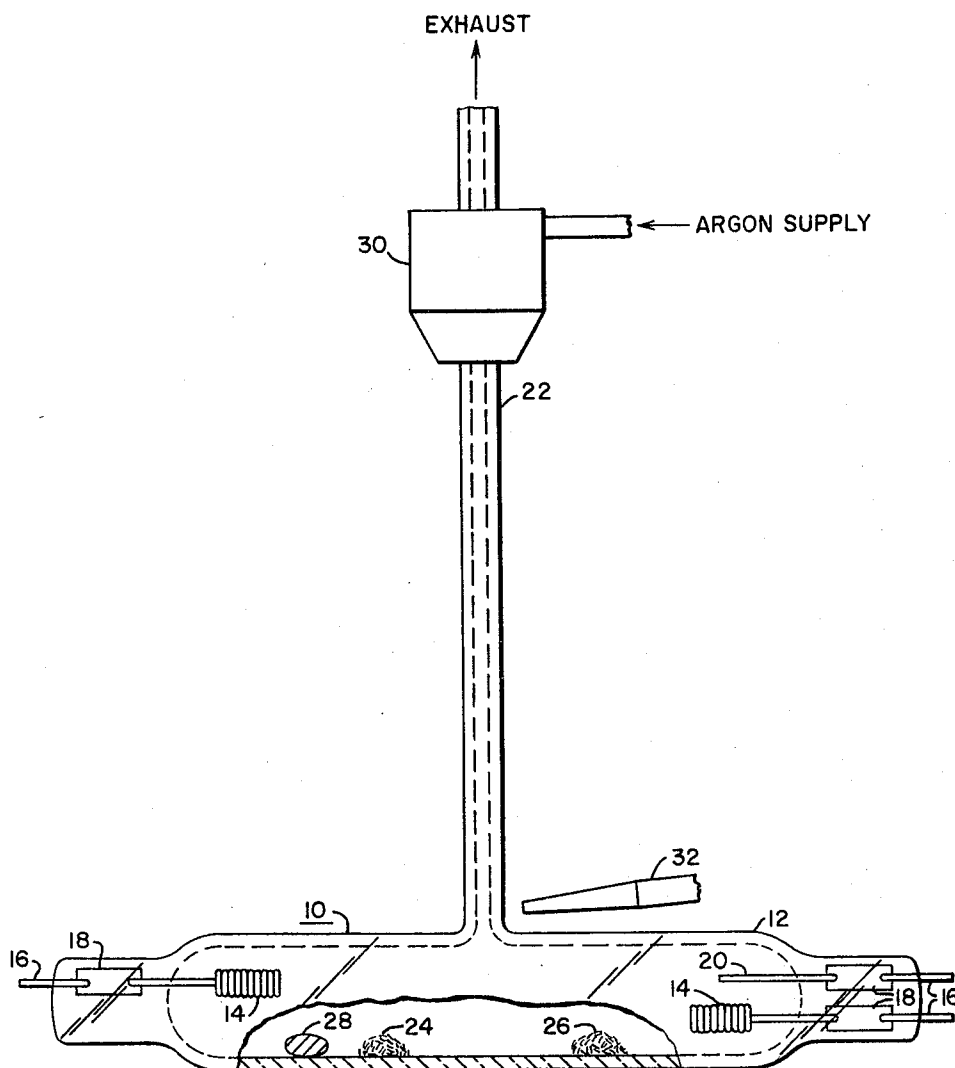


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METHOD FOR PROCESSING HIGH-PRESSURE
VAPOR-DISCHARGE ARC TUBE
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WITNESSES:

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**METHOD FOR PROCESSING HIGH-PRESSURE
VAPOR-DISCHARGE ARC TUBE**

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This invention relates to discharge devices and, more particularly, to a method for processing an arc tube for a high-pressure vapor-discharge lamp of the mercury-additive type.

It is known to modify high-pressure mercury-vapor discharge lamps by including additive materials, and particularly selected metallic iodides, in the arc tube. In the operation of such devices, the mercury, which is fully vaporized, establishes the proper loading or voltage drop across the lamp and the additive iodides improve the color and luminous output of the discharge. Such so-called additive lamps are generally disclosed in Illuminating Engineering, June 1963, article titled "Higher Efficiency Light Source Through Use of Additives to Mercury Discharge."

The introduction of discharge-sustaining material into the arc tube of the discharge device is generally known in the art as "dosing." Heretofore, when dosing the discharge-sustaining materials into the arc tube for a so-called mercury-additive-type lamp, the mercury has been placed into the arc tube in predetermined amount and the additive iodide, such as sodium iodide, thallium iodide, or thin iodide, for example, is also introduced directly into the arc tube, along with a predetermined pressure of inert ionizable starting gas. Any impurities which are contained in the arc tube, or are introduced into the arc tube with the discharge-sustaining material, are objectionable since they may react with the components comprising the arc tube or create a tendency for hard starting of the arc tube. By "hard starting" is meant that the arc tube requires a greater-than-desired voltage to initiate the arc. Since such discharge devices are intended to operate in standard fixtures wherein the starting voltage is fixed, any undue increase in the required starting voltage for the lamp can result in an apparent failure. In the case of metallic halide additive material, difficulties are encountered in purifying and maintaining the purity of the additive material before it is introduced into the arc tube.

It is the general object of this invention to provide a method of dosing a partially fabricated, high-pressure vapor-discharge arc tube of the mercury-additive type with a discharge-sustaining filling, in order that substantially no deleterious impurities will be introduced into the arc tube during the dosing process.

It is another object to provide a method for dosing a partially fabricated mercury-additive type of arc tube in order that the sealed arc tube will have a predetermined low starting voltage.

The aforesaid objects of the invention, and other objects which will become apparent as the description proceeds, are achieved by introducing into a partially fabricated arc tube, prior to sealing such tube, a predetermined pressure of inert ionizable starting gas, a predetermined amount of mercury which is at least in part chemically combined with a predetermined amount of selected halogen, and a predetermined amount of additive metal which will react with mercury halide to form additive metal halide. The proportions of the discharge-sustaining filling are carefully controlled so that the amount of mercury introduced into the arc tube will establish a predetermined mercury-vapor pressure in the arc tube during operation. The total halogen which is

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introduced into the arc tube in the form of mercury halide is so controlled that it will react with the additive metal which is placed into the arc tube and form a predetermined amount of additive metal halide, in order to provide the arc tube, when operated, with the desired spectral output and efficiency. The total amount of additive metal which is introduced into the arc tube is selected so that it is at least sufficient to react with all of the halogen constituent of the mercury halide which is introduced into the arc tube.

For a better understanding of the invention, reference should be had to the sole figure of the drawing which illustrates a partially fabricated arc tube wherein a predetermined amount of mercury iodide, mercury, and additive metal have been introduced into the arc tube along with a predetermined pressure of argon starting gas, and the arc tube is about to be sealed by tipping off the exhaust and dosing tubulation.

While the teachings of the present invention are applicable to lamps or discharge devices of varying size and designed wattage input, high-pressure vapor-discharge lamps having a designed power input of 400 watts are used extensively, and hence an arc tube for such a lamp has been illustrated and will be so described.

With specific reference to the arc tube processing operation as illustrated in the drawing, the arc tube 10 in its partially fabricated form comprises an elongated envelope 12 which is formed of light-transmitting refractory material such as quartz or polycrystalline alumina. Main operating electrodes 14 are disposed proximate either end of the envelope 12 and are connected to lead-in conductors 16 sealed through the ends of the envelope 12, which lead-in conductors include ribbon-type seals 18. As is usual, a starting electrode 20 is positioned proximate one of the main electrodes 14. Extending from a side of the envelope 12 is an elongated exhaust and filling or dosing tubulation 22. Prior to sealing the arc tube 10, a predetermined amount of mercury iodide powder 24, a predetermined amount of tin powder 26, and a predetermined amount of mercury 28 are placed into an upright capsule having an open end and positioned in the elongated tubulation 22. The tubulation is connected to a conventional exhaust and gas-filling head 30 and the arc tube is baked, exhausted and gas-filled with a predetermined pressure of inert ionizable starting gas, such as 20 mm. of argon. The arc tube and tubulation are then inverted to dose the mercury, mercury iodide and tin from the capsule and into the arc tube. This general technique of dosing is conventional and the capsule is not shown. After the discharge-sustaining filling has been introduced into the envelope 12, the envelope is tipped off by means of a conventional gas-air burner 32, as shown in the drawing, in order to complete the arc tube fabrication.

As a specific example, the arc tube 10 is designed to be operated with a predetermined power input of 400 watts, the distance between the operating electrodes 14 is approximately 67 mm. and the arc tube encloses a predetermined volume of approximately 22 cc. A specific discharge-sustaining filling desired for the operating arc tube is mercury in amount of 66 mg., stannous iodide in amount of 15 mg., and argon starting gas in such amount that the argon pressure in the cold arc tube is 20 mm. Hg. This amount of mercury is completely vaporized during lamp operation and with the tin iodide provides the lamp with an operating potential of approximately 190 volts. In the case of most so-called mercury-additive lamps, the vaporized mercury accounts for nearly all of the voltage drop across the lamp. Tin iodide additive, in contrast, has a relatively low boiling temperature, thus accounting for about 30% of the measured voltage drop for the specific lamp considered hereinbefore.

In dosing the foregoing specific lamp in accordance with the present invention, 18 mg. of mercuric iodide powder and 58 mg. of mercury are added to the arc tube along with 4.7 mg. of tin powder. In addition, argon starting gas at a pressure of 20 mm. Hg is included in the arc tube, after which the arc tube is sealed by tipping off. If desired, a small amount of tin powder may be added over that which is required to react stoichiometrically with the mercury iodide to form stannous iodide. Alternatively, the mercury as added to the arc tube could all be in the form of the iodide, which of course would require that the added tin be increased by such amount as required at least to react stoichiometrically with the added mercury iodide to form stannous iodide.

It should be clearly understood that the total amount of mercury which is introduced as free mercury and as the iodide into the arc tube is predetermined in accordance with that operating voltage which is desired to be developed across the lamp lead-in conductors 14.

The determination of the proper amount of mercury to achieve a predetermined voltage drop for any specific lamp is well known, and is generally described in U.S. Patent No. 2,892,665, dated June 30, 1959. If the present lamp were desired to be operated under either higher or lower voltage and power conditions, or the arc tube volume was modified, the proper charge of mercury to provide such a desired operating voltage could be readily determined. When the arc tube is first operated, the added tin powder reacts with the mercury iodide to form metallic mercury and tin iodide. The total halogen, such as the iodine, which is introduced to the arc tube in the form of mercury halide, when reacted with the finely divided additive metal, establishes a predetermined pressure of additive metal halide during normal operation of the arc tube, in order to provide desired discharge characteristics. The total amount of the finely divided or powdered additive metal, such as tin, which is introduced into the arc tube is at least sufficient to react with all of the halogen constituent of the mercury halide which is introduced into the arc tube. The inert, ionizable starting gas fill in the arc tube can be modified considerably with respect to the gas used and the gas pressure.

As noted hereinbefore, the powdered metallic additive metal can be present in amounts which are substantially greater than those required to react stoichiometrically with the halogen which is introduced with the mercury. Such additional amounts of additive metals may be desirable in some cases.

While an iodide additive is preferred, bromides or chlorides can also be substituted in whole or in part for the iodide, with mercury bromide or mercury chloride added to the arc tube in powder form in accordance with the present invention. Similarly, while a tin additive is useful to provide a very white light when combined with the iodide, other additive metals such as powdered zinc, thallium, sodium, thorium, gallium, indium, cadmium, calcium or barium, or mixtures thereof, can be substituted in whole or in part for the tin and placed in powder form into the arc tube when it is being processed in accordance with the present invention. The state of division of the powdered additive metal is not critical and the additive metal can be added as a slug, if desired. The amount of added metallic halide desired in the operating arc tube will vary. As an example, such halide can be present in total gram-mole amount which is equivalent to the tin iodide additive example as previously considered.

Since mercury iodide or the other specified mercury halides can be purified to a very high degree, and the additive metals can also be obtained in very pure form, arc tubes processed in accordance with the present invention normally display improved performance as compared to otherwise similar arc tubes which have been processed by dosing the additive materials directly into the arc tube as metallic halide. This is because the metallic halides per se are difficult to obtain and maintain in very pure

form. As a result, when such metallic halide is dosed directly into the arc tube, it carries with it some deleterious impurity constituents which are later released. These released impurities can manifest themselves by reacting with the arc tube components or by remaining as a gas in the arc tube, thereby creating hard starters.

It will be recognized that the objects of the invention have been achieved by providing an improved method for dosing a mercury-additive type arc tube for a gaseous discharge device in order that the processed arc tube will have improved operating characteristics.

While a best embodiment has been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

We claim as our invention:

1. The method of dosing a partially fabricated high-pressure vapor-discharge arc tube of the mercury-additive type with a discharge-sustaining filling, which arc tube when completely fabricated enclosed a predetermined volume and is adapted to be normally operated with a predetermined power input, which method comprises: introducing into said partially fabricated arc tube a predetermined pressure of inert ionizable starting gas, a predetermined amount of mercury at least part of which is chemically combined with a predetermined amount of selected halogen, and a predetermined amount of selected additive metal which will react with mercury halide to form additive metal halide; the predetermined amount of mercury introduced into said arc tube, when completely vaporized during normal operation of said arc tube, establishing a predetermined vapor pressure in said arc tube; the total halogen introduced into said arc tube in the form of mercury halide, when reacted with said finely divided additive metal; forming a predetermined amount of additive metal halide in said arc tube; and the total amount of said additive metal introduced into said arc tube being at least sufficient to react with all of the halogen constituent of the mercury halide introduced in said arc tube to form additive metal halide; and sealing said arc tube after introducing said discharge-sustaining filling into said arc tube.

2. The method as specified in claim 1, wherein said mercury halide is at least one material of the group consisting of mercury iodide, mercury bromide, and mercury chloride.

3. The method as specified in claim 1, wherein said additive metal is at least one finely divided metal of the group consisting of tin, zinc, thallium, sodium, thorium, gallium, indium, cadmium, calcium, and barium.

4. The method of dosing a partially fabricated high-pressure vapor-discharge arc tube of the mercury-tin iodide type with a discharge-sustaining filling, which arc tube when completely fabricated encloses a predetermined volume and is adapted to be normally operated with a predetermined power input, which method comprises: introducing into said partially fabricated arc tube a predetermined pressure of inert ionizable starting gas, a predetermined amount of mercury at least part of which is chemically combined with a predetermined amount of iodine, and a predetermined amount of tin; the predetermined amount of mercury introduced into said arc tube, when completely vaporized during normal operation of said arc tube, establishing a predetermined vapor pressure in said arc tube; the total iodine introduced into said arc tube in the form of mercury iodide, when reacted with said finely divided tin, forming a predetermined amount of tin iodide in said arc tube; and the total amount of said tin introduced into said arc tube being at least sufficient to react with all of the iodine constituent of the mercury iodide dosed into said arc tube to form tin iodide; and after introducing said discharge-sustaining filling into said arc tube, sealing said arc tube.

No references cited.

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