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EXPLOSIVE COMPOSITION

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This invention relates to explosive compositions and to explosive formulations which have a reduced sensitivity to impact. More particularly, this invention relates to a method of reducing the impact sensitivity of nitroglycerin without adversely affecting the explosive's strength.

Nitroglycerin alone and in admixture with the nitroglycols, the nitrated sugars and the like has been widely used as a constituent of explosive compositions such as the dynamites and gelatine dynamites. Nitroglycerin has also found application in the liquid form for oil well shooting. However, a serious disadvantage in its use for these purposes is its extremely high degree of sensitivity to impact which causes it to be very dangerous during handling and especially during truck transportation, loading of bombs, lowering into oil wells, and other operations. Its sensitivity to impact has made its manufacture, compounding, and use extremely hazardous even under favorable conditions, and although the introduction of many safety measures has improved the working conditions many accidents occur which cause damage to property and loss of life.

Due to the high impact sensitivity, nitroglycerin should not be transported in the liquid state, and even in mixture with oxidizing agents and reducing or carbonaceous materials, special precautions are necessary during transportation. To overcome these hazards it has been suggested that the nitroglycerin be colloided with a high percentage of nitrocotton. However such an admixture does not lend itself readily to compounding into the desired type explosive composition. It has further been suggested by Hale in U. S. 2,004,941, that nitroglycerin be admixed with nitroethylbenzenes as these materials will reduce its sensitivity. However, the addition of any considerable quantity of the nitroethylbenzenes not only reduces the impact sensitivity, but also makes the mixture insensitive to blasting caps. Furthermore, there may be at the same time a considerable reduction in the explosive strength. It may be noted that even dinitroethylbenzene has the low oxygen balance of —130% and its explosive energy is low.

It is the object of this invention to provide a material which when admixed with nitroglycerin reduces its sensitivity to impact without unfavorably affecting its strength.

A further object of this inventon is to provide nitroglycerin mixtures which may be handled with greater safety.

A further object of this invention is to provide explosive compositions which have reduced sensitivity to impact.

A further object of this invention is to provide a liquid explosive adaptable for use in oil well shooting.

A still further object of this invention is to provide explosive compositions which are not sensitive to impact, but which will detonate with a commercial blasting cap.

Other objects will be apparent hereinafter.

In general, the objects of this invention have been accomplished by mixing with the nitroglycerin now known to the art various percentages of nitroparaffins. The nitroparaffins are insensitive to impact and will not shoot under ordinary confinement when primed with a No. 8 blasting cap, but will when in admixture with nitroglycerin develop approximately the same explosive power as an equal weight of the nitroglycerin that it displaces. Thus, by admixing nitroparaffin with nitroglycerin and using these admixtures in various explosive compositions, explosives have been produced which have a reduced sensitivity to impact but which do not have a decreased explosive power.

More specifically, the objects of this invention were accomplished by admixing one part of nitroglycerin with one part of nitromethane. The admixture produced had an oxygen balance of —18% and the explosive energy of the mixture was practically equivalent to that of pure nitroglycerin. The 50–50 mixture of nitroglycerin and nitromethane was insensitive to impact but was sensitive to detonation by a commercial blasting cap. By varying the percentage of nitromethane added to the nitroglycerin, it has been found that about 15% nitromethane markedly reduces the sensitivity of the nitroglycerin and that an addition of over about 50% nitromethane to nitroglycerin reduces the sensitivity of the nitroglycerin to a point where a booster charge is required to effect detonation. The explosives which are obtained by compounding admixtures of nitromethane and nitroglycerin vary in sensitivity in about the same proportion as the sensitivity of the liquid mixture is affected. Thus, explosive compositions containing a definite percentage of nitroglycerin may have any lower sensitivity desired by adding thereto a proper amount of nitromethane.

In order to show more specifically the effect of the addition of nitroparaffin to nitroglycerin, Table 1 is given in which the properties of various

nitroglycerin-nitromethane compositions are listed.

Table 1

Nitroglycerin	Nitromethane	Oxygen balance	Sensitiveness to impact [1]		Sensitiveness to caps [2]
			Shot	Failed	
		Per cent	*Cm.*	*Cm.*	
100	0	+3.5	1	½	S No. 6.
90	10	−0.8	2	½	Do.
85	15	−2.5	15	1	Do.
80	20	−5.1	40	15	Do.
75	25	−7.2	--	----	Do.
70	30	−9.3	--	100	Do.
60	40	−13.6	--	----	Do.
50	50	−17.9	--	100	S No. 8, F No. 6.
40	60	−22.2	--	100	F No. 8.

[1] Height of fall of 2 kg. weight in the U. S. Bureau of Mines impact machine to produce either 5 shots out of 5 trials or 5 failures in 5 trials. First column shows height for 5 shots and second for 5 failures.
[2] S indicates shot, F indicates failure when firing with a commercial blasting cap, either No. 6 or No. 8 in size.

In the above table the nitroglycerin which was used did not include any of the various materials such as nitroglycol or nitrated sugars that are sometimes added to nitroglycerin. However, the mixing of nitroparaffins with nitroglycerins-containing materials such as the nitroglycols or nitrated sugars effects a reduction in the sensitiveness similar to the reduction which is effected when the nitroparaffin is added to pure nitroglycerin.

A nitroglycerin composition which comprised 42% nitroglycerin, 41% nitroglycol and 17% sucroseoctanitrate was mixed with varying portions of nitromethane and the oxygen balance and sensitiveness of the admixture determined. The results are given in Table 2.

Table 2

Nitromethane	"N. G."	Ox. balance	Sensitiveness [1]
0	100	−0.1	S No. 6.
30	70	−11.9	S No. 8 cap.
40	60	−15.8	F No. 8 cap.

[1] S=shot. F=failed with.

To show further how the addition of nitromethane reduces the sensitivity of nitroglycerin compositions, a composition comprising 40% nitroglycerin, 40% nitroglycol and 20% nitrosorbitol was mixed with varying proportions of nitromethane, and the oxygen balance and sensitiveness were determined. The results obtained are listed in Table 3.

Table 3

Nitromethane	"N. G."	Ox. balance	Sensitiveness [1]
0	100	+2.8	S No. 6.
30	70	−9.8	S No. 6 cap.
40	60	−14.0	S No. 8.
50	50	−18.3	F No. 8 cap.

[1] S=shot with. F=failed with.

From the foregoing results it will be seen that nitromethane affects the nitroglycerin alone or in admixture with other of the nitric esters and, therefore, wherein this specification and claims is used the term nitroglycerin, it should be understood that by the term, the compound by itself or with addition or partial substitution of any of the commonly used freezing point depressants such as, for example, ethylene glycol dinitrate, nitrated polymerized glycerin, nitrated sugars, nitrated chlorhydrins and the like is contemplated. The term nitroglycerin as here described is well known and accepted in the art. It has also been found that the nitroparaffins will reduce the sensitiveness of the above mentioned nitric esters when they are used alone.

It will be observed that sensitiveness of the nitroglycerin as shown in the above tables has been materially decreased by the addition of as little as 15% of nitromethane, and that by the time the percentage of nitromethane has been raised to about 30%, the mixture has become quite insensitive to impact; and, that on further raising of the percentage of nitromethane, the admixture becomes less sensitive until it will no longer detonate with a No. 8 blasting cap. Detonation of the insensitive composition may be effected by boosters; e. g., such as a half stick of 40% dynamite, or a charge of TNT or tetryl. The use of such boosters is oftentimes desirable and is to be understood as contemplated by this invention.

In addition to the reduction of sensitivity which is effected by the addition of nitromethane to the nitroglycerin, the nitromethane also, due to its low molecular weight and its low freezing point, effectively lowers the freezing point of nitroglycerin. Since the nitromethane added to the nitroglycerin lowers the freezing point, it is unnecessary to include with the nitroglycerin high percentages of freezing point depressants such as, nitrated glycols and nitrated sugars. This is advantageous since nitration of the mixtures may sometimes present difficulties not experienced when nitrating glycerin alone.

The liquid explosives comprising mixtures of nitroglycerin and nitromethane in accordance with this invention are highly desirable in oil well shooting. Thus, for example, a mixture of nitroglycerin and nitromethane, 75–25, is very much safer to handle in the liquid state than pure nitroglycerin and actually provides a means of using a high explosive composition safely. The use of mixtures of nitroglycerin containing as much as 50% nitromethane for shooting oil wells has been found advantageous by the inclusion of a booster charge of TNT or tetryl. The handling and loading of the 50–50 mixture of nitroglycerin and nitromethane even with the inclusion of the booster charge is relatively safe because the assembly is not sensitive to impact.

The sensitivity of various explosive compositions containing nitroglycerin, oxidizing salts and carbonaceous materials may be reduced by the addition of nitromethane to the composition either by adding it to the nitroglycerin before the nitroglycerin is compounded with the other ingredients or by adding it to the explosive composition after the mixing procedure is under way. Thus the nitroparaffin may be added to the explosive composition at any time during the preparation thereof, or to the individual ingredients. Any of the various explosive compositions now containing nitroglycerin may be reduced in sensitivity by the addition of nitromethane without reducing their explosive power and by this addition increased safety is obtained in the compounding, packing and use of the various explosives. The hazard of handling the explosives is materially reduced and in particular the hazard accompanying the packing of ordinary nitroglycerin explosives into cartridges manufactured of paper, plastics or metal is substantially decreased.

To show the various type explosives which may be compounded by the use of nitromethane, Table 4 is given which lists a dynamite, an ammo-

nium nitrate dynamite, a gelatin dynamite, and an extra gelatin dynamite composition that includes as an ingredient nitromethane:

Table 4

	A Dynamite	B Ammonium nitrate dynamite	C Gelatin dynamite	D Ammonium nitrate gelatin dynamite
Nitroglycerin	20	10	25.0	20.0
Nitromethane	20	5	25.0	10.0
Nitrocellulose			2.0	0.5
Sodium nitrate	48	23	39.0	32.0
Ammonium nitrate		50		26.0
Manioc meal		7		
Wood flour	7		4.0	1.0
Bagasse	4		4.0	1.0
Starch				7.5
Sulfur		4		1.0
Chalk	1	1	1.0	1.0
	100.0	100.0	100.0	100.0

From the above table, it is obvious that the nitromethane of this invention may be compounded with most of the various explosive compositions now known to the art. The addition of nitromethane to these explosive compositions, materially decreases the sensitivity of the composition. The advantage of this invention lies in the fact that the sensitivity of various explosive compositions may be reduced without the reduction of their explosive power.

While throughout the foregoing examples I have used nitromethane, I have also found that other nitroparaffins such as, for example, dinitroethane, dinitropropane may be substituted for the nitromethane or may be admixed therewith in order to obtain the decreased sensitivity desired. The nitroparaffins with materially lower oxygen balances, such as, nitroethane, nitropropane, and nitrobutane may also be used provided they are mixed with nitromethane to give a mixture with an oxygen balance greater than about −100%.

It will be understood that the details and examples hereinbefore set forth are illustrative only, and that the invention as broadly described and claimed is in no way limited thereby.

What I claim and desired to protect by Letters Patent is:

1. A dynamite including an oxidizing salt, a carbonaceous material, and an explosive ingredient, said ingredient comprising an admixture of a liquid explosive nitric ester and at least 15% by weight of a nitroparaffin composition selected from the group consisting of nitromethane, dinitroethane, dinitropropane, mixture of nitroethane and nitromethane, mixture of nitropropane and nitromethane, and mixture of nitrobutane and nitromethane, said dynamite being characterized by a much lower sensitivity to shock than a corresponding dynamite in which the nitroparaffin has been replaced by an equal weight of explosive nitric ester.

2. A dynamite including an oxidizing salt, a carbonaceous material, and an explosive ingredient, said ingredient comprising an admixture of a liquid explosive nitric ester and at least 15% by weight of a nitroparaffin composition selected from the group consisting of nitromethane, dinitroethane, dinitropropane, mixture of nitroethane and nitromethane, mixture of nitropropane and nitromethane, and mixture of nitrobutane and nitromethane, said dynamite being characterized by being insensitive to a blow from a 2 kg. weight dropped from a height of at least 15 cm. when tested on the U. S. Bureau of Mines impact machine.

3. A dynamite including an oxidizing salt, a carbonaceous material, and an explosive ingredient, said ingredient comprising an admixture of a liquid explosive nitric ester and at least 15% by weight of nitromethane, said dynamite being characterized by being insensitive to a blow from a 2 kg. weight dropped from a height of at least 15 cm. when tested on the U. S. Bureau of Mines impact machine.

4. A dynamite including an oxidizing salt, a carbonaceous material, and an explosive ingredient, said ingredient comprising an admixture of a liquid explosive nitric ester and at least 15% by weight of dinitroethane, said dynamite being characterized by being insensitive to a blow from a 2 kg. weight dropped from a height of at least 15 cm. when tested on the U. S. Bureau of Mines impact machine.

5. A dynamite including an oxidizing salt, a carbonaceous material, and an explosive ingredient, said ingredient comprising an admixture of a liquid explosive nitric ester and at least 15% by weight of dinitropropane, said dynamite being characterized by being insensitive to a blow from a 2 kg. weight dropped from a height of at least 15 cm. when tested on the U. S. Bureau of Mines impact machine.

6. A dynamite including an oxidizing salt, a carbonaceous material, and an explosive ingredient, said ingredient comprising an admixture of nitroglycerin and at least 15% by weight of nitromethane, said dynamite being characterized by being insensitive to a blow from a 2 kg. weight dropped from a height of at least 15 cm. when tested on the U. S. Bureau of Mines impact machine.

7. A gelatin dynamite including an oxidizing salt, a carbonaceous material, and an explosive ingredient, said ingredient comprising an admixture of nitroglycerin, nitrocellulose and at least 15% by weight of nitromethane, said gelatin dynamite being characterized by being insensitive to a blow from a 2 kg. weight dropped from a height of at least 15 cm. when tested on the U. S. Bureau of Mines impact machine.

8. A dynamite including an oxidizing salt, a carbonaceous material, and an explosive ingredient, said ingredient comprising an admixture of nitroglycerin and at least 15% by weight of dinitroethane, said dynamite being characterized by being insensitive to a blow from a 2 kg. weight dropped from a height of at least 15 cm. when tested on the U. S. Bureau of Mines impact machine.

9. A dynamite including an oxidizing salt, a carbonaceous material, and an explosive ingredient, said ingredient comprising an admixture of nitroglycerin and at least 15% by weight of dinitropropane, said dynamite being characterized by being insensitive to a blow from a 2 kg. weight dropped from a height of at least 15 cm. when tested on the U. S. Bureau of Mines impact machine.

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