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[54] **TUNGSTEN-BROMINE CYCLE LAMP**

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[51] **Int. Cl.** **H01k 1/54**

[58] **Field of Search** 313/222, 174, 179

[56] **References Cited**

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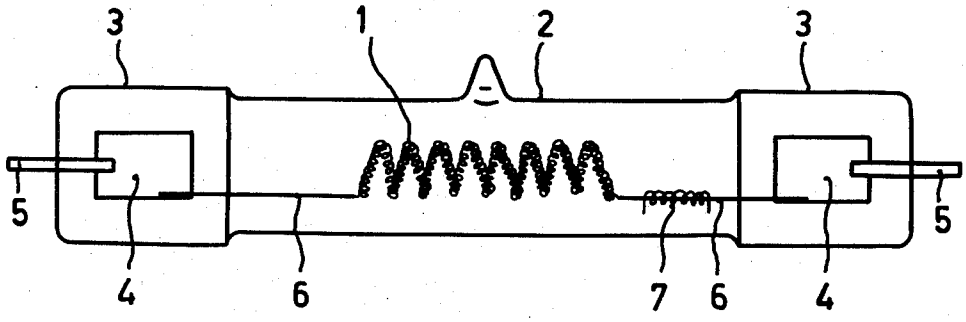
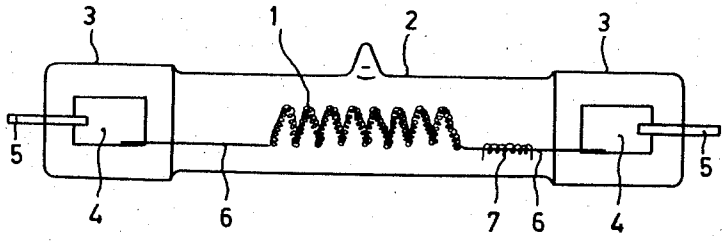
[57] **ABSTRACT**

A tungsten-bromine cycle lamp which comprises a metal chosen from the group formed by titanium, zirconium, hafnium, vanadium, niobium and tantalum as a material regulating the oxygen pressure.

2 Claims, 1 Drawing Figure

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TUNGSTEN-BROMINE CYCLE LAMP

The invention relates to an electric incandescent lamp having a filament body of tungsten; a gas filling comprising bromine and hydrogen and being proportioned in such a manner that the wall of the envelope during operation of the lamp everywhere assumes a temperature in which tungsten-bromine compounds formed in the lamp are volatile; hereinafter referred to as a tungsten-bromine cycle lamp.

Lamps of this type are known and are especially used under circumstances where with relatively small dimensions a high light output throughout the lifetime of the lamp is required. As a result of the presence of bromine and choosing the dimensions of the lamp in such a manner that the wall of the envelope during operation of the lamp everywhere assumes a temperature at which tungsten-bromine compounds formed in the lamp are volatile it is achieved that the wall of the envelope remains bright until the end of the life of the lamp.

Hydrogen present in the lamp has the object to suppress the direct reaction between bromine and the ends of the filament body and supports of tungsten if present by the formation of HBr in the vicinity thereof. The required bromine and hydrogen are usually introduced into the lamp as HBr or in the form of a hydrocarbon compound.

Furthermore the lamp generally comprises an inert gas or a mixture of gases such as argon, krypton, nitrogen.

The lifetime of the lamp in case of a given inert gas filling and filling pressure is the shorter and the light output in lumens per watt is the higher, the higher the temperature which is achieved by the filament body during operation.

It has been found in practice that incandescent lamps of the type described do not always reach the lifetime which might be expected on account of the filament temperature and gas filling of the lamp.

This is particularly evident in the case of lamps in which during their lifetime an unpredictable quantity of oxygen as such and/or in the form of compounds such as water or volatile metal oxides is released from the lamp parts.

The invention has for its object to prevent these difficulties. The incandescent lamp according to the invention is characterized in that the lamp comprises a metal chosen from the group consisting of titanium, zirconium, hafnium, vanadium, niobium and tantalum.

In the drawing, the sole FIGURE represents a frontal view of a lamp in accordance with the present invention.

The said metals getter under normal circumstances all constituents of the gas atmosphere present in a lamp with the exception of the rare gases present therein. However, it was surprisingly found that in a tungsten-bromine cycle lamp the presence of a small, but effective quantity of the said metals is not disturbing. Unexpectedly, a longer lifetime of the tungsten-bromine cycle lamps according to the invention could generally be found. This might indicate that under the circumstances prevailing in the lamp during operation the oxygen pressure in the lamp is stabilized by the said metals to a value below the value which is harmful for the lamplife, while hydrogen and bromine are not prevented from fulfilling their function in the tungsten-bromine

cycle. This is, however, surprising because oxygen as compared with the quantities of hydrogen and bromine used in the lamp is present in smaller quantities and because it could be expected that the said metals might form valatile bromides. The quantities of the said metals to be used are little critical. A quantity which might be exactly sufficient to bind all oxygen possibly released from the lamp during its lifetime is already found to be effective. The oxygen is mainly released from the tungsten filament which generally comprises not more than 50 ppm of oxygen. In the presence of hydrogen in the lamp atmosphere no real maximum usable quantity could be determined. A quantity which is larger than approximately three times the quantity required to bind the maximum quantity of oxygen which might be released from the filament does not, however, yield extra advantages. When the quantity of the said metals is at least sufficient to bind a quantity of 50 ppm of filament weight and is three times this quantity as a maximum, this has generally been found to be sufficient not only for binding the oxygen released from the filament to a sufficient extent but also for binding the oxygen which is released from the other lamp materials and is introduced into the lamp with the filler gas. The lifetime achieved may sometimes be 10 times longer than that of lamps without the metal addition. The said metals may be introduced into the lamp as wire pieces, foils, spheres or any other arbitrary form. During operation of the lamp it is to be ensured that the said metals do not contact the incandescent tungsten filament unless a metal mirror, which is generally semi-permeable, on the wall of the envelope is not a drawback. In this case it is alternatively possible to introduce the metals entirely or partly as metal bromides into the lamp.

The method according to the invention will be further described with reference to the following examples.

Example I.

The tungsten filament body (coiled-coil) of a 30V-375W tungsten-bromine cycle lamp exhibited strong whisker formation (length: several millimetres) already after an operating time of approximately 20 hours; the lifetime of the lamp was generally less than 200 hours. The gas atmosphere consisted of argon having a partial pressure of 700 Torr and CH_2Br_2 having a partial pressure of 5 Torr. The envelope has an internal diameter of 10.5 mms and a content of 2,600 cubic mm. The number of lumens per watt is 20. It was found that the tungsten filament for a weight of 932 milligrammes contained 40 microgrammes of oxygen. When using zirconium in a quantity of approximately 0.1 mgr. in the form of a piece of shredded foil as used in combustion flash bulbs it was found that the lifetime in case of the same gas filling and load was extended to values of at least 2,500 hours without whisker formation occurring.

Example II.

The tungsten filament body (coiled-coil) of a 225V-800W tungsten-bromine cycle lamp having a gasfilling consisting of nitrogen at a partial pressure of 1.5 atm and HBr at a partial pressure of 23 Torr exhibited strong whisker formation after 50 hours. When replacing HBr by CH_2Br_2 having a partial pressure of 11.5 Torr whisker formation was found to occur only in exceptional cases. This may indicate that during opera-

tion oxygen is released which, when CH_2Br_2 is used, chemically reacts with carbon and is then less harmful. Due to the relatively large quantity of carbon which was introduced into the lamp together with dibromomethane it was, however, impossible in practice to keep the lamp envelope free from black deposits. The lamp produces approximately 27 lumens per Watt. For an internal diameter of 12.5 mms the content of the lamp envelope is 4 cubic cm. The filament weight is 561 milligrammes and the filament contained an unknown quantity of oxygen.

When using approximately 0.1 mgr. of zirconium in the lamp comprising HBr the lifetime was found to be extended to 150 hours at an average.

Example III

A gas mixture was composed of argon, hydrobromic acid and oxygen for which the partial pressures were 679 Torr, 20 Torr and 1 Torr, respectively, which mixture was used in a 24 Volt - 100 W lamp (filament weight 60 mgs) having a light output of 22 lumens per Watt. The lamp was formed as a two-pinch lamp having an envelope of quartz with a content of 1.13 cubic cm. The table below shows the kind of metal, the quantity and the average lifetime of at least 10 lamps. The lifetime of the lamp without metal addition is 15 to 20 hours while strong whisker formation occurs. The latter is not the case when the metals mentioned in the table are used.

Metal	Quantity	Lifetime
Ti	50 μ gr.	1100 hours
Zr	80 μ gr.	1500 hours
Nb	80 μ gr.	1200 hours
Ta	150 μ gr.	1100 hours
V	50 μ gr.	1300 hours
Hf	160 μ gr.	1500 hours

The invention particularly provides the advantage that a simple step may prevent some tungsten-bromine cycle lamps from not reaching the calculated lifetime, while it is additionally achieved that the average lifetime of tungsten-bromine cycle lamps is extended. The tungsten filaments in the lamps according to the invention at their end of lifetime are found to burn through in the middle or at an area not far remote therefrom instead of at the relatively cold ends, which indicates the absence of the harmful effect of oxygen in these lamps while whisker formation does not occur or substantially does not occur.

In the sole FIGURE, an embodiment of a lamp in accordance with the present invention is shown.

A tungsten filament **1** is disposed in a quartz envelope **2,** The envelope is pinched off at the ends by pinch seals **3.** Within the pinch seals are molybdenum foils **4** to one side of which are connected molybdenum conductors **5.**

The ends of the filament **6** are directly connected within the pinch to the foils **4.** Between the opposite filament end **6** and the main body of the filament, a small spiral of getter metal **7** is wound as shown. As described above, this metal is chosen from a group formed by titanium, zirconium, hafnium, vanadium, niobium and tantalum.

What is claimed is:

1. An electric incandescent lamp comprising: a filament body of tungsten, a gas filling including bromine and hydrogen, said lamp being proportioned in such a manner that the wall of the envelope during operation of the lamp everywhere assumes a temperature at which tungsten-bromine compounds formed in the lamp are volatile, the lamp also comprising a metal chosen from the group formed by titanium, zirconium, hafnium, vanadium, niobium and tantalum.

2. An electric incandescent lamp as claimed in Claim **1,** wherein the quantity of metal is at least sufficient to bind a quantity of oxygen from the tungsten filament, corresponding to 50 ppm and as a maximum three times this quantity.

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