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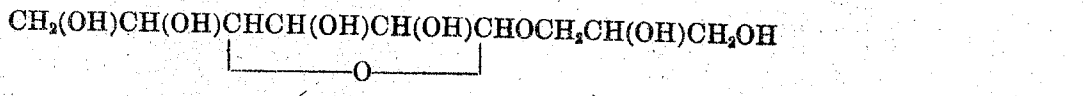
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NITROGLUCOSIDE EXPLOSIVE.

No Drawing. Original application filed January 23, 1923, Serial No. 614,455. Divided and this application filed November 6, 1925. Serial No. 67,207.

This invention relates to explosives, and particularly to high explosives such as dynamite, and comprises explosives of this type which contain, as the main explosive constituent or explosive base, a nitrated glucoside of a polyhydric alcohol either alone or in conjunction with a nitrated polyhydric alcohol.

The term "glucoside" is used herein in a generic sense to refer to the ethers formed by the condensation of hydroxy-hydrocarbons, and particularly polyhydric alcohols, with sugars (aldo-sugars) such as dextrose, mannose, galactose, and other hexoses, rhamnose (a methyl-pentose), and various other sugars. These glucosides are characterized by yielding upon hydrolysis a sugar and an alcohol. In the following description the chemical constitution of specific glucosides will be indicated by reference to both the sugar and the alcoholic components from which the particular glucoside may be assumed to have been derived. Thus, I designate the glucoside obtainable by the interaction of dextrose and glycerine as the dextrose-glucoside of glycerine, the generally accepted structural formula of the glucoside being:—



As set out in co-pending application, Serial No. 614,455, filed January 23, 1923, of which this application is a division, nitrated sugars have heretofore been used in the production of explosives for commercial purposes. The use of nitrated sugars possesses on the one hand the following advantages: first, it makes possible cheaper explosive bases due to the replacement in part of the nitrated polyhydric alcohols by the cheaper nitrated sugar; and, second, it permits the preparation of low-freezing explosive bases through the admixture of nitrated sugars with the nitrated polyhydric alcohols. On the other hand, the very great objection to the use of nitrated sugars in commercial explosives has been their instability.

For the production of explosives of low-freezing property, nitrated polymerized glycerine has been found advantageous. Such explosives are stable, but have the objection of relatively high cost, since nitrated polymerized glycerine is more expensive than nitroglycerine.

I have now discovered that nitrated glucosides may be used as explosives with essentially all the above-cited advantages associated with the use of both nitrated sugars and nitrated polymerized glycerine and at the same time without the above-cited disadvantages of either one. In other words, the use, as explosives, of nitrated glucosides, as for example the nitrated dextrose-glucoside of glycerine, involves the following advantages:—first, a cheaper explosive base with nitroglycerine is possible through substitution, in part, of the nitroglycerine or of nitrated polymerized glycerine by the cheaper nitrated glucoside; second, a stable explosive base with nitroglycerine is obtained; and, third, an explosive base with nitroglycerine can be obtained having a degree of low-freezing property comparable to that imparted by nitrated polymerized glycerine, and at a decided saving.

The glucosides, such as the dextrose, mannose, etc., glucosides of polyhydric alcohols, such as ethylene glycol, glycerine, etc., may be prepared by methods described in the literature (Ber. 26, 2411; 27, 2483; 28, 1145).

Nitrated glucosides of polyhydric alcohols may be prepared from the corresponding glucosides by the general method described in the literature (Ber. 31, 68). For use according to my invention such nitrated glucosides, as for example the nitrated dex-

trose-glucoside of glycerine, may be mixed with a nitrated polyhydric alcohol, as for example nitroglycerine, in proportions ranging from 80% to 20% nitrated dextrose-glucoside of glycerine to from 20% to 80% of nitroglycerine. While I have mentioned the above range of proportions of the nitrates as suitable, I wish it to be understood that I do not limit myself to any specific proportions.

Instead of mixing, as such, the nitrated glucosides of polyhydric alcohols and nitrated polyhydric alcohols, I prefer to nitrate the corresponding mixtures of the glucosides of polyhydric alcohols with polyhydric alcohols, as for example a mixture of dextrose-glucoside of glycerine and glycerine. This operation may be performed as follows:

Thirty parts of a glucoside, such as the dextrose-glucoside of glycerine, are dissolved in 70 parts of a polyhydric alcohol such as glycerine, and one part of this mixture is nitrated with 5 parts of a mixed acid of the approximate composition: Sulfuric acid 56%, nitric acid 44%. The temperature and time of nitration are approximately the same as for glycerine alone. When the nitration is complete, the solution or mixture of trinitroglycerine and nitrated glucoside of glycerine is separated from the spent acid and stirred until neutral with a 6% solution of sodium carbonate, in water, at a temperature of about 70–100° F. Instead of sodium carbonate another alkali such as sodium hydroxide, as well as sodium bicarbonate, may be used. The alkali solution is then drawn off and the nitrated mixture is washed with pure water at a temperature of 70–100° F. The mixture of trinitroglycerine and nitrated glucoside is then pure, and ready for use.

In regard to the above proportions, temperatures, etc., all these may be varied just as they can in the manufacture of nitroglycerine. The mixed acid can be of various strengths, either anhydrous or containing up to several per cent (4 or 5%) of water. Different proportions of glycerine, glucoside and mixed acid, different neutralizing agents of varying strength, and different temperatures of treatment are possible.

The same mixture proportions, nitration conditions, etc., hold for the other representative mixtures: (*a*) a glucoside of a glycol such as ethylene glycol and a polyhydric alcohol such as glycerine, (*b*) a glucoside of a glycol such as ethylene glycol glucoside and a glycol such as ethylene glycol, and, (*c*) a glucoside of a polyhydric alcohol such as glyceryl glucoside and a polyhydric alcohol such as glycerine.

According to my invention, desirable forms of dynamite may be made from explosive bases containing nitrated glucosides, as, for example, the nitrated dextrose-glucoside of glycerine, by mixing such base with the usual ingredients which make up nitroglycerine dynamites, such for example as sodium or potassium or ammonium nitrate, wood meal, etc. Moreover, it is possible by adding nitrocotton, to prepare gelatin dynamites of excellent character from explosive bases comprising nitrated glucosides of polyhydric alcohols.

The different forms of dynamites which can be made from explosive bases comprising nitrated glucosides may be illustrated by the following examples:

	Dynamite.	Gelatin dynamite.	Ammonia dynamite.
	Per cent.	*Per cent.*	*Per cent.*
Explosive base	40	33	10
Nitrocotton		0.75	
$NaNO_3$	45	51	
NH_4NO_3			80
Chalk	5	1	
Absorbent	14	14.25	10

The "explosive base" in the above examples may, for instance, consist wholly of the nitrated dextrose-glucoside of ethylene glycol, the nitrated dextrose-glucoside of butylene glycol, or the nitrated mannose-glucoside of glycerine. Or the "explosive base" in the above dynamite formulas may be composed of a mixture of equal parts of one of the above mentioned nitrated glucosides and of one of the following nitrated polyhydric alcohols: ethylene, propylene, and butylene, dinitrates, trinitroglycerine, and nitrated polymerized glycerine. Instead of equal parts of the two constituents, the explosive base may consist, for example, of 30 parts nitrated glucoside to 70 parts nitrated polyhydric alcohol.

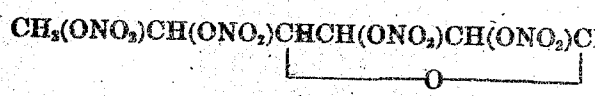
The nitrated glucosides which I prefer to use are derived from glucosides obtainable by condensing aldo-hexoses with polyhydric alcohols having from 2 to 9 carbon atoms, thus including polymerized, as well as unpolymerized, glycerine, and the glycols such as ethylene, butylene, and hexylene, glycols.

For the production of gelatin dynamites the nitrated glucoside-glycerine mixtures, are especially valuable, such mixtures gelatinizing more readily with nitrocotton than either nitrated sugar-glycerine mixtures or nitrated polymerized glycerine. As examples of such nitrated glucoside-glycerine mixtures there may be mentioned the mixtures of trinitroglycerine with the dextrose-glucoside of ethylene glycol, trimethylene glycol or glycerine.

By the expressions "nitrated glucosides" and "nitrated polyhydric alcohols" I mean, in general, glucosides and polyhydric alcohols which are completely nitrated, that is, in which each hydroxyl group has been con-

verted into a nitrate (—O—NO_2) group. Partially nitrated glucosides and alcohols, however, also come within the scope of my invention.

In the nitration of the glucoside, one or more of the hydroxyl groups may be converted to nitric esters, depending upon the amount of nitrating acid used. The end product, when the nitration is carried to completion, is the hexa-nitric ester of the dextrose glucoside of glycerine; the probable structural formula of which is:—



While the hexa-nitric ester is given as a specific example, it is understood that the extent of the nitration may be varied, as has been pointed out.

While I have described my new explosive compositions in detail, it will be understood that many changes may be made therein without departing from the spirit or scope of my invention.

I claim:

1. An explosive mixture comprising a nitrated glucoside of a polyhydric alcohol.

2. An explosive mixture comprising a nitrated glucoside of a polyhydric alcohol containing two nitro groups.

3. An explosive mixture comprising a nitrated glucoside of a polyhydric alcohol having from 2 to 9 carbon atoms.

4. A dynamite containing a nitrated dextrose-glucoside of a polyhydric alcohol.

5. A dynamite containing a nitrated dextrose-glucoside of a polyhydric alcohol containing two nitro groups.

6. A dynamite containing the nitrated dextrose-glucoside of glycerine.

7. An explosive composition containing a nitrated dextrose-glucoside of a polyhydric alcohol and a nitrated polyhydric alcohol.

8. An explosive composition containing the nitrated dextrose-glucoside of glycerine and a nitrated polyhydric alcohol.

9. An explosive composition containing the nitrated dextrose-glucoside of glycerine and nitrated glycerine.

10. An explosive composition comprising a nitrated glucoside of a polyhydric alcohol and an alkylene dinitrate.

11. A dynamite comprising a nitrated aldo-hexose-glucoside of a polyhydric alcohol.

12. A dynamite containing as the explosive base a mixture of a nitrated glucoside of a polyhydric alcohol and a nitrated polyhydric alcohol, from about 20 to 80% of said mixture being nitrated glucoside, and the remainder being the nitrated polyhydric alcohol.

13. An explosive composition comprising the nitrated glucoside of a polyhydric alcohol and a nitrated polyhydric alcohol.

14. An explosive composition comprising the nitrated glucoside of a polyhydric alcohol having two nitro groups, and a nitrated polyhydric alcohol.

15. An explosive composition comprising the nitrated glucoside of glycerine and a nitrated polyhydric alcohol.

16. An explosive composition comprising a nitrated hexose-glucoside of a polyhydric alcohol and nitroglycerine.

17. An explosive composition comprising a nitrated hexose-glucoside of a polyhydric alcohol having two nitro groups and an alkylene dinitrate.

18. An explosive composition comprising a nitrated hexose-glucoside of glycerine and nitro-glycerine.

19. An explosive composition comprising a nitrated glucoside of a polyhydric alcohol and ethylene dinitrate.

20. An explosive composition comprising a nitrated glucoside of glycerine and a nitrated glycol.

In testimony whereof I affix my signature.

ROBERT C. MORAN.