United States Patent

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[54] **HALOGEN REGENERATIVE CYCLE INCANDESCENT LAMPS**
2 Claims, 1 Drawing Fig.

[52] **U.S. Cl.** **313/222,** 313/223
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[50] **Field of Search** 313/222, 223

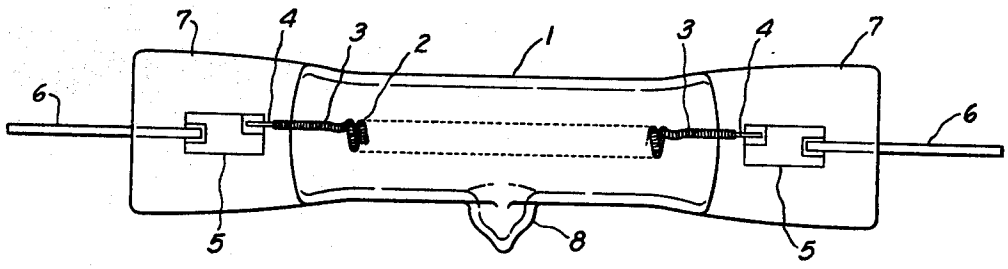
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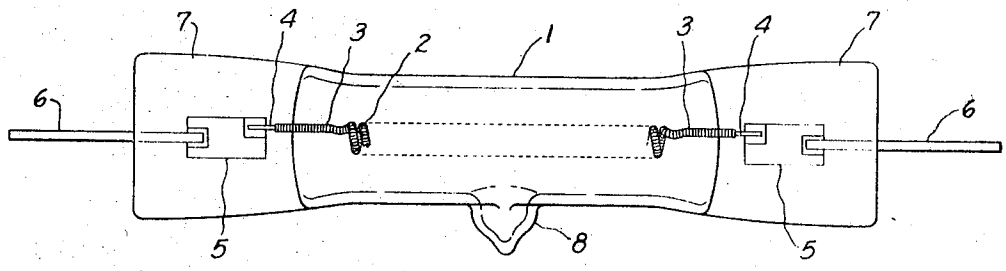
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ABSTRACT: A halogen cycle incandescent lamp contains, as the source of halogen, a hydrocarbon compound of iodine, such as methyl iodide.



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HALOGEN REGENERATIVE CYCLE INCANDESCENT LAMPS

This invention relates generally to electric incandescent lamps, and more particularly to incandescent lamps of the halogen regenerative cycle type which comprise a compact sealed envelope containing a tungsten filament, a filling of inert gas and a halogen which reacts with tungsten vaporized from the filament to form a compound which breaks down in the vicinity of the hot filament to redeposit tungsten on the filament.

It is well known that lamps containing iodine as the halogen can be made to operate for a long, useful life with virtual freedom from blackening, as described and claimed in U.S. Pat. 2,883,571 to E. G. Fridrich et al. However, the iodine is usually introduced in elemental form by distillation from solid iodine crystals. While the lamps are entirely satisfactory, the iodine vapor is highly corrosive and attacks lamp making machinery.

It is therefore an object of the invention to provide a source of iodine which is relatively noncorrosive and which will make good lamps, i.e., will not introduce impurities or materials which might adversely affect the operation of the regenerative iodine cycle.

In accordance with the invention, we have found that good lamps can be made by using a hydrocarbon compound of iodine, for example methyl iodide (CH_3I), as the source of iodine.

Further features and advantages of the invention will appear from the following detailed description and from the drawing which is a side view of one form of lamp in which the invention may be incorporated.

Referring to the drawing, the lamp shown therein by way of example only, is shown the tubular double ended type comprising a tubular envelope **1** which is preferably made of fused silica or a glass of high softening point. The envelope contains a tungsten filament **2** which may be a helical coiled coil extending axially of the envelope and having its ends or legs **3** connected to and firmly enclosing inner lead wires or spuds **4**, preferably of tungsten. The said inner lead wires are connected to the ends of respective thin foils **5** of molybdenum to which are also connected outer lead wires **6** which may also be of molybdenum. The foils **5** are hermetically sealed and embedded in respective flattened pinch seals **7** at the ends of the envelope **1**.

By way of an exhaust tube, the sealed off residue of which appears at **8**, the envelope **1** may be evacuated and filled with an inert fill gas such as nitrogen, argon, krypton, or xenon or mixtures thereof at pressures of from several hundred to several thousand torr, and small quantities of oxygen and of a hydrocarbon compound of iodine. Methyl iodide, for example, is a liquid having a vapor pressure of 400 torr at about 25° C. Since it is relatively noncorrosive, the methyl iodide can be stored in tanks along with the lamp filling gas and thus introduced into the lamp with the fill gas which preferably also contains the oxygen.

The hydrocarbon compounds of iodine, such as methyl iodide (CH_3I), methylene iodide (CH_2I_2) and iodoform (CHI_3), are to be distinguished from the corresponding compounds of bromine, for example. It is believed that the transport agent in the regenerative iodine cycle is WO_2I_2. On the other hand, tungsten-bromine compounds are well known as are tungsten-bromine-oxygen compounds. Therefore the transport agent in bromine-containing lamps may compound not containing oxygen. This may be a fundamental difference between the bromine cycle and the iodine cycle.

It therefore appears that a small amount of oxygen is necessary for the successful operation of the iodine cycle, whether

the oxygen is deliberately added as such as in U.S. Pat. 3,160,454 to E. G. Zubler et al., or is present in or on an internal component of the lamp such as the tungsten filament.

It has also been shown that the hydrocarbon compounds of iodine are to be distinguished from simple hydrogen iodide, for example. Thus, if hydrogen, oxygen and iodine are added to the lamps in the same amounts present when CH_3I is used, but without carbon, the cycle is too active for long life lamps. This has been demonstrated by introducing into 500 watt tubular iodine lamps, amounts of 1.4 torr oxygen and 2.8 torr hydrogen, 2.8 torr oxygen and 2.8 torr hydrogen, 1.4 torr oxygen and 5.6 torr hydrogen. None of those lamps contained carbon. In **28** hours all of the lamps showed a characteristic destructive cycling effect involving the transfer of tungsten from a hotter filament coil turn to an adjacent cooler turn whereby the hotter turn is eroded and burns through prematurely. Examination of the coils showed the cycling to be severe at 150 hours. On the other hand, several lamps of the same type containing 6 torr CH_3I and 1 torr oxygen burned 1,831 hours without cycling. Several 100 watt lamps were made with 6 torr CH_3I and 2 torr oxygen and burned an average of 1,585 hours with no destructive cycling.

It also appears, particularly in lamps of relatively low wattage and high voltage, for example 200 watts or less and 120 volts or more, that the quality of the lamps made with methyl bromide is a critical function of the oxygen present, and this is apt to be too critical to use the bromine compound in long life lamps made in large quantities under ordinary factory production conditions. On the other hand, lamps containing methyl iodide can tolerate rather wide variations in oxygen.

By way of example, tests indicate that the CH_3I can vary at least from about 2 torr to 6 torr, and oxygen from about 0.1 torr to 1 torr. This is particularly so in lamps of 100 watt, 120 volt rating which may have an envelope 1 of about one-fourth inch outside diameter and an internal length, between pinch seals **7** of about five-eighth inch or 1 inch, depending upon the physical parameters of the filament **2**, such as coil diameter and pitch. By way of example only, the lamps may contain a filling of about 5 torr CH_3I, 0.2 torr oxygen, 300 torr nitrogen and 2,000 torr krypton. The desirable or optimum amounts of methyl iodide and oxygen may vary with lamp wattage, design efficiency, envelope volume, etc.

Lamps made with methyl bromide are also more sensitive to the impurity level of the tungsten filament wire. If the impurities are present in too high a concentration then they react with and tie up at least some of the highly reactive bromine, and the lamp blackens due to a deficiency of bromine. If enough methyl bromide is added to the lamp to override such impurity gettering action, then lamps with a low impurity level will fail from too active a cycle. Since iodine is much less reactive than bromine, more of it can be used, and enough methyl iodide can be added to override any impurity gettering action, if indeed iodine is gettered at all.

We claim:

1. A halogen regenerative cycle incandescent lamp comprising a compact sealed envelope of light-pervious material of high softening point and containing a tungsten filament and a gas filling including an inert gas, a small quantity of oxygen and a source of halogen which reacts with tungsten vaporized from said filament to form a compound which breaks down in the vicinity of the hot filament to redeposit tungsten on the filament, and wherein said source of halogen is a hydrocarbon compound of iodine.

2. A lamp as specified in claim **1** wherein the hydrocarbon compound of iodine is methyl iodide.