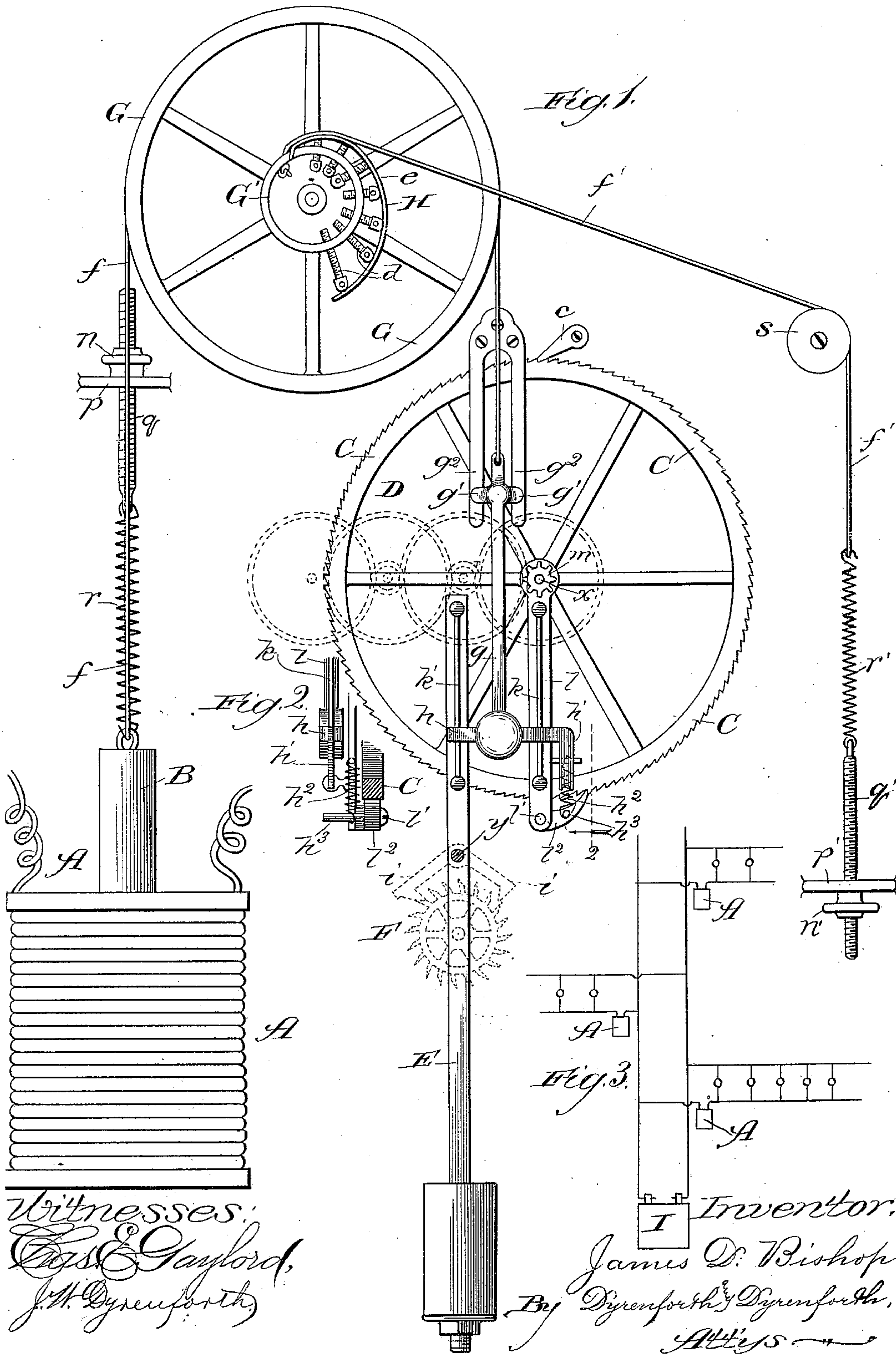


(No Model.)

J. D. BISHOP.  
ELECTRIC METER.

No. 420,762.

Patented Feb. 4, 1890.





# UNITED STATES PATENT OFFICE.

JAMES D. BISHOP, OF CHICAGO, ILLINOIS.

## ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 420,762, dated February 4, 1890.

Application filed June 17, 1889. Serial No. 314,524. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES D. BISHOP, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, (but at present sojourning in Paris, Republic of France,) have invented a new and useful Improvement in Registering-Meters for Electric Currents, of which the following is a specification.

My invention relates more particularly to improvements on the current-registering meter for which Letters Patent of the United States, No. 389,870, were granted me on the 25th day of September, 1888, and in which the movement of a solenoid-core by the current operates with the increase and decrease of the current to increase and decrease (though not to the same extent, as will be hereinafter more fully explained) the leverage of mechanism for actuating the registering-gear, which mechanism involves a pendulum vibrated by one or more electro-magnets, two of which are shown in the patent, and which are alternately short-circuited by the pendulum. Owing to the fact that the movement of a solenoid-core under the influence of an electric current varying in quantity (according to the consumption) is not directly proportional to the increase or decrease of the current, but that, on the contrary, the extent of the movement is greater than the variations in the current producing it, it follows that the indications on the register are not accurate indications of the amount of consumption of the current, to ascertain which accurately requires calculation by persons skilled to that end.

The ultimate object of my improvement is to provide a registering-meter for electric currents which shall serve to register with accuracy the quantity of current passed through it and indicate the same in a manner intelligible to the general consumer, as in the case of the gas-meter; and it is also my object to provide a generally improved construction of meter for registering electric currents. To these ends I provide in a meter such as that set forth in my aforesaid patent a compensator of especial construction and adjustable as to the degree of its function for the difference between the variation of the current and the extent of movement of the solenoid-core producible by the current, and I also improve,

in the matter of details and combinations of parts, upon the construction shown in my aforesaid patent.

In the accompanying drawings, Figure 1 is a broken view, diagrammatic in its nature, of my improved device, showing parts in elevation; Fig. 2, a broken enlarged view in section, taken on the line 2 of Fig. 1 and viewed in the direction of the arrow; and Fig. 3, a diagram representing an incandescent electric-lamp circuit and its branches, having my improved meter indicated in proper positions of its use.

A is the solenoid, supported, with the other details of the device hereinafter described, in a suitable case. (Not shown.) The solenoid-core B is supported to extend into the coil on a spring *r*, forming a link between the core and a threaded rod *q*, extending into a stationary bearing *p*, beyond which is a nut *n*, whereby the core may be adjusted with reference to its degree of extension into the coil.

C is a ratchet-wheel supported on a center *x*, carrying a pinion *m*, from which the train of register-wheels D is actuated, and from between the pinion *m* and wheel is suspended on the center *x* an arm or lever *l*, having secured to its lower end by a pin *l'* a dog *l''*, and provided longitudinally of its front side with a guide-rod *k*.

E is the pendulum, fulcrumed at *y*, where it carries the escapement *i* of an ordinary clock-movement, of which only the wheel F is indicated. The pendulum, which normally hangs parallel with the lever *l* in its normal perpendicular position, carries, like the latter, a guide-rod *k'* on its extension above its fulcrum, and on the rods *k* and *k'* is guided a weighted cross-head *h*, extending beyond the rod *k* and there bent into a downward-projecting finger *h'*, connected by a spring *h''* with a pin *h'''*, extending from the dog *l''* near its free end. From the weight at the center of the cross-head *h* extends perpendicularly upward a rod or bar *g*, having near its upper end a cross-head *g'*, movable between rigid guides *g''*, secured in proper position, as shown, and the bar *g* is connected by a cord or the like *f* with the core B.

G is a lever, which may be in the form of a pulley, over which the cord *f* passes between the solenoid-core and cross-head *g'*, and



around the center on one side of the pulley is a hub  $G'$ , carrying a cam  $H$ , which should be adjustable as to the degree of its curve, and which I accordingly provide in the form of a curved spring  $e$ , secured at one end to the hub  $G'$  and extending thence part-way around it, set-screws  $d$  serving to adjust the degree of its curve. A cord  $f'$  is secured at one end to the hub  $G'$  and leads therefrom over a guide-pulley  $s$  to a yielding retainer, which may be provided in the form of a spring  $r'$ , with one end of which the cord is connected, the opposite end of the spring being fastened to a threaded rod  $q'$ , supported in a bearing  $p'$ , and provided with a nut  $n'$  for adjusting the tension of the spring.

The operation of the device is as follows: The solenoid of the meter, which is intended to be provided, of course, for each branch of a circuit requiring a meter, (and indicated in Fig. 3 as leading from a generator  $I$ ), is included in such branch circuit to cause the entire current supplied thereon to pass through the solenoid-coil, which exerts upon the core the well-known suction effect, whereby, through the medium of the cord  $f$ , the cross-head  $h$  is raised or lowered between the pendulum  $E$  and lever  $l$ , according to variation in the quantity of current passing through the solenoid. The pendulum is vibrated continually by the action upon the escapement  $i$  of the wheel  $F$  of the clock-movement, which should be of a construction to cause it to run for the desired number of days forming the interval between inspections of the meter or for a longer time. When there is no current on, the core  $B$  is in its normal position with reference to the coil, which position is gaged to permit the cross-head  $h$  to assume its lowest position, in which the finger  $h'$  engages with the pin  $h^3$  and pushes the dog  $l^2$  out of engagement with the teeth of the wheel  $C$ , backward rotation of which is prevented by a dog  $c$ . When the dog  $l^2$  is thus disengaged from the wheel, the latter is not, as will presently appear, actuated or affected by the vibrations of the pendulum. As soon, however, as there is current on the line, the suction of the core into the solenoid-coil raises the cross-head  $h$  and causes the finger  $h'$ , by its connection with the dog  $l^2$ , to produce engagement of the latter with the teeth of the wheel  $C$ , so that each vibration of the pendulum toward the wheel produces turning of the latter owing to the connection with the pendulum of the lever  $l$ . Obviously, the greater the quantity of current passed through the solenoid the farther the wheel  $C$  should be turned in order to cause it to register an increase on the registering-dials. To accomplish this, the disposition of the movable cross-head  $h$  is such between the pendulum above its fulcrum and the lever  $l$  below its fulcrum that as the cross-head is raised with an increase of current it recedes from the fulcrum of the pendulum and approaches that of the lever  $l$ , thereby increasing the lev-

erage against the wheel  $C$ , while lowering of the cross-head with a decrease of the current produces the opposite effect. Thus the effect produced by the movements of the solenoid-core under the influence of the current is to rotate the wheel  $C$ , which actuates the register.

Were the difference in the degrees of extension of the core into the solenoid proportional to the degree of variation in the current, the measurement indicated by the turning of the wheel  $C$  would be accurately indicative of the quantity of current consumed. This not being the case, however, as hereinbefore explained, in order to cause the wheel  $C$  to be turned and produce indication of the exact amount of current passed through the meter, it is necessary to provide means for effecting compensation for the difference between the variation in the current and the extent of movement it is capable of exerting upon the solenoid-core. Accordingly I provide a compensator involving a cam  $H$ , adjustable as to the degree of its curve and formed, preferably, of the adjustable spring  $e$ , and which, through the medium of the cord  $f'$ , passed over it and held at one end by a yielding retainer, produces a leverage against the rotation of the wheel  $C$ , gradually increasing or decreasing, according as the current increases or decreases, and adjusted (by test) accurately to prevent the excess of movement of the core  $B$ . It should also be stated that a clock-movement herein referred to affords merely one of various forms of actuating means (as electric, pneumatic, or hydraulic power) for the pendulum.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a registering-meter for electric currents and employing a solenoid to actuate the registering mechanism by the movement of its core under the influence of the current, the combination, with the solenoid-core and registering mechanism, of a compensator having a cam  $H$ , adjustable as to the degree of its curve and secured upon a lever  $G$ , and a cord holding the cam to a yielding resistance against rotation by the said lever, substantially as and for the purpose set forth.

2. In a registering-meter for electric currents and employing a solenoid to actuate the registering mechanism by the movement of its core under the influence of the current, the combination, with the solenoid-core, of a compensator comprising a cam  $H$ , formed with a support  $G'$  on a pulley  $G$ , a spring  $e$ , secured to the support and having adjusting means for varying its curve, a cord  $f'$ , secured to the said support and passing on the cam  $H$  in the direction of its enlargement and secured at its opposite end to a yielding retainer, substantially as and for the purpose set forth.

3. In a registering-meter for electric currents, substantially as described, the combination, with the solenoid-core, pendulum, and ratchet-wheel  $C$ , of a lever  $l$ , adjacent to and



extending from its fulcrum in the direction opposite that of the extension of the unweighted end of the pendulum from its fulcrum, and provided with a dog  $l^2$  to engage the teeth of the wheel C, a cross-head  $h$ , movable between the pendulum and lever  $l$  and connected with the solenoid-core, and a releasing-finger  $h'$  on the cross-head, connected with the dog, substantially as and for the purpose set forth.

4. In a registering-meter for electric currents, substantially as described, the combination, with the solenoid-core, pendulum, and ratchet-wheel C, of a clock-movement for vibrating the pendulum, a lever  $l$ , adjacent to and extending from its fulcrum in the direction opposite that of the unweighted end of the pendulum from its fulcrum, and provided with a dog  $l^2$  to engage the teeth of the wheel C, a cross-head  $h$ , movable between the pendulum and lever  $l$ , and connected with the solenoid-core, and a releasing-finger  $h'$  on the cross-head, connected with the dog, substantially as and for the purpose set forth.

5. In a registering-meter for electric currents, substantially as described, the combination, with the solenoid-core, pendulum, and ratchet-wheel C, of a compensator having a cam H secured to a lever G, and a cord holding the cam to a yielding resistance against rotation by the lever, a lever  $l$ , adjacent to and extending from its fulcrum in the direction opposite that of the extension of the un-

weighted end of the pendulum from its fulcrum, and provided with a dog  $l^2$  to engage the teeth of the wheel C, a cross-head  $h$ , movable between the pendulum and lever  $l$  and connected with the solenoid-core by a cord passing over the lever G, and a releasing-finger  $h'$  on the cross-head, connected with the dog, substantially as and for the purpose set forth.

6. A registering-meter for electric currents, comprising, in combination, a solenoid A, a ratchet-wheel C, geared to the register, a pendulum E, vibrated by clock-movement, a lever  $l$ , carrying a dog  $l^2$ , engaging with the teeth of the ratchet-wheel, a cross-head  $h$ , confined between the pendulum and lever  $l$  and having a finger-extension  $h^2$  connected with the dog  $l^2$ , a cross-head  $g'$ , rigidly connected with the cross-head  $h$  and movable in guides  $g^2$ , a pulley G, a cord  $f$ , connecting the core B of the solenoid with the cross-head  $g^2$  and passing over the said pulley, a support G' on the pulley G, carrying an adjustable cam H, and a cord  $f'$ , secured at opposite ends, respectively, to the said support and a yielding retaining device and passing over the cam in the direction of its enlargement, the whole being constructed and arranged to operate substantially as described.

JAMES D. BISHOP.

In presence of—

R. J. PRESTON,  
E. P. MACLEAN.