No. 776,564. PATENTED DEC. 6, 1904.

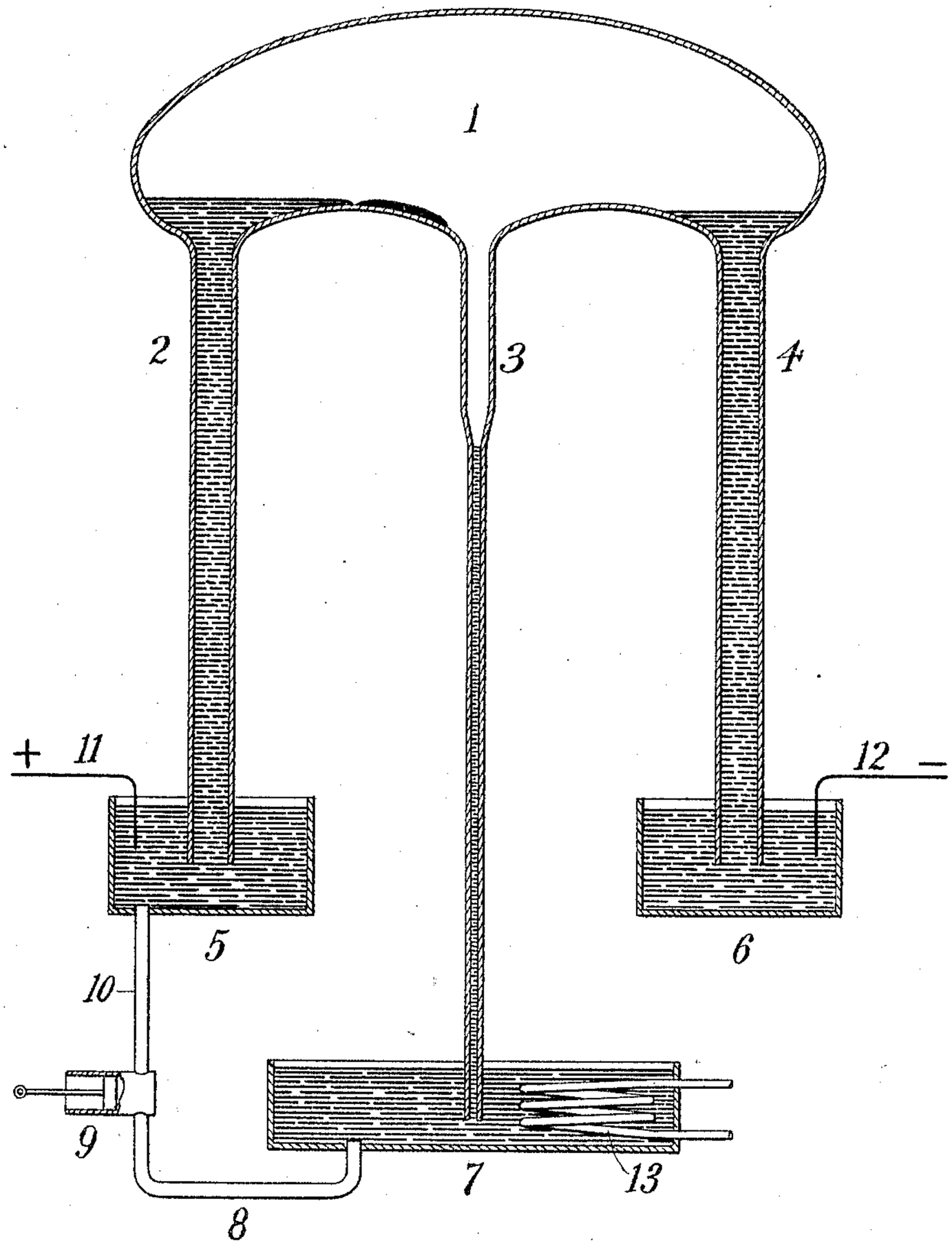
P. H. THOMAS.

CURRENT RECTIFIER.

APPLICATION FILED MAY 6, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig.1



Witnesses:
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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3

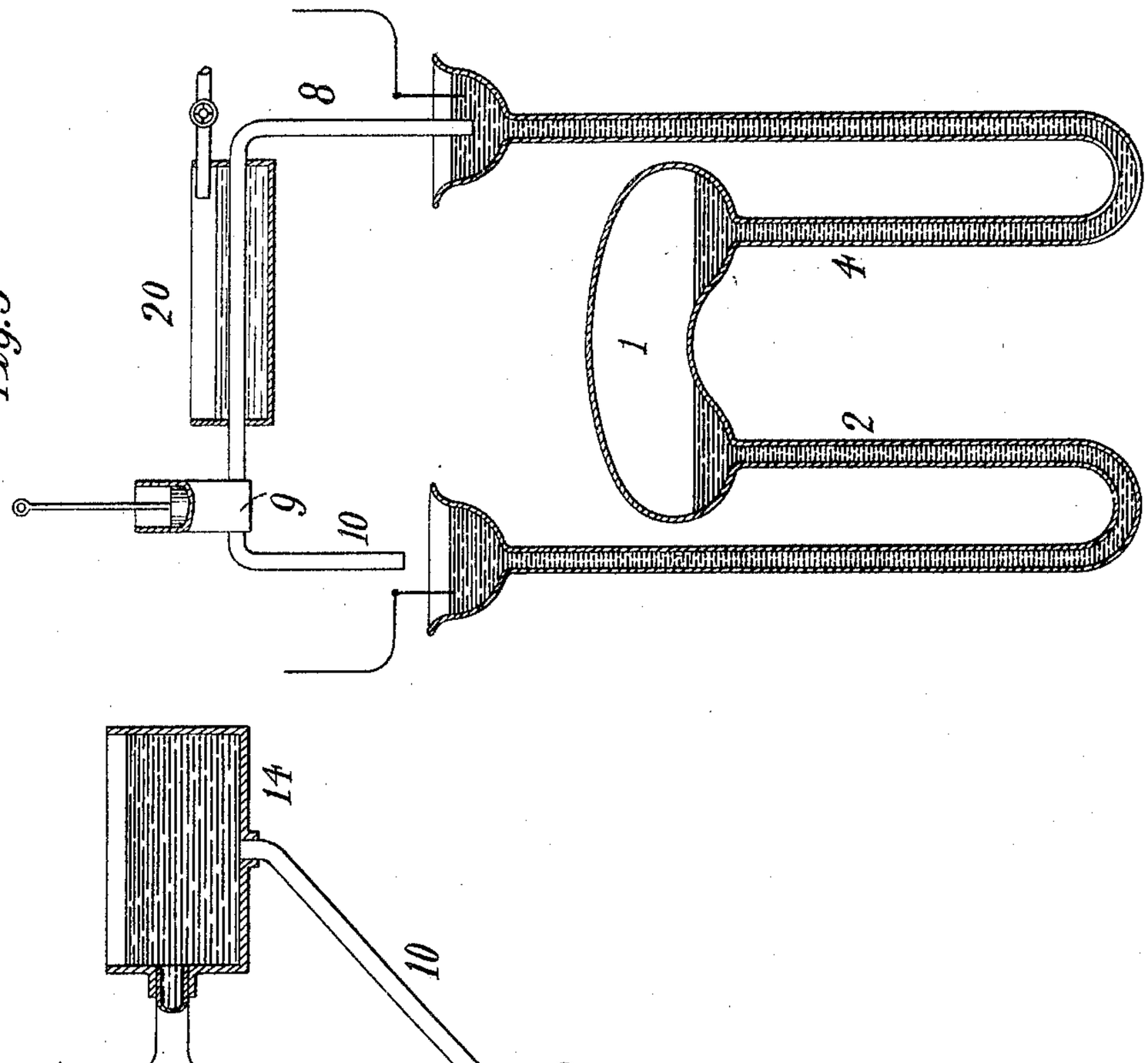
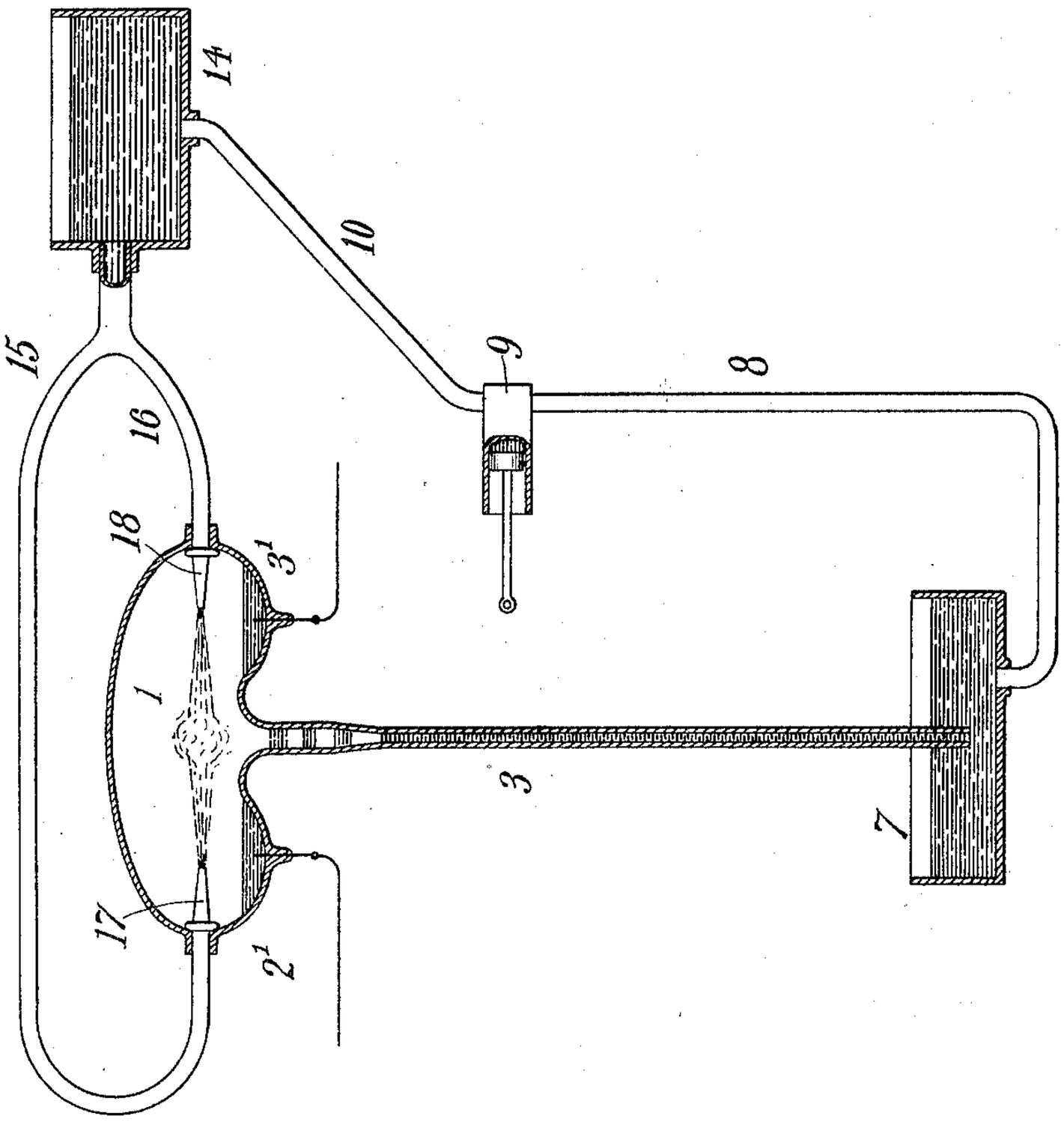


Fig. 2



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UNITED STATES PATENT OFFICE.

PERCY H. THOMAS, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO COOPER HEWITT ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CURRENT-RECTIFIER.

SPECIFICATION forming part of Letters Patent No. 776,564, dated December 6, 1904.

Original application filed February 4, 1903, Serial No. 141,804. Divided and this application filed May 6, 1903. Serial No. 155,925.

(No model.)

To all whom it may concern:

Be it known that I, PERCY H. THOMAS, a citizen of the United States, and a resident of Pittsburg, county of Allegheny, State of Pennsylvania, have invented certain new and useful Improvements in Current-Rectifiers, of which the following is a specification.

My invention relates to devices for obtaining a flow of current in a given direction from alternating electromotive forces.

In its physical embodiment the device herein described consists, in general, of an inclosing chamber containing a gas or vapor and separated electrodes, one or both usually consisting of mercury. When properly constructed and operated, a current may be caused to pass in one direction only through such a device, the device opposing so great resistance to flow of current in the opposite direction as to practically prohibit such flow.

The particular subject of this invention is a novel form and construction of such a device, the object being to provide means for keeping the device cool, maintaining the proper purity and density of the gas or vapor within the chamber, and adapting it to transmit currents of large quantity.

In carrying out my invention I provide means for conducting a large amount of current into and from the device with relatively small resistance and also means for carrying away from the chamber heat generated therein and for withdrawing from the chamber any excess of vapor and maintaining the vapor in the proper condition. Among the means employed for these purposes are tubular extensions of the main body of the container, these extensions being filled wholly or partially with mercury, if that be the substance of either or all of the electrodes. The lower ends of the tubes are open and are dipped into vessels containing mercury, the mercury columns inside the tubes being sustained by atmospheric pressure or in case of need by higher pressure, as will be explained farther on. I also provide a pump of suitable form for causing the circulation by positive means of mercury into and out of the main chamber. In this way a circulation of the mercury within the chamber is obtained.

During the process of circulation the mercury may be cooled by artificial means, as by one or more refrigerating-coils placed at a proper point or points in the cycle, or I may accomplish the cooling effect by causing the mercury to enter or reënter the chamber in the form of spray. These two means may, if desired, be combined, or other cooling devices may be employed.

The invention will be described more particularly in connection with the accompanying drawings, in which—

Figure 1 is a vertical section showing one form of apparatus, and Figs. 2 and 3 illustrate modifications.

Referring to the first figure of the drawings, 1 represents the inclosing chamber containing a suitable gas or vapor, which for convenience will be referred to as a "mercury-vapor." This is provided with two tubular extensions 2 and 4, containing columns of mercury which constitute, respectively, the positive and negative terminals of the device. The tubes are here represented as being filled with mercury and as terminating in vessels 5 and 6, respectively, in which vessels mercury is contained. The lower ends of the tubes 2 and 4 are open, and the mercury columns are sustained within them by atmospheric pressure. The chamber is provided with a third tube 3, which terminates in a vessel 7, also containing mercury. The vessel 7 is connected by a pipe 8 with any suitable form of pump 9, the outlet of which is connected by a pipe 10 with the bottom of the vessel 5.

In operation current is led from a conductor 11 into the mercury in the vessel 5, then passes up the mercury column contained in the tube 2, through the vapor in the chamber 1 to the column contained in the tube 4, thence to the vessel 6, and out by way of the conductor 12. Inasmuch as more or less heat will be developed in the passage of current through the device, it is found convenient to cause a more or less continuous flow of mercury upward through the tube 2 into the

chamber, from whence it flows downward through the tube 3, carrying with it more or less of the gas or vapor contained within the chamber. Such continuous flow will not only result in providing cool mercury for the positive terminal of the device, but will continually act as a pump for maintaining the requisite density and purity on the part of the vapor in the chamber. The mercury as it falls into the vessel 7 is withdrawn, preferably, from the bottom of the vessel, so as to be free from air, by way of the pipe 8 through the pump 9 and returned to the vessel 5. The vessel 7 may be so constructed as to afford a considerable heat-radiating surface to the mercury, and, moreover, there may be added a cooling-pipe 13 for circulating water or other cooling fluid. The surface of the mercury in the vessel 5 is so adjusted with reference to the tube 2 that the barometric height of the column of mercury in the tube 2 will bring the top of the column at the proper point for permitting the gradual flow of mercury from the depression in the chamber at the top of the tube over into the depression in which the tube 3 terminates.

It is generally found unnecessary to cool the negative terminal, as in some instances the device operates better while the negative terminal is hot; but, if desired, a like device may be employed in connection with the negative terminal.

There will always be more or less condensation of the mercury-vapor upon the walls of the vessel, and the presence of the cold body of mercury contributes to this action, which results in keeping the vapor at its proper density.

It should be observed that the pipe 3 should be of such length that the barometric pressure will leave its upper surface at a considerable distance below the body of the vessel 1, so as to better insure the pumping action of the mercury-flow. Moreover, by virtue of such an arrangement the mercury passing into the top of the chamber 3 will at first be present in the form of drops, which will carry more or less of the vapor from the chamber 1 down through the column in the tube 3 by an action similar to that of a Sprengel pump.

I show in Fig. 2 a construction in which the tubes 2 and 4 are dispensed with and the lead-wires connected directly with the positive and negative terminals 2 and 3 in the chamber 1. The tube 3 is present, as before, and the vessel 7 is connected through a pumping device similar to that already described with a vessel 14. From this vessel I branch two pipes or tubes 15 and 16, which are led into opposite ends of the chamber 1 and terminate in nozzles 17 and 18, respectively, through which the mercury, which is forced through these pipes by atmospheric pressure, passes into the chamber in the form of finely-divided spray. By these means not only are the terminals themselves cooled, but also the conducting-vapor within the chamber 1.

It may be found desirable for special purposes to maintain the conducting gas or vapor in the container at a very high pressure, in which case the atmospheric pressure exerted upon the outer terminals of the mercury columns might be insufficient to maintain the inner ends of such columns in operative relation with the conducting gas or vapor. Under such conditions an excess pressure may be applied to the outer terminals of the mercury columns, as by extending the said columns over into the other side or leg of a U-shaped tube, thus adding to the atmospheric pressure the weight of a part of the mercury column. The main thing to be obtained is that the column of conducting fluid, whatever the nature of the fluid is, may serve as a balance between the external and the internal pressures. This arrangement is illustrated in Fig. 3, where the tubes 2 and 4 are represented with extensions which return in such a manner as to form U-shaped tubes in which mercury is contained. In this case it is assumed that the conducting gas or vapor in the chamber 1 is under high pressure, and to compensate for such excessive pressure the weight of the mercury above the limit of atmospheric pressure is increased by the weight of the mercury in the outer sides of the tubes.

It will be observed that in Fig. 3 the exit-tube 3 is dispensed with and the pump is applied to the outer terminals of the tubes 2 and 4. In order to secure a good cooling effect, I may surround the tube 8 with a water-jacket 20.

Manifestly the term "extension" or "extensions" as used in this specification does not necessarily mean tubes formed in one piece with the chamber or formed on the chamber. Such extensions may be tubes secured in the walls of the chamber by any means which will prevent leakage. Obviously also one tube may be arranged within another, so as to leave an annular space outside the inner tube, the conducting fluid forming one electrode being contained in one of the tubes and the overflow taking place in the other tube.

So far as the cooling and purifying of the vapor is concerned, the liquid which is circulated need not be a conducting liquid, and it is not my intention to limit the present invention to the employment of conducting liquids only.

This application is a division of my application filed February 4, 1903, Serial No. 141,804.

Certain features of the invention herein described are claimed in a divisional application filed August 23, 1904, Serial No. 221,816.

I claim as my invention—

1. The combination of an exhausted chamber, a gas or vapor therein, a negative electrode, one or more positive electrodes presenting surfaces within the chamber, at least

one of which consists of an inclosed fluid column having an approximately level surface, and means for continuously supplying fresh fluid to said column or columns, and an outlet for excess fluid permitting a flow of fluid from said exhausted chamber.

2. The combination of an inclosing chamber, a gas or vapor within the same, a negative electrode, one or more positive electrodes within the chamber, consisting of columns of conducting fluid extending from points without the chamber, means for replenishing said columns, and means for withdrawing from the chamber the excess of fluid and simultaneously pumping out the chamber by the action of the outflowing fluid.

3. The combination of an inclosing chamber, a gas or vapor therein, two or more tubular extensions of said chamber, conducting fluids having definite surfaces and sealing said extensions and constituting electrodes, a supplemental extension and means for causing a flow of fluid through one or more of the electrode extensions into the chamber and through the supplemental extension out from said chamber.

4. The combination of an inclosing chamber, a gas or vapor therein, tubular extensions of said chamber, conducting fluids having definite surfaces and sealing said extensions and constituting electrodes, a supplemental extension, means for causing a flow of fluid through one or more of the electrode extensions into the chamber and through the supplemental extension out from said chamber, and means for cooling the fluid so withdrawn.

5. The combination of an inclosing chamber, a gas or vapor therein, tubular extensions of said chamber, conducting fluids having definite surfaces and sealing said extensions and constituting electrodes, an additional extension and means for causing a flow of fluid through one of the electrode extensions into the chamber and through the additional extension out from said chamber, means for cooling the fluid so withdrawn, and means for causing the cooled fluid to return to the chamber.

6. Means for cooling and exhausting a gas or vapor chamber containing one or more fluid-electrodes presenting to the vapor-path a substantially level surface, consisting of means for supplying fluid thereto through said fluid electrode or electrodes, means for causing a circulation of the fluid through the chamber, and an independent outlet for withdrawing the same from the chamber.

7. A current-rectifier comprising two fluid-electrodes, an inclosing gas or vapor, said electrodes comprising columns of mercury held in the proper position by atmospheric pressure, and an outlet for excess mercury sealed by a column of mercury of such height as to bring its surface under atmospheric pressure outside the main body of the chamber.

8. The combination of an inclosing chamber, a conducting gas or vapor therein, one or more fluid-electrodes presenting to the vapor-path a substantially level surface within the chamber, an exit-tube from the chamber, and positive means for causing a circulation of the fluid into and out of the chamber.

9. As a means for cooling and exhausting a gas or vapor electric apparatus, a conducting fluid presenting to the vapor-path a substantially level surface and constituting one of the electrodes of the apparatus and terminating outside the inclosing chamber thereof, means for causing a circulation of the fluid and means for withdrawing by such circulation a portion of the gas or vapor.

10. The combination with an inclosing chamber and a conducting gas or vapor therein, of tubular extensions of the said chamber, and fluid-electrodes within the said extensions presenting to the vapor-path a substantially level surface, the said fluid-electrodes being exposed to external pressure, and having their outer terminals connected through a suitable pump and exhausting devices interposed in the circuit.

Signed at New York, in the county of New York and State of New York, this 28th day of April, A. D. 1903.

PERCY H. THOMAS.

Witnesses:
WM. H. CAPEL,
GEORGE H. STOCKBRIDGE.