Fig. 1

INVENTOR:
J. Buser

ST

G1

G2

Hg

W1

MB

INVENTOR:
J. Buser

Richard Geier
ATTORNEYS
ELECTRIC LAMP FOR MIXED LIGHT
Johann Buser, Riehen, Switzerland
Application January 31, 1951, Serial No. 208,721

4 Claims. (Cl. 315—59)

1. Several types of electric lamps for mixed light are known which consist of a bulb with a base in which the illuminating bodies such as filament, mercury and/or sodium vapor discharge elements are arranged. This type of lamps serves for mixing light of different colours to obtain a light which is as similar as possible to normal daylight.

In the construction of such lamps up to now two known illuminating elements, for instance, a mercury vapour high pressure tube and a filament lamp were combined in a simple manner whereby the fact that the heat discharge of the two elements might be used to increase the light output was neglected.

In contrast to the natural operating possibilities quartz which may be subjected to very high temperatures was chosen for the discharge tube and the volume of the discharge vessel was kept small.

The subject of the present invention bases on the fact that the heat units available immediately after switching on the lamp from the heat radiator are fully utilized for controlling and for increasing the pressure in the discharge vessel. The known, substantially different working conditions of the two illuminating elements, heat radiator with ohm-type resistance and discharge tube with negative voltage characteristic, have led to many different arrangements to obtain as close an approximation to normal daylight as possible.

The sharply defined lines in the spectrum of the mercury vapour light prevent a close approximation to daylight with the customary design for shape and size of the discharge vessel (tubular shape) even when the two elements were adjusted electrically as well as possible. The thermal stress imposed on the quartz material did not permit the use of high pressure with the customary shapes of the discharge tube. The idea which led to the present invention was that the discharge vessel could be shaped in such a way and be given such a volume that the wall of the vessel surrounding the mercury vapour arc would have such a distance from the arc that the material of the vessel could not be softened by the high temperature. Stated differently, the volume of the vessel must be chosen in such a way that the heat coming from the heat radiator permits a maximum pressure rise.

To facilitate the realization of the invention, the two vessels, i.e. high-pressure mercury vessel and lamp bulb, can be joined by melting so as to form one piece. The object of the invention may be attained if the discharge vessel is designed in such a way that the discharge distance is smaller than the maximum diameter of the vessel along the discharge path.

Another object of the invention is to make possible also a higher loading of the heat radiator. For this purpose the main vessel of such lamps which contains the filament may contain a gas of high pressure under static working conditions. The rate of vaporization of the material of the filament can thus be decreased in known manner.

To provide for a fast pressure rise immediately after the lamp is switched on the lamp vessel contains inert gases and possibly metals which evaporate easily.

The exterior bulb must correspond in shape and size with the lamp unit to avoid cool spots. Glass with a high melting point is used as transparent material of the lamp. However, the use of hard glass or quartz material does not fall under the invention.

In the super high pressure discharge lamps known so far the only means for creating the high pressure was the high current. For instance, the operation of super high pressure discharge lamps requires 400 ma. for a cross section of 16 mm², i.e. 400/16=25 ma./mm². Such super high pressure mercury discharge lamps require forced cooling. Since pressure and temperature are depending from each other, the invention is based on the fact that the discharge vessel can be made much larger if the pressure necessary for the high pressure is furnished to the discharge vessel from an outside heat source. The power necessary for super high pressure discharge tubes operating on this principle is less than 50 per cent. The practical use of the super high pressure tubes which are very favourable with respect to light output necessitates additional cooling means.

In the accompanying drawing, the Figs. 1, 2 and 3 show three constructional examples of the present invention.

Fig. 1 shows a diagrammatic partial section of an electric lamp for mixed light with a discharge vessel for the operation of a super high pressure mercury discharge arc and a filament lamp.

In this example the discharge vessel is connected with the exterior bulb by a fin (base with current lead to electrode).

In the drawing:
E shows the discharge path of the high pressure arc.
Gt is the lamp's main vessel (exterior bulb).
2,669,676 3 G2 is the discharge vessel of the high pressure arc. W1 is the filament of a filament lamp. St is the fin connecting bulb, base and discharge vessel carrier of the lamp. The filament has been made thinner than the wall of the bulb so that any explosion which might occur is directed against the base of the lamp. Hg is a mercury condensate. MB is a metal body fitted to the exterior bulb (G1) by a distillation process which may consist of mercury, sodium, barium or a similar material. L are air inlets for ventilating the current leads and the base (S) of the lamp. S shows a standard Edison screw base. Another base type, e.g. a bayonet base might, of course, be used instead.

Fig. 2 shows a diagrammatic partial section of an electric lamp for mixed light similar to the one shown in Fig. 1. The most important differences of the example shown in Fig. 2 against the lamp according to Fig. 1 are:

The shape of the discharge vessel of the high pressure arc (G2) is different. In contrast to the lamp shown in Figs. 1 and 8 the front face of the discharge vessel is connected with the surrounding air. Fig. 3 shows a diagrammatic partial section of an electric lamp for mixed light, preferably for use in projectors and for vertical operation. The filament (W2) is arranged in one plane to make possible focusing of the light of the high pressure arc and the filament in a lens. The discharge vessel does not necessarily form the axis of the main vessel in this type of lamp. Fig. 3 also shows a so-called ignition pin which is arranged close to the electrode directed against the lamp's base and which is connected with a resistance of high value (W3) to the highest potential of the current source.

As shown in the three examples the lamp is preferably made by one single vessel which has two chambers completely separated from each other. In one of the chambers the mercury discharge arc will be established. This chamber contains the two electrodes and the mercury condensate. The other chamber contains the heat radiator which preferably takes the form of a filament made from tungsten.

To obtain a good temperature exchange between the high pressure mercury vessel (G3) and the main vessel (G1) containing the filament, a material which vaporizes easily, e.g. mercury, sodium, barium, etc. is enclosed. During operation a saturated atmosphere is created which has a good thermal conductivity. Since the mercury vapour discharge vessel must be made of a material resistant to mercury and as the discharge vessel is preferably molten into one piece with the main vessel (G1) mercury is preferably also used for the base metal body of the main vessel. The latter may also contain besides the base metal body a gas of high thermal conductivity which is inert so as not to effect the filament, e.g. Ar, Kr, Ne or a mixture of such gases. To improve saturation the main vessel can be frozen out after the base has been fitted by a distilling process and before the gases are enclosed.

Stationary operating conditions are established as follows:

After the lamp has been switched on the heat radiating from the filament vaporizes the metal base body of the bulb thus rapidly increasing the saturation pressure in the bulb. The arc in the mercury tube heats the inner wall of the vessel whereby also a rapid increase in vapour pressure is effected.

The maximum cross section of the vessel (G2) has been considerably increased in comparison with customary discharge tubes. The cooling surface has thus been increased in such a way that the discharge vessel cannot be overheated. This is the most important point for the operation of the lamp in accordance with the present invention. The further the wall of the vessel can be arranged away from the arc without impairing the required pressure rise the better the efficiency of such a lamp.

Mercury vapour light is a so-called cold light. For the operation of a mercury vapour discharge lamp much power is required to heat the discharge vessel. The comparatively high pressure necessary can only be obtained by heating a base body made of mercury. This is effected by using as fully as possible an element which is required for improving the quality of the light and which produces much heat, such as a filament. It is thus possible to improve considerably the ratio between light and heat.

The rate of evaporation of the filament glowing in a high pressure atmosphere is considerably smaller than with known filament lamps. It is thus possible to stress the filament more than is customary with known filament lamps. This results in a different light colour of the filament which is of special advantage since the high pressure tube produces a spectrum which as mentioned above has also a continuity and which gives especially a strong red region in the spectrum.

The present invention does not relate to the electric wiring which should be substantially similar to that of the lamp disclosed in the U. S. Patent No. 2,329,455. The whole economy, i.e. light produced, lamp life, initial costs, is improved to a high degree by the separate feeding of the single elements.

1. An electric lamp for mixed light, comprising, in combination, an outer bulb, an inner bulb within said outer bulb, high pressure arc-forming means within said inner bulb, said means forming an arc the length of which is less than the greatest diameter of said inner bulb measured in the direction of the arc, a carrier located within said outer bulb and carrying said inner bulb, a fin connecting said carrier with the inner walls of said outer bulb, said fin being thinner than the walls of said outer bulb, a filament supported by said carrier outside of said inner bulb and adjacent thereto, mercury within said inner bulb and adapted to be evaporated by said filament, an inert gas in said outer bulb, a vaporizable metal body in said outer bulb, and means supplying electrical current to said arc-forming means and said filament.

2. An electric lamp for mixed light, comprising, in combination, an outer bulb, an inner bulb within said outer bulb, high pressure arc-forming means within said inner bulb, said means forming an arc the length of which is less than the greatest diameter of said inner bulb measured in the direction of the arc, a carrier located within said outer bulb and carrying said inner bulb, a fin connecting said carrier with the inner walls of said outer bulb, said fin being thinner than the walls of said outer bulb, a filament sup-
ported by said carrier outside of said inner bulb and adjacent thereto, mercury within said inner bulb and adapted to be evaporated by said filament, an inert gas within said outer bulb, a vaporizable metal body in said outer bulb, said arc being substantially uniformly spaced from the walls of said outer bulb, a neck connected with said outer bulb and having ventilation openings formed therein, and means extending through said neck for supplying electrical current to said arc-forming means and said filament.

3. An electric lamp for mixed light, comprising, in combination, an outer bulb, an inner bulb within said outer bulb, high pressure arc-forming means within said inner bulb, said means forming an arc the length of which is less than the greatest diameter of said inner bulb measured in the direction of the arc, a carrier located within said outer bulb and carrying said inner bulb, a fin connecting said carrier with the inner walls of said outer bulb, said fin being thinner than the walls of said outer bulb, a filament supported by said carrier outside of said inner bulb and adjacent thereto, mercury within said inner bulb and adapted to be evaporated by said filament, an inert gas within said outer bulb, a vaporizable metal body in said outer bulb, said arc being substantially uniformly spaced from the walls of said outer bulb, said filament consisting of a plurality of coils located in one plane, an ignition pin in said inner bulb, and means supplying electrical current to said arc-forming means, said ignition pin and said filament.

JOHANN BUSER.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,056,639</td>
<td>Sperl</td>
<td>May 1, 1934</td>
</tr>
<tr>
<td>2,020,737</td>
<td>Pirani</td>
<td>Nov. 12, 1935</td>
</tr>
<tr>
<td>2,163,428</td>
<td>Inman</td>
<td>June 20, 1939</td>
</tr>
<tr>
<td>2,212,879</td>
<td>Kalsing</td>
<td>Aug. 27, 1940</td>
</tr>
<tr>
<td>2,285,386</td>
<td>Reger</td>
<td>Dec. 9, 1941</td>
</tr>
<tr>
<td>2,275,788</td>
<td>Kern</td>
<td>Mar. 10, 1942</td>
</tr>
<tr>
<td>2,277,876</td>
<td>Mackoud</td>
<td>Mar. 31, 1942</td>
</tr>
</tbody>
</table>

FOREIGN PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Country</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>493,831</td>
<td>Great Britain</td>
<td>Oct. 14, 1938</td>
</tr>
</tbody>
</table>