

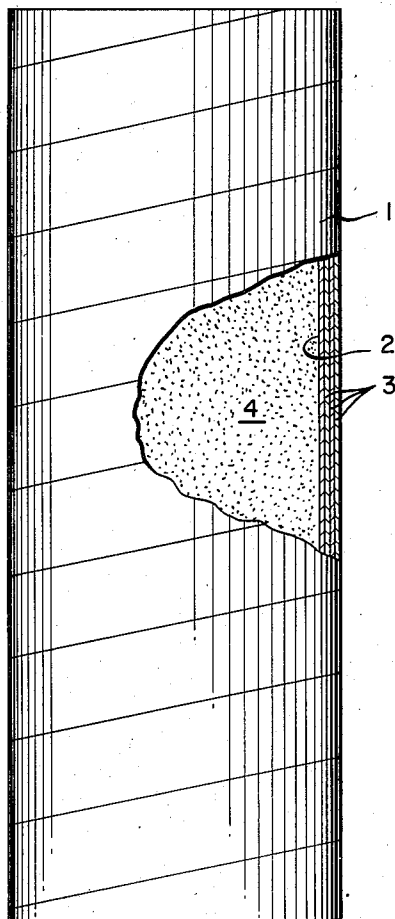
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J. P. SWED

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EXPLOSIVE CARTRIDGE

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INVENTOR

JAMES PERSHING SWED

BY

Thos. A. Wilson

ATTORNEY

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EXPLOSIVE CARTRIDGE

James Pershing Swed, Gibbstown, N.J., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware

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The present invention relates to a novel explosive cartridge. More particularly, this invention relates to an explosive cartridge especially adapted for underwater blasting.

Many blasting operations require the submergence of the explosive charge under water, in some cases for prolonged periods. In the case of submarine blasting, such as deepening rivers and harbors, removing underwater obstructions, and the like, and in many cases of quarry and construction work in terrain where the boreholes are at least partially filled with water, common practice in the industry has been to use a gelatin dynamite because of the excellent water-resistance of the composition and because the composition can be tamped to completely fill the bore hole or other excavation and thus obtain maximum blasting effect. However, gelatin dynamites cannot be readily transported from the manufacturing area to the scene of the blasting area and handled during storage and preliminary to loading unless they are in a packaged form. In the case of small diameter cartridges, the dynamite is conventionally packaged in a paper shell which has been rolled from a single sheet and treated to prevent leakage of nitroglycerin from the explosive composition. Cartridges of two inches in diameter and up are usually prepared by loading the explosive composition into spirally-wound paperboard tubes which have been treated to make them leakproof. The dynamite cartridges can be conveniently handled during shipment and storage, and the explosive is in a cylindrical form for easy loading into the round borehole. Unfortunately, however, the shell which provides the strength and rigidity prior to loading now interferes with the packing of the explosive composition so as to completely fill the borehole.

One widely used means of overcoming this deficiency is to slit the cartridges immediately prior to loading. If the slitting is not performed expertly, the composition may spill out before the charge can be introduced into the borehole, or the cartridge may lose its shape sufficiently to make loading difficult. In submarine loading in rivers or harbors, the use of slit cartridges is impractical because loading is done through pipes and the cartridge must, therefore, be perfectly round.

In the case of small diameter cartridges of the rolled shell types, an expedient which has gained wide acceptance involves providing a number of perforations in the blank prior to forming the shell, the perforations being so arranged that they overlie each other in the finished cartridge, so that the shell will rupture under tamping pressure. An alternative proposal which has been proposed involves the use of a pleated shell which expands under tamping pressure. Neither of the above proposals are practicable for a spirally-wound shell such as used for larger diameter cartridges and both possess

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the disadvantage of reduced strength and rigidity of the shell prior to loading.

Accordingly, an object of the present invention is to provide a dynamite cartridge which possesses the required rigidity and strength for handling prior to loading, but which can be tamped to completely fill the borehole or other blasting zone after loading. A further object is to provide a large diameter cartridge having the above properties. A still further object is to provide a low cost dynamite shell which will permit the manufacture of the described cartridge. Other objects will become apparent as this invention is more fully described.

I have found that the foregoing objects may be attained when I package an explosive composition into a shell which has a satisfactory strength when dry, but which loses at least 70% of its strength when immersed in water for one minute, as measured by the Elmen-dorf tear test. The cartridge of the present invention, therefore, comprises a water-resistant explosive composition, such as a gelatin dynamite composition, packaged in a shell having normal rigidity and rupture strength when dry, but which loses much of this rigidity and rupture strength after immersion in water for a time sufficient for absorption of the water into the shell.

The present invention is applicable to the smaller diameter cartridges wherein the shell is prepared by rolling a sheet into tubular form, but is most advantageous with respect to the larger diameter cartridges wherein the shell is prepared from a spirally-wound tube.

A typical explosive cartridge prepared in accordance with the present invention is depicted in the accompanying drawing, which is illustrative only, the invention not being limited thereto. In the drawing, 1 represents a spirally-wound shell consisting of an inner ply of a water-impervious material 2, for example, glassine paper, and three plies of a low-wet strength paper 3. Within the shell is a water-resistant explosive composition 4.

The invention is more fully described by the following examples which illustrate specific embodiments thereof.

EXAMPLE I

A conventional spiral-winding machine was used to prepare a tube having an outer diameter of 2 3/4 inches consisting of an inner ply of .007 inch thick wax laminated glassine paper and three outer plies of .009 inch thick of a special, low-wet strength, unsized kraft paper. The kraft paper had an Elmendorf tear test dry of 105 and wet of 20. The plies were held together by a water-soluble dextrin glue.

The tube was cut into a number of 19 inch lengths and one end was closed by crimping in the usual manner. The shell thus formed was able to support a load of 30 kilograms before collapse when stood on a level surface with the open end down, i.e., with the weight placed perpendicular to the longitudinal axis. When the shell was similarly loaded with a weight and the opened end immersed in water, the results were as follows:

Weight on Shell (kilograms)	Time required for Collapse, seconds
1.0	180
1.5	110
1.7	65

Upon remaining immersed in water for 18 minutes, the shell was unable to support its own weight.

EXAMPLE II

In order to show the essential difference between shells prepared in accordance with this invention, i.e., shells using the special high-dry and low-wet strength paper, and shells prepared in substantially the same manner using the conventional shell papers, the following tests were made. The materials indicated were assembled in tubular form having a diameter of 2½ inches by a conventional spiral-winding machine using a water-soluble dextrin glue, and then cut into 12 inch sections. Their strength was measured by means of a Tinius-Olsen Compression Tester, and the tests were made in the low-scale range of the machine so that the pounds compression could be read in ¼₁₀ pound increments. A constant compression speed of 0.5 inch per minute was used. The "wet" results were obtained by immersing the shell completely in water for a period of sixty seconds and then immediately making the compression test.

(A) The shells were prepared of 1 inner ply of 0.003 inch thick glassine paper and 3 outer plies of 0.006 inch low-wet strength paper (as described in Example I). The shell walls thus produced had a thickness of 0.024 inch. The average end-to-end compression resistance of ten shells when dry was 83.4 pounds. After the one minute immersion in water, the resistance dropped to 4.7 pounds, only 5.6% of the original shell strength.

(B) The shells were prepared of 3 plies of 0.006 inch thick manila paper conventionally used in preparing spiral tubes, and had a thickness of 0.018 inch. The average compression resistance of the dry shells was 78.7 pounds, and after 1 minute immersion, 20.3 pounds. Thus the wet shells had a strength equal to 25.8% of that of the dry shells.

(C) The shells consisted of 1 ply of 0.006 inch thick #5 paper (kraft) and 4 plies of 0.009 inch thick corrugated medium. The thickness of the shell was 0.045 inch. In the compression test, the dry strength was 97.0 pounds and the wet strength was 20.9 pounds. The wet strength was, therefore, 21.5% of the dry strength.

When a water-resistant explosive composition was loaded into shells prepared as described above, the dry cartridge had satisfactory storage and handling properties. Upon immersion of the cartridge in water, the shell softened so that the composition could be tamped with ease. In the foregoing test, a standard gelatin dynamite composition was used. The same results may be obtained with other water-resistant compositions, including non-gelatinous powders.

The foregoing examples illustrate a preferred embodiment of the present invention, i.e., a spirally-wound shell having one or two inner plies of a barrier material such as wax laminated glassine paper, metal foil, superpolymer impregnated paper, and the like, and two or more outer plies of a special high dry-strength, low wet-strength paper. The inner plies serve to prevent any leakage of liquid from the explosive composition during storage and the outer plies provide the required rigidity and strength. However, if desired, the barrier plies may be omitted and the inside of the shell or tubing provided with a liquid-impermeable coating, such as paraffin or lacquer, after the fabrication of the tube or shell. The latter procedure is preferable in the case of a rolled shell or other construction where the assembly of layers of different materials introduces manufacturing difficulties. Another alternative is to enclose the explosive composition in an impermeable wrapper of low strength, and provide an outer covering of the special high dry-strength, low-wet-strength, paper. From the foregoing, it is apparent that an essential feature of the present invention resides in the provision of a shell wherein at least the outer layer comprises a special paper which will readily absorb water and quickly lose strength by virtue of such absorption.

The special low-wet strength, high-dry strength paper

is commercially available in the form of "water-absorbent" kraft paper. The paper must be water-absorbent, i.e., free of rosin, wax, or other water-repellant material as a sizing or coating. A wetting agent may be incorporated for greater water absorption and the paper may contain a water-soluble sizing for greater dry strength. I have found that a paper which, by the Elmendorf tear test, has a strength of less than 30% of its dry strength after 1 minute immersion in water is satisfactory. The following table illustrates comparative test data by the Elmendorf tear test on various papers used in preparing shells for explosives.

Table I

Paper	Basic Weight	Thickness	Elmendorf Tear		Loss in Strength Percent
			Dry (lb.)	Wet (lb.) ¹	
Water-absorbent, low-wet strength	90	0.009	105	20	71
Sized kraft	100	0.012	398	348	13
Sized kraft	70	0.009	274	186	32
Manila	70	0.007	199	184	8
Corrugating medium (kraft)	105	0.001	151	73	52

¹ After 1 minute immersion in water.

Accordingly, the special paper used in preparing the shell in accordance with this invention is a water-absorbent paper which will lose at least 70% of its dry strength as determined by the Elmendorf Tear Test after 1 minute immersion in water.

The layers or plies of the shell may be bonded together with either water-soluble or water-insoluble adhesives, the former being preferred. The ends of the cartridges may be sealed with glue or wax to prevent leakage from the explosive composition. However, the substantial proportion of the outer layer must be free of any water-impenetrable coating to afford sufficient absorption areas.

The strength of the shell when immersed in water is dependent upon the strength of the non-absorbent components of the shell as well as upon the wet-strength of the absorbent portion. For satisfactory tamping, the wet-strength of the entire shell should not exceed 20% of the dry-strength of the shell, measured as described in the example in the present case.

A cartridge prepared in accordance with the present invention can be loaded, stored, and handled in the customary manner, except that prolonged exposure directly to water, such as rain, must be avoided. Normal humidity conditions will not seriously affect the rigidity and strength of the cartridge. During blasting operations, the shell will retain its strength sufficiently long to permit positioning the cartridge in the desired location.

The invention has been fully described in the foregoing. Many variations and modifications will be readily apparent to those familiar with the art. Therefore, I intend to be limited only by the following claims:

I claim:

1. An explosive cartridge comprising a gelatin dynamite composition packaged in a shell having in the form of a spiral winding an outer layer of a water-absorbent paper which will lose at least 70% of its dry strength as determined by the Elmendorf Tear Test after 1 minute immersion in water, said shell having a strength after 1 minute immersion in water of not more than 20% of the strength when dry.

2. An explosive cartridge comprising a gelatin dynamite composition packaged in a shell having in the form of a spiral winding an inner layer of a liquid-impermeable material and in the form of a spiral winding an outer layer of a water-absorbent paper which will lose at least 70% of its dry strength as determined by the Elmendorf Tear Test after 1 minute immersion in water, said

shell having a strength after 1 minute immersion in water of not more than 20% of the strength when dry.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 23,102	Baker	Apr. 26, 1949
	(Orig. 2,408,189)	
331,912	Rease	Dec. 8, 1885

936,192
2,345,654
2,463,709

Turton	Oct. 5, 1909
Bowman	Apr. 4, 1944
McFarland	Mar. 8, 1949

OTHER REFERENCES

5 "The Dictionary of Paper," 2nd edition, pages 235, 236, 328 and 345, published under direction of American Paper and Pulp Assn., New York City (1951), Geo. Banta Pub. Co., Menasha, Wis.