

EXPLOSIVE PACKAGE, PRIMARILY FOR SEISMIC USE

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The present invention relates to an assembly of components for making an explosives container. The container, when filled with explosive, forms a package useful primarily in seismic prospecting applications. The term "plastic" as used herein means those synthetic thermoplastic and thermosetting polymers capable of being moulded.

In the seismic prospecting industry, in which explosives are detonated at the bottom of a borehole drilled within a geologic formation, it is known to use, for example, nitroglycerin-based explosives packaged in cylindrical cardboard or plastic containers. One such plastic container, disclosed in Canadian patent 730 436, of J.F. Hamilton, which issued 1966 March 22 comprises a thin-walled substantially cylindrical plastic container closed at one end, having a male thread at the closed end and a female thread at the open end. Such a container, and similar ones, are adapted to be interconnected with other like containers. The containers may be filled with explosives of various types, depending on the intended use for the explosive. For example, the container may be filled with slurry explosives or nitroglycerin-based explosives. A closure cap is placed in the open end of the container to seal the explosive within the container.

Blasting explosives packaged in containers as described above may be primed for initiation to detonation by punching a hole in the container and inserting a blasting cap into the punched hole. Alternatively the blasting explosive package may be connected to a booster device, and the booster device primed with a blasting cap. An example of such a booster device is disclosed in Canadian patent 823 428, of S.F. Foster which issued 1969 September 23.

It may be seen therefore that for some applications it is desirable to have an explosive package comprising a booster device and blasting explosive encased in the

same container. Indeed such a package is envisioned by D.H. Pack et al in U.S. patent 3 504 628, which issued 1970 April 7.

Commercial booster devices generally comprise a highly brisant explosive e.g. trinitrotoluene (TNT), cyclonite (RDX), Composition B (a mixture of TNT and RDX) or pentolite (a mixture of TNT and pentaerythritoltetranitrate). The explosive, which may be cast or pressed, is encased in a tubular container having suitably positioned orifices adapted to receive a blasting cap e.g. a capwell, or detonating cord e.g. a through-tunnel.

Most known techniques for casting or pressing explosives to form a booster having a capwell involve inserting a thimble, tube or removable core longitudinally into the confines of a tubular casing. Explosive is then cast or pressed into the tubular casing to surround the thimble, tube or core, while leaving an open end of the thimble, tube or core at one end of the booster, to form the capwell. Examples of such techniques may be found in the disclosures of G.L. Griffith in Canadian patent 973 756 which issued 1975 September 2.

In seismic prospecting it is common to couple several explosives packages together to form a column. Only one of the packages, usually one at or near the bottom of the column, has a blasting cap inserted into the primer-end of the package. The remaining packages in the column do not have blasting caps therein. Initiation to detonation of the column occurs as follows: the blasting cap initiates the primer of the one package, which in turn initiates the main charge in the same package and in the package below; detonation of the main charge of the first package then causes initiation of the primer in the next-coupled package which in turn initiates the main charge in the same package; and so on, along the column of packages. A typical example of such a package is disclosed in U.S. Patent 4 294 171, of G.H. Ducharme which issued 1981 October 13.

In one commercially available embodiment of the package of Ducharme, a 76 mm by 12.7 mm outside diameter

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piece of Detaprime* flexible tubular explosive is situated around the closed end of the capwell. The capwell and Detaprime explosive are encapsulated in a block of cast TNT to form a primer. A disadvantage of such a package is that the primer may be difficult to be initiated to detonation, by detonation of a main charge in an adjacent package. As a result the detonation of the explosive column may not be as effective as desired.

The object of the present invention is to provide an explosive package which will overcome this disadvantage.

The present invention provides an explosive package of the type comprising a tubular plastics component having a male threaded connection at one end and intended to be connected to a similar package through threaded connections, which is characterised in that the said component has a capwell at the end bearing the male threaded portion, the capwell being situated coaxially within the tube and having an annular cap sensitive explosive disposed about the capwell along substantially the whole length of the capwell, said annular explosive having a diameter less than the smallest diameter across the inside of said threaded portion and being the only object between the capwell and the inside of the threaded portion of the tube.

The explosive package may take the form described and claimed in our copending Application No.2131924, of which an embodiment is described in detail in the accompanying drawings, in which

Fig. 1 is a cross-sectional representation of the container for the explosive package, this container being an assembly of three components;

Fig. 2 is a cross-sectional representation of an alternative female end closure coupling thereof;

Fig. 3 is a cross-sectional representation of an explosive package of the present invention; and

* denotes Trade Mark

Fig. 4 is a side view of a component to form the male threaded portion of the package.

Referring to Fig. 1 the first component is shown as cylindrical tube 1.

5 Second component 2 comprises a tube having open ends 4 and 5. Second component 2 is narrowed at the portion 7 juxtaposed to end 5, in order to allow portion 7 to slip inside tube 1. Portion 7 may merely be tapered or may have a shoulder 14 to allow portion 7 to fit snugly
10 within one end of tube 1. Second component 2 has female threads 6 therein. Female threads 6 may be coarse or fine i.e. have deep or shallow grooves between the threads.

Third component 3 comprises a tube having an open end 8 and a closed end 9. Third component 3 has male
15 threads 10 thereon which are adapted to engage with female threads 6 of a second component of a like container.

Closed

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end 9 may have a hole 12 therein in which is engagingly inserted a capwell thimble 13. Open end 8 has a tapered rim portion 11 adapted to slip into tube 1. Rim portion 11 is similar to portion 7 of second component 2 and may merely be tapered as shown or have a shoulder (not shown) akin to shoulder 14.

Closure disk 15 may be held in place on tube 1 by spin-bonding or using an adhesive. Alternatively closure disk 15 may be moulded integrally with tube 1, or may be mechanically held in place by its periphery resting on circumferential bead 16 on the inside of tube 1 and being trapped in position by the rim of portion 7 of the second component. Preferably however closure disk 15 is integral with second component 2 as shown in Figs. 2 and 3.

Referring now to Fig. 3, first, second and third components are arranged as in Fig. 1 and secured by, for example, spin-bonding. Closure disk 15 is integrally moulded with second component 2. A booster 20 is situated around the closed end of capwell 13 and extends substantially from closed end 9 of the third component to the closed end of capwell 13. A chub cartridge 21, which comprises e.g. an water gel explosive 26 packaged in tubular film 25, secured at both ends by clips 22 and 23, is contained within first component 1. The length of chub cartridge 21 is selected so that when second component 2 is fitted into and secured to first component 1, the chub cartridge is squashed between closure disk 15 and booster 20. This ensures that chub package 21 and booster 20 are in intimate contact. Capwell 13 is long enough to accomodate a blasting cap without the joint of the blasting cap and its leg wires protruding outside the capwell. Preferably the length of the third component is about the same length as the capwell.

Referring to the female end closure coupling of Fig. 2, the second component comprises closure disk 15 connected all around its periphery with second component 2 at end 5. Portion 7 is frusto-conical in shape having a taper e.g. of about 4 degrees. The end of portion 7 having the greater diameter is attached to female thread portion 16,

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there being a shoulder 14 which may abut an end of tube 1. (Fig. 1) The second component has deep female threads 6 having a pitch of for example about 1.33 threads per turn.

Referring to Fig. 4 the embodiment of the third component, 3, shown comprises a threaded tube, closed at end 9, apart from capwell hole 12 (not shown). Third component 3 is open at end 8. The rim portion 11 of component 3 adjacent open end 8 is frusto-conical. Attached to the frusto-conical portion 11 is threaded portion 17 having male threads 10. Male threads 10 are adapted to mate with female threads 6 of the second component. Male thread 10 is interrupted with a longitudinal furrow 18, which is deeper than the depth of the grooves 19 between turns of male thread 10. The depth and width of furrow 18 is sufficient to permit a strand of detonating cord or blasting cap legwires to lay therein. The end of furrow 18 adjacent to frusto-conical portion 11 is adapted to permit detonating cord to extend therefrom when the male and female threads are screwed together tightly.

Assembly of the explosives package may be carried out by first attaching a booster 20 to a capwell thimble 13. The capwell 13 is then inserted into the hole 12 in the closed end 9 of the third component. Capwell thimble 13 may be "snap-fitted" into hole 12 or may be otherwise securely engaged to the closed end 9 of the third component e.g. by spin-bonding.

Alternatively the capwell, if separate from the remainder of the third component, may be "snap fitted" or spin-bonded to the third component and the booster then attached to the capwell. The first component 1 is secured e.g. spin bonded to the third component 3 to form a long tube with a closed male e.g. threaded end. A chub cartridge 21 of water gel or emulsion explosive is inserted into the first component so that the chub cartridge abuts booster 20 and the second component 2 with integrally moulded end closure 15 is slipped into the open end of the first component. The first and second components are secured by, for example spin bonding. A particularly suitable booster is an

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extruded tube of pentaerythritoltetranitrate (PETN) in a plasticizer, available under the trade marks Detaprime or Detaflex.

Alternatively, another cap sensitive explosive may
5 be placed inside the third component. The main charge which may be cap sensitive or at least is sensitive to detonation of the explosive or booster inside the third component, is placed inside the first component. The closure disk serves to prevent the main charge from being removed from the
10 shell, which comprises the first and third components. The second component serves as part of a means for coupling like containers, so that a long column of explosive packages may be formed.

An advantage of the present container is that a
15 variety of lengths of the first component may be stocked, while requiring only standard second and third components.

It is preferred that the second and third components have easily engageable female and male threads thereon respectively, e.g. so-called buttress threads. Typically, one
20 to two turns of the thread are sufficient to couple adjacent packages. Positive locking of the threads, after screwing together, may also be provided.

Positive engagement between the first and second, and first and third components may be accomplished in a
25 number of mechanically equivalent ways, e.g. gluing, spin bonding, spot welding, snap-fittings, threads. Heat sealing by spin bonding, for example, is convenient for synthetic thermoplastic polymers, e.g. polyethylene, polypropylene, blends of polyethylene with ethylene-vinyl acetate copoly-
30 mers. Spin-bonding is known in the art of joining synthetic thermoplastic polymers and comprises spinning one part relative to a second part while keeping the two parts in frictional engagement. The friction is sufficient to melt contacting portions of the first and second parts. Upon stop-
35 ping spinning the molten portions fuse together to form a

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strong essentially water proof joint.

It will be understood that the capwell may be moulded integrally with the third component if desired.

It is preferred that the third component has a longitudinal furrow on the outside of the tube e.g, interrupting the threads, so that legwires from a blasting cap inserted in the capwell will not be damaged when two like containers are engaged e.g. threaded together.

The present invention may be further illustrated by reference to the following.

The first component preferably is made from high density polyethylene extruded in tubular form, and having an appropriate length. It may be produced by extruding the polyethylene in tubular form by methods known in the art. The thickness of the tube must be sufficient to give the assembled container rigidity and is generally between 1.0 and 2.5 mm. A thickness between 1.3 and 1.7 mm is especially preferred.

As stated hereinbefore the second component, which forms a female end closure coupling, is preferably combined with the closure disk. Such a coupling is preferably blow-moulded from high density polyethylene. The closure disk portion preferably is a flat disk, joined at all segments of its periphery with the tubular portion of the female end closure coupling. The disk may be, for example, from 1 to 2 mm in thickness. The frusto-conical portion of the second component, adjacent to the closure disk, preferably is tapered at from about 2° to 10°, especially from about 3° to 5°. Attached to the frusto-conical portion is a tubular portion having female threads therein. Preferably the threads have deep grooves therebetween to provide positive engagement of the male thread of the third component, especially at low temperatures, e.g. at -20°C and below. The depth of the grooves is preferably between about 4.5 and 8 mm. The threads may be interrupted as is known in the art. The threaded portion and the frusto-conical portion preferably are joined such that a shoulder, adapted to seat on the end of the first component, is present. The shoulder is

(19) preferably from about 0.5 to about 2.5 mm especially from 1.0 to 2.0 mm in depth.

5 A preferred embodiment of the third component is shown in Fig 4 and has male threads corresponding to the female threads of the second component. The third component is preferably blow moulded if the capwell is separate therefrom or is injection moulded if the capwell is integral therewith. The capwell, if separate, is preferably injection moulded in order to control its wall thickness. A
10 suitable capwell is disclosed in U.S. patent 4 294 191.

When the grooves between the threads of the second and third components are sufficiently deep, for example from about 4 to 6 mm deep for a nominally 56 mm diameter container, the male and female threads couple easily, even at low
15 temperatures e.g. below about -20°C . Such easily screwed threads permit columns of packages to be coupled quickly and easily even at such low temperatures.

In use, a first package of the invention is taken and a blasting cap inserted into the capwell. The detonating cord or leg wires attached to the blasting cap are laid
20 in the longitudinal furrow in the third component and taped to the outside of the first component. A like package is screwed onto the male end of the first package, thus preventing the blasting cap in the first package from becoming
25 dislodged. A similar package is screwed onto the female end of the first package; other packages may be attached to form a column of explosives packages. The detonating cord or legwires may be taped to the upper portions of the column.

The coupled column may have borehole centering
30 devices coupled to the ends thereof e.g. a drivepoint device as disclosed in Canadian Patent 827 427 of Graham and Rintoul, which issued 1969 November 18 to Graham and Rintoul. The coupled column is then lowered down a borehole and may be pushed with a loading pole with little risk that
35 the loading pole will dislodge or puncture the closure disk.

The packages are screwed together so that the closed end of the third component abuts the closure disk.

This permits transmittal of sufficient energy of a detonated donor main charge or booster to initiate to detonation an adjacent acceptor booster or main charge.

5 It is preferable that the booster be tubular and
made from a slightly deformable material e.g. PETN in a
plasticized matrix. The booster may then be pushed over the
capwell and be in intimate contact therewith. Use of a
10 tubular booster will necessarily leave an air gap between
the booster and the internal wall of the threaded portion of
the third component. It appears that the presence of the
air gap does not hamper the explosive performance of the
explosive package. Furthermore, provided that the booster
has a thickness greater than its critical detonation
15 diameter, it is not necessary to fill the gap between the
booster and the internal wall of the threaded portion of the
third component with a dense inert or explosive material
e.g. sand, resin, water gel explosive.

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CLAIMS :

1. An explosive package of the type comprising a tubular plastics component having a male threaded connection at one end, and intended to be connected to a similar package through threaded connections, character-
5 ised in that the said component has a capwell at the end bearing the male threaded portion, the capwell being situated coaxially within the tube and having an annular cap sensitive explosive disposed about the capwell along substantially the whole length of the capwell, said
10 annular explosive having a diameter less than the smallest diameter across the inside of said threaded portion and being the only object between the capwell and the inside of the threaded portion of the tube.

2. An explosive package according to claim 1 wherein
15 the cap sensitive explosive is PETN in a plasticized matrix.
