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BLASTING EXPLOSIVE

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This invention relates to gelatin dynamites of improved explosive properties and more particularly to gelatin dynamites in which the improvement results from the incorporation therein of low density, cellular, carbonaceous ingredients which have been specially treated to provide stiffened cell walls.

For use in blasting under wet conditions, or at various depths under liquid heads such as, for example, water and oil, blasting gelatin and gelatin dynamites have long been used. As is well known in the art, gelatin dynamites consist of a plastic explosive formed by the gelatinization of nitroglycerin with nitrocellulose to which mixtures may be added oxidizing salts and carbonaceous ingredients. These compositions are especially resistant to the penetration of water and for that reason are particularly useful for blasting under liquid heads.

Difficulties have been encountered in the past with gelatin dynamites becoming insensitive after prolonged storage and when used under the great depths of water and oil such as are encountered, for example, in seismographic prospecting and oil well shooting. In the latter case, it has been fairly well established that this results because the apparent density of the gelatin has increased, approaching the theoretical density of the mixture of ingredients used.

This difficulty has been overcome to a certain extent by the incorporation of suitable low density ingredients in the gelatin dynamite. However, when such gelatin dynamites are used under the high heads of liquid that are prevalent in oil well shooting and seismographic prospecting, they are very much compressed in consequence of the high pressure and the apparent densities of the gelatin dynamites approach the theoretical maximum density and the explosive becomes insensitive to detonation.

This invention has as an object the production of explosive compositions of improved sensitiveness under adverse conditions. A further object of this invention is the preparation of gelatin dynamites which will function successfully after more or less prolonged subjection to immersion under great depths of water or other liquids. A still further object of this invention is to accom-

plish this without seriously departing from the basic characteristics of gelatin dynamites, which involve in addition to water resistance, high density and plasticity. A still further object of this invention is to provide a low density, cellular, carbonaceous ingredient, which when incorporated in a gelatin dynamite, will prevent excessive compression under high pressures. Still further objects will appear hereinafter.

The objects of this invention are accomplished in accordance with this invention by using low density, cellular, carbonaceous ingredients, treated with a material which will effectively stiffen the ingredient so that the cell structure will not be destroyed under high liquid pressures, as an ingredient in gelatin dynamite.

We shall within this specification and claims use the term gelatin dynamite to include the three main classes of gelatin dynamites which are commonly known as straight gelatins, ammonia gelatins, and permissible gelatins. The straight gelatins range in strength, according to the usual terminology, from 20% to 100%. The latter is commonly known as blasting gelatin. These ordinarily contain a gelatinized liquid explosive ingredient, with varying proportions of sodium nitrate and combustibles, depending on the strength and other properties which may be required. The ammonia gelatins usually contain a smaller proportion of gelatinized liquid explosive than straight gelatins of the same grade strength, the strength being made up by the use of ammonium nitrate. Permissible gelatins may be of either the straight or the ammonia type, with the addition of a safety ingredient which permits their safe use in coal mines, where there is danger of explosion from mine gas and coal dust.

We have found that the low density, carbonaceous ingredients, prepared in accordance with the copending application of Lawrence Serial No. 326,654, produce a gelatin which will suffer less than the usual degree of compression under high pressures. Carbonaceous ingredients which are suitable for this purpose include ground cork, balsa, bagasse, bongo wood, hemp hurds and their equivalents. The treatment to which they are subjected involves impregnation of the ingredients to effect a stiffening of the cell walls

with a heat-hardening synthetic resin such as the urea-aldehyde, phenol-aldehyde, thiourea-aldehyde type resin and the like, and substantially heat-hardening in situ. The synthetic resins may be formed and hardened on and in the carbonaceous ingredient or applied as an intermediate condensation product, from a solution in water or an organic solvent, which is hardened after evaporation of the solvent. Thus, in accordance with this invention, there must be formed on and in the cell structure a heat-hardening resin which strengthens and supports the cell walls.

The art has heretofore incorporated low density carbonaceous ingredients such as cork, balsa wood, bagasse, etc., in gelatin dynamites to improve their sensitiveness under high water pressures. However, this incorporation has not given gelatins which are entirely satisfactory under high liquid pressures and the density is often lower than is desirable. By using treated carbonaceous ingredients, a considerably greater improvement in sensitiveness under high liquid pressure is secured with a small quantity of low density material and at the same time gelatins of the desired high density are produced. Thus, by the prior art gelatine dynamites can be prepared which will have a density of 1.3 g./cc. or less and will shoot after 2 hours under 120 lbs. per sq. in. (275 ft.) of water by incorporation of 4% of ordinary ground cork. However, incorporation of 2-3% of treated cork will give gelatins having a density of 1.4 g./cc. or more which will shoot after 2 hours under at least 250 lbs./sq. in. (580 ft.) of water.

Our invention makes it possible to prepare gelatin dynamites economically and simply which are of greatly increased effectiveness when used under high pressures.

We are aware that it has been proposed to use low density carbonaceous ingredients, which have been impregnated with materials to reduce their absorbency for nitroglycerin. These impregnated materials when incorporated in gelatin dynamites do not effectively improve their sensitiveness under high pressures. It is to be noted that the carbonaceous materials treated to give stiffened cell walls have substantially the same absorbency for nitroglycerin before and after treatment, and in some cases there is a material increase in absorbency.

In order to show that the absorbency of treated carbonaceous material is substantially constant or increased, the following table is given:

TABLE 1

Ingredient	Per cent absorbency		Absorbency factor ¹	
	Plain	Resin treated	Plain	Resin treated
Cork.....	37.1	45.0	59	82
Balsa.....	76.2	76.0	320	317
Bagasse-Celotex.....	78.0	76.0	355	317
Bagasse-Godchaux.....	68.0	65.4	212	189

¹ Factor equals pounds of nitroglycerin absorbed per 100 lbs. of carbonaceous material.

Having now described the invention in general terms, we shall by way of example describe the invention in greater detail by referring to cork in which the cell walls are stiffened with a urea-formaldehyde resin.

The cork used will preferably have a fair proportion on a 20-mesh screen. This is not, how-

ever, essential, as samples of cork with the following screen analyses have given good results.

Screen test	A	B	C	D	E
	Per cent	Per cent	Per cent	Per cent	Per cent
On 12 mesh.....	0.5	Nil	1.0	Nil	Nil
On 20 mesh.....	58.5	42.0	79.5	100	Nil
On 30 mesh.....	22.5	50.0	15.5	-----	100
On 40 mesh.....	17.5	6.0	3.0	-----	-----
Through 40 mesh..	1.0	2.0	1.6	-----	-----

The treatment may be carried out in the following manner. The cork is placed in a suitable container and a solution of urea in an aqueous formaldehyde solution is added to the cork and the mixture thoroughly incorporated. The mixture is then heated to cause condensation of the urea-formaldehyde resin and to dry the cork. This drying may conveniently be carried out at about 70-100° C. The impregnated cork and resin are then heated to harden the resin. This may be done by heating for ½ to 1 hour or more at 100° C. or for shorter periods at temperatures up to 150° C. This procedure, as will be obvious to those skilled in the art, may be varied considerably.

Alternatively the urea-formaldehyde solution may be sprayed on the hot cork and the mixture dried and the resin hardened as before, or the urea may be mixed with the cork and then the formaldehyde solution added and drying and hardening of the resin carried out as before.

The ratio of urea to formaldehyde may be varied over wide limits, for example, from 1 part of urea and 2 parts of 40% formalin (37% formaldehyde by weight) to 1 part of urea and 5 parts of 40% formalin, although we do not wish to be limited by these proportions. Furthermore, the solutions may be diluted to any desired degree, although for economy of operation, it is desirable to use quite concentrated solutions.

Instead of preparing the resin in above described manners, a partial condensation product of urea and formaldehyde may be prepared by methods well known in the art which can be applied from an aqueous solution or from solution in an organic solvent such as ethyl alcohol, the carbonaceous material treated, the solvent evaporated, and the resin heat-hardened.

In treating cork with urea-formaldehyde solution, good results have been obtained when the quantity used was such as to give a final product containing from about 15% to about 45% of resin. The preferred range is from about 30% to about 40% resin by weight of the final treated cork.

Other carbonaceous ingredients such as balsa, bongo wood, or bagasse may be used, but when these types of materials are used, it is found that a lower percentage of resin will give results which are as effective as higher percentages with ground cork. Thus, for example, with treated balsa, it is preferable to have about 25% to about 35% of urea-formaldehyde resin by weight of the final product. This urea-formaldehyde resin treated balsa or its equivalent may be used in explosive compositions in the same manner that the urea-formaldehyde resin treated cork is used to obtain explosives with approximately the same properties.

In the use of the phenol-aldehyde resins to treat cork, the most satisfactory results are obtained when the resin is formed in and on the cork cells. For example, cresol may be dissolved in 37% formaldehyde solution, catalyst stirred in and the mixture added to the cork. By heating

the mixture of the cork with the cresol and formaldehyde, condensation, drying and hardening of the resin are accomplished. The final hardening operation can be carried out at temperatures in the range of 100–150° C.

Other heat-hardening resins or combinations may be used to treat the cellular material, for example, a combination of chlorinated rubber and a heat-hardening phenol-aldehyde resin, such as Bakelite No. 3360, gives good results when applied to cork from an organic solvent and then heat-hardened. Alternatively, these materials may be applied from an aqueous emulsion of a concentrated solution of these materials in an organic solvent. This has the advantage of limiting the quantity of solvent used, thus reducing the fire hazard and eliminating the necessity of installing a recovery system for the solvent.

The carbonaceous ingredients such as cork, balsa, bagasse, etc., treated with a suitable heat-hardening resin have a hard, rather gritty feel in contrast to the soft and compressible qualities of the untreated material. Incorporation of these ingredients in gelatin dynamites to the extent of about 2–3% results in greatly improved ability to detonate under conditions of high water pressure.

In the preparation of the specially treated carbonaceous material, two factors are of especial importance: Mixing with the resin ingredients in a relatively low viscosity phase to insure thorough incorporation and subsequent hardening of the resins to form a hard, tough coating on the surfaces of the cell walls thus creating resistance to compression.

Several examples of the carbonaceous material used in this invention are shown in the following examples.

EXAMPLE 1

A quantity of ground cork was treated with urea-formaldehyde resin in the following manner. The cork, 354 lbs., was placed in a pan dryer and heated to about 150–160° F. Meanwhile, a solution was prepared by dissolving 135 lbs. of urea in 402 lbs. of a 37% (by weight) aqueous solution of formaldehyde. This solution was then sprayed on the hot cork, which was being constantly mixed by rotating plows, over a period of about ½ hour. Heating was continued until the cork was dry and the temperature had reached about 200° F., a period of about seven hours. The cork was then discharged from the dryer and after cooling was ready for use. The quantity of impregnated cork obtained was 549 lbs. and contained 38.3% of resin. The cork showed the following screen analysis:

	Per cent
On 12 mesh.....	2
On 20 mesh.....	38
On 30 mesh.....	36
On 40 mesh.....	14
On 60 mesh.....	4
Thorough 60 mesh.....	6

Other properties of the cork before and after treating are the following:

	Untreated	Treated
Apparent density.....g./cc.	0.09	0.19
Moisture.....per cent.	5.6	1.2
Nitroglycerin absorbcency per 100 lbs. of cork.....	50	84
Resin content.....per cent.		38.3

¹ Of dry weight.

The treated cork feels crisp and hard in contrast to the softness of the ordinary granulated cork.

EXAMPLE 2

Five hundred parts by weight of ground cork was mixed with 700 parts by weight of 37% (by weight) formaldehyde solution to which 26 parts by weight of concentrated hydrochloric acid had been added to serve as a catalyst. Two hundred sixteen parts by weight of cresol was added and the whole mixed together. The treated cork mixture was then dried and the resin hardened by heating for seven hours in an oven at about 135° C. A yield of 706 parts by weight of treated cork containing 33% of resin was obtained.

EXAMPLE 3

A solution consisting of 190 parts by weight of thiourea in 442 parts by weight of 37% (by weight) formalin solution was prepared by heating the mixture until the thiourea dissolved. The solution was added to cork which had been heated to about 100° C. The mixture was dried and the resin hardened by heating for 2 hours at 135° C. Seven hundred forty-five parts by weight of treated cork containing 36.5% of resin was obtained.

EXAMPLE 4

Five hundred parts by weight of ground balsa wood was placed in a steam-jacketed kettle equipped with a stirring device. A solution of 126 parts by weight of urea dissolved in 580 parts by weight of 37% (by weight) formalin solution was added to the balsa and the mixture was stirred for half an hour. Then the kettle was heated for 4 hours with steam to effect the resin reaction and to dry the mixture. The mixture was finally heated with 90 lb. steam for about two hours to complete the drying and harden the resin. A yield of 665 parts by weight of balsa, containing about 28.5% of resin, resulted.

The ground balsa wood used in this example showed the following screen analysis:

	Per cent
On 12 mesh.....	1.0
On 20 mesh.....	39.5
On 30 mesh.....	20.5
On 40 mesh.....	12.5
Through 40 mesh.....	26.5

EXAMPLE 5

Five hundred parts by weight of cork was mixed with 420 parts by weight of a 60% solution of an alcohol-soluble urea-formaldehyde resin (U-Formite F-224) and dried two hours in thin layers in an oven at 135° C. A yield of seven hundred two parts by weight of treated cork containing 33% of resin was obtained.

EXAMPLE 6

Five hundred parts by weight of bagasse was placed in a steam jacketed mixing kettle and a solution containing 190 parts by weight of urea and 562 parts by weight of 37% (by weight) formaldehyde solution was added with stirring to the bagasse.

Steam was applied to the jacket and the material was dried and the resin hardened during a period of 4 hours. About 693 parts by weight of treated bagasse containing 31% of resin was obtained.

EXAMPLE 7

Five hundred parts by weight of cork was mixed with a solution of 125 parts by weight of 20 cp. chlorinated rubber and 125 parts by weight of Bakelite 3360 in 500 parts by weight of toluene. The mixture was placed in an oven and dried for a period of 2 hours at 135° C. About 720 parts by weight of treated cork containing 34% of resin was obtained.

The carbonaceous materials described above

(100% gelatin dynamite, Table 4), and in extra gelatins of 80%, Table 5. These gelatins were tested for water-resistance by the procedure given hereinbefore. The first gelatin in each table is formulated according to commercial compositions, but the others contain our treated low density, cellular, carbonaceous material. Examination of these data shows the very marked improvement resulting from the use of the treated carbonaceous material.

TABLE 2

60% L. F. gelatin dynamites

	A	B	C	D	E	F	G	H	I	J
Nitroglycerin.....	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
Nitrocellulose.....	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.5	1.5
Sodium nitrate.....	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
Wood pulp.....	4.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Balsa pulp.....	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Ivory meal.....	3.0	3.0	3.0	2.9	3.2	3.1	4.0	3.0	2.9	2.9
Wheat flour.....	2.0									
Untreated cork.....		3.2					2.0			
Treated cork 1 ¹			3.0							
Treated cork 2 ¹				3.1						
Treated cork 3 ¹					2.8					
Treated balsa 4 ¹						2.9			3.1	
Treated bagasse 5 ¹										3.1
Treated bagasse 6 ¹										
Treated cork 7 ¹										
Chalk.....	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0	1.0	1.0
Density, gm./cc.....	1.35	1.41			1.51	1.51	1.46		1.52	1.52
Sensitiveness:										
Shot after x hrs. at y lbs./sq. in.	2 at 67	2 at 250	2 at 150	24 at 150	24 at 150	2 at 120	24 at 150	2 at 120	24 at 150	2 at 250

¹ The following list gives the compositions of the treated carbonaceous materials:

- Treated cork 1—38.3% urea formaldehyde resin
- Treated cork 2—33% cresol formaldehyde resin
- Treated cork 3—36.4% thiourea formaldehyde resin
- Treated balsa 4—28.4% urea formaldehyde resin
- Treated bagasse 5—31% urea formaldehyde resin
- Treated bagasse 6—35.6% urea formaldehyde resin
- Treated cork 7—34% resin consisting of equal parts of chlorinated rubber and a heat-hardening phenolic resin

have been used to produce greatly improved gelatin dynamites. The various dynamite compositions prepared by using the treated carbonaceous materials were tested for underwater use by placing three 2 x 16" sticks of the gelatin dynamite composition, end to end in a steel pipe capped at the lower end. A No. 6 or No. 8 electric blasting cap was inserted in the first stick of gelatin dynamite and the pipe filled with water. The blasting cap wires were fastened to the terminals of a spark plug mounted in a pipe cap. This cap was screwed on to the pipe and the pressure in the pipe was built up by applying compressed air through a valve. Any desired pressure within reason may be obtained in this way. The pipe or bomb containing the gelatin under water pressure was allowed to stand for any desired period of time, and then laid horizontally on top of 5 lead cylinders, 1½ in. diameter and 2 in. high, each covered with a steel disc of the same diameter. These five lead cylinders were spaced at intervals under the pipe and the charge fired. If the charge shoots completely, all of the lead cylinders are compressed to a considerable degree, for example, as much as an inch or more. If the detonation does not propagate completely, the cylinders under the portions of the charge which fail will not be compressed; in this manner it is easily distinguished whether or not the charge has completely detonated.

The value of the specially treated carbonaceous ingredients for improving the quality of gelatin dynamites is clearly shown in the following tabulations, which give the results of its use in the so-called L. F. (low freezing) gelatins (60% and 80% strengths, Tables 2 and 3), in blasting gelatin

It will be noted that in the above table the treated material used gives actual material content, exclusive of resin, of about 2%, except in Example G where net cork content is about 1.25%.

TABLE 3

80% L. F. gelatins

	1	2
Nitroglycerin.....	67.0	67.0
Nitrocellulose.....	2.5	2.5
Sodium nitrate.....	18.5	18.5
Wood pulp.....	2.0	2.0
Balsa.....	4.0	4.0
Ivory meal.....	1.5	1.5
Starch.....	1.5	1.5
Chalk.....	1.0	1.0
Untreated cork.....	2.0	2.0
Treated cork 1.....		
	100.0	100.0
Sensitiveness: Shot after x hrs. at y lbs./sq. in. pressure.....	2 at 43	2 at 150

TABLE 4

Blasting gelatin

	1	2
Nitroglycerin.....	89.0	89.0
Nitrocellulose.....	6.0	6.0
Balsa.....	4.0	4.0
Treated cork 1.....		
Chalk.....	1.0	1.0
	100.0	100.0
Sensitiveness: Shot after x hrs. at y lbs./sq. in. pressure.....	2 at 43	2 at 87

TABLE 5
60% ammonium nitrate gelatin

	A	B	C
Nitroglycerin.....	30.0	30.0	30.0
Nitrocellulose.....	1.25	1.25	1.25
Sodium nitrate.....	28.0	28.0	28.0
Ammonium nitrate.....	28.0	28.0	28.0
Wood pulp.....	2.25	2.25	4.75
Starch.....	4.5	4.5	4.0
Sulfur.....	3.0	3.0	3.0
Untreated cork.....	2.0		2.0
Treated cork 1.....		2.0	2.0
Balsa (urea-formaldehyde resin).....			2.0
Ivory meal.....	1.0	1.0	1.0
Chalk.....			
	100.0	100.0	100.0
Density, gm./cc.....	1.47	1.53	1.55
Sensitiveness: Shot after x hrs. at y lbs./sq. in.....	2 at 43	2 at 120	2 at 150

In order to show the decrease in compressibility of the gelatin dynamites containing the treated carbonaceous materials, the following test was conducted. A section of gelatin dynamite 2 inches in diameter and 2 inches long was placed under kerosene, or other suitable liquid, and the volume thereof determined. The liquid was then subjected to pressure, for example, 75 lbs./sq. in. gauge for 15 minutes, and the volume of the sample observed. The theoretical reduction of the gelatin's volume which should result from the above pressure was then calculated from the theoretical maximum density and its actual bulk density. The actual compressibility of the gelatin was then expressed as a relative compressibility; i. e., the ratio of the observed decrease in volume to the theoretical decrease. The results on a number of gelatin samples containing treated cork are given in Table 6 which show that the relative compressibility decreases as the ability to shoot under pressure improves.

TABLE 6

60% gelatin dynamite ¹ containing—	Theor. max. density	Original density	Density under 75#/sq. in.	Relative compressibility	Shot after x hours at y #/sq. in.
Untreated cork	1.77	1.39	1.70	1.02	2 at 43
Treated cork 1...	1.77	1.42	1.62	0.75	2 at 120
Treated cork 2...	1.77	1.445	1.64	0.77	2 at 150
Treated cork 3...	1.77	1.475	1.61	0.60	24 at 150

Cork 1—33.8%—resin consisting of 50% chlorinated rubber and 50% phenolic aldehyde resin.

Cork 2—32.7%—urea-formaldehyde resin.

Cork 3—39.6%—urea-formaldehyde resin.

¹ Each gelatin contains a quantity of treated cork equivalent to 2% actual cork.

In the above formulations where the use of nitroglycerin is indicated, it should be understood that by the term nitroglycerin is meant either this compound by itself or with the addition or partial substitution of any of the commonly used freezing point depressants such, for example, as ethylene glycol dinitrate, nitrated polymerized glycerin, nitrated sugars, nitrated chlorhydrins, etc. The term nitroglycerin as here described is well accepted in the explosive art.

The explosive compositions of our invention have been found especially advantageous in blasting operation where there is a substantial liquid head above the explosive charge. In deep well blasting such as, for example, seismograph prospecting, quarrying and oil well shooting, these compositions have proved invaluable since their sensitiveness is not impaired under the high pressures encountered. The compositions have also

found use in underwater operations, such as are carried out in channels and harbors, due to their constant sensitivity.

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 we claim and desire to protect by Letters Patent is:

1. A gelatin type explosive composition which includes as ingredients nitroglycerin and a cellular, carbonaceous material selected from the group consisting of cork, balsa, bagasse, bongo wood and hemp hurds and treated with a synthetic resin heat-hardened in situ, said treated carbonaceous material characterized by having stiffened cell walls and by having substantially the same nitroglycerin absorbency as the untreated material.
2. A gelatin type explosive composition comprising a stiffened, cellular, carbonaceous material selected from the group consisting of cork, balsa, bagasse, bongo wood and hemp hurds, said material treated with a synthetic resin heat-hardened in situ, and characterized by a nitroglycerin absorbency substantially equal to the absorbency of the untreated material and said composition containing less than about 80% nitroglycerin, said composition characterized by a density greater than 1.4 grams per cc., and the ability to detonate after 2 hours at 200 lbs. a sq. inch water pressure when disposed in a 2 x 48 inch column.
3. A gelatin type explosive composition comprising a stiffened, cellular, carbonaceous material selected from the group consisting of cork, balsa, bagasse, bongo wood and hemp hurds, said material treated with a synthetic resin heat-hardened in situ, and characterized by a nitroglycerin absorbency substantially equal to the absorbency of the untreated material and said composition containing between about 40% and about 60% nitroglycerin said composition characterized by a density greater than 1.4 grams per cc., and the ability to detonate after two hours under 200 lbs. per sq. inch water pressure when disposed in a 2 x 48 inch column.
4. An ammonium nitrate gelatin dynamite composition comprising a stiffened, cellular, carbonaceous material selected from the group consisting of cork, balsa, bagasse, bongo wood and hemp hurds, said material treated with a synthetic resin heat-hardened in situ, and characterized by a nitroglycerin absorbency substantially equal to the absorbency of the untreated material and said composition containing less than about 40% nitroglycerin said composition characterized by a density greater than 1.5 grams per cc., and the ability to detonate after 2 hours at 100 lbs. per sq. inch water pressure when disposed in a 2 x 48 inch column.
5. A gelatin type explosive composition comprising a liquid explosive, nitrocellulose, and between about 1.25% and about 4.0% of a treated cellular carbonaceous material selected from the group consisting of cork, balsa, bagasse, bongo wood and hemp hurds, having the cell walls thereof stiffened with a synthetic resin heat hardened in situ, said resin comprising between about 15% and about 45% by weight of said material.
6. A gelatin type explosive composition comprising a liquid explosive, nitrocellulose, and between about 1.25% and about 4.0% of a treated cork having the cell walls thereof stiffened with

a phenol aldehyde resin heat hardened in situ, said resin comprising between about 15% and about 45% by weight of said material.

7. A gelatin type explosive composition comprising a liquid explosive, nitrocellulose, and between about 1.25% and about 4.0% of treated cork having the cell walls thereof stiffened with a urea aldehyde resin heat hardened in situ, said resin comprising between about 15% and about 45% by weight of said material.

8. A gelatin type explosive composition comprising a liquid explosive, nitrocellulose, and between about 1.25% and about 4.0% of balsa having the cell walls thereof stiffened with a phenol aldehyde resin heat hardened in situ, said resin comprising between about 15% and about 45% by weight of said material.

9. A gelatin type explosive composition comprising a liquid explosive, nitrocellulose, and between about 1.25% and about 4.0% of balsa hav-

ing the cell walls thereof stiffened with a urea aldehyde resin heat hardened in situ, said resin comprising between about 15% and about 45% by weight of said material.

5 10. A gelatin type explosive composition comprising a liquid explosive, nitrocellulose, and between about 1.25% and about 4.0% of bagasse having the cell walls thereof stiffened with a phenol aldehyde resin heat hardened in situ, said resin comprising between about 15% and about 45% by weight of said material.

10 11. A gelatin type explosive composition comprising a liquid explosive, nitrocellulose, and between about 1.25% and about 4.0% of bagasse having the cell walls thereof stiffened with a urea aldehyde resin heat hardened in situ, said resin comprising between about 15% and about 45% by weight of said material.

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