Westinghouse
Types HA, HX and HY Instruments
INSTRUCTIONS

GENERAL

Unpack instruments carefully noting that bag containing terminal and mounting hardware, and any external resistors or reactor boxes required are present.

Drill panel according to information on last page, mounting the instrument according to instructions. Before tightening instrument in position it is recommended that alignment instrument be checked with a spirit level. If vibration is present on the mounting it should be damped or filtered out by springs or soft rubber bushings.

Connect instruments according to external wiring diagram on this leaflet or according to switchboard wiring diagram if instrument is furnished as part of a switchboard order. Observe all circuit precautions listed under diagrams in this leaflet. All external connections should be made with approved type of wire having sufficient cross-section and insulation for the service.

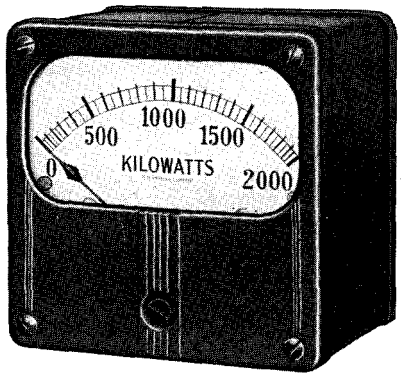
Adjustments and repairs should be made only by skilled meter men familiar with the instruments.

Do not disturb the balance of the moving element. Balance adjustments should be made only by skilled repair men.

Do not jar or strike the instrument to free the moving element in case it "seems to be stuck," as a cracked jewel or ruined pivot may result. Sticking is a sign that friction or misalignment is present, and to prevent further trouble, this must be corrected properly.

ALTERNATING CURRENT INSTRUMENTS

1. Type HA ammeters and voltmeters operate on the repulsion iron vane principle. Two flat Hipernik 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. Calibration adjustments are made by shifting the outer end of the spring in its holder after loosening the small clamping screw. The zero adjuster should be left in mid-position, the pointer being set to zero by shifting the small tail piece of the inner spring adjuster located beneath the



spring, using a small-bore aluminum tube as a wrench. The outer spring clamping screw must be tightened before shifting the inner spring adjuster.

2. Type HY wattmeters are of the electrodynamic type. Polyphase wattmeters may be checked on single phase circuits by testing each element separately, or the current coils may be connected in series and the potential coils in parallel, and both elements tested at the same time. Calibration adjustments are made by changing the resistance of the potential circuit.

3. Type HY power factor meters are of the crossed-coil, electrodynamic type. Highest accuracy is obtained when current in the current coils is from 2 to 5 amperes and voltage on the potential circuit from 75 to 125 per cent of normal. Transformers should be selected accordingly. Single-phase instruments are used on single-phase, two-phase, and three-phase four-wire circuits. Polyphase power factor meters are designed to indicate correctly only on balanced load. Polyphase power factor meters must be connected to three-phase, three wire circuits with proper sequence of voltage connections. A trial connection may be checked by shunting part of the current from the stationary coil with a low resistance wire (about 0.1 ohm) across the current terminals. If the pointer movement is toward the lag side of the scale, connections are correct. If the pointer movement is toward the lead side of the scale the connections to the first and third potential terminals should be interchanged on the line side of external resistors if any are used. Should the pointer remain at one end of the scale regardless of change in power factor the current connections should be interchanged. An angular error of 60 degrees or 120 degrees, caused by the current transformer being in the wrong phase is indicated by pointer remaining at one end of the scale against the stop. Calibration may be checked with a standard power factor meter, or with a voltmeter, an ammeter and a wattmeter. Polyphase power factor meters are adjusted by changing the value of resistance in the potential circuits. Single-phase instruments are adjusted by changing the size of the air gap of the iron in the reactor or changing the value of sesistance in the resistance circuit. Increasing the air gap shortens the scale length and vice versa.

4. Type HY frequency meters are of the crossed-coil electro dynamic type, the coils being connected into a network consisting of a reactor and a capacitor forming a resonant circuit. Calibration may be checked by comparing the readings to those of a revolution counter applied to the generator, or by checking with a synchronous clock. If errors are found, they may be corrected by adding to or removing iron from the reactor, or adjusting internal shunt. Decreasing the shunt resistance decreases the range of frequency and vice versa. Reactor adjustments shift the whole scale to the right or left.

5. Type HA synchroscopes operate on the rotating iron vane principle, the moving element being free of brushes, slip-rings or mechanical connections of any kind. Iron vanes on the moving element shaft are magnetized by a coil connected to one circuit, and are caused to rotate by an encircling rotating field set up by coils connected to the other circuit which is being synchronized with the first circuit. Calibration may be checked by connecting both circuits to the same source. The pointer should then indicate synchronism. If the pointer does not indicate synchronism, the set screw in the hub should be backed off, the pointer shifted to the position indicating synchronism, and the set screw tightened. Should any electrical adjustments be necessary, the currents in the reactor branch and resistance branch should be equalized.

6. Type HA 360-degree scale power factor meters are similar in mechanical construction to the type HA synchroscope. The electrical characteristics are different, the inner coils being wound as current coils and the outside stator

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*Supersedes I. L. 1968-H

coils wound as potential coils. Connections may be checked the same as type HY 100 degree scale power factor meters. It is essential that the moving element be in mechanical balance so that the pointer will remain in any position it is placed when all circuits of the instrument are de-energized.

7. Type HA position indicators are similar in mechanical construction to the type HA synchroscope, the electrical characteristics being different. Leads must be connected in the proper sequence to have the indicator follow the controller properly in the right direction.

DIRECT-CURRENT AND RADIO FREQUENCY INSTRUMENTS

All types HX instruments operate on the permanent magnet moving coil principle.

8. Type HX voltmeter calibration adjustments are made by changing the value of resistance in series with the element. When used with an external resistor on voltages higher than the insulation rating of the instrument, one terminal of the instrument should be kept at ground potential.

9. Type HX ammeter calibration adjustments are made by changing the resistance of the wire lead in series with the element. When connected to an external shunt, leads listed for use with the instrument, or leads of specified resistance should be used.

10. Type HX milliammeter calibration adjustments are made by changing the resistance of the internal shunt. Some ranges not provided with element shunts are adjusted by changing the strength of the magnet.

11. Type HX radio frequency instrument calibration adjustments are made by changing the value of the resistance in series with the thermocouple. To avoid burning out the thermocouple, the instrument should not be loaded above full scale.

12. Type HX R-F Instruments have the left terminal, as viewed from the rear, bonded to the metal chassis and dial of the instrument. This prevents electrostatic effects between pointer and dial and provides points of zero potential inside the instrument.

13. Type HX search coil temperature indicators are adjusted for balance by changing the resistance of the bridge arm windings in the external box. After balance is correct, calibration of other points on the scale is done by adjusting the series resistance spools in the external box. For further particulars see separate Westinghouse Instruction Leaflet on same.

14. Type HX rectifier type voltmeter calibration adjustments are made by changing the value of series resistance. Rectifier type milliammeters are calibrated by changing the strength of the magnet. Rectifier type instruments indicate correctly at 25°C. with 60 cycle pure sine wave. The frequency error is about ½% per kilocycle. The magnitude of the temperature error depends upon the range; the magnitude of wave form error is dependent upon the form factor.

15. Type HX speed indicator calibration adjustment is made by changing the series resistance of the circuit or by changing the resistance of the shunt of the element if a shunt is provided.

INSULATION RATING

16. HA ammeters and voltmeters are insulated for 750 volt service. HY wattmeters, power factor meters, frequency meters and HA power factor meters, synchroscopes and position indicators for use on 115 volt and 230 volt circuits are insulated for 250 volt service, those for use on 460 volt circuits are insulated for 500 volt service and those for use on 575 volt circuits are insulated for 600 volt service. All type HX instruments are insulated for 750 volt service.

POINTS TO BE CHECKED IN CASE OF INCORRECT INDICATIONS

17. Friction is the most common cause of inaccuracy. Possible points of friction in alternating-current instruments are: 1. The clearances between the aluminum vanes and the walls of the damping chamber are necessarily small and sometimes after a severe jar the vanes might rub against the walls of the damping chamber. 2. Pivots and jewels may become dirty and must be cleaned. Corn pith is often used for this purpose. 3. The control springs should be carefully inspected to see that convolutions are not touching each other or adjacent mechanical projections. 4. Lint may project from the stationary coils of a dynamometer type instrument, and rub on the moving coil. 5. The pointer or its tail-piece rubbing on adjacent parts, although a rare occurrence, it is well to watch for this condition.

18. Friction eliminated, there remain as causes of inaccuracies, zero error, partial short-circuits, and loose connections. A partial short-circuit in the element coils of ammeters, voltmeters and wattmeters will cause a low reading while a short-circuit in the resistors of voltmeters and wattmeters will cause a high reading. A partial short-circuit in the element coils, or reactor or resistors of power factor and frequency meters will cause erratic readings. Loose connections cause variable and erratic indications.

19. An unbalanced movement will cause inaccurate readings at some points on the scale. Balance adjustments should be made only by skilled repairmen. The pointer should stay on zero with the instrument face up and with the instrument face vertical with pointer horizontal to right and with pointer horizontal to left. Power factor and frequency meters have no control springs, so the pointer should stay at any point it is placed on the scale if the movement is in balance.

20. The motion of the pointer when brought down slowly from full scale, should be free and constant. If the movement is interrupted, stops, or is jerky, friction exists at some point and must be eliminated. A common cause of friction in permanent magnet moving coil type instruments is the presence of dirt or iron chips in the air gap. A piece of white paper placed back of the air gap will reflect light through the air gap so any foreign material can be detected and removed.

21. Pivots must have proper end-play and side-play in the jewels. Jewel screws in any instrument should never be screwed in too far as this will result in cracked jewels and ruined pivots. A good method of checking end play is to carefully move the element back and forth at right angles to the shaft by means of the pointer. The side play is normally several times the end play and can be more easily estimated.

RENEWAL PARTS

22. When ordering renewal parts, give the name of the part wanted and the style number and serial number of the instrument, which appear on the dial. Failure to give this information may result in delay.

23. Instruments provided with illuminated dials use #46 Mazda Lamps (6.3 volts 0.25 amp.) Westinghouse Style No. 1,001,663.

24. This bulb is rated at 3000 hour life with normal rated voltage. A 10 per cent overvoltage greatly decreases the life. For use on 115 volt lighting circuit a small potential transformer S# 971456 is supplied, rated at 115/6.3 volt, 100 volt-amperes.

REPAIRS

25. If an instrument is to be returned to the factory for repairs, write to the dealer or nearest Westinghouse Sales Office, for a return material tag, so that the apparatus will be properly identified at the factory.

CIRCUIT PRECAUTIONS

26. The secondary circuits of all instrument transformers and the cases of all instruments should be grounded.

When opening the secondary circuit of a current transformer, the terminals of the secondary winding must be short-circuited to prevent damage to the transformer.

DIRECT CURRENT AND RADIO FREQUENCY INSTRUMENTS

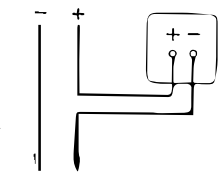


FIG. 1—AMMETER AND MILLIAMMETER, SELF-CONTAINED

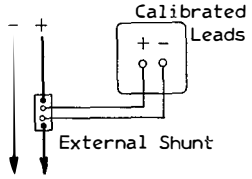


FIG. 2—HX AMMETER WITH EXTERNAL SHUNT

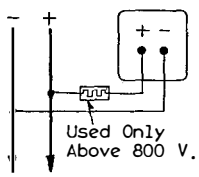


FIG. 3—HX VOLTMETER

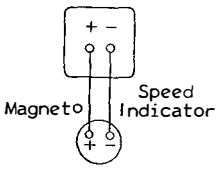


FIG. 4—SPEED INDICATOR

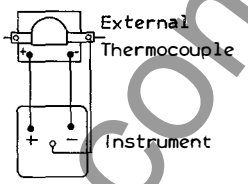


FIG. 5—RF AMMETER EXTERNAL THERMOCOUPLE

ALTERNATING CURRENT INSTRUMENTS

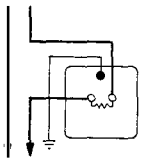


FIG. 6—HA AMMETER SELF-CONTAINED

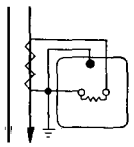


FIG. 7—HA AMMETER WITH CURRENT TRANSFORMERS

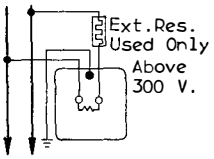


FIG. 8—HA VOLTMETER

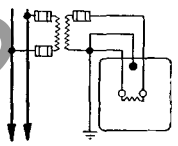


FIG. 9—HA VOLTMETER WITH POTENTIAL TRANSFORMERS

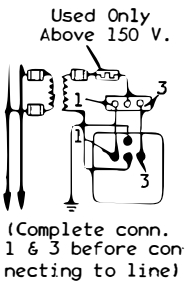


FIG. 10—HY FREQUENCY METER

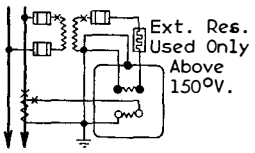


FIG. 11—HY WATTMETER SINGLE-PHASE

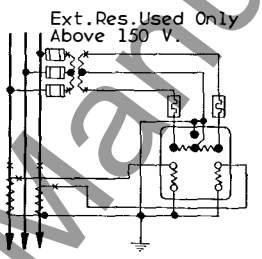


FIG. 12—HY WATTMETER 3-PHASE, 3-WIRE

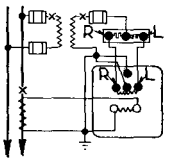


FIG. 13—HY AND HA POWER FACTOR METER, SINGLE-PHASE

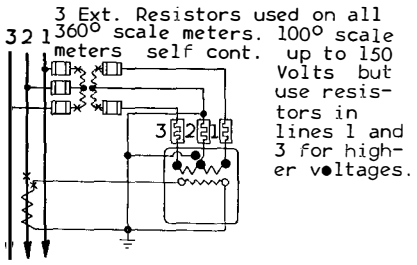


FIG. 14—HY AND HA POWER FACTOR METER, 3-PHASE, 3-WIRE

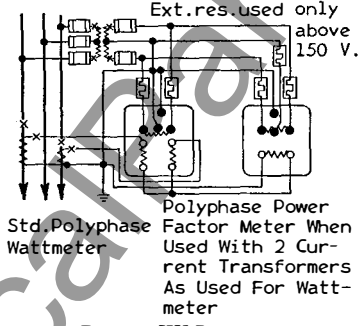


FIG. 15—HY POLYPHASE WATTMETER AND POWER FACTOR METER

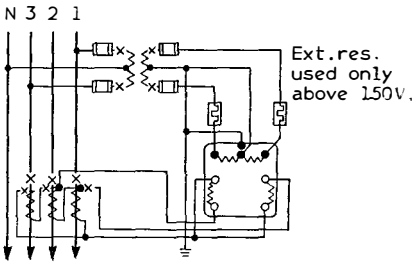


FIG. 16—HY WATTMETER 3-PHASE, 4-WIRE (DELTA, C.T.)

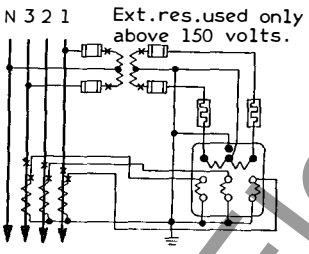


FIG. 17—HY WATTMETER 3-PHASE, 4-WIRE (Y, C.T.)

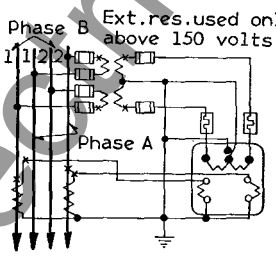


FIG. 18—HY WATTMETER 2-PHASE, 4-WIRE

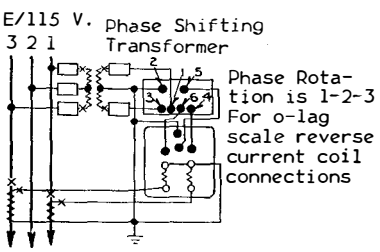


FIG. 19—HY VARMETER 3-PHASE, 3-WIRE

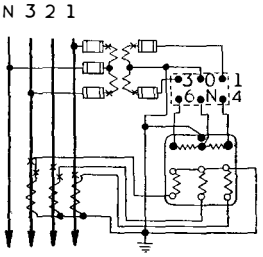


FIG. 20—HY VARMETER 3-PHASE, 4-WIRE WITH COMPENSATOR

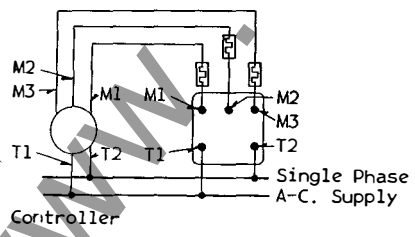


FIG. 21—TYPE HA POSITION INDICATOR

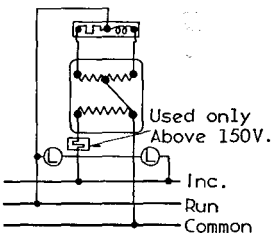


FIG. 22—HA SYNCHROSCOPE

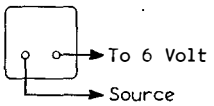


FIG. 23—FOR ALL INSTRUMENTS WITH ILLUMINATION*

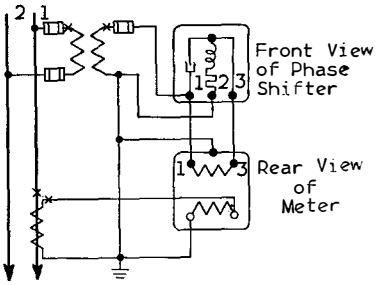


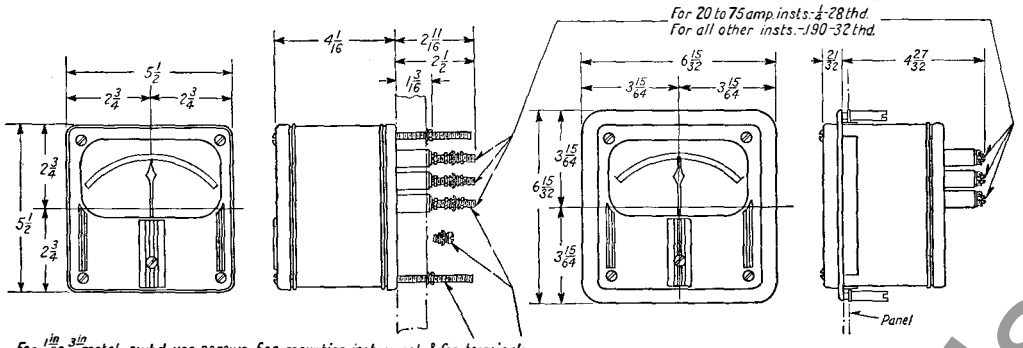
FIG. 24—HY VARMETER 1-PHASE 2-WIRE†

** For 115 volt 60 cycle supply use 115/6.3 volt transformer S# 971466 (100 Volts)*

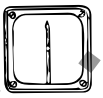
† These connections are for meters having lag-o-lead scales. If the scales are lead-o-lag, the current connections must be reversed.

OUTLINE DIMENSIONS IN INCHES

Projection Mounting **Flush Mounting**



Appearance of front plate for synchroscope or 360° power factor.



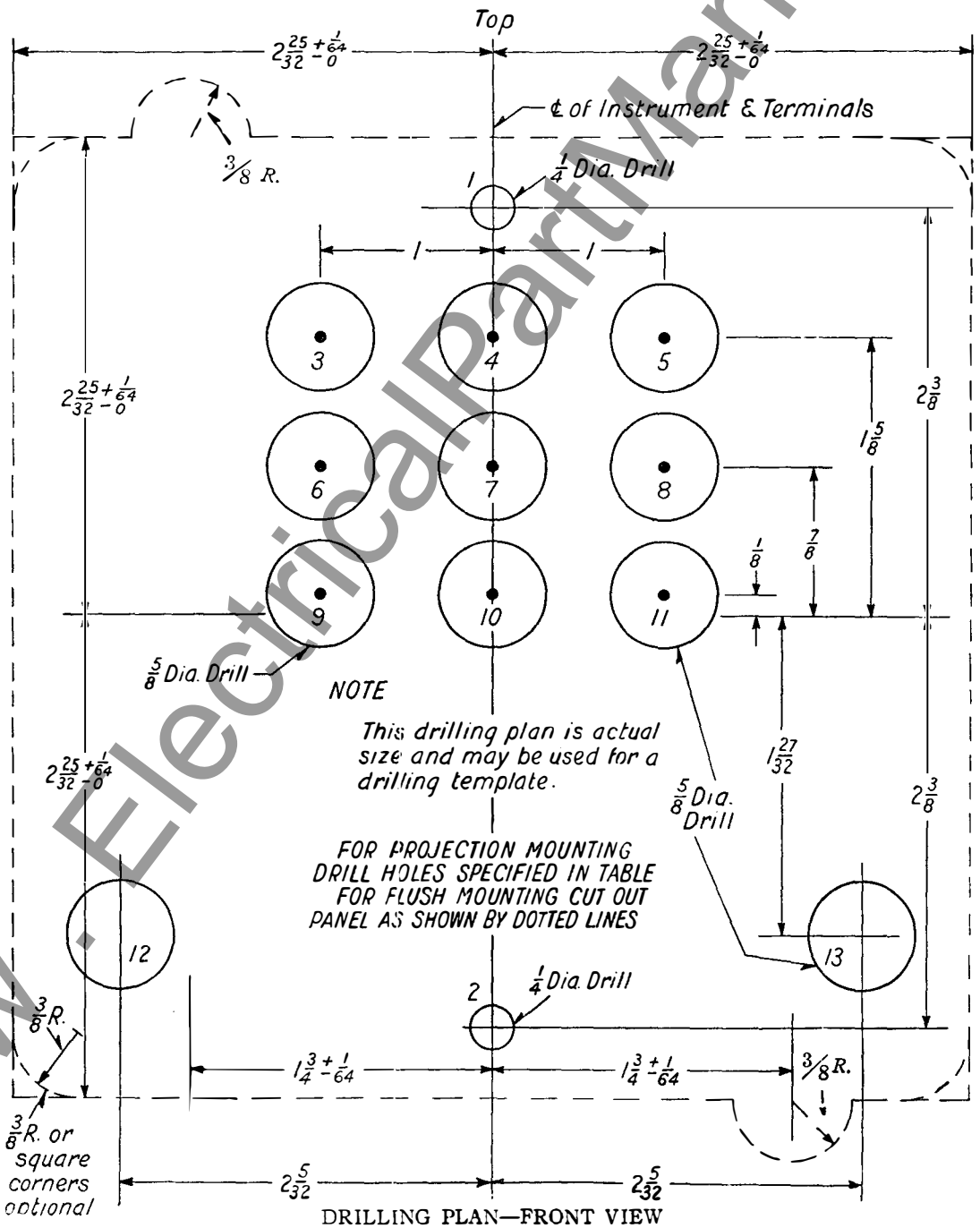
Appearance of front plate for position indicator.

For $\frac{1}{8}$ in or $\frac{3}{16}$ in metal swbd., use screws for mounting instrument & for terminals.
For $\frac{1}{4}$ in to 1 swbd., use studs for mounting instrument & screws for terminals.
For all other swbds., use studs for mounting instrument & for terminals.

DRILLING FOR PROJECTION MOUNTING

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



DRILLING PLAN—FRONT VIEW