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S. L. HANDFORTH ET AL
AMMONIUM NITRATE EXPLOSIVE

2,087,285

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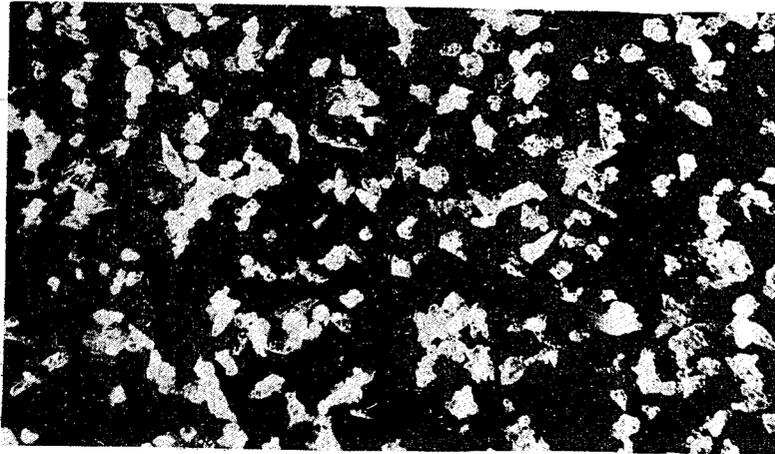


Fig. 1



Fig. 2

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2,087,285

AMMONIUM NITRATE EXPLOSIVE

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Application January 10, 1935, Serial No. 1,108

11 Claims. (Cl. 52—19)

This invention relates to low density dynamite compositions containing ammonium nitrate and, more particularly, to such explosives having improved properties adapting them for use in the blasting down of coal and other material.

The developments in recent years in explosives of the permissible type for use in coal mining have been particularly directed toward low density ammonia dynamites, usually with ammonium nitrate contents between 50 and 80%. Such explosives 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.

The attempts to attain low density properties in ammonium nitrate dynamites have been very successful, and this has resulted largely from the introduction of low density combustible ingredients, for example bagasse pith, balsa wood, cornstalk pith, impregnated ingredients, 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 meant, for example, a high ratio of wrapper weight per weight of actual explosive and consequently a dynamite quite deficient in oxygen. The fume properties, therefore, were not as satisfactory as would otherwise have been the case. Likewise, a given amount of very light weight carbonaceous material in many cases absorbed nitroglycerin more than a denser ingredient, and the sensitiveness of the explosive to detonation tended to become lower.

A more satisfactory solution of the low density problem would be attained if the desired effect could be brought about, at least in part, by control of the density of the ammonium nitrate since this is the predominating ingredient in dynamites of the ammonia permissible type. The use of a lower density ammonium nitrate would permit a reduction of the combustible content and in this way improvement could be brought about in fume properties, sensitiveness, and strength, since ammonium nitrate is an explosive material of relatively high strength. Efforts in this direction up to the present time, however, have not given a product sufficiently satisfactory to be introduced successfully into commercial practice.

The object of our invention is a new and improved ammonium nitrate explosive charac-

terized by relatively low density. A further object is such an explosive in which the low density property is attained to a greater degree than has been possible heretofore without introduction of disadvantageous effects. A further object is an explosive of the nature described in which the desired result is brought about by the utilization of a new 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 introduction into dynamite compositions of solid particles of ammonium nitrate having a relatively low apparent density as a result of the spraying of a highly concentrated solution of said salt at a temperature not substantially above the solidification point of the solution. Such an ammonium nitrate will have an apparent density not higher than 0.80, between 0.50 and 0.80 for example. By reason of the conditions under which the ammonium nitrate is produced, the separate particles will possess irregular shapes, very markedly distorted from the spherical and from the natural crystalline forms of ammonium nitrate.

The effect of these distorted forms of the individual particles is that the material is permitted to pack to a density substantially lower than it has heretofore been possible to attain satisfactorily and in such manner that the low density effect is not lost with continued storage under the slight pressures resulting from such storage.

The method by which our ammonium nitrate ingredient of irregular form is prepared is described in the copending application of S. L. Handforth and K. C. Simon, Serial No. 1,109 filed January 10, 1935. According to this process, highly concentrated ammonium nitrate solution, of a strength above 98% NH_4NO_3 for example, is sprayed by means of a revolving disc, the temperature of the solution prior to passage through the disc being maintained relatively close to the solidification point, but sufficiently high to assure fluidity during said passage. In this way, a substantially solid product of the irregular shape desired and practically free from water is obtained. Using the new form of ammonium nitrate described, sufficiently low densities will be obtained so that the weight of a $1\frac{1}{4} \times 8$ " cartridge will be less than 146 grams and preferably less than 125 grams.

Symmes (U. S. Patent 1,613,335) has disclosed the utilization in explosives of ammonium ni-

trate in the form of spherical grains having internal cavities and that such form of ammonium nitrate may be produced by a spraying process.

Champney (U. S. Patent 1,924,912) likewise discloses a low density dynamite containing crystalline ammonium nitrate of low density.

The irregular and distorted product employed in our invention is altogether different in appearance from the products obtained heretofore and possesses very characteristic low density properties that are permanent in nature. The process by which our product is obtained is controlled so that substantially solid particles result that are distorted from the shapes that would naturally be anticipated, both from the spherical globules of the Symmes patent and the crystalline forms of the Champney patent.

The low density ammonia dynamites heretofore considered so important in the mining of coal and other soft material for blasting have contained nitroglycerin as sensitizing agent, low density combustible ingredients being necessary as absorbents. According to our invention, solid organic explosive compounds of the desired degree of sensitiveness may replace the nitroglycerin, since the low density effect may be and is desirably obtained, at least in part, from the low density ammonium nitrate. As such sensitizing solid ingredients, we may use, for example, nitro-starch, pentaerythritol tetranitrate, trinitrotoluene, and the like. The presence of high percentages of low density carbonaceous materials in such compositions is undesirable because of their adverse effect on the oxygen balance, the above solid explosive compounds themselves being very deficient in oxygen. The use of low density ammonium nitrate is very advantageous for the purpose since this material contains a considerable oxygen excess.

By way of illustration, the following examples show the advantages of our new product.

Formula B shows that to attain the same low density effect in the explosive by variation in combustible content would mean a decided sacrifice in strength, sensitiveness, and fumes.

Similar formulas to illustrate our invention and using nitro-starch and trinitrotoluene as sensitizing ingredient are shown briefly below.

	D	E
Nitro-starch.....	14.0	14.0
Trinitrotoluene.....	7.5	7.5
Ammonium nitrate—crystallized.....	63.0	63.0
Ammonium nitrate—spray cooled.....	5.0	5.0
Sodium nitrate.....	6.5	6.5
Sodium chloride.....	3.7	3.7
Absorbent.....	0.3	0.3
Chalk.....	146	171
Ctgs./50 lbs.....		

As before the same density could be maintained, if desired, and an improvement obtained in strength and fumes.

In the foregoing description of our invention, it has been shown that greatly improved properties in ammonium nitrate dynamites are obtained by the replacement of the ammonium nitrate of the prior art by the new product obtained by the spraying of highly concentrated ammonium nitrate solutions under proper temperature conditions. To make the distinction clearer, the low density ammonium nitrate used by us is illustrated in Figures 1 and 2. Figure 1 shows the form of the fine particles and their irregular distorted shapes, while Figure 2 illustrates coarser

particles, the particles being magnified approximately 30 times in both figures.

	A	B	C
Nitroglycerin.....	14.0%	14.0%	14.0%
Crystallized ammonium nitrate*.....	57.0	52.0	57.0
Sprayed cooled ammonium nitrate**.....			57.0
Sodium nitrate.....	9.5	9.5	9.5
Bagasse pith.....	9.5	14.5	9.5
Flaked cereal product.....	9.0	9.0	9.0
Rice hulls.....	0.5	0.5	0.5
Chalk.....	0.5	0.5	0.5
Ctgs./50 lbs.....	225	250	250
Oxygen balance.....	-7.4	-14.7	-6.9
Oxy. bal. wrapped.....	-27.2	-35.9	-29.0
Weight strength.....percent.....	56	42	54
Sensitiveness.....	10''	6''	10''
Fumes.....liters CO/lb.....	54	72	58

Ammonium nitrate	Crystallized*	Spray-cooled**
Purity.....	97.9	99.2
Apparent density.....	0.85	0.73
Fineness:		
On 35-mesh screen.....percent.....	5	3
Passing 100-mesh screen.....percent.....	53	60

In the formulas presented, A represents a low density dynamite containing the crystallized ammonium nitrate of the prior art, while C gives an exactly similar formula except that the new type of sprayed ammonium nitrate is used instead. It will be seen that the use of the low density ammonium nitrate allows the attainment of 250 sticks per 50 lb. case in place of 225 sticks, and at the same time gives substantially the same properties with respect to oxygen balance, strength, fumes, and sensitiveness.

It will be seen that our invention makes it 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 formula or the same strength may be obtained with a decreased content of explosive. Improvement in sensitiveness and fume properties likewise result 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 has been indicated in the foregoing also that an ammonium nitrate product is used having an apparent density lower than 0.80. This density value is determined by filling a brass cylinder of an inside diameter of 2'' with five successive increments of 2.5'' each of ammonium nitrate, pressing each addition under a dead weight of 16 lbs., and obtaining the apparent density from the weight and volume of the pressed ammonium nitrate in the cylinder.

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

We claim:

1. A blasting explosive composition characterized by relatively low density and comprising an

organic explosive compound as sensitizing agent, and ammonium nitrate, said ammonium nitrate having an apparent density lower than 0.80 as a result of the spraying of a highly concentrated solution of said salt at a temperature not greatly above the solidification point of the solution.

2. The explosive composition of claim 1, in which the explosive compound is a liquid aliphatic nitric ester.

3. The explosive composition of claim 1, in which the explosive compound is nitroglycerin.

4. A blasting explosive composition characterized by relatively low density and comprising an organic explosive compound as sensitizing agent, and ammonium nitrate in the form of substantially solid particles of irregular shapes, said ammonium nitrate having an apparent density lower than 0.80 as a result of the spraying of a highly concentrated solution of said salt at a temperature not greatly above the solidification point of the solution.

5. The explosive composition of claim 4, in which the explosive compound is a liquid aliphatic nitric ester.

6. The explosive composition of claim 4, in which the explosive compound is nitroglycerin.

7. An explosive composition characterized by relatively low density and comprising an explosive liquid nitric ester, a carbonaceous combustible ingredient, and ammonium nitrate in the form of substantially solid particles of a shape markedly distorted from that of spheres and from the natural crystalline forms of ammonium nitrate,

said ammonium nitrate having an apparent density lower than 0.80 as a result of the spraying of a highly concentrated solution of said salt at a temperature not greatly above the solidification point of the solution.

8. The explosive composition of claim 7, in which the liquid nitric ester is nitroglycerin.

9. An explosive composition having a density such that a $1\frac{1}{4} \times 8$ " cartridge weighs less than 146 grams, said explosive comprising a liquid explosive nitric ester, a carbonaceous combustible ingredient, and ammonium nitrate in the form of particles of a shape markedly distorted from that of spheres and from the natural crystalline forms of ammonium nitrate as a result of the spraying of a highly concentrated solution of said salt at a temperature not greatly above the solidification point of the solution.

10. The explosive composition of claim 9, in which the ammonium nitrate has an apparent density lower than 0.80.

11. A blasting explosive composition characterized by relatively low density and comprising an organic explosive compound as sensitizing agent, and ammonium nitrate in the form of substantially solid particles of a shape markedly distorted from that of spheres and having a relatively low density as the result of the spraying of a highly concentrated solution of said salt at a temperature not greatly above the solidification point of the solution.

STANLEY L. HANDFORTH.
NORMAN GARDNER JOHNSON.

CERTIFICATE OF CORRECTION.

Patent No. 2,087,285.

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STANLEY L. HANDFORTH, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 3, beginning with the table strike out all to and including the word and period "sensitiveness." in line 35, and insert the same after line 41, in the first column, same page, following the words and period "new product."; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of January, A. D. 1938.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

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