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D. M. McFARLAND
AMMONIUM NITRATE EXPLOSIVE
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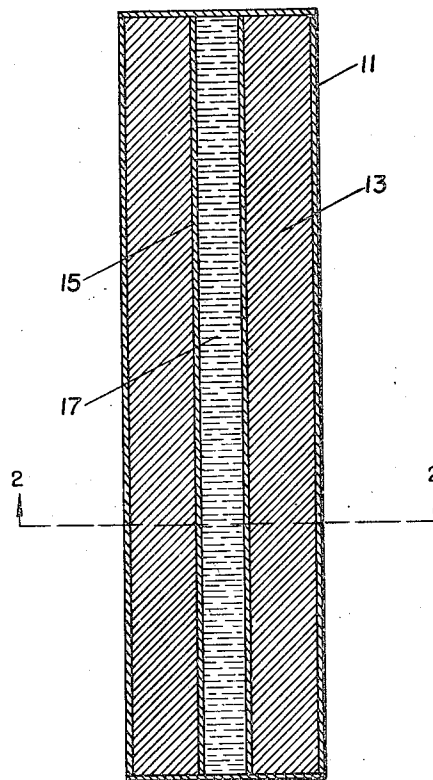


Fig. 1

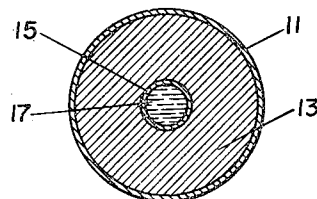


Fig. 2

David M. McFarland
INVENTOR

BY *Harold E. McFarland*
ATTORNEY

UNITED STATES PATENT OFFICE

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AMMONIUM NITRATE EXPLOSIVE

David M. McFarland, West Chester, Pa., assignor
to Atlas Powder Company, Wilmington, Del., a
corporation of Delaware

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6 Claims. (Cl. 102-24)

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The present invention relates to ammonium nitrate explosives.

One object of the present invention is to provide an ammonium nitrate containing explosive assembly which will function properly under wet conditions of operation.

It is another object of the present invention to provide an ammonium nitrate containing explosive assembly which is relatively safe yet detonates with complete efficiency.

A further object of the invention is to provide a method of exploding wet ammonium nitrate explosives.

For some time, ammonium nitrate explosives have been employed where a low-cost explosive having a relatively high strength but low brisance is desired. It has, however, been found imperative to water-proof carefully ammonium nitrate explosives before use. Such water-proofing has been accomplished in a number of ways. One common method has been to supply the explosive in sealed metal cans. Another similar method has been to pack the explosive in water-proof bagging materials. A third method, which has been found somewhat effective to water-proof ammonium nitrate explosives, has been to supply them in a composition which gels on contact with water. The gel produced then protects the ammonium nitrate from further contact with water. All of these methods are expensive and require unusually careful methods of preparation to see that water-proof characteristics are maintained.

If any of these methods fail and an ammonium nitrate explosive as heretofore prepared does become wet, its susceptibility to initiation and its ability to propagate detonation are severely lowered, and its efficiency often becomes so poor as to render it entirely useless. Blasting shots made with such wet ammonium nitrate give off dense red or yellow fumes indicating incomplete detonation and also give unsatisfactory results because of the power lost when the explosive is wet.

It has been found that, according to the present invention, an ammonium nitrate explosive assembly is provided which produces complete and efficient blasts even though wet. The discovery has been made that if ammonium nitrate is sensitized, and if a water-proof high explosive is used to initiate the ammonium nitrate, it may be detonated efficiently even when it is so wet as to be fluid.

According to the present invention, a water-absorbent sensitized ammonium nitrate explosive is packed in a water-pervious cartridge and provided with a core of water-proof high explosive.

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Gelatin dynamite has been found to be a most efficient core material. However, other water-proof high explosives may be used for cores. For example, a straight nitro glycerine dynamite contained in a water-proof bag or other water-proof container, or electro-plated TNT may be used.

The invention is more specifically described in connection with the accompanying drawing which illustrates a specific embodiment of the invention and in which Figure 1 is a longitudinal section of an explosive assembly of the present invention, and Figure 2 is a cross-sectional view of the same assembly taken on line 2-2 of Figure 1.

The explosive assembly comprises a paper cartridge 11 with crimped over ends. Inside cartridge 11 lies explosive charge 13, an ammonium nitrate composition sensitized with nitro glycerine. Running through charge 13 is central core 15, which is made up of paper wrapped cartridges 20 of gelatinized nitro glycerine dynamite 17. Core 15 is shown extending throughout the assembly. Alternatively, the core may extend only partially through the assembly. Cores extending through only about one-half of the assembly are satisfactory. It is preferred, however, for best propagation to provide a core running throughout the assembly.

The core is usually of higher velocity than the ammonium nitrate explosive, and consequently influences the longitudinal velocity of the assembly as a whole. The longitudinal velocity of the assembly may be altered by varying the diameter of the core or by varying the type of the core since gelatin dynamites and other water-proof explosives are available in a number of different velocities.

Cores small enough in diameter to occupy as little as 3% of the cross-sectional area of the entire assembly have been found to be satisfactory. On the other hand, cores may be used which occupy as much as 15% of the cross-sectional area of the assembly.

In general cores having velocities, measured in the open with 1 1/4" cartridges, much lower than 6,000 feet per second or much higher than 22,000 feet per second do not produce the most desirable results.

Cores are usually most conveniently made of preformed and wrapped cartridges of explosive. However, they may be included in the assembly without any wrapping.

Usually assemblies of the type of the present invention are employed in diameters greater than 2".

The ammonium nitrate explosive which makes

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up the main body of the assembly of the present invention may be of the type of any of the water-absorbent ammonia dynamites now extensively used. It has, however, been found necessary to employ a small quantity of sensitizer with the ammonium nitrate explosive. The sensitizer for the ammonium nitrate may be selected from the well-known sensitizers for ammonium nitrate. As examples may be listed mineral oils, vegetable oils, and other oily materials as declared in application of Claude H. Carey, Ser. No. 351,211, filed August 3, 1940, now abandoned, nitro compounds, such as dinitrotoluene, trinitrotoluene, cyclonite, nitric esters, such as nitro-glycerin, nitro-glycol, and nitro-sugars, and metal powders, such as aluminum dust. The amount of sensitizer may be considerably less than that present in many commercial dynamites. For example, quantities of nitro glycerine amounting to as low as 4% of the ammonium nitrate explosive composition are found to be satisfactory. On the other hand, the invention may be employed with dynamites containing as high as 20% nitro glycerine.

When the assemblies of the present invention are used wet, it is almost always necessary to initiate them in the core. This may be done, for example, by inserting a blasting cap detonator or detonating fuse into the core, or it may be done by charging a quantity of gelatin dynamite or other water-proof explosive, containing a detonator, into the charge hole along with the explosive assembly and adjacent to its core. Usually the latter method will be found simpler.

The explosive assembly of the present type should, of course, not be left in unconfined places under water for long periods of time lest the highly soluble ammonium nitrate leach away completely. Assemblies of the present type are highly satisfactory, however, when left for long periods of time under water in more confined places. Under such conditions, even if the ammonium nitrate does leach, it does not get away from the place where it is desired to use it. For example, explosive assemblies of the present invention are very useful in quarry blasting. In uses of this nature, the explosive is often loaded in well drill holes, containing many feet of water; and since extensive loading operations are usually necessary for any one blast, the explosive must often remain under water for a period of several days. The present assemblies are also very useful in stripping operations where frequently holes more nearly horizontal are used. A large amount of water usually seeps into such holes.

When water is absorbed in the assemblies of the present invention, it is found to produce positively beneficial results. The water content appears to lower the brisance of the ammonium nitrate without materially lowering its strength. Consequently, more of a heaving and less of a shattering action is obtained. This is highly desirable in quarry and stripping blasting.

When loading conditions are dry and explosive assemblies of the present invention are used, it often is desirable to wet the cartridges well before firing. This may often be most effectively done by pouring water down the bore hole after the explosive assemblies have been charged.

To produce the lowered brisance characteristics of the explosive assemblies of the present invention, it usually is desirable that water be absorbed in excess of about 6% of the weight of the explosive composition.

It is also within the contemplation of this

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invention to supply the water in the explosive composition at the time of manufacture as well as to supply it in the loading operation.

It should be noted that when the assemblies of the present invention are wet from the outside, as in loading wet bore holes or introducing water into a loaded hole, the outer portions of the assembly absorb more water than the inner portions of the assembly. This is believed to be definitely advantageous, since shattering explosive action appears to increase as detonation proceeds from the center of the cartridges outwardly. It is postulated that the wetting of the outside portions of the cartridge tempers this action, producing the better heaving characteristics.

Examples of assemblies prepared according to the present invention are set forth below.

Example I

Explosive assemblies were prepared in the form shown in the drawing using paper cartridges having glued seams. The composition of the water-absorbent ammonium nitrate explosive was as follows:

	Per cent
Ammonium nitrate-----	81
Nitro glycerine-----	6
Sulphur-----	4½
Sodium nitrate-----	½
Chalk-----	½
Carbonaceous ingredients-----	7½

This composition was packed in paper shells six inches in diameter around a core made of 1¼" thirty per cent nitro glycerine gelatin cartridges.

The entire assembly was about 24" long and weighed about 25 lbs.

A limestone formation was blasted using these cartridges in well drill holes containing as much as 16' of water. Each hole was primed at the top with gelatin dynamite into which was inserted a #6 electric blasting cap. The primer was lodged between the last two assemblies loaded into the bore hole. A number of the assemblies were punctured before loading. The blast was entirely satisfactory and produced no red or yellow fumes indicative of poor detonation.

Example II

Several blasts were conducted in another limestone quarry using cartridges having non-water-proof shells. The assemblies comprised sixty per cent nitro glycerine gelatin cores 1½" in diameter inside water-absorbent ammonium nitrate explosive having the following composition:

	Per cent
Ammonium nitrate-----	44.8
Nitro glycerine-----	8.0
Sodium nitrate-----	33.0
Chalk-----	0.5
Carbonaceous ingredients-----	13.7

These cartridges were each 5½" in diameter, about 27" long, and weighed about 25 lbs. They were loaded in well drill holes containing between 15' and 20' of water, and were initiated by electric blasting caps each inserted into a 2" x 4" cartridge of 40% gelatin loaded between the last two assemblies in each hole.

Again the blasts were entirely satisfactory and produced no objectionable red or yellow fumes. The powder employed in these assemblies was of an average of 42% weight strength per bore hole.

Other blasts in the same location, and under the same conditions, were made in holes loaded with ammonium nitrate explosives in water-proof

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containers. Using an approximately equal powder factor, in these last blasts, powder having an average weight strength of about 67% per bore hole failed to show as good results as did the blasts in which assemblies of the present invention were used.

It may be seen that according to the present invention an assembly is produced which may be manufactured of low-cost materials and without excessive precautions to provide for water-proofing, but yet an assembly more efficient than assemblies heretofore known is obtained.

In this specification and claims, the term "water-pervious shell" is meant to include shells which will admit water under conditions of 13 pounds per square inch water pressure held for 24 hours.

What is claimed is:

1. An explosive assembly which comprises a water-pervious shell, a water-absorptive ammonium nitrate explosive composition including a sensitizer in said shell, and a water-proof high explosive core said assembly having a diameter greater than about 2 inches and said core providing from about 3% to about 15% of the cross sectional area of said assembly.

2. An explosive assembly which comprises a water-pervious shell, a water-absorptive ammonium nitrate explosive composition including a nitric ester sensitizer in said shell, and a water-proof high explosive core said assembly having a diameter greater than about 2 inches and said core providing from about 3% to about 15% of the cross sectional area of said assembly.

3. An explosive assembly which comprises a water-pervious shell, a water-absorptive ammonium nitrate explosive composition including a nitro glycerine sensitizer in said shell, and a water-proof high explosive core said assembly having a diameter greater than about 2 inches and said core providing from about 3% to about 15% of the cross sectional area of said assembly.

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4. An explosive assembly which comprises a water-pervious shell, a water-absorptive ammonium nitrate explosive composition including a nitric acid sensitizer in said shell, and a gelatinized nitro glycerine core said assembly having a diameter greater than about 2 inches and said core providing from about 3% to about 15% of the cross sectional area of said assembly.

5. An explosive assembly which comprises a water-pervious shell, a water-absorptive ammonium nitrate explosive composition including a nitro glycerine sensitizer in said shell, and a gelatinized nitro-glycerine core said assembly having a diameter greater than about 2 inches and said core providing from about 3% to about 15% of the cross sectional area of said assembly.

6. An explosive assembly which comprises a water-pervious shell, a water-absorptive ammonium nitrate explosive composition including a nitric ester sensitizer and containing more than about 6% water in said shell, and a gelatinized nitro glycerine core, said assembly having a diameter greater than about 2 inches and said core providing from about 3% to about 15% of the cross-sectional area of said assembly.

DAVID M. McFARLAND.

REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
1,502,646	Hedin	July 22, 1924
2,048,831	White	July 28, 1936

FOREIGN PATENTS

Number	Country	Date
449,909	Great Britain	July 6, 1936

Certificate of Correction

Patent No. 2,463,709.

March 8, 1949.

DAVID M. McFARLAND

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 6, line 4, claim 4, for the word "acid" read *ester*;
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 2nd day of August, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

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