No. 679,304. Patented July 30, 1901.

W. C. FISH.

ELECTRIC METER.

(Application filed May 21, 1901.)

(No Model.)

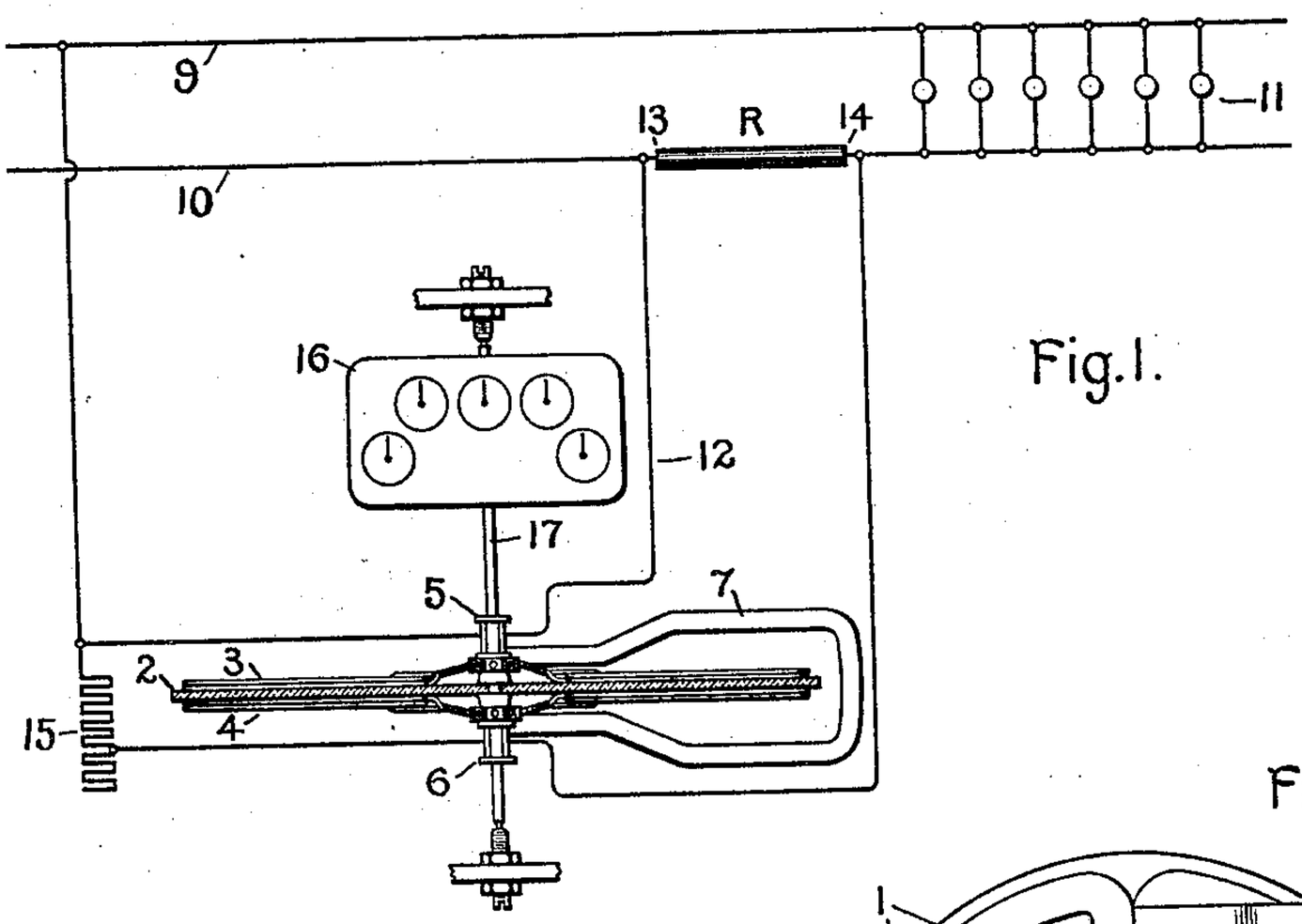
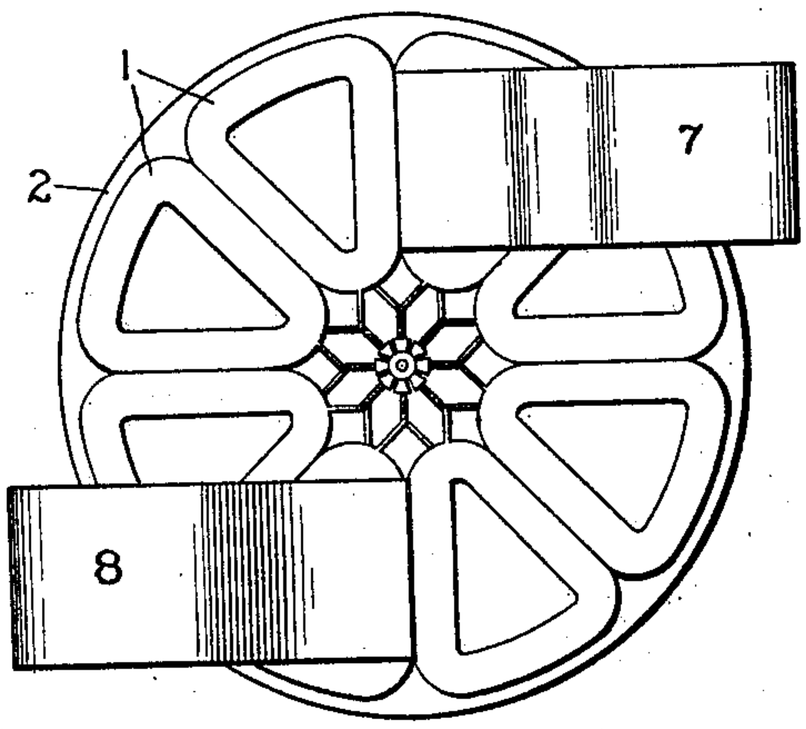


Fig. 1.

Fig. 2.



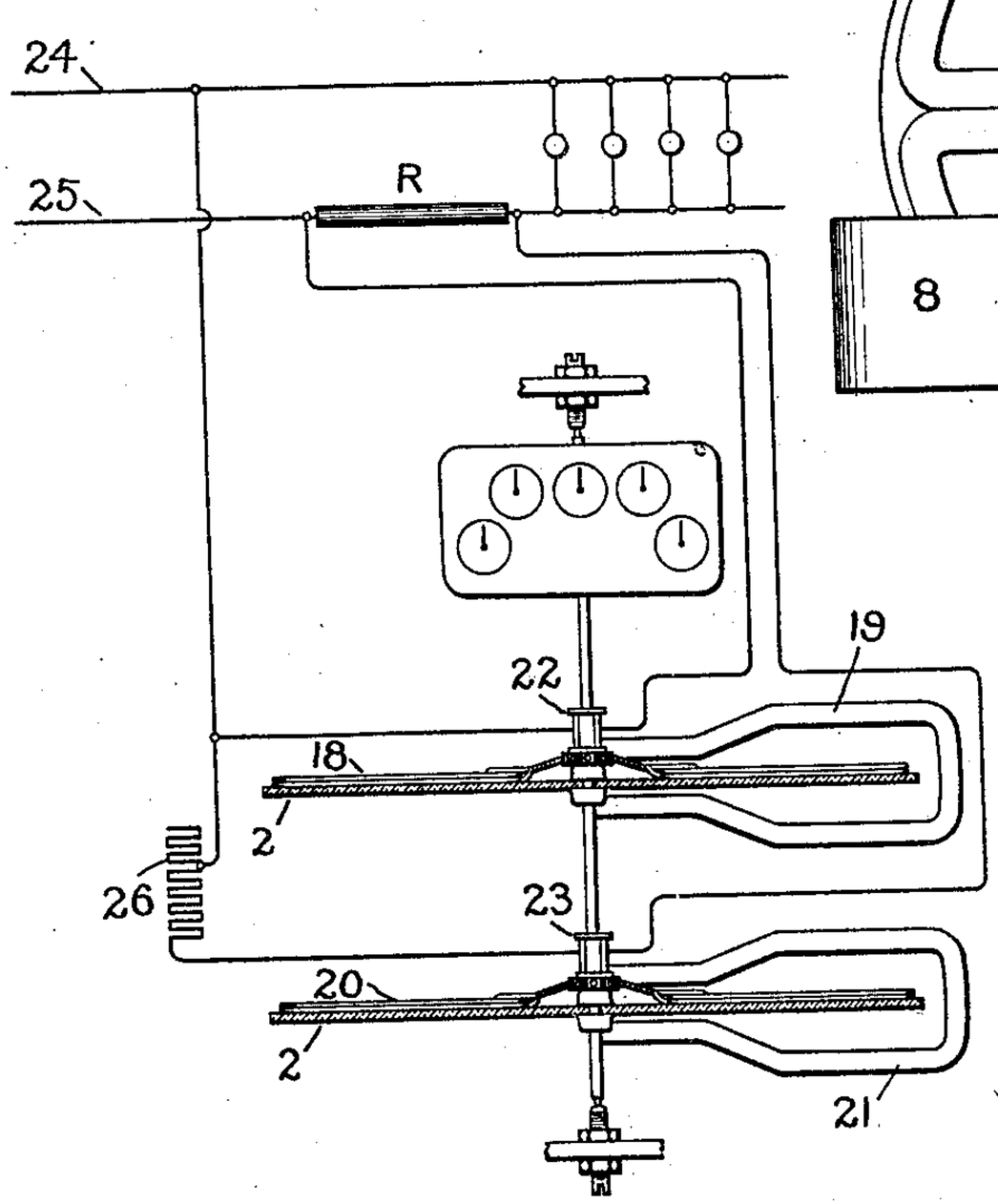


Fig. 3.

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UNITED STATES PATENT OFFICE.

WALTER C. FISH, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, OF NEW YORK.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 679,304, dated July 30, 1901.

Application filed May 21, 1901. Serial No. 61,322. (No model.)

To all whom it may concern:

Be it known that I, WALTER C. FISH, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Electric Meters, (Case No. 1,788,) of which the following is a specification.

My present invention is embodied in a novel type of electric meter in which movement of the recording device is produced as the result of the differential action of two motive devices the torques of which oppose each other.

The scope of my invention will be particularly pointed out in the appended claims, while the details of the invention and its mode of operation will be made clear by reference to the following description, taken in connection with the accompanying drawings, in which—

Figure 1 represents one embodiment of my invention; Fig. 2, a view of a detail of the same, and Fig. 3 a modified form.

My invention may be briefly characterized as consisting of mechanically-connected motive devices, one of which tends to produce motion in one direction and another in an opposite direction. So long as the motive effects of the devices are equal, no resultant motion takes place, as is obvious. I provide means responsive to the load to be measured for varying the motive effect of one of the devices, whereupon a resultant motion is produced and the parts accelerate or slow up, as the case may be, until the motive effects again balance, whereupon the resultant movement continues without further acceleration or retardation until the load again changes. A recording device records the movements of the meter, and therefore serves to indicate the energy to be measured.

The embodiment of my invention which I have shown diagramatically in Fig. 1 consists of two armature-windings, each provided with a commutator, these armature-windings and their coöperating commutators being carried by the same shaft. In the present instance I have by way of illustration shown these windings as consisting of a suitable number of pancake-coils arranged in a manner usual in disk armatures. These pancake-coils, a better understanding of which may be had by reference to the coils 1, (shown in Fig. 2,) are mounted upon a disk 2 of some non-conducting material, as mica, glass, or the like. One set of armature-coils 3 I have shown as being mounted upon the top side of the disk 2 and the other set of armature-coils 4 on the under side, the coils being held in place either by cement, clips, or other suitable means. The upper armature-winding 3 is connected in a well-known manner to a commutator 5, and the lower armature-winding 4 is in a similar manner connected to a coöperating commutator 6. The armature-windings which I have thus described are arranged to rotate through the same magnetic field, the field in this case being provided by two permanent magnets 7 and 8. (Shown in Fig. 2.)

One of the armature-windings—as, for example, the winding 3—has its commutator 5 connected across the supply-mains 9 10, which carry the load to be measured, (in this case indicated conventionally by the translating devices 11.) One terminal leading from the commutator 5—as, for example, the terminal 12—is connected to or near one end 13 of a resistance R, placed in series with the main 10, leading to the translating devices 11. In a similar manner the commutator 6, connected to the other armature-winding 4, has its terminals connected across the mains 9 10, the connections being made in this case, however, so that one of the terminals leading from the commutator 6 is connected to the opposite end 14 of the resistance R, as indicated clearly in the drawings.

The terminals bearing on the respective commutators 5 6 are so arranged relatively to each other as to cause one of the armature-windings to have a tendency to rotation in one direction and the other armature-winding a tendency to rotation in the opposite direction, the manner of making such connections to produce this result being well understood by any person skilled in the art.

When there is no current flowing in the main 10, there will be no drop of potential across the resistance R, and the electromotive force impressed upon the circuit of the commutator 5 will therefore be identical with

that impressed upon the circuit of the commutator 6. If the parts are properly adjusted with respect to each other, the rotating member of the motor will be impelled neither in one direction nor the other, since the tendencies to rotation are exactly balanced.

When current commences to flow in the supply-mains 9 10 to the translating devices 11, it passes through the resistance R, across which there then exists a difference of potential proportional to the amount of current flowing. To secure strict proportionality, the resistance R should be made of material having a very low temperature coefficient. The effect of a flow of current through this resistance is to diminish the difference of potential at the terminals of the circuit of the armature-winding 4 by an amount represented by the drop in potential across this resistance. The current flowing through the winding 4 is therefore reduced, thereby reducing its resisting torque. The armature-winding 4 is therefore overpowered by the armature-winding 3, which is fed, as will be understood, by a higher electromotive force. The movable member of the armature therefore starts into rotation, the winding 3 acting as a motor-winding and causing the winding 4 to be rotated backward in a direction contrary to that which it would take were it free to move in response to the current flowing therein. The winding 4 being thus moved backward has generated therein an electromotive force which is in a direction such as to be added to that flowing in its supply-circuit. As the parts accelerate this electromotive force increases correspondingly, thereby causing an increased current in the winding 4 and a consequent increase in torque. At the same time the motion of the motor-winding 3 induces therein a counter electromotive force which by reducing the current cuts down the motor-torque. The acceleration continues until the increasing opposing torque of the winding 4 becomes equal to the decreasing motor-torque of the winding 3, whereupon the acceleration ceases and the rotating member of the meter continues at the speed thus assumed until some further change occurs in the amount of current flowing through the resistance R, when the parts will assume a new speed, as may be required.

Since the armature-winding 4, which for convenience I may term the "generator-winding," moves through a field of constant value, furnished in this case by permanent magnets, and is automatically rotated by the motor action of the winding 3, so as to generate an electromotive force proportional to that consumed by the drop in the resistance R, it will be seen that the speed of rotation of the movable member of the meter is therefore proportional to the current-flow in the supply-mains 9 10. A counter 16 or other registering and recording device may be connected in the usual manner with the shaft 17 of the meter-armature.

In practice it may happen that owing to friction of the parts the meter may not start up upon very small loads, to overcome which I provide adjusting means consisting, for example, of a resistance 15 in series with the commutator 6, this resistance acting to cut down the current through the armature-winding 4 by an amount just sufficient to make the excess torque of the armature 3 almost but not quite enough to overcome the friction of the parts and start up the meter. The adjustment may also be such as to compensate for running friction.

Instead of mounting the motor and generator armature windings so as to revolve through the same magnetic field, as I have shown in Fig. 1, I may, if desired, provide each winding with its own magnetic field. This is the construction which I have represented in Fig. 3, in which the winding 18 acts as a motor-armature, the field for which is provided by permanent magnets, one of which is indicated at 19. The general arrangement of the magnets is the same as indicated in Fig. 2. The other armature includes the winding 20, which is arranged to coöperate in a similar manner with its own set of field-magnets, one of which is indicated at 21.

The respective windings 18 and 20 are connected through commutators 22 and 23 with the supply-mains 24 and 25, the connections being substantially the same as shown in Fig. 1. One of the mains has connected in series therewith a resistance R. A lead from one of the armatures connects with one end of this resistance and a lead from the other armature with the opposite end. The mode of operation is substantially the same as that already described in connection with Fig. 1.

A resistance 26 or any other suitable means may be employed for adjusting the relative torques of the armature-windings, so that the motor element will be just upon the point of starting when there is no load upon the meter, the effect of the friction of the brushes, pivot, &c., being thus effectively counterbalanced and the meter rendered exceedingly sensitive to light loads.

It is to be noted that the forms of meters above described are not intended to be supplied with any damping device, and for this reason the support for the armature-coils is purposely made of some non-conducting material. I may further observe that in case it is desired that the meter shall register watts instead of ampere-hours I may provide some field-weakening device responsive to variation of voltage of the mains. Inasmuch, however, as this constitutes no essential feature of my broad invention I have not considered it necessary to illustrate the same.

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

1. In an electric meter, the combination of motive devices normally tending to produce opposite directions of rotation, and means for varying the speed of the resulting rotation in response to variation of the quantity to be measured by the meter.

2. In an electric meter, the combination of armature-windings, means for impressing on one of said windings a given electromotive force, and means for impressing on another of said windings the same electromotive force diminished by an amount proportional to the quantity to be measured by the meter.

3. In an electric meter, the combination of armature-windings, means for impressing on one of said windings a given electromotive force, and means for impressing on another of said windings an equivalent electromotive force diminished by an amount proportional to the quantity to be measured by the meter.

4. In an electric meter, the combination of two armature-windings mounted in fixed relation to each other, means for impressing upon one of said windings a given electromotive force, and means for impressing on the other winding the same electromotive force diminished by an amount proportional to the flow of current to be measured.

5. In an electric meter, the combination of two armature-windings mounted in fixed relation to each other, means for impressing upon one of said windings a given electromotive force, and means for impressing on the other winding an equivalent electromotive force diminished by an amount proportional to the flow of current to be measured.

6. In an electric meter, the combination of two armature-windings mounted in fixed relation to each other, means for impressing upon the circuit of one of said windings the full electromotive force of the mains with which the meter is to be connected, and means for impressing upon the other winding the electromotive force of the mains diminished by the drop of potential across a resistance connected in one of said mains.

7. The combination with supply-conductors, a resistance device in circuit with one of said conductors, two armature-windings mounted to revolve in fixed relation to each other, a connection from one of said armature-windings to one end of said resistance device, and a connection from the other winding to the other end of said resistance device.

8. In an electric meter, the combination of two motive devices normally tending to produce opposite directions of rotation, and means for varying the torque of one of the motive devices in response to variation of current to be measured.

In witness whereof I have hereunto set my hand this 16th day of May, 1901.

WALTER C. FISH.

Witnesses:
DUGALD MCK. MCKILLOP,
HENRY O. WESTENDARP.