(No Model.)

2 Sheets—Sheet 1.

W. L. STEVENS.

ELECTRICAL METER.

No. 346,957. Patented Aug. 10, 1886.

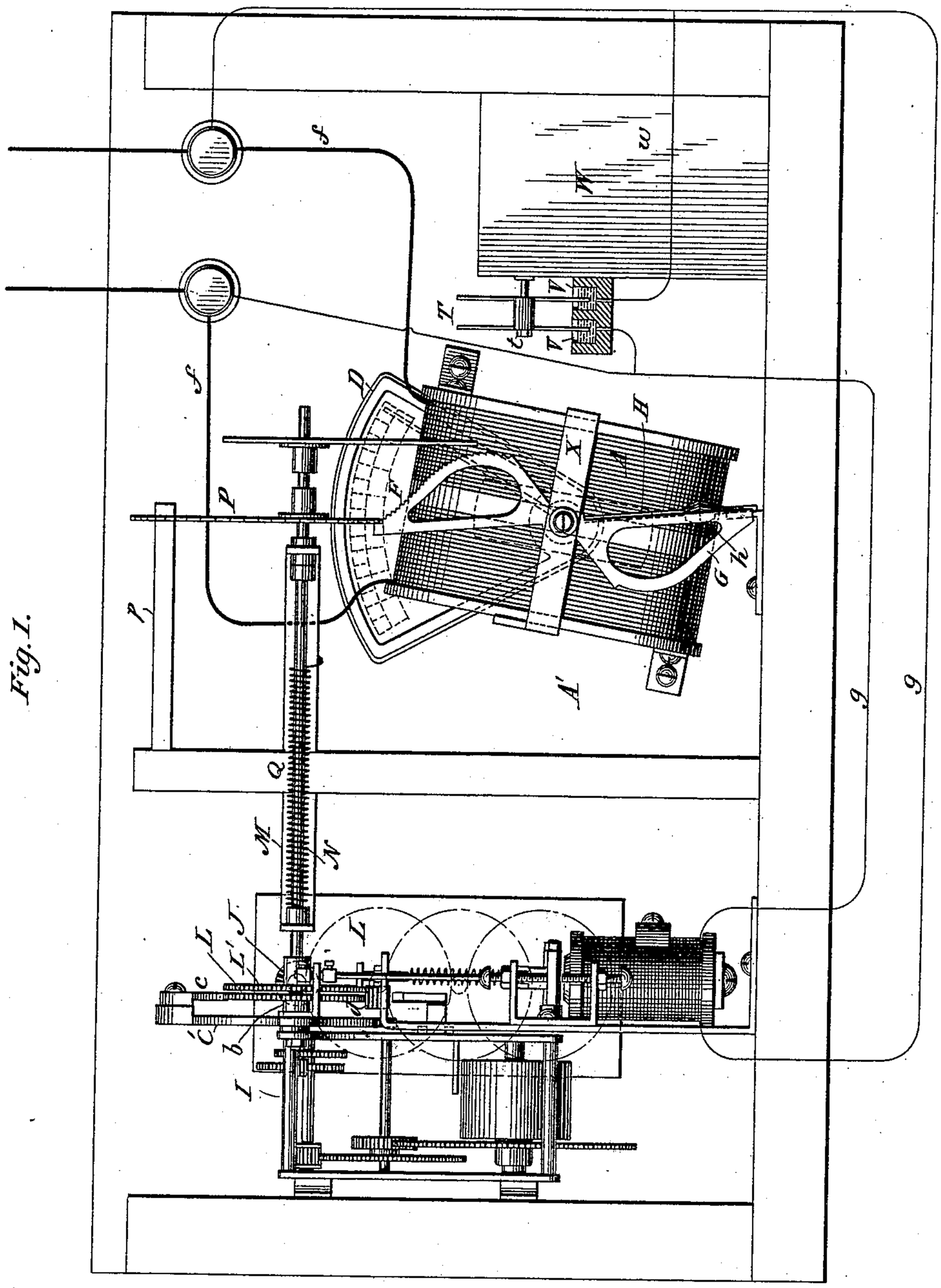

Fig. 1.

WITNESSES:

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INVENTOR

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(No Model.)

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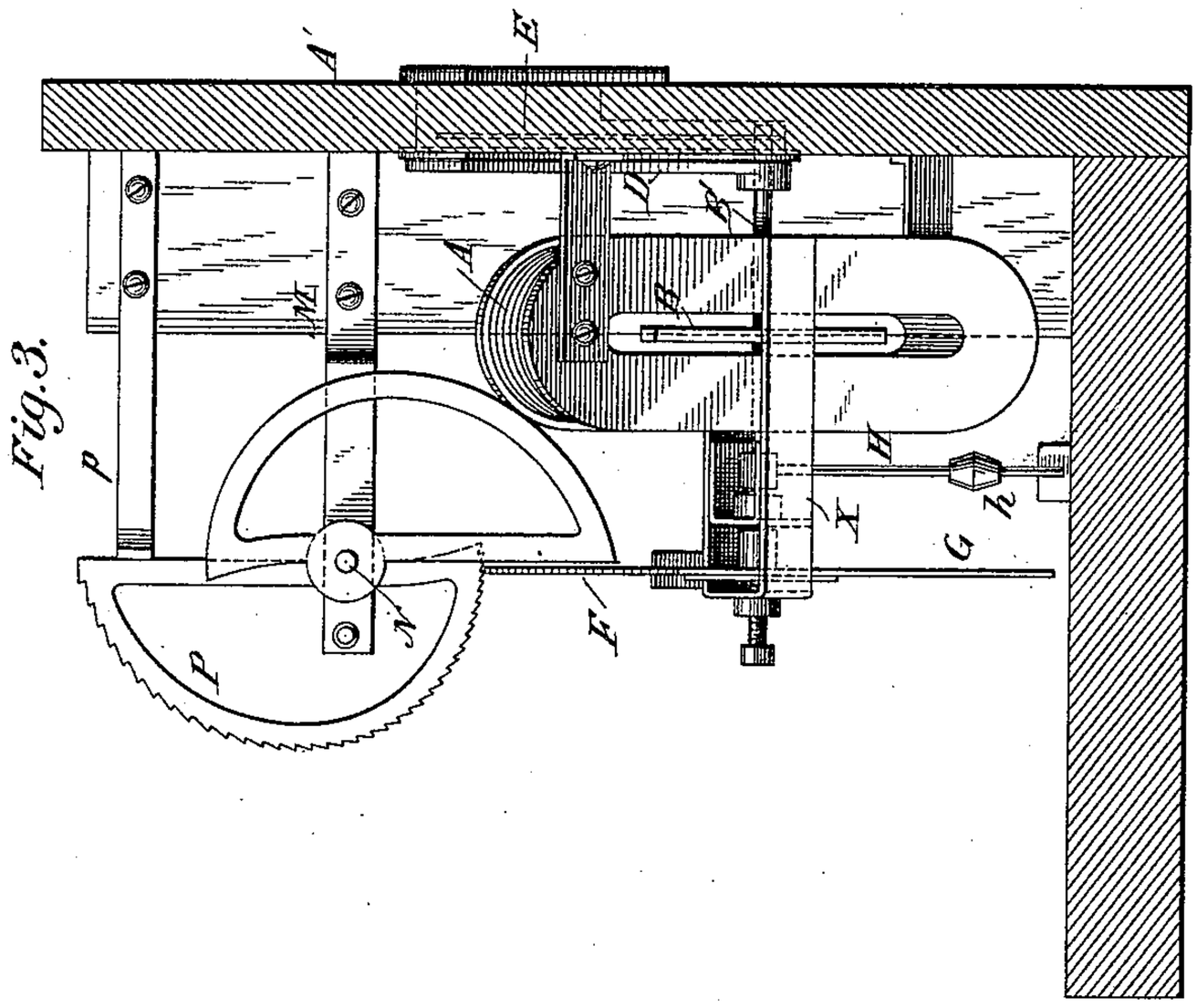

Fig. 3.

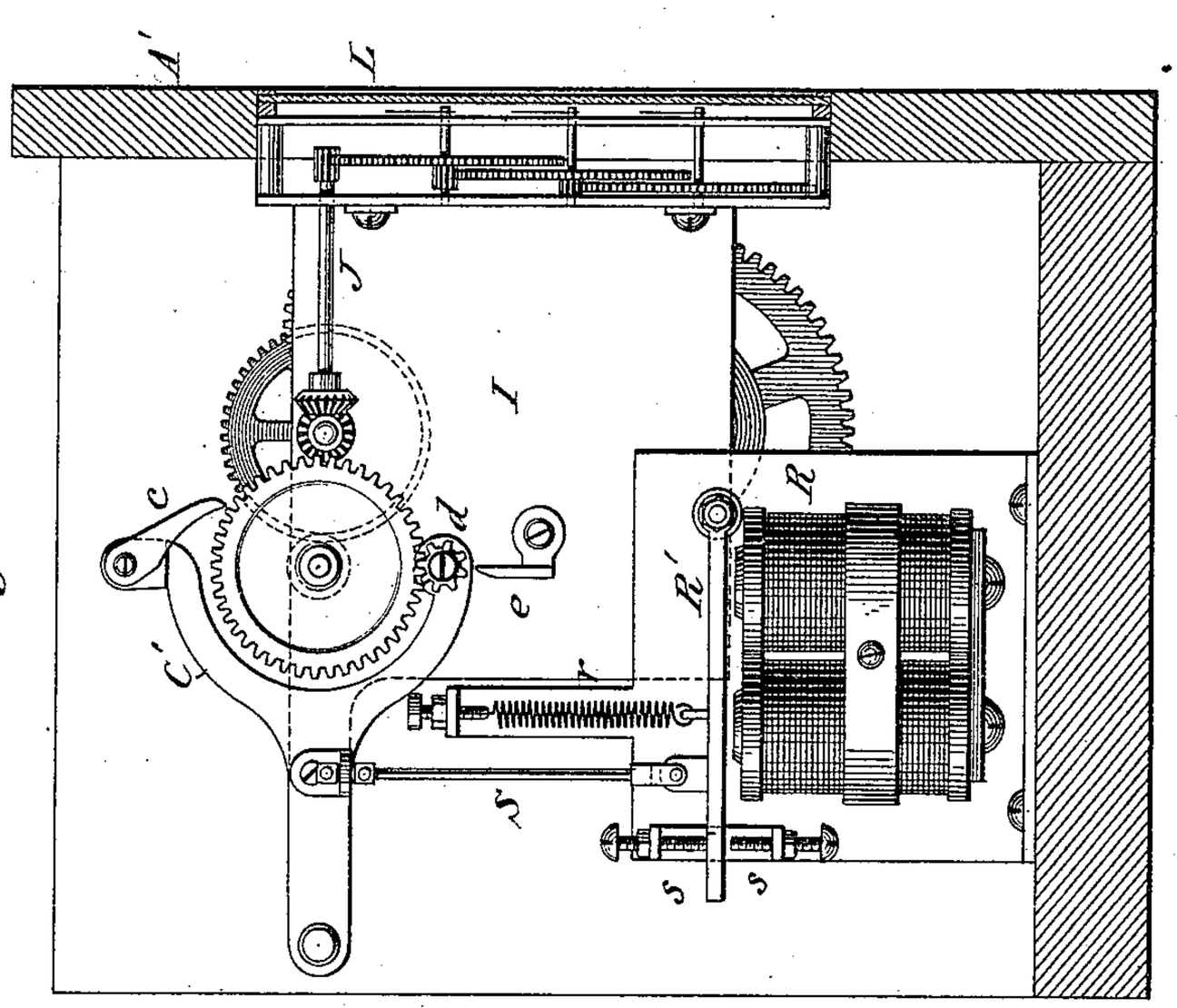

Fig. 2.

WITNESSES:

Robt. F. Gaylord

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UNITED STATES PATENT OFFICE.

WILLIAM L. STEVENS, OF DORCHESTER, MASSACHUSETTS.

ELECTRICAL METER.

SPECIFICATION forming part of Letters Patent No. 346,957, dated August 10, 1886.

Application filed May 27, 1886. Serial No. 203,416. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM L. STEVENS, a citizen of the United States, residing at Dorchester, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Electrical Meters, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

My invention is a device for measuring and recording the current that has passed over a circuit or branch of the same in a given time—in other words, a current-meter which is designed to be used with or on electric circuits in the same way that other meters are used for measuring gas or water. Instruments of this kind, as heretofore constructed, have contained an electro-magnetic or equivalent mechanism with a recording or indicating device, of which the rate or extent of movement is dependent upon the condition of the electro-magnetic portion at all times. Such a mode of operation involves, necessarily, a connection between the two parts or members, which influences to a greater or less extent the operation of that part which is affected or varied by the current. For example, a well-known form of meter contains a helix and movable core, the position of which is varied according to the strength of the current flowing, and clock-work that drives a train of registering-wheels. The core and the clock-work are so combined and adapted for co-operative action that the speed of the latter is determined by the position of the former, the speed being theoretically in proportion to the current-strength. In this form of instrument, as well as in all others of the kind, so far as I am aware, there is present a serious defect. An instrument that will record correctly for, say, from fifty to one hundred incandescent lamps is inaccurate for from one to ten, or conversely, and this results from the fact that with variations in a feeble current the load on the armature or core is more sensibly felt than with much stronger currents, and for the further general reason that it is a matter of great difficulty to obtain a sufficiently great range of movement in any such device to make a practicable meter.

My object is mainly to overcome this difficulty; and to this end I construct a meter in which the action of the part or parts affected by the current is entirely independent of that of the recording mechanism. The electro-magnetic and recording mechanism are not connected, the former being left free to assume a position determined by the current strength, while the recording mechanism operates at stated intervals, the extent of its movement being determined by the position or condition of the electro-magnetic part of the apparatus. This principle of construction or operation may be carried out in a great many ways. Of these I shall describe that which, while embodying the principle, contains numerous features of novelty which contribute to making it the best and most practicable form for general purposes of which I am at present aware. This device contains a current-indicator or ammeter, a recording mechanism, and a device for intermittently and at regular intervals of time setting the recording mechanism into operation. The current-indicator has a notched or toothed sectoral plate that is carried by the armature or moving part, and which therefore assumes a position dependent upon the strength of the current flowing through the ammeter-coils. The recording mechanism also carries a notched or toothed sectoral plate, placed so as to turn in a plane at right angles to the first. The indicator-sector is normally held in a position where it does not encounter the other, a spring or equivalent means being employed for this purpose, having at all times a tendency to bring it back from any other position to that named. At stated intervals a circuit is closed, as by a clock, which brings into play a clock-spring and gear-wheels, which, acting upon the recording-sector, turn it until it encounters the indicator-sector. The sectors are so placed relatively to each other that the greater the strength of current flowing through the coils of the ammeter or indicator the nearer to a full revolution the recorder-sector will make before the two come into contact. The movement imparted to the registering-train will therefore depend upon the current strength. The same device which sets the recording mechanism in operation by closing a circuit is arranged to break the circuit again for an interval sufficient to permit the recorder-sector to encounter the other. As soon as the cur-

rent is interrupted the recorder-sector is carried back to its normal position, in readiness for the next movement.

The specific character of this device will be better understood by reference to the accompanying drawings.

Figure 1 is a side elevation of the complete mechanism. Fig. 2 is a front view of the recording mechanism. Fig. 3 is a side view of the indicating mechanism.

As an ammeter, I have shown a flattened coil, A, of insulated wire, which is secured to the side of the case A′ containing the instrument. Within this coil is an armature, B, on a light shaft, B′, that extends through the coil, and has bearings in a frame, X, and a plate or frame, D, secured to the side of the box or case. The shaft may carry a needle, E, that is arranged to sweep over a graduated scale to indicate changes of current. To the other end of the shaft is attached a quadrant, F, with a serrated or notched edge, and a counter-balance, G, of the same general shape. An arm, H, with an adjustable weight, *h*, is also secured to the shaft, to maintain the armature B in position approximately parallel with the coils when no current is flowing. This portion of the apparatus may be made in many different forms. In principle of construction and operation it differs from an ordinary ammeter only in having the quadrant and counter-balance G H above described. Where a current passes through the coil A, the armature is moved with a tendency to assume a position at right angles to the coils, which tendency may be increased by the presence of iron cores, poles, or plates, as is well understood. As the quadrant moves with the armature it will occupy a position corresponding to the strength of current acting on the armature.

I is a clock-train or any other equivalent motor, gearing with a spindle, J, that runs an ordinary meter-register, L, for recording units, tens, hundreds, &c., of some predetermined scale. The motor I is securely fastened to the case and near the current-indicator. The arbor *b*, driven by the spring-motor, carries a gear-wheel, L. A frame, M, is secured to the case, and carries a long shaft, N, on one end of which is secured a gear-wheel, L′, of the same size as the wheel L. The shaft N is in line with the arbor *b*, and the two wheels L L′ are close together. A notched or serrated semicircular plate, P, is secured to the shaft N at a point thereon directly over the shaft B′, or thereabout, and near it is a second plate of similar shape, which is used as a counter-balance. The two parts or elements G P, which I term, for convenience, "sectors," are designed to encounter each other at some one point, in whatever position they may be turned. It is further intended that the space through which the sector P moves before it encounters the sector G shall be proportional to the angle of deflection of the armature B and sector G. To best accomplish this the sector P is mounted eccentrically and the other given the shape shown. This is a matter easily determined by calculation or experiment. A long spiral spring, Q, surrounds the shaft N, one end being attached to the shaft, the other to the frame M, the spring being under slight tension sufficient to turn the shaft and to bring the sector P against a stop, *p*, as shown in Fig. 3. A bifurcated lever, C′, is pivoted to the frame of the clock mechanism I a little to one side of the two wheels L L′. The upper arm carries a pivoted locking-pawl, *c*, which, in the normal position of the lever, engages with the wheel L and locks the train against movement. The under or lower arm carries a pinion, *d*, that turns loosely upon a stud, and is of sufficient length to engage with the teeth of the wheels L L′, and does so engage with them when the arms of the lever are raised. A fixed stop, *e*, is placed below the pinion, and engages with it when the arms are lowered, its office being to limit the downward motion of the arms. Below the lever C′, and secured in a convenient manner, is an electro-magnet, R, with a pivoted armature, R′. A spring, *r*, is connected with the armature, tending to draw it away from the poles of the magnet, and two adjustable stops, *s s*, are employed for limiting the motion of the armature. The armature is connected to the lever C′ by a rod, S, whereby the movement and position of the one are dependent upon those of the other. The current-indicator coils are in the main circuit, the wires of which are lettered *f f*. The magnet R is in an independent circuit, or in a shunt from the main, indicated by the wires *g g*. In such case the magnet is wound with very fine wire, or a resistance is placed in the circuit *g*, so that only a small proportion of the current flows through it.

The operation of the instrument is as follows: When the current passes, it turns the armature B to a certain position, depending upon the strength of the current, and this moves the sector G to a corresponding position. The magnet R is at the same time energized and the lever C′ drawn down, bringing the pawl *c* into engagement with the wheel L. The clock-train is thus locked and the sector P in its normal position, with its longer radius against the stop *p*. It is now desirable at regular intervals of time to break the circuit of the magnet R and permit the clock mechanism to move the register. For this purpose I employ a clock mechanism, W, of any kind, that turns a pair of contacts, T, and causes them to dip into insulated mercury-receptacles V. The details of the clock mechanism are not shown, as they may be of any ordinary and well-known character. The contacts T T are platinum rods extending from a metal hub, *t*, and are carried by an arbor that makes one revolution per minute. These contacts, when touching the mercury, close a circuit, *w*, thus short-circuiting the magnet R. I prefer this way of demagnetizing the magnet, as it does away with breaking the circuit; but it is to be observed that when the magnet is included in a

shunt from the main circuit the resistance of the shunt must be so distributed that the short-circuiting of the magnet will not materially lower the total resistance of the shunt. The demagnetization of magnet R permits the armature R′ to rise. This raises the arms of lever C, releasing the wheel L from the pawl *c* and bringing the pinion *d* into engagement with both of the wheels L L′. The clock-train, being now free, imparts movement to the wheel L′ and shaft N, turning the latter, and with it the sector P, until one of the stops or teeth on the latter encounters one of those on the sector G. The demagnetization of magnet R continues but for a short interval, sufficient, however, to bring the two sectors into engagement. Being then again magnetized by the interruption of the short circuit, the lever C′ is drawn down, the clock-train locked, and the shaft N left free. Thereupon the spring Q turns the shaft and sector P back to their normal position, and the apparatus is thus brought into condition for the next registering movement, which takes place after an interval of thirty seconds, or more or less, as may be determined by the construction of the circuit-closer. At each operation of the circuit-closer, the movement of the clock-train I and the register-wheels will depend upon the position of the sector G and the strength of the current which determines such position. It is evident, therefore, that the record made in a given time will be a true one of the amount of current that has passed.

It will now be more clearly seen that this invention is or may be carried out by devices differing widely in construction and mode of operation, the parts necessary to the successful operation of the instrument being, first, some device which assumes a different position or condition for every change in the strength or amount of current to be measured; second, are gistering device whose movement is intermittent and dependent in extent upon the position or condition of the first, and a means for imparting, directly or indirectly, this intermittent movement to the register.

The special form of device which I have herein shown presents certain advantages, among which is the current-indicator, which is so constructed that the instrument may be used as an ammeter or current-indicator, whether the registering devices are in operation or not.

The different parts are cheap and easily made and combined, and the device requires no attention, with the exception of winding the clock-springs.

What I claim is—

1. The combination, with a current-indicator, or a device of which the position or the condition is determined by the current acting upon it, of an intermittently-operating registering mechanism, the extent of movement of which is regulated by the position or condition of the current-indicator, as and for the purpose set forth.

2. The combination, with a current-indicator or ammeter having a moving part of which the position is determined by the current acting upon the ammeter, of a registering device, with a moving part adapted to encounter that of the ammeter, and to permit a greater or less movement of the register, according to the position of the moving part of the ammeter, and means for intermittently moving or operating the regulating mechanism, as set forth.

3. The combination, with a current-indicator or ammeter having a moving part of which the position is determined by the current acting upon the ammeter, of a registering device, with a moving part adapted to encounter that of the ammeter, and to permit a greater or less movement of the register, according to the position of the moving part of the ammeter, an electro-magnet and intermediate mechanism for controlling the action or operation of the register, and means for making and interrupting the current through said magnet at given intervals, as set forth.

4. The combination, with a current-indicator or ammeter having a notched or serrated sectoral plate moving with the armature or needle of the ammeter, of a train of registering-wheels in gear with a spring or other motor, a spring-actuated shaft carrying a notched or serrated sectoral plate adapted to move in a plane at right angles to that of the ammeter, and to encounter the same in whatever position it may be, and means for alternately locking and releasing the register-motor and throwing it into gear with the spring-actuated shaft at given intervals, as set forth.

5. The combination, with the ammeter having the notched or serrated sector G attached to its shaft, of the shaft N, carrying a notched or serrated sector, P, adapted to move in a plane at right angles to the sector P, and to encounter the same, the spiral spring connected with the shaft N, for turning it to a given position, the register-train and clock-movement geared therewith, the bifurcated lever C′, and parts carried thereby, adapted to lock and release the clock-movement, and to connect it with the shaft H when released, the electro-magnet for controlling the position of the lever C′, and a circuit-closer operated by a clock mechanism for interrupting the current through the magnet at stated intervals, as set forth.

6. The combination, with a current-indicator or ammeter which is free to assume a position or condition dependent upon the current acting upon it, of a registering device having an intermittent movement limited in extent by the indicator and varying in accordance with the position or condition of the same, as set forth.

WM. L. STEVENS.

Witnesses:
AUSTIN A. MARTIN,
AARON H. LATHAM.