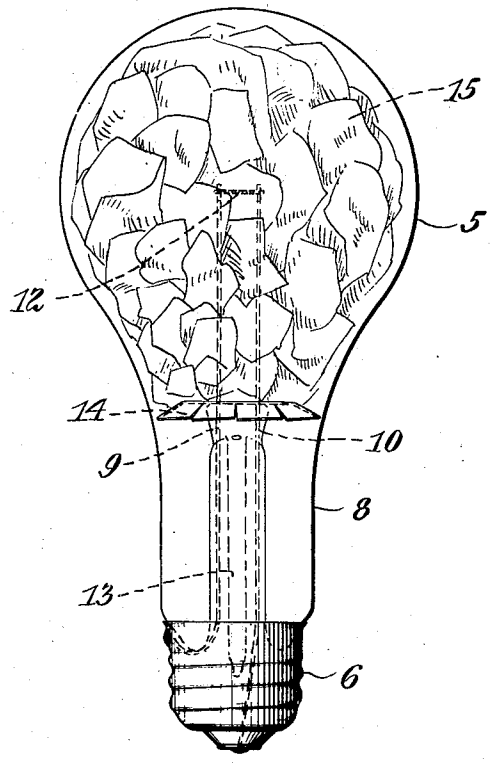
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TREATMENT OF PHOTOFLASH LAMP MATERIALS

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TREATMENT OF PHOTOFLASH LAMP MATERIALS

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My present invention pertains to photoflash lamps and particularly to the process of treating the aluminum foil employed in such lamps which upon combustion produces the well known intense momentary light for the taking of photographs and the like.

It has long been known in the art that aluminum foil which is heavy has a slower rate of combustion than does thinner foil. Consequently selection of the foil for utilization in photoflash lamps is made to maintain weight and thickness within prescribed limits. These sheets of foil are then packed by the manufacturer between adjacent sheets of paper and supplied to the lamp manufacturer. I have discovered, however, that despite the careful selection of the foil for proper weight characteristics, nevertheless, some of this foil exhibits a slower rate of combustion than is customary for such foil within the usual weight limits. Such is obvious from visual observations of the rate of combustion of individual sheets of foil packed adjacent to each other which clearly indicates a considerable difference in rate.

It is accordingly an object of my present invention to provide a photoflash lamp of the usual type with a plurality of sheets of combustible foil wherein the individual sheets have substantially equal rates of combustion.

Another object of my present invention is the provision of a photoflash lamp wherein the uniformity of rate of combustion of the metallic foil is increased when comparing one lamp with another.

Another object of my present invention is the provision of a method for treating metallic foil for photoflash lamps so that the individual sheets have substantially equal rates of combustion.

A further object of my present invention is the provision of a method for treating aluminum foil for photoflash lamps so as to increase its rate of combustion to a desired value.

Still further objects of my present invention will become obvious to those skilled in the art by reference to the following description in conjunction with the accompanying drawing wherein the single figure shows a photoflash lamp constructed in accordance with my present invention.

The lamp shown in the figure comprises a sealed envelope 5 provided with the usual screw base 6. A reentrant stem protrudes interiorly of the envelope and is sealed to the neck portion 8 of the envelope. Leading-in wires 9 and 10 are connected to the screw base 6 and are sealed into the press portion of the reentrant stem in the usual manner for the purpose of carrying electrical energy to the igniter element 12. An exhaust tube 13 is also provided as is customary in the art for exhausting the envelope and admitting a desired gaseous mixture. An insulating baffle 14 is provided interiorly of the envelope and supported by the stem thus forming an ignition chamber and preventing the hot products of combustion from falling in the vicinity of the seal.

Disposed within the envelope 5 in the vicinity of the igniter 12 are a number of leaves or sheets 15 of suitable metal foil, such as aluminum, which are readily combustible upon the passage of an electric current through the lamp. As hereinbefore pointed out these sheets of foil are carefully selected so as to have substantially uniform weight and thickness but despite such selection there is a considerable difference in the rate of combustion. Qualitative spectro-chemical analyses of the adjacent sheets of foil yields wide variations in the contents of copper, calcium, magnesium, silicon, and iron, but it is not at the present known just what effect this chemical variation has on the rate of combustion. Since it is impractical to test individual sheets of foil for quality before manufacturing into lamps and as all lamps contain a plurality of sheets one of which, if of poor quality, will adversely effect the rate of combustion, I find it expedient to treat all the leaves of foil at the same time.

Accordingly, in order to increase the uniformity in the rate of combustion I treat such foil either after insertion into the envelope or while in its original packages and interleaved with paper. To this end I take the foil having suitable weight and thickness characteristics but an unduly slow rate of combustion and anneal it for a short period at a temperature of 150° to 500° C. Irrespective of the fact that some of the sheets in any lamp or package may have a suitable rate of combustion such annealing treatment affects their combustion rate very little. In the case of initially slow burning or combustible foil, however, the annealing treatment increases the rate of combustion so as to approach the rate of the satisfactory sheets and thus makes for a substantially uniform rate of combustion.

The efficacy of my treating process may be best appreciated by citing the results of tests which I made. Taking a package of foil of proper weight and thickness characteristics but showing a slow rate of combustion I divided it into three parts with the foil remaining between the paper inserts. One portion was in no way treated while another portion was heated for 1½ hours in an oven maintained at a temperature of 225° C. The re-

maining portion of the same package was heated for the same period of time and in the same manner but maintained at a temperature of 250° C.

Ten or more lamps were then made from each portion all conditions of manufacture being maintained as constant as possible. The lamps were then burned and tested photographically to determine the time interval between the beginning of the electrical impulse which ignites the foil and the maximum light emission of the lamp, which occurs when a majority of the foil is burning. This interval is expressed in the table below as "Lag to peak," and is a function of the rate of combustion of the foil. Observations were also made of the maximum instantaneous light emission, expressed in the table as "Peak lumens" which is related both to rate of combustion and to uniformity of such rate as between different foils in the lamp.

Treatment of foil	Lag to peak	Peak lumens
	Seconds	*Millions*
Not annealed:		
Average	.0272	2.59
Maximum	.0294	4.00
Minimum	.0257	1.75
Annealed 1½ hours at 225° C.:		
Average	.0205	4.07
Maximum	.0224	4.8
Minimum	.0181	3.1
Annealed 1½ hours at 250° C.:		
Average	.0201	4.23
Maximum	.0209	5.1
Minimum	.0191	3.4

The annealing treatment of the foil, as hereinbefore stated, may be done either after the foil is inserted in the lamp or while in the original package. Moreover, any suitable heating medium may be used and atmospheres of air, inert or other gases, or vacuum may be employed.

Although the above table shows a time period of treatment of the order of one and one-half hours the time period required to anneal is inversely related to the temperature. Thus, if the temperature is raised to the upper limit of the range, hereinbefore mentioned, the time period may be reduced to the order of five minutes. Under such elevated temperatures it must be appreciated that the foil cannot be treated while in its original package with the customary paper separators interleaved therewith due to possible combustion of the separators. Accordingly, it is preferable to treat the foil after insertion in the lamp when using temperatures of the higher range.

The mechanism by which annealing accomplishes the result of promoting uniformity of rate of combustion by increasing the combustion rate of initially slow burning foil without affecting the rate of satisfactory foil, as indicated in the above table, is not definitely known. One theory I have entertained involves the effect of cold working of metals to reduce thermal conductivity. It is reasonable to assume that, other factors of foil weight, uniformity of thickness, chemical composition, surrounding atmosphere, etc., being equal, the rate of combustion of a foil will be higher the more readily the foil conducts heat from the part first ignited and heats other parts to the ignition temperature. It is well known that metals which have been severely cold worked, as is the case in the beating of this foil, suffer a loss in electrical and thermal conductivity. Annealing of the metal restores the conductivity values to normal for the metal.

Another possible explanation for the resulting phenomenon of increasing the uniformity of rate of combustion is that during the beating operation a foil may become coated with an organic lubricant, the effect of which is to delay access of oxygen to the foil during burning, such film or coating being destroyed or altered by exposure to a temperature above 110° C. Holding slow-burning foil at 105° to 110° C. for seven days produced no appreciable improvement, however, and it has not been possible to observe measurable loss in weight of a foil through annealing at 200° C.

As favoring the first mentioned theory I have measured an increase in electrical conductivity of the foil due to annealing. Since thermal and electrical conductivities of a metal rise or fall in closely parallel manner with treatment or annealing, I feel that this experiment indicates an increase in thermal conductivity of the foil as a result of annealing.

It thus becomes obvious to those skilled in the art that I have provided a photoflash lamp wherein the metallic foil is subjected to an annealing treatment. By such treatment the uniformity of rate of combustion of the foil is increased. Moreover, while any given package of foil may have satisfactory weight and thickness characteristics, it may also contain slow-burning foil. Yet subjecting the foil to my annealing treatment in no way impairs the rate of combustion of satisfactory sheets and at the same time increases the uniformity of rate of combustion of all sheets by increasing the rate of the initially slow-burning foil.

Although I have shown and described one specific embodiment of my present invention, I do not desire to be limited thereto as various other modifications thereof may be made without departing from the spirit and scope of the appended claims.

What is claimed is:

1. A photoflash lamp comprising a sealed envelope provided with a gas containing oxygen, an igniter element in said envelope, and metallic foil disposed in said envelope in close proximity to said igniter element and combustible with the oxygen in said envelope when said igniter element is supplied with electrical energy to produce a momentary intense light, said foil being preheated to a temperature not less than 150° C. to increase the rate of combustion of the thicker foil to cause all of said foil to have a substantially uniform rate of combustion and to give a more uniform peak intensity.

2. A photoflash lamp comprising a sealed envelope provided with a gas containing oxygen, an igniter element in said envelope, and a plurality of sheets of foil adapted to be ignited upon electrical energy being supplied to said igniter element to produce a momentary intense light, said foil having been annealed by heating to a temperature not less than 150° C. to increase the rate of combustion of the thicker foil to cause the rate of combustion of all the foil to be substantially uniform and to impart high thermal and electrical conductivity thereto and to increase the uniformity of peak intensity.

3. A photoflash lamp comprising a sealed envelope provided with a gas containing oxygen, an igniter element in said envelope, and metallic foil of substantially uniform weight and thickness disposed in said envelope in proximity to said igniter element and adapted to emit light upon combustion thereof with oxygen when electrical energy is supplied to said igniter element, said foil being preheated to a temperature not less than 150° C. to increase the rate of combustion

of the thicker foil to cause all of said foil to have a substantially uniform rate of combustion and to give a more uniform peak intensity.

4. The methd of treating metallic foil sheets for photoflash lamps of varying thickness which consists in annealing the foil by subjecting the same to a temperature of not less than 150° C. to increase the rate of combustion of the thicker sheets by increasing the thermal conductivity of such sheets and causing all the foil to have a substantially uniform rate of combustion and a more uniform peak intensity.

5. The method of treating aluminum foil sheets for photoflash lamps to increase the uniformity of the rate of combustion thereof which consists in heating the foil at a temperature ranging from 150° to 500° C. for a period of time inversely related to the temperature.

6. The method of treating metallic foil sheets for photoflash lamps to increase the uniformity of the rate of combustion thereof which consists in annealing the sheets by subjecting the same while in interleaved condition to a temperature ranging from 150° to 500° C. for a period of time ranging from an hour or more to a few minutes, depending upon the temperature.

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