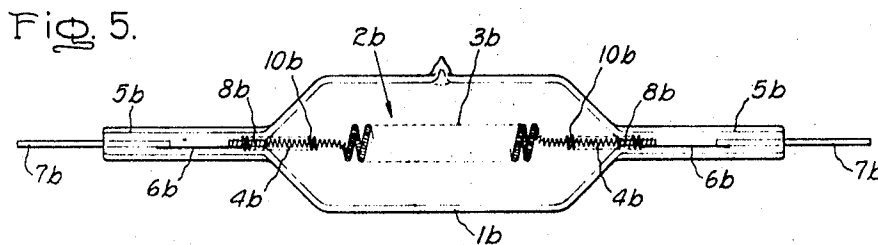
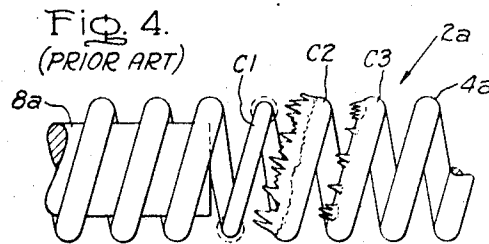
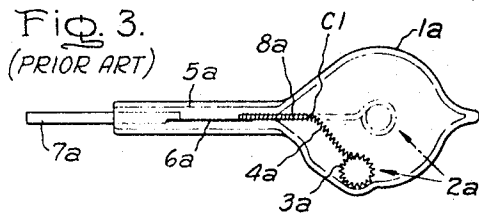
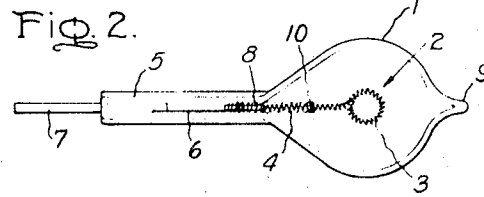
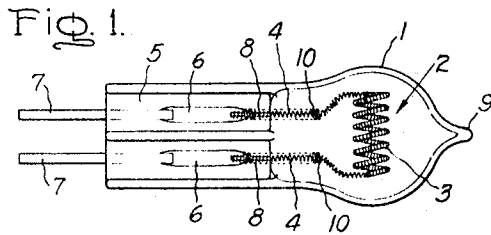


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BROMINE REGENERATIVE CYCLE INCANDESCENT LAMPS WITH PROTECTIVE
OVERWIND COILS ON COILED FILAMENT LEGS
Filed Jan. 16, 1967



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BROMINE REGENERATIVE CYCLE INCANDESCENT LAMPS WITH PROTECTIVE OVERWIND COILS ON COILED FILAMENT LEGS

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8 Claims

ABSTRACT OF THE DISCLOSURE

In a regenerative cycle tungsten filament lamp containing bromine, preferably as hydrogen bromide, coiled wire filament legs emerging from a pinch seal and supporting the body portion of the filament are enclosed in a close fitting wire coil overwind to provide flexible support and to effect a gradual temperature gradient downward from the filament coil turns immediately adjacent the coil overwind to thereby minimize destructive attack of the filament coil turns by the bromine. This also permits an increase in hydrogen bromide concentration which, in turn, minimizes destructive arcing across the filament legs.

BACKGROUND OF THE INVENTION**Field of the invention**

The present invention relates generally to electric incandescent lamps, and more particularly to tungsten filament incandescent lamps of the regenerative cycle type which comprise a compact sealed envelope of high melting point vitreous material containing a halogen as a regenerative getter which returns, to the filament, tungsten vaporized therefrom during operation. More particularly, the invention relates to such lamps employing bromine as the regenerative getter.

Description of the prior art

In the past, iodine had been used exclusively as the halogen regenerative getter in commercial lamps. For certain applications, bromine, especially in the form of compounds such as hydrogen bromide and hydrocarbons of bromine, has been more recently coming into use. However, bromine is much more reactive than iodine, so much so that it has led to a problem referred to as "end attack" wherein one or more coil turns adjacent the ends of the filament is eroded or etched sufficiently to lead to premature failure of the filament.

In a conventional form of lamp design, the filament comprises a helically coiled leg portion extending from a pinch seal into the interior of the lamp envelope, and support is provided in the form of a wire spud or mandrel which is fitted snugly within the coiled leg portion and extends from the pinch seal to a predetermined point along the filament leg. In single-ended lamps, two such filament leg portions extend from the same pinch seal longitudinally into the lamp envelope and support a helically coiled-body portion of the filament which may extend transversely of the envelope. Such a single-ended design has presented certain problems, especially in lamps designated for operation at relatively high voltage (say 120 volts) and at high intensities. Such problems include broken filament coils during shipment, arcing across the filament legs with consequent failure by burn-out, excessive end attack resulting in sagging filament coils and short life, and prolonged over-voltage seasoning to cut out bad lamps.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a lamp structure which will obviate the above-stated problems and disadvantages.

In accordance with the present invention, there is provided a support for the filament coiled leg portions which affords flexibility and greater strength and which also effects a gradual temperature gradient downward between the filament coil turns adjacent said support and those turns associated with the support, thereby greatly minimizing the end attack effect of the bromine. In further accord with the invention, the concentration of hydrogen bromide can be increased to minimize or eliminate arcing, by virtue of the arc-suppressing tendency of hydrogen, without incurring destructive end attack of the filament due to the increased bromine concentration.

In further accord with the invention, the support and temperature modifier is preferably in the form of a coiled wire overwind or slip-on coil fitted closely over each coiled filament leg in lieu of the solid internal spud which ends abruptly within the filament leg and produces an extreme temperature gradient which causes the aforesaid destructive end attack.

BRIEF DESCRIPTION OF THE DRAWING

Further features and advantages of the invention will appear from the following detailed description of species thereof and from the drawing wherein:

FIG. 1 is a front view of a single-ended lamp comprising the invention;

FIG. 2 is an end side view of the lamp of FIG. 1;

FIG. 3 is an end side view of a prior art lamp;

FIG. 4 is a fragmentary detail of the filament leg and support of the FIG. 3 lamp illustrating the effect of the bromine end attack; and

FIG. 5 is a side view of a double-ended lamp embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, the lamp illustrated therein comprises an envelope or bulb 1 of high melting point vitreous material, preferably quartz or fused silica or the material known as 96% silica glass and sold under the name Vycor. The envelope 1 contains a tungsten wire filament 2 which comprises a helically coiled-body portion 3 extending transversely of the envelope, and helically single-coiled end leg portions 4 which extend longitudinally of the envelope into a flattened pinch seal 5 at the end of the envelope. The outer ends of the filament leg portions 4, within the pinch seal 5, are connected to respective lead-in conductors, preferably comprising a molybdenum foil portion 6 which is hermetically sealed in the pinch 5 and an outer lead wire 7 preferably of molybdenum and extending exteriorly of the pinch seal. The filament leg 4 is preferably welded to the foil 6, and for ease of welding a short length of tungsten spud wire 8 is preferably provided in the interior of a portion of the leg 4 within the pinch seal.

The envelope 1 is filled with an inert gas and a source of bromine which might be elemental bromine in small amounts, or compounds of bromine such as hydrogen bromide or hydrocarbons of bromine. The fill gas and bromine may be introduced into the envelope through an exhaust tube, the tipped off residue of which is shown at 9.

Referring now to the prior art lamp of FIG. 3 (wherein corresponding parts are marked with the same reference numerals as in FIGS. 1 and 2 with the addition of the letter "a"), it will be noted that the spud 8a extends well into the filament leg 4a in the interior of the envelope 1a as a support for said leg. This construction resulted in many instances of short life and sagging of the filament coil due to end attack by the bromine. The solid spud 8a resulted in an extreme temperature gradient between the coil turns of leg 4a adjacent to and on the end of the spud.

The extreme temperature gradient caused a leg attack whereby tungsten was transferred between filament coil turns. As illustrated in FIG. 4, in a typical case there was a reduction or etching of a coil turn C1 and a growth of tungsten crystals on the side of the adjacent turn C2, as well as on turn C3, pointing generally in the direction from whence they came. The reduction in diameter of the coil turn C1 so weakened the structure in many cases that it caused the main body portion 3a of the filament to sag downward against the wall of the bulb 1a (FIG. 3) where it melted the bulb wall. A typical lamp in which this sort of action was likely to occur was one having an envelope 1a with a generally spherical bulbous portion of about 7/8 inch diameter, and designed for operation at 120 volts, 650 watts with a filament temperature of 3,400° K. The envelope contained nitrogen and about 2% HBr at a total pressure of 800 torr, that is, about 685 or 686 torr nitrogen and about 15 or 16 torr hydrogen bromide. In addition to the end attack problem, many such lamps failed due to arcing at seasoning, and others incurred broken filament coils during shipment.

Returning to FIGS. 1 and 2, the problems were solved by slipping a coil overwind 10 over each of the filament coil legs 4 and in short-circuiting engagement with the turns thereof. The slip-on or overwind coil 10 has an inside diameter the same as or only very slightly larger than the diameter of the filament coil legs 4, and it is preferably made of tungsten wire somewhat heavier than that of the filament. For example, in the particular 650 watt lamp described herein, the overwind 10 may be made of wire of 10.3 mil diameter as compared to a filament wire diameter of 7.85 mil.

Not only does this construction provide a flexible support which has been shown by tests to be far superior in resistance to shock and vibration, but it serves as a heat sink to effect a more gradual temperature gradient such that if any end or leg attack occurs, it is on the overwind or well within the overwind area. The reduced end attack, in turn, permits an increased hydrogen bromide concentration which greatly minimizes arcing by virtue of the increased hydrogen concentration. Thus, the lamp filling may consist of 800 torr nitrogen with 10% hydrogen bromide, that is, about 720 torr nitrogen and 80 torr HBr. Tests showed an immediate reduction in early failure by arc-outs from 15 to 30% with the prior art FIG. 3 construction, to less than 3% with the FIG. 1 construction containing the 10% (80 torr) HBr concentration.

In FIG. 5 there is shown a double-ended type lamp comprising the invention, parts corresponding to those in FIGS. 1 and 2 being numbered the same with the addition of the letter "b." In this case, a tubular envelope 1b is provided with a pinch seal 5b at each end in which is hermetically sealed the foil portion 6b of a lead-in conductor which also includes the outer lead portion 7b. As in FIGS. 1 and 2, a helically single-coiled end leg portion 4b of the filament 2b extends from each seal 5b into the interior of the envelope to a helically coiled-coil body portion 3b of the filament. The outer end of each filament leg 4b may, as in FIGS. 1 and 2, be welded to a respective foil 6b with the interpositioning of a short spud 8b. Each said filament leg 4b is also provided with the supporting and temperature modifying coil overwind 10b for strengthening the filament leg and for effecting a gradual temperature gradient to minimize end attack or etching of the coil turns of the filament leg. The envelope is also filled with inert gas plus a source of bromine, preferably hydrogen bromide which may in some cases be at fairly low concentrations, say 8 to 15 torr, but which is preferably increased to above about 30 torr, for example, 80 torr or more, when needed to suppress arcing in high voltage, high intensity lamps, especially those having a relatively short overall filament length.

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

1. An electric incandescent lamp of the halogen regenerative cycle type comprising a compact sealed envelope having a seal portion at least at one end thereof with a lead-in conductor sealed therein, a coiled tungsten filament in said envelope having a helically coiled end leg portion electrically connected to said lead-in conductor and extending from within said seal portion into the envelope interior, said envelope containing a filling of inert gas and a source of bromine gas as the halogen, and a helical tungsten wire coil overwind extending from within said seal portion and closely fitted over said leg portion and functioning as a flexible support for said leg and as a heat sink which effects a gradual temperature gradient between the filament coil turns adjacent the inner end of said coil overwind and those within the coil overwind which minimizes destructive attack by bromine of the said filament coil turns adjacent the end of said coil overwind.

2. A lamp as set forth in claim 1 wherein the source of bromine gas is hydrogen bromide.

3. A lamp as set forth in claim 1 wherein the source of bromine gas is hydrogen bromide at a pressure in excess of 15 torr and sufficient to prevent destructive arcing across the ends of the filament.

4. A lamp as set forth in claim 1 wherein the source of bromine gas is hydrogen bromide at a pressure of the order of 80 torr.

5. An electric incandescent lamp of the halogen regenerative cycle type comprising a compact sealed envelope having a pinch seal at an end thereof with a pair of lead-in conductors sealed therein, a coiled tungsten filament in said envelope having helically coiled end leg portions electrically connected to respective lead-in conductors and extending from within said seal longitudinally into the envelope and supporting a helically coiled-coil body portion extending transversely of the envelope, said envelope containing a filling of inert gas and a source of bromine gas as the halogen, and a helical tungsten wire coil overwind extending from within said seal portion and closely fitted over each said leg portion and functioning as a flexible support for said leg and as a heat sink which effects a gradual temperature gradient between the filament coil turns adjacent the inner end of said coil overwind and those within the coil overwind which minimizes destructive attack by bromine of the said filament coil turns adjacent the end of said coil overwind.

6. A lamp as set forth in claim 5 wherein the source of bromine gas is hydrogen bromide.

7. A lamp as set forth in claim 5 wherein the source of bromine gas is hydrogen bromide at a pressure in excess of 15 torr and sufficient to prevent destructive arcing across the ends of the filament.

8. A lamp as set forth in claim 5 wherein the source of bromine gas is hydrogen bromide at a pressure of the order of 80 torr.

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