Sept. 27, 1932. T. E. FOULKE 1,879,158

GLOW DISCHARGE LAMP

Filed Dec. 19, 1928

Fig. 1

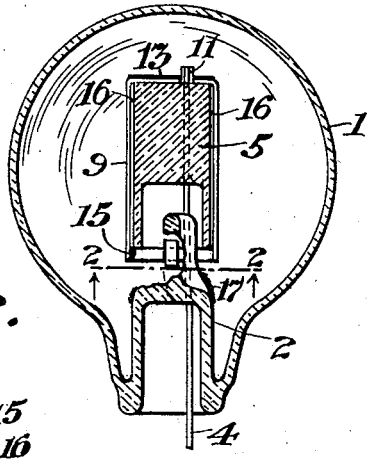


Fig. 2.

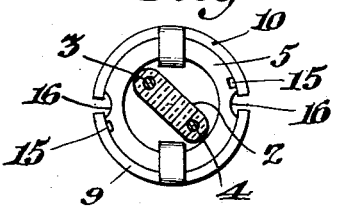


Fig. 4

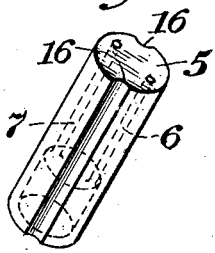


Fig. 3

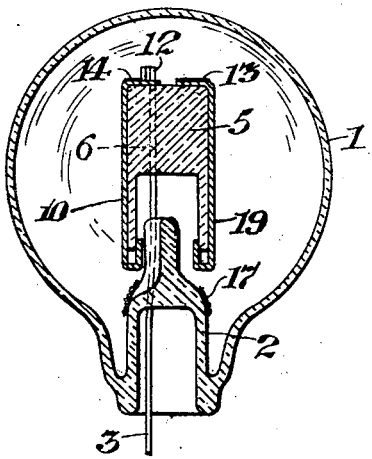


Fig. 5

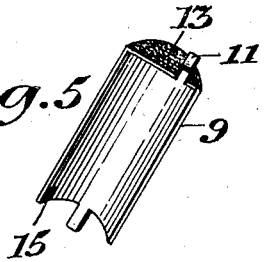
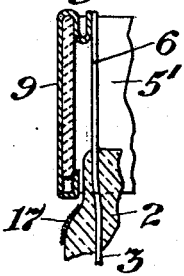


Fig. 6



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UNITED STATES PATENT OFFICE

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GLOW DISCHARGE LAMP

Application filed December 19, 1928. Serial No. 327,073.

The present invention relates to electric lamps of the negative glow type and has for its object to produce a lamp of this type having long commercial life, low voltage starting characteristics, where desired, maintenance of gas purity within the envelope and the attainment of the full corona over the area of the electrode or electrodes and to a construction lending itself to quick exhaust thus facilitating rapid shop production of the device.

Various other objects and advantages of the invention will be obvious from the following description of one form of lamp embodying the invention or from an inspection of the accompanying drawing and the invention also consists in certain new and novel features of the structure and combinations of parts hereinafter set forth and claimed.

In the accompanying drawing there is shown for purposes of illustration one form of lamp embodying the invention in which

Fig. 1 is a sectional elevation of my new lamp,

Fig. 2 is a view of the electrode assembly taken along the line 2—2 of Fig. 1,

Fig. 3 is a sectional view of said lamp taken at right angles to Fig. 1,

Fig. 4 is a view of the insulating block supporting the electrodes showing in dotted lines the cavities and holes for introducing the stem and leads for the electrodes and mechanical supports of the various parts,

Fig. 5 is a view of a semi-cylindrical electrode and

Fig. 6 is a sectional view of an alternative embodiment of my invention.

In the drawing the sealed envelope 1 has mounted therein a stem 2 having sealed therethrough lead wires 3 and 4. Above the stem 2 is mounted an insulating block 5 of lavite, porcelain, glass or other suitable insulating material, and in the event the member 5 is a solid block, holes 6 and 7 (see Figs. 3 and 4) are drilled therein to accommodate the lead wires 3 and 4.

The envelope 1 has a filling of gas, such as gas of the argon group, or hydrogen or a source of gas or vapor such as mercury, mercury alloy, lithium, cadmium, caesium or the like, or any mixtures of gas or vapor such as those named. One mixture found to give good results is the neon-helium 70—30 mixture. In the event it is desired to start the discharge at lower voltages than is possible with the 70—30 neon-helium mixture this mixture can be qualified by the addition of argon up to about 2% and in practice amounts greater than .1% of argon give good results. When using a neon-helium mixture electrode sputtering may be greatly reduced, with corresponding increase in the life of the lamp, by reducing the proportion of neon to the minimum which will still give the characteristic neon color, say 5% or less.

For operating on regular commercial circuits such as those of 110–220 volts a resistance (not shown) is necessary in the lamp circuit and this is preferably mounted in the base of the lamp. On the outside of the block 5 are mounted the semi-cylindrical electrodes 9 and 10 which are identical in configuration, the end of each of said electrodes 9 and 10 extending over the top of the block 5. The tabs 11 and 12 which extend upwardly from the ends of said electrodes 9 and 10, respectively, are connected by welding to the respective lead wires 4 and 3. The electrodes 9 and 10 are stamped from 5 mil sheet nickel, but other metals such as iron, copper, brass, zinc, aluminum. magnesium, calcium or any metals found suitable may also be used.

In the alternative structure shown in Fig. 6 the insulating block 5 is tubular, the leads passing through the center thereof, and the ends of the electrodes are crimped upon said insulating block 5 to hold them in place.

The lamp is provided with a getter and keeper material for maintaining the desired operating conditions in the interior of the device. By locating this getter on the electrodes and by using for this purpose a metal or metallic oxide of lower atomic weight than the electrode material a dual function may be performed by this getter, since in addition to maintaining the operating conditions it will also serve to materially reduce the sputtering of the electrode material. In those cases where nickel electrodes are used a paint of aluminum and magnesium pieces is prefer-

ably used as the getter material, although other materials of the class mentioned may be used. To accomplish the best results this material is applied on the top of the electrodes 9 and 10 near the tabs 11 and 12 as shown at 13 and 14, since I have discovered that the tendency to sputter is greater at this point than on the sides of the electrodes. The result of this construction is a great decrease in the sputtering of the electrodes, the useful life of the lamp being accordingly increased. A means of supporting these electrodes will be described later which practically eliminates any remaining tendency to sputter.

Each of the electrodes 9 and 10 in these devices is provided with a small piece of magnesium 15 welded at a corner of the electrode on the inner surface thereof so that in the finished lamp the magnesium pieces 15 are at opposite sides of the block 5 and this material or equivalent is present in the lamp, and it appears to serve as a getter and keeper but its principal function here, which is controlled by the treating process in finishing the lamp, is that of activating the surface of the electrode to lower the starting and operating voltages of the lamp. For any given set of starting and operating voltages, of course, it will be understood that other materials such as calcium, barium, strontium, lithium, potassium, rubidium and caesium or alloys thereof may be used in place of magnesium or any combination therewith and when desired compounds of the alkali metal or alkaline earth metals are also suitable, it being understood, of course, that in the finishing or treating of the lamp that the compounds are reduced to provide the metal surfaces desired which may be accompanied by applying heat to an electric discharge as is now well understood.

It will be noted that the block 5 is provided on opposite sides thereof with channels 16 and that the electrodes 9 and 10 are mounted on the block 5 so that the edges of the electrodes project slightly beyond the edges of the channels 16 but with an intervening space between the edges of the electrodes themselves. I have discovered that this particular construction lends itself readily to the starting into operation of the devices at lower voltages than if the channels 16 were not present at this point. It appears that where insulation is present between the electrodes whether they be of the rounded or flat type that if the insulation is parallel with the edges of the electrodes and more particularly when in contact therewith that difficulty is encountered in starting and maintaining operation on desired voltages and sputtering at this point is encountered. It will be understood, of course, that if desired the channel can be continued across the top of the block 5 but I prefer to mount a getter material on the top of the device as previously described, and this getter material obviates any tendency to sputter at that point. The use of the channel in proximity to the side edges of the electrodes removes the material of the block 5 from the immediate neighborhood of the electric field at this point. It appears that the insulating surface is charged negatively with respect to the space between the electrode edges and by removing the surface from the immediate neighborhood of the charged space, there is less tendency to attract positive ions from the space and thus it is possible to start a discharge across the space at lower applied potentials and at the same time, as less positive ions are drawn from the space there is less disintegration of the insulating material due to ionic bombardment thereof.

In addition to the foregoing elements of my device I provide a getter 17 of the keeper type, and commonly called a keeper which comprises any substance that will render innocuous any gaseous impurities evolved during normal operation of the device. For this purpose I preferably use lime and red phosphorous mixed with amyl acetate or water to form a paint and the mixture is painted on the stem 2 and serves, after heating to remove the amyl acetate or water, to absorb those gases developed in the operation of the device which do not appear to be taken up by the metallic getters and keepers above referred to.

The envelope 1 can be made of lead glass, or other soft glass, or lead boro-silicate or pyrex or G702P, or of quartz. Lamps made according to my invention can be started on regular commercial circuits such as those of 110 and 220 volts but it is desired that a lamp be provided that will operate efficiently on 110 volts as this is the most common type of circuit in use. Due to the combination of elements above described my lamp will start on such low voltage circuits and will operate for a long commercial life without substantial depreciation in operating characteristics or light giving properties.

The gas is fed into the lamp at 36 mm. pressure although good results will be obtained between pressures ranging from 30 mm. to 50 mm.

While I have shown and described and have pointed out in the annexed claims certain novel features of the invention it will be understood that various omissions and substitutions and changes in the forms, parts and details of the lamp illustrated and in its operation may be made by those skilled in the art without deviating from the spirit of the invention.

The terms "cylindrical" and "semi-cylindrical" have been used throughout in connection with the electrode support and electrodes. It is obvious, however, that other similar forms might be used to accomplish the same result, so long as the general effect is tubular,

and the terms used are intended to cover such other forms.

It is now well known that these lamp devices may be used as sources of illumination or as voltage regulators or negative characteristic grid leaks to be used in conjunction with currents such as are used in telephone and telegraph systems and to the rapid modulation of light sources and electric currents and in devices for producing periodic light or current fluctuations.

I claim:

1. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing gas capable of luminous discharge upon the passage of an electric current, a cylindrical electrode support of refractory material having two longitudinal grooves oppositely disposed therein and two semi-cylindrical metallic electrodes whose edges overlap the edges of said grooves.

2. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing gas capable of luminous discharge upon the passage of an electric current, a cylindrical electrode support of refractory material having two longitudinal grooves oppositely disposed therein, two semi-cylindrical metallic electrodes whose edges overlap the edges of said grooves and a getter on the exterior end of at least one electrode.

3. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing a mixture of helium and neon, a cylindrical electrode support of refractory material having two longitudinal grooves oppositely disposed therein and two semi-cylindrical metallic electrodes whose edges overlap the edges of said grooves.

4. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing a mixture of helium and neon, a cylindrical electrode support of refractory material having two longitudinal grooves oppositely disposed therein, two semi-cylindrical metallic electrodes whose edges overlap the edges of said groove, and a getter on the exterior end of at least one electrode.

5. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing a mixture of helium, neon and argon, a cylindrical electrode support of refractory material having two longitudinal grooves oppositely disposed therein, and two semi-cylindrical metallic electrodes whose edges overlap the edge of said grooves.

6. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing a mixture of helium, neon, and argon, a cylindrical electrode support of refractory material having two longitudinal grooves oppositely disposed therein, two semi-cylindrical metallic electrodes whose edges overlap the edges of said grooves, and a getter on the exterior end of at least one electrode.

7. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing gas capable of luminous discharge upon the passage of an electric current, a cylindrical electrode support of refractory material having two longitudinal grooves oppositely disposed therein, two semi-cylindrical metallic electrodes whose edges overlap the edges of said grooves, a getter on the exterior end of at least one electrode and a quantity of activating material on at least one electrode.

8. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing gas capable of luminous discharge upon the passage of an electric current, a cylindrical electrode support of refractory material having two longitudinal grooves oppositely disposed therein, two semi-cylindrical metallic electrodes whose edges overlap the edges of said grooves, a getter on the exterior end of at least one electrode and a keeper within said envelope.

9. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing a mixture of rare gases, a cylindrical electrode support of refractory material having two longitudinal grooves oppositely disposed therein, two semi-cylindrical metallic electrodes whose edges overlap the edges of said grooves, a getter on the exterior end of at least one electrode, a quantity of activating material on at least one electrode, and a keeper applied adjacent to the lead-ins of said envelope.

10. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing a mixture of helium, neon and argon, a cylindrical electrode support of refractory material having two longitudinal grooves oppositely disposed therein, two semi-cylindrical metallic electrodes whose edges overlap the edges of said grooves, a getter on the exterior end of at least one electrode, a quantity of magnesium on at least one electrode, and a keeper on the stem of said envelope.

11. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing gas capable of luminous discharge upon the passage of an electric current, an insulating body and two electrodes therein, an edge of one of said electrodes being adjacent to an edge of the other, said electrodes being adjacent to and conforming to the shape of said insulating body except at said adjacent edges, said edges being at an appreciably greater distance from said insulating body than the remainder of said electrodes.

12. In an electric lamp of the negative glow type, in combination, a gas tight envelope containing gas capable of luminous discharge upon the passage of an electric current, and

nickel electrodes therein, at least one of said electrodes having a coating of magnesium and aluminum.

Signed at Hoboken in the county of Hudson and State of New Jersey this 18th day of December A. D. 1928.

TED E. FOULKE.