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BLASTING EXPLOSIVE CONTAINING A
WATER - SOLUBLE POLYSACCHARIDE
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a corporation of Great BritainNo Drawing. Application August 13, 1951,
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7 Claims. (Cl. 52-7)

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The present invention is an improvement in or modification of the invention claimed in the specification of British patent specification No. 645,039 which latter relates to improvements in ammonium nitrate blasting explosives, and more especially in ammonium nitrate powder, semi-gelatine and gelatine blasting explosives.

It is stated in the specification of the said patent that certain defects of these explosives occasioned by the extreme water solubility and hygroscopicity of ammonium nitrate, including the rapid deterioration of cartridges containing ammonium nitrate powder and semi-gelatine explosives when the shots are laid in wet situations, are minimised by the inclusion in the composition of the explosive of a water-swellable and water-soluble ether of a macro-molecular polysaccharide, for instance a water-swellable and water-soluble ether of cellulose or of starch, a proportion of the said ether ranging from $\frac{1}{2}$ to 5% of the weight of the explosive composition being conveniently included. It is also stated that when the explosive cartridge is submerged under water it would appear that the water-swellable and water-soluble macro-molecular polysaccharide ether swells up when it comes into contact with the water and forms a surface protection for the interior of the mass of the explosive in the cartridge because of the low mobility of the swollen mass and the slow rate at which it interdiffuses with the surrounding water. In said specification it is further stated that the inclusion of this water-swellable and water-soluble ether enables ammonium nitrate semi-gelatine and powder blasting explosives to be used in wet situations, since although the cartridge wrapper may be ineffective to exclude the water the interior of the cartridges remains satisfactorily sensitive to detonation from the time the shot has been laid until the operator is ready to fire it.

In ammonium nitrate safety blasting explosive compositions such as are used in coal mining, the proportion of ammonium nitrate is high. These compositions also contain a substantial proportion of a flame quenching and cooling ingredient, and one of the most effective of these flame quenching and cooling ingredients is sodium chloride.

There are however advantages to be gained in safety and other characteristics in safety blasting explosives of the aforesaid kind by the replacement of the ammonium nitrate by equivalent amounts of sodium nitrate and ammonium chloride, with a corresponding partial or complete elimination of added sodium chloride. The re-

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sulting explosive compositions however are still hygroscopic and quickly deteriorate in sensitivity when used in wet situations.

We have now found that safety explosive compositions free from added ammonium nitrate but including sodium nitrate and ammonium chloride in association with explosive sensitising ingredients and optional additional constituents, whether of powder or semi-gelatine or even gelatine consistency, are rendered suitable for use in wet situations by the inclusion in the composition of a water-swellable and water-soluble macro-molecular polysaccharide ether, for instance a water-swellable and water-soluble ether of cellulose or of starch.

According to the present invention safety blasting explosive compositions are free from ammonium nitrate and comprise sodium nitrate, ammonium chloride, at least one explosive sensitising agent, and a water-swellable and water-soluble macro-molecular polysaccharide ether.

The water-swellable and water-soluble macro-molecular polysaccharide may be for instance a water-soluble methyl cellulose, a water-soluble methyl ethyl cellulose, a water-soluble hydroxy ethyl cellulose or a water-soluble sodium salt of a carboxymethyl cellulose. As an example of a suitable water-swellable and water-soluble starch ether a water-soluble sodium salt of carboxymethyl starch may be used.

The quantity of the aforesaid water-swellable and water-soluble macro-molecular polysaccharides may conveniently be from $\frac{1}{2}$ to 5% of the weight of the explosive composition.

It is preferred to mix the above water-swellable and water-soluble macro-molecular polysaccharide ethers with the inorganic salts or with the other combustibles before incorporating these with the other ingredients of the explosive, although it is also possible to incorporate the water-swellable and water-soluble ethers into the finished explosive with equally efficacious results.

Preferably according to the present invention the composition also contains a small proportion of a calcium salt of a high molecular weight fatty acid, for example calcium stearate. This confers on the composition a certain water repellent effect which is useful in delaying the wetting of even the surface of the explosive cartridge, especially when the situation in which it is used is only slightly wet, and it does not interfere with the efficacy of the ether of the macro-molecular polysaccharide in swelling up and protecting the interior of the explosive cartridge if and when the water overcomes the effect of the calcium

stearate and succeeds in wetting the surface. A proportion ranging from $\frac{1}{4}$ to 5% of the weight of the explosive composition may advantageously be included.

The invention is especially applicable to explosive compositions of powder and semi-gelatine consistency, since these normally deteriorate more rapidly than explosives of gelatine consistency when they are used in wet boreholes under such conditions that the water has access to the composition.

The following table illustrates how the replacement of 1.5% of woodmeal in the composition of MH 36 by 1.0% disintegrated water-soluble sodium carboxymethyl cellulose and 0.5% calcium stearate to give the composition MH 37 improves the waterproofness 32 to 60 times and how the replacement of 1.5% of woodmeal in the composition of MH 38 by 1.0% disintegrated water-soluble sodium carboxymethyl cellulose and 0.5% calcium stearate to give the composition MH 39 improves the waterproofness about 12 times; and how by increasing the percentage of disintegrated water-soluble sodium carboxymethyl cellulose by 2.5% in MH 57 to give the composition MH 58 the waterproofness is increased about 3.5 times, and by increasing the percentage of disintegrated water-soluble sodium carboxymethyl cellulose in MH 59 by 2.5% and leaving out the 1% wheatflour the waterproofness is increased about 2.5 times. The table also shows that the replacement of 1.5% woodmeal in the composition of MH 36 by 1.5% disintegrated water-soluble sodium carboxymethyl cellulose to give the composition MH 57 improves the waterproofness 32 to 60 times and how the replacement of 1.5% woodmeal in the composition MH 38 by 1.5% disintegrated water-soluble sodium carboxymethyl cellulose to give the composition MH 59 improves the waterproofness 5 to 6 times.

	MH 36	MH 37	MH 57	MH 58	MH 38	MH 39	MH 59	MH 60
Nitroglycerine.....	11.5	11.5	11.5	11.5	17.0	17.0	17.0	17.0
Orthonitrotoluol.....	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5
Nitrocellulose.....	0.25	0.25	0.25	0.25	3.5	2.0	2.0	2.0
Woodmeal.....	3.85	2.35	2.35	1.75	1.0	1.0	1.0	1.0
Wheatflour.....	32.4	32.4	32.4	31.9	28.5	28.5	28.5	28.0
Ammonium chloride.....	51.4	51.4	51.4	50.0	45.5	45.5	45.5	44.5
Sodium nitrate.....					4.0	4.0	4.0	4.0
China clay.....								
Disintegrated water-soluble sodium carboxymethyl cellulose.....		1.0	1.5	4.0		1.0	1.5	4.0
Calcium stearate.....		0.5				0.5		
Waterproofing test..... hrs..	< $\frac{1}{4}$	8-15	8-15	32-48	4-6	48-72	24-32	56-72

The invention is further illustrated by the following example in which the percentages are by weight.

Example

	Percent
A mixture of nitroglycerine and ethylene glycol dinitrate in the ratio 80:20	17.0
Nitrocellulose	0.5
Sodium nitrate	45.5
Ammonium chloride	28.5
Woodmeal	2.0
Wheatflour	1.0
China clay	4.0
Water-soluble sodium salt of carboxymethyl cellulose whereof a 1% solution has a pH of 6 to 9 and a viscosity of 30 to 70 cps. at 20° C.	1.0
Calcium stearate	0.5

is prepared in the following manner. The mixed liquid nitric esters, which are prepared by nitrat-

ing a 80:20 mixture of glycerine and ethylene glycol, are run on to the nitrocellulose and the woodmeal which is then hand stirred and when the mixture has become at least partly gelatinised it is transferred to an Atlas (registered trademark) mixer in which the sodium nitrate, the ammonium chloride, and the calcium stearate and the sodium salt of the carboxymethyl cellulose and the china clay have already been introduced and mixed together. During the action of the machine thereafter the wheatflour is worked in. The action of the machine is continued until the ingredients are well incorporated together. The resulting semi-gelatine explosive composition is cartridge and provided with waxed paper wrappers. Detonation of the cartridges of the explosive can still be satisfactorily initiated by means of a No. 6 commercial detonator after storage under 6 inches of water for more than 48 hours, even though the cartridge wrapper has been artificially perforated at several points. These cartridges are suitable for blasting coal in fiery or dusty mines.

The water-soluble sodium salt of carboxymethyl cellulose in the above example contains 0.75 sodium carboxymethyl groups per anhydro glucose unit of cellulose.

Similarly perforated cartridges containing a composition similar to the above except that the water-soluble sodium salt of carboxymethyl cellulose is replaced by 1% woodmeal or other insoluble cellulosic material and thus not in accordance with the invention, cannot be caused to detonate by means of a similar detonator after standing under 6 inches of cold water for 15 minutes.

What I claim is:

1. Safety blasting explosive compositions comprising sodium nitrate, ammonium chloride, at least one explosive sensitising agent, and a water-swella- and water-soluble macro-molecular

polysaccharide ether selected from the group consisting of a polysaccharide ether of starch and a polysaccharide ether of cellulose, said ether being homogeneously distributed throughout the blasting composition.

2. Safety blasting explosive compositions as claimed in claim 1 wherein the proportion of said water-swella- and water-soluble macro-molecular polysaccharide ether ranges from $\frac{1}{2}$ to 5% of the weight of the explosive.

3. Safety blasting explosive compositions as claimed in claim 1 wherein the said water-swella- and water-soluble macro-molecular polysaccharide ether is a water-swella- and soluble ether of cellulose.

4. Safety blasting explosive compositions as claimed in claim 1 wherein the said water-swella- and water-soluble macro-molecular polysaccharide ether is a water-swella- and soluble ether of starch.

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5. Safety blasting explosive compositions as claimed in claim 1 wherein the composition includes a proportion of a calcium salt of a high molecular weight fatty acid.

6. Safety blasting explosive compositions as claimed in claim 5 wherein the calcium salt of a high molecular weight fatty acid is calcium stearate.

7. A blasting cartridge containing a safety blasting explosive composition comprising sodium nitrate, ammonium chloride, at least one explosive sensitizing agent, and a water-swellable and water-soluble macro-molecular polysaccharide ether selected from the group consisting of a polysaccharide ether of starch and a polysaccharide ether of cellulose, said ether being homogeneously distributed throughout the blasting composition.

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