Sept. 8, 1936. C. H. BRASELTON 2,054,048

SIGNAL LAMP

Filed Dec. 4, 1931

Fig. 1.

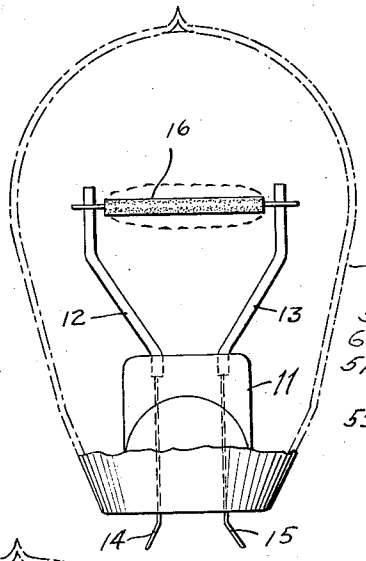


Fig. 4.

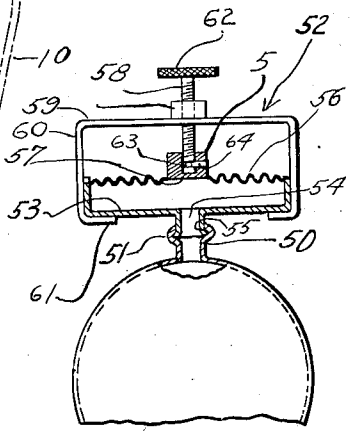


Fig. 3.

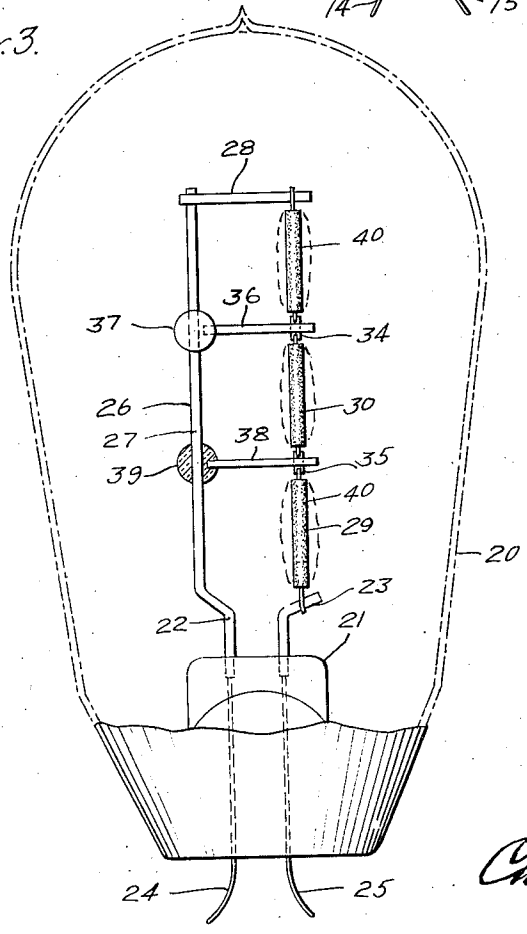
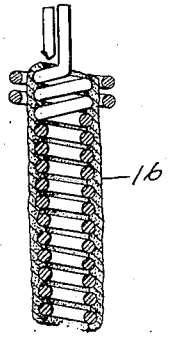


Fig. 2.



INVENTOR

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2,054,048

SIGNAL LAMP

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Application December 4, 1931, Serial No. 578,937

5 Claims. (Cl. 176—1)

This invention relates to lamps, particularly to such lamps as are useful for signalling purposes.

Among the objects of the present invention is to provide an electric signal lamp which will operate automatically. Another object of the invention is to provide an automatically operating lamp which will function without the use of current interrupting appliances.

A further object is to provide a signal lamp which is self-contained and incorporates a minimum number of parts. Another object is to provide a signal lamp in which there are no moving parts, either within the lamp itself or in the associated circuit, so that all that is necessary is that the lamp be applied to the appropriate voltage connections in order to operate.

Further objects will become apparent on consideration of the following specification and accompanying drawing, in which

Fig. 1 is a view in elevation of an embodiment of the invention;

Fig. 2 is a detail of the coated filament structure of Fig. 1;

Fig. 3 is a view of a modification of the invention; and

Fig. 4 is a view of another modification.

In Patent No. 2,007,919 dated July 9th, 1933, there is described a type of electric lamp or energy emitter in which a coil of refractory wire, such as tungsten, is coated with an electron emitting material and immersed within a container in an atmosphere of inert gases, such as argon or neon. When an electric current is passed from this conductor a halo of luminous gases forms about the diameter and its coatings, which serves, together with the conductor and its coating, as a source of radiant energy which may be in the form of visible light or which may be of radiation primarily in the infra-red or ultra-violet regions.

It is of importance in the manufacture of these lamps that the electron emitting coating be properly applied and treated for use with the lamp.

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 and which have an emissivity in excess of thorium oxide. 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 millimeter 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 actuation 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, and 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.

Applying the principles involved in the preparation and application of the coating hereinabove described, I employ a lamp bulb 10, which may be of transparent material, as of glass, in which is sealed a support 11, containing standards 12 and 13, to the outer ends of which are attached lead-in wires 14 and 15, adapted to be connected to a source of electric potential. Intermediate the standards 12 and 13 within the bulb is the tungsten coil 16 on which the coating 17 of electron emitting material, as hereinabove described, is applied. The dimensions of the coil with the applied coating are such as to be suitable for the particular voltage for which the lamp is intended. For instance, where the lamp is to be used for a commercial voltage of 110 volts, a greater length of filament is necessary than for lower voltages. The turns of the coil 16, as illustrated in Fig. 2, are relatively close together so as to insert a maximum amount of resistance. The ends of the coil are welded or otherwise attached to the nickel supports 12 and 13, which in turn are spaced apart so that the coil 16 may be suspended in approximately horizontal position. Where the length of the coil is excessive it may be necessary to add a third standard which may be positioned intermediate the standards 12 and 13 and contact at approximately the midpoint of the coil.

Within the container or envelope 10 is an atmosphere of inert gases, such as those hereinabove mentioned. These gases should be chemically pure, or at least have impurities not exceeding one percent by volume. I have found argon and neon to be particularly desirable, the proportion or amounts being approximately 50 mm. of neon and 150 mm. of argon, totaling about 200 mm. of gas. Other pressures may be used, as I have found that pressures below 50 mm. and in excess of 350 mm. are possible and give satisfactory results.

The operation of the lamp as hereinabove described for signalling purposes is as follows. When an electric potential is applied to the lead-in wires 14 and 15, the coil 16 becomes heated, causing the coating 17 to emit electrons in profusion, thereby ionizing the adjacent gases which form a sheath or layer of highly activated gases adjacent the coating. Should, however, the voltage applied to the conductor 16 be diminished, a point would be reached at which there is a critical balance between the gas pressure and the temperature of the coating, as well as with the drop of potential of the electric circuit along the coil 16. At this critical state the sheath or halo of gases about the conductor alternately collapses and develops with a certain definite frequency, which frequency may be made to vary by a slight change in the voltage, which in this way modifies the heat conditions and the potential drop. In one form of lamp I have found a pressure of about 200 mm. of mercury for the gas necessary to obtain the variable effects when a voltage of thirty-three volts was applied to the conductor. The basis of the fluctuation appears to lie in the fact that at the critical point the potential along the filament axis is identical to the breakdown potential of the heated and ionized gas adjacent the filament for the gas pressure prior to the formation of the halo. As soon as the halo forms, however, with its sudden increase in the heat content of the gas the increased pressure immediately increases the ionization constant and the halo disappears.

This alternate making and breaking of the luminous or ionized gas layer is useful where a signalling operation is desired. For visible signalling the container 10 should be transparent and the sheath or gas layer luminous. By modifying the gases it is possible to vary the color of the luminescence so that color, combined with the flickering of the light radiation, serves to call attention to the signal. Such a device would be useful as a signal for street intersections, or it could be used as a means for drawing attention to any other point. Such a device might be used also as a source of intermittent invisible radiation for various purposes.

In Fig. 3 of the drawing I have indicated a modification of the invention showing a modified arrangement of the lamp elements. Within the bulb or envelope 20 there is the usual support 21 on which is mounted the two standards 22 and 23, which in turn are attached to the lead-in wires 24 and 25. The standard 22 is extended in a straight section 26, which is coated with electrically insulating material, such as glass tubing 27, to prevent short-circuiting. To the upper end of the standard 26 is mounted a cross bar 28, and between the end of this bar and the standard 23 is attached the filament of the lamp. The filament takes the form of three coiled sections 29, 30, and 31, each separated by a length of conducting wire 34 and 35, the wire 34 having connection by means of the wire 36 to a glass bead 37, formed on the tubing 27, and the rod 35 having connection by means of the wire 38 to a glass bead 39 formed on the glass rod 27.

Appropriate inert gas, such as that hereinabove described, is included within the envelope immersing the various elements. Also, a coating 40 of electron emitting material is placed on the various sections 29, 30, and 31 of the filament. The operation of this lamp is similar to that shown in Fig. 1, with the exception that higher voltages are available in a lamp of this type than are possible in a lamp built according to Fig. 1.

In the modification of Fig. 1, for instance, an appropriate working potential has been ascertained as intermediate 20 and 40 volts. Where 110 volts or more are employed it may be expedient to divide the filament into sections of three or more, as shown in Fig. 3, to each of which a voltage less than 40 volts could be applied. Alternatively, a group of low potential lamps may be connected in series where use is made of 110 volts.

In the various modifications, electron emitting material is described as in the shape of a coating applied to the conductor. I have found, however, that this material may be mixed with the conducting substance, and by this means, electron emission increased over that possible from a plain conducting substance. For example, I may mix the electron emitting material with the conductor in powdered form, and the mixture treated so as to form a conducting filament; or I may chemically combine the conductor and the oxide to form a filament, such as thoriated tungsten, which is the result of a combination of tungstic acid and thorium nitrate. The coated material may be applied as a rod forming the core of the coil. The rod may have various shapes, one shape which I have found useful being triangular in section so that there are not over three points of contact with the in-

terior of the coil. In this manner the ionization is limited.

In Fig. 4 I have illustrated a modification of the invention in which means is provided for varying the pressure of the gas within the container. For this purpose the container is provided with a tubular outlet 50 having an annular bead 51 formed thereupon. To the tube 50 there is connected a pressure modifying unit 52 which consists of a cup-shaped base 53 having a central outlet 54 provided with an outwardly turned flange 55 adapted to seat in the annular bead 51 of the glass outlet 50. The base 53 and central connection 54 are of metal, the connection being of iron-nickel coated with copper, or of other metals which have, either singly or in combination, a co-efficient of heat expansion similar to that of glass and which will permit an air-tight welded joint with glass. Alternatively, cement may be used intermediate the glass neck and the cup base outlet, such as that of silver solder.

The base 53 is faced by a diaphragm plate 56 of flexible metal corrugated annularly and having a central flat portion 57 forming the contact area for the end of the screw 58 threaded in the cover plate 59. The plate 59 has an edge 60 with an inwardly turned flange 61 engaging the under portion of the base 53 and retained thereby. The screw 58 is provided with a head 62 by means of which the position of the diaphragm 57 is varied, and thereby the capacity of the diaphragm unit is varied. In order to adjust the diaphragm independently of the pressure in the container, the end of the screw is provided with a circular groove 63 in which a projection 64 fastened to the diaphragm contact area 57 is in constant engagement. It is apparent that the diaphragm follows the movement of the screw whether it is moved inwardly or outwardly, and in this manner the capacity of the container is varied.

Instead of the diaphragm unit as shown other equivalent means may be utilized for modifying the capacity of the container, such, for example, as trapped mercury in a tubular container having a flexible connection to the container outlet 50. Modification of the pressure in the container may also be obtained by utilizing a glass tubular connection terminating in an enlarged bulb which may be heated by a gas flame, for example.

Attention is directed to the fact that while the coated conductor may be coiled, as shown in Fig. 2, it is within the scope of the invention to employ a straight, uncoiled, coated conductor. Also, it has been found desirable to enlarge the current carrying capacity of the conductor at the section intermediate the coating and the point of adjustment to the standards 12 and 13. This may be done by increasing the diameter of the wire at this point or by various other means, such as to insert a short secondary coil over the coated end of the conductor and weld the other end to the support, thus giving two current carrying paths for the current from the main portion of the current conductor. This construction obviates fracture due to increase in current arising from flow through the ionized gases. The increase in the diameter of the conductor end should not be too great as to cause cooling of these ends, inasmuch as the efficacy of the auxiliary conductor is thereby impaired. I may also, in order to prevent leakage, insulate the standards 12 and 13 by inserting thereon a tube of glass or other highly resistant material, or by coating the same with substances nonconductive to electricity, such, for example, as described in my Patent No. 2,039,772, dated May 5, 1936.

Various other modifications of the invention will be apparent to those skilled in the art, to which this invention pertains, and hence I do not desire to be limited except as such limitations are imposed by the claims hereto appended.

I claim as my invention:

1. A process of producing a fluctuating radiation from an energy source which consists in mounting a conductor coated with electron emitting materials having an emissivity in excess of that of thorium oxide between lead-in wires sealed in a part of a closed container containing an inert ionizable gas, the breakdown potential of said gas per unit length when heated in the region adjacent the conductor being within the normal operative voltage range of a unit length of the conductor and the amount of said current being increased gradually from zero to a point where the breakdown gas potential per unit length and the potential per unit length along the conductor are equal.

2. A process of bringing about a fluctuating energy emission from a radiating source consisting of an electric conductor coated with electron emitting material having an emissivity in excess of that of thorium oxide which consists in enclosing said source in an envelope containing an inert ionizable gas at a given pressure; and raising the potential of the conductor per unit length to a point where it is equal to the breakdown potential of the heated gas adjacent the conductor.

3. In a lamp adapted to produce a fluctuating light emission the combination of an envelope; an atmosphere of ionizable gas within the container; a support mounted therein; a conductor mounted on said support; electron emitting material on the conductor, the length of the conductor being such that when a voltage of about 33 volts is applied thereto a layer of luminous gases forms about the conductor which is critical with respect to the forces maintaining it, the pressure of said gases within the envelope being approximately 200 mm. of mercury.

4. A process of producing a fluctuating radiation from an energy source which consists in mounting a conductor coated with electron emitting materials having an emissivity in excess of that of thorium oxide between lead-in wires sealed in a part of a closed container containing an inert ionizable gas, passing an electric current through said conductor; and varying the potential of the current and gas pressure till a value of potential and of pressure is obtained at which the breakdown potential of the gas and potential along the conductor per unit length are substantially the same.

5. The process of producing a fluctuating emission from an energy source which consists in mounting an electric conductor containing alkaline earth metal oxides adapted to emit electrons when heated between lead-in wires sealed in a glass container containing an ionizable gas; passing an electric current through said conductor; and gradually increasing the potential of the current from zero up to a point where the breakdown potential of the gas and potential along the conductor per unit length are substantially the same.

CHESTER H. BRASELTON.