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AMMONIUM NITRATE EXPLOSIVE

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This invention relates to explosive compositions high in ammonium nitrate, and more particularly to explosives high in ammonium nitrate in which no liquid explosive sensitizer is present.

Two types of ammonium nitrate explosives have heretofore been used in commercial blasting, namely (1) the standard ammonia dynamites which contain nitroglycerin as a sensitizer for the ammonium nitrate present, and (2) ammonium nitrate explosives containing no liquid explosive sensitizer of the general nature of nitroglycerin. In this latter type, normally solid sensitizers are used, which either are explosives themselves or function as oxygen-acceptors and fuels.

Because of the nature of explosives high in ammonium nitrate, careful sensitiveness control is necessary. From the point of view of safety, the lower degree of sensitiveness, characteristic of the absence of nitroglycerin or other explosive compound, is a very desirable property in quarrying operations generally, where large quantities of explosive must be handled under rather severe conditions. If, on the other hand, an ammonium nitrate explosive, as manufactured, has a border-line degree of sensitiveness, the effects of moisture pick-up and physical changes in the crystals may be such that the explosive will be too insensitive to detonate at the time and place of use.

An advance has been made recently in such explosives, as disclosed by Kirst and Woodbury in U. S. P. 1,992,217, who show an explosive of an initially low order of sensitiveness, such that it is incapable of detonation by a commercial blasting cap but will detonate and propagate the explosion with undiminished velocity, when initiation has once been brought about. While the above composition is relatively insensitive, no diminution in sensitiveness takes place with age, due to the fact that the material is maintained free from moisture effects by enclosure in a water-proof container. While these compositions of the prior art retain their initial sensitiveness, however, their maximum practical density is not so high as desired.

An object of the present invention is an improved explosive composition containing ammonium nitrate as the principal ingredient. A further object is an ammonium nitrate high ex-

plosive containing no liquid explosive sensitizing agent but characterized by an improvement in sensitiveness whereby higher densities may be attained with satisfactory sensitiveness to propagation. Additional objects will be disclosed as the invention is further disclosed in this specification.

I have found that the foregoing objects are accomplished by the preparation of an explosive composition comprising ammonium nitrate as the principal ingredient together with a normally solid nitrated aromatic compound and an organic fuel soluble in said nitrated aromatic compound when the latter is in a molten form. As examples of the nitrated aromatic compounds employed, the following are satisfactory: mononitronaphthalene, dinitronaphthalene, mononitrotoluene, dinitrotoluene, dinitrobenzene, dinitrochlorobenzene, and the like. Preferably, I use mononitronaphthalene as the solvent for the organic fuel. As such organic fuel, I may employ various materials, for example, normally solid hydrocarbons soluble in the molten nitronaphthalene, namely naphthalene, diphenyl, and the like. I may likewise use to advantage various normally solid, soluble amines such as diphenylamine and toluidine. From the point of view of efficiency in execution, I preferably select the proportions of nitronaphthalene and fuel such that a substantially evenly balanced composition is obtained from the point of view of oxygen balance and complete combustion in the explosive reaction.

In producing the intimately mixed compositions according to my invention, I may heat the nitrated naphthalene above its fusion point, dissolve the solid fuel in the molten compound, incorporate the solution with the proper amount of ammonium nitrate in suitable mixing apparatus, and then allow to cool during agitation. If, however, the soluble fuel and nitronaphthalene are heated together to the fusion point, the use of a lower temperature is possible because of the depressant effect of the dissolved material on the fusion point, and this is my preferred procedure.

My explosive compositions have a particular advantage at densities and degrees of incorporation where the material is not capable of detonation by means of the usual commercial initiators, namely blasting caps or Cordeau, but is capable

of detonation and of propagation of the explosive wave with undiminished velocity, when initiation has once taken place.

In the tabulation below, examples of compositions according to my invention are shown in comparison with the compositions of the prior art.

	Prior art composition		
	1	2	3
	Percent	Percent	Percent
Ammonium nitrate.....	92	92	92
Dinitrotoluene.....	4	5	5
Paraffin.....	4	3	3
Mononitronaphthalene.....			
Naphthalene.....			
Diphenyl.....			
Maximum density at which initiation takes place—2" diameter cty. primer			
80 g. TNT.....	1.06	1.11	1.14
100 g. TNT.....	1.11	1.16	1.20
110 g. TNT.....	1.12	1.18	1.22

It will be understood, as has been stated previously, that high ammonium nitrate compositions sensitized by solid fuels become less sensitive to initiators and less capable of propagating the explosive wave, as the density increases to the critical range. In the first example above, a composition is shown in which the nitrocompound is used in conjunction with a solid fuel which is not soluble in said nitrocompound when the latter is in a molten state. Hence, the advantages of my invention do not result there. Examples 2 and 3, however, are in accordance with my invention and show an increased degree of sensitivity over 1. While the sensitiveness has been expressed above in terms of the maximum density at which equal weights of a trinitrotoluene primer will bring about initiation, it will be understood that the increased sensitiveness may be shown also in terms of the gap across which propagation from one cartridge to another will take place, for example with 5 inch diameter columns.

In addition to increased sensitiveness by employment of the present invention, a velocity control may be obtained at the same time. Whereas composition 1 as shown in the table, has a maximum velocity of detonation in large diameter columns, 5 inches for example, of around 5,000 meters per second, composition 2, though of increased sensitiveness, has a velocity of about 4,000 meters per second. Composition 3, on the other hand, has a velocity not far below that of 1, namely about 4,700 meters per second. My invention, therefore, makes it possible to formulate compositions of increased sensitiveness over similar ones of the prior art of either substantially the same or of greatly reduced velocity, thereby allowing control of the velocity to fit the conditions of blasting.

The compositions disclosed and claimed in the present application contain ammonium nitrate as the principal ingredient and preferably over 85% of this compound. In view of the relative insensitiveness of the compositions and the deleterious effect of water or moisture thereupon, it is, of course, necessary that the compositions be protected from atmospheric influences. Preferably I pack them in water-tight containers and maintain them so protected until the time of shooting. The method of handling followed by Kirst and Woodbury in U. S. P. 1,992,217 will be found advantageous.

While my invention has been described fully in the foregoing, it will be understood that many

changes in details or compositions may be made without departure from the spirit of the invention. In my specification and claims, I have spoken of an organic fuel dissolved in the nitrated aromatic compound. For the purpose of this application, I wish the term organic fuel to designate organic compounds containing a high percentage of combustible elements, especially carbon and hydrogen.

I intend to be limited, therefore, only by the following patent claims.

I claim:

1. An explosive composition comprising ammonium nitrate as the principal ingredient, mononitronaphthalene, and an amino compound soluble in molten mononitronaphthalene, said amino compound being present in no greater amount than that of said mononitronaphthalene.

2. The explosive composition of claim 1, in which the amino compound comprises diphenylamine.

3. The explosive composition of claim 1, in which the amino compound comprises para-toluidine.

4. An explosive composition comprising ammonium nitrate as the principal ingredient, mononitronaphthalene, and a normally solid hydrocarbon soluble in molten mononitronaphthalene, said hydrocarbon being present in no greater amount than that of said mononitronaphthalene.

5. The explosive composition of claim 4, in which the hydrocarbon comprises diphenyl.

6. The explosive composition of claim 4, in which the hydrocarbon comprises naphthalene.

7. An explosive composition comprising more than 85% ammonium nitrate, 0.5 to 10.0% mononitronaphthalene and 0.5 to 10.0% of a normally solid oxygen-free organic fuel soluble in molten mononitronaphthalene, said fuel being present in no greater amount than that of said mononitronaphthalene.

8. An explosive composition comprising ammonium nitrate as the principal ingredient, a normally solid nitrated aromatic hydrocarbon, and a normally solid oxygen-free organic fuel soluble in said nitrated aromatic hydrocarbon when the latter is in the molten state, said fuel being present in no greater amount than that of said nitrated aromatic hydrocarbon.

9. An explosive composition comprising ammonium nitrate as the principal ingredient, a nitrated naphthalene product of a low degree of nitration, and a normally solid oxygen-free organic fuel soluble in said nitrated naphthalene when the latter is in the molten state, said fuel being present in no greater amount than that of said nitrated naphthalene.

10. An explosive composition comprising ammonium nitrate as the principal ingredient, mononitronaphthalene, and a normally solid oxygen-free organic fuel soluble in molten mononitronaphthalene, said fuel being present in no greater amount than that of said mononitronaphthalene.

11. An explosive composition of a degree of sensitiveness such that it is incapable of detonation by means of a commercial blasting cap but is capable of detonation by means of a suitable priming charge and of consistent propagation when once initiated, said composition comprising more than 85% ammonium nitrate, 0.5 to 10.0% mononitronaphthalene, and 0.5 to 10.0% of a normally solid oxygen-free organic fuel, said fuel being present in no greater amount than that of said mononitronaphthalene.

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