

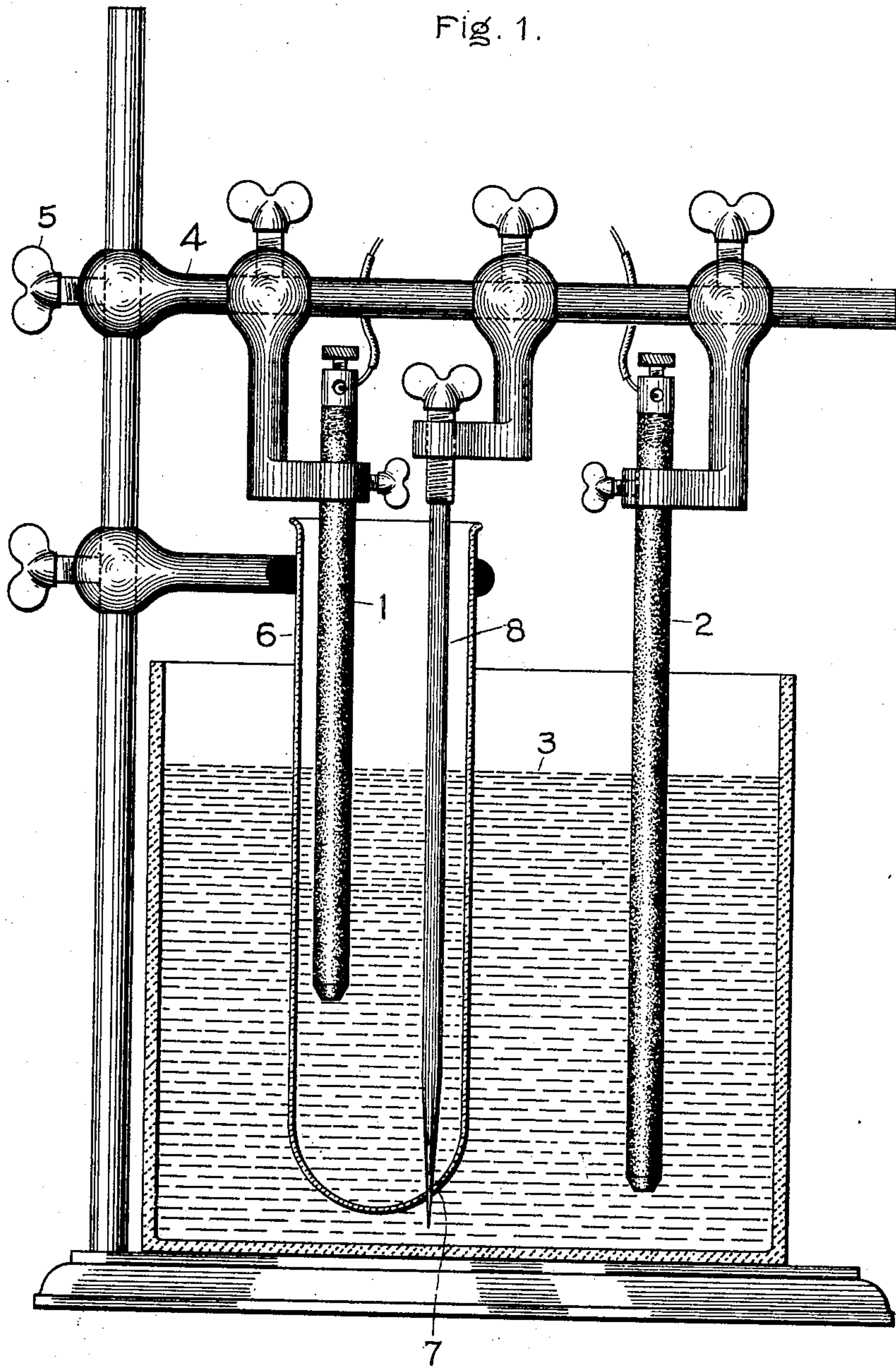
No. 708,182.

Patented Sept. 2, 1902.

M. S. WALKER.
CIRCUIT INTERRUPTER.
(Application filed Nov. 6, 1899.)

(No Model.)

3 Sheets—Sheet 1.



Witnesses.

Lewis P. Bell

Benjamin B. Hall

Inventor.

Milo S. Walker.

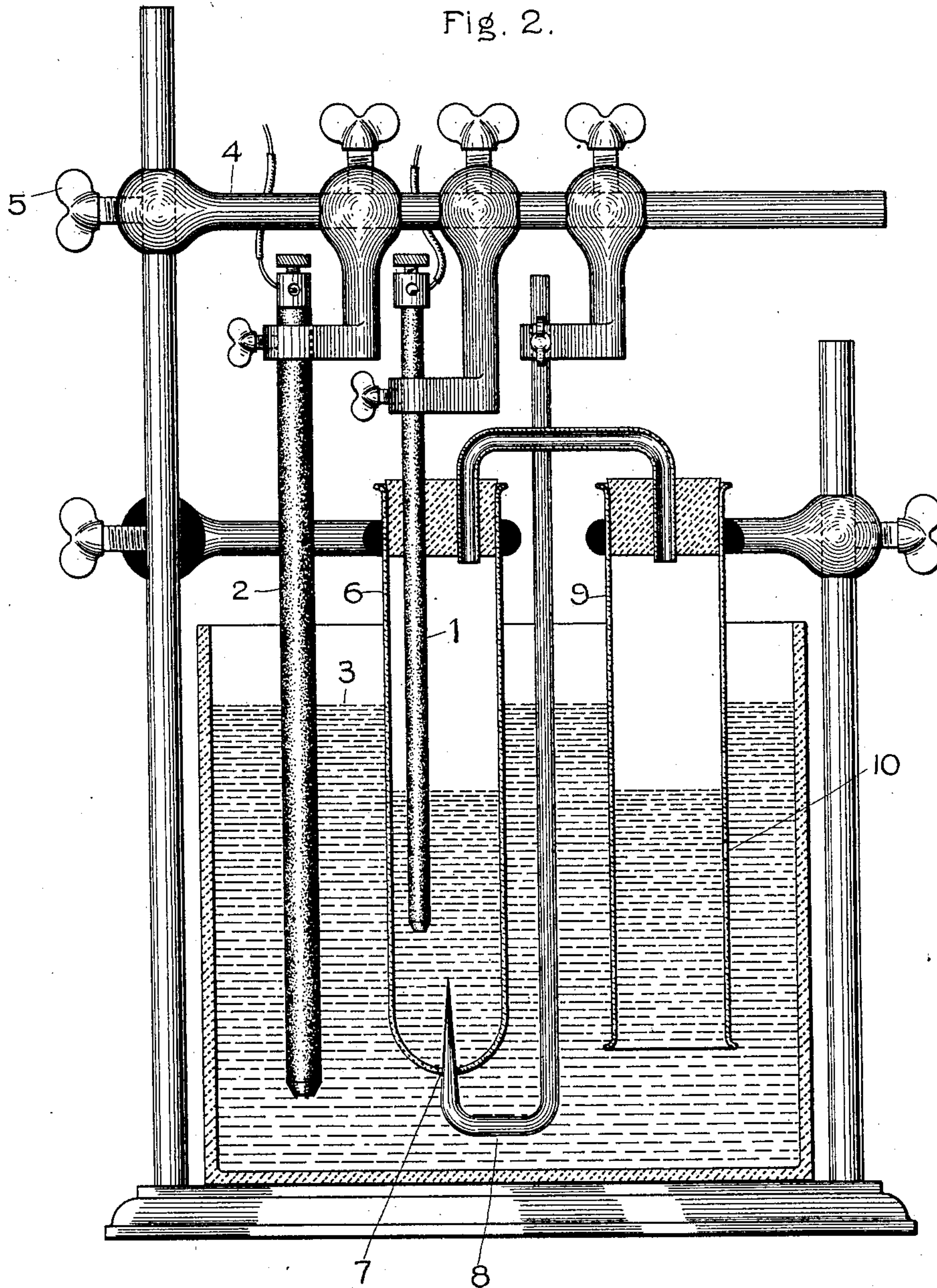
by

Albert H. Davis
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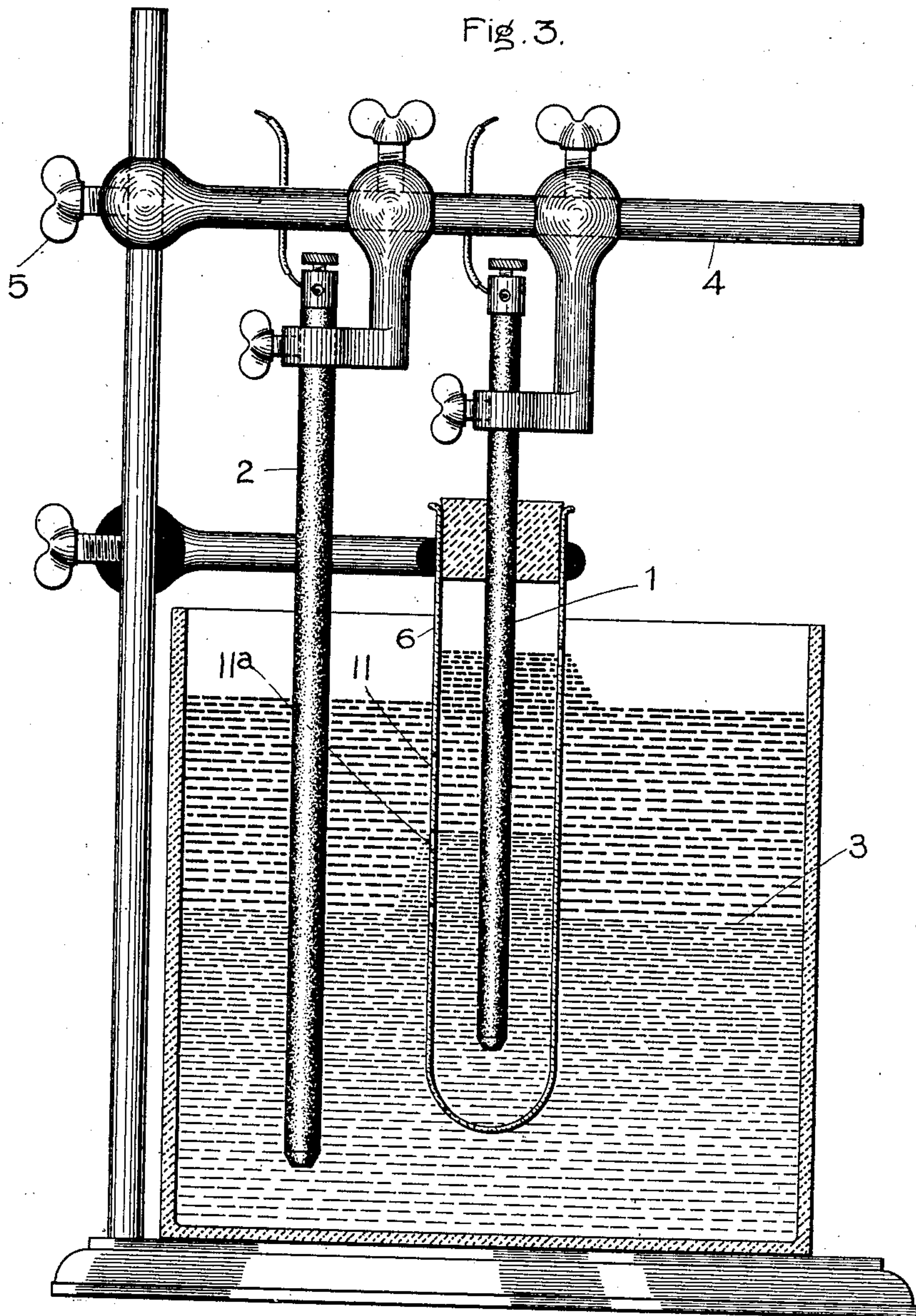
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UNITED STATES PATENT OFFICE.

MILO S. WALKER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CIRCUIT-INTERRUPTER.

SPECIFICATION forming part of Letters Patent No. 708,182, dated September 2, 1902.

Application filed November 6, 1899. Serial No. 735,924. (No model.)

To all whom it may concern:

Be it known that I, MILO S. WALKER, a citizen of the United States, residing at Chicago, county of Cook, State of Illinois, have invented certain new and useful Improvements in Circuit-Interrupters, (Case No. 1,318,) of which the following is a specification.

This invention relates to automatic interrupters for electric currents, and has for its object to provide a device of this character of simple construction and stability of action which may be interpolated in an electric circuit to provide a high rate of interruption of the current-flow in such circuit. A device of this kind is of particular value in such apparatus as is employed for the production of Roentgen rays, where a high rate of electric vibration is necessary.

In carrying out my invention I cause the current to traverse a thin body of film-like or thread-like character of a conducting liquid inclosed in a rigid envelop, which liquid under the influence of current is vaporized or decomposed into vapors or gases which momentarily separate two liquid-terminals of the conducting-stream, thereby producing an interruption of the circuit. The escape of condensation of the gases almost immediately permits a reestablishment of the circuit, after which the operation is repeated, and so goes on with great rapidity.

My invention may be carried out by various forms of apparatus; but I prefer an organization in which the size of the interrupting column of liquid may be varied at will to determine the rate of interruption according to the requirements of the circuit supplied or the character of the liquid operated with. A simple organization is to inclose within an insulating-tube one pole of an electric circuit, which may be a rod of carbon or a metal plate, and immerse this in an outer vessel in which is placed another rod or plate forming another terminal of the circuit. The inner vessel or tube is perforated with one or more openings, and the vessel is partially filled with a conducting liquid. With such an organization a small column of liquid exists in the openings in the inner vessel, and when the current is passed and the opening is of the proper size or caliber a rapid interruption

of the circuit is produced at or in the opening. I provide also means for regulating the size of the opening, which may be an adjustable insulating pin or plug capable of being inserted therein, so as to partially stop up the opening, or may be means for adjusting the level of the opening with relation to the conducting liquid.

I find in practice that the rapid disengagement of vapors or gases causes a boiling of the liquid, which interferes with the operation of the interrupter. I provide means to prevent this by maintaining the liquid under pressure while permitting the escape of such gases as are disengaged. In cases where the opening which establishes the interruption is adjustable with relation to the level of the conducting liquid I cover the latter with a layer of oil to prevent arcing.

The novel features of my invention will be hereinafter more fully described and will be definitely indicated in the claims appended to this specification.

In the accompanying drawings, which illustrate several forms of device for carrying out my invention, Figure 1 is a sectional view of an interrupter in which the size of the opening and the rapidity of interruption may be governed by means of an adjustable plug for the opening. Fig. 2 is a similar organization in which means are provided for preventing the boiling of the conducting liquid, and Fig. 3 is a sectional view of a modification in which the frequency of interruption is determined by establishing one or more thin columns of the conducting liquid in the circuit.

In Fig. 1, 1 and 2 represent terminals of an electric circuit. These may be mounted in any suitable way, so as to be adjustable with reference to a body of conducting liquid 3, contained in a reservoir beneath them. The terminals may be carried on adjustable insulating-supports capable of being raised and lowered with reference to the liquid-conductor—as, for example, by a sliding arm 4 and a thumb-screw 5. Similarly supported is a non-conducting-tube, which may be made of glass, preferably a form of glass, such as glass rich in lead, which will withstand a considerable degree of heat without great liability to fracture. This tube is indicated at

6 and is perforated at some suitable point, as indicated at 7, with an opening which may be from one to two millimeters in diameter. It will be evident that when the adjustable plug of insulating material, such as a glass rod tapered at the end, is withdrawn from the opening 7 the conducting liquid freely fills the same, and when a current of sufficient density passes violent action occurs in the neighborhood of the opening, causing the interruption of the circuit. I do not commit myself to any particular theory as to the cause of this action, whether electrolytic or thermal in nature. I find that the best results are secured when an electrolyte forms the liquid-conductor and find also that free gases are evolved at or near the opening when the apparatus is in action. By adjusting the tip of the plug 8 in the opening it may be rendered responsive to a current of smaller amperage, and for the same amperage will give an increase in the rate of interruption. It will of course be understood that in operation the current in traversing the circuit passes from the electrode 1 to 2, or vice versa, through the conducting liquid and the opening 7, which establishes communication with the two columns in the tube 6 and the outer vessel, respectively. The apparatus may be operated with either direct or alternating current. The size of the electrodes is a matter of no critical importance; but I find that good results are obtained with carbon electrodes of a half-inch in diameter or larger and an inner tube of from eight to ten inches in length and one inch in diameter. Obviously, however, the matter of proportions is a case merely of convenience for permitting the actions to be carried on without any great rise of heat and without undue agitation by the escape of gases or vapors evolved during action. The action of current-interruption is much steadier with a large inductance in circuit with the interrupter.

As a liquid-conductor I prefer to employ, as above stated, an electrolyte for which a dilute solution of sulfuric acid in the proportion of one of commercially-pure acid to eight of water yields the best all-around results; but I have also secured good results with acid sodium sulfate at 350° centigrade, or potassium chlorid at 800° centigrade, or even soft glass at 1,000° centigrade. Obviously, however, these latter compounds require extra provisions for maintaining the temperature, which is objectionable.

During the operation in an organization such as delineated in Fig. 1, in which the tube 6 is of large dimensions, the escape of vapors or gas causes violent bubbling or boiling of the liquid, which rises in the tube and sometimes overflows, unless the tube is of considerable length. This is annoying, not only from the point of view of convenience, but also from changing the resistance conditions of the liquid-conductor, and I find it therefore desirable to provide means for restrain-

ing this action. This may be effectively done by such an organization as that shown in Fig. 2, where the tube 6 is provided with a stopper and communicates by a suitable duct with another stoppered tube 9, the lower end of which is open and dips below the conducting liquid. Means are provided for regulating the depth of immersion of the tubes, as in the organization of Fig. 1; otherwise the apparatus may be the same as shown in Fig. 1, with the exceptions just described. The tube 9 is provided with an opening 10 below the level of the conducting liquid, which permits the escape of air, gas, or vapors when the pressure increases above a determinate point. By this organization the boiling in the tube 6 is restrained by reason of the pressure imposed upon it, and the operation of interruption may be carried on in a tube of comparatively small diameter without interference with the rate of interruption or annoyance from the slopping over of the conducting liquid.

In the construction shown in Fig. 3 of the drawings I have shown a modification in which the rate of interruption may be determined by establishing more than a single opening in the path of the current. In this case the tube 6 is provided with a plurality of openings in one side, as indicated at 11, 11^a, &c., which openings may be from one to three millimeters in diameter. The rate of interruption may be varied by bringing one or more of these holes under the conducting liquid, and the maximum rate may be secured by bringing only one of the holes partly below the top of the conducting liquid. With such an organization I find that the boiling of the liquid from the causes hereinbefore referred to causes it to stream through one of the upper openings and produces dangerous arcing. This may be effectually restrained by covering the conducting liquid with a layer of a high-boiling oil to the depth of five or ten centimeters. Any tendency to establish an arc is immediately overcome and the arc extinguished by the inflowing of the supernatant body of oil. When more than one hole is beneath the conducting liquid, the rate of interruption decreases, and one rate may be superposed upon another rate by establishing one of the openings partly beneath and partly above the level of the conducting liquid, while one or more others are beneath the liquid. The rate is of course determined by the size of the opening, and as the action may go on simultaneously in two or more openings by proportioning the sizes differently or by varying them in the manner just stated different rates may be simultaneously imposed upon the conducting-circuit.

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

1. The herein-described mode of maintaining electric vibration in a circuit, consisting of causing the current to traverse a narrow

thread or film of conducting liquid, and maintaining at the sides of said film or thread a larger body of conducting liquid whereby the vibration is maintained by the sole action of the current.

5 2. An electric interrupter comprising two terminals, an electric conducting liquid between the same and in continuous open relation to the electrodes, a spot of reduced current-carrying capacity in the electric path between the electrodes, and an adjusting device for varying its carrying capacity.

15 3. An electric interrupter, comprising two circuit-terminals, a liquid-conductor between them and in continuous open relation to them, a perforated wall of insulating material between them, and an adjusting device for varying the size of the opening in the wall.

20 4. An electric interrupter comprising two circuit-terminals, one inclosed in an insulating-tube, an opening of small cross-section establishing communication between the electrodes by a conducting liquid, means for permitting the escape of gases or vapors, and
25 means for subjecting the liquid-conductor in the tube to pressure.

5. An electric interrupter comprising circuit-terminals, a liquid-conductor between the same, and a vertically-adjustable separating-wall of insulating material provided with a plurality of vertically-disposed openings of small cross-section. 30

6. An electric interrupter comprising circuit-terminals, a liquid-conductor between the same, a vertically-adjustable separating-wall of insulating material provided with a plurality of vertically-disposed openings of small cross-section, and a bed of oil above the liquid-conductor. 35

7. An electric interrupter comprising circuit-terminals, a liquid-conductor between the same, a separating-wall of insulating material provided with a plurality of vertically-disposed openings of small cross-section and means for including or excluding the openings from the circuit. 40 45

In witness whereof I have hereunto set my hand this 2d day of November, 1899.

MILO S. WALKER.

Witnesses:

C. B. ZUNGMAN,
C. E. SPENCER.