	936 374	101.00
1.5– 15–150	75	173–25 –2.6	936 375	101.00
7.5– 30–150	60–75	20–12.5–2.9	936 376	101.00
15–150–1500	75	3.3–.75 –.08	936 377	104.00
30–300–3000	60	1.5–.2 –.022	936 378	108.00
150–750–3000	60–75	.27–.079 –.02	936 379	108.00

D-C MICROAMMETERS

300	60	66	423 255	69.00
500	100	40	423 256	69.00
1000	100	13	423 257	65.50

For Microammeters at higher sensitivity, see High Sensitivity Instruments below.

HIGH SENSITIVITY INSTRUMENTS

With High Coercive Magnets

D-C MILLIVOLTMETERS†

CAPACITY	SCALE DIVISIONS	APPROXIMATE RESISTANCE OHMS	STYLE* NUMBER	LIST PRICE
Single Range				
2	100	5.	838 718	$ 95.00
5	100	12.5	838 719	95.00
10	100	50	838 720	95.00
20	100	200	838 721	95.00
50	100	1000	838 722	95.00
Double Range				
2–20	100	5–50	838 723	102.00
10–50	100-100	50–250	838 724	102.00
20–50	100-100	200–500	838 725	102.00

*Style number and list price include one pair of leads, Style No. 819344.
†Not for use with external shunts, as damping would be excessive.

D-C MICROAMMETERS

CAPACITY	SCALE DIVISIONS	APPROXIMATE RESISTANCE OHMS	STYLE* NUMBER	LIST PRICE
25	50	550	838 726	$ 95.00
50	100	140	838 727	90.00
100	100	37	838 728	86.50
250	50	7.7	838 729	82.50
500	100	2.5	838 730	79.00

*Style number and list price include one pair of leads, Style No. 819344.

Prices Effective August 13, 1956; Subject to Change Without Notice

DISCOUNTS—See Selling Policy 43-000

LIST PRICES • PX-4 D-C, AUDIO AND RADIO FREQUENCY INSTRUMENTS

Type PX-4
D-C Ammeter

±¾% ACCURACY* D-C, AUDIO AND RADIO FREQUENCY INSTRUMENTS—TYPE PX-4—Continued

Self-Contained

CAPACITY	SCALE DIVISIONS	STYLE NUMBER	LIST PRICE
RADIO FREQUENCY AMMETERS			
.5	100	936 418	$ 82.50
1	100	423 292	82.50
2.5	50	423 293	82.50
3	60	936 419	82.50
5	100	423 294	82.50
10	100	423 295	84.00
15	75	423 296	84.00
20	100	423 297	84.00
RADIO FREQUENCY MILLIAMMETERS			
75	75	838 702	101.00
100	100	838 703	97.00
150	75	838 704	93.50
200	100	838 705	90.00
250	50	838 706	87.50
300	60	838 707	86.50
400	80	838 708	84.00
500	100	838 709	82.50
600	60	838 710	82.50
800	80	838 711	82.50
RECTIFIER MICROAMMETERS			
Audio Frequencies			
500	100	722 465	87.50
RECTIFIER MILLIAMMETERS			
Audio Frequencies			
1.5	75	722 461	79.00
5	100	722 462	79.00
10	100	722 463	79.00
20	100	722 464	79.00

CARRYING CASES AND LEADS FOR TYPE P-4 INSTRUMENTS

DESCRIPTION	STYLE NUMBER	LIST PRICE
Carrying case for all listings except Style Number 682 162	525 431	$14.50
Carrying case for Style Number 682 162	564 454	14.50
Pair 3-foot test leads, .017 ohms, prongs on one end.	818 183 Ⓢ	3.50
Pair 3-foot shunt leads, .017 ohms, open connectors on both ends	819 344 Ⓢ	3.50

D-C VOLTMETERS

Resistance 1000 Ohms per Volt

CAPACITY	SCALE DIVISIONS	STYLE NUMBER	LIST PRICE
Single Range			
1	100	936 380	$ 66.00
2.5	50	936 381	66.00
5	100	936 382	66.00
15	75	936 383	66.00
50	100	936 384 Ⓢ	66.00
150	75	936 385	69.50
300	60	936 386	73.50
600	60	936 387	75.50
750	75	936 388	77.00
Double Range			
2.5- 10	100–100	936 391	78.50
3- 15	60–75	936 389	78.50
10- 50	100–100	936 392	78.50
3–150	60–75	936 390	82.00
8–200	80	512 824	82.00
10–100	100	936 393	82.00
15–150	75	936 394	82.00
75–150	75	516 629	82.00
50–250	50	516 583	85.50
150–300	75–60	936 395 Ⓢ	85.50
75–750	75	936 396	90.50
300–600	60	936 397	89.00
150–750	75	936 398	90.50
Triple Range			
1.5- 15–150	75	936 399	90.50
3- 7.5- 30	60–75	936 400	87.00
3- 15–150	60–75	936 401	90.50
3–150–300	60–75	936 402 Ⓢ	94.00
7.5- 30- 75	60–75	936 403	87.00
7.5–300–750	60–75	936 404	100.00
50–250–750	50–75	838 272	100.00
75–300–750	60–75	936 405	100.00
150–300–750	60–75	936 406 Ⓢ	100.00

RECTIFIER VOLTMETERS

Audio Frequencies

Resistance 1000 Ohms per Volt

1	100	722 466	84.00
3	60	722 467	84.00
5	100	722 468	84.00
15	75	722 469	84.00
150	75	722 470	84.00

Resistance 2000 Ohms per Volt

1.5	75	838 712	90.00
2	100	838 713	90.00
2.5	50	838 714	90.00
3	60	838 715	90.00

Resistance 5000 Ohms Per Volt

.5	100	838 716	95.00
1.5	75	838 717	95.00

* Rectifier types are rated at 1¾% accuracy.

Prices Effective August 13, 1956; Subject to Change Without Notice

DISCOUNTS—See Selling Policy 43-000

LIST PRICES • PY-4 A-C INSTRUMENTS

±¾% ACCURACY A-C INSTRUMENTS—TYPE PY-4

Type PY-4
A-C Voltmeter

For Frequencies of 20 to 135 Cycles

A-C VOLTMETERS

RATING	SCALE DIVISIONS	APPROXIMATE RESISTANCE OHMS	STYLE NO.	LIST PRICE
Single Range				
1	100	1.75	701 296*	$ 69.50
3	60	19	701 297	67.50
7.5	75	75	701 298	67.50
10	100	100	936 360	67.50
15	75	300	701 299	67.50
20	100	400	936 869	67.50
30	60	1200	701 300	67.50
50	100	2000	936 361	67.50
60	60	2880	936 870	67.50
75	75	6000	701 301	67.50
100	100	8700	936 362	68.50
125	50	12500	936 871	68.50
150	75	19000	701 302	68.50
250	50	28000	936 872	69.50
300	60	38000	701 303	69.50
600	60	120000	701 304	80.50
750	75	150000	701 305	82.50

* Must be used with .017 ohm leads which are supplied with this style.

Double Range				
5–10	100	28–56	936 363	78.50
10–20	100	100–200	936 364	78.50
15–30	75-60	300–600	936 365	78.50
30–60	60	1200–2400	936 366	78.50
15–150	75	460–4600	682 164	80.00
75–150	75	6000–12000	936 367	80.00
150–300	60-75	21600–43200	820 036 Ⓢ	82.00
150–300	60-75	45000–90000	703 872	82.00
150–600	60-75	21600–86400	682 165	92.50
Triple Range				
4–8–150	80–75	18–36–16900	682 163	91.50
150–300–450	60-90	21600–43200–64800	936 368	98.50
150–300–600	75-60	21600–43200–86400	936 369 Ⓢ	104.00
150–300–750	60-75	21600–43200–108000	936 370 Ⓢ	105.50
Five Range				
4–8–16 / 150–750	80 / 75	18–36–72 / 16900–84500	682 162	132.00

A-C AMMETERS

RATING	SCALE DIVISIONS	APPROXIMATE RESISTANCE OHMS	STYLE NUMBER	LIST PRICE
Single Range				
1	100	.12	701 306	$62.50
1.5	75	.1	936 857	62.50
2	100	.04	936 858	62.50
2.5	50	.017	701 307	62.50
3	60	.015	936 859	62.50
5	100	.011	701 308	62.50
7.5	75	.008	701 309	62.50
10	100	.0014	701 310	62.50
15	75	.0010	701 311	62.50
25	50	.0006	701 312	62.50
30	60	.0005	936 860	62.50
50	100	.0003	701 313	64.50
Double Range				
1 / 5	100 / 100	.15 / .034	682 166 Ⓢ	87.50
5 / 10	100 / 100	.003 / .0016	682 167 Ⓢ	87.50
10 / 30	100 / 60	.0016 / .0005	682 168 Ⓢ	87.50

A-C MILLIAMMETERS

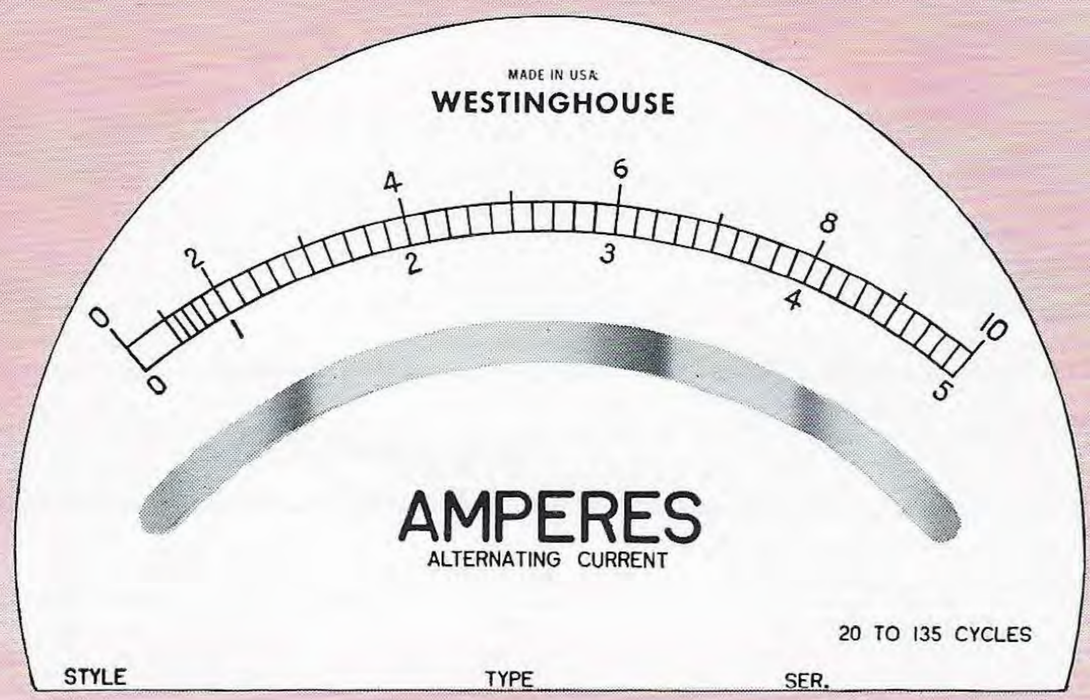
Single Range				
5	100	3850	682 169	64.50
10	100	730	701 314	64.50
15	75	250	936 861	64.50
25	50	115	701 315	64.50
30	60	79	936 862	64.50
50	100	29	701 316	64.50
75	75	15	936 863	64.50
100	100	7.2	701 317	64.50
150	75	3.0	936 864	64.50
200	100	1.9	936 865	64.50
250	50	1.1	701 318	64.50
300	60	.8	936 866	64.50
400	80	.5	936 867	64.50
500	100	.3	701 319	62.50
600	60	.2	936 868	62.50
750	75	.15	701 320	62.50
Double Range				
10 / 30	100 / 60	1450 / 155	682 170	82.50
50 / 150	100 / 75	58 / 6.7	682 171	82.50
250 / 750	50 / 75	2.5 / .3	682 172	82.50

Prices Effective August 13, 1956; Subject to Change Without Notice

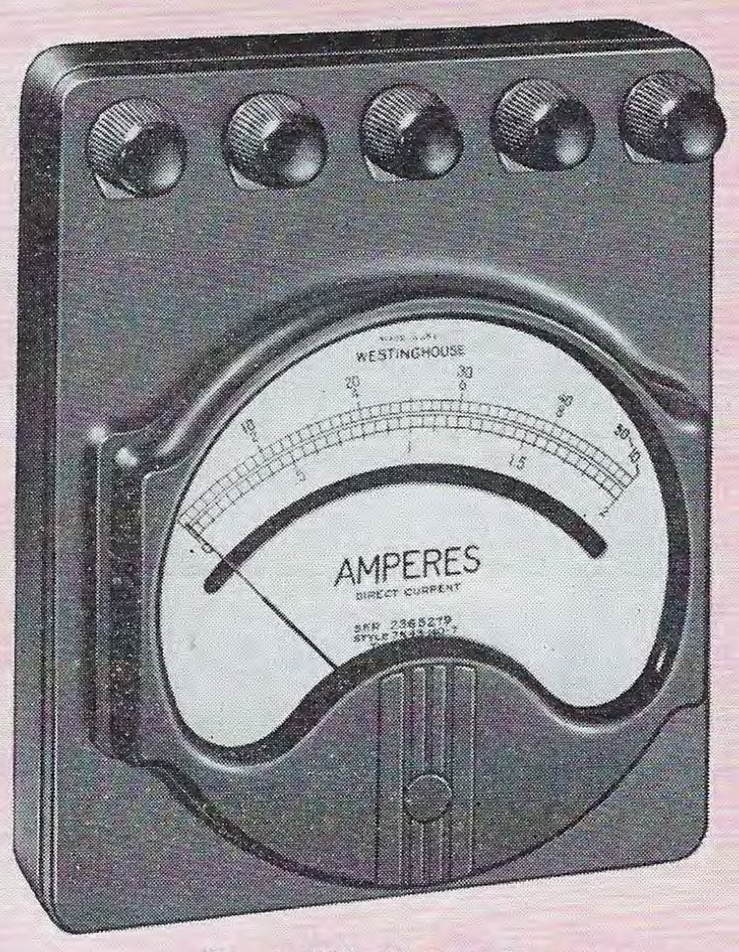
DISCOUNTS—See Selling Policy 43-000

TYPE P-14 INSTRUMENTS

ACCURACY ±1%



Type PA-14
A-c Ammeter Dial



Type PX-14 D-c Ammeter
with Open Face

- Conforms to **ASA** Standard C-39.1.
- Used extensively by military services in field and laboratory applications.
- Momentary overload capacity 35 times full-scale value for a-c iron vane instruments.
- Provided with mirror dial and knife-edge pointer.
- Pocket size.
- Wide variety of ranges are available.

Type PX-14 D-c Voltmeter
with Hinge Cover

LIST PRICES • PX-14 D-C INSTRUMENTS

±1% ACCURACY D-C INSTRUMENTS—TYPE PX-14

Type P-14
Open Face

Self-Contained

D-C AMMETERS*

	RANGE	SCALE DIVISIONS	OPEN FACE STYLE NUMBER	LIST PRICE	HINGE COVER STYLE NUMBER	LIST PRICE
Single Range	0–1	50	1538 330	**$53.00**	1538 340	**$59.50**
	0–2	40	1538 331	**53.00**	1538 341	**59.50**
	0–5	50	1538 332	**53.00**	1538 342	**59.50**
	0–10	50	1538 333	**53.00**	1538 343	**59.50**
	0–20	40	1538 334	**53.00**	1538 344	**59.50**
	0–50	50	1538 335	**54.00**	1538 345	**60.50**
Double Range	0–.5–2	50–40	1538 336	**58.00**	1538 346	**64.50**
	0–2–10	40–50	1538 337	**58.00**	1538 347	**64.50**
	0–10–50	50	1538 338	**59.00**	1538 348	**65.50**
Four Range	0–.5–2–10–50	50–40	1538 339	**69.50**	1538 349	**76.00**

D-C MILLIVOLTMETERS†

For Use with External Shunts

	RANGE	SCALE DIVISIONS	APPROX. RESISTANCE OHMS	OPEN FACE STYLE NUMBER	LIST PRICE	HINGE COVER STYLE NUMBER	LIST PRICE
Single Range	0–50	50	10	1538 350	**$54.50**	1538 352	**$61.00**
Double Range	0–50–100	50	10–20	1538 351	**62.00**	1538 353	**68.50**

D-C MILLIAMMETERS

Single Range	0–1	50	57	1538 354	**51.00**	1538 369	**57.50**
	0–2	40	15	1538 355	**51.00**	1538 370	**57.50**
	0–5	50	1.7	1538 356	**51.00**	1538 371	**57.50**
	0–10	50	5	1538 357	**51.00**	1538 372	**57.50**
	0–20	40	2.5	1538 358	**51.00**	1538 373	**57.50**
	0–50	50	1	1538 359	**51.00**	1538 374	**57.50**
	0–100	50	.5	1538 360	**51.00**	1538 375	**57.50**
	0–200	40	.25	1538 361	**51.00**	1538 376	**57.50**
	0–500	50	.1	1538 362	**51.00**	1538 377	**57.50**
Double Range	0–1–5	50	52–82	1538 363	**58.00**	1538 378	**64.50**
	0–5–20	50–40	1.5–9	1538 364	**58.00**	1538 379	**64.50**
	0–20–100	40–50	2.5–.6	1538 365	**58.00**	1538 380	**64.50**
	0–100–500	50	.5–.1	1538 366	**58.00**	1538 381	**64.50**
Four Range	0–1–5–20–100	50–40	52–82–24–5	1538 367	**72.50**	1538 382	**79.00**
	0–20–100–500–2000	50–40	2.5–.6–.1–.03	1538 368	**72.50**	1538 383	**79.00**

D-C MICROAMMETERS

Single Range	0–20	40	2200	1538 384	**83.50**	1538 392	**90.00**
	0–50	50	430	1538 385	**82.00**	1538 393	**88.50**
	0–100	50	110	1538 386	**80.00**	1538 394	**86.50**
	0–200	40	260	1538 387	**72.50**	1538 395	**79.00**
	0–500	50	120	1538 388	**71.00**	1538 396	**77.50**
Double Range	0–50–200	50–40	430–1000	1538 389	**89.00**	1538 397	**95.50**
	0–200–1000	40–50	300–100	1538 390	**80.00**	1538 398	**86.50**
Four Range	0–50–200–1000–5000	50–40	430–1000–235–50	1538 391	**103.50**	1538 399	**110.00**

*** PX-14 D-C Ammeters are shunted internally, the shunt having a drop of 50 MV at full-scale current.**

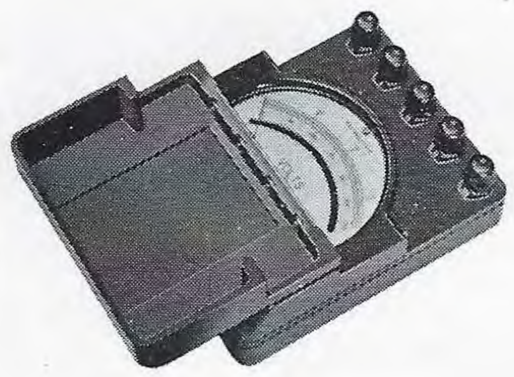
† Style number and list price include one pair of 5-foot leads, style number 1538 768. Resistance of leads, 0.065 ohm, is included in above resistance values.

Prices Effective August 13, 1956; Subject to Change Without Notice

DISCOUNTS—See Selling Policy 43-000

LIST PRICES • PX-14 D-C INSTRUMENTS

±1% ACCURACY D-C INSTRUMENTS—TYPE PX-14—Continued



Type P-14
Hinge Cover

Self-Contained

D-C MILLIVOLTMETERS

	RANGE	SCALE DIVISIONS	APPROX. RESISTANCE OHMS	OPEN FACE STYLE NUMBER	LIST PRICE	HINGE COVER STYLE NUMBER	LIST PRICE
Single Range	0–10	50	25	1538 400	**$69.00**	1538 407	**$75.50**
	0–50	50	1000	1538 401	**69.00**	1538 408	**75.50**
	0–200	40	10,000	1538 402	**69.00**	1538 409	**75.50**
Double Range	0–10–100	50	25–250	1538 403	**76.00**	1538 410	**82.50**
	0–100–1000	50	5,000–50,000	1538 404	**76.00**	1538 411	**82.50**
Three Range Center Zero	5–0–5 50–0–50 500–0–500	50	25–250–2500	1538 405	**83.50**	1538 412	**90.00**
Four Range	0–5–50–500–5000	50	12.5–125–1250–12,500	1538 406	**90.50**	1538 413	**97.00**

D-C VOLTMETERS

Resistance 1000 Ohms Per Volt

	RANGE	SCALE DIVISIONS	OPEN FACE STYLE NUMBER	LIST PRICE	HINGE COVER STYLE NUMBER	LIST PRICE
Single Range	0–1	50	1538 414	**$47.50**	1538 432	**$54.00**
	0–2	40	1538 415	**47.50**	1538 433	**54.00**
	0–5	50	1538 416	**47.50**	1538 434	**54.00**
	0–8	80	1538 417	**47.50**	1538 435	**54.00**
	0–15	75	1538 418	**47.50**	1538 436	**54.00**
	0–30	60	1538 419	**47.50**	1538 437	**54.00**
	0–80	80	1538 420	**47.50**	1538 438	**54.00**
	0–150	75	1538 421	**51.00**	1538 439	**57.50**
	0–300	60	1538 422	**54.50**	1538 440	**61.00**
	0–800	80	1538 423	**60.50**	1538 441	**67.00**
Double Range	0–3–15	30–75	1538 424	**58.00**	1538 442	**64.50**
	0–15–75	75	1538 425	**58.00**	1538 443	**64.50**
	0–30–150	60–75	1538 426	**62.00**	1538 444	**68.50**
	0–150–300	75–60	1538 427	**65.50**	1538 445Ⓢ	**72.00**
	0–150–750	75	1538 428	**71.00**	1538 446Ⓢ	**77.50**
Four Range	0–.75–7.5–75–750	75	1538 429	**92.50**	1538 447Ⓢ	**99.00**
	0–3–15–75–300	60–75	1538 430Ⓢ	**87.00**	1538 448Ⓢ	**93.50**
	0–75–150–300–750	60–75	1538 431	**92.50**	1538 449Ⓢ	**99.00**

CARRYING CASES AND LEADS FOR TYPE P-14 INSTRUMENTS

DESCRIPTION	STYLE NUMBER	LIST PRICE
Case for open face type PX-14	1542 670	**$12.50**
Case for open face type PA-14	1542 671	**12.50**
Case for hinge cover type PX-14	1542 672	**12.50**
Case for hinge cover type PA-14	1542 673	**12.50**
Pair 3-foot test leads, .017 ohms, prongs on one end	818 183Ⓢ	**3.50**
Pair 3-foot shunt leads, .065 ohms, open connection on both ends	1538 768Ⓢ	**3.50**

Prices Effective August 13, 1956; Subject to Change Without Notice

DISCOUNTS—See Selling Policy 43-000

LIST PRICES • PA-14 A-C INSTRUMENTS

±1% ACCURACY A-C INSTRUMENTS—TYPE PA-14

Type P-14
Open Face

For Frequencies 20 to 135 Cycles

Self-Contained

A-C AMMETERS

	RANGE	SCALE DIVISIONS	APPROX. RESISTANCE OHMS	OPEN FACE STYLE NUMBER	LIST PRICE	HINGE COVER STYLE NUMBER	LIST PRICE
Single Range	0–1	50	.20	1538 453	$57.00	1538 465	$63.50
	0–2	40	.05	1538 454	57.00	1538 466	63.50
	0–5	50	.02	1538 455	57.00	1538 467	63.50
	0–10	50	.005	1538 456	57.00	1538 468	63.50
	0–20	40	.0015	1538 457	57.00	1538 469	63.50
	0–50	50	.0003	1538 458	57.00	1538 470	63.50
Double Range	0–.5–1	50	.46–.12	1538 459	67.50	1538 471	74.00
	0–1–2	50–40	.12–.03	1538 460	67.50	1538 472	74.00
	0–2.5–5	50	.03–.007	1538 461	67.50	1538 473	74.00
	0–5–10	50	.02–.005	1538 462	67.50	1538 474	74.00
	0–10–20	50–40	.005–.0015	1538 463	67.50	1538 475	74.00
	0–25–50	50	.001–.0003	1538 464	67.50	1538 476	74.00

A-C MILLIAMMETERS

Single Range	0–5	50	6000	1538 477	57.00	1538 489	63.50
	0–10	50	1500	1538 478	57.00	1538 490	63.50
	0–20	40	360	1538 479	57.00	1538 491	63.50
	0–50	50	50	1538 480	57.00	1538 492	63.50
	0–100	50	15	1538 481	57.00	1538 493	63.50
	0–200	40	3.5	1538 482	57.00	1538 494	63.50
	0–500	50	.5	1538 483	57.00	1538 495	63.50
Double Range	0–10–20	50–40	1500–360	1538 484	67.50	1538 496	74.00
	0–25–50	50	240–50	1538 485	67.50	1538 497	74.00
	0–50–100	50	60–15	1538 486	67.50	1538 498	74.00
	0–100–200	50–40	15–3.5	1538 487	67.50	1538 499	74.00
	0–250–500	50	2.5–.5	1538 488	67.50	1538 500	74.00

A-C VOLTMETERS

Single Range	0–1.5	75	3	1538 501	57.00	1538 515	63.50
	0–3	60	12	1538 502	57.00	1538 516	63.50
	0–8	80	80	1538 503	57.00	1538 517	63.50
	0–15	75	150	1538 504	57.00	1538 518	63.50
	0–30	60	600	1538 505	57.00	1538 519	63.50
	0–80	80	800	1538 506	57.00	1538 520	63.50
	0–150	75	15,000	1538 507	58.00	1538 521	64.50
	0–300	60	60,000	1538 508	60.50	1538 522	67.00
	0–800	80	160,000	1538 509	72.50	1538 523	79.00
Double Range	0–7.5–15	75	75–150	1538 510	67.50	1538 524	74.00
	0–75–150	75	7500–15,000	1538 511	69.00	1538 525	75.50
	0–150–300	75–60	30,000–60,000	1538 512	71.00	1538 526	77.50
Three Range	0–150–300–750	60–75	30,000–60,000 150,000	1538 513 Ⓢ	94.50	1538 527 Ⓢ	101.00
Four Range	0–5–25–75–150	50–75	35–170–6600–13,200	1538 514	90.50	1538 528 Ⓢ	97.00

Prices Effective August 13, 1956; Subject to Change Without Notice

DISCOUNTS—See Selling Policy 43-000

LIST PRICES • PC-14 AND PT-14 INSTRUMENTS

±2% ACCURACY RECTIFIER TYPE INSTRUMENTS—TYPE PC-14

Type P-14
Hinge Cover

Self-Contained

RECTIFIER MILLIAMMETERS—AUDIO FREQUENCIES

	RANGE	SCALE DIVISIONS	APPROX. RESISTANCE OHMS	OPEN FACE STYLE NUMBER	LIST PRICE	HINGE COVER STYLE NUMBER	LIST PRICE
Single Range	0–.5	50	700	1538 529	$80.00	1538 534	$86.50
	0–1	50	400	1538 530	60.50	1538 535	67.00
	0–2	40	210	1538 531	60.50	1538 536	67.00
	0–5	50	100	1538 532	60.50	1538 537	67.00
	0–10	50	60	1538 533	60.50	1538 538	67.00

RECTIFIER VOLTMETERS—AUDIO FREQUENCIES

Resistance 1000 Ohms Per Volt

	RANGE	SCALE DIVISIONS	OPEN FACE STYLE NUMBER	LIST PRICE	HINGE COVER STYLE NUMBER	LIST PRICE
Single Range	0–2	40	1538 539	$57.00	1538 551	$63.50
	0–5	50	1538 540	57.00	1538 552	63.50
	0–15	75	1538 541	57.00	1538 553	63.50
	0–30	60	1538 542	57.00	1538 554	63.50
	0–80	80	1538 543	57.00	1538 555	63.50
	0–150	75	1538 544	60.50	1538 556	67.00
	0–300	60	1538 545	64.00	1538 557	70.50
	0–800	80	1538 546	69.00	1538 558	75.50
Double Range	0–3–15	60–75	1538 547	62.00	1538 559	68.50
	0–15–75	75	1538 548	62.00	1538 560	68.50
	0–30–150	60–75	1538 549	65.50	1538 561	72.00
	0–150–750	75	1538 550	74.50	1538 562	81.00

±1% ACCURACY RADIO FREQUENCY TYPE INSTRUMENTS—TYPE PT-14

Self-Contained

RADIO FREQUENCY AMMETERS

	RANGE	SCALE DIVISIONS	OPEN FACE STYLE NUMBER	LIST PRICE	HINGE COVER STYLE NUMBER	LIST PRICE
Single Range	0–1	50	1538 563	$76.00	1538 568	$82.50
	0–2	40	1538 564	76.00	1538 569	82.50
	0–5	50	1538 565	76.00	1538 570	82.50
	0–10	50	1538 566	76.00	1538 571	82.50
	0–20	40	1538 567	76.00	1538 572	82.50

RADIO FREQUENCY MILLIAMMETERS

	RANGE	SCALE DIVISIONS	APPROX. RESISTANCE OHMS	OPEN FACE STYLE NUMBER	LIST PRICE	HINGE COVER STYLE NUMBER	LIST PRICE
Single Range	0–2	40	750	1538 573	$87.00	1538 581	$93.50
	0–5	50	500	1538 574	87.00	1538 582	93.50
	0–10	50	200	1538 575	87.00	1538 583	93.50
	0–20	40	20	1538 576	87.00	1538 584	93.50
	0–50	50	8	1538 577	87.00	1538 585	93.50
	0–100	50	4.2	1538 578	87.00	1538 586	93.50
	0–200	40	1.8	1538 579	87.00	1538 587	93.50
	0–500	50	7	1538 580	87.00	1538 588	93.50

Prices Effective August 13, 1956; Subject to Change Without Notice

DISCOUNTS—See Selling Policy 43-000

TYPE PM PORTABLE TEST SETS

LIST PRICES • APPLICATION • SPECIFICATIONS

Type PM-32 A-C and D-C Volt-Ohm milliammeter with 11 Position Switch

THE TYPE PM-32 PORTABLE TEST SET meets the many diverse requirements for general testing, laboratory and radio work. The ohmmeters are designed primarily for circuit resistance, continuity and insulation testing in assembled apparatus. However, they are sufficiently accurate for resistor classification and condenser leakage limit testing. Ranges also are provided for measurement of a-c and d-c voltages and currents. They are invaluable instruments for exploration and trouble shooting in radios, signal systems, movie sets, control systems and other applications where detailed knowledge of circuit conditions and values must be obtained.

SPECIFICATIONS

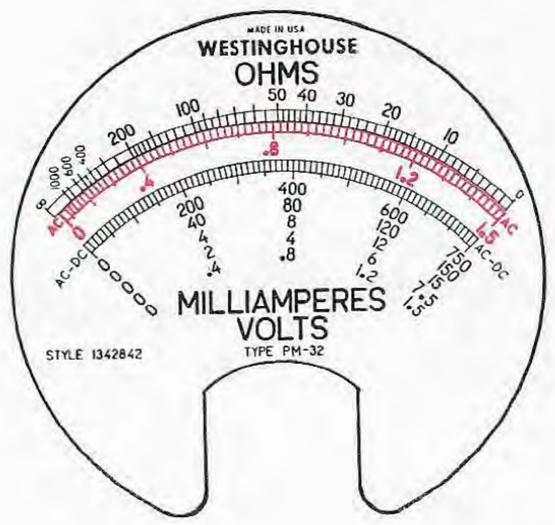
CASE SIZE—7″ x 4″ x 3¾″

SCALE LENGTH—2.4

MOVEMENTS—Permanent Magnet—Moving Coil

WEIGHTS—Approximately 3 lbs., Net; 5 lbs., Shipping.

The type PM-32 dial has only three sets of scale arcs. All of the ohm scales may be read from one arc. All of the voltage scales (both a-c and d-c) may be read from one arc, with the exception of the 0-1.5 voltage range which is read from a separate arc. This provides for maximum readability with minimum confusion.



CONSTRUCTION AND OPERATION

The movement of the Type PM-32 portable test set is the Type NX-35, which has a one-piece welded magnet assembly that remains free from derangement under the most severe conditions. Selector switch, battery, adjustor, terminal and circuit details are mounted on a Moldarta cover plate and are easily accessible. Pin jacks provide convenient connections to external circuits. Leads with prod terminals are provided.

SCALE AND POINTERS—Markings are in accordance with regular portable instrument practice. Knife-edge pointers and exclusive Westinghouse dials make correct readings easier to obtain.

SELECTOR SWITCHES—A suitable indexed and engraved rotary type switch is standard equipment on the test set.

BATTERIES—Standard batteries of 1½ x 4½ volts are used. A battery adjustor is conveniently mounted on the front panel.

LIST PRICES

PM-32 TEST SET, INCLUDING LEADS

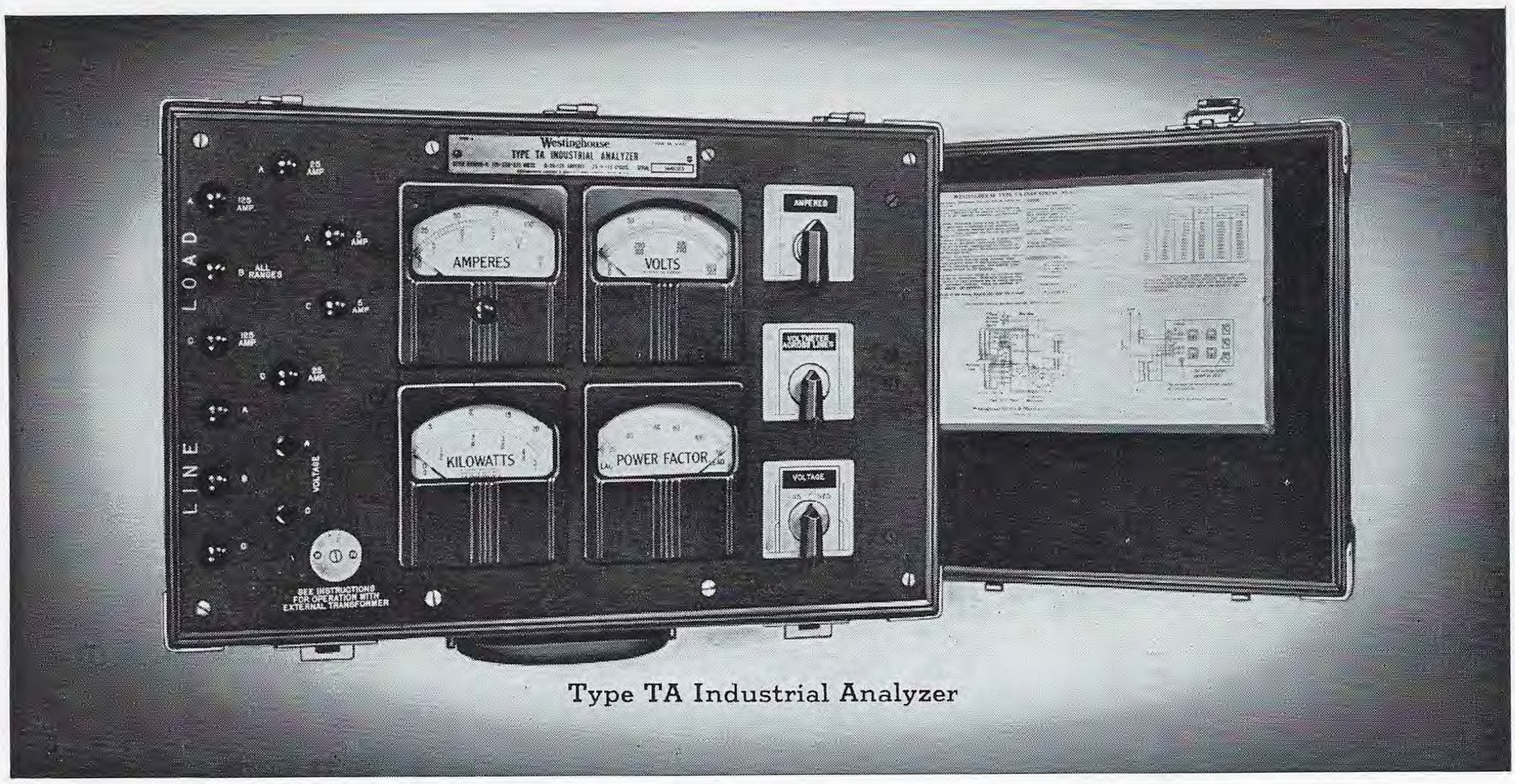
TYPE	OHMS FULL SCALE	OHMS MID-SCALE	VOLTS D-C	VOLTS A-C	MILLI-AMPS. D-C	OHMS PER VOLT	STYLE NUMBER	LIST PRICE
PM-32	1000	50	1.5	1.5	1.5	1000	1342 842	$133.00
	.....	.....	7.5	7.5	...	1000		
	100000	5000	15	15	15	1000		
	1000000	50000	150	150	150	1000		
			750	750	...	1000		
Carrying case for Type PM-32							931 331 Ⓢ	$27.00
Pair 3-foot test leads with prongs							1000 995 Ⓢ	3.50

Prices Effective August 13, 1956; Subject to Change Without Notice

DISCOUNTS—**See Selling Policy 43-000**

TYPE TA A-C INDUSTRIAL ANALYZER

LIST PRICE • SPECIFICATIONS • APPLICATION



Type TA Industrial Analyzer

THE TYPE TA INDUSTRIAL ANALYZER combines all of the instruments necessary for alternating-current testing, checking and installation work in industrial plants. Included in one case are all the necessary measuring units to make complete a-c circuit tests up to 125 amperes and 600 volts, single phase or polyphase (not including 2-phase, 4-wire).

- Compact, light weight, durable
- Eliminates necessity of selecting, gathering and carrying various pieces of equipment to the job.
- Greatly reduces connecting and set-up time.

SPECIFICATIONS

DIMENSIONS—9¼" x 13¼" x 18⅝"

ACCURACY—Ammeter and Voltmeter—1%
Wattmeter —2%

SCALE LENGTHS—3½"

RATINGS—5, 25, 125 Amps; 150, 300, 600 volts; 1, 2, 5, 10, 25, 50, 125 kilowatts, 25-133 cycles*

BURDENS—Current—13.5 volt-amps. per phase at 5 amps.
Voltage—5.6 volt-amps. per phase at 115 volts

WEIGHT—35½ pounds, Net; 47 pounds, Shipping

LIST PRICE

DESCRIPTION	STYLE NUMBER	LIST PRICE
Type TA Industrial Analyzer..	836 800 Ⓢ	$760.00

*The TA Analyzer can be supplied similar to Style 863 800 except calibrated for use on 400 cycles at a list price addition of $145.00.

CONSTRUCTION AND OPERATION

The TA Analyzer contains the following instruments: A triple-scale ammeter, a triple-range voltmeter, a triple-scale polyphase wattmeter, and a polyphase power-factor meter. The ammeter is equipped with a follow-up pointer for measuring motor-starting currents. Two special lightweight current transformers are connected into the circuit in the conventional three-phase wiring scheme to provide the multiple current ranges. The various voltage ranges are obtained by switching topped resistors in the potential circuits.

A three-phase ammeter switch is provided to switch the ammeter to read current in any of the three-phase lines and a switch is provided to connect the voltmeter across any two lines. This switching may be performed under load and provides a quick method of checking load balance and voltage balance on three-phase circuits.

Tests all a-c motors—three-phase, two-phase and single-phase motors and other apparatus may be tested and checked by connecting the Analyzer to the line at the fuse clips, junction box or terminals and connecting the outgoing terminals to the load.

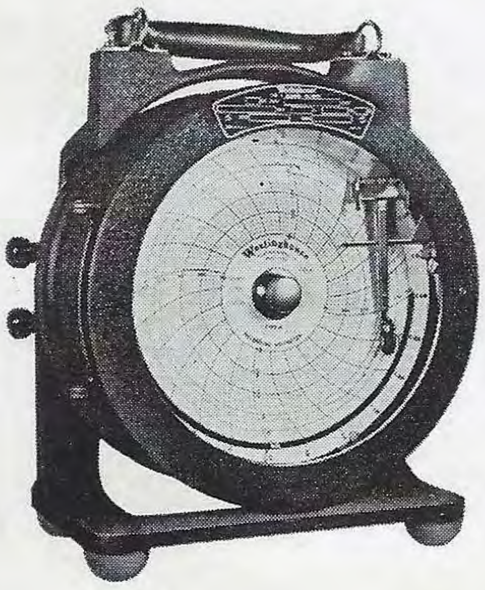
All measuring instruments are placed close together to permit accurate, simultaneous readings. This grouping minimizes mistakes and saves operator's time.

Prices Effective August 13, 1956; Subject to Change Without Notice

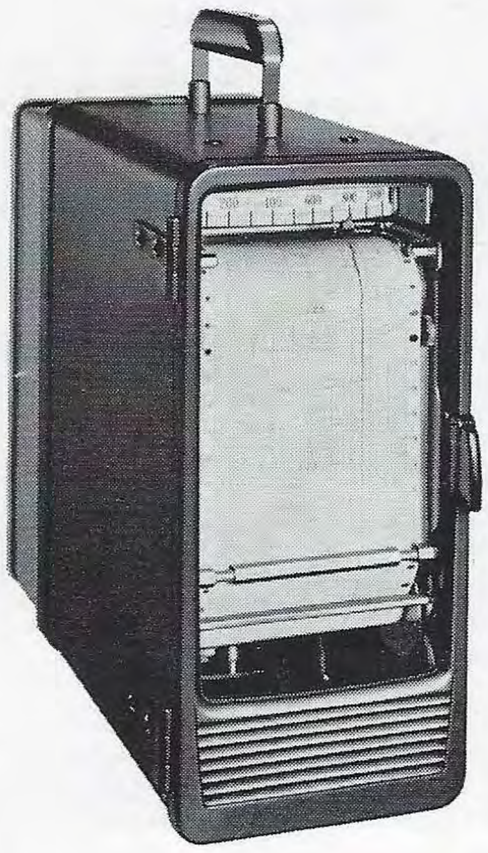
DISCOUNTS—See Selling Policy 43-000

OTHER PORTABLE MEASURING EQUIPMENT
AUXILIARY EQUIPMENT

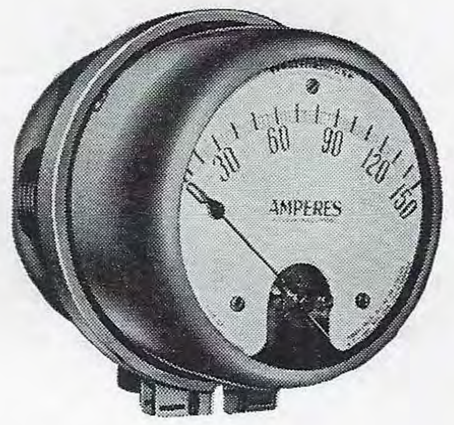
OTHER PORTABLE MEASURING EQUIPMENT



Portable Type
A Recorder
(C.S. 43-415)



Portable Type
P-44 Recorder
(C.S. 43-440)



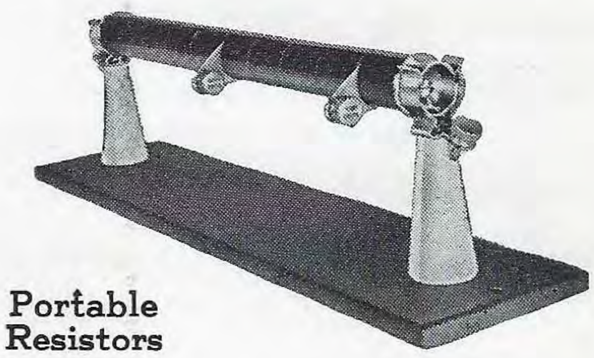
Type E
Socket Instruments
(C.S. 43-600)

AUXILIARY EQUIPMENT

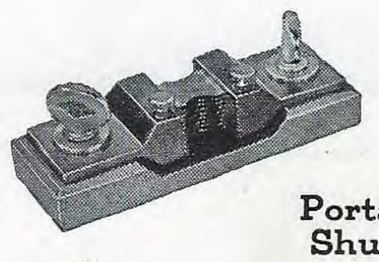
See Catalog Section 43-800 for details

Portable Current
Transformers

Portable Potential
Transformers



Portable
Resistors



Portable
Shunts

LITERATURE REFERENCE

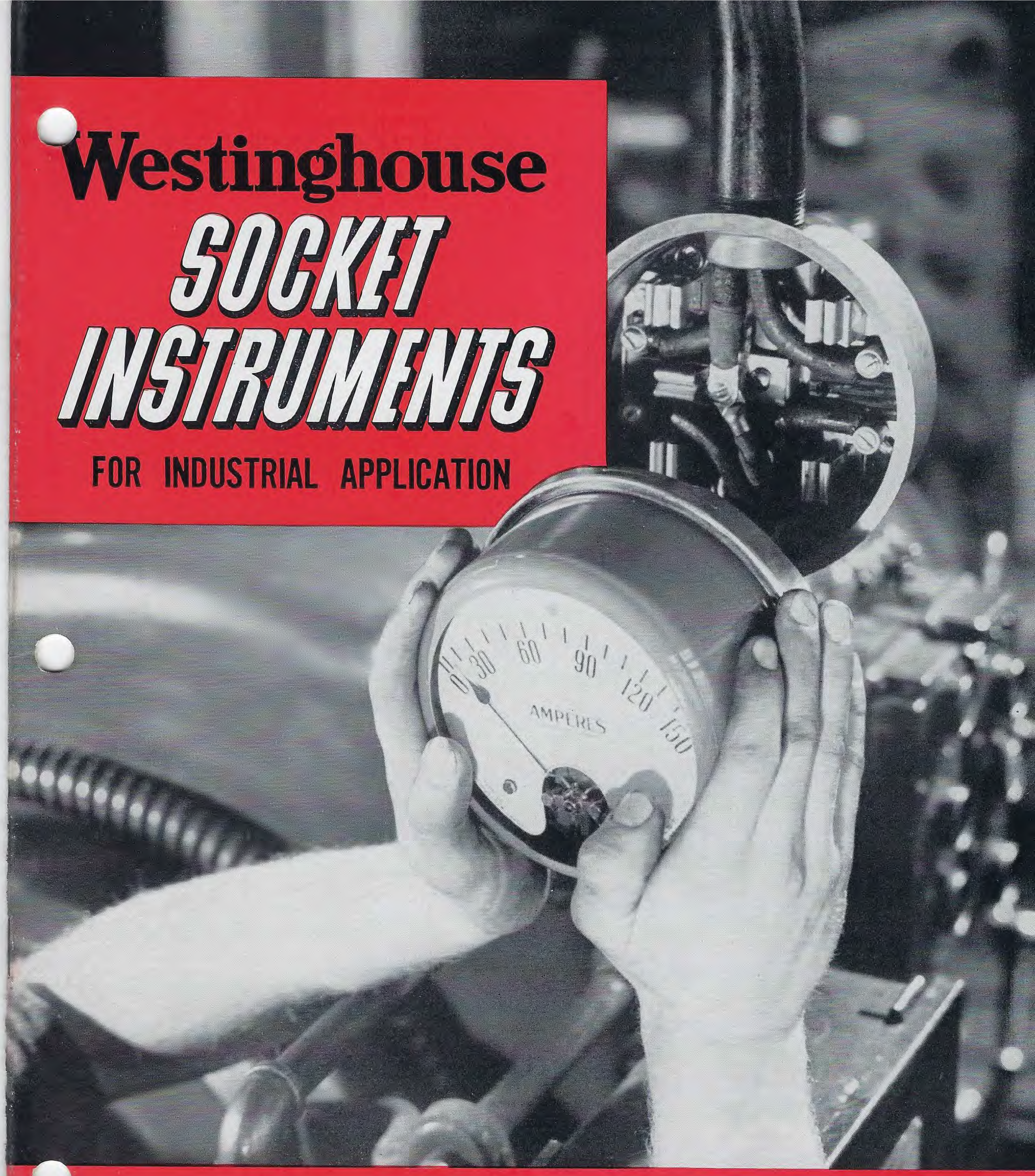
"GETTING A FULL MEASURE"—See Booklet 4696.
SWITCHBOARD INSTRUMENTS—See Catalog Section 43-200
PANEL INSTRUMENTS—See Catalog Section 43-300
RECORDING INSTRUMENTS—See Catalog Sections 43-415 and 43-440
SOCKET INSTRUMENTS—See Catalog Section 43-600
AUXILIARIES—See Catalog Section 43-800

WESTINGHOUSE ELECTRIC CORPORATION
NEWARK PLANT • METER DIVISION • NEWARK, N. J.
Printed in U.S.A.

Westinghouse

SOCKET INSTRUMENTS

FOR INDUSTRIAL APPLICATION



MARCH 7, 1938

CATALOG SECTION 43-600

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.

TYPE E SOCKET INSTRUMENTS

OUTDOOR AND INDOOR SERVICE FOR INDUSTRIAL APPLICATIONS

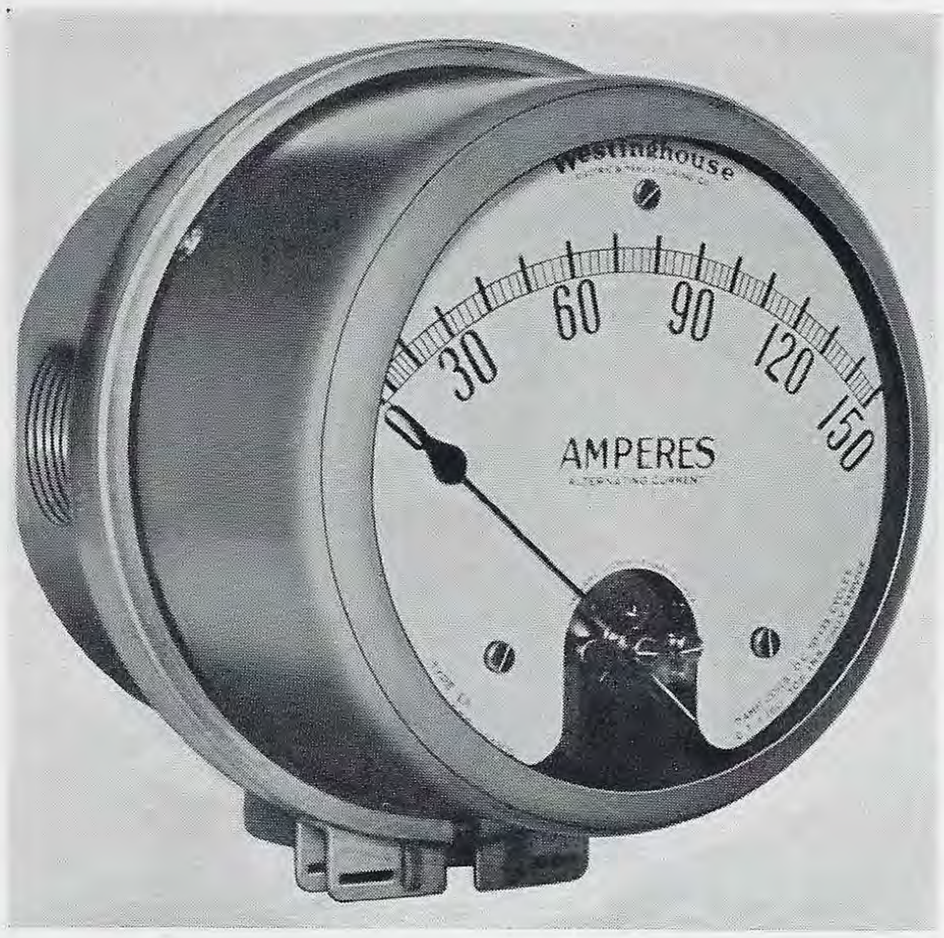


FIG. 1—TYPE EA SOCKET AMMETER WITH HORIZONTAL FEED SOCKET AND SEALING RING

FIG. 2—TYPE EA SOCKET VOLTMETER WITH HORIZONTAL FEED SOCKET AND SEALING RING

DATA

		Approximate Weight—Lbs. Net	Ship.
Type EA	Repulsion Iron Vane Measuring Element for A-C. Ammeters and Voltmeters. (Can be Used on D-C. with Limited Accuracy)	4	5
Type EX	D'Arsonval Measuring Element for D-C. Ammeters and Voltmeters	5½	6
Type EY	Dynamometer Measuring Element for A-C. and D-C. Wattmeters	5½	6
Sockets	Type S-2 with Sealing Ring (Consist of die-cast Ring on Box of Sheet Aluminum Alloy)	4¾	13
	Types S, S-5 and S-6 with Sealing Ring	2	4
Glass Cover for Socket		1	3
Scale Length	5¼ Inches		
Dial	Full Open Face, White with Black Figures		
Accuracy	1 Per Cent		
Size	6 31/32" Diameter by 5 7/8", 7 13/16" Deep		
Mounting	For Plugging Into Sockets Which may be Mounted in Conduit, Built-in Machine, or Fastened to Wall		
Case	Extra Strength Annealed Glass		

General

Electrical measuring instruments provide an accurate and reliable means of determining what is taking place in any electrical system. Millions of dollars are invested in electrical equipment in modern industrial plants and this equipment must be operated and maintained at maximum efficiency if the most is to be derived from the investment. For each dollar invested in electrical energy, there should result a certain return in production output, together with a minimum of up-keep and lost time due to failure of equipment. Data obtained from indications of electrical instruments point out losses and waste and make possible reductions in power, increased production efficiencies and prevent costly interruptions.

There are available extensive lines of electrical instruments of both the switchboard and portable types which can be used for developing this data. However, up to the present time little has been done to provide a low cost instrument that is easy to install so that electrical instruments can be more extensively used throughout all parts of the plant in permanent locations.

Westinghouse has now provided an answer to this problem. The extensive development of the detachable watthour meter used by public utilities has made possible a new kind of electrical instrument particularly suited for industrial plant applications. By an adaptation of the high production low cost parts of the detachable watthour meter, an instrument is now available which represents a minimum in investment, a maximum in ease of installation, plus great flexibility. This new development is identified as the Westinghouse Types EA, EX and EY Socket Instruments.

A socket instrument consists of two main units, first a socket or mounting device which is provided with electrical connection jaws, and second, the instrument mechanism mounted on a plate having electrical connection blades on the back and enclosed in a weatherproof housing of glass. The instrument

Westinghouse Electric & Manufacturing Company

Printed in U.S.A.

Newark Works, Newark, N. J.

TYPE E SOCKET INSTRUMENTS—Continued

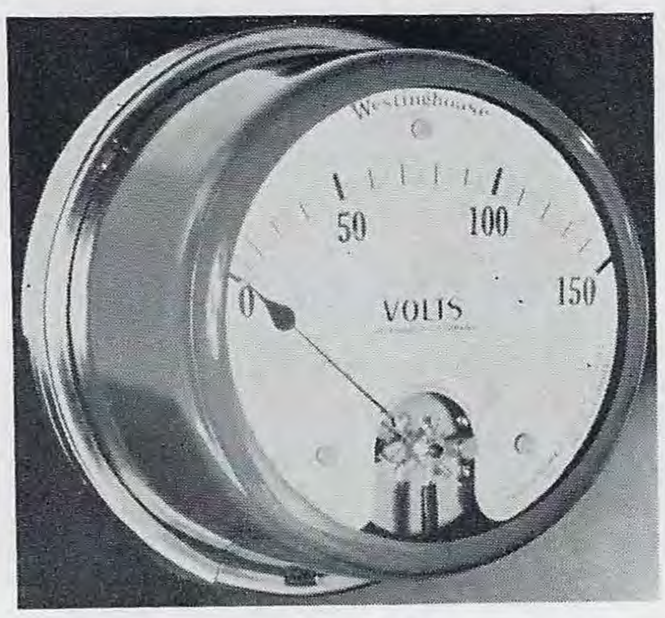


FIG. 3—SOCKET VOLTMETER

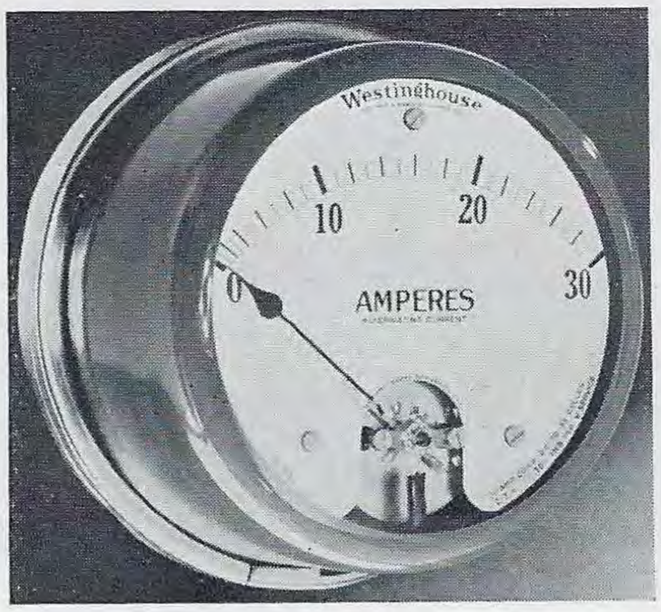


FIG. 4—SOCKET AMMETER

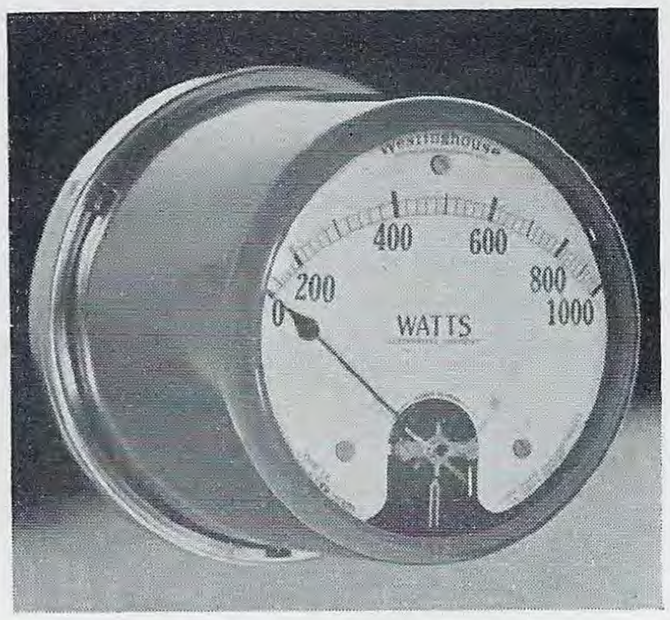


FIG. 5—SOCKET WATTMETER

unit is arranged to be plugged into the socket automatically completing all electrical connections between the jaws in the socket and the blades on the instrument. The two units are then sealed together with a tamperproof sealing ring forming a weatherproof unit which may be used either indoors or outdoors as desired.

Application of Socket Instruments

First, consider the electrical motor which offers the greatest opportunity to improve plant economy. By measurement of power drawn from the lines, it is easy to determine whether or not the motor is overloaded or underloaded and thereby wasting power through inefficient operation. A socket instrument connected in the power mains of a motor will show this quickly and is at all times in full view of the operator or the plant engineer. From this information, it may be found that motors can be interchanged and thus each be operated at maximum efficiency with no increase in investment in motors. Or it may be found that the load on the motor is excessive due to high friction losses, inefficient drives, etc.

A check on power factor is also important if the power bill is to be kept at a minimum, particularly where power is purchased at rates having penalties for poor power factor. Motors operated at full load have the highest power factor and, therefore, by keeping motors fully loaded, power factor may be kept at a satisfactory point. The permanently installed instrument will show loading conditions. Socket instruments are ideal for keeping a close watch on motor loads to maintain proper power factor

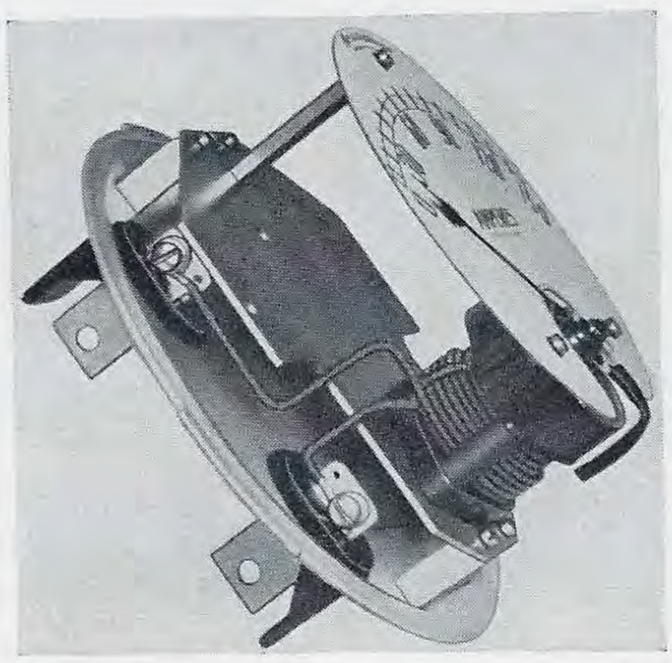


FIG. 6—INTERNAL VIEW OF SOCKET AMMETER SHOWING MOUNTING PLATE AND MECHANISM

as well as avoid excessive overloads which may result in breakdowns and costly interruptions of production.

Let us now consider the process itself. For example, take the polishing of plate glass by motor driven polishing wheels. By measuring the electrical input to the motor a direct indication is available on the condition of the polishing wheels. A wheel that needs replacing will show its presence by a larger than normal reading of power input to its motor which is indicated by the instrument connected to the motor circuit. Countless other similar economies can be obtained by application of instruments to the electrical circuit to obtain a measure of what is happening in the connected load. An outstanding one is the use of voltmeters connected across electrical furnaces used in the refining of aluminum ore. Here the instrument is used to control the process in addition to detection of abnormal operating conditions.

Economical Advantages

Certain definite economies and advantages are offered by the socket instrument in any of the above, or similar, applications. First, the socket provides a convenient low cost mounting structure for the instrument. Second, the instrument can be easily removed from the socket and another instrument plugged in to obtain various kinds of information, such as volts, amperes, watts, kilowatt hours, etc. Third, the sockets can be installed and sealed off without instruments in the circuit, thus providing convenient outlets for the future connection of instruments of either the socket form or complete portable analyzers for periodic analysis.

To eliminate the mounting details required with other forms of instruments, the socket is designed to be self-supporting in the conduit. The pipe conduit carrying the wiring can be screwed into the socket and this then acts as a support for the socket and the instrument. No other form of support is necessary. This arrangement provides a convenient way to place the instrument wherever desired in front of the operator by simply running the necessary lengths of conduit to and from the socket. New motor installations are still more convenient as the socket can be installed at the same time, thus avoiding extra cutting and threading of conduit sections.

TYPE E SOCKET INSTRUMENTS—Continued

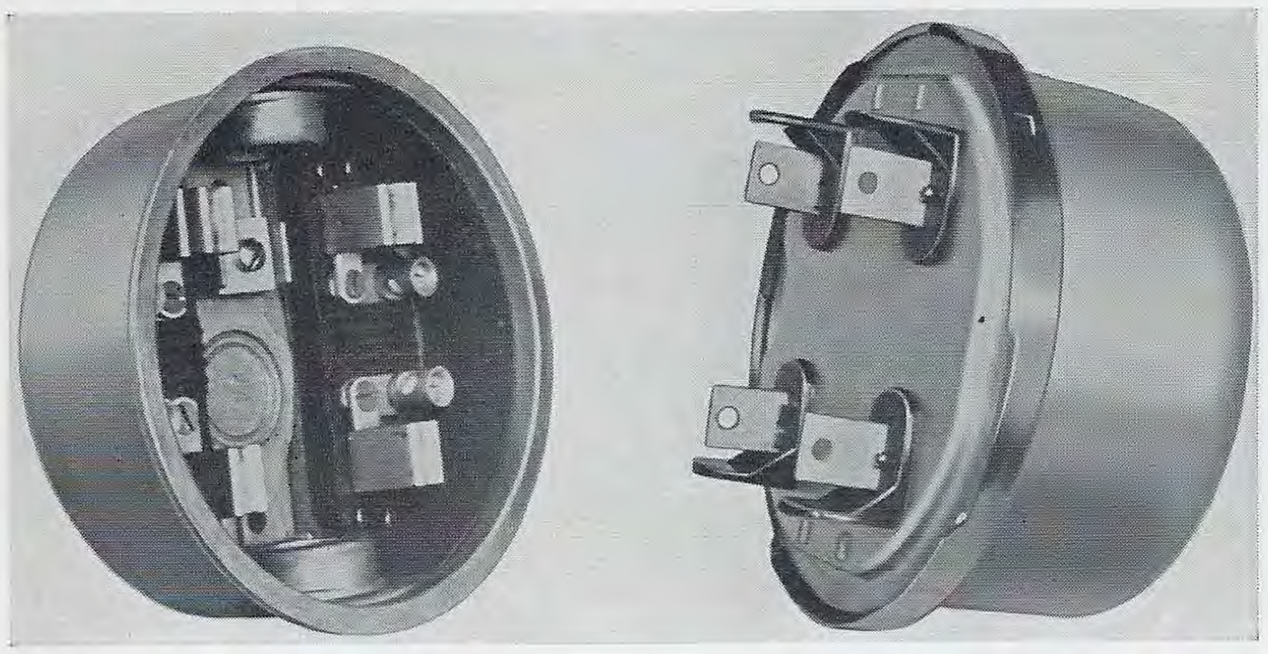


FIG. 7—TYPE S SOCKET AND SOCKET INSTRUMENT SHOWING CURRENT CONNECTION BLADES AND JAW RECEPTACLES.

Construction Details

The Socket

The socket is available with threaded outlets to receive ¾", 1" and 1¼" pipe conduit. The socket is equipped with terminal blocks fitted with solderless terminals for connection of the incoming and outgoing wires. The terminal blocks carry the heavy-duty jaws for receiving the switch blade connections on the back of the instrument base. Standard sockets are listed in a wide variety of styles, including vertical and horizontal arrangements, three sizes of conduit and with circuit closing devices all to meet the requirements of most any conceivable arrangement of wiring details.

The Instrument

The instrument unit consists of a standard switchboard instrument dial and mechanism mounted on a base plate. All internal connections are permanently made to this base plate at the factory which includes wiring to the mechanism and jumpers where necessary to complete the circuit when plugged into the socket. The base plate is equipped with heavy duty connection blades arranged to fit into the jaw receptacles in the socket. The instrument unit is enclosed with an extra strong annealed glass cover held to the base plate with a metal band having receptacles which slide on to lugs on the base when giving the cover unit a slight turn. The glass cover exposes the entire dial and pointer, making reading of the dial easy even at considerable distance from the instrument.

The instrument is plugged into the socket, which operation completes the connections from the socket to the instrument automatically. The instrument is sealed to the socket with a grooved ring, fitting over a flange on both the instrument and socket, making the entire unit dustproof and weatherproof. To remove the instrument, the sealing ring screw is loosened and the sealing ring removed. Then the instrument may be pulled from the socket without disturbing the permanent wiring to the socket.

The mechanisms used in Types EA, EX and EY socket instruments are time-tried and proven by many years of use in Westinghouse large switchboard instruments. No changes have been made, except details of mounting to adapt these mechanisms to the socket form of mounting.

Some of the outstanding features of these mechanisms are as follows:

Accuracy and Permanence of Calibration

All movements used in the socket Types EA, EX and EY instruments embody the highest grade workmanship and the best of instrument design practice. The control springs are made from special alloy material formed and heat treated by expert instrument craftsmen. Permanent magnets are formed from high quality tungsten steel properly aged and heat treated. Pivots are made from special composition steels properly treated to give long wearing qualities and low friction even when subjected to severe vibration. All moving and stationary coils are carefully wound to obtain adequate insulation and provide good overall performance without excessive weight in moving elements. On these fundamental parts depend the accuracy and permanence of calibration and the utmost care is given to their design and manufacture.

Torque—Weight Ratio

The torque-weight ratio is a measure of the ability of the instrument to provide accurate indications over long periods of time and under adverse conditions. Torque-weight ratios are kept high by careful design of moving parts and adequate torque in the electrical measuring elements. Particular attention has been given to these points in the socket instruments in order that they will provide the utmost in reliability when subjected to the severe service of industrial applications.

Damping

All dynamometer and repulsion vane measuring elements are air damped by means of specially shaped light weight vanes operating in closed dustproof chambers of moldarta. Adequate damping is obtained by this system with a minimum of parts and simple trouble-free construction. All D-C. measuring elements are damped by eddy currents generated in the moving coil frame.

Overload Capacity

All Type "E" measuring elements are designed to withstand temporary overloads without damage either electrically or mechanically. This permits leaving the instrument in the circuit while the motor is started as the instrument will carry the inrush current due to starting. This feature permits of application without limitations to motor circuits and results in reliability and a minimum of cost as no short-circuiting connections are necessary.

TYPE E SOCKET INSTRUMENTS—Continued

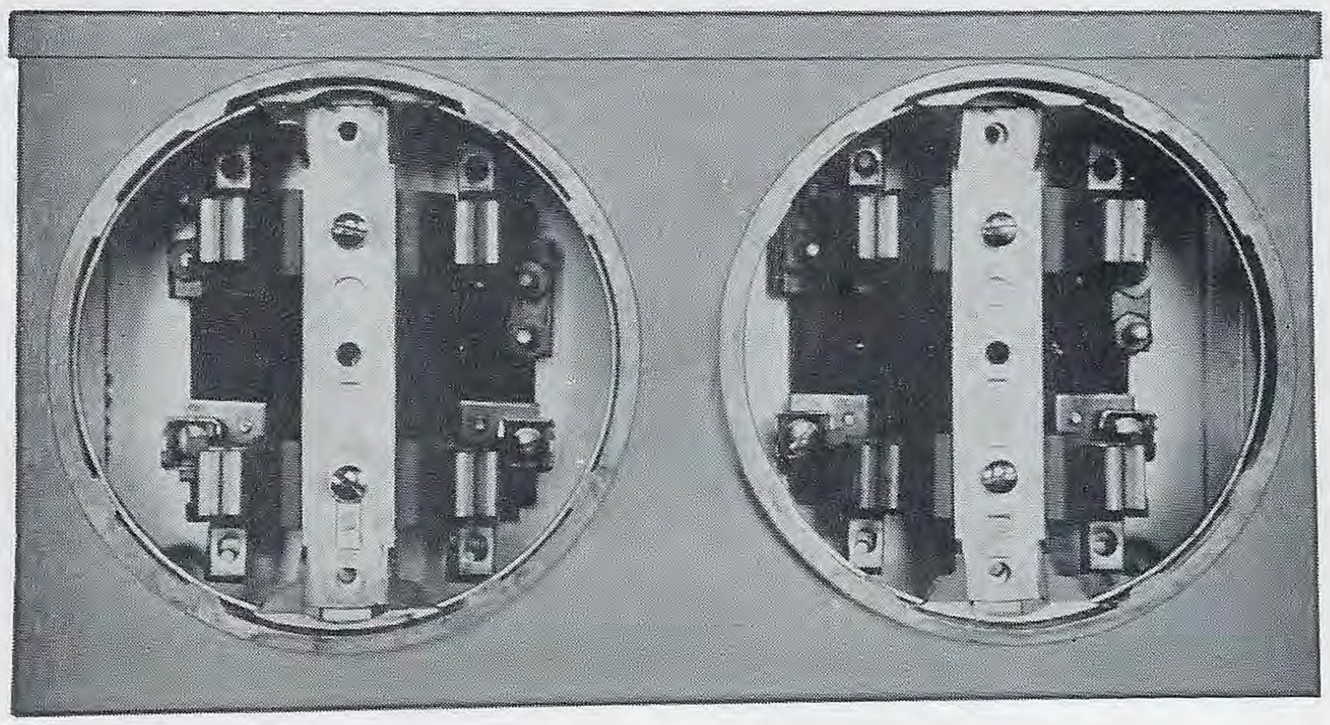


FIG. 8—FRONT VIEW OF TWO-UNIT TROUGH EQUIPPED WITH RING SOCKETS AND TERMINAL JAWS SUITABLE FOR EITHER WALL OR CONDUIT MOUNTING

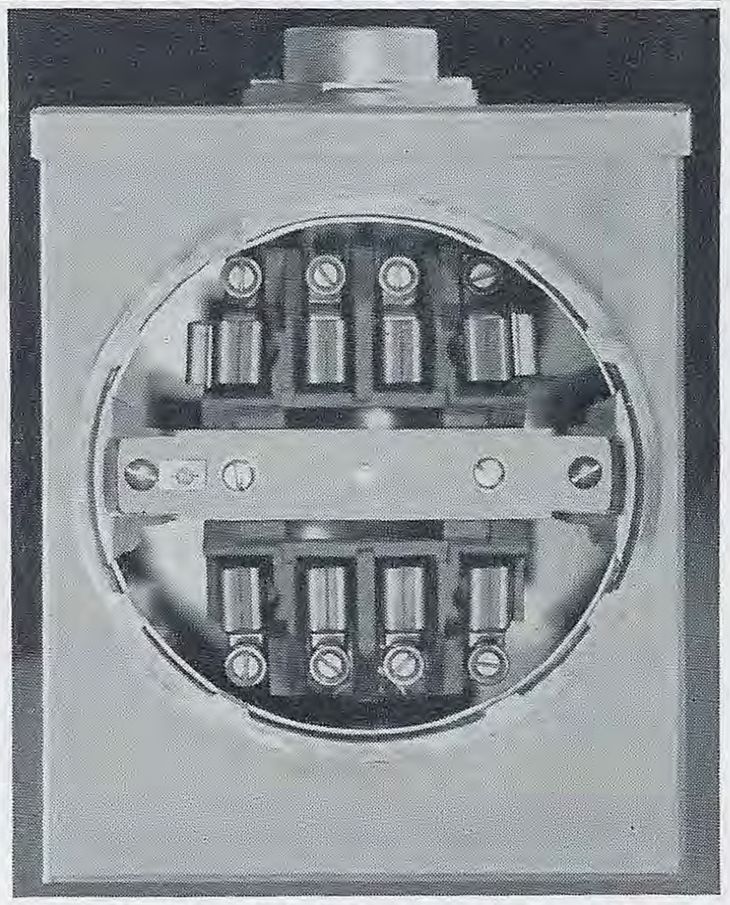


FIG. 9—TYPE S-2, 8-JAW SOCKET WITH CIRCUIT CLOSING DEVICE.

Trough Installations

Fig. 8 shows a two-unit trough equipped with sockets for socket instruments or watthour meters. These boxes are provided with knockouts of a variety of sizes on both ends. They are available with single, two, three or four instrument sockets. These trough units will receive standard conduit and can be mounted on a wall or angle iron frame.

The trough unit can be used in a variety of arrangements where it is desired to mount one or more instruments for test benches or provide panel arrangements for metering one or more circuits. The trough has adequate room for running large size wire which in some cases might be too large for ordinary Type S Sockets. It offers the advantage of great flexibility and low cost in providing economical metering arrangements in industry.

For the names of a partial list of manufacturers of these trough units, see page 11.

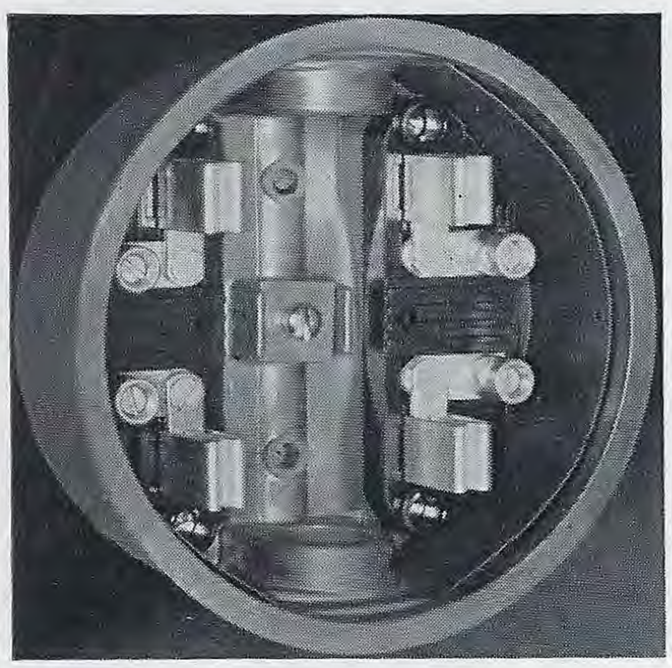


FIG. 10—TYPE S, 4-JAW SOCKET.

Convenience Testing Outlets

The socket offers many advantages from a maintenance and testing standpoint in industrial plants. Portable instruments, recorders or industrial analyzers are now being used extensively to check motors and processes in many plants. In order to connect any of these instruments, the circuits must be broken and frequently this must be done at night or over week-ends in order to avoid production interruption. The socket can be used to avoid this inconvenience by providing an outlet for the connection of any instruments at any time without circuit interruptions. It is designed for mounting directly in conduit, is low in cost and easy to install. Sockets can thus be mounted throughout a plant on all circuits where testing may be necessary. The cost of equipping a plant with these testing outlets is very reasonable, and in most cases the cost is saved within a short time by eliminating costly shut-downs and saving of time in making necessary tests.

Circuit Continuity Devices

Sockets are listed herein having circuit closing devices to provide a continuous circuit when the instrument is removed. Sockets with these features are recommended for all industrial applications.

When current transformers are used, the circuit closing device automatically short-circuits the transformer secondary when the instrument is removed.

The socket circuit closing device is designed to carry 20 amperes continuously or 100 amperes for one minute which provides safe circuit continuity while instruments are being plugged in or removed, or while the various testing jacks are being inserted.

Load Carrying Devices

When it is desired to use a socket as a convenience test outlet without having the instruments permanently plugged in, it is necessary to use separate jumpers to bridge the connection jaws to carry the circuit load and thus relieve the ordinary socket circuit closing device of this duty. For this purpose, two forms of load carrying devices have been provided. The lowest cost unit

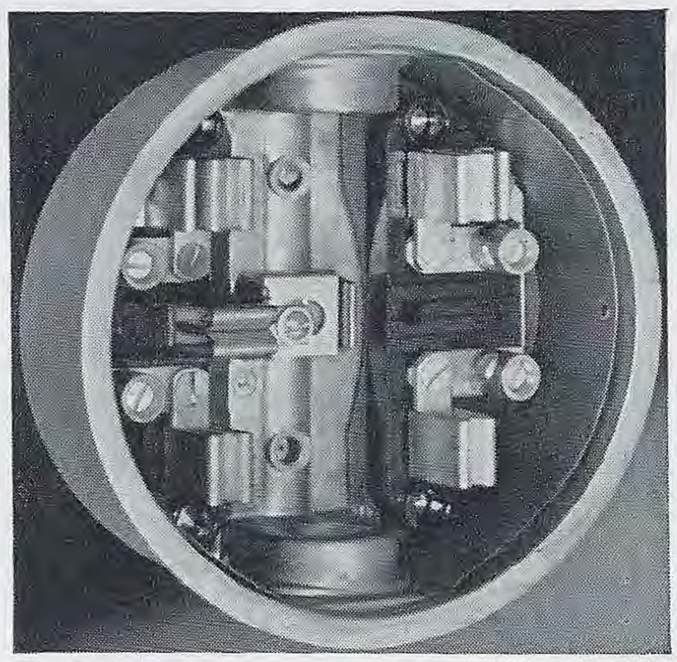


FIG. 11—TYPE S-5, 5-JAW SOCKET WITH CIRCUIT CLOSING DEVICE.

TYPE E SOCKET INSTRUMENTS—Continued

is a flat copper jumper with molded insulation in the center section which may be handled with a pair of pliers. It is arranged to be plugged into two socket jaws and thus bridge the circuit between the jaws. One jumper is required for each current circuit in a socket. The socket is sealed off with a flat glass plate held in place by a standard socket sealing ring.

The other form of load carrying device consists of an instrument base plate fitted with standard connection blades and a standard instrument cover. The load carrying jumpers are provided on the inner side of the base plate and connect between the current connection blades. This form of load carrying device is sealed to the socket in the same manner as a regular instrument unit. Although somewhat more expensive than the copper jumper, it offers the advantage of being plugged in or being removed in the same manner as the instrument and does not require the glass closing plate.

Selection of Sockets and Accessories

Complete wiring diagrams are shown with the various instruments. It is advisable to study these diagrams and the application chart on page 7 first before selection of the socket for a given application. Consideration should be given to the kind of indication desired; that is, whether volts, amperes, watts, etc., also whether or not current or potential transformers are required depending upon the load of the circuit. If the current to be measured exceeds the self-contained ratings of the instruments

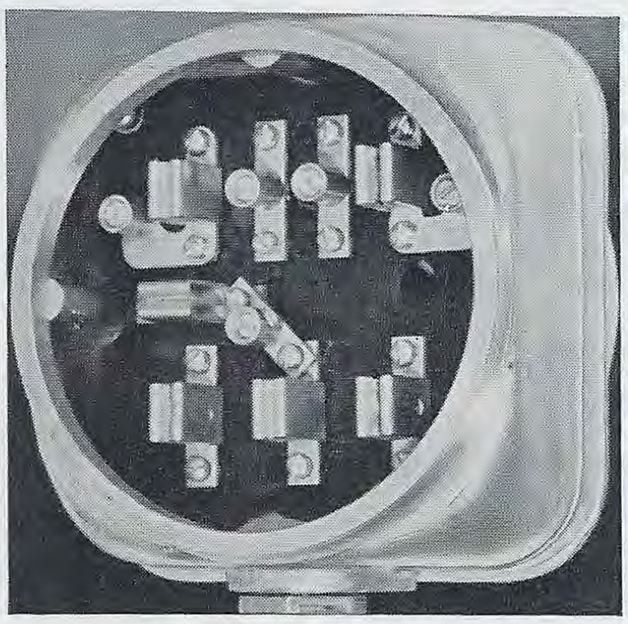


FIG. 12—INSERT SOCKET FOR CONNECTING ANALYZERS AND RECORDERS TO TYPE S SOCKETS LEAVING THE INSTRUMENTS IN THE CIRCUIT. PRODUCTION IS NOT INTERRUPTED DURING TIME OF TEST.

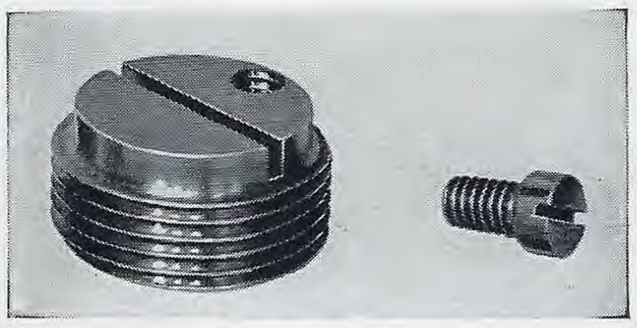


FIG. 13—PLUG WITH SEALING SCREW FOR SEALING UNUSED OUTLETS IN SOCKET.

listed, then it will be necessary to use transformers and a suitable socket can be selected by reference to the wiring diagrams and the tables listing the sockets.

By reference to the connection diagrams and the tables listing sockets, instruments, testing jacks, etc., it will be noted that a certain kind of socket or instrument is recommended depending upon the type of circuit. It is therefore only necessary to select first, the kind of circuit involved and second, the current and voltage capacity indicating whether or not current or voltage transformers are required. In selecting sockets from the tables, it is to be noted also that wiring has been standardized so that various kinds of instruments, test jacks and insert jacks can be used interchangeably in the same socket by selection of the proper ratings and providing the socket has been installed with consideration to circuit load (that is, with transformers when necessary).

Testing Jacks

Type "S sockets may be installed in a variety of circuits in a plant either with or without socket instruments mainly for the purpose of providing convenient outlets for temporary testing. In order that portable instruments, such as the Westinghouse TA and TX Industrial Analyzers and G-40 Recorders may be easily connected to these socket outlets, standard test jacks are available with cable connectors and arranged to be plugged into Type "S" sockets.

The test jack consists of a unit having a standard instrument base plate with the current connection blades and is fitted with a Moldarta cover with a convenience handle. An opening in the bottom is provided for bringing out the connection cable. The cover can be easily removed from the base plate, thus making the terminal connections readily accessible for various kinds of connections. The test jack is listed herein for each type of circuit and standard cable are listed for connecting Westinghouse Industrial Analyzers or Portable Recording Instruments to these test jacks.

Insert Sockets

The insert socket is to be used when it is desired to obtain a cable connection to a socket and at the same time have the instrument or watthour meter remain plugged into the circuit. The cable connection can then be used for connecting portable recorders or analyzers in the circuit. For industrial applications this is of considerable advantage on a circuit where the operator is using the socket instrument continuously on production and it is desired to make a short-time graphic record or a complete test with portable instruments or analyzers without interruption of production or loss of daily records.

The insert socket consists of a cast aluminum alloy housing and is fitted on the base with the regular instrument base plate with current connection blades. The front is provided with the standard socket arrangement having the connection jaws the same as in the regular socket. The side of the housing is provided with an opening for bringing out the cable connection. Internally the insert socket has an insulated terminal plate with standard solderless terminals for connecting cable leads in a variety of ways depending upon the kind of circuit connection desired. Provision is made in the insert socket for sealing it to a permanently installed socket and also for sealing instruments on the front.

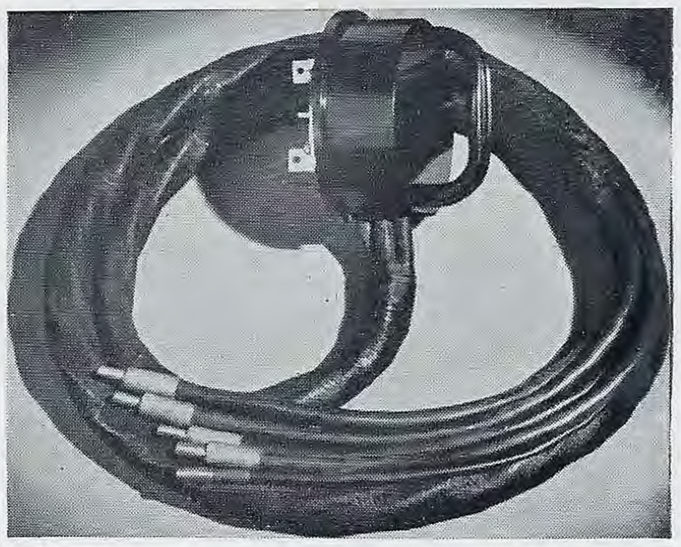


FIG. 14—TEST JACK AND CABLE FOR CONNECTING TO TYPE TA INDUSTRIAL ANALYZER.

TYPE E SOCKET INSTRUMENTS—Continued

FIG. 15—TYPE TA, A-C. INDUSTRIAL ANALYZER. THIS ANALYZER GIVES COMPLETE DATA WHEN CONNECTED TO TYPE S SOCKETS BY MEANS OF THE CONVENIENT TEST JACK.

FIG. 16—TYPE TX, D-C. INDUSTRIAL ANALYZER. THIS ANALYZER GIVES COMPLETE DATA WHEN CONNECTED TO TYPE S SOCKETS BY MEANS OF THE CONVENIENT TEST JACK.

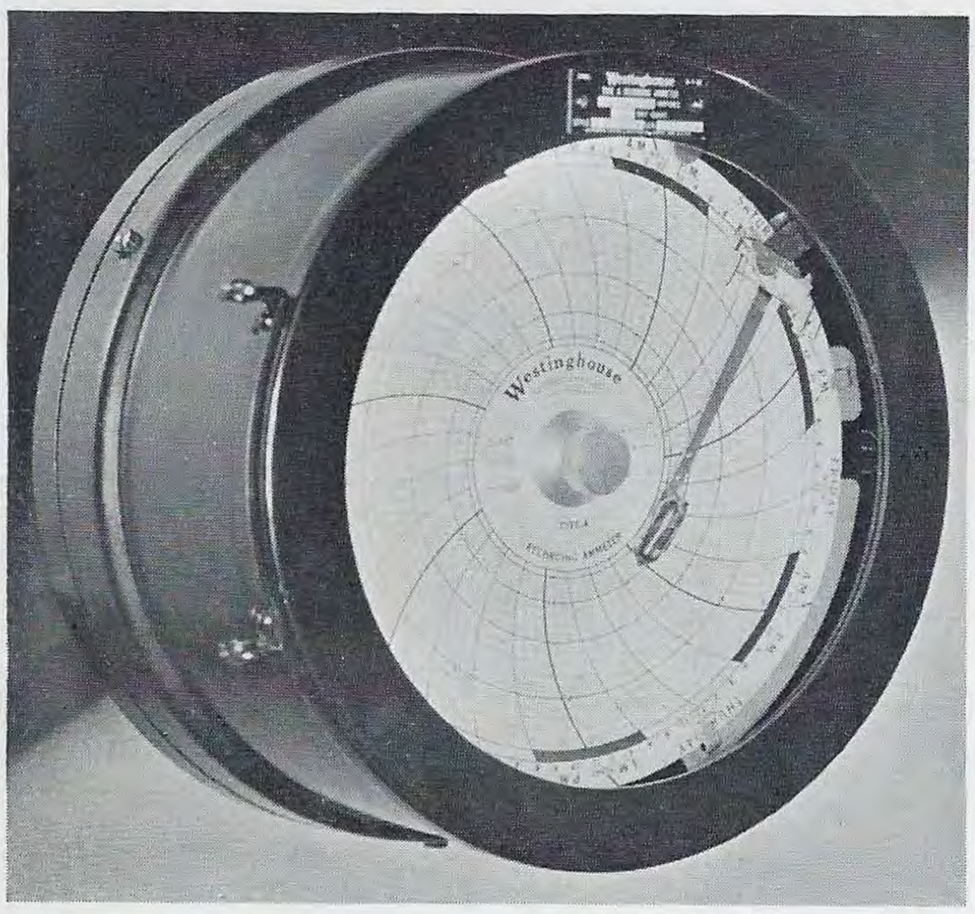


FIG. 17—SOCKET TYPE A RECORDING AMMETER PLUGS DIRECTLY INTO TYPE S SOCKETS.

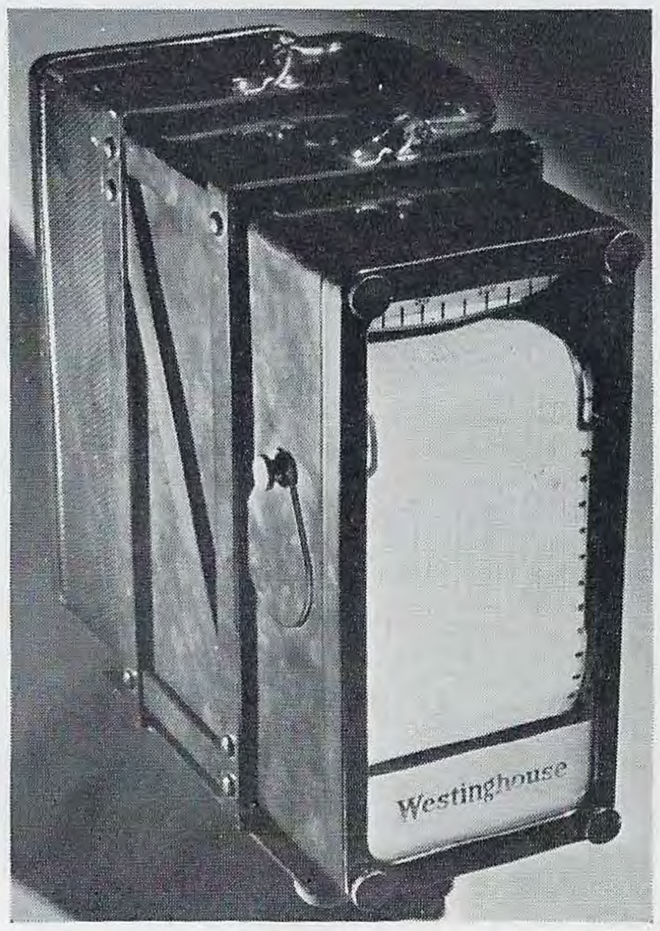


FIG. 18—TYPE G-40 PORTABLE RECORDER FOR OBTAINING GRAPHIC RECORDS FROM TYPE S SOCKETS BY MEANS OF THE CONVENIENT TEST JACK.

TYPE E SOCKET INSTRUMENTS—Continued

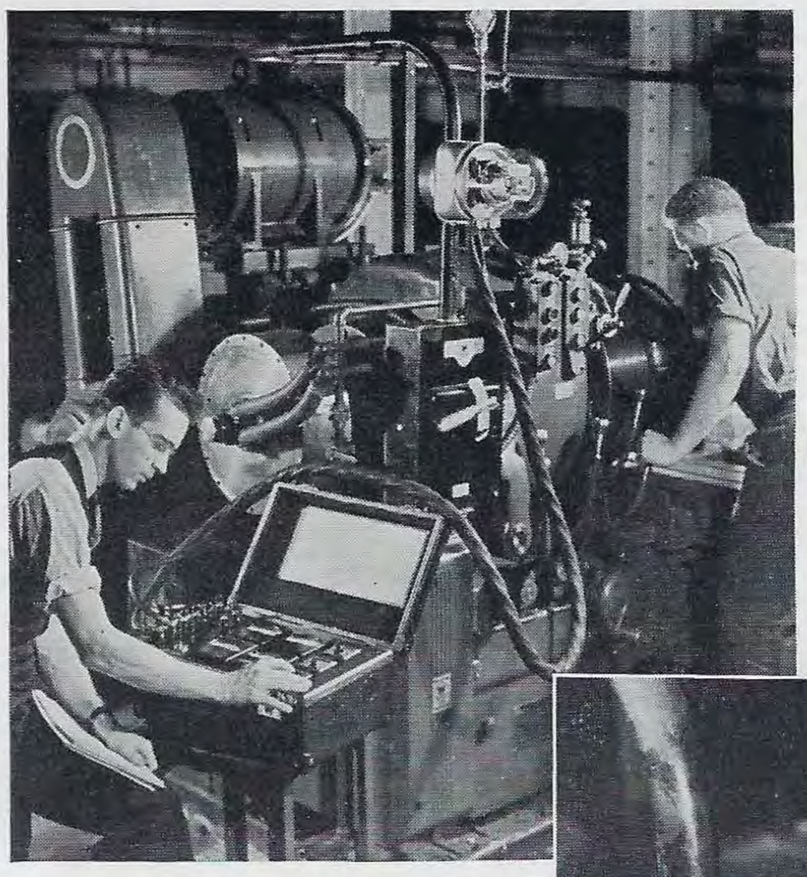


FIG. 19—INSERT SOCKET PLUGGED INTO TYPE S SOCKET AND WATTHOUR METER PLUGGED INTO THE CIRCUIT. COMPLETE TESTS ARE MADE WITH THE INDUSTRIAL ANALYZER WITHOUT LOSS OF KILOWATT, HOUR REGISTRATION OR INTERRUPTION OF PRODUCTION.

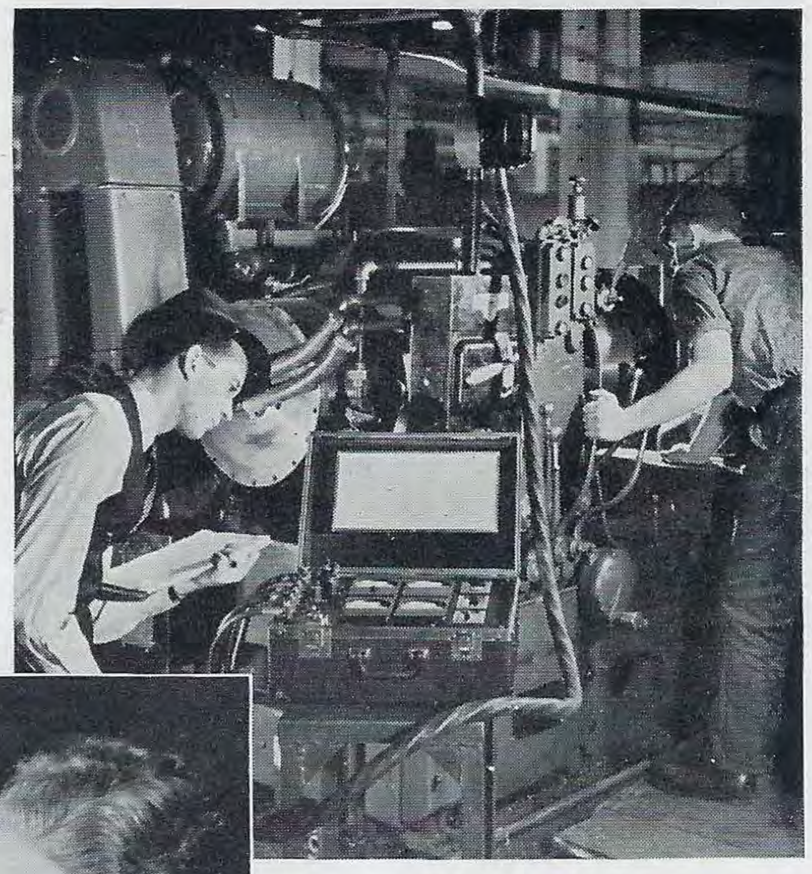


FIG. 20—TEST JACK PLUGGED INTO TYPE S SOCKET AND CONNECTED TO TYPE TA INDUSTRIAL ANALYZER, GIVES COMPLETE INFORMATION INCLUDING AMPERES, VOLTS, WATTS, POWER FACTOR WITHOUT INTERRUPTION OF PRODUCTION.

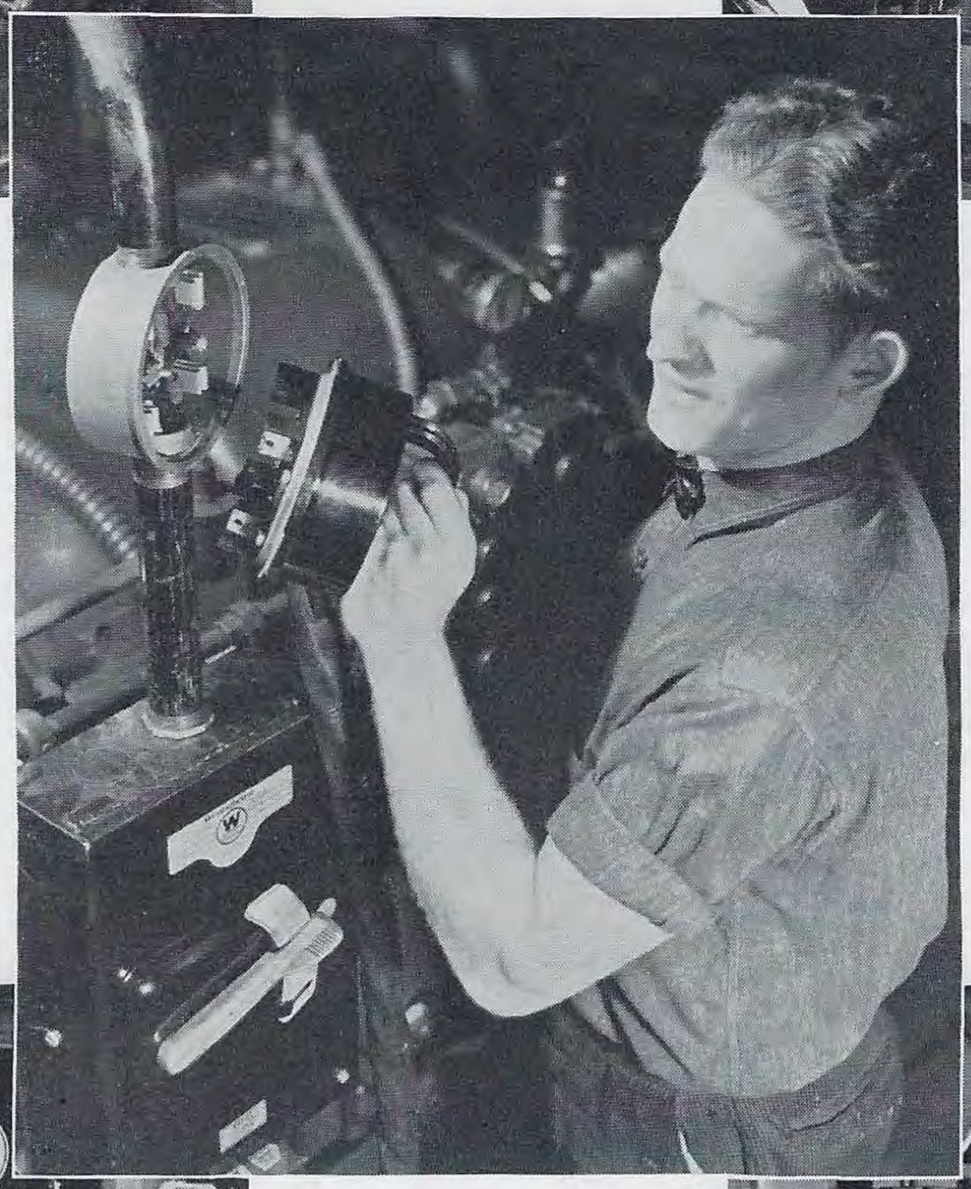


FIG. 21 — DEMONSTRATING THE EASE OF PLUGGING-IN TEST JACK TO OBTAIN CABLE CONNECTION TO INDUSTRIAL ANALYZER OR PORTABLE RECORDING INSTRUMENTS.

FIG. 22—INSERT SOCKET PLUGGED INTO TYPE S SOCKET AND INSTRUMENT ALSO PLUGGED INTO CIRCUIT FOR OPERATOR'S USE. COMPLETE TESTS ARE MADE WITH THE TA ANALYZER WITHOUT INTERRUPTION OF PRODUCTION.

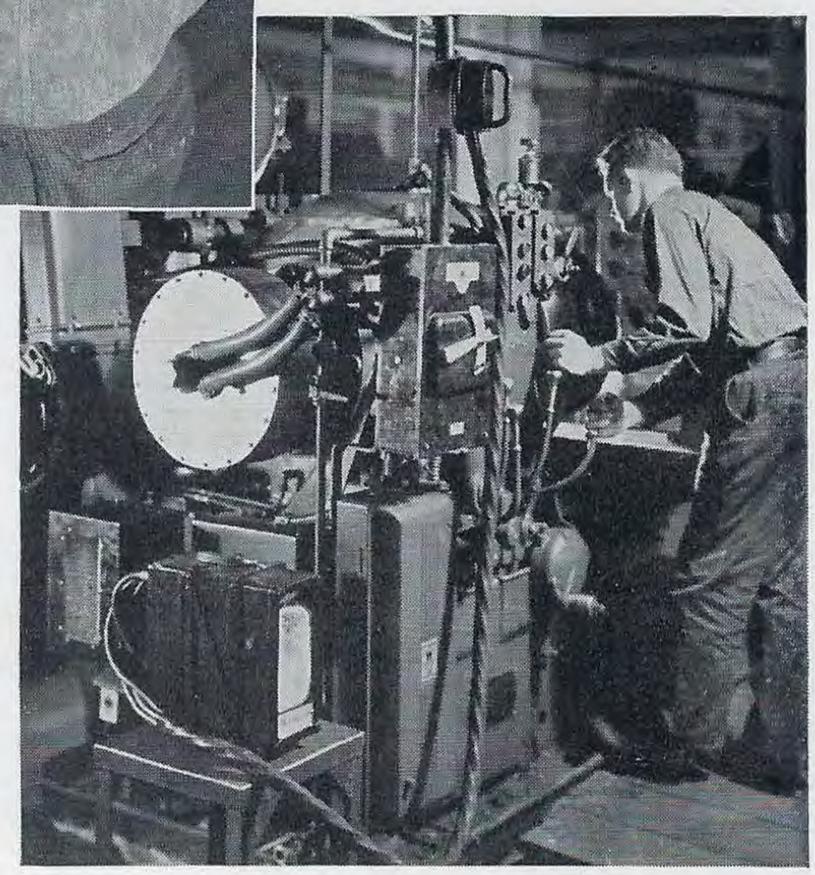


FIG. 23—TEST JACK PLUGGED INTO TYPE S SOCKET AND CONNECTED TO G-40 RECORDER. GIVES GRAPHIC RECORD OF CURRENT VOLTAGE OR TOTAL POWER WITHOUT INTERRUPTION OF PRODUCTION.

TYPE E SOCKET INSTRUMENTS—Continued

FIG. 24—TYPE A RECORDER PLUGGED INTO TYPE S SOCKET. GIVES GRAPHIC RECORD OF CURRENT.

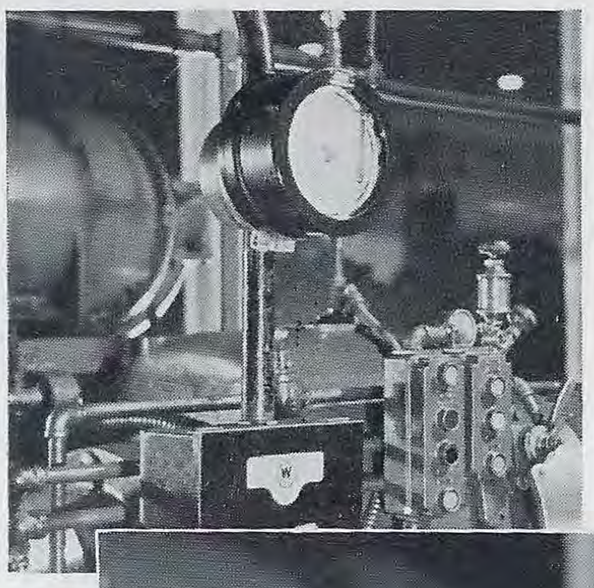


FIG. 25—WATTHOUR METER PLUGGED INTO TYPE S SOCKET. MEASURES TOTAL KILOWATT HOURS.

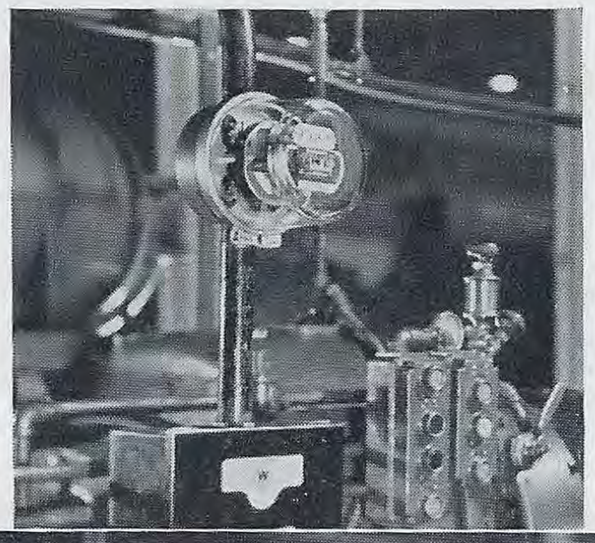
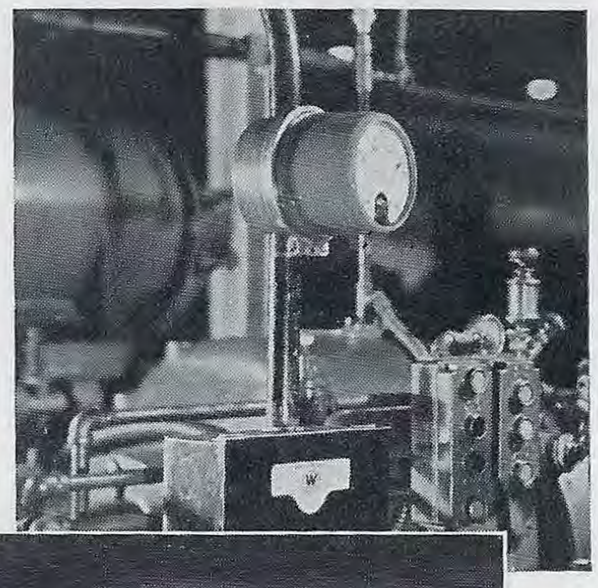


FIG. 26—WATTMETER PLUGGED INTO TYPE S SOCKET. MEASURES TOTAL POWER.



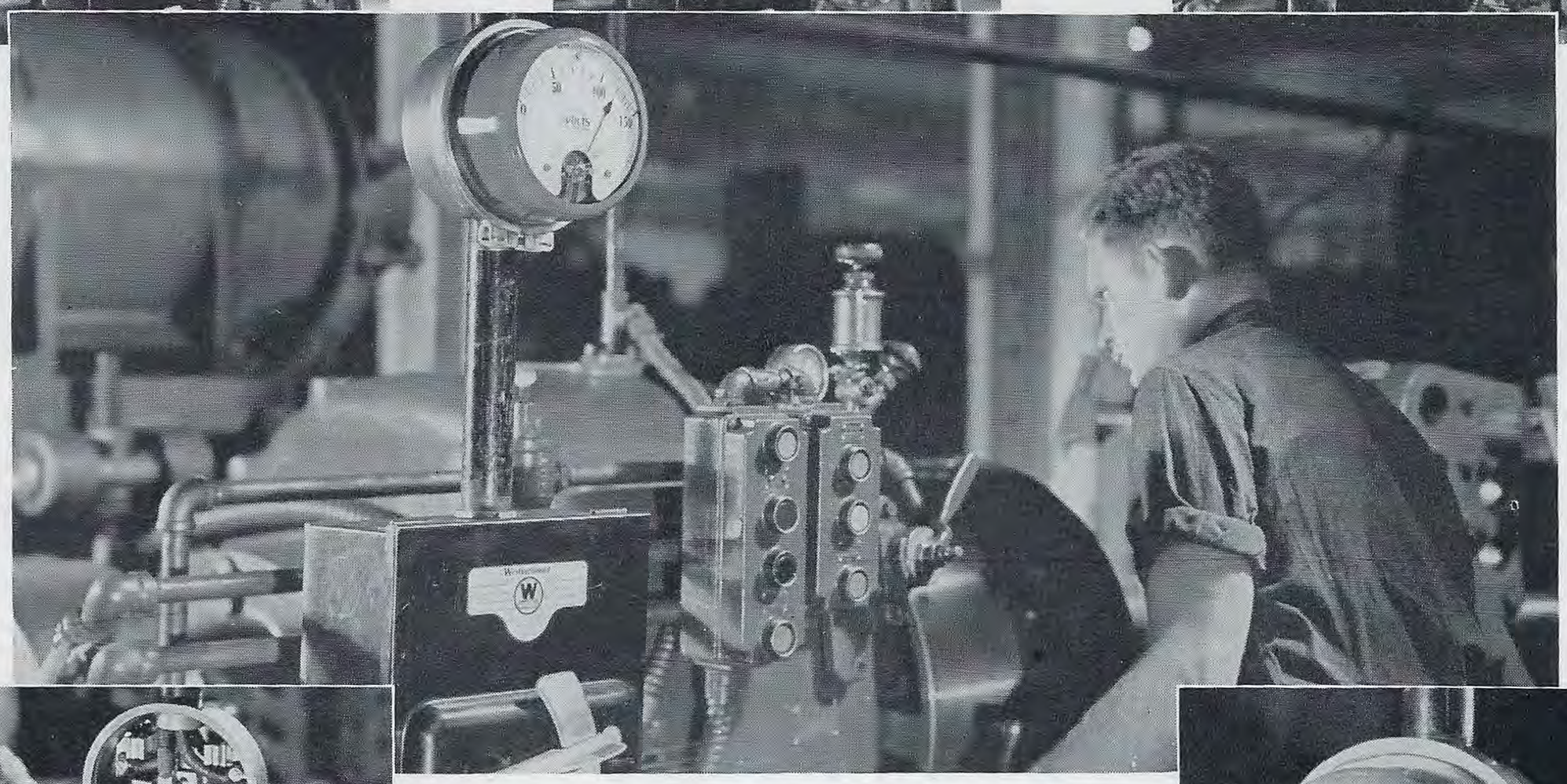


FIG. 28—VOLTMETER PLUGGED INTO TYPE S SOCKET. MEASURES LINE VOLTAGE.

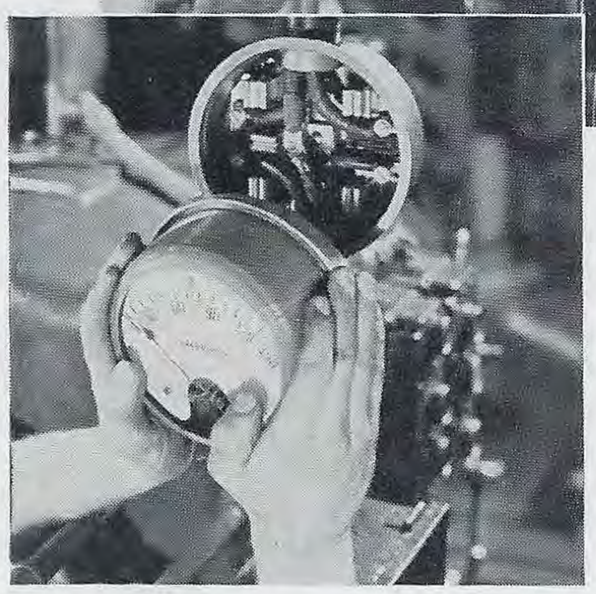


FIG. 27—DEMONSTRATING THE EASE WITH WHICH AN INSTRUMENT MAY BE PLUGGED INTO A TYPE S CONVENIENT TEST SOCKET.

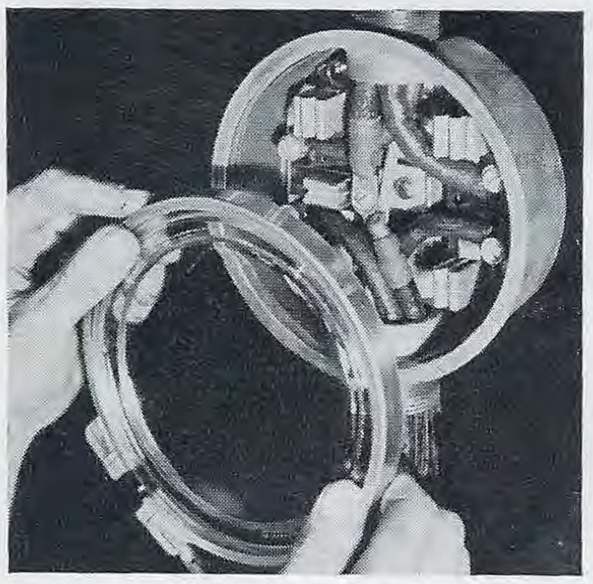


FIG. 31—TYPE S-5, 5-JAW SOCKET INSTALLED IN CONDUIT ON 3-PHASE, 3-WIRE SYSTEM. THIS SOCKET IS SEALED OFF BY MEANS OF A GLASS PLATE AND SEALING RING WHEN INSTRUMENTS ARE NOT PLUGGED IN.

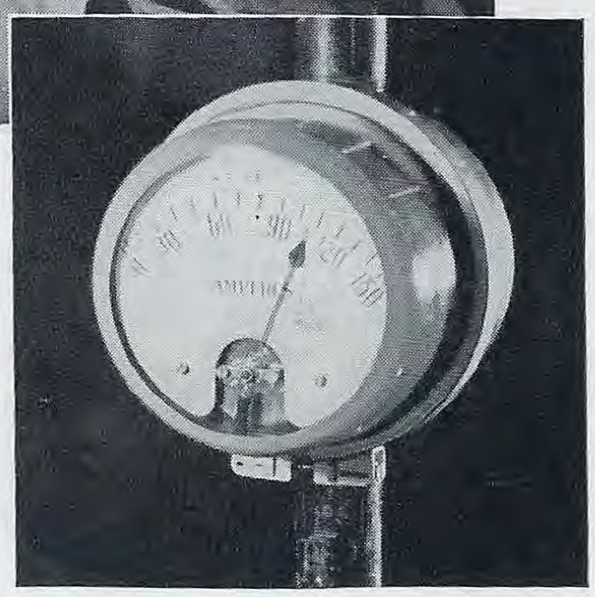


FIG. 29—AMMETER PLUGGED INTO TYPE S SOCKET. MEASURES LINE CURRENT.

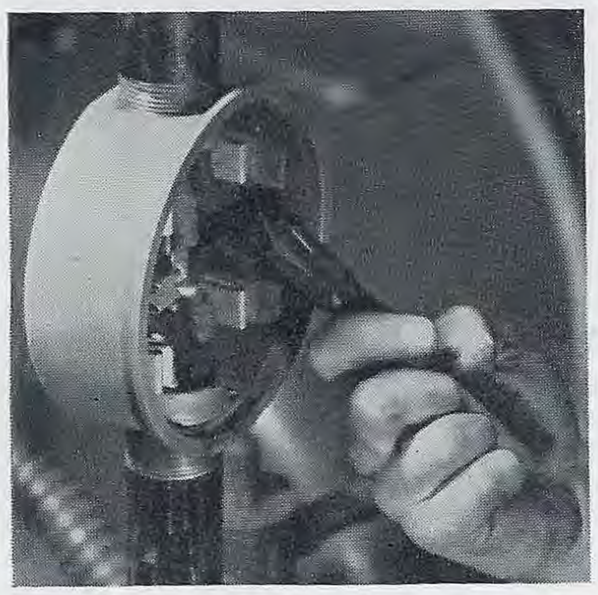


FIG. 30—TESTS CAN BE CONVENIENTLY AND QUICKLY MADE BY REMOVING THE LOAD CARRYING JUMPERS WITH A PAIR OF PLIERS AND PLUGGING IN THE DESIRED INSTRUMENT WITHOUT INTERRUPTION OF PRODUCTION.

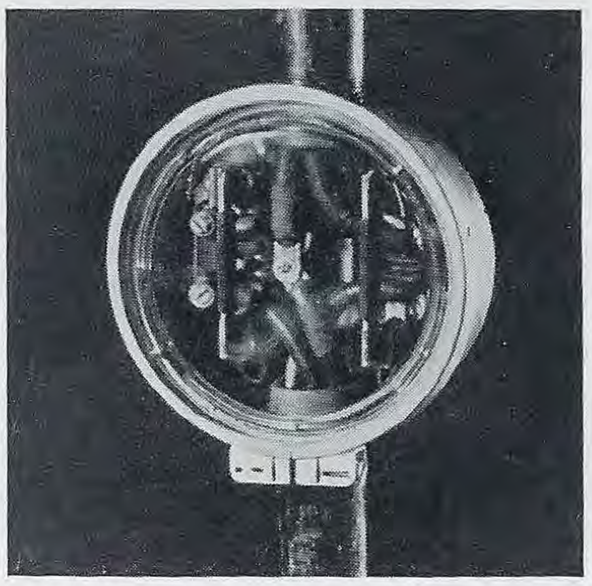


FIG. 32—TYPE S SOCKET INSTALLED IN CONDUIT, FITTED WITH INSULATED COPPER JUMPERS AND SEALED OFF WITH GLASS CLOSING PLATE. THIS SOCKET CAN BE USED AT ANY TIME AS A CONVENIENCE TEST OUTLET.

TYPE E SOCKET INSTRUMENTS—Continued

OUTLINE DIMENSIONS IN INCHES

Dimensions for reference only. For official dimensions refer to nearest Westinghouse Sales Office.

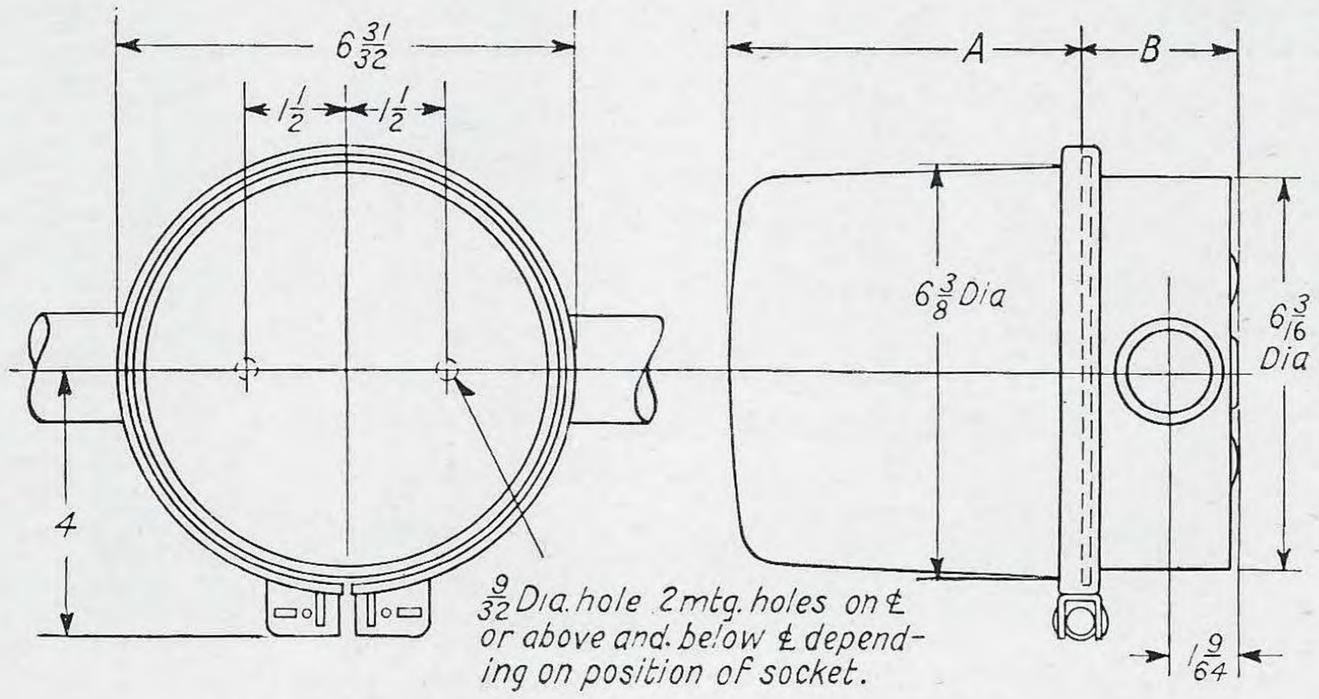


FIG. 33—VERTICAL OR HORIZONTAL TYPES S, S-5 AND S-6 SOCKETS AND TYPES EA, EX AND EY SOCKET INSTRUMENTS

Assembly No.	Cover	Dimensions in Inches A	B
1	Shallow	3 15/32	2 13/32
2	Deep	5 3/32	2 13/32

Assembly No. 2 for Polyphase Wattmeters

Assembly No. 1 for Ammeters, Voltmeters Single Phase Wattmetters and Total Hour Meters.

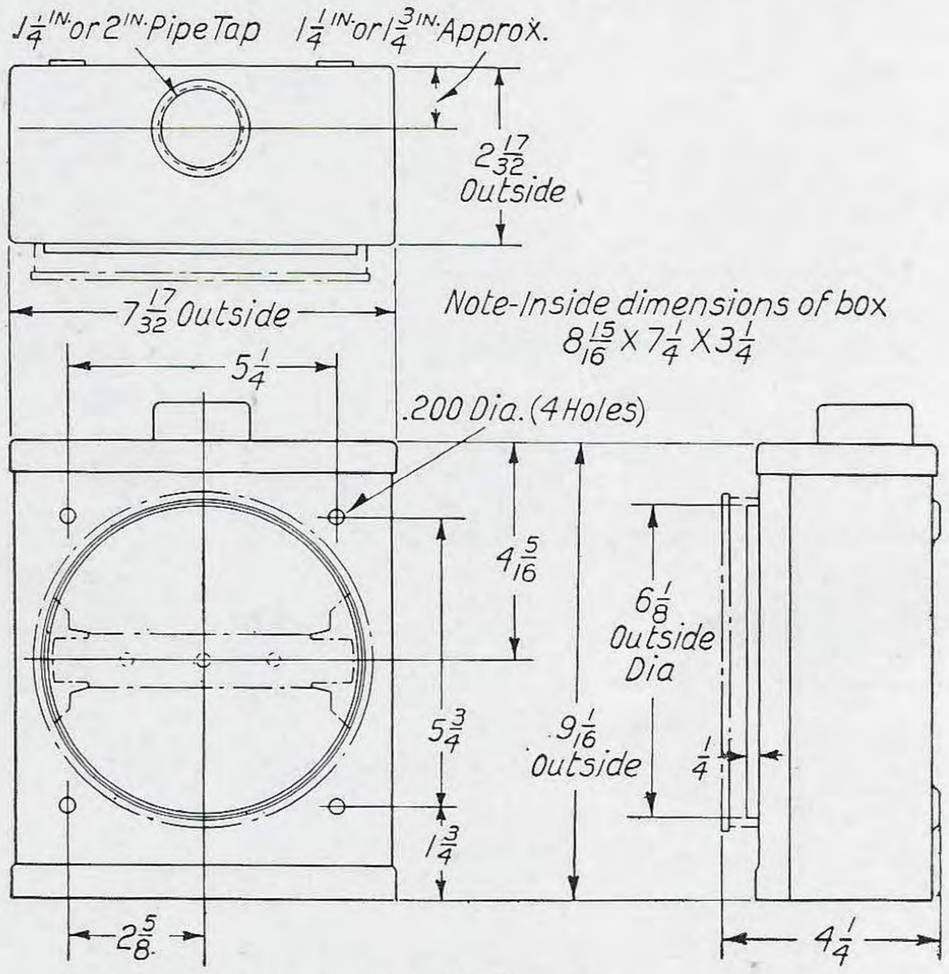


FIG. 34—TYPE S-2 OR S-8 SOCKET

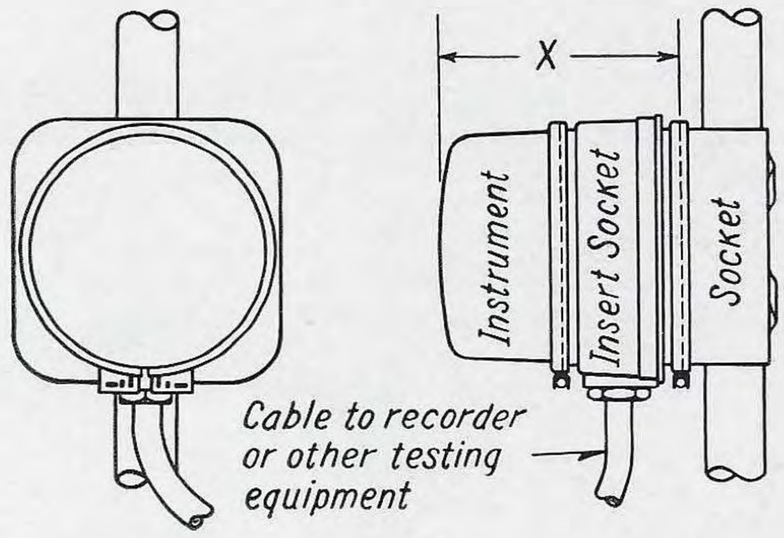


FIG. 35—INSERT SOCKET OUTLINE

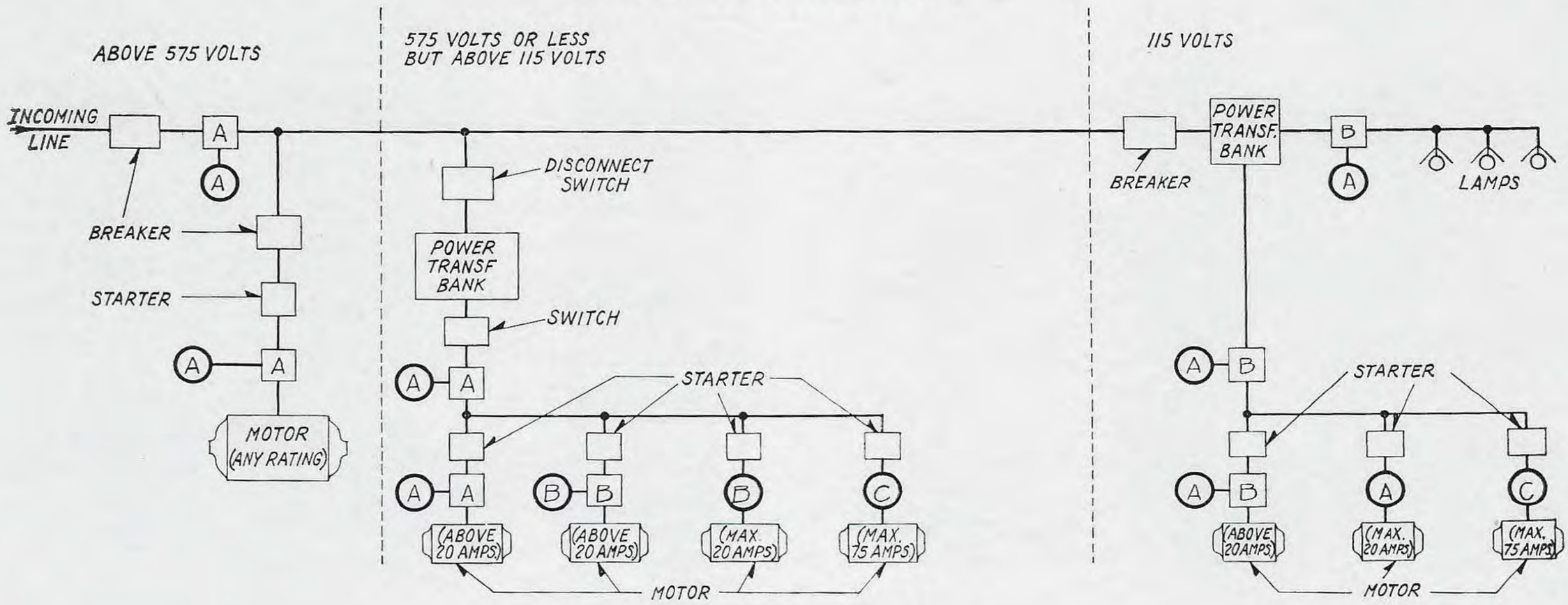
Assembly No.	Type of Instrument	Dim. X
1	Shallow Cover	7 1/8
2	Deep Cover	8 3/4

Assembly No. 2 for Polyphase Wattmeter

Assembly No. 1 for Ammeter and Voltmeter

TYPE E SOCKET INSTRUMENTS—Continued

APPLICATION CHART



SOCKET LEGEND

Ⓐ Will Receive
- *WATTMETER
- VOLTMETER
- AMMETER
- †WATTHOUR METER
- RECORDING AMMETER
- †TOTAL HOUR METER
- ‡*TA ANALYZER
- *PORTABLE RECORDING WATTMETER
- PORTABLE RECORDING VOLTMETER
- PORTABLE RECORDING AMMETER

Ⓑ Will Receive
- VOLTMETER
- AMMETER
- †WATTHOUR METER
- †TOTAL HOUR METER
- ‡TA ANALYZER
- RECORDING AMMETER
- PORTABLE RECORDING AMMETER
- PORTABLE RECORDING VOLTMETER
- PORTABLE RECORDING WATTMETER

Ⓒ Will Receive
- VOLTMETER
- AMMETER
- WATTHOUR METER
- TOTAL HOUR METER
- ‡TA ANALYZER

*Except 2-Phase, 4-Wire systems using connections in Figs. 53 and 55.
†Except on Direct Current.
‡Use TX Analizer on Direct Current.

TRANSFORMER LEGEND

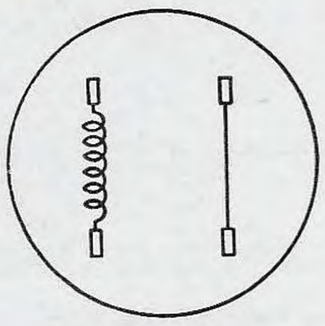
[A] = INSTRUMENT TRANSFORMERS (CURRENT AND VOLTAGE)

[B] = INSTRUMENT TRANSFORMERS (CURRENT ONLY)

3-PHASE, 3-WIRE USING S-5 SOCKETS STYLE NO. TABLE I		2-PHASE, 4-WIRE USING S-6 SOCKETS STYLE NO. TABLE II		3-PHASE, 4-WIRE USING S-2 SOCKETS STYLE NO. TABLE III		SINGLE PHASE, 2-WIRE USING S SOCKETS STYLE NO. TABLE IV		D-C., 2-WIRE USING S SOCKETS STYLE NO. TABLE V	
Legend	Socket Wiring Diag. Fig. No.	Legend	Socket Wiring Diag. Fig. No.	Legend	Socket Wiring Diag. Fig. No.	Legend	Socket Wiring Diag. Fig. No.	Legend	Socket Wiring Diag. Fig. No.
Ⓐ	44 or 45	Ⓐ	53	..	..	Ⓐ	65 or 66	Ⓐ	72
Ⓑ	44 or 45	Ⓑ	53	..	..	Ⓑ	65 or 66	Ⓑ	72
Ⓒ	44 or 45	Ⓒ	53	..	..	Ⓒ	65 or 66	Ⓒ	72
[A] Ⓐ	46 or 47	[A] Ⓐ	54	[A] Ⓐ	61	[A] Ⓐ	67	..	..
[B] Ⓑ	48 or 49	[B] Ⓑ	55	[B] Ⓑ	60	[B] Ⓑ	68	..	..
[B] Ⓐ	48 or 49	[B] Ⓐ	55	[B] Ⓐ	60	[B] Ⓐ	68	..	..

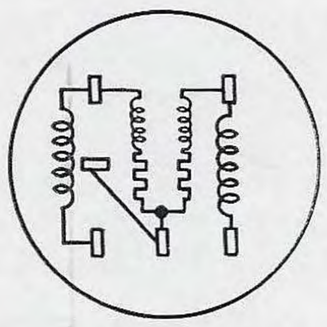
TYPE E SOCKET INSTRUMENTS—Continued

INTERNAL CONNECTIONS OF SOCKET INSTRUMENTS



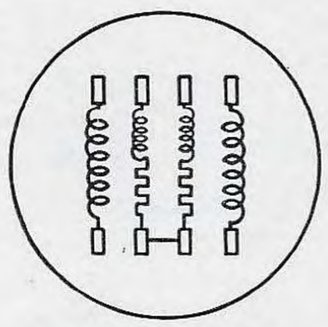
AMMETER

FIG. 36
3-PHASE, 3-WIRE
2-PHASE, 4-WIRE
3-PHASE, 4-WIRE
SINGLE-PHASE, 2-WIRE
D-C.



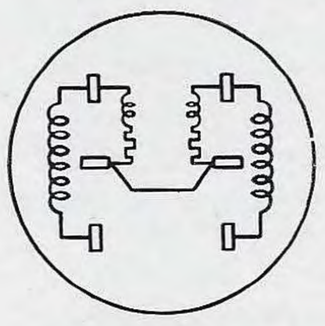
WATTMETER

FIG. 37
3-PHASE, 3-WIRE



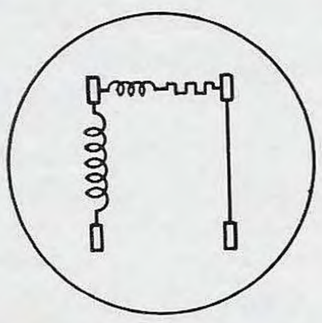
WATTMETER

FIG. 38
3-PHASE, 4-WIRE



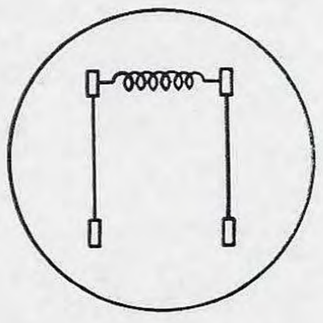
WATTMETER

FIG. 39
2-PHASE, 4-WIRE
FOR USE WITH CURRENT AND VOLTAGE TRANSFORMERS ONLY



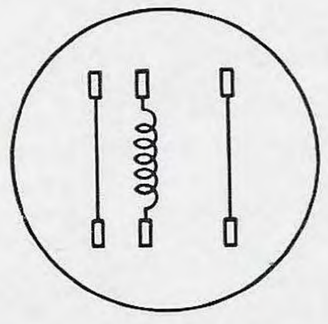
WATTMETER

FIG. 40
SINGLE-PHASE, 2-WIRE
D-C.



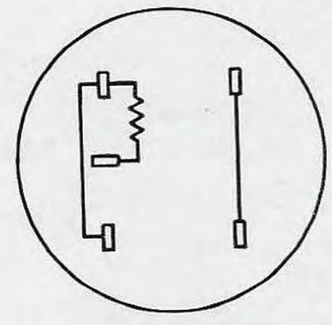
VOLTMETER

FIG. 41
SINGLE-PHASE, 2-WIRE
3-PHASE, 3-WIRE
D-C.



VOLTMETER

FIG. 42
3-PHASE, 4-WIRE



VOLTMETER

FIG. 43
2-PHASE, 4-WIRE

PARTIAL LIST OF TROUGH AND SWITCH MANUFACTURERS

SQUARE D COMPANY
6060 Rivard Street,
Detroit, Michigan

COLT'S PATENT FIRE ARMS COMPANY
Hartford
Connecticut

METROPOLITAN DEVICES CORP.
1250 Atlantic Avenue
Brooklyn, New York

PALMER ELEC. & MFG. CO.
Wakefield
Massachusetts

TRUMBULL ELECTRIC CO.
Plainville
Connecticut

ANCHOR MANUFACTURING CO.
40 Oliver Street
Boston, Mass.

TYPE E SOCKET INSTRUMENTS—Continued

3 PHASE, 3 WIRE INSTRUMENTS

TABLE I

The following instruments may be used interchangeably in the 5-Jaw, Type S-5 Sockets by selection of proper ratings. See Socket Connection Diagrams Figs. 44 to 49. See Instrument Internal Connections, Figs. 36, 37 and 41.

LIST PRICES

SOCKET INSTRUMENTS

Style number and price include the instrument unit calibrated and complete with glass cover ready to be plugged into socket, but **does not include the socket.**

TYPE EA

A-C. AMMETERS—SELF CONTAINED

(Measures Current in Line 1)

Rating	Scale Divisions	Style No.	List Price Discount Symbol BC
0–5	50	938 528	$ 28 00
0–10	50	938 529	28 00
0–15	30	938 530	32 00
0–25	50	938 531	32 00
0–30	30	938 532	32 00
0–50	50	938 533	34 00
0–75	75	938 534	34 00

A-C. AMMETERS

For Use with Transformers—5 Ampere Coil
Scale Marked for Primary Rating of Transformer

Rating	Scale Divisions	Style No.	List Price Discount Symbol BC
Uncal.‡	..	939 233	$28 00
0–10	50	938 535	28 00
0–15	30	938 536	28 00
0–25	50	938 537	28 00
0–50	50	938 538	28 00
0–75	75	938 539	28 00
0–100	50	938 540	28 00
0–150	30	938 541	28 00
0–200	40	938 542	28 00
0–300	30	938 543	28 00
0–400	40	938 544	28 00
0–500	50	938 545	28 00
0–600	30	938 546	28 00
0–800	40	938 547	28 00
0–1000	50	938 548	28 00
0–1500	30	938 549	28 00
0–2000	40	938 550	28 00
0–3000	30	938 551	28 00
0–4000	40	938 552	28 00
0–5000	50	938 553	28 00

‡ 5 Amp. Coil. Dial uncalibrated. Specify transformer ratio and dial marking.

A-C. VOLTMETERS—SELF CONTAINED

(Measures Voltage Between Lines 1 and 3)

Rating	Scale Divisions	Style No.	List Price Discount Symbol BC
0–150	30	938 554	$ 30 00
0–300	30	938 555	34 00
0–600	30	938 556	42 00

POLYPHASE WATTMETERS

Self-Contained

With 2 Current Coils and 2 Voltage Coils

(Measures Total Power)

Amperes	Volts	Style No.	List Price Discount Symbol BC
5†	115†*	938 569	$ 76 00
10	115	938 570	76 00
20	115	938 571	76 00

† These styles calibrated as desired for use with transformers.
* For circuits higher than 115 volts, voltage transformers must be used.

TEST JACK, 3-PHASE, 3-WIRE

Style No.	List Price Discount Symbol BC
1 055 810	$23 00

TEST JACK CABLES, 3-PHASE, 3-WIRE

For Connecting	Ampere Capacity of Cable	Style No.	Net Price
TA Analyzer	125	1 002 483	$20 00
G-40 Recorder	20	1 003 851	15 00

INSERT SOCKETS, 3-PHASE, 3-WIRE

Style No.	List Price Discount Symbol BC
1 056 868	$22 00

TYPE S-5, 5-JAW SOCKETS

For Use on 3-Phase, 3-Wire Circuits

With Circuit Closing Device on Both Sides

Complete with Terminal Block and Sealing Ring. Sockets have Two Threaded Outlets.

Size of Outlet in Inches	VERTICAL Style No.	VERTICAL List Price Discount Symbol SC	HORIZONTAL Style No.	HORIZONTAL List Price Discount Symbol SC
¾	934 315	$4 15	934 318	$4 50
1	934 316	4 05	934 319	4 40
1¼	934 317	4 15	934 320	4 50

For information and prices on the Type G-40 Recorders for use with the above accessories, refer to Catalog Section 43-400.

For information and prices on Industrial Analyzers for use with the above accessories, see Catalog Section 43-145.

For Type A Socket Recorders, See Catalog Section 43-650.

For Watthour Meters, See Catalog Section 42-210.

TYPE E SOCKET INSTRUMENTS—Continued

3 PHASE, 3 WIRE INSTRUMENTS—Continued

CONNECTION DIAGRAMS

Using 5-Jaw, Type S-5 Sockets with Circuit Continuity Devices (All Front Views)

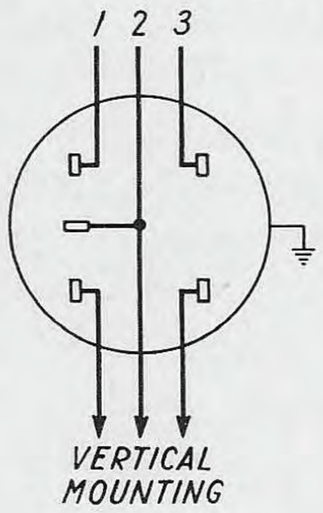


FIG. 44

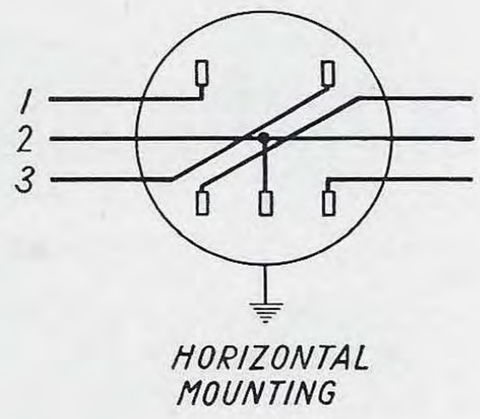


FIG. 45

SELF-CONTAINED—575 VOLTS AND LOWER

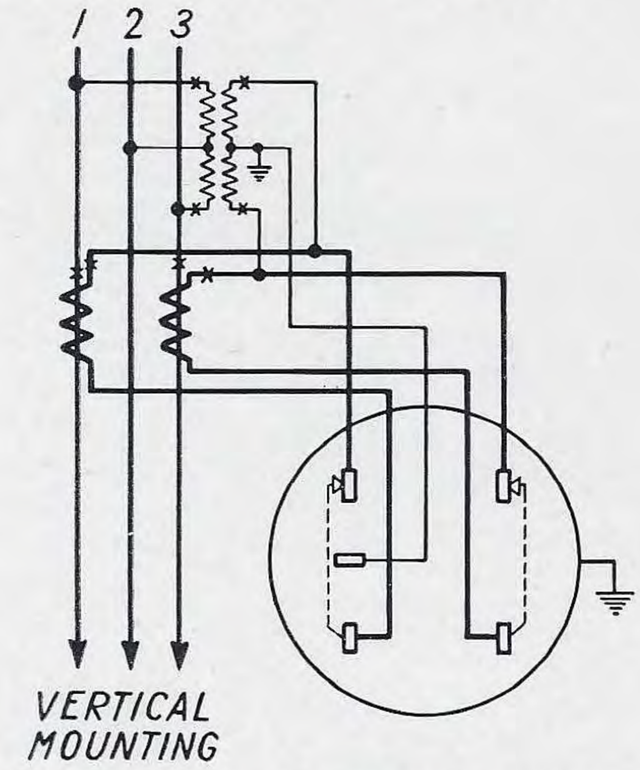


FIG. 46—CURRENT AND VOLTAGE TRANSFORMERS

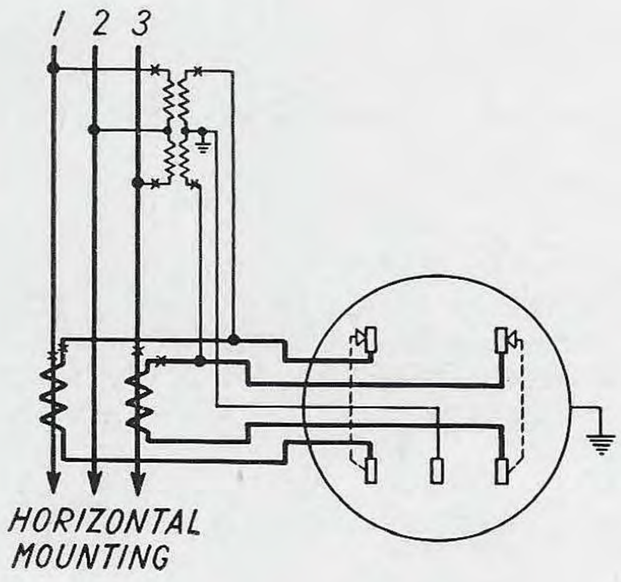


FIG. 47—CURRENT AND VOLTAGE TRANSFORMERS

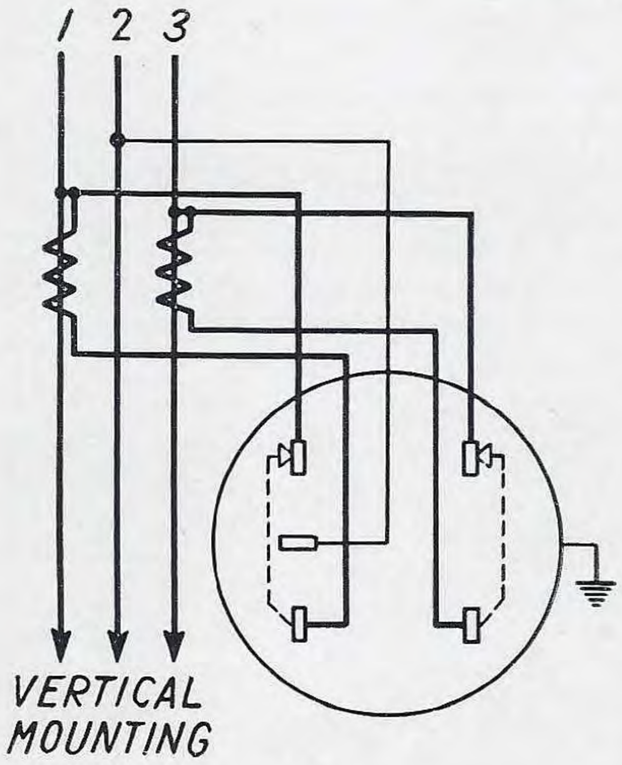


FIG. 48

CURRENT TRANSFORMERS—SELF-CONTAINED ON VOLTAGE, ABOVE 575 VOLTS USE VOLTAGE TRANSFORMERS

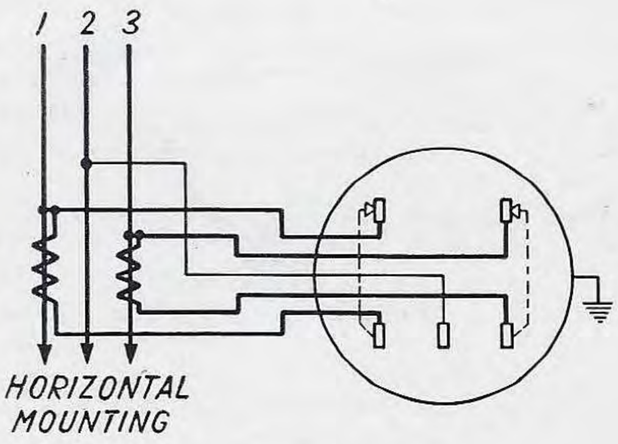


FIG. 49

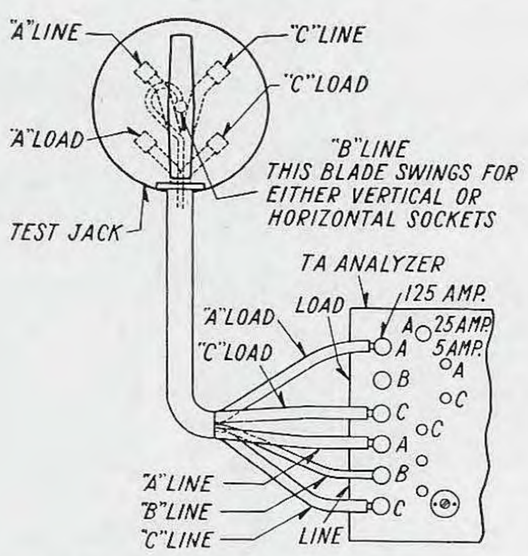


FIG. 50—TEST JACK SHOWING TYPICAL CONNECTIONS WITH TA INDUSTRIAL ANALYZER. CONTINUOUS CAPACITY OF HEAVY LEADS 90 AMPERES, LIGHT LEAD 15 AMPERES (SELF-CONTAINED OR TRANSFORMERS.)

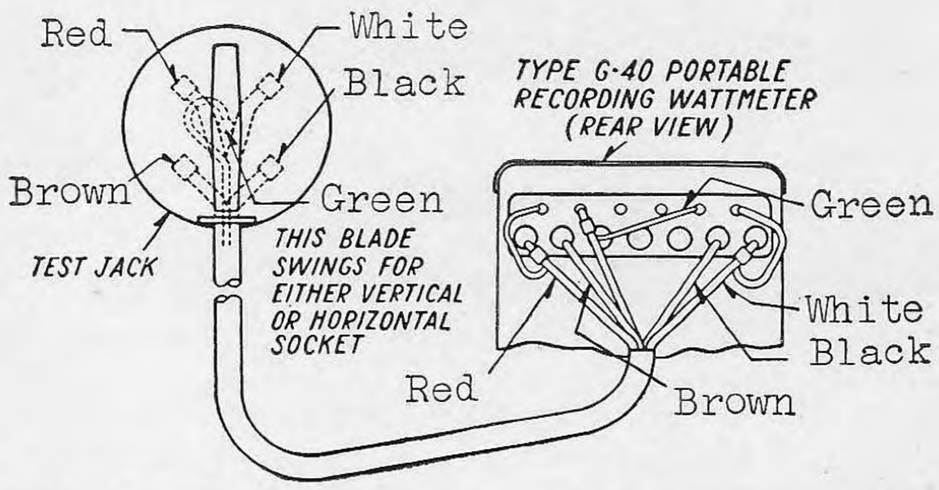
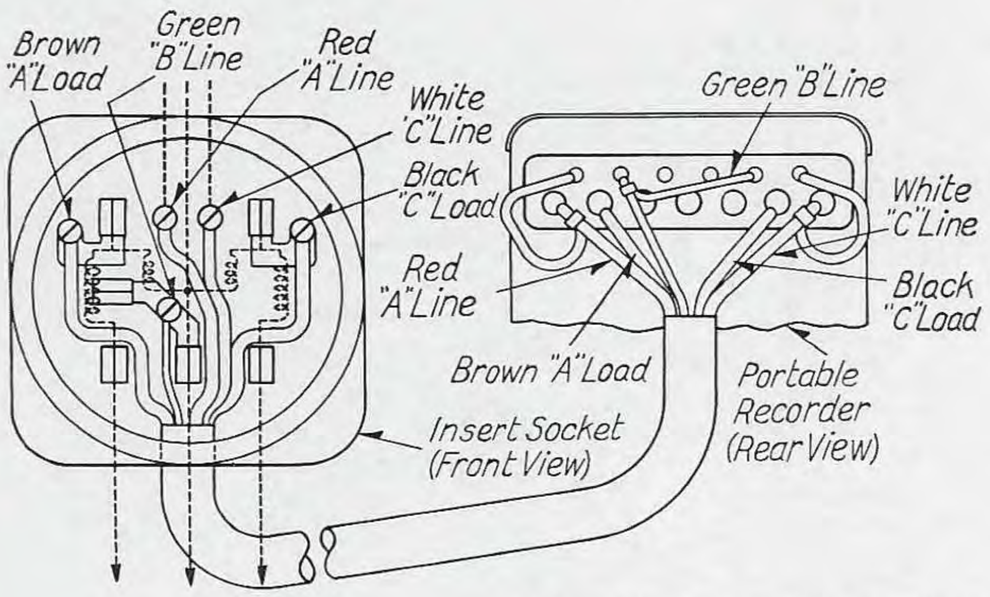


FIG. 51—TEST JACK SHOWING TYPICAL CONNECTIONS WITH G-40 RECORDER. CONTINUOUS CAPACITY OF LEADS 20 AMPERES (SELF-CONTAINED OR TRANSFORMERS.)

TYPE E SOCKET INSTRUMENTS—Continued

3 PHASE, 3 WIRE INSTRUMENTS CONNECTION DIAGRAMS

Using 5-Jaw, Type S-5 Sockets with Circuit Continuity Devices (All Front Views)



Dotted lines are the usual wiring and are for reference only.

Solid lines are for the insert socket wiring. Current wires must be large enough to carry the line current if the socket is self-contained. If current transformers are used, leads must carry the secondary current. If either or both current circuits are not used, they must be closed with jumpers.

Circuit closing devices must be used on transformer type installations.

FIG. 52—INSERT SOCKET SHOWING TYPICAL CONNECTIONS WITH G-40 RECORDER.

2 PHASE, 4 WIRE INSTRUMENTS
TABLE II

The following instruments (except wattmeters) may be used interchangeably in the 6-Jaw, Type S-6 Sockets by selection of proper ratings. See Socket Connection Diagrams Figs. 53 to 55. See Instrument internal connections Figs. 36, 39 and 43. For Wattmeter use connection diagram Fig. 54 only.

LIST PRICES
SOCKET INSTRUMENTS

Style Number and price include the instrument unit calibrated and complete with glass cover ready to be plugged into socket, but **does not include the socket.**

TYPE EA—A-C. AMMETERS

(Same as 3 Phase, 3 Wire (See Table I)
Measures Current in Phase A

TYPE EA—A-C. VOLTMETERS

Self-Contained
Measures Voltage on Phase A

Rating	Scale Divisions	Style No.	List Price Discount Symbol BC
0–150	30	1 056 848	$30 00
0–300	30	1 056 849	34 00
0–600	30	1 056 850	42 00

TYPE EY POLYPHASE WATTMETERS

Self-Contained
With 2 Current Coils and 2 Voltage Coils
(Measures Total Power)
For Use with Voltage Transformers Only

Amperes	Volts	Style No.	List Price Discount Symbol BC
5†	115†	1 056 851	$76 00
10	115	1 056 852	76 00
20	115	1 056 853	76 00

† These styles calibrated as desired for use with Transformers.

TYPE S-6, 6-JAW SOCKETS

For use on 2-Phase, 4-Wire Circuits
Complete with Terminal Block and Sealing Ring
Circuit Closing Device on Both Sides
Vertical Socket with Two-Threaded Outlets

Size of Outlet in Inches	Style No.	List Price Discount Symbol SC
¾	929 471	$4 55
1	929 472	4 45
1¼	929 473	4 55

TEST JACK, 2-PHASE, 4-WIRE

Style No.	List Price Discount Symbol BC
1 005 810	$23 00

TEST JACK CABLES, 2-PHASE, 4-WIRE

For Connecting	Ampere Capacity of Cable	Style No.	Net Price
TA Analyzer	20	1 056 863	$15 00
G-40 Recorder	20	1 003 851	15 00

INSERT SOCKETS, 2-PHASE, 4-WIRE

Style No.	List Price Discount Symbol BC
1 056 869	$22 00

For information and prices on the Type G-40 Recorders for use with the above accessories, refer to Catalog Section 43-400.

For information and prices on Industrial Analyzers for use with the above accessories, see Catalog Section 43-145.

For Type A Socket Recorders, see Catalog Section 43-650.

For Watthour Meters, see Catalog Section 42-210.

Order by Style Number

TYPE E SOCKET INSTRUMENTS—Continued

2 PHASE, 4 WIRE INSTRUMENTS—Continued

CONNECTION DIAGRAMS

Using 6-Jaw, Type S-6 Sockets with Circuit Continuity Devices (All Front Views)

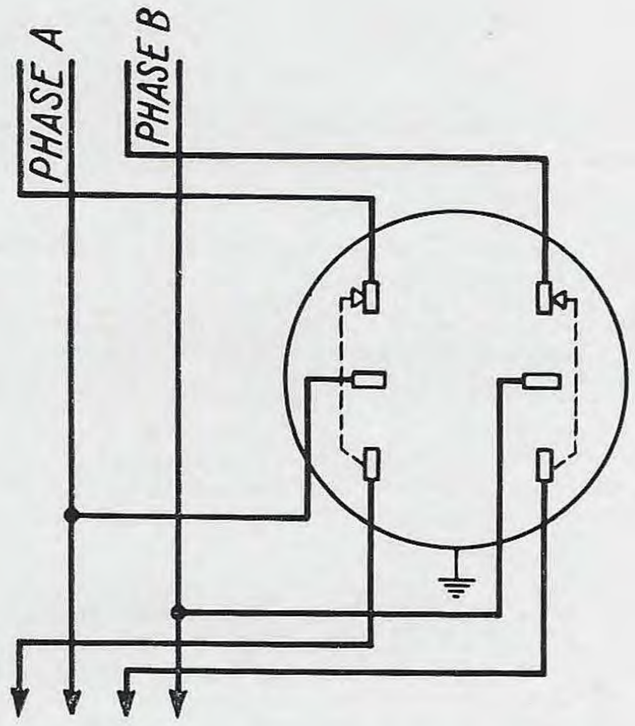


FIG. 53—SELF-CONTAINED (575 VOLTS AND LOWER) FOR VERTICAL MOUNTING ONLY.

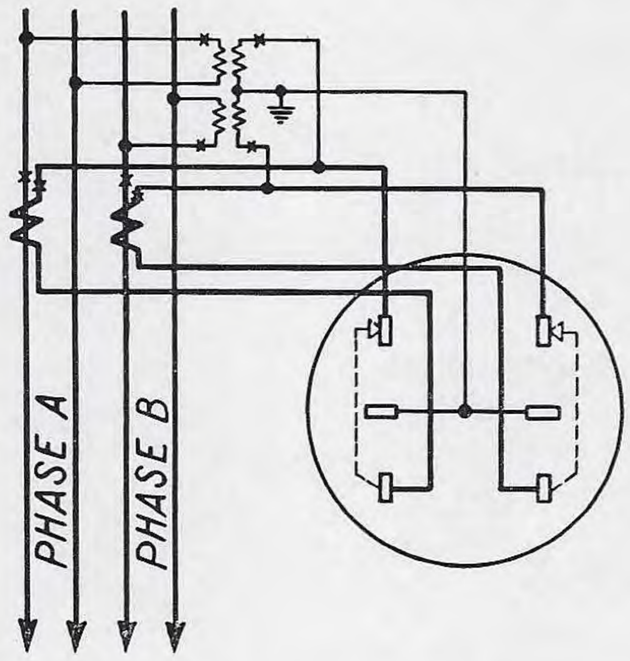


FIG. 54—CURRENT AND VOLTAGE TRANSFORMERS, FOR VERTICAL MOUNTING ONLY.

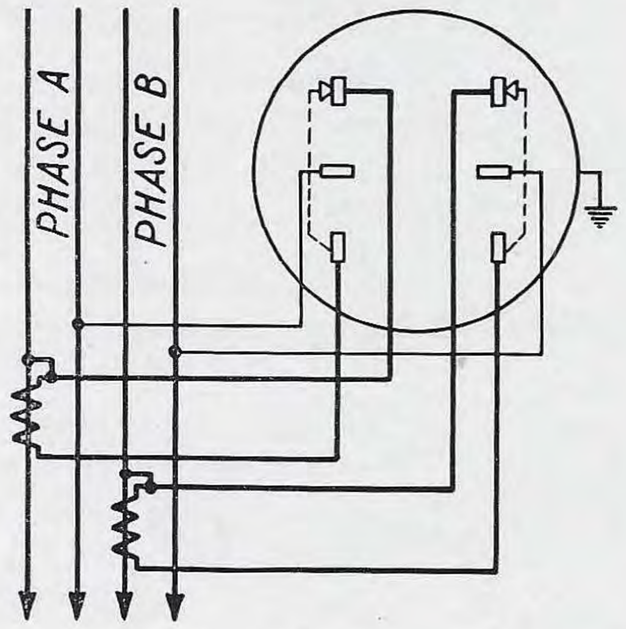
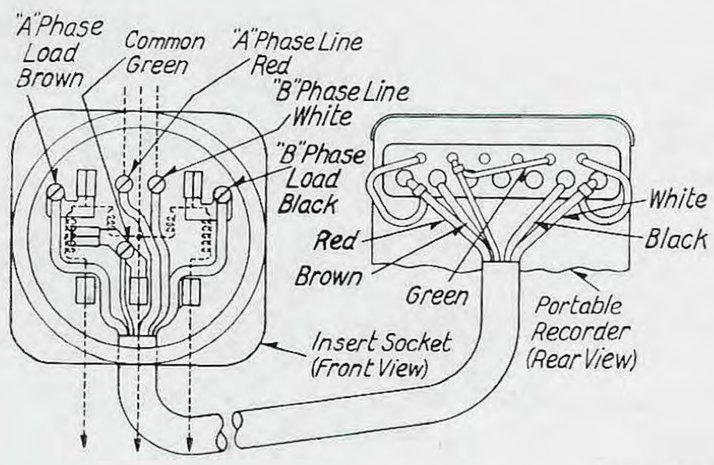


FIG. 55—CURRENT TRANSFORMERS ONLY (575 VOLTS AND LOWER) FOR VERTICAL MOUNTING ONLY.



Dotted lines are the usual wiring and are for reference only. Solid lines are for the insert socket wiring.

Current wires must be large enough to carry the line current if the socket is self contained. If current transformers are used leads must carry the secondary current. If either or both current circuits are not used, they must be closed with jumpers.

Circuit closing devices must be used on transformer type installations.

FIG. 56—INSERT SOCKET SHOWING TYPICAL CONNECTIONS WITH G-40 RECORDER. (CURRENT AND VOLTAGE TRANSFORMERS ARE USED).

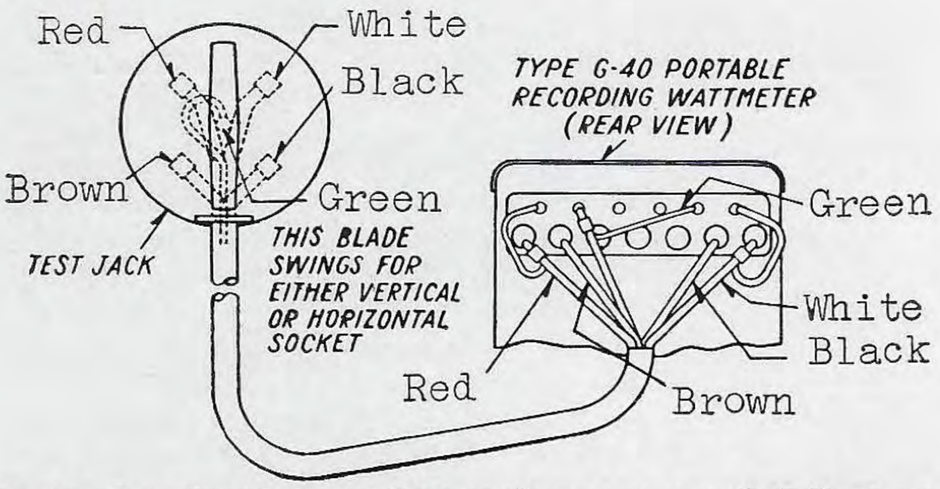


FIG. 57—TEST JACK SHOWING TYPICAL CONNECTIONS TO G-40 RECORDER. (CURRENT AND VOLTAGE TRANSFORMERS ARE USED). CONTINUOUS CAPACITY OF LEADS 20 AMPERES.

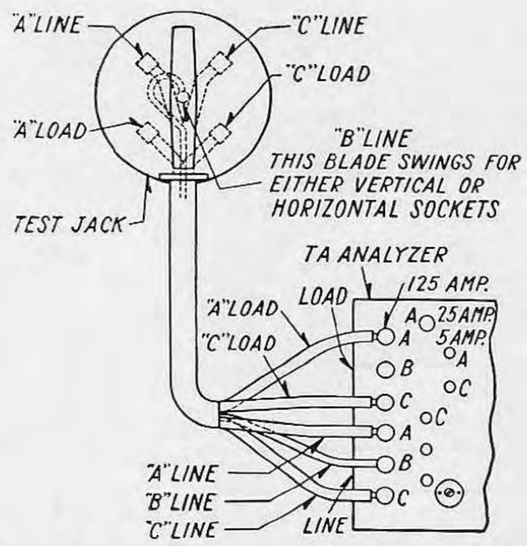


FIG. 58—TEST JACK SHOWING TYPICAL CONNECTIONS WITH TA INDUSTRIAL ANALYZER. (CURRENT AND VOLTAGE TRANSFORMERS ARE USED). CAPACITY OF LEADS 20 AMPERES.

TYPE E SOCKET INSTRUMENTS—Continued

3-PHASE, 4-WIRE INSTRUMENTS

TABLE III

The following instruments may be used interchangeably in the 8-Jaw Type S-2 Sockets by selection of proper ratings. See Socket connection diagrams Figs. 60 and 61. See Instrument internal Connections Figs. 36, 38 and 42.

LIST PRICES

SOCKET INSTRUMENTS

Style Number and price includes the instrument unit calibrated and complete with glass cover ready to be plugged into socket, but **does not include the socket.**

TYPE EA—A-C. AMMETERS

Measures Current in Line 1
(Same as 3 Phase, 3 Wire. See Table I)

TYPE EA—A-C. VOLTMETERS

Self-Contained
(Measures Voltage Between Line 1 and Neutral)

Rating	Scale Divisions	Style No.	List Price Discount Symbol BC
0–150	30	1 056 854	$30 00
0–300	30	1 056 855	34 00
0–600	30	1 056 856	42 00

TYPE EY POLYPHASE WATTMETERS

Self-Contained
With 2 Current Coils and 2 Voltage Coils
(Measures Total Power)

Amperes	Volts	Style No.	List Price Discount Symbol BC
5†	115†*	1 056 857	$76 00
10	115	1 056 858	76 00
20	115	1 056 859	76 00

† These styles calibrated as desired for use with transformers.
* For circuits higher than 115 volts, voltage transformers must be used.

TYPE S-2, 8-JAW SOCKETS

For use on 4-Phase, 3-Wire Circuits
(Vertical Mounting)
Socket Has One Threaded Outlet in Top and Knock-outs in Bottom
Style Number Includes Socket Complete with Terminal Block and Sealing Ring
With Circuit Closing Device

Size of Outlet in Inches	Style No.	List Price Discount Symbol SC
1¼	937 620	$15 00
2	937 621	15 85

TEST JACK, 3-PHASE, 4-WIRE

Style No.	List Price Discount Symbol BC
1 056 861	$23 00

TEST JACK CABLES, 3-PHASE, 4-WIRE

For Connecting	Ampere Capacity of Cable	Style No.	Net Price
TA Analyzer	20	1 056 865	$18 00
G-40 Recorder	20	1 056 866	18 00

INSERT SOCKET, 3-PHASE, 4-WIRE

Style No.	List Price Discount Symbol BC
1 056 870	$22 00

For information and prices on the Type G-40 Recorders for use with the above accessories, refer to Catalog Section 43-400.

For information and prices on Industrial Analyzers for use with the above accessories, see Catalog Section 43-145

For Type A Socket Recorders, see Catalog Section 43-650.
For Watthour Meters, see Catalog Section 42-210.

CONNECTION DIAGRAMS

Using 8-Jaw, Type S-2 Sockets with Circuit Continuity Devices (All Front Views)

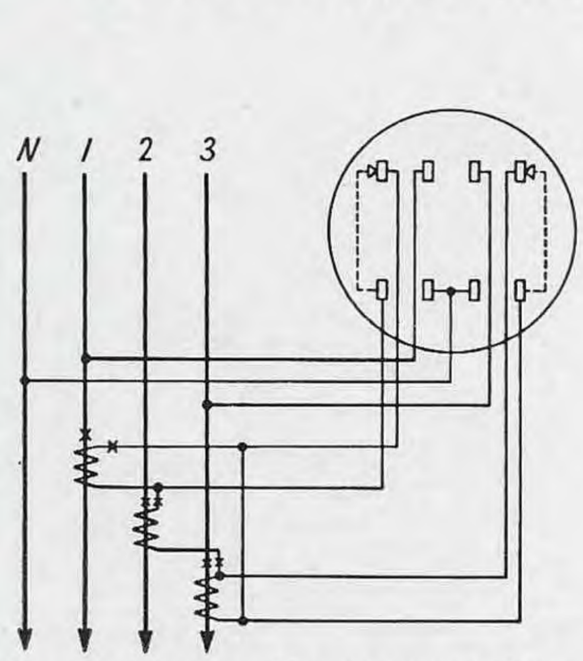


FIG. 60—CURRENT TRANSFORMERS ONLY 575 VOLTS AND BELOW.

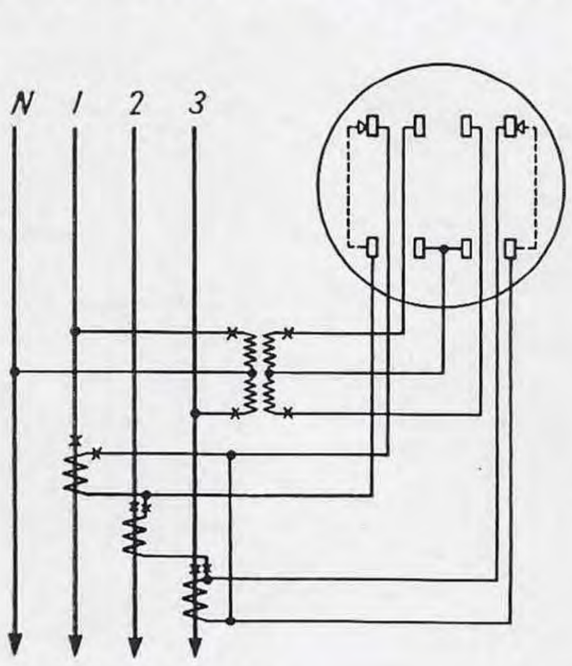


FIG. 61—CURRENT AND VOLTAGE TRANSFORMERS

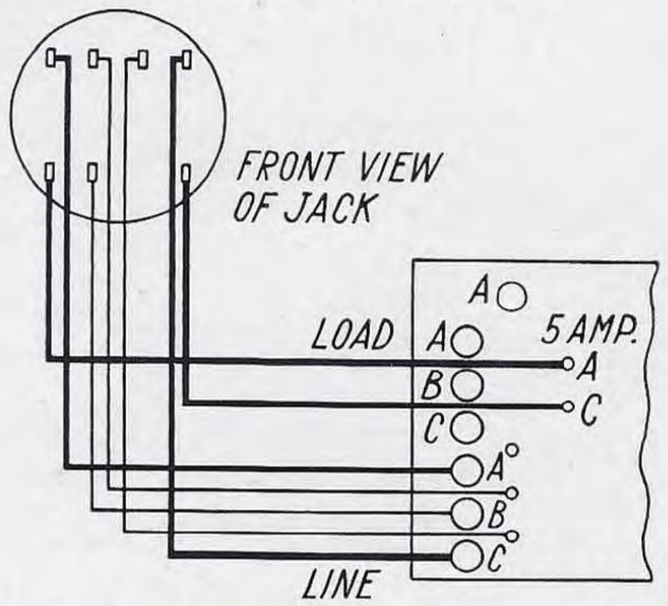


FIG. 62—TEST JACK SHOWING TYPICAL CONNECTIONS WITH TA ANALYZER. (CURRENT TRANSFORMERS MUST BE USED). CAPACITY OF LEADS 20 AMPERES.

TYPE E SOCKET INSTRUMENTS—Continued

3-PHASE, 4-WIRE INSTRUMENTS—Continued

CONNECTION DIAGRAMS—Continued

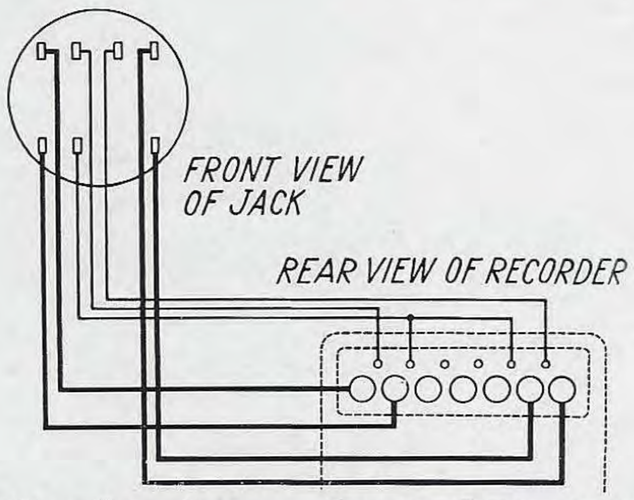


FIG. 63—TEST JACK SHOWING TYPICAL CONNECTIONS FOR G-40 RECORDER. CAPACITY OF LEADS 20 AMPERES. (CURRENT TRANSFORMERS MUST BE USED).

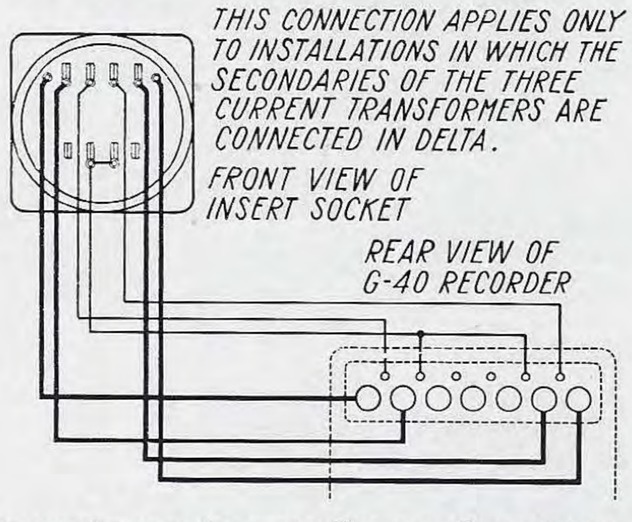


FIG. 64—INSERT SOCKET SHOWING TYPICAL CONNECTION WITH G-40 RECORDER. CAPACITY OF CABLE 20 AMPERES. (CURRENT TRANSFORMERS MUST BE USED.

SINGLE PHASE, 2 WIRE INSTRUMENTS

TABLE IV

The following instruments may be used interchangeably in the 4-Jaw, Type S Sockets by selection of proper ratings. See Socket Connection Diagrams, Figs. 65 to 68. See instrument internal connections, Figs. 36, 40 and 41.

LIST PRICES

SOCKET INSTRUMENTS

Style Number and price includes the instrument unit calibrated and complete with glass cover ready to be plugged into socket, but **does not include the socket.**

TYPE EA AMMETERS

(Measures Total Current)
Same as 3-Phase, 3-Wire (See Table I)

TYPE EA VOLTMETERS

(Measures Line Voltage)
Same as 3-Phase, 3-Wire (See Table I)

TYPE EY WATTMETERS

Single Phase
(Measures Total Power)

Amperes	Volts	Style No.	List Price Discount Symbol BC
5†	115†*	938 557	$50 00
10	115	938 558	50 00
20	115	938 559	50 00

† This style calibrated as desired, for use with transformers.
* For circuits higher than 115 volts, voltage transformers must be used.

TYPE S, 4-JAW SOCKETS

For use on Single Phase, 2-Wire Circuits
Same as D-C. 2-Wire (See Table V)

TEST JACK, SINGLE PHASE, 2-WIRE

Style No.	List Price Discount Symbol BC
1 056 862	$23 00

TEST JACK CABLES, SINGLE PHASE, 2-WIRE

For Connecting	Ampere Capacity of Cable	Style No.	Net Price
TA Analyzer	125	1 056 968	$18 00
G-40 Recorder	20	1 056 969	15 00

INSERT SOCKET, SINGLE PHASE, 2-WIRE

Style No.	List Price Discount Symbol BC
1 056 871	$22 00

For information and prices on the Type G-40 Recorders for use with the above accessories, refer to Catalog Section 43-400.

For information and prices on Industrial Analyzers for use with the above accessories, see Catalog Section 43-145.

For Type A Socket Recorders, see Catalog Section 43-650.
For Watthour Meters, see Catalog Section 42-110.

Order by Style Number

TYPES E SOCKET INSTRUMENTS—Continued

SINGLE PHASE, 2 WIRE INSTRUMENTS—Continued

CONNECTION DIAGRAMS

Using 4-Jaw, Type S Sockets with Circuit Continuity Devices (All Front Views)

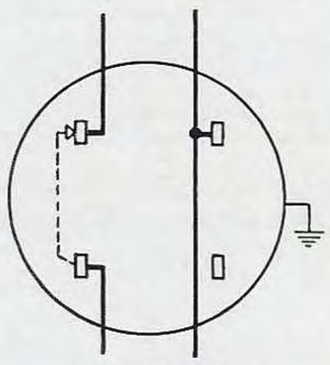


FIG. 65

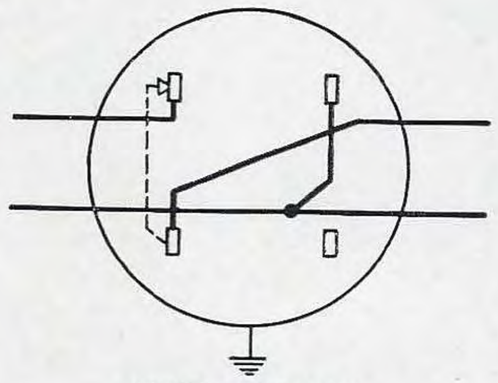


FIG. 66

SELF-CONTAINED, 575 VOLTS AND BELOW.

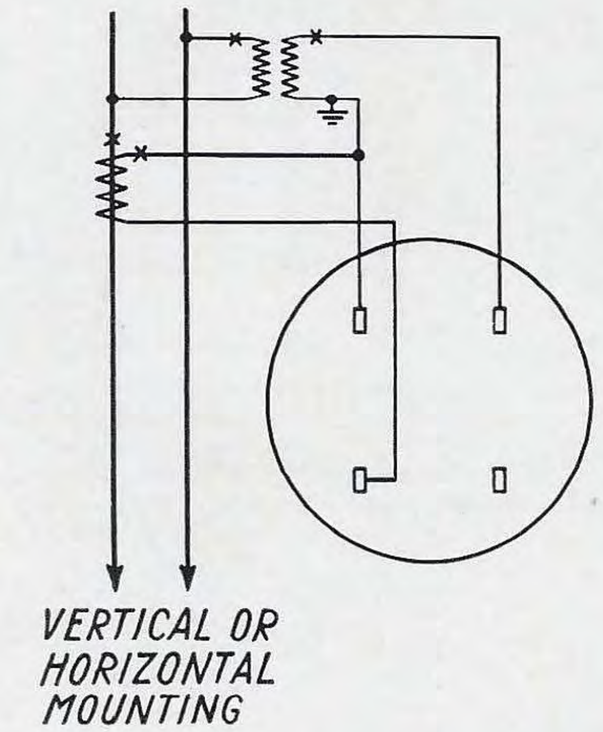


FIG. 67—CURRENT AND VOLTAGE TRANSFORMERS

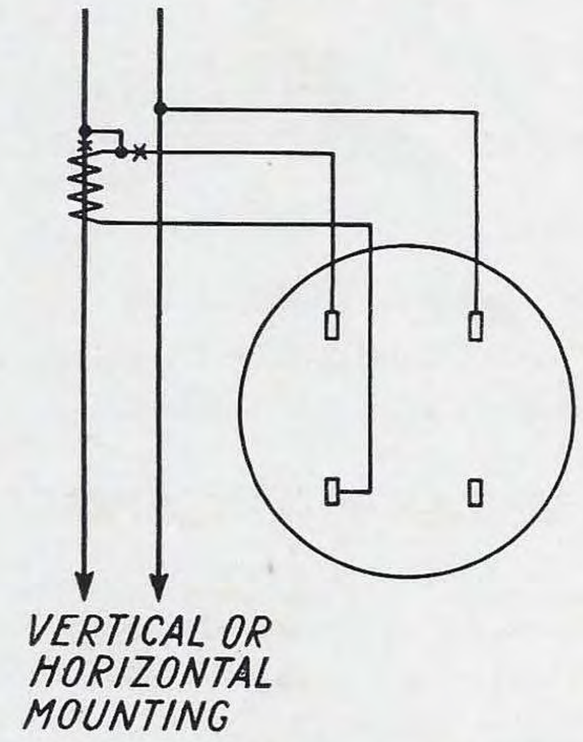


FIG. 68—CURRENT TRANSFORMERS ONLY—575 VOLTS AND LOWER.

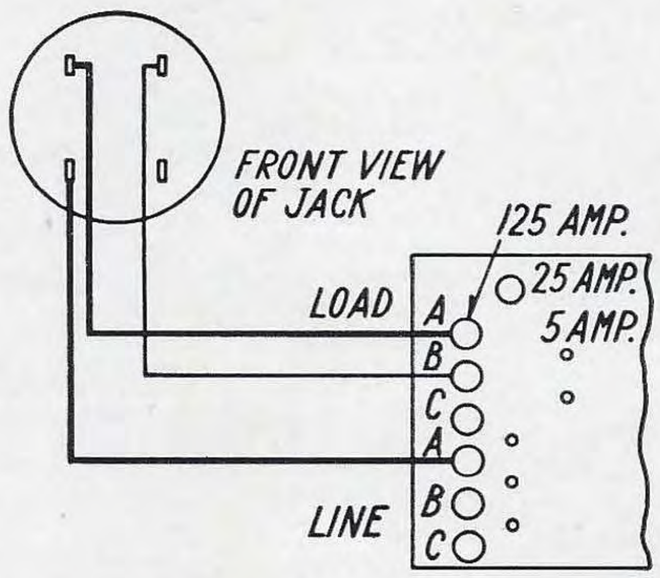


FIG. 69—TEST JACK SHOWING TYPICAL CONNECTIONS WITH TA ANALYZER. CABLE CAPACITY 125 AMPERES.

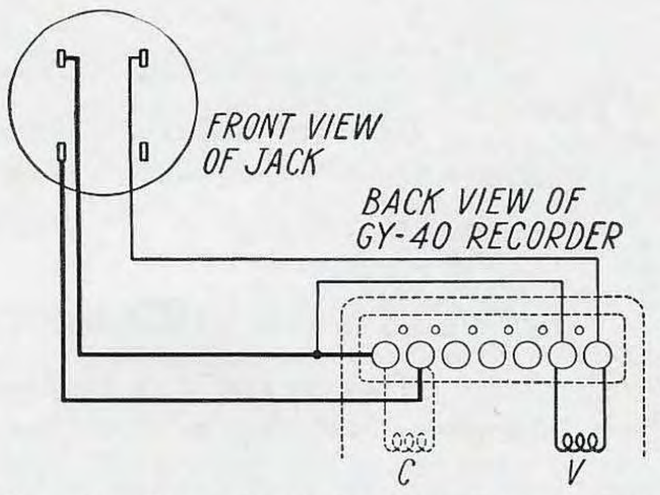


FIG. 70—TEST JACK SHOWING TYPICAL CONNECTIONS TO G-40 RECORDER. CABLE CAPACITY 20 AMPERES.

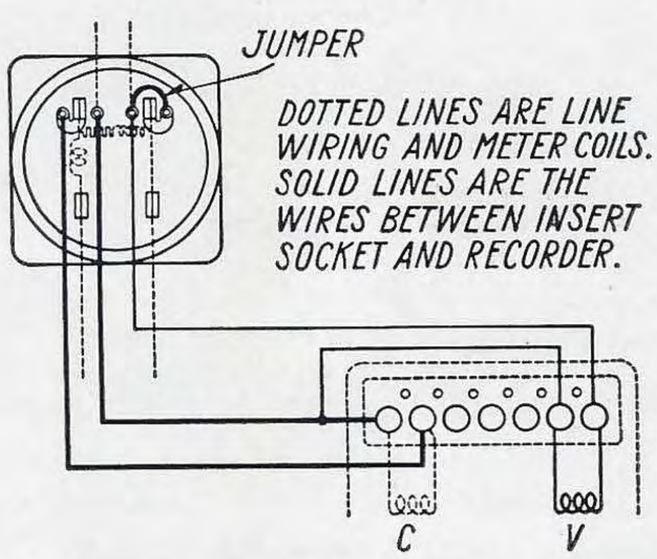


FIG. 71—INSERT SOCKET SHOWING TYPICAL CONNECTIONS TO G-40 RECORDER. CAPACITY OF LEADS 20 AMPERES.

TYPE E SOCKET INSTRUMENTS—Continued

D-C. 2 WIRE INSTRUMENTS

TABLE V

The following instruments may be used interchangeably in the 4-Jaw, Type S Sockets by selection of proper ratings.

See Socket Connection diagrams, Figs. 72 and 73.

See Instrument internal connections, Figs. 36, 40 and 41.

LIST PRICES

SOCKET INSTRUMENTS

Style number and price include the instrument unit calibrated and complete with glass cover ready to be plugged into socket, **but does not include the socket.**

TYPE EX
D-C. AMMETERS—SELF CONTAINED

(Measures Line Current)

Amperes	Volts	Style No.	List Price Discount Symbol BC
0– 5	50	938 518	$37 50
0-10	50	938 519	37 50
0–15	30	938 520	37 50
0–25	50	938 521	37 50
0-30	30	938 522	37 50
0–50	50	1094 858	37 50
0–75	75	1094 859	37 50

D-C. Ammeters for Use with Shunt

	Style No.	List Price Discount Symbol BC
Dial marked same as shunt rating	938 523	$ 32 00

Price and Style Number includes pair of 8-foot leads, but not the shunt.

D-C. VOLTMETERS—SELF CONTAINED

(Measures Line Voltage)
Resistance 200 Ohms Per Volt

Amperes	Volts	Style No.	List Price Discount Symbol BC
0–150	30	938 524	$32 00
0–300	30	938 525	36 00
0–500	50	938 526	39 00
0–750	75	938 527	48 00

TYPE EY
SINGLE PHASE WATTMETERS
A-C. AND D-C.

(Measures Total Power-Self Contained Only)

Amperes	Volts	Style No.	List Price Discount Symbol BC
5	115	938 557	$ 50 00
10	115	938 558	50 00
20	115	938 559	50 00

TEST JACK (D-C. 2-Wire)

Style No.	List Price Discount Symbol BC
1 056 862	$23 00

TEST JACK CABLES (D-C. 2-Wire)

For Connecting	Ampere Capacity of Cable	Style No.	Net Price
TX Analyzer	75	1 056 867	$18 00
G-40 Recorder	20	1 056 969	15 00

INSERT SOCKET (D-C. 2-Wire)

Style No.	List Price Discount Symbol BC
1 056 871	$22 00

SOCKETS

TYPE S 4 JAW SOCKETS

With Circuit Closing Device on One Side Only
For Use on Single Phase A-C., 2-Wire and D-C., 2-Wire Circuits
Complete with Terminal Block and Sealing Ring Sockets with Two Threaded Outlets

Size of Outlet in Inches	VERTICAL Style No.	VERTICAL List Price Discount Symbol SC	HORIZONTAL Style No.	HORIZONTAL List Price Discount Symbol SC
¾	837 679	$3 75	936 837	$4 10
1	837 680	3 65	936 838	4 00
1¼	837 681	3 75	936 839	4 10

For information and prices on the Type G-40 Recorders for use with the above accessories, refer to Catalog Section 43-400.

For information and prices on Industrial Analyzers for use with the above accessories, see Catalog Section 43-146.

Order by Style Number

TYPE E SOCKET INSTRUMENTS—Continued

D-C., 2-WIRE INSTRUMENTS—Continued

CONNECTION DIAGRAMS

Using 4-Jaw, Type S Sockets with Circuit Continuity Devices
(All front views)

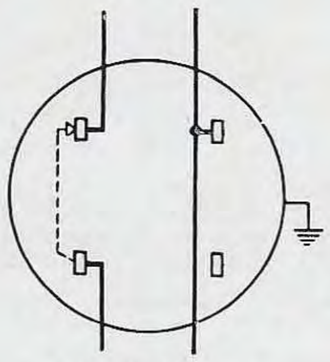


FIG. 72—VERTICAL OR HORIZONTAL SELF-CONTAINED.

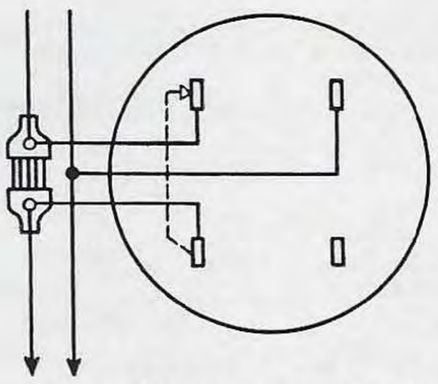


FIG. 73—VERTICAL OR HORIZONTAL WITH EXTERNAL SHUNT.

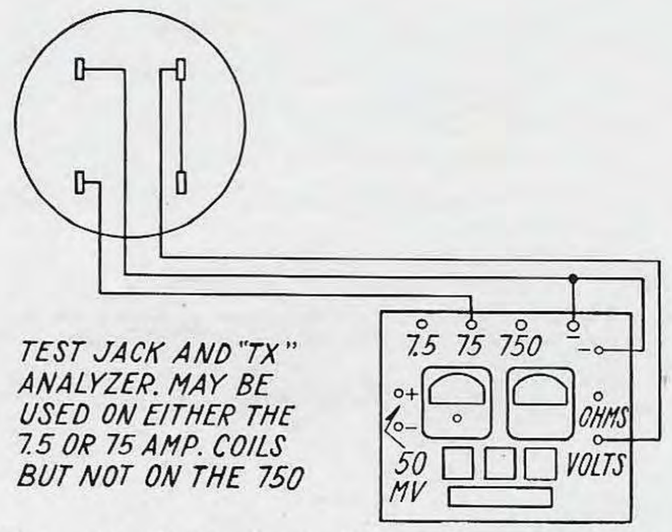


FIG. 74—TEST JACK WITH TX ANALYZER. CABLE CAPACITY 75 AMPERES.

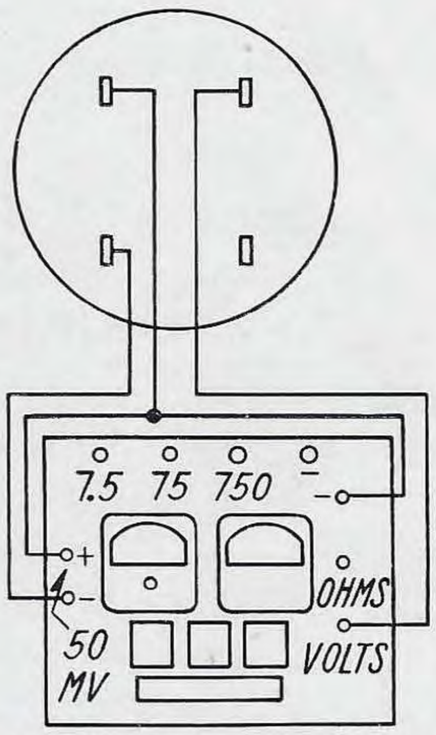


FIG. 75—TEST JACK WITH TX ANALYZER (EXTERNAL SHUNT)

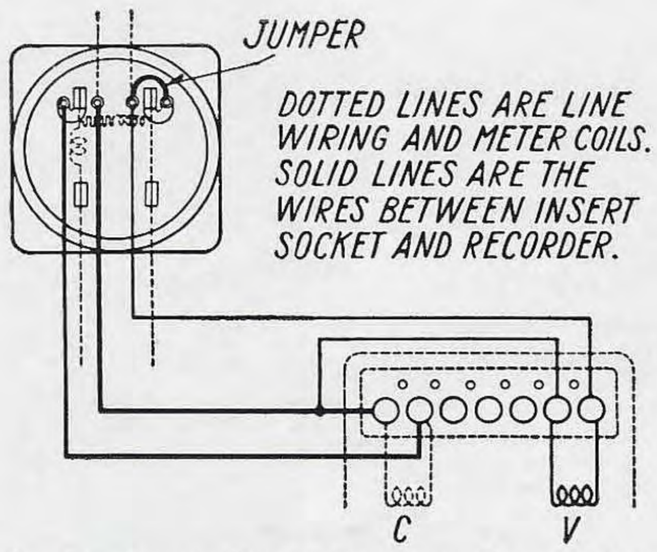


FIG. 76—INSERT SOCKET SHOWING TYPICAL CONNECTIONS TO G-40 RECORDER. CAPACITY OF LEADS 20 AMPERES.

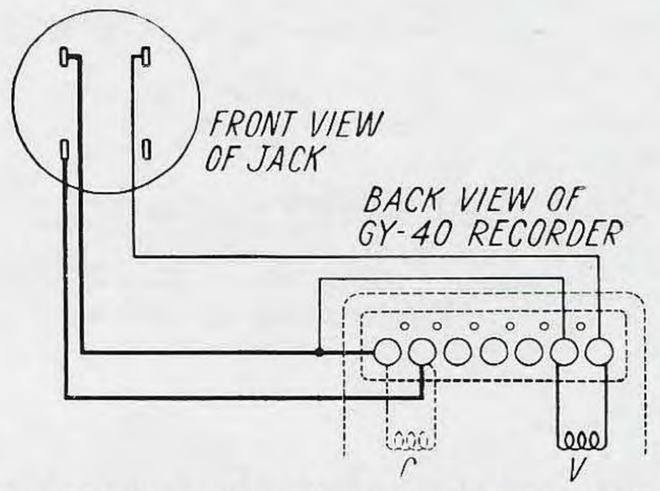


FIG. 77—TEST JACK SHOWING TYPICAL CONNECTIONS TO G-40 RECORDER. CABLE CAPACITY 20 AMPERES.

ACCESSORIES FOR ALL SOCKETS

	Size	Style No.	List Price Discount Symbol SC
Aluminum alloy plug complete with sealing screw for closing unused outlets in sockets.	1¼	838 314	35c each
	1	838 315	25c each
	¾	838 316	20c each
Glass cover plate for closing off sockets when not in use.....		878 373	25c each

LOAD CARRYING DEVICES FOR ALL SOCKETS

	Style No.	List Price Discount Symbol BC
Insulated Copper Jumper.....	1 002 402	50c each
Circuit Closing insert consisting of base plate with circuit jumpers and glass cover.....	1 009 979*	$3 00

* Not to be used with 3-phase, 4-wire Sockets.

Order by Style Number

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