No. 621,005. Patented Mar. 14, 1899.

W. S. WESTON.

ELECTRIC METER.

(Application filed July 1, 1898.)

(No Model.) 2 Sheets—Sheet 1.

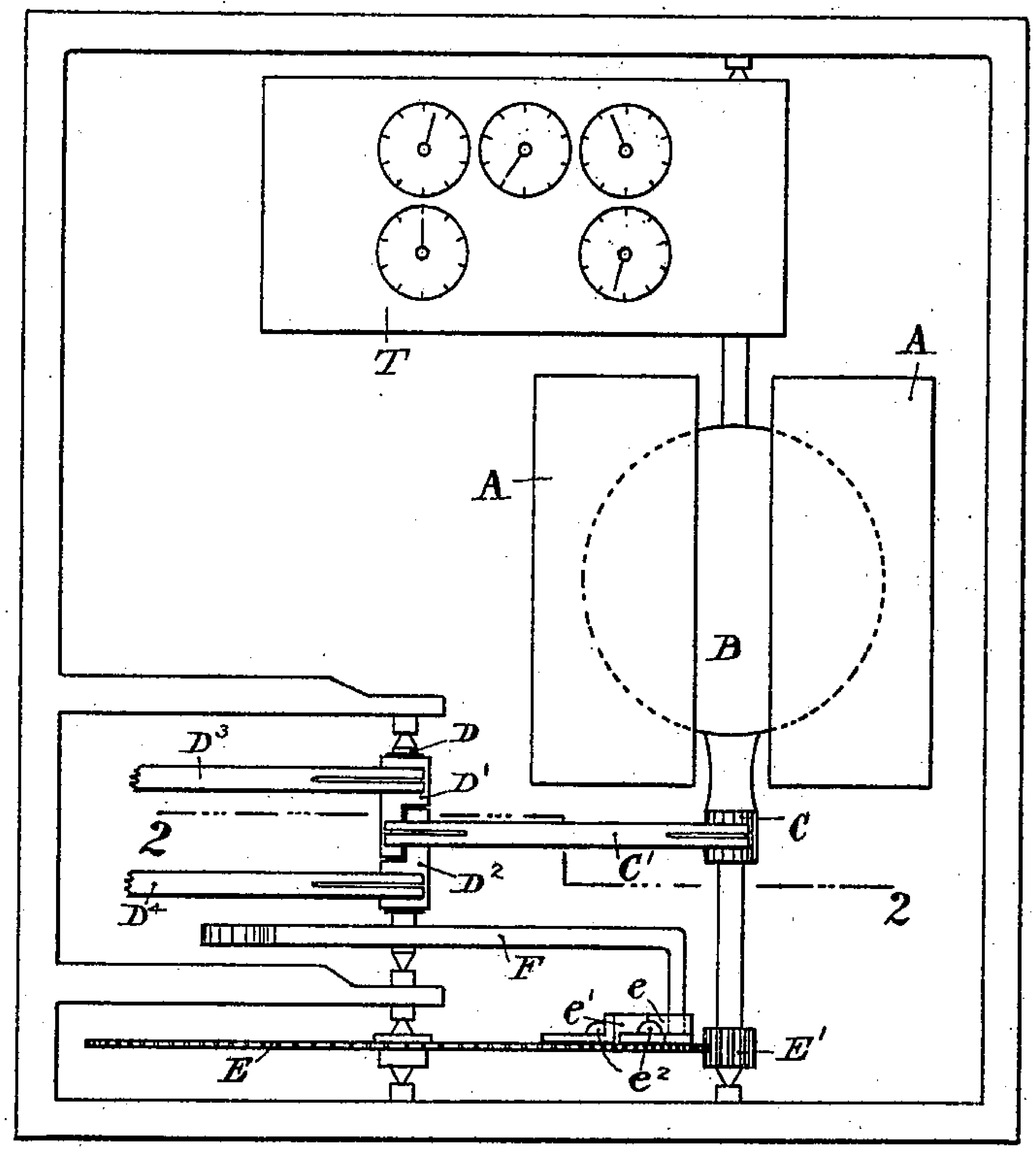

Fig. 1

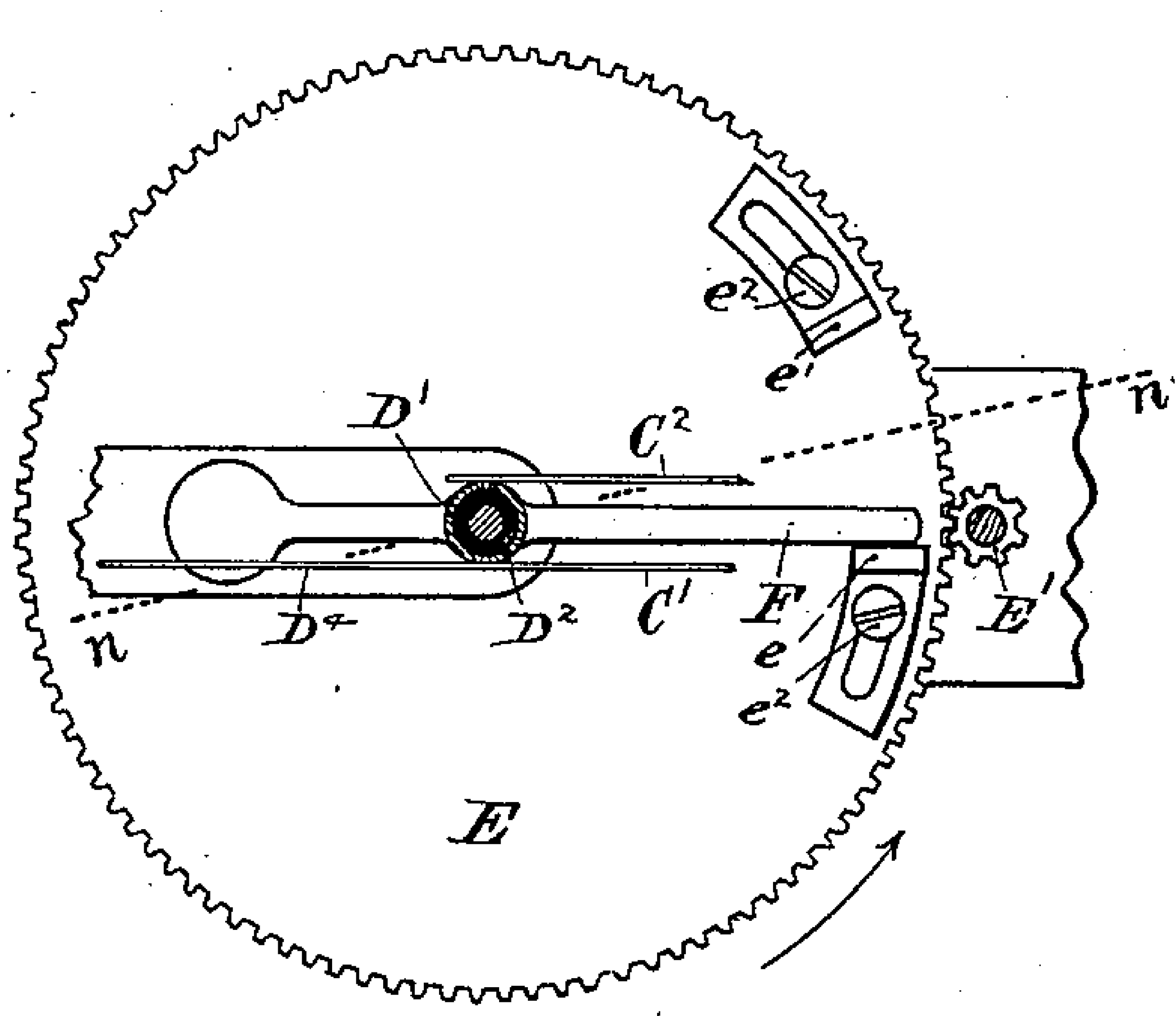

Fig. 2

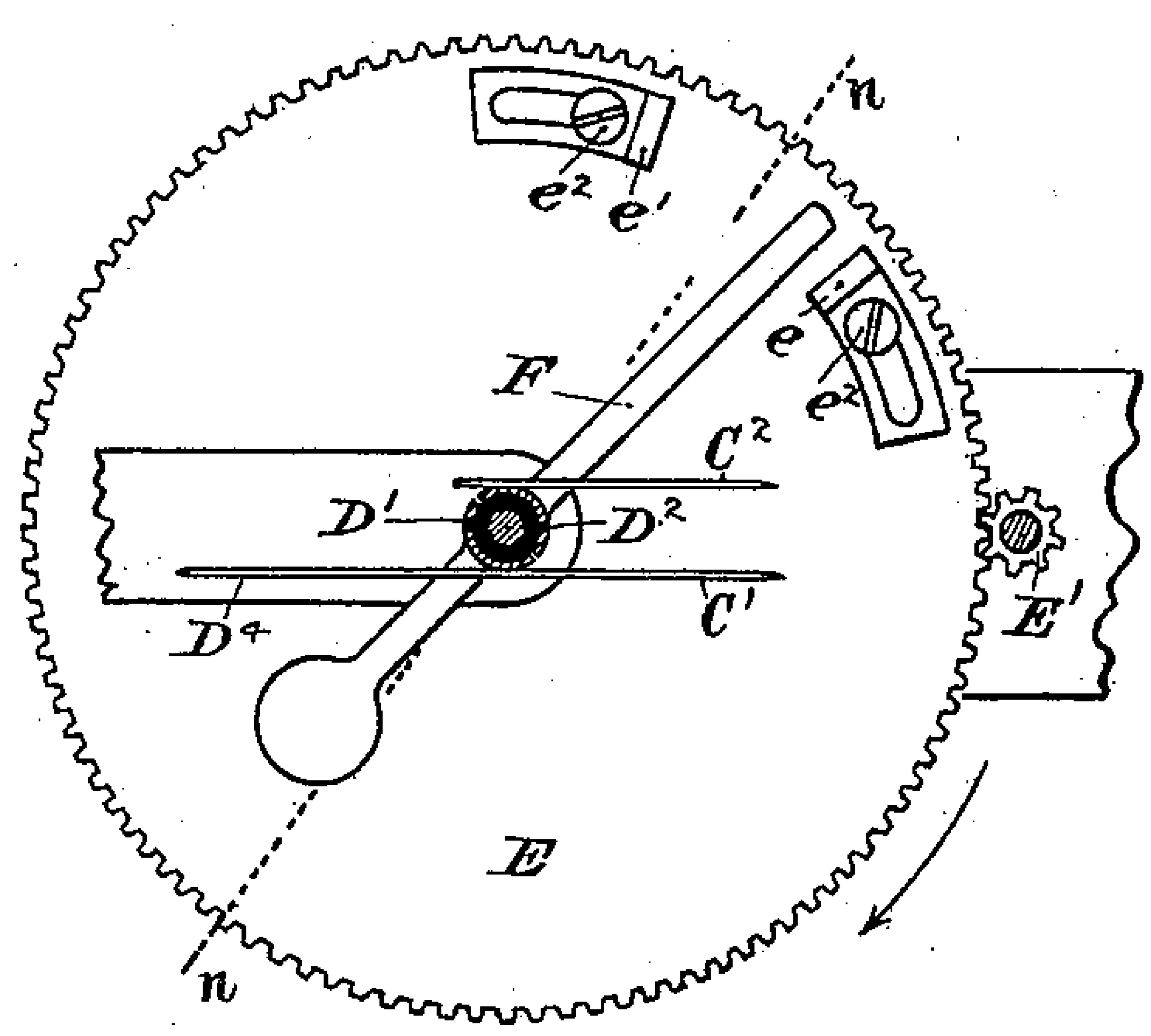

Fig. 3

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

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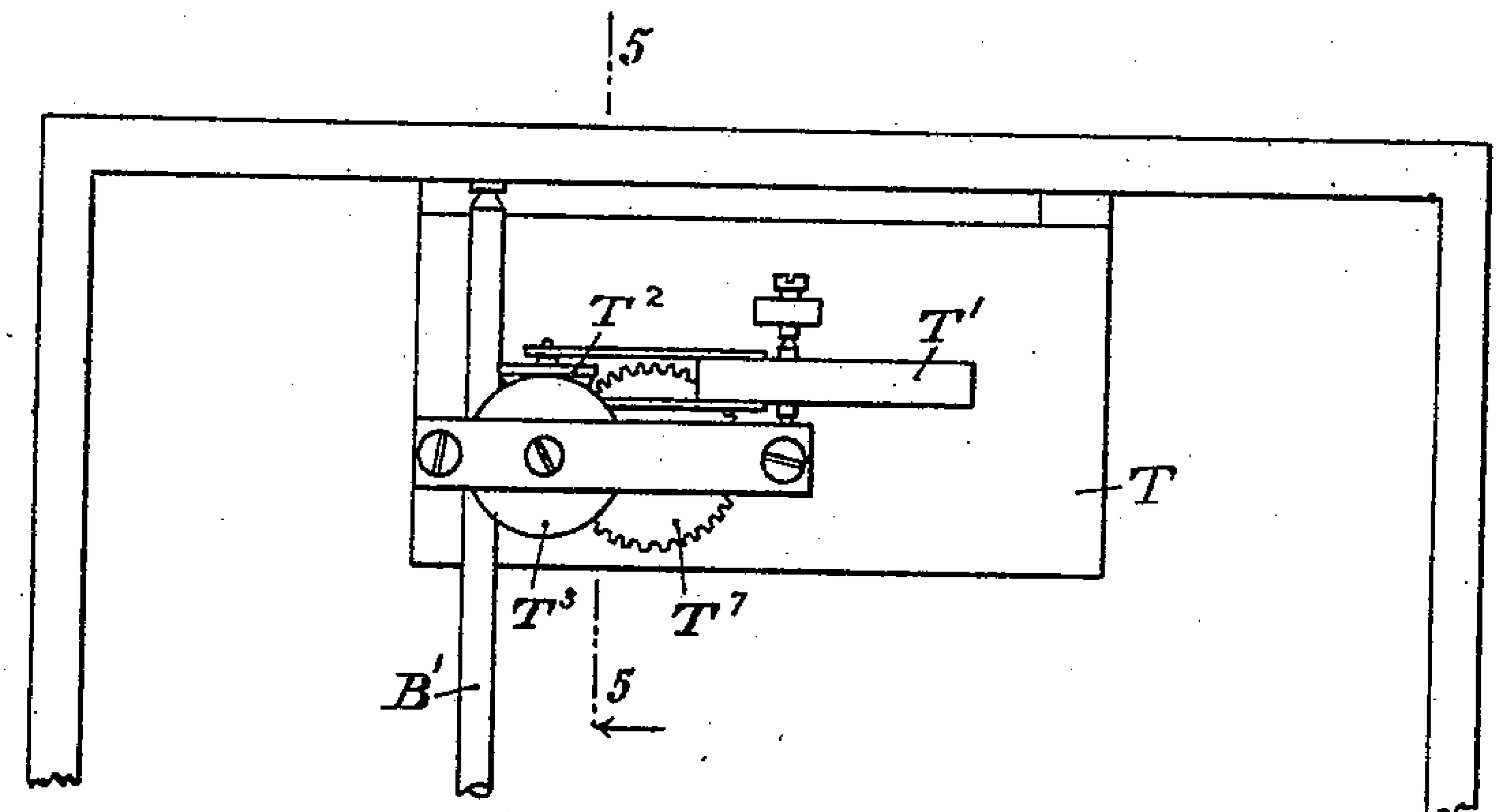

Fig. 4

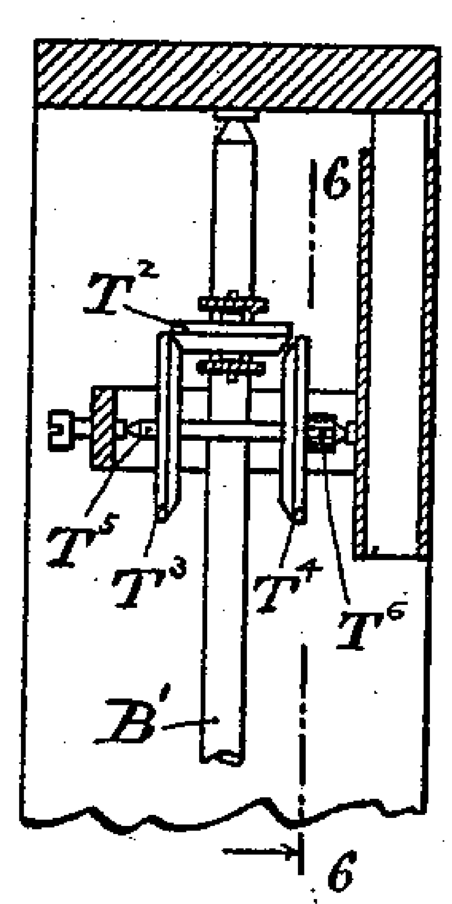

Fig. 5

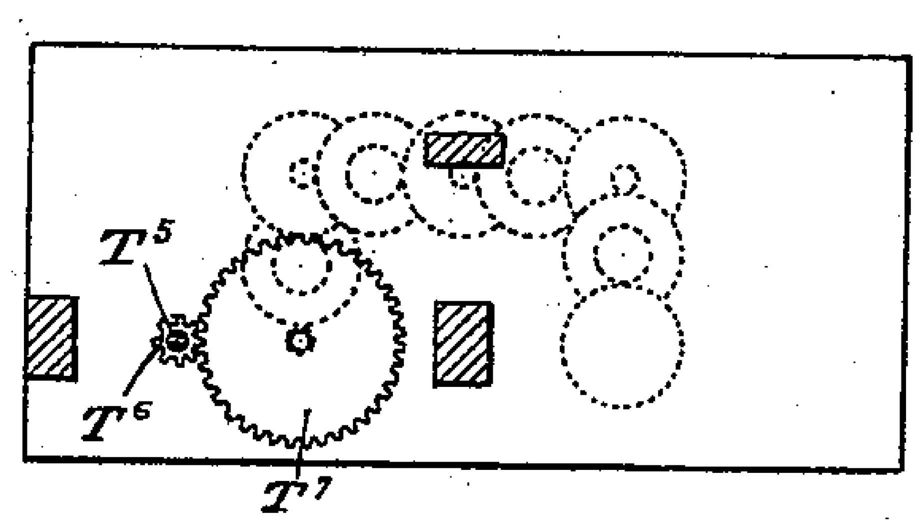

Fig. 6

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UNITED STATES PATENT OFFICE.

WILLIAM S. WESTON, OF CHICAGO, ILLINOIS.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 621,005, dated March 14, 1899.

Application filed July 1, 1898. Serial No. 684,954. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM S. WESTON, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Electric Meters, of which the following is a specification.

My invention is a wattmeter having an alternating or to-and-fro rotative motion; and it consists of an electric motor in which the torque is reversed for each movement, a set of swinging commutator-segments whereby the reversal takes place after the motor has passed the center of its movement in either direction, and a dial-train for recording the total movement of the motor. The motor, which is preferably of the revolving type, is perfectly balanced, so that its motion is independent of gravitation. By the method of reversing the motor after it has passed the center of movement in the direction in which it is moving compensation is made for the loss of power due to the friction in the contacts and bearings. With a constant value for the friction and power loss the summation or total movement in any length of time is proportional to the power absorbed by the current or currents being measured, and the dial will give a direct-reading record. The motor is constructed on the well-known dynamometer principle, with a coarse-wire coil in series with the work-circuit and a fine-wire coil in shunt.

In the drawings furnished herewith and forming part of this specification I have shown an ordinary commutated motor and means for reversing the flow of the current through the armature. It will become obvious, however, that an induction-motor might be employed equally as well and the reversal of motion obtained by reversing the current in one set of coils.

Figure 1 is an elevation of the motor; Fig. 2, a section on the line 2 2 of Fig. 1, and Fig. 3 another view showing the parts in a different position from that in Fig. 2. Fig. 4 is a back view of the top of the meter, showing the mechanism for transforming the alternating or to-and-fro rotative movement of the armature-shaft into a rotative movement continuous in one direction for driving the dial-train. Fig. 5 is a section on the line 5 5 of Fig. 4, and Fig. 6 is a section on the line 6 6 of Fig. 5.

The same letters refer to the same parts in all the views.

A A are the field-coils of the motor, preferably made of coarse wire and connected in series in the work-circuit.

B is the fine-wire armature, connected in the shunt-circuit, provided with a commutator C and brushes C′ C^2.

D is a pole changer or reverser, having two insulated segments D′ D^2. The segments D′ D^2 are provided with supply-brushes D^3 D^4, respectively.

The outer end of the commutator-brushes C′ C^2 bear on opposite sides of the pole-changer, and the segments D′ D^2 are so shaped that when the pole-changer is moved away from its central position brush C′ is in contact with one segment and brush C^2 is in contact with the other segment.

E is a spur-wheel centered concentric with the axis of the pole-changer and meshing with a pinion E′ on the shaft of the motor.

F is a lever attached to the pole-changer and is provided with an arm adapted to play between lugs *e e′* on the spur-wheel E.

T is a dial-train adapted to record the amount of rotation of the armature-shaft in both directions.

All oscillating or rotating parts are accurately balanced on their centers. When the line *n n*, which bisects the angle between the lugs *e e′*, passes through the center of reversal—that is, the position occupied by the pole-changer at the moment of change (shown in Fig. 2)—the motor and wheel E are at the center of their alternating movement. As the lever F is moved only by one or the other of the lugs *e e′*, the reversal of current always takes place after the motor and wheel E have passed the center of movement.

Consider that the wheel E actuated by the motor is moving in the direction indicated by the arrow in Fig. 2. As the pole-changer passes through the position shown therein segment D′ is changed to brush C′ and segment D^2 to brush C^2, reversing the torque of the motor. The motor and wheel are gradually brought to a stop and started back in the direction indicated by the arrow in Fig. 3, leaving the lever F stationary until moved by the other lug e'. The force in the motor acts as an accelerating force through a greater arc than as a retarding force, the difference being equal to the angle between the lugs e e'. This excess accelerating force compensates the friction and load losses. The total arc of movement is proportional to the power expended, and for a constant value of the friction and load losses the summation on the dial may be calibrated to give a direct-reading record of the power being expended in the electric circuit in which the meter is connected.

It is to be observed that the current forces act on the moving masses of the meter alternately to accelerate and retard the movement and that the excess of accelerating force is obtained for the purpose of compensating the friction and load losses.

If the current force is increased while the angle between e e' remains fixed, the excess accelerating force is increased and is therefore able to drive the mass of the meter against the constant friction through a greater amplitude.

The size of the angle between the lugs e e' and the friction and load losses determine the total amplitude of movement for any given current force. By adjusting this angle the meter may be calibrated to give a unit reading on the dial for a unit of current force in a unit of time, or if the angle between e e' is fixed and preferably made as small as practicable for a minimum current force the instrument may be calibrated by varying the mass of its moving parts, so that the dial will show a unit reading for a unit current in a unit time.

The stops e e' are adjustably secured to the wheel E by set-screws e^2, so that the angle between said stops can be adjusted or varied as required.

On the back of the dial-train T a lever T' is mounted pivotally and carries a partially-beveled friction-wheel T^2, journaled on one end thereof. The square face of this wheel has a continuous friction connection with the shaft B', while the beveled face has a friction connection alternately with the beveled faces of the wheels T^3 T^4. The shaft T^5, on which the wheels T^3 T^4 are fixed, is lightly pivoted on the back of the dial-train and is provided with a pinion T^6, adapted to mesh with a gear T^7, mounted on the initial shaft of the dial-train. The operation of this mechanism is simple. As the shaft B' rotates in one direction the wheel T^2 is caused by friction against the shaft to swing on its pivotal lever T' until it comes in contact with and rotates the wheel T^3. When the shaft B' rotates in the opposite direction, the wheel T^2 is swung over until it comes in contact and rotates the wheel T^4 in the same direction that the wheel T^3 was rotated. The rotation of the shaft T^5 is therefore always in one direction, giving a continuous movement to the train and practically a summation of the alternating rotative movement of the motor and is independent of its direction of movement. The swing of the wheel T^2 between wheels T^3 T^4 is very small, as indicated in Fig. 5, and need be only sufficient for the wheel T^2 to clear one wheel while it is driving the other.

While I prefer mechanism substantially as shown and described for transforming the alternating rotative movement of the armature-shaft into a movement continuous in one direction, I do not limit myself to its use, as other well-known means for changing an oscillating, reciprocating, or alternating rotative movement into a movement continuous in one direction may be adapted to needs of my invention.

The dial-train may be any of the well-known forms which record the total movement of the initial or unit shaft and need not be described in detail.

The minimum movement of the wheel E is slightly greater than the arc between the stops e e', (sufficient to shift the segments D' D^2 between the brushes C' C^2,) while the maximum movement is about equal to a complete circle, the limit being reached when the downward-projecting arm of the lever F comes in contact with a bracket of the supporting-frame. By making the arc e e' small the minimum movement may be accomplished with a fractional turn of the motor, while the maximum movement will require several turns of the motor, depending upon the relative diameters of the spur-wheel E and pinion E'.

The objects attained by mounting the armature B on a shaft to one side and parallel to the axis of the pole-changer and providing the intermediate spur-wheel E and pinion E' for operating the pole-changer are twofold. The power of the motor to overcome friction in the pole-changer is greatly increased, and the minimum movement of the motor is sufficiently great to give a positive or perceptible movement to the mechanism of the dial-train.

While I prefer a proportion between the wheel E and pinion E' which makes it necessary for the motor to turn through several complete circles while turning the wheel E and pole-changer through a maximum arc less than one complete circle, I do not limit myself to the use of such a proportion. The diameter of the pinion E' might be made equal to or greater than the wheel E, in which case the maximum turn of the motor as well as the wheel E would be less than one complete circle and the parts might be said to oscillate through an arc whose amplitude varies with current force being measured.

I claim—

1. An electric meter consisting of an electric motor having an alternating or to-and-fro rotative movement, a pole-changer adapted to reverse the torque of the motor after it

has passed the center of movement, and a registering-train for recording the total movement of the motor, substantially as specified.

2. In an electric meter of the motor type, having a to-and-fro rotative movement whose amplitude of movement varies with the current being measured, the combination of a motor and a swinging or shifting pole-changer whereby the torque of the motor is reversed after it has passed the center of movement, substantially as specified.

3. A recording wattmeter consisting of a motor which is driven by the mutual action between currents in the coarse and fine wire coils, a pole-changer for reversing the current in one of these coils, the said pole-changer being provided with a predetermined amount of lost motion so that the reversal takes place after the motor has passed the center of its amplitude of movement, and a registering-train for summarizing the total movement of the motor, substantially as specified.

4. In an electric meter, whose amplitude of movement varies with the current being measured, the combination of a motor and a moving set of contact-segments for reversing the torque or action of the coils, the said contact-segments being provided with a predetermined amount of lost motion so that their movement lags behind that of the motor, substantially as specified.

5. A wattmeter balanced so as to be independent of gravitation, and consisting of a rotating motor, a shifting pole-changer or switch for reversing the motor so that it has a rotative movement to and fro through an arc varying with the current being measured, and a registering-train for recording the total movement of the motor.

6. In an oscillating electric meter, the combination of a rotating motor, an oscillating body driven by the motor, a pole-changer operated with oscillating body whereby the motor is reversed after the oscillating body has passed the center of its amplitude of oscillation, and a registering-train for summarizing the total movement of the motor, substantially as specified.

7. In a recording oscillating wattmeter in which the amplitude of oscillation is proportional to the power absorbed in the electric circuit during the time of oscillation, the combination of an actuating-motor and a pole-changer or reversing-switch adapted to reverse the motor after the oscillating parts have passed their center of amplitude, substantially as specified.

8. In a recording oscillating wattmeter in which the amplitude of oscillation is proportional to the power absorbed in the electric circuit during the time of oscillation, the combination with the actuating-motor adapted to rotate to and fro, of reversing mechanism whereby the actuating force in the meter acts as an accelerating force through a greater arc than as a retarding force, substantially as specified.

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Witnesses:
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D. BARSTOW.