Aug. 4, 1942. M. PIPKIN 2,291,983

FLASH LAMP

Filed April 8, 1940

Fig. 1.

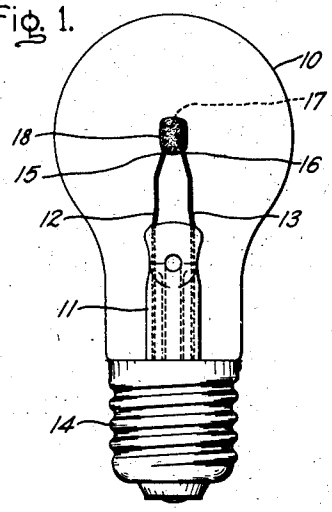


Fig. 2.

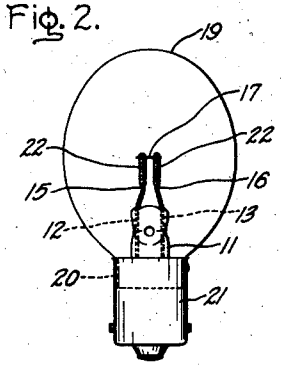


Fig. 6.

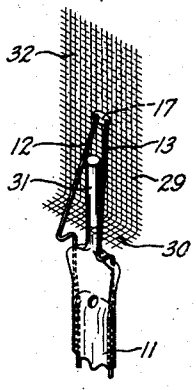


Fig. 5.

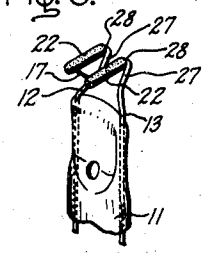


Fig. 3.

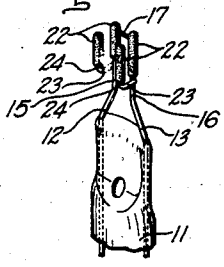
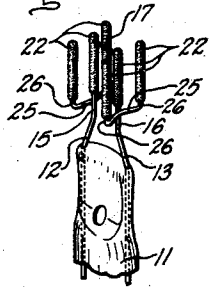


Fig. 4.



Inventor:
Marvin Pipkin,
by John J. Henderson
His Attorney.

Patented Aug. 4, 1942

2,291,983

UNITED STATES PATENT OFFICE

2,291,983

FLASH LAMP

Marvin Pipkin, Cleveland Heights, Ohio, assignor to General Electric Company, a corporation of New York

Application April 8, 1940, Serial No. 328,399

14 Claims. (Cl. 67—31)

My invention relates in general to flash lamps, and more particularly to that type of flash lamp used for photographic purposes which usually comprises a sealed light-transmitting bulb in which is enclosed suitable means for producing, upon ignition of the lamp, a flash of actinic light. The present application is a continuation-in-part of my co-pending application Serial No. 104,595, filed October 8, 1936, the subject matter of which is incorporated herein by reference.

At present, the combustible material generally employed in flash lamps consists either of a quantity of extremely thin metallic foil or a quantity of extremely fine metallic wire of aluminum or magnesium or alloys thereof. Such material, when ignited in an oxygen or oxygen-containing atmosphere, burns very rapidly with the resulting emission of a substantial amount of actinic light. Although both forms of material have proved to be very satisfactory, care is required in forming the foil into sheets of the required thinness and in obtaining uniform thickness in the sheets. Variations in thickness of the sheets results in variations in the time of combustion and in the duration and amount of the actinic radiation for individual lamps. Furthermore, the handling of such thin foils and their insertion into the bulbs are comparatively difficult and require careful manual operations. This, together with the relatively high cost of the thin foil, makes such foil flash lamps fairly expensive. Likewise, the wire used at present in flash lamps must undergo an involved and comparatively expensive wire-drawing process in order to be drawn to the required size or fineness for satisfactory use in flash lamps. In addition, care must be taken in loading the wire into the bulb to insure uniform distribution of the wire in individual lamps and therefore to insure uniform performance thereof. For the above reasons, wire flash lamps, as well as foil flash lamps, are relatively expensive.

One object of my invention is to provide flash lamps which are relatively inexpensive and which are uniform in flash characteristics.

Another object of my invention is to provide flash lamps having a construction suitable for machine production so as to eliminate hand labor and reduce the cost of production of such lamps.

A feature of the invention is the use of one or more beads or coatings of a readily ignitable light-producing material as the sole source of actinic light. A further feature is the use of a wire framework or supporting structure, preferably of non-combustible material, for the light-producing material whereby the latter, instead of being formed as a large single bead, is distributed within the bulb in the form of relatively small masses or beads, thereby facilitating the complete combustion of such material.

Further objects and advantages of my invention will appear from the following description of species thereof and from the accompanying drawing in which:

Fig. 1 is a front elevation of a flash lamp comprising my invention; Fig. 2 is a front elevation of a modified form of flash lamp comprising my invention; and Figs. 3 to 6 are perspective views of the mount construction of various other modifications of my invention, Figs. 3 to 5 being on an enlarged scale.

Referring to the drawing, the flash lamp shown in Fig. 1 comprises a sealed light-transmitting envelope or bulb 10 of suitable material, such as glass, having a reentrant stem 11 and a pair of conventional leading-in wires 12, 13 extending through the said stem and connected at their outer ends to the terminals of a conventional lamp base 14. The bulb is coated on its inner or outer surface, preferably on both surfaces, with a coating of a suitable light-transmitting varnish or lacquer to thereby minimize cracking of the bulb on charge-flashing and to render the bulb substantially shatterproof, as disclosed and claimed in co-pending application Serial No. 269,197, H. D. Blake, filed April 21, 1939. The inner ends of the leading-in wires 12, 13 are formed with straight parallel portions 15, 16 disposed more or less centrally within the bulb and in relatively close relation to each other. At their innermost ends, the leading-in wires 12, 13 are bridged by a small filament 17 constituting the ignition means for the flash lamp.

The actinic light-producing means according to the invention comprises a quantity of suitable combustible light-giving material 18 mounted on the juxtapositioned portions 15, 16 of the leading-in wires 12, 13 and entirely enclosing the filament 17. Upon the passage of an electric current through the filament 17, the light-giving material 18 is ignited and emits a flash of actinic light. The light-giving material is applied to the lead-in wire portions 15, 16 in the form of a paste which, on drying, forms a bead or coating on the wires. The light-giving material is composed of a mixture of extremely sensitive metal powder (or powders) and oxidizing powder (or powders) bonded together by a suitable binder or agglutinant. The powdered material is thus held together as a mass solely by the binder so that no separate enclosure or container means for

such purpose is required. If desired, the bead or coating of agglutinated light-giving material may be provided with a coating of varnish or lacquer or other suitable substance to thereby strengthen the bead and so prevent the same from breaking and falling off the wire portions 15, 16. To insure the complete combustion of the combustible light-giving material 18 and thereby obtain the maximum light output therefrom, the bulb 10 is preferably filled with oxygen or an oxygen-containing gas at a suitable pressure, for instance, from 100 mm. of mercury up to one atmosphere or so. However, if desired, the bulb may be left open to the atmosphere or sealed off in air.

While the single large bead construction shown in Fig. 1 is entirely satisfactory insofar as the production of a flash of light suitable for photographic purposes is concerned, neverthless I prefer to employ one of the constructions shown in Figs. 2 to 6 wherein the combustible material is provided in the form of a coating or small bead on each of a plurality of support wires or on a wire framework. With such a construction, greater uniformity in the perforamance of individual lamps is obtained inasmuch as the greater distribution of the combustible material controls the burning of the same. Also, the light of the flash is distributed more uniformly in all directions.

Referring to Fig. 2, the modified form of flash lamp there shown is of the general type described and claimed in my co-pending application Serial No. 320,818, filed February 26, 1940, and comprises an ovoidal-shaped bulb 19 having a relatively short neck portion 20 entirely enclosed and reinforced by a base 21 secured thereto. Sealed into the bulb 19 is a mount construction similar to that shown in the lamp in Fig. 1 except that the combustible light-giving material, instead of being formed as a single bead 18 enclosing the juxtapositioned wire portions 15, 16 and filament 17, is arranged in the form of an extended coating or separate bead 22 on each of the said wire portions 15, 16 and covering the ends of the filament 17 where the latter is connected to the lead-in wires. Such a construction better assures the complete combustion of, and the maximum intensity from the light-giving material and results in greater uniformity in the flash characteristics of individual lamps.

The modification shown in Fig. 3 is similar to that shown in Fig. 2 except that each leading-in wire 12, 13 is provided with an additional L-shaped wire support 23 welded or otherwise secured at one end to the said leading-in wires at a point removed from the inner extremities thereof and having, on their free leg portions 24, a coating or bead 22 of combustible material similar to that on the lead-in wire portions 15, 16. The L-shaped wire supports 23 are arranged with their free leg portions 24 upstanding so as to extend substantially parallel to and coextensive with the portions 15, 16 of the leading-in wires. In addition, they are preferably arranged so that the upstanding leg portions or posts 24 and the juxtapositioned inner end portions 15, 16 of the leading-in wires are spaced substantially equidistant from one another. Thus, the said upstanding leg portions 24 and the inner end portions 15, 16 of the leading-in wires may be arranged in square formation; that is to say, they may be arranged so as to form the four corners of a square. By means of the additional support wires 23, 23, which together with the inner end portions 15, 16 of the leading-in wires form a sort of non-combustible wire framework or support structure for the combustible material 22, a greater quantity of such material may be incorporated within the lamp without unduly increasing the size or thickness of the bead or coating 22. The greater quantity of combustible material provides a greater light output, while the distribution of the same into relatively small size beads or coatings 22 tends to assure the complete combustion of, and consequently the maximum light output from the combustible material as well as uniformity in the characteristics of individual lamps.

In the modification shown in Fig. 4, the principle involved in the construction of Fig. 3 is carried out still further by providing each leading-in wire 12, 13 with an additional wire support 25 having two upstanding prongs or posts 26, 26 which, together with the juxtapositioned inner end portions 15, 16 of the leading-in wires 12, 13, constitute a non-combustible wire support structure for the agglutinated light-giving material in the form of a group of six spaced posts or prongs. As in Fig. 3, the additional wire supports 25 are welded or otherwise secured to the leading-in wires 12, 13 at a point removed from the inner ends thereof, and are preferably so arranged that the upstanding prongs 26 are disposed symmetrically about the leading-in wire portions 15, 16. Thus the upstanding prongs 26, constituting the outer group of wire support posts for the combustible light-giving material, may be arranged in either a square or rectangular formation about the inner group of posts constituted by the inner-end portions 15, 16 of the leading-in wires. Furthermore, the outer posts 26 are preferably arranged so that each is substantially equidistant from the adjacent inner post or leading-in wire portion 15 or 16 and so that the pair of posts 26 on each wire support 25 are spaced from each other at least a distance equal to that of the spacing of the juxtapositioned wire portions 15, 16. Each of the posts 26, as well as the inner end portions 15, 16 of the leading-in wires, are provided with a relatively small bead or extended coating 22 of agglutinated combustible light-giving material of the general composition referred to above in connection with Fig. 1. The use of six wire support posts, instead of the four shown in Fig. 3, permits a still greater quantity of light-giving material to be arranged within the bulb and distributed in relatively small masses so as to insure the complete combustion thereof.

In the modification shown in Fig. 5, the inner ends of the leading-in wires 12, 13, instead of extending straight inward from the stem 11 as in the previous forms of the invention, are bent into parallel hooks 27 with the free ends 28 of the hooks extending substantially transversely to the longitudinal axis of the stem 11. Each of the free ends or prongs 28 is provided with a relatively small size bead or coating 22 of light-giving material as described hereinbefore. With such a construction, a considerable portion of the light-giving material, upon ignition of the lamp, is projected in the direction of the length of the lamp bulb so that the said material has to travel through a greater distance before reaching the bulb wall. As a result, the material is apt to be more nearly consumed before reaching the bulb wall so that the possibility of cracking of the glass by the contact of the hot metal particles therewith is reduced to a minimum.

The forms of the invention shown in Figs. 1 to 5 lend themselves particularly well to manufacture by machine methods inasmuch as the combustible light-giving material may be applied to the mounts simply by inverting and dipping them into a paste of such material. By controlling the consistency of such material and the extent of immersion of the mount, a uniform quantity of the combustible paste material is applied to the individual mounts and distributed uniformly thereon in the form of coatings or beads. As a consequence, the flash characteristics of individual lamps tend to be uniform.

While I have shown, in Figs. 3 and 4, the preferred arrangement of the wire support posts for the combustible material where a plurality of such posts are employed, other modifications are possible. Thus, a plurality of wire supports or posts may be arranged about the lead-in wire portions 15, 16 in the form of a circle or in any other desired configuration, the only condition being that the posts should not be so close to one another or to the lead-in wire portions 15, 16 as to cause a bridging of the combustible paste material therebetween when the mount is removed from the dipping batch.

In the modified construction shown in Fig. 6, a piece of screen 29, preferably of aluminum wire of large enough diameter to be substantially non-combustible, is mounted above the stem 11 so as to extend adjacent the longitudinal axis of such stem. The screen 29 has a laterally bent lower end 30 having an opening therein through which extends a short tube or rod 31 extending from the end of the stem 11. The leading-in wires 12, 13 are bent so as to locate the filament 17 adjacent to a portion of the screen 29. At least a portion of the said screen 29 and the filament 17 are provided with a coating 32 of combustible paste or light-giving material which, upon passage of an electric current through the filament 17, is ignited and emits a flash of actinic light. The coating 32 is of the general composition specified hereinabove and consisting of a mixture of extremely sensitive metal powder (or powders) and an oxidizing powder (or powders) held together with a suitable binder. The ingredients are mixed to a paste into which the screen 29 and filament 17 may then be dipped. The mount is then sealed in a bulb which is preferably exhausted and filled with a suitable amount of oxygen, for example to a pressure of about 200 mm. of mercury. If desired, the screen 29, instead of being made of aluminum wire heavy enough to be non-combustible, may be made of very fine wire so that it is ignited as well as the coating 32 to thereby increase the intensity of the radiation.

The composition of the combustible paste material used for the bead 18 or coatings 22 and 32 may be varied to provide, on ignition, the particular type of light flash desired. One composition which I have found to be particularly suitable for the lamp shown in Fig. 1 consists of a mixture of 2 grams of zirconium metal powder and 3 grams of calcium peroxide powder made into a thick paste by the addition of glue water and applied in the form of a bead to the wire portions 15, 16. The dried bead is then dipped into a mixture consisting of 1 gram of aluminum powder (sufficiently fine to pass a 100 mesh screen) and 2 grams of calcium peroxide powder made into a paste with a solution of nitrocellulose, for example, a 4% solution of nitrocellulose in amyl acetate. A lacquer coating is then applied over the composite bead for strengthening purposes. The use of calcium peroxide as the oxidizing agent results in the formation of a white oxide on the lamp bulb upon flashing of the lamp, in contradistinction to the darker colored oxides formed when certain other well-known oxidizing powders are used instead. In this manner, the tendency of the products of combustion to mask the actinic light produced by the flash is minimized.

To produce what is known as a "fast" lamp, i. e., one in which the duration of the flash is relatively short, I have found the following composition to be particularly suitable: 3 grams zirconium metal powder, 1 gram magnesium metal powder (325 mesh), 1 gram C. P. (chemically pure) sodium chlorate powder (200 mesh) and 1 gram C. P. potassium perchlorate powder (300 mesh) intimately admixed and made into a paste by the addition of about 2 cc. of a 4% solution or so of nitrocellulose in amyl acetate. The total light output of a lamp having a bulb such as that shown in Fig. 2, when provided with a single bead of about 50 to 60 milligrams of combustible paste material of the above composition and a filling of oxygen at a pressure of about 500 mm. of mercury, is approximately 5,000 lumen-seconds. The peak of the light flash of such a lamp occurs at about 1½ milliseconds after closure of the circuit through the filament, while the effective duration is about 10 milliseconds.

To produce a flash of light having its peak at about 20 milliseconds following closure of the circuit through the lamp, I have found the following composition to be particularly suitable: 0.5 gram magnesium metal powder, 0.5 gram zirconium metal powder, 1 gram aluminum powder, 1 gram calcium peroxide powder and 1 gram C. P. potassium perchlorate powder intimately admixed and made into a paste by the addition of about 3 cc. of a 4% solution or so of nitrocellulose in amyl acetate. Flash lamps of the type shown in Fig. 4, having about 70 milligrams of combustible paste material of the above composition and a filling of oxygen at a pressure of about 500 mm. of mercury, will produce a flash of light peaking at about 19½ milliseconds after closure of the lamp circuit and having a total output of about 6,900 lumen seconds and an effective duration of about 12 milliseconds.

For the production of a light flash having a peak of extended duration, the following composition may be used: 1.5 grams C. P. potassium perchlorate powder (325 mesh), 1.5 grams C. P. sodium chlorate powder (200 mesh), and 3.6 grams magnesium metal powder (325 mesh) made into a paste by the addition of about 2 cc. of a 4% or so solution of nitrocellulose in amyl acetate. Approximately 50 to 60 milligrams of this material mounted within a flash lamp of the type shown in Fig. 2, having a filling of oxygen at a pressure of about 500 mm. of mercury, will produce a flash of light of about 5,600 lumen seconds having an extended peak of about 25 milliseconds duration.

The color of the actinic light radiated by the light-giving material, and thus its photographic effect, may be modified by the application of various chemical substances to the coatings or beads of light-giving material, either by including such substances in the mixture of which the beads or coatings are made, or by applying such substances over the beads or coatings. Such substances may be, for instance, salts of strontium, calcium, sodium or potassium and the like.

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

1. A flashlamp comprising a container, non-combustible support means in said container, a quantity of combustible material adhering to said support means for emitting upon combustion a flash of actinic radiation of sufficient intensity for photographic purposes, said combustible material constituting substantially the sole source of actinic radiation produced by the lamp, and comprising an intimate admixture of finely divided readily combustible metal and oxygen-liberating material bonded together by a binder, and electrical means in said container in contact with said combustible material for igniting the same.

2. A flashlamp comprising a container filled with a gaseous oxygenous substance, noncombustible support means in said container, a compact quantity of finely divided agglutinated combustible material adhering to said support means for emitting upon combustion a flash of actinic radiation of sufficient intensity for photographic purposes, said combustible material constituting substantially the sole source of actinic radiation produced by the lamp and comprising a mixture of a finely divided readily combustible metal, an oxygen-liberating material and a binder, and electrical means in said container in contact with said combustible material for igniting the same.

3. A flashlamp comprising a sealed container filled with a gaseous oxygenic substance, non-conmustible support means within said container comprising a pair of leading-in wires having juxtapositioned inner end portions, a filament electrically connected between said wires, and a compact quantity of combustible material in the form of finely divided agglutinated light-giving material coated on said juxtapositioned wire portions and on at least a portion of said filament, said material constituting substantially the sole source of actinic radiation produced by the lamp and comprising an intimate admixture of finely divided readily combustible metal and oxygen-liberating material bonded together by a binder.

4. A flashlamp comprising a sealed container filled with a gaseous oxygenic substance, non-combustible support means within said container comprising a pair of leading-in wires having juxtapositioned straight inner end portions extending substantially parallel to each other and a plurality of wire support posts extending parallel to and co-extensive with said juxtapositioned wire portions but spaced therefrom, a filament electrically connected between said wires, and a coating of agglutinated light-giving material on said juxtapositioned wire portions and said support posts and covering at least a portion of said filament, said material constituting substantially the sole source of actinic radiation produced by the lamp.

5. A flash lamp comprising a sealed container filled with a gaseous oxygenous substance and containing a plurality of spaced non-combustible support members each carrying a discrete compact quantity of combustible material comprising finely divided agglutinated metallic material and oxygen-liberating material which emits, upon combustion, a flash of actinic radiation of sufficient intensity for photographic purposes, said combustible material constituting substantially the sole source of actinic radiation produced by the lamp, and means in said container for igniting said combustible material.

6. A flash lamp comprising a container filled with a gaseous oxygenous substance, non-combustible support means within said container comprising a pair of leading-in wires and a plurality of wire support posts mounted adjacent said leading-in wires and spaced therefrom, a filament electrically connected between said leading-in wires, and a discrete coating on adjacent portions of each of said leading-in wires and support posts of light-emitting material comprising metallic powder and a binder, said coatings being arranged to be ignited by said filament, said coatings constituting substantially the sole source of actinic radiation produced by the lamp.

7. A flash lamp comprising a container filled with a gaseous oxygenous substance, non-combustible support means within said container comprising a pair of leading-in wires and a plurality of wire support posts mounted on said leading-in wires and extending adjacent thereto, a filament electrically connected between said leading-in wires, and a discrete coating on adjacent spaced portions of each of said leading-in wires and support posts of light-emitting material comprising metallic powder and a binder, said coatings being arranged to be ignited by said filament, said coatings constituting substantially the sole source of actinic radiation produced by the lamp.

8. A flash lamp comprising a sealed container filled with a gaseous oxygenous substance and containing non-combustible support means provided with a coating of a combustible material which emits upon combustion a flash of actinic radiation of sufficient intensity for photographic purposes, said coating constituting substantially the sole source of actinic radiation produced by the lamp and comprising an admixture of a finely divided readily combustible metallic material and oxygen-liberating material bonded together by a binder, and means in said container independent of said support means for igniting said coating.

9. A flash lamp comprising a sealed bulb filled with a gaseous oxygenous substance, a pair of leading-in wires extending into said bulb, a filament bridging said leading-in wires, and a compact quantity of combustible material adhering to said leading-in wires in position to be ignited upon heating of said filament, said combustible material constituting substantially the sole source of actinic radiation produced by the lamp and comprising an admixture of a finely divided readily combustible metallic material and an oxygen-liberating substance bonded together by a binder.

10. A flash lamp comprising a sealed bulb filled with a gaseous oxygenous substance, a pair of leading-in wires extending into said bulb, a filament bridging said leading-in wires, and a compact quantity of combustible material adhering to each of said leading-in wires in position to be ignited upon heating of said filament, said combustible material constituting substantially the sole source of actinic radiation produced by the lamp and comprising an admixture of a finely divided readily combustible metallic material and an oxygen-liberating substance bonded together by a binder.

11. A flash lamp comprising a transparent container, a compact body of agglutinated material supported therein and comprising a combustible and a supporter of combustion intimately associated with each other, and electrical means at least a portion of which is in contact with said body for developing an ignition temperature

therein, said body constituting the sole source of radiation emitted by said lamp.

12. A flash lamp comprising a transparent container, a compact body of agglutinated material supported therein and comprising a combustible and a supporter of combustion intimately associated with each other, and electrical means comprising a filament at least a portion of which is in contact with said body for developing an ignition temperature therein, said body constituting the sole source of radiation emitted by said lamp.

13. A flash lamp comprising a transparent container, a plurality of leads within said container, a compact body of agglutinated material adhering to said leads and comprising a combustible and a supporter of combustion intimately associated with each other, and electrical means at least a portion of which is in contact with said body for developing an ignition temperature therein, said body constituting the sole source of radiation emitted by said lamp.

14. A flash lamp comprising a transparent container, a plurality of leads within said container, a compact body of agglutinated material adhering to said leads and comprising a combustible and a supporter of combustion intimately associated with each other, and electrical means comprising a filament extending between said leads, at least a portion of which is in contact with said body for developing an ignition temperature therein, said body constituting the sole source of radiation emitted by said lamp.

MARVIN PIPKIN.