April 30, 1963 G. L. GRIFFITH, JR 3,087,425

EXPANSIBLE EXPLOSIVE UNIT FOR USE IN WET BOREHOLES

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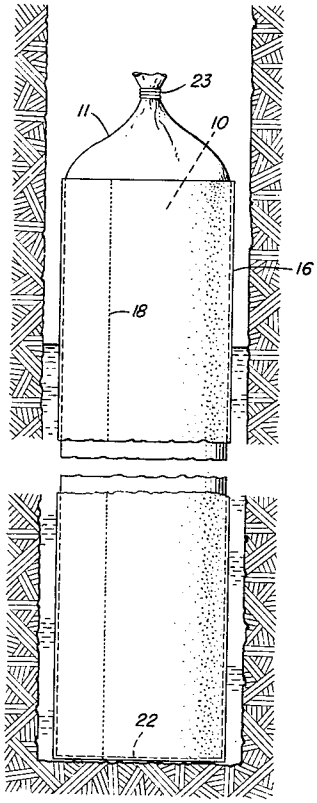


FIG. 1

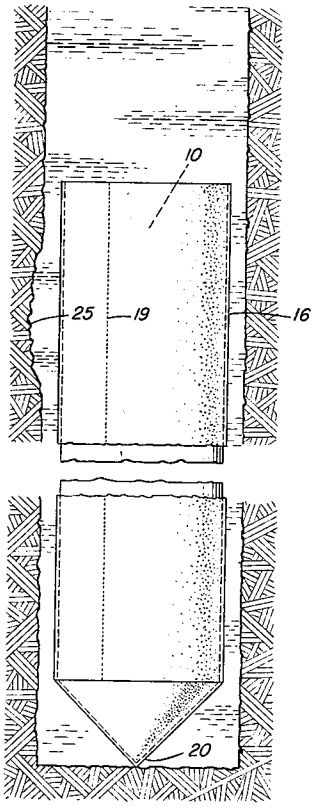


FIG. 2

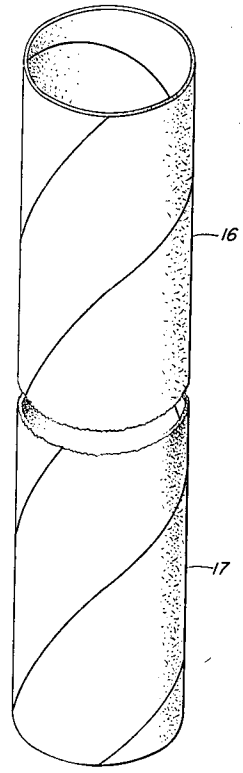


FIG. 5

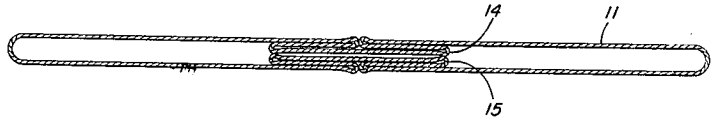


FIG. 4

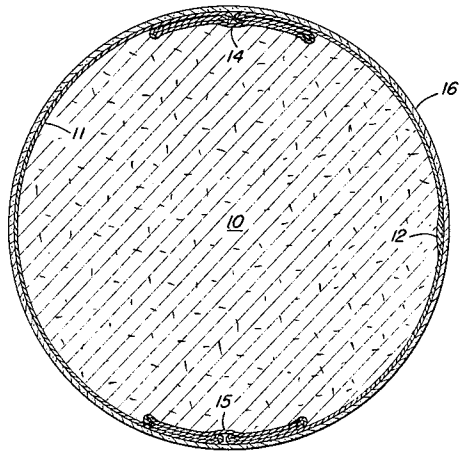


FIG. 3

Inventor:
George L. Griffith, Jr.
By Henry H. Snelling
his Attorney

United States Patent Office

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EXPANSIBLE EXPLOSIVE UNIT FOR USE IN WET BOREHOLES

George L. Griffith, Jr., P.O. Rte. 2, Coopersburg, Pa.

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This invention relates to blasting and has for its principal object the provision of a cartridge primarily intended for use in wet boreholes and therefore when containing blasting powders of types which are adversely affected by water has temporary means to protect the powder while the filled cartridge is being lowered into chosen position and then permitting expansion of the charge to fit the borehole.

A further object of the invention is to provide a bag for use with explosives which has a water-proof inner envelope having one or more expansion pleats to permit easy entry into a borehole and yet will have the ability when dropped theredown to increase in diameter to fill the bottom of the bore hole upon impact therewith, the bag having an integral or separate outer water-destructible covering to prevent expansion of the inner envelope or tube until after the bag or cartridge has reached a chosen position in the wet borehole.

The standard practice in charging dry boreholes is to load them with a train of cylindrical explosive cartridges which have a diameter about an inch or less than that of the borehole diameter, lowering the charges successively to the bottom of the hole by gravity, tamping the charge to destroy the container (which is often slit longitudinally just before dropping it into the hole) so that the charge fills the hole as completely as possible because the efficiency of the blast is greatly decreased by any cushioning of the shock due to the presence of a fluid between the wall and the explosive which results in a heavy loss of potentially available energy as is well known. Frequently the container may be omitted and a bulk explosive simply poured down the hole, tamped, possibly stemmed, and then discharged, usually by the detonation of a primer charge.

With a wet borehole, however, serious trouble may be anticipated. A few expensive bulk explosive powders may be poured down the hole but only if these are waterproofed, are of sufficient specific gravity to sink promptly, and will not, because of occluded air and other causes, form an arch at the water level, thus preventing the blasting powder reaching the desired immersed location. While such costly powders may be used the expense is so great as to make such process commercially unacceptable.

It is also inadvisable to use a weak or weakened container, the latter often being a slit bag, because of the danger of the cartridge rupturing too soon, for example upon striking the unyielding surface of the water in the hole at a level possibly far above the bottom and in bursting, filling the hole so firmly and completely as to block downward passage of succeeding cartridges, which simply means that none of the charge is placed at the proper location. A cure for these ills lies in protecting the blasting powder from contact with water in its passage down to the bottom of the borehole and thereupon having the water itself insure that the charge shall then expand to fill the hole making solid contact with the wall of the hole even if this is only raggedly cylindrical, as is often the case. An embodiment of means for accomplishing this result is shown in the accompanying drawing in which

FIG. 1 is a vertical section showing an explosive charge in a borehole.

FIG. 2 is a similar section showing a different type of bag.

FIG. 3 is a cross-sectional view through the cartridge.

FIG. 4 shows a transverse section through a flattened bag.

FIG. 5 is a perspective view of the preferred form of outer tube.

The explosive charge **10** is poured in the usual manner into a tubular bag or container **11** of water-impervious material and having means which may be longitudinal pleats **14** and **15** for allowing lateral expansion of the diameter of the container by from one to two or more inches. Such increase in diameter is temporarily prevented by a tube **16** of a material having considerable dry strength but little wet strength so that when the tube or covering **16** comes in contact with the water in the borehole it quickly loses its ability to confine the pleated container, which property is essential during the time required to lower the cartridge into the hole but is undesirable after the cartridge is in its appointed place.

A single pleat is often sufficient for a container but two, three or more may be used depending upon the material from which the bag is made. As shown in FIGURE 3 there are two diametrically opposite pleats spaced apart circumferentially by a greater distance than the width of either folded pleat. If made of fabric or rubber sheeting the tubular container may have a seam **12** closed in waterproof manner, but the container may be seamless when formed of certain other materials. It may be of fabric coated with rubber, polyethylene or polypropylene or the like but may be formed merely of the coating materials in which case such material itself may have sufficient expansion quality to avoid the need for the pleats or the side seams but the material must be flexible and waterproof so as to protect the powder from the ill effects of contact with water.

It is frequently desirable to form the outer tube of a number of plies of high porosity paper with the overlapping plies unified by the use of an adhesive that is readily soluble in water so that upon reaching the water in the hole the tube is quickly disintegrated by the combined action of the slipping of the plies as the sealing glue becomes soft and the rupture of the tube by its lack of wet strength as the water rapidly moves toward the flexible inside container which then expands as readily permitted by the pleats or due to its own power of stretching laterally.

The outer tube or covering **16** may or may not be integral with the container **11** but must be susceptible of rapid destruction upon contact with water, either by being of a material such as porous paper or chipboard which disintegrates quickly when wet. The preferred form **17** of outer tube is the well-known spirally wound one as that provides a greater length of seam. It may be formed from a roll of sheet material formed into bag form and sealed by a longitudinal seam such as **18** in FIG. 1 or **19** in FIG. 2, the latter figure showing the outer tube as having a pointed bottom **20** while the former figure shows the well-known flat or self supporting bottom **22**, the seam of all forms preferably being closed by glue or other adhesive which passes rapidly into solution when wet and thus allowing quick weakening of the outer covering so that the inner tube may expand so that the blasting powder still in the water-impervious container may effectively fill the borehole at the chosen position, usually at the bottom of the hole.

The outer tube may be open at both ends and only of such length as to extend from the bottom of the container to the top of the cylindrical portion of this inner bag, the bottom of which is closed after loading, often by merely tying the top as at **23**. The blasting powder is therefore amply protected as the container **11** is water impervious.

If so desired the covering **16** may be made from an outer shell or tube of water-soluble material, for example, one of the solid polyethylene glycols such as the carbo-

waxes 600—6,000; analogous polypropylene glycols, methyl cellulose, carboxy methyl cellulose or similarly acting materials.

The size of the cartridge varies with that of the borehole, the latter usually running from the smallest size up to perhaps 10" and sometimes larger. The length of the cartridge is purely optional but convenience in loading indicates two feet is preferable. The diameter is in accordance with the size and condition of the hole. An expansion of a single inch is often satisfactory but when there are irregularities such as at **25** in the wall, as shown in FIG. 2, it is best to use a container expansible to a greater extent so as to insure filling the full cross section, for example in an irregular 7" borehole the water destructible retaining tube should be 6" so as to pass down readily but the water impervious and protected inner container or bag should be capable of expanding to 8" in diameter to give a cross sectional area equivalent to that caused by the irregularity.

The method of blasting a wet borehole is as follows: The water proof expansible cartridge is closed at the bottom by tying, heat-sealing or in other well known manner and is covered by the outer tube **16** which confines the container throughout most or all of its length but is not necessarily closed either at bottom or at top, although it usually is closed at both ends. The container is now filled and its top sealed in any manner and the loaded cartridge placed in a mechanically strong closed end shipping tube having a cap. This tube forms no part of the invention and is therefore not illustrated. While the cartridge fits the shipping case reasonably snugly the fit is not such as to interfere with the release by gravity of the cartridge upon turning the shipping tube upside down.

The cartridge, usually with others and having a primer charge (not shown), is lowered into the wet hole, the water level standing less or greater than the height of the

cartridge, and the charge ignited after a sufficient time has elapsed to be sure the outer shell has disintegrated, thus allowing a minimum of cushioning.

What I claim is:

An explosive cartridge for use in a wet borehole comprising an inner container, an explosive within the container of a type of blasting powder adversely affected by water, and an outer covering consisting of a tube shorter in length than that of the inner container and formed of a number of plies of high porosity paper of low wet strength unified by an adhesive readily soluble in water; said container being a bag having two lengthwise pleats spaced apart circumferentially by a greater distance than the width of either folded pleat and being sufficiently waterproof to protect the powder from the ill effects of contact with water both in descent in the bore hole and when at a chosen position therein, and sufficiently flexible to fill the borehole laterally when unconfined by the outer covering, whereby the explosive is protected by the outer covering in its descent down the borehole and upon reaching said chosen position the outer covering is disintegrated by the combined action of the slipping of the plies as the sealing adhesive becomes soft and by the rupture of the covering because of its lack of wet strength, with a consequent lateral expansion of the inner container to fill the borehole by making solid contact with the wall of the borehole while still protecting the explosive from contact with the water.

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