

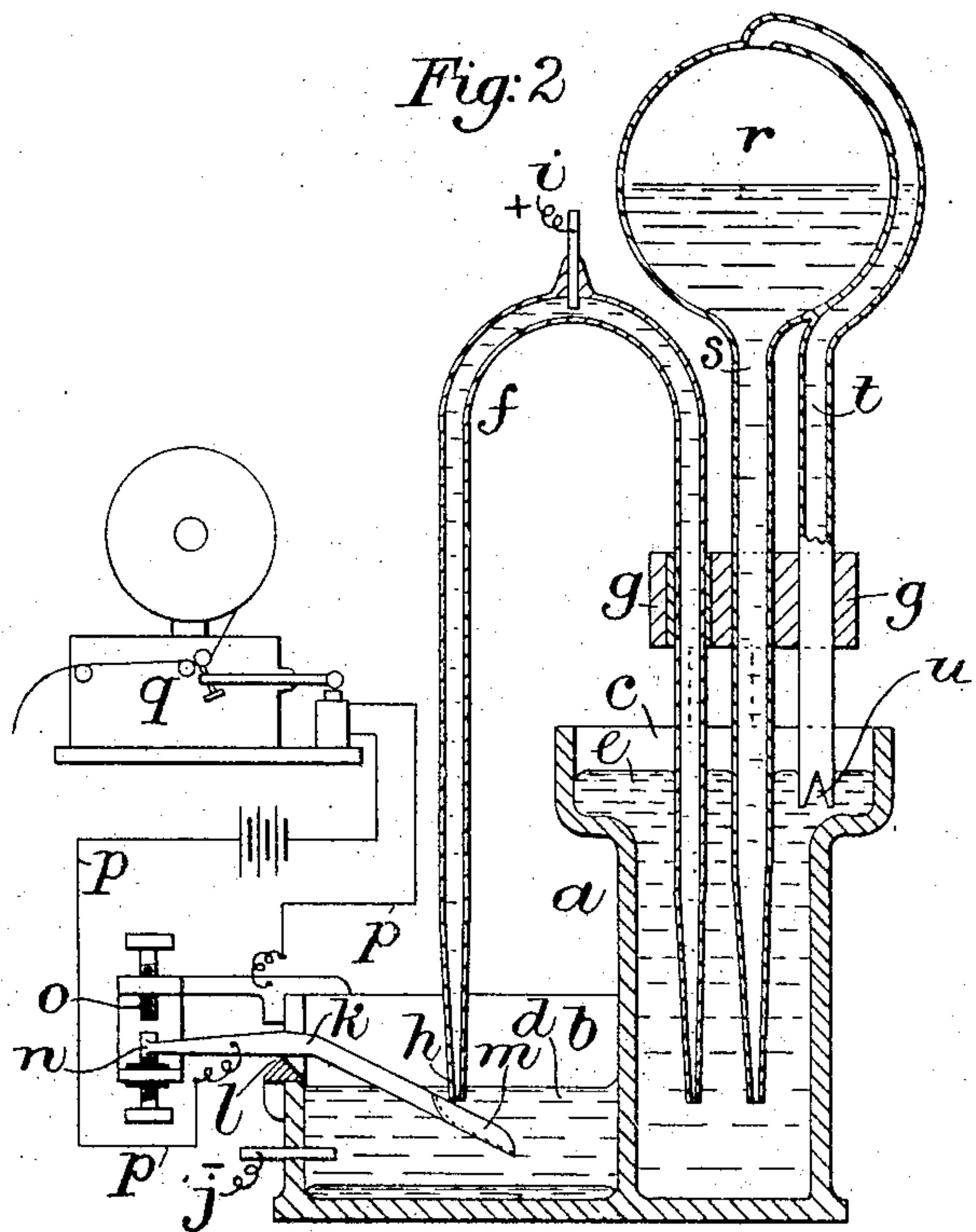
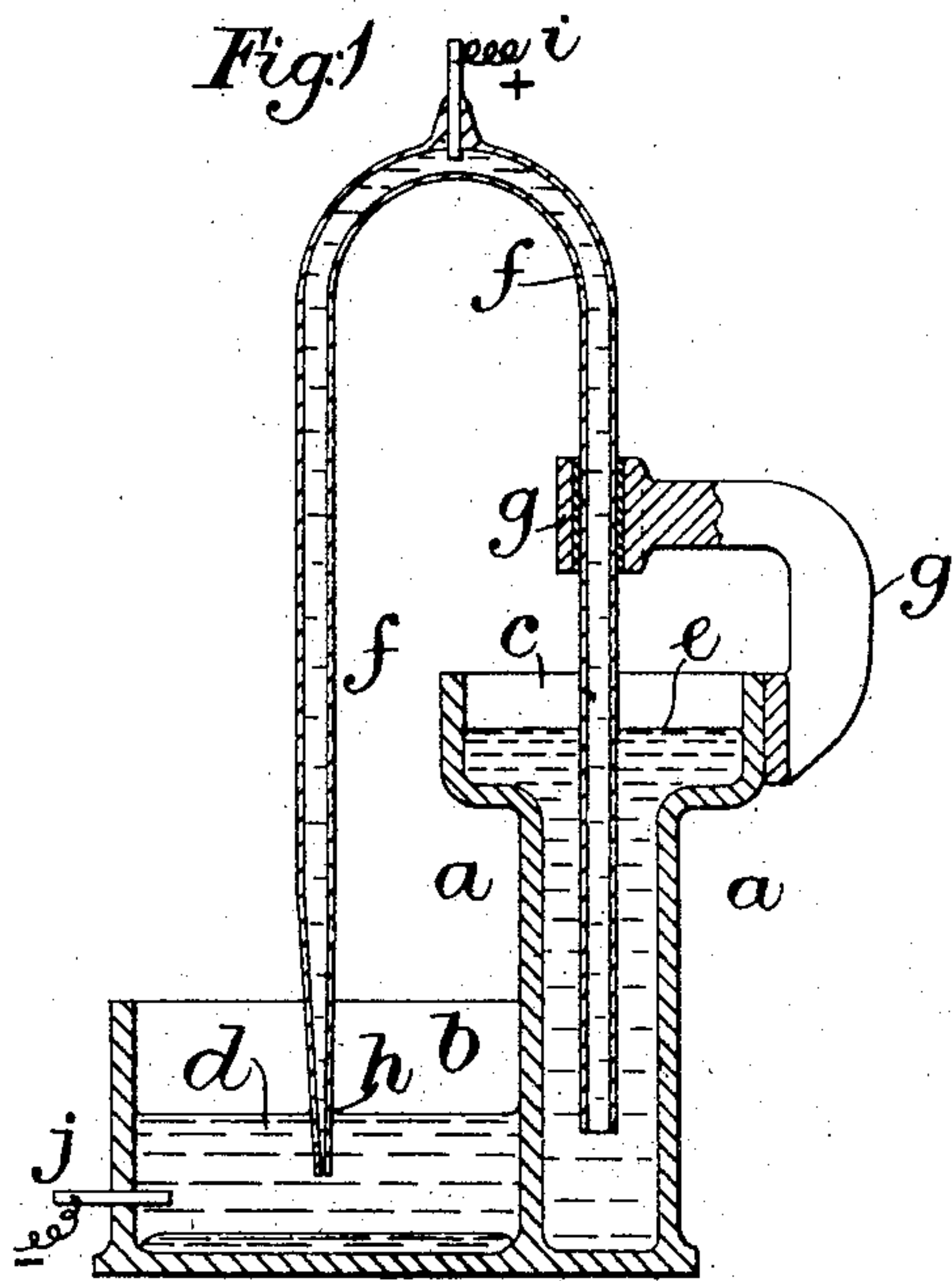
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PATENTED AUG. 29, 1905.

J. T. ARMSTRONG & A. ORLING.

GALVANOSCOPE.

APPLICATION FILED MAY 19, 1902.



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UNITED STATES PATENT OFFICE.

JAMES T. ARMSTRONG AND AXEL ORLING, OF LONDON, ENGLAND.

GALVANOSCOPE.

No. 798,152.

Specification of Letters Patent.

Patented Aug. 29, 1905.

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To all whom it may concern:

Be it known that we, JAMES TARBOTTOM ARMSTRONG, a subject of the King of England, and AXEL ORLING, a subject of the King of Sweden, both residing at London, England, have invented new and useful Improvements in and Connected with Galvanoscopes and Means of Actuating One or More Relays Thereby, of which the following is a specification.

Our invention relates to apparatus employed to detect the presence of electrical currents, and has for its object improvements whereby extremely weak currents may be detected and caused to actuate other apparatus or mechanisms directly or through one or more relays.

In carrying out our invention we make use of the electrocapillary force exerted at the surfaces in contact of certain dissimilar fluid conductors (such as mercury and dilute acid or a solution of spirits of wine and potassium iodide) when an electric current flows through one to the other. This force brings about a displacement of the said fluids, which effect we employ to start the action of a siphon or to disturb the balance of a delicately-poised part of the apparatus, by means of either of which or a combination of both a relay-circuit may be closed. In any case the normal condition of the apparatus is one of equipoise and the effect of the electrocapillary force is to disturb the equilibrium. It is therefore manifest that the displacement (which always accompanies the passage of even the weakest currents) must vary the distribution of weight and cause a preponderance on one side that will effectually operate the apparatus.

According to our invention the fluid conductors are in some cases contained by separate receptacles, which communicate with each other through a tube or other suitable channel, or alternatively we employ a tube or an equivalent part of suitable form alone, as is hereinafter particularly described with reference to the accompanying drawings, in which—

Figures 1 and 2 represent vertical sectional views of two forms of the apparatus embodying our invention.

According to the simplest form of our invention (shown in Fig. 1) we employ a vessel *a*, having two chambers *b* and *c*, the former of which is shallow and contains dilute acid *d*, while the latter is considerably deeper and contains mercury *e*, the surface of which

is maintained at a considerably higher level than that of the dilute acid in *b*.

Above the chambers *b c* is an inverted-U-shaped siphon *f*, constituting the fluid-conducting tube, which is filled with mercury and is supported by a bracket *g*, while its legs dip into the fluids contained by the chambers *b c*.

In order to prevent the mercury from normally flowing through the siphon in the absence of the electrocapillary force, the end of the delivery-leg *h* is constricted. When, however, the current flows, it is at this precise point that the electrocapillary force is set up and displacement of the fluid in the direction from positive to negative takes place. In order, therefore, that this displacement may be in the same direction that the mercury flows through the siphon, the current enters the apparatus at *i*, where it enters the mercury passing through it in the siphon into the dilute acid in the chamber *b* when it leaves the apparatus at *j*. In this way the electrocapillary force acts to reduce the resistance which the constricted portion of the delivery-leg *h* of the siphon *f* opposes to the flow of the fluid in its absence.

In Fig. 2 is shown another form of our invention, which is provided with a means of maintaining the level of the mercury in the chamber *c* and is adapted to operate a relay. According to this arrangement a lever *k* is delicately poised at a point *l* adjacent to the delivery end of the siphon *h*, while one of its ends *m* extend beneath the surface of the dilute acid in the chamber *b* in order that any mercury delivered by the siphon *f* may fall upon it, and so cause its other end *n* to make contact at *o*, and thereby close a relay-circuit *p*, by means of which a telegraph instrument *q*, a call-bell, or any other apparatus or mechanism may be operated. Preferably the end *m* of the lever *k* is trough-shaped in order that the mercury delivered onto it may remain in contact therewith for an appreciable time. According to the construction shown in this figure both ends of the siphon are constricted for the same purpose as the one shown in Fig. 1.

In order to preserve the level of the mercury *e* in the chamber *c*, a reservoir *r* is provided. This reservoir contains mercury and is provided with two tubes or tubular legs *s t*, the former of which extends beneath the surface, where its lower extremity may be constricted to prevent a too rapid supply of mercury, while the other leg *t* is shorter and

terminates with a V-shaped aperture *u* in order that it may be gradually opened as the level of the mercury in the chamber *c* falls.

The mercury in the reservoir *r* is retained
5 by a partial vacuum that is gradually destroyed by the admission of air through the leg *t* as the level of the mercury in the chamber *c* falls, and it is on account of this that sufficient mercury is allowed to leave the reservoir to maintain the level, and so close the
10 vent.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

15 1. In electrocapillary apparatus, the combination of a tube containing an electric conducting fluid with means for imparting an electric charge to such fluid to reduce the capillary force and so allow the fluid to flow out
20 of said tube, substantially as set forth.

2. In electrocapillary apparatus, a tube having a constricted end and containing an electrically conducting fluid in combination with means for supplying such fluid thereto and
25 means for imparting an electric charge to such fluid, said charge being sufficient to cause the fluid to flow out of the tube substantially as and for the purpose set forth.

3. In electrocapillary apparatus, the combination of a tube containing a single fluid only, the same being an electric conductor and subject to electrocapillary action, with means for imparting an electric charge to said fluid to change the capillary force and allow the
30 said fluid to flow in said tube substantially as set forth.

4. In electrocapillary apparatus, the combination with a tube containing a single fluid only, which is an electric conductor and in contact at one end of the said tube with another fluid, of means for imparting an electric charge to the fluid in the tube to change the capillary force and cause the flowing of the fluid in the tube substantially as set forth.
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5. In electrocapillary apparatus, a tube of siphon form opening at its ends into two different fluids, in combination with means for setting up a potential difference between such fluids substantially as set forth.
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6. In electrocapillary apparatus, a tube of siphon form supplied with mercury and dipping at one end into a different conducting fluid, in combination with means for setting up a potential difference between such fluids
50 substantially as set forth.

7. In electrocapillary apparatus, a tube of siphon form containing electrically conducting fluid, in combination with a receptacle for said fluid receiving one leg of said tube, a receptacle for another fluid receiving the other leg of said tube and means for setting up a potential difference between such fluids for the purpose set forth.
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8. In electrocapillary apparatus, a tube of
65 siphon form, containing mercury, in combination

with a mercury-receptacle, receiving one leg of the said tube, a receptacle for acid solution or other suitable liquid receiving the other leg of said tube and conductors arranged to impart a positive charge of electricity to
70 the mercury in said tube substantially as set forth.

9. In electrocapillary apparatus, a tube of siphon form containing mercury, in combination with a mercury-receptacle receiving
75 one leg of the said tube, a receptacle for acid solution or other suitable liquid receiving the other leg of said tube and conductors arranged to set up a potential difference between the said liquids substantially as and for the purpose set forth.
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10. In electrocapillary apparatus, a tube of siphon form, containing electrically conducting fluid and having its discharge end constricted, in combination with receptacles for
85 diverse fluids receiving its ends or legs and means for setting up a potential difference between such diverse fluids substantially as set forth.

11. In electrocapillary apparatus, a tube of
90 siphon form, containing electrically conducting fluid and having both ends constricted, in combination with receptacles for diverse fluids, receiving its ends or legs and means for setting up a potential difference between
95 such diverse fluids substantially as set forth.

12. In electrocapillary apparatus, the combination of a tube containing an electrically conducting fluid with means for imparting an electric charge to the same to reduce the capillary force and so allow the fluid to flow through said tube, a movable part arranged to be moved by the fluid falling from said tube and operative devices controlled by the said movable part substantially as set forth.
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13. In electrocapillary apparatus, a fluid-conducting tube supplied with diverse fluids at its ends, in combination with means for imparting an electric charge to the fluid contained by the said conducting-tube or some part thereof and mechanism arranged and adapted to be moved by the fluid falling from the said tube, substantially as set forth.
110

14. In electrocapillary apparatus, a fluid-conducting tube supplied with diverse fluids
115 at its ends, in combination with means for imparting an electric current to the fluid contained by the said conducting-tube or some portion thereof, a pivoted part arranged to have its center of gravity changed by the movement of fluid through the said tube, and operative devices governed by the said pivoted part.
120

15. In electrocapillary apparatus, a fluid-conducting tube means for imparting an electric charge to the fluid contents of the same to produce a flow of fluid, a movable part arranged to be actuated by the fluid thus discharged, an electric circuit closed by such movement of the said part, the said circuit in-
125 130

cluding and operating a relay substantially as set forth.

16. In electrocapillary apparatus a tube of siphon form, containing electrically conducting fluid in combination of imparting an electric charge to the fluid contents of the said tube to cause an electrocapillary flow of said liquid through the discharge end thereof, a movable part arranged to be struck by the said liquid as the latter falls by gravity out of the said tube and operative devices governed by the said movable part.

17. In electrocapillary apparatus, a tube of siphon form, containing electrically conducting fluid, a receptacle for such fluid receiving also one end of the said tube means for imparting an electric charge to the said fluid, a receptacle for the liquid discharge, a movable part arranged in the latter receptacle in position to be struck and moved by the falling liquid and an electric circuit arranged to be closed by thus moving the said part substantially as set forth.

18. In electrocapillary apparatus a tube of siphon form, means for supplying diverse fluids to its ends, means for setting up a potential difference between such diverse fluids to produce a flow of fluid a movable part arranged to be actuated by the fluid thus discharged and an electric circuit closed by such movement of the said part, substantially as set forth.

19. In electrocapillary apparatus a tube containing an electrically conducting fluid means for imparting an electric charge to the latter to produce a flow of fluid, a receptacle which supplies the said tube, a reservoir which supplies the said receptacle, a tube, *t*, extending from the top of the said reservoir to the upper part of the said receptacle and a tube *s*, constricted at the lower end, extending from the bottom of the said reservoir to the lower part of the said receptacle substantially as set forth.

20. In electrocapillary apparatus a fluid-conducting tube of siphon form, fluid-receptacles receiving its ends, means for setting up a potential difference between the diverse fluids,

a mercury-reservoir and a tube conducting the said liquid by gravity to one of the said receptacles, the lower end of the said supply-tube and the delivery end of the siphon-tube being constricted substantially as set forth.

21. In electrocapillary apparatus, a tube containing electrically conducting fluid, means for imparting an electric charge to the same, a receptacle for mercury receiving and supplying one end of the said conductor, a mercury-reservoir, a tube supplying said receptacle from said reservoir and means for automatically admitting atmospheric pressure to the said reservoir when the mercury descends in the said receptacle substantially as and for the purpose set forth.

22. In electrocapillary apparatus, a tube of siphon form, a pair of receptacles respectively containing mercury and other fluid and receiving the ends of the said tube and a pair of electric conductors constituting the positive and negative poles of the apparatus and connected respectively to the interior of the said tube and the interior of the receptacle receiving its discharging end in order that a potential difference may be conducted to the diverse fluids for the purpose of promoting an electrocapillary flow of liquid substantially as set forth.

23. In electrocapillary apparatus, a receptacle for liquid, a reservoir, devices connecting said reservoir to said receptacle and arranged to be automatically controlled by the level of the fluid in the latter, a tube leading out of the said receptacle and means for imparting an electric charge to a part of the contents of the said receptacle to cause an electrocapillary flow of liquid through the said tube substantially as set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

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AXEL ORLING.

Witnesses:

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