

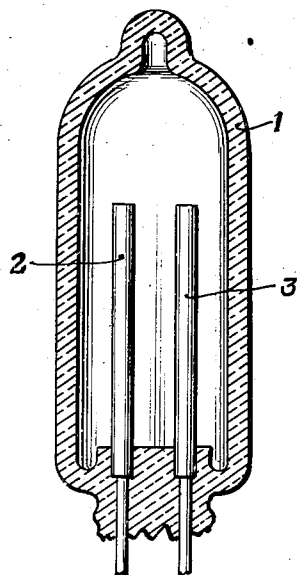
May 1, 1945.

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2,374,677

GLOW DISCHARGE LAMP

Filed Sept. 20, 1943



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UNITED STATES PATENT OFFICE

2,374,677

GLOW DISCHARGE LAMP

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Application September 20, 1943, Serial No. 503,046

3 Claims. (Cl. 176-122)

Our invention relates to a new and improved gas-containing discharge lamp, of the type which is designated as a "glow lamp" or a "glow tube." Such lamps are also designated as cold electrode lamps, because the electrodes of such lamps remain unheated save by the very moderate heat which is developed by the discharge itself.

Such lamps are intended for operation under a predetermined operating voltage. In order to start or to strike such a lamp, it is necessary to apply a striking voltage which exceeds said operating voltage. In the circuit in which such a lamp is located, it is necessary to apply an over-voltage, which exceeds the striking voltage. This is done in order to suppress or minimize the delay in starting the lamp.

For example, in the type of lamp which is specifically described herein, as one example of our invention, the striking voltage can vary from 70 volts to 90 volts and the operating voltage is about 15 volts less than the striking voltage. The over-voltage which is applied to the lamp in order to start the same promptly, exceeds the striking voltage by about 5 volts.

Experience has shown that the striking voltage can vary greatly, depending upon the length of time in which the lamp has been shielded from light. For many uses, it is necessary to locate the lamp in a hood or casing which shields the lamp from external light, so that the lamp can remain unexposed to light for long and varying periods of time. The period during which the lamp remains inoperative is designated as the "idle period." The striking voltage varies greatly with the length of said idle period, when the lamp is struck for the first time after such idle period, if the lamp is shielded from external light during such idle period. Such idle period is designated as a shielded idle period, during which the lamp is shielded from external light.

In certain uses, the idle period can be as long as one or two days, during which period the lamp is shielded from light. Under such circumstances, there can be a variation in the striking voltage of as much as 50%, in the first striking after such shielded idle period. Hence, if the circuit is designed so as to supply a normal over-voltage which exceeds the striking voltage by only 5 volts, the starting of the lamp can be greatly delayed, and such starting may not take place, in the first attempted striking after such shielded idle period, thus producing great uncertainty in operation, because the necessary striking voltage itself may greatly exceed even the over-voltage which is applied to the lamp by the

circuit, when it is desired to start the lamp after such shielded idle period.

According to our invention, we continuously irradiate the interior of the lamp, including its internal electrodes as well as its internal wall, by means of a source of light which is independent of the circuit of the lamp. For example, this independent irradiation can be produced by means of a phosphorescent or fluorescent material, such as phosphorescent zinc sulfide, intermixed with radium bromide or other radioactive material which emits alpha rays. Such mixture continuously produces light which sufficiently irradiates the glow lamp, so that the variation of the striking voltage in the first striking after a shielded idle period is limited to less than 10%, as compared with the present usual variation of about 50% or more. By supplying sufficient irradiation, we can reduce the variation in the required striking voltage after such shielded idle period to much less than 10%, to as low as 5% or even less.

Another object of our invention is to provide an irradiation, wholly or mainly in those wave lengths to which the electrodes are sensitive. These wave lengths will depend upon the material of the electrodes, and it will also depend upon whether the electrodes are coated or uncoated. In many cases, the cold electrodes are coated with a material which emits electrons readily, and under the application of low energy. These materials are designated as "low work-function substances." Examples of such low work-function substances are caesium oxide, barium oxide and other materials which are well known for this purpose.

If the lamp has such coated electrodes, visible light may be used to irradiate the bulb. However, even in this case, the violet and ultra-violet light will be more efficient. By selecting from the well-known luminescent materials, which include phosphorescent and fluorescent materials, we can secure radiated light of various colors, thus selecting a range of wave length which will have the maximum photoelectric effect.

Other important objects of our invention will be stated in the annexed description and single diagrammatic drawing, which illustrate an embodiment of our invention.

Our invention is described with reference to a standard commercial lamp, which has a glass bulb or envelope 1, whose height is about 20 millimeters. This is provided with spaced cold electrodes 2 and 3 which are made of nickel. Said envelope 1 has a gaseous filling whose pressure at

normal temperature of about 20° C.-25° C. is about 20 millimeters of mercury. This filling consists of 99% of neon and 1% of argon. Each of the electrodes 2 and 3 is a solid metal cylinder. The height of each cylinder is 12 millimeters, and its diameter is 1 millimeter. In the example stated herein as an illustration, the electrodes 2 and 3 are equal and parallel to each other. The width of the space between said electrodes is about 2-3 millimeters. The internal wall of the envelope is substantially cylindrical and the diameter of such internal wall is about 5 millimeters.

Since commercial lamps of this type will vary from lamp to lamp, due to inaccuracies in commercial manufacture, the striking voltage can vary from lamp to lamp from about 70 volts to 90 volts, and possibly more. One the average, the operating voltage is 15 volts less than the striking voltage. The over-voltage which is applied in order to strike the lamp without undue delay, exceeds the striking voltage by about 5 volts. This is stated by way of illustration, because the important factor herein is to provide a uniform striking voltage so that said striking voltage is stabilized, with a variation which is insignificant for practical purposes.

The improved lamps can be used in switches, relays, transmitting pictures by wire or radio, and for many other purposes, in which a stable striking voltage is required.

After a lamp of this type has had an idle period of one or two days, during which idle period the lamp is shielded from light, the striking voltage for the particular lamp may increase by as much as 50%. After the lamp has been struck for the first time after a long shielded idle period, its striking voltage during subsequent striking will have only a much smaller value, if the intermediate shielded idle period is very short. Therefore, an important feature of our invention is to stabilize the striking voltage, even if the lamp has been shielded from light during a long idle period. A long idle period can vary from ten minutes to one or two days, or even more.

A suitable self-luminescent composition can be made, for example, by intermixing with 1 gram of fluorescent zinc sulfide, 100-130 micrograms of radium, in the form of radium bromide or other suitable radium salt.

When we refer to this mass 100-130 micrograms of radium, we refer to the mass of the radium in the radium bromide, so that the mass of the radium bromide itself will exceed 100-130 micrograms. A self-luminescent composition of this type will produce a luminescence of approximately 100 micro-lamberts.

Such a composition can be applied either to the internal wall or to the external wall of the envelope 1. The wall of the envelope 1 can be made of material which is permeable to ultra-violet rays. There are wellknown types of glass which are permeable to ultra-violet rays, and we can use such wellknown glass compositions. However, the invention is not limited to the use of ultra-violet rays, and it may be that ultra-violet rays are not emitted by the activated fluorescent zinc sulfide.

It is well known to apply such compositions to a glass wall or the like, by incorporating such compositions in suitable transparent varnishes or lacquers which are optionally but not necessarily, permeable to the ultra-violet rays, as well as to the rays in the visible spectrum. It

is therefore unnecessary to describe the specific mode of applying the self-luminescent composition, either to the interior or exterior wall of the bulb 1. The composition is preferably applied over the entire internal wall, or over the entire external wall of the bulb 1, but our invention is not limited thereto. Said composition may be applied to one or more spots, either to said internal wall or to said external wall. The composition is preferably not applied to the electrodes 2 and 3.

The photoelectric effect of an illumination of about 100 micro-lamberts is sufficient to supply enough photons, so that according to our theory, there will also be sufficient free electrons in the gaseous filling of the lamp in order to stabilize the striking voltage. Likewise, some ionization may be produced by the alpha and beta rays which are emitted by the radium, but our invention is particularly directed to the photoelectric effect.

On the other hand, if the coating would consist of zinc sulfide or other phosphorescent material alone, such coating would not stabilize the striking voltage after a substantial shielded idle period.

In addition to making the walls of such tubes of glass or other light-permeable material, it is well known to make such walls of metal or other material which is impermeable to light. In such case, we locate the self-luminescent material in the interior of the bulb. The self-luminescent material can be applied to the inner surface of the glass or metal bulb, or to the inner surface of a bulb made of any suitable material, or to any suitable carrier which is located within the bulb. Said carrier may be fixed to the interior wall of the bulb. For example, such carrier may be a rod of glass or the like, which is fixed to the interior wall of the bulb. In effect, such a carrier would be an extension of the interior wall of the bulb.

Likewise, if the self-luminescent material is external to the wall of the bulb, such self-luminescent material may be mounted upon a carrier which may be spaced from the outer face of the bulb.

Therefore, our invention is not limited to any particular location of the mass of self-luminescent material. However, it is preferred to locate the self-luminescent material directly upon the bulb, in order to secure maximum photoelectric effect.

In the specific example stated herein, the discharge current is about 1 milliamper, which is regulated by the operating voltage and the external resistance. The action of the self-luminescent material does not affect this normal discharge current under the same conditions of voltage and external resistance.

The weight of the radium which is utilized in the self-luminescent material for the specific lamp described herein, may vary from about 2 micrograms to 20 micrograms.

When we refer to a "glow discharge," we refer to a discharge in which the discharge current is less than in the arc discharge or in the spark discharge. In order to maintain the glow discharge between cold electrodes, and in order to prevent such discharge from becoming an arc discharge or a spark discharge, we limit the discharge current by suitable external resistances. The cold electrodes 2 and 3 have substantially no disintegration in the glow discharge. Such electrodes

have a high rate of disintegration in a sustaining arc discharge or spark discharge.

We are concerned primarily with the starting of the lamp. After the lamp has been started by the discharge between cold electrodes, the intensity of the discharge current may exceed the intensity of the glow discharge, so that the lamp may operate, after starting, at glow discharge or arc discharge or spark discharge. For some uses, the conservation of the electrodes may not be important. Hence, we do not limit our invention to a lamp which operates only at glow discharge, after the starting.

The drawing does not show the light-impermeable hood or casing in which the lamp is located. This may be the casing of a calculating machine, switch, relay, etc.

We claim:

1. A glow discharge lamp which has an ionizable gaseous filling and spaced cold electrodes, said lamp, when not irradiated as later specified

herein, having a striking voltage which varies more than 10% for striking said lamp initially after a light-shielded idle period of more than ten minutes, said lamp having a source of light rays associated therewith, said source delivering light rays to the interior of said lamp, said source comprising radioactive material and additional material which is activated by said radioactive material to emit said light rays, said source delivering a substantially uniform supply of light rays, said supply being sufficient to make said striking voltage in said initial striking uniform within a range of less than 10%.

2. A glow discharge lamp according to claim 1, in which said source is fixed to said lamp.

3. A glow discharge lamp according to claim 1, in which said source is fixed to said lamp, and said source is spaced from said electrodes.

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