P. C. HEWITT.

DIRECTIONAL CURRENT ARRESTER.

APPLICATION FILED FEB. 3, 1903. RENEWED APR. 5, 1910.

1,163,664.

Patented Dec. 14, 1915.

2 SHEETS—SHEET 1.

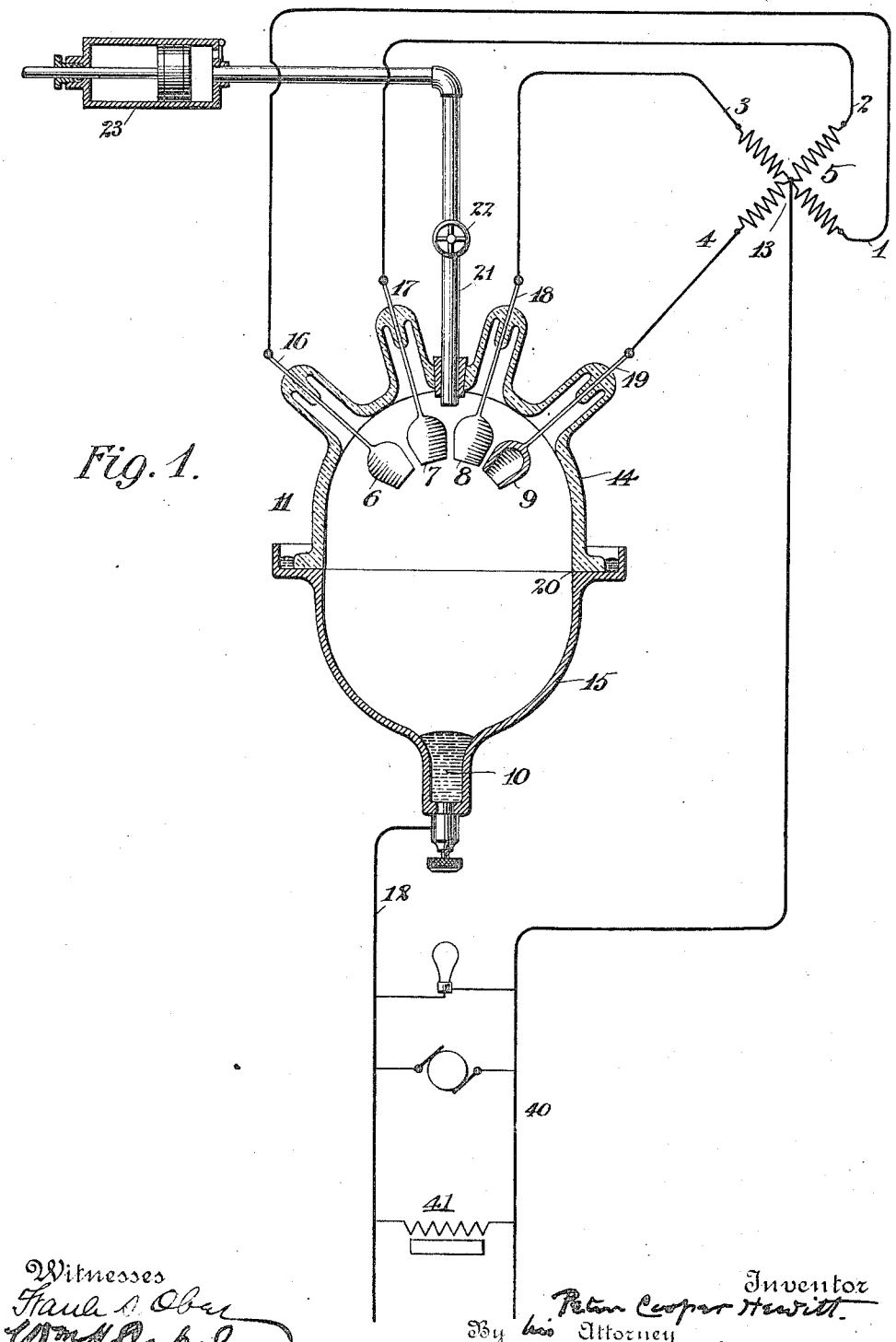

Fig. 1.

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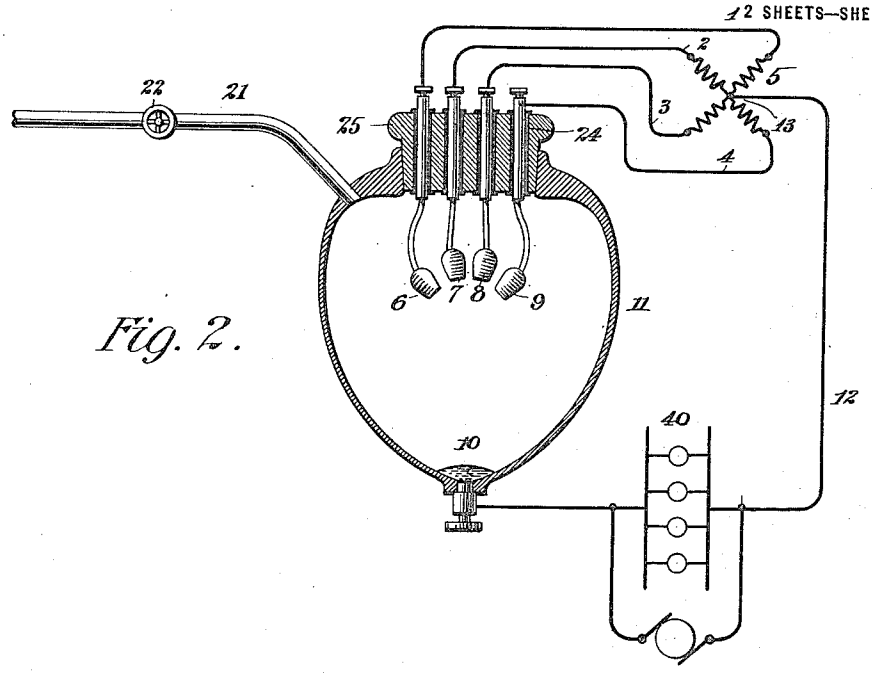
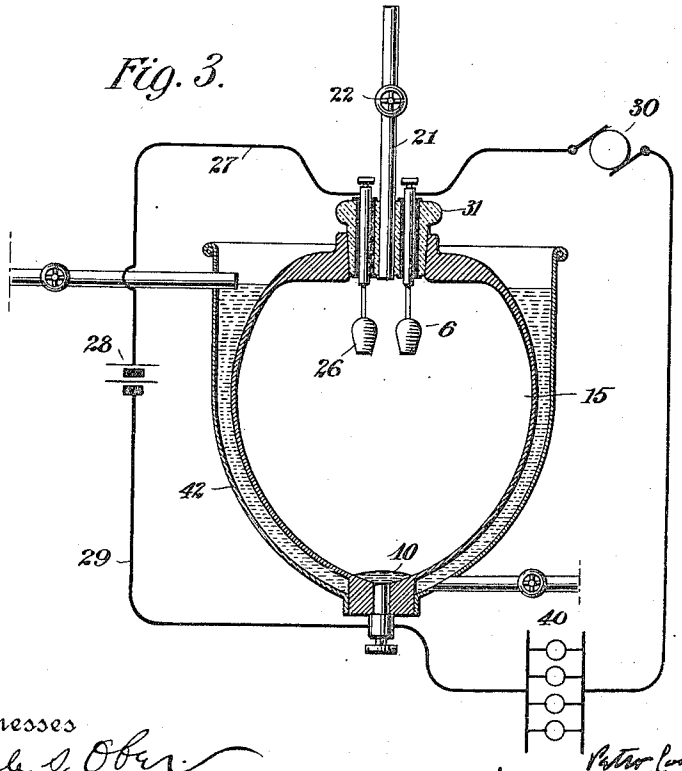


Fig. 2.

Fig. 3.



Witnesses

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UNITED STATES PATENT OFFICE.

PETER COOPER HEWITT, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO COOPER HEWITT ELECTRIC COMPANY, OF HOBOKEN, NEW JERSEY, A CORPORATION OF NEW JERSEY.

DIRECTIONAL-CURRENT ARRESTER.

1,163,664. Specification of Letters Patent. Patented Dec. 14, 1915.

Application filed February 3, 1903, Serial No. 141,661. Renewed April 5, 1910. Serial No. 553,547.

To all whom it may concern:

Be it known that I, PETER COOPER HEWITT, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Directional-Current Arresters, of which the following is a specification.

My invention relates to certain improvements in electrical apparatus for deriving uni-directional electric currents from alternating electric currents, the device being useful, however, for various other purposes.

In carrying out my invention suitable gases or vapors are inclosed within a properly prepared chamber provided with electrodes for connection with the source of current. The general characteristics of such a device are set forth in certain patents issued to me on 17th day of September, 1901. This device will permit the passage of current in a given direction, while practically prohibiting the flow of currents in the reverse direction. Thus, when used in connection with a source of alternating currents, uni-directional currents may be obtained due to the successive electro-motive-forces of one direction. If alternating electro-motive-forces of different phases are employed and each phase connected to its electrode and the device is at all times subjected to an impressed electro-motive-force from one or another of the electrodes in a given direction, then there will be a continuous flow of current from the source or sources in one direction. The evenness of the flow will be largely dependent upon the number of phases employed, although this may be more or less modified by inductive effects or other causes. In constructing the apparatus, I have found it convenient to employ multiple electrodes of a suitable solid metal such, for instance, as chromium, copper or iron, but for the electrode acting as the negative, I have generally found mercury the most practical and durable. I have found it also convenient to employ mercury for the other electrodes under some conditions. For the purposes of the present description, however, reference will be had to forms using solid materials for the last named electrodes. The tendency of the negative electrode is to vaporize, and mercury serves well for the negative electrode by reason of its property of being able to vaporize and reconstruct itself, but other materials that possess this property will be serviceable for a negative electrode. When I speak of substances including mercury, I desire to have it understood that the phrase may refer either to mercury alone or to mercury in combination with some other substance. When mercury is used, the conducting vapor will consist of mercury; other vapors and gases being as far as practical removed from the chamber. While initially, there is offered a high resistance or reluctance to, starting the passage of current through the device due to a condition which exists in or at the neighborhood of the electrode which is negative with reference to the applied electro-motive-force, yet when this reluctance to starting has been overcome or broken down, at said electrode, current will flow through the device under the influence of a relatively low electro-motive-force; and this condition continues at this electrode so long as the resistance or reluctance at this negative electrode is prevented from re-establishing itself, while this reluctance existing at the other electrodes prevents current flowing therein. By connecting several electrodes with the respective leads of a suitable polyphase source, and one electrode with a return conductor leading to a neutral point, there will always be impressed upon the device a difference of potential in the direction tending to pass current from one or another of the several electrodes to the last named electrode. For convenience this latter is referred to as the negative, and the others as the positive electrodes. While each positive electrode is in turn negative with reference to the other positive electrodes, yet no current will pass from one to another of these, because the negative electrode reluctance at said electrode has not been broken down and prevents the flow. I have further found that the current does not necessarily pass into the negative electrode at the point nearest the positive electrodes, and that, when a vaporizing or volatilizing material such, for instance, as mercury, forms part of the negative electrode, the current enters such part of the cathode to the exclusion of other portions thereof and that, therefore, such a construction allows me to avail myself of the greater

heat-conducting power of substances which may be electrically conducting for the walls of the vessel. Where it is desired to dissipate larger quantities of heat than would be carried off through glass or porcelain, it is possible to use a conductor for a large portion of the container without interfering with the action of the device. I have further found that it is possible to maintain the contents of such an inclosing chamber sufficiently free from foreign or deleterious gases or vapors, and where the apparatus is liable to leakage, or transmission of gases they may be removed by the action of a pump which may be continuously or intermittently brought into action. If a gas tight joint is effected between the various parts of the inclosed chamber, the device may be initially pumped out and no further exhaustion required. For the purpose of making the device of considerable mechanical strength, my present invention aims to make the chamber largely of metal.

In the accompanying drawings, I have illustrated different forms of devices showing containers partly of metal and partly of insulating materials.

By reason of the fact that the apparatus permits the flow of the current in one direction but arrests the flow in the reverse direction, it may be conveniently and properly termed a uni-directional current arrester.

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

Referring to Fig. 1, 5 represents a source of polyphase electric currents (in this instance four phase), and 1, 2, 3 and 4, represent the conductors leading therefrom. These are, respectively, connected with positive electrodes 6, 7, 8 and 9, of the current arrester 11. The negative electrode 10 is connected by a conductor, 12, through any desired circuit with a neutral point 13 of the source 5. The wall of the inclosing chamber is shown in Fig. 1 as consisting of two main sections 14 and 15. The section 14 is of glass or other suitable insulating material through which are passed the leading-in conductors 16, 17, 18 and 19, connected with the respective electrodes 6, 7, 8 and 9. The section 15 consists of metal, such for instance, as copper or iron, which is fitted to the section 14 by a suitable joint as, for instance, by a ground joint as indicated at 20. The joint may be further sealed by any suitable plastic material, or sealed with mercury as shown. I have shown the negative electrode 10 as consisting of a quantity of mercury which, in this case, yields the conducting vapor through which the currents pass. A nozzle 21 is here shown as connected with the chamber. It is provided with a suitable stop-cock, 22, and an exhaust pump, 23, of any suitable character, is shown as being connected with this nozzle. This pump may be operated at such times as necessary for maintaining the proper exhaustion within the chamber. It may be run continuously or at intervals as found necessary.

The general method of manufacturing the device is that set forth in certain patents issued to me on the 17th day of September, 1901, for instance patents numbered 682,692 and 682,699.

In Fig. 2, I have illustrated a modification in which practically all of the inclosing chamber is made of metal and the positive electrodes 6, 7, 8 and 9, are carried by leading-in-conductors passed through insulating plugs, 24, which are tightly fitted into a metallic cover or cap, 25, which may be a ground fit or otherwise fastened into the main body of the chamber.

In Fig. 3, I have shown a source, 30, of single phase currents, having one pole connected with the single positive electrode 6, and its other pole with the electrode 10 through the work circuit 40. The current flowing by reason of the electro-motive-force produced by the single phase current will be intermittent but in the same direction. In this figure, I have illustrated a supplemental electrode, 26, which is connected by a conductor 27, with the positive pole of a source, 28, of continuous currents, the negative pole of which is connected by a conductor, 29, with the negative electrode 10. Through the employment of this source of continuous current and the supplemental electrode, and their connections, a constant flow of current through the device may be maintained regardless of the flow of current from the electrode 6, so that even though there be an interruption or temporary cessation of the applied electro-motive-force from the alternating source, the negative electrode reluctance would still remain overcome or broken down. The leads of the electrodes 6 and 26 in Fig. 3 may pass through a plug, bushing, or stopper, 31, of glass, or other insulating material, the plug being suitably sealed into the main body 15 of the container.

For the purpose of starting the device by breaking down or overcoming the initial negative electrode reluctance, a momentary impulse of high electro-motive-force is applied to the device, or a contacting device may be made use of. Any of the means described in my patents of September 17, 1901, may be employed for starting the device.

The currents caused by the device to pass through the circuit 12 leading from the negative electrode may be employed for any desired purposes, and I have indicated in diagram at 40, such a work circuit. It may be desired to use an inductance device, 41,

in some portion of the circuit especially when the load upon the work circuit is light.

In operation the device will generate more or less heat. It is desirable that the temperature be maintained reasonably low. The metal surfaces will radiate heat more readily than most insulating materials, and for this reason a current selector of given dimensions can be used in connection with currents of much larger quantities than one consisting essentially of glass or other similar material.

If desired, the natural radiation of the device may be increased by means of a water-jacket, 42, as shown in Fig. 3, arranged in any suitable way to permit the circulation of water or some other cooling fluid. Any other convenient well-known means may be used for conducting away the heat.

In a divisional application filed June 13, 1907, Serial Number 378,710, claims are made upon certain features of the system of distribution disclosed herein.

I claim as my invention:

1. A mercury vapor rectifier comprising an exhausted container composed largely of metal, a plurality of solid anodes therein insulated from each other and from the container, and a mercury cathode also therein, the joints between the insulating and conducting portions of said container being ground and mercury sealed.

2. A container for a mercury vapor apparatus, requiring the exhaustion of the interior, comprising two separable portions, a metal portion and a portion of insulating material, said first named portion being the lower portion, anodes within the last named portion, and a cathode within the first named portion and means for uniting the two portions with an air-tight joint.

3. An electric rectifier comprising a container, the major portion of which is a metal which is mercury resisting, an anode therein, a mercury cathode also therein, insulating material forming part of the container wall through which the anodes are supported, and an air-tight joint connecting the metallic and insulating portions.

4. An electric rectifier having an anode and a mercury cathode, and including a portion of insulating material and a portion of metal which is mercury resisting, and is a relatively good heat-conducting material, the latter inclosing the cathode and having its inner surface exposed to vapor produced within the container in operation.

5. A mercury vapor rectifier comprising a section of metal which is mercury resisting, a vaporizable conducting material including mercury, inclosed therein, a hermetically sealed insulating plug within the metal section, an electrode mounted within the plug, the path between the metal section and the electrode being longer than the distance to which the solid liquid mercury is carried during operation.

6. A container for an electric vapor rectifier, consisting of a pot of metal which does not amalgamate with mercury, a negative electrode therein including mercury, and a positive electrode also located therein and insulated from the metal pot, the distance between the electrodes being greater than that traversed by the material of the former electrode in liquid form during the operation of the device.

7. An electric vapor rectifier comprising a container, the major portion of which is of a metal which is mercury resisting, an anode therein, a mercury cathode, insulating material forming part of the container wall through which the anode is supported, and an air-tight joint connecting the portions.

8. An electric vapor rectifier comprising a container, the major portion of which is of a metal which does not amalgamate with mercury, an anode therein, a cathode therein consisting of a material including mercury, and insulating material forming part of the container wall.

9. The combination of an evacuated inclosing chamber that is an electrical conductor composed of metal which does not amalgamate with mercury, a conducting gas or vapor therein, an electrode contained therein and insulated therefrom, and a second electrode including mercury also contained in the inclosing chamber.

10. A unidirectional arrester consisting of an inclosing chamber containing a conducting gas or vapor therein, and having the major portion of its wall composed of metal, positive electrodes within the chamber, means for forming electrical connections therewith, and an electrode including mercury also contained within the chamber and inert with respect thereto.

11. An electric rectifier comprising a container, the major portion of which is of iron, an anode therein, a mercury cathode also therein, insulating material forming part of the container wall through which the anodes are supported, and an air-tight joint connecting the metallic and insulating portions.

12. A container for an electric vapor rectifier, consisting of a pot of iron, a negative electrode therein including mercury, and a positive electrode also located therein and insulated from the said iron pot, the distance between the electrodes being greater than that traversed by the material of the former electrode in liquid form during the operation of the device.

13. An electric vapor rectifier comprising a container, the major portion of which is iron, an anode therein, a mercury cathode,

insulating material forming part of the container wall through which the anode is supported, and an air-tight joint connecting the portions.

14. The combination of an evacuated inclosing chamber that is an electrical conductor composed of iron, a conducting gas or vapor therein, an electrode contained therein and insulated therefrom, and a second electrode including mercury also contained in the inclosing chamber.

15. The combination of an evacuated inclosing chamber that is an electrical conductor composed of a metal which resists mercury, a conducting gas or vapor therein, an electrode contained therein and insulated therefrom, and a second electrode including mercury also contained in the inclosing chamber.

16. The combination with a metallic inclosing chamber, insulated electrodes extending within the same, a vaporizable electrode also within the chamber, means for condensing gases or vapors within the chamber, and means permitting the removal of gases or vapors from the chamber.

17. In a vapor rectifier in combination with an exhausted container including a metallic portion exposed to the vapor path and suitable electrodes therein together with means for immersing the metallic portion of said container coöperating with the vapor path in a cooling bath.

18. A rectifier for alternating currents, comprising an exhausted container and suitable electrode surfaces exposed therein, in combination with means for maintaining said electrode surfaces at predetermined relative temperatures.

19. A vapor electric device comprising an exhausted container and electrodes therein in combination with means for controlling the temperature of the vapor path relatively to the electrodes.

20. A vapor electric device comprising an exhausted container and electrodes therein, one at least being an anode in combination with means for cooling the vapor as distinguished from the anode.

21. A vapor electric device comprising an exhausted container and electrodes therein, one at least being an anode in combination with means for controlling the temperature of the vapor relatively to that of the electrode.

22. A vapor electric device comprising an exhausted container and electrodes therein including a vaporizable cathode and at least one anode in combination with means for condensing vapor from the neighborhood of said cathode and means for abstracting uncondensable gases from the portion of the container remote from said vaporizable electrode.

23. In a vapor electric device, the combination with an exhausted container and electrodes therein, said devices being characterized in operation by the development of gas and vapor, of means for condensing out the condensable vapor and separate means for subsequently removing the non-condensable gas residue.

24. A mercury vapor device comprising an exhausted container, a cathode and a plurality of anodes grouped together therein, in combination with means for withdrawing gaseous impurities from the space immediately behind said anodes, said means including an exhaust pump, a connection therefor traversing the wall of the container and a cut-off valve in said connection.

25. A mercury vapor device comprising an exhausted container, electrodes including a cathode and at least one anode, and a vapor path therein between said electrodes, in combination with means for relieving said container of foreign gases during operation, said means including a vacuum pump and a connection therefrom to the interior of said container, said connection opening into said container at a point out of the vapor path between the electrodes.

26. A mercury vapor device comprising an exhausted container, electrodes including a cathode and at least one anode, and a vapor path therein between said electrodes, in combination with means for intermittently relieving said container of foreign gases during operation, said means including a vacuum pump and a connection therefrom to the interior of said container, said connection opening into said container at a point out of the vapor path between the electrodes.

27. A vapor electric device comprising an exhausted container, at least one anode and a cathode therein, in combination with means for removing during operation the accumulation of noncondensable gases or vapors on a side of said anode remote from said cathode.

Signed at New York, in the county of New York, and State of New York, this 31st day of January, A. D. 1903.

PETER COOPER HEWITT.

Witnesses:

M. v. RECKLINGHAUSEN,

WM. H. CAPEL.