United States Patent

[11] 3,627,459

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[21] Appl. No. **12,779**
[22] Filed **Feb. 19, 1970**
[45] Patented **Dec. 14, 1971**

[73] Assignee **U. S. Philips Corporation New York, N.Y.**

[32] Priorities **Feb. 21, 1969**
[33] **Netherlands**
[31] **6902808;**
Dec. 13, 1969, Netherlands, No. 6918743

[54] **FLASHBULB**
9 Claims, 11 Drawing Figs.

[52] **U.S. Cl.** **431/95**
[51] **Int. Cl.** **F21k 5/02**
[50] **Field of Search** 431/94, 95, 93

[56] **References Cited**

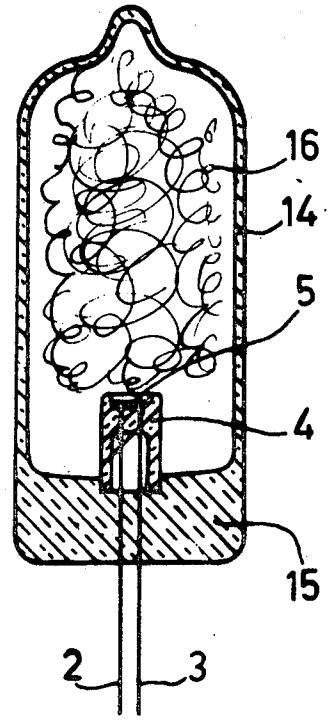
UNITED STATES PATENTS

2,071,369	2/1937	Williams et al.	431/95
2,771,765	12/1956	Arnott et al.	431/95
3,501,254	3/1970	Nijland et al.	431/95

Primary Examiner—Edward J. Michael
Attorney—Frank R. Trifari

ABSTRACT: A flashbulb of the combustible type for ignition by means of a voltage increasing to a maximum value within a short period, the ignition mass being provided in a cavity in a body of electrically insulating material which encompasses and shields the current conductors within the envelope.

The invention relates to a flashbulb including an envelope of light-transmitting material within which an actinically combustible material, a gas maintaining the combustion and a stem are provided; the stem comprises two current conductors sealed in the lamp base and fixed relatively to each other within the envelope by means of a body of electrically insulating material. On the insulating material there is provided an ignition mass which connects the ends of the current conductors and is ignited by electric breakdown and subsequently burns explosively when a voltage is set up across the ends. Due to the explosively burning paste, the reaction between the actinically combustible material and the gas maintaining the combustion is initiated.



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SHEET 1 OF 2

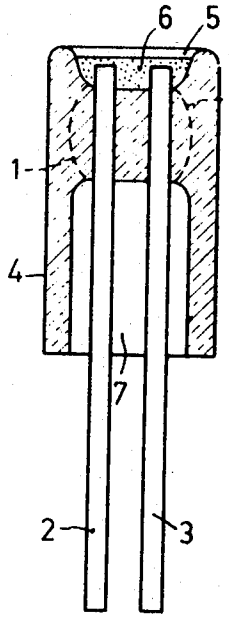

Fig.1

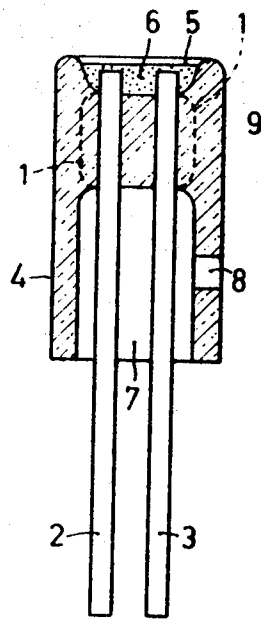

Fig.2

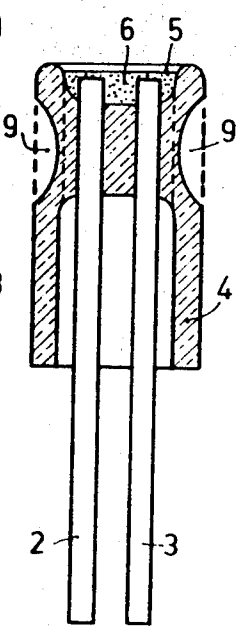

Fig.3

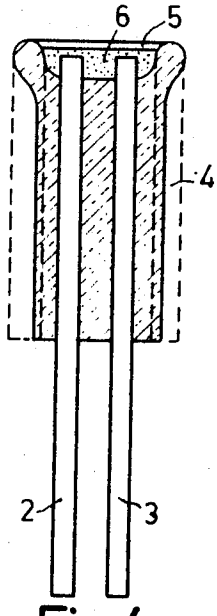

Fig.4

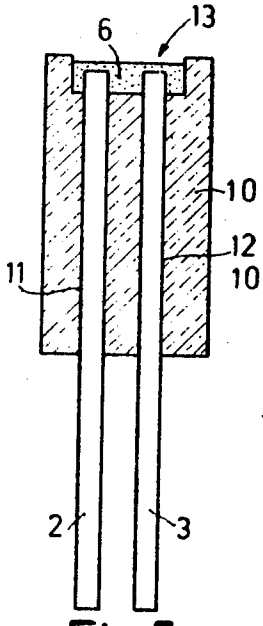

Fig.5

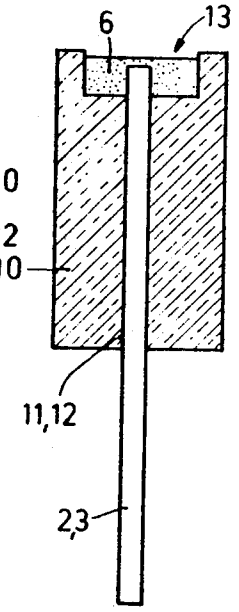

Fig.6

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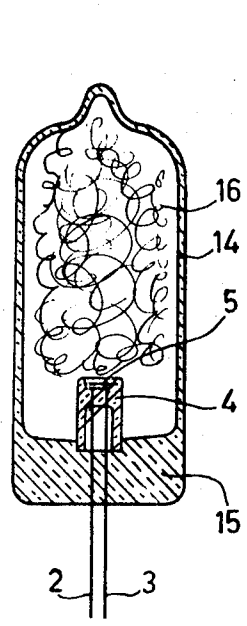

Fig.7

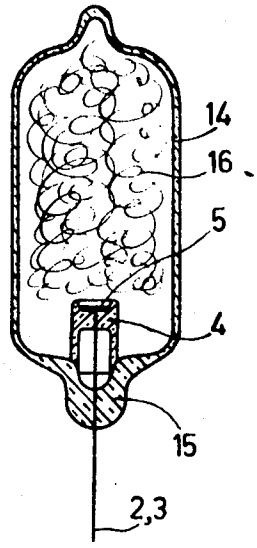

Fig.8

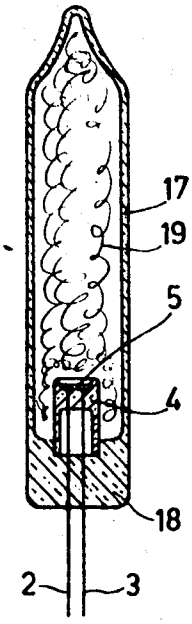

Fig.9

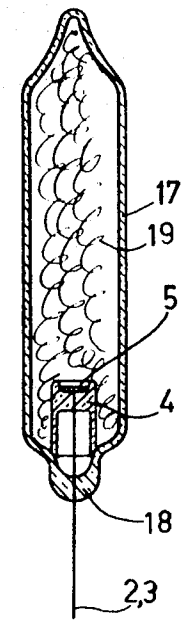

Fig.10

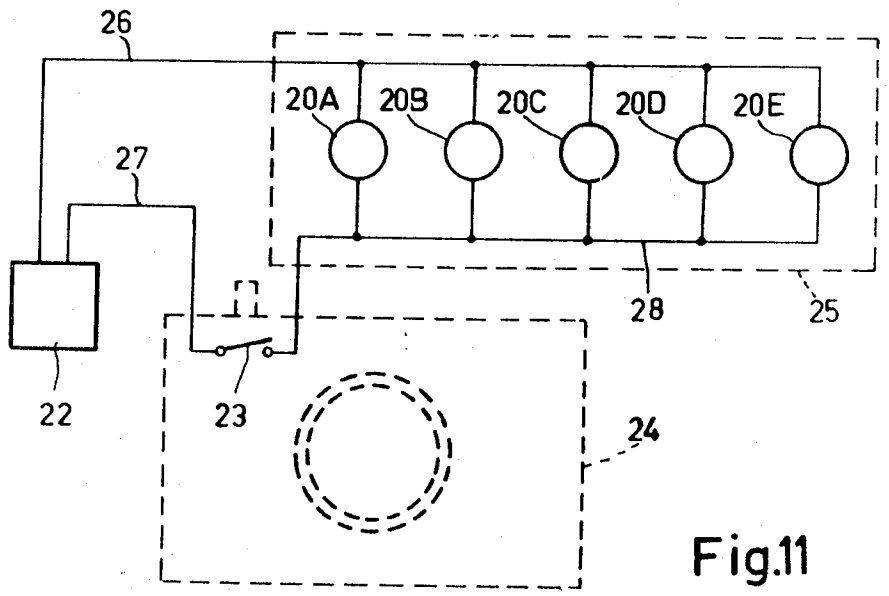

Fig.11

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FLASHBULB

Such combustion flashbulbs are described in U.S. Pat. application No. 3,501,254. These bulbs have a current-voltage characteristic in which the first differential coefficient of the voltage to the current has a negative value over part of the curve denoting the relationship between voltage and current. Therefore these bulbs may be used in a magazine in which the flashbulbs are mutually arranged in parallel. Ignition takes place by setting up a voltage across the parallel arranged flashbulbs, which voltage increases to a high value within a short period when the shutter of the camera to which the magazine is connected is opened. When reaching the breakdown voltage of the flashbulb having the lowest breakdown voltage in the magazine, a breakdown of the ignition mass takes place in this flashbulb followed by passage of current, the applied voltage across this flashbulb decreasing to a value at which none of the remaining flashbulb in the magazine can be ignited. This is repeated when taking the next photographic picture.

It has been found that due to different causes the operation of this system may be influenced detrimentally resulting in the occurrence of so-called "failures."

The above-mentioned U.S. Pat. application No. 3,501,254 has described that the combustion flashbulbs must be constructed in such a manner that no leakage paths between the current conductors in a used flashbulb can be formed due to electrically conducting products of combustion. These electrically conducting products of combustion may consist of particles of the metal wire filling which have not completely reacted with the gas atmosphere. Also, electrically conducting particles of the ignition mass may contribute to the formation of leakage paths.

If leakage paths of this nature are formed in a used flashbulb in a magazine having parallel arranged flashbulbs, then this has the result that these leakage paths short circuit the voltage source when the next flashbulb is to be ignited. The nonused flashbulbs still present in the magazine can then no longer be ignited.

According to the above-mentioned U.S. Pat. application, the formation of leakage paths may be prevented by using means in the bulbs which shield a portion of the wall of the envelope around one or both current conductors from deposition of products of combustion. The means proposed in the said patent application have the special feature that the current conductors are not connected together by means of a breadlike body of electrically insulating material. The current conductors may both be provided with beads, or only one of the current conductors has a bead. In this manner flashbulbs can be obtained wherein the formation of leakage paths after ignition is impeded. It will, however, be evident that these special constructions constitute a serious complication for the mechanized manufacture of such flashbulbs. In addition, for flashbulbs to be used in magazines employing parallel arrangement it is desired that the distance between the terminals in the ignition mass be small and only differs little from bulb to bulb and that the quantity of ignition mass be slight. These requirements are difficult to combine with the means already proposed for reducing the formation of leakage paths for the electric voltage in flashed bulbs.

A further cause of the occurrence of failures may be the presence of leakage paths in bulbs which have not yet been flashed. The applied voltage across these leakage paths may also decrease to a value which is insufficient to bring about a breakdown in the ignition mass between the terminals of the current conductors.

Leakage paths of this nature may be caused if parts of the actinically combustible material contact the ignition mass or approach it closely, or if they contact one of the current conductors or both current conductors.

According to the invention the described drawbacks are obviated in a flashbulb of the combustible type which is characterized in that the body of electrically insulating material completely encompasses the parts of the current conductors located within the envelope and that the end remote from the lamp base is provided with a cavity connected to the space within the envelope, in which cavity the current conductors terminate and which contains the ignition mass.

The stem which is provided in the combustion flashbulbs according to the invention may consist of, for example, glass or a ceramic material. It may either be solid or it may have a hollow space which is connected or not connected to the space within the envelope, the end of the stem facing the lamp base may be locally sealed to the wall of the envelope. This provides the advantage of a robust construction.

The stem may be obtained of sliding a tube of sufficient length and diameter on a conventional set of beads and to seal this tube to the bead in such a manner that the cavity for accommodating the ignition mass is formed simultaneously.

It is alternatively possible to form the stem from a glass tube which, subsequent to the current conductors being introduced therein, is plastically deformed over a smaller or larger part of its length such that a cavity is formed for accommodating the ignition mass. An internal hollow space possibly formed in this construction through which space the current conductors are passed, may be connected to the space within the envelope by means of an aperture in the wall of the tube. This provides the advantage that as little as possible space is lost for accommodating the gas maintaining the combustion.

The stem may alternatively consist of a solid rod of ceramic material which is provided with two longitudinally extending ducts terminating in a cavity provided at one of the ends of the rod and being intended for accommodating the ignition mass. The ducts include the current conductors. The cavity for accommodating the ignition mass may consist of, for example, a groove which is directed either transversely to an imaginary line of connection between the ends of the current conductors or coincides therewith.

When using flashbulbs in a magazine it would be desirable to have bulbs whose contents are less than 0.5 c.c. and whose external diameter is less than 7 mm. so that more bulbs can be accommodated side by side in the same space than is possible for bulbs of conventional diameter (approximately 9 mm.) and contents (> 0.5 c.c.).

Bulbs whose contents are less than 0.5 c.c. and which have a diameter of less than 7 mm. are known per se from U.S. Pat. specification No. 3,263,457. According to this patent specification it is only possible for this type of bulbs to produce a light output which is comparable with that of the conventional bulbs if the ignition device extends through the bulb over no more than 25 percent of the internal length of the bulb. Although this is correct, the maximum period of these bulbs is, however, between 15 and 20 mm; whereas this is approximately 13 mm. for the conventional bulbs. A maximum period is understood to mean the period extending between ignition and the instant when the bulb provides its maximum luminous flux. This U.S. Pat. No. 3,263,457 describes the possibility to ignite these bulbs by means of a high voltage.

The invention has been found to be interesting for combustible flashbulbs having an external diameter of less than 7 mm., a length of more than 30 mm., contents of less than 0.5 c.c. and a gas pressure of more than 1,000 cm. Hg.

In order that the invention may be readily carried into effect, a few embodiments thereof will now be described in detail by way of example with reference to the accompanying diagrammatic drawings, in which

FIGS. 1 to 6 inclusive are cross-sectional views of a few stem constructions,

FIG. 7 to 10 are cross-sectional views of flashbulbs according to the invention,

FIG. 11 shows a principle circuit diagram of a magazine including parallel-arranged flashbulbs according to the invention.

FIG. 1 is a cross-sectional view of a stem which is obtained by sealing a bead (broken line 1), provided with current conductors 2 and 3 to a glass tube 4. The stem has a cavity 5 accommodating an ignition mass 6 which covers the ends of the current conductors 2 and 3. Furthermore the stem has a hollow space 7.

The reference numerals in FIG. 2 have the same significance as those in FIG. 1. An aperture 8 is provided in the wall of the glass tube 4, and the hollow space 7, subsequent to sealing the stem in a flashbulb, is in open communication with the space within the envelope through the aperture 8. In this construction the hollow space 7 in the stem may also be filled with the gas maintaining the actinic combustion. When using a construction of the stem of FIG. 1, in which the hollow space 7 will generally be filled with air, there is the risk that the gas atmosphere in the space within the envelope is contaminated when the stem is ruptured or when a leakage occurs upon sealing the stem to the wall of the envelope. It is, however, alternatively possible in the construction of FIG. 1 to seal the stem to the wall of the envelope in such a manner that the hollow space 7 remains in open communication with the space within the envelope.

FIG. 3 shows a slightly deviating stem construction. This has been obtained by introducing the current conductors 2 and 3 into a glass tube 4 (shown by broken lines) and to subsequently reduce them in area at 9 while using plastic deformation. The other reference numerals in this FIG. have the same significance as those in the previous FIGS.

The stem according to FIG. 4 is obtained in the same manner as the stem according to FIG. 3. The glass tube 4 is, however, sealed throughout its length below the cavity 5.

FIG. 5 and FIG. 6 show stem constructions which are obtained by providing a body 10 of, for example, ceramic material with two ducts 11 and 12 which terminate in a cavity 13. As is shown in the FIG. this cavity 13 consists of a saw cut. The cavity consisting of a saw cut accommodates the ignition mass 6. The saw cut may be directed transversely to an imaginary line of connection between the ends of the current conductors 2 and 3 (FIG. 5) or it may coincide therewith (FIG. 6).

FIG. 7 is a cross-sectional view taken on the plane of the two current conductors 2 and 3, and FIG. 8 is a cross-sectional view at right angles to this plane of an embodiment of a combustion flashbulb according to the invention.

The combustion flashbulb comprises a glass envelope 14 and a lamp base 15. The actinically combustible material 16 and the stem 4 which corresponds to the construction of FIG. 1 are contained within the envelope 14. In a flashbulb according to the invention, which bulb was satisfactory in practice, the glass envelope 14 had a diameter of approximately 9 mm., the overall length of the lamp was approximately 245 mm. The contents of the envelope were approximately 560 mm.^{3}. The envelope contained 19.3 mg. of zirconium as an actinically combustible material in the form of shreds having a width of approximately 40 μm, a thickness of approximately 20 μm and a length of approximately 10 cm. The bulb was filled with oxygen up to a pressure of 657 cm. The length of the stem 4 in the envelope was 5 mm., the diameter 3 mm., the contents of the cavity were approximately 0.26 mm.^{3} The cavity 5 contained approximately 0.13 mm.^{3} of an ignition mass having the following composition:

2.07 g. zirconium powder
1.68 g. $KC10_4$
1.61 g. $LaCoO_3$ (contains approximately 1 percent of Sr)
2.70 g. of a 5 percent by weight solution of nitrocellulose.

The maximum period, which is the period between the instant of applying the voltage and the instant of the maximum luminous flux being applied, averaged 8.5 milliseconds in this combustion flashbulb. In a comparable combustion flashbulb for ignition by means of a filament and ignition mass, the maximum period averaged 12.7 milliseconds.

The combustion flashbulb according to the invention produced more light during the initial 40 milliseconds, than conventional combustion flashbulbs (ignition arrangement employing filament) with the same amount of zirconium.

This is an important advantage of the invention since flashbulbs are particularly used for shutter times of 1/25 second and less.

FIG. 9 is a cross-sectional view in the plane of the two current conductors 2 and 3, FIG. 10 is a cross-sectional view at right angles to this plane of an embodiment of another combustible flashbulb according to the invention.

The combustible flashbulb has a glass envelope 17 and a bulb cap 18. The envelope 17 comprises the actinically combustible material 19 and the system of stems 4 which corresponds to the construction of FIG. 1. In a flashbulb according to the invention which is quite satisfactory in practice the glass envelope 17 has a diameter of approximately 6 mm, the overall length of the bulb is 32 mm. The envelope contents are approximately 300 mm.^{3}. The envelope comprises 19.3 mg. of zirconium as an actinically combustible material in the form of shreds having a width of approximately 40 μm, a thickness of approximately 20 μm and a length of approximately 10 cm. The bulb is filled with oxygen up to a pressure of 1,400 cm. Hg. The length of the system of stems 4 in the envelope is 3 mm, the diameter is 3 cm., the contents of the cavity are approximately 0.26 mm.^{3} The cavity 5 comprises approximately 1.13 mm.^{3} of an ignition mass having the following composition:

2.07 g. zirconium powder
1.68 g. $KC10_4$
1.61 g. $LaCo0_3$ (includes approximately 1 percent of So)
2.70 g. of a 5 percent by weight nitrocellulose solution.

The maximum period, which is the period between the instant when the voltage is applied and the instant when the maximum luminous flux is provided, is 8.5 milliseconds at an average in this combustible flashbulb. In a comparable flashbulb ignited by means of a filament and an ignition mass the maximum period is between 15 and 20 milliseconds.

In addition to the essentially shorter maximum period other advantages of the flashbulbs according to the invention are:

1. When being used in a magazine in which the bulbs are mutually parallel arranged, there are no longer any failures as a result of internal short circuits.
2. Since the distance between the ends of the current conductors can be chosen to be very small and the amount of ignition mass is determined by the dimensions of the cavity, there are no longer any failures as a result of too small a quantity of ignition mass between the ends of the current conductors as is often the case when using the conventional bead construction.

FIG. 11 shows a principle circuit diagram for a magazine 25 provided with a plurality of electrically parallel arranged combustion flashbulbs 20A, 20B, 20C, 20D and 20E.

The reference numeral 22 denotes a voltage source which supplies a voltage increasing within a short time to a maximum value when the switch 23 closes. The voltage source may be, for example, a piezoelectric crystal which supplies a voltage increasing to approximately 3,000 volts within 10 microseconds. The switch 23 is generally accommodated in the camera 24 and when the shutter is opened, the switch is closed for s short period. The voltage source 22 may likewise be accommodated in the camera 24. The flashbulbs 20A and 20E are ignited one by one in an arbitrary sequence which is exclusively determined by the breakdown voltage of the ignition masses. The electric connections between the components of the circuit arrangement are denoted by the reference numerals 26, 27 and 28.

It will be evident that the magazine 25 may contain an arbitrary number of combustion flashbulbs.

What is claimed is:

1. A flashlamp comprising a light-transmitting envelope having walls which define a bulb with a hollow interior, with one wall formed as the base of the bulb, an electric insulating member having one part closely adjacent the base and a remote part extending into the interior of said bulb, an ignition mass on said remote part, two spaced current conductors, each having a central part extending through the base and electric insulating member with a first end part extending external of the base and a second end part extending through said remote part and connected to said ignition mass, whereby said central parts are shielded from said interior of the bulb, the lamp further comprising a a quantity of actinically com-

bustible material and a gas for supporting combustion within said bulb.

2. A flashlamp according to claim 1 wherein the electrically insulating material has a hollow space through which the current conductors are passed.

3. A flashlamp according to claim 1 wherein the electrically insulating material has a hollow space through which the current conductors are passed, which space is in open communication with the interior of the envelope.

4. A flashlamp according to claim 1 wherein the remote part of said electrically insulating material has a cavity for accommodating the ignition mass and said cavity includes a groove which is directed transversely to an imaginary line of connection between the first ends of the current conductors.

5. A flashlamp according to claim 4 wherein said cavity has a groove coinciding with an imaginary line of connection between the ends of the current conductors.

6. A device according to claim 1 wherein said insulating member is a glass tube formed as a stem.

7. A magazine provided with a plurality of electrically parallel arranged flashbulbs which can be ignited one by one in an arbitrary sequence by setting up across the flashbulbs a voltage increasing within a short period to a maximum value when the shutter of a camera to which the magazine is connected is opened, characterized in that the magazine comprises a plurality of flashbulbs of the combustible type as claimed in claim 8.

8. A flashlamp comprising a light-transmitting envelope having walls which define a bulb with a hollow interior, with one wall formed as the base of the bulb, an electric insulating member having one part closely adjacent the base and a remote part extending into said interior, an ignition mass on said remote part, said member and base defining a passage shielded from the said interior part of the bulb, two spaced current conductors, each having a central part extending through said passage with a first end part extending external of the base and a second end part extending through said remote part of the insulating member and connected to said ignition mass, and actinically combustible material and a gas for supporting combustion within said bulb.

9. A flashlamp comprising glass envelope having walls which define a bulb with a hollow interior, with one wall formed as the base of the bulb, a glass tube having one part adjacent the base and a remote part extending into said interior, an ignition mass on said remote part, two spaced current conductors, each having a central part extending through the base and the tube with a first end part extending external of the base and a second end part extending through said remote part and connected to said ignition mass, whereby said central parts are shielded from said interior, and actinically combustible material and a gas for supporting combustion within said bulb.

* * * * *

PO-1050
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3627459 Dated December 14, 1971

Inventor(s) JOHANNES CORNELIS VAN DER TAS ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

IN THE ABSTRACT - " Delete the paragraph "The invention relates to a flashbulb including .....is initiated"

Col. 1, before line 1, insert

--The invention relates to a flashbulb including an envelope of light-transmitting material within which an actinically combustible material, a gas maintaining the combustion and a stem are provided; the stem comprises two current conductors sealed in the lamp base and fixed relatively to each other within the envelope by means of a body of electrically insulating material. On the insulating material there is provided an ignition mass which connects the ends of the current conductors and is ignited by electric breakdown and subsequently burns explosively when a voltage is set up across the ends. Due to the explosively burning paste, the reaction between the actinically combustible material and the gas maintaining the combustion is initiated.--

Col. 2, line 10 "of" should be --by--

Col. 4, lines 10, 17 and 18, delete the little "3"

Col. 5, line 27, "8" should be --1--.

Signed and sealed this 8th day of May 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents