PATENT SPECIFICATION

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DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in Mercury Vapour Halogen Discharge Lamps

We, PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED, of Abacus House, 33 Gutter Lane, London, E.C.2., a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a mercury vapour discharge lamp in which the discharge space contains not only mercury and a rare gas, but also one or more halides, more particularly iodides.

Mercury vapour discharge lamps with the aforementioned addition of halides in the discharge space have been known for various uses. In accordance with the desired effect, halides of different elements are used. It has been suggested, for example, to use the iodides of the elements gallium, thallium and indium in the discharge space in order to improve the spectrum emitted by the lamps.

These discharge lamps are generally high pressure lamps, that is to say lamps in which the discharge is contracted during operation. In operation, the overall vapour pressure generally lies between 1 and 50 atmospheres. The wall load then amounts to 5 to 35 W/cm^2. The most important advantage of these lamps is their very high output.

The spectral distribution of the emitted radiation naturally depends upon the quantities of the various elements in the discharge space and upon their relative ratios. (In this case, the rare gas hardly plays a part and only serves to facilitate the ignition). These ratios may be chosen so that the spectrum of the radiation emitted by the lamps is suitable for a given use, for example, for illumination. The light outputs of these known lamps are considerably higher than those of the corresponding lamps which only contain mercury (and a rare gas). Outputs between 50 and 100 lumen/W have already been realized.

In general, the aforementioned known lamps are high-pressure discharge lamps of comparatively small dimensions. The length of the discharge space generally does not exceed 15 cms and the diameter generally lies between 6 and 20 mms. The discharge in these lamps may be both wall-stabilized and electrode-stabilized. Small discharge lamps are less suitable for use in many photo-chemical processes, since large surfaces must frequently be irradiated at the same time. This more particularly holds for photo-copying methods, but also for the irradiation of continuously flowing liquids in which chemical reactions have to take place. An example thereof is found in the synthetic substance industry for the manufacture of caprolactan, which is a starting substance for the nylon manufacture. For certain processes, lamps are manufactured which have a length of even more than 1 metre. Also in such lamps the discharge may be contracted so that a high-pressure lamp is concerned. In these long lamps, the discharge is naturally well-stabilized.

For many of the aforementioned photo-chemical processes, it is not necessary that the energy in the discharge is converted to a high degree into visible radiation, but it is desirable that a strong radiation is emitted in a wave range lying between 350 and 450 nm. The mercury spectrum has a plurality of strong lines in this range, it is true, but it is desirable to increase the amount of energy in this range, if necessary at the expense of radiation above 450 nm and below 350 nm. This is the object of the invention.

The present invention provides a high-pressure mercury vapour halogen discharge lamp having a discharge space which contains mercury, rare gas, a halogen, lead and optionally gallium and/or indium, wherein the discharge space contains from 0.004 to 0.12 mgs. of lead per cubic cm. and a quantity of halogen which is chemically equivalent to at least

the total lead plus gallium plus indium and to not more than twice the total lead plus gallium plus indium.

In lamps in accordance with the present invention, it was found that the efficiency of the conversion of the electric energy supplied into radiation is considerably higher within the aforementioned range lying between 350 and 450 nm than that of the known lamps with or without the addition of the halides already suggested. This is obviously due to the presence of the lead in the discharge space. This holds for high-pressure mercury vapour halogen lamps both with a wall-stabilized and with an electrode-stabilized discharge.

Since the vapour pressure of the lead alone is too low to bring about a sufficient conversion of the electric energy into its characteristic radiation at the temperatures prevailing in the discharge space during operation, the lamps in accordance with the present invention invariably contain the above-mentioned quantity of halogen, more particularly of iodine.

In order to facilitate the manufacture and to obtain an accurate dosage, the lead is preferably introduced into the discharge space in the form of halide, more particularly of iodide. Furthermore, apart from the quantity of halogen which is chemically equivalent to the lead, an additional quantity of halogen may be present; this additional quantity serves to lengthen the life of the lamp. If desired, this additional quantity of halogen may be introduced into the discharge space in the form of a mercury halide, for example, mercury iodide. It stands to reason that, when the quantity of metallic mercury to be introduced into the discharge space is ascertained, the additional quantity of mercury introduced in the form of halide must be taken into account.

The total quantity of mercury in the discharge space of lamps in accordance with the present invention is preferably from 0.1 mg to 5 mgs per cubic cm. for wall-stabilized discharge lamps. For electrode-stabilized discharge lamps, the total quantity of mercury is preferably from 10 to 50 mgs per cubic cm. of the discharge space. If the discharge space contained less than 0.004 mgs per cubic cm. of lead, the increase of the radiation between 350 and 450 nm would be very small; if the discharge space contained more than 0.12 mgs. per cubic cm. of lead, self-absorption would occur.

By using lead in the discharge space, it was found that an increase of the radiation emitted in the range lying between 350 and 450 nm of at least 25% is obtained as compared with corresponding lamps without the addition of lead.

When the discharge space contains indium and/or gallium in addition to the mercury and lead, an increased radiation may result in the visible range lying below 450 nm. The elements indium and gallium must also be present in the discharge space in the form of halides or there must be a possibility of forming halides therein.

The invention will now be described with reference to the single Figure of the accompanying diagrammatic drawing, which shows a broken plan view of a discharge lamp according to the present invention.

A discharge lamp has a quartz glass tube 1 which terminates at the ends in pinches 2 and 3. Foil-shaped current supply conductors 4 and 5, respectively, which are connected in the discharge space to electrodes 6 and 7, respectively, are disposed in these pinches. These electrodes consist, for example, of tungsten helices. The distance between the electrodes amounts to 300 mms and the diameter of the discharge space is approximately 16 mms. The lamp is suitable for use at an operational power of 2 kW, has an arc voltage of 500 to 550 V and a lamp current of 4 to 4.5 A.

In order to illustrate the influence of the various elements in the discharge space, two examples are given below.

EXAMPLE 1:

The discharge space of a lamp shown in the drawing contains 150 mgs of mercury, 3 mgs of a lead iodide (PbI_2) and as ignition gas 10 mms of argon.

EXAMPLE 2

The discharge space of a lamp shown in the drawing contains 150 mgs of Hg, 0.25 mg of Ga, 3 mgs of HgI_2, 3 mgs of PbI_2 and as ignition gas 10 mms of argon.

In the following Table, the energy distribution of the lamps of the Examples 1 and 2 is compared in various wave ranges with the energy emitted by a lamp of quite equal structure which solely contains 150 mgs of mercury and 10 mms of argon. The energy of the radiation of this lamp is assumed to be 100 for each of the wave ranges.

TABLE

Wave range in mm	Hg	Hg + PbI_2	Hg + GaI_3 + PbI_2
300 — 350	100	55	31
325 — 375	100	168	116
350 — 400	100	175	120
375 — 425	100	273	508
400 — 450	100	128	204
425 — 475	100	52	34
450 — 500	100	29	100
500 — 550	100	62	38
525 — 575	100	59	38
550 — 600	100	39	22
350 — 450	100	150	156
450 — 550	100	61	40

As appears from the Table, in the wave range lying between 350 and 450 nm the lamps containing not only mercury but also iodides of lead or of lead and gallium, emit a considerably greater amount of energy than the lamp which solely contains mercury. It is also apparent from the Table, that when gallium is used, a considerably greater amount of energy is emitted in the visible part of the spectrum below 450 nm than in the case of a lamp containing beside mercury only lead iodide. It further appears from the Table, that the increase of the amount of energy emitted in the wave range lying between 350 and 450 nm is obviously obtained at the expense of the radiation at wave lengths greater than 450 nm and smaller than 350 nm. The last two horizontal rows indicate the total amount of energy emitted in the wave ranges lying between 350 and 450 nm and in those lying between 450 and 550 nm respectively.

WHAT WE CLAIM IS:—

1. A high-pressure mercury vapour halogen discharge lamp having a discharge space which contains mercury, a rare gas, a halogen, lead and optionally gallium and/or indium, wherein the discharge space contains from 0.004 to 0.12 mgs of lead per cubic cm. and wherein the quantity of halogen in the discharge space is chemically equivalent to at least the total lead plus gallium plus indium and to not more than twice the total lead plus gallium plus indium.

2. A high-pressure mercury vapour halogen discharge lamp as claimed in Claim 1, having a wall-stabilized discharge and wherein the discharge space contains from 0.1 to 5 mgs of mercury per cubic cm.

3. A high-pressure mercury vapour halogen discharge lamp as claimed in Claim 1, having an electrode-stabilized discharge and wherein the discharge space contains from 10 to 50 mgs of mercury per cubic cm.

4. A high-pressure mercury vapour halogen discharge lamp as claimed in any preceding Claim, wherein the halogen is iodine.

5. A high-pressure mercury vapour halogen discharge lamp, substantially as herein described with reference to any of the Examples and to the accompanying drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*