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[54] **ELECTRIC INCANDESCENT LAMPS**

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[52] **U.S. Cl.** **316/20,** 313/174, 313/222, 313/223, 316/24

[51] **Int. Cl.**.....**H01j 9/38**

[58] **Field of Search** 316/15, 20, 24; 313/223, 222, 313/174; 316/25

[56] **References Cited**

UNITED STATES PATENTS

1,246,118	11/1917	Langmuir	313/222 X
1,944,825	1/1934	Millner	313/174
3,465,193	9/1969	Beauvens et al.	313/174 X

FOREIGN PATENTS OR APPLICATIONS

763,062	7/1967	Canada	313/222

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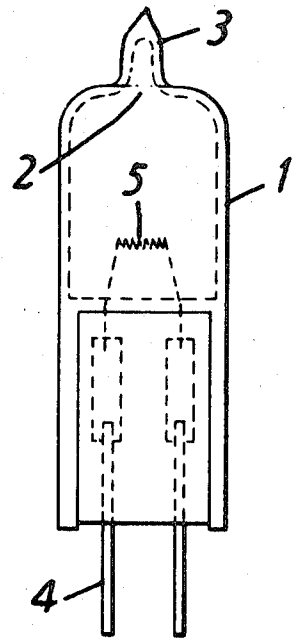
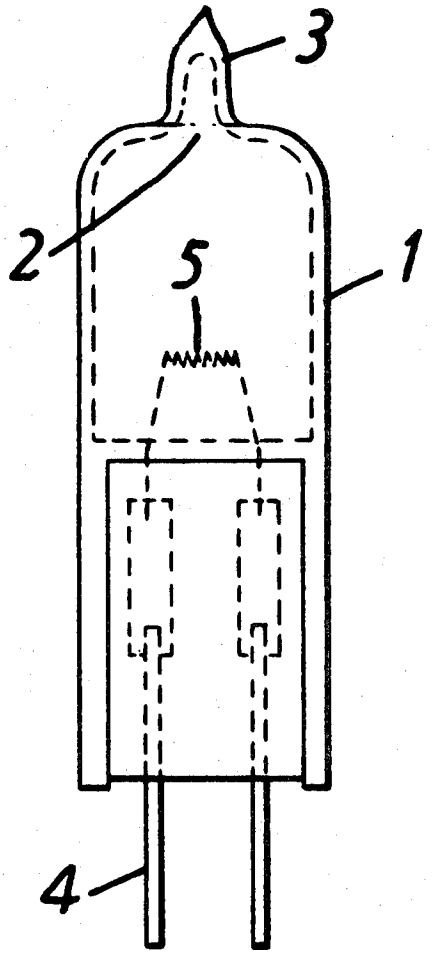
[57] **ABSTRACT**

A tungsten-halogen cycle electric incandescent lamp has a fill including a phosphonitrilic halide. Mixtures of more than one of the halides may be employed. The halide can be introduced into the lamp envelope in solution, the solvent being evaporated thereafter to leave the halide as residue.

7 Claims, 1 Drawing Figure

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ELECTRIC INCANDESCENT LAMPS

This is a division of application Ser. No. 1,404, filed Jan. 8, 1970.

The present invention relates to tungsten-halogen cycle electric incandescent lamps.

In operation of these lamps a halogen element, usually either bromine or iodine acts in association with tungsten vapor evaporated from the filament, to minimize deposition of tungsten on the envelope wall.

While allowing the use of compact and mechanically strong lamp envelopes, permitting pressure filling to several atmospheres, and increased filament life, these lamps are more difficult to produce than conventional incandescent lamps. Under the relatively high temperatures of operation of these lamps, impurities can be released which interfere with efficient working, but it is difficult to introduce a getter for impurities which will remain active after lamp processing but not interfere with the regenerative cycle. Furthermore, whereas close control of the quantity of halogen present is necessary in order to achieve optimum efficiency of the regenerative cycle, in known methods losses of halogen can occur either through evaporation or by chemical reaction or physical absorption either before or during lamp processing after introduction of the halogen.

The present invention provides a means whereby the halogen can be introduced as a substance which remains inert during lamp processing, but releases a pre-determined quantity of halogen and provides a gettering action upon thermal dissociation.

According to the present invention there is provided a tungsten-halogen cycle electric incandescent lamp having a fill including a phosphonitrilic halide.

Mixtures of phosphonitrilic halides having different halogen atoms and/or different number of (PNY_2) units, where Y is the halogen, in the molecule may be employed, such as a mixture of $(PNBr_2)_3$ and $(PNBr_2)_4$.

The phosphonitrilic halides can be prepared by conventional techniques.

The halides are stable at room temperature. However, they can be dissociated into their elements by heating within the lamp envelope, for example by operating the lamp. The halogen supports the regenerative cycle, and the phosphorous provides a gettering action.

Before the present invention, in the case of lamps having a fill including elementary bromine, precise control of the quantity of bromine was necessary in order to avoid corrosion of the tungsten filament by excess bromine, which would lead to lamp failure. Although corrosion could be reduced by introducing hydrogen with the bromine, as for example as hydrogen bromine or as $CHBr_3$, CH_2Br_2 or C H_3Br, the hydrogen tended to diffuse through the fused silica of the envelope, leading to the formation of an excess of bromine. In the present invention, the phosphorous serves a function similar to that of hydrogen, when the halogen is bromine, in that it inhibits the reaction between bromine and the tungsten filament, but the disadvantage of a short lamp life resulting from loss of hydrogen by diffusion is avoided.

The phosphonitrilic halides can be dissolved in inert solvents, preferably non-polar solvents such as benzene, ether, petroleum ether and chlorinated hydrocarbons, and can thus be introduced into the lamp envelope as a solution, for example by injection onto the filament or envelope wall, facilitating close control of the quantity of halide introduced. The solvent can be evaporated from the envelope, e.g., under a vacuum, leaving the halide as a residue.

For example a solution of a mixture of trimeric and tetrameric bromides, e.g. in benzene or a solution of a mixture of $(PNCl_2)_4$, $(PNCl_2)_5$, $(PNCl_2)_6$ and $(PNCl_2)_7$e.g. in petroleum ether can be used.

The following are some examples of methods of making lamps in accordance with the present invention.

EXAMPLE 1

In making a 12 v. 100 w. compact projection lamp having an internal volume of 0.65 cc.s approximately, a lamp envelope having filament-supporting lead-in wires sealed through the wall of the envelope, and an aperture in the envelope wall with an exhaust tube sealed around the aperture, was formed in the conventional manner.

A solution in benzene of a mixture of trimeric and tetrameric phosphonitrilic bromides containing 0.15 g. of the mixture per 100 c.c.s of solution was prepared and 0.0355cc.s of the solution was injected into the lamp envelope. An exhaust/gas-filling apparatus was connected to the exhaust tube and the envelope was evacuated, flushed with nitrogen and heated to a low temperature (about 150°C) to evaporate the solvent of the solution. Thereafter the envelope was filled with an inert gas e.g. N_2, Ar, Kr or Xe to the required pressure in the conventional manner and the exhaust tube was sealed.

EXAMPLE II

In making a 12v. 55 w. compact car lamp having an internal volume of 0.65 cc.s approximately the procedure of Example 1 was followed except that 0.024 cc.s of the solution was injected into the lamp envelope.

EXAMPLE III

In making a 12v. 55w. compact car lamp having an internal volume of 0.65 cc.s approximately the procedure of Example I was followed except that 0.05 cc.s of a solution in petroleum ether of a mixture of $(PNCl_2)_4$, $(PNCl_2)_5$, $(PNCl_2)_6$ and $(PNCl_2)_7$ containing 0.05 g. of the mixture per 100 cc.s of solution was injected into the lamp envelope instead of the solution of mixed phosphonitrilic bromides.

The solution used in Example III has been found to be particularly well suited for lamps having a loading of less than 20w./cm.^{2} of internal envelope wall area.

In the method described in the Examples the exhaust/gas filling system is not exposed to the corrosive action of halogens. Thus the need for the usual corrosion-resistant materials and frequent maintainance of the system can be avoided. In addition, the disadvantage of halogen-degradation of the lubricants employed, leading to a reduction in the life of the vacuum pumps, can be avoided.

Whereas before the present invention specialized procedures for handling and processing the components for tungsten-halogen lamps were required, the procedures for making lamps according to the inven-

tion as described in the examples are more similar to those for making conventional electric incandescent lamps, because of the gettering action of the phosphorus released on dissociation of the halides. As a result of the accuracy with which the halogen can be introduced, a lower standard deviation in the lamp life may also be achieved. In addition, a longer lamp life may be obtained. The present invention also allows the use of less expensive materials, containing greater amounts of impurities than were hitherto practicable, to be used for the lamp envelopes, as for example high melting point glasses, or Vycor (approximately 96 percent silicon glass), instead of the more usual high purity fused silica envelopes.

The accompanying drawing illustrates an example of one form of lamp prepared as described in Example I. Referring to the drawing, the lamp has a high melting point glass envelope **1** provided with an aperture **2** through which the lamp was exhausted and filled. The lamp was thereafter sealed by sealing off an exhaust tube **3** with which the aperture **2** is provided. The envelope has two lead-in wires **4** sealed therethrough, connected to a tungsten filament **5**.

We claim:

1. A method of making an electric incandescent lamp which comprises: providing a light-transmitting envelope of a high temperature-resisting material having an aperture therein and having electrically-conducting lead-in wires sealed through said envelope and a tungsten filament connected to said lead-in wires; introducing a solution of a phosphonitrilic halide in a solvent into said envelope through said aperture; evaporating said solvent; filling said envelope with an inert gas; and sealing said aperture.

2. A method according to claim **1** in which said solution contains a mixture of $(PNBr_2)_3$ and $(PNBr_2)_4$ as said halide.

3. A method according to claim **2** in which said solution contains 0.15 g of said mixture per 100 c.c.s of solution.

4. A method according to claim **3** in which said solvent is benzene.

5. A method according to claim **1** in which said solution contains a mixture of $(PNC\lambda_2)_4$, $(PNC\lambda_2)_5$, $(PNC\lambda_2)_6$ and $(PNC\lambda_2)_7$ as said halide.

6. A method according to claim **5** in which said solution contains 0.05 g of said mixture per 100 c.c.s of solution.

7. A method according to claim **6** in which said solvent is petroleum ether.

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