(No Model.)

2 Sheets—Sheet 1.

M. KOECHLIN.

ELECTRIC METER.

No. 458,755. Patented Sept. 1, 1891.

Fig. 2.

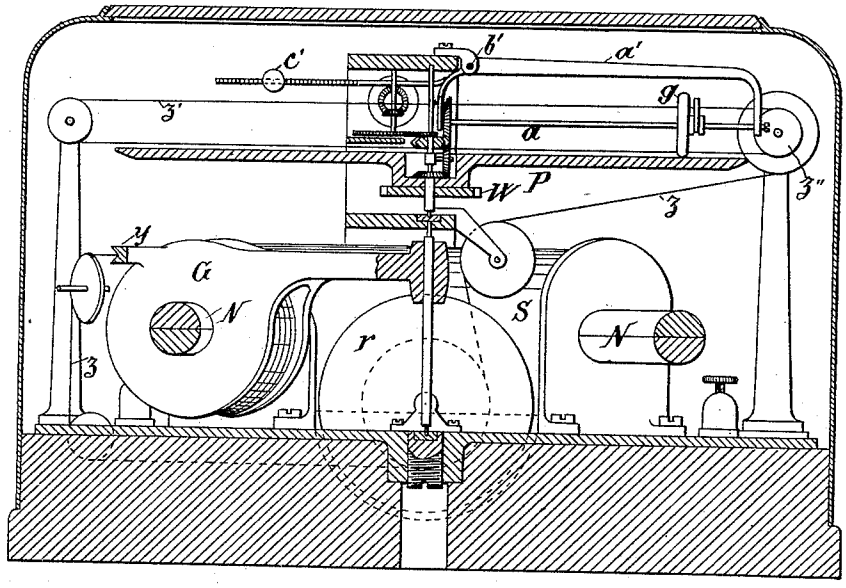


Fig. 1.

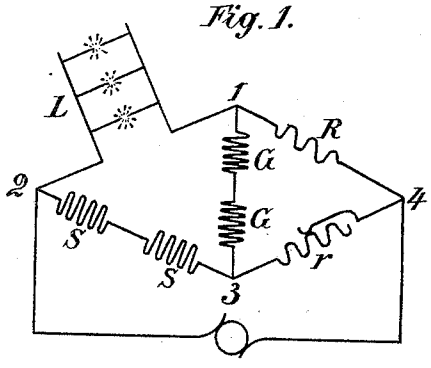
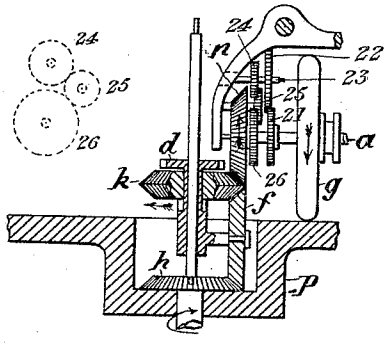


Fig. 6.



WITNESSES:

John Becker

Fred White

INVENTOR:

Maurice Koechlin,

By Arthur O. Fraser & Co.

Attorneys.

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

(No Model.)

2 Sheets—Sheet 2.

M. KOECHLIN.

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Fig. 3.

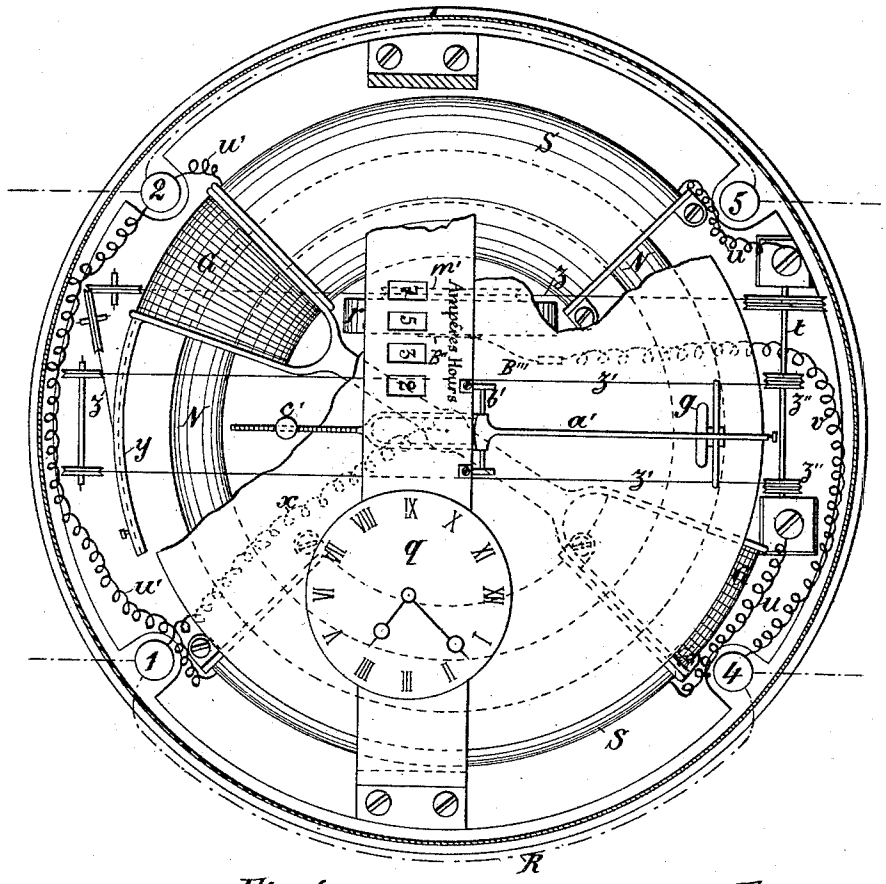


Fig. 4.

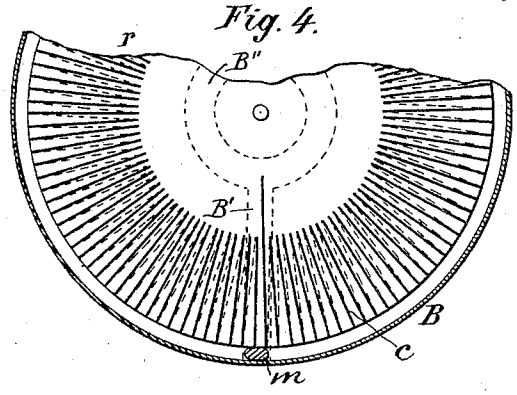
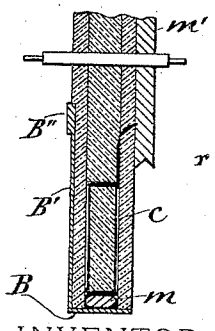


Fig. 5.



INVENTOR

Maurice Koechlin,

By Arthur O. Fraser & Co

Attorneys.

WITNESSES:

John Becker

Fred White

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

UNITED STATES PATENT OFFICE.

MAURICE KOECHLIN, OF BELFORT, FRANCE.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 458,755, dated September 1, 1891.

Application filed October 16, 1890. Serial No. 368,265. (No model.)

To all whom it may concern:

Be it known that I, MAURICE KOECHLIN, a citizen of the French Republic, residing in Belfort, France, have invented certain new and useful Improvements in Electric Meters, of which the following is a specification.

This invention relates to an electric meter which is based on the principle of the Wheatstone bridge.

Figure 1 of the accompanying drawings is a diagram of a Wheatstone bridge, illustrating the circuits of my improved meter. Fig. 2 is a vertical mid-section of the meter. Fig. 3 is a plan thereof with the case in horizontal section and the internal structure partly broken away. Fig. 4 is an enlarged fragmentary vertical section of the variable rheostat. Fig. 5 is a fragmentary vertical axial section thereof; and Fig. 6 is a fragmentary section on a large scale, showing the details of a portion of Fig. 2.

Referring to Fig. 1, which shows a Wheatstone bridge with a branch circuit L containing the lamps of the subscriber introduced as one of the branches of the bridge, S S are the coils of two solenoids forming resistances, R is a fixed rheostat absorbing in the lamp-circuit less than one-half a volt, r a variable rheostat, and G G two solenoids forming the galvanometric branch. If the relation of the resistances is such that $\frac{L}{S}=\frac{R}{r}$, no current will circulate in G G; but if the relation is modified by the variation of the resistance of the lamps in L a current will circulate through G in one direction or the other, according as the resistance L is increased or diminished. In my electric meter the solenoids S S excite a soft-iron core N, in the field of which two solenoids G G are movable. It results from this that if the equilibrium of the bridge is broken the solenoids G G are repelled or attracted, and by their movement alter the resistance of the rheostat r to such extent that the equilibrium is again established. The solenoids are connnected together, and being preferably of equal weight each counterbalances the other. At the same time that this movement occurs a roller g, movable on a circular table P, turning under the action of a clock-work, is moved correspondingly to a new position. The table P is turned by the wheel W. The roller g is mounted to slide along an arbor a, to which it is rotatively connected by a spline or feather. This arbor a drives the wheels of the counter or totalizer. Binding-posts 1 and 2, Figs. 1 and 3, communicate with the lamp-circuit L, while the binding-posts 4 and 5, Fig. 3, are in communication with the line or source of electricity. The binding-posts 5 and 2 are electrically connected in any manner. The rheostat R is formed of a ribbon of German silver, connected between the binding-posts 1 and 4.

The variable rheostat r is arranged in such manner that for equal mechanical displacements it gives equal variations of resistance. To this end, Figs. 4 and 5, this rheostat is formed of three disks of vulcanized fiber. The middle disk, which is of a smaller diameter than the others, is formed with regular teeth, as also with a circular series of holes. Between the teeth and the holes is wound a spiral of iron wire c, of which one extremity is disconnected, while the other is in communication with the metallic pulley m'. The two outer disks are connected by a sheet-iron ribbon B. A drop of mercury m is imprisoned in the remaining space. It is obvious that by the rotation of the disks the drop of mercury remains always at the lowest point and varies the interposed resistance—that is to say, the length of the iron wire c, over which the current passes in flowing between the pulley m' and the iron ribbon B. The rotation of the disks is effected by means of wires or cords $z\,z'\,z'$ and of pulleys driven by the solenoids G G. These same cords drive also the roller g. The movements of the roller are consequently proportional to those of the rheostat r, and hence inversely proportional to the resistances of the lamps L. As the roller travels farther from the center of the table, its speed of rotation increases in the same ratio. In order to avoid placing the roller at the center of the table when the consumption falls to zero, which would prevent mounting the table between pivots, and would also wear facets on the roller, it is given a differential movement in the manner represented in Fig. 6. This differential movement is imparted by a planet-gear so arranged that the movements of the totalizer shall be equal to the difference between the speed of this roller

and of the table. In this manner, when the roller is at a distance from the center equal to its own radius, the totalizer rests motionless, while the roller still turns on itself. The small wheel d, which turns with the intermediate wheel f, drives the wheels of the totalizer. The wheel h turns with the table and the wheels k and n with the roller. The roller g turns the arbor a, on which is fixed a gear-wheel 21, which drives a gear 22 on an arbor 23, on which is fixed a gear 24, which through an idler-gear 25 drives a gear 26, fixed to the gear n, which turns loosely on the arbor a. Thus the gear n is turned in the opposite direction to the roller g, but at the same speed, and it drives the gear k, which meshes with the planet-gear f, which it tends to drive in one direction, while the gear h tends to drive it in the other. When the roller g is as near the center as it can go, the wheel k is driven at the same speed as h, but in the contrary direction, so that f merely revolves idly between them and does not travel around, and consequently does not drive the totalizer. A clock-dial is provided to give assurance of the correct running of the clock-work, and in case of its derangement to afford means for correcting the reading of the totalizer.

In order to complete the description of my meter, I have yet to indicate how the electric connections are established between the several elements of my meter, in order that these connections may realize the results of the Wheatstone bridge represented diagrammatically in Fig. 1. These connections are made as follows: The binding-post l is connected to the lamp-circuit L, as also to the rheostat R, and leads the current by means of a flexible conductor x to the two coils G G, connected in series, and the current passes out from the second of these coils by the frame of the latter and through an arm y, projecting from this frame and provided with a groove, in which is fixed the end of the wire z, which consists of a silver wire. By this wire, which passes over the conducting-pulley m' of the variable rheostat r, the current is led on the one hand into the wire c of this rheostat and passes by the drop of mercury m, the metal ribbon B, a metallic band B′, Fig. 5, a conducting-ring B″, and a brush B‴, Fig. 3, into the conductor v, connected to the binding-post 4, and on the other hand into the axis t, carrying the pulleys, and passes by the supports of this axis and the conductors u u into the fixed solenoids S S, connected in derivation through the wires u' u' to the binding-post 2. The contact of the silver wire z with the pulley m' of the variable rheostat constitutes, consequently, the point of bifurcation 3 of the diagram represented in Fig. 1.

As seen in Fig. 3, the sliding movement of the roller g on the arbor a during the displacement of the coils G G is imparted by the rotation of the endless wires z' z', driven by the pulleys z'' z'', fixed on the axis t, whenever this axis is turned under the influence of the movements of the wire z. The arbor a, which carries the roller g, is carried by a support a', pivoted at b', Fig. 2, to the frame of the meter and provided with an arm carrying a counter-weight c' in such manner that by the adjustment of this counter-weight the pressure exerted by the roller g against the table P may be regulated at will.

It will be understood that this resistance-integrating apparatus may be used in series installations as well as in those in derivation.

It must not be inferred from the detailed illustration and description of the preferred form of my improved meter that I have given that my invention is limited to the specific details set forth. The construction may be modified in many ways without departing from the essential features of the invention.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is the following-defined novel features and combinations, substantially as hereinbefore specified, namely:

1. An electric meter comprising a Wheatstone bridge, one branch of which includes the circuit the current on which is to be measured and another branch of which includes a variable rheostat, combined with an electromotive device in the galvanometric branch of the bridge, and a connection between the movable member thereof and said rheostat, whereby whenever the equilibrium is disturbed the consequent movement of said member alters the resistance of said rheostat until equilibrium is restored and the position of said member becomes an indication of the current to be measured.

2. An electric meter comprising a Wheatstone bridge, one branch of which includes the circuit the current on which is to be measured and another branch of which includes a variable rheostat, combined with an electromotive device in the galvanometric branch of the bridge, a connection between the movable member thereof and said rheostat, whereby whenever the equilibrium is disturbed the consequent movement of said member alters the resistance of said rheostat until equilibrium is restored, and a counting mechanism constructed to progress at a rate proportional to the displacement of said member, whereby its total increases in the same ratio as the total consumption of electric energy in said circuit.

3. In an electric meter, the combination of a circuit divided into two branches, one of which includes the circuit the current on which is to be measured, a variable rheostat, an electro-motive device responding to the differential current between said branches, with its movable member connected to said rheostat, whereby whenever it is moved by a differential current it alters the resistance of said rheostat to restore an equilibrium, and a counting mechanism constructed to progress at a rate proportional to the variations in re-

sistance of said rheostat, whereby its total increases in the same ratio as the total consumption of energy to be measured.

4. In an electric meter, the combination, as an electro-motive device, of an iron core, fixed coils for magnetizing it, and a movable coil mounted to move along said core and balanced so as to be in equilibrium in any position.

5. In an electric meter, the combination, as an electro-motive device, of a circular iron core, coils of wire inclosing said core for magnetizing it, a pivoted frame mounted to turn on an axis concentric with and perpendicular to said core, and counterbalanced movable coils of wire inclosing said core and supported by said frame, whereby they are movable along said core by a current through them in either direction.

6. In an electric meter, a variable rheostat consisting of rotatively-mounted insulating-disks, a coil of resistant wire carried thereby, exposed on its outer side, a mercury contact at the lower side of the disks with which the lowermost convolutions of said coil make electric connection, an electric conductor in connection with the mercury contact, and a conductor in connection with one end of said coil, whereby as the disks are turned more or less of the resistance-coil is interposed through the mercury between said conductors.

7. In an electric meter, a variable rheostat consisting of rotatively-mounted insulating-disks constructed to form an inclosed annular space containing a drop of mercury, a coil of resistant wire carried by said disks and exposed at its outer side in said space, and an annular conductor communicating with the drop of mercury, consisting of a metallic rim carried by said disks.

8. In an electric meter, the combination of an electro-motive device consisting of fixed and movable solenoids, a grooved arm *y*, carried by the movable solenoid, a variable rheostat constructed to vary its resistance by a rotative movement and formed with a grooved pulley, and a cord connecting said solenoid and rheostat, winding on said grooved arm and pulley.

9. In an electric meter, the combination of an electro-motive device responding by changes of position of its movable member to changes in current, a counting mechanism consisting of a totalizer, a frictional roller for driving it, a uniformly-revolving disk or table for rotating said roller, and a connection between said movable member and roller acting to displace the roller radially of the table as the movable member assumes a new position, and a differential gear interposed between the roller and totalizer, transmitting to the totalizer a movement equal to the difrence between the rotative speeds of the table and roller, whereby the roller at zero does not move to the center of the table and the consequent wearing of facets on the roller is avoided.

10. In an electric meter, the combination of an electro-motive device responding by changes of position of its movable member to changes in current, a counting mechanism consisting of a totalizer, a frictional roller for driving it, a uniformly-revolving disk or table for rotating said roller, and a connection between said movable member and roller acting to displace the roller radially of the table as the movable member assumes a new position, and a differential gear interposed between the roller and totalizer, consisting of a wheel driven in one direction by the table at a uniform speed, a wheel driven in the opposite direction by the roller at a varying speed, the minimum of which equals the speed of the table-driven wheel, and a planet-gear interposed between said wheels and traveling around an axis at a speed proportional to the difference between the speeds of said wheels and said axis connected to and directly driving the totalizer.

11. The combination to form an electric meter of an invariable rheostat, a variable rheostat, an electro-motive device consisting of an iron core and fixed and movable solenoids in inductive relation with said core, said rheostats and solenoids being connected in branch circuits according to the Wheatstone bridge, a connection between the movable solenoids and the variable rheostat for varying the resistance of the latter upon the movement of the solenoid due to a disturbance of the balance of resistances until the variation of resistance restores the equilibrium, and a counting mechanism consisting of a uniformly-revolving disk or table, a frictional roller driven thereby, a connection between the movable solenoids and said roller acting to shift it radially of the disk upon the movement of the solenoids to a new position, whereby the roller is driven at varying speeds, and a totalizer driven from the roller.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

MAURICE KOECHLIN.

Witnesses:
GEORGE GIFFORD,
AMAND RITTER.