Dec. 29, 1942. M. PIPKIN 2,306,563

FLASH LAMP

Filed Feb. 26, 1940

Fig. 1.

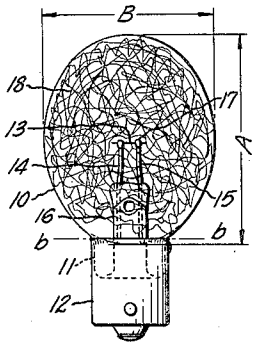


Fig. 2.

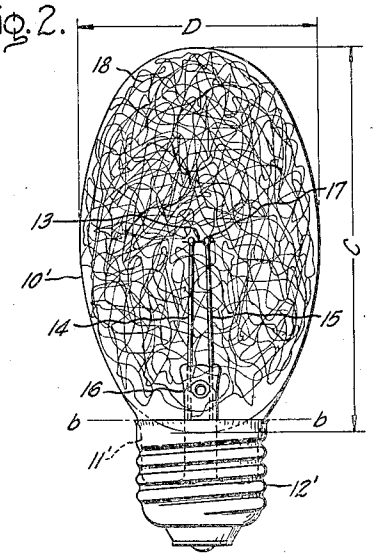


Fig. 3.

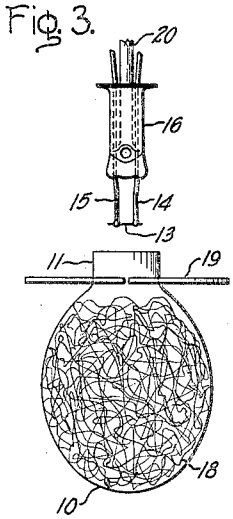


Fig. 4.

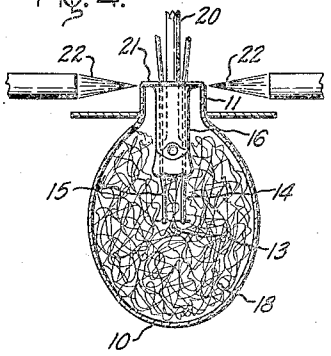


Fig 5.

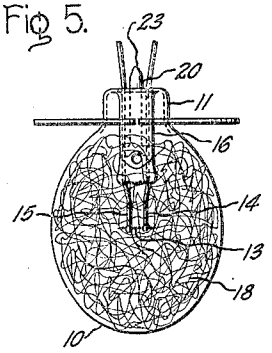
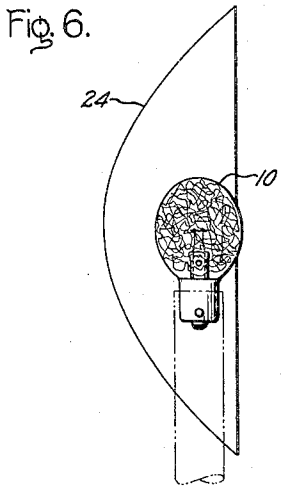


Fig. 6.



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UNITED STATES PATENT OFFICE

2,306,563

FLASH LAMP

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

Application February 26, 1940, Serial No. 320,316

3 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 bulb in which is enclosed suitable means for producing, upon ignition of the lamp, a flash of actinic light.

Photoflash lamps in commercial use at present have been provided, in practically all cases, with bulbs similar in shape to the conventional pear-shaped bulb employed for electric incandescent lamps. While such pear-shaped bulbs are desirable for incandescent lamps, they present certain disadvantages when used for flash lamps. Thus, the reverse-curved portions joining the bulbous portion to the bulb neck is a source of weakness in pear-shaped bulbs when used for flash lamps, and bulb strength is an important consideration in flash lamps where considerable internal pressure is developed when the lamp is flashed. This weakness of pear-shaped bulbs therefore places a limitation upon the amount of the loading or light-giving charge which can be safely introduced into the bulb. Another disadvantage connected with the use of pear-shaped bulbs for flash lamps is in the presence of the extended neck portion which constitutes more or less waste space since the combustible filling material is generally disposed, for the most part, in the bulbous portion of the bulb. The neck portion is thus an unnecessary part insofar as the production of the flash of light is concerned. As a consequence, the size of the bulb is unnecessarily large, whereas the desideratum is to make flash lamps as small as possible for convenience in transportation and use and for various other purposes.

One object of my invention is to provide a flash lamp which, for a given bulb size and a given factor of safety, will produce a greater total light output, and therefore a greater light output per unit of volume, than has heretofore been obtainable.

Another object of my invention is to provide a flash lamp which is more efficient in the generation of light than flash lamps heretofore in use.

Still another object of my invention is to provide a flash lamp with a bulb of improved shape and of greater strength and uniformity than the bulbs heretofore employed for flash lamps.

A further object of my invention is to provide flash lamps with bulbs of relatively small size as compared to the bulbs heretofore in use for flash lamps of comparable total light output.

A still further object of my invention is to provide a flash lamp of exceedingly small size and of relatively high light output.

A feature of the invention is the use of a substantially ovoidal and neckless bulb as the container for the flash lamp, with the combustible material disposed uniformly throughout practically the whole of the space within the bulb.

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 an elevation of a miniature flash lamp comprising my invention; Fig. 2 is an elevation of a larger sized flash lamp comprising my invention; Figs. 3, 4 and 5 are views illustrating the successive steps involved in the manufacture of the flash lamp comprising my invention; and Fig. 6 is a diagrammatic illustration of the flash lamp shown in Fig. 1 mounted within a concentrating reflector of substantially paraboloidal shape.

Referring to the drawing, the flash lamp according to my invention comprises a hermetically sealed vitreous envelope or bulb 10 of substantially ovoidal or ellipsoidal shape and having a relatively short neck portion 11 (Figs. 3–5) extending from one end thereof. Secured to the bulb neck portion 11 and entirely enclosing the same is a base 12 of the bayonet or any other suitable type. The base is preferably fastened to the bulb neck by means of cement, although other means may be employed if desired. The base is secured to the bulb with its upper edge or rim abutting against the ovoidal portion of the bulb. Thus the base encloses the entire length of the neck portion 11 and, together with the intermediate ring of cement, serves to reinforce the said neck portion. The bulb is coated on its inner or outer surface, preferably on both surfaces, with a coating of a suitable transparent varnish or lacquer to thereby prevent 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 coating is applied over the entire inner surface of the bulb including the small neck portion 11 thereof. Through the use of an improved method of bulb sealing, the burning away of this inner protective coating during such sealing operation is localized to a relatively small area of the bulb neck adjacent the outer end thereof so that the inner protective coating remains intact over the entire inner surface of the ovoidal portion of the bulb as well as the small reversely curved portions joining the

ovoidal and neck portions. As a result, the bulb 10 is better protected against cracking and shattering than is the case with the conventional pear-shaped bulbs used at present for flash lamps the inner lacquer coating of which is burned off the extended neck portion of the bulb during the sealing-in operation thereby leaving an appreciable area of the bulb unprotected from the hot particles of combustible material.

Mounted substantially centrally within the ovoidal portion of the bulb 10 is a small filament 13 the ends of which are connected to leading-in wires 14, 15 which extend through a stem 16 to the base 12. The filament 13 and adjacent portions of the leading-in wires 14, 15 are coated with a layer of a suitable fulminating substance 17 to thereby form the primer or ignition means for the lamp. The fulminating material is preferably of the type disclosed and claimed in co-pending United States application Serial No. 278,288, filed June 9, 1939, by George H. Merideth and assigned to the assignee of the present application. The fulminating substance therein disclosed comprises a mixture of magnesium and zirconium metal powders and potassium perchlorate powder bonded together by a suitable binder such as nitro-cellulose.

A quantity of loosely arranged readily combustible material 18 is disposed within the bulb 10 so as to occupy substantially the entire space within the ovoidal portion thereof and surround the ignition filament therein. The combustible material may consist of either a relatively thin foil or a filamentary wire or ribbon of aluminum and/or magnesium, the filamentary wire or ribbon being the preferred form. The filamentary aluminum wire employed may be of the type produced by the method disclosed in my co-pending United States application Serial No. 169,838, filed October 19, 1937.

Where wire is used as the combustible material, it is desirable to distribute the same as uniformly as possible throughout the effective portion of the bulb to thereby obtain the most effective combustion of the wire. To maintain such a uniform distribution of the wire at all times prior to the flashing of the lamp, I have found it advisable to positively secure the wire in place within the bulb in a manner similar to that described and claimed in co-pending United States application Serial No. 285,980, filed July 22, 1939, by John H. Oram and assigned to the assignee of the present invention. The securing of the wire in place within the bulb is accomplished according to the present invention, by employing a thermoplastic lacquer for the protective coating on the inner wall of the bulb. Because of its thermoplastic nature, it is merely necessary to heat the lacquer coating to secure the wire in place within the bulb. Under the influence of heat, the thermoplastic lacquer becomes soft and tacky so that those portions of the wire which are in contact with the inner coating become embedded therein and are consequently stuck to the bulb wall upon hardening of the coating. In this manner the wire becomes attached to the inner wall of the bulb at a plurality of points, thus effectively maintaining the uniform spacing or distribution of the wire throughout the bulb and so insuring the most effective combustion of the wire as well as uniform flash lamp characteristics. The heating and consequent softening of the thermoplastic inner lacquer coating may be produced by the heat attending the sealing-in of the bulb or it may be produced by an entirely separate heating operation.

As a result of the distribution of the combustible material throughout substantially the entire space within the bulb, the flash lamp according to the invention is more efficient and uniform in the generation of light than flash lamps heretofore in use employing conventional pear-shaped bulbs. Because of the constricted neck portion of such pear-shaped bulbs and the glass stem extending therethrough, the combustible material was disposed only in the bulbous or spherical portion of the bulb. Consequently, the combustion-supporting gas within the bulb neck, because of its disposition at some distance from the location of the combustible material, was not efficiently utilized in the instantaneous reaction producing the flash of actinic light. In the lamps according to the invention, however, the combustible material is distributed uniformly throughout the entire volume of combustion-supporting gas within the bulb so that the entire quantity of gas effectively assists in the combustion of the combustible material and ensures the complete combustion thereof.

The bulb also contains a filling of oxygen or oxygen-containing gas at a suitable pressure for supporting the combustion of the combustible material 18. The pressure of this gaseous filling will vary, depending upon the type of gas employed, the size of the bulb, and the quantity and type of combustible material therein. For the bulb sizes disclosed herein, and with oxygen being used as the combustion-supporting gas and pure aluminum as the combustible material, the pressure of the gaseous filling will vary up to 600 mm. of mercury or even close to one atmosphere.

The flash lamp shown in Fig. 2 differs from that shown in Fig. 1 only in that it is of larger size and is adapted to produce a flash of light of greater total output. Like the miniature lamp shown in Fig. 1, this larger lamp is also provided with an ovoidal or ellipsoidal bulb 10' and a base 12' which in this case is of the screw-threaded type.

The substantially ovoidal or ellipsoidal shaped bulbs which are used in accordance with the invention as the container for flash lamps, can be made more uniformly and possess considerably greater strength than the conventional pear-shaped bulbs heretofore in use. According to present-day methods of manufacturing lamp bulbs, the bulbs are formed from gobs or blanks of molten glass the central portion of which is allowed to fall freely into a mold where it is then blown into the shape of the mold. The ovoidal shape of the bulbs according to the invention conforms very nearly to the shape of such a free falling gob of glass, much more so than the conventional pear-shaped bulb. Consequently, when the free falling gob of glass is finally blown out against the walls of the ovoidal shaped mold, very little deformation or stretching of the glass occurs. As a result, the walls of such ovoidal or ellipsoidal bulbs possess substantially the same uniform glass distribution which they possessed immediately prior to the blowing operation. There are no rapid changes in wall thickness, the inner and outer surfaces of the bulb wall having a smooth and uninterrupted curvature in the same direction, with no abrupt irregularities therein. In addition, such ovoidal blown bulbs do not have thin maximum diameter side wall portions such as are characteristic of a pear-

shaped or spherical-shaped blown bulb, nor do they have neck juncture portions as thin as those present in a spherical-shaped bulb, such thinner side walls and neck juncture portions constituting points of greater weakness in pear-shaped and spherical-shaped blown bulbs. In other words, the wall of the ellipsoidal bulb is free of relatively sharp variations in thickness. It is for this reason, among others, that the ovoidal shaped bulb possesses greater strength than the pear-shaped bulb heretofore in use. Another reason for the greater strength of the ovoidal shaped bulb is the absence of the reversely curved portions present in the pear-shaped bulb, which portions join the neck and the bulbous portions of such bulbs. It is known that such reversely curved portions are a source of weakness in bulbs which are to be used for flash lamps, where considerable internal pressure is produced when the lamp is flashed. In the flash lamps according to the invention, the relatively small reversely curved portion joining the ovoidal bulb portion and the short neck portion is effectively reinforced by the surrounding base member 12, thus eliminating any weakness at such point.

As a result of their increased strength, the ovoidal shaped bulbs according to the invention can be safely loaded to a much higher degree than heretofore possible, thus enabling the use of bulbs of considerably smaller size for lamps of comparable light output. As far as known, the smallest flash lamps heretofore produced have employed bulbs the volumes of which amount to around 68 to 70 cc. My invention, however, has rendered it possible to produce flash lamps employing bulbs having considerably less volume than the smallest bulbs heretofore used, and in particular, less than 60 cc. Thus, the miniature flash lamp shown in Fig. 1 employs a bulb having a volume of approximately 25 cc. Such a bulb may be safely charged with approximately 30 milligrams of filamentary aluminum wire or ribbon having a weight of approximately 1.14 milligrams per meter or thereabouts, together with a filling of oxygen at a pressure of approximately 600 mm. of mercury. Such a miniature flash lamp produces a flash of light averaging around 16,000 lumen seconds, which constitutes a relatively large amount of light for the size of bulb employed. As far as known, the highest light ouput per unit of bulb volume heretofore obtainable in flash lamps has been about 400 lumen seconds per cc. However, the light output per unit of bulb volume of the miniature lamp according to the invention amounts to approximately 640 lumen seconds per cc. Thus it will be seen that the miniature flash lamp comprising the invention has a considerably higher light output per unit of bulb volume than has ever been heretofore obtainable.

The larger sized flash lamp shown in Fig. 2 employs a bulb having a volume of approximately 90 cc. This bulb may be safely charged with approximately 60 milligrams of the above specified aluminum wire or ribbon and a filling of oxygen at a pressure of approximately 500 mm. of mercury. Such a flash lamp produces a flash of light averaging around 50,000 lumen seconds. The light ouput per unit of bulb volume of this lamp therefore amounts to approximately 555 lumen seconds per cc. While this figure is not as high as the figure for the miniature flash lamp referred to above, nevertheless it is considerably higher than the highest light output per unit of volume (400 lumen seconds per cc.) heretofore obtainable. The reason, of course, for the increased light output per unit of volume of flash lamps according to the invention is the elimination of the extended neck portion present in the pear-shaped bulb, which constitutes more or less waste space, together with the increased loading of the bulb made possible by their increased strength as compared to the pear-shaped bulb.

As to the relative size and dimensions of the ovoidal bulbs according to the invention, the bulb 10 of the miniature flash lamp shown in Fig. 1 conforms substantially to an ellipsoid having a major axis A of about 1⅝ inches and a minor axis B of about 1¼ inches. The ratio of length to width of such a dimensioned bulb is therefore approximately 1.21. The neck portion 11 is of about ½ inch diameter and is of such a length that the total overall length of the sealed bulb is approximately 1⅞ inches. The axial longitudinal cross-sectional or projected area above the basing line *b—b* of such a dimensioned bulb is approximately 11 square cms. while the volume above the basing line is, as stated above, approximately 25 cc. The ratio of the longitudinal projected area to the bulb volume is therefore approximately 0.44. The bulb 10' of the larger-sized flash lamp shown in Fig. 2 is also of substantially ellipsoidal shape having a major axis C of about 2 31/32 inches and a minor axis D of about 1⅞ inches. Accordingly, the ratio of length to width of such a dimensioned bulb is approximately 1.58. The neck portion 11' is of such a length that the total overall length of the bulb is approximately 3¼ inches. The axial longitudinal cross-sectional or projected area above the basing line *b—b* of such a dimensioned bulb is approximately 27.7 square cms. while the volume above the basing line is, as stated above, approximately 90 cc. The ratio of the longitudinal projected area to the bulb volume is therefore approximately 0.308.

Through the use of an improved method for sealing the bulb 10, it has been possible to practically eliminate the burning away of the inner protective lacquer coating on the bulb neck and adjacent portions of the bulb. Figs. 3, 4 and 5 illustrate the successive steps involved in the sealing of a bulb according to the invention. The bulb 10, having its entire inner surface coated with a layer of protective lacquer and containing its filling 18 of combustible material, is mounted in a vertical inverted position so that its neck porton 11 extends upwardly. The bulb is supported in this position partly by means of a combination support and heat shielding member or guard 19 which engages around the bulb neck at a point adjacent the junction of the bulb neck with the ovoidal portion of the bulb. A filament mount, comprising the stem 16, leading-in wires 14, 15, filament 13 and exhaust tube 20, is mounted above the bulb in an inverted position in alignment with the bulb neck, as shown in Fig. 3. This mount structure is then inserted into the bulb until the flange 21 of the stem tube 16 rests on the edge or rim of the bulb neck 11, as shown in Fig. 2. Sharp pointed fires 22 are then directed onto the rim of the bulb neck 11 and the edge of the flange 21 on the stem tube until the glass softens and fuses together. The seal is then preferably stretched, in accordance with known practice, to remove internal strains therein, after which the bulb is filled through the exhaust tube 20 with oxygen to the desired pressure and the exhaust tube sealed or tipped off in the usual manner, as shown at 23

in Fig. 5. The base 12 is then cemented in place on the bulb neck and the outer protective lacquer coating applied to the bulb.

Instead of sealing the bulb 10 while in an inverted position, it may be sealed while in an upright position as is customary in regular incandescent lamp manufacture.

By the use of sharp-pointed sealing fires 22, general heating of the bulb neck by the sealing fires is entirely obviated. The heat guard 18 shields the ovoidal portion of the bulb from the heat radiated by the sealing fires 22 and prevents the splashing of the latter onto such portions of the bulb. The combination of the sharp-pointed fires 22 together with the heat shield 18 thus localizes the heating of the glass to the bulb neck only and effectively prevents the burning away of the inner protective lacquer coating on the ovoidal portions of the bulb adjacent the bulb neck. In this manner, the inner protective lacquer coating is preserved over substantially the entire ovoidal portion of the bulb, i. e., the exposed portion of the bulb not enclosed by the base 12. As a result, the bulbs of flash lamps made according to the invention are better protected against cracking and shattering than the conventional pear-shaped bulb heretofore used in which the greater part of the extended and exposed neck portion was left unprotected because of the burning off of the inner lacquer coating thereon during the sealing-in of the lamp. Although a portion of the inner lacquer coating on the neck portion 11 of the bulb 10 is burned away by the heat attending the sealing-in operation, this loss in bulb strength and in protection against shattering is more than offset by the added support or reinforcement given to the bulb neck by the enclosing base 12 which completely surrounds and engages the surface of the bulb neck. Thus, the combination of the inner protective lacquer coating over the entire inner surface of the ovoidal bulb portion, together with the reinforcing base entirely enclosing the bulb neck, results in a bulb of high strength and maximum protection against cracking and shattering. Accordingly, such bulbs can be safely loaded or charged to a higher degree than bulbs having a portion of their inner surface unprotected by a lacquer coating and unsupported by any external reinforcing means.

The exceptionally small size of the miniature flash lamp shown in Fig. 1 has made it possible to effectively employ therewith a substantially parabolic reflector 24 of a relatively small and practical size, as shown in Fig. 6, to thereby produce an intense concentrated beam of light. With such a combination, the major portion of the light output of the lamp is concentrated into the beam and therefore utilized in the taking of the picture, making it possible to take pictures of objects at relatively great distances. The miniature lamp 10 is mounted centrally about the focal point of the reflector 24, and because of its smallness in size (it more or less approximating a point source of light), the major portion of the reflected rays are redirected substantially parallel to, or at relatively small angles to the axis of the reflector. The effective utilization of the light output of the lamp when used in such a concentrating reflector has rendered possible the taking of excellent pictures at distances of 100 feet and even more with present day photographic equipment. Such extraordinary results have been heretofore possible only with the aid of relatively large-sized, and therefore impractical, reflectors.

Where it is desirable to obtain a greater light output than that obtainable from one flash lamp only, a number of lamps according to the invention may be grouped together in a large reflector and simultaneously flashed. In this manner, a greater utilization of the light output from the several lamps is obtained than is possible from one large lamp designed to give the same light output as the combined total output of the several lamps. The reason for this is that by combining the light output of the several lamps, the peaks of the individual lamps average up so that the peak of a group of lamps occurs with more uniformity at the desired time instant when the camera shutter is at the mid-point of its exposure than is the case with a large single lamp designed to give a light output equal to the combined total light output of the several lamps.

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

1. A flash lamp of the type comprising a sealed blown glass bulb containing a charge of combustible flash material, in which the said bulb is of ellipsoidal shape, the wall of said ellipsoidal bulb being substantially free of relatively sharp variations in thickness and having a smooth curvature in the same direction throughout its longitudinal cross-sectional periphery.

2. A flash lamp of the type comprising a sealed blown glass bulb containing a charge of combustible flash material and a base secured to said bulb, wherein the said bulb is of ellipsoidal shape with a short tubular neck portion at one end, the wall of said ellipsoidal portion of the bulb being substantially free of relatively sharp variations in thickness and having a smooth curvature in the same direction throughout its longitudinal cross-sectional periphery, and the said base entirely encloses and reinforces the neck portion of said bulb so that only the ellipsoidal portion is exposed.

3. A flash lamp comprising a blown glass bulb of ellipsoidal shape having a short tubular neck portion at one end thereof, the wall of the ellipsoidal portion of said bulb being substantially free of relatively sharp variations in thickness and having a smooth curvature in the same direction throughout its longitudinal cross-sectional periphery, a glass stem extending into said bulb through said neck portion and fused at its outer end to the end of said bulb neck portion, electrical ignition means in said bulb supported by said stem, a charge of combustible flash material in said envelope arranged to be ignited by said ignition means, and a base surrounding the entire bulb neck portion and firmly secured thereto to reinforce it so that only the ellipsoidal portion of the bulb is exposed.

MARVIN PIPKIN.