Feb. 19, 1935. R. M. WILLIAMS 1,991,479

GLOWLAMP

Filed March 29, 1929

Fig. 1

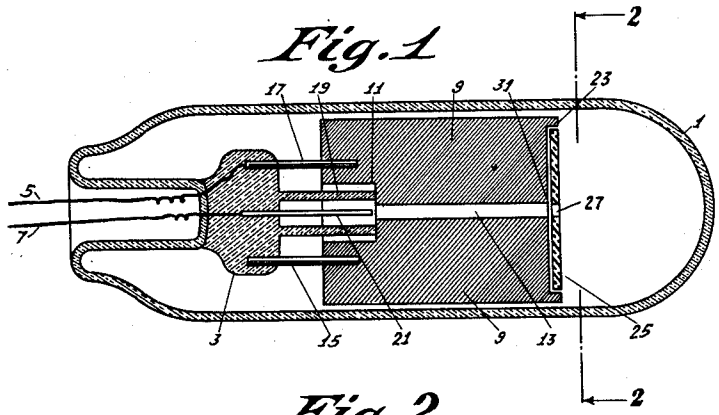
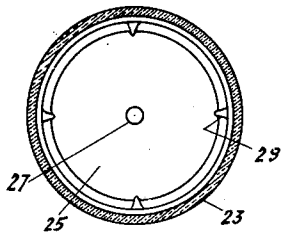


Fig. 2



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GLOW LAMP

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The present invention relates to glow lamps, and particularly to the glow lamps adapted and suited to use in connection with facsimile and television systems working in conjunction with radio, wired radio, or telegraph line transmitting and receiving systems.

Particularly, the invention is directed to glow lamps of the type which are known as point discharge lamps, in that the glow appears as a point source in contrast to lamps over which the glow appears over a relatively large area.

In the prior art, so far as I am aware, one of the principle difficulties encountered in connection with glow lamps of the general type to be hereinafter described has been the fact that the life of the lamp was relatively short, and, in many cases, limited to such values as 50 to 60 hours of use. This difficulty has been principally due to the fact that the electrodes disintegrate when potentials are applied thereto, and particularly refers to what has become known in the art as the cathode spatter. This spatter action, produced by disintegration of the cathode member of glow lamps has, heretofore, been most objectionable in that the disintegrated particles seem to collect on the inside of the glass envelope or window which surrounds the electrodes of the lamp, and as this inner surface becomes blackened by the action of the collected disintegrated particles, it will eventually prevent light produced within the lamp from being projected outwardly through the glass envelope housing the electrodes.

It is therefore an object of my present invention to develop a glow lamp in which the life is increased to a very material extent.

Still a further object of my invention is to produce a glow lamp in which any cathode spatter will in no way tend to block light from passing beyond the electrodes and a lamp in which the spatter cannot cover the inner surface of the enclosing envelope or casing.

Still another object of my invention is to provide a glow lamp in which means is provided for collecting the cathode spatter and thus prevent it from reaching the inner surface of the glass enclosing envelope.

Still another object of my invention is to provide a glow lamp arrangement in which provision is made for producing better heat radiation and thus increase efficiency in the lamp by conducting the heat away from the cathode glow portion to the outside portions of the tube.

Still further objects of my invention are to provide a glow lamp structure of the type to be hereinafter described, which is relatively simple in its construction and arrangement of parts, a glow lamp which is cheap and inexpensive to manufacture, one which can be easily installed in the now existing types of facsimile and television receiving apparatus, and a glow lamp in which the efficiency of operation is increased to a material extent.

Still other and ancillary objects of my invention will at once become apparent and suggest themselves to those skilled in the art to which the invention relates from a reading of the following specification in connection with the accompanying drawing, wherein:

Fig. 1 illustrates a longitudinal sectional view through a glow lamp construction of a preferred form; and,

Fig. 2 illustrates a sectional view taken on the line 2—2 of Fig. 1, in which the shield for preventing cathode spatter from blackening the inner surface of the envelope is more particularly shown.

Now referring more particularly to the drawing forming a part of the present disclosure, I have shown a glass enclosing envelope 1 as housing the cathode and anode members of the glow lamp. This enclosing envelope is of the same general type as the well known audions or triodes well known in the radio art, and may be mounted upon the usual supporting base provided with four prongs extending outwardly therefrom for the purpose of mounting in a socket in the same manner as the usual audion, although for convenience of illustration and showing, this has not been specifically illustrated.

Extending inwardly from the mounting portion of the enclosing envelope 1, I have supported a sealed-in stem member 3 for the purpose of supporting the electrodes of the lamp and forming therethrough a connection with external circuits by means of connecting wires 5 and 7, which if desired, may be connected with two of the terminals of the four prong base, generally known as the "UX" base of vacuum tube amplifiers. In this type of construction, the remaining two prongs will serve as blank contacts and function merely as an additional mounting means.

The cathode member 9 of the glow lamp structure is preferably formed from a solid metal ring or cylinder, whose cross-sectional shape is preferably that which is shown in the above illustration, and consists in a recess portion 11 extending inwardly from the lower portion thereof for a predetermined distance, with a small cylindrical opening 13 extending through the center

thereof from the outer portion thereof inwardly to the recess portion 11. The entire cathode structure is then supported within the enclosing envelope 1 by means of supporting members or feet 15 and 17, with the supporting element 17, for example, connected with the external circuit connection 5. So as to form a rigid supporting element 15 or 17 for the cathode member of the glow lamp, it is preferable to provide a sort of rigid wire mounting which is sealed into the supporting foot 3. Such wire should in its nature be a metal which forms a good electrical conductor, and, for this purpose, I have, therefore, preferably formed the supporting elements 15 and 17 from nickel wire, due to its inherently good conducting properties and its unusual strength, although it is to be understood that other types of wire, such as tungsten, copper, or molybdenum, might be substituted where desired.

Also supported from the supporting stem 3, and preferably formed as a part thereof by fusing the same, I have provided a glass sleeve member 19 extending into the recess portion 11 of the cathode structure, and within the enclosing sleeve 19, I have mounted the anode member 21, forming the second electrode of the glow lamp. The anode member, similarly to the supporting elements 15 and 17 for the cathode structure 9, is also rigidly mounted in the supporting stem 3, and is likewise preferably formed from a nickel wire, and connected by means of the conductor 7 to one of the four prongs of the base mounting (not shown).

Upon the upper portion of the cathode member, I have provided a ring like projection 23 extending about the circumference thereof, and within this ring like portion, I have placed a circular piece of insulating material 25, such as a mica washer, for example, which is provided at its central portion with an opening 27 through which the glow discharge, produced by the cooperative action of the cathode and anode with an application of potential thereto, may be seen. For the purpose of securely fastening the mica strip 25 to the cathode structure 9, I have crimped the portions 29 which serve to rigidly secure the mica washer to the cathode structure.

To describe now the operation of the glow lamp when potentials are supplied thereto through the conductors 5 and 7, it will appear that there will be a glow taking place between the cathode structure 9 and the anode structure 21. Since the anode is arranged at the center of the tube and along the axis thereof, and since ionization occurs between the cathode and anode, all of the glow produced will be concentrated within the space 13 formed by the cylindrical opening through the cathode member, and the glow therein produced may be observed by looking at the tube along the axis thereof in a direction as shown by the arrow on Fig. 1. In order that there may be no conduction between the anode and cathode leads 17 and 21 in the lower portion of the cathode member, and also in order that there may be no glow produced in this portion where the cathode member 9 is recessed at 11, I have arranged the glass sleeve 19 which will concentrate all of the glow within the cylindrical opening 13 as above described.

To describe now further properties of the glow lamp by which the window portion of the enclosing envelope 1 may be shielded from the spatter or disintegration of the cathode member 9, which will commence at the edges 31 thereof, it will be recognized that if potentials are applied to the anode and cathode members 21 and 9 respectively, the space portion 13 and exterior region adjacent to opening 27 will become ionized and positively charged. This will cause the mica or other insulating surface 25 to assume a positive charge, since it is located within a positive region. It is well known in the art that the spatter particles are negative, and as these spatter particles fly through the hollow cathode portion 13, they may pass through the opening 27 in the mica. However, due to the positive charge on the mica surface, which is opposite to the charge existent on each particle, the particles are deflected and, consequently, concentrated about the mica washer beginning at a point immediately adjacent the opening 27 and produce a blackening thereon. As the lamp is used more and more, the blackening action produced gradually spreads out from the center of the mica washer 25 until it extends substantially over the entire area. Thus, it will be apparent that the rate of blackening of the window of the enclosing envelope will be greatly decreased and the useful life of the lamp accordingly increased.

With further reference to the structure of the cathode member 9, it will be observed that this is formed from a hollow cylindrical block, which may preferably be of aluminum, although nickel, or iron, or other metals may be substituted where desired. However, most satisfactory operation has been found to be produced by the use of aluminum due to the low cathode voltage drop, the low spattering properties, the lightness in weight thereof, which tends to reduce the size of the supporting elements therefor, and the fact that aluminum is an unusually good conductor of heat.

Also, in view of the fact that the cathode member is formed from a hollow cylindrical block, better heat radiation is accomplished, and the temperatures within the lamp during periods of glow therein are considerably reduced because of the fact that the aluminum serves to conduct the heat away from the cathode glow portion to the outer portions of the tube, where a relatively large radiating surface is provided.

It is also well known in the art that various inert gases are much preferred to the chemically active gases such as hydrogen, nitrogen, for example, although either of these gases might be used and still produce an operative arrangement. However, due to the fact that a gas of a chemically active nature seems to eventually disappear, the use of such gases has not been found to be especially practical. In the case of the inert gases, when using neon gas, for example, the light produced from the glow has been found to consist principally of red light with small portions of yellow and green mixed therewith; when using argon, for example, the light produced has been found to be distributed more evenly over the entire visible spectrum and to be much richer in the ultraviolet; and, when using helium gas, for example, the light produced by the glow action will consist of the red, the yellow, and the violet, although to the eye the glow appears rather yellowish.

By experimentation, it has been observed that argon gas within the enclosing envelope produces most satisfactory results due to its low ionizing potential and actinic light produced. Helium gives a very actinic light but is not used because of its high ionization potential.

It is also possible to utilize a mixture of the

above named inert gases to produce satisfactory glow results. Or, if a trace of mercury is used in conjunction with the various inert gases which fill the lamp, the actinic value of the light is greatly increased, and, in many instances, this is desirable, as will hereinafter appear.

In the absence of any mercury in conjunction with the lamp, if an observer should look at the glow produced by the combined action of the cathode and anode during periods when potentials are applied thereto, in case there is a relatively large opening, for example $\frac{3}{4}$ of an inch, and sufficiently high gas pressure, the light, due to the cathode glow, that would appear would seem to be a ring of light, but with mercury used jointly with the various inert gases especially argon a bright or intense core of light appears along the axis of 13. This core emits the mercury arc spectrum which is rich in ultraviolet light.

In conjunction with the use of mercury and the other inert gases, the mercury spectrum will be present at the expense of the inert gas spectrum. That is, the mercury atoms receive their energy directly by impacts with positive ions and hence the greater the average kinetic energy of the positive ions, the more strongly will the mercury spectrum appear.

In addition to what has been above described, certain modifications and changes will at once suggest themselves to those skilled in the art to which the invention relates, and I therefore believe myself to be entitled to make all of such changes and modifications which fall fairly within the spirit and scope of the present invention as defined by the hereinafter appended claims.

Having now described my invention, what I claim and desire to secure by Letters Patent is the following:

1. A glow lamp structure having a cylindrical cathode member, an anode member supported within said cathode member, means for insulating the anode and cathode members with respect to each other for a space substantially corresponding to the distance which the said anode extends within the cathode, and an enclosing envelope surrounding each of said members.

2. A glow lamp structure having a hollow cylindrical cathode member, an anode member mounted in the hollow portion of said cathode member, an insulator extending within the hollow portion of the cathode for a distance substantially corresponding to the distance which said cathode extends therein for rendering the said portion of the cathode inactive, and an enclosing envelope surrounding both of said members.

3. A glow lamp structure having a cylindrical cathode member provided with a hollow portion extending through the central portion thereof, an anode member extending within an inactive portion of said hollow cathode member, and an enclosing envelope surrounding both of said members.

4. A glow lamp structure having a cylindrical cathode member provided with a hollow portion extending through the central portion thereof, shielding means within one end portion of the cathode, an anode member supported within the hollow portion of said cathode member and extending therein over an inactive portion, an enclosing envelope surrounding both of said members, and an inert gas in combination with a mercury vapor sealed within said enclosing envelope.

5. In a glow lamp construction, a solid cylindrical cathode member having a central opening therethrough, an anode member positioned along the axis of said cylindrical cathode member and extending into an inactive portion of the cathode and an enclosing envelope for both of said anode and cathode members.

6. In a glow lamp construction, a solid cylindrical cathode member having a central opening extending longitudinally thereof, an anode member positioned within said cylindrical opening and along a portion of the axis thereof, an insulating member between said anode and cathode extending inwardly of said cathode structure over a distance substantially corresponding to the extension of said anode member within said cathode, and an enclosing envelope surrounding both said cathode and anode structures.

7. In a glow lamp construction, a cylindrical cathode member having a central opening therethrough, an anode member positioned along the axis of said cylindrical opening in said cathode member and extending for a small distance within an inactive portion of said cathode member, whereby the glow produced by the application of electrical potentials to said cathode and anode members is concentrated within the cylindrical opening through said cathode member, and an enclosing envelope surrounding both said anode and cathode members.

8. In a glow lamp construction, a solid cylindrical cathode member having a central opening extending longitudinally therethrough, said opening being enlarged at one end thereof, an anode member positioned within said enlarged portion of the opening in said cathode member and along the axis thereof and extending within said cathode member for a portion thereof substantially corresponding to the enlargement of said recessed portion, an insulating member extending within said enlarged recessed portion of said cathode for shielding the said cathode and anode one from the other and concentrating the glow discharge produced by the application of electrical potentials to said cathode and anode within the cylindrical recessed portion of said cathode, and an enclosing envelope surrounding said cathode and anode structures.

9. In a glow lamp construction, a solid cylindrical cathode member having a longitudinal opening extending therethrough, an anode member extending within the lower portion of said cathode member along the longitudinal axis thereof for a predetermined distance, a layer of insulating material supported upon the upper portion of said cylindrical cathode member for concentrating the entire glow discharge produced by the application of electrical potentials to said cathode and anode within the said hollow cylindrical portion thereof and for collecting spattered particles produced by the disintegration of said cathode member during periods of glow discharge, and an enclosing envelope surrounding said cathode and anode structures.

10. In a glow discharge lamp, a solid cylindrical cathode member having a longitudinally extending central opening therethrough, said opening being enlarged at one end thereof, a ring of insulating material extending about the inner surface, of said enlarged portion of said cathode opening for rendering the enlarged portion of the cathode opening inactive, an anode member extending inwardly with respect to said cathode member for a distance substantially corresponding to the length of said insulating shield extending thereabouts, a layer of insulating material supported upon the opposite end portion of said

cathode member for concentrating the entire glow discharge produced by the application of electrical potentials to said cathode and anode members within the said longitudinally extending cylindrical portion of said cathode, means provided by said insulating ring for collecting spattered particles produced by cathode disintegration, and an enclosing envelope surrounding said cathode and anode members.

11. In a glow lamp construction, a solid cylindrical cathode member having a longitudinal opening extending through the central portion thereof, an anode member extending inwardly of said cathode member for a predetermined distance through said longitudinal opening therein, means for shielding said anode and cathode structures with respect to each other over a distance corresponding to the extension of said anode member within said cathode, a layer of insulating material supported by said cathode structure along the surface thereof opposite said anode structure for concentrating the entire glow discharge within the cylindrical portion of said cathode member and for collecting spattered particles produced by cathode disintegration during periods of glow discharge produced by the application of electrical potentials of said cathode and anode members, and an enclosing envelope housing said cathode and anode structures.

12. In a glow lamp, a solid cylindrical cathode having a central opening therethrough, a punctiform anode located axially of said opening, nonconducting means supported by the cathode to restrict the area of glow discharge within the cathode opening, and an enclosing envelope closely adjacent said cathode and surrounding both of said electrodes.

13. Electrodes for vacuum tubes comprising an elongated conductor open at both ends, and a conductor extending partially into said first conductor from an end thereof, and means for restricting electrode action to the interior of said elongated conductor.

14. A light producing unit comprising a glass envelope, a tube-like electrode therein and another electrode having a portion extending into an end of said first electrode a distance less than the length of said first electrode, said electrodes being spaced with respect to said envelope in a manner preventing light producing action at the exterior portions of said electrodes.

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