

[54] **HALOGEN LAMP WITH INTERNAL MOLYBDENUM PARTS**

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[52] **U.S. Cl.** 313/222; 313/271; 313/318

[51] **Int. Cl.²** H01K 1/20; H01K 1/50

[58] **Field of Search** 313/222, 178, 271, 318, 313/331

[57]

ABSTRACT

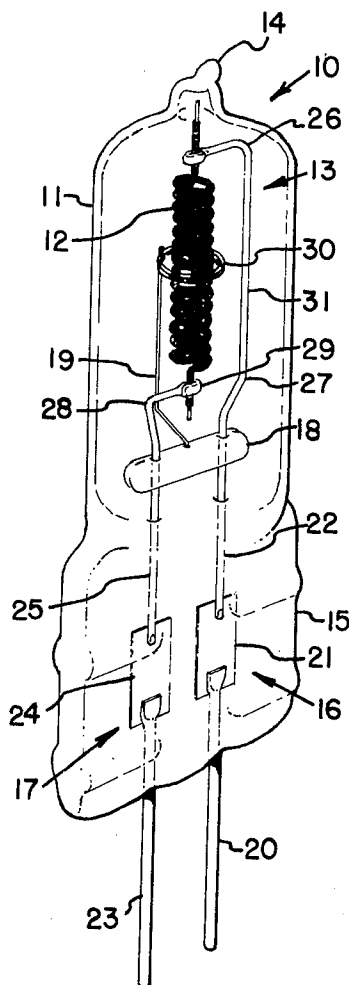
A regenerative cycle incandescent lamp containing bromine or iodine as a halogen has a mount structure all of which is made of a highly ductile molybdenum. The particular molybdenum has a percentage of elongation which is greater than 20%.

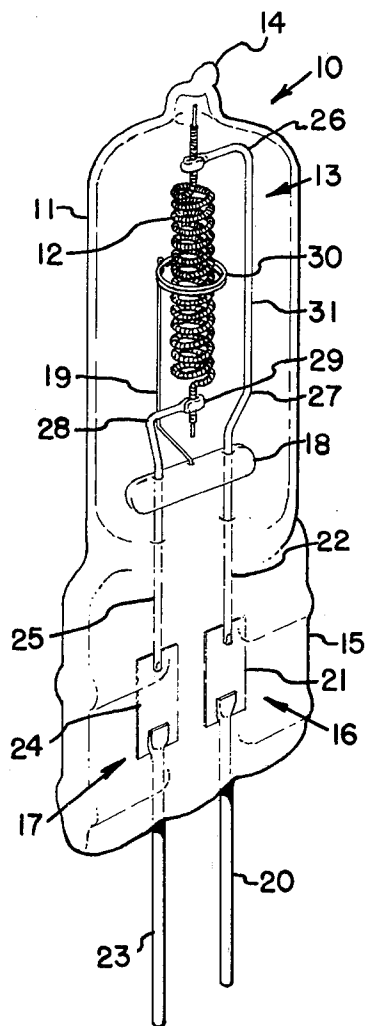
[56] **References Cited**

UNITED STATES PATENTS

3,418,512 12/1968 T'Jampens et al. 313/222 X

6 Claims, 1 Drawing Figure





HALOGEN LAMP WITH INTERNAL MOLYBDENUM PARTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to regenerative cycle incandescent lamps. More particularly, the invention relates to the use of highly ductile molybdenum internal lamp parts which are used in a lamp containing a halogen gas such as iodine or bromine.

2. Description of the Prior Art

Incandescent tungsten-halogen lamps were first disclosed in Fridrich et al U.S. Pat. No. 2,883,571. These lamps employed iodine as a regenerative cycle agent to remove evaporated tungsten from the bulb wall and re-deposit it on the tungsten filament. Other internal lamp parts such as filament supports and inner lead-in conductors were also made of tungsten.

Because tungsten is brittle and slightly more expensive than other refractory metals, efforts have been made to replace tungsten inner leads and filament supports. One of the replacement metals which has been tried is molybdenum.

The types of molybdenum tried as substitutes are commercially known as Type R molybdenum, 99.95% molybdenum, and Type KW molybdenum, 99.90% molybdenum. Although these molybdenum substitutes were less expensive than tungsten, they were comparatively brittle having a percentage elongation which varied between 6 and 10%. With this degree of brittleness, or lack of ductility, it was difficult to manufacture lamps using this type of molybdenum on high-speed equipment. It was found that a high percentage of the molybdenum parts used on the high-speed equipment would fracture from the cold-working processes associated with automated manufacturing techniques.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to manufacture a halogen lamp which uses a highly ductile refractory metal for internal lamp parts. A further object of the invention is to use a refractory metal which costs less than tungsten. Still another object of the invention is to use a ductile refractory metal which can be cold-worked on high-speed production equipment, thereby decreasing the cost of the lamp. Yet another object of the invention is to make a halogen lamp without tungsten inner parts and still maintain the envelope wall free of discoloration.

Briefly stated, the objects of the invention are accomplished by making internal lamp parts of a highly ductile molybdenum, with a minimum percent elongation of approximately 20%, for use in a bromine or iodine regenerative cycle lamp. In one embodiment utilizing the particular wire, the level of bromine is controlled within certain limits to make a lamp. The observed range of bromine is from 0.025 to 0.075% of the envelope volume. A lamp having a concentration of bromine above 0.075 shows attack of the molybdenum lamp parts which can cause premature failure; whereas, the use of less than 0.025% of bromine causes wall blackening after several hours of operation presumably because there is an insufficient amount of halogen present to carry the tungsten from the bulb wall back to the filament.

The molybdenum wire used in the invention is sufficiently ductile and can be cold-worked without fractur-

ing or embrittlement. This property makes it possible to manufacture the lamp mount and the lamp itself on high-speed automatic equipment. Previously, tungsten and KW molybdenum and R molybdenum parts required heating before they could be formed to avoid fracture problems. Heating necessarily slowed down the manufacturing process and made lamps of this type less adaptable to high-speed equipment.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE of the drawing is a perspective view of the lamp of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, lamp 10 therein illustrated is a form of a tungsten-halogen lamp of the invention. The lamp is comprised of an envelope 11 which is made of a vitreous material, such as quartz or 96% silica known as Vycor, a tungsten filament 12 which is part of mount 13, tipped-off residue 14, and pinch seal 15. Mount 13 is further comprised of filament 12, lead-in conductors 16 and 17, bridge 18, and support 19. Lead-in conductor 16 has an outer lead wire 20, thin molybdenum foil portion 21, and long inner lead wire 22. All of the internal metal parts, other than the tungsten filament, are made of highly ductile molybdenum.

Lead-in conductor 17 also has an outer lead wire 23, thin molybdenum portion 24, and a short inner lead 25. Both lead-in conductors are held in fixed relation to each other by bridge 18 which also holds filament support 19.

A commercial embodiment using the lamp illustrated in the drawing is a PAR 38 reflector lamp which uses the halogen lamp inside a reflector and cover. This lamp operates at 250 watts, 120 volts for approximately 4000 hours and has an initial lumens-per-watt rating of 17.0. In the manufacture of the lamp illustrated in the drawing, the mount 13 is held in fixed relationship to the envelope 11, and fires (not shown) are applied to the envelope in the area of pinch seal 15. Pinch jaws, also not shown, then squeeze the molten glass together to form a hermetic seal with molybdenum foils 21 and 24. After the envelope is pinch sealed, the lamp is flushed and filled with a gas mixture through an exhaust tube, the tipped-off residue of which is shown at 14. The fill gas used to make this particular lamp is one which contains 12% nitrogen, 87.950% argon, and 0.050% CH_3Br , at a pressure of 3000 ± 300 torr.

An automated process for making mount 13 is more fully described in patent application Ser. No. 424,875 assigned to the assignee of the present invention. Briefly stated, the inner leads 22 and 25 are preformed by cold-working molybdenum wire to give the desired length and other geometry. These leads are then secured to bridge 18 along with support 19. Spiral 30 of support 19 is open at this point in the processing. Coil 12 is then clamped to the respective inner leads and is tensioned by elongating inner lead 22 which has a bend, not shown, at location 31. Following this, the spiral is closed around the filament, and the inner leads are connected to molybdenum foils 21 and 24 and outer leads 20 and 23.

As shown at locations 26 and 27, the molybdenum is bent by cold-working to make the proper configuration for inner lead 22. Inner lead 22 also contains a tensioning bend, not shown, at what is designated as location

31. Inner lead 25 also requires several bends as illustrated at locations 28 and 29. Ordinarily, if tungsten parts were used, such bends would require heat treatment, or if done in a cold state, the parts would most likely fracture. This is also true of the standard grades of molybdenum wire which have a percentage elongation between 6 and 10%.

Using the molybdenum wire of the invention which has a minimum of 20% elongation, it becomes relatively easy to make the bends and do various flattening and tensioning operations on the molybdenum wire on high-speed automatic equipment. This is so because the molybdenum of the invention has a greater degree of ductility and therefore can be cold-worked without inducing stresses and strains which will cause cracking and fracture.

The percentage of elongation was obtained by placing a sample wire on a standard tensile tester. The gauge length, length of wire between the tester jaws, was 10 inches and the cross head speed was 2 inches per minute.

As indicated earlier, the fill gas mixture is controlled within a certain range. It has been found, after testing the lamp shown in the drawing inside a PAR 38 jacket, that the range of bromine can vary from as low as 0.025% to as high as 0.075%. In the event the percentage of bromine exceeds the upper limit, a corrosive action of the bromine on the molybdenum parts has been observed, and if the concentration goes below 0.025%, the bulb wall blackens presumably because there is an insufficient amount of halogen to combine with the evaporated tungsten. Bromine is added to the lamp of

the example discussed in the form of CH_3Br , methyl bromide. Iodine has also been successfully used in the form of methyl iodide.

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

1. A regenerative cycle incandescent halogen lamp comprising an envelope of vitreous material with at least one pinch seal, and a mount structure, said mount structure having outer lead-in wires connected to foils which are hermetically sealed in said pinch seal, inner lead wires connected to an incandescible tungsten filament at one end and to the molybdenum foils at the other end, said envelope being filled with an inert gas and a halogen gas selected from the group comprising iodine and bromine wherein the improvement comprises that the inner leads of the mount structure are made of a highly ductile molybdenum better than 99.95% molybdenum and having a minimum of 20% elongation.

2. The lamp claimed in claim 1 wherein said mount structure contains a filament support made of highly ductile molybdenum having a percentage of elongation which is equal to 20.

3. A lamp as claimed in claim 1 wherein said halogen gas is iodine.

4. The lamp claimed in claim 3 wherein said iodine is added to said lamp as methyl iodide.

5. The lamp claimed in claim 1 wherein said halogen is bromine.

6. The lamp claimed in claim 5 wherein said bromine is added to said lamp as methyl bromide.

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