W. D. LE BARON.

ELECTRIC METER.

APPLICATION FILED DEC. 14, 1917.

1,315,781.

Patented Sept. 9, 1919.

2 SHEETS—SHEET 1.

Fig. 1

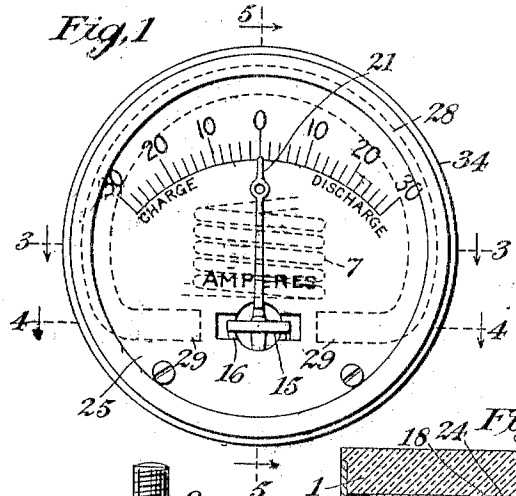


Fig. 2

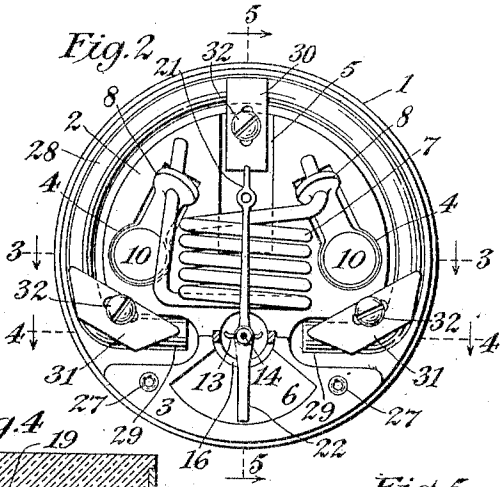


Fig. 3

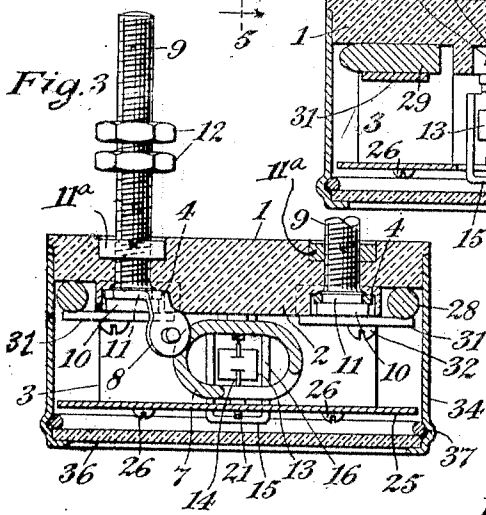


Fig. 4

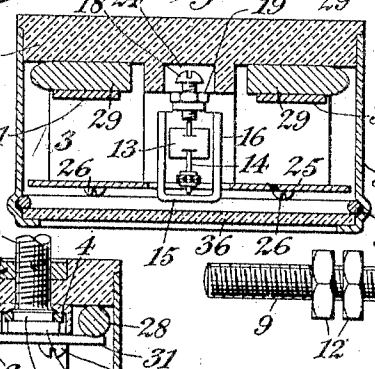


Fig. 5

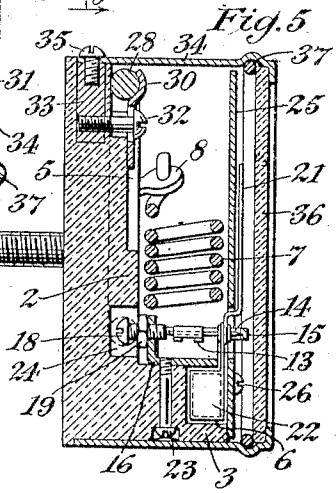


Fig. 6

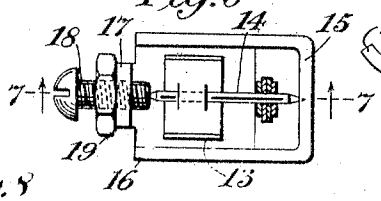


Fig. 10

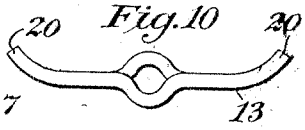


Fig. 9

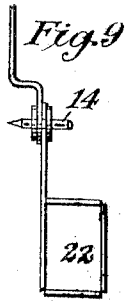


Fig. 8

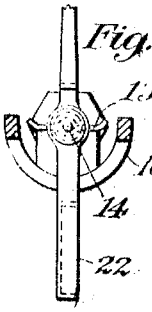


Fig. 7

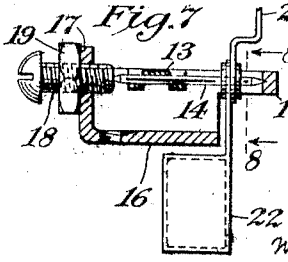
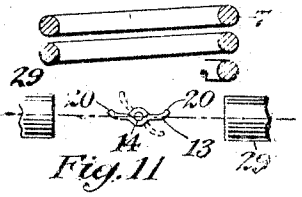


Fig. 11



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2 SHEETS—SHEET 2.

Fig. 12

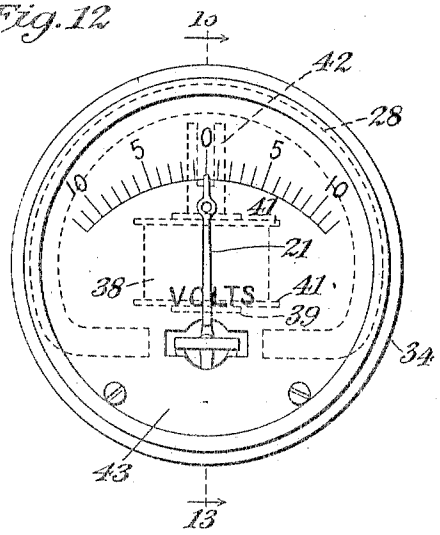


Fig. 13

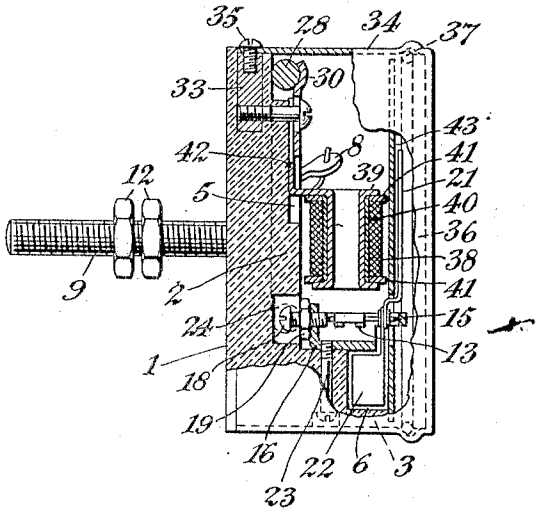


Fig. 14

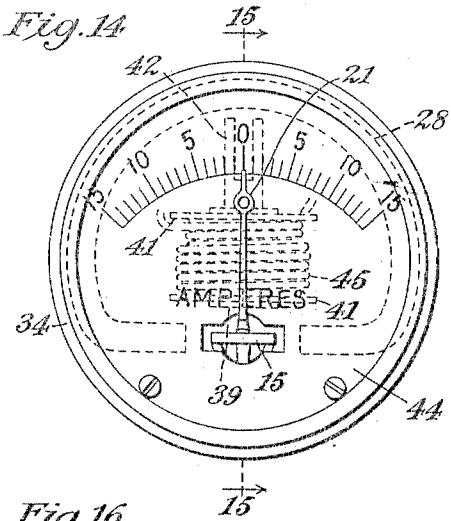


Fig. 15

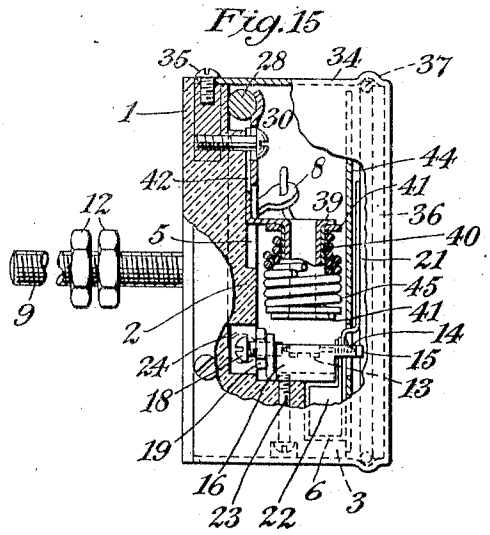
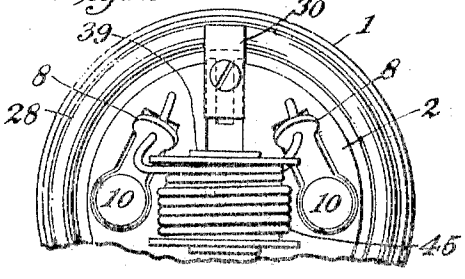


Fig. 16



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UNITED STATES PATENT OFFICE.

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ELECTRIC METER.

1,315,781. Specification of Letters Patent. Patented Sept. 9, 1919.

Application filed December 14, 1917. Serial No. 207,056.

To all whom it may concern:

Be it known that I, WILBUR DUANE LE BARON, a citizen of the United States, residing at the borough of Bronx, in the county of Bronx and State of New York, have invented certain new and useful Improvements in Electric Meters, of which the following is a specification, reference being had therein to the accompanying drawings, forming part thereof.

My invention relates to electric meters such as ammeters and voltmeters, and more particularly those which are adapted to give readings or indications at opposite sides of a zero point. Objects of my invention are reliability, accuracy of indication, simplicity of construction, inexpensiveness of manufacture, and other objects and advantages which will hereinafter appear. My invention includes in a general combination various features of construction and combinations of parts and subcombinations thereof as will appear from the following description.

I shall now describe the three electric meters embodying my invention illustrated in the accompanying drawings and shall thereafter point out my invention in claims.

Figure 1 is a face view or front elevation of an ammeter embodying my invention.

Fig. 2 is a similar view with the cover and dial plate removed, and with parts in section.

Fig. 3 is a central horizontal section on a plane indicated by the line 3—3 of Figs. 1 and 2 as viewed from above.

Fig. 4 is a similar view on a plane indicated by the line 4—4.

Fig. 5 is a central vertical section on a plane indicated by the line 5—5 of Figs. 1 and 2 as viewed from the left.

Fig. 6 is an enlarged plan view of the movement assembly as seen from above in Fig. 5 with parts in horizontal section.

Fig. 7 is a similarly enlarged vertical section of the movement assembly as it appears in Fig. 5, the section being taken on a plane indicated by the line 7—7 of Fig. 6 as viewed from below.

Fig. 8 is a front elevation of the movement assembly partly in section on a plane indicated by the line 8—8 of Fig. 7 as viewed from the right.

Fig. 9 is a side elevation of parts of the movement as viewed from the right in Fig. 8, and showing the other side from that which appears in Fig. 7.

Fig. 10 is a greatly enlarged front elevation of the pivoted magnetic indicating armature in the position in which this armature appears in Figs. 2 and 8.

Fig. 11 is a diagram illustrating the operation of this armature.

Fig. 12 is a view similar to Fig. 1 of a voltmeter, the construction being modified only to the extent of providing a bobbin for supporting the fine wire forming the voltmeter coil.

Fig. 13 is a partial central vertical section on a plane indicated by the line 13—13 of Fig. 12 as viewed from the left.

Fig. 14 is a front elevation similar to Figs. 1 and 12 showing an ammeter of a construction similar to the voltmeter illustrated in Fig. 12.

Fig. 15 is a partial central vertical section similar to Fig. 13 on a plane indicated by the line 15—15 of Fig. 14 as viewed from the left.

Fig. 16 is a partial front elevation with the cover and dial plate removed of the construction illustrated in Figs. 14 and 15.

In the electric meter embodying my invention illustrated in Figs. 1 to 11 inclusive, all of the other parts of the meter are carried or supported by and are mounted upon a base 1 of insulating material and which may be readily molded from a suitable composition as is well understood in the art. The base 1 is circular in plan view as appears in Figs. 1 and 2, and at its forward side is provided with a partly circularly curved substantially central boss 2 and at one side or edge is provided with a substantially segment-shaped standard or pedestal 3 which at its upper or inner side and middle is connected to and which rises above the boss 2. The front or forward face of the boss 2 has therein two similar terminal-receiving recesses 4 and at the top the boss 2 has a clip-receiving recess 5. The upper side of the standard 3 at the middle thereof is of arcuate concave shape, and is shown as of substantially semi-circular form, and in the front or forwardly projecting end of this standard 3 there is provided a fan-shaped or sector-shaped damper-receiving recess 6 of considerable depth, which at the top or upper side opens into the concavity formed

in the upper side of the standard 3, as appears in the drawings.

A coil 7 through which the current to be measured passes is located at the front of and substantially centrally of the base 1, and is shown as slightly spaced forwardly from the boss 2, and the coil 7 is arranged with its axis substantially vertical in the position of the meter appearing in Figs. 1, 2 and 5 of the drawings, and this coil 7 has its lower end adjacent to but spaced from the middle hereinbefore mentioned concave upper surface of the standard or pedestal 3, the coil 7 being shown as of flattened cross-section. The terminals of the coil 7 pass through and are shown as soldered to the forwardly projecting ends of two laterally extending coil terminals 8 located within the respective terminal-receiving recesses 4 in the boss 2 of the base 1.

The coil terminals 8 are mounted upon and fixedly carried by the inner ends of terminal studs 9 which extend rearwardly through the base 1 and project from the back thereof for receiving the circuit wires. The inner end of each of the terminal studs is provided with a head 10 which is received within a somewhat enlarged end part of the terminal-receiving recesses 4, as clearly appears in the drawings. Immediately rearward from the inner head 10 of the terminal studs 9, a slightly enlarged or offset shoulder-forming part 11 is provided over which the apertured end of the coil terminal 8 snugly fits, the shoulder 11 being riveted or upset against the adjacent surface of the coil terminal 8, as is shown in Fig. 3 of the drawings, so that the coil terminal 8 becomes virtually integral or a single part both mechanically and electrically with the terminal stud 9, whereby a good electrical and firm mechanical connection of the parts is provided. Each of the terminal studs 9 is screw-threaded, and at the back or rear of the base 1 is provided with a terminal nut 11^a which is shown as countersunk a little more than flush into the back of the base 1 and which not only firmly holds the stud 9 to the base 1, but which also rigidly holds the coil terminal 8 within its recess 4, whereby rotative movement of the coil terminal 8, such as might break its connection to the end of the coil 7, is prevented, and also whereby the coil 7 will be held in the correct position, no support other than the coil terminals 8 being provided for the coil 7 in the particular instrument now being described, in which the wire forming this coil is of a size and strength sufficient to be self-supporting. However, for purposes of adjustment, hereinafter more particularly referred to, the coil 7 may be slightly moved about or shifted, the free ends of the coil, which both form the electrical connections and support the coil, being adapted to bend sufficiently for this purpose. In the meter illustrated in the drawings, the terminal studs 9 are also employed as attaching studs for holding the meter in place, and are provided with nuts 12.

A movement assembly is provided and is shown separately in Figs. 6, 7 and 8, and the movement or movable parts of this movement assembly are subject to the control of the magnetic field produced by the coil 7. The movement includes a pivoted armature 13 formed of sheet iron and carried by an arbor 14 having pointed ends, the outer or forward end of which is shown as pivoted in a cross-bar 15 forming the outer part of a substantially semi-circular frame or movement support 16, having at its inner end a lug 17 which receives a jewel screw 18 the end of which forms the inner pivot of the arbor 14, all as clearly appears in the drawings, this jewel screw 18 being shown as provided with a lock nut 19. The movement support 16, the pivot screw or jewel screw 18 and its lock nut 19, are of non-magnetic material, such as brass. The armature 13 has its extremities or free ends 20 curved or bent so that both of these ends 20 project laterally at an inclination from the same side thereof and the armature 13 is so arranged that the laterally projecting ends 20 are turned toward or project toward the adjacent end of the coil 7, as appears in the drawings. The purpose or function of these laterally and upwardly inclined armature ends 20 is to permit or provide for the use of a scale having equidistant or uniform calibrations, as will hereinafter more clearly appear.

The arbor 14 also carries a pointer 21 and a combined counterweight and damping vane or fan 22, both formed of non-magnetic material, preferably aluminum. The convex or circularly curved back of the movement support 16 conforms to and fits against the hereinbefore mentioned concavely curved upper face of the forwardly projecting standard or pedestal 3, and extends forward nearly but not quite even with the end of the standard 3, so that excepting for a slight open space at the front, the upper narrow side of the sector-shaped damping recess 6 in the end of the pedestal 3 is closed by the movement support 16. The movement support 16 is firmly secured in place by means of a screw 23 extending from the outside upwardly through the base or inner part of the pedestal 3 and screwing into the back of the movement support 16, as clearly appears in the drawings, particularly in Fig. 5 thereof. The base 1 is shown as provided with a circular recess or well 24 for the reception of the inner end or head of the adjustable bearing screw or jewel screw 18. A non-magnetic dial plate 25 is secured upon the forward end of the

standard or pedestal 3 of the base 1 by means of a pair of screws 26 which enter metallic inserts 27 molded into the material of the base 1, so that the dial plate 25 closes the outer side or end of the damping recess 6 which it will be noted is entirely closed excepting for the slight space or slot left between the outer end of the movement support 16 and the back of the dial plate 25. The damping vane 22 is located within and is freely movable in the damping recess or fan box 6, and has an arm or shank extending out through the above noted slit for connection to the arbor 14.

The pointer 21 projects through a slot in the dial plate 25, as appears in the drawings, to the front thereof for coöperation with a calibrated scale thereon. The dial plate 25 is provided with a double scale having uniform calibrations extending in both directions from a middle zero point. The particular instrument now being described has a range of 30—0—30 amperes being adapted to give indications from zero up to thirty amperes for current in either direction, the part of the scale at the left of the zero point being marked "Charge" and that part at the right of the zero point being marked "Discharge" for thereby indicating whether a storage battery is receiving a charge or that current is being used therefrom, the armature 13 and pointer 21 controlled thereby being deflected in either one direction or the other according to the direction of current flowing through the coil 7, as is well understood in the art.

Means are provided which tend to maintain the pointer 21 at the zero indication, and a permanent magnet 28 is provided for this purpose. The magnet 28 is circularly curved so as to extend somewhat loosely around the circularly curved surface of the substantially central boss 2 on the base 1, and this magnet 28 has spaced pole-forming ends 29 turned inward toward and into alinement with each other, these ends 29 being straight and extending partly between the lower side of the boss 2 and the upper side of the pedestal or standard 3, as clearly appears in the drawings, more particularly in Figs. 1 and 2. The straight pole-forming ends 29 of the magnet 28 are arranged horizontally in the position of the meter appearing in the drawings, and substantially at right angles to the axis of the coil 7 and terminate at opposite sides of the rearwardly extended axis of the arbor 14. The magnet 28 is shown as of cylindrical cross-section, and it may be readily formed by a shaping machine from a suitable piece of round rod, being then in a finished condition and not requiring any machining. The cross-sectional diameter of the rod which forms the magnet 28 is shown as substantially equal to the height or extent of projection in a forward direction of the central boss 2 on the base 1, and the magnet 28 is firmly held in the desired adjusted position on the base 1 by means of suitable clips shown as an upper clip 30 and two similar lower clips 31 of non-magnetic sheet metal shown as having slotted holes therein through which pass similar retaining screws 32 which screw into the sides of three similar metallic inserts 33 in the base 1 and the upper one of which appears in Fig. 5 of the drawings, the upper clip 30 being shown as located within the hereinbefore mentioned clip-receiving recess 5 in the boss 2.

It is to be noted that the substantially ring-shaped magnet 28 is located entirely out of the planes of the coil 7 and the armature 13 so that all straight lines which could be drawn between any parts of the curved magnet 28 will be free from at the rear of and will not pass through any part of the coil 7 or of the pivoted armature 13. That is to say, said bent permanent magnet is so located that no part of said armature or of said coil will be positioned between any parts of said bent magnet. There are substantial advantages in this arrangement which are to be pointed out herein. Commonly heretofore a pivoted armature has been located between the opposed poles of a permanent magnet and also commonly heretofore an armature-deflecting coil has been located directly within a substantially ring-shaped permanent magnet. When a coil is thus arranged an overcharge of current is likely to result in the permanent disarrangement and distortion of the magnetic field of the permanent magnet, as is well understood in the art, whereas in the meter embodying my invention now being described, the location of the coil 7 at the outside of the nearly closed ring formed by the magnet 28 and in a position farther away from the magnet greatly lessens the disturbing effect of this coil upon the permanent magnet 28. The location of the pivoted armature 13 out of the planes of the opposed poles 29 of the magnet 28 results in a plurality of advantages now to be noted. When a pivoted armature as heretofore is located directly between the opposed poles of a permanent magnet, such armature will be in the direct line of the magnetic flux or lines of force passing between such magnetic poles and when unrestrained will of course arrange itself in parallelism with these lines, but when such pivoted armature is moved on its pivot or deflected, as by another magnetic field, a very slight rotative movement of the pivoted armature will tend to greatly lengthen the path of the lines of force through such armature between the poles of the permanent magnet and the result will

be that a large number of such lines of force will not be equal to the strain brought upon them and will snap or break and pass across the air gap between the spaced magnetic poles and thereby their effect upon the pivoted armature will be lost. However, when a pivoted armature such as the armature 13 is located in a position out of alinement with the magnet poles such as the opposed poles 29 of the magnet 28 not only fewer of the lines of force pass through such armature and more of such lines across the air gap, but when such armature is deflected there will be merely what may be termed a torsional strain or twisting upon the lines of force, and a less abrupt bending and stretching strain thereon so that far fewer of such lines of force passing through the pivoted armature will be broken and substantially the entire available directive force of the magnet 28 will thereby continue to be exerted upon the pivoted armature 13 regardless of the angular position to which such armature may be deflected in performing its indicating function. Furthermore, by reason of this arrangement of the armature 13, it will be evident that it will be subjected to a more uniformly graduated directive force by the magnet 28, and in fact in the meter illustrated in the drawings a substantially uniformly graduated magnetic directing force is at all times exerted upon the pivoted armature 13, thereby to tend to move the pointer 21 toward the zero indication, and this arrangement effectively coöperates with the upwardly turned inclined ends 20 of the pivoted magnetic armature 13 in producing correct indications by the pointer 21 as it moves over a uniformly calibrated scale, as will be readily understood. It will be noted that the magnet 28 may be slightly shifted for purposes of adjustment, and in practice I prefer to shift the magnet 28 for effecting adjustment of the pointer 21 to the zero indication, and I prefer to shift the coil 7, as hereinbefore mentioned, for effecting adjustment of the pointer 21 in its movement over the uniformly calibrated scale. It is to be noted that the dial plate 25 extends at the front of the flattened coil 7 in spaced relation thereto so that this coil 7 is located between the back of the dial plate 25 and the front face of the boss 2 on the base 1.

A thin non-magnetic metal casing or cover 34 fits over the base 1 and is shown as abutting against a small shoulder formed thereon and is held in place on the base 1 by means of screws 35 which enter the outer ends of the hereinbefore mentioned metallic inserts 33, one of which appears in Fig. 5. The casing or cover 34 is closed at the front by a cover glass 36 which is shown as resting upon the inner side of a flange provided on the cover 34 and is held in place by means of a wire ring 37 which engages an internal annular groove provided for the purpose in the casing or cover 34.

It will now be evident that the above described electric meter will present the hereinbefore mentioned advantageous results in its manufacture and operation.

The electric meter hereinbefore described in reference to Figs. 1 to 11 inclusive, as hereinbefore noted, is an ammeter having a range of indication of 30—0—30 amperes, and in such an instrument the coil 7 will be of sufficient size and strength, as indicated in the drawings and as hereinbefore described, that it will be self-supporting and will retain its position without any support other than that provided by the attachment of its ends to the coil terminals 8, as hereinbefore described. However, in the case of a meter in which finer wire is employed, for example, in an ammeter having a scale of the same length but giving a maximum indication of a lower number of amperes, and also more particularly in the case of a voltmeter in which, as is well understood in the art, a coil is employed having a great number of turns of very fine wire, some additional support is needed for the coil, and in such cases the coil is supported by a bobbin upon which the coil is wound, as is usual in this art. This provision of a supporting bobbin for the finer wire and a correspondingly suitable scale upon the dial plate are the only changes required in the above described meter for converting it into a voltmeter, or into an ammeter giving a lower indication as above mentioned.

In Figs. 12 and 13 of the accompanying drawings, a voltmeter embodying my invention is illustrated, and this voltmeter excepting in the particulars now to be noted is of a construction identical with that above described in reference to Figs. 1 to 11 inclusive. In this voltmeter a coil 38 of a great number of turns of fine wire is employed and is shown as mounted upon and supported by a non-magnetic sheet metal spool or bobbin 39, which is provided with an insulating sleeve 40 and insulating end plates 41 and which is supported upon the base 1 by means of an integrally rearwardly and upwardly extending bracket 42 which at its upper end is bifurcated and is inserted between the upper magnet-holding clip 30 and the adjacent front face of the base 1 within the clip-receiving recess 5 thereon, and is adjustably held in place by the magnet clip 30 and its screw 32, which latter passes between the prongs of the bifurcated end of the magnet-supporting bracket 42, all as clearly appears in the drawings. In this voltmeter a dial plate 43 is shown as provided which is the same as the dial plate 25 hereinbefore described, excepting it is calibrated for voltage indications and is shown as adapted to give

voltage readings at both sides of a zero point throughout a range of 10—0—10 volts to harmonize with the windings of the coil 38.

In Figs. 14, 15 and 16 there is illustrated an ammeter having a dial plate 44 provided with a double calibrated scale of the same length as in the case of the two meters hereinbefore described, but adapted to give indications throughout a range of 15—0—15 amperes and this ampere meter accordingly has an electric coil 45 composed of correspondingly finer wire than is the coil 7 in the ammeter first above described, and which therefore is provided with a supporting bobbin of the same construction as that illustrated and described in reference to the voltmeter shown in Figs. 12 and 13, and in fact, excepting as to the differently calibrated dial 44 and the ampere winding 45 of coarser wire, the electric meter illustrated in Figs. 14, 15 and 16 is identical with the voltmeter illustrated and described in reference to Figs. 12 and 13. Fig. 16, wherein is shown a front view of the ampere coil 45 and some of the immediately adjacent parts, illustrates more clearly the manner in which the coil-supporting spool or bobbin 39 employed in the two constructions illustrated respectively in Figs. 12 and 13 and in Figs. 14, 15 and 16, is supported upon the base 1 by means of the upper magnet clip 30 and its retaining screw 32.

The operation of the voltmeter illustrated in Figs. 12 and 13, and of the ammeter illustrated in Figs. 14, 15 and 16 is substantially the same so far as my invention is concerned, as in the ammeter illustrated and hereinbefore described in reference to Figs. 1 to 11 inclusive.

It is obvious that various modifications may be made in the constructions above particularly described and shown in the accompanying drawings within the principle and scope of my invention.

I claim:

1. An electric meter comprising a base of insulating material provided with a substantially central boss and with a pedestal rising above said boss adjacent to one side thereof, the top of said pedestal having therein a damping recess open at the front and at the side of the pedestal adjacent to the boss, a permanent magnet around said boss and having opposed spaced inturned ends alongside of said pedestal, a movement support closing the open side of said damping recess, a magnetic indicating armature pivoted on the movement support and occupying a position entirely out from between said magnet poles, a damping vane movable with said armature within said recess, a dial plate closing the front of said recess, a pointer movable with said armature, an electric coil located between said boss and dial plate, terminal studs secured to and passing through said base adjacent to said coil, and coil terminals fixedly carried by said studs and non-rotatively recessed into the boss of said base.

2. The invention claimed in claim 1 in combination with clips mounted upon said boss for holding said magnet in place; in which said armature has free ends projecting toward said coil, and in which each of said terminal studs has an inner head and beneath the head a shoulder over which said coil terminal fits and which is upset to hold the coil terminal in place on the stud so that said coil terminal virtually forms an integral part of said terminal stud both mechanically and electrically.

3. An electric meter having, in combination, a base of insulating material having in the front thereof a damping recess open at one side and at the front, a movement support closing the side of said recess, a dial plate closing the front of said recess, and a damping vane pivoted on said movement support and movable within said recess.

4. An electric meter having, in combination, an electric coil adapted to be traversed by the current to be measured, a pivoted magnetic indicating armature in the magnetic field produced by said coil and having its ends projecting toward said coil and beyond the contiguous parts of said armature, and means tending to move said armature to a zero position.

5. The invention claimed in claim 4 in which said means is a permanent magnet.

6. The invention claimed in claim 5 in which said magnet and armature are so arranged that no parts of said armature are located between any parts of said magnet.

7. A base of insulating material for an electric meter, such base being provided at the inner side thereof with a substantially central magnet-receiving boss and being provided at the inner side and one edge thereof with a movement-supporting pedestal having in the top or front end thereof a fan-shaped recess for a damping vane.

8. A magnetic indicating armature for an electric meter, such armature comprising a piece of thin metal adapted to be pivoted at a middle point and having its free ends projecting laterally both toward the same side of the armature.

9. The invention claimed in claim 8 in which said laterally projecting armature ends are both inclined outward.

10. An electric meter having, in combination, a pivoted flat sheet metal magnetic indicating armature having its free ends projecting laterally toward the same side thereof, and an electric coil for deflecting the armature on its pivot and located at the side of the armature toward which the ends of said armature project.

11. The invention claimed in claim 10 in

combination with a bent permanent magnet tending to move said armature to the zero indication and so located that no part of said armature will be located between any parts of said bent magnet.

12. An electric meter having, in combination, a base of insulating material provided with a substantially central boss and with a pedestal rising above said boss adjacent to one side thereof, the top of said pedestal having therein a damping recess open at the front and at the side of the pedestal adjacent to the boss, a permanent magnet around said boss, a movement support closing the side of said recess, a dial plate closing the front of said recess, and a damping vane pivoted on said movement support and movable within said recess.

13. An electric meter having, in combination, a base of insulating material provided with a substantially central boss and with a pedestal rising above said boss adjacent to one side thereof, the top of said pedestal having therein a damping recess open at the front and at the side of the pedestal adjacent to the boss, a permanent magnet around said boss, a movement support closing the side of said recess, a magnetic indicating armature pivoted on the movement support, a damping vane movable with said armature within said recess, a dial plate closing the front of said recess, a pointer movable with said armature, and an electric coil between said base and dial plate.

In testimony whereof, I have affixed my signature to this specification.

WILBUR DUANE LE BARON.