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AMMONIUM NITRATE EXPLOSIVE

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This invention relates to low density dynamite compositions containing ammonium nitrate as an ingredient and more particularly to such compositions having improved properties adapting them for use in the blasting down of coal and other readily disintegratable materials.

The developments in recent years in explosives of the permissible type, for use in coal mines, have been particularly directed toward low density ammonia dynamites, usually with ammonium nitrate contents between 50 and 80%. Such explosives have allowed a more economical and more efficient loading of bore holes, with a decrease in the shattering effect and the production of a high proportion of lump coal. They have approached the desirable properties of black powder in the latter respect, and at the same time have retained all the safety features of permissible explosives.

Very successful results have been obtained in the attainment of low density properties in ammonium nitrate dynamites. This has resulted largely from the introduction of low density combustible ingredients, for example bagasse pith, balsa wood, corn stalk pith, impregnated ingredients, expanded cereal products, and the like.

While a new type of commercial blasting explosive has resulted from the lowering of the density of the ammonium nitrate dynamites, problems have been introduced in the control of the properties of the finished explosive. The use of very low density explosives has meant, for example, a high ratio of wrapper weight to the weight of actual explosive, and consequently a dynamite quite deficient in oxygen. The fume properties, therefore, have not been as satisfactory as would otherwise have been the case. Likewise a given amount of very light weight carbonaceous material in many cases absorbs nitroglycerin to a greater extent than does a denser ingredient, and for this reason the sensitiveness of the explosive to detonation has tended to become lower.

A more satisfactory solution of the low density problem would be attained if the desired effect were brought about, at least in part, by control of the density of ammonium nitrate, since this is the predominating ingredient in dynamites of the ammonia permissible type. The use of the lower density ammonium nitrate would permit a reduction in the combustible content, and in this way improvement could be brought about in fume properties, sensitiveness, and strength, since ammonium nitrate is an explosive compound of relatively high strength.

An object of our invention is a new and improved ammonium nitrate explosive, characterized by low apparent density. A further object is such an explosive wherein the low density property is attained to a high degree, and with the absence of objectionable effects that have heretofore accompanied the attainment of a portion of our objective. A further object is an improved low density ammonium nitrate explosive as a result of the utilization of a new and improved type of material. Additional objects will become apparent as the invention is further described.

We have found that the foregoing objects are accomplished by the utilization, as an ingredient in dynamite compositions, of particles of ammonium nitrate of relatively low apparent density, as a result of a process involving the subjection of molten ammonium nitrate of low water content to a pressure less than atmospheric, and the subsequent disintegration of the dry, solidified mass. Such an ammonium nitrate will have an apparent density lower than 0.70, and commonly below 0.55. The ammonium nitrate produced by the above process is porous in nature and, when broken down, is present in the form of flakes that pack in such manner that low apparent density results.

The ammonium nitrate disclosed as an ingredient of our composition is produced by the process described in the copending application of W. A. Gideon and T. W. Hauff, Serial No. 91,304, filed July 18, 1936. According to this process, a molten mass of ammonium nitrate, having a water content not greater than 10%, preferably between 2 and 8%, is introduced into a chamber maintained under reduced pressure, for example, under a vacuum of 27", the molten mass of ammonium nitrate being in the form of a relatively thin layer. Under such conditions, the escape of the water in vapor form causes the crystallizing melt to puff up to a greatly expanded volume, and results in a dry product permeated with cavities. The material is consequently of low packing density. The dry low density product is subsequently scraped from the surface on which it has been expanded, and is disintegrated to the desired degree of fineness.

Using the form of ammonium nitrate described in the foregoing, sufficiently low density will be imparted to dynamite compositions containing it so that the weight of a 1¼ x 8" cartridge will be less than 90 grams.

We are aware of the fact that previous disclosures have been made of explosives containing

ammonium nitrate of low apparent density. Symmes (U. S. Patent 1,613,335), for example, describes a low density explosive containing ammonium nitrate in the form of spherical grains, having internal cavities as a result of a spraying process. Champney (U. S. Patent 1,924,912) likewise disclosed the utilization of crystalline nitrate of low density in dynamite compositions. His ammonium nitrate product was one that was obtained by simple crystallization from relatively dilute solutions. A low density dynamite product has been disclosed also by Handforth and Johnson (Serial No. 1,108, filed January 10, 1935), said dynamite containing ammonium nitrate of low density as the result of the spraying of a highly concentrated solution of ammonium nitrate at a temperature not greatly above the solidification point of the solution.

While the foregoing inventors obtained products that were an advance over the prior art, the low density ammonium nitrate employed to bring about the present invention is a decided improvement over that heretofore disclosed, and permits the ready attainment of a density that has heretofore been impossible, or extremely difficult, to obtain.

By way of more exact illustration, the following examples of dynamite compositions show the advantages of our new product.

	A	B
Nitroglycerine	13.0	13.0
Ammonium nitrate	58.5*	58.5**
Sodium nitrate	9.2	9.2
Carbonaceous combustible material	19.0	19.0
Chalk	0.3	0.3
Ctgs./50 lbs.-1¼" x 8"	250	277
Ammonium nitrate, apparent density	0.75	0.53

* Ammonium nitrate of prior art.
** Ammonium nitrate obtained by the crystallization of the molten salt under reduced pressure.

In the formulas shown, A represents a standard low density dynamite of the prior art, containing ammonium nitrate of the density shown. B is a formula identical with A except that the new type of ammonium nitrate is incorporated in the formula. The increased stick count, representing a decreased density of explosive, is clearly shown. It will be appreciated that such an increase in the number of cartridges per 50 lbs. of dynamite could have been obtained alternatively by increasing the amount of low density combustible material, this increased amount being substituted for ammonium nitrate in the formula. Such a substitution, however, would mean a greatly enhanced oxygen deficiency in the explosive, with increased formation of the undesirable carbon monoxide in the fumes. A decided weakness in strength and sensitiveness would result at the same time. While the importance of such changes in the formulas of high explosive compositions may not be realized by those not versed in the subject, it will be apparent to explosives experts that a marked advance has been made by our invention.

In the formulas shown for low density dynamite compositions, nitroglycerin has been included as the organic sensitizing agent, and this will be the sensitizer commonly used. It is to be understood, however, that other liquid explosive nitric esters may be used to replace nitroglycerin. Ethylene glycol dinitrate, for example, may be substituted for any portion of nitroglycerin, with no impairment of the explosive properties, as may solutions in nitroglycerin of various explosive materials commonly employed as freezing point depressants, nitrated sugars, nitrochlorohydrins, aromatic nitrocompounds, and the like. Moreover, we may completely eliminate liquid explosive ingredients from the compositions and use such solid sensitizing agents as nitrostarch, trinitrotoluene, pentaerythritol tetranitrate, and the like. In such cases it will be understood that proper adjustment must be made of oxidizing and combustible ingredients to give the proper oxygen balance.

In the foregoing compositions for explosives, according to our invention, greatly improved properties in all types of ammonium nitrate dynamites may be obtained by the replacement of ammonium nitrate of the prior art by the new product, obtained by subjecting a molten body of ammonium nitrate of low water content, in the form of layers of solution, to pressures less than atmospheric.

It will be apparent that our invention makes is possible to produce ammonia dynamites, characterized by low density and having considerable advantages over similar explosives previously made. Improvement in strength may be obtained, for example, with the same density of explosive, or the same strength may be obtained with a decreased density of explosive. Improvement in sensitiveness and fume properties likewise results for similar compositions.

In the description of our invention it has been described as directed toward the production of low density explosives. It will be understood that such explosives may be produced of varying velocities by the method of using coarse or fine ammonium nitrate grains, according as relatively low or high velocities are desired. The utilization of both types of granulations in low density dynamites is contemplated by our invention. It will be apparent that coarser or finer material may be obtained by the degree of disintegration of the bulk low density product, and by proper sieving.

It has been indicated in the foregoing that an ammonium nitrate product is used, having an apparent density lower than 0.70 and commonly below 0.55. This density value is determined by the standard method of subjecting the material to compression in a brass cylinder by a pressure of 25 lbs. per sq. in. An amount of material is used in the method such that the volume after compression will occupy between 25 and 30 cc. When the density of the material is referred to in our disclosure, the value by the method described is meant. It will be realized that a lower value would be obtained if the density were determined on loose material, or by mere packing of the product into a measuring cylinder.

While our invention has been described fully in the foregoing, it will be apparent that many changes may be made in the compositions cited, and in details without departing from the spirit of the invention. We intend, therefore, to be limited only by the following patent claims.

We claim:

1. A high explosive composition characterized by relatively low denisty and comprising an organic explosive sensitizing agent and ammonium nitrate, said ammonium nitrate having an apparent density lower that 0.70 and a puffed porous texture as a result of subjecting a layer of molten ammonium nitrate of low water content to a pressure considerably lower than atmos-

pheric thereby bringing about solidification, and subsequently disintegrating the dry solidified mass of low density material.

2. The explosive composition of claim 1, in which the sensitizing agent comprises a liquid aliphatic nitric ester.

3. The explosive composition of claim 1, in which the sensitizing agent comprises nitroglycerin.

4. The explosive composition of claim 1, in which the ammonium nitrate has an apparent density lower than 0.55.

5. A high explosive composition having a density such that a 1¼" x 8" cartridge weighs less than 90 grams, said composition comprising a liquid explosive nitric ester, a carbonaceous combustible ingredient, and ammonium nitrate having a puffed porous texture resulting from the solidification of molten ammonium nitrate of low water content at a pressure considerably lower than atmospheric and the subsequent disintegration of the dry solidified mass.

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