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EXPLOSIVE

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This invention relates generally to explosives and more particularly to a novel deflagrating type of explosive composition.

Secondary explosives such as trinitrotoluene, tetryl and cyclotrimethylenetrinitramine and mixtures of such with ammonium nitrate and other materials have been ordinarily utilized heretofore as the explosive charge in projectiles adapted for destroying aircraft, military tanks and similar devices. Such projectiles must be capable of successful functioning at the low pressures and temperatures of high altitudes and at the same time must be resistant to guns whose temperatures are elevated as a result of successive multiple firing. Further, to have any utility they must be capable upon reaching their objective of dealing a destructive blow and any improvement in the destructive power of the explosive charge used in such projectiles is advantageous. While many explosives and explosive compositions have great destructive power, not all will function satisfactorily under such a variety of conditions of temperature and pressure and most in particular do not have a satisfactory "cook-off" time. The period of time that an explosive can be subjected to the elevated temperatures of a gun which has become heated by firing several cartridges in rapid succession is commonly known as the "cook-off" time and the most desirable explosives for use in projectiles to be fired from rapid fire guns are those having maximum "cook-off" times.

It is, therefore, an object of this invention to provide a novel explosive composition particularly well suited for use in projectiles to be fired from guns adapted to fire cartridges in rapid succession. Another object of this invention is to provide an explosive composition having improved demolition properties or high blast effect and having sufficient heat stability to enable its use in explosive projectiles to be fired from rapid fire guns. A more specific object of this invention is to provide an explosive composition adapted for use in projectiles, bombs or the like having improved demolition characteristics or blast effect over conventional explosive compounds such as cyclotrimethylenetrinitramine, trinitrotoluene, tetryl and the like and having the additional property of improved heat stability over such explosives.

The foregoing objects as well as others are accomplished in accordance with this invention by providing a composition containing a major amount of a metal having a high heat of oxidation, an oxidizer for the metal coated with trinitrotoluene or other suitable sensitizing explosive, and a minor amount of cyclotetramethylenetetranitramine. More specifically, the invention contemplates an explosive composition containing from about 30 to about 70 percent of powdered aluminum, magnesium, zinc, zirconium, titanium, boron, alloys thereof, or mixtures thereof, from about 18 to about 35 percent of an oxidizer for the metal and from about 2 to about 4 percent trinitrotoluene intimately associated with the oxidizer and from about 6 to about 30 percent cyclotetramethylenetetranitramine. The oxidizer should be either a perhalate of ammonium, a perhalate of an alkali metal, or a nitrate of one of the alkali metals or alkaline earth metals.

It is usually advantageous to mold pellets from the explosive composition and to thereafter use the pellets as the charge in explosive projectiles. This composition can be conveniently pelleted by first mixing it with about 2 parts calcium stearate and about one part graphite per 100 parts of the explosive composition.

The following specific examples have been found particularly advantageous for loading explosive projectiles used in conventional 20 millimeter and 40 millimeter cartridges:

Example I

	Parts
Aluminum	About 54
Ammonium perchlorate	About 36
Trinitrotoluene	About 4
Cyclotetramethylenetetranitramine	About 5.8
Paraffin wax	About 0.2

Example II

Aluminum	About 50
Potassium nitrate	About 18
Trinitrotoluene	About 2
Cyclotetramethylenetetranitramine	About 29
Paraffin wax	About 1

Example III

Aluminum	About 50
Barium nitrate	About 18
Trinitrotoluene	About 2
Cyclotetramethylenetetranitramine	About 29
Paraffin wax	About 1

Example IV

Magnesium	About 54
Ammonium perchlorate	About 36
Trinitrotoluene	About 4
Cyclotetramethylenetetranitramine	About 5.8
Paraffin wax	About 0.2

In each of the foregoing examples the various parts of the ingredients are expressed as parts by weight. In each instance, in order to insure that the trinitrotoluene is closely associated with the oxidizing agent, the particles of the oxidizer are coated with trinitrotoluene. This coating can be achieved by melting the trinitrotoluene and pouring it over the crystals of the ammonium perchlorate or other oxidizer while the oxidizer is at a temperature of from about 92° C. to about 95° C. The particles of the oxidizer should be stirred until the trinitrotoluene is distributed substantially uniformly over the crystals. An alternate method for coating the particles of the oxidizer with trinitrotoluene involves dissolving the trinitrotoluene in acetone or other low boiling solvent for the trinitrotoluene and non-solvent for the oxidizer, pouring the solution over the crystals of the oxidizer and agitating until a uniform dispersion is obtained and thereafter removing the acetone or other solvent by evaporation.

In forming the explosive composition the trinitrotoluene coated oxidizer, the powdered metal and the cyclotetramethylenetetranitramine are mixed together by any suitable means. One method that may be utilized involves tumbling the powdered materials together until a substantially uniform composition is obtained. The mixing may also be achieved by a series of screening operations and, indeed, almost any method which does not involve stirring the powdered material can be utilized. It is preferred to not stir the materials together because of the sensitivity of the explosive composition to friction.

It has been found that the explosive composition pro-

vided by this invention is much more effective for destroying hollow structures such as aircraft wings than a similar weight of any of the conventional explosives such as cyclotrimethylenetrinitramine, trinitrotoluene or tetryl. For example, in tests in which projectiles containing explosive charges are fired into hollow aluminum panels, simulating the wing of an airplane, the explosive composition of this invention is over ten times as destructive as a projectile containing an equal weight of tetryl.

The composition provided by this invention is relatively heat stable and projectiles containing the same can be safely left in the chamber of a gun which has become heated by the firing of several rounds of ammunition in rapid succession for a longer period of time than can projectiles containing tetryl, cyclotrimethylenetrinitramine, and similar explosives. This characteristic of improved "cook-off" time is a distinct advantage in projectiles utilized by aircraft because the guns used are capable of firing cartridges in rapid succession and become heated to well above 280° F. As an example of the improved heat stability of the explosive composition provided by this invention it has been found that the composition having cyclotetramethylenetetranitramine is much more heat stable than a similar composition in which cyclotrimethylenetrinitramine has been substituted for the cyclotetramethylenetetranitramine. In one type of test designed to bring out the difference in heat stability of the various explosive compounds about 0.3 gram of an explosive is placed in a small glass capsule and the open end is sealed to provide a gas-tight capsule. The capsule is then immersed in a molten Wood's metal bath at a known temperature and the length of time required for the explosive to detonate is accurately measured. When the explosive composition of this invention was compared with explosive compositions similar in all respects thereto except that cyclotrimethylenetrinitramine was substituted for cyclotetramethylenetetranitramine it was found that the composition containing the cyclotetramethylenetetranitramine could be immersed in the molten metal having a temperature of 250° C. for 46 minutes before the mixture detonated. The composition containing cyclotrimethylenetrinitramine exploded after only 12 minutes' immersion time.

It is believed that the unusually good demolition characteristics of the explosive provided by this invention are due to the fact that the gases developed by the explosion of the relatively small amount of explosive compound, namely cyclotetramethylenetetranitramine, are rapidly and greatly increased in volume by the intense heat developed by the burning of the metal powder. In a sense the explosion may be a two-step process in which the explosive compound, cyclotetramethylenetetranitramine, first explodes and ignites the metal which because of the presence of the efficient oxidizing agent burns very rapidly and developes an intense heat which greatly expands the volume of gas developed by the explosion of the cyclotetramethylenetetranitramine. For best results, the granulation of the metal must be such that it burns very rapidly so it is preferred that the granulation of the metal be such that substantially 100% thereof will pass through a Standard U.S. 200 mesh screen. In other words, the maximum particle size should be about 74 microns. Also for best results the granulation of the oxidizing agent should be such that 100% thereof will pass through a 100 mesh screen and not more than about 50% thereof will pass through a 325 mesh screen. In other words, 100% of the particles of the oxidizer should have a granulation of not more than about 150 microns and 50% thereof should be less than 44 microns. The explosive composition provided by this invention should have a granulation such that all particles will pass through a U.S. Standard No. 40 sieve and not more than about 5% will pass through a U.S. Standard No. 60 sieve. In order to waterproof the cyclotetramethylenetetranitramine the particles thereof are preferably coated with paraffin wax in the amount of about 0.2% by weight of the total composition.

Several specific examples have been given in the foregoing for the purpose of illustration but it is to be understood that each particular composition can be varied within the limits specified therein for each ingredient and that each of the metals contemplated for this invention can be utilized in the particular embodiments presented in detail. It is also to be understood that other modifications can be made in the invention by those skilled in the art without departing from the spirit and scope thereof except as it is limited by the appended claims.

I claim:

1. As a new composition of matter, an explosive composition consisting essentially of from about 30 percent to about 70 percent of powdered metal selected from the group consisting of aluminum, magnesium, zinc, titanium, zirconium, boron, alloys thereof and mixtures thereof, about 18 percent to about 36 percent of an oxidizer selected from the group consisting of a perhalate of ammonium, a perhalate of an alkali metal, a nitrate of an alkali metal, and a nitrate of an alkline earth metal, from about 2 percent to about 4 percent of trinitrotoluene in the form of a coating on the particles of the oxidizer, and about 6 percent to about 30 percent cyclotetramethylenetetranitramine.

2. The composition of claim 1 wherein said metal is aluminum.

3. The composition of claim 1 wherein the metal is aluminum and the oxidizer is ammonium perchlorate.

4. The composition of claim 1 wherein the granulation of the metal is not more than about 200 microns and the particle size of the oxidizer is such that 100% thereof is no greater than about 74 microns and at least about 5% thereof has a granulation of not more than about 44 microns.

5. An explosive composition consisting essentially of from about 30 percent to about 70 percent of aluminum, about 18 percent to about 36 percent of barium nitrate coated with about 2 percent trinitrotoluene, and about 6 percent to about 30 percent of cyclotetramethylenetetranitramine.

6. An explosive composition, adapted for use in projectiles designed to destroy hollow targets, consisting essentially of from about 30 percent to about 70 percent of a powdered metal selected from the group consisting of aluminum, magnesium, zinc, titanium, zirconium, boron, alloys thereof, and mixtures thereof, from about 18 percent to about 35 percent of an oxidizer for the metal coated with trinitrotoluene and from about 6 percent to about 30 percent of cyclotetramethylenetetranitramine.

7. As a new composition of matter, an explosive composition consisting essentially of from about 30 percent to about 70 percent of a powdered metal selected from the group consisting of aluminum, magnesium, zinc, titanium, zirconium, boron, alloys thereof, and mixtures thereof, about 18 percent to about 36 percent of an oxidizer for the metal selected from the group consisting of a perhalate of ammonia, a perhalate of an alkali metal, a nitrate of an alkali metal, and a nitrate of an alkaline earth metal coated with from about 2 percent to about 4 percent of trinitrotoluene, and about 6 percent to about 30 percent of cyclotetramethylenetetranitramine coated with paraffin wax.

8. As a new composition of matter, an explosive composition consisting essentially of from about 30 percent to about 70 percent of a powdered metal selected from the group consisting of aluminum, magnesium, zinc, titanium, zirconium, boron, alloys thereof, and mixtures thereof, about 18 percent to about 36 percent of an oxidizer for the metal selected from the group of a perhalate of ammonia, a perhalate of an alkali metal, a ni-

trate of an alkali metal, and a nitrate of an alkaline earth metal, from about 2 percent to about 4 percent of trinitrotoluene as a coating on the oxidizer, and from about 6 percent to about 30 percent of cyclotetramethylenetetranitramine.

9. The composition of claim 7 wherein the metal is aluminum.

References Cited in the file of this patent

UNITED STATES PATENTS

2,410,699 Wyler ---------- Nov. 5, 1946

FOREIGN PATENTS

402,862 Italy ---------- Mar. 27, 1943