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TRACER MATERIAL FOR MISSILES

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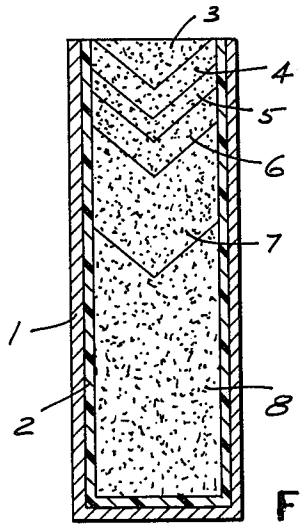

FIG. 1

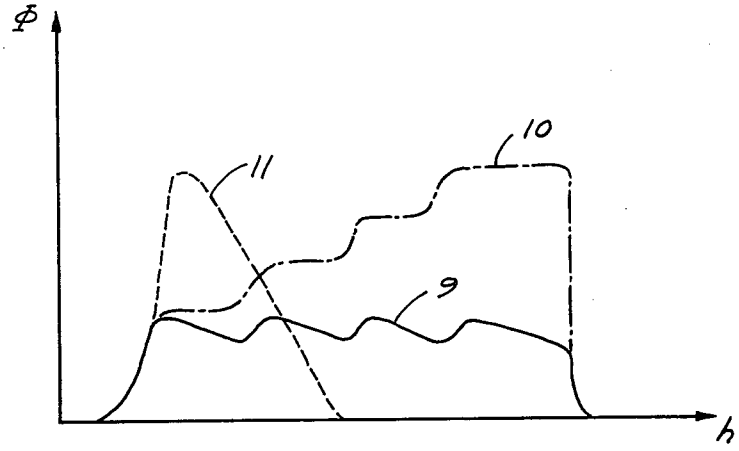

FIG. 2

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TRACER MATERIAL FOR MISSILES

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The present invention relates to light generating tracer material for insertion in or attachment to a missile to facilitate visual tracing of the trajectory of the missile when the same is propelled by means of a suitable weapon.

Tracer materials of this kind are heretofore known to have a short burning time—about 5–10 seconds—and generate a substantially constant light output while being consumed. As is well known, the intensity of light incident upon the eyes of an observer stationed for instance near the point from which the missile, including the tracer material, is propelled decreases by the square of the distance from the observer. Due to the constant light output of the tracer material, the intensity of the light as seen by such observer is excessively strong during the first part of the trajectory, but becomes rapidly too faint for reliable observation as the missile moves further away from the observer, particularly since the observer tends to be momentarily blinded by the initial high brilliancy of the tracer light. Attempts have been made to use a delay composition causing the tracer material to become ignited only after a certain distance of flight, but this entails the danger that the specific missile which the observer wants to observe cannot be located within the available short period of time. Furthermore, the effect of the delay composition does not eliminate the problem, but at best mitigates it.

It is the broad object of the invention to provide a novel and improved tracer material of the general kind above referred to which has for a given volume of material, a longer burning time than heretofore obtainable and a light output which increases during the burning of the tracer material. Such combination of features affords the advantage that the missile bearing the tracer material can be observed for a greater part of its trajectory and that the danger of a temporary blinding of the observer by an initial excessive brilliance of the tracer light is eliminated, or at least reduced.

The use of tracers according to the invention is particularly advantageous in conjunction with manually remote-controlled, rocket-motor driven, armor-piercing projectiles. Such projectiles have a comparatively low velocity, which makes a prolonged burning time particularly useful, and having a rather flat trajectory which often nearly coincides with the usual sighting line, thus making an initial strong glare particularly troublesome.

A more specific object of the invention is to provide a novel and improved tracer in which the luminous material is so shaped that the maximum light output is attained therefrom.

Luminous compositions used as tracer materials usually comprise a mixture of magnesium, an oxydizing agent, a desensitizing agent and a binder. It has been found that the intensity of the light output of such mixture can be increased by reducing the relative proportions of the desensitizing agent and the binder in the mixture, but such increase in intensity is obtained at the expense of the burning time. The invention utilizes the afore-described phenomenon by combining in a tracer a plurality of compositions which have different burning times and different light-emitting properties and arranging these compositions so that the composition having the longest burning time and the lowest light emission is burned first and the composition having the shortest burning time and the highest light emission is burned last. By selecting the mass of each composition appropriately, a tracer charge is obtained which has a long total burning time and the light output of which increases towards the end of the burning time, whereby the light intensity of the tracer as seen by a stationary observer remains approximately constant.

Other and further objects, features and advantages are pointed out hereinafter and set forth in the appended claims constituting part of the application.

In the accompanying drawing, a preferred embodiment of the invention is shown by way of illustration and not by way of limitation.

In the drawing:

FIG. 1 is a sectional view of a tracer according to the invention, and

FIG. 2 is a graph showing comparative light intensity-time curves of tracer materials.

Referring first to FIG. 1 in detail, the entire tracer charge is placed in a cylindrical can **1** open at one end and made of suitable material such as steel. The inside of the can is lined with a liner **2** made of a mixture of hardening plastic and glass powder.

The tracer charge is a composite charge made up of a plurality of layers, some serving as primers and others as light generating layers.

More specifically, layer **3** is a black powder priming charge.

Layer **4** is a priming charge having a composition of 59% of barium peroxide, 36% of stannic oxide and 5% of chlorinated rubber. Such composition does not produce any appreciable light when burned.

Layer **5** is a composition consisting of 35% of the composition of layer **4** and of 65% of a light generating tracer composition comprising 64.7% of strontium nitrate, 8.8% of strontium chloride, 11.8% of magnesium, 8.8% of polyvinyl chloride and 5.9% of chlorinated rubber.

Layer **6** is a light generating composition consisting entirely of the tracer material composition used for layer **5** in a proportion of 65% of the total mass of that layer.

Layer **7** is a light generating composition consisting of 64.7% of strontium nitrate, 5.9% of strontium chloride, 17.6% of magnesium, 5.9% of polyvinyl chloride and 5.9% of chlorinated rubber.

Finally, layer **8** is also a light generating composition consisting of 58.8% strontium nitrate, 29.4% of magnesium, 5.9% of polyvinyl chloride and 5.9% of chlorinated rubber.

The aforelisted compositions are placed in the can in reverse order in relation to the desired ignition sequence thereof. As shown in FIG. 1, layer **8**, which produces the highest light intensity and has the shortest burning time, is at the bottom, thus it will burn last, and priming composition **3** is at the top of the can at which combustion of the tracer material is started. FIG. 1 further indicates by the spacing of the lines indicating the layers that the layers have different volumes. The proportion of the volumes of the layers is selected in accordance with the desired distribution of the light output during the flight of the missile and the desired total burning time.

The compositions are pressed together successively by any suitable means, such as a cylindrical punch. The punch has preferably a conical point to obtain the illustrated conical mating surfaces of the layers. As has been pointed out before, a more uniform increase of the intensity of the light output as the consumption of the tracer material progresses from layer to layer, is obtained by the illustrated conical shape.

FIG. 2 shows light intensity θ as a function of the burning time h. The curve **9** indicates the light intensity of tracer material according to the invention. As shown,

the tracer material reaches rather rapidly its peak intensity and then remains substantially constant as seen by a stationary observer.

Curve **10** shows the actual light intensity of the tracer material according to the invention. As is apparent, the light intensity increases during the burning time of the tracer material.

Finally, curve **11** shows the light intensity of conventional tracer material. The curve indicates that the light intensity reaches rapidly a high peak and then decreases equally rapidly. The peak being located at the beginning of the total time causes the aforementioned temporary blinding of an observer. A comparison of curves **9**, **10** and **11** respectively also demonstrates the much longer burning time of the tracer material according to the invention, for a given total volume of tracer material.

While the invention has been described in detail with respect to a certain now preferred example and embodiment of the invention, it will be understood by those skilled in the art after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, to cover all such changes and modifications in the appended claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A luminous tracer for use with a missile, comprising a container, tracer material of a plurality of combustible, light-generating compositions in said container, said compositions having different burning times for a given mass and generating light of different intensities when ignited, the burning time and the light intensities of the compositions being inversely proportional, said compositions being stacked in said container to form a column in which the compositions are superimposed in an order such that the composition having the longest burning time and generating the lowest light intensity is located at one end of the column and the composition having the shortest burning time and generating the highest light intensity is located at the other end thereof, and a priming charge disposed in said container adjacent the composition having the longest burning time and generating the lowest light intensity, whereby upon ignition of the column at the end thereof including the composition having the longest burning time and generating the lowest light intensity, the intensity of the light emitted by the tracer material increases as the consumption thereof progresses toward the other end of the column so that the light intensity of the tracer as the time and distance of flight of the missile increases provides a light intensity which, as seen by a stationary observer, remains approximately constant.

2. A tracer material according to claim 1 wherein the facing surfaces of adjacent compositions are slanted in reference to the center axis of said column.

3. A tracer material according to claim 1 wherein the facing surfaces of adjacent compositions have a conical configuration, the splices of the conical surfaces being aligned along the center axis of the column.

4. A tracer material according to claim 1 wherein said container has an open end, the composition generating the lowest intensity of light being located at the open end of said container.

5. A tracer material according to claim 1 wherein the priming charge is placed upon the outer side of said composition at the open end of said container.

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