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EXPLOSIVE CHARGE

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This invention relates to a new and improved high explosive charge and more particularly to one especially adapted for military purposes.

Trinitrotoluene has been known for many years to possess properties that make it well suited for use as a filling charge in high explosive shells, projectiles and the like. It is stable to a high degree over long periods of storage, relatively insensitive to shock or blows, and forms no sensitive explosive compounds by reaction with metals. Furthermore, it melts at a relatively low temperature, so that it is well adapted for forming cast explosive charges, since fusion can be brought about by use of hot water or low pressure steam.

While trinotrotoluene has the foregoing favorable properties for employment as the explosive for cast charges, it is not altogether satisfactory. For example, in spite of the fact that it has always been considered a very high velocity explosive, it is considerably exceeded in this respect by some other organic explosives, for example pentaerythritol tetranitrate. Moreover, cast trinitrotoluene is relatively insensitive to ignition, so that a booster of considerable strength is required for its detonation.

An object of the present invention is a high density explosive charge of improved properties adapted for shell filling and the like. A further object is a cast explosive charge possessing the favorable properties of trinitrotoluene for military purposes but having a higher velocity of detonation than the latter and greater sensitiveness to the action of commercial initiators. A still further object is a cast explosive of the above desirable characteristics but resembling trinitrotoluene in its safety in handling and inertness toward metals. Additional objects will be disclosed as the invention is described more at length hereinafter.

We have found that the foregoing objects are accomplished when we employ a high density explosive charge comprising a mixture of not more than 40% pentaerithritol tetranitrate with not less than 60% trinitrotoluene. Preferably we use between 5 and 40% of the former and between 95 and 60% of the latter compound. Using compositions such as the above, we find that the charge possesses the high velocity and high degree of sensitiveness to initiation characteristic of pentaerithritol tetranitrate while retaining the insensitiveness to shock characteristic of trinitrotoluene.

The above compositions may be prepared in various ways, as by composition of the mixed compounds in the desired proportions. We find the blends particularly attractive as cast charges, however, since the fusion point of trinitrotoluene is lowered still further by the presence of dissolved pentaerythritol tetranitrate. In preparing cast charges, we prefer to employ those ranges of composition in which the pentaerythritol tetranitrate is completely soluble in the trinitrotoluene. Compositions containing between 9 and 12% pentaerythritol tetranitrate and between 91 and 88% trinitrotoluene satisfy this condition. Using such limits, true solutions are obtained rather than suspensions or slurries such as would result with higher percentages of pentaerythritol tetranitrate. Consequently, there is no segregation on solidification and greater uniformity of properties prevails throughout the charge. Such solutions may be prepared, for example, by dissolving pentaerythritol tetranitrate in molten trinitrotoluene at 85° C., pouring such solution into the designated shell or other receptacle, and causing it to solidify. In addition to the above methods, we may prepare blends of the two materials by coprecipitation, for example from solution in a minimum amount of acetone by flowing into water with agitation. By this method a wider range of densities can be obtained than with the cast product, while a favorable free-running product is obtained for loading into blasting caps and the like and one also that is less sensitive to shock than the pressed material.

The following tabulation shows the properties of a cast charge according to our invention, in comparison with a similar charge comprising trinitrotoluene only.

	A	B
Composition:		
Trinitrotoluene	100	90
Pentaerythritol tetranitrate		10
Fusion point, °C.	80+	75.5
Density of cast charge, g./cc.	1.57	1.58
Velocity of detonation:		
(1¼ x 18"—unconfined) (12.5 gm. booster charge of 67% PETN—33% TNT pressed to d=1.55)	(1)	7,240
Fragmentation test (cast iron bomb):		
Fineness modulus of fragments—		
Cast charge	4.74	4.30
Pressed charge	3.49	3.32
Effective velocity—		
Cast charge	1,380	2,050
Density	1.57	1.57
Pressed charge	4,500	6,500
Density	1.30	1.30

[1] Failed.

In the above tabulation, the fineness modulus is intended to give comparative values for fragmentation effects. It is obtained by totaling the percentages of the fragments held on a definite

series of sieves and dividing the total by 100. The screens employed were the ⅔, 1, 2, 4, 8 and 14 mesh. Using such a method, a lower modulus represents fragments of a greater degree of fineness. The effective velocities in the above tabulation likewise do not represent absolute determinations but are based on data obtained with standard dynamites of accurately measured velocities, that gave the same degree of fragmentation as indicated for the explosive charges used here. They should be considered as of comparative significance only.

The foregoing tabulation of properties of a preferred composition according to our invention shows strikingly the resulting advantages, which are quite remarkable. It will be seen that the presence of as little as 10% of pentaerythritol tetranitrate in the cast mixture imparts to the charge the explosive properties which are characteristic of that explosive compound when used alone, namely high velocity and increased initiability. The 90–10 trinitrotoluene-pentaerythritol tetranitrate blend is, in fact, closer to the latter compound in properties than to the former, in spite of the great preponderance of the former compound in percentage by weight. At the same time, the blends possess the insensitiveness to accidental shock characteristic of trinitrotoluene.

It will be readily understood that high velocity and consequently high shattering power are very desirable properties in disruptive explosives for military uses. The advantages of the present invention are particularly apparent when it is realized that an effectiveness approaching that of pentaerythritol tetranitrate alone is obtained by use of a relatively small percentage of this less readily available material with an explosive compound as widespread in use as trinitrotoluene.

The use of the compositions of our invention for various military purposes has been suggested and this will include charges for high explosive shells, fuses and exploders. Furthermore, they may be used in making a superior detonating fuse and as base charges in blasting caps. It will be understood that they may replace trinitrotoluene in practically all places where this material has been used, and give increased disruptive effect.

We have described our invention at length in the foregoing. It will be understood, however, that many variations may be introduced in compositions and in blending procedures without departure from the scope of the invention. We intend to be limited therefore only by the following patent claims:

We claim:

1. A high density explosive charge comprising a mixture of pentaerythritol tetranitrate and trinitrotoluene wherein the amount of pentaerythritol tetranitrate present is not substantially in excess of the amount which is capable of being dissolved in the trinitrotoluene in the molten state.

2. A high density explosive charge comprising a mixture of pentaerythritol tetranitrate and trinitrotoluene wherein the pentaerythritol tetranitrate is present in an amount not substantially greater than 12%.

3. A high density explosive charge comprising a solid solution of pentaerythritol tetranitrate in trinitrotoluene.

4. The method of preparing a high density explosive charge which comprises forming a solution of pentaerythritol tetranitrate in molten trinitrotoluene, the proportion of pentaerythritol tetranitrate being limited substantially to that amount which will fully dissolve in the molten trinitrotoluene.

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