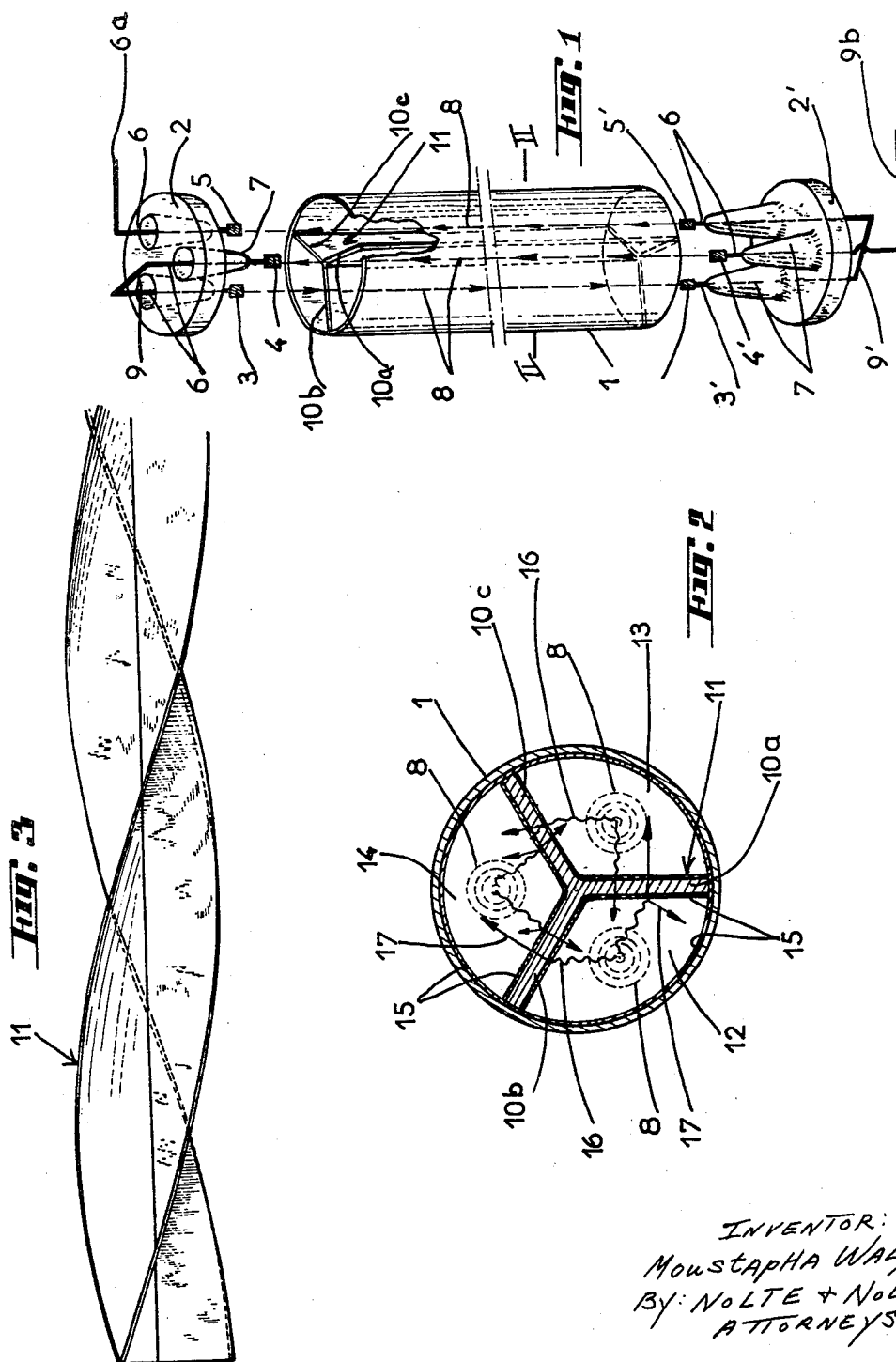


July 13, 1965

M. WALY
ELECTROLUMINESCENT LIGHTING DEVICE AND LAMP
SYSTEMS EQUIPPED THEREWITH
Filed Aug. 1, 1962

3,194,997



INVENTOR:
MOUSTAPHA WALY
BY: NOLTE + NOLTE
ATTORNEYS

1

3,194,997

ELECTROLUMINESCENT LIGHTING DEVICE AND LAMP SYSTEMS EQUIPPED THERE- WITH

Moustapha Waly, Geneva, Switzerland, assignor to Anicet
Anstalt, Vaduz, Liechtenstein, a body corporate organ-
ized under the laws of Liechtenstein

Filed Aug. 1, 1962, Ser. No. 214,110

5 Claims. (Cl. 313-109)

This invention relates essentially to electroluminescent lighting devices and has specific reference to a device constituting an electroluminescent source of light, and also to installations and lighting systems or lamps equipped with this device.

A great variety of illuminating light sources of the type constituting fluorescent electric lamps are already known.

Among these lamps, notably those designed more particularly for illuminating streets and rooms, the high-pressure mercury vapor lamp has become increasingly prevailing due to its considerable light flux efficiency (about 57 lumens per watt) and to the spreading of the fine spectral lines in the form of luminous strips in the visible portion of the spectrum within the range of 4358 to 5770 Å. The spreading of the spectral lines is due to the formation of an electric arc in a high-pressure mercury vapor medium.

The construction of these high-pressure mercury vapor lamps is well known; they comprise an outer, bulb-forming glass envelope having mounted therein a small quartz tube containing the mercury vapor under a relatively high pressure and provided with electrodes between which the electric discharge constituting the arc proper is struck. The walls of the outer envelope are coated preferably with fluorescent materials of which the spectral emission is so selected as to compensate, by its color, for the dominant blue-greenish color of the high-pressure mercury vapor arc. In spite of their high luminous efficiency, that is, the amount of light emitted per unit power consumption, these lamps suffer more particularly from the following two inherent drawbacks:

(1) As the discharge tube operates under a relatively high pressure, the arc striking time, with the assistance of auxiliary electrodes incorporated with the tube, may be as long as about five minutes;

(2) If the feed voltage drops momentarily, for example by 25%, below the normal or rated voltage, the lamp dies out and can only be relighted after a time period of 10 or 15 minutes which is the time period needed by the mercury vapor to cool enough so as to allow formation of an arc.

On the one hand these two inherent drawbacks make the lamp unsuitable for all applications requiring a rapid or instantaneous lighting, and on the other hand there is the risk of suddenly causing complete darkness in a strongly illuminated place (accommodation time of the human eye) for a relatively long period, if the mains or supply network failed were it only during one fraction of a second. Therefore, an emergency lighting system must compulsorily be associated with these lamps and comprise conventional incandescent lamps or fluorescent tubes of the instantaneous or rapid lighting type. In some cases, owing to the sudden dying out of the light, there is a danger or risk of fatal accidents, if an emergency system has not been provided.

It is the object of the present invention to avoid the drawbacks set forth hereinabove while increasing the lighting efficiency and reducing the cost of a powerful lighting lamp intended for illumination in general. It is concerned with a device constituting a light source of the electroluminescent lighting type, which comprises at least one electric discharge tube, preferably of cylindrical

2

configuration, operating with a low-pressure mercury vapor arc, and having the inner wall of its transparent envelope coated with fluorescent materials of which the maximum excitation photosensitivity corresponds substantially to the 2537 Å. wavelength ultraviolet radiation.

This device is characterized in that said discharge tube comprises at its opposite ends the same number of electrodes substantially aligned by pairs of opposite electrodes, adapted to form a plurality of preferably substantially parallel electric arcs connected in series. The tube is divided into longitudinal and substantially parallel compartments or ducts enclosing said arcs, the latter being insulated from each other by a central insert element made of a material transparent to the radiations involved and arranged in said tube substantially throughout the useful length thereof. The element is coated throughout its lateral surfaces with a layer of the aforesaid fluorescent substances. Thus, the excitation of adequate "phosphors" by an electric discharge in the form of a low-pressure mercury vapor arc produces a conversion of electrical energy into luminous energy having a maximum efficiency with respect to the "resonance" production of the 2537 Å. wavelength ultraviolet radiation.

According to another feature characterizing this invention the aforesaid insert element is made of molded glass or like material and formed with continuous radial longitudinal fins, of rectilinear or helical configuration, constituting as many partitions dividing the tube into said compartments or ducts and having thus a spider or star-shaped cross-section. The edges of said partitions, which contact the inner wall of said tube envelope, are preferably not fitted in relationship sealing on this inner wall in order to provide intercommunication between said compartments or ducts to promote equalizing of pressures.

With this arrangement it is possible, for a given power consumption, to obtain a light emission which is greater than that of conventional lamps and with a tube of a length much shorter than that of conventional lamps.

This invention is also concerned with installations and lighting lamps and systems equipped with devices of the type broadly set forth hereinabove.

Other features and advantages of this invention will appear as the following description proceeds with reference to the accompanying drawing given by way of example only and illustrating diagrammatically typical forms of embodiment of the invention. In the drawing:

FIGURE 1 is a diagrammatic perspective partially exploded view with parts partially broken away showing a device constructed according to the teachings of this invention;

FIGURE 2 is a cross-section taken on a larger scale upon the line II-II of FIGURE 1, and

FIGURE 3 is a diagrammatic view showing a modified insert element.

In the form of embodiment illustrated in FIGURE 1, the discharge tube comprises a glass envelope 1 of generally cylindrical shape having its ends closed by glass members 2, 2' shown in exploded view, and each carrying a plurality of electrodes, each end member carrying the same number of electrodes, for example three as shown at 3, 4, 5 and 3', 4', 5'. Lead-in wires 6 of these electrodes extend in a fluid-tight manner through the glass members 2, 2'. To this end, the lead-in wires 6 pass through these end members by being housed in glass pockets or recesses 7 thereof which project for instance inwards, the inner ends of these recesses being welded on the wire to seal the passage.

Each electrode of an end member 2 or 2' is substantially in axial confronting alignment with a registering corresponding electrode carried by the opposite end member, so that the tube illustrated in the figure comprises three pairs of opposite electrodes aligned by pairs. Each

pair of opposite electrodes will thus produce an electric arc 8 during the operation of the device, the three arcs being therefore substantially parallel and the electrodes of each end member 2, 2' are electrically interconnected in such a manner that the electric current flows in series through the arcs thus produced according to the paths shown in broken lines with arrows in FIGURE 1. To this end, for instance, the electrodes 3 and 4 of end member 2 are connected through a conductor 9 and the electrode 5 is connected directly through a wire 6a to a supply terminal of the mains or other source of current. Similarly, the electrodes 3' and 5' of the opposite end member are connected through an electrical conductor 9', and the third electrode 4' of this end member is connected through a wire 9b to the other terminal of the mains or other source of current.

The three arcs are electrically insulated from one another by partitions 10a, 10b, 10c carried by a central insert element 11 located inside the tube 1 and dividing the inner space of this tube into three longitudinal compartments or ducts 12, 13 and 14. These partitions which consist of longitudinal or radial fins of said insert element may be rectilinear as shown in FIGURE 1 or, according to an alternate embodiment, helical as shown in FIGURE 3, this last configuration being advantageous in that the curvilinear or developed length of the electric arcs hence their luminous emission is increased.

The three partitions thus formed define with the inner face of the tube wall 1 three longitudinal compartments and the edges of these partitions, although being in contact with the inner wall of the tube envelope, are preferably not in sealing engagement therewith, so as to leave some intercommunication between the different compartments with a view to promote equalizing of pressures therein.

The central insert element 11 may advantageously be made of molded glass and is introduced into the tube preferably during the tube assembly, that is, before the end members 2, 2' are welded thereon.

The inner wall of tube 1 as well as the two side faces of each partition of the central element 11 are coated with adequate fluorescent substances 15 so-called "phosphors" (FIGURE 2), so selected that their maximum spectral sensitivity in case of excitation corresponds to the 2537 A. resonance line emitted by the low-pressure mercury vapor arc. Thus, the tube 1 and its insert element 11 can be manufactured in a simple and economical manner.

The operation of this device is particularly simple and efficient. Considering in FIGURE 2 the compartment 12 consisting of two partitions 10a and 10b of the central insert element and one adjacent portion of the peripheral wall of tube 1, an arc 8 is formed therein which emits ultraviolet radiations 16. This emission of ultraviolet rays 16 excites the phosphors 15 coating the inner surface of the tube and of the partitions 10a and 10b, thus producing a visible light 17 which enters the light generating electroluminescent layer while propagating this visible light through the adjacent compartments 13 and 14. Each one of these three compartments 12, 13 and 14 operates in the same manner, whereby the total surface subjected to the ultraviolet radiations comprises, in the case illustrated, nine surfaces, that is three per compartment, which act as sources of useful visible light radiation.

It should be noted that the problems involved in starting series-connected lamps are well known, as well as the means for solving them. It is believed that these means do not have to be described or shown herein, since they are not a part of the claimed invention.

In effect, there is no difficulty at all in starting or igniting three arcs connected in series; these are very easily struck and maintained by merely connecting the lead-in wires, for example, to two phase lines of an A.C. sup-

ply from the mains through the medium of a step-up transformer (having, as a matter of example, a secondary output voltage of 450 v.), and through a conventional ballast resistor or reactive impedance connected in series therewith.

In spite of the provision of any kind of a communication between the chambers, the arc will not take the shortest path from electrode 6a to electrode 9b and so will not by-pass the remainder of the tube. This is so because of the low-pressure gaseous atmosphere filling the tube; the low pressure is required to produce the 2537 A. resonance ray.

The amount of light emitted by the fluorescent lamp thus constructed is considerably greater than that emitted by conventional lamps while utilizing tubes of a length about, for example, six times smaller than that of conventional lamps, for a same power consumption. A lamp according to this invention will operate very satisfactorily with, for example, a tube about 16" long and about 2" in diameter.

Of course this invention should not be construed as being limited to the forms of embodiment shown and described herein which are given by way of example only, as many modifications and alterations may be brought thereto without departing from the scope of the invention as set forth in the appended claims.

What I claim is:

1. An electroluminescent lighting device embodying at least one tightly sealed electric multiple-discharge lamp of the low-pressure mercury-vapor type, comprising a transparent, elongated, substantially cylindrical, tubular, closed envelope the inner wall of which is coated with fluorescent materials having maximum excitation photosensitivity substantially corresponding to the 2537 A. wave-length of ultraviolet resonance radiation, an equal number of at least three inwardly projecting electrodes provided at opposite ends of said envelope and substantially aligned by pairs of confronting opposite registering electrodes, conducting means electrically interconnecting said electrodes by separate pairs at each envelope end, while leaving two of the total number of electrodes electrically disconnected from the remaining electrodes, two input lead-in wires electrically connected to said two disconnected electrodes respectively and brought out of said envelope for connection with a source of electric power supply, whereby said electrodes are so interconnected that they produce a plurality of substantially parallel arc streams connected in series through said electrodes and said conducting means, at least one arc-stream separator member of insulating material transparent to said radiation, located inside and extending substantially the full inner length of said envelope, said separator member being coated on all sides with a layer of said fluorescent materials and formed with a plurality of continuous, radially outwardly extending, longitudinal partition fins providing said separator member with a substantially star-shaped cross-sectional contour and dividing the interior of said envelope into separate longitudinal, substantially parallel and adjacent compartments enclosing each a pair of said registering electrodes together with the arc struck therebetween so as to insulate said arc streams from each other, said partition fins having substantially parallel peripheral edges conforming in shape to and freely engaging in abutting relationship said inner envelope wall along fluid-pervious joints leaving some intercommunication between said compartments to promote pressure balance therebetween.

2. An electroluminescent device according to claim 1, wherein said separator member is formed with substantially straight, flat partition fins.

3. An electroluminescent device according to claim 2, wherein said envelope is made of molded glass and closed endwise by mount-like cap elements formed with hollow, inwardly protruding, recessed pocket-like parts opening

5

to the outside and supporting each an electrode, said conducting means and said lead-in wires being inserted from the outside in said pocket-like parts and sealed therein.

4. An electroluminescent device according to claim 1, wherein said separator member is formed with partition 5 fins twisted in helical shape.

5. An electroluminescent device according to claim 4, wherein said envelope is made of molded glass and closed endwise by mount-like cap elements formed with hollow, inwardly protruding, recessed pocket-like parts opening 10 to the outside and supporting each an electrode, said

6

conducting means and said lead-in wires being inserted from the outside in said pocket-like parts and sealed therein.

References Cited by the Examiner

UNITED STATES PATENTS

2,076,286	4/37	Warren et al.	313—204
3,084,271	4/63	Swanson	313—204 X

10 GEORGE N. WESTBY, *Primary Examiner*.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,194,997

July 13, 1965

Moustapha Waly

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 32, for "relationship sealing" read --
sealing relationship --.

Signed and sealed this 8th day of March 1966.

SEAL)

test:

RNEST W. SWIDER

Testing Officer

EDWARD J. BRENNER
Commissioner of Patents