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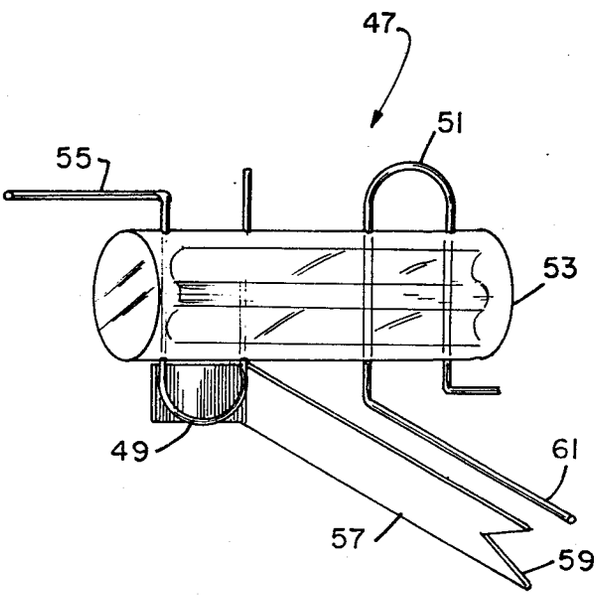
(54) Electric discharge lamp with thermal switch.

(57) An electric discharge lamp has an arc tube within an outer gas filled glass envelope and a thermal switching means (47) is located within the outer envelope. The thermal switching means has a silica support (53) with a pair of electrical conductors affixed (51, 55) thereto and a bimetal strip (57) and a spring-like member (61) are affixed to at least one of the electrical conductors, whereby upon application of heat the bimetal strip (57) and spring-like member (61) are flexed to short-circuit the electrical conductors and remove any D.C. potential between the main electrode and the starting electrode minimizing electrolysis.



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ELECTRIC DISCHARGE LAMP WITH THERMAL SWITCH

This invention relates to electric discharge lamps and more particularly to electric discharge lamps having a normally open thermal switch therein and to normally open thermal switches having switch distortion inhibiting capabilities.

Electric discharge lamps such as metal halide lamps which include mercury, the metals of various halides and particularly sodium iodide undesirably are subject to electrolysis between the usual starter electrodes and the electrode immediately adjacent thereto. Moreover, any DC potential existing between the above-mentioned electrodes undesirably increases electrolytic activity and especially so as operational temperatures increase.

Generally, the metal halide lamps include a sealed glass envelope with a fused silica arc tube disposed within the sealed glass envelope. For some time, the outer glass envelope was evacuated whereupon a thermal switch was subjected to a temperature which was determined by lamp wattage and substantially independent of lamp orientation or position of operation. Thus, a simple thermal switch could be incorporated into the outer glass envelope and accommodate temperature variations encountered while employing commercially available bimetal materials.

However, better performance and other desirable features and considerations led to the use of a gas fill within the outer glass envelope. Accordingly, the variable of convective heating was added to lamp wattage in determining the operating temperatures of a thermal or bimetal type switch. Moreover, lighting fixture manufacturers, in recent years, are designing systems to widen the beam spread of available lamps and have utilized the concept of

moving the lamp further into the reflector cavity of the fixture. As a result, the temperature of the lamp components and of the thermal switch associated with the lamp has been increased. Unfortunately, such increased temperatures tend to stress the bimetallic material of available thermal switches beyond the elastic limit whereupon permanent deformation of the thermal switch undesirably results. Thus, thermal switch failure permits the previously-mentioned electrolysis to take place and results in failure of the discharge lamp.

Additionally, the above-mentioned overheating of the thermal switch presents no problem with regard to deformation when a switch is used which is normally closed and opens as the temperature is increased. However, for normally open switches which close as the temperature increases such permanent deformation of the switch is a problem. Therein, contact closure imposes a restraint in movement of the bimetal material, and this restraint may cause a permanent deformation which prevents return of the switch to a normally open condition and eventually results in lamp failure.

An object of the present invention is to provide an improved electric discharge lamp. Another object of the invention is to enhance the response capability to increased temperature variations in an electric discharge lamp. Still another object of the invention is to provide an improved thermal switch applicable for use in an electric discharge lamp. A further object of the invention is to provide a thermal switch of enhanced capability to respond to variations in operational temperatures.

These and other objects, advantages and capabilities are achieved in one aspect of the invention by an electric discharge lamp having an arc tube with an electrode and an adjacent starting electrode sealed therein with the arc tube disposed within a gas filled envelope and a thermal switch external to the arc tube and internal to the envelope. The switch has a pair of electrical

conductive members affixed to a silica support member and a bimetal strip and a spring-like member are affixed to one of said pair of conductive members and operative to short-circuit the pair of conductive members.

In another aspect of the invention a thermal switch has a pair of electrical conductors attached to a silica support member and a bimetal strip and spring-like member are affixed to at least one of the electrical conductors in a manner to short-circuit the pair of electrical conductors upon application of heat thereto in an amount sufficient to reach the closure temperature of the switch. The spring-like member flexes to prevent permanent deformation of the bimetal upon application of an increased temperature.

The invention is illustrated by way of example in the accompanying drawings, in which:

FIG. 1 is an elevation of a metal halide lamp having one embodiment of a thermal switch of the invention therein;

FIG. 2 is an enlarged perspective view of a thermal switch of the invention; and

FIG. 3 is an enlarged perspective view of an alternative embodiment of a thermal switch of the invention.

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following disclosure and appended claims in conjunction with the accompanying drawings.

Referring to FIG. 1 of the drawings, a metal halide lamp 5 includes an outer glass envelope 7 having a bulged substantially tubular configuration with a neck portion 9 closed by a stem member 11 hermetically sealed thereto. A pair of electrically conductive leads 13 and 15 are sealed into and pass through the stem member 11 and are electrically connected to the contacts of a screw-in base member 17.

Disposed within the outer glass envelope 7 is a fused silica arc tube 19. The arc tube 19 has electrodes 21 and 23 sealed into opposite ends thereof and a starting electrode 25 is sealed into one end of the arc tube 19 and positioned adjacent one of the electrodes 21. The electrodes 21 and 23 and the starting electrode 25 each have an electrical conductive member, 27, 29 and 31 respectively, electrically connected thereto and passing through the sealed arc tube 19.

A first cage-like mounting member 33 is affixed to one end of the arc tube 19 and includes a pair of spring-clips 35 and 37 thereon which contact the outer glass envelope 7 and serve to support the arc tube 19 therein. The electrical conductive member 29 connected to the electrode 23 is also connected by a curved wire 39 to one of the electrically conductive leads 13 sealed into the stem member 11 affixed to the outer glass envelope 7.

A second cage-like mounting member 40 is affixed to the opposite end of the arc tube 19 and also includes a pair of spring-clips 41 and 43 thereon which contact the outer glass envelope 7 and serve to more rigidly support the arc tube 19 therein. The second cage-like mounting member 40 is affixed to the other electrically conductive lead 15 sealed into and passing through the stem member 11 affixed to the outer glass envelope 7. The electrical conductive member 27 connected to the electrode 21 is also connected to the other electrically conductive lead 15 by way of the second cage-like mounting member 40. Also, the starting electrode 25 is connected by way of an electrical conductive member 31 to a resistor 45 which is, in turn, connected to the electrically conductive lead 13 sealed into the stem member 11.

Additionally and importantly, a thermal switching means 47 is spaced from the arc tube 19 and affixed to the second cage-like mounting member 40. The thermal switching means 47 is of a configuration such that location thereof at a relatively cool or lower temperature within the outer glass envelope 7 is attainable without other deleterious effect. In other words, increases in lamp temperature by as much as a hundred degrees due to the use of wide beam fixtures wherein the lamp is moved further into the fixture and

universal burning positions of the lamp have necessitated movement of the thermal switching means 47 from the usual location on the electrical conductive members 27 and 31 to a location more remote from the arc tube 19. Thus, remotely locating the thermal switching means 47 tends to reduce overstressing of the bimetallic material of the switching means 47 beyond the elastic limit thereof negating any permanent deformation of the switching means 47 or malfunctioning of the lamp 5 due to such deformation.

As to the thermal switching means 47, FIG. 2 illustrates a preferred embodiment thereof which includes a pair of electrical conductors 49 and 51 embedded in a silica support member 53. The one electrical conductor 49 includes an outwardly extending portion 55 which is formed to provide for attachment of the support member 53 to an adjacent structure at a desired location relatively remote from the arc tube, 19 of FIG. 1, such as the second cage-like mounting member, 40 of FIG. 1. Also affixed to one 49 of the pair of electrical conductors 49 and 51 is a bimetal strip 57 preferably extending in a direction normal to the plane of the support member 53. Moreover, the bimetal strip 47 preferably has a notched end portion 59 which will be explained hereinafter.

The second one 51 of the pair of electrical conductors 49 and 51 is preferably formed to provide a spring-like member 61 extending substantially parallel to and spaced from the bimetal strip 57. In this manner, the bimetal strip 57 as well as the spring-like member 61 are individually adjustable whereby compensation for variations in temperature due to differing locations of the thermal switching means 47 is readily effected.

As to operation, the arc tube 19 of a metal halide lamp for example normally has a fill which includes mercury and halides of various metals including sodium. Also, the outer glass envelope 7 includes a fill of an inactive gas, such as nitrogen for example. The thermal switching means 47 is in the form of a normally-open (N/O) switch at room temperature. Moreover, the closure temperature of the thermal switching means 47 is dependent upon numerous factors, such as the placement of the switching means 47 within the

envelope 7, the gas fill and the design of the switching means 47. Common thermostats practical for lamp use have been found to be satisfactory to the present application.

Initially current flow to the electrode 21 and starting electrode 25 is effected with the thermal switching means 47 at room temperature. As the temperature increases, the bimetal strip flexes causing the pair of electrical conductors 49 and 51 to short-circuit. Thereupon, any electrolysis inducing D.C. potential between electrode 21 and starting electrode 25 is eliminated. Also, it can be seen that the notched end portion 59 of the bimetal strip 57 is formed to accommodate the spring-like member 61 whereupon improved electrical connection therebetween is effected. Moreover, the flexible spring-like member 61 readily flexes whenever the bimetal strip 57 flexes. In this manner, distortion of the bimetal strip 57 due to an excessive increase in temperature is prohibited.

Alternatively, the thermal switching means 47 may be of a form, illustrated in FIG. 3, having a glass bridge member 63 with a pair of electrical conductors 65 and 67 affixed thereto. One electrical conductor 65 is formed with an outwardly extending portion 69 whereby attachment of the switching means 47 may be effected. Also, the one electrical conductor 65 has an upstanding portion 71 adjacent the other one 67 of the pair of electrical conductors 65 and 67. The other electrical conductor 67 has a bimetal strip 73 affixed thereto with a flexible spring-like member 75 attached to the bimetal stip 73 at the end thereof 77 most distant from the bridge member 63. Also, the other electrical conductor 67 is formed for connection to an electrode.

Again, a normally-open (N/O) switching condition is in effect at room temperature. However, an increase in temperature causes the bimetal strip 73 to flex in one direction whereupon the spring-like member 75 is flexed in the opposite direction. As result, the spring-like member 75 contacts the upstanding portion 71 of the one electrical conductor 65. Thus, the electrical conductors 65 and 67 are short-circuited, and any electrolysis inducing D.C. potential between the electrode and the starting electrode of an electric discharge lamp is eliminated.

Moreover, the spring-like member 75 permits flexing of the bimetal strip 73 without permanent deformation of the bimetal strip 73 even though subjected to excessive temperature excursions.

While there has been shown and described what is at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined by the appended claims.

CLAIMS

1. An electric discharge lamp comprising:

a gas filled outer glass envelope having a pair of electrically conductive leads sealed therein and passing therethrough;

an arc tube within said outer glass envelope having an electrode sealed into opposite ends thereof and a starting electrode adjacent one of said electrodes, said arc tube having an ionizable fill and subject to electrolysis under electrical stress at high temperatures; and

thermal switching means internal of said outer glass envelope and external of said arc tube and in the form of a pair of electrical conductive members embedded in a silica support member with one of said pair of electrical conductive members connected to an electrode and the other one to said starting electrode adjacent thereto and a parallel extending bimetal strip and spring-like member affixed to at least one of said pair of electrical conductive members and formed to short-circuit said pair of electrical conductive members and said electrode and adjacent starting electrode upon application of heat to said bimetal.

2. The electric discharge lamp of Claim 1 wherein said thermal switching means is affixed to one of said pair of electrically conductive leads and spaced from said arc tube.

3. The electric discharge lamp of Claim 1 wherein said bimetal strip and said spring-like members are each affixed to a separate one of said pair of electrical conductive members whereby precise adjustment of the gap therebetween is provided.

4. The electric discharge lamp of Claim 1 wherein said bimetal strip and said spring-like member are affixed to one of said pair of electrical conductive members and formed to electrically contact the other one of said pair of electrical conductive members upon application of heat thereto.

5. The electric discharge lamp of Claim 1 wherein said bimetal strip has a notch at one end thereof and said notched end of said bimetal contacts said spring-like member upon application of heat to said bimetal strip.

6. The electric discharge lamp of Claim 1 wherein one of said pair of electrical conductive members is formed to include said spring-like member.

7. A normally open thermal switch for use with temperature excursions beyond normal closure temperatures thereof comprising:

a silica support member;

a pair of electrically conductive members affixed to said silica support member; and

a bimetal strip and a spring-like member affixed to at least one of said pair of electrically conductive members affixed to said silica support member and formed to short-circuit said pair of electrically conductive members upon heating to a switch closure temperature and to distort said spring-like member upon heating to a temperature greater than said switch closure temperature.

8. The normally open thermal switch of Claim 7 wherein said bimetal strip and said spring-like member are each affixed to a separate one of said pair of electrically conductive members whereby precise adjustment of a gap therebetween is provided.

9. The normally open thermal switch of Claim 7 wherein said bimetal strip is affixed to one of said pair of electrically conductive members and the other one of said electrically conductive members is formed to provide said spring-like members extending substantially parallel to said bimetal strip.

10. The normally open thermal switch of Claim 7 wherein said bimetal switch has a notched end portion formed to contact said spring-like member upon heating to a switch closure temperature and to bend said spring-like member at temperatures greater than said switch closure temperature.

11. The normally open thermal switch of Claim 7 wherein at least one of said pair of electrically conductive members is formed for supporting and attaching said thermal switch.

12. The normally open thermal switch of Claim 7 wherein each of said pair of electrically conductive members includes a substantially U-shaped configuration embedded in said silica support member.

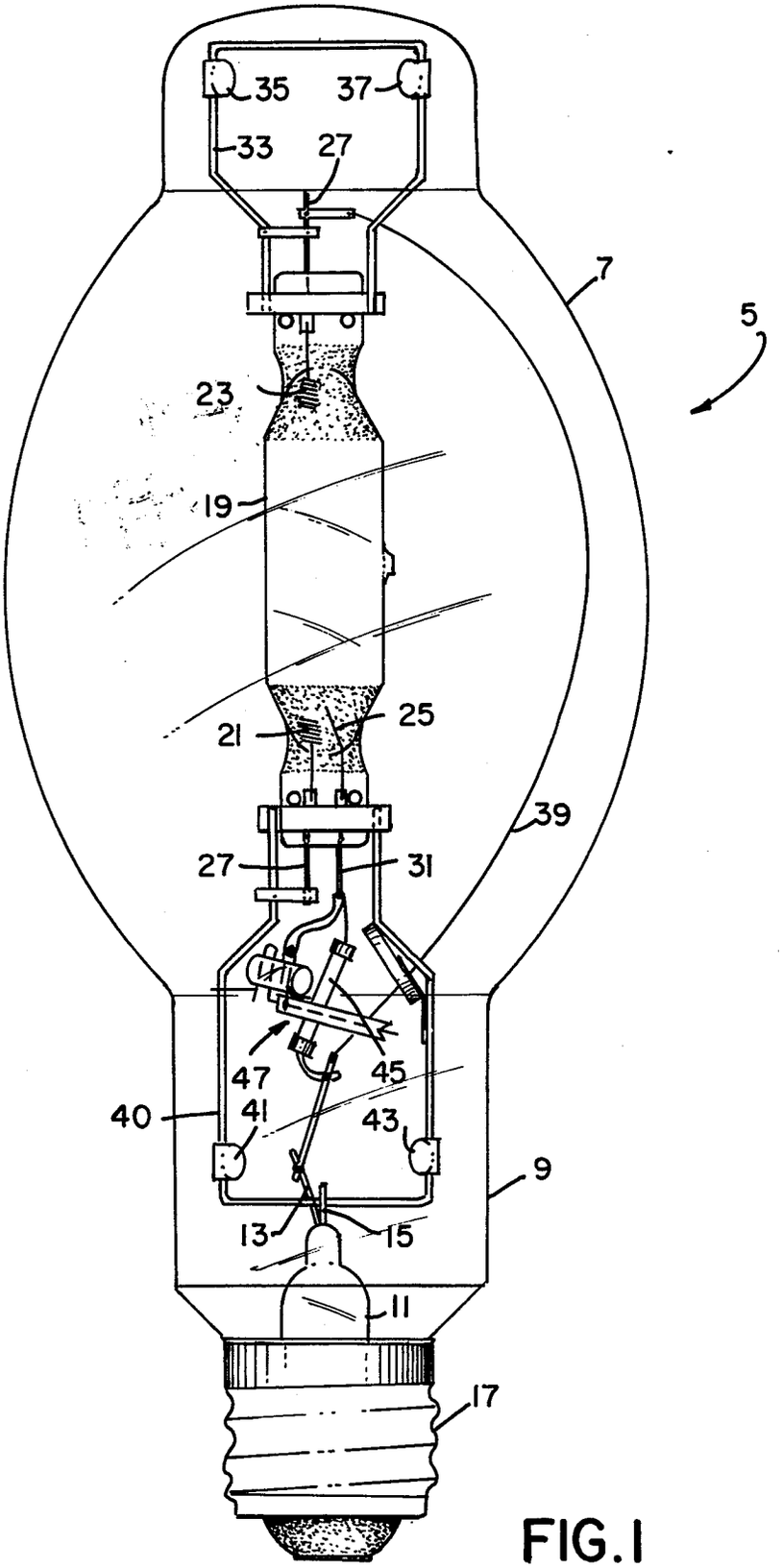

FIG.1

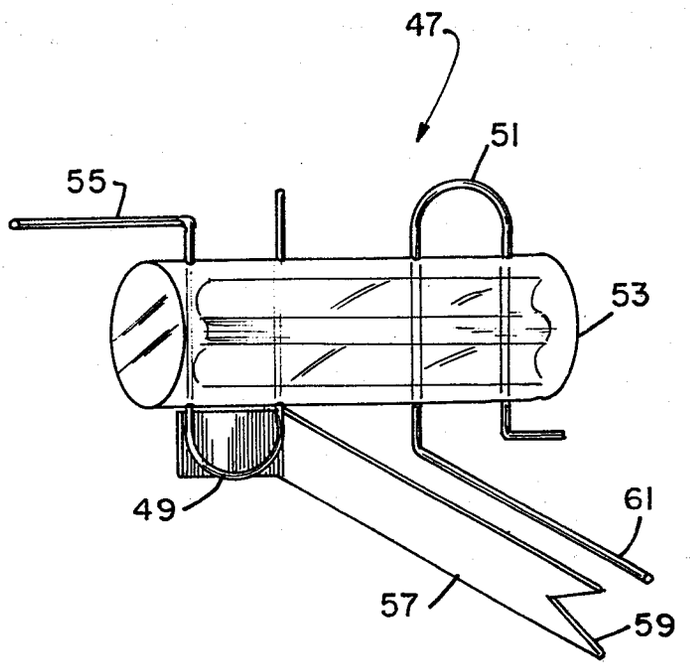

FIG. 2

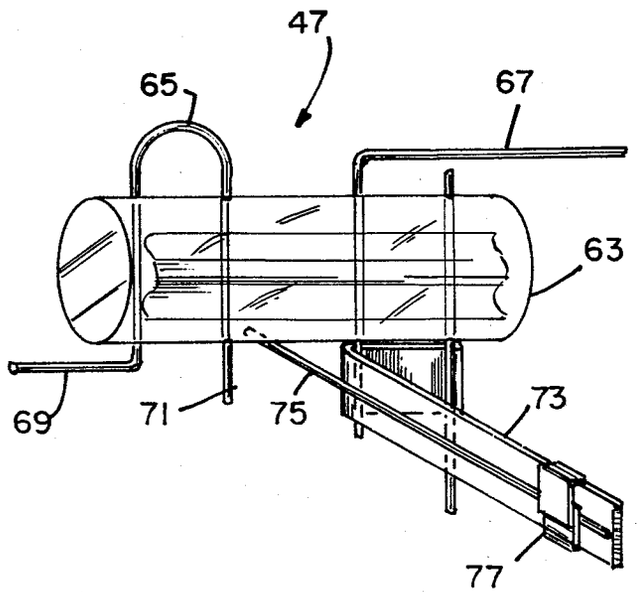

FIG. 3

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EUROPEAN SEARCH REPORT

Application number

EP 84302857.2

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	US - A - 3 965 387 (STUART) * Column 3, lines 28-62; fig. 2-5 *	1-6	H 05 B 41/06 H 01 J 7/44 H 01 J 17/34 H 01 J 61/56
X	US - A - 3 619 710 (WAYMOUTH) * Fig. 2-3; column 3, lines 11-28 *	1-6	
A	EP - A1 - 0 057 093 (WESTINGHOUSE) * Fig. 1; page 6, lines 33, 34 *	1	
A,P	EP - A2 - 0 089 582 (GTE) * Fig.; page 3, lines 16-21 *	1	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	EP - A2 - 0 054 272 (GTE) * Fig. 2; page 87, lines 22-24 *	1	H 05 B 41/00 H 01 J 7/00 H 01 J 17/00 H 01 J 61/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	31-07-1984	VAKIL

CATEGORY OF CITED DOCUMENTS

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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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