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EXPLOSIVE CONTAINER WITH YIELDABLE SEAL

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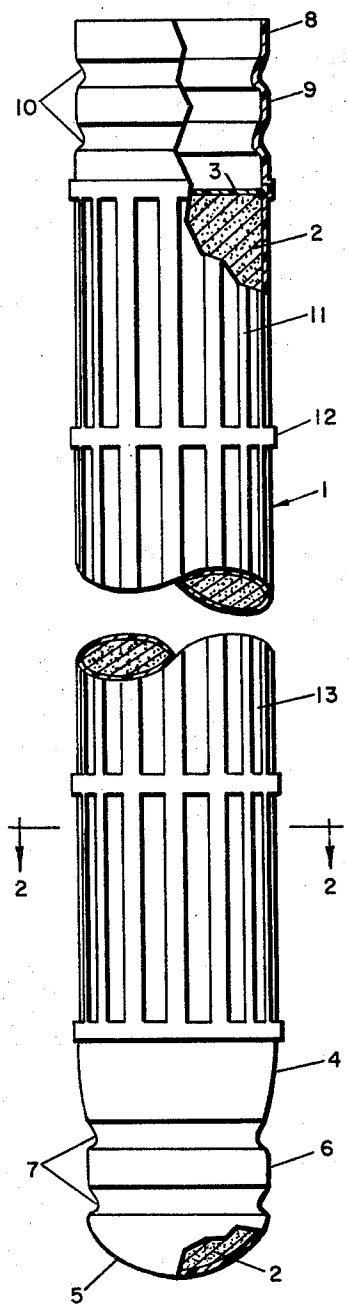

FIG. 1

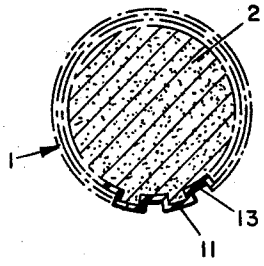

FIG. 2

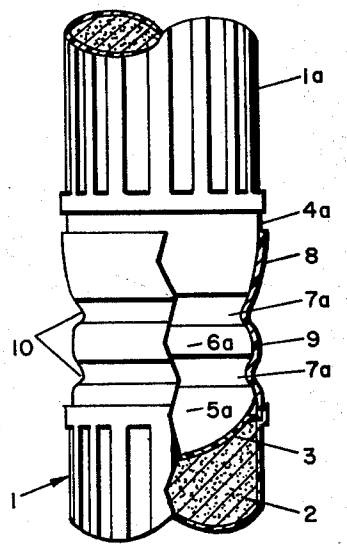

FIG. 3

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EXPLOSIVE CONTAINER WITH YIELDABLE SEAL

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This invention relates to an explosive column assembly especially adapted for use in seismic operations and more particularly to an improved explosive column assembly and plastic containers therefor.

The explosives industry has for many years packaged explosives in paper, metal and plastic containers, all of which have been provided with various types of coupling means for forming an explosive column. On a commercial basis, only the paper and metal containers have found wide acceptance primarily due to the economic factors involved when using plastic. Paper containers have been most widely accepted in view of their versatility for handling both sensitive and insensitive explosives; however, paper containers require a considerable amount of waterproofing and wall thickness to insure a substantially rigid explosive column. Metal containers have been widely accepted in view of their strength, waterproofness and ease of providing coupling means therefor; however, they have been limited to the packaging of relatively insensitive explosives in view of the hazards involved in packaging and sealing sensitive explosives in metal. Plastic containers have not heretofore been appreciably accepted in view of the economic factors mentioned although it has long been realized that the material possessed many advantages, particularly in respect to waterproofness and safety for the packaging of sensitive as well as insensitive explosives.

Therefore, it is a principal object of the present invention to provide plastic containers which may be manufactured in an economical manner and which containers may be assembled in a facile, efficient and economical manner. Moreover, a further object is to provide additional desirable features heretofore not available to the art such as placing the packaged explosive under compressive force during assembly where if the container is not properly filled or if the column tends to elongate, improved contact between adjacent explosive charges is insured with attendant consistency of propagation and rate. Still another object is to provide plastic containers which may be quickly interconnected and locked in place.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

Generally described, the present invention comprises an explosive column assembly having a plurality of substantially cylindrical blown plastic containers charged with explosive, each of said containers having a beaded male coupling and an end closure at one end and having a beaded female coupling and a yieldable seal adjacent the explosive at the other end, said containers being slidably interconnected by yielding engagement of the beads of said male and female couplings, and said containers having the end closures of the male couplings exerting compressive force on the yieldable seals and adjacent explosive of the female couplings. In a more specific aspect in accordance with the present invention, there is provided a container for explosives, adapted for interconnection with like containers to form an explosive column assembly, which comprises a thin-wall elongated substantially cylindrical blown plastic container having explosive disposed therein throughout the major length of the container and having a yieldable seal within the container adjacent the explosive, a male coupling and end closure on one end of the container, said male coupling having at least one peripheral bead, a female coupling on the other end of the container, said female coupling having at least one peripheral bead compatible with the bead of the male coupling, and the male coupling having a reduced external diameter relative to the internal diameter of the female coupling whereby like containers of explosive may be slidably interconnected by yielding engagement of the beads thereof to form an explosive column assembly having the end closures of the male couplings exerting compressive force on the yieldable seals and adjacent explosive of the female couplings.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings where reference symbols refer to like parts wherever they occur.

FIG. 1 is an elevational view of a container in accordance with the invention with a part thereof in section showing the yieldable seal and adjacent explosive within the container;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1; and

FIG. 3 is a fragmentary part elevational and part sectional view showing the interconnection of the containers of FIG. 1 to form an explosive column assembly.

With reference to the drawings, a thin-wall elongated blown plastic container 1 has an explosive 2 disposed therein throughout the major length of the container. A yieldable seal 3 is provided within the container 1 adjacent the explosive 2. A slightly tapered male coupling 4 with a convex end closure 5 are formed as a unitary structure in the thin wall at one end of the container 1 and the explosive 2 extends into the bottom of the coupling. The male coupling 4 has a peripheral bead 6 with no pitch at the lower end thereof. The peripheral bead 6 has a bead groove 7 each side thereof with the lower surface of each groove at an angle of about thirty degrees and the upper surface of each groove at an angle of about sixty degrees relative to the transverse axis of the bead. The grooves have a smooth transition as between the angles with the more acute angles forming the tension bearing surfaces to insure durable interconnection of like containers and since no pitch is involved, freedom from the possibility of unscrewing when subjected to rather heavy tension loads as imparted by their own weight. A female coupling 8 adapted to receive the male coupling of a like container is provided at the other end of the container 1. The female coupling 8 has a peripheral bead 9 and a bead groove 10 each side thereof. The female coupling 8 has its bead and grooves compatible with the bead and grooves of the male coupling 4 for engagement of a like container as hereinafter described.

Referring now more particularly to FIG. 3 depicting the interconnection of like containers to form an assembly, 1*a* and its like parts represent a superjacent container and 1 and its like parts represent the subjacent container. The male coupling 4*a* of container 1*a* is longitudinally and slidably inserted into the female coupling 8 of container 1 with the convex end closure 5*a* exerting a positive compressive force on the yieldable seal 3 and adjacent explosive 2 whereby the yieldable seal 3 is depressed. The slidable and forceful insertion of the male coupling 4*a* proceeds until the bead 6*a* and its grooves 7*a* are fully interlocked with the bead 9 and its grooves 10 with FIG. 3 illustrating the locked position. It will be appreciated that the thin plastic wall of the female coupling 8 is sufficiently elastic to accommodate the tapered male coupling 4*a* at its upper end to give a tight water resistant fit as well as being sufficiently elastic and dimensioned to permit yielding engagement of the beads and grooves of the respective couplings.

Furthermore, it will be appreciated that a considerable bending moment can occur in the thin body plastic containers of this invention particularly when several containers are interconnected in a horizontal position and then lifted for insertion in a vertical borehole. To counteract unusual bending moments imparted to the body of the thin-wall container **1**, a plurality of longitudinal reinforcing ribs **11** is spaced circumferentially about and substantially coextensive with that portion of the body of the container lying between the male coupling **4** and the female coupling **8**. Additionally, a plurality of girth reinforcing ribs **12** is spaced along the length of the longitudinal ribs **11** to insure overall integrity of the body structure of the container **1** against deformation under various conditions of manufacture and field handling. It has been found that the longitudinal reinforcing ribs **11** should have a width of not more than the width of the areas **13** lying therebetween and that ordinarily three to five of the girth reinforcing ribs **12** spaced along the length of the longitudinal ribs **11** give very satisfactory results for the average size of most commercial cartridges. Moreover, the length of the male coupling **4** and its bead position **6** is correlated with the female coupling **8** and its bead position **9** to insure that in assembling a column of the containers **1**, the convex end closure **5** of the male coupling exerts a positive compressive force on the yieldable seal **3** and adjacent explosive **2** of the female coupling of a like container. This insures a consistent propagating relationship with consistency of rate and quite advantageously is accomplished in the field at the time the explosive column is being readied for use. Moreover, a tight seal is effected as between adjacent containers as the female coupling **8** being elastic has its end maintained in tension as it is forced to accommodate the tapered upper portion of the male coupling **4**.

The following example will serve to illustrate a commerically sized preferred embodiment of this invention. It is to be understood, however, that the scope of the invention is not limited thereby with respect to the specific structure or to the explosive charges utilized.

A series of thin-wall containers was formed by blow-molding high-density polyethylene having a density of 0.962 and a nominal melt index of 0.8 (I_2 at 190 C.). These containers were molded in a split mold designed to yield the structure heretofore described and illustrated as a preferred embodiment of the invention. Approximate dimensions of the containers were 21½" overall length; 2 21/32" body diameter; sixteen reinforcing ribs 3/16" wide raised 1/32" around 2 19/32" diameter; male coupling slightly tapered and 4" long with a convex end; bead ½" long with grooves each side ¾" c. to c.; female coupling 3" long, bead ½" long with grooves each side ¾" c. to c., the width and depth of the male coupling grooves being 15 to 75 mils greater than the width and depth of the female coupling grooves and respective bead surfaces thereof. The ribbed body portion was 14½" long and had five girth ribs 3/16" wide equally spaced with the exception of a midportion 4" long wherein three longitudinal ribs were omitted to provide a smooth area for labeling. The wall thickness of the body of the container, including the female coupling, was approximately 40 mils, and the wall thickness of the male coupling was approximately 55 mils. Programming was used during the blow-molding process to obtain female couplings that were uniform in thickness and strength.

Each of these containers was charged with approximately 5 pounds of explosive composition consisting of 49.0% nitroglycerin, 1.5% nitrocotton, 36.0% sodium nitrate, 7.0% pulp, 3.0% coated cob meal, 2.0% starch, 0.5% bagasse and 1.0% chalk. A cupped polyethylene sealing disk approximately 25 mils thick was then placed over the explosive and snugly fitted into the upper girth rib annulus. The containers thus manufactured were tested and initiated under conventional field conditions as explosive column assemblies containing from two to ten containers in each assembly. The tests were satisfactory in all respects with additional advantages hereinafter set forth.

With reference to the foregoing, it will be appreciated that the containers of this invention may be formed from many of the plastic materials capable of being blown but that the economy of the material will largely dicate its use. Thus, although linear polyethylene is preferred and has been found highly satisfactory, polyolefins generally, and copolymers and alloys thereof and other materials such as ABS terpolymer, plasticized vinyl chloride, plasticized vinyl chloridevinyl acetate copolymer and the like may be used. Also, it will be appreciated that in addition to the specific seismic explosive used in the example, other explosives of various types suitable for various other blasting purposes may be used such as generally, gelatins, dynamites, permissibles, safety explosives, slurry explosives and the like. Moreover, distinct advantages inure when employing the present invention for slurry explosives which show a 1" or 2" propagation gap under water, and for gelatin dynamites where under very high water pressure, the propagation gap is markedly reduced as compared to that observed under low water pressure. Furthermore, in addition to the polyethylene yieldable seal used in the example, other plastics such as those set forth for the container body and nonplastic seals may be used including treated paper board, waxes, resins, waterproofing compounds, and the like. Also, the seal can be a plastic cup sealed around its lip and the shell body with a hot melt adhesive, or a wax such as paraffin or resins or asphaltic compounds or the like where extreme waterproofness is desired. The essential thing is that the seals should be yieldable in respect to deflection or in respect to sliding along the wall of the container or otherwise yielding so that compressive force is gently but firmly developed with close proximity assured as between adjacent container explosive charges. Still further, although one bead had been described in the preferred embodiment for the male coupling and one bead for the female coupling, several may be used if desired including, also, variation in respect to groove configurations. Moreover, although the reinforcing ribs have been described as raised, they may be obtained also by providing a constant body diameter with the areas such as **13** depressed thus forming ribs such as **11** and **12**. Ordinarily, the explosive containers of this invention are made available in sizes from about 6 to about 36 inches in length and from about 1 to about 8 inches in diameter with the number of interconnected units dependent upon the specific service desired. Generally, for seismic work, not more than about 10 units are used, and the 2½" x 21½" container herein specifically described has been found a popular size. In progressing to the larger sizes, an increase in the wall thickness of the plastic is, of course, necessary but, nevertheless, due to the blown feature and other structural features introduced by this invention, the wall thickness need be only slightly increased, not exceeding about 10 to 25%, thus retaining economical manufacture.

The additional advantages previously referred to in connection with the example and field tests are as follows relative to prior art paper containers since metal containers cannot be used for this type explosive: 15% more explosive energy obtained through using plastic shells; an increased overall specific gravity, which, coupled with the plastic surface features, results in improved gripping surface and improved sinking rate in drill mud, consequently reducing the need or poling of charges; shorter shell length per given weight of charge provides a more compact charge; the charges in soft containers are easier to prime for the shooter by conventional means; a longitudinally slidable coupling feature making assembly or disassembly a faster and simpler task; increased protection to the powder charge because the plastic is impervious to water; a unit susceptible for use wherever paper containers or metallic containers formerly were

preferred and in some instances unalterably necessary; and a general purpose plastic unit which does not tend to disintegrate or rust internally in the presence of moisture or water-containing explosives and does not tend to disintegrate or rust in the presence of moisture or water as externally encountered in water-containing boreholes and unsheltered storage.

From the foregoing, it will be evident to those skilled in the art that various modifications can be made or followed, in the light of the foregoing disclosure and discussion, without departing from the spirit or scope of the disclosure or from the scope of the claims.

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

1. A container for explosives adapted for interconnection with like containers to form an explosive column assembly, which comprises:

(*a*) a thin-wall elongated substantially cylindrical blown plastic container having explosive disposed therein throughout the major length of the container and having a yieldable seal within the container adjacent the explosive,

(*b*) a male coupling and end closure on one end of the container, said male coupling having at least one peripheral bead,

(*c*) a female coupling on the other end of the container, said female coupling having at least one peripheral bead compatible with the bead of the male coupling, and

(*d*) the male coupling having a reduced external diameter relative to the internal diameter of the female coupling and the end closure of said male coupling having protrusion means to contact and to force the yieldable seal of a like container into the explosive adjacent thereto so that like containers of explosive slidably interconnected by yielding engagement of the beads thereof to form an explosive column assembly have the end closures of the male couplings exerting compressive force on the yieldable seals and adjacent explosive of the female couplings.

2. A container for explosives adapted for interconnection with like containers to form an explosive column assembly, which comprises:

(*a*) a thin-wall elongated substantially cylindrical blown plastic container having explosive disposed therein throughout the major length of the container and having a yieldable seal within the container adjacent the explosive,

(*b*) a male coupling and end closure on one end of the container, said made coupling having at least one peripheral bead,

(*c*) a female coupling on the other end of the container, said female coupling having at least one peripheal bead compatible with the bead of the male coupling,

(*d*) a plurality of longitudinal reinforcing ribs spaced circumferentially about and substantially coextensive with that portion of the body of the container lying between the male coupling and the female coupling, and

(*e*) the male coupling having a reduced external diameter relative to the internal diameter of the female coupling and the end closure of said male coupling having protrusion means to contact and to force the yieldable seal of a like container into the explosive adjacent thereto so that like containers of explosive slidably interconnected by yielding engagement of the beads thereof to form an explosive column assembly have the end closures of the male couplings exerting compressive force on the yieldable seals and adjacent explosive of the female couplings.

3. A container for explosives adapted for interconnection with like containers to form an explosive column assembly, which comprises:

(*a*) a thin-wall elongated substantially cylindrical blown plastic container having explosive disposed therein throughout the major length of the container and having a yieldable seal within the container adjacent the explosive,

(*b*) a male coupling and end closure on one end of the container, said male coupling having at least one peripheral bead,

(*c*) a female coupling on the other end of the container, said female coupling having at least one peripheral bead compatible with the bead of the male coupling,

(*d*) a plurality of longitudinal reinforcing ribs spaced circumferentially about and substantially coextensive with that portion of the body of the container lying between the male coupling and the female coupling,

(*e*) a plurality of girth reinforcing ribs, spaced along the length of the longitudinal reinforcing ribs, and

(*f*) the male coupling having a reduced external diameter relative to the internal diameter of the female coupling and the end closure of said male coupling having protrusion means to contact and to force the yieldable seal of a like container into the explosive adjacent thereto so that like containers of explosive slidably interconnected by yielding engagement of th beads thereof to form an explosive column assembly have the end closures of the male couplings exerting compressive force on the yieldable seals and adjacent explosive of the female couplings.

4. A container for explosives adapted for interconnection with like containers to form an explosive column assembly, which comprises:

(*a*) a thin-wall elongated substantially cylindrical blown polyethylene plastic container having explosive disposed therein throughout the major length of the container and having a yieldable seal within the container adjacent the explosive,

(*b*) a male coupling and end closure on one end of the container, said male coupling having at least one peripheral bead,

(*c*) a female coupling on the other end of the container, said female coupling having at least one peripheral bead compatible with the bead of the male coupling,

(*d*) a plurality of longitudinal reinforcing ribs spaced circumferentially about and substantially coextensive with that portion of the body of the container lying between the male coupling and the female coupling,

(*e*) a plurality of girth reinforcing ribs spaced along the length of the longitudinal reinforcing ribs, and

(*f*) the male coupling having a reduced external diameter relative to the internal diameter of the female coupling and the end closure of said male coupling having protrusion means to contact and to force the yieldable seal of a like container into the explosive adjacent thereto so that like containers of explosive slidably interconnected by yielding engagement of the beads thereof to form an explosive column assembly have the end closures of the male couplings exerting compressive force on the yieldable seals and adjacent explosive of the female couplings.

5. The explosive cartridge according to claim 4 wherein the longitudinal reinforcing ribs have a width of not more than the width of the areas lying therebetween.

6. The explosive cartridge according to claim 4 wherein the blown polyethylene plastic is high-density polyethylene characterized by a density of 0.962 and a nominal melt index of 0.8.

7. An explosive column assembly comprising:

(*a*) a plurality of substantially cylindrically blown plastic containers charged with explosive,

(*b*) each of said containers having a beaded male coupling and a projected end closure having protrusions means at one end and having a beaded female coupling and a yieldable seal adjacent the explosive at the other end,

(*c*) said containers being slidably interconnected by

yielding engagement of the beads of said male and female couplings, and

(*d*) said containers having the protrusion means of the end closures of the male couplings exerting compressive force on the yieldable seals and adjacent explosive of the female couplings.

8. The explosive column assembly according to claim 7 wherein the containers are longitudinally reinforced.

9. The explosive column assembly according to claim 7 wherein the containers are longitudinally and transversely reinforced.

10. The explosive column assembly according to claim 7 wherein the plastic is high density polyethylene characterized by a density of 0.962 and a nominal melt index of 0.8.

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BENJAMIN A. BORCHELT, *Primary Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,185,091 May 25, 19

John F. Hamilton

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 71, strike out "a projected".

Signed and sealed this 19th day of October 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents