(No Model.) 2 Sheets—Sheet 1.

E. WESTON.

POTENTIAL INDICATOR.

No. 444,803. Patented Jan. 13, 1891.

Fig. 1.

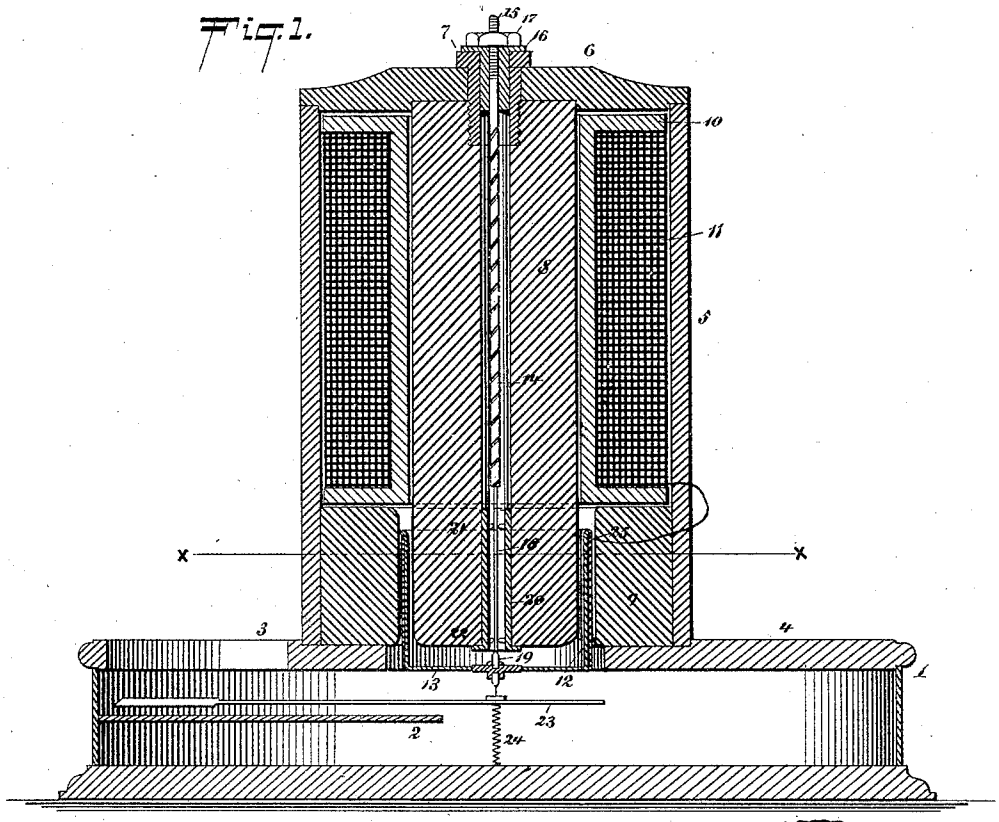
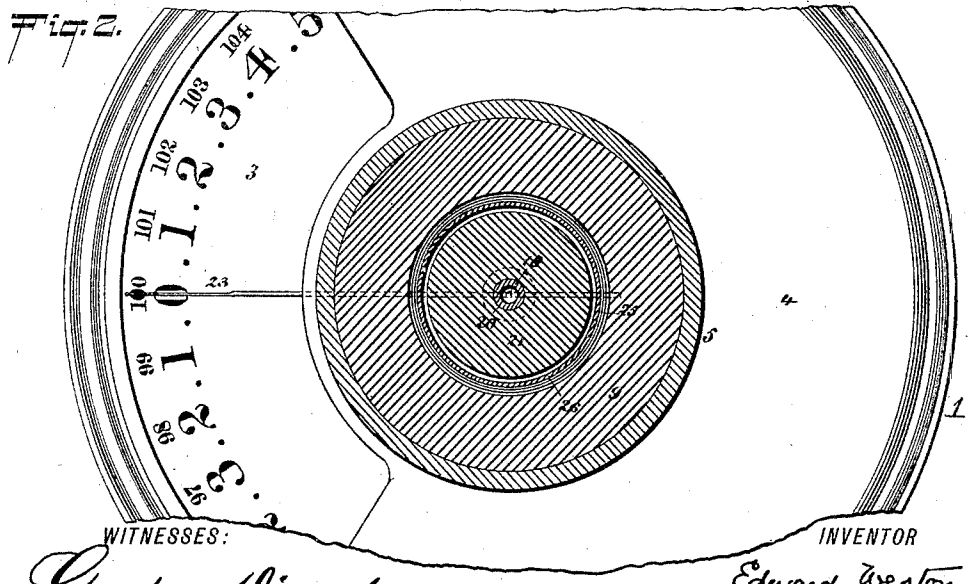


Fig. 2.



WITNESSES:

Gustave Heinrich.

William Goebel.

INVENTOR

Edward Weston

BY Park Benjamin

Lis ATTORNEY.

(No Model.)

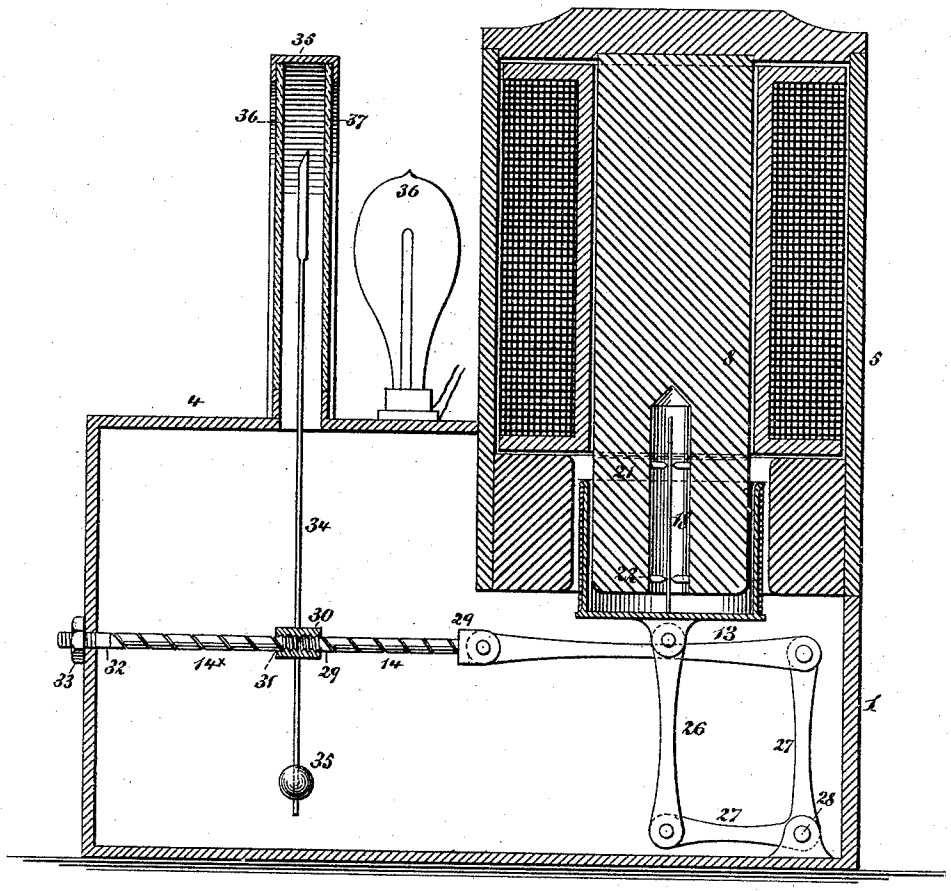
2 Sheets—Sheet 2.

E. WESTON.

POTENTIAL INDICATOR.

No. 444,803. Patented Jan. 13, 1891.

Fig. 3.



WITNESSES:

Gustave Dieterich.

M. Bosch.

INVENTOR

Edward Weston

BY Park Benjamin

his ATTORNEY.

UNITED STATES PATENT OFFICE.

EDWARD WESTON, OF NEWARK, NEW JERSEY.

POTENTIAL-INDICATOR.

SPECIFICATION forming part of Letters Patent No. 444,803, dated January 13, 1891.

Application filed June 5, 1890. Serial No. 354,307. (No model.)

To all whom it may concern:

Be it known that I, EDWARD WESTON, of Newark, Essex county, New Jersey, have invented a new and useful Improvement in Potential Indicators or Voltmeters, of which the following is a specification.

My invention relates to an instrument for showing variations in potential of the current maintained on a circuit or for indicating the electrical pressure of a current in volts.

My invention consists, broadly, in an electrical measuring-instrument embodying two coils connected in circuit and having their longitudinal axes in prolongation, one of said coils being both rotary on its axis and movable with reference to the other coil, near which it is placed in inductive proximity, and a means for indicating the extent of rotary movement of said movable coil; also, in an electrical measuring-instrument having a translucent scale-plate, and, also, in the various instrumentalities and combinations, as hereinafter described, and more particularly set forth in the claims.

In the accompanying drawings, Figure 1 is a vertical section of the instrument. Fig. 2 is a horizontal section on the line X X of Fig. 1. Fig. 3 is a vertical section of a modification of the apparatus, in which the dial or scale is disposed vertically and an incandescent lamp is arranged to illuminate the scale marking.

Similar numbers of reference indicate like parts.

Referring first to the form shown in Figs. 1 and 2, 1 is a circular case forming the base or standard of the instrument, within which is arranged the horizontal segmental scale-plate 2. This plate is visible through an opening 3 and cover 4, which opening may be closed with glass. Supported on the cover 4 is a cylindrical case 5, provided with a head 6. Secured to this head 6 by the hollow screw-bolt 7 is a core 8. Within the case 5 and secured to the inner periphery thereof at its lower portion, and resting also on the cover 4, is a ring 9. The ring 9, case 5, cover 6, and core 8 constitute a magnet, in which the ring 9 and core 8 are the pole-pieces. Between the ring 9 and the core 8 there is a narrow annular interval in which an intense magnetic field is produced. Surrounding the core 8 within the ring 9 is a spool or bobbin 10 of non-magnetic material, which carries a coil 11 of insulated wire. In the interval between the core 8 and ring 9 is disposed a ring 12, of brass or other non-magnetic material, closed at its lower side by a diaphragm 13. Extending through the core 8 is an axial opening, in which is disposed a spiral spring 14. This spring is connected at its upper end to a threaded rod 15, which passes through a flanged sleeve 16, supported in the hollow bolt 7, and receives on its threaded end above said sleeve a nut 17. The lower end of the spring is connected to a short rod 18, which is fastened to a pin 19, secured at the center of the diaphragm 13.

In the lower portion of the opening extending through the core 8 is disposed a flanged sleeve 20. In said sleeve are two transverse partitions or guides 21 and 22, which may carry jewels, through which jewels the rod 18 passes. It will be seen, therefore, that the ring 12 is thus suspended by the spring 14, and that because of the reception of the rod 18 in the jewels in the transvere partitions 21 and 22 transverse motion to the suspension device is prevented. On the under side of the diaphragm 13 is a pin from which is suspended an index-needle 23, the extremity of which extends over the scale 2 and is visible through the opening 3. Extending from the under side of the needle 23, below its point of suspension, is a spring 24, by means of which the needle is held in a horizontal position. Surrounding the ring 12 is a coil of insulated wire, which is connected in series with the coil 11. The operation of the instrument is as follows: When a current the potential of which is to be measured is passed through the coil 11 and also the coil 25, its effect, in accordance with well-known laws, is to cause the coil 25, and hence its supporting-ring 12, to be moved longitudinally (upward or downward) in the space between the core 8 and ring 9; but by reason of the spring 14 the ring 12 is also caused to rotate, the rod 18 then turning in its jewel-bearings. The extent of rotation of the coil is proportional to and hence measures its movement, and this movement has a relation to the magnetic force due to the difference of potential between the terminals at which the current

enters and leaves the instrument. As the rotary movement of the ring 12 is transmitted to the needle 23 it is obvious that the movement of this needle over the scale 2, which is suitably marked in volts, will show the said difference of potential on the scale.

Referring now to the modification shown in Fig. 3, the lower case or standard of the instrument is here enlarged and the vertical case 5 is set for some distance down into it. The central opening in the coil 8 does not extend entirely through the core. The rod 18, entering said opening and passing, as before, through the jeweled bearings 21 22, terminates in said opening, and hence acts simply as a guide-rod. To the center of the lower side of the diaphragm 13 is pivoted a link 26, the lower extremity of which is pivoted to a bell-crank lever 27, which in turn is pivoted to a fulcrum 28 on the bottom of the case. To the end of the vertical arm of the bell-crank lever 27 is pivoted a forked piece 29, to which is secured one end of the spiral spring 14. The other end of the spiral spring is fastened to a short threaded rod 29, which is received in the collar 30. Another spiral spring 14* is provided with a threaded rod 31, which enters the collar 30. The other end of the spring $14^{\times}$ is fastened to a threaded bolt 32, which passes through the side of the case 1, and receives on the outside of said case a nut 33. The springs 14 and $14^{\times}$ together correspond to the spring 14, (shown in the form of instrument illustrated in Fig. 1.) Supported on the collar 30 and extending vertically upward is the needle 34, which is counterweighted at 35. In the cover 4 of the case there is an opening through which the needle extends, and above this opening there is a circular frame 35, in which are set two plates of glass 36 and 37. On one of these plates of glass 37 is inscribed the scale marking, and this plate of glass is ground or made partly translucent. Between the case 35 and the case 5 and resting on the cover 4 of the instrument is an incandescent electric lamp 36. The coil 11 and the coil 25 are connected in series, as before. The lamp 36 is connected with any independent source of electricity. The operation of this form of instrument is as follows: When the current the potential of which is to be measured is passed through the coils 11 and 25, the ring 12, as before, is moved upward or downward, and its motion is transmitted through the link 26 and bell-crank lever 27 to the springs 14 14*. These springs then, by reason of their construction, rotate, thus rotating the sleeve 30, and so causing the needle 34 to move in front of the scale. The principle of the apparatus is the same as that already described in connection with Figs. 1 and 2, the extent of movement of the coil having a relation to the magnetic force due to the difference of potential between the terminals of the instrument, and this difference of potential being shown by the extent of movement of the needle over the scale.

It will be obvious that in Fig. 1 the position of the ring 12 may be adjusted by means of the nut 17, and that in the form shown in Fig. 3 the same result may be accomplished by adjusting the nut 33.

I claim—

1. In an electrical measuring-instrument, two coils having their longitudinal axes in prolongation, one of said coils being supported so as to be rotary on its axis, and also movable with reference to the other coil and in inductive proximity thereto, and means for indicating the extent of rotary movement of said movable coil, said coils being connected in circuit.

2. In an electrical measuring-instrument, two coils having their longitudinal axes in prolongation, one of said coils being rotary on its axis and movable with reference to the other coil and in inductive proximity thereto, and means for initially adjusting one coil with reference to the other, said coils being connected in circuit.

3. In an electrical measuring-instrument, a fixed coil and a movable coil having their longitudinal axes in prolongation and placed in inductive proximity, the said movable coil being rotary on its axis and connected in circuit with said fixed coil, and means for initially adjusting the movable coil with reference to the fixed coil.

4. In an electrical measuring-instrument, two coils having their longitudinal axes in prolongation, one of said coils being movable with reference to the other coil, connected in circuit therewith, and in inductive proximity thereto, an elastic support for said movable coil, and a means of indicating the extent of movement of said movable coil.

5. In an electrical measuring-instrument, two coils having their longitudinal axes in prolongation, one of said coils being movable with reference to the other coil and electrically connected in circuit therewith and in inductive proximity thereto, the said movable coil being supported between opposed springs extending from said coil to abutment.

6. In an electrical measuring-instrument, two coils having their longitudinal axes in prolongation, one of said coils being movable with reference to the other coil, connected in circuit therewith, and in inductive proximity thereto, means for guiding the movement of said movable coil in the direction of its longitudinal axis, and means for indicating the extent of movement of said movable coil.

7. In an electrical measuring-instrument, an electro-magnet, a coil surrounding the core thereof and free to move in the direction of the axis of said core, a spiral spring connected to said coil, and an index-needle vibrated by said spring, the said magnet and coil being in circuit and the said spring rotating by its own elasticity during the movement of said coil and so vibrating said needle.

8. In an electrical measuring-instrument, an electro-magnet having one pole surround-

ing the other, a coil supported and free to move in an axial direction in the space between said poles, a means of causing said coil while so moving to rotate on its axis, and a means of indicating the extent of rotary motion of said coil, the said coil and magnet being connected in circuit.

9. In an electrical measuring-instrument, an electro-magnet, a hollow core, a coil surrounding said core, free to move in the direction of the axis thereof, and a spiral spring within said core and extending between said coil and a fixed abutment, the said coil and magnet being connected in circuit.

10. In an electrical measuring-instrument, an electro-magnet, a hollow core, a coil surrounding said core and free to move in the direction of the axis thereof, and a suspension device for said coil extending through said core, the said magnet and coil being connected in circuit.

11. In an electrical measuring-instrument, an electro-magnet, a hollow core, a coil surrounding said core, free to move in the direction of the axis thereof, and two opposed springs extending from said coil to abutments, one of said springs being within said core, the said magnet and coil being connected in circuit.

12. In an electrical measuring-instrument, an electro-magnet, a movable coil surrounding the core of said magnet and free to move in the direction of the longitudinal axis thereof, and a guide-rod connected to said coil, moving in fixed bearings, and preventing lateral movement of said coil.

13. In an electrical measuring-instrument, an electro-magnet having an aperture or recess within its core, a movable coil surrounding the core of said magnet and free to move in the longitudinal axis thereof, and a guide-rod connected to said coil, extending into said recess and through a fixed bearing therein.

14. In an electrical measuring-instrument, an electro-magnet having the hollow vertical core or pole-piece 8 and the ring pole-piece 9, surrounding the end of said core, the coil 25, suspended in the annular interval between said ring 9 and core 8, the suspending-spring 14, threaded rod 15, connected to said spring 14, and nut 17.

15. In an electrical measuring-instrument, a tubular electro-magnet having its coil within its inclosing-tube, a core within said coil, and an annular pole-piece also within said tube and surrounding the protruding end of said core, in combination with a coil suspended in the annular space between said pole-pieces and free to move in the direction of the longitudinal axis of said magnet.

16. In an electrical measuring-instrument, an electro-magnet having the hollow core 8 and ring 9, the suspended ring 12 and coil 25 therein, the spiral suspension-spring 14 for said ring 12, the guide-rod 18 and bearings therefor, and the needle 23, connected to said core.

17. In an electrical measuring-instrument, the standard or case 1, case 5 thereon, and inclosing an electro-magnet having the core 8 and ring 9, the suspended ring 12 and coil 25 thereon, the needle 23, connected to said coil, and the scale-plate 2.

EDWARD WESTON.

Witnesses:
R. C. FESSENDEN,
M. BOSCH.