April 9, 1968 L. M. NIJLAND ET AL 3,377,126

COMBUSTION FLASH BULB LAMP

Filed May 10, 1966

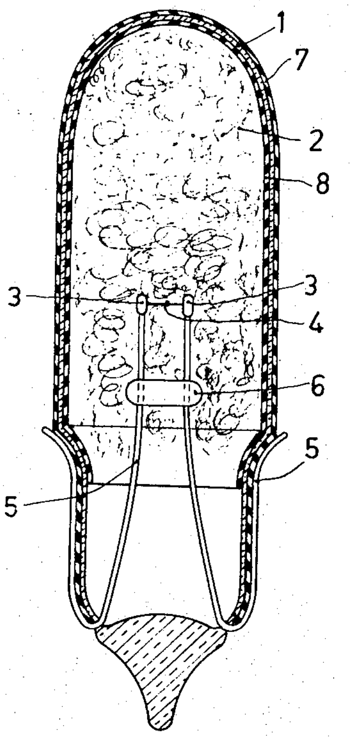

FIG. 1

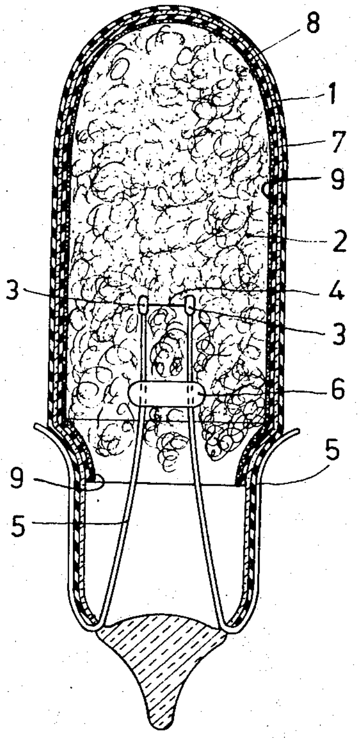

FIG. 2

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United States Patent Office 3,377,126
Patented Apr. 9, 1968

3,377,126
COMBUSTION FLASH BULB LAMP

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Filed May 10, 1966, Ser. No. 548,980
Claims priority, application Netherlands, June 15, 1965, 65—7,601
5 Claims. (Cl. 431—94)

ABSTRACT OF THE DISCLOSURE

A flash bulb lamp having an inner colorless coating that gives off a colorless gas, the colorless coating not reacting with the gas atmosphere in the bulb but reacting with solid substance filling material of the bulb.

The invention relates to a combustion flash bulb lamp of the type producing actinic light by the reaction of a solid substance with a gas.

Such a lamp comprises a closed glass bulb containing a solid substance and a gas, which react with each other after ignition resulting in irradiation of actinic light. The bulb contains furthermore an electric ignition mechanism capable of producing a spark or of heating an incandescent wire. The incandescent wire or the terminals of the current supply wires may be provided with a mass which explodes when heated. This mass may consist of a mixture of a metal powder, an oxidizing agent and a binder.

Flash bulb lamps are employed in photographing for obtaining an adequately exposed photographic negative under unfavourable light conditions. For this purpose the light-time characteristics of the flash bulb lamp must match the exposure characteristics of the camera shutters and the spectral distribution of the light emanating from the lamp must be adapted to the spectral sensitivity of the film. The quantity of light emitted by the flash bulb lamp must be sufficiently great.

In connection herewith the following requirements have to be fulfilled by a combustion flash bulb lamp:

(1) The flash bulb lamp has to emit a great quantity of lights for a few milliseconds.

(2) The colour temperature of the emitted light has to amount for colour photography to at least 4700° K., preferably to 5500° K.

(3) The dimensions of the lamp have to be small.

(4) The lamp should not explode upon use.

(5) The quantities of emitted light should vary little with the same type of lamps.

Combustion flash bulb lamps which fulfill these requirements to a greater or lesser extent are known. Usually they contain, as a solid substance, zirconium or an alloy of aluminium and about 10% by weight of magnesium in the form of metal wool of a wire or a foil. Other metals, such as aluminium, magnesium and other alloys of these two metals, tungsten, molybdenum, lanthanum, tantalum, cerium, thorium, titanium have been proposed for this purpose. The gas is usually oxygen. Instead of using oxygen, fluorine or fluorides, for example oxygen fluoride (OF_2) and nitrogen fluorides (NF_3, N_2F_4) may be employed. There may furthermore be present gaseous compounds which accelerate or decelerate the combustion. The filament of the ignition mechanism usually consists of tungsten or a tungsten-rhenium alloy. The filament may, however, also be made of metals which are burned explosively in the gas contained in the lamp, when heated, for example zirconium, titanium, tantalum. Usually the filament is provided with an explosive mass consisting of zirconium powder, lead dioxide and nitrocellulose. Other metals in the form of powder, which may be used in the production of said mass, are tungsten, magnesium, aluminium, antimony, silicon, iron, calcium. As oxygen producing compounds there may be employed chromates, peroxides, nitrates, chlorates or perchlorates. The bulb is usually made of lead glass and is externally coated with one or more lacquer layers in order to avoid scattering of glass fragments upon a break-down.

The effective combustion time of flash bulb lamps of this kind usually lies between 5 and 25 msec. The color temperature of the emitted light during the conventional reaction is about 4000° K. to 4500° K. The color temperature may be raised by coating the bulb with a blue lacquer layer. Then a value lying between 4700° K. and 6000° K. can be attained. However, this rise in color temperature is obtained at the expense of a loss of about 20 to 30% of the total quantity of emitted light.

It has been proposed to increase said light output of the combustion flash bulb lamps by coating the internal surface of the bulb with a substance which is capable of reflecting the free radicals formed during the combustion. This proposal is based on the assumption that the light emitted by a combustion flash bulb lamp is produced by the radiation of excited, gaseous free radicals. In colliding with the bulb wall these free radicals might loose their energy without emitting light. When the wall is coated with a substance which reflects said radicals, the risk of such a loss of energy might be reduced, so that the quantity of emitted light would be greater.

Substances recommended for this purpose are alkali chlorides, potassium borate, boric acid, manganese chloride, barium chloride, sodium tungstenate, phosphoric acid. As far as known this proposal has not been carried out in practice. From experiments it has appeared that in the conventional zirconium-oxygen flash bulb lamp these substances provide only a comparatively small increase in light output, whereas in certain cases it is even reduced. The use of sodium chloride, for example, results in an increase in light output of at the most 5% and when sodium metaphosphate ($NaPO_3$) is used, the quantity of emitted light even decreases by 6%. The coating was obtained by flushing the bulbs with a 10% and a 30% solution of said salts in water (percent by weight) and by subsequently drying the bulbs.

The invention is based on the following acquired knowledge.

From measurements of the quantity of light of zirconium-NF_3-flash bulb lamps it appeared that with a decreasing bulb volume the light output per unit of weight of zirconium decreased. A decrease in light output per unit of weight of zirconium was also assessed when in zirconium-oxygen flash bulb lamps the quantity of zirconium and oxygen was chosen to be markedly greater than the conventional quantity, the ratio remaining the same for the same volume of the bulb. With the same bulb volume an increase of 17.5% of the quantity of zirconium and oxygen was found to provide an increase in light output of not more than 14.5%. The light absorption assessed in these experiments was caused by combustion products (ZrF_4, ZrO_2), which are deposited on the bulb wall or condensate thereon already during the period of flashing. It will be obvious that this light absorption increases with a decrease in surface of the bulb wall or with an increased concentration of the combustion products. Moreover, due to the shorter distances in a smaller bulb and to the greater concentration gradient deposition of the combustion products on the bulb wall may occur sooner, that is to say at an earlier moment during the combustion process. The fact that the effect described is more conspicuous in a flash bulb lamp containing a fluorine gas than in a flash bulb lamp filled with oxygen may be related to the fact that the more volatile fluoride compounds (boiling point $ZrF_4 \approx 1200°$ K., boiling point $ZrO_2 \approx 4000°$ K.) condense very rapidly from the gas phase on the comparatively cold bulb wall, whereas the considerably less volatile oxides are separated off more slowly in the form of liquid droplets or solid particles on the wall.

The average light absorption of the layers on the bulb wall of a flash bulb lamp having a bulb capacity of about 2 mls. and a zirconium filling of 22 to 25 mgs. and a stoichiometric quantity of oxygen amounts to about 40%, measured after the combustion.

In a flash bulb lamp filled with a stoichiometrically fluorine-containing atmosphere the deposit on the bulb wall is white and uniform, whereas in a flash bulb lamp filled with oxygen the deposit is not uniform, gray and exhibits black stains, even with an excess quantity of oxygen. The latter is due to a nonquantitative combustion, so that incompletely burned reaction products of a dark color may condense on the bulb wall. Moreover, the hot, incompletely burned reaction products have a strongly reducing effect on the material of the bulb wall. If, as usual, the bulb wall is made of lead glass, lead my even be separated out of the glass forming back stains of lead, which could be assessed by chemical analysis. The incomplete combustion can be remedied only little by means of an excess quantity of oxygen. The excess quantity of oxygen does, however, increase the risk of explosion of the lamp.

It has furthermore been found that scattering of the bulb wall, which occurs during flashing in substantially any flash bulb lamp, is caused by combustion products condensing on the bulb wall. Due to this condensation a great quantity of heat is released locally, so that the bulb wall is heated non-uniformly.

The invention has for its object to prevent the deposition of light absorbing layers on the bulb wall of flash bulb lamps or at least to decelerate this deposition to an extent such that only after a considerable quantity of light has been emitted or even later the combustion products are deposited.

A further object of the invention is a quantitative combustion of the solid substance so that the bulb wall cannot be affected or darkened by incompletely burned reducing reaction products.

According to the invention this is achieved in a combustion flash bulb lamp in which the inner wall of the bulb is coated with one or more thin layers of colorless substances which evaporate or release gaseous dissociation products which are colorless at a comparatively low temperature and which substances, like their dissociation products, if any, do not or substantially do not react with the gas atmosphere in the lamp, but which substances or dissociation products react with the solid substance which is then oxidized.

The wall coating of flash bulb lamp according to the invention may consist of organic or of inorganic substances or of both.

Suitable organic substances are colorless, polymeric, fluorated hydrocarbon compounds, which evaporate or dissociate at a comparatively low temperature, that is to say about 800° C. and which contain little or no hydrogen. Examples of such compounds are: polytetrafluoroethylene, polymonochlorotrifluoroethylene, polydichlorodifluoroethylene.

Suitable inorganic substances are: colorless compounds releasing oxygen or a halogen at a comparatively low temperature, that is to say below about 800° C., which remain colorless even after reduction. These compounds have to be anhydrous and preferably non-hygroscopic, since otherwise the improvement of the light output aimed at is not obtained.

In lamps, the wall temperature of which rises very rapidly during the combustion, that is to say within a few milliseconds, above about 800° C., inorganic substances may be used under certain conditions, which develop oxygen or halogen only in excess of said temperature to a sufficient extent.

Satisfactory results are obtained with nitrates, chlorates and perchlorates, particularly of the alkali metals; particularly the use of KNO_3 and $KClO_3$ yields very good results, but also peroxides and other compounds which give off oxygen upon being heated and compounds with alkali-earth metals provide the effect.

It is preferred to use a wall coating of a first layer on the inner surface of the bulb consisting of one of said organic polymers and a second layer of one of said inorganic compounds.

If a wall coating of an organic polymer is used, an improvement in light output of 10% can be attained and an inorganic substance may provide an improvement of about 12%.

When these two are combined, however, an improvement of 14% is attainable. These percentages were measured on lamps of a capacity of about 2 mls., having a zirconium filling of about 22 to 25 mgs. and a stoichiometric oxygen filling. Lamps having a smaller volume and the same quantities of zirconium and oxygen or a greater quantity may provide improvements of more than 20%, when the combination is employed.

It is known as such to use films or thin layers of organic compounds on the inner surface of the bulb of combustion flashlight lamps containing oxygen. However, as far as could be assessed, this is not or no longer done in practice. This may be due to the fact that the wall coating proposed, for example, of cellulose acetate is not inert to the gas atmosphere in the lamp and is burned during flashing or is dissociated, forming tar-like, black products. Oxygen from the gas filling is consumed, so that the risk of incomplete combustion of the solid substance increases and hence also the risk of decomposition of light-absorbing layers on the wall, while the bulb wall may be scattered by non-uniform heating. It has been found that films of combustible substances, for example hydro-carbons, also nitrocellulose, and of ammonium salts and hydrous water containing compounds, produce a marked decrease in the quantity of emitted light both in zirconium-oxygen lamps and in zirconium-fluorine lamps.

The wall coating in flash bulb lamps according to the invention does not only provide a higher quantity of light. The thickness and the light absorption of the wall coating of oxides, fluorides and in completely combusted products are highly different in the conventional flash bulb lamps of the same type and of the same series. The use of the wall coating in the flash bulb lamps according to the invention, however, reduces this spread in the quantity of light.

An important advantage of the use of the combined wall coating in the flash bulb lamps according to the invention is that scattering of the bulb wall due to non-uniform heating is effectively counteracted. Apparently the wall coating delays the condensation of combustion products on the bulb wall to an extent such that during that phase of flashing in which the oxygen has not yet been consumed, no break-down of the bulb wall due to non-uniform heating occurs. When the combined wall coating is used, practically no cracks are found in the bulb, so that the risk of explosion is very slight in lamps of this embodiment of the invention.

With the same bulb volume of the combustion flash bulb lamps according to the invention, the quantity of solid substance and the pressure of the gas atmosphere may be increased as compared with those of the conventional flash bulb lamps, if a wall coating of chlorates, perchlorates, nitrates if desired in conjunction with a film of polymonochlorotrifluoroethylene is used. In order to reduce the risk of explosion, the pressure of the gas atmosphere and hence the quantity of gas in the bulb is chosen to be lower than is required for a complete conversion with the solid substance. When this wall coating is used, no incomplete combustion occurs in spite of the non-stoichiometric ratio between the solid substance and the gas atmosphere. In comparison with a similar lamp the light output could thus be increased still further. By suitable measures it can be ensured that the gain of light output of flash bulb lamps according to the invention is completely utilized for the use desired. This may be achieved inter alia by coating the lamp at the areas where the light disappears without being used effectively or where it is absorbed, with a light-reflecting layer, for example, on the inner or outer side of the lamp foot and, as the case may be, the ring around the lamp foot. With certain types of flash bulb lamps said ring serves for fixing the current supply wires to the outer side of the lamp foot and to clamp them against the lamp foot. The ring is usually made of cardboard, but it may also be made of light reflecting material.

When these measures were applied, it was found that as compared with lamps to which these measures were not applied the light output increased by 4%.

Sealing of the bulb of lead glass by means of a reducing flame has to be avoided. The dark coloring of the glass involved therein produces loss of light by absorption.

The invention will now be described more fully with reference to the accompanying figures, tables and embodiments shown therein.

FIGS. 1 and 2 are sectional views of flash bulb lamps according to the invention.

FIG. 1 shows the sectional view of a possible embodiment of a flash bulb lamp according to the invention on an enlarged scale.

A glass bulb **1** contains a metal wool **2**, for example, of zirconium shred and an ignition mechanism consisting of an explosive paste **3**, applied to the terminals of the current supply wires **5**. The current supply wires are interconnected by an incandescent wire **4** of tungsten. The wires are held together by a glass bead **6**.

The bulb is externally coated with a lacquer layer **7**, for example, of ethylcellulose, which may have a blue color. The bulb is internally coated with a layer **8**, which may consist either of a fluorinated polymeric carbon compound or of an inorganic substance, which is capable of giving off oxygen or a halogen when heated gently. FIG. 2 shows a similar lamp. The bulb **1** of this embodiment is coated with two layers **8** and **9**, the layer **8** consisting of a fluorinated, polymeric carbon compound and the layer **9** of an inorganic substance, which is capable of giving off oxygen or a halogen upon gentle heating.

The layers **8** and **9** may be obtained as follows:

(A) *Layer of a fluorinated, polymeric carbon compound*

By way of example there will be described the application of a layer of polymonochlorotrifluoroethylene.

Polymonochlorotriflouroethylene is dissolved in a suitable, volatile, organic solvent, for example acetone, benzene, ether. Then the bulb **1** is filled with this solution to the desired height, after which the bulb is immediately emptied by suction by means of a capillary tube. The lacquer layer is then dried. Subsequently, the metal wool **2** and the ignition mechanism **3**, **4**, **5**, **6** are introduced into the bulb in known manner, the bulb is filled with the desired gas and sealed.

(B) *Layer of a substance giving off oxygen upon moderate heating*

By way of example the application of a layer of potassium nitrate will be described. KNO_3 is dissolved in water and the solution is heated at 80 to 90° C.; it is poured into a bulb heated at 100 to 120° C. to the desired height. The bulb is immediately emptied by suction by means of a capillary tube and then treated as described under A.

(C) *Combined layers*

By way of example the application of a layer **8** of polymonochlorotrifluoroethylene and a layer **9** of potassium nitrate to the former will be described. First, in the manner described under A, a layer of polymonochlorotrifluoroethylene is applied to the inner side of the bulb wall. After the solvent is removed, for example by drying with the aid of heat, the layer **8** is powdered with fine crystalline potassium nitrate. A few milligrams of KNO_3 are shaken in the hot bulb (30 to 50° C.) after which the quantity not adhering to the layer **8** is blown off. A uniform thin salt layer is thus left on the polymeric layer.

The fine crystalline material may be obtained, for example, by pouring out an aqueous solution of the substances concerned, saturated at normal temperature in a 5- to 10-times larger volume of acetone, while stirring. The precipitated, fine crystalline material is filtered off, and dried; it is then ready for use.

In the following Tables 1 to 8 are given a number of embodiments of lamps according to the invention and the increase in light output obtained thereby.

Table 1 relates to flash bulb lamps as shown in FIG. 1, in which the layer **8** consists of a fluorinated carbon compound. The internal volume was 1.9 mls., the quantity of ziconium wool was 23 mgs. and the lamp contained a stoichiometric quantity of oxygen. In order to ensure a reliable comparison the bulbs provided with a layer **8** were mixed in each experiment with a number of bulbs not treated. The treated lamps and the non-treated lamps were subjected satistically to the manufacturing process on the machine. The quantities of light were averaged and the averages were compared with each other; the increase in light output was expressed in a percentage of the mean quantity of light of the non-treated lamps. This also applies to the experiments indicated in Tables 2, 3 and 4.

TABLE 1

	Composition of liquid used	Treatment	Number of lamps treated	Increase in average light output in percent
1	5% by weight of polymer A[1] in acetone.	A	100	+10.1
2	do	A	9	+13.3
3	5% by weight of polymer B[2] in acetone.	A	10	+11.7
4	5% by weight of polymer A in ether.	A	8	+11.3

[1] Polymer A: polymonochlorotrifluroethylene degassed in a high vacuum, having a viscosity of 75 cp. at 99° C., a melting point of 38° C. and a density of 1.92 (Kel-F40 of the Minnoseta Mining and Manufacturing Co.).

[2] Polymer B like polymer A but not degassed.

Table 2 relates to the same type of flash bulb lamps. The layer **8** consisted of a substance giving off oxygen at moderate heating. The process was otherwise completely the same.

TABLE 2

	Composition of liquid used	Treatment	Number of lamps treated	Increase in average light output in percent
5	10% by weight of $NaNO_3$ in water.	B	32	+10.8
6	10% by weight of KNO_3 in water.	B	86	+10.1
7	15% by weight of KNO_3 in water.	B	147	+12.9
8	do	B	239	+11.4
9	7.5+ by weight of KNO_3+ 7.5% by weight of $NaNO_3$ in water.	B	76	+11.5
10	10% by weight of KNO_3+ 10% by weight of $NaNO_3$ in water.	B	20	+13.0
11	10% by weight of $KClO_3$ in water.	B	18	+8.6
12	5% by weight of $KClO_3$+ 5% by weight of $KClO_4$ in water.	B	21	+10.7
13	5% by weight of $KClO_3$+ 5% by weight of KNO_3.	B	21	+11.5
14	5% by weight of $KClO_3$+ 5% by weight of $KClO_4$+ 5% by weight of KNO_3 in water.	B	19	+11.1

From these and from further experiments it appears that, in general, the best results are obtained by means of the inexpensive potassium nitrate.

Table 3 relates to the combined wall coating of FIG. 2 (layers **8** and **9**) in the same type of lamps.

TABLE 3

	Composition of liquid used	Treatment	Number of lamps treated	Increase in light output in percent
16	5% by weight of polymer A in acetone, $KClO_3$.	C	19	+13.0
17	2% by weight of polymer A in acetone, $NaNO_3$.	C	14	+11.7
18	2% by weight of polymer A in acetone, $NaK(NO_3)_2$.	C	44	+13.1
19	4% by weight of polymer A in acetone, $NaK(NO_3)_2$.	C	39	+13.5
20	2% by weight of polymer A, KNO_3.	C	57	+14.5
21	3% by weight of polymer A, KNO_3.	C	119	+15.1
22	4% by weight of polymer A, KDO_3.	C	47	+13.8

The experiment 23 of Table 4 relates to a lamp having a combined wall coating as shown in FIG. 2 (layers **8** and **9**), in which the quantity of zirconium of 23 mgs. is raised to 26.5 mgs., the oxygen filling being stiochiometrically chosen. The experiment 24 raltes to a lamp having a bulb of 1.25 mls. instead of 1.9 mls., having a zirconium filling of 22 mgs. and a stoichiometric quantity of oxygen.

TABLE 4

	Composition of liquid used	Treatment	Number of lamps treated	Increase in light output in percent
23	2% by weight of polymer A in acetone, KNO_3.	C	210	+24.0
24	3% by weight of polymer A in acetone, KNO_3.	C	37	+19.0

Table 5 relates to the light absorption of the bulb wall of lamps according to the invention; the indicated values are the averages of three measurements, unless otherwise stated. The embodiment of the lamps is like that of Table 1.

TABLE 5

	Composition of liquid used	Treatment	Light absorption in percent	
			Prior to flashing	After flasning
25	10% by weight of $NaNO_3$ in H_2O	B	1.0	30
26	15% by weight of KNO_3 in H_2O (eight lamps).	B	7.3	31
27	2% by weight of polymer A in acetone $NaK(NO_3)_2$.	C	0.5	24
28	4% by weight of polymer A in acetone $NaK(NT_3)_2$.	C	2.5	23
29	5% by weight of polymer A in acetone KNO_3 (eight lamps).	C	6.5	23

By way of comparison it should be noted that the bulb wall of a comparable, non-treated flash bulb lamp had a light absorption of 1% prior to flashing and of 41% after flashing.

Table 6 relates to a lamp as shown in FIG. 2, in which the quantity of zirconium is raised to 26.5 mgs. with a stoichiometric oxygen content. The embodiment of the lamps is like that indicated in Table 1.

TABLE 6

	Composition of liquid used	Treatment	Light absorption in percent	
			Prior to flashing	After flashing
	Non-treated (seven lamps)		1.0	43
30	3% by weight of polymer A in acetone, KNO_3 (eight lamps).	C	(1)	26.4

[1] Not measured.

The following Tables 7 and 8 relate to lamps having a fluorine-containing gas filling.

Table 7 relates to lamps as shown in FIG. 2 having an internal volume of 1.9 cc. and a filling of 10 mgs. of zirconium and a stoichiometric NF_3 filling (calculated on the formation of ZrF_4).

TABLE 7

	Composition of liquid used	Treatment	Number of lamps treated	Increase in light output in percent
31	4% by weight of polymer A in acetone, KNO_3.	C	8	31.3
32	4% by weight of polymer A in acetone, $KClO_3$.	C	8	24.6

Table 8 relates to a lamp as shown in FIG. 1 having a bulb capacity of 1.9 cc., a zirconium filling of 22 mgs. and a stoichiometric filling of N_2F_4 (calculated on the formation of ZrF_4).

TABLE 8

	Composition of liquid used	Treatment	Number of lamps treated	Increase in light output in percent	Mol ratio Zr/N_2F_4
33	5% by weight of polymer A in acetone.	A	8	10.3	0.97
34	do	A	8	11.4	1.1

What is claimed is:

1. A flash lamp producing actinic light by the reaction of a solid substance with a gas atmosphere contained in a sealed bulb comprising at least one thin layer of a colorless substance coating the inner wall of said bulb which gives off colorless gas dissociation products at a comparatively low temperature, said colorless substance and products substantially not reacting with the gas atmosphere in said bulb both before and after flashing of said lamp but said colorless products reacting with said solid substance.

2. A flash lamp producing actinic light by reaction of a solid substance with a gas atmosphere contained in a sealed bulb comprising at least one thin layer of a colorless substance coating the inner wall of said bulb which gives off colorless gas dissociation products at comparatively low temperature, said colorless products substantially not reacting with the gas atmosphere in said bulb, said inner wall coating being constituted of a polymeric, fluorinated carbon compound.

3. A flash lamp producing actinic light by reaction of a solid substance with a gas atmosphere contained in a sealed bulb comprising at least one thin layer of a colorless substance coating the inner wall of said bulb which gives off colorless gas dissociation products at comparatively low temperature, said colorless products substantially not reacting with the gas atmosphere in said bulb, said inner wall coating being constituted of polymonochlortrifluoroethylene.

4. A flash lamp producing actinic light by reaction of a solid substance with a gas atmosphere contained in a sealed bulb comprising at least one thin layer of a colorless substance coating the inner wall of said bulb which gives off colorless gas dissociation products at comparatively low temperature, said colorless products substantially not reacting with the gas atmosphere in said bulb, said inner wall coating being selected from the group consisting of chlorate, perchlorate, nitrate and mixtures of said compounds.

5. A flash lamp producing actinic light by reaction of a solid substance with a gas atmosphere contained in a sealed bulb comprising at least one thin layer of a colorless substance coating the inner wall of said bulb which gives off colorless gas dissociation products at comparatively low temperature, said colorless products substantially not reacting with the gas atmosphere in said bulb, said inner wall coating being constituted of a first layer of polymonochlortrifluoroethylene and a second layer affixed on said first layer selected from the group consisting of alkali chlorates, perchlorates and nitrates.

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JAMES W. WESTHAVER, *Primary Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,377,126 April 9, 1968

Louis Marius Nijland et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 22, "my" should read -- may --. Column 4, line 36, "decomposition" should read -- deposition --; line 47, "in completely" should read -- incompletely --. Column 6, line 25, "ziconium" should read -- zirconium --; line 30, "satistically" should read -- statistically --. Column 7, TABLE 3, second column, line 14 thereof, "KDO_3" should read -- KNO_3 --; same column 7, line 26, "raltes" should read -- relates --. Column 8, TABLE 7, fifth column, line 1 thereof, "31.3" should read -- 21.3 --.

Signed and sealed this 19th day of August 1969.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents