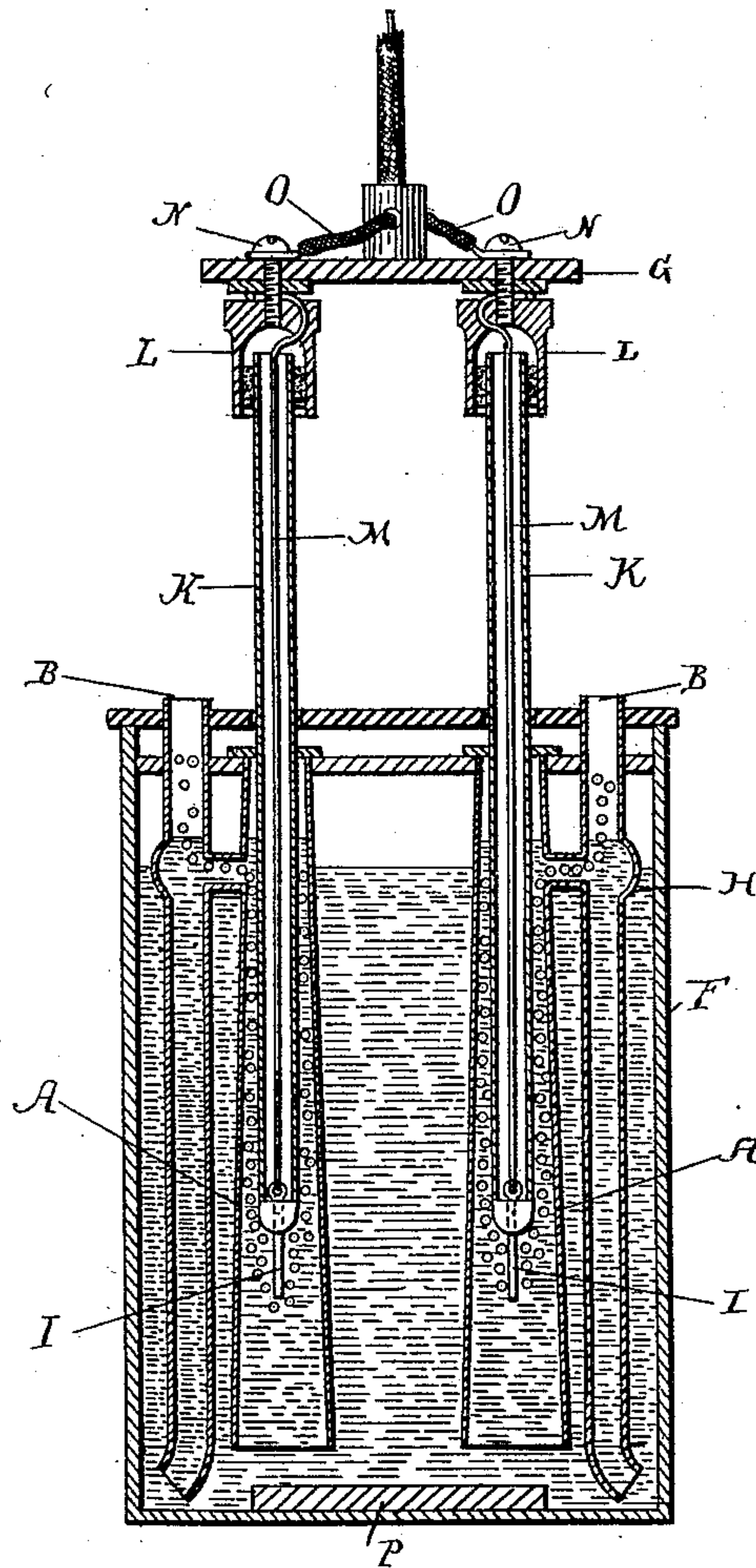


(No Model.)

H. LEMP.  
LIQUID RHEOSTAT.

No. 467,255.

Patented Jan. 19, 1892.



Witnesses  
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# UNITED STATES PATENT OFFICE.

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## LIQUID RHEOSTAT.

SPECIFICATION forming part of Letters Patent No. 467,255, dated January 19, 1892.

Application filed March 22, 1889. Serial No. 304,279. (No model.)

*To all whom it may concern:*

Be it known that I, HERMANN LEMP, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improved Liquid Regulators, of which the following is a specification.

My invention relates to those forms of electric-resistance devices in which a body or column of liquid is employed and the amount of resistance is determined by variations in the length or cross-section of the liquid column between two electrodes in contact with the liquid.

The invention is designed especially as an improvement upon the form of liquid-resistance device described in a prior application for patent filed by myself jointly with Merle J. Wightman June 21, 1887, Serial No. 241,996, for electric regulating or controlling mechanism, in which application is described an insulating-tube immersed in a body of liquid and containing a column of liquid of comparatively small sectional area, forming the electric resistance between the electrodes. In that application the resistance is varied by moving the electrodes with relation to one another, and by preference two movable electrodes are employed suspended from a proper support and movable, respectively, into tubes of insulating material containing the liquid resistance.

I find in practice that in an apparatus of this nature certain irregularities of action arise, especially when the resistance is employed to regulate the flow of current in the field-magnet of a dynamo-machine, such irregularities arising, among other things, from the heating of the column of liquid in the tube and increase in the acidity of the liquid when an acid solution is employed and the evolution of gas at the electrodes. To overcome these irregularities, some means must be provided to change the liquid in the tubes; and the object of my invention is to permit this change to be automatically and readily effected without disturbing the apparatus while in action.

My invention consists in providing for a circulation of the liquid forming the electric resistance by connecting with the insulating-

tube a circulating tube or duct, through which a circulation and change of the liquid in the tube may take place. For producing a circulation of the liquid I usually prefer to depend upon the difference in weight between the hydrostatic column in the tube itself and that surrounding the tube and connected to the same at its bottom, such difference being due primarily to the presence in the tube of bubbles of gas evolved from the contained liquid by the action of the electric current. An automatic tendency to circulation is also attributable to the differences of level produced by other actions, which need not be more particularly described.

My invention consists, further, in a novel form of immersed electrode designed to take the place of the carbon electrode heretofore employed with the apparatus. When a carbon stick is used as the electrode, the carbon is greatly disintegrated and becomes pointed at its end and gradually wears away, so as to diminish in length. This necessitates frequent renewal and changes the adjustment of the apparatus. In order to overcome this difficulty, I propose to employ a platinum electrode made in the manner hereinafter described.

My invention consists, further, in certain details of construction to be hereinafter described, and more particularly specified in the claims.

In the accompanying drawing the figure is a vertical central section of an apparatus embodying my invention.

F indicates the containing-vessel, of glass or other suitable material, and A A two tubes of comparatively small sectional area, open at their lower ends and immersed in the liquid contained in the vessel F. In these tubes the electrodes K K are moved up and down by any suitable means, so that the distance through which the electric current has to flow from the end of one electrode to the end of the other may be varied. The electrodes K are of a construction to be presently described and are supported from a cross head or plate G, of any suitable description, which may be moved up and down by any desired means. To each of the tubes A is connected a circulating-tube H, which at its lower end



opens into the body of liquid in the vessel F and at its upper end opens into the tube B at a level above the point where the liquid is decomposed by the current passing from the electrode to the liquid. Owing to the difference in the weight of the liquid columns within the tube A, and without, as in tube II, due to the actions before mentioned, and owing, perhaps, in some degree to the other effects stated, a continuous circulation of the liquid within the tube is produced, thus changing the same constantly and keeping it in approximately uniform condition.

In order to prevent the accumulation of gas at the upper end of the circulating-tube II, which accumulation might finally interfere with the circulation, I provide escape or vent tubes B, applied as indicated, through which the gas may escape.

The electrodes which move up and down in the tubes A are provided with tips I, made, preferably, of platinum or other suitable material not subject to disintegration under the effect of the current and sealed in the lower end of tubes of glass K, which at their upper end are fixed in sockets or nipples L, of brass or other suitable material, wherein the tube is fixed by means of plaster-of-paris or other cement. Within the tubes are conductors M, of copper or other good conducting material, which, within the tubes of glass and near the lower end thereof, are attached in any proper manner to the pieces of platinum I and at their upper ends pass through or are attached to the nipples or sockets L. The latter are secured to the cross head or plate G by means of suitable screws or clamps N, which screws may serve to clamp the ends of the wires M and may also serve to form the electrical connection to conductors O, leading to the electric source in any desired way.

I do not limit myself to the employment of platinum for the electrode-tip, but prefer to use one of the noble metals and to connect the same with a baser cheaper metal within the tube for the sake of economy.

At the bottom of the glass jar F is a plate P of some conducting material, upon which the electrodes may rest when lowered to the bottom of the vessel. By this means a direct

connection is formed between the electrodes independently of the liquid. This device, however, forms no part of my present invention.

I do not limit myself to any particular kind of material for the tube which protects the conductor M from the liquid, though I prefer to employ glass, because a ready seal may be formed at the point where the tip passes through for connection with the conductor; nor do I limit myself to the particular manner of supporting the sheath or tube at its upper end.

What I claim as my invention is—

1. The combination, with the tube of insulating material containing a liquid resistance and communicating at its lower end with an exterior body of liquid, of a circulating-tube connected at one end to the first tube at a level below the level of the liquid therein and at its other end with said exterior liquid body at a lower level.

2. The combination, with the insulating-tube immersed in a body of liquid and containing the liquid resistance, of a circulating-tube connected to the same and immersed at its lower end in the liquid outside of the tube, as and for the purpose described.

3. The combination, with the liquid-resistance tube or receptacle, of the liquid-circulating tube connected therewith above the point where decomposition of the liquid takes place and a gas-vent for said circulating-tube, as and for the purpose described.

4. The combination, with the vertical resistance-tube immersed at its end in a body of liquid, of an adjustable electrode movable up and down in said tube, a glass tube in the end of which said electrode is sealed, a supporting movable socket or nipple in which the upper end of the tube is fastened, and a connection through said tube to the electrode sealed in the end thereof.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 20th day of March, A. D. 1889.

HERMANN LEMP.

Witnesses:

MERLE J. WIGHTMAN,  
WM. J. HALL.