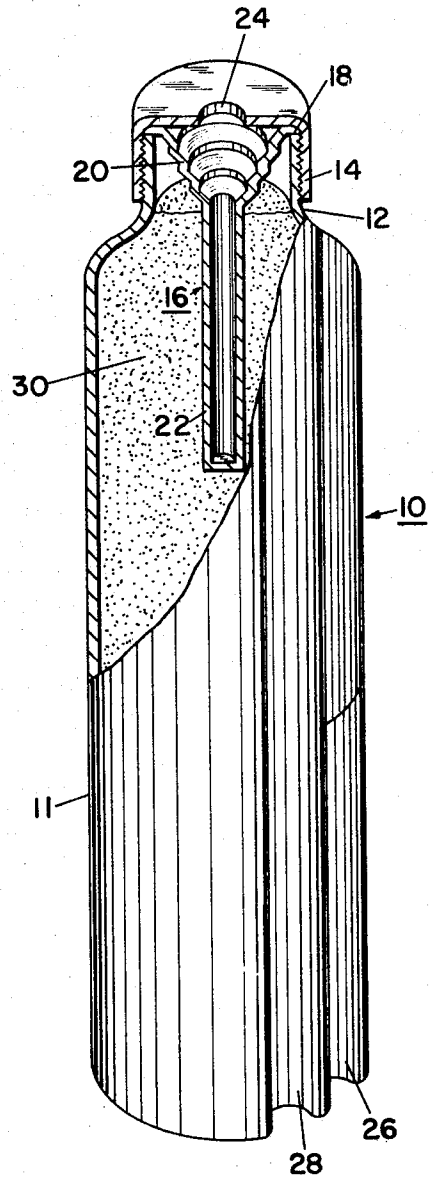
June 30, 1970 G. D. MARTIN 3,517,616

AXIALLY EXPANDABLE AND CONTRACTABLE CONTAINER

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AXIALLY EXPANDABLE AND CONTRACTABLE CONTAINER

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ABSTRACT OF THE DISCLOSURE

A thin-walled cap well is provided having bellows disposed along its length for axial expansion and contraction. The cap well is useful in combination with a container having materials therein which undergo variation in volume through physical or chemical changes. The container is particularly useful for containing blasting compositions and for forming an explosive column assembly comprising a number of individual containers.

This invention relates to a new, axially expandable and contractable cap well for use in combination with a container for materials which undergo variation in volume through either physical or chemical changes. More particularly, the present invention relates to a cap well having a flexible conical bellows member integrally attached to a receptacle tube member. The cap well is particularly useful in combination with a container for blasting compositions which undergo variation in volume.

In the packaging, storing, and handling of blasting compositions, containers formed of various materials such as paper, metal, and plastic have been employed in combination with various types of cap wells, typically formed of similar materials, except having a fixed volume receptacle for receiving an explosive initiator. Paper containers have found wide acceptance for packaging explosives primarily because of inherent economic and safety factors. Normally, however, paper packaged explosives are initiated by punching a hole through the side of the package and inserting an explosive initiator such as a blasting cap. Once the paper package is penetrated, damage from water may result which limits the effectiveness of the contained explosive.

Metal cotainers have been widely accepted for containing blasting compositions because of their strength properties, waterproofness, and ease of coupling in forming an explosive column assembly. Typically, metal containers are provided with a metal cap well into which is inserted an initiator such as a blasting cap. The metal cap well usually holds a blasting cap in such a manner that much of the effectiveness of the initiating force is lost.

Plastic containers have also been used for packing blasting compositions. These containers generally have standard configurations used for either paper or metal containers except for special construction features required in forming the plastic containers. As in the case of paper or metal containers, plastic containers employed in the explosive industry have included rigid or fixed volume cap wells in combination generally with fixed volume containers.

It has now been found that by the practice of the present invention there is provided an axially expandable and contractable cap well for use in combination with a fixed volume container that may usefully contain blasting compositions which undergo variation in volume through physical or chemical changes.

Generally stated, the present invention includes a new cap well which may be useful in combination with a fixed volume, generally, cylindrical container.

The present invention more particularly provides a cap well which includes a flanged annular support member, a flexible conical bellows member formed of yieldable material, and a receptacle tube member for receiving an explosive initiator. The present cap well is particularly useful in combination with a standardized container for use in packing a unit weight of a series of blasing compositions which, depending upon the required function to be performed, may vary in volume by the addition of various proportions or additions of ingredients.

The present invention also provides an explosive column assembly having a plurality of substantially cylindrical plastic containers charged with a blasting composition and suitably connected to an initiating means.

The present invention will become more apparent from the following detailed description taken with regard to the accompanying drawing wherein there is illustrated a side elevational view of the present cap well in combination with a partially broken view cylindrical container having a blasting composition disposed therein.

Referring to the drawing, there is illustrated container **10** having thin-walled substantially cylindrical body **11** and threaded neck **12** with container cap **14** suitably positioned thereon. Any desirable means may be used for supporting cap **14** on neck **12**, although simple screw threads are ample and are thus preferred. Cap well **16** is held by container cap **14** through flanged annular support member **18**. Cap well **16** further includes flexible conical bellows **20** formed of yieldable material and having a large diameter open end and a small diameter open end with flanged annular support member **18** integrally connected to the larger diameter open end. Receptacle tube member **22** having a closed end is integrally connected by an open end thereof to the small diameter open end of bellows **20**. Although a conical bellows is preferred because of ease of construction with limited volume restrictions, in use, other shaped bellows may also prove useful such as a cylindrical bellows or the like.

Aperture **24** approximately centrally disposed on container cap **14** is provided for introducing an explosive initiator into the cap well **16**.

Along thin-walled cylindrical body member **11** may optionally be disposed booster-receiving groove **26** which may be used for receiving an explosive booster charge. Conveniently, booster-receiving groove **26** may be positioned along the cylindrical surface and desirably terminates to provide a convenient cavity means for receiving an explosive booster charge, since typically no auxiliary fixtures such as lead-in wires are required for the explosive booster charge.

Disposed adjacent to booster-receiving groove **26** may be detonator-receiving groove **28** for receiving a cord-like detonating means. The detonator-receiving groove **28** is axially disposed along the entire length of thin-walled cylindrical surface **11** whereas booster-receiving groove **26** is illustrated as terminating at an intermediate position along the cylindrical surface.

Booster-receiving groove **26** and detonator-receiving groove **28** may be formed as substantially U-shaped grooves molded alongside of each other and generally parallel to the axis of the container. The depth of these grooves is generally that sufficient to receive the prescribed elements while permitting space for a sleeve, not shown, to be fitted thereover. The sleeve may be formed of flexible or rigid materials such as paper, plastic, or other suitable material formed as a tubular section which may be readily slipped over the outer surface of the thin-walled cylindrical surface **11** of the container. Other means may be used for supporting elements in booster-receiving groove **26** and detonator-receiving groove **28** such as adhesive tape or the like as desired.

In preparing a column assembly of a series of the present containers, a cord-like detonator means is suitably secured to the first of the containers to form the series and the remaining containers are positioned as desired, along the length of the cord-like detonator means. In at least one of the series of containers forming the explosive column assembly, an explosive initiator cap may be positioned in the provided cap well **16**. Ignition of the cap will thus initiate the cord-like detonator and the blasting composition. The cord-like detonator then proceeds to set off the remaining containers of the assembly.

An example of a physical change which expands or contracts the bellows **20** is that of density which results by variation of temperature, while an example of a chemical change is the generation of gas during storage by fermentation. Other well-known examples of such changes will become readily apparent to those skilled in the art.

A specific example of a blasting composition which may be contained in the present containers and which undergoes significant volume changes either through physical or chemical changes is the following:

Ingredient:	Parts by weight
Aqueous nitric acid solution (60%)	100
Ammonium nitrate	400
Parafin wax	50
Sorbitan monooleate	25
Copolymer of methyl vinyl ether-maleic anhydride	20

The present cap well may be formed of any desirable thin-walled material which is compatible with blasting compositions and which, when provided with bellows, preferably conical in shape and formed along its cylindrical length, may be axially expanded and contracted by materials which undergo significant variations in volume through either physical or chemical changes. Thermoplastic materials are particularly useful for preparing the present cap well since they generally possess favorable properties and may be economically prepared such as by blow-molding or injection molding methods. Useful thermoplastic materials for preparing the present containers include materials such as polyvinyl resin, polyvinyl chloride, polystyrene, polyethylene, polypropylene, and cellulose and acrylic containing resins, Copolymers of these materials along with other materials such as plasticized vinyl chloride-vinyl acetate copolymers are also useful as are related terpolymers exemplified by acrylonitrile-butadiene-styrene terpolymer.

The present cap well may also be formed of thin metal, paper, or the like provided the bellows retain the ability to expand and contract through changes of volume of materials disposed in a fixed volume container.

The present fixed volume container may be prepared from any materials typically used in the art such as plastic, metal, or paper.

Although the fixed volume containers having the present cap well in position are especially useful to contain blasting compositions which experience significant variations in volume by either physical or chemical changes, they are also useful for containing non-explosives or otherwise unrelated materials which undergo significant variations in volume by either physical or chemical changes.

One of the advantages of the present container and cap well combination is that a unit weight of a blasting composition may be packaged in a standardized volume container without concern for reasonable volume variations of the contained material.

A cord-like detonating means useful with the present container for firing an explosive column may be, for example, the well-known Primacord or Cordeau. Other detonating means may also be used with modification, as may be reasonably necessary, if desired.

Commercial blasting caps which may be used with the present container are those which may contain primary explosives such as diazodinitrophenol, lead azide, mercury fulminate; either alone or combined with an oxygen-carrying salt such as, for example, potassium chlorate. These commercial blasting caps may also contain in conjunction with the primary explosives, secondary explosives such as tetryl, T.N.T., nitrostarch, P.E.T.N., or the like.

What is claimed is:

1. An explosive package comprising:

(a) a closed body having an open neck;

(b) a flexible bellows positioned within said body in sealed relationship with the neck thereof; and

(c) means for holding a blasting cap within said body, said means comprising a cap well sealed to the base of said bellows in open linear communication to the outside of said body.

2. The explosive package of claim **1** wherein said bellows is conical, the narrower end of the cone being next to said tube.

3. The explosive package of claim **1** wherein said bellows and tube are plastic.

4. The explosive package of claim **1** wherein said bellows is connected with said neck by means of a flanged annular support member.

5. The explosive package **1** wherein a container cap having an aperature at its center is securely fitted over the neck of said container.

6. The explosive package **1** wherein said body is cylindrical.

7. The explosive package of claim **6** wherein said cylindrical body has at least one substantially U-shaped channel along its length.

8. The explosive package of claim **1** wherein an explosive which can undergo a significant variation in volume as a result of physical or chemical change is contained therein.

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VERLIN R. PENDEGRASS, Primary Examiner

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,517,616 Dated June 30, 1970

Inventor(s) Graham D. Martin

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 46, for "cotainers" read -- containers --.
Column 2, line 7, for "blasing" read -- blasting --.
Column 3, line 26, for "Parafin" read -- Paraffin --.
Column 3, line 45, for "resins," read -- resins. --.
Column 4, lines 29 and 31, for "tube" read -- cap well --.
Column 4, line 36, for "aperature" read -- aperture --.

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SEALED
JAN 5 1971

(SEAL)
Attest:

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Attesting Officer

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PO-1050
(5/69)

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