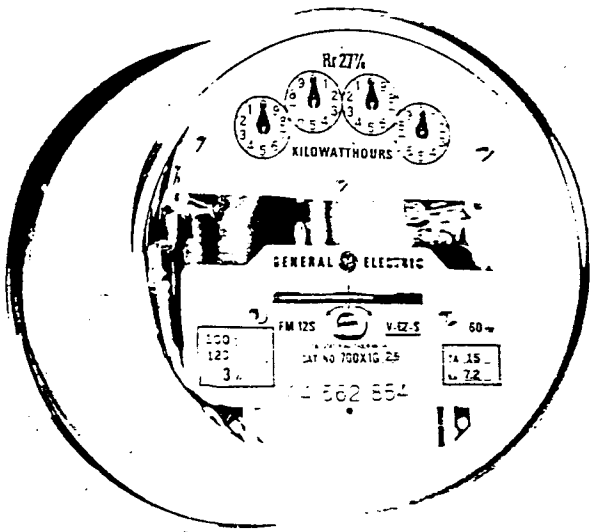
INSTRUCTIONS

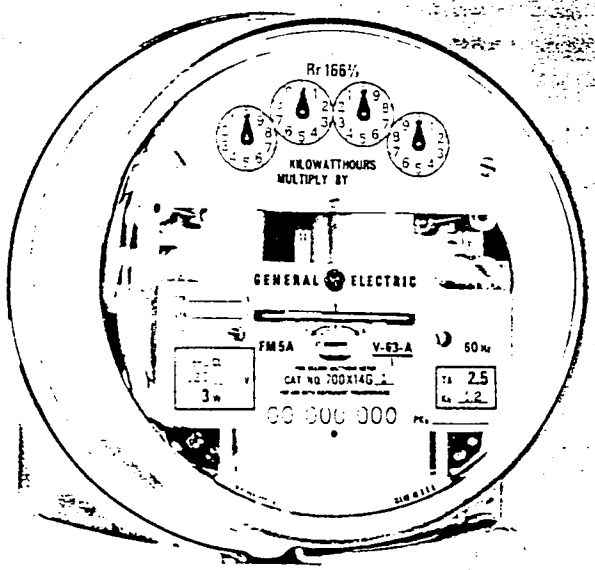
GEH-2758C
Supersedes GEH-2758B

V-60 FAMILY OF POLYPHASE WATTHOUR METERS

GE Meter and Control



TYPE V-62-S SOCKET-CONNECTED



TYPE V-63-A BOTTOM-CONNECTED

GENERAL ELECTRIC

SOMERSWORTH, NEW HAMPSHIRE 03878

CONTENTS

NOTICE OF CHANGES:

This issue of GEH-2758C is a complete revision of the previous issue of GEH-2758B.

V-60 FAMILY OF POLYPHASE WATTHOUR METERS

INTRODUCTION

These instructions apply to General Electric two- and three-stator polyphase meters of the following types:

TYPE METER		CIRCUIT APPLICATION
Socket-connected	Bottom-connected	
Two-stator:		
V-62-S	V-62-A	3-wire network 3-wire; 1-, 2-, or 3-phase
V-63-S	V-63-A	3-wire; 1-, 2-, or 3-phase
V-65-S	V-65-A	4-wire Y; 3-phase
V-66-S	V-66-A	4-wire delta; 3-phase
Three-stator:		
V-64-S	V-64-A	4-wire Y; 3-phase

The letter "M" in the type designation denotes a watthour demand meter with mechanical demand register (Type M-30, M-31, M-50, M-51, or M-60); for example: Type VM-62-S.

Similarly, the letter "W" in the type designation denotes a watthour meter with a pulse initiator (Type D-20-V, D-30-V, D-41, D-51, D-52 or D-72); for example: Type VW-62-A.

INSTALLATION

All meters are factory-calibrated before shipment.

The meter should be installed plumb and in a location that is free from heavy vibration.

The glass cover can be sealed independently before mounting the meter for service, if desired. Refer to "Sealing the Meter," page 4.

The following procedure should be observed when installing meters.

SOCKET-CONNECTED "S" CONSTRUCTION METERS

1. Make sure that the meter socket is mounted securely in place and in such a position that the rotor shaft will be vertical when the meter is mounted.

> **NOTE:** *The meter socket used must be compatible with the circuit and with the meter used. See the connection diagrams in this book.*

2. In order to ground the meter frame, and surge protectors (if present), good contact between ground straps and socket rim should be ensured by scraping off paint, if any, from the socket rim at the points where these straps make contact.

3. Make connections to the socket terminals as shown in the proper diagram included in this book. For connections of pulse initiators, refer to the instruction book covering the particular type of end device being operated by the pulse initiator.

4. Plug the meter into the socket, with the meter cover sealed separately, if desired. Make sure that the meter terminal blades properly engage with the socket jaws. In order to ensure connection of the meter to its load circuit before line voltage is applied, always insert the meter load (bottom) terminal blades into the socket jaws first; when removing, withdraw them last.

5. Push the meter into place so that the base fits tightly against the socket rim. If a sealing ring is used, place it around the adjoining meter cover and socket rim. Position it so that the clamp is at the bottom of the meter, then tighten in place. If the sealing ring is marked to identify one side as "FRONT," be sure it is installed accordingly.

6. Seal the latch or clamping screw of the sealing ring or the cover latch of the ringless socket.

BOTTOM-CONNECTED "A" CONSTRUCTION METERS

These meters have mounting and terminal chamber dimensions which conform to industry standards, and can therefore be used with all standard meter mountings intended for use with bottom-connected multi-stator meters.

If used without a mount, proceed as follows:

1. Locate, and insert in the mounting surface, the top supporting screw. Use a round-head screw not smaller than No. 12 American Standard.

2. A reversible meter hanger is attached to the back of the base by a single screw. Adjust this hanger to the desired position and hang the meter by inserting the head of the supporting screw through the larger part of the keyhole opening in the hanger. (See also step 5 below.)

3. Remove the terminal cover.

4. Holes are provided in the lower corners of the base for insertion of the two bottom supporting screws. Level the meter by eye, insert the two lower screws, and tighten. Use round-head screws not smaller than No. 12 American Standard.

5. It is recommended that the meter base be grounded, in order to make the surge-relief gaps (if present) effective in self-contained 120- and 240-volt meters, and for reasons of safety in all meters used with instrument transformers. This can be done by using the hanger on the back of the meter in the external position, i.e., with the top mounting screw exposed, and then securing the ground wire terminal between the head of this screw and the meter hanger. This connection, using No. 12 AWG copper wire, should be completed before external connections to the meter are made.

6. Make the external connections to the meter as shown in the proper diagram included in this book. For connections of pulse initiators, refer to the instruction book covering the particular type of end device being operated by the pulse initiator.

The connections should be made by working from right to left. This assures connection of the meter to its LOAD circuit before the LINE voltage is applied. Disconnection of the meter should be made in the reverse order. The terminal holes for current leads will accept No. 2 (0.292-inch diameter) stranded wire. Use thimble adapters, Cat. No. 4124628G3 (package of eight adapters), for larger wire sizes.

SEALING THE METER

"S" CONSTRUCTION METERS

The glass cover is held to the meter base by three spring clips which engage with lugs on the molded base. When the cover is tightened by being turned clockwise, the seal holes in the cover ring will line up opposite the seal pocket in the molded base. A "break-off" type sealing tab or a lead wire seal may be used.

CAUTION: *IF A LEAD WIRE SEAL IS USED, AFTER CRIMPING THE SEAL BE SURE TO CUT OFF THE EXCESS WIRE TO PREVENT POSSIBLE SHORTING WITH SOCKET JAWS WHEN THE METER IS MOUNTED.*

"A" CONSTRUCTION METERS

The glass cover is held to the meter base by three bayonet-type spring clips located inside the cover ring, which engage with lugs on the die-cast base. When the cover is tightened by being turned clockwise until seated firmly, the cover seal bar located on the right-hand top surface of the terminal chamber can be slid to the left, where it engages a lug on the cover ring. When locked in this position by a seal through the slot on the right-hand side of the terminal chamber, it prevents removal of the glass cover.

The terminal cover can also be sealed and, when in place, prevents removal of the glass cover, so that the entire meter can be protected by the single seal. The standard gasketless terminal cover is held in place by the insertion of the seal in the slot provided. Terminal covers with gaskets are also available. These are held in place by two screws which are covered, after tightening, by a sliding seal bar.

INSTRUMENT TRANSFORMERS

Both current and voltage transformers have polarity markings of white paint or markers (H_1 for primary, X_1 for secondary) located on or near one primary and one secondary terminal. These markings denote relative polarity of the windings and indicate that the instantaneous direction of currents in the leads is the same; namely, toward the transformer in the marked primary lead, and from the transformer in the secondary lead, or vice versa. The polarity markings are shown in the connection diagrams. In order to obtain correct direction of rotation of the watthour meter rotor, these markings must be followed, regardless of their physical location on the transformers.

The bases of meters used with current and voltage transformers, or with current transformers only, should be connected to the grounded side of the secondary circuit of each transformer. Number 12 AWG copper wire is adequate for this purpose. At the ground end of the wire the usual precautions employed in connection with lightning arresters should be followed.

WARNING: *UNDER NO CONDITIONS SHOULD THE CURRENT CIRCUIT OF A TRANSFORMER-RATED METER BE OPENED WITHOUT FIRST SHORT-CIRCUITING THE SECONDARY WINDING OF THE CURRENT TRANSFORMER.*

READING THE REGISTER

The 4-dial registers used on self-contained meters of the lower capacities read in kilowatthours directly. Registers used on the higher-capacity meters may have 5 dials and read directly, or may have 4 dials and require a register multiplier (register constant), by which the register reading must be multiplied in order to obtain kilowatthours. This multiplier is usually 10 or 100 and is shown on the register face or nameplate.

Transformer-rated meters are furnished with either "secondary-reading" or "primary-reading" registers.

Secondary-reading registers have high register ratios to read the energy in the transformer secondary circuit. To obtain kilowatthours, the actual reading of the secondary-reading register must be multiplied by the register multiplier, which equals the CT ratio x VT ratio. Meters with secondary-reading registers can be used with instrument transformers of any ratio without changing registers, since only the multiplier is affected.

Primary-reading registers usually have low register ratios. The gearing of the register is designed to "include" the CT ratio and VT ratio. Changing transformer ratios usually requires changing the register ratio. The register multiplier for a primary-reading register is normally 10, 100, 1000, etc.

The watthour constant "K_h" marked on the nameplate is for use only in calibrating and checking the meter, and must not be used in connection with the register reading.

When reading the pointer-type register, the position of each pointer in its dial must be determined accurately. In deciding upon the reading of the numeral of each pointer, the pointer before it (to the right) must be observed. Unless this pointer has reached or passed zero or, in other words, completed a revolution, the pointer to its left has not completed the division upon which it may appear to rest. For this reason, the register can be read most easily and rapidly from right to left, although the recording of the numerals of its reading is from left to right.

On watthour demand meters the demand registers may be either the sweep-hand, cumulative or dial type. Refer to the applicable demand-register instructions (see list on page 14) for reading these registers.

FIGURING REGISTER RATIOS

The register ratio "R_r" is defined as the number of revolutions of the worm gear (which meshes with the rotor shaft) required to produce one revolution of the fastest (right-hand) pointer.

For example, if the register is direct-reading, i.e., having a multiplier of 1, then one revolution of the fastest pointer equals 10 kilowatthours. Now determine how many disk revolutions equal 10 kilowatthours:

Disk revolutions for one kilowatthour =

$$\frac{1000 \text{ (watthours per kilowatthour)}}{K_h \text{ (watthours per disk revolution)}}$$

Disk revolutions for 10 kilowatthours =

$$10 \times \frac{1000}{K_h}$$

K_h is the watthour constant which appears on the meter nameplate, and is the watthours recorded for one revolution of the rotor disk.

For example, calculate the register ratio for a 15-ampere, 120-volt, V-62 meter. This meter has a K_h of 7.2 watthours per disk revolution. Therefore,

Disk revolutions for 10 kilowatthours =

$$10 \times \frac{1000}{7.2} = 1388\ 8/9$$

To determine the register worm-gear revolutions for 10 kilowatthours, divide this figure by the gear reduction between the rotor shaft and the worm gear. This reduction is the number of teeth on the worm gear (100) divided by the pitch of the worm on the rotor shaft (2). Therefore, the first gear reduction is $\frac{100}{2} = 50$. Dividing the disk revolutions for 10 kilowatthours by 50 gives

Worm-gear revolutions for 10 kilowatthours =

$$\frac{1388\ 8/9}{50} = 27\ 7/9$$

Since this is the number of worm-gear revolutions for one revolution of the first pointer, it is by definition the register ratio, R_r.

Consolidating the above steps,

$$R_r = \frac{10 \times \frac{1000}{K_h}}{\frac{100}{2}} = \frac{10,000}{50\ K_h} = \frac{200}{K_h}$$

As another example, consider a 30-ampere, 240-volt, V-62 meter with $K_h = 28.8$:

$$R_r = \frac{200}{28.8} = 6\frac{17}{18}$$

However, a 4-dial register with this low ratio might turn over completely between monthly readings, if the meter were operated continuously at heavy load, so normal practice would call for either a 5-dial direct-reading register, $R_r = 6\ 17/18$, or a 4-dial register with a multiplier (register constant) of 10, in which case the register ratio would be

$$R_r = 10 \times 6\ 17/18 = 69\ 4/9$$

The general formula for the register ratio, including register multiplier, is therefore:

$R_r = \frac{200}{Kh}$ x register multiplier, for self-contained V-60 series meters.

For further information on register ratios, refer to publication GET-1887.

TESTING

Detailed procedures for testing and adjusting General Electric ac watthour meters are given in publication GET-813.

When using a photoelectric tester to test meters with demand registers, refer to "Testing Type VM Meters," page 11.

WATTHOUR CONSTANT

The watthour constant "K_h" marked on the nameplate is the number of watthours per revolution of the meter rotor. On the nameplate of transformer-rated meters, however, two watthour constants are shown; namely, "Test K" or "K_h" for use when testing the meter without transformers, and the "Primary Test K" or "Primary K_h" as the over-all constant for the meter with its transformers.

CALIBRATING ADJUSTMENTS

The following adjustments are provided for calibrating the meters for all load conditions met in normal service. All adjustments increase the meter speed when turned counterclockwise and decrease the speed when turned clockwise, as indicated on the nameplate around the full-load adjustment screw. See Figs. 1 and 2.

FULL LOAD

Full-load adjustment is made by turning the micrometer screw shown in Figs. 1 and 2. This screw has sufficient range for all normal requirements, including adjustment of a replacement magnet, should this ever be necessary. This adjustment affects the meter calibration equally at all loads and power factors. One turn of the screw will change the calibration approximately 0.3 to 0.4 percent.

CAUTION: *DURING THE ADJUSTMENT, CLEANING, OR REPLACEMENT OF A RETARDING MAGNET, IT IS IMPORTANT NOT TO ALLOW ANY MAGNETIC OBJECT, SUCH AS A SCREWDRIVER BLADE OR MAGNETIC GAP CLEANER, TO COME INTO CONTACT WITH THE MAGNET POLE FACES BECAUSE IT WILL POSSIBLY WEAKEN THE MAGNET.*

LIGHT LOAD

Light-load adjustment is made by moving the light-load plate sidewise, to the right or left, in the air gap of each stator with the adjusting screws provided. See Figs. 1 and 2. Since this adjustment introduces a fixed torque of a magnitude depending on the amount the plate is moved, the effect varies inversely with the load torque. For example, a 5.0 percent change at 1/10 rated load current will cause approximately 0.5 percent change in the same direction at rated load 1.0 power factor, and approximately 1.0 percent change at rated load 0.5 power factor. The direction of adjustment is the same as for full load, i.e., counterclockwise to increase speed.

For the Type V-64 meters, the light-load adjustment is furnished on the left and right stators only, none being necessary on the rear stator. On 10 percent series load, the sensitivity is about 0.5 percent per turn of both screws. For all other Type V-60 meters, sensitivity of this adjustment is about 0.7 percent per turn when testing one stator at 20 percent rated load, or 1.4 percent per turn when both stators are working at 10 percent load, and both adjusting screws are turned.

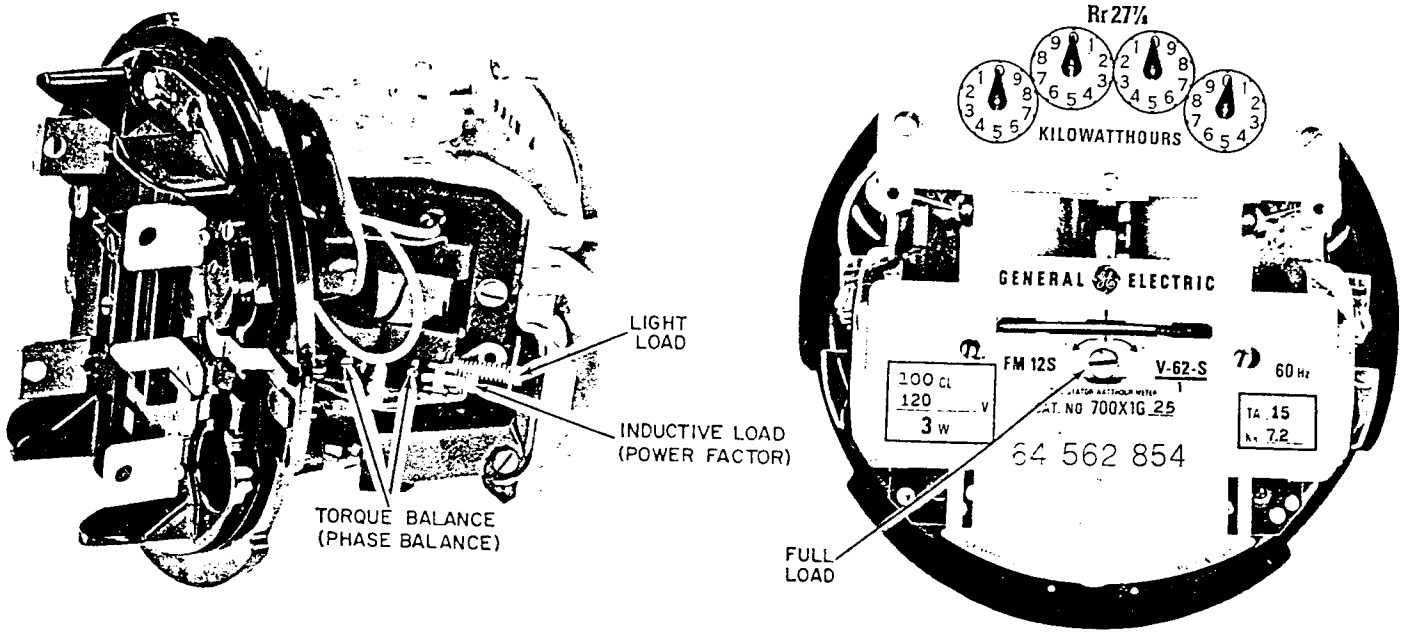


Fig. 1. Location of adjustments on V-60 family of 2-stator meters

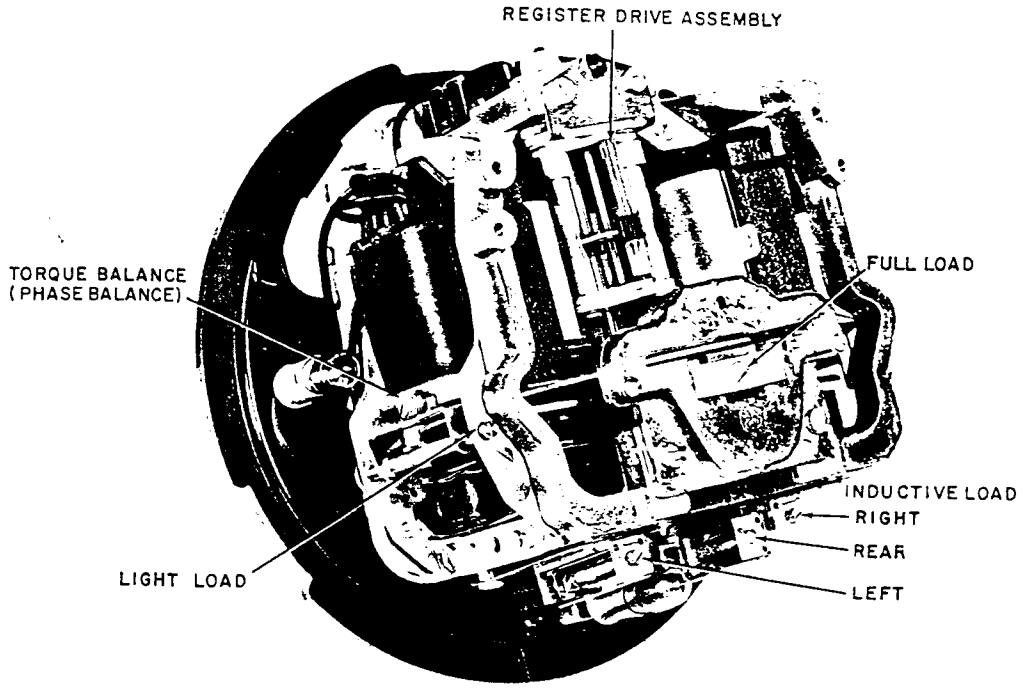


Fig. 2. Location of adjustments on Type V-64-S 3-stator meters

NOTE: *If the meter under test has a Type D-20 or D-30 contact device, the light-load check should cover sufficient revolutions (4 to 6) of the rotor to average out variations in friction due to contact position.*

INDUCTIVE LOAD (Power Factor)

For Type V-64 meters, inductive-load (power-factor) adjustment is made by turning three micrometer resistance adjusting screws located at the bottom of the meter (see Fig. 2). The sensitivity is roughly 0.3 percent per turn on the average, depending somewhat on the position of the adjustment. The adjustment is not linear.

For all other Type V-60 meters, inductive-load adjustment is made by moving the lag plate radially with respect to the disk, into or out of the air gap on each stator with the adjusting screw provided. See Fig. 1. The sensitivity is approximately 0.5 percent per turn.

The direction of adjustment is the same as for full load, i.e., counterclockwise to increase speed. Whenever the inductive-load adjustment is changed, both full-load and light-load calibrations should be checked, as they may be affected a small amount.

TORQUE BALANCE (Phase Balance)

For Type V-64 meters, torque-balance (phase-balance) adjustment is made by turning a single flux-shunting screw in both the left and right stators. See Fig. 2. The sensitivity is about one percent per turn. On the rear stator the torque is factory-adjusted.

For all other Type V-60 meters, the two stators in each meter have their torques equalized at the factory by means of the two steel adjusting screws located in the shunt voltage flux gaps of each stator. These appear just above the supporting bracket for the lag and light-load plates and are readily accessible from the sides of the meter. See Fig. 1.

If it becomes necessary to make any change in this adjustment, as may be the case when installing a new stator, the two screws of each stator should always be moved exactly the same number of turns and in the same direction. This will prevent excessive shift in light-load calibration. Turning the screws counterclockwise increases the speed of the rotor. Sensitivity is about 0.75 percent per turn of the two screws. After balancing the torques of the stators, the accuracy of the meter should be checked on full load, inductive load and light load.

REGISTER DRIVE FOR V-64 METERS

The register drive assembly (see Fig. 2) consists of two vertical shafts, one of which carries an idler gear which meshes with the 20-tooth pinion on the rotor shaft, and also meshes with and drives a similar 20-tooth pinion on the second, or driven, shaft. This driven shaft thus rotates at the same speed and in the same direction as the rotor shaft, and serves to drive all the registers used with this meter. For pointer-type registers and Types M-30, M-31, M-50 and M-51 demand registers, a double-pitch worm is cut into the driven shaft. The 20-tooth pinion on the driven shaft is also used to drive the Type M-60 demand register, when used. The driven shaft in the register drive is furnished with a hobbed 8-tooth pinion for use in driving a pulse initiator.

NOTE: *The gear and bearings in the register drive should never, under any circumstances, be oiled. They are designed with a low friction level to last indefinitely without lubrication.*

The adjustment on the register drive is for the purpose of setting the mesh between the idler gear and the rotor-shaft pinion only, and *should not* be used to adjust mesh of the register. (This is done in the normal way by using the adjustment on the register.) For this reason, the adjusting screw on the register drive is not slotted. When it is necessary to adjust the mesh of the idler gear with the rotor-shaft pinion, this should be done with the register removed, and is accomplished by turning the adjusting screw clockwise to deepen the mesh or counterclockwise to lighten the mesh, until the correct mesh (1/2 tooth depth) is obtained. The adjustment is locked by spring tension.

MAINTENANCE

MAGNETIC SUSPENSION SYSTEM

No maintenance of the magnetically suspended rotor in the V-60 family of meters should be required in normal service during the life of the meter. No lubrication is required nor should any be used.

Inspection

With the meter in its normal operating position, inspection can be made as follows (see Fig. 3):

1. The position of the disk should be approximately centered in the retarding magnet gap. Raise the disk from its float height until movement stops.

It should have moved 0.008 inch to 0.015 inch, and there should be clearance between the disk and the upper pole faces of the retarding magnet as well as lag plates and voltage-coil poles on all stators.

2. Allow the rotor assembly to return to its normal float height and then lower the disk until movement stops. It should have moved 0.005 inch to 0.010 inch, and there should be clearance between the disk and the lower pole faces of the retarding magnet. Also, be sure that no voltage leads are interfering with the disk.

If the above conditions are not met, the suspension system should be reset. Refer to "Assembly of Suspension."

Removal of Suspension

If it becomes necessary to remove the suspension system, it can be done in the following manner:

1. Remove the register, nameplate, and retarding magnet. On Type V-64 meters, also remove the register drive assembly (see Fig. 2).

CAUTION: *IN REMOVING THE RETARDING MAGNET, IT IS IMPORTANT NOT TO ALLOW ANY MAGNETIC OBJECT, SUCH AS A SCREWDRIVER BLADE OR MAGNETIC GAP CLEANER, TO COME INTO CONTACT WITH THE MAGNET POLE FACES BECAUSE IT WILL POSSIBLY WEAKEN THE MAGNET. ALSO, KEEP THE MAGNET AWAY FROM MAGNETIC PARTICLES. CLEANLINESS IS ESSENTIAL DURING HANDLING.*

2. Loosen the lower guide setscrew (Fig. 3) and remove the lower guide.

3. Loosen the upper suspension setscrew and remove the outer suspension assembly.

NOTE: *The outer suspension assembly contains the outer magnet and centering pin. Necessary precautions should be observed in handling to prevent demagnetization of the magnet or damage to the centering pin. Magnetic objects should not touch the magnet. Cleanliness is essential when handling this assembly. Keep it away from magnetic particles.*

4. Carefully remove the rotor. The die-cast section at the top of the shaft contains the inner magnet, so take precautions as described in the Note under step 3 above.

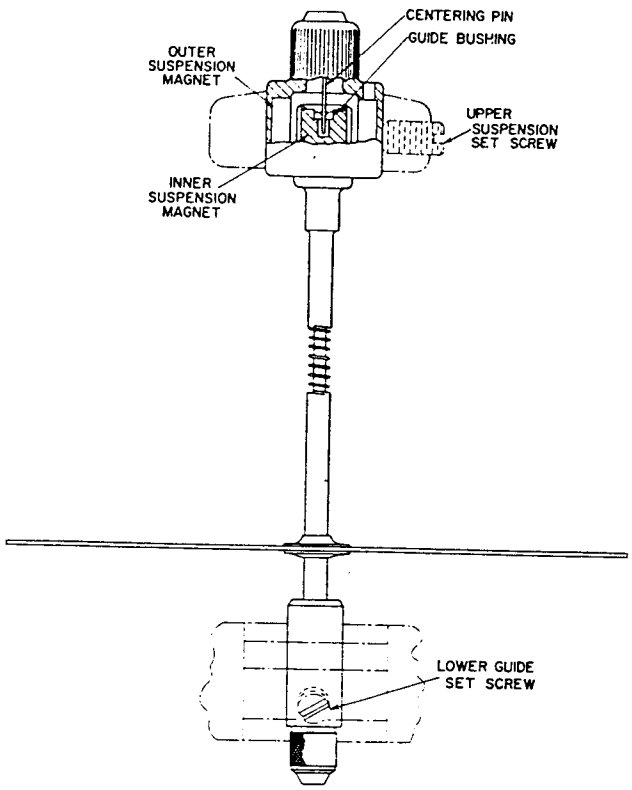


Fig. 3. Magnetic suspension system

Assembly of Suspension

Assemble the suspension system as follows (see Fig. 3):

1. Place the meter in its normal operating position.

2. Inspect the inner magnet for any dirt or magnetic particles. (Use a non-magnetic tool to clean, if necessary.) Insert the rotor into the die-cast frame.

3. Inspect the outer suspension assembly for any dirt or magnetic particles. (Use a non-magnetic tool to clean, if necessary.) Insert it into the hole at the top of the die-cast frame and enter the rotor into the assembly. The centering pin will be guided into the hole in the bushing by the countersink.

4. Finger-tighten the upper suspension setscrew.

5. Inspect the lower guide for any dirt. Insert it into the hole at the bottom of the die-cast frame, and enter the centering pin into the bushing in the bottom of the shaft.

6. Finger-tighten the lower guide setscrew.

7. Assemble the retarding magnet. On V-64 meters, assemble the register drive assembly before adding the magnet, and check its mesh.

8. Center the disk in the retarding-magnet air gap by moving the outer suspension assembly. Tighten the upper suspension setscrew.

9. Move the lower guide upward until motion of the disk is noted. Then move the lower guide downward 0.005 inch to 0.010 inch. Tighten the lower guide setscrew.

10. Check the position of the disk in the magnet gap. Refer to "Inspection," page 8.

11. Replace the register and nameplate.

STATOR

If a voltage coil or current coil is damaged, the entire stator should be replaced.

REGISTER

When replacing a register, be sure the new register has the same register ratio and multiplier. Carefully inspect the mesh of its worm gear with the worm on the rotor shaft to see that it is approximately 1/2 the depth of tooth on the register worm gear. A means for adjustment is provided in the eccentric adjusting screw in the bracket on the back of the register. Avoid meshing too deeply, which might cause friction and affect the accuracy of the meter.

To properly clean registers, it is recommended that a reliable ultrasonic cleaning system be used.

The use of oil on the register bearings is not recommended.

For proper care of demand registers, refer to their respective instructions. See the list of publications on page 14.

SURGE PROTECTORS

Self-contained meters with serial numbers 51,075,000 and above, Types V-62-S, V-64-S, V-65-S and V-66-S meters, rated 120 and 240 volts, have external surge protectors assembled to the meter base. Two protectors are used on the V-62-S, while the V-64-S, V-65-S and V-66-S have three each (as shown in Fig. 4).

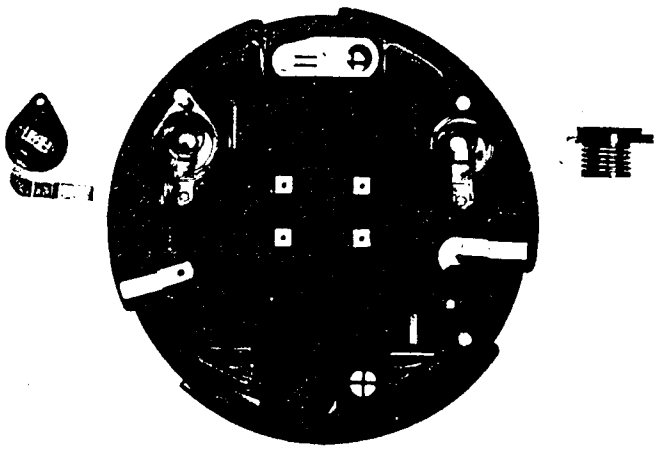


Fig. 4. V-60 polyphase meter base with two of the three surge protectors removed from the base

The surge protector provides protection for the meter against high voltage surges caused by lightning discharges. Its design permits 20 or more operations before replacement is necessary. The surge protector can be inspected by first removing it from the meter base, then taking off the cap, which is held in place by one screw. When installing a new protector, no adjustment is necessary.

Meters with surge protectors can be used on any distribution system regardless of the maximum current capacity of the system. This is possible because the surge protector is designed to limit the follow current, thus providing proper operation under all conditions.

Surge protectors are not designed for use on 480- and 600-volt meters.

For detailed information on the surge protector, see GE publication GEA-9057.

SURGE RELIEF GAPS

Self-contained meters with serial numbers below 51,075,000, Types V-62-S, V-63-S, V-65-S and V-66-S meters, rated 120 and 240 volts, have built-in surge relief systems incorporating controlled air gaps between incoming lines and ground. These are factory-adjusted and require no further attention, other than proper grounding of the meter. However, if a meter stator is replaced, it is important that the air gaps have proper clearance. Refer to Figs. 5 and 6 for correct gap dimensions.

Bottom-connected meters rated 120 and 240 volts, with serial numbers below 50,891,090, have surge relief gaps. Refer to Fig. 7 for correct gap dimensions.

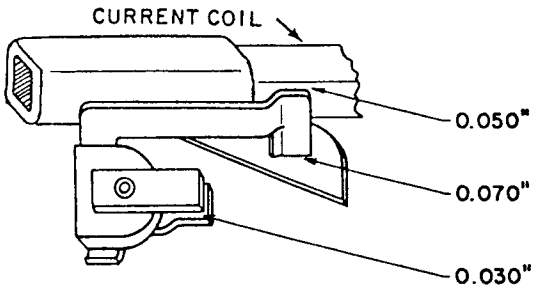


Fig. 5. Surge relief gaps on Types V-62-S and V-63-S meters

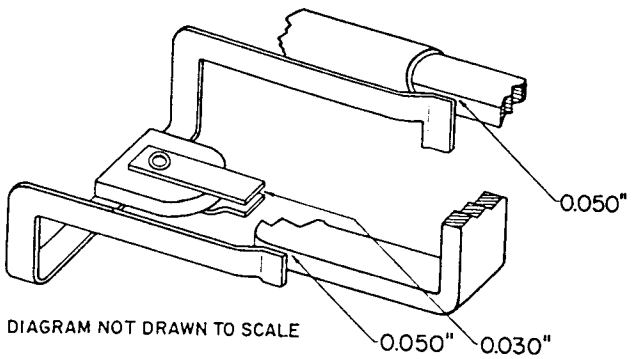


Fig. 6. Surge relief gaps on Types V-65-S (120-volt) and V-66-S meters

NOTE: *If distribution-system fault currents at the meter can exceed 2500 amperes rms, then external valve-type lightning protection should be provided.*

If an "S" base assembly is ordered from the factory for replacement on meters with surge relief gaps, the new base will be furnished with surge protectors rather than relief gaps. Accompanying each supply base is a kit containing leads, screws and a connection diagram. No adjustment is necessary on these protectors.

TESTING TYPE VM METERS

Refer to separate instructions for proper care and installation of demand registers. See the list of publications on page 14.

When using a photoelectric tester for testing meters having the Type M-60 demand register, the photocell unit may be used on either side of the meter, although the left side is easier. See Fig. 8a. The glass cover may be left on the meter. Proceed as follows:

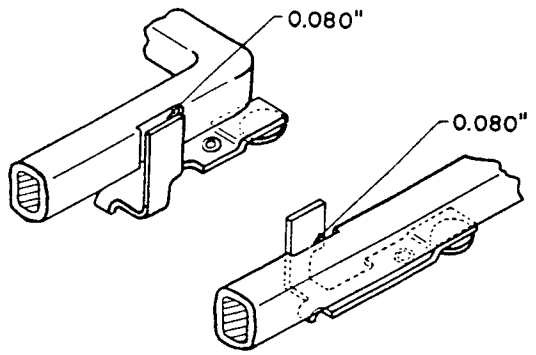
1. Arrange the light source so that it shines through the disk hole.

2. Place a hand or piece of paper under the disk to locate the light source. Move the tester probe under the disk and into the light beam.

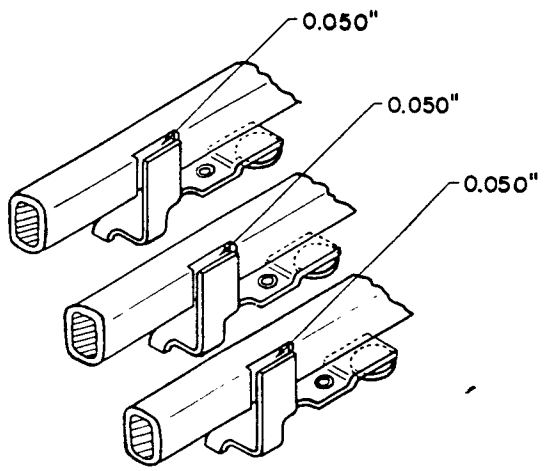
3. Check to ensure proper operation of the tester.

When using a photoelectric tester to test meters with Types M-30, M-31, M-50, and M-51 demand registers, some difficulty may be encountered in finding a light path through the register and disk. This can be done by aiming the light source at a slight angle to the vertical, and passing the light beam downward by the rear end of the right-hand motor field coil, either through the hole provided in the motor shield at this point, or entirely back of the shield. This is demonstrated in Fig. 8b.

A more convenient and flexible method of obtaining a triggering pulse from the disk is to use a high-sensitivity photocell assembly. This assembly operates from reflected light on the disk surface, with triggering occurring when the light beam is interrupted by the long black mark printed on the disk.

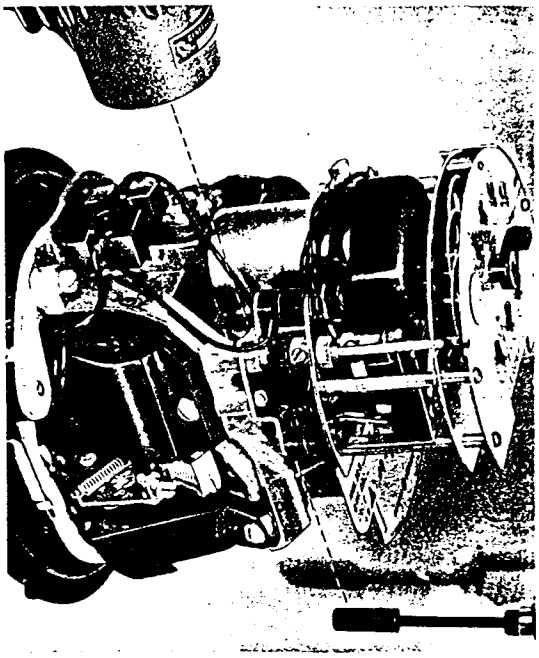


(a) Type V-62-A

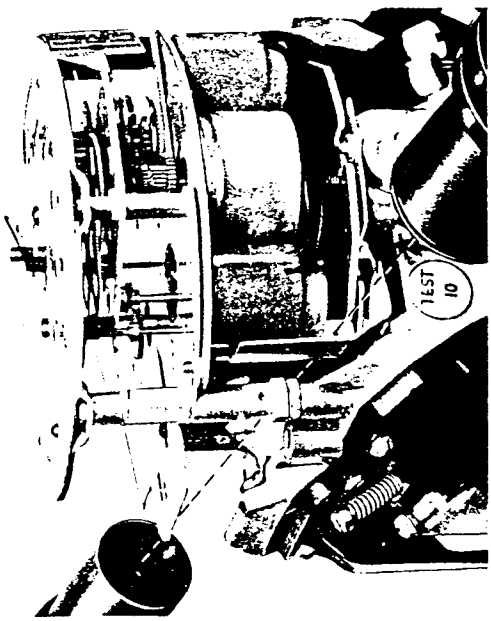


(b) Types V-63-A, V-65-A and V-66-A

Fig. 7. Surge relief gaps on A-type meters



(a) Meter with Type M-60 register



(b) Meter with Type M-30, M-31, M-50, or M-51 register

Fig. 8. Recommended position of photoelectric tester when testing meters having demand registers

PULSE INITIATORS

Pulse initiators (formerly called "contact devices") for the VW-60 family of meters are mounted on the front of the meter frame, just below the register. A separate pair of mounting holes is provided for this purpose. See Fig. 9. The spur drive gear on the pulse initiator meshes with a spur pinion hobbed into the rotor shaft.

Six types of pulse initiators may be used on VW-60 series meters:

1. Two-wire, low pulse rate – Type D-20-V
2. Three-wire, low pulse rate – Type D-30-V
3. Three-wire (with auxiliary amplifier), with very high pulse rate – Type D-41
4. Three-wire, with very high pulse rate – Types D-51, D-52 and D-72

CAUTION: *WHEN A TYPE D-41, D-51, D-52 OR D-72 IS USED, COLOR CODING MUST BE CAREFULLY FOLLOWED ON THE K (RED), Y (YELLOW), AND Z (BLACK) LEADS, SINCE THE Y AND Z LEADS HAVE DIFFERENT VOLTAGE LEVELS. ON THE D-41 DO NOT APPLY HI-POT VOLTAGE TO KYZ TERMINALS, OR THE SOLID-STATE COMPONENTS MAY BE DAMAGED. ON TYPES D-51, D-52 AND D-72, DO NOT APPLY HI-POT VOLTAGE TO KYZ TERMINALS. IF THE TRANSFORMER IS HI-POTTED, DO NOT EXCEED 1500 VOLTS.*

For separate instructions covering wiring and installation of pulse initiators, refer to the list of publications on page 14.

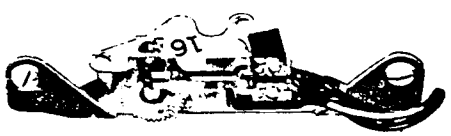


Fig. 9. Type D-30-V pulse initiator (contact device) mounted on a Type VW-63-A polyphase meter

NOTE: *Types D-5, D-12, and D-13 contact devices used on earlier VW series meters cannot be used on VW-60 series meters.*

All meters ordered with a pulse initiator, or for use with a pulse initiator, have, in addition to the pinion on the rotor shaft, three pulse initiator leads and terminals, so that either a 2-wire or 3-wire pulse initiator can be used.

Meters of the V-60 family which were not ordered for use with a pulse initiator have the frame bosses machined for mounting the pulse initiator. To convert a meter which is already in service into a VW-60 meter with pulse initiator, it is necessary to purchase a conversion kit, in addition to the pulse initiator itself. Refer to the Meter Handbook, Section 7780, or contact the nearest General Electric Sales Office.

NOTE: *For V-64 meters, the register drive assembly contains the necessary spur pinion.*

The drilling necessary to accommodate the pulse initiator leads or terminals in such a conversion is accomplished as follows:

Type V-62-A meters have drill spots molded into the terminal block to facilitate drilling holes for the pulse initiator leads, which are brought out through the bottom of the block. See Fig. 11b.

Types V-63-A, -64-A, -65-A and -66-A meters have spaces molded into the terminal block for the pulse initiator terminals, but do require drilling through the molded barriers in the front and bottom of the block to allow clearance for the terminal set-screw and entry of the external connection lead. See Fig. 11.

All V-60 socket-type, 5-, 7-, and 8-terminal meters require that a barrier (identified by KYZ, see Fig. 4) be drilled out to open the hole through the molded base for the 3-conductor, pulse initiator lead cable. No drilling is necessary on 13-terminal socket-type meters.

VOLTAGE INDICATORS

Meters rated for use with instrument transformers are furnished with voltage indicators. These are connected to isolated secondary windings on the voltage coil cores and give a positive indication of the presence of voltage magnetic flux in the stator core. The indicators are located in the general area of their respective voltage coils. For the rear stator on the Type V-64 meter, the indicator is located near the magnetic-suspension lower guide.

DETENT

For applications in which reverse rotation of the meter must be prevented, a detent is available. The detent used on the V-60 family of meters is located at the lower end of the rotor shaft. The pawl support is seated upon the frame surface around the lower guide, and the ratchet is attached to the lower end of the shaft (see Fig. 10). With the ratchet seated up against the shoulder on the shaft, the pawl will have correct mesh with the ratchet and no further adjustment will be necessary.

This detent can be installed readily on any V-60 meter. For installation instructions, refer to Instructions GEH-2763.

Q-HOUR METERING

With the advent of magnetic-tape demand recorders and the resulting capability of rapid data calculation with data processing equipment, electric utilities are now calculating "kVA Demand," "kvar Demand," and/or "load power factor" by using kWh/kW Demand with kQ-Hours/kQ Demand, rather than the historic kWh/kW Demand with kvarh/kvar Demand. This new approach eliminates the need for a phase-shifting transformer to obtain kilovarhours.

The statistic kQ-Hours/kQ Demand can be obtained from a conventional V-60 watthour meter if the voltage to each voltage coil is lagged 60 degrees from the voltage that is normally applied to the voltage coil when the meter is connected to measure kilowatthours. In a three-phase circuit,

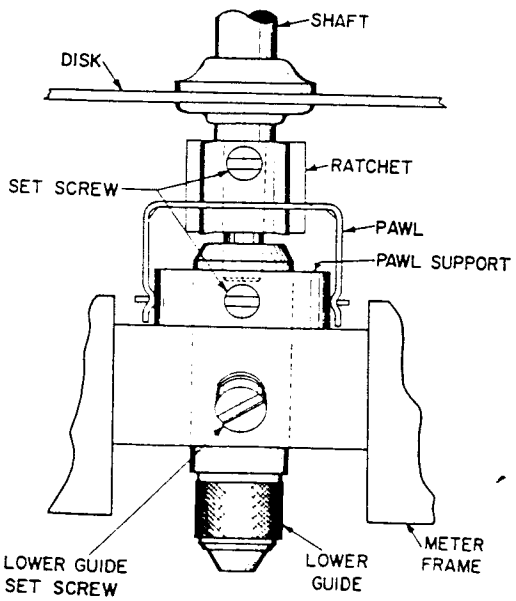


Fig. 10. Detent assembly

with few exceptions, the proper voltage (lagged 60 degrees) can be obtained by cross-phasing (i.e., using another equal voltage in the circuit).

To calculate kvarh/kvar Demand, use the following formulas:

$$\text{kvarh} = \frac{2 \times \text{kQh} - \text{kWh}}{\sqrt{3}}$$

$$\text{kvar Demand} = \frac{2 \times \text{kQ Demand} - \text{kW Demand}}{\sqrt{3}}$$

NOTE: *In the latter formula, kvar Demand will only be meaningful if the kQ Demand and kW Demand are measured during the same demand interval.*

For connection diagrams of Q-Hour meters, refer to Instructions GEH-2791.

FORM DESIGNATIONS

The form number shown on the meter nameplate identifies a meter for a particular application. It identifies wiring and terminal arrangement, and also whether a meter is self-contained or transformer-rated. The number does not change with current and voltage rating or when auxiliary equipment (such as demand registers, detents, or pulse initiators) is used. When replacing a meter, one having the same form number and the same voltage and current rating should be used.

Listed below are the numbers shown in this book (Fig. 11 and following), "S" numbers for socket-connected meters and "A" numbers for bottom-connected meters.

Form No.	Type Meters	No. Stators	No. Current Circuits	No. External Circuit Wires
5S, 5A	V-63*	2	2	3 (or 4)
6S, 6A	V-65*	2	3	4Y
7S	V-65*	2	3	4Y (Alt)
8S, 8A	V-66*	2	3	4Δ
9S, 9A	V-64*	3	3	4Y
10S (alt)	V-64*	3	3	4Y
12S, 12A	V-62	2	2	3
13S, 13A	V-63	2	2	3 (or 4)
14S, 14A	V-65	2	3	4Y
15S, 15A	V-66	2	3	4Δ
16S, 16A	V-64	3	3	4Y

*Transformer-rated

LIST OF PUBLICATIONS

(Order from Distribution Services, General Electric Co., Bldg. 705, Corporations Park, Scotia, N.Y. 12302)

Instruction Books:

Type M-30 Demand Register	GEH-1529
Type M-50 Demand Register	GEH-2785
Type M-51 Demand Register	GEH-2783
Type M-60 FS-2 Demand Register	GEH-2778
Types D-20 and D-30 Pulse Initiators	GEH-2754
Type D-41 Pulse Initiator	GEH-2767
Type D-51 Pulse Initiator	GEH-2781
Types D-52 and D-72 Pulse Initiators	GEH-2786
Installation of Detent Assembly	GEH-2763

Renewal Parts Bulletins:

V-60 Family of Watthour Meters	GEF-4132
Types M-30 and M-31 Demand Registers	GEF-3594
Type M-50 Demand Register	GEF-4385
Type M-51 Demand Register	GEF-4372
Type M-60 FS-2 Demand Register	GEF-4333
Types D-20, D-30 and D-41 Pulse Initiators	GEF-4091
Type D-51 Pulse Initiator	GEF-4344
Types D-52 and D-72 Pulse Initiators	GEF-4386
How to Test and Adjust GE Watthour Meters	GET-813
Constant and Register Ratio Data	GET-1887
How to Select Pulse Initiators	GET-3048

TROUBLE SHOOTING

Trouble	Probable Cause	Remedy
Meter does not run	Loose connection	Tighten connections
	Test link(s) open	Close test links
	Dirt on disk or in disk air gaps	Clean air gaps*
	Disk dragging on pole faces	Adjust disk height in air gap
	Register mesh too deep, causing jamming against rotor shaft	Adjust mesh to approximately 1/2 the tooth depth
	Wrong connections (stators opposing)	Connect according to applicable wiring diagram
Meter slow and/or variable on light load	Dirt on disk or in disk air gaps	Clean air gaps*
	Register mesh too deep	Adjust mesh to approximately 1/2 the tooth depth
	Dirt in outer suspension or lower guide	Clean parts*
(with demand register)	Register driving pointer	On M-30, M-31, M-50, and M-51 registers, set the pointer pusher to zero and the pointer(s) at full scale before checking calibration. On M-60 registers, be sure that the register is set in the sensing position and that the reset actuator does not reset during test.
	Demand register motor not energized	Energize motor
	Demand register motor connected with polarity reversed	Connect leads according to polarity markings
(with pulse initiator)	Pulse-initiator drive gear meshed too deep in rotor shaft pinion	Adjust mesh to approximately 1/2 the tooth depth
	Calibration checked over too few disk revolutions	Light-load check should cover sufficient revolutions of disk to average out variation in friction due to contact position (4 to 6 revolutions)

*In cleaning any part which incorporates a permanent magnet, such as the retarding magnet, outer suspension assembly, or the inner magnet at the top of the rotor shaft (see Fig. 3), it is very important that the surfaces of these magnets never come into contact with any magnetic object, as this could cause a partial loss of strength of the magnet.

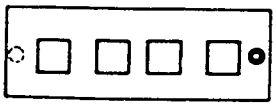
TROUBLE SHOOTING (Cont'd)

Trouble	Probable Cause	Remedy
Meter runs at half speed	Wrong K_h being used	Use nameplate K_h to determine correct revolutions for meter under test
	One test link open (on meters with 2 or 3 test links)	Close test links
	One voltage coil open-circuited, as shown by ohmmeter check with meter de-energized, or by lack of vibration of steel screwdriver blade held near torque balance screws with meter energized	If open-circuited winding is indicated, replace complete stator
Meter runs fast on all loads (beyond range of FL adjustment)	Retarding magnet demagnetized	Replace magnet
Meter runs backward at full load	Wrong connections	Correct the connections
Meter creeps on voltage only (more than one disk revolution)	Light-load adjustment set too fast or too slow	Adjust light-load calibration
	Voltage too high	Operate at not over 130 percent rated voltage
	Shorted current coil turns	If 0.5 PF calibration is outside range of PF adjustment, shorted coil is indicated. Replace stator
Meter creeps on current only (rated current)	Shorted or unbalanced current coil turns	Replace stator
Meter runs slow at 0.5 PF (beyond range of PF adjustment)	Shorted turns in voltage or current coils	Replace stator
Noisy meter	Insufficient vertical clearance between rotor shaft and lower guide pin	Adjust height of rotor and lower guide
	Torque screw spring is loose	Tighten the spring
	Double voltage on meter	Operate at not over 130 percent rated voltage

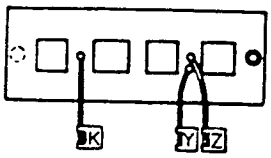
TROUBLE SHOOTING (Cont'd)

Trouble	Probable Cause	Remedy
Meter overheats	Meter overloaded	Use higher capacity meter
	Meter mounting of insuf-ficient capacity	Install heavy-duty mounting
	Double voltage on meter	Operate at not over 130 percent rated voltage
	Shorted turns in voltage coils	If 0.5 PF calibration is outside slow range of PF adjustment, shorted coil is indicated. Replace stator

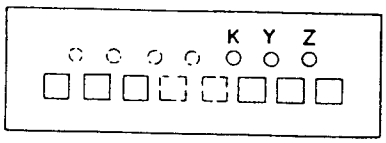
TERMINAL MARKINGS — BOTTOM-CONNECTED METERS



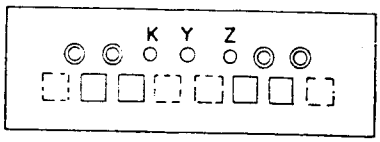
(a) Types V-62-A and VM-62-A—Form 12A, self-contained



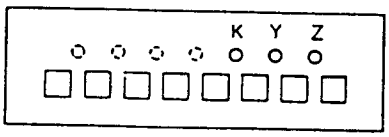
(b) Type VW-62-A—Form 12A, self-contained



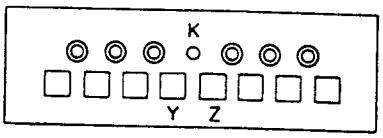
(c) Types V-63-A, VM-63-A and VW-63-A; 3-wire, 1-, 2-, or 3-phase—Form 13A, self-contained



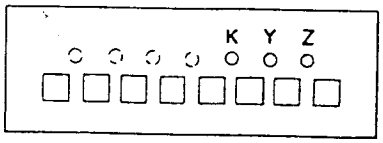
(d) Types V-63-A, VM-63-A and VW-63-A; 3-wire, 1-, 2-, or 3-phase and 4-wire, 2-phase—Form 5A, transformer-rated



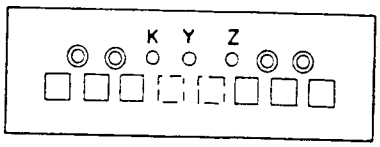
(e) Types V-64-A, VM-64-A and VW-64-A; 4-wire Y, 3-phase—Form 16A, self-contained



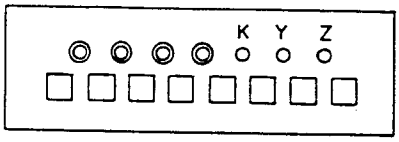
(f) Types V-64-A, VM-64-A and VW-64-A; 4-wire Y, 3-phase—Form 9A, transformer-rated



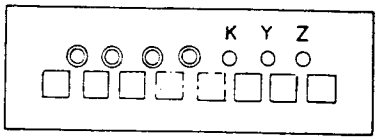
(g) Types V-65-A, VM-65-A and VW-65-A; 4-wire Y, 3-phase—Form 14A, self-contained



(h) Types V-65-A, VM-65-A and VW-65-A; 4-wire Y, 3-phase—Form 6A, transformer-rated



(i) Types V-66-A, VM-66-A and VW-66-A; 4-wire △, 3-phase—Form 15A, self-contained



(j) Types V-66-A, VM-66-A and VW-66-A; 4-wire △, 3-phase—Form 8A, transformer-rated

NOTES: 1. Voltage terminals identified by white marking (◎)

2. On VW-60 meters only:

a. Terminals K, Y and Z used for 3-wire pulse initiators

b. Terminals K and Z used for 2-wire pulse initiators

c. Pulse initiator terminals identified by red marking

Fig. 11. Terminal arrangements and markings for bottom-connected meters

EXTERNAL CONNECTION DIAGRAMS

NOTE: Dotted arrows indicate socket circuit-closing devices.

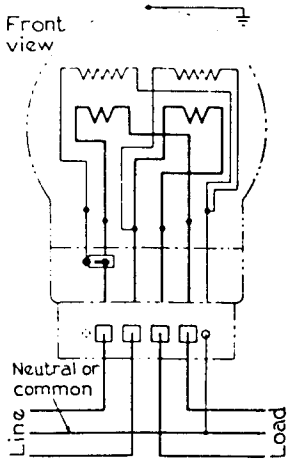


Fig. 12. *Types V-62-A and VM-62-A; 3-wire network, 1-, 2-, and 3-phase – Form 12A, self-contained*

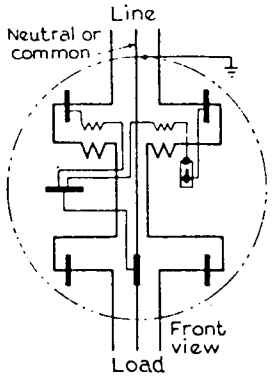


Fig. 13. *Types V-62-S and VM-62-S; 3-wire network, 1-, 2-, and 3-phase – Form 12S, self-contained*

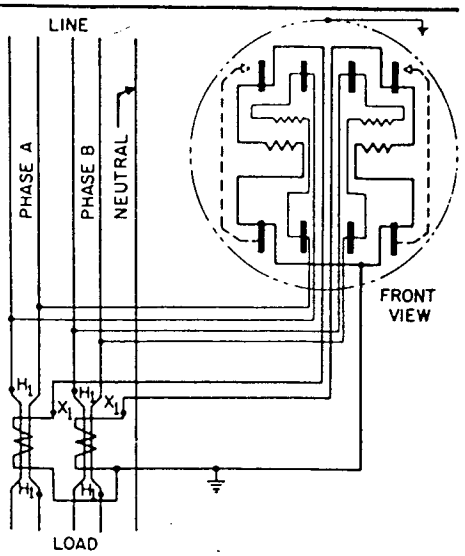
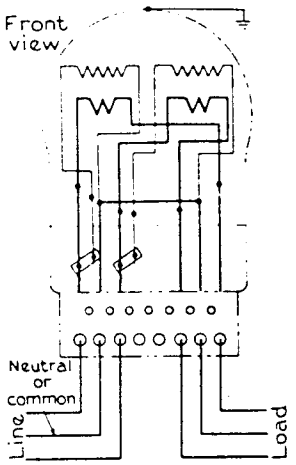
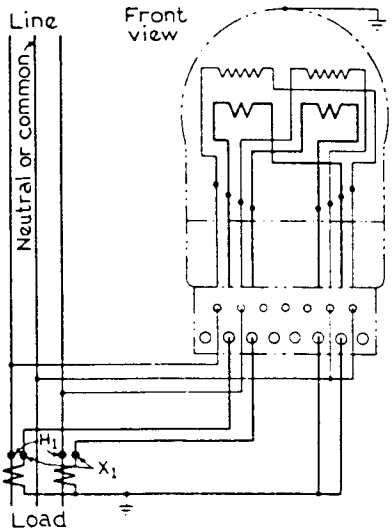


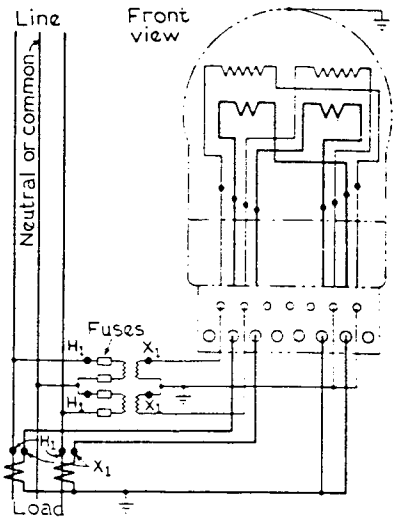
Fig. 14. *Type V-63-S meter for 5-wire, 2-phase circuits or for totalizing two 3-wire, single-phase circuits – Form 5S, with 3-wire current transformers*



(a) Form 13A, self-contained

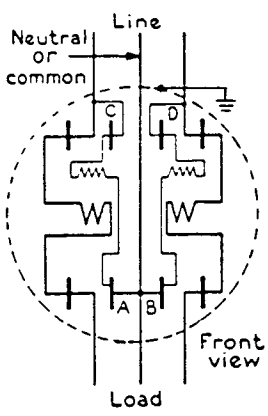


(b) Form 5A, with current transformers



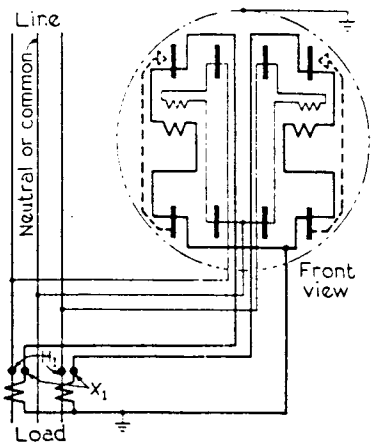
(c) Form 5A, with current and voltage transformers

Fig. 15. *Types V-63-A and VM-63-A 2-stator meters for 3-wire, 1-, 2-, or 3-phase circuits*

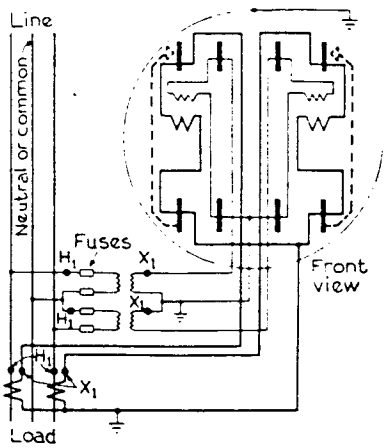


NOTE: Make jumper connections A, B, C and D in socket

(a) Form 13S, self-contained



(b) Form 5S, with current transformers

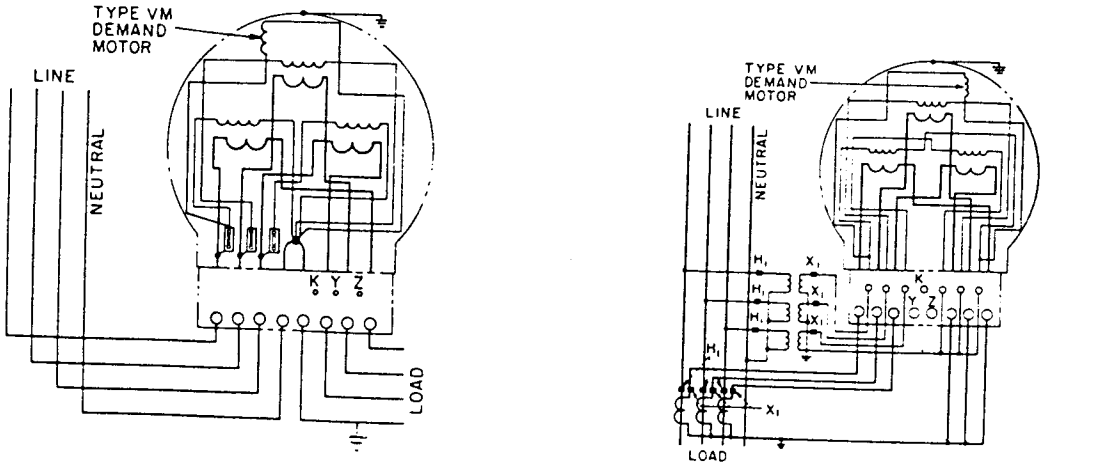


(c) Form 5S, with current and voltage transformers

Fig. 16. *Types V-63-S and VM-63-S 2-stator meters for 3-wire, 1-, 2-, or 3-phase circuits*

EXTERNAL CONNECTION DIAGRAMS

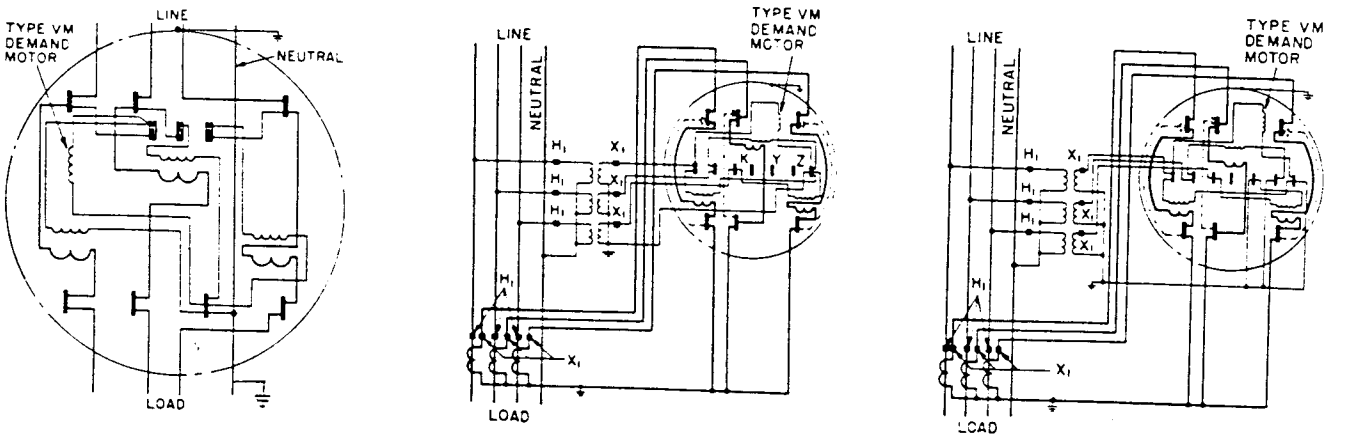
NOTE: Dotted arrows indicate socket circuit-closing devices.



(a) Form 16A, self-contained

(b) Form 9A, with current and voltage transformers

Fig. 17. Types V-64-A and VM-64-A 3-stator meters for 4-wire Y, 3-phase circuits (front views)



(a) Form 16S, self-contained

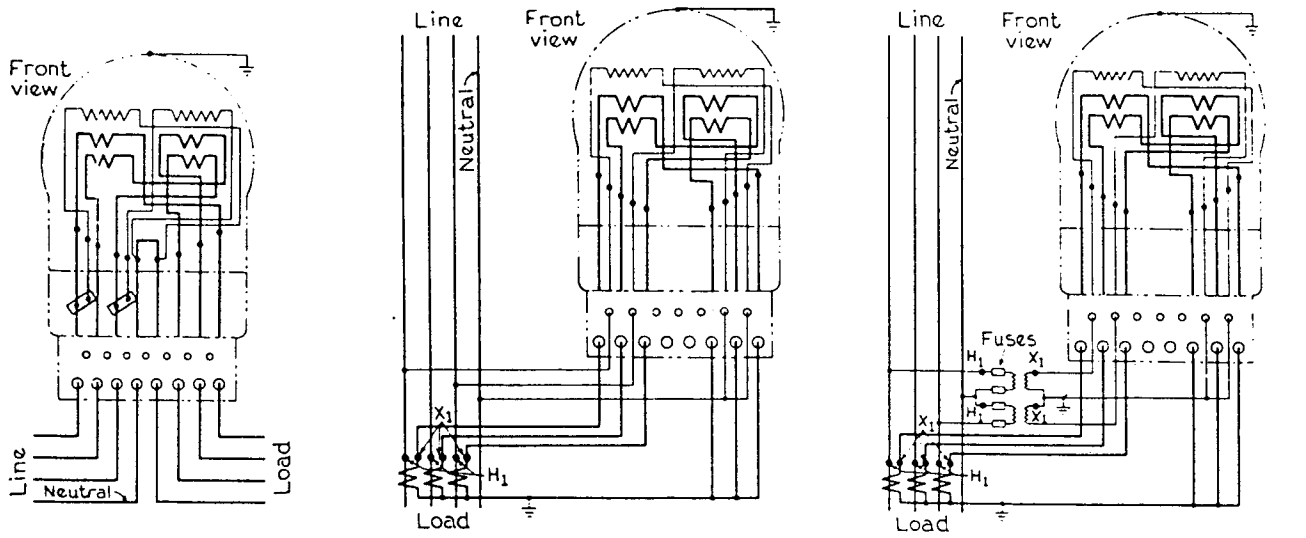
(b) Form 9S, with current and voltage transformers

(c) Form 10S, with current and voltage transformers

Fig. 18. Types V-64-S and VM-64-S 3-stator meters for 4-wire Y, 3-phase circuits (front views)

EXTERNAL CONNECTION DIAGRAMS

NOTE: Dotted arrows indicate socket circuit-closing devices.

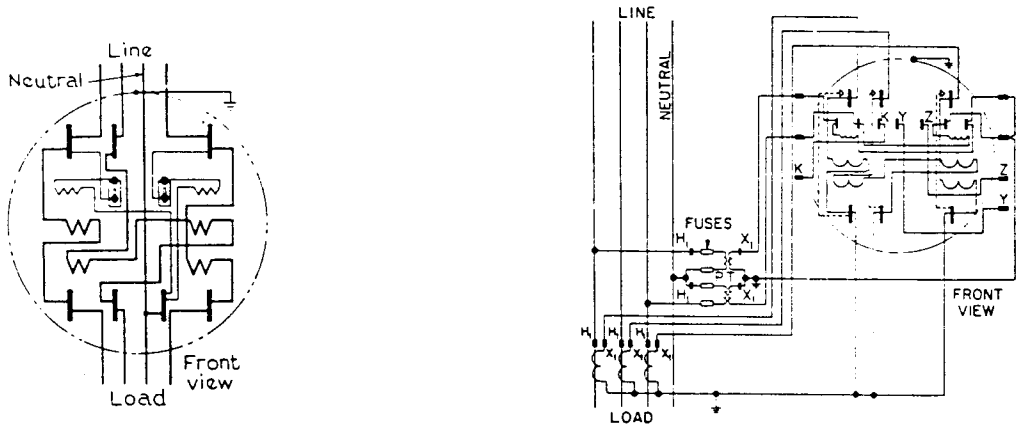


(a) Form 14A, self-contained

(b) Form 6A, with current transformers

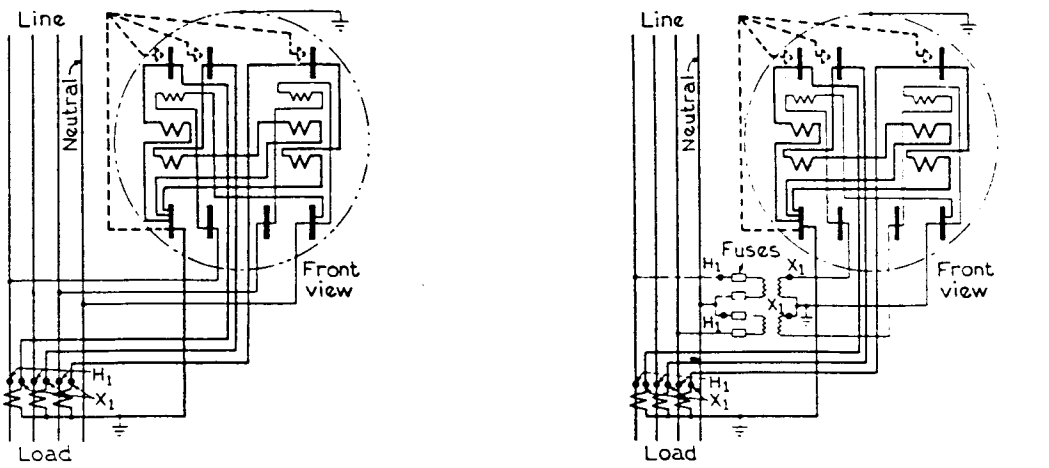
(c) Form 6A, with current and voltage transformers

Fig. 19. Types V-65-A and VM-65-A 2-stator meters for 4-wire Y, 3-phase circuits



(a) Form 14S, self-contained

(b) Form 6S, 13-terminal, with current and voltage transformers



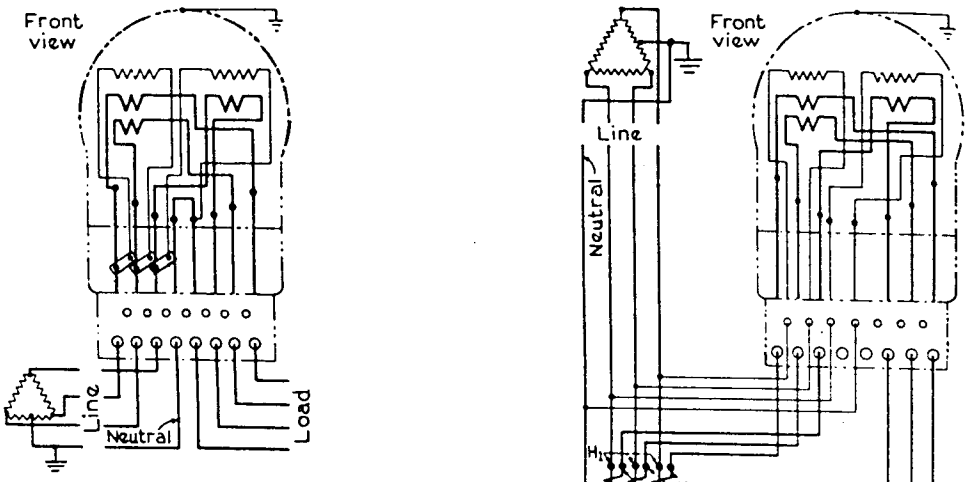
(c) Form 7S, 7-terminal, with current transformers

(d) Form 7S, 7-terminal, with current and voltage transformers

Fig. 20. Types V-65-S and VM-65-S 2-stator meters for 4-wire Y, 3-phase circuits

EXTERNAL CONNECTION DIAGRAMS

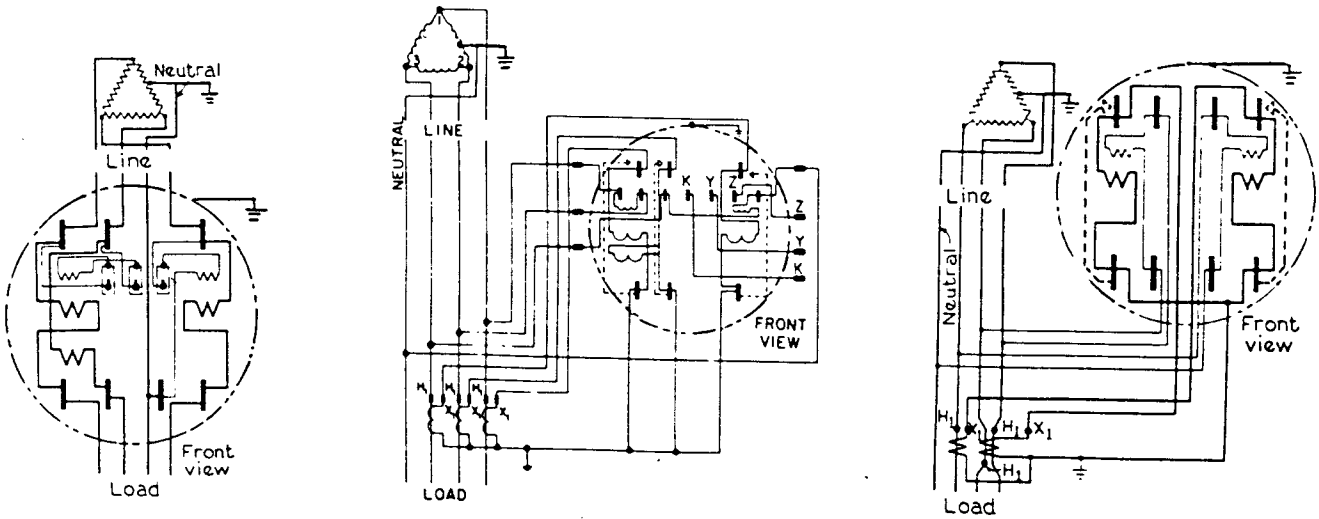
NOTE: Dotted arrows indicate socket circuit-closing devices.



(a) Form 15A, self-contained

(b) Form 8A, with current transformers

Fig. 21. Types V-66-A and VM-66-A 2-stator meters for 4-wire Δ, 3-phase circuits



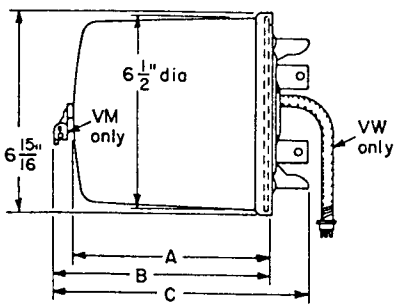
(a) Types V-66-S and VM-66-S—Form 15S. self-contained

(b) Types V-66-S and VM-66-S 13-terminal meters—Form 8S with current transformers

(c) Types V-63-S and VM-63-S 3-wire, 3-phase meters—Form 5S, with one 3-wire and one regular current transformer

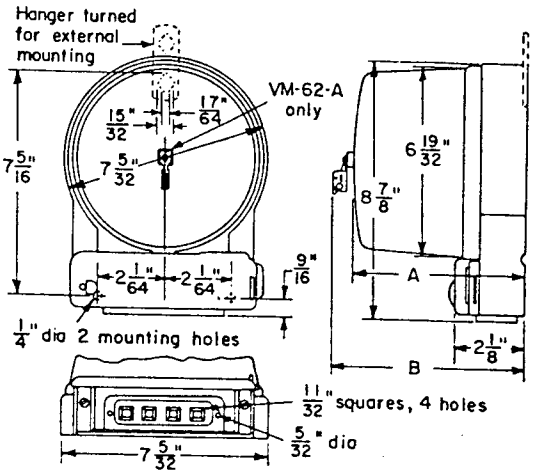
Fig. 22. Types V-66-S, VM-66-S, V-63-S and VM-63-S 2-stator meters for 4-wire Δ, 3-phase circuits

OUTLINE AND MOUNTING DIMENSIONS



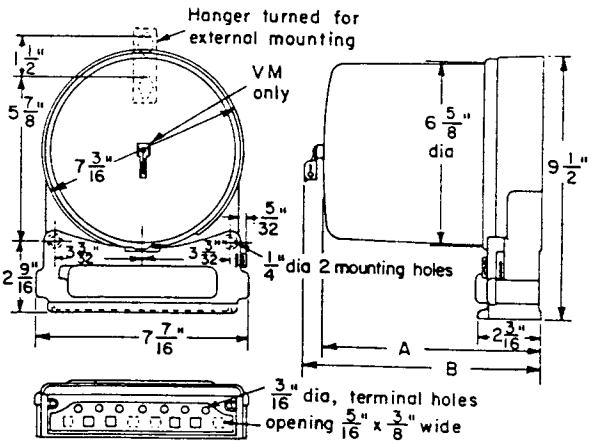
No. of Stators	Meter Types	Demand Register	Dimensions in Inches (Max) A	B	C
2	V, VW	.....	5 7/8	.....	7 1/4
2	VM	M-60	8 3/16	8 13/16	10 3/16
2	VM	M-30, -31, -50, -51	7 1/16	7 3/4	9 1/8
3	V-64, VW-64	.....	6 1/4	.....	7 5/8
3	VM-64	M-60	8 3/4	9 7/16	10 13/16
3	VM-64	M-30, -31, -50, -51	7 11/16	8 3/8	9 3/4

Fig. 23. Types V-62-S, V-63-S, V-65-S and V-66-S 2-stator meters and Type V-64-S 3-stator meters. Also for VW and VM models



Meter Types	Demand Register	Dimensions in Inches (Max) A	B
V, VW	.....	5 7/8	.....
VM	M-60	8 1/2	9 3/16
VM	M-30, -31, -50, -51	7 1/2	8 3/16

Fig. 24. Types V-62-A, VM-62-A and VW-62-A 2-stator meters



No. of Stators	Meter Types	Demand Register	Dimensions in Inches (Max) A	B
2	V, VW	.....	6 3/16	.....
2	VM	M-60	8 3/4	9 3/8
2	VM	M-30, -31, -50, -51	7 3/4	8 3/8
3	V-64, VW-64	.....	6 1/2	.....
3	VM-64	M-60	9 5/16	9 15/16
3	VM-64	M-30, -31, -50, -51	8 1/2	9 3/16

Fig. 25. Types V-63-A, V-65-A and V-66-A 2-stator meters and Type V-64-A 3-stator meters. Also VW and VM models

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