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(54) **Single-ended short arc lamp of low colour temperature with reduced sodium loss**

(57) The present disclosure provides a single ended short arc metal halide lamp without outer jacket comprising an arc tube (101) equipped with a pair of tungsten electrodes (102), wherein the arc tube is filled with sodium-bearing metal halide chemistry and an electrical re-

turn lead (108) is contiguously juxtaposed alongside the arc tube. The return lead (108) is completely or partially embedded in a fused glass sleeve (107), thereby interrupting the cycle of sodium loss and leading to low colour temperature of the lamp, which is stable during life.

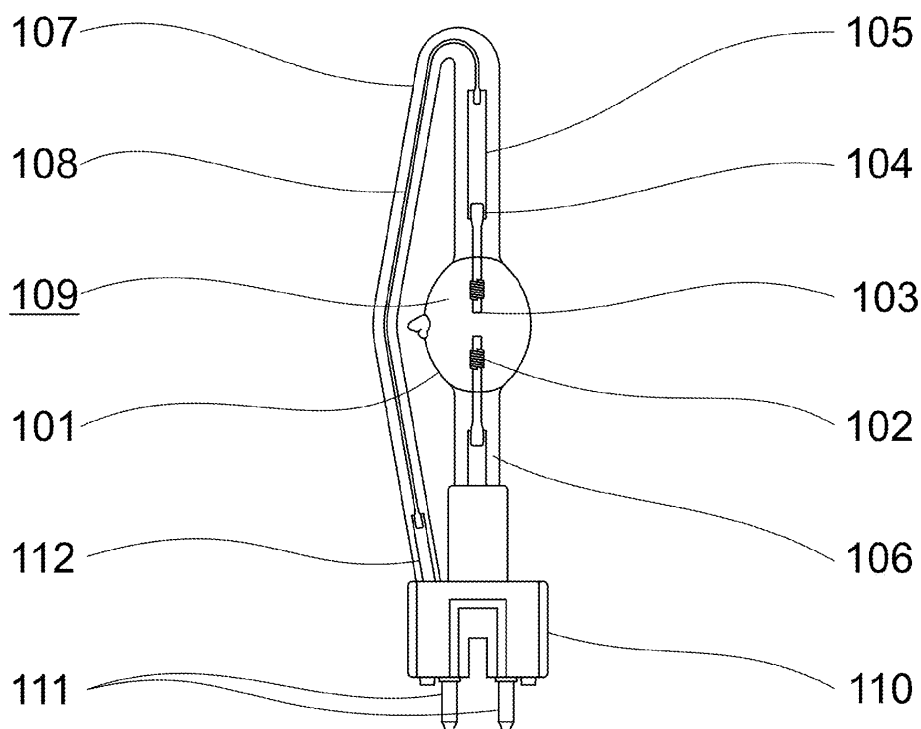


Figure 1a shows a discharge lamp provided in accordance with the present invention;

Description

TECHNICAL FIELD:

[0001] The present invention relates to a short arc HID (high intensity discharge) lamp, and particularly to single ended short arc HID lamp with low colour temperature and stable colour during life.

DESCRIPTION OF THE RELATED ART:

[0002] Light sources for photographic lighting are produced in two different color temperatures, 5600K to suit the daylight film stock used for outdoor shooting and 3200K to suit the Tungsten film stock used for indoor lighting. The 5600K light is produced by high intensity metal halide lamps of the quartz short arc variety. The 3200K light until now is produced almost exclusively by Tungsten halogen lamps since it has not been possible to fabricate a short arc quartz metal halide lamp of such low colour temperature in single ended version which also remains stable during life. This is unfortunate because the life of such halogen lamps is rather short, their luminous efficacy is very low and they produce tremendous amounts of unwanted infrared radiation. In order to realise a 3200K HID lamp, sodium is necessary in the chemical fill of the arc tube. While this is well known in general lighting lamps, it has not been possible to fabricate a lamp suitable for photo/projection services because of very high power loading, in which colour temperature and lamp voltage will increase rapidly due to sodium loss and lamp life would be extremely short

[0003] The problem has been partially solved in the prior art by the use of ceramic tube materials instead of quartz. However these have the major drawback of being translucent, but not optically transparent enough, and are therefore not suitable for short arc lamps of the type claimed here. The diffuse nature of the ceramic material scatters light excessively and makes them unsuitable for use in optical projection apparatus. Additionally, the power loading with ceramic arc tubes is limited and they exist only up to about 400W. Much higher wattages are required for optical projection applications.

[0004] A well known method to solve the problem of sodium loss in a single ended quartz lamp is to cover the return lead with a sleeve of opaque material, such as a ceramic, quartz or hardglass material, but for highly loaded lamps this is not enough to protect against sodium loss.

[0005] Another method to solve the problem of sodium loss in a quartz lamp is to make a double ended version, in which the adjacent return lead which drives the sodium loss phenomenon is of course eliminated. However the dimensions of a double ended lamp are too large for the intended photo-optic applications.

[0006] US Publication No. 2009/0256460 relates to high-temperature lamps characterised by having optical or photometric performance, or life, or reliability that is

limited by the high temperature of the light source, or the high temperature of the envelope that encloses the light source. The lamp is preferably received in an outer jacket, capsule, or shroud. The shroud is generally made from quartz and in selected embodiments the shroud is formed from a high-temperature glass shroud, for example aluminosilicate glass or other high-temperature glass having at least 5% molar fraction of alkali oxides and alkaline earth oxides in the glass. The burner is made of ceramic material and this cannot be used for photo-optical applications because the light source has to be as small as possible for a good performance in an optical system.

[0007] US Publication No. 2009/230864 relates to a compact high intensity discharge (HID) arc lamp having a shrouded arc tube and provides an improved arc tube mounting assembly for such a lamp. Surrounding the arc tube and shroud is an outer glass envelope, typically of fused quartz, having a base portion, a distal dome-shaped portion and a cylindrical body portion. The discharge-sustaining materials in the discharge space are typically mercury, a rare gas and one or more metal halides, e.g., sodium iodide, calcium iodide and one or more rare earth iodides, or in the case of a fused quartz arc tube, sodium iodide, calcium iodide and scandium iodide.

This invention is a ceramic lamp with an outer jacket and hence not suitable for photo optical applications.

[0008] US Patent. 6,741,013 relates to electric lamps having shroud. The shroud is made of a light-transmissive and heat-resistant material, such as fused quartz.

The invention reduces the overall complexity of the assembly and provides a method for modular assembly of a metal halide lamp. The lamp also takes advantage of the fact that the passage of sodium through alumina ceramic arc tubes is suppressed by several orders of magnitude relative to quartz. However, if this construction is used with a quartz arc-tube, the lamp will not have a stable colour, because the shroud is not mounted in an electrically floating configuration (isolated from conductors that carry current when lamp is in operation).

[0009] US patent 4,888,517 describes double-enveloped lamp having a shield surrounding a light-source capsule within a thick-walled outer envelope so that the lamp may be safely operated without necessity of a protective fixture. The lamp includes electrically conductive frame as a "floating" frame. The frame is electrically isolated from the lamp's circuit in order to reduce sodium migration out of capsule. The lamp disclosed in said Keffe et al patent includes a shroud surrounding the arc tube and a frame for mechanically supporting the shroud and the arc tube. When a safety filament is included in such a lamp, excessive arc tube voltage rise is seen and changes in the color temperature of the lamp are observed in a relatively short time.

[0010] It has been found that sodium loss in a highly loaded quartz lamp could only be prevented when the lamps are made in double ended configurations without outer jacket. The dimension of these is physically large and not optically suited to modern fixtures. Opaque

sleeves, such as of steatite ceramic are not effective due to the porosity which allows freed photo-electrons to penetrate its wall. Disposing the arc tube within an electrically floating shroud increases the dimension of the lamp and is not suitable for use in compact optical systems which must be positioned very close to the arc tube.

[0011] With all the above discussed restrictions or limitations, it is essential to have a single ended short arc HID lamp having low colour temperature and optically transparent arc tube material which is stable during life due to suppression of sodium loss.

OBJECTS:

[0012] The principal object of the present disclosure is to provide a single ended short arc HID lamp having a low correlated colour temperature which is maintained stably throughout its life.

[0013] Another object of the present disclosure is to provide short arc HID lamp, which reduces the sodium loss.

[0014] Still another object of the present disclosure is to provide short arc HID lamp with constant colour, which replaces the use of ceramics by transparent quartz which brings considerable advantages in optical projection equipment.

[0015] Yet another object of the present disclosure is to provide a short arc HID lamp with smaller dimension than a lamp having a shroud.

[0016] Further object of the present disclosure is to provide a short arc HID lamp, which has smaller dimensions than a double ended lamp.

SUMMARY OF THE INVENTION:

[0017] In order to overcome the above mentioned problems and to achieve said objects, the present disclosure provides a short arc HID lamp having low colour temperature, which is stable during life due to suppression of sodium loss. The lamp has smaller dimensions than a double ended lamp and provides stable colour during life. The present disclosure has smaller dimension than a lamp having shroud. The useful life and lamp efficacy is increased and the heat output over halogen is reduced. Use of transparent quartz provides advantages in optical projection equipment.

[0018] In a preferred embodiment of the present disclosure, the arc tube (discharge vessel) is in essentially ellipsoidal or spherical form with a seal equipped at the two ends of the discharge vessel in each case, wherein the discharge vessel comprises a pair of tungsten electrodes with a free end longitudinal along the axis of symmetry projected into the interior of the arc tube (discharge vessel) from each seal wherein each electrode is sealed into the quartz containment in a vacuum-tight fashion by a foil of molybdenum, and wherein the arc tube is filled with a sodium-bearing metal halide chemistry and characterized in that the return lead which runs alongside the

arc tube is completely or partially embedded in a fused glass sleeve thereby interrupting the cycle of sodium loss and ensuring stability of the low colour temperature during the life of the lamp.

5 [0019] The fused glass sleeve, which encases the adjacent return lead, consists of glass or quartz, preferably a material having reduced UV transmission properties.

[0020] The correlated colour temperature of the lamp is in the range 3000-3500K, preferably about 3200K.

10 [0021] The electrical loading is 50-250W/mm arc length and the wall loading is around 50-150W/cm².

[0022] The lamp according to the present disclosure is suitable up to and above 4000W.

15 BRIEF DESCRIPTION OF THE DRAWINGS:

[0023] It is to be noted, however, that the appended drawings illustrate only typical embodiments of this disclosure and are therefore not to be considered for limiting of its scope, for the disclosure may admit to other equally effective embodiments.

Fig. 1a shows a single ended short arc metal halide lamp having constant low colour temperature during life, in accordance with the present disclosure.

Fig. 1b shows an alternative embodiment made in accordance with the present disclosure, in which the return lead is only partially sealed in the quartz sleeve.

FIG 2 shows the mechanism of sodium loss from the arc tube due to the adjacent lead wire.

35 Fig 3 shows CCT (correlated colour temperature) results over life with lamps, made according to the present disclosure.

40 DESCRIPTION OF THE PREFERRED EMBODIMENTS:

[0024] Reference may be made to figure 1a, which shows a single ended short arc metal halide lamp (100) without outer jacket of the type claimed in the present application. It comprises a quartz discharge tube (101) having an approximately ellipsoidal or spherical shape which is equipped with a pair of tungsten electrodes (102) whose distal ends (103) are projected into the interior of the discharge vessel (109) and whose proximal ends (104) are welded to a short length of molybdenum sealing foil (105), these being hermetically sealed into the quartz containment (106) in a vacuum-tight fashion. The interior volume (109) of the discharge tube (101) is filled with a sodium-bearing chemistry which produces the low colour temperature desired. The single ended short arc metal halide lamp without outer jacket (100) is characterised by the fact that the adjacent return lead (108) is sealed in quartz material (107) so as to interrupt the cycle leading

to sodium loss, which in turn ensures maintenance of the low colour temperature during the life of the lamp. The sealing may optionally be effected on both sides of the return lead (108), for instance by employing an optional third molybdenum sealing foil (112). The lamp is equipped with a single base (110) which provides an electro-mechanical interface with the equipment in which it is to be used. The base (110) bears two contact pins (111) which are connected to a branch of the electric power supply.

[0025] The present disclosure increases the useful lamp life and lamp efficacy.

[0026] Figure 1b illustrates a similar single ended short arc metal halide lamp (200) without outer jacket of the type claimed in the present application. Its design is substantially the same as the lamp shown in Figure 1a, except that the quartz sleeve (207) within which the adjacent lead wire (208) is disposed is not fabricated from the same piece of quartz (206) as is used in the construction of the discharge tube. The technical function of the disclosed lamp is however the same.

[0027] Fig. 2 shows the mechanism of sodium loss due to adjacent lead wire. The mechanism of sodium loss is initiated by high energy photons of short wavelength 302 traveling from the arc tube 301 and impinging on adjacent lead wire 306. These high energy photons lead to photoemission of free electrons 303 from the lead wire 306 which results in a negative charge in the environment around the arc tube surface 304. This negative charge pulls the positively charged sodium ions out of the discharge and into the quartz arc tube wall 305. A quartz sleeve (307), which may be fabricated in clear or preferably UV stop quartz, is fused around the adjacent lead wire 306 interrupts the process of photoemission of electrons such that sodium loss from the arc tube can be effectively prevented.

[0028] Fig. 3 is a graph which expresses the correlated colour temperature of the lamp (in Kelvins) as a function of its rated life, both for the prior art as well as for lamps made according to the present disclosure. It is clear that the colour temperature of lamps made according to the present disclosure remains constant with respect to the life of the lamp and is in the range of 3000 to 3500K. Furthermore it is clear that the prior art lamps which are not made according to the teachings of the present disclosure suffer from rapid increase of colour temperature, and are consequently rendered useless for the intended application after an inconveniently short period of time.

[0029] It is to be noted that the present invention is susceptible to modifications, adaptations and changes by those skilled in the art. Such variant embodiments employing the concepts and features of this invention are intended to be within the scope of the present invention, which is further set forth under the following claims.

Claims

1. A single ended short arc metal halide lamp comprising an arc tube equipped with tungsten electrodes, said arc tube is filled with a sodium-bearing metal halide chemical mix **characterized in that** an electrical return lead contiguously juxtaposed alongside the arc tube is completely or partially embedded in a fused glass sleeve so as to interrupt the cycle of sodium loss and lead to low colour temperature of the lamp, which is stable during life of the lamp.
2. The single ended short arc metal halide lamp as claimed in any of the preceding claims, wherein the fused glass sleeve which encases the adjacent return lead, consists of quartz, or preferably a quartz material having reduced UV transmission properties.
3. The single ended short arc metal halide lamp as claimed in any of the preceding claims, wherein the outer extremity of the adjacent return lead is hermetically sealed into the glass encasement by a secondary molybdenum foil seal.
4. The single ended short arc metal halide lamp as claimed in any of the preceding claims, wherein the adjacent return lead is optionally sealed along its entire length into the glass encasement by a molybdenum foil.
5. The single ended short arc metal halide lamp as claimed in any of the preceding claims, wherein the molybdenum foil which forms the adjacent return lead is a continuation of the molybdenum foil which forms the seal of the arc tube and is welded directly to the tungsten electrode at its proximal end.
6. The single ended short arc metal halide lamp as claimed in any of the preceding claims, wherein the shroud fused adjacent the lead wire is made of transparent quartz.
7. The single ended short arc metal halide lamp as claimed in any of the preceding claims, wherein the lamp has a single base, with two electrical contacts formed, connected over two contact pins with a branch of the electric power supply in each case and the discharge vessel and return lead are held by the lamp base.
8. The single ended short arc metal halide lamp as claimed in any of the preceding claims, wherein the electrical loading of the lamp is in excess of 100 watts per millimetre of arc length.
9. A single ended short arc metal halide lamp substantially as herein described with reference to the drawings accompanying this specification

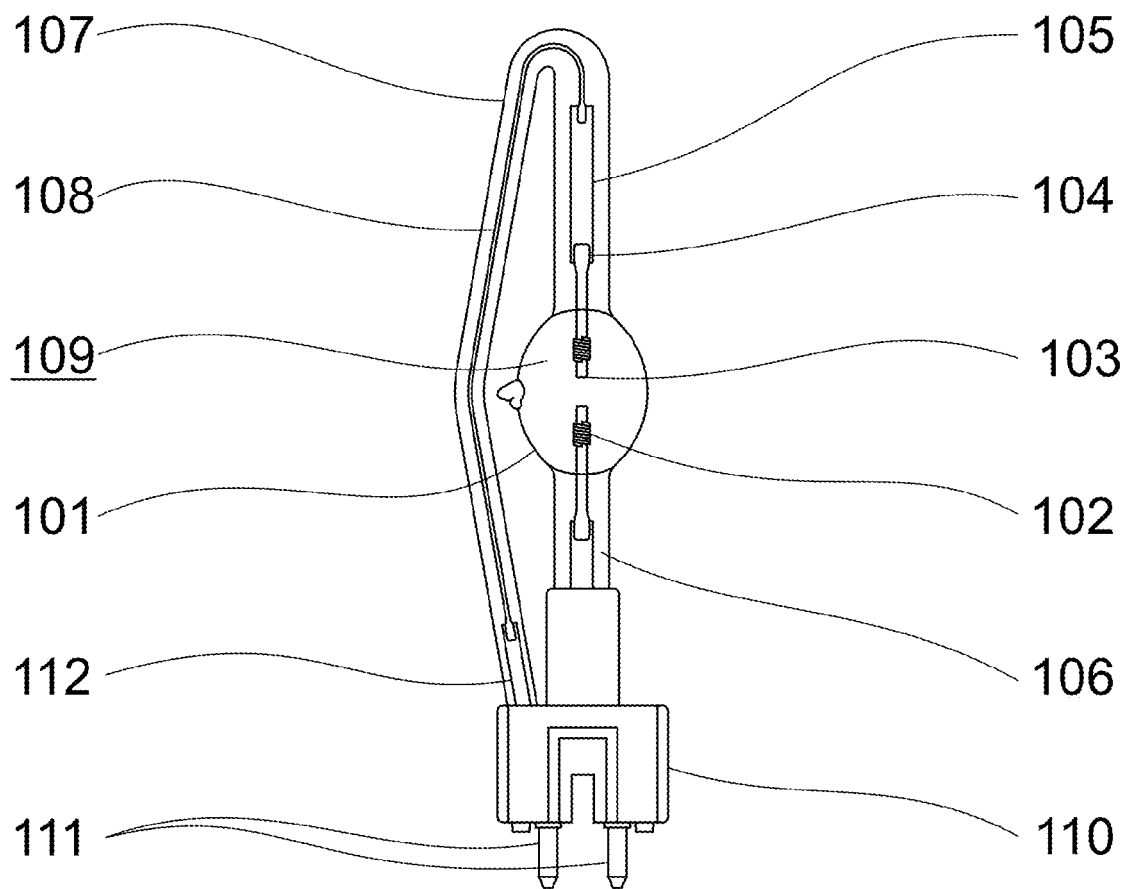


Figure 1a shows a discharge lamp provided in accordance with the present invention;

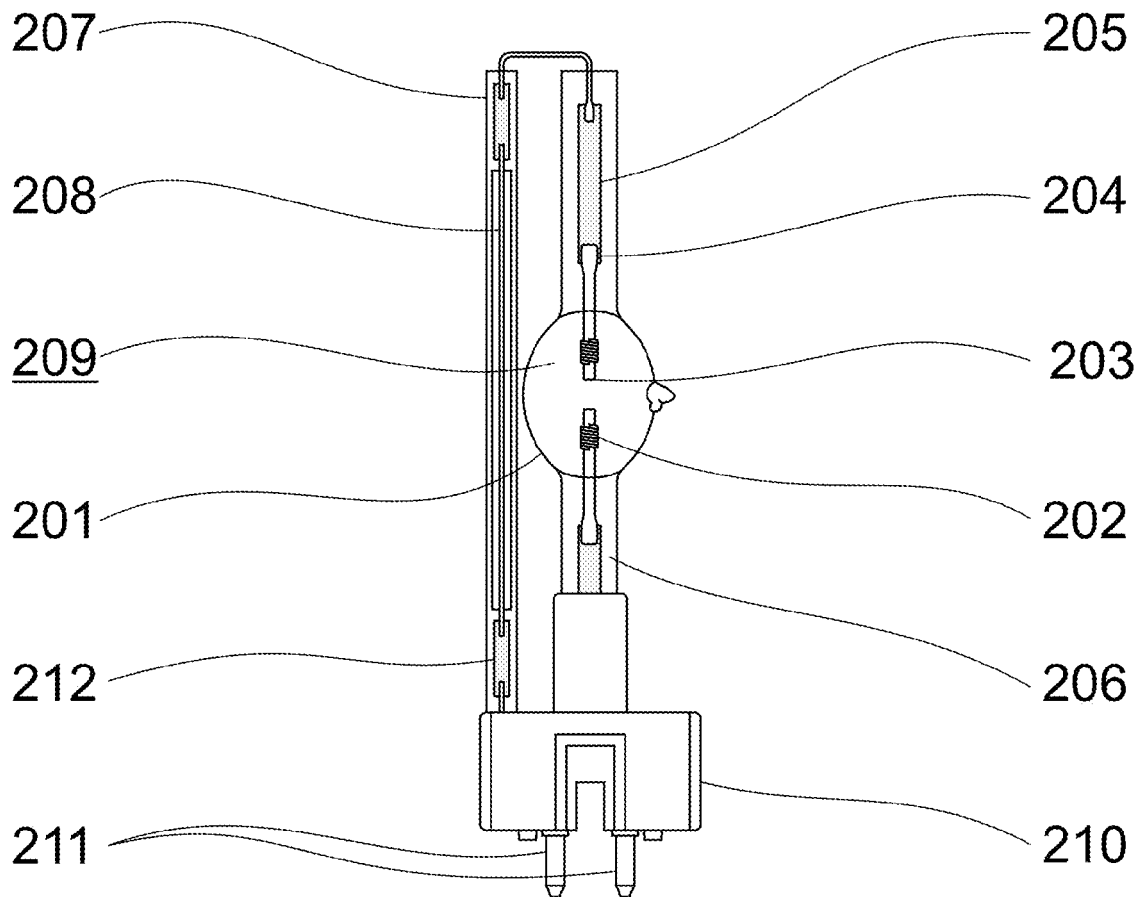


Figure 1b shows return lead partially sealed in sleeve

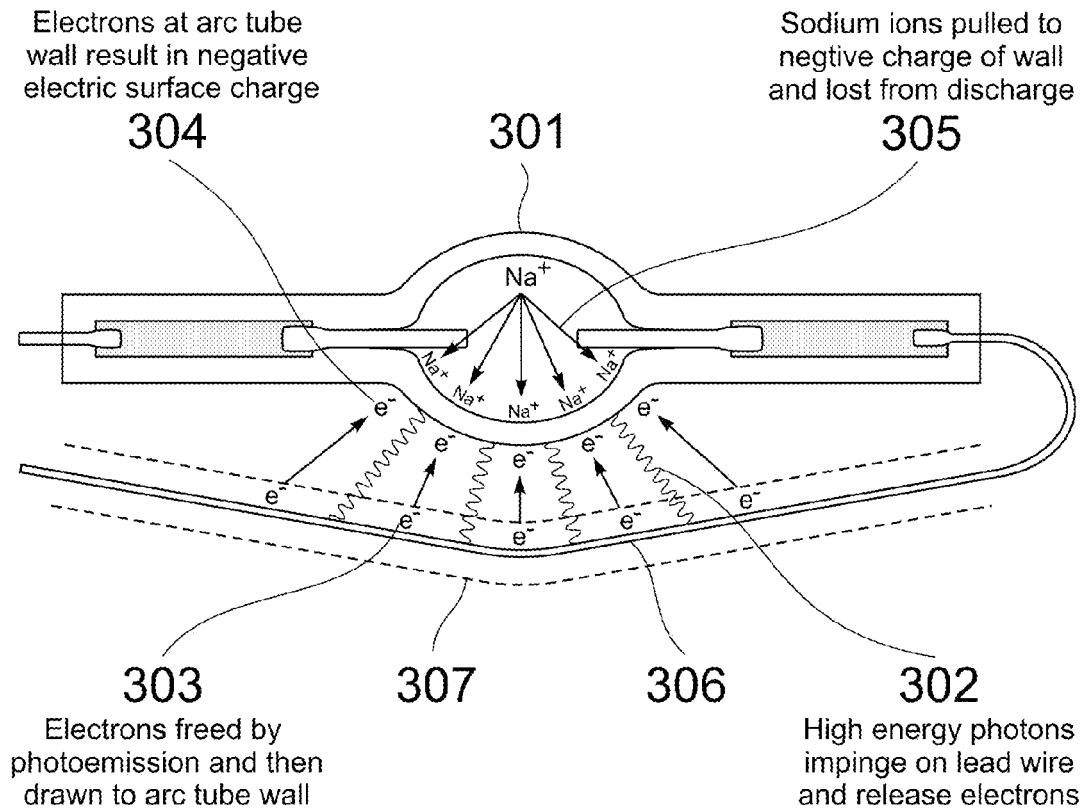


Fig 2 shows the mechanism of sodium loss due to adjacent lead wire

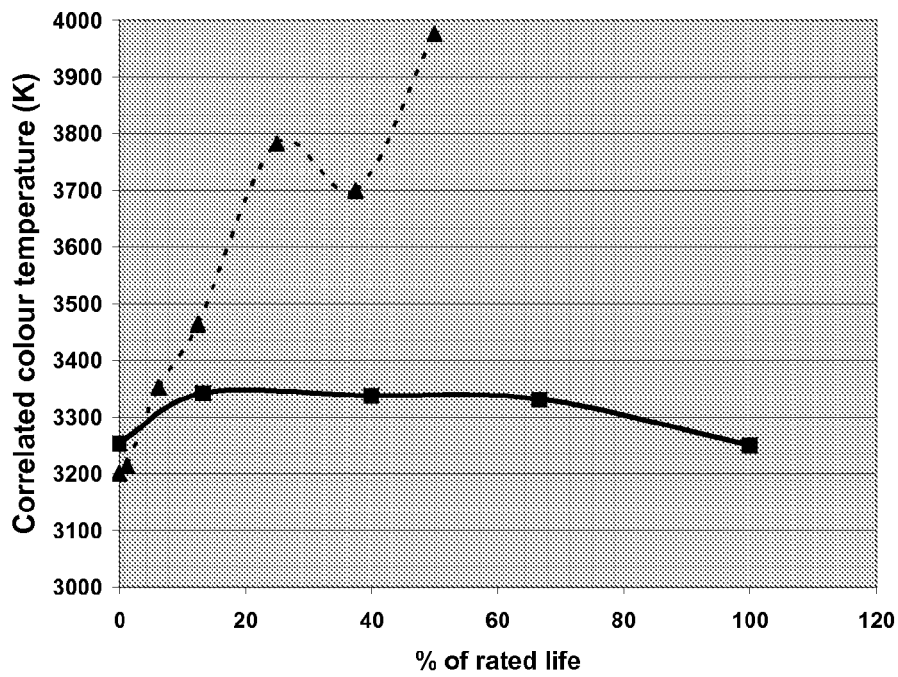


Fig 3 shows CCT (correlated colour temperature) results over life with lamps according to invention.

REFERENCES CITED IN THE DESCRIPTION

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