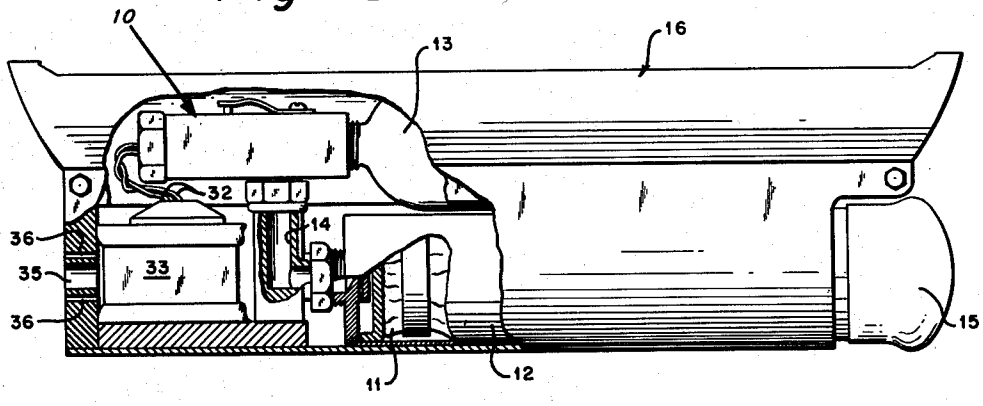
July 12, 1960 A. J. FRUENDT 2,944,268

ACTUATING MECHANISM FOR EXPANDING AN INFLATABLE ARTICLE

Filed April 28, 1959

Fig. 1



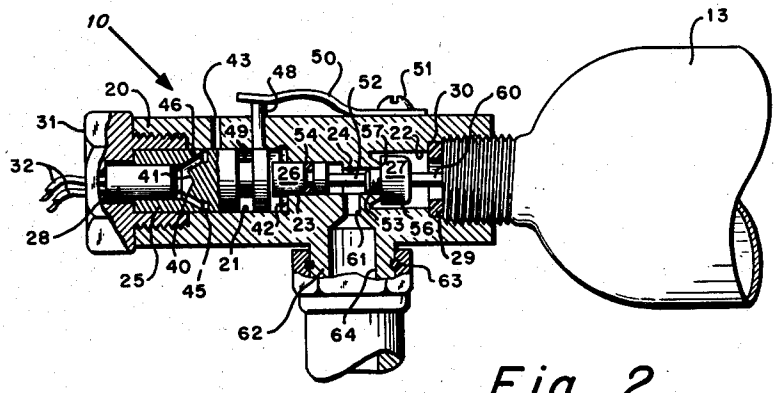


Fig. 2

INVENTOR.
ADEL J. FRUENDT

BY Arthur A. Brennan

AGENT

United States Patent Office 2,944,268
Patented July 12, 1960

2,944,268

ACTUATING MECHANISM FOR EXPANDING AN INFLATABLE ARTICLE

Adel J. Fruendt, 17 S. York Road, Hatboro, Pa.

Filed Apr. 28, 1959, Ser. No. 809,580

5 Claims. (Cl. 9—8)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to actuating mechanisms and more particularly to explosion operated actuator mechanisms especially adapted for use with sea markers of the flotation type.

An object of the present invention is the provision of a new and improved explosion operated actuating mechanism.

Another object of the invention is the provision of a new and improved explosion operated actuating mechanism in combination with a valve.

Another object of the invention is the provision of an actuating mechanism, referred to in the preceding object, having the characteristics of being of simple construction, of having a minimum number of parts, and of being easily operated.

A still further object of the invention is the provision of a new and improved explosion operated actuating mechanism especially adapted to open an end closure cap or valve in a compressed fluid container, such as a carbon dioxide capsule.

A still further object of the invention is the provision of a compact explosion actuated linear actuating mechanism comprising an electrically triggered explosive charge, a primary driver piston which opens valve means, and means for limiting the forward movement of the piston and locking the piston in place for assuring that the valve menas will be held open.

Yet another object of the invention is the provision of a compact explosion actuated linear actuating mechanism, as set forth in the preceding object, which mechanism has a portion functioning as a valving apparatus for metering the passage of pressure fluid therepast.

The invention further resides in certain novel features of construction, combinations and arrangements of parts, and further objects and advantages of the invention will be apparent to those skilled in the art to which it pertains from the following description of the present preferred embodiment thereof described with reference to the accompanying drawing, which forms a part of this specification, and wherein the same reference characters represent corresponding parts throughout the several views, and in which:

Fig. 1 is a plan view of a device embodying a preferred form of the invention, a portion of the device being broken away and in section for showing details thereof; and

Fig. 2 is an enlarged view of a portion of Fig. 1, the portion being partially in section for illustrating certain details thereof.

It is to be understood that the invention is not limited to the details of construction and arrangement of parts shown in the drawing and hereinafter described in detail, but is capable of being otherwise embodied and of being

practiced or carried out in various ways. It is to be further understood that the phraseology or terminology employed herein is for the purpose of description and there is no intention to herein limit the invention beyond the requirements of the prior art.

Referring to the Figs. 1 and 2, an explosion operated actuating mechanism, embodying the invention, is indicated generally by the reference numeral **10**. The mechanism **10** is embodied in a flotation bladder assembly unit comprising a flotation bladder device **11** packed in a cylindrical casing **12** and adapted to be ejected and inflated with a buoyant pressure fluid, such as carbon dioxide, from a capsule **13** via the mechanism **10** and a tubular conduit **14** coupled to the mechanism **10** and the casing **12**. A rubber cap **15** encloses an outer end of the casing **12**. Details of the structure and operation of the bladder device **11** is shown and described in applicant's copending patent application Serial No. 809,579 for "Flotation Bladder Assembly Unit," filed April 28, 1959, in the U.S. Patent Office. The reference numeral **16** indicates generally a housing or container for the above described assembly.

More particularly, the mechanism **10** comprises a generally cylindrical housing **20** having a relatively large coaxial cylindrical bore opening **21** in one end and a smaller cylindrical opening **22** having a parallel, eccentric axis in an opposite end. The opening **21** communicates with a concentric cylindrical bore **23**. A small cylindrical guide passage **24** connects the openings **23** and **22** and is coaxial with the opening **22**. A relatively large cylindrical primary driver piston **25** is slidably disposed in the opening **21** and is adapted to drive a juxtaposed coaxial smaller secondary shuttle piston **26**, slidably disposed in the bore **23**, against valve opening means **27**, slidably guided in the guide passage **24**, by igniting an explosive charge **28**. The explosive charge is in the form of a cylindrical squib.

The valve opening means **27** is adapted to unseat a conventional closure cap or valve in the necked end of the capsule **13**, the necked end being threaded into and sealed with a packing ring **29** in a counterbore **30** in the opening **22**. It is to be understood that the valve opening means **27** can be a puncture pin for puncturing closure caps in capsules which must be punctured to be opened.

The squib **28**, which is partially carried by and enclosed in an outer end of the driver piston **25**, is secured in place and enclosed by means of a coaxial hollow stud bolt **31** threaded into an enlarged outer end of the opening **21**. Specifically, the bolt **31** is bored to receive the protruding outer end of the squib **28** and is counterbored to a depth and diameter consistent with the dimensions of the driver piston **25**. A pair of insulated electrical leads **32**, terminating within the squib **28**, extend from a salt water activated storage battery **33**, such as that referred to in U.S. Patent No. 2,801,026, dated July 30, 1957. A duct **35** in the end of the container **16** adjacent the battery **33** permits the entrance of the salt water. Small drill holes **36** permit the egress of any trapped fluid, such as atmospheric air.

Ignition of the squib **28** causes the instantaneous generation of burned gases which expand within a generally cylindrical combustion chamber **40** and against a coaxial conical pent head portion **41** for driving the primary piston **25** to the right. An annular shoulder or end portion **42** of the bore opening **21** serves as a stop for limiting the travel of the piston **25**. The portion **42** terminates in an annular fillet of arcuate section at the junction thereof with the wall of the opening **21** for the purpose of relieving the concentration of stresses.

An arrangement for exhausting the burned gases as well as limiting the travel of the piston **25** and reducing

the impact thereof against the stop 42, comprises an exhaust port or vent hole 43 connecting the opening 21 with the exterior of the housing 20. The combustion chamber 40 communicates with the vent 43 by means of an annular groove 45 of rectangular cross section in the periphery of the piston 25 and two communicating exhaust ducts 46. Each of the ducts 46 is obliquely outwardly extending and has one end terminating in the conical wall portion 41 in juxtaposition with the cylindrical wall portion of the combusiton chamber 40. The other or outer ends of the ducts 46 terminate in a transverse side wall portion of the groove 45. As many ducts 46 may be provided as are necessary although only two are shown 180° apart.

As the piston 25 abuts against the stop 42, a cylindrical lock pin 48, which is slidably guided in a similarly-shaped transverse opening in the wall of the housing 20, is urged into locking position in an annular lock receiving groove 49 formed in the piston 25. A leaf spring 50, secured with a screw 51 to the outside of the housing 20, biases the lock 48 into place. The groove 49 also functions to reduce the sliding friction between the piston 25 and the wall of the opening 21.

The secondary or shuttle piston 26 has a cylindrical body portion with a driver head 52 on its right hand end, Fig. 2. The head 52 is adapted to engage an adjacent coaxial anvil portion 53 of the valve opening means 27 under the impact of the driver piston 25 at the larger butt end of the secondary piston 26. Preferably, a peripheral groove is formed in the larger body portion of the piston 26 for the purpose of retaining a rubber O-ring type of seal 54. The seal 54 helps to prevent the transgression of pressure fluids therepast in either direction.

The valve opening means 27 has an annular shoulder portion 56 which serves as a poppet type of closure valve, Fig. 2, and seats upon a circular coaxial valve seat 57 embossed in the bottom of the opening 22 and formed as a part of the housing 20. The anvil portion 53 of the valve opening means 27 is cylindrical and terminates in a frusto-conical butt-end anvil portion.

The cylindrical anvil portion 53 of the valve opening means 27 is very loosely slidably guided in the correspondingly shaped passage 24, there being sufficient axial spacing between the anvil portion 53 of the valve opening means 27 and the head 52 of the secondary piston 27, or the piston 25 and the shuttle 26, to permit the proper seating of the valve portion 56 of the valve opening means 27 upon the valve seat 57.

The travel of the shuttle or secondary piston 26 against the valve opening means 27 is sufficient to cause an axially projecting cylindrical shaft portion 60 of the means 27 to unseat the closure valve of the capsule 13, and unseat the valve 53. The unseating of the valve 53 permits pressure fluid to flow from the capsule 13 into the passage 24, through a laterial passage means 61 and the duct 14 into the casing 12 for ejecting and inflating the bladder 11.

Preferably, the passage means 61 terminates in a cylindrical embossment 62 capable of having the duct 14 coupled thereto in a conventional manner. The other end of the duct 14 is also coupled to the casing 12 in a suitable manner. Packing rings 63 are provided in the couplings to hermetically seal the same. Also, it is preferred that the lateral passage means 61 terminate in a counterbore 64.

It is the intention to hereby cover not only the preferred construction shown and described herein, but to also cover all adaptions, modifications, and uses thereof which come within the practice of those skilled in the art to which the invention relates and the scope of the appended claims.

What is claimed is:

1. In an explosion-operated actuating mechanism, housing means, a first, second, third, and fourth cylindrical opening formed in said housing, first piston means slidably disposed in said first cylindrical opening, second piston means slidably disposed in said second cylindrical opening, third piston means loosely and slidably disposed in said third cylindrical opening, said first piston means being adapted to be explosively actuated towards said second piston means and driving said second piston means against and axially displacing said third piston means, means for limiting the travel of said first piston means, means for venting the burned gases from said first cylindrical opening as said first piston means approaches the end of its travel, sealing means disposed about said second piston means for preventing the transgression of pressure fluid therepast, valve seat means at the mouth of said third cylindrical opening and projecting into said fourth cylindrical opening, said third piston means having annular valve means adapted to seat upon said valve seat means and partition said third and fourth cylindrical openings, lateral duct means communicating with said third cylindrical opening means between said sealing means and said valve seat means, said fourth cylindrical opening being adapted to have a pressure fluid capsule secured therein in such a manner that the axial displacement of said third piston means causes the unseating of said valve means and the release of pressure fluid from the capsule into said lateral duct means via said fourth and third cylindrical openings, respectively.

2. In an explosion-operated actuating mechanism, housing means, a first, second, third, and fourth cylindrical opening formed in said housing, first piston means slidably disposed in said first cylindrical opening, second piston means slidably disposed in said second cylindrical opening, third piston means loosely and slidably disposed in said third cylindrical opening, said first and second cylindrical openings being coaxial and communicating with each other, said third and fourth cylindrical openings being coaxial with each other and eccentric to said first and second cylindrical openings, said first piston means being adapted to be explosively actuated towards said second piston means and driving said second piston means against and axially displacing said third piston means, means for stopping and limiting the travel of said first piston means, means for locking said first piston means in place after said stop means has stopped the same, means for venting burned gases from said first cylindrical opening after said first piston means has been stopped by said stop means, sealing means disposed about said second piston means for preventing the transgression of pressure fluid therepast, embossed annular valve seat means formed at the mouth of said third cylindrical opening and projecting into said fourth cylindrical opening, said third piston means being enlarged at a midportion thereof and having annular valve means adapted to seat upon said valve seat means and partition said third and fourth cylindrical openings, lateral duct means communicating with said third cylindrical opening means at a point between said sealing means and said valve seat means, said fourth cylindrical opening being adapted to have a pressure fluid capsule secured therein in such a manner that the axial displacement of said third piston means causes the unseating of said valve means and the release of pressure fluid from the capsule into said laterad duct means via said fourth and third cylindrical openings, respectively.

3. In an explosion-operated actuating mechanism, housing means, a first, second, third, and fourth cylindrical opening formed in said housing, first piston means slidably disposed in said first cylindrical opening, second piston means slidably disposed in said second cylindrical opening, third piston means loosely and slidably disposed in said third cylindrical opening, said first and second cylindrical openings communicating with each other, said first piston means being adapted to be explosively actuated towards said second piston means and driving said second piston means against and axially displacing said third piston means, means for limiting the travel of said first

piston means, means for venting the burned gases from said first cylindrical opening, sealing means disposed about said second piston means for preventing the transgression of pressure fluid therepast, said fourth cylindrical opening in said housing means communicating with said third cylindrical opening, said housing means having valve seat means formed therein about one end of said third cylindrical opening and protruding into said fourth cylindrical opening, said third piston means being adapted to seat against said seat means and prevent the transgression of fluid from said fourth cylindrical opening into said third cylindrical opening before said first piston means is explosively actuated, lateral duct means communicating with said third cylindrical opening between said sealing means and said valve seat means, said fourth cylindrical opening being adapted to have a pressure fluid capsule secured therein in such a manner that the axial displacement of said third piston means causes the release of pressure fluid from the capsule into said lateral duct means via said fourth and third cylindrical openings, respectively.

4. In an explosion-operated actuating mechanism, housing means, a first, second, and third cylindrical opening formed in said housing, first piston means slidably disposed in said first cylindrical opening, second piston means loosely and slidably disposed in said second cylindrical opening, said second and third cylindrical openings being coaxial with each other and eccentric to said first cylindrical opening, said first piston means being adapted to be explosively actuated towards and axially displace said second piston means, means for limiting the travel of said first and second piston means, sealing means disposed about said first piston means for preventing the transgression of pressure fluid therepast, valve seat means formed at the mouth of said second cylindrical opening and projecting into said third cylindrical opening, said second piston means being enlarged at a midportion thereof and having annular valve means adapted to seat upon said valve seat means and partition said second and third cylindrical openings, lateral duct means communicating with said second cylindrical opening means between said sealing means and said valve seat means, said third cylindrical opening being adapted to have a pressure fluid capsule secured therein in such a manner that the axial displacement of said second piston means causes the unseating of said valve means and the release of pressure fluid from the capsule into said lateral duct means via said third and second cylindrical openings, respectively.

5. In a device of the character described having an inflatable flotation bladder, a buoyant fluid capsule, an explosive charge, and electrical means for firing the explosive charge, the improvement comprising in combination, housing means, a first, second, third and fourth cylindrical opening formed in said housing, first piston means slidably disposed in said first cylindrical opening, second piston means slidably disposed in said second cylindrical opening, third piston means loosely and slidably disposed in said third cylindrical opening, said first and second cylindrical openings being coaxial and communicating with each other, said third and fourth cylindrical openings being coaxial with each other and eccentric to said first and second cylindrical openings, said first piston means being adapted to be explosively actuated towards said second piston means upon the firing of the explosive charge and driving said second piston means against and axially displacing said third piston means, means for limiting the travel of said first piston means, means for venting the burned gases from said first cylindrical opening, sealing means disposed about said second piston means for preventing the transgression of pressure fluid therepast, said fourth cylindrical opening in said housing means being larger than said third cylindrical opening and communicating with said third cylindrical opening, valve seat means formed at the mouth of said third cylindrical opening and projecting into said fourth cylindrical opening, said third piston means being enlarged at a midportion thereof and having annular valve means adapted to seat upon said valve seat means and partition said third and fourth cylindrical openings, lateral duct means communicating with the bladder and said third cylindrical opening means between said sealing means and said valve seat means, said fourth cylindrical opening having the capsule secured therein in such a manner that the axial displacement of said third piston means causes the unseating of said valve means and the release of pressure fluid from the capsule into said lateral duct means via said fourth and third cylindrical openings, respectively, for inflating said bladder.

References Cited in the file of this patent

UNITED STATES PATENTS

2,422,853	Reising	June 24, 1947
2,515,068	Young	July 11, 1950
2,780,389	Sandgren	Feb. 5, 1957
2,840,833	Freundt	July 1, 1958