

[54]	<b>CAP SENSITIVE AMMONIUM NITRATE-HYDRAZINE-WATER- EXPLOSIVE</b>	3,419,443	12/1968	Maes.....	149/36 X
		2,978,864	4/1961	Stengel.....	149/36 X
		3,061,489	10/1962	Stengel et al.....	149/36

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[52] U.S. Cl. .... 102/24 R, 149/36, 149/46,

149/76

[51] Int. Cl. .... C06b 1/04, C06b 13/00

[58] Field of Search..... 149/36, 46, 76;  
102/24 R

[56] **References Cited**

**UNITED STATES PATENTS**

3,124,495 3/1964 Hradel..... 149/36 X

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[57] **ABSTRACT**

An explosive adapted for field mix and comprising about ten parts by weight of a first ingredient in solid form which in ammonium nitrate or mixtures of ammonium nitrate with a minor or equal amount of other oxidizer salt such as ammonium perchlorate or the like and about 1 part by weight of a second ingredient in liquid form which comprises about equal parts of hydrazine and water by weight.

**19 Claims, No Drawings**

## CAP SENSITIVE AMMONIUM NITRATE-HYDRAZINE-WATER-EXPLOSIVE

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

This invention relates to a two-part explosive adapted for field use by mixing the two components at the time of use, or alternately which can be factory mixed.

#### 2. Description of the Prior Art

It is known to add about 5 percent fuel oil to about 95 percent ammonium nitrate to make an explosive mixture. However, for detonation this mixture requires a powerful booster and diameters of at least 3 inches or more.

In Maes U.S. Pat. No. 3,419,443, there is disclosed an explosive composition comprising hydrazinium nitrate, hydrazine and ammonia, with or without hydrazinium perchlorate. Other related patents are Audrieth et al. U.S. Pat. No. 2,943,927; Audrieth et al. U.S. Pat. No. 2,704,706; Hradel U.S. Pat. No. 3,124,495; and Rank et al. U.S. Pat. No. 3,558,749.

It has been known that ammonium nitrate can be combined with hydrazine in the ratio of about two to one by weight to make an explosive that is cap sensitive (i.e. can be detonated with a blasting cap without the aid of a booster charge, and that the amount of hydrazine added can be reduced to about one part hydrazine to ten parts ammonium nitrate to make what is still a cap sensitive explosive.

Also it has been known that a mixture of ammonium nitrate and hydrazinium hydrate (i.e. 64.4 percent by weight hydrazine and 35.6 percent water) in the ratio of about 2 parts ammonium nitrate to one part hydrazinium hydrate is a blasting agent (i.e. can be detonated with a booster, but which is not ordinarily detonable by a blasting cap alone). However, it is also known that as the amount of hydrazinium hydrate added goes below about 30 percent, the mixture becomes quite insensitive. With 20 percent hydrazinium hydrate, the mixture is almost impossible to detonate.

### SUMMARY OF THE INVENTION

The present invention resides in the discovery that ammonium nitrate or a mixture of ammonium nitrate with ammonium perchlorate or the like can be wetted with a relatively small amount of a liquid comprising both hydrazine and water to make an explosive mixture that is cap-sensitive, i.e. is a mixture which can be detonated simply with a blasting cap and without the aid of any booster charge, but which is quite insensitive to shock and is also in other respects quite safe to use. The liquid-to-solid ratio is between about 1 to 2 parts liquid to 15 parts solid, and desirably about one part liquid to 10 parts solid.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention comprises a safe two-part explosive adapted for field use, characterized by a solid component, preferably in granular or powdered form, and a liquid component.

The solid component is ammonium nitrate, with the possible addition of other compatible oxidizer salts, such as ammonium perchlorate or the like (which would include salts having ammonia or a metal as the cationic radical and nitrate or perchlorate as the anionic radical). For example, ammonium perchlorate

can be added to the ammonium nitrate for increased detonation velocity up to about 50 percent by weight of the total weight of the solid component. Also, compatible fuel constituents, such as carbon black, sugar, aluminum powder or ground-up polyethylene can be added, if desired, for example in an amount of about 10 percent by weight of the total solid component. Greater amounts can be added, but this oftentimes results in incomplete combustion of the added fuel constituents and provides no real advantage.

The liquid component comprises hydrazine and water. For maximal safety, the amount by weight of water is at least about equal to, or slightly greater than, the amount by weight of hydrazine. This ratio is particularly advantageous since the hydrazine with at least an equal amount of water can be shipped by common commercial transportation. However, lesser percentages of water can be used, down to an amount which is about half by weight of the hydrazine. A readily available form of this liquid component is hydrazine hydrate, which can be used either without water dilution or can be diluted with up to an equal amount of water.

It is known that certain aliphatic derivatives of hydrazine, namely, monomethylhydrazine and unsymmetrical dimethylhydrazine and mixture thereof with hydrazine, function in an equivalent manner in explosive compositions and these equivalent compounds are to be considered the equivalents of hydrazine for purposes of practice of the present invention.

To prepare the explosive at the point of use, about one part liquid component is added to 10 parts of the solid component. This amount of liquid is sufficient to wet but not dissolve the solid component. A blasting cap is placed in this mixture, and the explosive mixture can then be detonated simply by detonation of the blasting cap. The ratio of the liquid to the solid can vary between about 1 to 2 parts liquid to 15 parts solid, by weight. The preferred ratio is one part liquid to 10 parts solid, by weight.

Also the two components can be placed in separate packages or in separate chambers of a two chamber package and then combined at the site of use. Alternatively the two components could be factory mixed and if desired placed in relatively small packages. A package of this explosive mixture with a diameter no greater than about three inches and down to about 1½ inches in diameter is still cap sensitive.

### EXAMPLE 1

A tubular plastic bag 10 inches long and 1.6 inches in diameter was filled with 330 grams of ammonium nitrate. 33 grams of a liquid, consisting of 50.5 percent water and 49.5 percent hydrazine were poured into the bag to wet the ammonium nitrate. A conventional blasting cap (No. 6 EB cap) was placed in the top of the bag into the explosive mixture. The blasting cap was fired and the mixture exploded.

### EXAMPLE 2—IMPACT SENSITIVITY

The same explosive mixture as in Example 1 was impacted several times with a 6 kilogram weight from a height of 50 centimeters. Such impaction was performed (a) immediately after mixing the explosive, (b) 48 hours after mixing, and (c) after the mixture was subjected to an elevated temperature of 186° F. for 48 hours and allowed to cool down to ambient temperature of 79° F.

In no instance was the mixture detonated.

#### EXAMPLE 3—RIFLE BULLET IMPACT TEST

Four packages of the mixture as prepared in Example 1 were taped together and abutted to a field target plate. Rifle bullets were repeatedly fired into the mixture. There was no detonation.

#### EXAMPLE 4

Two and a half pounds of the mixture made according to Example 1 were placed in a quart size polyethylene bottle. The bottle was dropped 40 feet onto a very hard dry clay-type ground surface. This was repeated 10 times with two separate bottles. No detonation occurred.

#### EXAMPLE 5

A mixture of 75 percent by weight of ammonium nitrate, 15 percent by weight ammonium perchlorate, 6.5 percent hydrazine and 3.5 percent water was prepared in the same manner as in Example 1 in an amount to fill a plastic bag 2 inches wide and 18 inches long. This was detonated with a No. 6 EB cap. The detonation velocity was approximately 3,000 meters per second as measured by an electronic chronograph counter ( $10^{-7}$  sec.).

#### EXAMPLE 6

A mixture of 60 percent by weight ammonium nitrate, 30 percent by weight ammonium perchlorate, 5 percent hydrazine and 5 percent water was prepared and detonated in the same manner as Example 5. The detonation velocity was 3,300 meters per second.

What is claimed is:

1. A unitary cap sensitive explosive composition comprising:
  - a. a first ingredient selected from the group consisting of:
    1. ammonium nitrate,
    2. mixtures of ammonium nitrate with ammonium perchlorate or the like, with the amount of ammonium nitrate being at least about half the total weight of the first ingredient,
  - b. a second ingredient comprising hydrazine and water wherein the water is by weight at least about half the amount of the hydrazine, with the proportion of the second ingredient to the first ingredient being between about 1 to 2 parts to about 15 parts by weight and present in an amount sufficient to form an explosive composition capable of being detonated by a blasting cap.
2. The composition as recited in claim 1, wherein said first ingredient is essentially ammonium nitrate.
3. The composition as recited in claim 1, wherein said second ingredient has approximately equal amounts of hydrazine and water.
4. The composition as recited in claim 3, wherein said first ingredient is essentially ammonium nitrate.
5. The composition as recited in claim 1, wherein about one part by weight of said second ingredient is present to about ten parts by weight of said first ingredient.
6. The composition as recited in claim 5, wherein said second ingredient comprises about equal parts by weight of hydrazine and water.

7. An explosive package having:
  - a. a first containing means containing a first ingredient selected from the group consisting of:
    1. ammonium nitrate,
    2. mixtures of ammonium nitrate with ammonium perchlorate or the like, with the amount of ammonium nitrate being at least about half the total weight of the first ingredient,
  - b. a second containing means containing a second ingredient comprising hydrazine and water wherein the water is by weight at least about half the amount of the hydrazine, with the proportion of the second ingredient to the first ingredient being between about 1 and 2 parts to about fifteen parts by weight and present in an amount sufficient to form a cap sensitive explosive composition.
8. The as recited in claim 7, wherein said first ingredient is essentially ammonium nitrate.
9. The as recited in claim 7, wherein said second ingredient has approximately equal amounts of hydrazine and water.
10. The as recited in claim 9, wherein said first ingredient is essentially ammonium nitrate.
11. The as recited in claim 7, wherein about one part by weight of said second ingredient is present to about 10 parts by weight of said first ingredient.
12. The as recited in claim 11, wherein said second ingredient comprises about equal parts by weight of hydrazine and water.
13. A tubular explosive package having a diameter no greater than about 3 inches and containing a cap sensitive explosive composition, comprising:
  - a. a first ingredient selected from the group consisting of:
    1. ammonium nitrate,
    2. mixtures of ammonium nitrate with ammonium perchlorate or the like, with the amount of ammonium nitrate being at least about half the total weight of the first ingredient,
  - b. a second ingredient comprising hydrazine and water wherein the water is by weight at least about half the amount of the hydrazine, with the proportion of the second ingredient to the first ingredient being between about 1 to 2 parts to about 15 parts by weight and present in an amount sufficient to form an explosive composition capable of being detonated by a blasting cap.
14. An explosive package as recited in claim 13, wherein the package diameter is between about 1½ inches to 3 inches.
15. The as recited in claim 13, wherein said first ingredient is essentially ammonium nitrate.
16. The as recited in claim 13, wherein said second ingredient has approximately equal amounts of hydrazine and water.
17. The as recited in claim 16, wherein said first ingredient is essentially ammonium nitrate.
18. The as recited in claim 13, wherein about one part by weight of said second ingredient is present to about ten parts by weight of said first ingredient.
19. The as recited in claim 18, wherein said second ingredient comprises about equal parts by weight of hydrazine and water.

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UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,768,410 Dated October 30, 1973

Inventor(s) Michel E. Maes and Albert F. Abbott

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the title, change "HYDRAZING" to -- HYDRAZINE --.

Column 4, line 17, after "The" insert -- explosive package ---.  
Column 4, line 19, after "The" insert -- explosive package ---.  
Column 4, line 22, after "The" insert -- explosive package ---.  
Column 4, line 24, after "The" insert -- explosive package ---.  
Column 4, line 27, after "The" insert -- explosive package ---.  
Column 4, line 51, after "The" insert -- explosive package ---.  
Column 4, line 53, after "The" insert -- explosive package ---.  
Column 4, line 56, after "The" insert -- explosive package ---.  
Column 4, line 58, after "The" insert -- explosive package ---.  
Column 4, line 61, after "The" insert -- explosive package ---.

Signed and sealed this 1st day of October 1974.

(SEAL)  
Attest:

McCOY M. GIBSON JR.  
Attesting Officer

C. MARSHALL DANN  
Commissioner of Patents