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PHOTOFLASH LAMP

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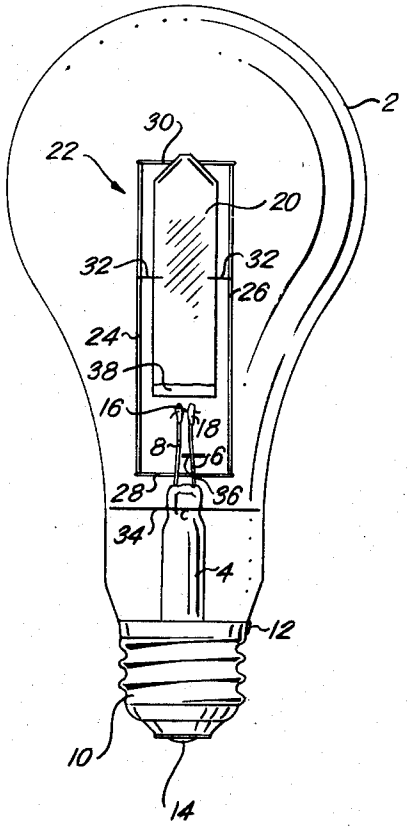


Fig. 1

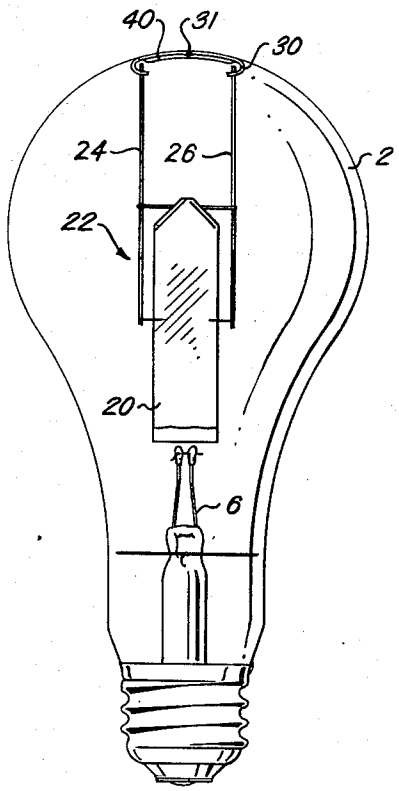


Fig. 2

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PHOTOFLASH LAMP

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This invention relates to photoflash lamps and more particularly to photographic flash lamps characterized by a duration of light emission at useful light levels many times longer than that of presently available commercial flash lamps.

Generally speaking, the present art of making photoflash lamps is concerned primarily with photographic flash lamps which have a high intensity light peak or a certain level of light intensity for a maximum duration of about 60 milliseconds. Such a light source usually comprises a glass envelope, provided with a protective interior and exterior coating, and filled with pure oxygen and fine aluminum shreds which, upon ignition, burn with a brilliant, fast flash. The ignition system usually comprises a pair of lead-in wires, a coating of ignition paste on the inner ends of the lead-in wires, and a fine tungsten filament attached to and supported by the lead-in wires near the inner ends thereof.

Although this type of photographic flash lamp has proved to be quite satisfactory for the more conventional uses, it has been found that, for certain applications, such as motion picture and especially high speed motion picture photography for example, a light source of useful light levels characterized by a duration of light emission of several seconds is highly desirable. In view thereof, the principal object of this invention is to provide such a flash lamp.

The flash lamp of our invention comprises a sealed transparent envelope, within which a strip of magnesium foil is supported, and which is provided with a gas filling of nitrogen and oxygen. A range of about 2% to about 12% nitrogen by volume in the gas mixture has been found to give the best results.

In the accompanying drawing, Figure 1 is an elevational view of a photoflash lamp illustrating one embodiment of our invention and Figure 2 is an elevational view of a photoflash lamp illustrating another embodiment of our invention.

Referring now to the embodiment illustrated in Figure 1, the photoflash lamp comprises a sealed transparent envelope 2, of glass or the like, within which a stem 4 is disposed. A pair of lead-in wires 6 and 8, preferably of nickel, are supported by and extend through the stem 4, the outer ends of the wires 6 and 8 being connected to the base 10, with which the envelope 2 is provided, at 12 and 14 respectively, to provide the means through which electrical energy may be supplied to a lamp filament 16 which is attached to and supported by the lead-in wires at the inner ends thereof. The inner end of each of the lead-in wires 6 and 8 is provided with a gob of ignition paste 18 which usually contains an oxydizer, zirconium metal powder and nitrocellulose binder.

A strip of magnesium foil 20 is supported within the envelope 2 by a framework 22. The framework 22 comprises a pair of nickel wires 24 and 26, the lower end of each of which is attached to a molybdenum wire 28, which is in turn attached to nickel lead-in wire 6. The upper end of the strip of magnesium foil 20 is offset sufficiently to facilitate the insertion therethrough of a molybdenum wire 30, to the free ends of which the upper ends of the pair of nickel wires 24 and 26 are attached. A pair of molybdenum wires 32, extending between the strip of magnesium foil 20 and the nickel wires 24 and 26, provided additional support for the strip 20 intermediate its ends. The stem 4 is provided with an asbestos disc 34 to prevent hot particles from falling into the neck of the lamp envelope. The lead-in wire 6 is provided with a molybdenum tab 36 to retard conduction of heat from the inner end of the lead-in wire 6 to the stem 4. To facilitate ignition of the strip of magnesium foil 20, the lower end thereof is preferably provided with a coating 38 comprising a mixture of zirconium metal powder and nitrocellulose binder.

In initial tests, pure oxygen, which is the gas filling usually employed, was used with unsatisfactory results. It was found that the heat of combustion and the explosive force of the reaction in pure oxygen either destroys the envelope or blows a hole into the envelope interrupting the light emission. However, we have found that this difficulty can be avoided by the use of a mixture of nitrogen and oxygen rather than pure oxygen. A range of between about 2% to about 12% nitrogen by volume in the gas mixture has been found to be best suited for the purpose. A mixture containing about 20% or more nitrogen seems to prevent the ignition of the strip of magnesium foil by the use of conventional ignition paste and the conventional electrical system usually employed. This phenomenon is rather surprising since the magnesium foil, once ignited, will burn in air, which is roughly a mixture of about 79% nitrogen and 21% oxygen. The combustion in the specified range of nitrogen and oxygen is slower and does not develop enough explosive strength to break the envelope.

The tabular data set forth below indicates the beneficial results which may be obtained with the flashlamp of our invention:

Test	Total Bulb Vol., ml.	Thickness of Mg Foil in Mils	Wt. of Mg Foil in mg.	Total Gas Pressure, cm. Hg	Ratio of $N_2:O_2$	Average lum.	Total lum., sec.	Total Duration of Flash, sec.
1	233	20	330	55	5:95	15,600	46,000	3.3
2	233	5	330	55	10:90	33,900	63,600	2.45
3	233	10	330	55	10:90	19,000	74,300	4.0
4	233	10	360	72	7.5:92.5	45,000	125,000	3.5

Magnesium foil was selected because it is easily ignitable with the conventional ignition paste and electrical means normally employed in the manufacture and use of photoflash lamps. The foil thickness preferably should be between about 5 mil and 20 mil. As Test #2 indicates, a 5 mil foil lamp is characterized by a relatively short duration. On the other hand, as Test #1 indicates, a 20 mil foil lamp is characterized by a relatively low light level. Test #4 indicates that a foil thickness of about 10 mils was found as optimum for total duration and light level. The gas pressure of 72 cm. and a total weight of 360 mg. Mg (Test #4) gives the closest approach to the desired goal, viz., long duration and high light level.

In the embodiment shown in Figure 2, in which parts corresponding to those in Figure 1 have been identified by the same reference numbers, the framework **22** which supports the strip of magnesium foil **20** is in turn supported from the top of the envelope **2** instead of on the lead-in wire **6**. A molybdenum wire **31**, disposed transversely to the molybdenum wire **30** and affixed thereto, improves the stability and rigidity of the supporting framework **22**. The inner wall of the top of the envelope **2** is provided with a body of a suitable cement mixture **40** within which the wires **30** and **31** are embedded, thereby providing the means for supporting the combustible assembly as described. The cement mixture may be a mixture of equal parts by weight of an epoxy resin, such as Shell Epon #828, and a polyamid resin, such as General Mills Versamid 125, for example. The support wires **24** and/or **26** of the framework **22** may be provided with a hook on the free end thereof to facilitate insertion of the assembly, of which they are a part, into the lamp envelope. The "cross," defined by the transverse wires **30** and **31** is embedded in the liquid cement which is then cured for about three minutes at about 140° C., thereby firmly attaching the framework to the top of the lamp envelope.

What we claim is:

1. A photoflash lamp comprising: a sealed transparent envelope; a gas filling in said envelope, said gas filling consisting essentially of oxygen and between about 2% to about 12% of nitrogen by volume; a strip of magnesium foil disposed axially in said envelope; support means for said strip of magnesium foil; and ignition means disposed in said envelope in operative relationship with respect to said strip of magnesium foil.

2. A photoflash lamp comprising: a sealed transparent envelope; a gas filling in said envelope, said gas filling consisting essentially of oxygen and about 7% of nitrogen by volume; a strip of magnesium foil disposed axially in said envelope; support means for said strip of magnesium foil; and ignition means disposed in said envelope in operative relationship with respect to said strip of magnesium foil.

3. A photoflash lamp comprising: a sealed transparent envelope; a gas filling in said envelope, said gas filling consisting essentially of oxygen and between about 2% to about 12% of nitrogen by volume; a strip of magnesium foil disposed axially in said envelope, said strip being between about 5 mils and about 20 mils thick; support means for said strip of magnesium foil; and ignition means disposed in said envelope in operative relationship with respect to said strip of magnesium foil.

4. A photoflash lamp comprising: a sealed transparent envelope; a gas filling in said envelope, said gas filling consisting essentially of oxygen and about 7% of nitrogen by volume; a strip of magnesium foil disposed axially in said envelope, said strip being about 10 mils thick; support means for said strip of magnesium foil; and ignition means disposed in said envelope in operative relationship with respect to said strip of magnesium foil.

5. A photoflash lamp comprising: a sealed transparent envelope; a gas filling in said envelope, said gas filling consisting essentially of oxygen and between about 2% to about 12% of nitrogen by volume; a strip of magnesium foil disposed axially in said envelope; support means for said strip of magnesium foil; ignition means disposed in said envelope in operative relationship with respect to said strip of magnesium foil; and a coating, comprising a mixture of zirconium metal powder and a binder, on a portion of said strip adjacent to said ignition means whereby firing of said strip by said ignition means is facilitated.

6. A photoflash lamp comprising: a sealed transparent envelope; a gas filling in said envelope, said gas filling consisting essentially of oxygen and about 7% of nitrogen by volume; a strip of magnesium foil disposed axially in said envelope; support means for said strip of magnesium foil; ignition means disposed in said envelope in operative relationship with respect to said strip of magnesium foil; and a coating comprising a mixture of zirconium metal powder and a binder, on a portion of said strip adjacent to said ignition means whereby firing of said strip by said ignition means is facilitated.

7. A photoflash lamp comprising: a sealed transparent envelope; a gas filling in said envelope, said gas filling consisting essentially of oxygen and between about 2% to about 12% of nitrogen by volume; ignition means, including at least one lead-in wire, disposed in said envelope; and a strip of magnesium foil, disposed axially in said envelope, supported by said lead-in wire, and in operative relationship with respect to said ignition means.

8. A photoflash lamp comprising: a sealed transparent envelope; a gas filling in said envelope, said gas filling consisting essentially of oxygen and between about 2% to about 12% of nitrogen by volume; a strip of magnesium foil disposed axially in said envelope; means for supporting said strip of magnesium foil from the inner wall of said envelope; and ignition means disposed in said envelope in operative relationship with respect to said strip of magnesium foil.

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