

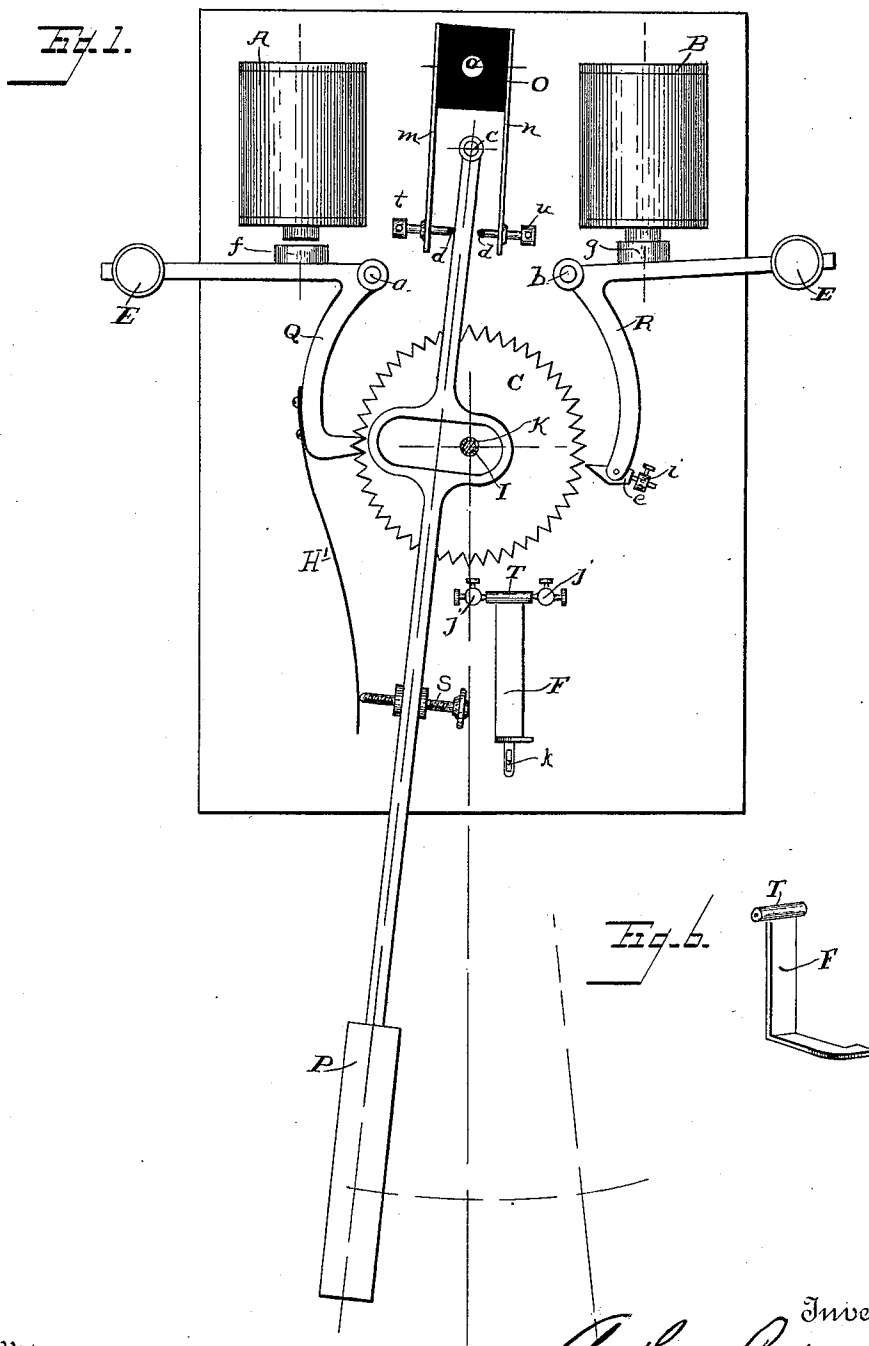
(No Model.)

4 Sheets—Sheet 1.

A. RECKENZAUN.
ELECTRIC METER.

No. 463,711.

Patented Nov. 24, 1891.



Witnesses
C. E. Hunt.
Alfred T. Gage.

Inventor
Anthony Reckenzaun
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his Attorney.

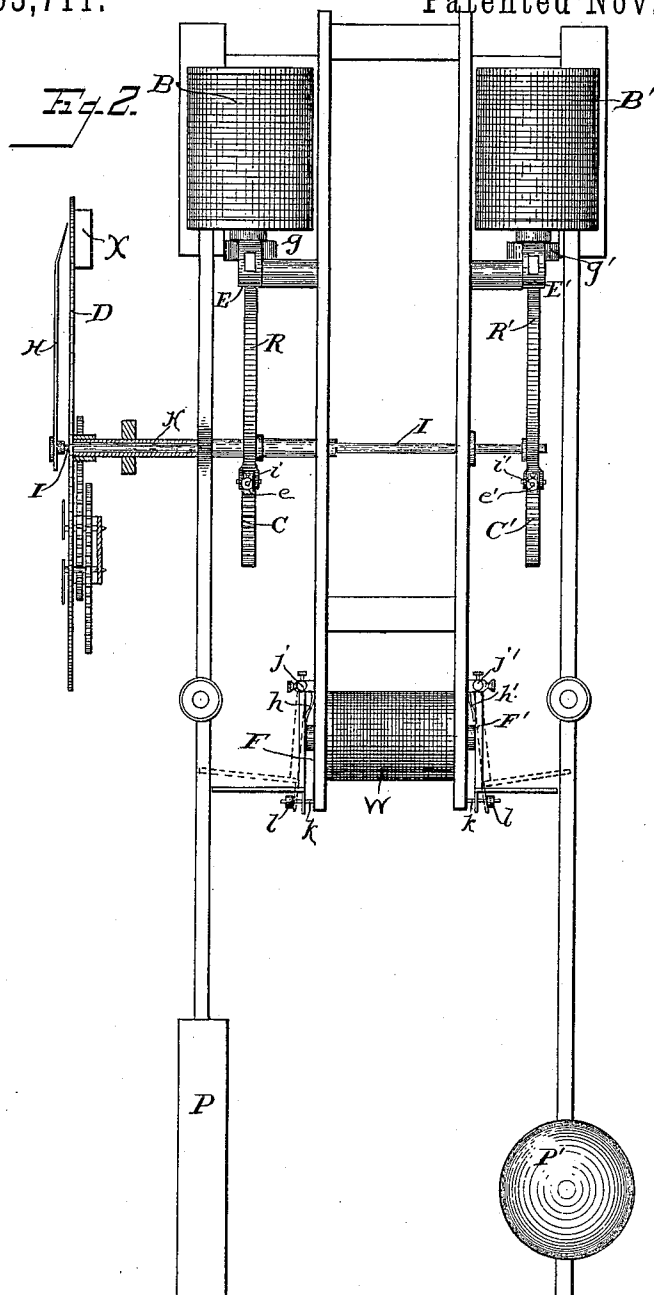
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4 Sheets—Sheet 2.

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(No Model.)

4 Sheets—Sheet 3.

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Fig. 3.

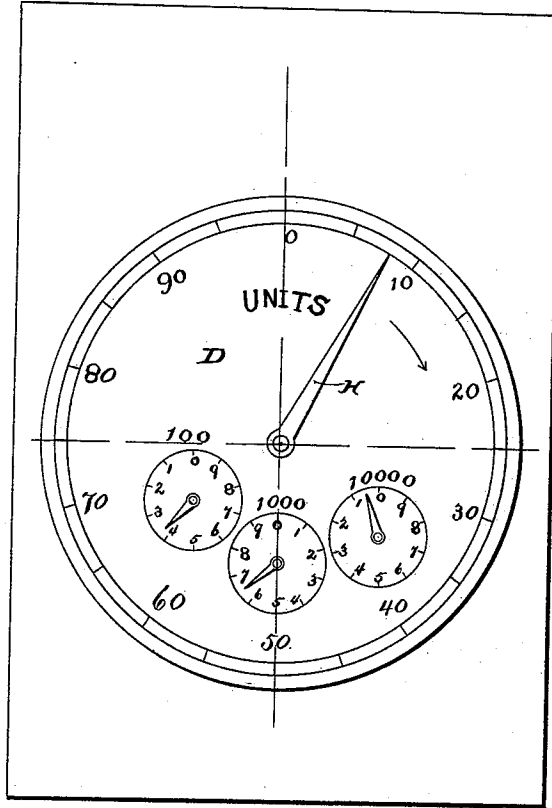
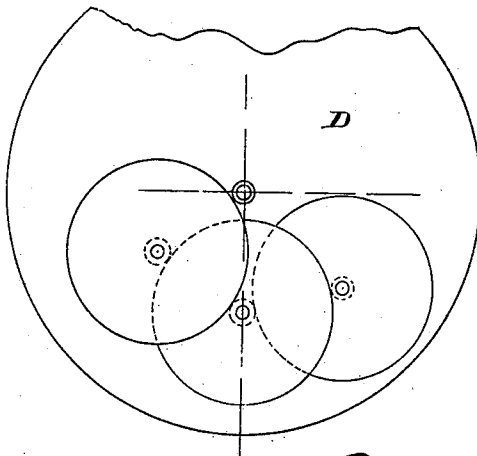


Fig. 4.



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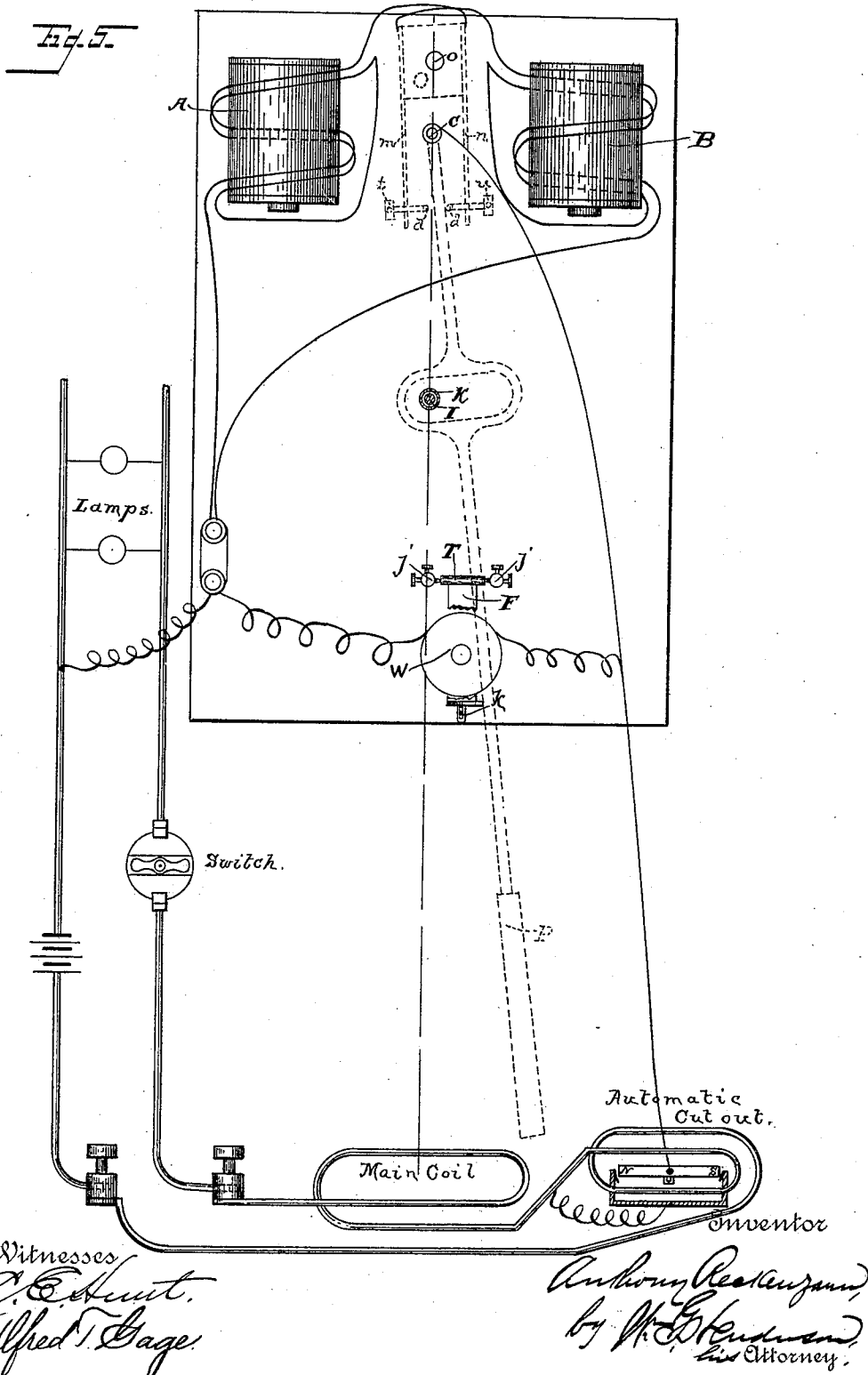
(No Model.)

4 Sheets—Sheet 4.

A. RECKENZAUN.
ELECTRIC METER.

No. 463,711.

Patented Nov. 24, 1891.



UNITED STATES PATENT OFFICE.

ANTHONY RECKENZAUN, OF LONDON, ENGLAND, ASSIGNOR OF ONE-HALF
TO JAMES A. PENTZ, OF PHILADELPHIA, PENNSYLVANIA.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 463,711, dated November 24, 1891.

Application filed November 1, 1890. Serial No. 370,033. (No model.)

To all whom it may concern:

Be it known that I, ANTHONY RECKENZAUN, a subject of the Queen of Great Britain, residing at London, in the county of Surrey, England, have invented certain new and useful Improvements in Electric Meters; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to improvements in apparatus for measuring electric currents and for registering currents and time. It is an improvement upon those for which I have applied or obtained Letters Patent in the United States of America.

In the application for one patent I described a method of driving a pendulum by means of specially-constructed electro-magnets and cause rotary motion to a spindle through work done by the pendulum.

The improved method, which I am about to describe with the aid of drawings, dispenses with the necessity of imparting rotary motion through the momentum acquired by a pendulum. In fact, in the present case the said pendulum is almost entirely free, and serves solely for the purpose of periodically making and breaking contact with the coils of electro-magnets. These electro-magnets lift alternately arms or levers, which engage in the teeth of a star-wheel and cause the latter to revolve at a speed corresponding to the swings of the pendulum, the work being done at the instant when the levers are free to fall by gravity. Gravity in this case is a constant force, and variations in the electro-motive force of the supply-current for magnetization can in no way influence the constancy of rotation. One of these arms has a prolongation in the form of a spring which touches the pendulum at each return swing, and thus keeps it in motion. This is done during the downward movement of the lever, so that in this case also gravity alone comes into play. I provide means for automatically stopping and starting the pendulum, means

for suppressing sparks at the moment of breaking circuit, and means for registering the speed of one or more pendulums or the difference in their speeds.

In the accompanying drawings, Figure 1 represents the front elevation of the apparatus. Fig. 2 is a side elevation showing two movements with attachments to counter. Figs. 3 and 4 show the dial carrying the gear and hand, and Fig. 5 explains in diagrammatic form the electric circuits and spark-suppressing device. Fig. 6 is a perspective of the projection or stop F.

Referring to Fig. 1, it will be seen that the pendulum P is freely suspended by any suitable pivot, as at *c*, and it has no work to do except to carry with it or move the contact-strips *m n*, which swing through a very small arc and offer negligible resistance. These contact-strips are fastened to an insulating-block O, pivoted at *o*. At the lower extremity of the strips *m* and *n* (which are of metal) are adjustable set-screws *t* and *u*, provided with platinum points, as indicated by *d*. These screws come alternately in contact with the pendulum and open or close the circuit of wire round the electro-magnets A and B, the wires and their connections being omitted in Fig. 1, but illustrated in Fig. 5. Underneath the iron cores of A and B are iron armatures *f* and *g*, each of which is rigidly attached to a lever Q and R, both of which levers may have weights E. The lever Q is pivoted at *a*, and, as represented on the drawings, it has just dropped off its magnet, engaged with a tooth in the star-wheel C, and its spring H' has just met the pendulum, say, through the adjustable screw S, as it completed its forward swing. The upper part of the pendulum is touching screw *t*, which made circuit with bobbin B and lifted the lever R, pivoted at *b*. Owing to momentum and the slight tap given by Q, the pendulum will make its return swing, break circuit at *t*, and after a moment's perfect freedom (during which both levers hold the star-wheel) it will touch screw *u* and cause a flow of current round magnet A. At this instant lever Q is raised, disengages from the star-wheel C, and lever R drops, carrying wheel C one tooth forward,

the lower part of the lever R being shaped in a manner—as, for instance, by the pivoted pawl *e*, which may have an adjusting-weight *i*—to effect this movement. There is just sufficient friction at O, so that the fork formed by the strips *m* and *n* easily follows the movement of the pendulum and remains in any position within the limits of its swing if not touched. The whole mechanism will keep in motion as long as energy is supplied to the electro-magnets A and B. Immediately the supply is stopped the pendulum, in its endeavor to complete its return swing, is caught by a projecting piece or stop F, Figs. 1 and 2. This projecting piece has been held clear of the pendulum by an electro-magnet W, which is in a shunt-circuit, as illustrated in Fig. 5, all the time the meter is at work, and only releases its armature, which is the stop F, when the supply of current ceases. The armature-stop F, when the magnet W is demagnetized, is pushed out by a spring, as *h*, against the pendulum, as indicated by dotted lines in Fig. 2 and full lines in Fig. 5, which remains in a slanting position, as indicated by dotted lines in Fig. 5, ready to recommence its swing when released by the stop F. The inner edge of the projecting piece or stop F nearest the center line of the drawings is cut away at an angle, as illustrated in Fig. 6, so as to allow the pendulum to slide over or past it until it is caught by the projection or stop. The stop F may be suspended or supported in any suitable way. For instance, it may have a cross-arm *T*, having pivotal bearings in the boxes *j*, and its lower portion may be bent out at right angles to its vertical portion and its end bent sideways, as illustrated in Fig. 6. A pin *k*, projecting from the frame of the apparatus, may extend through the lower portion of the armature-stop, and be provided with a set or adjusting screw *l* to limit the movement of the stop.

In Fig. 2 of the drawings there is shown two sets of mechanism identical in every respect, excepting the spindles and pendulums. The letters in each view correspond, except that on one side they are primed, and the description of one will answer for both, with the exceptions that may be noted. On the star-wheel C is fixed a hollow spindle K, which carries at its outer extremity a dial D, which rotates with spindle K. To the star-wheel C' is fixed a solid spindle I, which fits easily in the hollow spindle K, but projects beyond it and carries the hand H. Both the dial and the hand rotate in the same direction, and if both pendulums swing at the same speed the dial D and the hand H will move together as if they were connected. If, on the other hand, pendulum P' is accelerated by some external force, then hand H must gain upon dial D, and the ratio of this acceleration can be read off the divisions of the dial. Instead of being accelerated, the pendulum P' may be retarded, in which case the hand will lag be-

hind the dial, or both pendulums may be influenced by external force, if desirable, and the differences recorded. Figs. 3 and 4 of the drawings show the dial and multiplying gear attached to the dial, and which need not be particularly referred to and described, as it may be of well-known construction. In this instance it is carried by the dial D, as illustrated. The weight of this gear is counter-balanced by the weight X on the opposite side of the disk, and for convenience' sake the divisions are multiples of the number ten. The bob of pendulum P' may be made of magnetic material, or it may be a coil of wire, moving in the vicinity of another coil, through which the main current (to be measured) flows. The principle of accelerating or retarding pendulums or balance-wheels (the equivalent) by means of electric currents is old. It has been applied by Watkin in or about the year 1838 and by Professors Ayrton and Perry in 1882. Therefore I lay no claim upon this part of the invention, except in combination with the devices herein described. The acceleration or retardation, as is well known, is proportional to the current flowing. Consequently with my pendulums the indications on the dial are the product of time and current, each division representing one or more ampere-hours or lamp-hours.

In Fig. 5 of the drawings there is represented in diagram the electrical connections. Magnets A and B are wound with thin wire of high resistance and form a "shunt" to the main circuit. Each bobbin is wound with a pair of wires of equal length and section; but only one of these wires is used for magnetizing the iron core, the other being closed upon itself, and the object of the latter is to oppose the secondary current at the moment of breaking circuit, thus suppressing the spark, which otherwise would occur between the contact-screws and pendulum. This drawing shows the pendulum at rest, leaning against the projecting piece or stop F. Below the pendulum will be seen the "main coil." For clearness' sake this is represented in plan and with only a single turn of thick wire. This main coil influences the speed of one pendulum, and it is in series with another smaller coil actuating an automatic cut-out. This cut-out consists of a permanent magnet NS, pivoted in the center and free to deflect and make contact with a bent metal strip. Directly the current is turned on to one or more lamps, the magnet NS will close circuit and cause a fraction of this current to circulate around the electro-magnet W, which pulls back the stop F and releases the pendulum. Simultaneously by virtue of metallic contact between pendulum P and contact *u* another fraction of the main current must flow around coil A, energize the magnet to lift lever Q, which is then ready to strike pendulum P, when it commences its return swing, the current being again cut off at *u* and circuit made through *t* when magnet B is energized and

lever R lifted. When the current in the main is entirely interrupted, the automatic cut-out breaks circuit, and the stop F is released by magnet W and catches the pendulum at the moment it swings past it. Magnet W forms a very high resistance-shunt and uses only a small fraction of an ampère. The main coil is of low resistance, and is made to carry as much current as the lamps, motor, &c., require.

I have illustrated one construction and arrangement of parts by which my invention can be carried into effect; but the details of the several parts may be infinitely varied to carry out the invention, and I wish it distinctly understood that I do not restrict myself to such details.

Having now particularly described and ascertained the nature of my invention and in what manner the same is to be performed, I declare that what I claim is—

1. An apparatus for measuring electric currents or the product of time and currents, comprising indicating mechanism, electro-magnets, gravitating means intermediate of said magnets and indicating mechanism and acting by gravity to move said indicating mechanism, and a member periodically making circuit with said magnets in alternation for energizing them to lift said gravitating means, substantially as and for the purposes set forth.

2. In an apparatus for measuring electric currents, the combination of the dial and the hand moving independent of each other, the electro-magnets, gravitating means intermediate of said magnets, dial and hand moved by said magnets and acting by gravity to move said dial and hand, and a gravity-acting member periodically making circuit with said magnets in alternation for energizing them, substantially as and for the purposes set forth.

3. In an apparatus for measuring electric currents, the combination of two pendulums, electro-magnets with which said pendulums make periodic circuit, arms or levers lifted by said magnets, and rotatable mechanism acted on by said levers when falling to impart rotary motion.

4. In an apparatus for measuring electric currents, having two pendulums making periodic circuit for the purpose of producing rotary motion, and two concentric spindles dependent upon said pendulums for motion, both revolving in the same direction, one carrying a dial and the other a hand, thereby registering the differences in speed between the two pendulums.

5. In an apparatus for measuring electric currents, having two pendulums making periodic circuit, and two concentric spindles dependent upon said pendulums for motion, one being solid and provided with a hand at its extremity, the other hollow and carrying a graduated dial, to which multiplying gear is attached and revolves with it.

6. In an apparatus for measuring electric currents, the combination of two pendulums making periodic circuit, and electro-magnets with which they make the circuit, the coils of which magnets are wound with two equal lengths of wire, one of which coils has its ends joined, thereby suppressing sparks usually set up by secondary currents at the moment of breaking circuit.

7. In an apparatus for measuring electric currents, the combination, with two pendulums making periodic circuit, electro-magnets with which they make the circuit, the speed of one or both pendulums being influenced by a coil which carries the main current, power-imparting levers, a stop for said pendulums, and a magnet influencing said stop, of an automatic device for making and breaking the shunt-current through the electro-magnets actuating the levers, as well as the current in the electro-magnet holding the pendulums when the apparatus is intended to be at rest.

8. In an apparatus for measuring electric currents, the combination, with a gravity-acting member periodically making circuit and electro-magnets with which it makes circuit for energizing the same in alternation, of a movable stop holding said gravity-acting member in position to move by gravity when released from the stop, and a magnet for moving said stop to release said member when the current is on, substantially as and for the purposes set forth.

9. In an apparatus for measuring electric currents, the combination, with an electro-magnet and a member making periodic circuit therewith for energizing the same, of an indicating or registering device and a device moved in one direction by said magnets and in the other by gravity to impart motion to said indicating or registering device, substantially as and for the purposes described.

10. In an apparatus for measuring electric currents, the combination, with an electro-magnet and a gravity member making periodic circuit therewith for energizing the same, of a device intermediate of said magnet and gravity member moved in one direction by said magnet and in its return movement exerting a pressure upon said gravity member to assist its return swing, substantially as and for the purposes set forth.

11. In an apparatus for measuring electric currents, the combination, with an electro-magnet and a gravity member making periodic circuit therewith for energizing the same, of a device intermediate of said magnet and gravity member moved in one direction by said magnet and having a portion thereof constituting a spring to bear against a part of said gravity member to exert a spring-pressure on said member to assist its return swing, substantially as and for the purposes set forth.

12. In an apparatus for measuring electric currents, the combination, with the electro-

magnets, of the contact-points pivoted to move
back and forth in the arc of a circle and the
gravity member alternately bearing against
one contact-point and then the other for ener-
5 gizing said magnets, said contact-points be-
ing moved by said gravity member, substan-
tially as and for the purposes set forth.

In testimony whereof I affix my signature in
presence of two witnesses.

ANTHONY RECKENZAUN.

Witnesses:

FRANCIS W. FRIGOUT,
A. G. BROPONT.