

June 25, 1940.

R. L. BREADNER ET AL

2,205,809

ELECTRIC LAMP

Filed July 23, 1937

Fig. 1

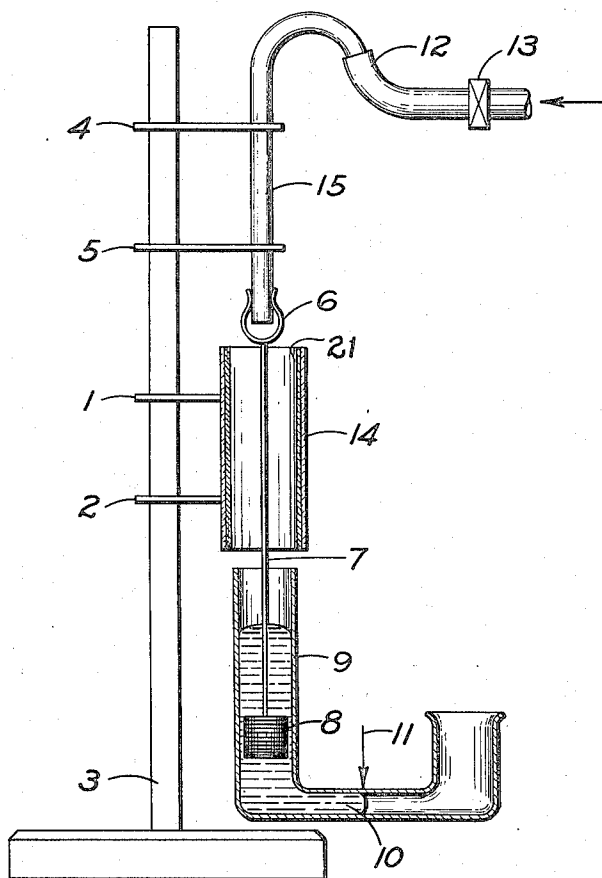
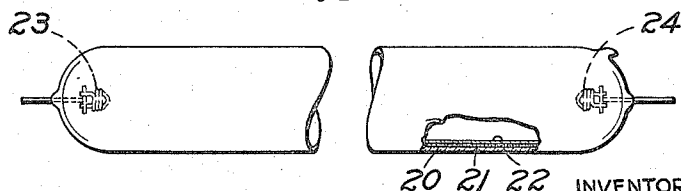


Fig. 2



INVENTORS
Robert L. Breadner
John T. Randall
John W. Ryde
BY *Harry E. Sunbury*
ATTORNEY

UNITED STATES PATENT OFFICE

2,205,809

ELECTRIC LAMP

Robert L. Breadner, John T. Randall, and John
Walter Ryde, Middlesex, England, assignors to
General Electric Company, a corporation of
New York

Application July 23, 1937, Serial No. 155,304
In Great Britain July 23, 1936

4 Claims. (Cl. 176—122)

This invention relates to electric lamps of the type comprising a sealed envelope, a gaseous filling, electrodes (which may or may not be thermionic) within the envelope, and material (also within the envelope) adapted to be excited to luminescence by radiation from a discharge through the said filling. More particularly it relates to such lamps in which the said filling comprises mercury vapor (possibly mixed with other constituents) and the radiation emitted by the discharge through it comprises the low-pressure spectrum of mercury.

It is known that the luminous efficiency of such lamps may be much greater than that of similar lamps containing no luminescent material. Thus, in a 50-watt lamp 700 mm. long and 30 mm. in diameter, filled with the usual mercury-argon mixture, and carrying 0.5 ampere, the efficiency in the absence of luminescent material is about 5 lumen/watt. If the interior surface of the walls is coated with a suitable layer of zinc silicate, the initial efficiency may be as high as 80 lumen/watt. But the efficiency falls off rapidly with life; if the nature of the luminescent material is varied, the efficiency in general falls off more rapidly, the greater the initial efficiency.

The object of the invention is to provide means for preventing or reducing this fall of efficiency during life.

The decrease in efficiency is not nearly so rapid if the gaseous filling is a rare gas free from mercury, especially neon. It is therefore natural to suspect that it is due to contact with the mercury, and could be avoided by placing the luminescent material outside the envelope. But then it has to be asked whether the material can be placed outside the envelope without removing it from the exciting agencies, which may include slow electrons or quantum radiation of frequency so high that it will not penetrate any convenient envelope. It has also to be asked whether so extreme and inconvenient a measure is necessary; it would probably be necessary if the decrease was due to adsorption of the unionized mercury; it may not be necessary, if the decrease is due to reaction with ionized or metastable atoms.

We have demonstrated that the decrease in the luminescence of many materials commonly used in association with the mercury discharge (and particularly of the luminescent silicates) can be prevented, without any serious loss in initial luminescence, by interposing, between the material and the discharge, a sheath transparent to radiation of wavelengths between 4000 and 2000 Å. (and particularly to the mercury line as 2536 Å.),

even if this sheath is not air-tight and does not prevent the access of unionized mercury to the material. It thus appears that, in this case, the main agency in exciting the luminescence is quantum radiation of which a considerable part has a wavelength longer than 2000 Å., and that the decrease of luminescence cannot be due merely to the adsorption of unionized mercury.

According to the invention an electric lamp of the type specified comprises an unclosed sheath within the envelope intervening between the discharge path and the luminescent material, the said sheath being so placed and so highly transparent to the radiation emitted by the discharge which excites the luminescence that the initial efficiency of the lamp is substantially unaltered by the presence of the said sheath, while the fall of efficiency during life is substantially reduced. Preferably the sheath is close to the luminescent material; but the presence of an appreciable gap between them may be tolerated, if matters are arranged so that the discharge does not pass through the gap. The sheath must, of course, be of a material not itself blackened by the discharge; quartz is suitable and so are some "ultra-violet" glasses. But some glasses that have relatively low transmission in the ultra-violet can be used, if the sheath is extremely thin; thus glasses of the lime-alkali type rich in potash are suitable, if the sheath is thin enough. A suitable glass has the composition SiO_2 65%, K_2O 16%, CaO 5%, MgO 2%, B_2O_3 2%, BaO 2%, Na_2O 5%, Al_2O_3 3%.

The sheath may be a member independent of the envelope and simply inserted within it. But, if it is of glass of relatively low melting point, it may be blown within the envelope, so that it fits closely against the interior surface of the envelope which carries the luminescent material. In this case it may be closed at the far end, even if this end is not coated with luminescent material; but, if so, it must be unclosed at the other end.

In the drawing accompanying and forming part of this specification,

Fig. 1 is a schematic representation of an apparatus useful in applying the sheath to the envelope, and

Fig. 2 is a side elevational, partly sectional view of a gaseous electric discharge lamp device embodying the invention.

Referring to Fig. 1 of the drawing 14 is a tube 30 mm. in diameter and 300 mm. long, coated internally with luminescent material 21, which is to form the envelope of an electric discharge device. It is supported vertically by the rings 1

and 2 on the stand 3. Above it is supported by other rings 4 and 5 on the same stand, the second tube 15 which is 15-20 mm. in diameter. The lower end of tube 15 is closed and held by the spring chuck 6 at the upper end of a rod 7 terminating in a weight 8, which slides as a piston in the oil-filled cylinder 9, terminating at its lower end in a tube 10, which can be closed by a tap 11. The upper end of tube 15 is connected by the flexible tube 12, which can be closed by a tap 13, to a supply of compressed air (not shown).

In operation the tube 15 and weight 8 are raised by sliding the rings 4, 5 on the stand. The tube 15 is then heated by a blow-pipe (not shown) below the lower ring 5. When the glass is thoroughly hot the taps 11 and 13 are opened, so that the melted tube is drawn within the tube 14 by the falling weight and, at the same time, expanded against it by the air pressure. The timing of the taps and the rate at which they pass air and oil have to be adjusted by trial so that the right result is obtained; but once they are adjusted the process can be repeated uniformly.

It has been found possible by this means to obtain nearly uniform layers of glass 0.025 mm. thick on the luminescent material. A suitable glass for this layer is the lime-alkali glass rich in potassium above-mentioned.

In an alternative embodiment, the sheath is drawn by a method resembling more closely that of the tube maker. The tube 15 is now an iron rod, the member 6 a crucible containing glass, kept hot (e. g.) by an electric current passed through it. The sheath is now formed by lowering the crucible and at the same time blowing through the iron tube.

A common feature of these methods of applying a thin film of glass to the inner surface of a tube, the said surface being coated with luminescent material, is that they involve means producing within the said tube and substantially coaxial with it a second tube of glass at a temperature well above its softening point and controlled means for simultaneously increasing the gas pressure within the said second tube and elongating it along the axis of the first said tube. This axis is preferably vertical. "Controlled" implies that the rate of increase of gas pressure and the rate of elongation can both be set to predetermined values.

The gaseous electric discharge lamp device illustrated in Fig. 2 of the drawing has an envelope 20 made in accordance with one of the methods described above. The envelope 20 has therein a starting gas, such as argon, and a quantity of vaporizable material, such as mercury, the vapor of which is excited to luminescence during the operation of the device. Thermionic, activated electrodes 23 and 24 of the type heated to an electron emitting temperature by the discharge are sealed into said envelope 20, one at each end thereof. When desired, thermionic, activated electrodes of the type requiring a special heating current or "cold" electrodes are used in place of one or both of said electrodes 23 and 24. The inner surface of said envelope 20 has a coating 21 of luminescent material, such as zinc silicate, applied thereto by methods now known in the art. A sheath 22 of vitreous material, such as the glass disclosed above, is applied to the luminescent coating 21 to protect said coating from the deleterious effects of the discharge.

A lamp having the above structure is an effi-

cient light source which retains its initial efficiency substantially unimpaired for a long useful operating life.

While we 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, substitutions and changes in the forms and details of the device illustrated and in its use and operation may be made by those skilled in the art without departing from the broad spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. A gaseous electric discharge lamp device comprising a container, electrodes sealed therein, a gaseous atmosphere therein comprising mercury vapor, a coating of heat sensitive luminescent material on the inner surface of said container, said material being deleteriously affected by the discharge during the operation of said device, and a glass sheath interposed between said luminescent material and the discharge path between said electrodes to protect said material from the effects of said discharge during the operation of said device and to thus decrease the rate of depreciation of said lamp device, said sheath being supported by said coating and being so thin that it is highly transparent to the radiation from said discharge which excites the luminescence in said material so that the initial efficiency of the lamp is substantially unaltered by the presence of said sheath, said sheath consisting of a low melting point glass having the following composition:

	Per cent
Silica (SiO ₂)	65
Potassium oxide (K ₂ O)	16
Calcium oxide (CaO)	5
Magnesium oxide (MgO)	2
Boric oxide (B ₂ O)	2
Barium oxide (BaO)	2
Sodium oxide (Na ₂ O)	5
Alumina (Al ₂ O ₃)	3

2. A gaseous electric discharge lamp device comprising a container, electrodes sealed therein, a gaseous atmosphere therein comprising mercury vapor, a coating of heat sensitive luminescent material on the inner surface of said container, said material being deleteriously affected by the discharge during the operation of said device, and a thin glass sheath interposed between said luminescent material and the discharge path between said electrodes to protect said material from the effects of said discharge during the operation of said device and to thus decrease the rate of depreciation of said lamp device, said sheath being supported by said luminescent material and consisting of a low melting point, non-blackening, lime-alkali glass rich in potash and being so thin that it is highly transparent to the radiation from said discharge which excites the luminescence in said material so that the initial efficiency of the lamp is substantially unaltered by the presence of said sheath.

3. A container for a mercury vapor electric discharge lamp, said container having on the inner surface thereof a coating of luminescent material and a thin glass sheath supported by said luminescent coating, said luminescent coating being a heat sensitive one and being deleteriously affected by the discharge during the operation of the discharge lamp, said sheath protecting said luminescent coating from the

discharge to minimize the depreciation of said lamp, said sheath consisting of a low melting point, non-blackening glass and being so thin that it is highly transparent to the radiation from said discharge which excites the luminescence in said material so that the initial efficiency of the lamp is substantially unaltered by the presence of said sheath.

4. A container for a mercury vapor electric discharge lamp, said container having on the inner surface thereof a coating of luminescent material and a thin glass sheath supported by said luminescent coating, said luminescent coating being a heat sensitive one and being deleteriously affected by the discharge during the

operation of the discharge lamp, said sheath protecting said luminescent coating from the discharge to minimize the depreciation of said lamp, said sheath consisting of a low melting point, non-blackening lime-alkali glass rich in potash and being so thin that it is highly transparent to the radiation from said discharge which excites the luminescence in said material so that the initial efficiency of the lamp is substantially unaltered by the presence of said sheath.

ROBERT L. BREADNER.
JOHN T. RANDALL.
JOHN WALTER RYDE.