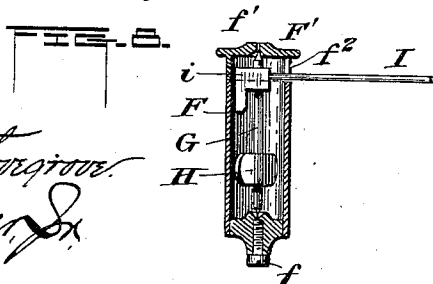
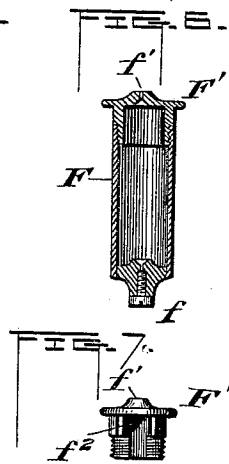
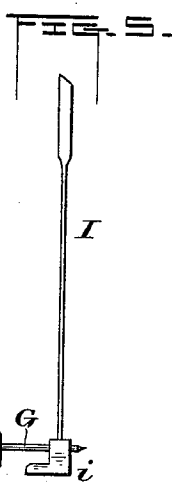
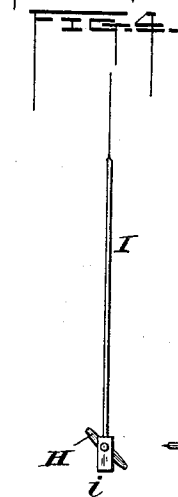
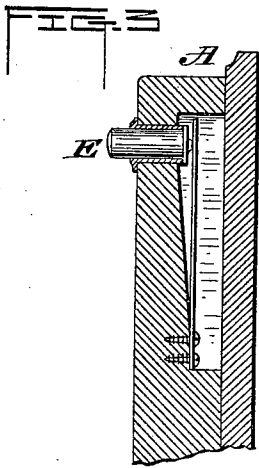
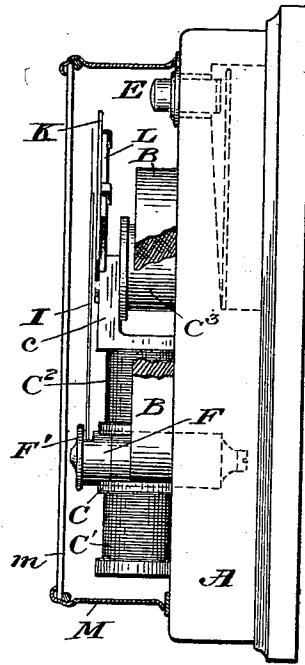
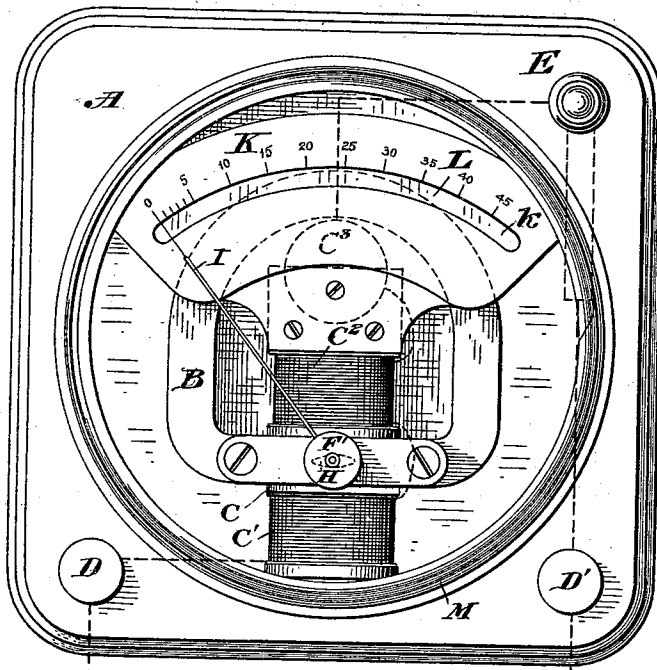


(No Model.)

E. R. KNOWLES.
VOLT METER.

No. 520,789.

Patented June 5, 1894.



Witnesses:

Walter W. Longgrove.
L. A. Comer, Jr.

Inventor:

Edward R. Knowles
By Bentley & Berdgett
attys.

UNITED STATES PATENT OFFICE.

EDWARD R. KNOWLES, OF MIDDLETOWN, CONNECTICUT, ASSIGNOR TO
THE SCHUYLER ELECTRIC COMPANY, OF CONNECTICUT.

VOLTMETER.

SPECIFICATION forming part of Letters Patent No. 520,789, dated June 5, 1894.

Application filed December 5, 1893. Serial No. 492,863. (No model.)

To all whom it may concern:

Be it known that I, EDWARD R. KNOWLES, a citizen of the United States, residing at Middletown, in the county of Middlesex and State of Connecticut, have invented certain new and useful Improvements in Voltmeters, of which the following is a specification.

My invention relates to instruments for measuring and indicating the voltage of electric currents, or the difference in potential between two conductors of electricity. Its object is to simplify the construction, cheapen the cost of manufacture, and facilitate the adjustment and repair of the instrument.

My improved volt meter comprises a removable needle of soft iron placed between the poles of a permanent magnet, and inclosed in a shell or tube of copper, to prevent excessive oscillations. A mirror placed under the index enables the readings to be made with greater accuracy. Other details of construction are hereinafter set forth, and the especially novel features are pointed out in the claims.

In the drawings, Figure 1 is a front elevation of a volt meter embodying my improvements. Fig. 2 is a side elevation thereof partly in section. Fig. 3 is a vertical section of a portion of the base showing the push button. Fig. 4 is a front elevation of the needle and index. Fig. 5 is a side view thereof. Fig. 6 is an axial section of the copper shell. Fig. 7 is a side view of the cap for said shell, and Fig. 8 shows the needle mounted in the shell.

The apparatus is mounted on a base or back A of insulating material, preferably slate. Firmly secured to the base is a permanent horseshoe magnet B whose poles are fastened to the middle of a non-magnetic spool C, whose axis lies at right angles to the line joining the poles of the magnet. On this spool are wound the coils C' C², in series, the terminal of one being connected with a binding post D on the base A. The free terminal of the other coil is connected with a resistance coil C³, which is in turn connected through a push button E with the binding post D'. The line wires are indicated at x, y.

In the middle portion of the spool C, between the poles of the magnet B, is a cylindrical

socket, in which fits the removable shell F of copper, provided with a removable cap F'. The shell incloses a spindle G, journaled at one end in an adjustable screw bearing *f* in the inner end of the shell, and at the other end in a central bearing *f'* in the cap F'. The spindle carries a short wide needle or armature H of soft iron, and an index I, of some light material, preferably aluminum. A counterweight *i* balances the index, which projects through a wide slot *f*² in the upper part of the shell, or in the cap.

The scale plate K is preferably supported on a bracket *c* projecting from the upper end of the spool C. The plate has a slot *k* concentric with the spindle G, and back of the slot is a mirror L, in which the thin end of the index is reflected. By ranging the index with its reflection, the exact reading on the graduations along the edge of the slot will be readily ascertained.

The operation of the meter is as follows: The lines of force of the permanent magnet thread themselves through the soft iron needle or armature, and turn it till it comes to rest in the position shown in dotted lines in Fig. 1. The torque tending to return it to this normal position increases with the deflection of the needle from this position. The passage of an electric current through the coils C' C² tends to swing the needle to a position parallel with the axis of the spool C, but the torque exerted decreases as the needle approaches that position. When the opposing forces of the magnet and the coils balance each other, the needle comes to rest, and the index points on the scale to the number indicating the voltage of the current. The currents induced by the armature H in the surrounding shell of copper F retard or dampen the movement of the armature, and thus prevent the index from oscillating so much as to render it difficult to get an accurate reading. The push button enables readings to be taken at will, by merely closing the circuit through the coils C' C². The removable shell F enables the needle and index with the spindle and its bearings to be quickly removed for repairs or adjustment, or to permit other shells containing different needles to be inserted.

The working parts of the instrument are protected by a cover M having a glass top *m*.

Having thus described my invention, what I claim is—

5 1. In a volt meter, the combination with a permanent magnet, of a spool of non-magnetic material lying transverse to the poles thereof, and containing a socket, and a shell remov-
10 ably fitted into said socket and having journal bearings for an armature spindle, substantially as described.

2. In a volt meter, the combination with a permanent magnet, of a spool of non-magnetic material lying transverse to the poles thereof,
15 and containing a socket, a shell fitted removably into said socket, and a spindle carrying an armature and an index, journaled in bearings in said shell, substantially as described.

3. In a volt meter, the combination with an armature, of a spindle on which it is mount- 20
ed, and a copper shell surrounding said spindle and having bearings in which the spindle is journaled, substantially as described.

4. In a volt meter, the combination with an armature, of a spindle on which it is mount- 25
ed, an index on the spindle, and a copper shell surrounding said spindle, having bearings in which the spindle is journaled, and a slot through which the index projects, substantially as described. 30

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

EDWARD R. KNOWLES.

Witnesses:

D. J. GLAZIER,

JO. T. ELLIOTT.