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A. C. CREHORE & G. O. SQUIER.

CAPILLARY ELECTROMETER FOR RELAY PURPOSES.

(No Model.) (Application filed Oct. 20, 1899.)

Fig. 1.

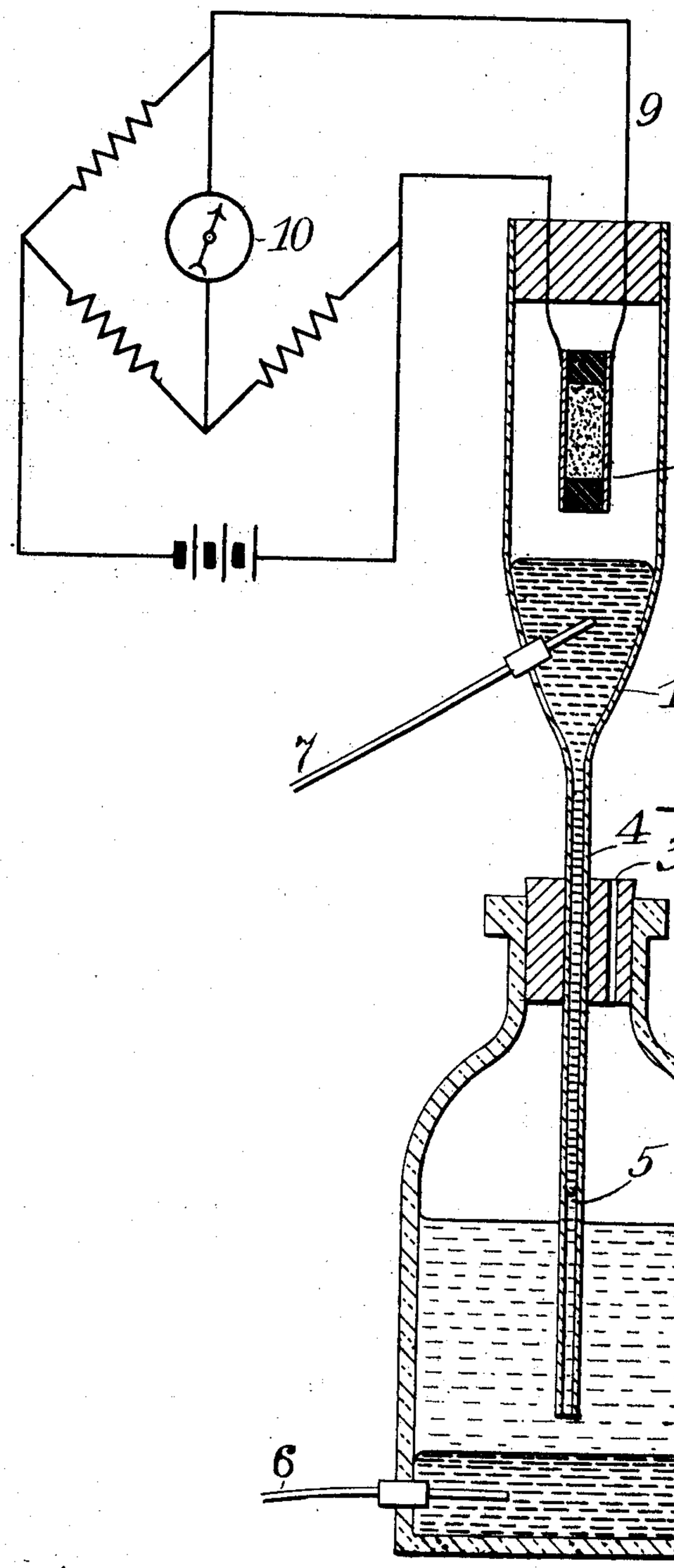
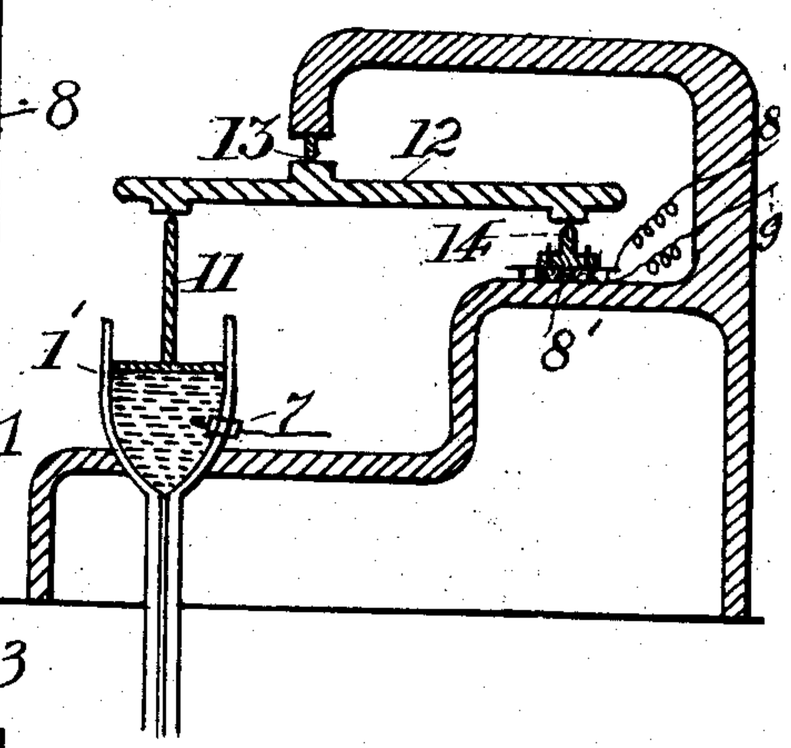


Fig. 2.



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CAPILLARY ELECTROMETER FOR RELAY PURPOSES.

SPECIFICATION forming part of Letters Patent No. 669,149, dated March 5, 1901.

Application filed October 20, 1899. Serial No. 734,177. (No model.)

To all whom it may concern:

Be it known that we, ALBERT C. CREHORE, a resident of Tarrytown, Westchester county, New York, and GEORGE O. SQUIER, a resident of Washington, District of Columbia, citizens of the United States, have invented a certain new and useful Capillary Electrometer for Relay Purposes, of which the following is a specification.

This invention relates to the use of a capillary electrometer for relay purposes, said electrometer being substantially such as that disclosed by Lippmann. The Lippmann electrometer consists of a glass tube drawn down to capillary size at its lower end and filled with mercury. Said lower end was then immersed in a vessel containing dilute sulfuric acid and a layer of mercury, the end of the tube being at some distance above the mercury in the vessel. Terminals of an electric circuit were connected to the mercury in the tube and in the vessel, respectively. The sulfuric acid arose in the tube by capillary attraction and raised the mercury therein to a certain point. Then as the electric circuit was completed any variation in potential at the terminals of the circuit would cause the meniscus formed between the surfaces of the mercury and acid in the tube to move up and down, the extent of movement of the meniscus measuring said variation. Upon this phenomenon the present invention is based. The circuit whose fluctuations or variations in potential are to be utilized is connected to the terminals of the capillary electrometer. Said electrometer may then be made to operate upon another or local circuit by utilizing the movement of the mercury in the tube. This movement may be made use of by means of any of the various devices for multiplying motion and the resultant applied to the opening and closing of an electric circuit or to the variation of resistance in such circuit, or said movement may be made to act more directly upon a resistance in such circuit, as will be hereinafter described, as the most practical means yet conceived for the utilization of all of the movements of the mercury column even to the slightest.

The accompanying drawings show in Figure 1, in section and diagrammatically, the capillary electrometer and the manner in which it may be made to relay a circuit to a local circuit. Fig. 2 shows a modified construction.

In said drawings, 1 refers to the mercury-tube of the electrometer, and 2 to the vessel containing mercury in its bottom and dilute sulfuric acid above it. This vessel is preferably open to the air, as shown by the passage 3 in its cork.

4 refers to the mercury in the tube, and 5 to the meniscus between the mercury and the acid.

6 7 refer to the terminals of the main circuit.

The tube 1 is sealed, and the space above the mercury is preferably filled with some liquid of slight compressibility, such as oil. In the oil is located a receptacle, as 8, (shown in vertical transverse section,) one or both sides of which are formed of metallic diaphragms. These are insulated from each other and form terminals of the local circuit 9, and between these diaphragms a suitable variable resistance is placed—such, for instance, as carbon granules.

Any variation in the elevation of the mercury in tube 1 will cause the diaphragms of receptacle 8 to be pressed inward, thereby decreasing the resistance through the granular carbon, and vice versa. Therefore by placing in the local circuit 9 any suitable device responsive to this variable resistance the variations in the main circuit may be shown. For example, a Wheatstone-bridge arrangement may be employed, as indicated, in one leg of which the variable resistance 8 is placed, the other legs each having a fixed resistance, and in the bridge is placed the operating-coil 10, of any suitable indicator or recorder—such, for instance, as a siphon-recorder.

It is clear from the above description that a change in potential in the circuit 6 7 will cause a movement of the meniscus 5, which means a change in the height of the mercury in tube 1 and a variation in the pressure on the diaphragm of the receptacle 8—hence a change in the resistance in said receptacle

and an unbalancing of the bridge, and consequently a flow of current over the coil 10, whereby an indication or record is produced.

The meniscus is very sensitive and rapid in its movements, and therefore the apparatus is well adapted for use as a receiver for submarine cables. Though especially applicable to the above use, it is clear that it is capable of a wide range, since it responds quickly to changes of current, the deflection of the meniscus is proportional to difference of potential, it takes no current, it is dead beat, and it responds to exceedingly small voltages.

No attempt has been made to illustrate a working apparatus, but simply to give a clear idea of the adaptation of the capillary electrometer to practical uses. Obviously the movements of the meniscus may be transmitted in a purely mechanical manner, as by a series of levers, to that on which the changes in circuit 6 7 are to be impressed, or the movements of the mercury in tube 1 may be made to act upon a variable resistance in many ways other than that shown. The transmission of the movements of the meniscus by lever construction is graphically illustrated in Fig. 2, wherein the piston 11 is placed upon the mercury in tube 1′, and upon this rests a lever 12, fulcrumed at 13 and resting at its opposite end upon a post 14, which is supported by the upper diaphragm of the variable resistance 8′ in the circuit 9. Obviously any movement of the piston will be transferred to and multiplied upon this variable resistance. All these variations and many others may be made in adapting the capillary electrometer to practical use without departing from the invention residing in the adaptation thereof to the purposes of a relay.

We claim as our invention—

1. The combination with a capillary electrometer, substantially such as described, of an electric circuit controlled by the movement of the fluids separated by the meniscus in said electrometer.

2. The combination with a capillary electrometer, substantially such as described, of a liquid body or column affected by the movements of the liquids separated by the meniscus in said electrometer and means actuated by said column of liquid for controlling an electric circuit.

3. The combination with a tube containing conducting fluids between which a meniscus is formed and the position of which meniscus is varied by the fluctuation of an electric current passed through the liquids across the meniscus, of an electric-circuit-controlling apparatus actuated in response to the movements of the fluid above the meniscus.

4. The combination with the capillary electrometer, substantially such as described, of a closed space or chamber above the mercury in the capillary tube of the electrometer filled with a non-compressible fluid, and a current-varying device located in said fluid and operated by the rise and fall of the mercury.

5. The combination with a capillary electrometer substantially as described, of a closed space or chamber above the mercury in the capillary tube of the electrometer filled with a non-compressible fluid, a receptacle located in said chamber and having flexible walls, a variable resistance within said receptacle, an electric circuit containing said resistance, and an indicator in said circuit, for the purpose set forth.

Signed at New York city, in the county of New York and State of New York, this 12th day of June, 1900.

ALBERT C. CREHORE.
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