No. 787,256. PATENTED APR. 11, 1905.

J. S. ANTHONY.

DIRECT CURRENT METER.

APPLICATION FILED AUG. 15, 1902.

2 SHEETS—SHEET 1.

Fig. 1

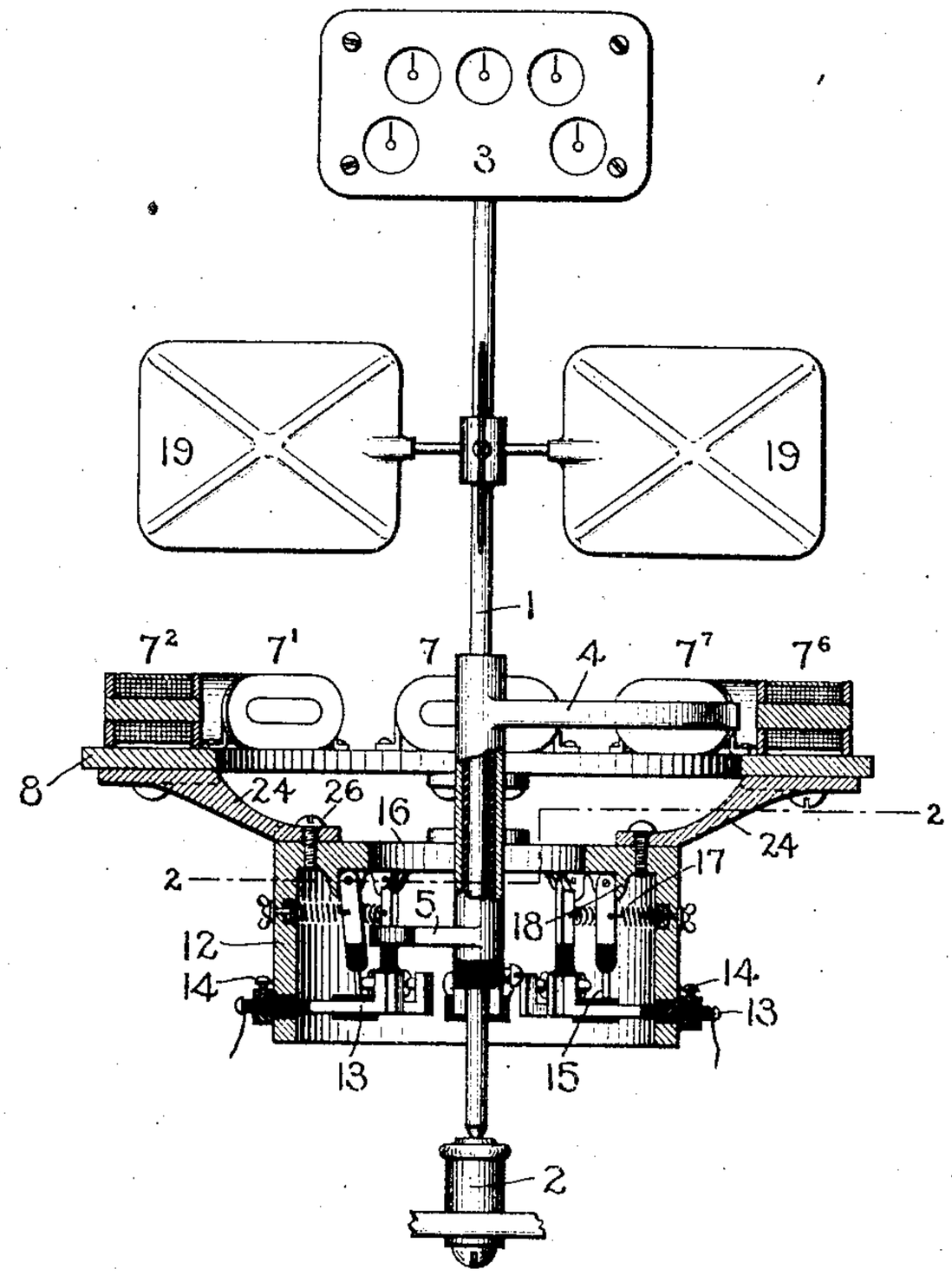
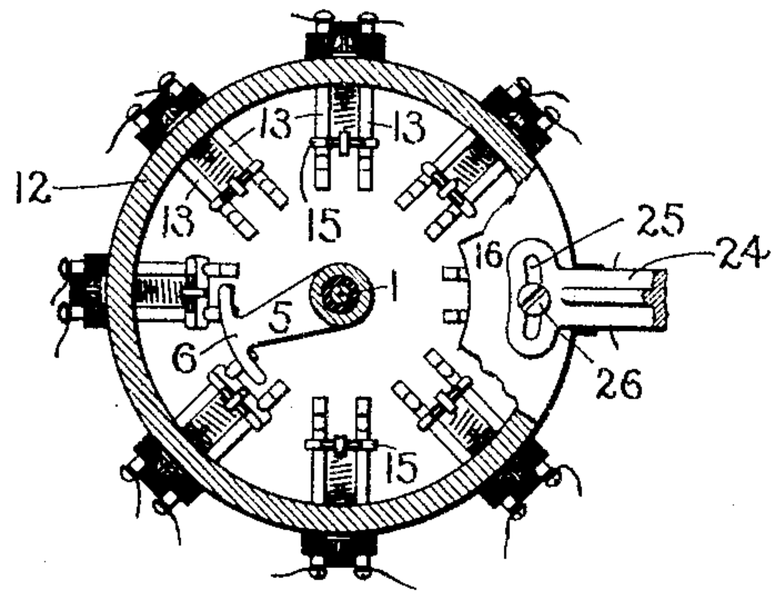


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3

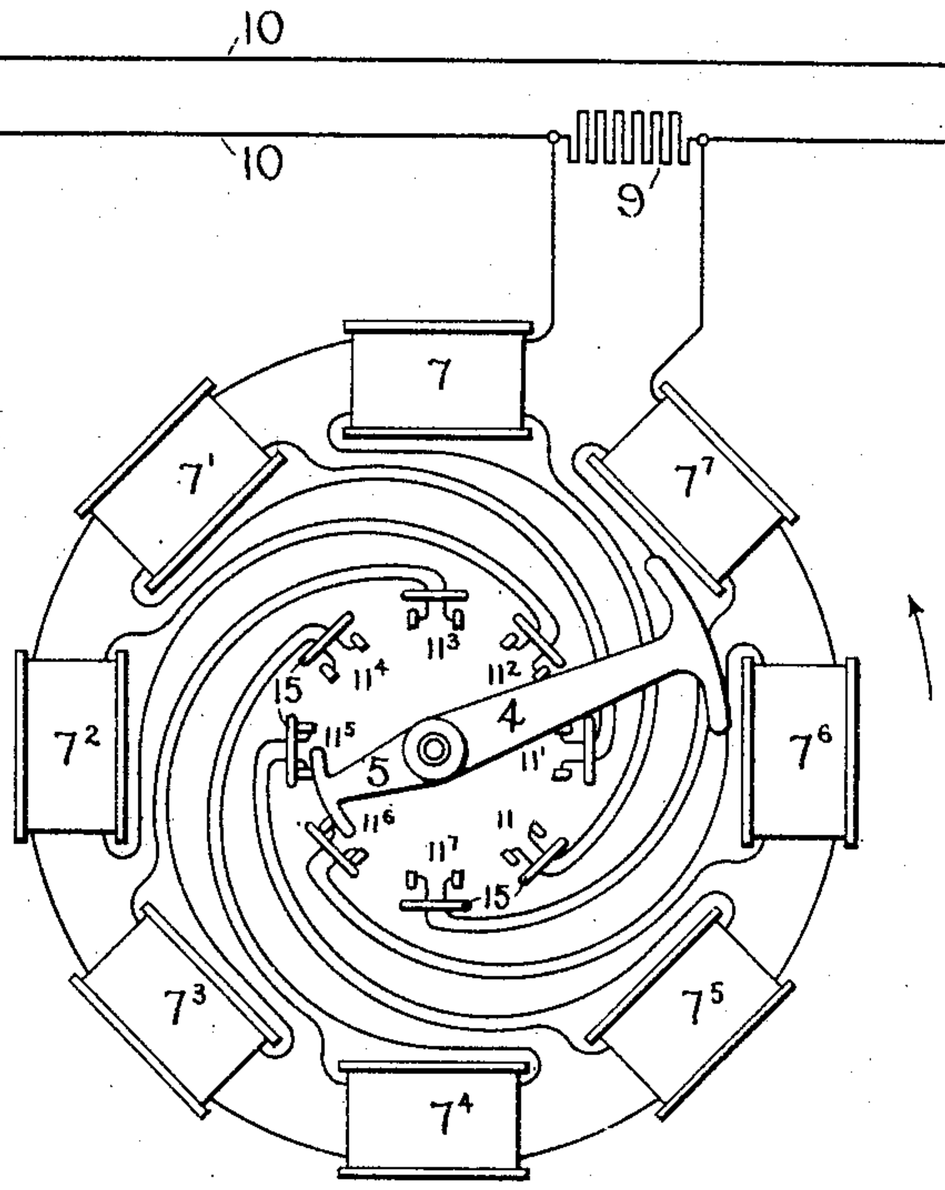


Fig. 4

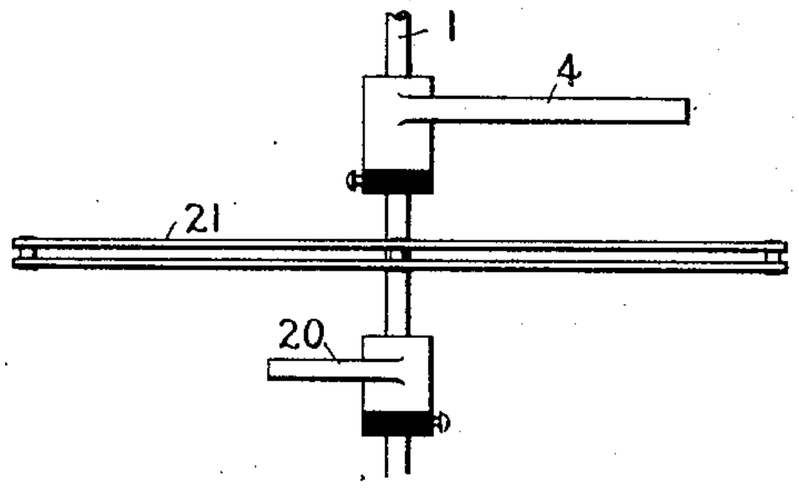
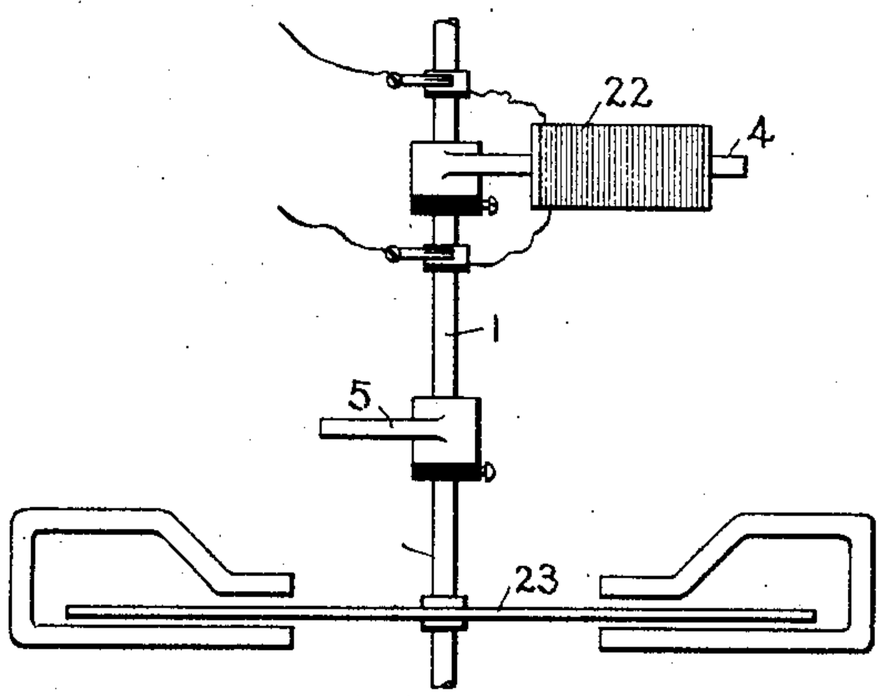


Fig. 5.



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No. 787,256. Patented April 11, 1905.

UNITED STATES PATENT OFFICE.

JAMES S. ANTHONY, OF NEW YORK, N. Y., ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

DIRECT-CURRENT METER.

SPECIFICATION forming part of Letters Patent No. 787,256, dated April 11, 1905.

Application filed August 15, 1902. Serial No. 119,692.

To all whom it may concern:

Be it known that I, JAMES S. ANTHONY, a citizen of the United States, residing at New York, county of New York, State of New York, have invented certain new and useful Improvements in Direct-Current Meters, of which the following is a specification.

This invention relates to electric meters for direct current, and more especially to that kind known as "motor-meters." In all forms of direct-current motor-meters heretofore used the current is brought into the actuating-coils by a commutating device or through a moving contact of some kind. This involves a certain amount of mechanical retardation which is not a constant factor, and therefore introduces irregularities into the working of the meter.

The object of my invention is to avoid all moving contacts actuated mechanically by the moving element of the meter and provide for the necessary switching of the current by magnetically-operated devices or devices operating in an equivalent manner, as hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is an elevation of the working parts of a meter embodying my invention, certain portions being in section. Fig. 2 is a top plan sectional view on the line 2 2, Fig. 1. Fig. 3 is a diagram of the circuits. Fig. 4 is a side elevation of a portion of the staff, showing a modification. Fig. 5 is a further modification.

The staff 1 is supported by a jeweled step-bearing 2 and is geared to the registering-train 3 at its upper end, all as usual. Rigidly attached to the staff is an armature of soft iron having a long upper horizontal arm 4 somewhat enlarged at its outer end, so that the mass of iron may be more readily acted upon by the actuating field-coils. The lower arm 5 is also horizontal and is provided with an enlargement 6 in the form of a segment of a circle for a purpose hereinafter set forth.

The actuating field-coils 7 7′ 7^2, &c., are arranged symmetrically around the staff 1 and concentric with it in the plane of the upper armature-arm 4, the axes of the coils being preferably radial to the staff. The number of coils is immaterial; but I prefer to use eight or more, as with this number the movement of the armature is more uniform. The coils are supported by a suitable frame 8, of non-magnetic material. All the coils are of low resistance and as nearly alike electrically as possible. They are connected in series, and the whole winding is in shunt to a resistance 9, which is in series with one of the mains 10 of the circuit whose energy is to be measured.

The terminals of each coil are electrically connected with a pair of contacts 11 11′ 11^2, &c., arranged adjacent the plane of revolution of the lower arm 5 of the armature. The contacts are preferably supported by an insulating-ring 12, in which they are radially adjustable by means of the insulated shanks 13, on which they are carried, and the set-screws 14 engaging therewith. When any pair of contacts is connected, their coil is deënergized by being short-circuited. Adjacent each pair of contacts is a movable bridging contact adapted to bridge the space between them, and thus connect them electrically, so that each pair of contacts, together with its bridging contact, constitutes an electric switch. The bridging contact is preferably a small soft-iron bar 15, pivotally suspended from a flange 16 on the ring 12 and movable in a plane radial to the staff 1, so that it may be operated by magnetic attraction from a body carried by the staff. It is held normally away from the contacts 11 by a light spring 17 or its equivalent and rests against a pillar 18, projecting from the ring 12. The amplitude of movement of the bar between the pillar 18 and the contacts 11 should be no greater than will insure the breaking of the circuit when the bar moves away from the contacts. The several bars are in the plane of revolution of the armature-arm 5 and quite near thereto.

The bridging contacts are operated from the meter-staff without any actual contact between moving parts in such a manner as to deënergize the field-coils adjacent the armature on one side thereof, and the movable member of the meter is caused to rotate be-

cause of the magnetic attraction existing between the armature and the field-coils on the other side.

The operation of my meter is as follows: Suppose the long arm 4 of the armature is in the position shown in Fig. 3 between the coils 7^6 7^7. Then the shorter arm 5 of the armature will be opposite the contacts 11^5 and 11^6. In order to have the arms balance each other, I prefer to arrange them in the same vertical plane, but on opposite sides of the staff, as shown, though it is evident that they may stand at any desired angle with each other. In any event the contacts for each coil must be so placed that when the long arm stands between two coils one of these and the one next in the rear will be connected with the contacts opposite the short arm of the armature. If the circuit of the mains 10 is now closed, the magnetic flux of the coils 7^6 7^7 will magnetize the armature, and its short arm will attract the bars 15 of the contacts 11^5 11^6, thus short-circuiting the coils 7^5 7^6. This leaves the coil 7^7 free to attract the armature 4, moving it in the direction of the arrow in Fig. 3; but when the armature reaches the center of the coil 7^7 this coil is short-circuited by the contacts 11^7 and the armature continues its movement, attracted by the next coil 7. The speed of the meter under these circumstances is proportional to the square of the current, and the load on the meter may therefore be produced by fans 19 on the armature-staff.

If desired, a permanent magnet 20 may be substituted for the soft-iron shorter arm 5, as shown in Fig. 4; but in that case the permanent magnet must be separated from the longer arm 4 magnetically. It may also be found desirable to interpose a magnetic shield between the two arms, such as a plate of soft iron 21 at right angles to the staff.

By substituting for the larger arm of the armature a coil with its axis radial to the staff and its winding connected across the mains of the circuit to be measured, so that the current passing through the coil will always be proportional to the potential on the line, the instrument will register watts instead of amperes. It will be necessary in this case to use a permanent magnet for the lower arm of the armature and to provide a Foucault disk and magnet instead of the fans above mentioned. This construction is indicated in Fig. 5, wherein the coil is shown at 22 and the damping-disk at 23.

In order to compensate for a proper lag or lead in the adjustment of the meter, the ring 12, carrying the contacts 11 11′, &c., may be angularly adjustable with reference to the frame on which the field-coils are mounted. Such an arrangement is shown in Fig. 2, the brackets 24 on the field-frame having slots 25 concentric with the staff 1, so that the ring 12 can be angularly adjusted by shifting the supporting-bolts 26 in said slots.

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

1. An electric motor-meter, comprising a plurality of field-coils, an armature operatively related thereto, switches for modifying the circuit connections of said field-coils in such a manner as to operate the movable element of the meter, and means fixed with reference to the armature for operating the said switches without actual contact therewith.

2. An electric motor-meter, comprising a plurality of field-coils, an armature operatively related thereto, switches for deënergizing the field-coils adjacent to the armature on one side to operate the movable element of the meter, and means fixed with reference to the armature arranged to operate the said switches without actual contact therewith.

3. An electric motor-meter, comprising a plurality of field-coils, an armature operatively related thereto, switches for modifying the circuit connections of the field-coils in such a manner as to operate the movable element of the meter, and means fixed with reference to the armature arranged to actuate said switches by magnetic attraction.

4. An electric motor-meter, comprising a plurality of field-coils, a body of magnetic material constituting an armature operatively related to said coils, and magnetically-operated switches for deënergizing one or more of said field-coils in succession to operate the movable element of the meter.

5. An electric motor-meter, comprising a plurality of field-coils, a body of magnetic material constituting an armature operatively related to said coils, switches for deënergizing one or more of said coils in succession to operate the movable element of the meter, and means fixed with reference to the armature for operating the said deënergizing-switches without actual contact therewith.

6. An electric motor-meter, comprising a plurality of field-coils, a body of magnetic material constituting an armature operatively related to said coils, and magnetically-operated switches for deënergizing the field-coils adjacent to the armature on one side to operate the movable element of the meter.

7. An electric motor-meter, comprising a plurality of field-coils, a body of magnetic material constituting an armature operatively related to said coils, magnetically-operated switches for deënergizing the field-coils adjacent to the armature on one side to operate the movable element of the meter, and a magnet fixed with reference to the armature arranged to actuate said switches by magnetic attraction.

8. An electric motor-meter, comprising a plurality of field-coils concentric with the meter-staff, an armature on said staff having its

axis radial to said coils, and magnetically-operated switches in circuit with said coils and controlled by said armature.

9. An electric motor-meter, comprising a plurality of field-coils concentric with the meter-staff, a soft-iron armature on said staff having one arm in inductive relation to said coils, and switches in circuit with said coils and responsive to magnetism in the other arm of said armature.

10. An electric motor-meter, comprising a plurality of field-coils concentric with the meter-staff, an armature in inductive relation to said coils, contacts connected with the terminals of said coils, movable bridging contacts coöperating with the coil-contacts, and means for operating said bridging contacts in synchronism with the rotation of the armature.

11. An electric motor-meter, comprising a plurality of field-coils concentric with the meter-staff, an armature in inductive relation to said coils, contacts connected with the terminals of said coils, soft-iron movable bridging contacts coöperating with the coil-contacts, and a magnetized arm on said staff for successively operating said bridging contacts as the staff rotates.

12. An electric motor-meter, comprising a plurality of field-coils concentric with the meter-staff, an armature in inductive relation to said coils, contacts connected with the terminals of said coils, movable bridging contacts coöperating with the coil-contacts, means for operating said bridging contacts in synchronism with the rotation of the armature, and means for angularly adjusting all of the coil-contacts.

In witness whereof I have hereunto set my hand this 12th day of August, 1902.

JAMES S. ANTHONY.

Witnesses:
BENJAMIN B. HULL,
EDWARD WILLIAMS, Jr.