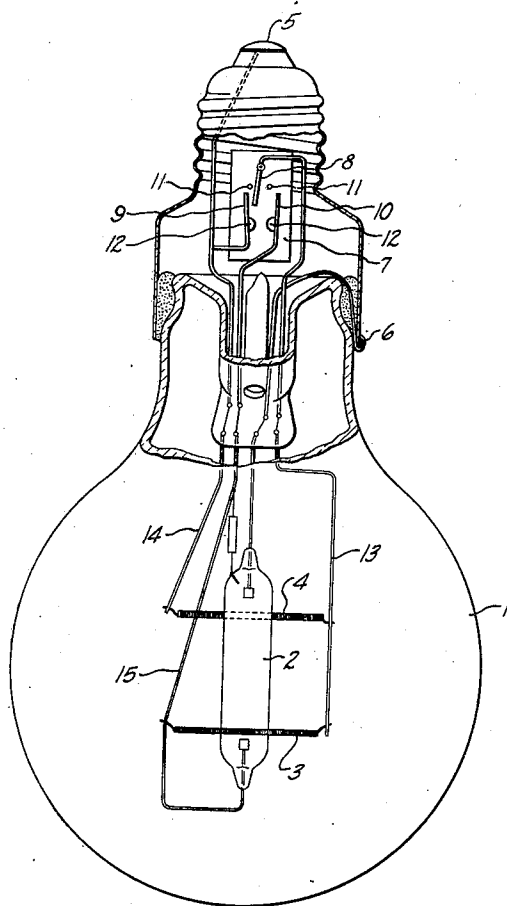


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ELECTRIC DISCHARGE LAMP

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Our invention relates to electrical discharge lamps and more particularly to electric mixed-light lamps, such as have proved to be very valuable for combined illumination and ultraviolet irradiation, and which comprise a high-pressure vapor-discharge tube and a series filament which is usually built into the lamp bulb. This series filament is subjected to considerable overloads due to the low voltage which prevails at first in the high-pressure tube when the latter is switched in. These overloads are bound to impair the economy of the lamp or to shorten its life considerably.

In order to eliminate this disadvantage, it has been already proposed to dampen the harmful overcurrent, occurring at the start, by means of a special starting filament which is in series with the series filament and the high-pressure tube, and which can be by-passed by means of a switch once the lamp has been started. However, it was found that even when the overcurrent at the start is completely suppressed, the longevity of this series filament will not be sufficient since, in order to obtain a sufficient light output, this filament must be dimensioned for a considerable operating temperature. Its atomization and vaporization at the operating temperature shortens its life, which becomes much shorter than that of the discharge tube.

This disadvantage is obviated when a mixed-light lamp is used, according to the invention, in which two filaments are connected ahead of the high-pressure vapor-discharge tube, which filaments are themselves connected in series; a change-over switch combined with the lamp being provided which, after a certain operating time, for instance after each new switching-in of the lamp and starting of the high-pressure discharge tube, will by-pass alternately one of the two incandescent filaments connected ahead of the lamp. To this end a small switching lever, mounted either in the bulb or in the base of the high-pressure discharge tube, can be applied, which lever is turned, by means of a bimetallic strip influenced by the heat of the series filaments, alternately in one or the other contact position.

In such a mixed-light lamp, the overcurrent at the start is lowered, since then both filaments ahead of the tube lie simultaneously in the lamp circuit. Moreover, the life of the series filaments can be nearly doubled and the light output can be increased by raising the operating temperature of each filament, the two series

filaments being used alternately as operating filaments. Inasmuch as, according to experience, the utilization of the lamp after each switching-in is nearly always very short compared to the life of the lamp, both series filaments in the lamp, according to the invention, are used up very evenly, provided at each new starting another filament is by-passed. More precisely, the two filaments are used alike when successive periods of operation of the lamp are equal and the concomitant operating conditions are the same.

In order to lengthen the life of the lamp or to increase the light output of mixed-light lamps, it has been already proposed to switch in, parallel with the series incandescent filament, a second filament which is switched in as substitute (for instance by means of an oxidic layer which becomes punctured when the first filament breaks down). However, with such a mixed-light lamp, only one filament is connected in series ahead of the discharge tube at the moment of starting; thus, the harmful overcurrent at the start is not lowered. Besides, when the first filament breaks down, the partial burning off of its ends will blacken the lamp vessel which contains said filament. Finally, there is the danger of arcing due to displacement of the parts when the first filament burns out, and this may cause the base fuses to respond.

For a further understanding of our invention, reference may be had to the single figure of the drawing which is an elevation, partly in section, of a lamp comprising our invention.

Referring to the drawing, the lamp comprises a bulb 1 containing a small mercury high-pressure discharge tube 2 for an operating pressure of about 5 atmospheres; it contains also the two similar series filaments 3, 4, which consist of tungsten wires constituting a simple coil or a coiled coil filament. Filaments and high-pressure tube are connected in series in the current-supply circuit between the two base contacts 5 and 6. Within the base, the change-over switch 7 is mounted with the switching lever 8, which can be turned under friction, and with the two bimetallic strips 9 and 10 which, when heated, move in the direction of the switching lever 8. The travel of the switching lever 8 is limited at both ends by the limit pins 11. The short insulating parts 12 at the bimetallic strips or thermostats 9 and 10 prevent the two bimetallic strips from coming into simultaneous contact with the switching lever 8.

The point of interconnection of filaments 3, 4 is connected to the switching lever 8 by means of shunting circuit conductor 13. The other or opposite ends of the filaments 3, 4 are connected to the bimetallic strip 9 or 10, respectively, by way of conductors 14, 15. Depending upon whether the bimetallic strip 9 or the bimetallic strip 10 comes in contact with the switching lever 8, the incandescent filament 4 or the incandescent filament 3 will be short-circuited.

When the mixed-light lamp is switched in and energized for operation, the discharge current during the starting period of tube 2 flows from the base contact 5 through the filaments 4 and 3 and the tube 2 to the base contact 6. Both filaments 3, 4 are connected ahead of the discharge tube 2 and thus coact as ballast to prevent a harmful rising of the starting current. Owing to the heating effect of the incandescent filaments 3 and 4 and of the discharge tube 2 developed when the supply circuit is energized, which effect manifests itself also in the base, both bimetallic strips 9 and 10 begin to move slowly and oppositely, after a time which can be easily adapted to the starting characteristic of the discharge tube 2, toward the switching lever 8. Inasmuch as this lever, as shown in the drawing, rests against the left stop, it will be the bimetallic strip 9 which will first engage and press against that switching lever, so that incandescent filament 4 will be shunted, and the bimetallic strip 9 will be additionally heated by the lamp current flowing through it, to such an extent that it will move the switching lever 8 until the latter reaches the stop 11 on the right side, and in doing this will push back, by means of the insulating element 12, the bimetallic strip on the right. When the lamp is turned off, both bimetallic strips 9, 10 go back to the position shown in the drawing, so that the switching lever 8 remains in its new position on the stop at the right. If the lamp is switched in again, the bimetallic strip 10 will first touch the switching lever 8 so that filament 3 is short-circuited and filament 4 remains the only one which acts as series resistance during the further operation of the lamp.

If both incandescent filaments 3, 4 are built into the lamp bulb 1, the latter should be able to disperse the light, i. e., it should be frosted. The bulb may also be lined with phosphorus (in the well-known manner) which, by utilizing the short-wave radiation, will increase the effect of the visible radiation or of the long-wave ultraviolet radiation. If the two filaments have different dimensions, one and the same lamp will make it possible to obtain, with good efficiency, two different light intensities and spectra of the mixed-light radiation, and these light intensities and spectra may be switched in at will by means of a change-over switch mounted outside the lamp. By applying a change-over switch which is manually operated, one may also continue to use the lamp even after one of the two filaments has burned out, since the damaged filament can be now permanently by-passed. The lamp behaves then as the usual mixed-light lamp with only one filament connected ahead of the tube. It is also possible to apply the invention when the filaments are mounted separately from the high-pressure vapor-discharge tube, that is to say when two incandescent lamps are connected ahead of the high-pressure discharge tube. Even in this case a change-over switch may be used which may be mounted separately from the lamps, and which may be actuated

either electromagnetically or manually so as to by-pass one or the other incandescent lamps after the starting of the tube.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A method of operating a gaseous electric discharge lamp with a pair of ballasting filaments which comprises connecting both the filaments in series with each other and with the discharge gap of the lamp, to coact as ballast therefor, when energizing the lamp for operation; and following the successive starting periods of the lamp at successive energizations thereof as aforesaid, connecting a shunting circuit around the several filaments alternately; so that while the lamp always starts with both filaments as ballast and runs with only one, the filaments are used in alternation in the successive periods of operation of the lamp.

2. The combination with a gaseous electric discharge lamp and its current supply circuit, of a pair of filaments both connected in said current supply circuit in series with the discharge gap of the lamp, as well as in series with one another, and switch means operable to shunt out said filaments alternately at successive energizations of said current supply circuit.

3. The combination set forth in claim 2 wherein the switch means comprises a lever part connected to one end of each of the filaments and bimetallic strips arranged at opposite sides of said lever and connected, respectively, to the opposite ends of the filaments from their ends that are interconnected as aforesaid, said bimetallic strips moving into engagement with said lever to make electrical connection and change its setting in response to temperature changes, and being provided with separator means, so that only one of the strips at a time can engage said lever and thus shunt the filament connected thereto.

4. The combination with a gaseous electric discharge lamp and its current supply circuit, of a pair of filaments both connected in said current supply circuit in series with the discharge gap of the lamp, as well as in series with one another, and thermal switch means, actuated by heat developed when said current supply circuit is energized, for shunting out said filaments alternately at successive actuations of said switch means as aforesaid.

5. The combination with a gaseous electric discharge lamp and its current supply circuit, of a pair of filaments both connected in said current supply circuit in series with the discharge gap of the lamp, as well as in series with one another, and thermal switch means for shunting out said filaments alternately at successive energizations of said current supply circuit, comprising thermostats that move oppositely in response to heat developed when said current supply circuit is energized and are connected to ends of both filaments, and a switch device for engaging with either of said thermostats itself connected to the other ends of both filaments and shiftable by each thermostat, when engaged thereby, into a position where it engages the other thermostat at the next succeeding energization of said current supply circuit.

6. In combination, a gaseous electric discharge lamp, a pair of filaments connected in series with each other and with the discharge gap in said lamp, and switch means comprising a movable contact member connected to one end of each of

75 said filaments, and a pair of actuating contact

members connected one to each of the opposite ends of said filaments, said movable contact member being located in one position to be engaged by one of said actuating contact members upon starting of the discharge in said lamp to shunt the filament connected thereto and to move the said movable contact member to a second position where it is engaged by the other actuating contact member and moved back to its first-mentioned position upon subsequent energization of the combination.

7. In combination, a gaseous electric discharge lamp, a pair of filaments connected in series with each other and with the discharge gap in said lamp, and switch means comprising a movable contact member connected to one end of each of said filaments and arranged to move between two positions, and a pair of thermally-responsive contact members mounted on opposite sides of said movable contact member and

movable toward it and connected one to each of the opposite ends of said filaments, said movable contact member being closer to one or the other of said thermally-responsive contact members in either one of its two positions, said thermally-responsive contact members being arranged to alternately engage said movable contact member upon successive energizations of the combination to shunt the filament connected to the thermally-responsive contact member which is then in engagement with the movable contact member and to move the said movable contact member to the other of its two positions, and means for maintaining one of said thermally-responsive contact members out of electrical contact with said movable contact member when the other thermally-responsive contact member is in engagement with the said movable contact member.

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