No. 702,213. Patented June 10, 1902.

E. G. HOLM.

ELECTRICITY METER.

(Application filed Dec. 21, 1901.)

(No Model.)

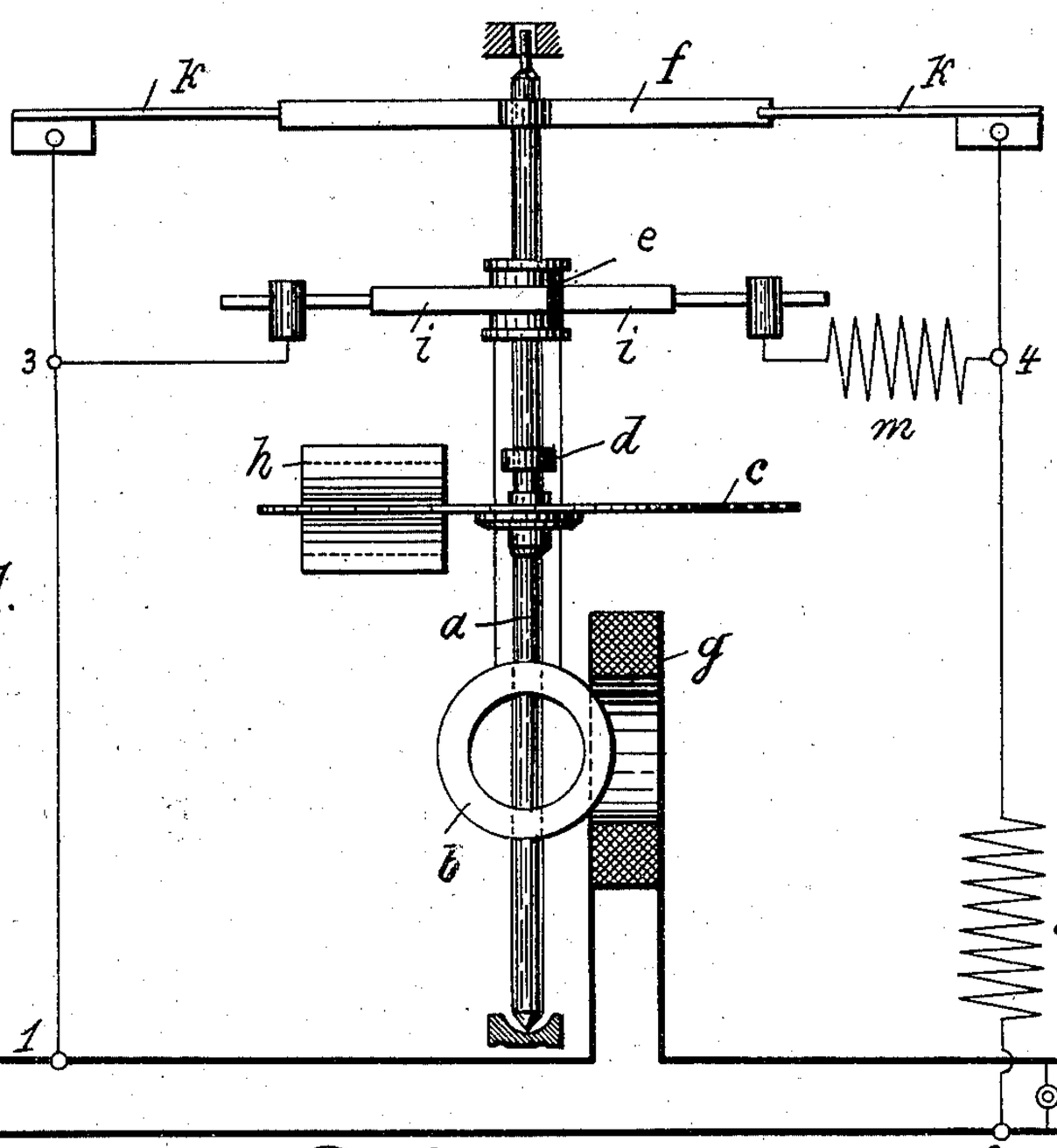

Fig. 1.

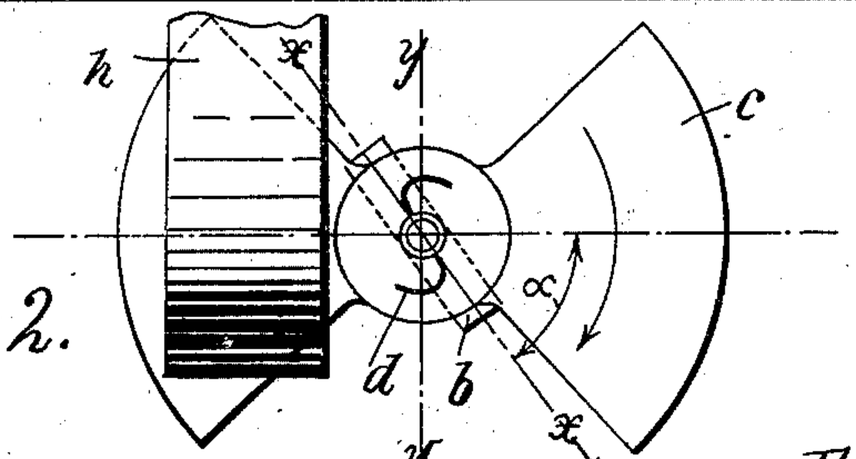

Fig. 2.

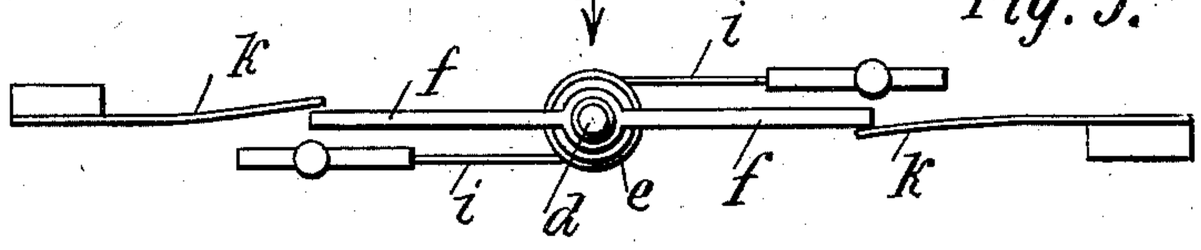

Fig. 3.

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UNITED STATES PATENT OFFICE.

ERNEST G. HOLM, OF BERLIN, GERMANY.

ELECTRICITY-METER.

SPECIFICATION forming part of Letters Patent No. 702,213, dated June 10, 1902.

Application filed December 21, 1901. Serial No. 86,803. (No model.)

To all whom it may concern:

Be it known that I, ERNEST G. HOLM, a citizen of the United States, residing at 12 Voelckerstrasse, Berlin, in the Empire of Germany, have invented new and useful Improvements in Electricity-Meters, of which the following is a specification.

The subject of this invention is an electricity-meter which, in contradistinction to the "drum-armature" which has been generally used hitherto and which consists of a number of pressure-coils and commutator-segments, possesses one pressure-coil only.

The object of employing only one pressure-coil is primarily a simplification of the armature and a diminution of its weight. Through the simplification of the armature the cost of manufacture is reduced and repairs are facilitated, while through the diminution of the weight the sensitiveness and durability of the meter are enhanced. Again, the reduction of the number of armature-coils involves the reduction of the number of commutator-segments to two and a diminution of the diameter of the commutator, which in its turn results in a diminished friction of the brushes. The employment of only one pressure-coil and two commutator-segments entails, however, the stoppage of the armature at its "dead-points," which in view of the inconsiderable load occur at each turn or reversal of the current, and it is necessary to provide means to obviate this.

The objects above stated are in accordance with this invention attained in an extremely simple and easy manner. The means employed consist of a small piece of soft iron of any suitable shape attached to a part which revolves with the brake-disk in such a manner that the attraction which the brake-magnet or a separate magnet exercises upon it constantly tends to move the armature away from the dead-points which it occupies at the short-circuiting periods of the pressure-coil through the brushes of the commutator. This arrangement is not to be regarded merely as means for auxiliary driving, for while during the revolution of the armature the soft-iron piece alternately comes nearer to and recedes from the magnet the attractive power of the magnet is constantly exercised in the same direction—that is to say, it alternately accelerates and retards rotation.

In a meter of the class described there come into operation during one complete revolution of the armature four different forces, which all act upon it—viz, the electromotive force, the kinetic energy, the magnetic arresting force, and the magnetic attractive force. The two first-mentioned forces are proportionate to the currents to be measured, the second of the two being, moreover, proportionate to the weight of the armature and to the speed wherewith it is moving at the time, while the two last-mentioned forces are independent of the values of measurement. Hence the fourth force, since the sensitiveness of the meter naturally depends upon its dimensions, must be very small in proportion to the two first forces, and as regards the third force it can only operate in conjunction with the first for the following reasons: Where comparatively great loads are used, the energy may still suffice to drive over the dead-angle, so that its speed is in the dead-angle also practically proportionate to the driving force—*i. e.*, to the currents to be measured. With a decreasing load, however, it may occur that the energy proves no longer sufficient for the purpose, so that in running through a portion of the dead-angle the magnetic power of attraction must be resorted to to assist in accomplishing this. The attractive force should, however, as already stated, be small, so that the speed in the dead-angle in this case shall be comparatively small. Hence there will occur cases in which the meter will be loaded in such a manner that the armature will require considerably more time for traversing the small dead-angle than is necessary for traversing the supplemental angle. The speed of the passage through the latter is proportionate to the driving force; but this only acts during an infinitesimally short space of time, so that the duration of one revolution, which is to be regarded as a unit of measurement, varies little or not at all as a result of the varying loads put upon the meter. Accordingly there must occur a discontinuance in the curve of proportionalities of the meter by reason of the necessity of using armatures of a minimum weight in these

meters and of the small measure of oscillation which this involves, given from ten to fifteen per cent. of the maximum load, so that in the case of all the smaller loads there occur somewhat serious errors on the minus side; but the present state of the art of electric-meter manufacture implies a range of measurement for each meter varying between a minimum of five per cent. and one hundred per cent. of the maximum load, so that the point of the brake occurring in the curve of proportionalities has to be shifted downward. In practice this can only be done by bringing into operation at the right moment the energy accumulated during the growth of the driving power in the armature instead of being just then converted into heat, as is the case when magnetic brake action is employed. The most simple means to this end is to render the brake action inoperative at the proper time, and this is done by means of a corresponding break in the brake-disk. The energy in this case will drive the armature through the dead-angle without the aid of the magnetic attractive force even at only three or four per cent. of the maximum load, and the attractive force will therefore exercise no influence within the proper range of the meter, but will only serve to prevent the armature from coming to a standstill within the dead-angle. In such a meter with only one pressure-coil this coil must necessarily comprise a great number of convolutions, so that its resistance turns out to be comparatively great, and that a comparatively large portion of the total pressure is short-circuited by the commutator-brushes, so that sparks are not to be avoided. Now in order to keep these sparks away from the commutator proper of the meter and to shift it to another safer position, where they will be, moreover, rendered harmless by rapid break of contact, auxiliary brushes are provided for the purpose of short-circuiting the main brushes at the moment of the change over or reversal of current.

An electric meter constructed in accordance with this invention is represented in the accompanying drawings, in which—

Figure 1 is an elevation; Fig. 2, a plan of the same, but without showing the reversing or change-over switch; and Fig. 3 a plan of the reversing or change-over device.

Upon a spindle a, made readily revoluble both at the top and bottom, there is mounted the annular pressure-coil b, the brake-disk c, the soft-iron piece (a double hook) d, the commutator e, and the insulated short-circuiting piece f. The stationary parts are the main-current coil g, the brake-magnet h, the commutator-brushes i, and the auxiliary brushes k. In the main circuit there is only the one coil g, while in the pressure-circuit 1 2 in addition to the coil b, the two segments of the commutator e, and the brushes i, sweeping along these, there are located the preliminary switching resistance l and the small auxiliary resistance m, and in addition to that there are situated at the points 3 and 4 the auxiliary brushes k.

The winding plane of the pressure-coil b is, as shown in Fig. 2, displaced in relation to the middle line of the brake-disk c at the angle α. The armature is at the dead-point when the winding plane x is parallel to the winding plane y of the main-current coil g. The soft-iron piece (small double hook) d is placed at right angles to the middle line of the brake-disk c—*i. e.*, at an angle of ninety degrees $-\alpha$ to the plane x. The result is that the magnet h attracts the small piece of iron d the moment the armature passes beyond the position shown and before it reaches the dead-point, so that it passes beyond this point without any retardation. As the armature comes to the dead-point one of the two symmetrical sector-shaped notches in the brake or arresting disk c takes up its position between the poles of the magnet h, so that the brake action of the latter becomes practically equal to zero. The consequence is that the speed with which the armature traverses the dead-angle, $2 \times (90-\alpha,)$ is so regulated that the meter will be correct even with smaller loads. The action of the small piece of iron d recommences whenever the armature completes a revolution of one hundred and eighty degrees—that is to say, passes over the whole position delineated in the diagram.

As will be seen in Fig. 3, the free ends of the auxiliary brushes (springs) k are situated within the circle described by the ends of the short-circuiting piece f during the rotation of the armature. The piece f is placed at right angles to the plane which separates the two segments of the commutator e from each other, while the brushes k are arranged at right angles to the plane y, Fig. 2, so that they maintain the main brushes i in the short-circuited condition on the commutator e during the reversion, owing to the contact of the piece f with the auxiliary brushes k. To prevent an appreciable current from passing through the main brushes i at the moment of the reversion, there is short-circuited in addition an auxiliary resistance m through as nearly radial a position of the brushes k in relation to the spindle a or to the short-circuiting piece f as possible, a rapid break of contact between the latter and those brushes is insured.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a motor electricity-meter in which one pressure-coil and two commutator-segments are employed, an armature, a piece of soft iron attached to said armature, a magnet disposed in such relation to said piece of soft iron as to exercise an attraction upon it to move the armature away from the dead-point positions, substantially as described.

2. A motor electricity-meter, in which one pressure-coil and two commutator-segments

are employed, an armature, a piece of soft iron secured to said armature, a brake-magnet, said brake-magnet being arranged in such position in relation to the piece of soft iron as to exercise an attraction upon it to move the armature away from the dead-point positions, substantially as described.

3. In a motor electricity-meter in which one pressure-coil and two commutator-segments are employed, an armature, a piece of soft iron secured to said armature, a brake-magnet, said brake-magnet being arranged in such position in relation to the piece of soft iron as to exercise an attraction upon it to move the armature away from the dead-point positions, a brake-disk, said brake-disk being cut away at those points, which while the armature traverses the dead-angle, lie between the poles of the brake-magnet, substantially as described.

4. A motor electricity-meter in which one pressure-coil and two commutator-segments are employed, an armature, a piece of soft iron attached to said armature, a brake-magnet disposed in such relation to said piece of soft iron as to exercise an attraction upon it to move the armature away from the dead-point positions, and a brake-disk cut away at those points which while the armature traverses the dead-angle, lie between the poles of said brake-magnet, substantially as described.

5. In a motor electricity-meter in which one pressure-coil and two commutator-segments are employed, an armature, a piece of soft iron attached to said armature, a magnet disposed in such relation to said piece of soft iron as to exercise an attraction upon it to move the armature away from the dead-point positions, and means for short-circuiting the main brushes at the moment of reversion of the current, for the purpose and substantially as hereinbefore described.

6. In a motor electricity-meter, in which one pressure-coil and two commutator-segments are employed, an armature provided on the rotating spindle, a piece of soft iron attached to said armature, a magnet disposed in such relation to said piece of soft iron as to exercise an attraction upon it to move the armature away from the dead-point positions, an insulated short-circuiting piece secured to the rotating spindle, and auxiliary brushes which coöperate with said insulated short-circuiting piece to short-circuit the main brushes at the moment of reversion of the current, substantially as hereinbefore described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ERNEST G. HOLM.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.