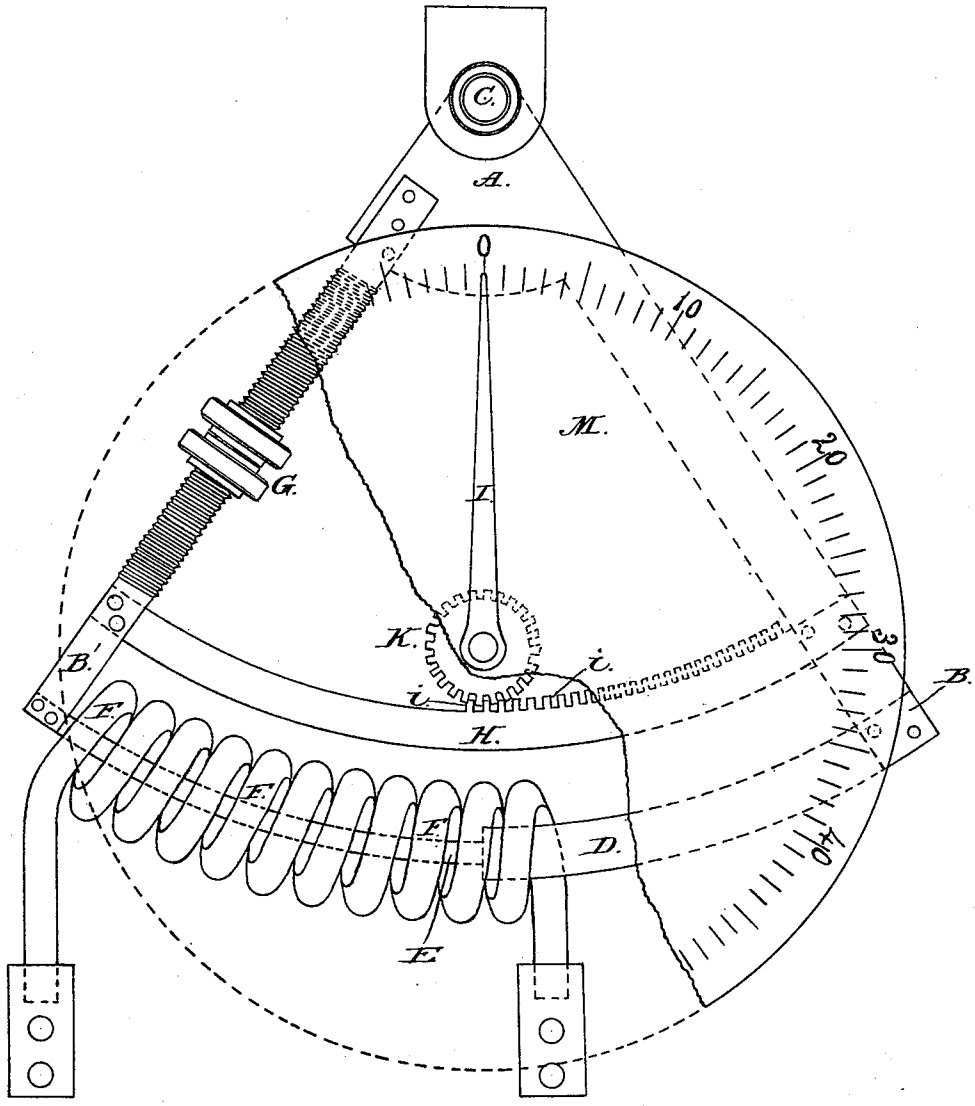
(No Model.)

M. WADDELL.

ELECTRIC CURRENT INDICATOR.

No. 353,649. Patented Nov. 30, 1886.



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MONTGOMERY WADDELL, OF COBOURG, ONTARIO, CANADA, ASSIGNOR TO HIMSELF AND WILLIAM S. ANDREWS, OF NEW YORK, N. Y.

ELECTRIC-CURRENT INDICATOR.

SPECIFICATION forming part of Letters Patent No. 353,649, dated November 30, 1886.

Application filed April 8, 1885. Serial No. 161,559. (No model.)

To all whom it may concern:

Be it known that I, MONTGOMERY WADDELL, of Cobourg, in the Province of Ontario and Dominion of Canada, have invented a new and useful Improvement in Electric-Current Meters; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawing, and to the letters of reference marked thereon, making a part of this specification.

My invention relates to an automatic current or Ampère meter for measuring an electric current.

It consists of a pendulum in the form of a quadrant or sector having a curved bar of soft iron projecting from the lower end of one of its arms in an arc having the pivot of the pendulum as its center, and of a fixed rigid coil, preferably of copper wire, curved in an arc whose radius corresponds to that of the arc described by the iron bar, and which is mounted in front of said bar, so that the latter may swing freely in and out of the coil when vibrating upon its axis. When the coil is included in an electric circuit, the vibrating bar will be drawn more or less into the coil by the attraction of the current, and the extent of the movement thereby imparted to the pendulum will afford an accurate indication of the intensity of the current.

The use of a pendulum for carrying the curved solenoid-core makes the meter or indicator sensitive, accurate, and uniform in its action, and causes it to maintain its position at zero by being at that time in a condition of stable equilibrium. The pendulum is also provided with a weight, adjustable, so as to change its center of gravity. The effect of the adjustment of this weight is to vary the normal or zero position of the pendulum and to adjust the initial relation of the solenoid-core with the stationary coil. The curved solenoid-coil, which attracts the core formed by the curved bar of soft iron, is composed of open rigid convolutions of bare metal held apart by their rigidity and insulated from each other only by the intervening air-spaces. This enables the coil to be connected directly in the main line of the circuit the current of which is to be measured or indicated without a detrimental waste of current. This feature adds largely to the sensitiveness of the instrument, and, in connection with a pendulous curved core and an adjustable weight for changing the center of gravity of the pendulum, makes a highly efficient instrument for current indication.

In the accompanying drawing, A B B′ represent a frame or pendulum in the form of a sector, which is pivoted at its angle C, so as to swing with the utmost freedom in a vertical plane.

The pivotal suspension of the sectoral frame is made as delicate as possible, so that it shall vibrate under the least impulse. A bar, D, of soft iron is fixed to the lower end of one of the side bars, B, of the pendulum, so as to project therefrom toward the opposite side bar, B′, in a curve constituting an arc having the pivot C at its center. This iron bar projects about midway between the extremities of the bars B B′, and is there preferably joined to a rod, E, of brass or other non-magnetic material, which, extending in the same arc, connects it to the opposite arm of the pendulum.

F is the solenoid-coil, intended to be connected directly in the main line of the circuit, and composed of bare copper wire sufficiently large to form open rigid convolutions, the coil being of low resistance and maintaining its shape and the separated condition of its convolutions by its rigidity. It is large enough to encircle the whole length of the copper rod, and to terminate at or about the point of its juncture with the iron rod. The internal diameter of this coil F is large enough to permit the soft-iron rod or core D to swing freely into it without contact. The non-magnetic supporting-rod E may be dispensed with, leaving the end of the iron core D to project free into the coil F, the coil being curved in an arc corresponding with that described by the core D, so that the latter may swing freely into the coil.

The vibration of the pendulum may be indicated by means of a pointer or index-finger fixed upon the transverse bar H of the frame, so as to move with the pendulum over a scale fixed beneath it; or a rack, *i i*, may be formed upon the edge of said bar H, to engage a pinion, K, rotating upon a fixed arbor, and an

index-pointer, L, be fixed to the pinion to project therefrom and sweep over the face of a dial, M, having a suitable scale marked upon its periphery, whereby the least movement of the pendulum is made apparent and is readily measured.

For the purpose of adjusting the pendulum or frame A B B′ so that the end of the core D shall barely enter the coil F when the pendulum is at rest and its index is at the zero-point of the scale, one of its arms, B′, may be threaded to carry a counterbalance-weight in the form of a nut, G, which is adapted to screw up or down upon the arm, and whose position will determine the center of gravity of the pendulum.

In the use of the device the coil F is placed in the electric circuit whose current is to be measured. The attraction of the electric current for the iron bar D will cause it to be drawn into the coil more or less, according to the intensity of the current, and the consequent oscillation of the pendulum, as indicated upon the scale, will afford a measure thereof. The position of the pendulum when it is at rest and there is no current in the circuit serves to indicate the zero or initial point for the scale.

I am aware that it has been proposed to produce a recording electric meter by the employment of a traveling recording-sheet moved by clock-work, and that it has been proposed to vary the position of a style laterally of such traveling recording-sheet by means of two curved solenoid-cores attached to the opposite ends of a centrally-pivoted horizontal arm or walking-beam and acted on by two curved solenoid-coils, the cores being retracted to the zero-point by a coiled spring, and the coils in attracting such cores being opposed by the retracting force of the said coiled springs; but with such an instrument it is evidently immaterial whether the cores work in a vertical plane or in a horizontal plane, and the instrument, in fact, instead of being a pendulum instrument, like mine, is simply a pivoted core attracted by a coil and retracted by a spring, which has never been found a practical form of apparatus for current indication.

I claim as my invention—

1. In a electric-current meter or indicator, the combination, with a pendulum, of a horizontally-projecting curved solenoid-core carried by such pendulum and a curved coil in an electric circuit acting upon such core, substantially as set forth.

2. In an electric-current meter or indicator, the combination, with a pendulum in the form of a sector, of a horizontally-projecting curved solenoid-core carried by such pendulum and a curved coil in an electric circuit acting upon such core, substantially as as set forth.

3. In an electric-current meter or indicator, the combination, with a pendulum, a horizontally-projecting curved solenoid-core carried by such pendulum, and a curved attracting-coil, of a weight carried by such pendulum, and adjustable, so as to change the center of gravity of such pendulum, substantially as set forth.

4. In an electric-current meter or indicator, the combination of two arms projecting below and diverging radially from a pivotal center, and forming a pendulum, with an adjustable weight carried by one of such arms, a horizontally-projecting curved solenoid-core carried by such pendulum, and a curved coil acting upon such core, substantially as set forth.

5. In an electric-current meter or indicator, the combination, with a pendulous curved solenoid-core, of a fixed curved solenoid-coil adapted to be placed directly in the main line, and composed of open rigid convolutions of bare metal, substantially as set forth.

6. In an electric-current meter or indicator, the combination, with a pendulum, of a horizontally-projecting curved solenoid-core carried thereby, a fixed curved solenoid-coil composed of open rigid convolutions of bare metal, and a weight on the pendulum, adjustable, so as to change the center of gravity of such pendulum, substantially as set forth.

7. In an electric-current meter, the combination of a rigid curved coil forming part of the circuit whose current is to be measured or indicated, a similarly-curved core having an arm extending upwardly from its outer end, a curved non-magnetic bar extending from the inner end, and an arm extending upwardly from said non-magnetic bar, said upward arms being joined at their upper ends and pivotally supported thereat, substantially as set forth.

8. The combination, with an iron core pivoted to swing as a pendulum and curved in an arc described about said pivot as its center, and with a coil serving as a conductor for an electrical current, and which is curved in its length and fixed in position to permit the core to swing therein, of a transverse rack-bar moving with the core and gearing into a pinion carrying an indicator fitted to move over a suitable scale or dial, substantially in the manner and for the purpose herein set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

MONTGOMERY WADDELL.

Witnesses:
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