No. 822,319. PATENTED JUNE 5, 1906.

J. B. TAYLOR.

# PORTABLE POTENTIAL INDICATOR.

APPLICATION FILED JUNE 10, 1905.

Fig. 2.

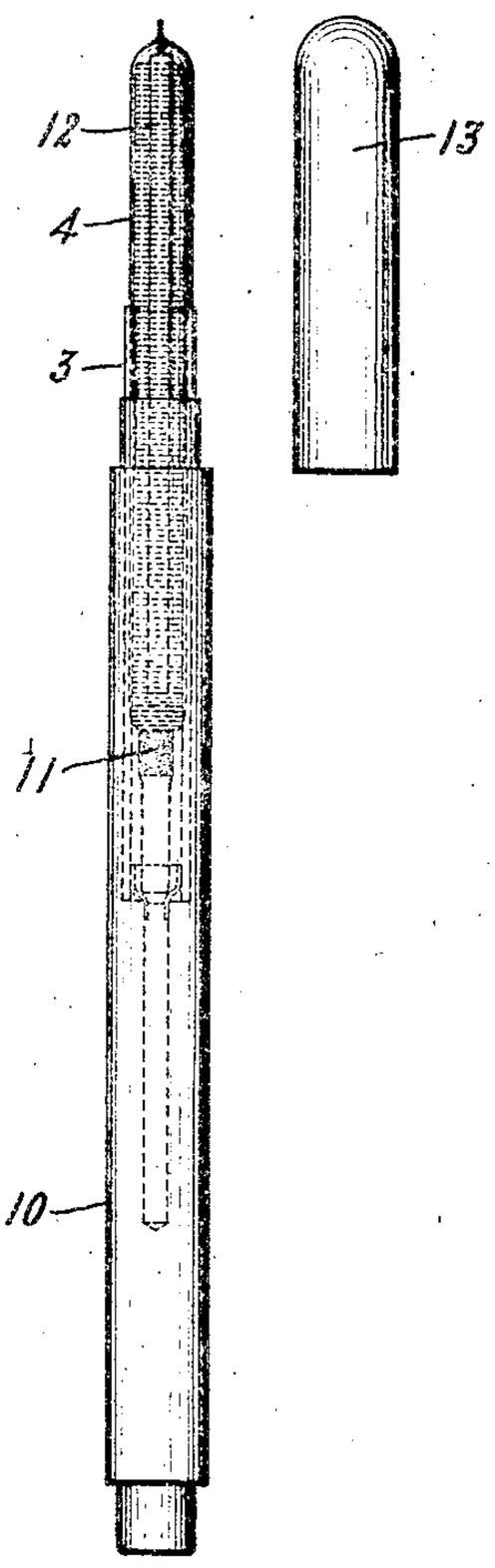



Fig. 1.

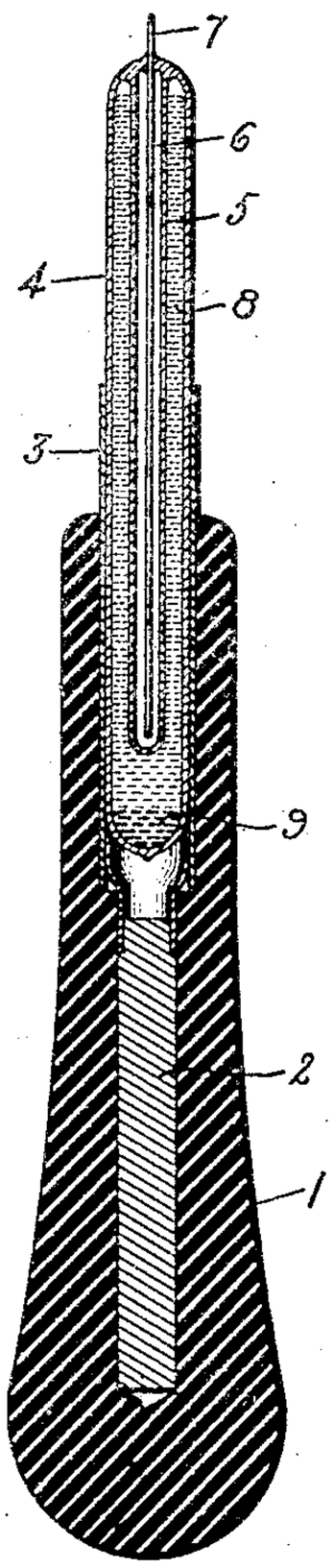



Fig. 3.

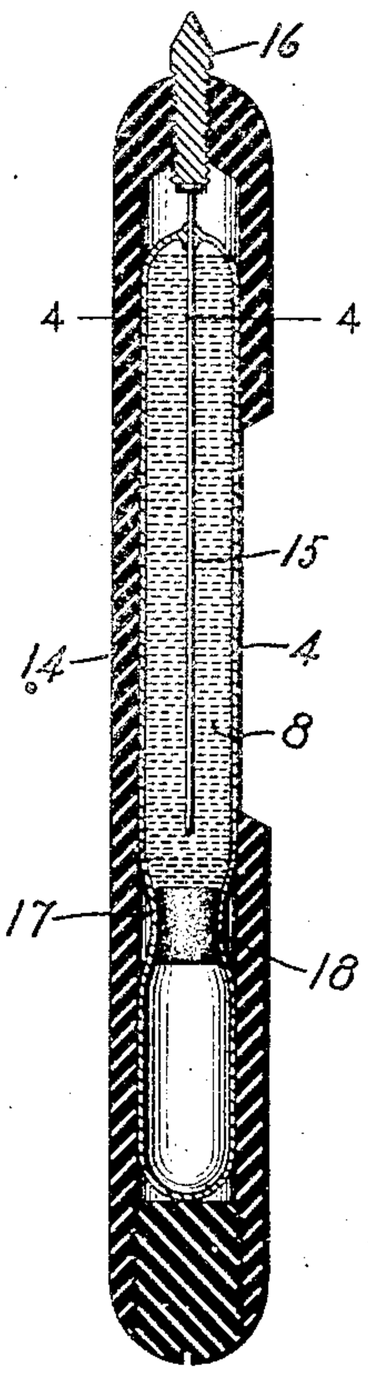



Fig. 4.

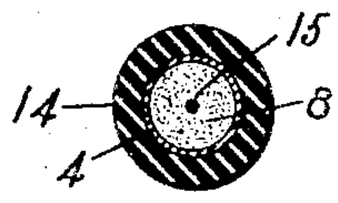
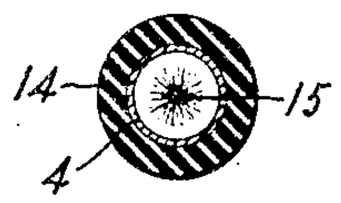



Fig. 5.

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# UNITED STATES PATENT OFFICE.

JOHN B. TAYLOR, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## PORTABLE POTENTIAL-INDICATOR.

No. 822,319. Specification of Letters Patent. Patented June 5, 1906.

Application filed June 10, 1905. Serial No. 264,606.

*To all whom it may concern:*

Be it known that I, JOHN B. TAYLOR, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Portable Potential-Indicators, of which the following is a specification.

This invention relates to electrical instruments; and it consists in a device for indicating whether or not an electrical conductor is alive—that is, whether its potential differs in greater or less degree from that of the earth or of the person using the device.

The invention comprises a glass tube filled with a finely-divided conducting substance held in suspension in a liquid insulator. A metallic electrode is sealed into one end of the tube, and if the tube is held in the hand and brought into proximity to a charged conductor the suspended conducting particles become electrified inductively and are attracted to the electrode and to the walls of the tube. This motion of the particles causes a change in the appearance of the liquid and the powder, which indicates that the conductor is charged.

In the accompanying drawings, Figure 1 is a longitudinal section of a device embodying my invention. Fig. 2 is a side elevation of a modification thereof. Fig. 3 is a longitudinal section of a further modification. Figs. 4 and 5 are cross sections of Fig. 3 on the line 4 4, showing the position of the divided metallic substance when uncharged and when charged.

Referring first to Fig. 1, there is seen a handle 1, of hard rubber or other good insulating material, in which is inserted a rod 2, of metal, having a tubular extension or sleeve 3, which projects beyond the end of the handle. Closely fitted into this sleeve is a glass tube 4, hermetically closed at each end and containing an inner concentric and smaller tube 5. An electrode 6 of some suitable metal, such as platinum, is inserted into the inner tube and extends beyond the end thereof at 7. It may be of any desired shape, and the greater its surface the more quickly it effects the movement of the conducting particles. The annular space around the inner tube is filled with a liquid insulator 8—such as gasolene, benzene, kerosene, turpentine, or some vegetable oil—having in suspension in it some powdered metallic substance, such as sulfid of tin or aluminium powder. There is also placed in the tube a small quantity of mercury 9, by which the inner walls of the tube may be scoured upon giving the device a rapid agitation.

Fig. 2 shows the device mounted in a case similar to a fountain-pen. The tubular barrel 10 partially incloses the sleeve 3 and the glass tube 4, the lower end of the latter being reduced in diameter and closed with a stopper 11 before being hermetically sealed. The electrode is in the form of a strip 12, and it is in contact with the liquid instead of being inclosed in an inner tube. While being carried in the pocket and out of use the exposed portions of the sleeve, tube, and electrode may be covered by a cap 13.

In Fig. 3 the glass tube is inclosed in a sheath 14, of hard rubber or other insulating material, a portion of which is cut away on one side so as to expose the glass tube. This form of the device protects the tube from mechanical injury. The electrode 15 is immersed directly in the liquid and makes contact with an adjustable tip 16, projecting beyond the end of the sheath.

In case gasolene or other volatile and readily-ignited liquid is used some difficulty is experienced and some skill is required to seal off the tube after it has been filled. In Fig. 3 the tube is shown as contracted at the point 17, and after the proper amount of liquid and powder and mercury have been placed in the tube a small cork 18 is forced into the contracted portion, making a tight joint. The end of the tube can then be safely sealed off, as there is sufficient distance between said end and the cork to prevent the heat of the sealing-flame from evaporating and igniting the volatile liquid.

The operation of the device is as follows: It is held in the hand of the operator, and the projecting end of the electrode is approached to a conductor. In the case of high voltages it is not necessary to make actual contact with the conductor. If the latter is charged, the floating particles in the liquid become electrified inductively and are attracted to the inside of the glass tube and to the electrode or the outside of the inner glass tube when one is used. In the form shown in Fig. 1 the device is virtually several condensers in series, the sleeve tending by electrostatic

capacity to come to the same potential as the hand of the operator, while the outer surface of the inner glass tube inductively tends to approach the potential of the electrode—that is, of the conductor under test.

The motion of the conducting particles causes a change in the appearance of the liquid and powder, which is the indication that the conductor is charged. If sulfid of tin is used, the contents of the tube change from a gold color to a dark brown. In some forms, depending on the size, relative position of electrodes, &c., the liquid changes color at moderate voltages, while at higher voltages the particles are attracted so closely to the walls of the glass tube that they form a coating which clings to the tube until removed by shaking, in which operation the mercury assists very materially in mixing the liquid and the powder. This kind of indication while quite different from the change of color is readily distinguished and in a rough way gives an opportunity for differentiating high voltages from low ones.

The action is somewhat different on direct currents from that which takes place with alternating currents. With direct current there is a tendency for all of the metallic particles and the inner surface of the glass tube to come to the same potential, because of the transfer of charges from the electrode to the walls of the tube by means of the moving particles. As soon as this condition of equal potential exists there is no attraction of the particles for each other or for the tube or the electrode, and indication ceases. In general the lighter liquids, such as gasolene, reach this condition more rapidly than the heavier liquids. I may therefore use turpentine mixed with castor-oil or any other oil which will increase the viscosity of the liquid, and thus retard the motion of the metallic particles. With gasolene the indications on direct current may appear and disappear inside of one second, while with heavier liquids this time may be increased to a number of seconds.

In the case of alternating currents the conditions are different, since the tendency is for the particles to go first to one electrode and then to the other.

The indications may be made more pronounced by placing some coloring-matter in the liquid—as, for instance, black—which makes a greater contrast with the gold color of the sulfid of tin than an uncolored liquid. In the case of aluminum-powder a red dye makes a good contrast with the gray color of the powder.

It will be seen that the device is easily transported and that the glass parts being small and inclosed are not likely to be broken even with rough handling. As the active elements are hermetically sealed in glass, atmospheric conditions have no effect on the indications. The device consumes an infinitesimal amount of energy, and its application to a conductor has therefore absolutely no effect on the system. Safety to the user is insured by making the thickness of the glass and insulating-handle sufficient to stand a potential many thousand volts greater than that of any circuit on which there is a chance of its being used. The device has no delicate parts and requires no adjustment, so that it can be used indiscriminately on circuits having either high or low voltages without being damaged. It is applicable to both direct-current and alternating-current systems of any voltage and can be used in any position.

I do not desire to restrict myself to the particular form or arrangement of parts herein shown and described, since it is apparent that they may be changed and modified without departing from my invention.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A potential-indicator comprising a vessel, movable particles of conducting material in said vessel, and an electrode extending into said vessel.

2. A potential-indicator comprising a sealed glass vessel, a liquid insulator in said vessel, metallic particles in said liquid, and an electrode extending into said vessel.

3. A potential-indicator comprising a sealed glass tube, a liquid insulator in said tube, metallic particles suspended in said liquid, and an electrode extending into said tube.

4. A potential-indicator comprising an insulating-handle, a glass tube mounted in said handle, a liquid insulator in said tube, powdered conducting material in said liquid, and an electrode extending into said tube.

5. A potential-indicator comprising an insulating-handle, a metallic sleeve mounted therein, a glass tube fitting inside said sleeve, an inner glass tube, an electrode inclosed in said inner tube, a liquid insulator in the space between said tubes, and conducting particles in said liquid.

6. A potential-indicator, comprising a glass tube, an electrode therein, a liquid insulator in said tube, conducting particles in said liquid, and a small quantity of mercury in said tube.

In witness whereof I have hereunto set my hand this 8th day of June, 1905.

JOHN B. TAYLOR.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.