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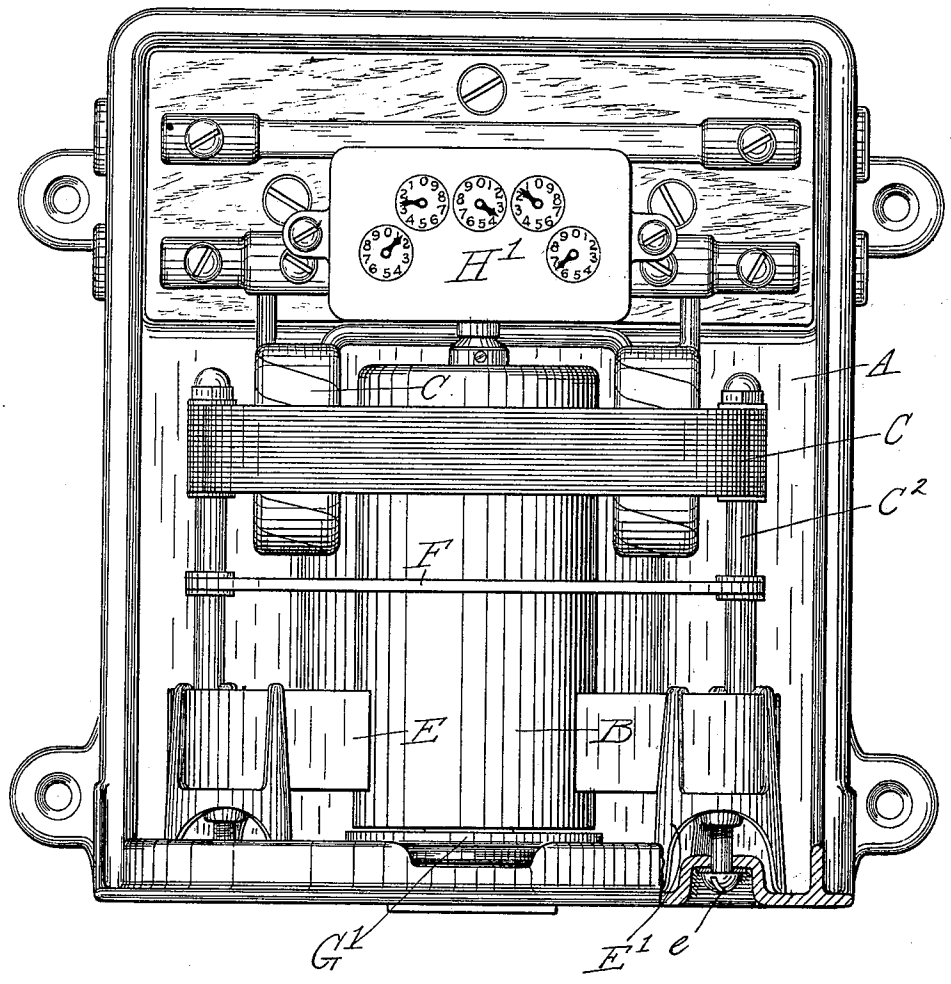
6 Sheets—Sheet 1.

T. DUNCAN.

ELECTRIC METER.

No. 605,949. Patented June 21, 1898.

Fig. 1.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.)

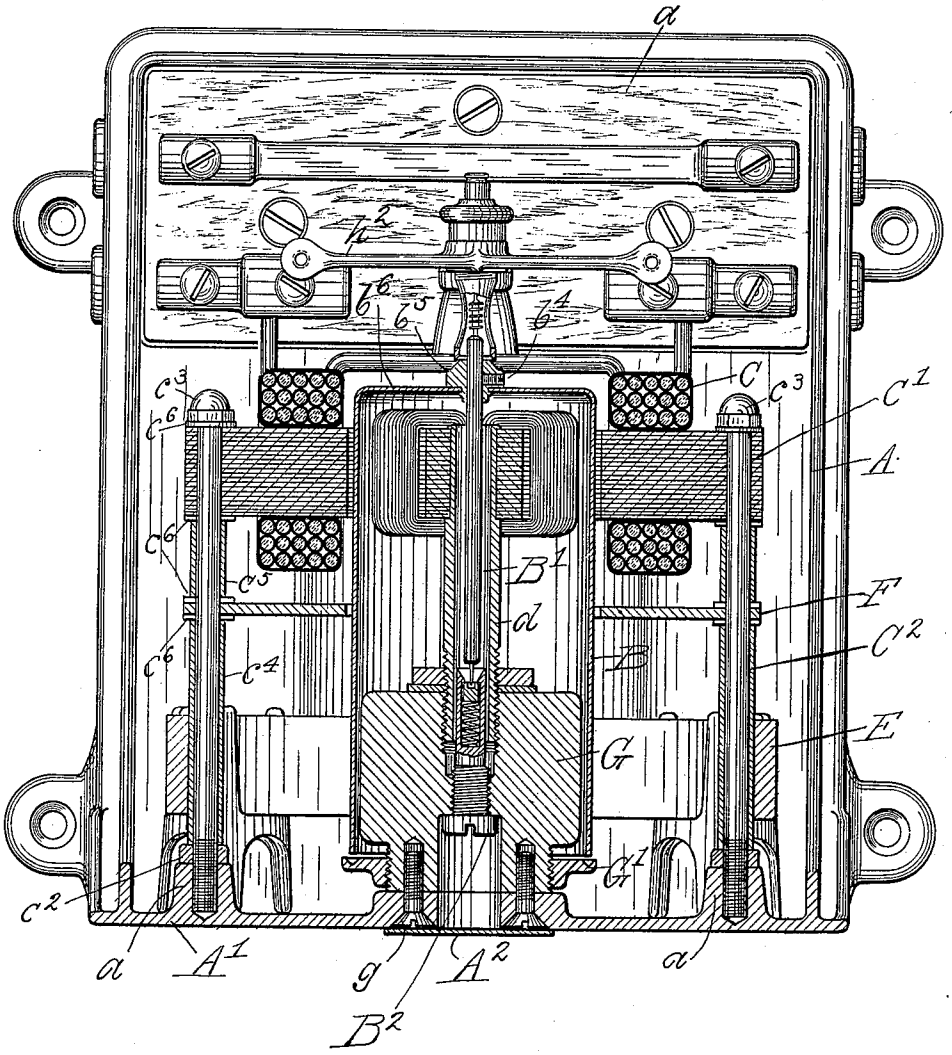
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Fig. 2.



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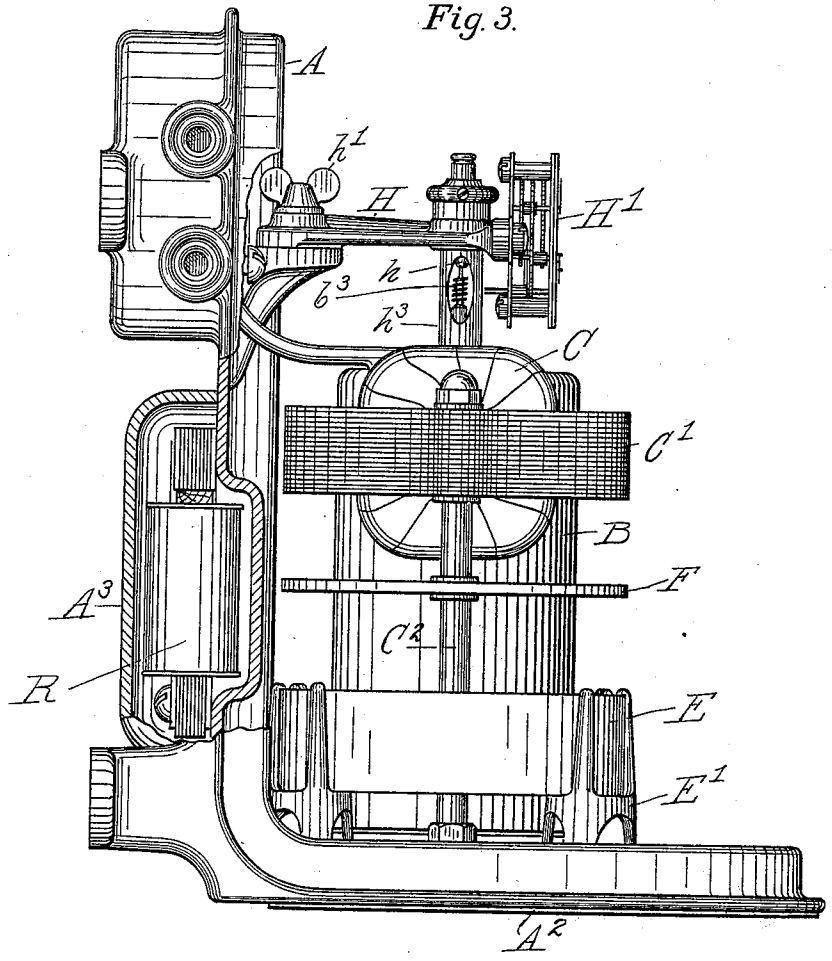
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Fig. 3.



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Fig. 4.

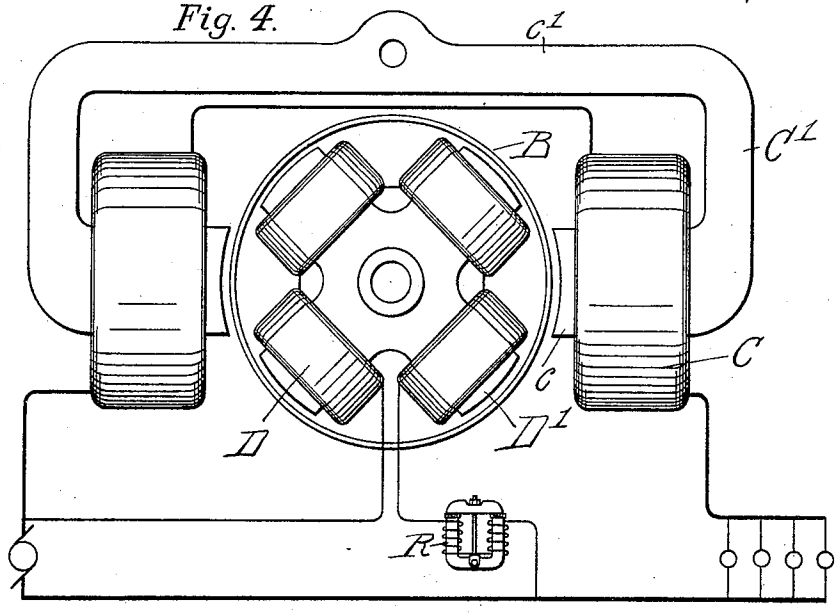
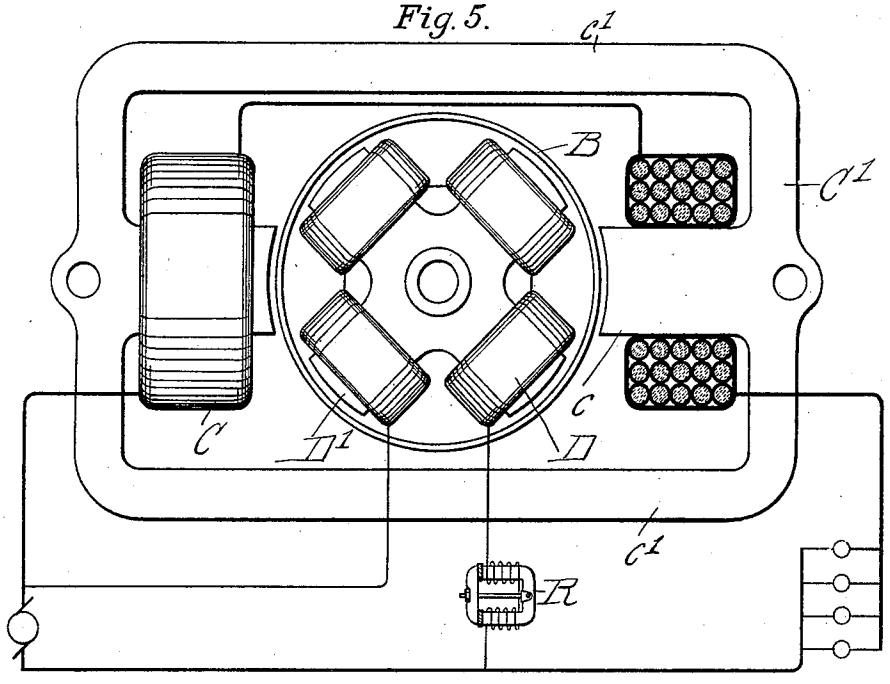


Fig. 5.



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Fig. 6.

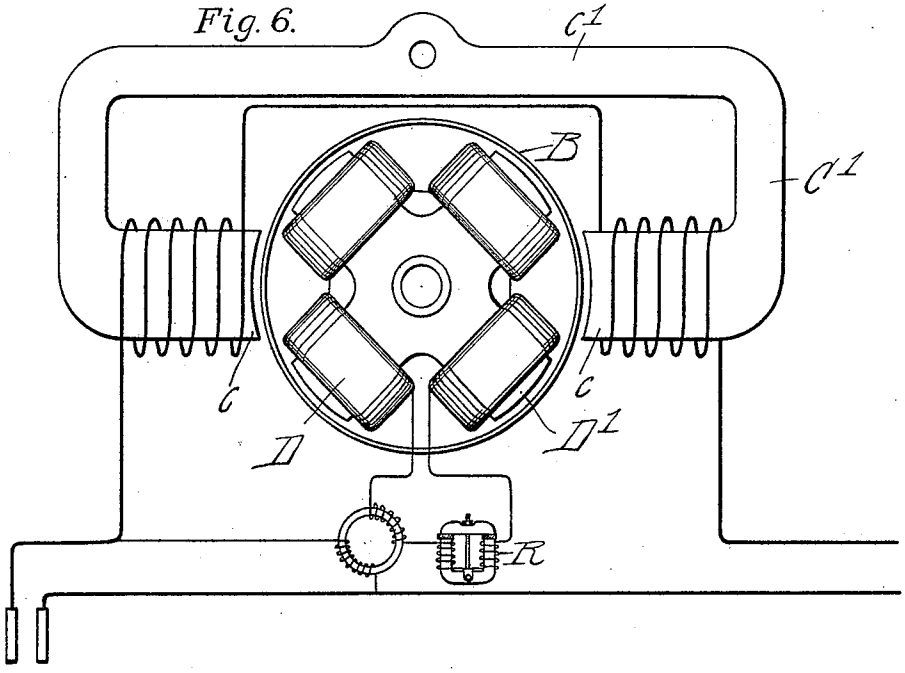
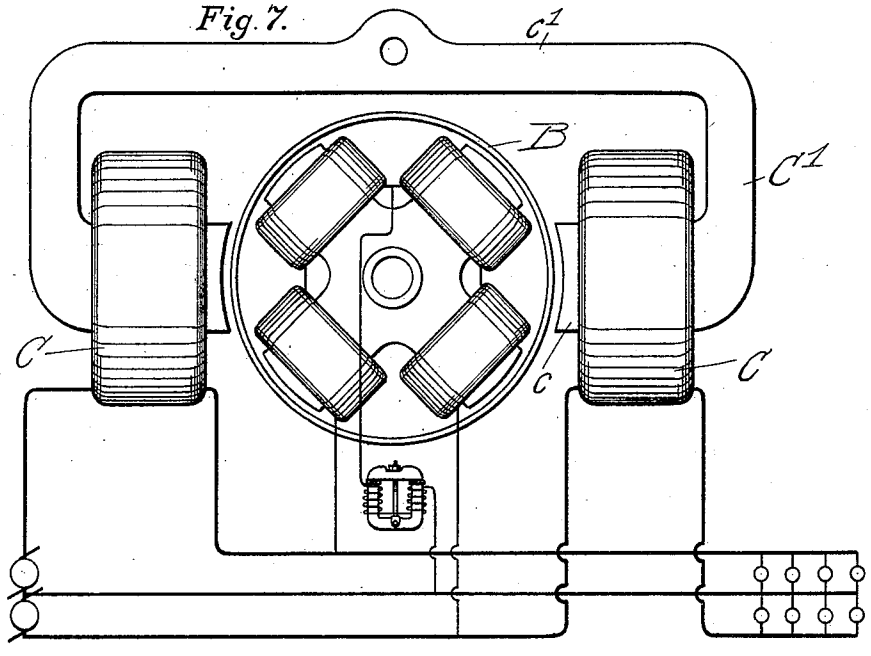


Fig. 7.



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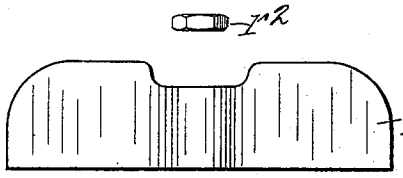


Fig. 9.

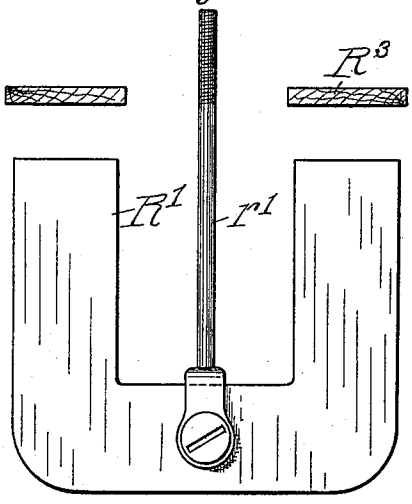


Fig. 8.

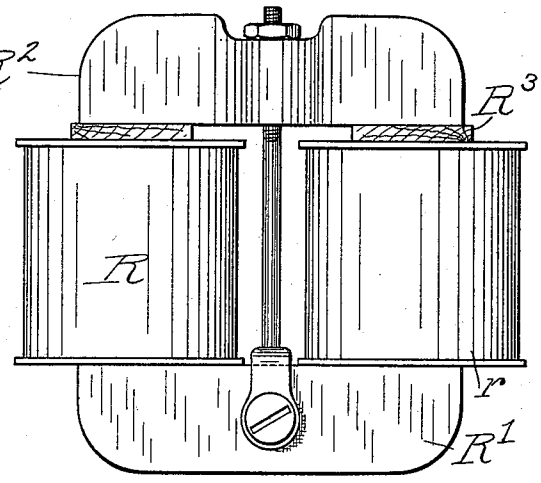


Fig. 10.

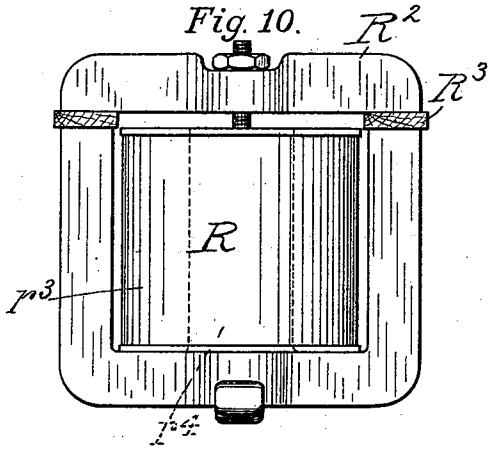
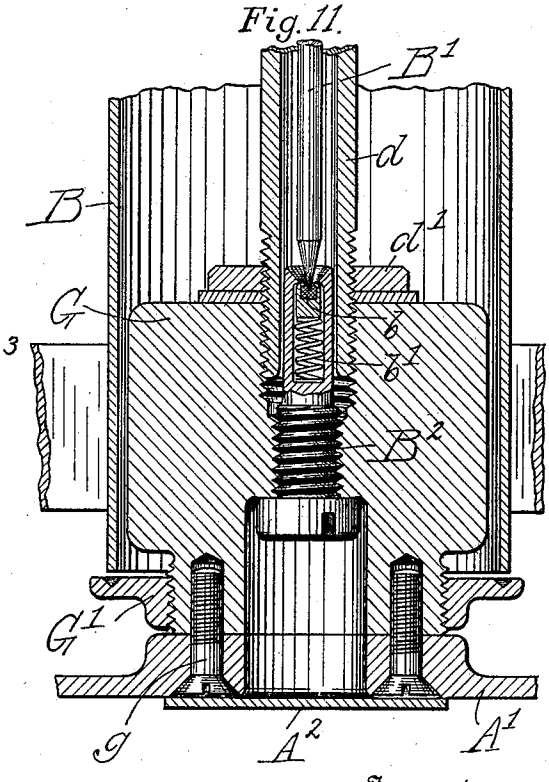


Fig. 11.



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UNITED STATES PATENT OFFICE.

THOMAS DUNCAN, OF FORT WAYNE, INDIANA.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 605,949, dated June 21, 1898.

Application filed June 24, 1897. Serial No. 642,212. (No model.)

To all whom it may concern:

Be it known that I, THOMAS DUNCAN, of Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Electric Meters, of which the following is a specification.

This invention relates to alternating-current meters of that class in which a closed secondary or armature is set in motion by the inductive action of two magnetic fields of differing phase, and in most of its features it relates more particularly to that type of such meters known as "integrating" wattmeters and in which the two fields referred to are set up, one by a coil connected in series in the work-circuit and the other by a coil in shunt between the main leads thereof, and in which the movement of the armature is resisted by a magnetic drag. In some of its features, however, the present improvement is applicable to meters of other types.

Among the objects of the invention are to provide a superior instrument of the character referred to and one capable of accurate operation in three-wire systems of distribution as well as in ordinary two-wire circuits.

The invention shows an application to wattmeters of the principles more fully developed in my concurrent application, Serial No. 647,303, filed August 6, 1897; and it consists in the matters hereinafter set forth, and more particularly pointed out in the appended claims.

In the accompanying drawings, Figure 1 is a front elevation of a meter constructed in accordance with my invention. Fig. 2 is a front sectional elevation taken on a plane through the axis of rotation of the armature. Fig. 3 is a side elevation of the meter. Figs. 4 and 5 are top plan diagrams illustrating different shapes of series-coil cores. Fig. 6 illustrates a method of connecting in which a transformer is employed in the shunt-circuit. Fig. 7 shows one method of connecting the meter in a three-wire system. Figs. 8, 9, and 10 are details of the impedance-coil and core. Fig. 11 is a sectional detail showing the manner in which the jeweled bearing for the lower end of the armature-spindle is rendered accessible.

In said drawings, A designates the meter-frame, B the rotary armature, which is made cylindric in form, and C C and D D the series and shunt coils, respectively. The series coils are made of sufficiently heavy wire to carry the full current of the circuit and are mounted upon the insetting pole-pieces c of a laminated magnetic core C′, which extends around the armature, so that its poles are located on the opposite sides thereof, and which may be made either with one connecting arm or slide c' or may be made double, as shown, respectively, in Figs. 4 and 5. The meter is connected in circuit by means of the usual binding-post and connections mounted upon an insulating-block a in the upper part of the meter-frame.

The cylindric armature B extends downward from between the field-coils C to between drag-magnets E, that are located near the base A′ of the meter-frame. These magnets are of modified horseshoe shape and in the present improvement are conveniently held in place by metal chairs E′, that rest upon the meter-base and are secured thereto by screws e. The series coils and cores are supported in proper position by standards C^2, that are screwed into lugs a' of the base and locked there by check-nuts c^2. The several laminæ of the cores C′ are apertured to slip over these standards, and cap-nuts c^3 serve to clamp them in place. The standards also hold a soft-iron or steel plate F, which is interposed between the field-coils and drag-magnets to prevent them from exerting a disturbing influence upon each other. In the details shown this plate rests upon the upper end of short tubes c^4, which are first slipped over the standards. Then after the plate is placed in position other short tubes c^5 are slipped on, and the core C′ rests upon the upper end of the latter tubes, suitable washers c^6 being provided at the several joints. A circular aperture slightly larger than the armature is cut out at the center of the plate F to admit the armature, which rotates freely therein.

G designates a core of soft iron or the like that projects upward into the open lower end of the cylindric armature between the drag-magnets E and serves to draw the lines of magnetic force through the walls of the armature, so as to thereby increase the drag. Said core is shown as secured to the base of

the meter-frame by screws g, and its lower end is reduced in diameter and threaded to support a thumb-nut G′, that serves to raise the armature off its bearings. From the upper side of the core G a standard d rises to support the shunt-coils D, which are located within the upper part of the cylindric armature, opposite the series coils C. Said standard consists of a piece of tubing threaded at its lower end to engage a threaded aperture in the core, and it is locked in place therein by a nut d'. The supporting-spindle B′ of the armature passes down through the standard d and rests upon a jewel b, that is supported upon a spring b'. Both the jewel and the spring are contained within a hollow screw B^2, that is seated in a threaded aperture of the core G. An enlarged counterbore in the lower part of the core receives the head of the screw, and a corresponding bore in the base of the meter-frame permits said screw to be removed and replaced at will without detaching the core from the base or removing the armature. The aperture in the base may be covered by a slide A^2, that is movably attached to the lower side of the base in any convenient manner. The construction thus set forth permits the jewel to be readily replaced as often as the wear upon it necessitates.

The bearing h for the upper end of the spindle is carried by an arm H, which is detachably secured to the meter-frame by a thumb-nut h' or the like. Said arm H is also provided with laterally-spreading branches h^2, to which the usual registering-train H′ is attached, and the driving-gear of said train is actuated, as usual, by a worm b^3 on the spindle. The armature B is rigidly secured upon the spindle in any suitable manner, as by a set-screw b^4 in the hub b^5 of the top wall b^6 of the armature. A centering-tube h^3 depends over the bearing h to within a short distance of the hub b^5, and when the thumb-nut G′ is screwed up beneath the armature it raises the spindle off its jewel and locks the hub against said centering-tube, so that the meter may then be safely handled and transported without danger of injury.

The volt-coils D are herein shown as four in number and are located upon the extremity or poles of a core D′, that is made in the shape of a Greek cross. The laminæ of this core are apertured to slip over the reduced upper end of the tubular standard d, and the latter is then riveted or beaded over to clamp them together and hold the core securely in place. Said coils D are connected in shunt between the main leads of the circuit, and the necessary phase displacement between the current in the series and shunt coils is effected by an inductance-coil R, placed in the shunt-circuit. This coil may be conveniently located in a recess at the back of the meter-frame and protected by a removable cover A^3. As herein shown, the core R′ of the inductance-coil is made of U shape, and the wire is wound in two spools r, which are slipped over its extremities or poles. As a further improvement the inductance of the coil is made variable by means of an adjustable keep or armature R^2, which is secured to the core by a screw-bolt r' and nut r^2. Space-blocks R^3, of hard wood or the like, are inserted between the poles of the core and said keeper and are held in place by turning up the nut r^2 until the keeper is clamped down tightly upon them. By providing space-blocks of different thicknesses the air-gap between the core and keeper, and consequently the inductance of the coil, may be varied as desired to adjust the speed of the meter in calibrating, the construction thus described affording a very simple method of accomplishing this result. It will be obvious that the wire need not necessarily be wound directly upon the poles of the magnet. Thus, as shown in Fig. 10, it may be wound in a single spool r^3 and slipped over an intermediate limb r^4 of the core, (shown in dotted lines in said figure,) between the main poles thereof.

When employed in the ordinary two-wire circuit, the volt-coils will usually be connected in series in the shunt-circuit, and the latter may be either connected directly between the main leads, as in Figs. 4 and 5, or may be a derived circuit energized by a transformer the primary of which is in shunt between the main leads, as in Fig. 6. In three-wire systems one of the series coils may be connected in each of the main leads, while the several volt-coils are separated into two groups, which are severally connected, one in shunt between the neutral wire and one of the main leads and the other in shunt between the neutral wire and the other main lead, as in Fig. 7. When so connected, each side of the meter acts in effect as a distinct instrument, and the registration will be substantially accurate even though a considerable disproportion may occur between the loads on the different sides of the system.

I claim as my invention—

1. An electric meter provided with a cylindric armature, a series field without the armature, and a shunt-field within the armature comprising a cross-shaped core, and shunt-coils upon said core.

2. An electric meter provided with a cylindric armature, a core extending around the armature and having insetting poles on opposite sides thereof and series coils upon said poles, a cross-shaped core within the armature, and shunt-coils upon the several poles of said cross-shaped core.

3. An electric meter provided with a cylindric armature, series coils without the armature, and two pairs of shunt-coils within the armature, one pair adjacent to each series coil, and the two members of each pair being arranged on opposite sides of the common axis of the series coils.

4. An electric meter provided with a cylin-

dric armature, a core extending around the armature and having insetting poles on opposite sides thereof and series coils upon said poles, a cross-shaped core within the armature, and two pairs of shunt-coils upon the poles of said cross-shaped core, one pair adjacent to each of the field-poles and the two coils of each pair being arranged on opposite sides of the axis of said field-poles.

5. An electric meter provided with a cylindric armature, a series field without the armature and a shunt-field within the armature, drag-magnets exerting a retarding influence on the armature, and a magnetic shield apertured for the passage of the armature inserted between the series field and drag-magnets.

6. The combination with the meter-frame A, the armature B′, and the series and shunt coils C and D, of the series core C′, the standard C^2 supporting said core, tubes c^4 upon said standard, magnetic plate F resting on the upper ends of said tubes, upper tubes c^5 upon the standard, and cap-nut c^3 clamping the core C′ down upon said upper tubes.

7. The combination with the meter-frame and armature, of the series and shunt fields and drag-magnets, the core G projecting from the base of the meter-frame up into the cylindric armature, the tubular standard d screwed into the upper side of said core and supporting a shunt-field, the screw B^3 seated in a screw-threaded bore of the core and projecting upward into the tubular standard, the enlarged counterbore and registering aperture in the base of the frame giving access to said screw, the spring-supported jewel in said screw, the armature-spindle B′ resting upon said jewel, and the detachable upper bearing of said armature.

8. In an induction-motor meter, the combination with a rotary armature and two fields for actuating said armature, of an impedance-coil provided with a U-shaped core having a separable keeper, non-magnetic space-blocks inserted between the keeper and the poles of the core and means for detachably clamping the parts in this relation.

9. In an induction-motor meter, the combination with the rotary armature and two fields for actuating said armature, of an impedance-coil provided with a U-shaped core having a detachable keeper, non-magnetic space-blocks inserted between the keeper and core, and a screw-bolt r' and nut r^2 for adjustably clamping the keeper in place.

10. A meter for three-wire systems of electric distribution, comprising a cylindric armature, a series coil without the armature connected in each of the outer main leads and two pairs of volt-coils within the armature, one pair connected in shunt between one of the main leads and the neutral wire and the other in shunt between the other main lead and the neutral wire.

11. A meter for three-wire systems of electric distribution, comprising a cylindric armature, a core and coil without the armature connected in series in each of the main leads, a cross-shaped core within the armature having two pairs of volt-coils upon its poles, one pair of volt-coils being connected in shunt between one main lead and the neutral wire and the other pair in shunt between the other main lead and the neutral wire.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two subscribing witnesses, this 29th day of May, A. D. 1897.

THOMAS DUNCAN.

Witnesses:
CHARLES C. MILLER,
M. G. WEBBER.