Aug. 14, 1962 C. W. EILO 3,049,079

WATERPROOF CONTAINER AND CLOSURE THEREFOR

Filed Nov. 18, 1957

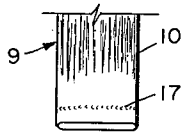

FIG. 3

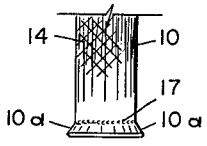

FIG. 4

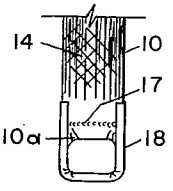

FIG. 5

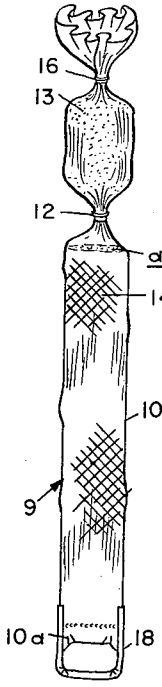

FIG. 1a

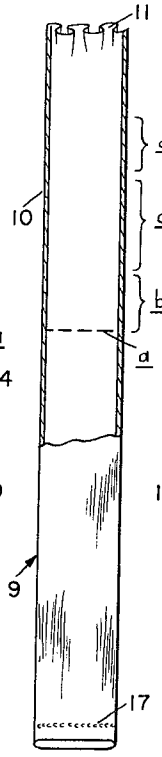

FIG. 1

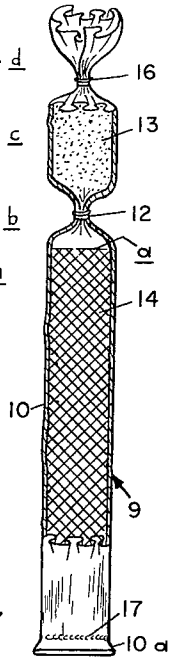

FIG. 2

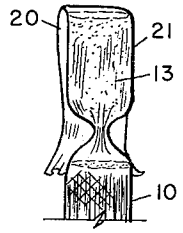

FIG. 6

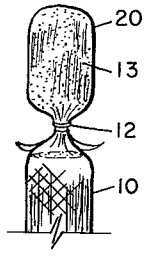

FIG. 7

INVENTOR.
CLYDE W. EILO
BY Ernest G. Peterson
AGENT.

United States Patent Office 3,049,079 Patented Aug. 14, 1962

3,049,079

WATERPROOF CONTAINER AND CLOSURE THEREFOR

Clyde W. Ello, Kenvil, N.J., assignor to Hercules Powder Company, Wilmington, Del., a corporation of Delaware

Filed Nov. 18, 1957, Ser. No. 696,994
17 Claims. (Cl. 102—24)

This invention relates to improved water-impervious containers. In one aspect, this invention relates to a closure assembly for a container fabricated from a flexible water-impervious material, the closure assembly comprising a water barrier material supported so as to prevent access of water or moisture to the inside of the container. In another aspect, this invention relates to an explosive cartridge fabricated from a water-impervious material and containing an explosive maintained moisture free by an improved closure means utilizing a water barrier material. In another aspect, this invention relates to a method for detonating hygroscopic explosive materials in the presence of water even when the explosive container has been in contact with water over a prolonged period.

Explosives, in order to function as such, must generally be maintained in a dry state. The problem is, of course, particularly serious with reference to hygroscopic explosive compositions, especially ammonium nitrate-containing explosives. Thus, the use of ammonium nitrate as an explosive, or a constituent thereof, is restricted by its water solubility and hygroscopicity. Although many cartridges containing ammonium nitrate are moisture-proof to a large degree, they are nevertheless pervious to water over prolonged periods of time, particularly under waterhead in a borehole. Accordingly, the explosives art has for some time endeavored to develop a suitable container for retaining its explosives content free from moisture over prolonged periods.

Waterproof bags can be fabricated from materials which can be heat sealed to make the bag water impervious. However, as applied to explosives, any application of heat to the otherwise packed cartridge to heat seal it closed, is considered to be a hazardous undertaking and is, of course, undesirable. Further, heat sealing such a packed bag would be difficult due to the dust particles deposited on the bag surfaces during loading.

The problem has been, therefore, to develop a closure assembly that prevents access of moisture to the inside of the bag to thereby maintain the bag interior free from moisture over prolonged periods. Various types of bag closures have been utilized with only limited success such as by sewing, the use of ties, folding the open end to a bag closing position and the like.

A heat sealable bag is advantageously sealed at the bottom end, by heat sealing prior to packing same. Such a seal, however, leaves a flat surface across the bottom end along with "ears" that often protrude beyond the bag diameter. Ears, thus formed, generally add difficulty to lowering the bag into the borehole inasmuch as tearing at the ears often takes place to nullify all resistance to moisture. Even when such a heat seal is formed as a triangle with the apex at the bottom of the bag to place the seal far enough into the bag to be between any tear and the contents of the bag, the ears that are formed often interfere with loading in the borehole.

This invention is concerned with a container fabricated from a flexible water-impervious material, and a closure member therefor, by which the interior of the container is maintained moisture free, and with such a bag type container heat sealed at one end, prior to packing, without there being inherent difficulties arising in its utilization as a cartridge casing in a borehole.

An object of the invention is to provide water-impervious containers having improved closure means by which the interior of the container is maintained free from moisture. Another object is to provide an improved closure assembly for a water-impervious container so as to prevent access of water or moisture from the outside of the container to its interior. Another object is to provide for the utilization of water barrier materials as elements of a closure assembly for a bag fabricated from a flexible water-imprevious material. Another object is to provide for the utilization of a heat seal as a closure member of a plastic bag prior to packing same without the usual difficulties, inherent in use of the bag as a cartridge casing in a borehole, arising from the presence of ears formed in making the seal. Another object is to provide a method for detonating an explosive maintained moisture-free in a container in direct contact with water over prolonged periods. Another object is to provide a water-impervious explosive cartridge containing ammonium nitrate as the chief explosive component and a closure assembly for maintaining the explosive moisture-free over prolonged periods. Other aspects and objects will be apparent from the accompanying disclosure and the appended claims.

In accordance with this invention, an improved closure is provided for a container fabricated from a flexible water-impervious material and containing an opening through a side thereof, which comprises a mass of a water barrier material disposed in direct closing contact with said opening; said container containing a first substantially closed constriction adjacent said mass and in direct communication with the interior of said container, and a second substantially closed constriction intermediate said mass and the exterior of said container.

Further in accordance with the invention, an explosive assembly is provided which comprises a flexible water-impervious plastic bag having an open end portion; a hygroscopic explosive material contained within said bag; a mass of a water barrier material in direct closing contact with the said open end bag portion; a first tie means adapted to maintain the said open end portion substantially closed at a point below the said mass, and a second tie means adapted to maintain the said open end portion substantially closed at a point above the said mass.

Still in accordance with the invention an improved method is provided for detonating a hydgroscopic explosive material in the presence of water, the said improvement comprising maintaining said explosive in a water-imprevious container, and confining communication of said explosive with the exterior of said container through an opening in a side of said container; supporting a mass of a water barrier material within said opening so as to completely close same by forming a first constriction adjacent said mass in direct communication with said explosive, and a second constriction intermediate said mass and the exterior of said container, whereby the said explosive is maintained free from moisture so that it can be detonated after exposure of said container to water over prolonged periods.

The invention is illustrated with reference to the drawings of which FIGURE 1 is a view of an open end container to be packed and then closed in accordance with the invention; FIGURE 1*a* is a perspective view of a packed container, with closure assembly; FIGURE 2 is a cross-sectional front elevation of FIGURE 1*a*; FIGURE 3 is a view of a bottom portion of a tubular container such as one of FIGURE 1 prior to packing same and containing a heat seal at its closed end; FIGURE 4 is a view of the container of FIGURE 3 packed with a hygro-

scopic material with the concomitant formation of "ears"; FIGURE 5 is a view of the ears of FIGURE 4 taped to form a bail and FIGURES 6 and 7 are views of a portion of a container assembly, with closure member, and with the end of the container folded back (FIGURE 6) and tied (FIGURE 7) on the water barrier material.

Referring to FIGURE 1, container **9** is fabricated from a flexible water-impervious material such as plastic material **10**, for example polyethylene, and in a preferred form is tubular. Container **9**, as shown with reference to FIGURE 1*a*, is packed with a material **14**, preferably hygroscopic, such as an explosive containing ammonium nitrate as a chief component, through the open end **11** (FIGURE 1) to a level *a*, e.g., a nitrocarbonitrate. Container **9** in tubular form is conveniently utilized as a casing for an explosive cartridge to be lowered into a borehole. A water barrier material **13** such as a water swellable compound, for example sodium carboxymethylcellulose or a mannogalactan, is introduced into the container **9** through opening **11** and supported in the container section *c* by gathering the container section *b* to form a substantially closed constriction immediately below mass **13**. The constriction is advantageously supported by a suitable ring type closure **12**. Mass **13** is confined within the section *c* by a gathering of section *d* of the tube **9** to form a substantially closed constriction immediately above the mass **13** advantageously supported by a suitable metal ring member **16**. Rings, or ties, **12** and **16** are sufficiently tight as to substantially completely close the container so as to prevent any appreciable loss of material **13** from the container section *c*. Further, a tight constriction at **16** is important in order to hold to a minimum the amount of water or moisture that invariably finds its way through such a constriction over a period of time especially when the container is under a head of water as would be the situation when utilized as a cartridge in a water-filled borehole. Preferably, mass **13** substantially fills container section *c* so as to eliminate, or in any event, minimize void spaces therein. In this manner, water barrier material **13** most efficiently serves to intercept moisture finding its way through the gathering at **16**. The elements of the container assembly of FIGURE 1*a* are more clearly shown with reference to the sectional front elevation of FIGURE 2.

With reference to FIGURE 3 there is shown a bottom section of container **9** of FIGURE 1 which has been closed by heat sealing a tubular, heat sealable plastic such as polyethylene.

FIGURE 4 shows a bottom section of FIGURE 3 filled with material **14** together with the ears **10***a* formed concomitantly with the packing of the heat sealed bag end.

FIGURE 5 shows a suitable bail **18** affixed across ears **10***a* to confine the ears to substantially within the diameter of the cylindrical container **9**. Any suitable material **18** such as a cloth, a tape, or the like, can be utilized as the bail material. A carrying tape **18** is generally preferred because in most instances it can be very easily made to adhere to the material **10** to form a bond sufficiently strong to support the weight of the packed container. Bail **18** serves conveniently as a handle in the utilization of the packed container.

FIGURES 6 and 7 show a closure assembly of the invention, wherein the water barrier material is supported by a ring type closure, at its bottom, such as closure **12** of FIGURE 1*a*, and in lieu of a closure type **16** of FIGURE 1*a* is supported by a doubling back of the top end of the container including section *d* to a point intermediate the mass **13** and material **14** to provide a fold **20** which can be terminated and supported (ring **12**) in the same constriction as supported by a ring closure **12** of FIGURE 1.

The invention is further illustrated with reference to the following examples:

Example 1

A "lay flat" polyethylene tubing having a wall thickness of 0.006 inch (6 mils), a length of about 10 inches, and a diameter of about 4½ inches was heat sealed at one end and then partially filled through its open end with granular ammonium nitrate coated with 0.5 percent rosin/paraffin (80/20). The tubular bag was then gathered and closed at a point immediately above the explosive material. The gathering was supported by a metal ring type support, such as ring **12** of FIGURE 1*a* and referred to in the art as a "vac-tie," which is a horseshoe-shaped ring clamped around the gathering in a tight gripping position to function as a tightly fit ring. About 50 ccs. of 200 mesh water swellable bentonite was introduced into the open tube through the open end and supported therein as a mass against the vac-tie supported constriction. The tube opening was then gathered immediately above the bentonite mass and the resulting gathering was then secured by a vac-tie support ring. The resulting packed container, or cartridge, was then immersed in water under a pressure of 40 p.s.i. for 72 hours, and then opened. No moisture reached the ammonium nitrate explosive which was found to be in its original dry state.

Example 2

The test of Example 1 was repeated except that a conventional wire tie was utilized in lieu of each of the vac-ties of Example 1, the wire tie having been made by twisting a wire strand around the gathering. The results were the same as those of Example 1.

Example 3

The test of Example 1 was repeated except that Guartec F (a mannogalactan) was utilized in lieu of bentonite as the water barrier, the duration of the test period being 24 hours. The results were the same as those of Example 1.

Any suitable water barrier material can be utilized in the practice of the invention, water swellable materials such as polyvinyl alcohol, gelatins, water swellable and water soluble natural gums, mannogalactans, xylogalactans, water swellable and water soluble ethers of macro-molecular polysaccharides, cold water swellable starches, cold water swellable cellulose, water soluble and water swellable salts of alginic acid, being preferred inasmuch as upon coming in contact with the water, the swellable material swells up and forms a protective gel for the interior of the mass. The gel portion thus formed interdiffuses with incoming water at a slow rate and in that sense functions as an effective water barrier. Accordingly, the rate at which the remaining mass of water swellable material absorbs water from the gel is so low as to substantially be unaffected by water over prolonged periods. Thus, a water swellable type barrier of the invention assures against access of water into the container interior even after a period of several hundred hours. Further, by utilization of a water swellable barrier material as a component of an explosive cartridge, in accordance with the invention, there is no adverse effect of the barrier material on sensitivity, rate of detonation, or general performance of the explosive powder, as is the case when a water barrier material is admixed with the powder in accordance with most prior art methods, particularly inasmuch as large amounts of barrier material are generally required under such prior art conditions in order to impart 100 percent water resistance.

Further exemplary of water swellable type barriers of the invention are sodium alginate guar gum, locust bean gum, carob bean gum, British gum, karaya gum, ground psyllium seed husks, sodium cellulose glycollate, sodium carboxymethylcellulose, hydroxyethyl cellulose, methyl cellulose, gelatin, tragacanth, and Irish moss.

Although water swellable type barriers are preferred

in the practice of the invention, other water-impervious materials can be utilized such as waxes, rosins, tars, greases and the like, the requisite in any instance being that the barrier material functions as such.

The amount of barrier material utilized is not particularly critical, it being preferred, however, that the barrier utilized adequately fill all the folds in the container so as to afford maximum protection of the contents of the container against moisture. In preferred practice of the invention, the folds are substantially completely filled so that moisture cannot under any circumstances by-pass the barrier material and thereby find its way into the container interior. In those instances wherein protection is required only over relatively short periods, it is less important that all folds be substantially completely filled.

As illustrated with reference to the examples, closure members of the invention, even under high waterheads, provide for maintaining the contents of the container completely dry over prolonged periods. By way of further illustration, a closure assembly utilizing guar gum, even under a waterhead, prevents access of water to the contents of the container over periods in the order of 100 to 400 hours and longer, the maximum period generally being determined by the water resistance of the material from which the bag is fabricated.

Any suitable, flexible, water-impervious plastic material can be utilized in the fabrication of the container body, polyethylene being now preferred. Such fabricating materials are inclusive of rubber, polytetrafluoroethylene, polyvinyl chloride, polyvinyl fluoride, synthetic linear polyamides, polyethylene, terephthalate, polyvinylidene chloride and other such polymers and interpolymers of the art.

A bail element 18 of FIGURE 5 is advantageously applied to the lowering of the packed cartridge into a borehole not only because it confines the ears to within the tube diameter so as to minimize possible tearing of the cartridge but also because it permits the weight of the explosive material in the cartridge to bear against the constriction supporting the water barrier mass so that in the event of failure or even a weakening of the constriction the barrier material is retained in its operating position.

When utilizing a container of the invention as an explosive cartridge, it is preferably detonated as a member of an explosive column containing a separate primer cartridge in accordance with conventional practice.

Although the invention is particularly advantageously applied to hygroscopic explosives, it can also be utilized in the handling of hygroscopic chemicals, food products, and any other material which requires isolation from moisture during its handling, particularly during storage and/or shipping.

Although a supporting ring such as specifically illustrated with reference to elements 12 and 16 of the drawings are advantageously employed, any suitable means for supporting the water barrier material can be utilized, for example, friction tape or twine, elastrator rings or the like.

In a preferred method for fabricating a closed container of the invention, a strip of lay flat plastic tubing such as polyethylene of about 2½ to 17½ inches in diameter and from about 6 to 20 mils in wall thickness is heat sealed at one end and then filled to from about 50 to 80 percent of its volume with the material to be protected from moisture, for example, a hygroscopic explosive. The container is then gathered at a point in close proximity to the top surface of the container contents to form a constriction, substantially closed, which is then supported in that position such as by a metal ring. The water barrier material is then poured through the open end of the tube to fill from about 10 to 80 percent of the remaining tube volume, i.e., above the constriction, and the topmost portion of the bag is then gathered to form a constriction immediately above the barrier mass, substantially closing the tube, being preferably supported by a metal ring closure so as to be contiguous with the barrier material. The ears formed at the bottom of the container are, when desired, turned back to within the diameter of the tube and supported in that position by a bail such as illustrated with reference to FIGURE 5.

As will be evident to those skilled in the art, 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. An explosive assembly comprising a bag formed from a flexible water-impervious material; a body of a hygroscopic explosive material within said bag; a mass of a material in said bag, water swellable to form a gel, intermediate said body of explosive and the open end portion of said bag; the walls of said bag being gathered to substantially close said bag in an area intermediate said body of explosive and said mass of water swellable material, and also in an area intermediate said mass of water swellable material and the open end of said bag; and tie means around each said gathered wall portion of said bag to support each substantially closed.

2. An assembly of claim 1 wherein said bag is formed from a plastic tube and the end thereof opposite said open end portion is closed by heat sealing, whereby the end portion of said bag containing said heat seal protrudes outwardly from said bag; a strap member affixed at its ends to said opposite end so as to encompass said protruding portion and support same within the confines of the tube walls, and arched in a direction longitudinally away from said bag as a bail member therefor.

3. An assembly of claim 1 wherein said flexible water-impervious material is a plastic.

4. An assembly of claim 1 wherein ammonium nitrate is a chief constituent of said explosive.

5. An assembly of claim 4 wherein said bag is fabricated from a polyethylene.

6. An assembly of claim 1 wherein said water swellable material is selected from the group consisting of a polyvinyl alcohol, a gelatin, a water swellable natural gum, a mannogalactan, a water swellable ether of a macromolecular polysaccharide, and a water swellable salt of alginic acid.

7. An assembly of claim 1 wherein said water swellable material is a water swellable bentonite clay.

8. An assembly of claim 1 wherein said water swellable material is a mannogalactan.

9. An assembly of claim 1 wherein said water swellable material comprises sodium carboxymethylcellulose.

10. An assembly of claim 1 wherein said water swellable material comprises a guar gum.

11. In an assembly of claim 1, said water swellable material substantially filling the bag portion containing same.

12. An assembly of claim 11 wherein each said tie is a ring formed around the gathered wall portion.

13. The improvement of claim 11 wherein ammonium nitrate is a chief constituent of said explosive.

14. The improvement of claim 13 wherein said water swellable material is a bentonite.

15. An explosive assembly comprising a bag formed from a flexible water-impervious material; a body of a hygroscopic explosive within said bag; a mass of a material in said bag, water swellable to form a gel, intermediate of said body of explosive and the open end of said bag; the walls of said bag being gathered in an area intermediate said body of explosive and said mass of water swellable material, and an open end portion of said bag being doubled back, as a reverse fold, along the outer surface of said bag and extending at least to the area of said gathered portion; and tie means around the bag intermediate said mass of water swellable material and said explosive and encompassing both said reverse fold and said gathered wall portion and securing said reverse

fold and said gathered wall portion each substantially closed.

16. An assembly of claim 15 wherein said tie means is a single ring around said bag.

17. The improvement of claim 15 wherein said water swellable material is selected from the group consisting of a polyvinyl alcohol, a gelatin, a water swellable natural gum, a mannogalactan, a water swellable ether of a macromolecular polysaccharide, and a water swellable salt of alginic acid.

References Cited in the file of this patent

UNITED STATES PATENTS

1,388,429	Heyl	Aug. 23, 1921
1,889,882	Woods	Dec. 6, 1932
2,155,499	Lawson	Apr. 25, 1939

2,441,397	Counterman	May 11, 1948
2,503,269	Hickman	Apr. 11, 1950
2,730,505	Jordan	Jan. 10, 1956

FOREIGN PATENTS

2,753	Great Britain	1883
398,030	Great Britain	Sept. 7, 1933
737,255	Great Britain	Sept. 21, 1955

OTHER REFERENCES

Uses and Applications of Chemical and Related Materials, by Gregory, Reinhold Publishing Co., N.Y., page 85.

"New Package Dehydrator," Henry H. Wilkinson, Chem. Eng. News, volume 21, pages 1054–55, 1943; Chemical Abstracts, column 4936, volume 37, 1943.