Feb. 25, 1936. C. H. BRASELTON 2,031,927

LAMP

Filed Dec. 4, 1931 2 Sheets-Sheet 1

Fig. 1.

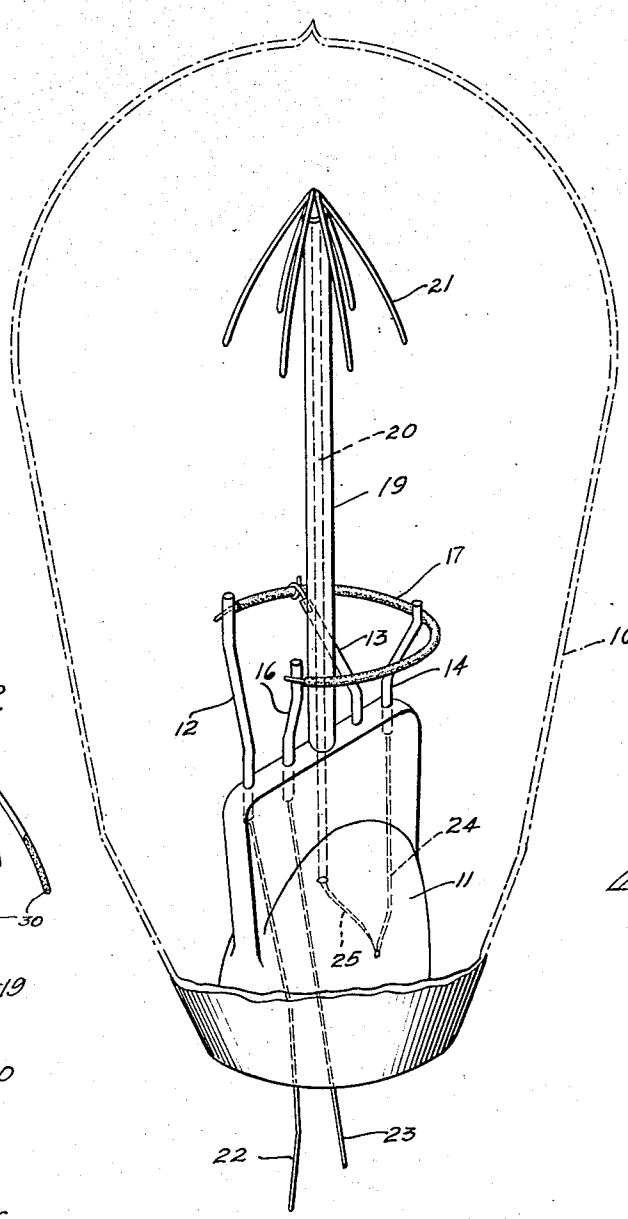


Fig. 2.

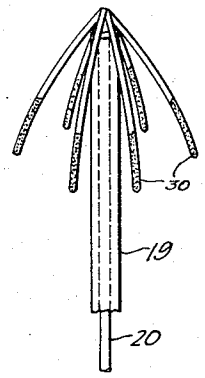


Fig. 3.

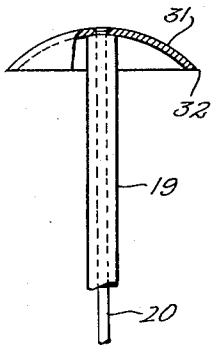
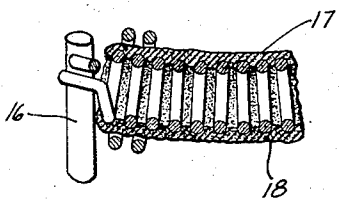


Fig. 6.



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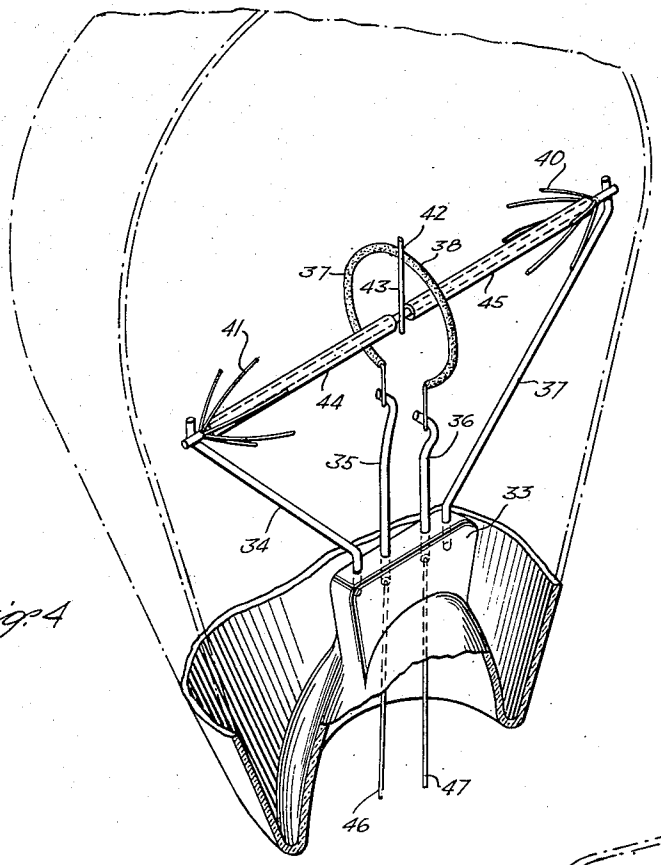


Fig. 4

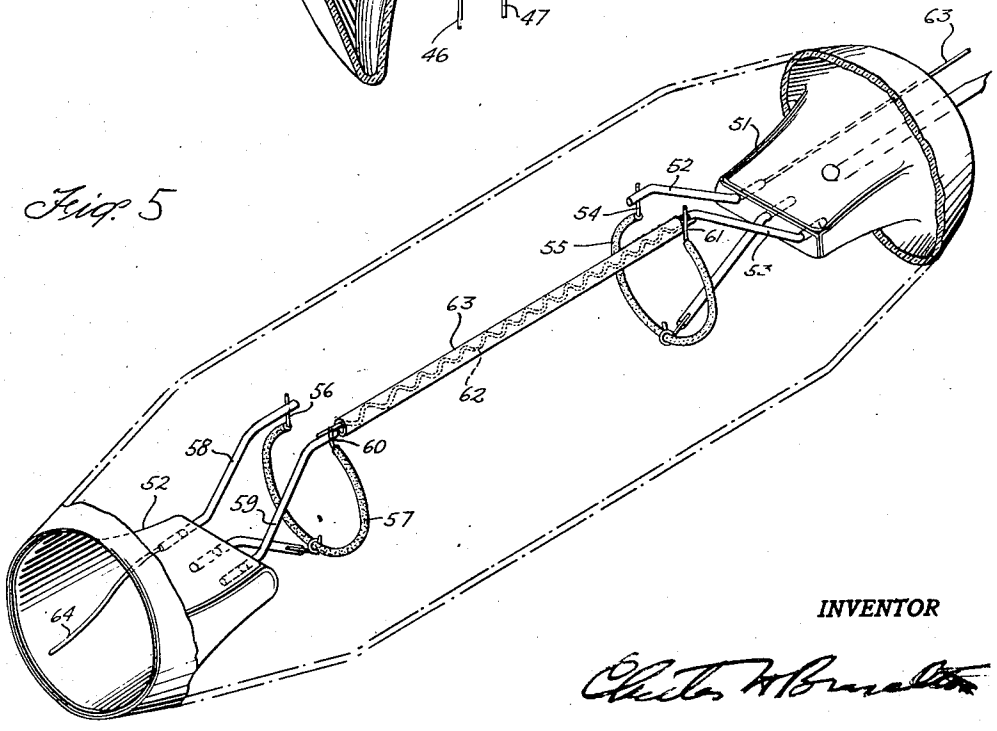


Fig. 5

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Patented Feb. 25, 1936

2,031,927

UNITED STATES PATENT OFFICE

2,031,927

LAMP

Chester H. Braselton, New York, N. Y., assignor to Sirian Lamp Company, Newark, N. J., a corporation of Delaware

Application December 4, 1931, Serial No. 578,936

7 Claims. (Cl. 176—123)

This invention relates to lamps having particular adaptation for exit lights or for signalling purposes.

Among the objects of the invention is to provide a lamp of relatively low brilliancy which, nevertheless, has sufficient luminosity to be visible at considerable distances therefrom.

Another object of the invention is to provide a lamp, the luminosity of which is of such a character as to readily penetrate partially opaque atmospheres, such as that of smoke, fog, and the like.

Another object is to provide a type of lamp of the gas filled type which functions at relatively low voltages, such as that normally used for house lighting; that is, approximately 110 volts.

Another object of the invention is to provide a lamp of the gas filled type which will cause a luminous discharge of the gas in a relatively concentrated area as distinguished from an elongated or tubular type of lamp.

Still another object of the invention is to provide a type of lamp which has plural sources of luminosity, derived not only from emission from incandescent solids but also from associated gases immersing said solids.

Various other objects pertaining to the underlying ideas of the invention, as well as to the details of construction and methods of manufacture, will appear on consideration of the following description and in conjunction with the accompanying drawings, in which

Fig. 1 is a view in elevation showing a lamp embodying the essential structural features of the invention, which may be preferred;

Figs. 2 to 5 inclusive illustrate modification; and

Fig. 6 is a detail showing a solid light emitter in magnified form.

In my co-pending application, Serial No. 459,048, filed June 3, 1930, an energy radiating device or lamp is described in which utilization is made of a coil of tungsten wire coated with an electron emitting material, and this coated tungsten is immersed in an atmosphere of inert gases, such as argon and neon, within an enclosed container. When the tungsten wire is heated by the passage of an electric current, the coating causes the adjacent gases to become ionized in the form of a luminous halo or layer surrounding the conductor.

In accordance with said application, a filament of appropriate resistance, such, for example, as 150 ohms, is placed in heating relationship with various alkaline oxides such as the oxides of barium, strontium, calcium or other materials which have been found to emit electrons densely when heated. The base filament is tungsten or tantalum wire, although other metal conductors may be used. It is not necessary ordinarily that the base material be highly refractory, as the operating temperatures may be relatively low, in many cases not being above that of low red heat.

The filament is preferably coiled and the oxides either applied as a paste to the exterior of the coil, or as a core or rod to the coil interior. The oxide material initially may be in the proportions of 40 grams of barium carbonate, 40 grams of calcium carbonate, 8 grams of barium nitrate with a binder of sufficient nitrocellulose dissolved in amyl acetate to hold the coating on the wire. The filament is then mounted on a stem support and sealed in the bulb of the envelope.

The exhaust pump is then connected to the bulb and an oven lowered thereupon to raise the temperature of the bulb and contents to about 400° C., or to as high a temperature as the envelope will stand without softening. Simultaneously electric current is passed through the filament, which is heated to red heat of approximately 600° C. The heat and exhausting process is continued until there is no fluorescence when the high tension current is directed against the wall of the bulb, or in other words, until there is practically no more gas inside of the bulb. A vacuum of about one-half of a micron is an approximate limiting value.

The current is then increased through the filament so that the temperature thereof is slowly raised until it is about 800 degrees, or a bright red color, the exhaust operation being continued until the newly emitted gases are removed. The oven is then raised from the bulb and the filament heated to about 1200° C., the pumping being continued until a high vacuum of one-half micron is again obtained.

The pump is then shut off and the current turned off, thus completing the process. Where a more complete amalgamation of the coating is desired the following steps are included: About one-half mm. of neon gas is admitted to the bulb. The filament current is then turned on and gradually increased until a diffused glow completely fills the bulb. When the discharge is uniform throughout the bulb, the filament current is turned off and the pump applied to remove the neon gas. The filament temperature is then raised for a short interval to about 1400° C., with the pump operating to remove any undesirable gases which may have been thrown off during the activation process. Should white discharge spots

appear on the filament or support rods, it is an indication that the gases or vapors within the bulb have not been completely removed, and the bulb is again exhausted and the whole process of activation repeated.

With the activation process satisfactorily completed the filament circuit is disconnected and the pump turned off and the appropriate amount of gas admitted to the bulb. In one form of my invention I utilize neon and argon gases in the relative amounts of 50 mm. of neon gas, and 150 mm. of argon. Other monatomic gases, such as krypton, helium, or metal vapors such as those of mercury, caesium, and rubidium may also be used. The bulb is then sealed off and a small quantity of magnesium flashed to absorb additional impurities, thus completing the process.

Utilizing the principles involved in applying the activated coating as hereinabove described, I insert in a bulb 10, which is preferably transparent, a support 11 which forms a closure seal of the bulb. Mounted on said support and sealed therein are the supporting standards 12, 13, 14, 15, and 16, to the upper ends of which standards is welded or otherwise attached a coil 17 of tungsten, molybdenum, tantalum, or other wire which is preferably refractory, although the degree of resistance to high temperatures is a factor dependent upon the specific uses involved. In a given instance I employ tungsten wire in a coil about two and one-eighth inches long of a diameter formed in a 0.010'' mandrel. This tungsten is coated with a coating 18 of alkaline earth metal oxides, singly or in combination, referred to hereinabove, the coating either being applied exteriorly or inserted within the coil. The coating may be formed as a rod which is then inserted as a core within the coil 17.

Arising centrally from the support 11 is a glass tube 19, which is preferably fused to the support 11, although it may rest thereon without fusion with the support. A conducting wire 20 forms a core to this tube, the lower end of which is fused into the support 11, and the upper end of which is attached to a plurality of curvilinear depending wires 21. These wires 21 are made from molybdenum, tungsten, nickel or any other wire material which has sufficient resistance to heat to withstand a temperature not exceeding ordinarily a red temperature. Lead-in wires 22, 23, and 24 are connected to the supporting standards 12, 16, and 14 respectively. Lead-in wire 25 is connected to the tube wire 20 at one end, and at its other end is connected to the lead-in wire 24.

The container 10 is filled with an inert gas, preferably neon, which has a relatively low breakdown potential and which also is luminous when subjected to the electric discharge. Various pressures of the gases may be used, but I have found that a pressure in excess of 20 mm. of mercury, and below 50 mm., gives satisfactory results, although the limiting pressures mentioned may be exceeded. Other gases which may be used are argon, nitrogen, and helium, although the latter, because of its heat conductivity, is not so useful. Also, certain metal vapors may be mixed with any of these mentioned gases, or a mixture of them, such as vapors including those of mercury, caesium, and rubidium. Krypton and xenon are other gases which may be used.

In operation, when an electric current is applied to the lead-in wires 22 and 23, electric current traverses the tungsten coil 17 and heats the coating 18 to a point where it emits electrons freely, and through said emission, breaks down the normal resistance of the neon gas in which these elements are immersed. It is pointed out that since lead-in wires 24 and 25 are connected together, the depending rods 21 are at the same potential as standard 14, which in turn is attached approximately to the mid-point of the tungsten coil 17. There is thus a potential drop between rods 21 and the conductor 17 which is maximum at the junction of the coil 17 with the supports 12 and 16. The decrease of resistance of the gas, due to the emission of electrons from the heated coating of the conductor, permits an active electrical discharge to traverse the gas intermediate the rods 21 and the conductor 17. This discharge is pronouncedly red where neon is used, and is not only intermediate these two particular elements, but fills the entire space as defined by the enclosing bulb. This red luminosity is combined with that arising from the heated conductor 17, which is relatively white, and from the outer sections of the rods 21, which is red or yellow in color. This luminosity is sufficient and is of such a character as to penetrate murky atmospheres, such as that which exists in the presence of fogs, smoke, or other non-transparent gases. A lamp incorporating the features herein described accordingly is of value as a theatre exit warning light, inasmuch as for this use it has high visibility with low brilliancy. These features, combined with its penetration and the fact that the lamp is usable across 110 volt electric mains, increases the utility of the device for this purpose.

In Fig. 2 I have shown a modification of the disclosure of Fig. 1 in which the ends of the depending wires 21 are coated with electron emitting oxides 30. As hereinabove stated, the ends of these wires during the operation of the lamp become heated, and when coated, the coating emits electrons and ionizes the adjacent gases so that the performance of the lamp is modified beneficially.

In Fig. 3 I have shown a modification of the arrangement including the depending wires 21, in which is substituted a downwardly concave dish-like member 31, the edges 32 of which being closer to the emitting conductor 17 than the center thereof, and the discharge being initiated between the edges 32 and the conductor 17.

Fig. 4 illustrates a modification of the disclosure of Fig. 1 in which a mid-potential discharge element is placed on either side of the plane of the conductor. The stem 33 supports four standards, 34, 35, 36 and 37. To the ends of the standards 35 and 36 is connected the coiled tungsten conductor 37, which has a coating 38 thereon. Intermediate the ends of the standards 34 and 37 is a conductor 39, to the ends of which are mounted the inwardly directed curvilinear electrode wires 40 and 41. The approximate mix-point 42 of the conductor 37 is connected by the wire 43 to the conductor 39. Glass tubing 44 and 45 insulates the wire 39 so as to prevent any short-circuiting discharge. Lead-in wires 46 and 47 connect to standards 35 and 36, respectively, so that an electrical potential may be applied to the conductor 37.

The operation of this modification is similar to that described in connection with Fig. 1, with the exception that discharge in this case is on either side of the plane of the conductor 37, so that an increased amount of energy is utilized in the discharge.

In Fig. 5 a further modification of the invention is illustrated in which I have shown a tubu-

lar lamp casing 50 having end supports 51 and 52 in either end thereof. Within the tube on the support 51 are the standards 52 and 53, which support a loop of coiled tungsten wire 54, which is preferably coated with electron emitting material 55. A similar conductor 56 having a coating 57 is mounted on the standards 58 and 59 in the stem support 52 at the other end of the tube. Opposite ends 60 and 61 of the conductors are connected together by the resistance wire 62 which is enclosed in a glass tubing 63, or otherwise insulated. Lead-in wire 64 is attached to the stem 58 so that when a potential is applied to these lead-in wires, current passes through each of the conductors 54 and 56 by means of the connecting wire 62.

When the envelope 50 contains inert ionizable gases, such as neon, argon and other gases or metallic vapors as hereinabove mentioned, at appropriate pressures, a discharge forms between the conductors.

The voltage drop of the resistance wire 62, which may be either of tungsten or a nickel iron wire, nichrome, or any other metal having satisfactory heat and electrical resistance properties, is such that an appreciable voltage exists between the parallel coils 54 and 56 in order to facilitate the formation of the discharge as described. For instance, where a total voltage of 110 volts is employed each end coil might have a drop of two volts, with the junction wire taking up the remainder. The value of the resistance between coils in this modification could be varied within wide limits, however, without eliminating the discharge. Similarly, the conductors 20 and 39 may have a resistance suitable for obtaining the type of radiation desired.

Mention has been made of the use of a coating 18 of alkaline earth metal oxides as serving to augment the electron emission from the conductor and thus bring about an ionization of the adjacent gaseous layer. In Fig. 6 I have illustrated a coating so applied. However, I have found that it is not necessary that the coating be applied external to the conducting coil, as the same may be applied within the coil. I have found also that the conductor may be mixed with the oxides and other electron emitting material to form a homogeneous solid mixture which, when heated, has the characteristics of a coated filament. Thoriated tungsten, for example, formed of tungsten mixed with thorium metal or oxides of thorium, this being the chemical combination of tungstic acid and thorium nitrate, forms a filament which satisfactorily ionizes the surrounding gases for certain uses. Also, the coating material may be applied in the shape of a core having limited contact with the interior of the coil so that the electron emission may be thereby limited. For instance, I may employ a triangular shaped core which contacts at three points on the core material.

I have shown the standard 19 as including an insulating tube 19 in Fig. 1, and similarly in Fig. 6, the tube 63 insulates and encloses the conductor 62. It is within the scope of my invention, however, to insulate all of the standards, such as 12, 13, 14, and 16 of Fig. 1, and the various standards shown in Figs. 5 and 6, either by positioning them in glass tubing or by painting them with appropriate insulating material, such, for example, as that described in my co-pending application, Serial No. 578,940, filed December 4, 1931. Also, as shown in detail in Fig. 2, the heating conductor of the various modifications is in the shape of a coil.

However, there are uses in which it is preferable to employ a straight wire properly coated or impregnated with electron emitting material, and the alternative use of a straight wire is contemplated as within the scope of this invention. Attention is directed further to the increase in the conductor capacity of the coils adjacent the point of attachment. For instance, as shown in Fig. 6 of the drawings at the point the conductor is welded to the support 16 there is an additional conductor in the shape of a short coil which is also welded to the support and which may not be in electrical contact with the primary conductor or its coating. The cross-section of the coil is such as to permit conveyance of excess current due to gas without unduly cooling the primary conductor during normal operative conditions. Also, thereby, the strength and stability of the coil is increased.

A feature of the invention is the restraining vaporization of heated tungsten because of the presence of the emitted electrons and the ionized gases. This prevents blackening of the bulb, and hence increases the longevity of the lamp.

I have found also that the presence of vapors of calcium or caesium tends to increase the emissivity of the conductor, and hence, the efficiency of the lamp. It is desirable also that the gases used be chemically pure, or at least that the impurities do not exceed one percent.

Mention has been made of the use of the lamp on commercial voltages such as 110 volts. In the modification of Fig. 1 where 110 volts is used, the maximum drop from the ends of the coil 17 to the electrodes 21 would be 55 volts, and the minimum drop from the electrodes to the end point of the coil 17 would be approximately zero. These maximum and minimum values would, of course, vary when the discharge forms in the container and the resistance of wire 20 becomes effective.

Either singly or in banks of lights the lamps embodying the features hereinabove described are useful for signalling purposes, as, for example, signalling to aeroplanes or across rivers between land stations, or for other purposes. The lamp is also usable in connection with advertising because of its pronounced color characteristics in conjunction with its low voltage feature.

While I have described a single modification of the invention, it is of course apparent that subject to the claims hereto appended, various other modifications may be made which include the essential features of the modification herein described.

Having thus described my invention, what I desire to claim is:

1. A lamp comprising the combination of a transparent container, a support mounted therein, a plurality of standards mounted on said support, a coil of electrically conducting wire mounted on said standards, said coil being continuous between separated points attached to adjacent standards, lead-in wires connected to said last mentioned standards, a coating of electron emitting material on said coil, an electrode having rods extending radially therefrom mounted within said container at a point displaced from said continuous conductor, means including a metallic circuit for electrically connecting the radiating rods to a point on said continuous conductor, an atmosphere of neon gas immersing said conductors within the container, and a tubular insulating element surrounding the circuit con-

necting the radiating rods with the continuous conductor.

2. A device for radiating energy comprising the combination of a container adapted to transmit the energy evolved, a support mounted therein, an electrical conductor mounted on said support, said conductor having ends displaced from each other, means for passing an electric current through said conductor, a coating of alkaline oxides on said conductor, an electrode mounted on said support, said electrode being electrically connected with a point on said conductor intermediate its ends whereby it is adapted to be maintained at a uniform potential when current flows through said first named conductor, and an atmosphere of inert gases within said container.

3. A radiating device comprising the combination of a container, an inert gas contained therein, an electrical conductor mounted within the container, an electron emitting material adjacent said conductor adapted to be heated thereby, and an electrode connected to a point on said conductor intermediate its ends, said electrode being positioned in proximity to said conductor but spaced therefrom whereby a discharge forms between the electrode and conductor when the electron emitting material is heated to electron emitting temperature.

4. A radiating device comprising the combination of a container, an inert gas contained therein, an electrical conductor mounted within the container, an electron emitting material adjacent said conductor adapted to be heated thereby, and an electrode connected to a point on said conductor intermediate its ends, said electrode being positioned in proximity to said conductor, and an insulatingly coated electrical connection between the conductor and electrode.

5. A lamp comprising the combination of a transparent container, a tungsten conductor supported therein, a coating of alkaline earth metal oxides on said conductor, an electrode positioned within said container and displaced from said conductor, a circuit connection between said electrode conductor intermediate its ends, a means for electrically insulating said circuit connection, and an atmosphere of neon gas within said container.

6. A lamp comprising the combination of a container, a support mounted therein, a plurality of standards within said support, a coiled tungsten conductor mounted on said standards having separated ends, lead-in wires connecting said tungsten coil to points exterior to the container, an electrode within the container, said electrode having a central mass and a plurality of open-ended radiating rods attached thereto, electron-emitting oxides coated on the open ends of said rods, an insulated electric connection between said electrode and a point intermediate the ends of said conductor, and an atmosphere of neon gas within said container.

7. A radiating device comprising a container, two lead-in wires within the container, a conductor forming a closed circuit between said lead-in wires, and an electrode displaced from said conductor but connected by an insulated metal circuit thereto at a point intermediate its ends.

CHESTER H. BRASELTON.