Dec. 2, 1924. 1,517,466

O. SCHALLER ET AL

GASEOUS CONDUCTION LAMP

Filed July 22, 1920 2 Sheets-Sheet 1

Fig. 1

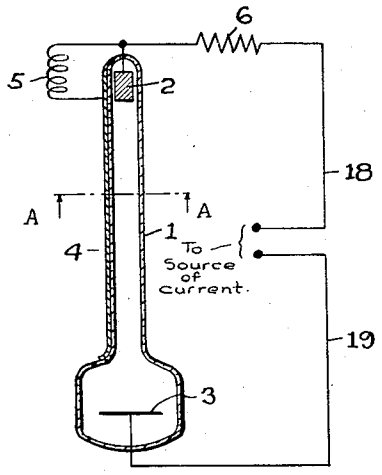

Fig. 2

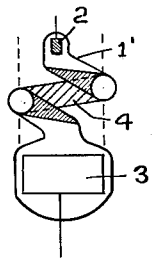

Fig. 1a

Fig. 3

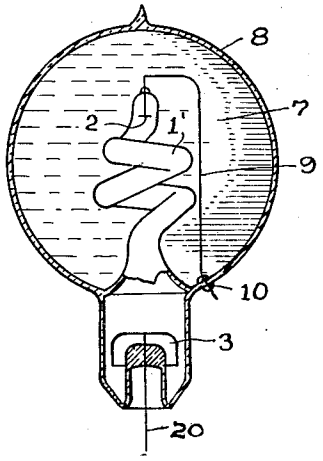

Fig. 4

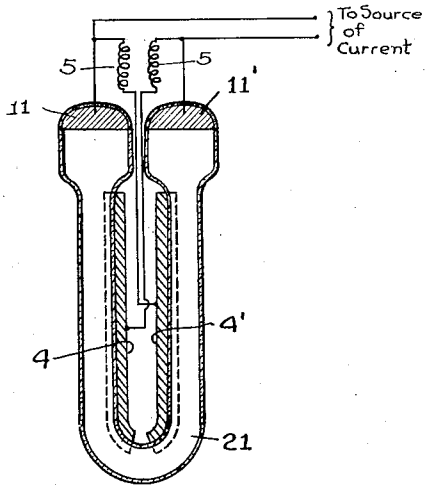

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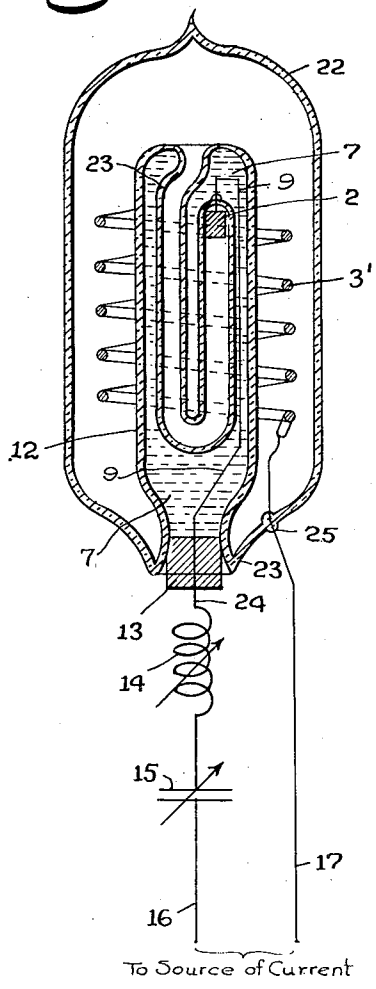
Fig. 5



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UNITED STATES PATENT OFFICE.

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GASEOUS-CONDUCTION LAMP.

Application filed July 22, 1920. Serial No. 398,274.

To all whom it may concern:

Be it known that we, OTTO SCHALLER, of Berlin-Sudende, Germany, and FRITZ SCHRÖTER, of Berlin-Schmargendorf, Germany, citizens of the German Republic, have invented an Improvement in Gaseous-Conduction Lamps, of which the following is a specification.

This invention relates to gaseous conduction lamps and more particularly to lamps of the above character in which illumination is obtained by the luminous discharge in the gases and passing between the electrodes contained in the lamp.

One of the objects of this invention is to provide a gaseous conduction lamp in which efficient use as a source of illumination may be made of the luminous discharge passing between the electrodes and in which such discharge may be started and maintained at relatively low voltages and without intervention of auxiliary starting devices. In various types of gaseous or vapor conduction lamps heretofore known to the art, use has been made of external devices for increasing the applied circuit voltage to a substantial degree in order to start the functioning of the lamp. Such devices have included transformers and other inductive apparatuses used in connection with an auxiliary electrode inserted in the lamp. This invention aims, in particular, to provide a gaseous conduction lamp in which the starting, at relatively low voltages, of the luminous discharge from one electrode to the other is automatically accomplished, in a simple and practical manner, and in which the disadvantages and objections accompanying the use of auxiliary inductive devices are avoided.

Another object of this invention is to provide a simple and effective method for starting gaseous conduction lamps and to provide starting means of dependable action, which means may constitute a part of the lamp proper to form an integral or unitary structure therewith.

Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, arrangement of parts, and combination of steps as will be exemplified in the structure hereinafter described and the scope of the application of which will be indicated in the following claims.

In the drawings in which are shown one or more of various possible embodiments of the mechanical features of our invention,

Figure 1 is a diagrammatic longitudinal sectional view of a lamp and associated electrical circuits illustrative of certain features of our invention.

Figure 1ª is a sectional view taken on the line A—A of Figure 1;

Figure 2 is a front elevation of a modified form of gaseous conduction lamp;

Figure 3 is a vertical longitudinal sectional view of a modified form of lamp, certain parts being shown in elevation;

Figure 4 is a vertical sectional view of a modified form of lamp in which a preferred circuit arrangement is diagrammatically indicated; and

Figure 5 is a vertical longitudinal sectional view showing another modified form of gaseous conduction lamp embodying certain features of our invention, this view indicating diagrammatically also certain possible circuit arrangements therefor.

Referring in detail of Figure 1 of the drawings, we have diagrammatically shown a pair of metallic electrodes 2 and 3 of suitable material mounted in the respective ends of a suitably formed container or vessel 1, preferably of glass, filled with a suitable gas, preferably such as neon, for example, or any of the gases of the argon group, or a suitably proportioned mixture thereof. The gases within tube 1 are preferably under a substantially slight pressure. The electrodes 2 and 3 are connected to the conductors 18 and 19, respectively, leading to a suitable source of current and there is preferably included in the circuit of the lamp, as for example in the conductor 18, a suitable current limiting resistance 6.

Upon the exterior of the vessel or tube 1, we have provided an electrically conductive coating 4 extending longitudinally of the tube to an extent sufficient to reach the immediate vicinity of the two electrodes 2 and 3 within the vessel 1. As will be clear from Figure 1, the coating 4 is preferably in the form of a strip of a suitable material and so disposed with respect to the exterior surface of the tube 1 that the light rays emitted from the gaseous discharge between the elec-

trodes 2 and 3 may freely pass through the opposite wall portions of the vessel 1. This disposition of the coating 4 is more clearly shown in the sectional view of Figure 1ª. The coating 4 is connected to one side of the circuit, as the conductor 18, to which also is connected the electrode 2. The connection of the coating 4 is preferably made through a suitable inductance, 5 whose value of inductance may be suitably proportioned with respect to the capacity of the coating 4 to the electrode 3.

As soon as the circuit through the conductors, 18 and 19 leading to the source of current, is closed, the applied voltage, being within the range of ordinary lighting voltages, is insufficient to initiate a direct ionization of the gases within the tube 1 and between the electrodes 2 and 3 and hence is insufficient to start directly a luminous discharge from one electrode to the other. The closing of the circuit, however, causes a substantial displacement current to flow between the exterior coating 4 and the electrode 3, the intervening wall of the vessel 1 and the gaseous content of the latter functioning as the dielectric between the two conducting elements 4 and 3. Such displacement current at once causes an ionization of the gaseous content and by reason of the coating 4 extending within the substantially immediate regions of the electrode 2, such ionization within the tube 1 is caused to extend substantially from the electrode 2 to the electrode 3. The gaseous content having thus been initially ionized, the luminous discharge between the electrodes 2 and 3 is at once begun and thereupon maintained directly by the voltage applied to the two electrodes.

The value of the displacement current thus functioning to cause an initial ionization of the gaseous discharge path extending from one electrode to the other, may be conveniently controlled or regulated by means of the inductance 5 suitably proportioned with respect to capacity formed by the coating 4 and the electrode 3. It will be understood that the greater the value of the displacement current, the greater will be the initial ionization of the gaseous content and the more readily will the gaseous discharge be initiated; the inductance 5 is thus preferably of such a value that it will form, with the above mentioned capacity a circuit resonant to the frequency of the applied alternating current so that the initial flow of current through this circuit will be a maximum.

The exterior coating 4 is preferably made of a material capable of functioning also as a reflector of light rays and in the embodiment illustrated in Figure 1, functions to reflect the light rays emitted by the luminous discharge in a predetermined direction and may envelope the exterior of the tube to an extent commensurate with the production of a sufficiently large displacement current to initiate the ionization of the gas content and with the desired reflecting property.

The exterior coating above described may be made of any suitable conducting material, such as for example zinc, aluminum, silver, and the like. Where the coating is made of metal it may conveniently take the form of leaves of the particular metal and may be, for example, pasted on in any convenient manner.

In Figure 2, we have illustrated a modified form of the lamp of our invention, the electrical circuits being omitted and being substantially similar to those of Figure 1. The tube or vessel 1′ is shaped in the form of a spiral and has mounted therein at its respective ends the two electrodes 2 and 3. The exterior conductive coating 4 is mounted on the walls of the spiral facing inwardly and toward the center line or axis of the spiral. The coating 4 functions similarly as in Figure 1 and in connection with the spiral arrangement of the tube 1′ serves to reflect the light rays in all directions.

The exterior coating forming a capacity with one of the electrodes may be made in various forms. Thus, for example, it may take the form of a conductive mesh or a coil which may substantially entirely surround the tube in which the luminous discharge is to take place, or it may also be made of a conductive liquid or electrolyte. In Figure 3, we have illustrated an embodiment of our invention in which the tube or vessel 1′, in which the luminous discharge is to take place, is mounted within a suitable secondary container or bulb 8, preferably of glass, and which may be given a form substantially similar to that of ordinary incandescent lamp bulbs. The tube 1′ is preferably made in spiral form so as to obtain as great a length of luminous discharge between the electrodes 2 and 3 mounted in its respective ends as is possible within a given over-all length, and the space intervening the tube 1′, and the bulb 8, is filled with a translucent conductive liquid or electrolyte 7, which, surrounding substantially entirely the exterior of the tube 1′, functions as the exterior coating between which and the electrode 3 the displacement current necessary for producing an initial ionization of the discharge path within the tube 1′ passes. The electrode 2 may be connected to one terminal 10 of the lamp by means of a conductor 9 passing through the electrolyte 7, the electrode 3 being connected to the other terminal 20 of the lamp. It will be clear that, if the electrolyte 7 is sufficiently conductive it may form the connection between the electrode 2 and the terminal 10, but in order

to avoid possible electrolytic effects, the conductor 9 is preferably employed and it will be noted that the conductor 9 thus acts to maintain the electrolyte 7 at the same relative potential as that of the terminal 10, which is connected to one side of the electrical circuit. The exterior electrical circuit may be similar to those shown in Figure 1, excepting that the inductance 5 interposed between one side of the circuit and the exterior coating may be omitted.

In the operation of the embodiment of Figure 3, the electrolyte 7 serves as an efficient cooling medium in that the heat generated, principally at the electrodes, is rapidly conducted therefrom and radiated from the large exterior surface of the bulb 8. Such cooling effect is particularly advantageous in minimizing disintegration of the electrodes which otherwise tend to vaporize and the small particles of which are precipitated upon the interior walls of the discharge tube; thus tending to render the tube opaque. Preferably an electrolyte having a low light absoportion effect is chosen and furthermore suitable substances may be dissolved in the electrolyte to render it fluorescent, such fluorescence being characteristically enhanced under the influence of the particular type of light rays emitted from the luminous discharge. Such fluorescence may greatly increase the luminosity of the lamp. Furthermore. various coloring matters may be dissolved in the electrolyte to obtain an ultimate light of any desired color or tone.

The electrolyte may conveniently take the form of a suitable salt solution, such as for instance a solution of sodium sulphate and, as will be clear from the foregoing, any suitable electrolyte which is of course conductive may be employed. Where it is desired to make the electrolyte fluorescent, uranium salts, for example, may be dissolved in the electrolyte. Also, if for example it is desired to bring about an absorption of certain colors of the spectrum of the discharge, such as the blue thereof for example, the electrolyte may be given a yellowish color by dissolving therein a suitable chromate.

In Figure 4 is illustrated a lamp embodying certain features of our invention and particularly adapted for use in connection with alternating currents. The vessel or tube 21 is U-shaped and has mounted in its two upper ends the electrodes 11 and 11'. The conductive coating for producing with an associated electrode the starting displacement current is preferably made in two sections 4 and 4', the two exterior coatings being mounted upon the interiorly facing exterior walls of the U-shaped tube 21. The two coatings 4 and 4' may be connected through a suitable inductance, as 5 in Figure 1, in any suitable manner to the electrodes 11 and 11'. Preferably, however, the coating 4 is in electrical connection with the electrode 11' and the coating 4' with the electrode 11 as shown in Figure 4. In this arrangement, the initial ionization of the gaseous path extending from the electrode 11 to the electrode 11' and requisite for the starting of the lamp takes place, the value of the displacement currents being controlled, if desired, by inductances such as 5 of Figure 1 these inductances being also shown in Figure 4.

In Figure 5 is illustrated an embodiment in which the capacitative exterior liquid coating is minimized in volume and thickness so as to minimize the absorption of light rays within the electrolyte. Within the exterior bulb 22 there is mounted a secondary tube 12, the construction being preferably of glass throughout, and the lower ends of the tubes 12 and 22 are joined to form a single opening 23 into the tube 12. Within the tube 12 is mounted the U-shaped tube 23 extending inwardly substantially throughout the entire length of the tube 12 and having its upper end sealed to the upper end of the tube 12 to form a substantially continuous interior space with the tube 22, which space is filled with a suitable gaseous content to provide a luminous discharge. The space between the tube 23 and the tube 12 is filled with a suitable translucent and conductive electrolyte sealed therein as by a suitable stopper or seal 13 and electrically connected to the exterior electrical circuit as by the conductor 24 extending through the seal. An electrode 2 of suitable material is mounted within the upper sealed end of the tube 23 and is electrically connected to the electrolyte 7 by means of a suitable connection or terminal sealed in the upper end of the tube. Preferably a conductor 9 connects the electrode 2 to the terminal 24. The electrode cooperating with the electrode 2 may take the form of a grid or spiral 3' surrounding the tube 12 and is connected to one terminal 25 of the lamp.

The terminals 24 and 25 of the lamp are connected to a suitable source of current, preferably an alternating current source, and there is preferably inserted in this circuit an inductance 14 and a capacity 15. The closing of the circuits to the lamp cause a displacement current to flow from the electrolyte 7, forming the coating of the tube 23 and forming also the interior coating of the tube 12, to the electrode 3' connected to the opposite terminal of the source. Such displacement current causes the ionization of the gaseous discharge path extending from the electrode 2 to the eletrode 3', whereupon the luminous discharge between electrodes 2 and 3', the ionization having been initially

established, is maintained automatically between these electrodes. The inductance 14 and the capacity 15 may be suitably adjusted with respect to one another to control the amount of current flowing to the lamp and may replace the resistance 6 of Figure 1 inserted in the supply circuit. The inductance 14 and the capacity 15 may be adjusted with respect to the capacity constants of the lamp so as to form therewith an oscillatory circuit or a circuit resonant with the frequency of the alternating current source. They are primarily so adjusted as to result in a displacement current of sufficient magnitude to cause the ionization of the gaseous discharge path between the two electrodes requisite for the starting of the lamp. The electrolyte 7 may be given the same characteristics or properties as described in connection with Figure 3 and functions also as an efficient cooling medium by providing, in part at least, a heat-conductive path within the otherwise gaseous path extending from the innermost parts of the device to the walls of the vessel.

As various possible embodiments may be made in the above invention and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein set forth, as shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

What we claim is:

1. In a device of the class described, in combination, a glass vessel substantially elongated and bent back upon itself to form at least two substantially adjacent branches and having a rarefied gaseous content, a pair of electrodes mounted within said vessel and adapted to maintain a luminous discharge therebetween at relatively low voltages, and means forming a conductive coating in electrical connection with one of said electrodes and disposed substantially upon the adjacent exterior surfaces of said two branches of said vessel for producing a displacement current adapted to ionize said gaseous content, the disposition of said conducting coating upon the adjacent exterior surfaces of said two branches permitting the free radiation of light from said vessel.

2. In a device of the class described, in combination, a glass vessel substantially elongated and bent back upon itself to form at least two substantially adjacent branches and having a rarefied gaseous content, a pair of electrodes mounted within said vessel and adapted to maintain a luminous discharge therebetween at relatively low voltages, and reflecting means interposed between adjacent branches of said vessel for preventing the emisson of light rays from each branch in a direction substantially toward the other branch.

3. In a device of the class described, in combination a glass vessel substantially elongated and bent back substantially upon itself to form at least two substantially adjacent branches and having a rarefied gaseous content, a pair of electrodes within said vessel adapted to maintain a luminous discharge therebetween and in said gaseous content, a conductive coating on each branch of said vessel and on that side thereof substantially facing the other branch, and means for electrically connecting each coating to one electrode terminal.

4. In a device of the class described, in combination, a substantially U-shaped glass vessel having an electrode mounted in the end of each leg thereof and having a gaseous content within which said electrodes are adapted to maintain a luminous discharge, a conductive coating on each leg of said vessel and on that side thereof substantially facing the other leg, and means connecting the coating on one leg to the terminal of the electrode mounted in the end of the other leg of said vessel.

5. In a device of the class described, in combination, a substantially elongated closed glass vessel bent into curved form to provide outer exterior wall portions of greater radial distance from the axis of bending of said vessel and inner exterior wall portions of lesser radial distance from said axis, said vessel having a rarefied gaseous content and a pair of electrodes therein adapted to maintain a luminous discharge therebetween at relatively low voltages, and light reflecting means operatively related to said inner exterior wall portions of said vessel.

6. In a device of the class described, in combination, a substantially elongated closed vessel having a rarefied gaseous content and a pair of electrodes mounted therein adapted to maintain a luminous discharge therebetween at relatively low voltages, conductive means related to said vessel but only upon substantially one side thereof and extending lengthwise thereof, said vessel with said conductive means being bent into curved form and with said conductive means facing toward the axis about which said vessel is bent and means for connecting said conductive means to one of said electrodes for producing a starting displacement current for causing an initial ionization of said gaseous content.

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