Dec. 17, 1957 H. J. EPPIG 2,816,406

PHOTOFLASH LAMP

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Fig. 1.

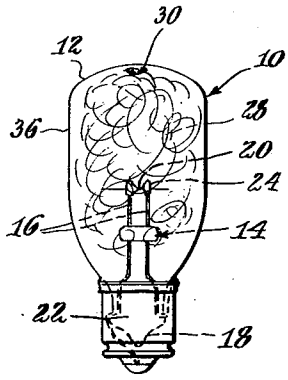


Fig. 2.

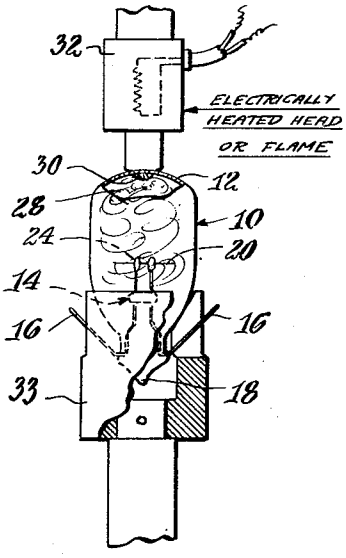
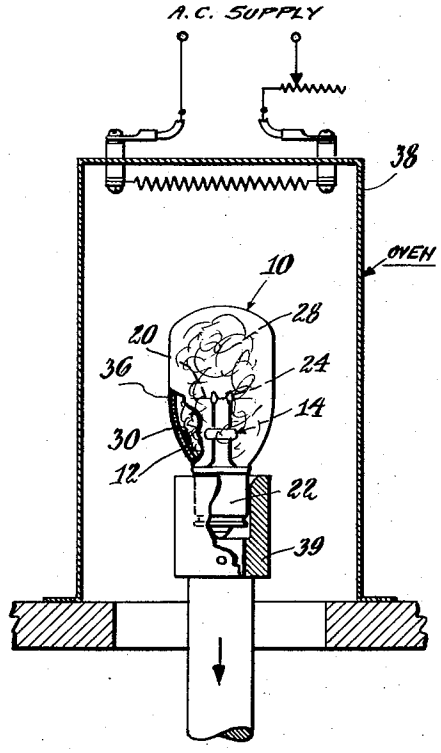


Fig. 3.



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PHOTOFLASH LAMP

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8 Claims. (Cl. 53—21)

This invention relates to photoflash lamps and, more particularly, to a method of filling photoflash lamp envelopes with oxygen gas at pressures greater than atmospheric.

The dictates of competitive photoflash lamp practice demand more and more light without increasing the envelope size. In order to achieve such increased light output, the best solution is to increase the weight of actinic foil and the amount of oxygen contained within the envelope. Increasing the weight of actinic material in the envelope presents no problem, but increasing the amount of oxygen within the envelope does present a difficult problem as the oxygen-fill pressures are presently from about 600 mm. to 700 mm. mercury which is the maximum pressure obtainable with existing methods of lamp manufacture. Any further substantial increase in oxygen-fill pressure may be achieved only by initially filling the lamp with oxygen pressures which are greater than atmospheric, which filling procedures are difficult.

In the usual well-known procedures used in filling and hermetically sealing photoflash lamp envelopes, the actinic foil material is first shredded into the envelope by means such as outlined in Patent No. 2,347,046 to Geiger, for example. The mount carrying the filament and primer material is then sealed to the neck of the envelope. The envelope is then exhausted through the exhaust tubulation, filled with oxygen gas at a pressure slightly below atmospheric, for example, 650 mm., and the exhaust tube is tipped off to seal the envelope. In the usual tipping-off procedure, the exhaust tube is heated substantially above the softening temperature of the glass so that the surface tension of the heated glass causes the open tube to suck in and form a sealed end. Since the fill pressure within the lamp is below atmospheric, there exists no tendency for the oxygen gas-fill to force its way through the softened glass of the exhaust tubulation. When the pressures within the envelope are greater than atmospheric, however, the envelope gas-fill will tend to force its way through the softened glass at the point of tip off, thus spoiling the seal and allowing the above-atmospheric pressure of the gas-fill to be relieved.

Various means for so-called pressure tipping for photoflash lamps have been suggested, but these have never been very practical because of the cost and equipment limitations as well as the expense involved. It has also been suggested to cool the lamp with refrigerated air or liquid nitrogen, for example, but this has not been particularly satisfactory since cooling with refrigerated air does not produce a very high fill pressure and the use of liquid nitrogen is quite expensive and difficult to maintain. In addition, lamps produced by these methods are quite dangerous prior to coating with a protective lacquer film, and in factory handling operations the accidental ignition of one lamp by static electricity, for example, is likely to lead to a very violent explosion of an entire hamper of uncoated bulbs with attendent high velocity flying glass. It should be understood that when the term "pressure tipping or pressure filling" is used herein, fill pressures which under standard conditions are greater than atmospheric are intended, as is well known and understood in the art.

In order to avoid and overcome the foregoing and other difficulties of and objections to prior practices, it is the general object of this invention to provide an improved method for pressure-filling photoflash envelopes.

It is a further object of this invention to provide an improved method for pressure filling photoflash envelopes wherein the envelope may be sealed or tipped off at less than atmospheric pressure.

It is another object of this invention to provide an improved method for pressure filling photoflash lamp envelopes, which method is safe from the factory handling standpoint.

The aforesaid objects of the invention, and other objects which will become apparent as the description proceeds, are achieved by including in the foil-filled envelope a material containing oxygen in chemically-combined form, which oxygen can be released in free form upon application of heat. The envelope is also provided with a fill of oxygen gas at a pressure somewhat below atmospheric, after which the envelope is tipped off by conventional procedures. The oxygen-containing material is then heated to cause it to release at least a portion of the chemically-combined oxygen in order to increase the fill pressure within the envelope to greater than atmospheric. In addition, the oxygen-containing material can be heated after the protective lacquer coating is applied, thus providing a lamp having a relatively low fill pressure which is safe to handle in factory operations before and during lacquer coating. Once the protective lacquer coating has been applied, the oxygen-containing material may be heated to cause it to liberate the oxygen and effect a pressure fill.

For a better understanding of the invention, reference should be had to the accompanying drawing, wherein:

Fig. 1 is an elevational view of a photoflash lamp manufactured in accordance with the teachings of this invention;

Fig. 2 is an elevational view, partly in section, illustrating one method of heating the oxygen-containing material;

Fig. 3 is an elevational view, partly in section, of an oven-type heater containing a lamp incorporating the oxygen-containing material, illustrating the material heating step.

Although the principles of the invention are broadly applicable to pressure filling any type of photoflash lamp, the invention is conveniently employed in conjunction with pressure filling an M–2 type photoflash lamp and hence it has been so illustrated and will be so described.

With specific reference to the form of the invention illustrated in the drawing, the numeral **10** in Fig. 1 indicates generally an M–2 type photoflash lamp which comprises a radiation-transmitting vitreous envelope **12**, and a mount **14** which includes leads **16**, tipped-off exhaust tubulation **18** and a filament **20** connected near the inwardly extending extremities of the leads **16**. The lamp may be provided with a base **22**, of brass for example, connected to the envelope **12** at its neck and the leads **16** are electrically connected to this base to provide a connection for electrically firing the filament **20**. In the case of the M–2 type photoflash lamp, the envelope **12** encloses a volume of about 6 to 7 cubic centimeters and the envelope also contains an oxidizing atmosphere such as oxygen, at a pressure of greater than 1 atmosphere, in accordance with this invention. The envelope is provided with a coating of lacquer, preferably only on the outside surface of the lamp envelope, but permissably on both the inner and the outer surfaces. Such a lacquer is intended to provide against violent eruption against the high temperatures and pressures generated in reacting the

actinic material with the oxygen to produce the well-known flash. In the case of an M–2 type lamp, the external lacquer may consist of a 12 mil thick film of cellulose-acetate butyrate, for example. A primer material **24** is supported by the inwardly-extending portions of the leads **16** and the filament **20** and in the case of an M–2 type photoflash lamp, the primer material may consist of ½ milligram of a mixture of 60% zirconium and 40% potassium perchlorate with a small amount of nitrocellulose binder, for example. Primer materials are well known and any suitable primer material may be substituted for this specific example as given. Supported at the top of the envelope **12** by the shredded foil material **28** is the residue of the oxygen-supplying material, which may take the form of a pellet **30**. This pellet has been at least partially decomposed to release its oxygen by means as hereinafter described. The shredded actinic material **28**, which may consist of aluminum or magnesium foil, or a mixture thereof, as is well-known, substantially fills the envelope in accordance with photoflash lamp practice and in the case of an M–2 type there may be 10 mg. of foil per 650 mm. of total oxygen-fill pressure. It should be understood that other suitable actinic materials can be substituted for the examples given.

In fabricating a lamp in accordance with the teachings of this invention, the small pellet **30** of material which contains oxygen in chemically-combined form is first inserted into the lamp envelope. In loading M–2 type photoflash lamps, the neck is normally uppermost and the pellet **30** will be carried by gravity to the lowest part of the envelope, which in this loading position is the top portion. The aluminum shredded foil is then loaded into the envelope in a conventional manner and this shredded foil will hold the oxygen-containing pellet in place at the top of the envelope. In the case of other types of lamps, this procedure may be somewhat modified according to the loading techniques utilized and the pellet **30** may be loaded after the foil **28** in some types of vacuum loading. In such cases, the foil **28** will be released upon the cessation of the vacuum and evenly dispersed throughout the lamp by the recurrent flow of gas therein to hold the pellet **30** in place against the sides of the envelope **12**. These vacuum loading techniques are well-known and are described in the aforementioned patent to Geiger, for example. The mount **14** is then sealed to the envelope neck by conventional, well-known methods and in the case of an M–2 type photoflash lamp, butt-sealing techniques are normally utilized. The lamp is then exhausted and filled with oxygen gas at a pressure of between 600–700 mm. mercury, as is customary. The exhaust tube **18** is then tipped off to seal the lamp and with the exception of the insertion of the oxygen-containing pellet **30**, the aforementioned lamp fabricating steps are well-known.

In Fig. 2 is shown one embodiment of the pellet decomposition step which will produce the pressure fill within the lamp envelope. If this embodiment is to be utilized, it is preferable that the pellet be positioned at the top of the lamp envelope and contiguous with the envelope interior surface in order to receive sufficient heat to effect decomposition. In this embodiment the pellet **30** is illustrated as being positioned at the top of the envelope and such a positioning is preferred in order to keep the decomposition heat as far as possible from the primer-coated filament **24** in order to prevent any premature flashing of the lamp. However, the pellet **30** may be positioned along the side of the lamp envelope, such as illustrated in Fig. 3, and the heat of decomposition applied to the exterior surface of the envelope approximating the location of the pellet **30**. Heating may be supplied by an electrical-heater type of unit **32**, such heating units being well-known, or alternatively, the heating may be applied by means of a gas flame, although the electrical-heating type of unit may be controlled more readily. In the embodiment as illustrated, the bulb is retained by a conventional holder **33**. Upon decomposition of the pellet **30** to increase the oxygen-gas fill, the base is applied to a lamp and the external protective lacquer applied. Alternatively, the base **22** may be applied to the lamp before the pellet is decomposed.

In Fig. 3 is shown still another embodiment of the pellet-decomposition procedures, which embodiment is preferred because the pellet can be decomposed to produce the greater than atmospheric fill after the protective lacquer has been applied and the lamp is completely fabricated. It should be understood that the greater the oxygen fill pressures within the lamp, and of course the weight of corresponding actinic material required to react substantially with the oxygen, the greater the hazards involved in handling the lamp if perchance a premature explosion should occur before the lamp has been coated with the protective lacquer. In the embodiment in Fig. 3, as illustrated, the lamp has been previously provided with the protective lacquer coating **36** and after coating, the oxygen-containing pellet **30** is heated, as in an electrically-heated oven **38**, for example, in order to decompose the pellet **30**. In this embodiment the pellet has been illustrated as positioned toward the neck portion of the envelope **12**, although such a pellet positioning is not necessary and it could be located at the top of the lamp envelope as illustrated in Figs. 1 and 2, or even apart from the interior surface of the envelope **12**. The embodiment as illustrated in Fig. 3 has the additional advantage in that the protective lacquer coating **36** is often required to be cured or polymerized by heat, such as with "plastisol" type coatings containing polyvinyl chloride, and the heat of the oven may thus serve the dual purpose of curing the protective coating while causing the pellet **30** to decompose to release its oxygen.

Regarding specific compositions for suitable oxygen-containing materials which can release their oxygen upon application of heat, it has been found that solid hydroperoxides are suitable materials for fabricating the pellet **30** and these compounds can be decomposed by heating to temperatures within the range of 100–200° C. and even at lower temperatures in the presence of suitable catalysts. As a specific example, a pellet of sodium carbonate hydroperoxide can be inserted into the flash bulb before sealing. After preliminary oxygen fill to about 650 mm., for example, and hermetically sealing the envelope by tipping off, the lamp which may be either coated with the protective lacquer or left uncoated, can be heated in an electrically-heated oven **38**, as illustrated in Fig. 3, and large quantities of oxygen will be liberated by the pellet **30**. In general, the quantity of oxygen which is produced is a function of the heating temperature, the presence or absence of a suitable catalyst, the quantity of oxygen-producing material and the heating time. In the following Table I are specific examples of hydroperoxides and catalysts therefor which can be used in conjunction with an M–2 type photoflash lamp. All examples are given for an initial oxygen-fill pressure of 650 mm. The oven **38** is of standard type and may be gas or otherwise heated if desired. In the oven embodiment as illustrated the lamps may be loaded by a conventional reciprocal loading carriage **39**.

TABLE I

Substance and Catalyst, if used	Amount, gm.	Temp., ° C.	Time, Hrs.	Final Fill Pressure, mm.
Sodium carbonate hydroperoxide:				
$Na_2CO_3.3H_2O_2$	0.070	120	1	900
$Na_2CO_3.3H_2O_2$	0.070	120	5	1,300
$Na_2CO_3.3H_2O_2$	0.140	120	5	2,000
$Na_2CO_3.3H_2O_2$, 5% Fe_2O_3	0.070	50	1	850
Sodium perborate:				
$NaBO_2.H_2O_2$	0.10	120	1	900
$NaBO_2.H_2O_2$	0.10	200	¼	1,000
$NaBO_2.H_2O_2$, 5% Fe_2O_3	0.10	100	½	1,000

The above substances indicated in the table decompose at comparatively low temperatures, liberating one molecule of water for each atom of oxygen. The water slowly combines with the residual salt of the pellet during the course of lamp storage which is normally several weeks after the decomposition. This incidentally is the normal holding period in order to detect any possible envelope leaks which could allow the oxygen fill to escape. Of course, the decomposition procedure as illustrated in Fig. 2 could also be used to decompose the foregoing oxygen-containing materials.

Other classes of substances can be used to liberate oxygen without forming water vapor in the course of decomposition, but these substances must normally be heated to higher temperatures in order to effect decomposition. With such materials, heating ovens normally cannot be used because of possible decomposition of the primer ignition mixture in the lamp due to high temperatures required for decomposition. In such a case, it is preferable to use a pellet-decomposition procedure as is illustrated in Fig. 2. Typical substances which may be used for decomposition to produce free oxygen without the formation of water vapor are easily decomposible peroxides such as magnesium peroxide and easily decomposible chlorates such as potassium chlorate. Catalysts are perferably used with these materials in order to accelerate the rate of decomposition and in the following table, indicated Table II, are specific examples of peroxide and chlorate which may be used.

TABLE II

Substance	Catalyst	Weight, gm.	Time, sec.	Temp., ° C.	Final Pressure mm.
Magnesium peroxide.	5% MnO_2	0.10	20	450	950
	5% Fe_2O_3				
Potassium chlorate.	10% MnO_2	0.25	20	450	1,050

It should be realized that the foregoing numerous examples of suitable oxygen-containing materials which can be decomposed to release free oxygen are only illustrative and are by no means all inclusive. Also, in the specific examples as given, the oxygen-containing materials are normally not completely decomposed, but rather are partially decomposed under the conditions as specified to produce the fill pressures as indicated. Of course, the oxygen-containing materials could be completely decomposed, if desired.

It will be recognized that the objects of the invention have been achieved by providing an improved method for pressure-filling photoflash lamp envelopes, wherein the envelope may be sealed or tipped off at less than atmospheric pressure and, if desired, the actual pressure filling need not be effected until the lamp is completely fabricated and coated with the protective lacquer coating, thereby minimizing the dangers encountered in handling unprotected high-pressure filled photoflash lamps.

While in accordance with the patent statutes, one best-known embodiment has been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

I claim:

1. The method of pressure filling with oxygen a radiation-transmitting photoflash lamp envelope, comprising inserting into said envelope an actinic material in a predetermined amount and a material containing oxygen in chemically-combined form which is releasable in free form, filling said envelope with oxygen gas to a pressure somewhat less than atmospheric, hermetically sealing said envelope, and causing the oxygen-containing material in said envelope to release at least part of its chemically-combined oxygen as oxygen gas to increase the oxygen fill pressure within said envelope to greater than atmospheric.

2. The method of pressure filling with oxygen a radiation-transmitting photoflash lamp envelope, comprising inserting into said envelope an actinic material in a predetermined amount and a material containing oxygen in chemically-combined form which is releasable in free form upon application of heat, filling said envelope with oxygen gas to a pressure somewhat less than atmospheric, hermetically sealing said envelope, and heating the oxygen-containing material in said envelope to cause it to release at least a part of its chemically-combined oxygen as oxygen gas to increase the oxygen fill pressure within said envelope to greater than atmospheric.

3. The method of pressure filling with oxygen a radiation-transmitting photoflash lamp envelope, comprising inserting into the top portion of said envelope a material containing oxygen in chemically-combined form which is releasable in free form upon application of heat, substantially filling the remainder of said envelope with a predetermined amount of actinic material, filling said envelope with oxygen gas to a pressure somewhat less than atmospheric, hermetically sealing said envelope, and heating the top portion of said envelope to cause the oxygen-containing material in said envelope to release at least part of its chemically-combined oxygen as oxygen gas to increase the oxygen fill pressure within said envelope to greater than atmospheric.

4. The method of pressure filling with oxygen a radiation-transmitting photoflash lamp envelope, comprising inserting into said envelope contiguous with the interior surface thereof a material containing oxygen in chemically-combined form which is releasable in free form, substantially filling the remainder of said envelope with a predetermined amount of actinic material, filling said envelope with oxygen gas to a pressure somewhat less than atmospheric, hermetically sealing said envelope, and heating said oxygen-containing material through the envelope to cause said oxygen-containing material to release at least a part of its chemically-combined oxygen as oxygen gas to increase the oxygen fill pressure within said envelope to greater than atmospheric.

5. The method of pressure filling with oxygen a radiation-transmitting photoflash lamp envelope, comprising inserting into said envelope an actinic material in a predetermined amount and a material containing oxygen in chemically-combined form which is releasable in free form upon application of heat, filling said envelope with oxygen as to a pressure somewhat less than atmospheric, hermetically sealing said envelope, and heating the sealed envelope to cause the oxygen-containing material in said envelope to release at least a part of its chemically-combined oxygen as oxygen gas to increase the oxygen fill pressure within said envelope to greater than atmospheric.

6. The method of pressure filling with oxygen a radiation-transmitting photoflash lamp envelope, comprising inserting into said envelope an actinic material in a predetermined amount and a material containing oxygen in chemically-combined form which is releasable in free form upon application of heat, said oxygen-containing material being selected from one of the group consisting of readily decomposable hydroperoxides, peroxides and chlorates, filling said envelope with oxygen gas to a pressure somewhat less than atmospheric, hermetically sealing said envelope, and heating the oxygen-containing material in said envelope to cause it to release at least a part of its chemically-combined oxygen as oxygen gas to increase the oxygen fill pressure within said envelope to greater than atmospheric.

7. The method of pressure filling with oxygen a radiation-transmitting photoflash lamp envelope, comprising inserting into said envelope an actinic material in a predetermined amount and a material containing oxygen in chemically-combined form which is releasable in free form upon application of heat, filling said envelope with oxygen gas to a pressure somewhat less than atmospheric, hermetically sealing said envelope, coating the exterior of

said envelope with a radiation-transmitting plastic material, and heating the sealed envelope to cause the oxygen-containing material in said envelope to release at least a part of its chemically-combined oxygen as oxygen gas to increase the oxygen fill pressure within said envelope to greater than atmospheric.

8. The method of pressure filling with oxygen to a predetermined greater-than-atmospheric pressure a radiation-transmitting photoflash lamp envelope, comprising inserting into said envelope an actinic material in a predetermined amount and a material containing oxygen in chemically-combined form which is releasable in free form, filling said envelope with oxygen gas to somewhat less than said predetermined pressure, hermetically sealing said envelope, and causing the oxygen-containing material in said envelope to release at least part of its chemically-

combined oxygen as oxygen gas to increase the oxygen gas fill pressure within said envelope to said predetermined pressure.

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