May 12, 1936. O. T. McILVAINE 2,040,753

ELECTRIC RAY PRODUCING DEVICE

Filed Feb. 3, 1930

Fig. 1

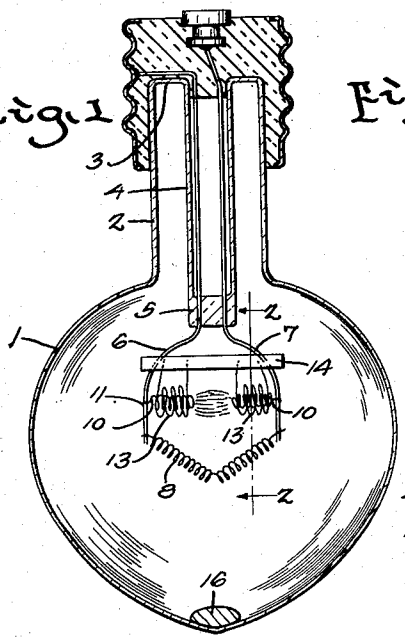


Fig. 2

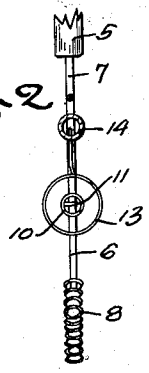


Fig. 3

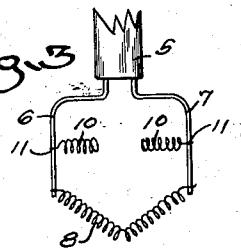


Fig. 4

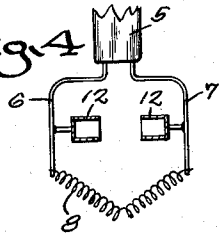


Fig. 5

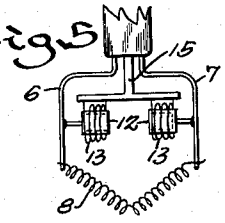


Fig. 6

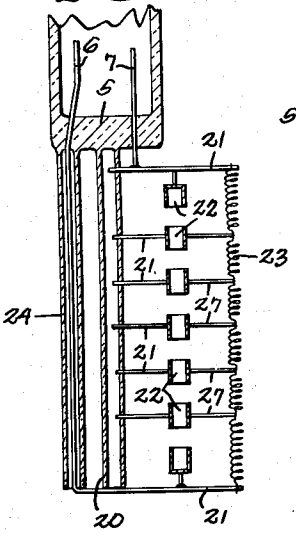


Fig. 7

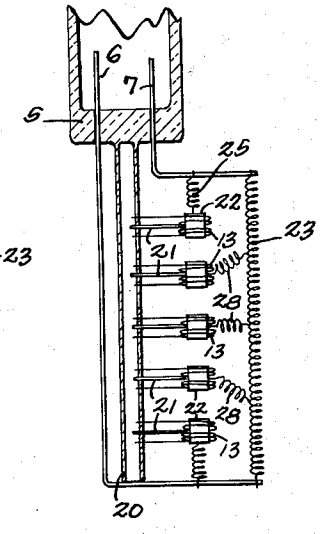
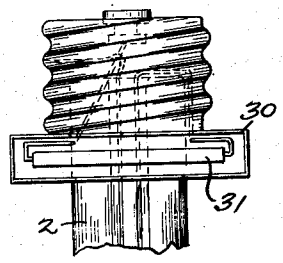


Fig. 8



Oran T. McIlvaine
Inventor
by Smith and Freeman
Attorneys

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ELECTRIC RAY PRODUCING DEVICE

Oran T. McIlvaine, Cleveland, Ohio, assignor to McIlvaine Patent Corporation, St. Charles, Ill., a corporation of Delaware

Application February 3, 1930, Serial No. 425,455

13 Claims. (Cl. 176—1)

This invention relates to electric ray-producing devices and has for its objects the provision of an improved lamp of the bulb type adapted to produce a mixture of all kinds of rays, viz: infra-red, visible, actinic, and ultra-violet capable of affording the physiological effects of sunlight and with a minimum of complication, expense, or servicing requirements and also with a minimum of apparatus such as transformers, coils and the like. Another object of the invention is the provision of means for reducing the tendency of metallic arcs or gas-discharge apparatus to blacken the container walls by sputtering. Another object of the invention is the provision of a simple and inexpensive lamp which shall produce a very large amount of light. Another object of the invention is the production of a white light containing all wave lengths, and at a high efficiency ratio of light production to energy consumed. Further objects and advantages of the invention will be apparent as the description proceeds.

In the drawing accompanying and forming a part of this application I have shown a few specimen embodiments of my inventive idea. Fig. 1 is a vertical sectional view through a complete lamp containing my improvements but designed for rather low voltage; Fig. 2 is a sectional view drawn to a rather large scale showing the relation of the light-giving parts; Figs. 3 to 7 inclusive show modified arrangements of the light-giving parts, the two last mentioned being arranged for 110 volt operation without transformers; and Fig. 8 illustrates a modified form of lamp base provided with a resistance and heat-producing element in lieu of a transformer.

My improved lamp combines the principle of filament operation and that of positive-column discharge illumination. It preferably comprises a glass container or globe 1 having a neck 2 fitted with a flange 3 provided with a tube 4 and press 5. Sealed in the press are leading-in wires 6 and 7 between which is connected the filament 8.

Carried by the two leading-in wires and facing each other are electrodes 10—10 for the positive column discharge. These in their preferred form are made of hollow helical coils of tungsten wire the turns laid closely together, the interiors open and facing each other at some little distance depending upon the size of the lamp but generally from one-fourth inch to about an inch. These coils are easily supported in place by having the terminals of the tungsten wire welded to the leading-in wires as shown at 11 in Fig. 3, and the parts thus far described are sufficient for the simplest type of lamp when the globe is provided with a filling of easily-ionizable gas such as argon, neon, helium, etc., at a pressure from 1 to 300 mm. of mercury and preferably between about 50 to 100 mm. When a current is applied to such a lamp the glowing filament soon ionizes the gas to the point where an independent discharge begins to take place between the electrodes 10—10 resulting in a great increase in the amount of light produced, this light also proving very rich in ultra-violet and actinic rays. It should be noted, although I have not illustrated the same, that provision should ordinarily be made for controlling the amount of current either manually or automatically since the discharge path by way of the electrodes as soon as established ordinarily exhibits much less resistance than the filament, so that an excessive current can easily be developed unless suitable precautions are taken. These precautions can consist of manually connecting the lamp through a higher resistance or to a source of lower potential as will be obvious, or by employing what is known as a constant current transformer.

Such an intense positive-column discharge always tends to produce what is known as "sputtering" of the electrodes with consequent blackening of the container-walls. I have found that the employment of coiled tungsten wire is of peculiar advantage in preventing this since the mechanically-treated and drawn wire has a greater density than other forms of the metal, and because such hollow electrode carries most of its discharge on the interior, thereby confining the sputtering to the inside of the electrode, and preventing or at least retarding the blackening of the globe or container. The advantages of the hollow electrode can of course be enjoyed without making the electrode of coiled wire. In Fig. 4 I have shown the electrodes as consisting of pressed cups 12—12 of tungsten carried by the wires 6 and 7 and facing each other.

The very great intensity of the discharge however causes it to tend to overrun onto the exterior of these electrodes and to oppose and diminish this tendency I preferably surround each electrode with a spaced insulated wire coil 13 parallel and more or less accurately concentric therewith, although the latter point is of comparatively small importance within wide limits. Preferably these coils 13—13 are spaced entirely apart and insulated, a separate coil for each electrode. In Fig. 1 I have shown these coils as sealed to a glass header 14 carried by the leading-in wires. In Fig. 5 I have shown them as carried by a glass header

15 sealed in the press. The operation of these coils depends upon the fact that insulated metallic bodies of this nature, located inside such a container, tend to pick up stray electrons until a considerable charge is accumulated, and this charge exhibits the phenomenon of repelling the cathode glow and causing it to confine itself inside the electrodes, at least throughout a much larger range of current-densities than otherwise. This arrangement effectually prevents or retards the blacking of the bulb interior.

It is also within my invention, and frequently a desirable step, to include in the bulb or container a small quantity of mercury 16 which has the properties of increasing the conductivity of the medium and hence the proportion of ultra-violet radiation and of increasing the intensity of the arc. This also renders the device much more efficient as a producer of light, the light emitted greatly increasing and the electromotive force decreasing even with constant current, say 15 volts down to 10 volts across gap.

Of course it is also possible and within my invention to coat the interior of the electrodes with emission-facilitating material, such for example as alkali metals, thorium, caesium and other known emissive substances.

The form of the device shown in Figs. 1 to 5 inclusive is designed to run at less than 110 volts, for example about 35 to 40 volts starting, and 15 to 20 volts running, at which potential it utilizes about 400 watts and affords a dazzling intensity of light. In Figs. 6 and 7 I have shown modifications to facilitate the use of the lamp on 110 volt circuit without special transformer. The press 5 carries a post 20 of insulating material from which project the spaced wires 21 carrying spaced electrodes 22 each of which is preferably a hollow cylinder of highly-resistant metal such as tungsten or other metal having a melting point above 2300° C. The terminal wires 21 are extended beyond the rest and connected by the filament 23 and also connected one to each of the leading-in wires, one of the latter being preferably surrounded by a glass-tube 24 to avoid accidental arcing.

In the form of the invention shown in Fig. 6 the two terminal electrodes 22 are carried directly by the terminal wires 21; in the modification shown in Fig. 7 the terminal electrodes 22 are connected to the terminal wires by filaments 25 of such size as to tend to hold the current in the arc constant after starting. For example the filament 23 shown in Fig. 7 may be a 110 watt filament, while the arcs between the different electrodes will carry a 500 watt current when once started, the resistance of the filaments 25 being so chosen as to limit the current-consumption to this point. In Fig. 7 I have also shown each electrode as surrounded by an insulated wire coil 13 for the purpose above described.

When the electrodes in series are above two in number it becomes important to provide means for leaking-off any collected potential from the intermediate electrodes. This can be done by providing any conductive path, for example by blackening the surface of the post 20 in a gas flame, or by sufficiently reducing the lead content of the glass by a reducing flame, or by applying a thin metallic film. Another mode is by connecting each of the intermediate electrodes to corresponding points of the filament, either by the conductor leads 27 shown in Fig. 6 or by fine filament leads 28 as shown in Fig. 7. When grid coils 13 are also employed as shown in Fig. 7 the post must, of course, be kept free from any conductive layer, and the filaments 28 must be kept out of contact with the grid-coils, though no care in spacing is necessary since no arcing can occur.

In Fig. 8 I have shown another mode of holding the consumption in such a lamp within bounds. Carried by the exterior of the lamp-base is a metallic reflector-element 30 in which is mounted a suitable resistance-element 31, preferably of rather high resistance type which in conjunction with the arc shall arrest the current-consumption at the point desired.

The material of the container is chosen to allow the free passage of the rays produced, being preferably a glass of the type which will transmit light waves down to a wave length of about 2900 A. U.

It will be understood that many changes in detail can be made without departure from the scope of my inventive idea.

Having thus described my invention what I claim is:

1. An electric lamp comprising a closed transparent container having therein an atmosphere of readily ionizable gases at a pressure between about 1 and 300 mm. of mercury when cold, spaced metallic electrodes inside said container, leading-in wires connected to said electrodes respectively, and an insulated wire-coil surrounding and spaced from each of said electrodes, the electrodes being hollow and cylindrical and having their adjacent ends open and their axes substantially parallel to the axes of said coils.

2. An electric lamp comprising a closed transparent container having therein an atmosphere of readily ionizable gases at a pressure between about 1 and 300 mm. of mercury when cold, spaced metallic electrodes inside said container, leading-in wires connected to said electrodes respectively, and an insulated wire-coil surrounding and spaced from each of said electrodes, the electrodes being hollow and cylindrical and having their adjacent ends open and their axes substantially parallel to the axes of said coils, in combination with a filament adjacent to said electrodes and adapted upon being energized to ionize the gas about said electrodes.

3. An electric lamp comprising a closed transparent container having therein an atmosphere of readily ionizable gases at a pressure between about 1 and 300 mm. of mercury when cold, spaced metallic electrodes inside said container, leading-in wires connected to said electrodes respectively, an insulated wire-coil surrounding and spaced from each of said electrodes, the electrodes having their axes substantially parallel to the axes of said coils, in combination with a filament adjacent to said electrodes and adapted upon being energized to ionize the gas about said electrodes, and a small quantity of mercury inside said globe, out of contact with either said filament or said electrodes.

4. An electric lamp comprising a closed transparent container of globular form, having therein an atmosphere of readily ionizable gases at a pressure between 1 and 300 mm. when cold of mercury, said container having a hollow neck projecting from its top, a pair of spaced, leading-in wires depending in said neck and having their lower ends offset away from each other and having their adjacent portions insulated from each other, an incandescible filament connecting the extremities of said offset portions, a pair of electrodes carried by said offset portions above

said filament, each of said electrodes facing the other electrode and said filament having its middle portion deflected downwardly away from the arc-space between said electrodes, an insulated wire coil surrounding and spaced from each of said electrodes, and a small quantity of mercury inside said globe, out of contact with either said filaments or said electrodes.

5. Apparatus for producing electric light comprising a closed container which is transparent to the rays desired, a pair of spaced hollow metallic bodies located inside said container having open ends turned toward each other, metallic leading-in wires connected to said bodies, a readily ionizable gas at subatmospheric pressure in said container, and electrostatic shields surrounding said bodies and spaced therefrom and positioned within the container to receive and maintain a negative charge whereby the cathode glow is confined inside said electrodes.

6. An electric lamp comprising a closed container having therein an atmosphere of readily ionizable gases at a subatmospheric pressure, spaced metallic electrodes inside said container, leading-in wires connected by metallic conducting elements to said electrodes respectively, a filament inside said container connected as a shunt across said electrodes, and separate insulated wire coils surrounding and spaced from each of the metallic conducting elements inside said container whereby the arc is confined to the electrodes.

7. In an electric lamp, a closed container having therein an atmosphere of readily ionizable noble gases at a pressure between about 10 and 300 mm. of mercury when cold, spaced metallic electrodes inside said container, leading-in wires connected to said electrodes respectively, a wire coil surrounding and spaced from each of said electrodes, and having the end portions thereof spaced apart and completely insulated from each other against an electric circuit therethrough, and means for initiating ionization of the gases, said container being of a substance which is transparent to the wave lengths produced therein.

8. An electric lamp comprising a closed container having therein an atmosphere of readily ionizable noble gases having a subatmospheric pressure, spaced metallic electrodes inside said container, leading-in wires connected to said electrodes respectively, an incandescible filament permanently connected to said leading-in wires at one side of said electrodes for initiating the ionization of the gases in said container, a hollow metallic shield surrounding each of said electrodes and insulated therefrom, each of said shields having an opening facing the other electrode and having interposed towards said filament a side wall which is substantially impervious to electronic penetration, and mercury in said container adapted to become volatilized and take part in the arc as the temperature of the same becomes increased.

9. An electric lamp comprising a closed transparent container having therein an atmosphere of readily ionizable gases at a pressure between about 10 and 300 mm. of mercury at room temperature, spaced metallic electrodes inside said container, leading-in wires connected to said electrodes respectively, and a wire-coil surrounding and spaced from each of said electrodes and from each other, said wire-coil having the ends thereof completely insulated from each other, the electrodes being hollow and cylindrical and having their adjacent ends open and their axes substantially parallel to the axes of said coils.

10. An electric lamp comprising a closed transparent container having therein an atmosphere of readily ionizable gases at a pressure between about 10 and 300 mm. of mercury at room temperature, spaced metallic electrodes inside said container, leading-in wires connected to said electrodes respectively, and an insulated wire-coil surrounding and spaced from each of said electrodes to prevent blackening of the container, the electrodes being hollow and cylindrical and having their adjacent ends open and their axes substantially parallel to the axes of said coils, in combination with a filament having its ends permanently connected one to each leading-in wire and located outside of said wire coils.

11. An electric lamp comprising a closed transparent container having therein an atmosphere of readily ionizable gases at a pressure between about 10 and 300 mm. of mercury at room temperature, spaced metallic electrodes inside said container having their adjoining ends opposite to and spaced from each other so as to define a gap therebetween, leading-in wires connected to said electrodes respectively, each of said electrodes consisting of a hollow helical coil of metallic wire having a melting-point above 2300° C., metallic electrostatic shields within the container surrounding and insulated from said electrodes to receive a negative charge, said electrodes being spaced apart and having their hollow interiors turned toward each other, and supplementary means for ionizing the gases about said electrodes to initiate the arc.

12. An electric lamp comprising a glass globe containing one or more of the ionizable chemically-inactive atmospheric gases at a pressure between 1 and 300 mm. of mercury when cold, a pair of leading-in wires sealed in the wall of said globe and projecting into the interior thereof, said wires being spaced from each other and from the glass walls, an incandescible filament connecting the lower extremities of said wires and comprising a fine refractory wire wound in a helical coil, and a pair of spaced, metallic electrodes carried one by each of said leading-in wires above and adjacent to said filament and defining therebetween a positive-column-path located in multiple-circuit with said filament, each of said electrodes comprising a hollow, cylindrical body having solid side walls made of electrically-conducting substance, the hollow portions thereof being turned toward each other.

13. An electric lamp comprising a closed transparent container having therein an atmosphere of readily ionizable gases at a pressure between 1 to 300 mm. of mercury when cold, an incandescible filament in said container, leading-in wires connected to said filament, and spaced electrodes in said container defining a positive-column discharge path, one of said electrodes being connected to one of said leading-in wires and the other of said electrodes being connected to said filament at a point intermediate its ends for limiting the amount of current passing through said positive-column path.

ORAN T. McILVAINE.