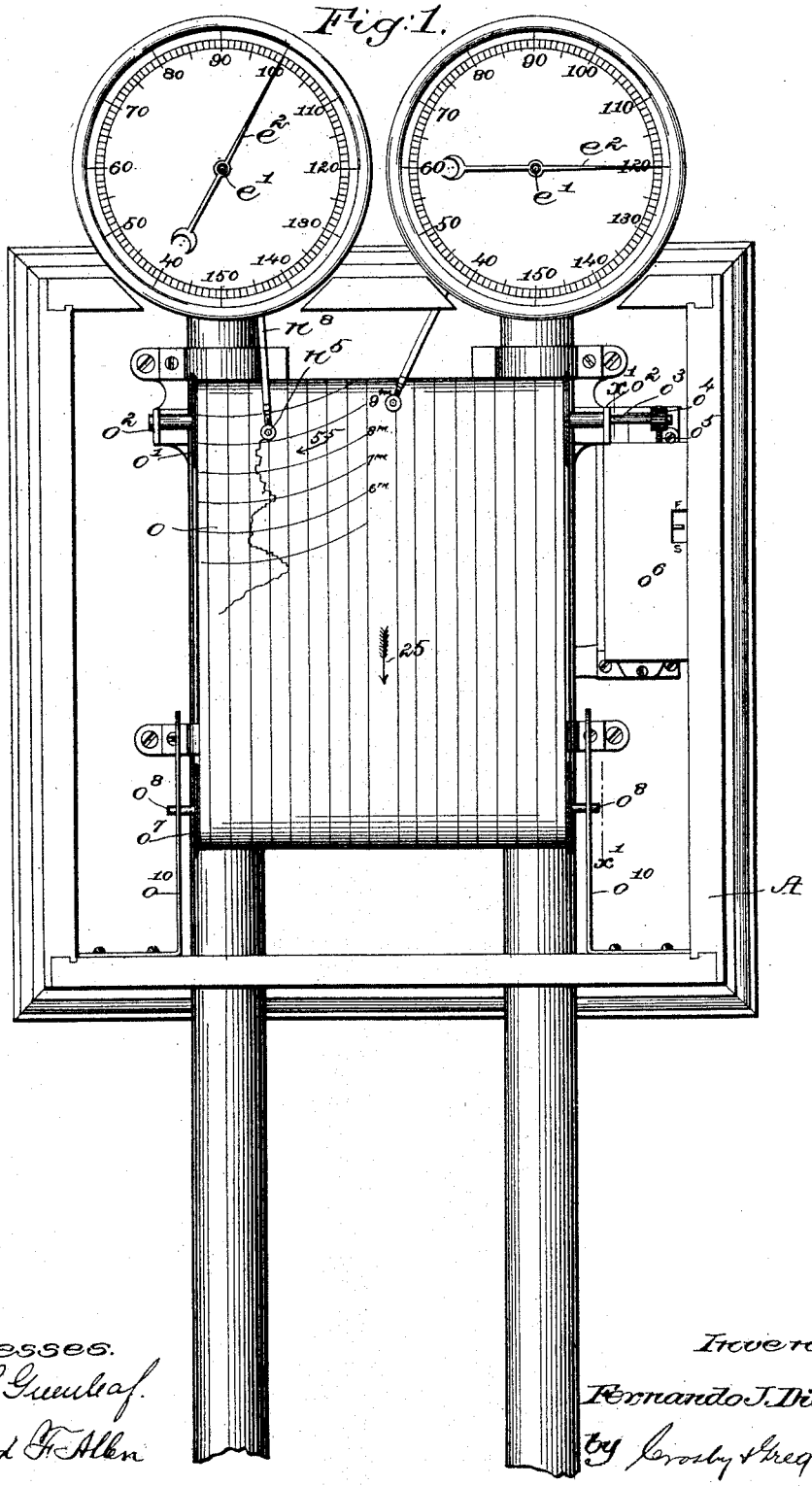
(No Model.) 5 Sheets—Sheet 1.

F. J. DIBBLE.

ELECTRIC METER.

No. 490,011. Patented Jan. 17, 1893.

Fig. 1.



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Edward F. Allen

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(No Model.) 5 Sheets—Sheet 2.

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ELECTRIC METER.

No. 490,011. Patented Jan. 17, 1893.

Fig: 2.

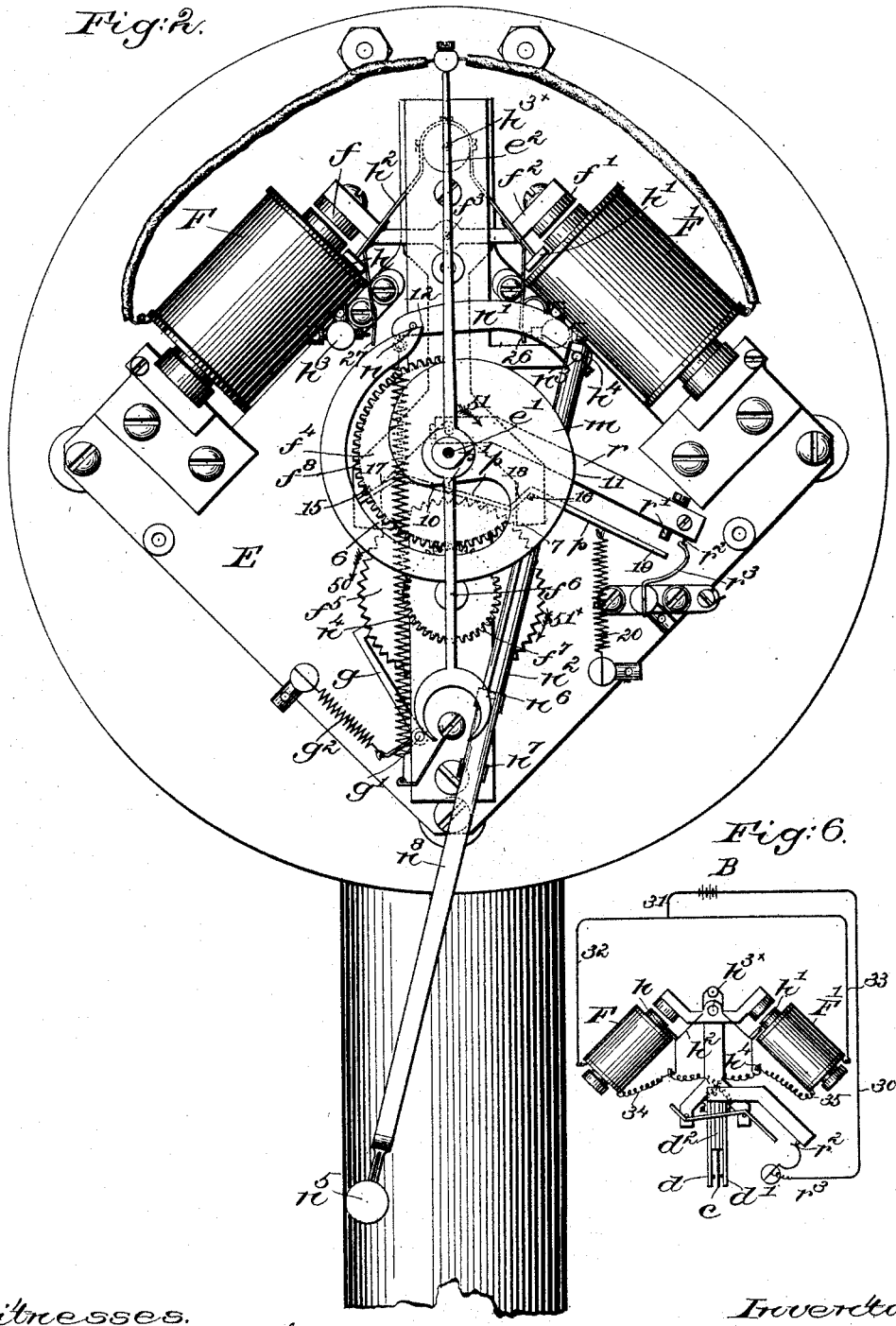

Fig: 6.

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(No Model.) 5 Sheets—Sheet 3.

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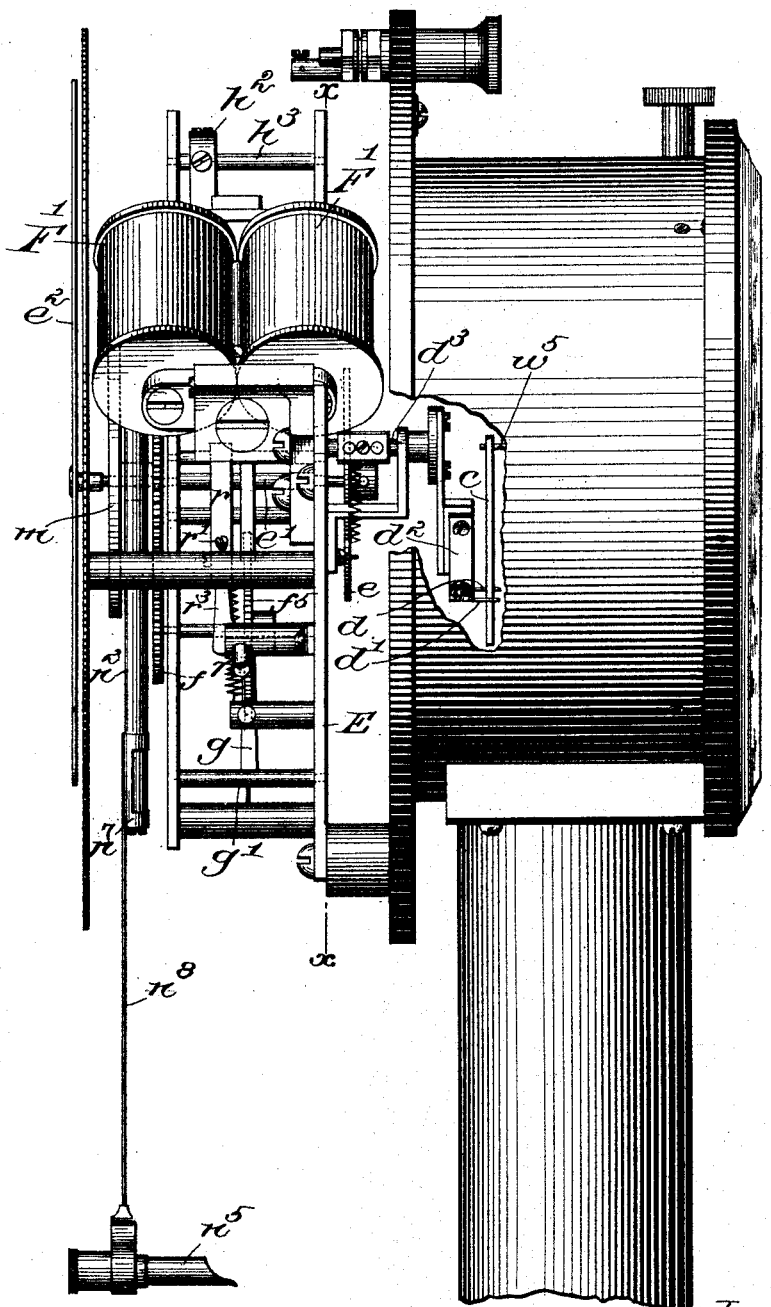
ELECTRIC METER.

No. 490,011 Patented Jan. 17, 1893.

Fig. 3.



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(No Model.) 5 Sheets—Sheet 4.

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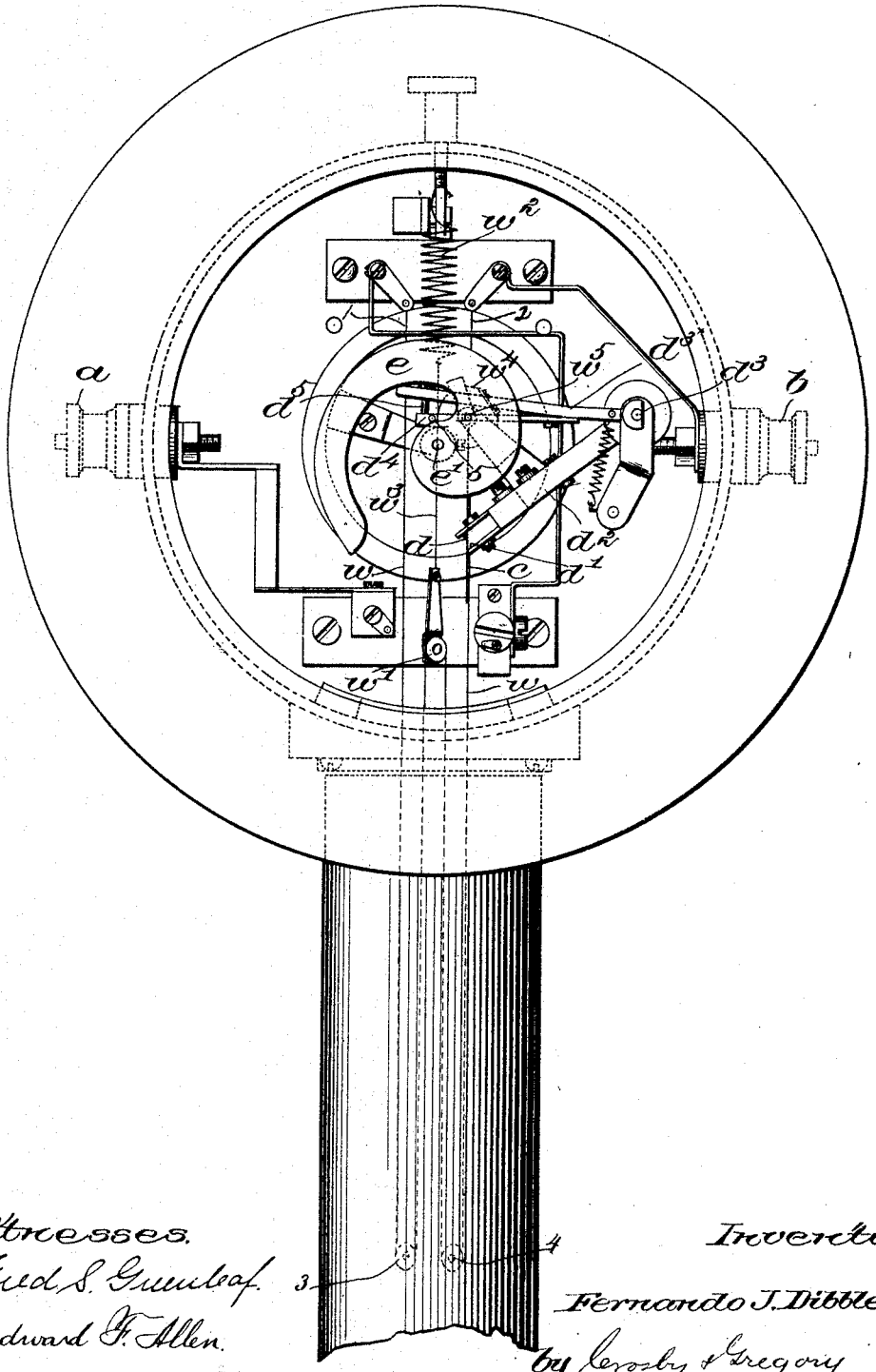
ELECTRIC METER.

No. 490,011. Patented Jan. 17, 1893.

Fig. 4.



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(No Model.) 5 Sheets—Sheet 5.

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ELECTRIC METER.

No. 490,011. Patented Jan. 17, 1893.

Fig: 5.

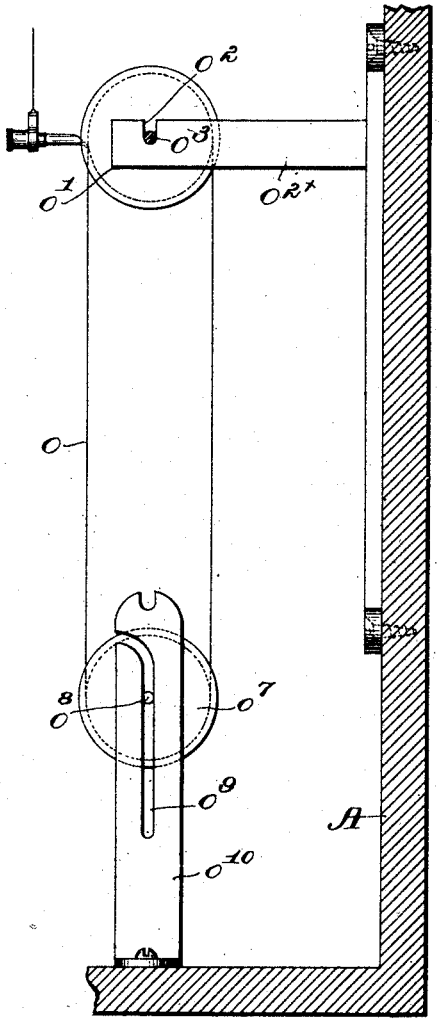

Fig: 8.

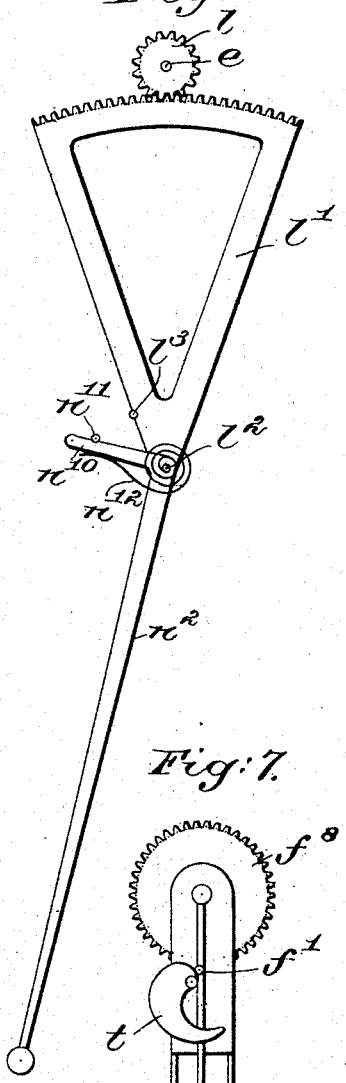

Fig: 7.

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UNITED STATES PATENT OFFICE.

FERNANDO J. DIBBLE, OF PEABODY, MASSACHUSETTS.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 490,011, dated January 17, 1893.

Application filed November 21, 1891. Serial No. 412,669. (No model.)

To all whom it may concern:

Be it known that I, FERNANDO J. DIBBLE, of Peabody, county of Essex, State of Massachusetts, have invented an Improvement in Telemeter Systems, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention relates to telemeters, one object of the invention being to provide suitable means whereby irregular movements of the contact arm or member may be caused to transmit a regular and uniform movement to the indicating or recording arm or device.

The invention also comprehends a device which is self-contained,—*i. e.*, wherein a signaling circuit both transmits and indicates or records, in contradistinction to devices of this class as heretofore constructed, which, so far as I am aware, have employed two separate apparatus, one to transmit and the other to record. The recording arm or device is so actuated that a record or indication may be made between certain determined and variable points or limits only, so that when the device is employed to register the voltage of an electric current, it may be so adjusted as to remain unmoved or to be unaffected by voltage below a certain limit, but to indicate the variations in voltage above such limit. These features, together with other features of this invention, will be hereinafter fully set forth and specified in the claims.

Figure 1 represents in front elevation a telemetric device embodying this invention; Fig. 2, an enlarged view of one of the individual telemetric devices with the face-plate or dial removed to expose the working parts; Fig. 3, a right-hand elevation of Fig. 2; Fig. 4, a section on the dotted line x—x, Fig. 3; Fig. 5, a sectional detail taken on the dotted line x'—x', Fig. 1; Fig. 6, a diagram showing the arrangement of circuits; and Figs. 7 and 8, modifications to be described.

The drawings represent a telemetric device adapted to indicate and record the variations in voltage of an electric current, the line wires being attached to the binding posts a and b shown by dotted lines Fig. 4, which are electrically connected with the fixed ends 1, 2 of the platinum wire w, which latter is extended down and about the fixed pulleys 3, 4 represented in dotted lines Fig. 4, thence up and over a pulley w' hung from the spring w^2, which latter maintains the wire under a constant tension.

The connection w^3 between the pulley w' and the spring w^2 is represented as passed about and secured to a wheel or disk w^4, see dotted lines, Fig. 4, so that expansion and contraction of the wire due to variations in the voltage of the current of electricity passing through it will cause the wheel or disk w^4 and its shaft w^5 to be rotated in one or the other direction, all as in the well-known Cardew volt-meter, further description of which herein is deemed unnecessary.

The expansion and contraction of the wire w and the consequent rotation of the shaft w^5 are not uniform, the expansion and contraction due to a change in current of a certain number of volts when the voltage is low being considerably less than a variation in the same number of volts when the voltage is high; for instance, a variation of ten volts from thirty to forty volts will cause the shaft w^5 to be rotated a certain distance, while a variation of ten volts from one hundred and thirty to one hundred and forty volts will cause a rotative movement of the shaft some four or five times greater than the same variation at the low voltage.

In a telemeter it is desirable that the recording device or member move uniformly for certain specified variations at all times, whether the voltage be high or low, and a construction to effect a uniform movement of the recording and indicating members from an irregular movement of the shaft w^5 is represented in the drawings, wherein the said shaft w^5 has flexibly connected to it a contact arm c, which normally lies between two insulated contacts d, d', mounted on and insulated from a carrying arm d^2, pivoted at d^3 at one side of or out of line with the axis of the shaft w^5, said carrying arm d^2 having a second arm $d^{3\times}$, to the under side of which is secured one end of a spring plate d^4, acted upon by a screw d^5, tapped through the outer end of the arm $d^{3\times}$, as represented in Fig. 4. A pin 5, projecting laterally from the outer end of the plate d^4, rests upon the surface of a cam e, fast on the inner end of the staff e', journaled in a suit-

able frame E, said staff at its outer end carrying an indicating pointer or hand e^2, see Figs. 2 and 3.

Two electro-magnets F, F′, arranged at right angles to each other or obliquely with relation to the vertical pointer e^2, as represented in Fig. 2, have their main armatures f, f' fast upon opposite ends of an armature-carrying lever f^2, pivoted on a shaft f^3, journaled in the frame E, said shaft also carrying a forked lever or pallet f^4, the ends 6, 7 of which straddle the toothed driving wheel f^5, fast on an arbor f^6, said arbor also carrying a pinion f^7, in mesh with and operating the larger toothed wheel f^8, fast on the staff e', see Fig. 2. According as the pallet f^4 is vibrated to one or the other side of its middle position by the attraction of the armatures f, f' by their respective magnets F, F′, will the driving wheel f^5 be rotated in one or the other direction to thereby rotate the staff e' and pointer e^2 in one or the other direction, the wedge-shaped end of a pawl g, pivoted at g' and acted upon by a spring g^2 springing between the successive teeth of the driving wheel f^5 to thereby insure a uniform movement at each vibration in either direction and hold the driving wheel in normal position. The magnets F, F′ are also provided with smaller auxiliary armatures h, h', carried by two arms of the U-shaped spring-carrier h^2, pivoted at $h^{3\times}$, see Fig. 2, the outer ends 26, 27 of the said U-shaped carrier normally lying between and out of contact with the adjustable fixed contacts h^3, h^4, said auxiliary armatures being attracted first by their respective magnets prior to the attraction of the main armatures f, f' by reason of the smaller current necessary to move them, for a purpose to be hereinafter described.

The staff e', at or near its outer end, has fast upon it a cam m, Fig. 2, shaped to present a cam surface extending from a point 10, such being the shortest radial distance from the axis of the staff e', gradually rising to at or about the point 11 at the greatest radial distance from the axis of the said staff, the difference in the radial distances of the points 10 and 11 from the axis of the staff constituting the throw of the cam, the said surface being further continued beyond the point 11 to form a concentric surface extending, as herein represented, to a point 12, a pin n on the short arm n' of the recording arm n^2, pivoted at n^3, normally resting upon this concentric portion of the cam m, as represented in Fig. 2.

The recording arm n^2 is herein represented as slotted to receive a pin or projection n^6 on the sliding sleeve n^7, having attached to it the flexible arm n^8, carrying at its outer end a recording pen n^5 or other suitable marking device. This construction permits the sleeve and its recording pen to be moved up out of the way when it is necessary to change the recording sheet, the sliding movement of the sleeve being limited by the slot in the arm n^2, so that when the sleeve is drawn fully down the pen n^5 will lie in correct position over the recording sheet. The concentric portion of the cam m permits the staff e' to be rotated for a greater or less distance without causing movement of the recording member n^2, said member not being moved until the pin n reaches and begins to follow the working or cam surface extending between the points 10 and 11, said arm being caused to follow said surface by a spring n^4 which keeps the pin n always in operative contact with the surface of the cam.

The recording pen n^5 is adapted to sweep over the recording sheet o, herein represented as in the form of a continuous band, see Fig. 5, extended over a top roll o', journaled in the bottoms of the slots or recesses o^2 in the fixed brackets $o^{2\times}$, the shaft o^3 forming the journals for said roll carrying a pinion o^4, which drops down into mesh with a toothed wheel o^5, forming part of a clock movement of any usual or suitable construction contained within the casting o^6, see Fig. 1, movement of the clock acting through the toothed wheel o^5 to slowly rotate the roll o' to cause the recording sheet o to slowly pass under the end of the recording pen n^5 in the direction of the arrow 25, Fig. 1.

A bottom roll o^7 is suspended in the recording sheet o, as represented in Figs. 1 and 5, the journals o^8 of said bottom roll lying in the vertical open slots o^9 in the standards o^{10}, herein represented as secured to the inclosing case A of the telemeter, the said roll o^7 by its weight keeping the recording sheet always taut or stretched tightly over the top roll o'. At the same time, the bottom roll o^7 not being journaled in fixed bearings but suspended in the recording sheet o, is simply revolved by and in said sheet as the latter is moved by the rotation of the top roll, thus keeping the sheet tightly drawn about the top roll, and at the same time offering a minimum resistance to the rotation of said top roll by the clock work. The pinion o^4, on the journals o^3 of the top roll, simply rests in mesh with the toothed wheel o^5 of the clock mechanism, permitting the said roll to be readily lifted from its bearings, and when replaced the said pinion immediately settles into mesh with the said toothed wheel. The bottom roll o^7 being also readily removable, the recording sheet may be changed at will, or the rolls replaced by rolls of a different diameter, without in any manner interfering with the clock movement.

The pallet f^4 has its arms 6, 7 provided with pins 15, 16, lying on upper and under sides respectively of the inclined faces 17, 18 of the lever p, pivoted at p' and having its end 19 acted upon by a spring 20, normally lying below the screw r' of the circuit-breaking lever r, having its contact r^2 normally in engagement with the fixed contact spring r^3, see Fig. 2. When the pallet f^4 is vibrated in either direction by the magnets F, F′, one of the pins 15 or 16 will act upon its inclined face 17 or

18 to lift the outer end 19 of the lever p to thereby cause it to strike against the screw r' and lift the circuit-breaking lever r, to interrupt or break the circuit between the contacts r^2, r^3, as will be more fully hereinafter set forth. The lever p also acts as a centering device to keep the pallet f^4 normally in a central position.

Referring to Fig. 6, the arrangement of circuits is represented in diagram, the battery B having one of its poles connected by a wire 30 with the fixed contact spring r^3, the wire 31 leading from the other pole of the battery being divided and connected by wires 32, 33 with the electro-magnets F, F', said magnets being connected respectively by wires 34, 35 with the fixed contacts h^3 h^4, the pivot $h^{3\times}$ of the U-shaped spring h^2 carrying the auxiliary armatures h and h', being connected by the base of the movement with the contact arm c and also with the circuit-breaking lever r, the contacts d and d' being connected respectively with the fixed contacts h^4 and h^3, as shown.

The operation of the device is as follows,—a current of electricity being passed through the volt-meter from the main line wires, will cause the wire w to expand more or less according to the voltage of the current, such expansion of the wire causing the disk w^4 and its shaft w^5 to revolve and cause the contact arm c to engage the contact d on the arm d^2 to close the circuit from the battery through the wires 31, 33, magnet F', wire 35, contact h^4, contact d, contact arm c, thence by the base of the movement to the circuit-breaking lever r, through the contacts r^2 and r^3, and wire 30 to the battery again. As soon as the circuit is established the auxiliary armature h' is attracted by the core of the magnet F', bringing the end 26 of the U-shaped carrier h^2 into contact with the fixed contact h^4, to thus shunt out the contact arm c and its contact d, the current from the magnet F', instead of passing through the said contact d and contact arm c, will then pass through the wire 35, fixed contact h^4, arm 26 of the carrier h^2, thence back to the battery as before, such shunt being provided for the reason that the contact between the contact arm c and its fixed contact d is so delicate that a current of sufficient strength to properly energize the magnet F for the attraction of its main armature cannot safely be passed through without danger of injuring the contact points; whereas, with the contact shunted out, a current of great strength may with safety be passed through the magnet F'. The magnet F' being thus energized will attract its main armature f', throwing the pallet f^4 to the left, Fig. 2, causing its end 7 to engage one of the teeth of the driving wheel f^5, moving the same in the direction of the arrow 50, and rotating the staff e' to the right in the direction of arrow 51. As the staff e' is rotated to the right, the cam e on the inner end thereof will also be moved, it, acting through the pin 5 and arm d^3 on the contact-carrier d^2, will raise the outer end of the latter slightly to move its contact d away from the contact arm c with which it had previously been in engagement. The circuit is broken at each impulse between the contacts r^2 r^3, as described, so that in case the expansion of the wire w should be sufficient to cause its contact arm c to closely follow its contact pin d, as the latter is moved up by attraction of the armature f', the circuit will be broken at the points r^2, r^3 to permit the armature f' to return to its retracted position in order that it may be again attracted by the continued contact between the contact arm c and point d, to rotate the wheel f^4 another tooth to still further raise the outer end of the contact-carrying arm d^2, to move the point d away from the contact arm c, this operation being repeated by successive breaks at the points r^2, r^3, and closures between the contact arm c and contact point d, until the contact arm c has reached the limit of its movement, when the next succeeding impulse will carry the contact point d away from the arm c, leaving the circuit broken at this point. If the voltage has now reached its highest point and should, for any reason, fall, the wire w will contract slightly and move the contact arm c in the opposite direction to close the circuit through the contact point d', the current then passing from the battery through the wires 31, 32, magnet F, wire 34, fixed contact h^3, thence to the contact d', through the contact arm c to the circuit-breaking lever r, contacts r^2, r^3, wire 30, to the battery again. The magnet F being thus slightly energized will attract its auxiliary armature h to bring the arm 27 of the U-shaped spring-carrier h^2 into engagement with the fixed contact h^3, so that the current leaving the magnet F will pass from the contact h^3 through the arm 27 of the carrier h^2 to the pivotal point h^3, thus shunting out the contact arm c and its contact d' and permitting the full strength of current from the battery to pass through the magnet F, to attract its main armature f and move the pallet f^4 to the right, Fig. 2. Such movement of the pallet f^4 will cause its end 6 to engage one of the teeth of the wheel f^5 and rotate the latter one tooth in the direction opposite to that indicated by arrow 50, moving the indicating pointer e^2 back or to the left one point, and through the cam e dropping the contacts d, d' one point to move the contact d' out of engagement with the contact arm c to break the circuit, when the parts will again resume their normal positions, Fig. 2. Should the voltage continue to fall, the wire w will continue to contract and cause the contact arm c to follow the contact d' as it is moved away, when the circuit-breaking lever r will operate to break the circuit successively after each impulse, as previously described, until the contact d' has been moved beyond the limit of movement of the contact arm c. As the

voltage rises, the expansion of the wire w, due to a change of any specified number of volts, will increase so that the contact arm c will be moved through a greater distance for a certain change in the voltage when the latter is high than it will for a change of the same number of volts when the voltage is low; but the contact-carrying arm d^2 is pivoted at one side of the axis of the shaft w^5 of the contact arm c, so that as the contact arm c moves to the left, Fig. 4, and the contacts d, d' are raised, the said contacts d, d' will approach nearer to the axis of the shaft w^5 than when in their lowermost position, so that, although the contact arm may be moved through a greater distance for a certain change in voltage, the contacts d and d', lying nearer to the axis of movement of the said contact arm, will reduce the difference to a considerable extent, so that the relative movement between the contact arm and the two contacts will remain substantially the same. If, however, the variations in movement of the contact arm are so great that the pivoting of the contact-carrying lever d^2 at one side of the axis of the shaft w^5 will not sufficiently equalize the relative movements of the contact arm and contacts, the cam e will be employed, which, acting through the pin 5 on the arm d^4 will by its gradually rising surface move the contacts d and d' further or through a greater distance at each impulse as the voltage increases; and as the throw of the cam e may be made as great as desired, the movements of the contacts d and d' may be increased to compensate for the greatest possible variations in the movement of the contact arm c. Conversely, as the voltage is lowered, the contacts d, d' will be moved a less distance at each successive impulse by the cam e, and, by reason of the carrier d^2 being pivoted at one side, the movement of the contact arm c with relation to the contacts d, d' will increase gradually, thus equalizing the movements perfectly, so that a uniform or regular movement of the staff e' and indicating pointer e^2 is at all times secured notwithstanding the variations in movement of the contact arm. As the staff e' and pointer e^2 are revolved in the direction of arrow 51, the pin on the arm n' of the recording member n^2 will follow along the concentric surface of the cam m until the point 11 on the said cam is reached, when further movement of the staff and cam will cause the pin n to follow down the retreating cam face to move the marking pen n^5 on the outer end of the member n^2 in the direction of arrow 55, Fig. 1, causing it to trace the variations in voltage in either direction upon the moving sheet o, as shown. According as the concentric portion of the cam between the points 11 and 12 is made greater or less will the variation in voltage remaining unrecorded be greater or less; for, if the cam is terminated at the point 11 the record of the variations in voltage will begin immediately as the cam is rotated, but as a concentric surface of greater or less length is provided before the point 11 is reached, the rise in the number of volts which will remain unrecorded will be greater or less; as, for instance, the concentric surface may be of such length that the voltage may rise to 100 without making any record, but any variation above 100 will be traced upon the recording sheet by the cam surface of the cam m.

From the foregoing it will be seen that the magnets F, F' constitute not only the transmitting magnets but the receiving magnets as well.

This invention is not limited to the particular arrangement and construction shown, as the same may be varied without departing from the spirit and scope of the invention.

The invention herein disclosed may be employed in connection with any volt-meter, ammeter, or primary actuating instrument other than the particular one herein shown and described.

In the principal figures of the drawings I have employed a cam m to move the recording member n^2; but instead of the cam m, I may employ other devices for accomplishing the same result, as, for instance, that represented in Fig. 8, wherein the pinion l is in mesh with the sector l', pivoted on the arbor l^2. The recording member n^2, also pivoted loosely on said arbor l^2, has an arm n^{10}, which is normally pressed toward and against a pin n^{11} by a coiled spring n^{12}, attached to the arbor and bearing at its free end against said arm n^{10}. As the staff e' is rotated it will move its pointer a certain distance without moving the recording member n^2, or until the projection l^3 on the sector l' strikes against the arm n^{10}, when the said arm and member n^2 will thereafter be moved in unison with the sector l'.

In the principal figures I have also represented the contact arm as fast on and movable irregularly with the rotating shaft of the volt-meter or prime actuator, the co-operating fixed contacts being moved irregularly through the cam e. In lieu of such an arrangement, the irregularly-rotating shaft of the volt-meter or prime actuator may be provided with a cam t, Fig. 7, which shall act on a pin f' on the contact arm to give to the latter a perfectly regular movement, in which case the contacts d, d' may also be rotated uniformly by being attached directly to the staff e'.

I claim—

1. A contact arm, and a prime actuator therefor, combined with a movable contact to co-operate with said contact arm, and actuating mechanism to impart to said contact an intermitting movement with a greater movement between some of the intermissions than between others, substantially as described.

2. A contact arm, and an actuator to impart a rotary movement thereto, combined with a rotary movable contact to co-operate with said contact arm, and mechanism controlled by the closure of a circuit by said contact arm and contact to impart to said con-

tact an intermitting rotary movement with a greater movement between some of the intermissions than between others, substantially as described.

3. A pivoted contact arm, and an actuator therefor, combined with a pivoted contact carrying arm the pivotal axis of which is parallel to the pivotal axis of the contact arm, a contact carried by the said carrying arm, and to engage with said contact arm and mechanism controlled by the electrical engagement between said contact arm and contact to impart to the latter an intermitting movement with a greater movement between some of the intermissions than between others, substantially as described.

4. A pivoted contact arm, and an actuator to impart an irregular movement thereto, combined with a pivoted contact-carrying arm, a contact thereon to co-operate with said contact arm, a rotating shaft and a cam thereon to move said contact-carrying arm, substantially as described.

5. A pivoted contact arm, and an actuator to impart an irregular movement thereto, combined with two movable contacts between which said contact arm normally moves, a rotatable staff, and mechanism actuated by electrical engagement of the contact arm with one or the other of said contacts to rotate said staff uniformly in one or the other direction, and devices intermediate said staff and contacts, whereby uniform movement of the former will impart a variable movement to the latter, substantially as and for the purpose specified.

6. A pivoted contact arm, and an actuator to impart an irregular movement thereto, combined with a pivoted contact-carrying arm d^2, contacts d, d' thereon to co-operate with said contact arm, a rotating staff e', a cam e thereon, and the arm d^3, plate d^4, and a screw to separate said arm and plate, substantially as described.

7. In a telemetric device, a contact arm and an actuator therefor, two contacts to co-operate with said contact arm, a staff, and mechanism controlled by the electrical engagement of said contact arm with one or another of said contacts to effect the rotation of said staff in one or the other direction, a pivoted recording arm, and devices intermediate the said arm and staff to move the former by the latter and arranged to permit a predetermined movement of the staff prior to the movement of the recording arm thereby, substantially as and for the purpose specified.

8. In a telemetric device, a contact arm and an actuator therefor, two contacts to co-operate with said contact arm, a staff, and mechanism controlled by the electrital engagement of said contact arm with one or another of said contacts to effect the rotation of said staff in one or the other direction, a cam on said staff, and a recording arm moved by said cam as the latter is rotated by said staff, substantially as described.

9. In a telemetric device, a contact arm and an actuator therefor, two contacts to co-operate with said contact arm, a staff, and mechanism controlled by the electrical engagement of said contact arm with one or another of said contacts to effect the rotation of said staff in one or the other direction, a cam on said staff having a cam surface and a concentric surface, and a recording arm moved by said cam as the latter is rotated by said staff, substantially as described.

10. In a telemetric device, the combination of the following instrumentalities, viz:—an automatically-movable contact arm, two movable contacts to co-operate with said contact arm and between which said contact arm normally moves, two electro-magnets in circuit respectively with said movable contacts, armatures for said magnets, and a staff rotated by movement of the same, a recording device actuated by said staff, and devices intermediate said staff and movable contacts, whereby the latter are moved by the former, substantially as described.

11. In a telemeter system, a clock mechanism, and a spur wheel forming a part thereof, combined with a roll provided with a pinion having spur teeth which rest in mesh with the teeth of the spur wheel of the clock mechanism in a manner to permit the said pinion to be readily removed from mesh with the said wheel, and fixed journal bearings for said roll which permit the roll to be removed from its bearings and to remove its pinion from mesh with its supporting wheel at will, a marking device, and a recording sheet therefor moved by said roll, substantially as described.

12. The combination with a marking device, a roll, fixed journal bearings in which said roll is removably mounted, and an endless recording sheet passed about said roll, of a roll suspended in said recording sheet, and vertical guideways for said suspended roll, an entrance opening for said vertical guideways through which the suspended roll may be removed from the guide-ways for the application of a new recording sheet substantially as described.

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

FERNANDO J. DIBBLE.

Witnesses:

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