Feb. 9, 1943. J. BARAB 2,310,343

BLASTING CARTRIDGE

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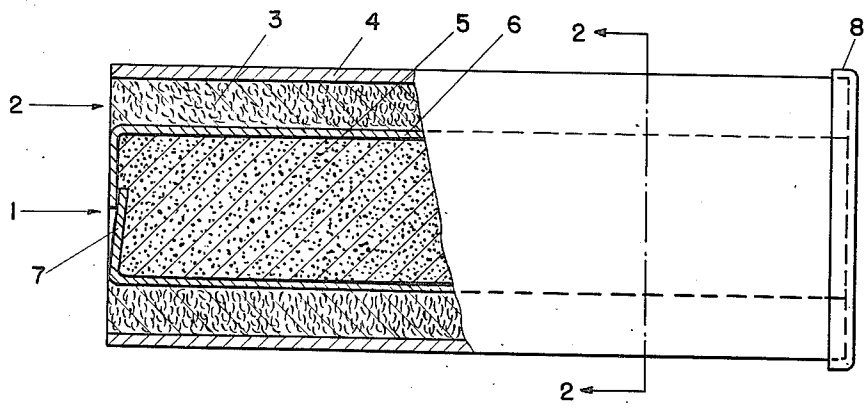


FIG.-1

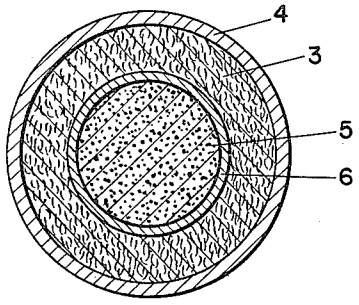


FIG.-2

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BLASTING CARTRIDGE

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Application July 16, 1940, Serial No. 345,712

8 Claims. (Cl. 102—24)

This invention relates to an improved blasting cartridge and to methods of production thereof. It relates more particularly to a blasting cartridge surrounded by a compressible material of low apparent density which provides a cushioning action for the initial explosive shock.

It is the principal object of this invention to provide a blasting cartridge enclosed in a sheath comprising a compressible cushioning material. A further object of this invention is to provide a sheath comprised of a compressible material and a flame-quenching salt. A further object of this invention is to provide a low density admixture which may be packed into a tubular sheath for use around an explosive cartridge.

A further object of this invention is to provide an explosive cartridge surrounded by a low density, tubular sheath which will cushion the initial shock of the explosion. A still further object of this invention is to provide an explosive cartridge which is surrounded by a tubular sheath of low density, compressible material that will give improved blasting results in operations such as coal mining.

Other and further objects will be apparent hereinafter.

The cushioning of the initial shock of a blasting explosion with a compressible, cushioning material in accordance with this invention is of particular importance for explosive cartridges subject to use in producing high percentages of lump material such as is desired in coal mining. After the initial shock of the explosive has been absorbed by the cushioning material, the expanding gases released by the explosion further expand, but without a shattering force, into the cleavage planes of the seam being blasted with a resulting pushing action which breaks up the structure in such a manner that large firm lumps are obtained. Without the cushioning material about the explosive, the shattering force causes a large amount of pulverized material to be produced. In particular, for example, lump coal brings higher prices and any improvement which will give a larger percentage of lump in any given blast constitutes a highly desirable improvement in the blasting operation necessary in coal mining.

The improvement in blasting cartridges described in accordance with this invention may be accomplished with any desired form of explosives, but will be found most advantageous in connection with, for example, the dynamites developed for use in coal mining. The shattering effect of coal mining explosives, for example, the permissible dynamites, when fired in direct contact with coal, while not of the high order of that obtained with straight dynamites, is, nevertheless, undesirable. By sheathing these explosives, especially the permissibles, a higher percentage of lump coal is obtained.

The improved explosive cartridge which provides the advantage related above in the mining of lump coal may be produced in accordance with the present invention by surrounding an explosive cartridge with a sheath comprising an admixture of expanded sodium silicate and a binder; in addition to the expanded sodium silicate and the binder, the admixture may, if desirable, include a flame-quenching salt. The binders which I have found desirable for use with the expanded sodium silicate may be materials having adhesive properties or material which form materials such as, for example, dextrin, clay, waste sulfite liquor, wood pulp, such as kraft pulp or sulfite pulp, asbestos fiber, balsa, bagasse, and other similar binding materials. The flame-quenching salt which I have found to be adaptable for use in my admixture may be, for example, sodium bicarbonate, sodium chloride, boric acid, ground gypsum, borax, calcium chloride or the like.

The admixture prepared in accordance with this invention may be formed into a tubular sheath by packing it into an annular ring within a substantially rigid tube so that the internal diameter thereof is equivalent to the diameter of the explosive cartridge which is to be inserted within the tubular member. The formed sheathing will be semi-rigid and have a cellular, favose structure. The packing of the material may be accomplished by machines such as, for example, described in the co-pending application of R. B. Smith and K. Wassen, Serial No. 273,301, filed May 12, 1939.

Having now indicated in a general way the nature and purpose of this invention, there follows a more detailed description of preferred embodiments thereof with reference to the accompanying drawing in which Fig. 1 represents a cushioning sheath partially in section and containing an explosive cartridge, and Fig. 2 is a view of the cushioning sheath of Fig. 1, on line 22.

Referring now to the drawing, the assembled article of this invention comprises a blasting cartridge 1 surrounded by a cushioning sheath 2 comprising a packed, homogeneous material 3 retained in position by a surrounding tube 4. The explosive cartridge 1 comprises an explosive

composition 5 wrapped by a paper 6 which is crimped 7 at the end.

If desirable, a cap 8 may be placed over either or both ends of the assembly, but this cap 8 is not generally used. The cap will be found desirable when a unitary explosive charge is manufactured. The cap may be placed on the end of the cushioning sheath as shown in Fig. 1 and either be composed of a sheet of material such as cardboard or the like or composed of the compressible admixture 3 which surrounds the explosive cartridge. If it is desirable, the cap may be formed in the shape of a plug and inserted in the end of the sheath 2 proper. In such instances the sheath 2 will be slightly longer than the explosive cartridge which is to be used. The plug may be retained by any adhesive, taping or similar expedient.

The thickness of the cushioning material may be varied to provide varying amounts of cushioning effect. A thickness of about ⅛ to about ¾ inch is desirable for most purposes. Thus, a sheath to fit around a 1¼ by 8 inch dynamite cartridge will be about $1\frac{3}{32}$ inches, inside diameter, and about $1\frac{7}{32}$ inches to about $1\frac{9}{32}$ inches outside diameter. This sheath may, of course, be about the same length as the cartridge and open on both ends in order to aid propagation of the explosive, or the ends of the cartridge may be closed with caps or plugs described hereinbefore, and made either of cardboard or of the sheathing composition. The closing of the ends of the cartridge slightly retards the propagation of detonation from one cartridge to another, but, when only one cartridge is to be used in the explosion, the closed end sheath is desirable.

The expanded sodium silicate which is used in accordance with this invention is preferably prepared from a commercial sodium silicate of the following approximate composition.

	Per cent
Na_2O	19.4
SiO_2	62.5
H_2O	18.1

This material is a standard article of commerce and consists of small beads of hydrated solid sodium silicate. These beads are made by spray drying and possess a hollow center surrounded by a relatively thick wall. The material has the property, when heated to about 400° F., of intumescence; i. e., the material softens sufficiently at about 400° F. to allow the steam entrapped in the bead to bulge or blow walls outward making a product of much lower apparent density. For example, the original apparent density of this sodium silicate is in the vicinity of 0.75 g./cc., but on expanding drops to as low as 0.025 g./cc. and sometimes even lower.

If desirable, in making the expanded sodium silicate, it may be treated to render the expanded material insoluble in water. Surface treatments of various kinds may be used. One of the most satisfactory methods to make expanded sodium silicate for use in the sheaths of this invention has been to dehydrate the sodium silicate during the expansion procedure.

It has been found when there is over about 7% water in the sodium silicate being expanded a material may be produced which is too soluble to be completely satisfactory in the production of sheathing. However, by essentially complete dehydration during the expansion procedure or of the expanded material after the procedure so that a material having less than about 2% moisture is produced a satisfactory expanded substantially water-insoluble silicate is obtained. The pre-dried material may be expanded so that it loses practically all of its residual water and samples having less than 2% residual moisture have a satisfactory insolubility for the production of sheaths.

For example, a pre-dried sample of sodium silicate, containing about 9% H_2O when on expanding was reduced to 1% residual water was only 5% water-soluble. In a comparable test a material having about 18% moisture when on expanding was reduced to only 9% residual water the expanded material was 35% water-soluble.

It was found, however, that when there was only 6–7% moisture in the material to be expanded no expansion would take place even if the material is given a very high temperature treatment. The water content of the sodium silicate particles before expansion should be maintained above about 8% and the water content of the expanded material kept below about 2%.

Although the expanded sodium silicate can be produced in densities as low as 0.025 g./cc., it is desirable to use meterial of somewhat higher apparent density since the walls of the beads have greater mechanical strength when the beads are not expanded to their ultimate extent. Thus, a sodium silicate expanded to give an apparent density between about 0.10 and about 0.05 g./cc. is the preferred material for use in producing the cellular, favose sheathing of this invention. Materials having a density higher than 0.10 g./cc. may, of course, be used, but it is rather uneconomical to do so since a large amount of expanded sodium silicate is required to accomplish the desired lowering in density of the sheath.

In processes of formulating sheathing where mechanical strength of the expanded sodium silicate is not so important, as when a matrix of fiber is used, sodium silicate expanded to its ultimate low density is quite suitable.

The sheathing in accordance with this invention may comprise as high as about 50% expanded sodium silicate, but will preferably contain between about 10% and about 25% expanded sodium silicate. The composition and use of the sheaths are illustrated by the following examples.

Example 1

Sheaths were made from the following admixture:

Sodium bicarbonate	g.	333.2
Expanded sodium silicate	g.	71.8
Sodium silicate solution—1 part in 4 parts of water	cc.	178

by packing into a spiral-wound paper tube. The wall thickness of the packed sheaths was 0.233" and the average weight of a 1¼" x 8" sheath, exclusive of the paper tube, was approximately 91 g. Similar sheaths composed of only sodium bicarbonate and a dextrin binder weighed 154 g. The apparent densities of the two types sheaths were 0.62 g./cc. and 1.05 g./cc. respectively.

Example 2

Sheaths were made from the following composition:

Sodium bicarbonate	g.	333.2
Expanded sodium silicate	g.	71.8
Dextrin binder	cc.	100.0

This composition produced a sheath for a

1¼" x 8" explosive cartridge which had a dry weight of 93 g. with a wall thickness of approximately 0.23" and a density of 0.64 g./cc.

In comparison, a sheath having the following composition:

Sodium bicarbonate	g.	565
Diatomaceous earth	g.	243
Dextrin binder	cc.	190

had an average weight of 119 g. This was definitely heavier than the sheath using expanded sodium silicate even though the amount of low density filler and diatomaceous earth used was definitely increased.

In comparing the two sheaths described above, the strength of the one including expanded sodium silicate was definitely superior to the one carrying diatomaceous earth. This is shown by results obtained when dried sheaths were crushed in a hydraulic press. The method was to place the sheaths between two saddles 1 inch wide and apply hydraulic pressure until $\frac{1}{8}$ inch movement took place. On this test the crushing strength of the sample with expanded silicate was over 150 lbs., while the crushing strength of the sample with diatomaceous earth was only 63 lbs. Thus, it is apparent that the use of expanded sodium silicate shows advantages over other materials.

Example 3

Sheaths were made on the following composition:

Sodium chloride	g.	82.2
Expanded silicate	g.	17.8
Dextrin binder	cc.	24.8

Apparent densities around 0.65 were obtained.

Example 4

Sheaths were made on the following composition:

Boric acid	g.	82.2
Expanded sodium silicate	g.	17.8
Dextrin binder	cc.	30.0

Apparent densities around 0.55 were obtained.

Example 5

Sheaths were made on the following composition:

Ground gypsum	g.	82.2
Expanded sodium silicate	g.	17.8
Dextrin binder	cc.	24.8

Apparent densities around 0.65 were obtained.

The above examples, when tested for strength and compressibility, compared favorably with sheaths containing sodium bicarbonate and expanded sodium silicate.

The advantages of the sheaths of this invention are also apparent in that only relatively small quantities of expanded sodium silicate are required to obtain the low densities desired. Further, the sheath material has stronger compression coefficient and this is highly desirable since the sheathing is handled and oftentimes is crushed. Sheathing to be adaptable for use must have sufficient strength to withstand the rough handling which it obtains in loading and it has been found that the sheathing containing an expanded sodium silicate gives highly desirable results. Further, it has been found that the strength of the expanded sodium silicate is high enough so that sheathing may be prepared at an explosive plant and shipped without insertion of a support within the tube. The sheathings may be shipped in normal cases, and, upon arriving at the destination, are not broken or crushed. The possibility of shipping sheaths without supports within the tube allows a reduction of freight rates and does away with the necessity of removing the supports whenever the tubes are to be used. Of course, it is possible to ship the sheath around explosive cartridges, but in doing this, the freight rates are much higher since explosive materials carry premium freight rates. Likewise, it is oftentimes desirable to use explosive cartridges without the sheath around the cartridge, especially when overburden of slate must be broken out of the way to contact the coal face. By shipping the sheath and explosive cartridges in separate containers, it is possible to use one type explosive within a mine, and this is advantageous since the fewer materials there are to be isolated, the more efficient the operation of the mine becomes.

It will be appreciated that the above details and examples are given merely for the purpose of illustrating my invention and are not intended to limit the invention. Moreover, many variations in the compositions and procedures employed may be made without departing from the scope of the invention.

The present application is a continuation-in-part of my application filed August 17, 1938, Serial No. 225,342, now U. S. Patent No. 2,277,059.

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

1. An improved blasting assembly including an explosive cartridge surrounded by a preformed, annular, tubular sheath comprising between about 10% and about 50% of expanded sodium silicate and a flame-quenching salt, said sheath characterized by a semi-rigid, cellular, favose structure which is adapted to provide a cushioning action for the initial explosive shock.

2. An improved blasting assembly including an explosive cartridge surrounded by a preformed, annular, tubular sheath comprising between about 10% and about 50% of expanded sodium silicate, a binder, a flame-quenching salt, said sheath characterized by a semi-rigid, cellular, favose structure which is adapted to provide a cushioning action for the initial explosive shock.

3. An improved blasting assembly including an explosive cartridge surrounded by a preformed, annular, tubular sheath comprising between about 10% and about 50% of expanded sodium silicate, a matrix, and a flame-quenching salt, said sheath characterized by a semi-rigid, cellular, favose structure which is adapted to provide a cushioning action for the initial explosive shock.

4. An improved blasting assembly including an explosive cartridge surrounded by a preformed, annular, tubular sheath comprising between about 10% and about 50% of expanded sodium silicate and a flame-quenching salt, said sheath characterized by a semi-rigid, cellular favose structure which is adapted to provide a cushioning action for the initial explosive shock.

5. An improved blasting assembly including an explosive cartridge surrounded by a preformed, annular, tubular sheath comprising between about 10% and about 25% of expanded sodium silicate, sodium bicarbonate and a binder, said sheath characterized by a semi-rigid, cellular, favose structure which is adapted to provide a cushioning action for the initial explosive shock.

6. An improved blasting assembly including an explosive cartridge surrounded by a preformed,

annular, tubular sheath comprising between about 10% and about 25% of expanded sodium silicate, dextrin, and a flame-quenching salt, said sheath characterized by a semi-rigid, cellular, favose structure which is adapted to provide a cushioning action for the initial explosive shock.

7. An improved blasting assembly including an explosive cartridge surrounded by a preformed annular, tubular sheath comprising between about 10% and about 25% of expanded sodium silicate and wood pulp and a flame-quenching salt, said sheath characterized by a semi-rigid, cellular, favose structure which is adapted to provide a cushioning action for the initial explosive shock.

8. An improved blasting assembly including an explosive cartridge surrounded by a preformed, annular, tubular sheath comprising between about 10% and about 25% of expanded sodium silicate, sodium bicarbonate, said sheath characterized by a semi-rigid, cellular, favose structure which is adapted to provide a cushioning action for the initial explosive shock.

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