June 15, 1965 F. J. BECK 3,188,906

EXPANSIBLE MEANS FOR LOADING A SHOT HOLE

Filed May 16, 1963 2 Sheets-Sheet 1

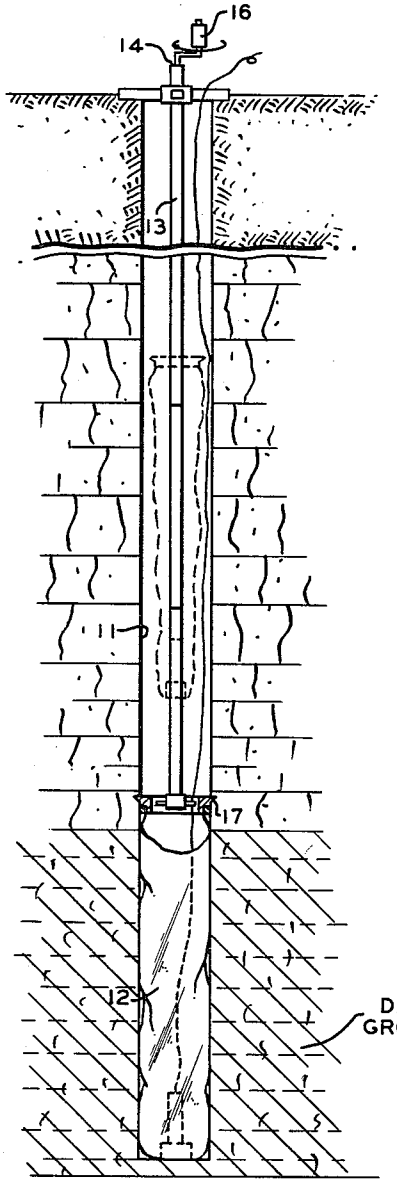


FIG. 1

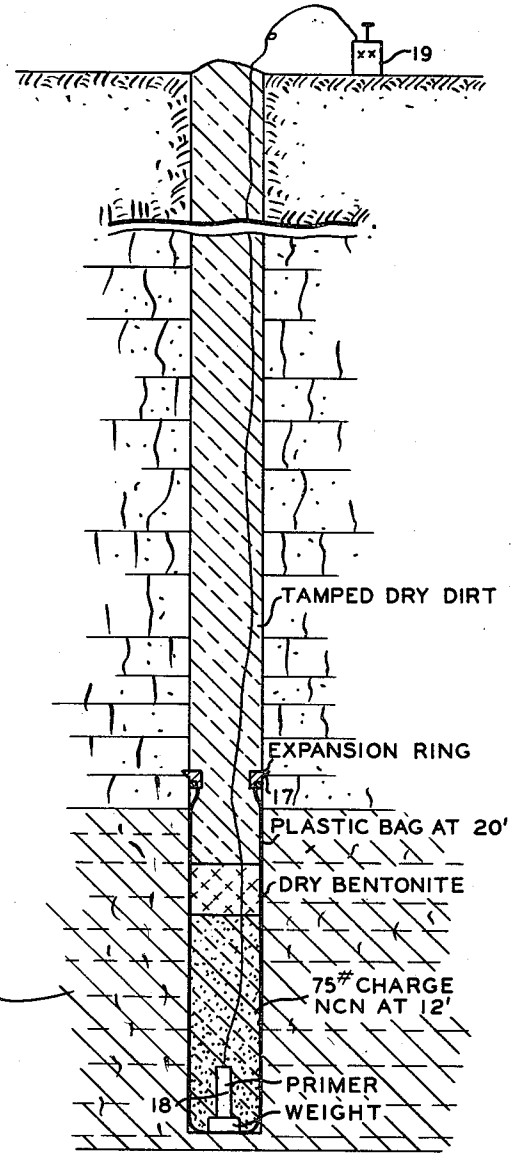


FIG. 2

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EXPANSIBLE MEANS FOR LOADING A SHOT HOLE

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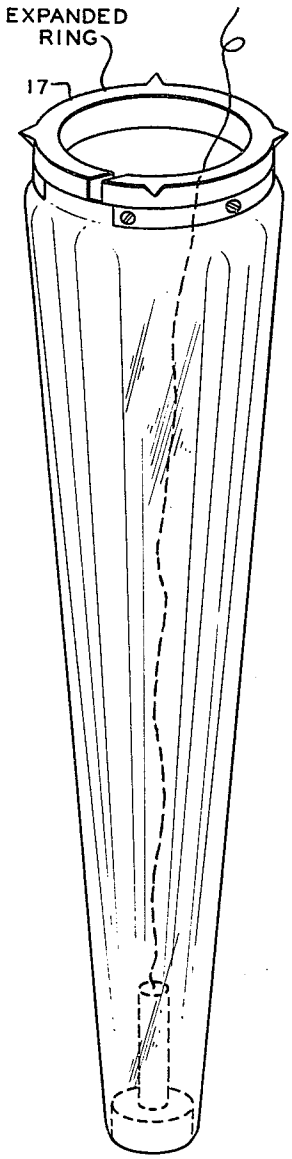


FIG. 3

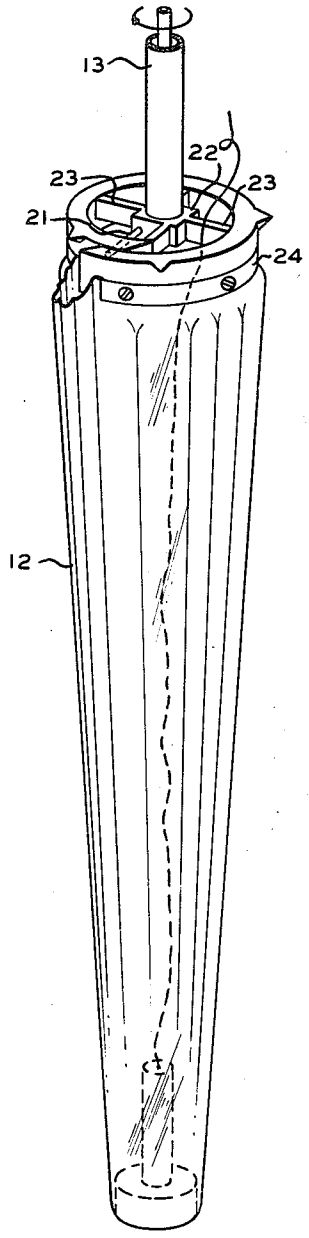


FIG. 4

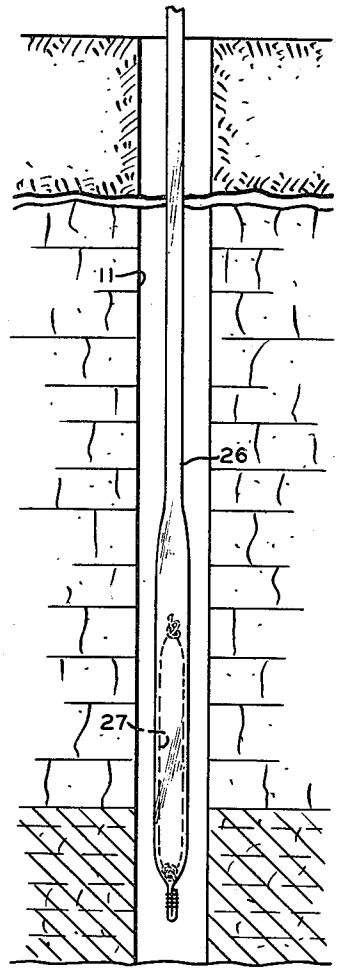


FIG. 5

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United States Patent Office

3,188,906
Patented June 15, 1965

3,188,906

EXPANSIBLE MEANS FOR LOADING A SHOT HOLE

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Filed May 16, 1963, Ser. No. 280,980
3 Claims. (Cl. 86—20)

This invention relates to preparing a shot hole for blasting. In one aspect, the invention relates to charging an explosive in a shot hole. In another aspect the invention relates to a method and means for charging a water-sensitive explosive in a water-containing drilled hole.

Drilled shot holes or blast holes frequently are used in seismic exploration as well as in mining operations. Ammonium nitrate plus a sensitizer forms a very efficient and inexpensive explosive for such use. A very practical way to load such a hole with this type of explosive is to pour particles of the explosive into the hole and place a detonating charge and suitable tamping material if desired. However, such explosive is water sensitive and, if the hole contains water or if water seeps in from the surrounding formation, proper detonation may be prevented. The use of a plastic tube to line such a hole to protect a water-sensitive explosive is known. When using such a liner, to obtain maximum efficiency, it is desirable to have the liner fit tightly against the wall of the hole. This has been accomplished by inflating the liner, a difficult and relatively expensive operation requiring extensive equipment.

An object of my invention is to provide a practical method for utilizing water-sensitive explosives in drilled shot holes.

Another object of my invention is to provide a shot hole liner, in contact with the wall of the hole, without inflation.

Another object of my invention is to provide a practical shot hole liner and weight for lowering.

Another object of my invention is to provide an improved method for charging shot holes.

Other aspects, objects, and the advantages of my invention are apparent in the written description, the drawing and the claims.

According to my invention, a shot hole is loaded by closing one end of a flexible water-proof tube having a diameter, when fully opened to circular cross section without stretching, larger than the nominal diameter of the hole, lowering the tube, with the closed end down, into the hole, and filling at least a portion of the tube with a free-flowing solid particulate explosive, which thereby opens the tube to cause the wall of the tube to contact the wall of the shot hole. Preferably the flexible tube is made of a polymer of ethylene.

Further according to my invention, a flexible tube having a diameter, when fully opened to circular cross section without stretching, larger than the nominal diameter of the hole can be prepared for lowering into the hole by affixing into one end thereof a weight formed of a section of flexible tubing having a diameter, when fully opened to circular cross section without stretching, smaller than the nominal diameter of the hole, filled with a solid particulate weight weighting material.

Further according to my invention, there is provided a method and apparatus for affixing a section of flexible tubing into a well by expanding the upper end of the section and affixing it to the wall of the hole at a point below the surface of the ground and above all water seepage into the hole.

In the drawing, FIGURE 1 is a vertical cross section of a shot hole showing a flexible tube being lowered into a hole and affixed in the hole.

FIGURE 2 is a vertical cross section showing the hole and tube of FIGURE 1 filled with a suitable explosive, timer, and tamp.

FIGURE 3 shows the tube having an expansion ring opened in the position in which it is affixed in the well.

FIGURE 4 shows the tubing of FIGURE 3 having the expansion ring collapsed for lowering into the well.

FIGURE 5 illustrates lowering a tube extending to the surface of the ground, utilizing a weight according to my invention.

In FIGURE 1, a short hole 11 has been drilled into the earth and has penetrated damp ground at the bottom of the hole. A plastic liner 12 has been lowered into hole 11 on a pipe 13. A shaft 14 extends throughout the length of pipe 13 and terminates in a crank 16 at the surface. In the dotted position the liner 12 is being lowered to the bottom of hole 11. It will be seen that the expander ring 17 is collapsed while the liner is being lowered into the well and expanded to hold the liner in place after it reaches the bottom.

The construction and operation of expander ring 17 is explained in more detail with respect to FIGURES 3 and 4.

After the liner is installed, the pipe 13 and shaft 14 are removed from the hole, as explained below. A suitable amount of dry granular explosive is then poured into the hole with a primer or detonator 18 placed at the desired location. Primer 18 can be at the bottom as illustrated or can be lowered at any time after a portion of the explosive has been placed in the hole so that it will be properly located with respect to the body of the explosive. The explosive can fill only a portion of the liner as illustrated or can completely fill the liner or extend upwardly into a part of the open hole, the liner being needed only to exclude moisture. After the explosive and primer are placed, a suitable parting material such as dry bentonite is poured on top, followed by sufficient tamping such as, for example, dry dirt. At the proper time detonation generator 19 is actuated to set off the explosive which has been protected from the desensitizing effect of water by the plastic liner.

As illustrated in FIGURE 4, expander ring 17 comprises a split spring metal ring which normally is expanded as shown in FIGURE 3. For lowering into the well the ring is collapsed and a pin 21 inserted into the two ends of the ring to hold it in collapsed position. Pin 21 is screw threaded on its inner end and held in a gear block 22 which is attached to the lower end of pipe 13, and contains a gear actuated by shaft 14 to turn a nut on the end of pin 21 to withdrawn pin 21 from the holes permitting ring 17 to open to its expanded position against the wall of the hole. Gear block 22 is provided with guide extensions 23 so that pin 21 is withdrawn as it is retracted into block 22. Removal of pin 21 not only permits ring 17 to snap into place against the wall of the hole thus supporting the liner, but also frees block 22 and pipe 13 from ring 17 permitting the lowering and expanding mechanism to be withdrawn from the well prior to drilling and detonation.

A support ring 24 holds sleeve 12 in place on ring 17 and, as seen in FIGURE 4, sleeve 12 is larger in diameter than ring 17 in the collapsed position. When ring 17 expands against the wall of the hole, explosive poured down the hole must enter sleeve 12 thus expanding sleeve 12 against the wall of the hole, sleeve 12 having a diameter, when fully opened to circular cross section without stretching, larger than the nominal diameter of the hole.

In FIGURE 5 there is illustrated a similar bore hole 11 into which is being lowered a plastic liner 26 which extends to the surface of the ground. Also illustrated is a suitable weight according to my invention which can be

used either with the sleeve 26 or with the sleeve 12. This weight 27 comprises a section of flexible tubing having a diameter, when fully opened to circular cross section without stretching, smaller than the nominal diameter of the hole and is filled with a particular weighting material. Weight 27 is shown as being formed by having knots tied in the end of the tube to retain the weighting material and it is installed in the lower end of tube 26 by folding the end of tube 26 over and wrapping a suitable fastening material around the folded portion.

Using a tube 26 which extends to the surface of the ground demands that a longer section of liner be utilized but eliminates the necessity for the use of an expander ring. The tubing is held at the surface of the ground and filled with the desired amount of explosives with the detonator or primer installed at the proper location, after which the tamping material is poured to one side of the tubing forming the liner.

Although the weight formed of a flexible tubing filled with a particulate weighting material is a particular feature of my invention, other weighting means can be utilized. For example, the weight illustrated in FIGURES 1–4 is a relatively small diameter solid weight. Such a weight tends to keep the plastic tubing elongated sufficiently that it avoids substantial contact with the wall hole.

In all instances a primer or detonator is utilized. Where the explosive is ammonium nitrate, preferably a primer charge along with a detonator is used to initiate the explosion. This igniting means can be placed in the tubing and lowered with the tubing, along with suitable detonator conductor wires in the hole with the tubing, or it can be lowered at a later time prior to or subsequent to placing the explosive or at an intermediate point in the body of explosive.

Reasonable variation and modification are possible within the scope of my invention which comprises method and apparatus for providing an impermeable liner in a damp shot hole to permit the use of a water-sensitive explosive.

I claim:

1. Means for loading a shot hole, comprising:
- a section of flexible tubing having a diameter when fully open to circular cross section without stretching larger than the nominal diameter of the hole;
- a weight in the lower end of said tubing;
- an expansible means attached to the upper end of said tubing, said expansible means comprising an expansible generally circular ring, said ring when relaxed having an outer diameter greater than the diameter of said hole at a locus where it is desired to suspend said tubing;
- a pin extending through one end of said ring and into the other end thereof to maintain said ring in compressed configuration having a diameter smaller than the smallest diameter of that portion of the hole through which said ring is to be lowered, said pin having one end extending into the central area encompassed by said ring and being screw threaded on said one end;
- means to lower said tubing into said hole while maintaining said ring in compressed configuration to clear the wall of said hole;
- screw threaded means operatively associated with said one end of said pin and operative from the surface of the ground after said tubing is lowered into said hole, to withdraw said pin from said ring releasing said ring, thus permitting said ring to expand to contact the wall of said hole to suspend said tubing.

2. Means for loading a shot hole having a substantially circular cross-section wall with a solid, water-sensitive explosive; comprising:
- a section of flexible water-tight tubing, sealed at its lower end to retain said explosive and exclude water, said tubing having a diameter when fully open to circular cross-section without stretching larger than the nominal diameter of the hole, said tubing having a length sufficient to extend without stretching from the bottom of the hole to a point in said hole above any water inlet point;
- a weight in the lower end of said tubing;
- an expansible means attached to the upper end of said tubing adapted to grip the wall of said hole by contact therewith for support of said tubing;
- means to lower said tubing into the hole while maintaining said expansible means in retracted condition to clear the wall of the hole; and
- means to release said expansible means to permit it to contact the wall of the hole to suspend said tubing at a point below the surface of the ground, said means to lower said tubing and said means to release said expansible means being removable from said hole, leaving said tubing suspended in position below the surface of the ground to retain said explosive for protection against water.

3. Means for loading a shot hole having a substantially circular cross-section wall with a solid, water-sensitive explosive, comprising:
- a section of flexible water-tight tubing, sealed at its lower end to retain said explosive and exclude water, said tubing having a diameter when fully open to circular cross section without stretching larger than the nominal diameter of the hole, said tubing having a length sufficient to extend without stretching from the bottom of the hole to a point in said hole above any water inlet point;
- a weight in the lower end of said tubing;
- an expansible means attached to the upper end of said tubing, said expansible means comprising an expansible generally circular ring;
- means to lower said tubing into the hole while maintaining said ring in compressed condition to clear the wall of said hole; and
- means to release said ring to permit it to contact the wall of the hole to suspend said tubing at a point below the surface of the ground, said means to lower said tubing and said means to release said ring being removable from said hole, leaving said tubing suspended in position below the surface of the ground to retain said explosive for protection against water.

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