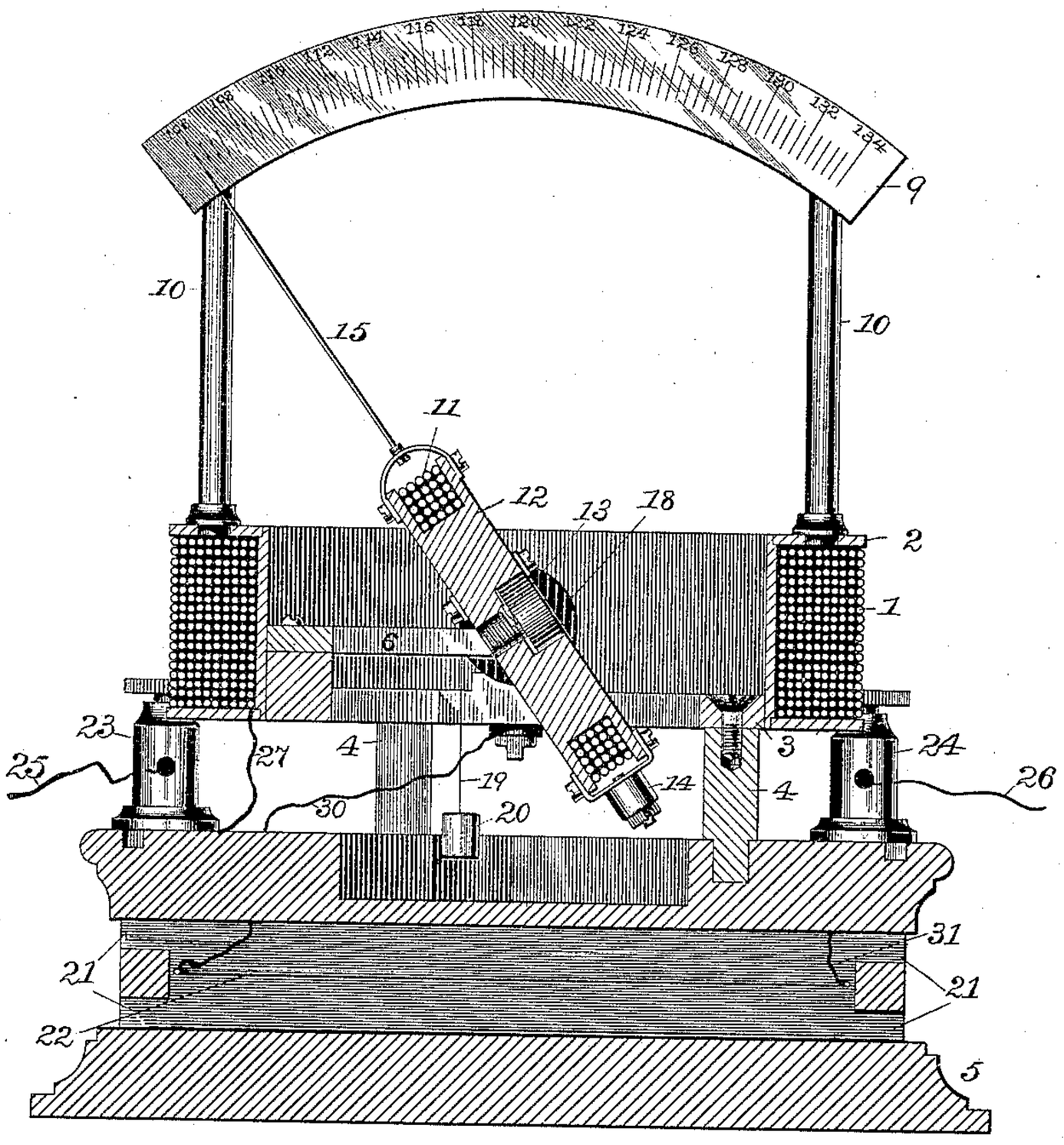
(No Model.) 3 Sheets—Sheet 1.

W. A. ANTHONY.

ELECTRIC INDICATOR.

No. 387,131. Patented July 31, 1888.

Fig. 1



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(No Model.) 3 Sheets—Sheet 2.

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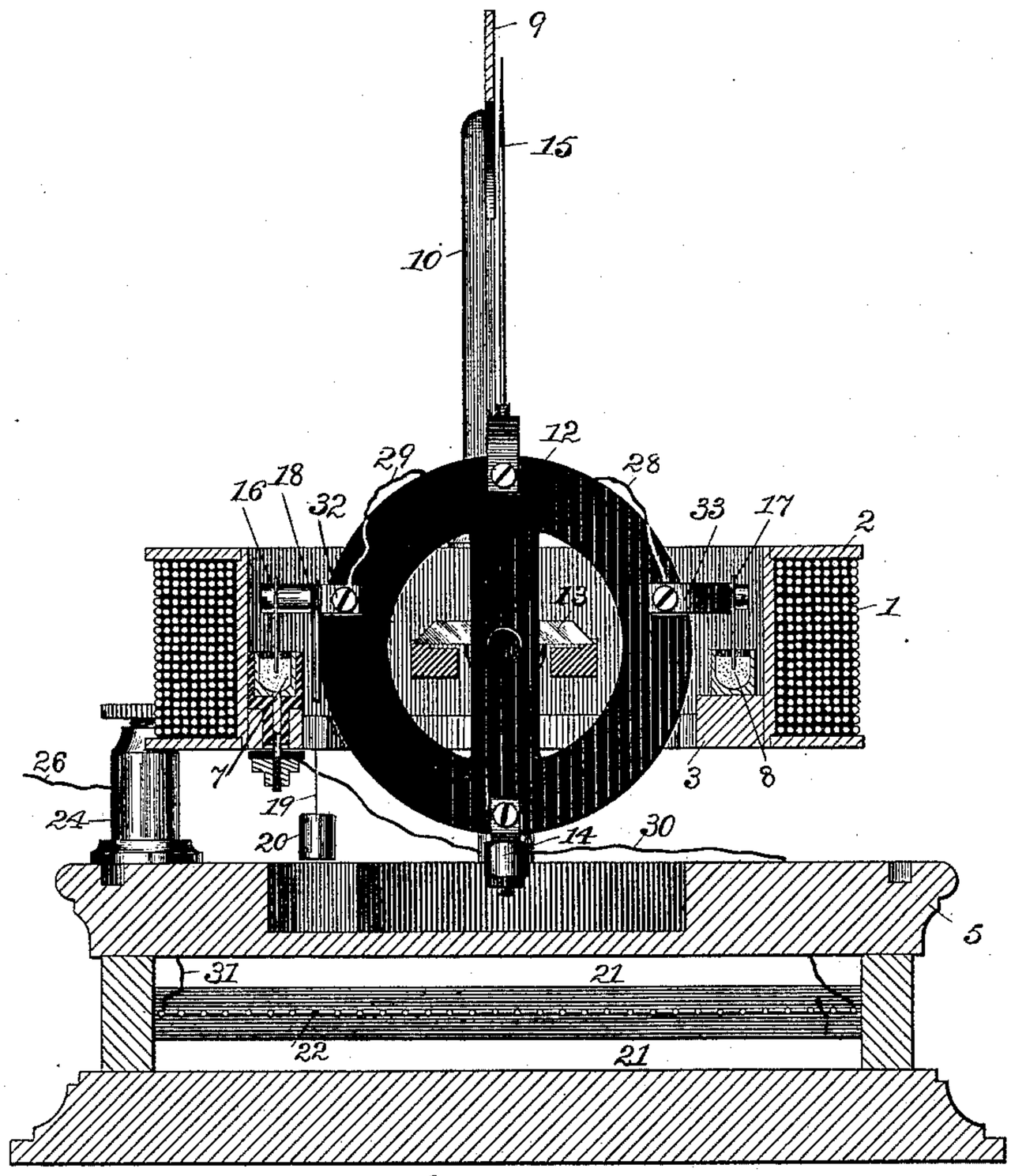
Fig. 2



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(No Model.) 3 Sheets—Sheet 3.

W. A. ANTHONY.

ELECTRIC INDICATOR.

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Fig. 3

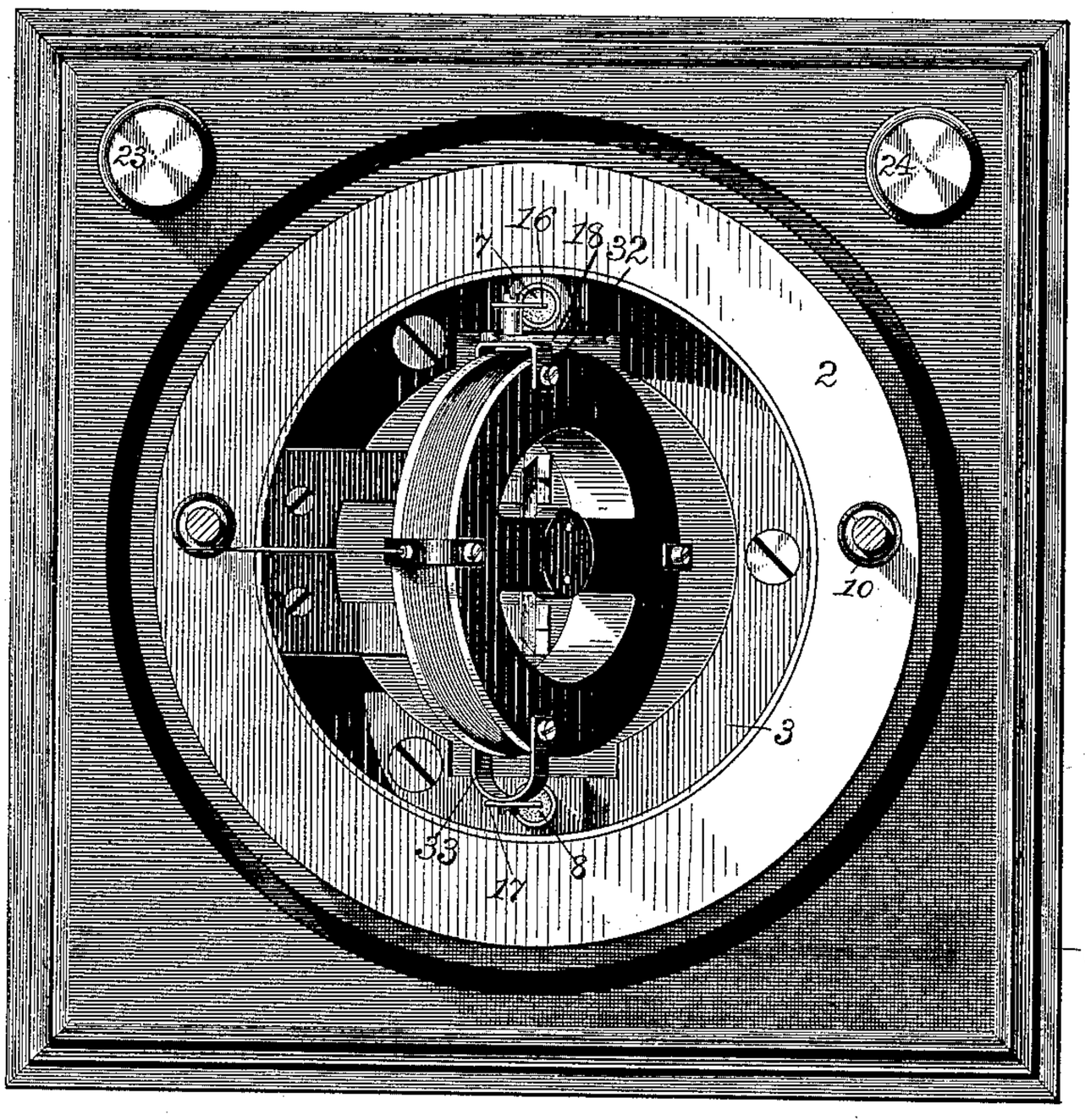


Fig. 4

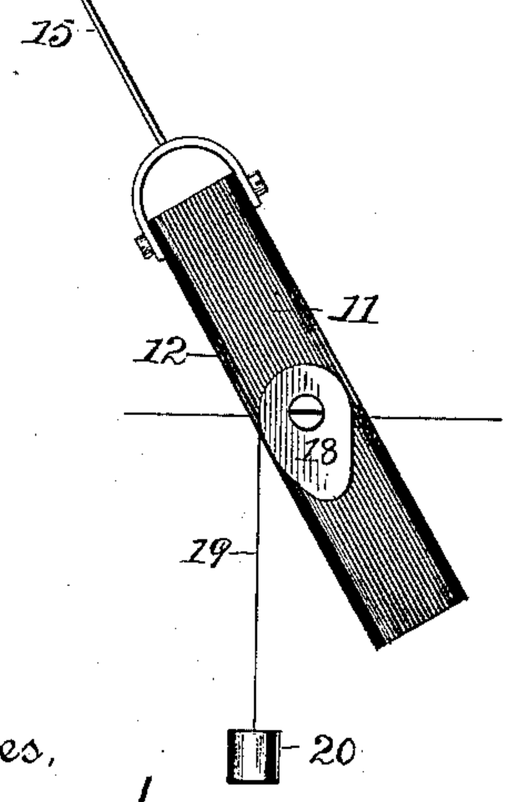
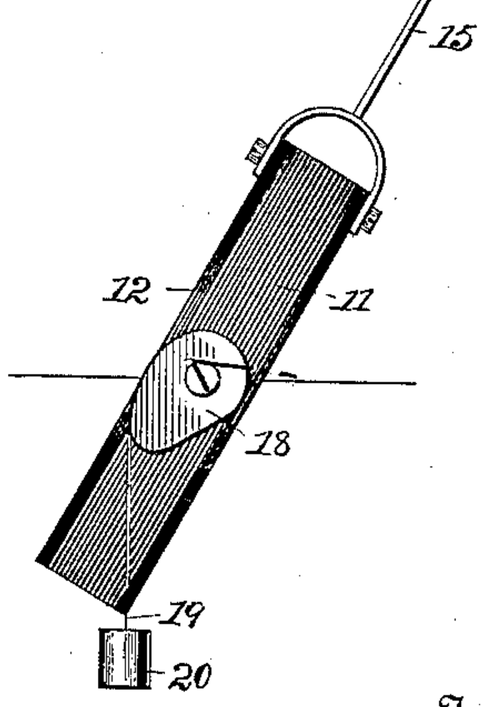


Fig. 5



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UNITED STATES PATENT OFFICE.

WILLIAM A. ANTHONY, OF MANCHESTER, CONNECTICUT, ASSIGNOR TO THE MATHER ELECTRIC COMPANY, OF SAME PLACE.

ELECTRIC INDICATOR.

SPECIFICATION forming part of Letters Patent No. 387,131, dated July 31, 1888.

Application filed March 26, 1888. Serial No. 268,502. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. ANTHONY, of Manchester, in Hartford county, Connecticut, have invented certain new and useful Improvements in Electric Indicators, which improvements are described in the following specification, and are illustrated by the accompanying drawings.

The invention relates to that class of electric indicators in which a stationary helix and a movable helix of insulated wire, forming part of an electric circuit, interact upon each other to produce in such movable helix those movements of partial revolution which indicate changes of current or electro-motive force.

The object of the invention is to cause equal electric changes to be indicated by equal movements throughout the whole range of such an instrument. To accomplish this result my invention opposes to the directing power of the stationary and movable helices the force of a weight which is applied to the movable helix by means of a flexible connection running over a curved surface.

The best method in which I have contemplated applying the principle of my invention is illustrated in the drawings.

Figure 1 is a central vertical section of a potential indicator, which is constructed in accordance with my invention for the purpose of indicating a normal difference of potential of one hundred and twenty volts, and other differences of potential not more than fourteen volts greater or less than one hundred and twenty volts. Fig. 2 is a central vertical section of the same in a plane which is at right angles with the sectional plane of Fig. 1. Fig. 3 is a plan of the same, excepting the graduated scale. Figs. 4 and 5 are details showing a modified construction.

The numeral 1 denotes a stationary helix of insulated fine wire, which is wound upon a hollow brass spool, 2. This spool, which is short and of large internal diameter, is provided at the bottom with an inwardly-projecting annular brass flange, 3, and is supported in a horizontal position by metallic standards 4, which rise from the top of base 5, and are attached to flange 3 by screws. Upon this flange is mounted an inwardly-projecting horizontal bracket, 6, having two arms for the support of the moving parts of the indicator. Two small cups, 7 and 8, containing mercury, are secured to flange 3 on opposite sides of bracket 6. Cup 7 is insulated and cup 8 is not insulated from said flange. An arched scale-plate, 9, which is held up by standards 10, spans the top of spool 2. This plate is graduated uniformly from end to end, and reads through a predetermined range of fourteen volts, more or less, in each direction from the central reading of one hundred and twenty volts, the latter being the normal electro-motive force of the circuit whose changes of potential are to be observed. A similar but smaller helix, 11, is wound upon a similar spool of insulating material, 12. Spool 12 is provided with a central cross-bar carrying a knife, 13, whose edge occupies a diametrically horizontal position in the annular helix and spool 11 and 12. Knife-edge 13, resting in a V-groove across the two arms of bracket 6, supports the moving parts of the instrument. On the lower edge of spool 12 is an adjustable weight, 14, whereby the center of gravity of said spool and its attachments is located slightly below the line of knife-edge 13. On the upper edge of spool 12 is a radially-directed pointer, 15. Spool 12 also carries two contact plates or hangers, 16 and 17, of amalgamated copper, which are attached to said spool by brackets 32 and 33, and hang down into cups 7 and 8, respectively. Bracket 32 holds a circular plate or disk, 18, which is at right angles with the line of knife-edge 13 produced, and has a grooved periphery on which runs a silk thread, 19. One end of this thread is fastened to disk 18, and the other end of the same is fastened to a dependent weight, 20. Base 5, which is a wooden box having air-holes 21, contains an artificial resistance, 22, consisting of German silver, carbon, or other material of low or negative temperature coefficient. Resistance 22, being in the form of wire or filament, is freely dispersed in base 1 to avoid heating. Binding-posts 23 and 24 are the terminals of the indicator, and wires 25 and 26 are a shunt to the main circuit, whose potential is to be indicated. One end

of the wire composing helix 1 is soldered to spool 2, and the other end of the same is connected to post 23 by wire 27. Helix 11 is connected with bracket 33 by wire 28 and with bracket 32 by wire 29. Resistance 22 is connected with cup 7 by wire 30 and with binding-post 24 by wire 31. In short, said helices and said resistance are connected in series.

The remaining features of construction of this potential indicator will sufficiently appear from the drawings and from the mode of operation, which is now to be described.

The mode of operation of this instrument is similar to that of the well-known "Weber dynamometer." When no difference of potential, or no difference exceeding the minimum indication of the instrument, exists between terminals 23 and 24, pointer 15 stands in the position in which it is shown in Fig. 1, and is stopped from greater deflection from a vertical position. When the difference of potential between terminals 23 and 24 stands at the normal limit of one hundred and twenty volts, pointer 15 is held in a vertical position, as in Fig. 2. The current takes its course from terminal 23 successively through wire 27, helix 1, spool 2, flange 3, cup and contents 8, plate 17, bracket 33, wire 28, helix 11, wire 29, bracket 32, plate 16, cup and contents 7, wire 30, resistance 22, and wire 31 to terminal 24. Resistance 22 prevents helices 1 and 11 from becoming so much heated as to present any considerable variations in resistance, and easily radiates heat from its own surface into the surrounding air. A condition of thermal equilibrium is accordingly reached with little delay. If the difference of potential which is to be observed rises above or falls below one hundred and twenty volts, the change within a total range of twenty-eight volts is indicated to the eye of the observer by a proportionate deflection of pointer 15 before scale-plate 9. This deflection results from the directing power of helices 1 and 11, the opposing force of weight 20, and the relative position of the axis of support and center of gravity of helix 11 and its attachments. The directing power of said helices is variable with the relative positions which they occupy and the electro-motive force with which they are supplied. Equal changes in electro-motive force affect the directing power of said helices unequally for different parts of the scale. The opposing force of weight 20 is constant in all positions within the range of the instrument. The effect which is due to the relative positions of the axis and center of gravity of helix 11 and its attachments varies according to the side of the angle at which pointer 15 is deflected from the perpendicular. By correctly determining the necessary curvature of plate 18 the described forces can be balanced against each other in such a manner that equal changes of potential will produce equal movements of the pointer throughout the whole range of the instrument, and in the described indicator this result is accomplished with practical accuracy when that curvature is circular, as described.

Such are the construction and operation of my invention in its primary form as a potential indicator.

The modification which is illustrated in Figs. 4 and 5 needs but little explanation. Those figures are views of one edge of helix 11 and its attachments in positions of extreme deflection from the perpendicular in opposite directions, respectively. A plate, 18, having a grooved edge on which runs cord 19, sustaining weight 20, takes the place of the above-described circular disk, which is indicated by the same numeral 18. This plate has such a peripheral curvature that the moment of weight varies inversely as the directing force of the interacting helices 1 and 11. By varying the curvature of plate 18, or by changing the location of said plate relatively to its axis of oscillation, or by a combination of these methods, the moment of weight 20 may be rendered constant or caused to vary in accordance with any desired law.

The foregoing statement of the construction and mode of operation of my invention has special reference to the construction and operation of the same as a potential indicator for constant-potential circuits. When constructed and used as a current-indicator for constant-current circuits, helices 1 and 11 are formed of coarse wire, resistance 22 is omitted, plate 9 is graduated to indicate changes of current, and the instrument takes all or a known fractional part of the current of the circuit to which it is applied. In that case wires 25 and 26 are a part of the main circuit, whose current changes are to be indicated.

Such being the construction and operation of my invention, I claim—

1. In an instrument for indicating or measuring current or potential, an electric conductor which is pivoted in a magnetic field, and a curved plate or lever which is attached to said pivoted conductor, in combination with a weight and a flexible connection whereby said weight is suspended from said curved lever, substantially as and for the purpose specified.

2. In an electric indicator, means for producing a magnetic field, and an oscillating conductor which is located in said field and is provided with an attachment having a curved surface, in combination with a cord running upon said curved surface and a weight which is suspended by said cord, substantially as and for the purpose specified.

3. A stationary helix, an oscillating helix, and a plate which has a peripheral curvature and is attached to said oscillating helix, in combination with a weight and a flexible connection by which said weight is suspended from said plate, substantially as and for the purpose specified.

4. A stationary helix and an oscillating helix which is pivoted therein and is pro-

vided with a pointer, in combination with a graduated scale, a plate which has a peripheral curvature and is attached to said oscillating helix, a weight, and a thread by which said weight is suspended from said plate, substantially as and for the purpose specified.

5. A stationary helix and a movable helix of copper wire, and an artificial resistance of low or negative temperature, coefficient, all connected in series, in combination with a plate which has a peripheral curvature and is attached to said oscillating helix, a weight, and a thread by which said weight is suspended from said plate, substantially as and for the purpose specified.

In testimony whereof I hereunto set my hand in the presence of two witnesses.

WILLIAM A. ANTHONY.

Witnesses:
WILLARD EDDY,
EBEN E. SMITH.