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DESENSITIZED LIQUID EXPLOSIVES

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This invention relates to explosive liquids and, more particularly, to explosive, liquid, nitric esters which are desensitized for transportation and storage and from which the desensitizing agents may be readily removed prior to use.

The extreme shock sensitivity of explosive, liquid, nitric esters, and especially nitroglycerin, has long constituted a serious problem in the explosives field. These explosive oils are so readily detonated by shock that handling, transportation, and storing them are accompanied by extreme hazard unless they are desensitized in some manner. Therefore, unless the nitroglycerin or other explosive oils are to be used immediately after formulation and at the point of manufacture, they are normally desensitized. In the past such desensitization of explosive, liquid, nitric esters has generally been accomplished by the addition of some type of diluent which lowers shock sensitivity to the point where the liquid explosives can be handled with reasonable safety. These diluents may be classified into two general groups: (1) water-soluble, volatile compounds, such as acetone and ethyl alcohol and (2) water-insoluble, nonvolatile compounds, such as triacetin and dimethylphthalate.

Because of their volatility, the water-soluble, volatile additives present a serious storage problem. If any container is not completely air-tight, the evaporation of the volatile desensitizing agent results in a progressive sensitization with a relative increase in shock sensitivity. Furthermore, if any of the desensitized explosive is inadvertently spilled, the volatile diluent quickly evaporates leaving the highly sensitive explosive for disposition. In addition, large quantities of these volatile additives are necessary to effect the desired insensitivity to shock and as a result, when such volatile additives are employed, the explosive solution is usually shipped as a "tincture" containing only about 10% of the explosive ester. The shipping weight and space and the resulting shipping costs make the use of these volatile desensitizing agents additionally undesirable.

While the nonvolatile, water-insoluble desensitizing agents do exhibit a greater desensitizing power per unit volume than the volatile, water-soluble diluents and thus allow shipment of explosive solutions of high concentration, their use is also accompanied by serious disadvantages. In the first place, such materials are almost prohibitively difficult to separate from the explosive, liquid nitric ester. Furthermore, such compounds as triacetin and alkyl phthalates are relatively expensive materials.

As a result, there exists today no completely satisfactory method or means by which highly shock-sensitive, liquid explosives, such as nitroglycerin, can be desensitized for shipment, stor-

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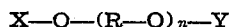
age, or general handling and still be readily recovered for subsequent use. Since in many cases it is neither practical nor possible to make nitroglycerin or another similar liquid explosive at the point of use and immediately prior to use, the problem faced by the explosives industry is one of increasing importance.

Therefore, an object of the present invention is a means by which highly shock-sensitive, explosive, liquid, nitric esters, such as nitroglycerin, can be sufficiently desensitized to insure safe handling, transportation, and storage.

An additional object of the invention is a solution of the explosive, liquid, nitric ester which may be safely handled, transported, and stored.

A further object of the invention is a method by which explosive, liquid, nitric esters can be desensitized for safe handling, transportation, and storage and then can be readily returned to a highly sensitive stage for subsequent use.

Generally described, the present invention is a solution comprising a normally highly sensitive, substantially water-insoluble explosive, liquid, nitric ester and a liquid, water-soluble, substantially nonvolatile compound having at least three carbon atoms and being characterized by the structural formula



in which R is a member of the class consisting of alkylene, ketoalkylene and hydroxyalkylene groups having from 2 to 6 carbon atoms; X and Y may be different and are members of the class consisting of alkyl, ketoalkyl, hydroxyalkyl, acyl and oxysubstituted acyl groups, and hydrogen; and n is an integer from 1 to 10; said liquid, water-soluble, substantially nonvolatile compound being capable of subsequent removal by water extraction. The present invention also includes a process for desensitizing an explosive, liquid, nitric ester for storage and transportation and for preparing said desensitized ester for subsequent use which comprises admixing with the ester a liquid, substantially nonvolatile, water-soluble compound having at least three carbon atoms and being characterized by the structural formula

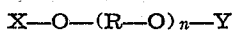


in which R is a member of the class consisting of alkylene, ketoalkylene and hydroxyalkylene groups having from 2 to 6 carbon atoms; X and Y may be different and are members of the class consisting of alkyl, ketoalkyl, hydroxyalkyl, acyl and oxysubstituted acyl groups, and hydrogen; and n is an integer from 1 to 10; and subjecting the resulting solution to at least one water extraction to extract said liquid, substantially nonvolatile, water-insoluble compound.

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In practicing the invention, the nitroglycerin or other explosive, liquid, nitric ester is mixed at the point of manufacture with the desired amount of a diluent in accordance with the invention. Preferably, the solution should also contain a small amount, such as 1%, of a stabilizer for the explosive, liquid, nitric ester. Suitable stabilizers are known to the art and include centralite and 2-nitrodiphenylamine. This solution may then be packaged, stored, handled, or transported to the point of intended use. At the point of use, the solution is introduced into a suitable vessel equipped with agitating means, and water is added thereto. It is generally preferred that sufficient water may be added, that the resulting mixture contain one part of the solution and two parts of water. However, as will be hereinafter shown, substantially smaller amounts of water may be used. The mixture is then agitated for a period necessary to effect the desired separation (usually about 10 minutes). Agitation is discontinued and the mix is allowed to settle until a layer of explosive, liquid, nitric ester, or explosive, liquid, nitric ester and stabilizer, settles out clearly. This layer is then drawn off into a second container and the remaining small amounts of water are allowed to rise to the surface. The water extraction may be repeated as desired or as necessary with the particular diluent employed.

As recited in the general statement of invention, the diluents operable in the present invention are water-soluble, substantially nonvolatile compounds having at least three carbon atoms and being characterized by the structural formula



in which R is a member of the class consisting of alkylene, ketoalkylene and hydroxyalkylene groups having from 2 to 6 carbon atoms; X and Y may be different and are members of the class consisting of alkyl, ketoalkyl, hydroxyalkyl, acyl and oxysubstituted acyl groups, and hydrogen; and n is an integer from 1 to 10. Such operable materials include diols having from 3 to 6 carbon atoms, such as diethylene glycol, polyethyleneglycol, polypropyleneglycol, triethylene glycol, dimethoxytetraglycol, and trimethyleneglycol. Also operable are their related compounds such as the alkyl-substituted glycol ethers in which the hydrogen of at least one hydroxyl group of the parent glycol has been replaced by an alkyl group. These compounds are commercially known as the Cellosolves, examples of which are glycolmonomethylether, glycolmonoethylether, glycolmonobutylether, etc. The di-substituted Cellosolves such as glycol diethyl ether are also operable as are such substitution products as hydroxy ethyl acetate, bis(methoxyethyl) acetal and bis(methoxyethyl) formal. The Carbitols, such as diethyleneglycolmethylether, diethyleneglycolethylether, and diethyleneglycolbutylether are also operable, as are the Carbitol substitution products, such as methoxyethyl acetoxylethyl ether. Of all the operable compounds having the structural formula as set forth above, diethylene glycol is the preferred desensitizing agent.

As will be illustrated, the amount of diluent may be varied in accordance with the degree of insensitivity desired. If the desensitized solutions are to be stored and used at the point of manufacture, it may be unnecessary and undesirable to employ as much diluent as when the solutions are to be transported to the point of storage and/or use. Furthermore, the amount

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of a particular diluent necessary to desensitize a particular explosive, liquid ester to a predetermined degree depends on the sensitivity of pure ester. For general purposes of storage or transportation, however, it is preferred to employ a diluent concentration of between 25 and 35% when desensitizing nitroglycerin and relatively lower diluent concentrations with the lower potential explosive, liquid esters.

In the structural formula which characterizes the operable diluents, the value of n may not be greater than 10 since the compounds then represented are solids or liquids of such high viscosity that they are inoperable. Similarly, the group represented by R may not contain more than six carbon atoms. If R does contain more than six carbon atoms, the water-solubility of the resulting compounds is decreased to the extent that they become inoperable. While it has been found that the chain length of the group X or Y, when it is alkyl, ketoalkyl, hydroxyalkyl, acyl or oxysubstituted acyl, does not affect the operability of the resulting compound, for best results it is preferred that the number of carbon atoms in X or Y be restricted to 4.

Having generally described and illustrated the present invention, the following examples are given for purposes of further illustration.

EXAMPLE 1

Desensitized nitroglycerin, in accordance with the invention, was prepared for shipment as follows: 65 parts by weight of nitroglycerin was mixed with 34 parts by weight of diethylene glycol and one part of ethyl centralite. This solution was placed into copper cans having a capacity of about 30 pounds and was trucked to the point of use. At the receiving facility the nitroglycerin and stabilizer were recovered as follows: 30 pounds of the solution NG/DG/EC (65/34/1) was added to a lead drowning tank equipped for air agitation. Sixty pounds of water at room temperature was then added to the tank to make a total mix of 2 parts by weight of water and 1 part by weight of nitroglycerin solution. The mixture was air-agitated vigorously for 10 minutes. The air was then turned off and the agitated mix was allowed to settle until a layer of nitroglycerin and stabilizer settled out clearly. This layer was drawn off into large separatory funnels and the remaining small amounts of water were allowed to rise to the surface. The nitroglycerin (containing the stabilizer) was then run into lead containers. An analysis was made of the contents of a container taken from each of six separate washes with the following results:

No. of test	Percent NG (dry basis)	Percent Ethyl Centralite (dry basis)
1	98.30	1.61
2	98.23	1.52
3	99.34	1.04
4	98.83	1.73
5	100.58	.80
6	98.13	1.77

In Table 1, Examples 2-24 are presented to illustrate the general operability of the class of compounds employed in accordance with the invention. In the recorded tests, 37.5 g. of nitroglycerin (containing 1.3% ethyl centralite) and 12.5 g. of specified diluent were admixed to form the desensitized solution. One hundred grams of water at room temperature was added to the solution. After air agitation for 10 minutes, the

mix was allowed to separate into 2 layers. The nitroglycerin layer was drawn off and analyzed with the following results:

Table I

ANALYSES OF NG LAYER IN SYSTEMS OF NG-DILUENT AFTER ONE WATER EXTRACTION

Example	Diluent	Vapor Press., mm. Hg at 20° C.	Percent NG (Dry Basis)	Percent EC (Dry Basis)	Percent Moisture
2.....	Polypropyleneglycol (M. W. 400).....	<0.01	95.9	1.2	-----
3.....	Diethyleneglycol diacetate.....	0.02	79.4	1.0	-----
4.....	Polyethyleneglycol (M. W. 200).....	<0.01	92.3	.8	-----
5.....	Diethyleneglycolbutylether.....	0.06	78.5	1.2	-----
6.....	Glycolmonoethylether.....	3.8	93.4	1.3	1.1
7.....	Diethyleneglycoldiethylether.....	0.4	95.3	.9	1.2
8.....	Diacetone alcohol.....	1.4	92.4	.9	.6
9.....	Triethylene glycol.....	<0.01	98.8	1.4	.1
10.....	Polyethylene glycol (M. W. 300).....	0.01	98.5	1.8	.2
11.....	Hydroxyethylacetate.....	1.2	83.8	1.4	3.1
12.....	Diethyleneglycolethylether.....	0.2	98.5	1.5	.3
13.....	Dimethoxytetraglycol.....	<0.01	94.2	1.0	.4
14.....	Trimethyleneglycol.....	<0.2	96.8	1.1	.1
15.....	Glycoldiethylether.....	9.4	92.4	1.0	4.3
16.....	Ethoxyethyl acetoxyethyl ether.....	0.1	82.2	.8	1.3
17.....	Diethyleneglycolmethyl ether.....	0.2	98.5	1.7	1.1
18.....	Methoxyethyl acetoxyethyl ether.....	0.12	85.8	.9	.8
19.....	Glycolmonomethylether.....	7.4	93.4	1.1	.6
20.....	Bis(methoxyethyl) formal.....	<0.1	92.2	1.1	.6
21.....	Bis(methoxyethyl) acetal.....	0.1	94.8	1.4	2.3
22.....	2-Methoxymethyl-2,4-dimethylpen- tane diol-1,5.....	<0.1	93.5	1.5	0.5
23.....	Butanediol-1,3.....	<0.1	96.9	-----	0.3
24.....	2-Methyl-Pentanediol-2,4.....	<0.1	95.9	1.2	0.7

In Table III, Examples 29 through 39 are presented to illustrate the insensitivity of the solutions of liquid high explosive and desensitiz-

In Table II, Examples 25 through 28 are presented to illustrate the operability of the invention with liquid explosives other than nitroglycerin. In each example a 50-g. solution 74/25/1, explosive/DEG/EC was formed and washed with 100 g. of water as above described. The results were as follows:

Table II

RECOVERY OF EXPLOSIVES FROM DIETHYLENE GLYCOL SOLUTION BY WATER WASH

[50 g. solution 74/25/1, explosive/DEG/EC, used with 100 g. water for washing.]

Example	Explosive	Recovered Material	
25.....	Glycol dinitrate.....	98.1 GDN.....	1.3 EC.
26.....	Glycol dinitrate/nitroglycerin (1/1).....	97.8 GDN/NG.....	0.9 EC 0.4 moisture.
27.....	Glycerol glycol ether trinitrate.....	96.2 GGEN.....	1.4 EC 1.3.
28.....	Diethylene glycol dinitrate.....	99.9 DGDN.....	0.9 EC 0.8.

ing diluent prepared in accordance with the invention. Each test consisted of five shots. The method of testing was as follows: A standard lead plate used in standard blasting cap tests was supported on the end of a piece of pipe. A 10-g. sample of the solution maintained at a temperature of about 70° F. was placed in a 19 x 65 mm. glass vial secured to the plate by a cellulose acetate tape. The electric blasting cap was taped in the vial so that its end just dipped in the center of the liquid surface. If, after firing the cap, the plate was severely disfigured or perforated, it was considered that a detonation of the solution had occurred. Examples 29 and 30 are given for purposes of comparison. The solutions tested were standard, transportable solutions used as casting solvents in fabrication of large gas-producing grains and as desensitizing agents contained, respectively, triacetin and dimethylphthalate.

Table III

BLASTING CAP SENSITIVITIES OF EXPLOSIVE-DIETHYLENE GLYCOL MIXTURES

Example	Mixture	Sensitivity to—	
		#6 Cap	#8 Cap
29.....	NG/TA/EC (74/25/1).....	2 detonations.....	5 detonations.
30.....	NG/DMP/EC (74/25/1).....	3 detonations.....	
31.....	NG/DG/NDPA (74/25/1).....	no detonations.....	
32.....	NG/DG/NDPA (60/19/1).....	5 detonations.....	
33.....	NG/GDN/DG/NDFA (32.5/32.5/34/1).....	no detonations.....	
34.....	NG/GDN/DG/NDFA (37/37/25/1).....	do.....	4 detonations.
35.....	NG/GDN/DG/EC (37/37/25/1).....	do.....	Do.
36.....	NG/DGDN/DG/NDFA (37/37/25/1).....	do.....	1 detonation.
37.....	DGDN/DG/NDFA (74/25/1).....	do.....	no detonations.
38.....	GDN/DG/EC (74/25/1).....	do.....	Do.
39.....	GGEN/DG/EC (74/25/1).....	do.....	Do.

In Table IV, Examples 40 through 46 are presented to compare the impact sensitivity of straight nitroglycerin and solutions of 75 parts nitroglycerin with 25 parts diethylene glycol, triacetin or dimethylphthalate. The test was conducted on a standard Bureau of Mines impact machine having a 2 kg. weight and a design 5 hammer and anvil. In each case, the distance of fall necessary to give 50% shots was determined.

Table IV

Example	Percent NG	Diluent	Percent Diluent	Height in cm. Giving 50% Shots
40.....	100			
41.....	74	TA/EO	24/1	5. no shots at 100 cm.
42.....	74	DMP/EC	24/1	Do.
43.....	74	DEG/EC	24/1	Do.
44.....	80	DEG	20	83.
45.....	85	DEG	15	60.
46.....	90	DEG	10	37.

In Table V, Examples 47 through 49 are presented to illustrate the ease of removal of diethylene glycol from a solution of nitroglycerin, diethylene glycol, and ethyl centralite (74/25/1) with varying amounts of water. Fifty grams of the solution was washed with the indicated amounts of water, the layers formed were analyzed, and the amount of nitroglycerin recovered was determined.

Table V

Example	Amount of Water, g.	NG Layer, Percent NG	Water Layer, Percent NG	NG Recovered, Percent
47.....	1	97.8	3.1	99.0
48.....	5	97.3	0.5	99.7
49.....	100	97.0	0.7	98.0

The foregoing examples illustrate that explosive, liquid, nitric esters may be desensitized for safe handling, transportation, and shipment and readily recovered in a highly pure state by water extraction in accordance with the invention. It will be noted that in all the examples only one water extraction was employed. Where the purity of the recovered product was in the order of 98% or more, additional water extraction would be unnecessary for all practical uses of the explosive ester. Those showing a purity of the recovered product of lower than 98% would probably be classified as unsatisfactory for a one-wash procedure where substantially pure explosive ester is desired, but are obviously easily adaptable to a multiple wash process.

The desensitizing diluent may be recovered from its aqueous solution for re-use by any suitable process. It is preferred to destroy the residual explosive by boiling with sodium carbonate and then put the solution through a suitable stripping column.

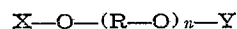
While the invention has been most specifically described in conjunction with desensitizing nitroglycerin for storage and shipment, the invention is not so limited but is equally operable with the other explosive, liquid, nitric esters, such as dinitroglycerin, ethylene glycol dinitrate, nitroisobutyl glycerol trinitrate, and 1,2,4-butanetriol trinitrate. Mixtures of the various explosive, liquid, nitric esters are also operable.

It is at once apparent from the examples that the invention has attained its objects. In ac-

cordance with the invention highly shock-sensitive explosive, liquid, nitric esters can be desensitized for safe handling, transportation, and storage and recovered from the desensitized solution by a simple, inexpensive process without employing any expensive or complicated apparatus. It is apparent that those skilled in the art will be able to employ many variations of the procedure and concentrations herein disclosed without departing from the scope of the invention. The invention is therefore to be limited only by the scope of the appended claims.

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

1. As a new composition of matter which may be safely transported and stored, a solution comprising a normally highly sensitive, substantially water-insoluble, explosive, liquid, nitric ester, and as a desensitizing agent, a liquid, substantially nonvolatile, diol having at least 3 carbon atoms which is soluble at room temperature in both water and explosive, liquid nitric esters and has the structural formula



in which R is a member of the class consisting of alkylene, ketoalkylene and hydroxyalkylene groups having from 2 to 6 carbon atoms; X and Y may be different and are members of the class consisting of alkyl, ketoalkyl, hydroxyalkyl, acyl and oxy-substituted acyl groups, and hydrogen; and n is an integer from 1 to 10; said diol being present in such amount that the solution is characterized by a sensitivity not greater than that of a solution of 25% of the diol in nitroglycerin, said diol being capable of subsequent removal by water extraction.

2. As a new composition of matter which may be safely transported and stored, a solution comprising nitroglycerin and as a desensitizing agent at least 25% of diethylene glycol; said diethylene glycol being capable of subsequent removal by water extraction.

3. As a new composition of matter which may be safely transported and stored, a solution comprising nitroglycerin, a small amount of stabilizer for the nitroglycerin, and as a desensitizing agent at least 25% of diethylene glycol; said diethylene glycol being capable of subsequent removal by water extraction.

4. As a new composition of matter which may be safely transported and stored, a solution comprising a normally highly sensitive, substantially water-insoluble, explosive, liquid, nitric ester, and as a desensitizing agent, a liquid, substantially nonvolatile alkyl-substituted glycol ether in such amount that the solution is characterized by a sensitivity not greater than a solution of 25% of the said ether in nitroglycerin; said alkyl-substituted glycol ether being capable of subsequent removal by water extraction.

5. As a new composition of matter which may be safely transported and stored, a solution comprising a normally highly sensitive, substantially water-insoluble, explosive, liquid, nitric ester, and as a desensitizing agent, a liquid, substantially nonvolatile alkyl-substituted glycol ether in such amount that the solution is characterized by a sensitivity not greater than a solution of 25% of the said ether in nitroglycerin; said alkyl-substituted glycol ether being capable of subsequent removal by water extraction.

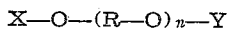
6. As a new composition of matter which may be safely transported and stored, a solution com-

prising nitroglycerin and as a desensitizing agent at least 25% of glycolmonoethylether; said glycolmonoethylether being capable of subsequent removal by water extraction.

7. As a new composition of matter which may be safely transported and stored, a solution comprising a normally highly sensitive, substantially water-insoluble, explosive, liquid, nitric ester, and as a desensitizing agent, a liquid, substantially nonvolatile alkyl ether of diethylene glycol in such amount that the solution is characterized by a sensitivity not greater than a solution of 25% of the said glycol in nitroglycerin; said desensitizing agent being capable of subsequent removal by water extraction.

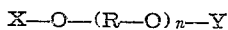
8. As a new composition of matter which may be safely transported and stored, a solution comprising nitroglycerin and as a desensitizing agent at least 25% of diethyleneglycolethylether; said diethyleneglycolethylether being capable of subsequent removal by water extraction.

9. A process for desensitizing substantially water-insoluble, explosive, liquid, nitric esters for storage and transportation and for recovering said ester for use which comprises admixing with the ester a desensitizing amount of a liquid, substantially nonvolatile, compound having at least 3 carbon atoms which is soluble at room temperature in both water and explosive, liquid nitric esters and is characterized by the structural formula



in which R is a member of the class consisting of alkylene, ketoalkylene and hydroxyalkylene groups having from 2 to 6 carbon atoms; X and Y may be different and are members of the class consisting of alkyl, ketoalkyl, hydroxyalkyl, acyl and oxysubstituted acyl groups, and hydrogen; and n is an integer from 1 to 10; and subjecting the resulting solution to at least one water extraction to extract said liquid, substantially nonvolatile, water-soluble compound.

10. A process for desensitizing substantially water-insoluble, explosive, liquid, nitric esters for storage and transportation and for preparing said desensitized ester for use which comprises admixing with the ester a small amount of stabilizer for the ester and a desensitizing amount of a liquid, substantially nonvolatile, compound having at least 3 carbon atoms which is soluble at room temperature in both water and explosive, liquid nitric esters and is characterized by the structural formula



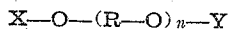
in which R is a member of the class consisting of alkylene, ketoalkylene and hydroxyalkylene groups having from 2 to 6 carbon atoms; X and Y may be different and are members of the class consisting of alkyl, ketoalkyl, hydroxyalkyl, acyl and oxysubstituted acyl groups, and hydrogen; and n is an integer from 1 to 10; and subjecting the resulting solution to at least one water extraction to extract said liquid, substantially nonvolatile, water-soluble compound.

11. A process for desensitizing nitroglycerin for storage and transportation and for subsequently preparing said desensitized nitroglycerin for use which comprises admixing nitroglycerin and a desensitizing amount of diethylene glycol with agitation to form a solution thereof, subsequently introducing said solution into a vessel equipped with agitating means, adding to said solution sufficient water at room temperature to produce

a total mix of two parts by weight of water and one part by weight of solution, agitating the mix, allowing the mix to stand until a layer of nitroglycerin is formed and separating said layer from the remaining contents of the vessel.

12. A process for desensitizing nitroglycerin for storage and transportation and for subsequently preparing said desensitized nitroglycerin for use which comprises admixing nitroglycerin, a small amount of a stabilizer for the nitroglycerin and a desensitizing amount of diethylene glycol to form a solution thereof, subsequently introducing said solution into a vessel equipped with agitating means, adding to said solution sufficient water at room temperature to produce a total mix of two parts by weight of water and one part by weight of solution, agitating the mix, allowing the mix to stand until a layer of nitroglycerin and stabilizer is formed, and separating said layer from the remaining contents of the vessel.

13. As a new composition of matter which can be safely transported and stored, a solution comprising at least one normally highly sensitive, substantially water-insoluble, explosive, liquid nitric ester and as a desensitizing agent, a substantially nonvolatile liquid compound having at least 3 carbon atoms which is soluble at room temperature in both water and explosive, liquid nitric esters and has the structural formula



in which R is a member of the class consisting of alkylene, ketoalkylene and hydroxyalkylene groups having from 2 to 6 carbon atoms; X and Y may be different and are members of the class consisting of alkyl, ketoalkyl, hydroxyalkyl, acyl and oxysubstituted acyl groups, and hydrogen; and n is an integer from 1 to 10; the amount of desensitizing agent being such that the solution is characterized by a sensitivity equal to that of a solution of from 25-35% of the desensitizing agent in nitroglycerin.

14. As a new composition of matter which may be safely transported and stored, a solution comprising nitroglycerin and from about 25 to about 35% of a substantially nonvolatile liquid compound having at least 3 carbon atoms which is soluble at room temperature in both water and nitroglycerin and has the structural formula



in which R is a member of the class consisting of alkylene, ketoalkylene and hydroxyalkylene groups having from 2 to 6 carbon atoms; X and Y may be different and are members of the class consisting of alkyl, ketoalkyl, hydroxyalkyl, acyl and oxysubstituted acyl groups, and hydrogen; and n is an integer from 1 to 10.

15. As a new composition of matter which may be safely transported and stored, a solution comprising nitroglycerin and from about 25 to about 35% of diethylene glycol.

16. A composition of matter in accordance with claim 13 in which a small amount of stabilizer for the liquid nitric ester is incorporated.

17. As a new composition of matter which can be safely transported and stored, a solution comprising at least one normally highly sensitive, substantially water-insoluble, explosive, liquid nitric ester and as a desensitizing agent, a substantially nonvolatile liquid compound having at least 3 carbon atoms which is soluble at room temperature in both water and

explosive, liquid nitric esters and has the structural formula



in which R is a member of the class consisting of alkylene, ketoalkylene and hydroxyalkylene groups having from 2 to 6 carbon atoms; X and Y may be different and are members of the class consisting of alkyl, ketoalkyl, hydroxyalkyl, acyl and oxysubstituted acyl groups, and hydrogen; and n is an integer from 1 to 10; the amount of desensitizing agent being such that the solution has a sensitivity not greater than a solution of 25% of the desensitizing agent in nitroglycerin.

18. A process for desensitizing substantially water-insoluble, explosive, liquid, nitric esters for storage and transportation and for recovering said ester for use which comprises admixing with the ester a desensitizing amount of diethylene glycol and subjecting the resulting solution to at least one water extraction to extract the diethylene glycol.

19. A process for desensitizing substantially water-insoluble, explosive, liquid, nitric esters for storage and transportation and for recovering said ester for use which comprises admixing with the ester a desensitizing amount of glycol monoethyl ether and subjecting the resulting solution to at least one water extraction to extract the glycol monoethyl ether.

20. A process for desensitizing substantially water-insoluble, explosive, liquid, nitric esters for storage and transportation and for recovering said ester for use which comprises admixing with the ester a desensitizing amount of diethylene glycol ethyl ether and subjecting the resulting solution to at least one water extraction to extract the diethylene glycol ethyl ether.

21. A process for desensitizing substantially

water-insoluble, explosive, liquid, nitric esters for storage and transportation and for recovering said esters for use which comprises admixing with the ester a desensitizing amount of alkyl-substituted glycol ether and subjecting the resulting solution to at least one water extraction to extract the alkyl-substituted glycol ether.

22. A process for desensitizing substantially water-insoluble, explosive, liquid, nitric esters for storage and transportation and for recovering said esters for use which comprises admixing with the ester a desensitizing amount of alkyl-substituted ether of diethylene glycol and subjecting the resulting solution to at least one water extraction to extract the alkyl-substituted ether of diethylene glycol.

RALPH F. PRECKEL.

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