No. 741,527. PATENTED OCT. 13, 1903.

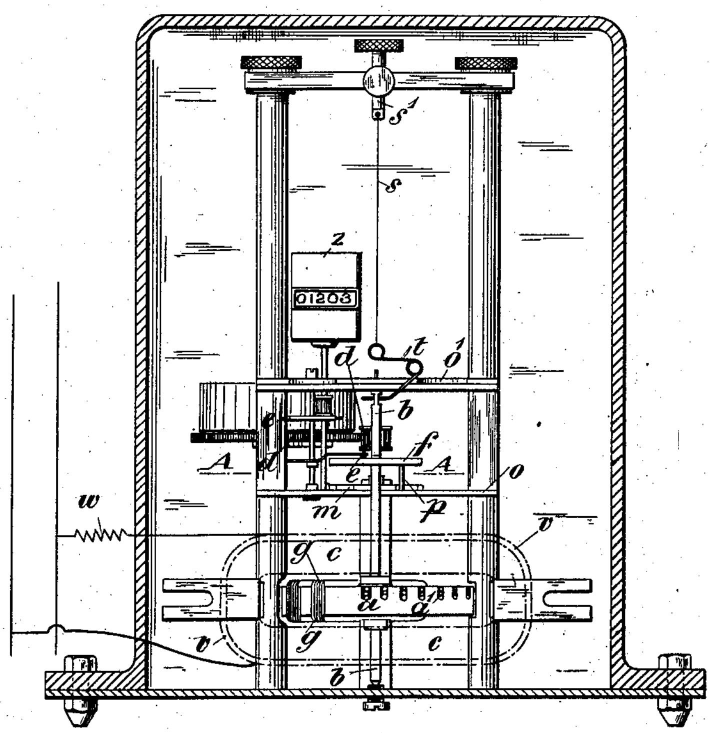
W. M. MORDEY & G. C. FRICKER.

ELECTRICITY METER.

APPLICATION FILED APR. 7, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



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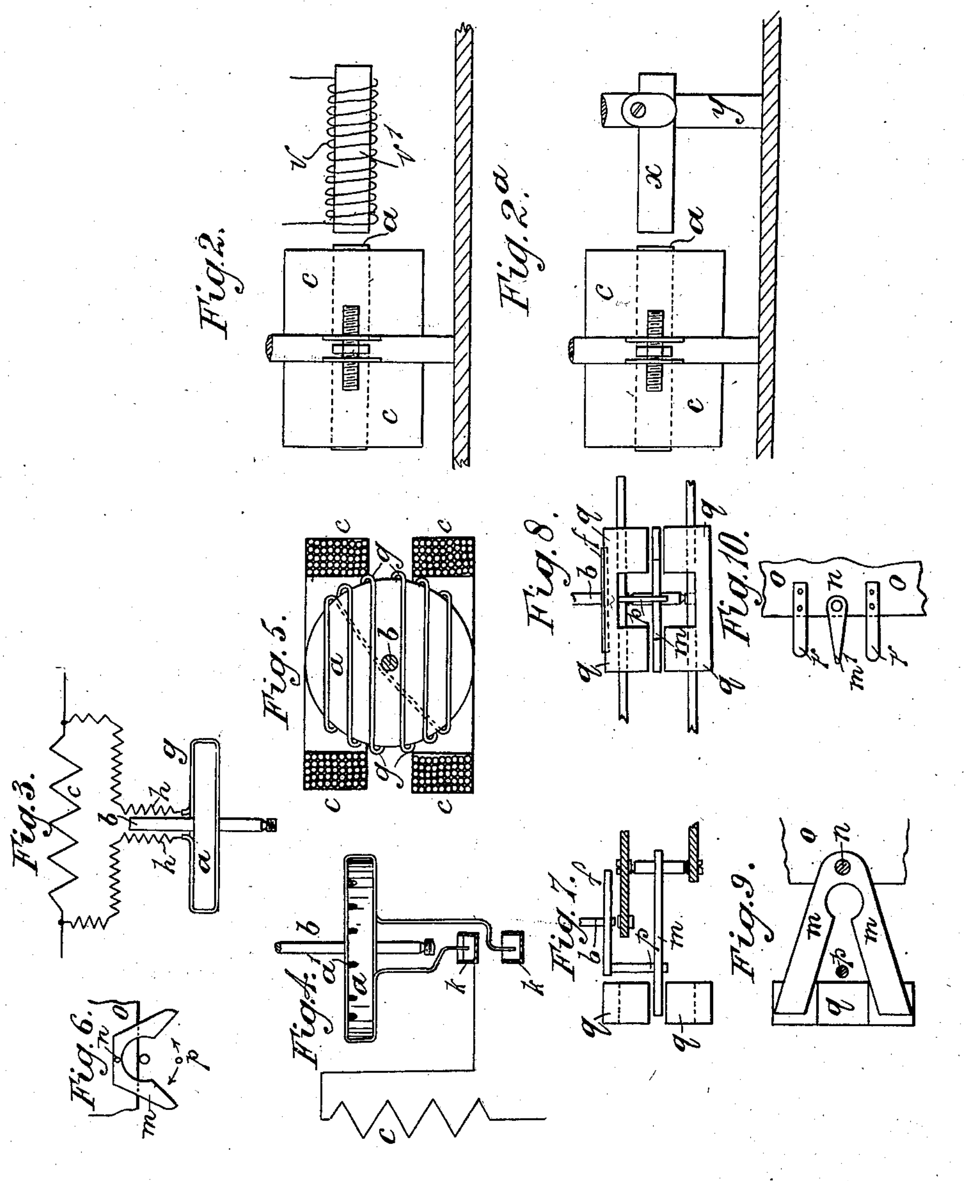

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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UNITED STATES PATENT OFFICE.

WILLIAM MORRIS MORDEY AND GUY CAREY FRICKER, OF WESTMINSTER, ENGLAND.

ELECTRICITY-METER.

SPECIFICATION forming part of Letters Patent No. 741,527, dated October 13, 1903.

Application filed April 7, 1902. Serial No. 101,708. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM MORRIS MORDEY and GUY CAREY FRICKER, subjects of the King of Great Britain and Ireland, residing in the city of Westminster, England, have invented Improvements in Electricity-Meters, of which the following is a specification.

This invention has reference to further improvements in electricity-meters of the type described in the specifications of former Letters Patent granted to us, Nos. 660,021 and 664,092, dated, respectively, October 16, 1900, and December 18, 1900, the object being to insure greater durability and a higher degree of accuracy throughout the whole working range of such instruments than heretofore.

The invention consists, for the purposes mentioned, in various novel features of construction and in combinations and arrangements of parts, all as hereinafter described, and pointed out in the claims annexed.

In the accompanying illustrative drawings, Figure 1 shows in elevation an electricity-meter of the kind referred to constructed according to the present invention, the casing inclosing the meter being in vertical section. Fig. 2 is a side view taken at right angles to Fig. 1, showing part of the meter. Fig. 2ª is a similar view to Fig. 2, showing a modification. Figs. 3, 4, and 5 show diagrammatically an armature and coil thereon, the figures showing three different modes of coupling up the coil ends, as hereinafter described. Fig. 6 is a section on the line A A of Fig. 1, showing a detail. Figs. 7, 8, and 9 show, respectively, in side elevation, front elevation, and plan a modified form of damping device for limiting the oscillations of the armature of the meter. Fig. 10 shows in plan a further modified arrangement of damping device.

a is the armature of the meter, fixed on a spindle *b* and mounted to oscillate within the coil or winding *c*, through which the current to be measured is caused to flow, and *d* is a clock-train provided with a springless escapement *e*, acting upon a balance wheel or disk *f*, fixed on the spindle *b*, the arrangement being such that when a current flows through the coil *c* the armature *a* will be caused by the combined action of the current and escapement to oscillate at a rate proportional to the current, as described in our said former specifications.

On the oscillating armature *a* of the meter, preferably constructed of a disk of non-magnetic material in which a series of parallel iron wires *a'* are placed, as described in our said former specifications, is placed a coil *g*, Fig. 1, wound so that in the middle position of the oscillation of the armature it will be coaxial with the fixed coil *c* of the meter. This armature-coil *g* may be arranged in parallel or in series with the fixed coil, as shown, respectively, in Figs. 3 and 4, the current being sent through it by suitable flexible connections *h* or mercury connections *k*, these arrangements being suitable either for direct or alternate currents. We may, as shown in Fig. 5, dispense with the iron of the armature and depend on the solenoidal action of the coils *c* and *g* in conjunction with the escapement action for oscillating the armature. For alternate currents the armature-coil *g* is preferably closed on itself, as shown in Fig. 5. Secondary currents are then induced in it by the current in the fixed coil *c*, the directive action due to these currents in conjunction with the escapement action producing the required oscillating movement of the armature. We may in this case also dispense with the iron of the armature, as shown.

In order to secure a nearly-constant amplitude of movement of the armature, however constructed, at all working rates of oscillation and within practical limits independently of the strength of the clock-spring, we arrange that toward the ends of the stroke friction shall limit the extent of oscillation of the armature in such a way as to diminish the natural difference between the longest and shortest amplitudes of the latter at the lowest and highest loads, respectively, and thus to counteract the tendency to quicken unduly when the directing forces are large. In this way the amplitude of oscillation is prevented from becoming unduly large at low loads. The friction is so applied that it only opposes the increase of amplitude in either direction and does not prevent the free return movement of the armature. A friction device suitable for the purpose mentioned comprises, as shown in Fig. 6, a V-shaped or forked piece or plate m of metal pivoted at n to the stationary plate o and arranged to be moved to and fro by a pin or projection p, carried by the armature or armature-spindle. In Fig. 1 the pin p is shown as carried by the balance wheel or disk f. The pin p moves between the two arms of the V-piece m, which are separated by such an angle that the pin p only strikes the V-piece near the limit of its stroke in either direction. When the V-piece is so struck, the excess of energy is dissipated by the friction of the V-piece acting in one direction as a sliding stop on the plate o, but allowing the armature freedom to return until the V-piece is again struck by the pin at the other extremity of its stroke, when the V-piece is similarly moved in the reverse direction. The V-piece may conveniently be arranged horizontally, as shown. If otherwise arranged, it should be balanced so that it has no tendency to move from the position it takes up when struck by the oscillating pin p. We do not limit ourselves to this particular construction of friction device and only describe it as one convenient means of attaining the end mentioned. The same result can be obtained by damping the movement of the metallic stop-piece m in a magnetic field instead of employing ordinary mechanical friction. Figs. 7, 8, and 9 show an arrangement for this purpose wherein the ends of the arms of the metal V-piece m are each arranged to move in a magnetic field set up between the poles of a pair of magnets q. Also in either case instead of the damping-piece m being moved by a pin p, carried by the armature-spindle b, it may, as shown in Fig. 10, be in the form of a finger m', frictionally mounted to turn on the spindle and be moved by striking against fixed side stops r.

To reduce pivot or bearing friction and to prevent the difficulty sometimes experienced with electricity-meters when the armature-spindle is arranged vertically—viz., wearing or cracking of footstep-bearings or jewels and injury to pivots—and also to enable an armature having a larger moment of inertia than would otherwise be practicable to be used, the armature a, which is constructed so as to have a large moment of inertia, and the armature-spindle b may according to this invention be supported by a practically torsionless fiber s, Fig. 1, so arranged that while the armature a is free to move through its full amplitude the whole or almost the whole weight is carried by the fiber. Preferably this fiber is hung from a spring or combined with a spring t to facilitate adjustment and to prevent breakage of the fiber or damage to the pivots or jewels by any sudden jar or vibration of the armature. The spring may, as shown, conveniently be interposed between the armature-spindle b and fiber s. With this mode of suspension center pivots or jewels may in some cases be dispensed with, simple guiding-holes in the plates o and o' being used for the armature-spindle b. The fiber s or combined fiber s and spring t is or are suspended from an adjustable pin s', whereby the tension of the connected fiber and spring can be adjusted vertically so as to relieve the bottom bearing of more or less of the weight of the armature.

In order to compensate for or counteract the effect of magnetic retentiveness in any iron contained in the oscillating armature a of the meter, means may be provided to weaken or counteract the field produced by the main coil c. One arrangement for this purpose comprises, as shown in Figs. 1 and 2, a high-resistance coil v, that is adapted to be connected as a shunt across the constant-pressure-supply mains with which the meter is used, and which is so disposed, as shown, as to slightly weaken or counteract the field produced by the main coil c. This resistance-coil v may be wound on the same bobbin as the main coil c. In the example it is mounted upon the said coil c and fixed in such a position thereon as is necessary to give the right amount of correction, or the said shunt-coil v may be arranged quite distinct from the main coil c, as shown in Fig. 2, and so connected as to oppose or weaken the field of such coil. In this case the coil v may contain an iron core v'. A resistance w, Fig. 1, preferably a non-inductive resistance, may be put in series with the shunt-coil v or v'. These arrangements are suitable for either direct-current or alternate-current meters. For direct-current meters we may dispense with the shunt-coil v and use a small permanent magnet so disposed as to slightly oppose or counteract the field of the meter-coil c. In Fig. 2^a a horizontal permanent magnet x is for the purpose mentioned shown fixed to the framework y of the meter in such a manner that it can be moved endwise nearer to or farther from the end of the coil c, so as to vary its action on the field thereof.

The meter is provided, as usual, with a suitable counter worked from the clockwork for recording the amount of electricity supplied. This counter is indicated diagrammatically at z in Fig. 1.

What we claim is—

1. In an electricity-meter of the type herein referred to, the combination with the fixed meter-coil, the clock-train, the springless escapement, the oscillatory part of the meter, and a counter adapted to register, the number of oscillations of said armature and directly indicate the amount of electricity supplied, of a coil mounted on said oscillatory part.

2. In an electricity-meter of the type herein referred to, the combination with the fixed meter-coil, the escapement, and the oscillatory part of the meter located within said fixed coil, of a coil mounted upon said oscillatory part so as to be coaxial with said fixed coil when in the mid-position of its oscillation, substantially as described.

3. In an electricity-meter of the kind herein referred to, the combination with the fixed meter-coil, the escapement, and the oscillatory part of the meter mounted within said fixed coil, of a closed coil carried by said oscillating part.

4. In an electricity-meter of the kind herein referred to, the combination with the fixed meter-coil, the escapement, and the oscillatory armature of the meter located within said fixed coil, of a coil carried by said armature, substantially as described.

5. In an electricity-meter of the kind herein referred to, the combination with the fixed meter-coil, the escapement, and an oscillatory armature comprising subdivided iron, of a coil carried by said armature.

6. In an electricity-meter of the kind herein referred to, the combination with the fixed meter-coil, the escapement, and an oscillatory armature comprising a number of iron wires arranged parallel to one another and a non-magnetic carrier therefor, of a coil carried by said armature.

7. In an electricity-meter of the kind herein referred to, the combination with the fixed meter-coil, the escapement, and the oscillatory armature of the meter located within said fixed coil, of a coil carried by said armature and closed upon itself, substantially as described.

8. In an electricity-meter of the kind herein referred to, the combination with the oscillating armature, of means disconnected from said armature and adapted to limit and regulate the extent of oscillation of said armature in each direction, said means being arranged to come into action only near the end of each stroke of the armature and to then oppose a retarding but yielding force to the armature movement during the completion of the stroke.

9. In an electricity-meter of the kind herein referred to, the combination with the oscillatory armature, of an energy-absorbing device disconnected from said armature, arranged to act upon the armature only when the same nears the end of but before it completes its stroke in each direction, and to then exert a damping effect on the armature during the remaining portion of its stroke.

10. In an electricity-meter of the kind herein referred to, the combination with the oscillatory armature, of a pivoted damping device, means for retarding movement of said device in each direction, and a pin connected to said armature and arranged to oscillate between and abut against portions of said damping device, substantially as described for the purposes set forth.

11. In an electricity-meter of the kind herein referred to, the combination with the oscillatory armature, of a support, a bifurcated friction device pivoted to said support and mounted to slide thereon, and a pin connected to said armature and arranged to oscillate within the bifurcated portion of said friction device and abut against the same near the limit of its stroke in each direction, substantially as described.

12. In an electricity-meter of the kind herein referred to, the combination with the fixed coil, of an oscillatory armature, a practically torsionless fiber, and a spring connected to said fiber and arranged to support said armature, substantially as described.

13. In an electricity-meter of the kind herein referred to, the combination with the fixed coil, of an oscillatory armature having a large moment of inertia, a practically torsionless fiber and a spring, said fiber and spring being connected together and to the said armature so as to suspend the latter, substantially as described.

14. In an electricity-meter of the kind herein referred to, the combination with the fixed coil, of an oscillatory armature, a practically torsionless fiber arranged to support said armature, a spring connected to said fiber, and means for adjusting said connected armature, fiber and spring vertically, substantially as described and for the purposes specified.

15. In an electricity-meter of the kind herein referred to, the combination with the fixed coil, of an oscillatory armature having a large moment of inertia, a practically torsionless fiber and a spring connected together and to said armature, and vertically-adjustable supporting means for said connected fiber, spring and armature, substantially as described.

16. In an electricity-meter of the kind herein referred to, the combination with the meter-coil and oscillatory armature, of means adapted to compensate for or counteract the effect of retentiveness in any iron contained in said armature.

17. In an electricity-meter of the kind herein referred to, the combination with the meter-coil and oscillatory armature, of means adapted to weaken or counteract the field produced by said meter-coil.

18. In an electricity-meter of the kind herein referred to, the combination with the meter-coil and oscillatory armature, of means for producing an opposing magnetic field to that of the meter-coil.

19. In an electricity-meter of the kind herein referred to, the combination with the meter-coil and oscillatory armature, of a magnet arranged to weaken or counteract the field produced by said meter-coil, substantially as described.

20. In an electricity-meter of the kind herein referred to, the combination with the meter-coil and oscillatory armature, of a permanent magnet arranged to weaken or counteract the field produced by said meter-coil.

Signed at 75 and 77 Cornhill, London, England, this 26th day of March, 1902.

WILLIAM MORRIS MORDEY.
GUY CAREY FRICKER.

Witnesses:
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EDMUND S. SNEWIN.