No. 768,982. PATENTED AUG. 30, 1904.

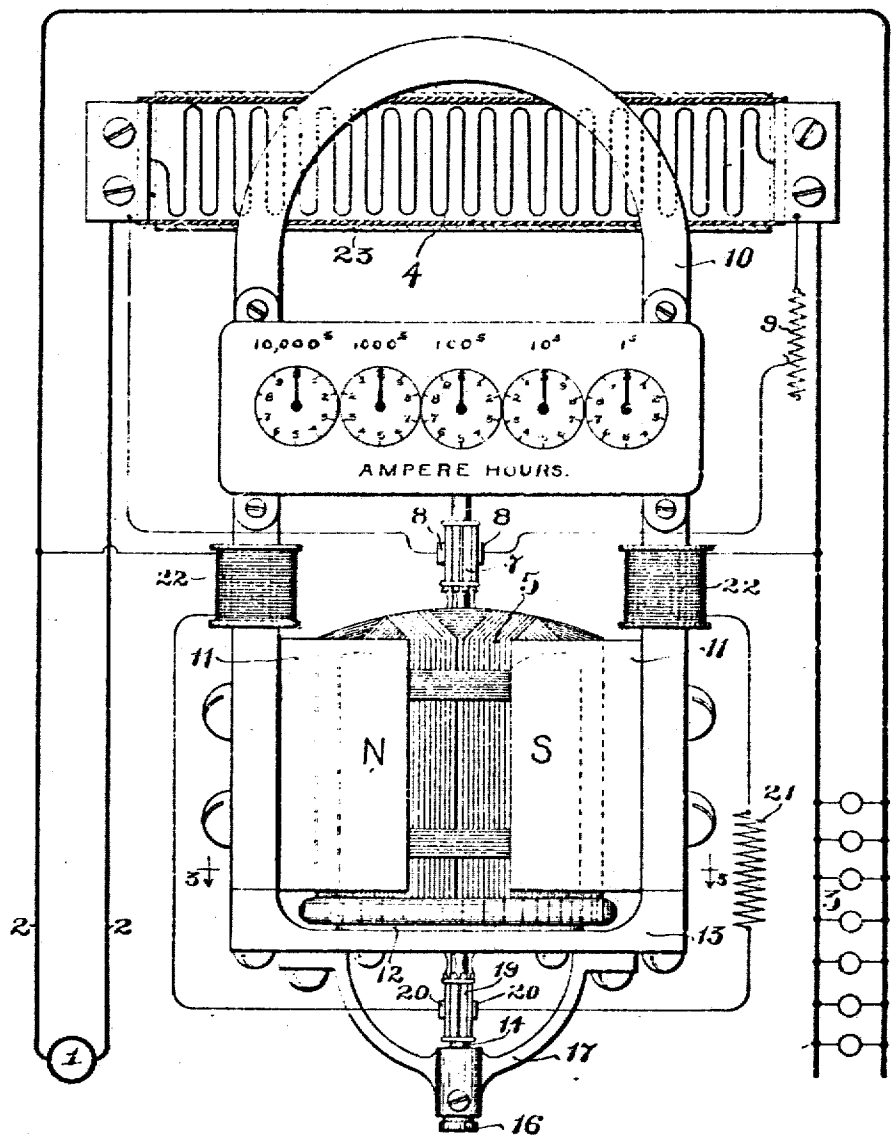
T. DUNCAN.

ELECTRIC METER.

APPLICATION FILED JULY 11, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.



Witnesses
Max W. Zabel
Harvey L. Hanson.

Inventor
Thomas Duncan

By Charles A. Brown Cragg & Orfield
Attorneys

No. 768,982. PATENTED AUG. 30, 1904.

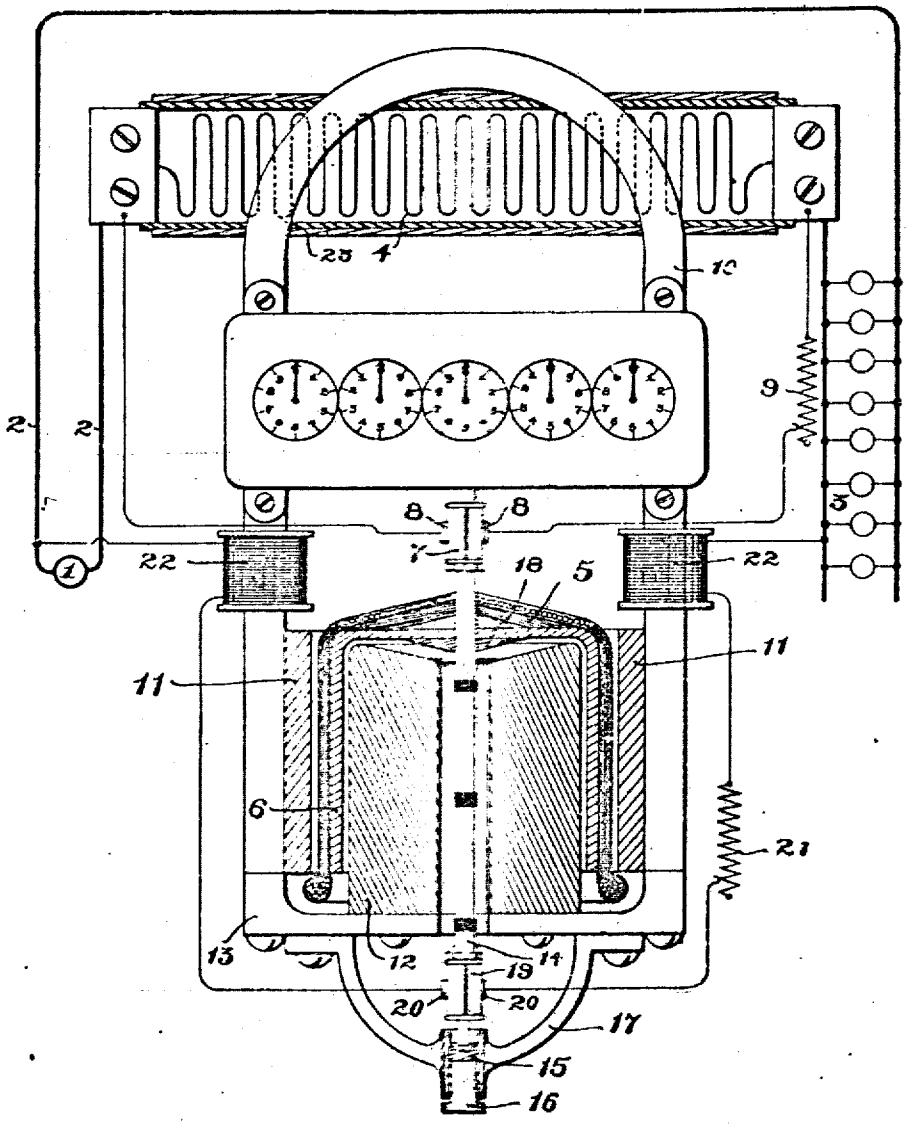
T. DUNCAN.

ELECTRIC METER.

APPLICATION FILED JULY 11, 1901.

NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.



Witnesses
Mary A. Lalor
Harold L. Hanson.

Inventor
THOMAS DUNCAN.
By Charles A. Brown Cragg & Belfield
Attorneys.

No. 768,982. PATENTED AUG. 30, 1904.

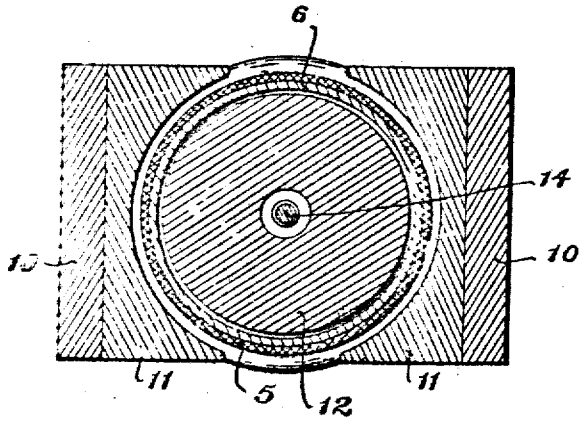
T. DUNCAN.

ELECTRIC METER.

APPLICATION FILED JULY 11, 1901.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.



Witnesses
May W. Zabel.
Harvey L. Hansen.

Inventor
Thomas Duncan

By Charles A. Brown Cragg & Brefield
Attorneys

No. 768,982. Patented August 30, 1904.

UNITED STATES PATENT OFFICE.

THOMAS DUNCAN, OF CHICAGO, ILLINOIS.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 768,982, dated August 30, 1904.

Application filed July 11, 1901. Serial No. 67,820. (No model.)

To all whom it may concern:

Be it known that I, THOMAS DUNCAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Electric Meters, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to coulomb-meters, and has for its objects the provision of means whereby meters of this class may be cheaply built; to adapt such meters to large currents, at the same time making them accurately responsive to small currents; to provide means for producing a constant magnetic field to react upon the armature of the meter, whereby a torque will be produced proportional to the current rather than proportional to the square of the current, as hitherto; to obviate the use of the damping devices heretofore employed for furnishing a load to the instrument that will modify the action of the torque hitherto existing to produce a rotation of the armature in proportion to the current.

The invention has for a further feature the provision of a resistance in shunt to the armature and in series with one of the main conductors and means whereby the field due to this resistance-winding will not modify the action of the meter.

In practicing my invention I dispense with the field-winding of the meter that was heretofore used, which field-winding was included in series in one of the main conductors, and substitute therefor a resistance in parallel with an armature preferably connected to the terminals of the resistance by means of commutator-brushes engaging the commutator connected with the armature-winding. I associate with the armature-winding thus included in shunt of a resistance included in series in one of the main conductors a supplemental armature-winding connected in bridge of the transmission-mains and serving to furnish the necessary starting torque to overcome friction. The field for the armature that was hitherto supplied by the current field-winding is in accordance with my invention replaced by means for producing a field of permanent strength, this field being preferably produced by a permanent electromagnet. The armature-winding is preferably placed about a cup or disk of aluminium or other suitable metal, which preferably acts as a retarding element by being placed within the influence of the permanent field. In order to maintain the permanent magnet of constant strength, I preferably wind coils about the legs thereof that are connected in bridge of the transmission-mains or otherwise subject to the pressure between the same, which coils while strong enough to maintain the proper degree of magnetism in the permanent magnet do not create a field varying with the pressure reacting upon the armature, as this would change the meter to a wattmeter. The starting-coil of the meter is preferably connected in series with these strengthening magnet-windings through the agency of a commutator and commutator-brushes, a resistance being preferably included in series with the starting armature-winding to adjust the strength thereof in accordance with the amount of friction to be overcome.

To prevent that resistance which is included in one of the mains and in shunt of the main armature-winding from modifying the action of the meter by reason of lines of force emanating therefrom, I interpose a magnetic shield between the resistance and the motor element of the meter, the shield being preferably tubular, entirely inclosing the resistance.

I will explain my invention more fully by reference to the accompanying drawings, illustrating the preferred embodiment thereof, in which—

Figure 1 is a diagrammatic view of a system of electrical-current distribution with the working parts of a meter constructed in accordance with my invention shown in full elevation. Fig. 2 is a similar view, portions of the meter being shown in section to reveal features of construction. Fig. 3 is a sectional plan view on line 3 3 of Fig. 1.

Like parts are indicated by similar characters of reference throughout the different figures.

I have illustrated in Figs. 1 and 2 a source

of current 1, supplying current to transmission-mains 2 2, that convey the same to translating devices 3. A resistance 4 sufficiently high to divert current through the main armature-winding 5 is employed. This armature-winding 5 is of low resistance and is preferably wound in the fashion shown and is supported by an aluminium cup constituting also a damping element 6. The armature-winding 5 is connected with the segments of the commutator 7, with which the commutator-brushes 8 8 are connected, these brushes being connected with the terminals of the resistance 4. An adjusting resistance 9 is provided for accurately determining the strength of the field due to the said armature-winding, and thereby the speed of the meter. A permanent magnet 10 is provided with pole-pieces 11 11, constructed, preferably, of soft iron, which pole-pieces are curved to conform to the contour of the armature. To reduce the magnetic reluctance between the poles of the permanent magnet, I prefer to employ a cylindrical body of soft iron 12, that is stationarily mounted upon a brass yoke 13, secured to the ends of the permanent magnet. This cylindrical body of iron is provided with an axial bore, through which the meter-shaft 14 extends, the meter-shaft being of course free from the cylinder 12, but fixed with relation to the armature-winding 5 and the aluminium cup 6. The shaft 14 of the meter is mounted at its lower end upon a bearing 15, that may be vertically adjusted by a suitable adjusting-screw 16, the screw being secured within the sleeve of a support 17, mounted upon and extending beneath the yoke of non-magnetic material 13.

To provide for the necessary starting torque in the instrument, a supplemental armature-winding 18 of high resistance is preferably provided, this supplemental winding being connected in bridge of the mains 2 2 through the agency of a commutator 19 and the commutator-brushes 20. An adjusting resistance 21 is included in series with the commutator-brushes 20 and the starting armature-winding 18 for the purpose of determining the torque of the armature-winding 18 that is necessary to overcome friction.

To preserve the uniform strength of the permanent magnet, I prefer to employ a winding subject to the pressure in the system, the winding being preferably subdivided into two coils 22 22, each inclosing a limb of the magnet.

While the coils 22 22 are possessed of the requisite number of turns to maintain the proper magnetism in the permanent magnet, they are not strong enough to alter the nature of the meter—that is, they are not adapted nor so located as to transform the meter into a wattmeter.

To prevent the resistance 4 from reacting magnetically upon the motor element of the meter, I interpose a shield 23 between this resistance and the motor element of the meter, the shield being preferably in the form of an iron tube completely inclosing the resistance.

I have illustrated an indicating-dial upon which the ampere-hours may be read; but I have not deemed it essential to illustrate the mechanism for actuating the indexes of the reading-dial, as this is well understood by those skilled in the art.

The motive power of the meter is developed by the armature-winding 5 and the permanent magnet 10 and is proportional to the resistance 4 and the current traversing the latter. The drag upon the armature is obtained by means of the damping element 6, which by being within the field of the permanent magnet and secured to the shaft of the meter produces the necessary modification in the speed of the said shaft. The starting torque is produced by the cooperative relation of the supplemental high-resistance winding 18 with the permanent magnet.

I have herein shown and particularly described the preferred embodiment of my invention; but it is obvious that changes may be made without departing from the spirit thereof, and I do not, therefore, wish to be limited to the precise disclosure herein set forth; but,

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a system of electrical distribution, the combination with a current-generator, of a coulomb-meter, having a main armature-winding subject to the current in the system, a supplemental armature-winding subject to the pressure of the system, and means for producing a magnetic field within which the said armature-windings are located, substantially as described.

2. In a system of electrical distribution, the combination with a current-generator, of a coulomb-meter having a main armature-winding subject to the current in the system, a supplemental armature-winding subject to the pressure of the system, and a permanent magnet for producing a field within which the said armature-windings are located, substantially as described.

3. In a system of electrical distribution, the combination with a current-generator, of a coulomb-meter having a main armature-winding subject to the current in the system, a supplemental armature-winding subject to the pressure of the system, means for producing a magnetic field within which the said armature-windings are located, and a body 12 of magnetic material inclosed by the armature-windings, substantially as described.

4. In a system of electrical distribution, the combination with a current-generator, of a coulomb-meter having a main armature-winding subject to the current in the system, a supplemental armature-winding subject to the

pressure of the system, a permanent magnet for producing a field within which the said armature-windings are located, and a body 12 of magnetic material inclosed by the armature-windings, substantially as described.

5. In a system of electrical distribution, the combination with a current-generator, of a coulomb-meter having a main armature-winding subject to the current in the system, a supplemental armature-winding for furnishing an initial starting torque to compensate for friction, and means for producing a magnetic field within which the said armature-windings are located, substantially as described.

6. In a coulomb-meter, the combination with means for producing a field of permanent strength, of an armature provided with a winding subject to the current in a system of distribution, said armature-winding being in shunt of a resistance in series with one of the mains of said system, and a tubular magnetic shield inclosing the said resistance to prevent lines of force thereof from influencing the operation of the meter, substantially as described.

In witness whereof I hereunto subscribe my name this 3d day of June, A. D. 1901.

THOMAS DUNCAN.

Witnesses:
GEORGE L. CRAGG,
HERBERT F. OBERGFELL.