No. 837,066. PATENTED NOV. 27, 1906.

F. HOLDEN.

METER.

APPLICATION FILED NOV. 17, 1905.

Fig. 1.

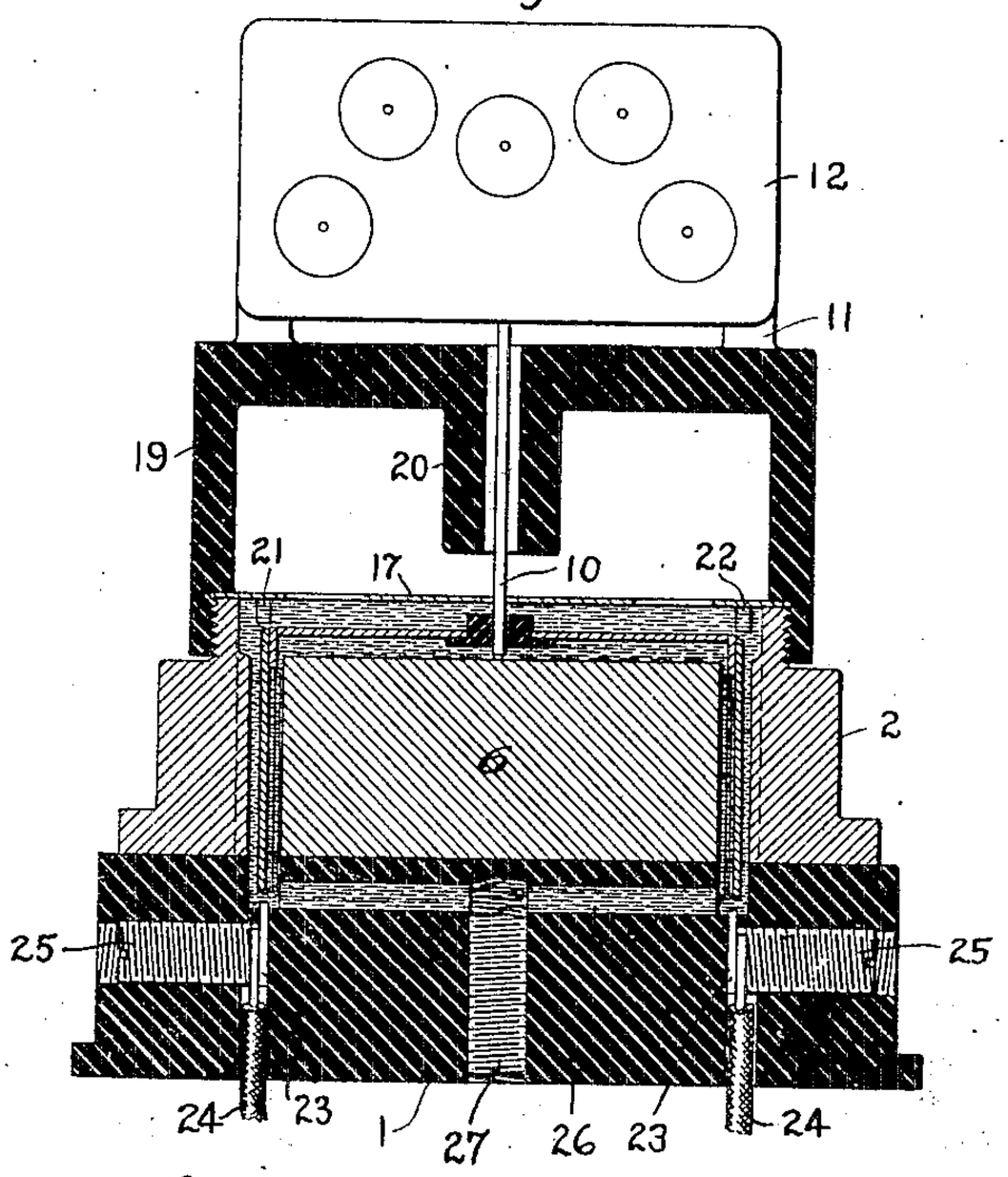


Fig. 2.

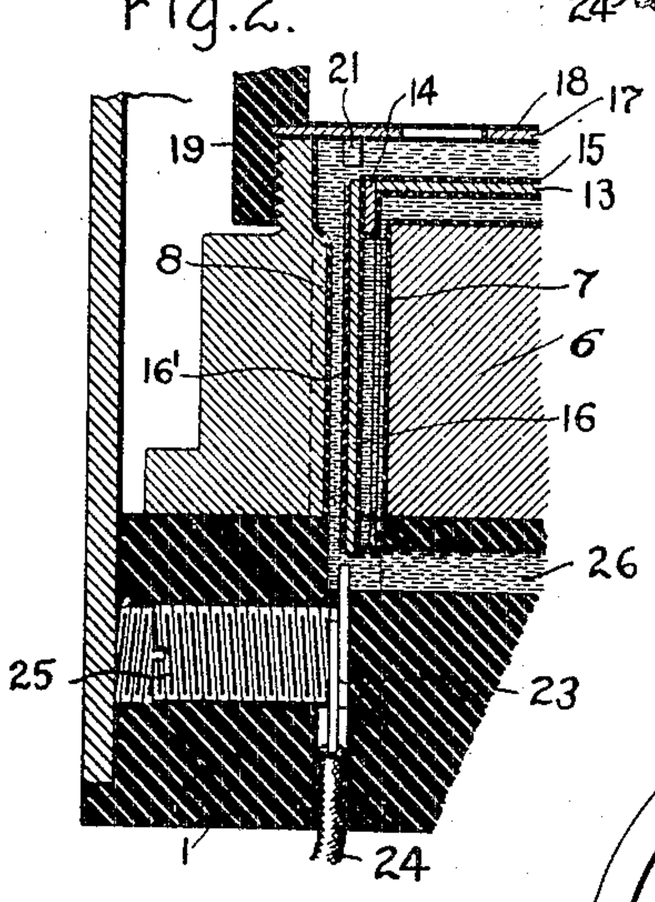


Fig. 3.

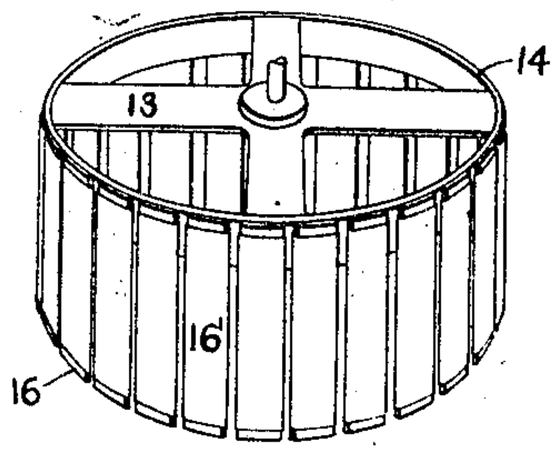
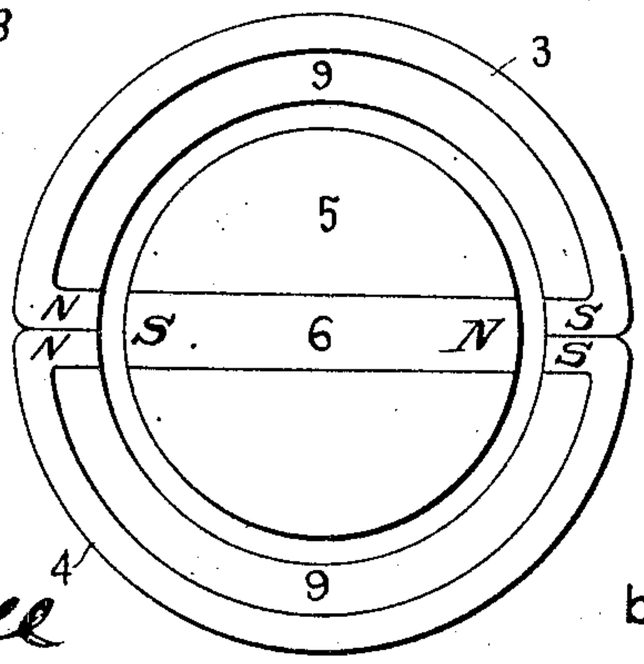


Fig. 4.



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UNITED STATES PATENT OFFICE.

FRANK HOLDEN, OF RUGBY, ENGLAND, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

METER.

No. 837,066. Specification of Letters Patent. Patented Nov. 27, 1906.

Application filed November 17, 1905. Serial No. 287,800.

To all whom it may concern:

Be it known that I, FRANK HOLDEN, a citizen of the United States, residing at Rugby, England, have invented certain new and useful Improvements in Meters, of which the following is a specification.

This invention relates to electric meters for measuring the energy of a factor of the energy supplied to electric translating devices, and more particularly to the type commonly known as "mercury-meters," in which the moving element is partially or wholly immersed in a bath of mercury.

The principal object of my invention is to provide a meter having a greater torque than those now in use, and I accomplish this by employing a plurality of armature-conductors on the moving element of the meter and a stationary conductor arranged to connect two or more of the armature-conductors in series, connection being made between the stationary and movable conductors by the mercury in which the armature is immersed and the magnetic field of the meter being arranged to act effectively on the current in all of the movable conductors so connected in series to produce a torque.

The novel features of my invention will be definitely indicated in the claims appended hereto. The details of construction and the mode of operation of my improved mercury-meter will be better understood by reference to the following description, taken in connection with the accompanying drawings, which show one embodiment of my invention, and in which—

Figure 1 is a section of the meter. Fig. 2 is a section, on an enlarged scale, through the mercury-receptacle. Fig. 3 is a perspective view of the armature, and Fig. 4 is a plan view showing the arrangement of the magnetic field.

Referring to the drawings, 1 indicates a base of insulating material, preferably wood, on which is mounted an annular permanent magnet 2, having two inwardly-projecting poles at diametrically opposite points. This annular magnet structure may consist of two semicircular permanent magnets 3 and 4, each having inwardly-projecting poles at its ends mounted with their like poles side by side, as shown in Fig. 4.

Mounted on the base 1 concentric with the annular magnet is a cylindrical block 5 of insulating material having embedded therein a bar of magnetic material or a permanent magnet 6, the extremities of which are presented to the poles of the magnet 2. The extremities and also the top of the bar 6 and the pole-faces of the magnet 2 are covered with a thin film of insulating material, as indicated at 7 and 8 in Fig. 2. Insulating material 9 is filled in around the inner side of the magnet 2 between the poles thereof, so as to form a narrow annular chamber, the interior wall of which is formed by the surface of the cylindrical block 5 and the insulated extremities of the bar 6 and the outer wall by the insulating material 9 and the insulated pole-faces of the magnet 2. This chamber is filled with mercury, and the armature is arranged to rotate therein immersed in the mercury. The armature is carried by a spindle 10, mounted for rotation in suitable bearings, one of which is seated in the top of the bar 6 and the other in a frame 11. This frame carries a dial 12, which is geared to the spindle 10 in the usual manner. Extending radially from the spindle 10 immediately above block 5 are a plurality of arms 13, carrying at their outer ends a ring 14, the ring and arms being completely insulated by a thin film of insulating material, as indicated at 15 in Fig. 2. Secured to the ring 14 and extending parallel to the spindle 10 are a plurality of thin flat armature-conductors 16. These armature-conductors are completely insulated, except at the ends, by a thin film of insulating material, as indicated at 16′, Fig. 2. Mounted directly above the armature and extending across the top thereof is a diaphragm 17, of non-magnetic sheet-metal coated on both sides with a thin film of insulated material, as indicated at 18, Fig. 2. Secured to the magnet 2 and inclosing the diaphragm 17 is a cover 19, shaped so as to form a receptacle between it and the diaphragm. Depending from the under side of this cover is a tubular stem 20, through the opening of which the spindle 10 of the meter extends. Openings are provided through the diaphragm 17 at the center for the spindle 10 and at the edges to permit the mercury to flow freely from the armature-chamber into the receptable formed by the cover 19 and diaphragm 17. With this construc-

tion it will be seen that as the under side of the diaphragm is very close to the moving element it serves to confine the mercury within the armature-chamber, so that when the meter is moved about surging of the mercury is prevented, thereby avoiding any damage to the armature, which might result if free movement of the mercury were permitted. Also when the meter is tilted the mercury runs from the armature-chamber through the openings in diaphragm 17 into the receptacle formed by the cover 19 and diaphragm 17, but the stem 20 is of such a length that even though all of the mercury flows into this receptacle it will not rise to such a height therein as to allow any of it to flow out around the spindle 10 and be lost. Depending from the under side of the diaphragm 17 and in electrical connection therewith are two studs 21 and 22, extending in proximity to the path of movement of the upper ends of the armature-conductors 16. These studs are uninsulated and are mounted one above each of the inwardly-projecting poles of the magnet 2. Mounted in the base 1 and extending into the mercury-chamber directly under each of the magnet-poles is a leading-in conductor 23. Openings are provided in the base, permitting line conductors 24 to be inserted therein to make electrical connection with the leading-in conductors 23, and threaded openings are also provided in the base, permitting the insertion of plugs 25, which may be screwed up to press the line conductors 24 into good electrical contact with the leading-in conductors 23.

As thus constructed it will be seen that the permanent magnet 2 and the bar 6 establish strong magnetic fields between the poles of the magnet and the extremities of the bar, which are magnetically in series with each other. Current enters the meter at one of the conductors 24 and flows to the contact 23, then through the mercury to the uninsulated end of one of the armature-conductors 16, through the conductor thus traversing the magnetic field, and at the upper end of the conductor it again passes through the mercury to the stud 21. It then passes across the upper end of the armature through the diaphragm 17 to the stud 22 and then down through another armature-conductor 16 and the mercury and out by the other conductor 24. Two of the armature-conductors 16 lying in the two gaps in the magnetic circuit are thus connected in series, and a torque is developed tending to turn the movable element. As the two conductors thus connected in series move out of the magnetic fields two other conductors move into the fields and are connected in series in a similar manner and produce a driving torque. In this way pairs of conductors are successively connected in series as they move into the magnetic fields, and the torque of the meter is greatly increased, due to the fact that there are always two active conductors connected in series.

Meters of this type are usually connected in circuit around the terminals of a suitable shunt, since it is not desirable to carry all of the line-current through the meter. I have provided a novel form of shunt, the conductivity of which may be delicately adjusted as desired. I provide in the block 1 an opening extending from the bottom of the mercury-chamber at the point where one of the leading-in conductors enters the chamber diametrically across to the bottom of the mercury-chamber on the other side where the conductor 23 enters it. This passage is filled with mercury, as shown in the drawings, which serves to carry a portion of the current directly across from one conductor 23 to the other instead of permitting it to flow through the armature-conductors and the diaphragm 17. In order to adjust the conductivity of this shunt, I provide a transverse threaded opening intercepting the opening 26 and a plug 27, of insulating material, which may be screwed into or out of the threaded opening more or less to partially or wholly close the passage-way for the current through the mercury in the passage 26.

I do not wish to be understood as limited to the exact construction which I have illustrated and described herein, as various modifications can be made therein without departing from the spirit of my invention, and all such modifications I aim to cover by the terms of the claims appended hereto.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. An electric meter comprising a magnet structure having two gaps therein arranged magnetically in series, an armature having a plurality of conductors mounted for movement in said gaps, and means including a bath of a conducting liquid in which the armature is immersed for connecting a plurality of said conductors in series.

2. An electric meter comprising a magnet structure having two gaps therein arranged magnetically in series, an armature having a plurality of conductors mounted for movement in said gaps, and a stationary conductor extending from one gap to the other to connect a plurality of said armature-conductors in series.

3. An electric meter comprising a magnet structure having two gaps therein arranged magnetically in series, an armature having a plurality of conductors mounted for movement in said gaps, a bath of a conducting liquid in which the armature is immersed, and a stationary conductor extending from one gap to the other and making contact with said conducting liquid to connect a plurality of said armature-conductors in series.

4. An electric meter comprising a magnet structure having two gaps therein arranged magnetically in series, an armature having a plurality of armature-conductors mounted for movement in said gaps, a bath of mercury in which the armature is immersed, and a stationary conductor extending from one gap to the other and making contact with the mercury at said gaps to connect pairs of said conductors in series successively.

5. An electric meter comprising a magnet structure having two gaps therein arranged magnetically in series, an armature having a plurality of conductors mounted for movement in said gaps, a conducting liquid in which the armature is immersed, and a stationary conductor extending from one gap to the other and having its ends in contact with said conducting liquid and in proximity to the path of movement of the armature-conductors.

6. An electric meter comprising means for establishing a magnetic field, an armature having a plurality of armature-conductors mounted for rotation therein, means including a stationary conductor located across one end of the armature for carrying current from one armature-conductor to another, and means for registering the movements of the armature.

7. An electric meter comprising means for establishing a magnetic field, an armature having a plurality of armature-conductors mounted for rotation therein, a bath of a conducting liquid in which the armature is immersed, a stationary conductor for carrying current across the end of the armature from one armature-conductor to another, and means for registering the movements of the armature.

8. An electric meter comprising means for establishing a magnetic field, an armature having a plurality of armature-conductors mounted for rotation therein, a bath of mercury in which the armature is immersed, a stationary conductor making contact at its ends with the mercury for carrying current across the end of the armature from one armature-conductor to another, and a register actuated by the armature.

9. An electric meter comprising means for establishing a magnetic field, an armature having a plurality of armature-conductors mounted for rotation therein, a bath of mercury in which the armature is immersed, a stationary conductor extending across the end of the armature and having its ends in contact with the mercury and in proximity to the path of movement of the armature-conductors, and a register actuated by the armature.

10. An electric meter comprising a mercury-receptacle having walls of insulating material, mercury therein, a magnet establishing magnetic fields across said receptacle, an armature having a plurality of armature-conductors mounted for rotation in said receptacle, a stationary conductor extending across one end of the armature and having its ends in contact with the mercury and in proximity to the path of movement of the armature-conductors, means for leading current to and from the mercury-receptacle at the other end of the armature, and a register actuated by the armature.

11. An electric meter comprising a magnet structure having two gaps therein arranged magnetically in series, an armature having a plurality of conductors mounted for movement in said gaps, a bath of a conducting liquid in which the armature is immersed, means for carrying current to and from the mercury at one end of said gaps, and a stationary conductor extending across the other end of the armature and making contact with the mercury at the other end of the gaps.

12. In an electric measuring instrument, a mercury-receptacle, mercury therein, a moving element in the receptacle, means for establishing a magnetic field acting on the moving element, means for carrying current to and from the mercury-receptacle, and a passage communicating with the mercury-receptacle and filled with mercury, said mercury forming a path for current in shunt to the path through the moving element.

13. In an electric measuring instrument, a mercury-receptacle, mercury therein, a moving element in the receptacle, means for establishing a magnetic field acting on the moving element, means for carrying current to and from the mercury-receptacle, a passage communicating with the mercury-receptacle and filled with mercury, said mercury forming a path for current in shunt to the path through the moving element, and means for varying the conductivity of this shunt-path.

In witness whereof I have hereunto set my hand this 3d day of November, 1905.

FRANK HOLDEN.

Witnesses:
H. D. JAMESON,
A. NUTTING.