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PYROTECHNIC COMPOSITION

Donald Edgar Olander, Fair Oaks, Calif., assignor to Explosive Technology, Inc., Fairfield, Calif., a corporation of California

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ABSTRACT OF THE DISCLOSURE

Pyrotechnic composition for use as a first fire or ignition mixture consisting of a mixture of amorphous boron and anhydrous calcium chromate.

BACKGROUND OF THE INVENTION

This invention relates to a pyrotechnic composition which has characteristics such that it may be easily ignited by a relatively low temperature heat source and which has a calorific heat output when ignited such that it can, in turn, readily ignite pyrochemical or explosive compositions that are normally insensitive to ignition. Such compositions have heretofore been available and have been identified as "first-fire" or "ignition" mixtures. Such mixtures generally must be relatively safe to prepare and physically dry. In addition, the mixture must be able to be ignited relatively easily and thereafter ignite a secondary element of a train of pyrochemical elements. In most applications for such pyrotechnic compositions, there is an increasing demand for greater reliability and safety in the design and function of pyrochemical and explosive devices. In addition, there is a requirement that the composition be able to withstand higher temperatures. Previously, in an attempt to meet any of these more stringent requirements, it has been necessary to make a compromise in either the safety or reliability of the pyrotechnic composition, or there has been a need to provide more elaborate and costly assemblies in order to fulfill the functional requirements with the heretofore available compositions. There is, therefore, a need for a new and improved pyrotechnic composition which will meet the present stringent requirements without sacrificing any other desirable factor for such compositions.

SUMMARY OF THE INVENTION

The pyrotechnic composition consists essentially of a mixture of amorphous boron and anhydrous calcium chromate in which the boron can vary between 5 and 25% by weight and the calcium chromate can vary between 75 and 95% by weight. In addition, the mixture can include from zero to 15% of a filler.

In general, it is an object of the present invention to provide a pyrotechnic composition which has low sensitivity to accidental ignition.

Another object of the invention is to provide a composition of the above character which has low gas evolution during burning.

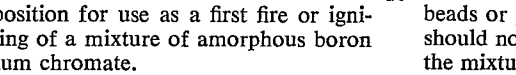
Another object of the invention is to provide a pyrotechnic composition of the above character which has a high thermal output.

Another object of the invention is to provide a pyrotechnic composition of the above character which displays excellent characteristics as a delay train first-fire.

Another object of the invention is to provide a pyrotechnic composition of the above character which can be easily ignited by relatively low temperature flame fronts.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The pyrotechnic composition comprising the present invention consists of a mixture of amorphous boron and anhydrous calcium chromate. This mixture reacts in accordance with the following equation:



$$2B+CaCrO_4 \rightarrow CaO \cdot B_2O_3+Cr$$

The barium and calcium chromate are solids as are the reactants calcium oxide and barium oxide and chromium. The boron can comprise between 5 to 25% by weight of the mixture, whereas the calcium chromate can comprise between 75–95% by weight of the mixture. A suitable filler material such as diatomaceous earth, micro-glass beads or powdered glass may be utilized if desired, but it should not comprise more than zero to 15% by weight of the mixture.

In the mixture, the boron serves as the fuel and the calcium chromate serves as the oxidizer. If desired, small amounts of a different reactive fuel and different oxidizer can be used. For example, up to 5% of a different reactive fuel, such as silicon, zirconium, aluminum or magnesium, and up to 10% by weight of a different oxidizer, such as lead chromate, may be included in the mixture. These small portions of a different reactive fuel and a different oxidizer should not make it necessary to sacrifice the desirable features of the pyrotechnic composition.

By way of example, one mixture which was made in accordance with the present invention comprised 13% boron and 87% calcium chromate. The boron was of 95% purity. Although the theoretical heat of reaction is 983 calories per gram but because of contaminants normally found in the commercial grade boron, the heat output was approximately 870 calories per gram. This heat output can be varied as can the burning rate and the sensitivity characteristics by variation in the percentages of the constituents and also by the addition of inert fillers such as diatomaceous earth or by the use of reactive modifiers such as various alternate fuels and oxidizers. In the example, the gas evolution was found to be very small and to only constitute 26.8 milliliters per gram. The burning rate was found to be 1.15 seconds per inch with the mixture compacted at 30,000 p.s.i. The ash retention was 90.5%. The mixture did not ignite when friction was utilized of a magnitude which would ignite PETN. In the impact test utilizing with a Bureau of Mines type apparatus which had a 300 kilogram-centimeter limit, it was found that the mixture would not ignite on impact of over 300 kg.-cm. In electrostatic tests, it was found that the material was not ignited by an electrostatic charge of 8×10^6 ergs in a point discharge through loose non-consolidated powder.

It has been found that the mixture is exceptionally stable up to the auto-ignition temperature as viewed by differential thermal analysis. At 722° C., the mixture undergoes a sharp exothermic reaction as it reacts in auto-ignition. This makes the mixtures particularly desirable for use in environments of long high temperature without affecting its ultimate performance. Because of the very high percentage of ash retention, the natural burning rate of the mixture and the minor alteration of the ignition characteristics or gas evolution caused by varying the proportions of the basic ingredients of the mixture, the mixture is particularly well suited for use as a pyrochemical time delay. The mixture also is particularly suitable for this purpose because it requires no intermediate first-fire element to gain full ignition from a limited heat output ignition source such as a low output primer. This, therefore, substantially reduces the cost and complexity of any hardware incorporating the mixture and increases the intrinsic reliability of the system incorporating the mixture within the system. Also, because of the low production of gas and the high percentage of ash retention, the pyrotechnic composition burns in a repeatable manner which particularly adapts it for use as a pyrotechnical time delay.

The pyrotechnic composition is also very desirable because it does not create excessive gun flash. In other words, it does not give off a bright flash when fired to give away the position of the person who fires the weapon or other device utilizing the pyrotechnic composition.

It is apparent from the foregoing that there has been provided a new and improved pyrotechnic composition which has greatly improved qualities over pyrotechnic compositions previously available. It is particularly adaptable for igniting a pyrochemical train from a mechanical stimulus such as a primer. It will provide a time delay as a function of the burning rate which will ignite the base charge element.

I claim:

1. A pyrotechnic composition comprising about 5–25% by weight boron and about 75–95% by weight calcium chromate.

2. A composition as in claim 1 wherein said boron is of the amorphous type and wherein said calcium chromate is anhydrous.

3. A composition as in claim 1 together with a filler comprising up to 15% by weight of the composition.

4. A composition as in claim 1 wherein the boron comprises approximately 17% by weight of the composition and calcium chromate comprises approximately 83% by weight of the composition.

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CARL D. QUARFORTH, Primary Examiner

M. J. SCOLNICK, Assistant Examiner

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