J. T. H. DEMPSTER.

MERCURY VAPOR APPARATUS.

APPLICATION FILED MAR. 6, 1905.

982,228. Patented Jan. 17, 1911.

Fig. 1.

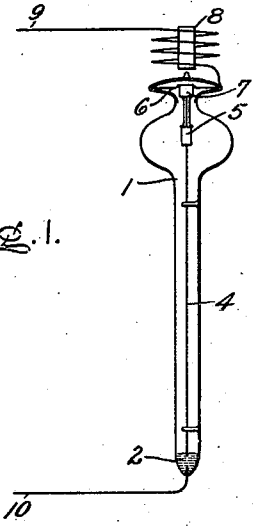


Fig. 4.

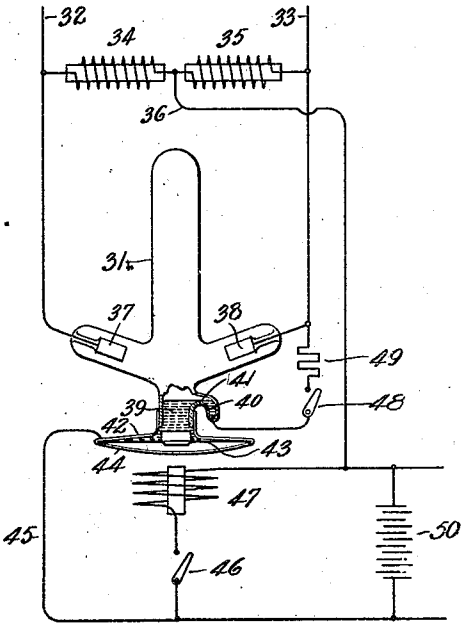


Fig. 2.

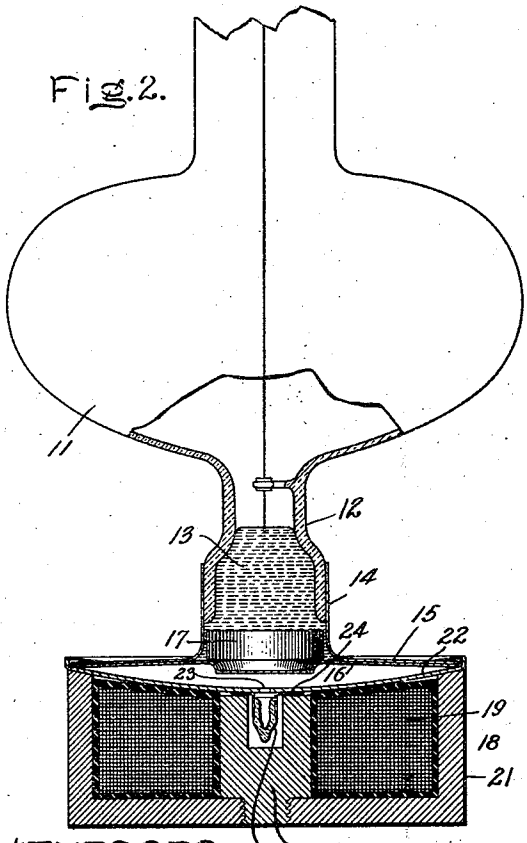
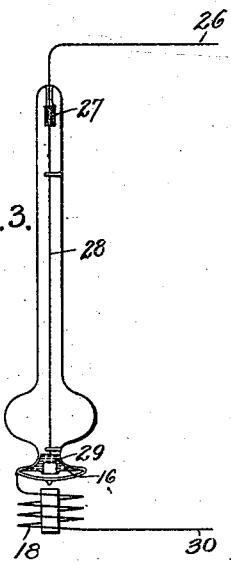


Fig. 3.



WITNESSES:

George J. Thornton.

Helen Wyford

INVENTOR:

John T. H. Dempster,

By Albert G. Davis,

Atty.

UNITED STATES PATENT OFFICE.

JOHN T. H. DEMPSTER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MERCURY-VAPOR APPARATUS.

982,228. Specification of Letters Patent. **Patented Jan. 17, 1911.**

Application filed March 6, 1905. Serial No. 248,398.

To all whom it may concern:

Be it known that I, JOHN T. H. DEMPSTER, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Mercury-Vapor Apparatus, of which the following is a specification.

This invention relates particularly to electrical apparatus in which current is passed through an evacuated chamber containing a metallic vapor and a vaporizable electrode, such for instance as mercury. When apparatus of this type is connected to a source of direct or alternating current it is found that very little current will pass through the tube unless some special means is provided for exciting the mercury electrode, or otherwise ionizing the evacuated space, and so rendering it conductive for current.

The present invention relates particularly to means for producing this initial excitation of the tube.

While the improvement shown in the drawing and described in this specification is intended primarily as a starting means it possesses certain other advantageous features which are more specifically pointed out in the following description.

The annexed claims indicate the scope of my present invention.

Figure 1 shows a lamp adapted for connection to a direct current source and provided with a diaphragm, for lifting the starting filament out of the mercury cathode; Fig. 2 shows a direct current lamp in which the mercury and the filament are separated by lowering the level of the mercury; Fig. 3 shows the method of connecting in circuit the modification shown in Fig. 2; Fig. 4 shows the application of my invention to an alternating current lamp or rectifier.

In Fig. 1 an evacuated chamber 1 of glass or other suitable material is provided at its base with a mercury electrode 2 into which dips a high resistance filament 4 of carbon or other suitable material supported from the carbon or iron anode 5, which in turn is secured to the resilient diaphragm 6 near the top of tube 1. This resilient diaphragm may be made of thin sheet metal, and is of magnetic material or has secured thereto a block of magnetic material as shown at 7 in Fig. 1. An electromagnet 8 is mounted in proximity to this diaphragm and is preferably connected in series with the lamp as shown. At starting, the current flows from the direct current main 9, through the electro-magnet winding 8, through the diaphragm 6 to electrode 5, then through filament 4 and electrode 2 to the direct current main 10. The flow of current through electromagnet 8 energizes the diaphragm 6 sufficiently to separate filament 4 from the mercury cathode 2, thus forming an incipient spark at the surface of the mercury cathode and rendering the space within the tube conductive for current after which practically the entire flow of current takes place between electrode 5 and cathode 2 through the mercury vapor which fills the tube.

The modification shown in Fig. 2 differs from that just described in that instead of raising the filament out of the mercury, the mercury is lowered away from the filament. In Fig. 2 the lower end of the evacuated chamber 11 is provided with a tubular extension 12 forming a receptacle for the mercury cathode 13. Around the outside of this extension 12 is a tubular member 14 of sheet metal carrying at its outer end a wide annular flange 15, the outer edge of which is hermetically sealed to the resilient diaphragm 16. This diaphragm may be made of sheet metal and may be of magnetic material or have attached thereto an iron block 17 energized by an electromagnet 18 to produce movement of the diaphragm. I have shown this electromagnet as consisting of a coil 19 inclosing a cylindrical iron hub 20 screw threaded into an iron casing 21 which completely incloses the outer edge of coil 19, thus insuring a good magnetic circuit and protecting the coil from mechanical injury. I have found that to secure a maximum sensitiveness of the diaphragm to the magnetic action of electromagnet 18 it is desirable to prevent free access of air to the outer side of the diaphragm, for as the pressure within tube 11 is much less than atmospheric pressure considerable energy must be expended by electromagnet 8 in overcoming the force exerted by the atmosphere unless special precautions are taken. To overcome this atmospheric pressure I inclose the diaphragm in

a sheet metal dish 22, the outer edges of which are hermetically sealed about the outer edges of diaphragm 16. The center of this dish-shaped closure 22 is provided with an opening 23 about which is arranged an annular flange 24, carrying a glass sealing member 25 which, prior to the completion of the apparatus, is provided with an opening through which the air may be exhausted, but which is finally sealed off as shown in the drawing. Preferably the space within closure 22 is not completely exhausted as I prefer to have pressure enough therein to maintain the diaphragm in the position shown in the drawing, when the lamp is not in circuit. This lamp is connected to the direct current circuit as shown in Fig. 3 and the current flows from the lead 26 through anode 27 and filament 28 to the mercury cathode 29 and then through diaphragm 16 and electromagnet 18 to the other direct current lead 30. The electromagnet 18 draws down the diaphragm 16, thus forming an incipient spark at the end of the filament, and so rendering the space within the tube conductive for current, after which the lamp continues to operate in the manner well-known to persons skilled in the art.

The types of lamps just described are not well adapted for use on alternating current circuits, because of the peculiarities of an alternating current flow. There is a point between each successive half wave of an alternating current during which no current is supplied by the source. Under such conditions a lamp of the above described types would become "dead" during this interval of no-current flow. To overcome this difficulty the scheme of connection shown in Fig. 4 has been utilized, in which 31 is the evacuated tube, 32 and 33 the alternating current leads, 34 and 35 reactances connecting in series between these leads and provided with the tap 36 for the purpose hereinafter described. The vapor tube is provided with two anodes 37 and 38 connected directly to the alternating current leads 32 and 33, and is also provided with a mercury cathode 39 and an auxiliary or starting electrode 40 separated from cathode 39 by a bridge wall 41. The lower end of tube 31 is provided with a metal closure 42 carrying a diaphragm 43, in all respects similar to that shown in Fig. 2. This diaphragm is protected from atmospheric pressure by an outer shield 44 and is provided with a lead 45 connected to a switch 46, which when closed completes the circuit through an electromagnet 47 to the tap 36 of the reactance coils. The auxiliary or starting electrode 40 is connected through switch 48 and a resistance 49 to the alternating current lead 33.

To start the lamp switches 46 and 48 are closed so that current may flow from lead 33 through resistance 49 and switch 48 to the starting electrode 40, then through the thin layer of mercury which covers the bridge wall 41 to electrode 39, then through diaphragm 42 and conductor 45, through electromagnet 47 to tap 36, and then through reactance 34 to lead 32. This current energizes electromagnet 47 and draws down diaphragm 43 sufficiently to separate the two bodies of mercury immediately above the bridge wall 41 thereby producing an arc at this point. This arc excites the cathode and ionizes or otherwise affects the space through the tube so that current from anodes 38 and 37 will flow through the mercury vapor to cathode 39. As is well-known the current flow from these anodes is substantially unidirectional in character so that the current delivered from the tube through conductor 45 is unidirectional, and may be used for charging a storage battery 50, or for doing other work. The lamp or rectifier is prevented from going out during the dead points of the alternating current pressure, because of the reactive discharges of the coils 34 and 35. Thus if the current flow is from electrode 38 to cathode 39, and finally back to the tap 36 and then by way of reactance 34 to the lead 32, there will be stored up in reactance 34 a certain amount of energy which will be available for work as soon as this flow of current ceases. In other words, before the current from electrode 38 reaches zero the reactance 34 will begin to discharge through the tube by way of electrode 37 thereby producing an overlapping wave of current which will maintain the evacuated space in a conductive condition until the next successive half way of pressure.

Although I have illustrated in Fig. 4 a type of apparatus which may be used to produce direct current from alternating current to charge storage batteries and do other similar work it should be understood that my invention is applicable as well to alternating current apparatus used entirely for the production of light. It is also applicable to polyphase apparatus, as will be readily understood by persons skilled in the art.

While my improvement is particularly adapted as a starting means, it also possesses valuable features as a shock resisting device to prevent fracture of the glass tube by the sudden rush of mercury when the lamp or rectifier is suddenly inverted, as may occur during manufacture or transportation.

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

1. A gas or vapor electric apparatus having a movable diaphragm, an electrode movable therewith, and electromagnetic means for moving said diaphragm.

2. The combination of a source of cur-

rent, a vapor electric apparatus having an evacuated chamber and a movable diaphragm, and electromagnetic means for moving said diaphragm to initiate the flow of current from said source through said evacuated chamber.

3. An evacuated chamber having a resilient diaphragm in the wall thereof, a heavy liquid in said chamber, and means for maintaining a pressure less than atmospheric on the outside of said diaphragm.

4. In a vapor electric apparatus, a resilient diaphragm of conducting material, an electrode electrically connected thereto, and automatic means for moving said diaphragm and electrode.

5. In a vapor electric apparatus, a resilient diaphragm of conducting material, an electrode electrically connected thereto, automatic means for moving said diaphragm, and means for maintaining a pressure less than atmospheric on both sides of said diaphragm.

6. In a vapor electric apparatus, the combination of an evacuated envelop, a liquid body therein, and a resilient diaphragm of metal in the wall of said envelop.

7. A vapor electric device having a resilient diaphragm in the wall thereof, a body of heavy liquid therein, and means for maintaining a pressure less than atmospheric on the other surface of said diaphragm.

8. A vapor electric device having an evacuated envelop with a movable diaphragm in the wall thereof, electrodes in said envelop, and means for automatically moving said diaphragm to start an arc between said electrodes.

9. The combination of an envelop, electrodes therein through which current initially passes, and a diaphragm automatically movable to start an arc in the path of said initial current.

10. The combination of an evacuated envelop having a diaphragm in the wall thereof, magnetizable material carried by said diaphragm, and an electromagnet in inductive relation to said magnetizable material.

11. The combination of an evacuated envelop closed by a metal diaphragm, an anode within said envelop, a mercury electrode carried by said diaphragm, and means for moving said diaphragm to start an arc to said mercury electrode.

In witness whereof I have hereunto set my hand this 3rd day of March, 1905.

JOHN T. H. DEMPSTER.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.