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[73] Assignee **The United States of America as represented by the Secretary of the Army**

[54] **NONCORROSIVE PYROTECHNIC COMPOSITION**
4 Claims, No Drawings

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[50] **Field of Search** 149/18, 20, 30, 37, 19, 114, 44

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ABSTRACT: A noncorrosive pyrotechnic igniter composition in combination with corrosive pyrotechnic tracer compositions for use in very small tracer cavities. A noncorrosive igniter composed of lead dioxide as the noncorrosive oxidizer, zirconium as the fuel and stabilized red phosphorus as the sensitizer all in predetermined proportions, prevents the premature ignition of the corrosive tracer composition.

NONCORROSIVE PYROTECHNIC COMPOSITION

the invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to us of any royalty thereon.

The trend in small arms technology has been to develop smaller projectiles or rounds which travel at much higher velocities than heretofore. With these smaller projectiles come many associated problems. The invention is concerned with the problem of how to make an effective tracer round which can be seen at these high velocities. The problem is compounded by the fact that the tracer cavities in these new rounds are only 0.050 inch to 0.060 inch in diameter as compared with 0.180 inch diameter for 5.56 mm. rounds. Conventional tracer compositions have been found to be ineffective in these new rounds.

Heretofore there was developed a nonconventional tracer composition which had quite good visibility and performed excellently in many other respects. This composition, consisting of potassium chlorate or potassium perchlorate as an oxidizer, zirconium as a fuel, and vinyl alcohol acetate resin as a binder, is described in *Ordinance*, July & Aug. 1967, vol. 52, No. 283, pp 66–7.

One of the main problems regarding this special composition is that oxidizers such as chlorates and perchlorates produce corrosive combustion products. The burning of these corrosive oxidizers in a firing weapon can be quite harmful thereto. It was found that rusting occurred if the barrel was not cleaned each time a round with this composition was fired. Another problem was that of ignition reliability. The new composition proved to be only 50–60percent reliable. Since the corrosive composition was very satisfactory in many other respects, it was determined that the solution to both problems lay not in the development of a new tracer composition, but in the development of a noncorrosive igniter to delay the combustion of the corrosive tracer composition until the projectile was out of the barrel.

Many igniters, standard and nonstandard, were tested in an attempt to solve these problems, but were not successful. High-speed X-ray studies were initiated to identify the igniter problem. Through these studies it was learned that the ignitable composition having no binders blewout before igniting the corrosive tracer column. When binders were added to prevent blowout, it was found that the compositions were extremely difficult to ignite. Various mechanical devices were tried to lock-in the ignitable compositions, e.g. lockwashers, crimping and the like, but due to the miniaturized dimensions of the projectiles, none of these techniques were successful.

In the present invention lead dioxide, used as a noncorrosive oxidizer, was found to have excellent binding characteristics without the need of additives. This compound was capable of holding the sensitizer against the corrosive tracer composition sufficiently for ignition to occur. The proper sensitizer for use with our composition is also important. Because of the miniature size of the tracer cavity, and the necessity of having enough corrosive tracer composition for the projectile to be seen throughout its entire path, there is only a very small volume available for the igniter. It is also desirable for the corrosive tracer composition to ignite as close as possible to the end of the barrel of the gun. The use of stabilized red phosphorous provided unexpected results when used as the sensitizer. Other compositions with equivalent tribochemical sensitivities provided inferior performances. It was hypothesized that it is the particular mechanism of the combination of stabilized red phosphorus and potassium chlorate or potassium perchlorate which produces such reliable ignition. It was first discovered during World War II, when stabilized red phosphorus first became readily available, that serious explosions occurred during the drying process of compositions containing both stabilized red phosphorus and potassium chlorate. It soon became clear that this mixture was unstable and not compatible for pyrotechnic applications. As a result of this experience, pyrotechnic handbooks and safety manuals warn users against the hazard of using mixtures containing both stabilized red phosphorus and potassium chlorate. Apparently, in the tracer system under consideration, the stabilized red phosphorus in a balanced composition, sensitizes the surface of the corrosive tracer composition, since it is in intimate contact with it, and reliable ignition is produced.

Numerous blends were evaluated having lead dioxide as the oxidizer, zirconium as the fuel and stabilized red phosphorus as the sensitizer. The results showed that at high fuel to oxidizer ratios, i.e., 50—50 to 80–20 by weight, the compositions were visible but were poorer igniters of the corrosive tracer column. At stoichiometric ratios of fuel to oxidizer, i.e., 30–70 by weight, the compositions were the best in ignition but were inferior in visibility. When no sensitizer was used, the ignition of the corrosive tracer was unsatisfactory and when too much sensitizer was used and the fuel-to-oxidizer ratio was too far out of balance, the ignition of the corrosive tracer was erratic. Since the visibility of the igniter is not of prime consideration, the blends which produced the most reliable ignition were considered acceptable. Table I shows the acceptable range of components. The optimum combination was found to be 68.25 percent lead dioxide, 29.25 percent zirconium (40 microns optimum), and 2.50 percent stabilized red phosphorus.

TABLE I

Acceptable Ranges of Components in Noncorrosive Igniter

Component	Acceptable Range
Oxidizer-lead dioxide	65–70%
Fuel-zirconium (20 microns to 100 microns)	28–33%
Sensitizer-stabilized red phosphorus	2–6%

In range tests it was found that when an amount of noncorrosive igniter is used which is small enough to produce optimal performance characteristics in the system as a whole, the display reliability is increased from 50–60 percent without the igniter to 75–85 percent with the noncorrosive igniter and no corrosive residue was found to have been left in the gun.

We claim:

1. A noncorrosive igniter composition suitable for use with corrosive pyrotechnic tracer compositions in very small cavities of tracer rounds, said igniter composition consisting essentially of

lead dioxide	65 to 70 weight percent
zirconium (diameter of 20 to 100 microns)	28 to 33 weight percent
stabilized red phosphorus	2 to 6 weight percent

2. An igniter composition in accordance with claim 1 consisting essentially of

lead dioxide	68.25 weight percent
zirconium (diameter approx. 40 microns)	29.25 weight percent
stabilized red phosphorus	2.50 weight percent

3. An igniter composition in accordance with claim 2 wherein said corrosive pyrotechnic tracer compositions include a composition consisting essentially of

an oxidizer selected from the group consisting of potassium chlorate and potassium perchlorate,

a fuel consisting of zirconium, and

a binder consisting of vinyl alcohol acetate resin.

4. An igniter composition in accordance with claim 1 wherein said corrosive pyrotechnic tracer compositions include a composition consisting essentially of

an oxidizer selected from the group consisting of potassium chlorate and potassium perchlorate,

a fuel consisting of zirconium, and

a binder consisting of vinyl alcohol acetate resin.

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