Sept. 29, 1964 L. E. OLIPHANT 3,150,388

PRESSURE FLUID CONTAINER FOR INFLATING DEVICES

Filed Dec. 5, 1960

FIG. 1.

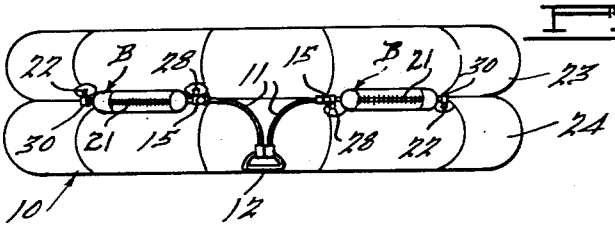

FIG. 4.

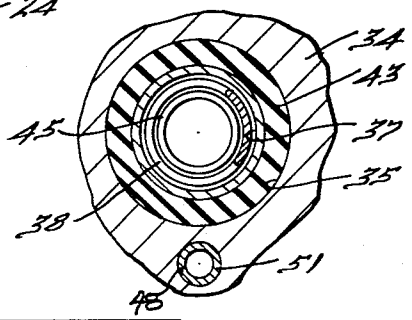

FIG. 3.

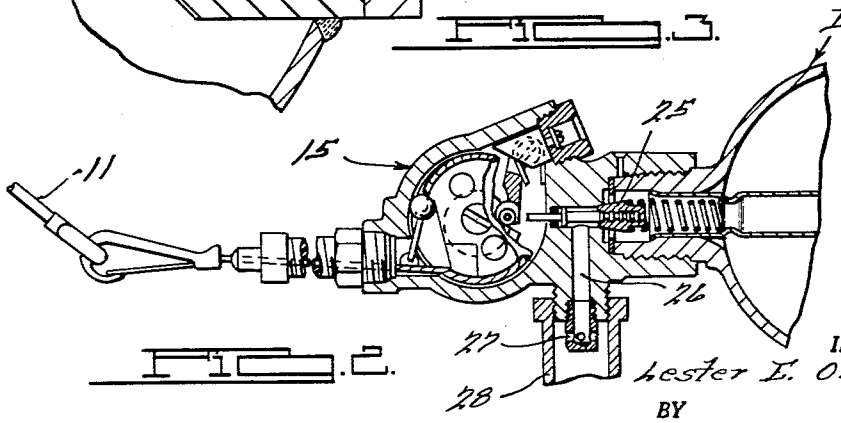

FIG. 2.

INVENTOR.
Lester E. Oliphant.
BY
George W. Talburtt
ATTORNEY.

United States Patent Office 3,150,388 Patented Sept. 29, 1964

3,150,388
PRESSURE FLUID CONTAINER FOR INFLATING DEVICES

Lester E. Oliphant, 19561 Lindsay, Detroit 35, Mich.

Filed Dec. 5, 1960, Ser. No. 73,908
10 Claims. (Cl. 9—11)

This invention relates to pressure fluid containers or bottles for confining liquid and/or gaseous materials under relatively high pressures and more particularly to the valving means associated therewith that is used to inflate pneumatic devices such as life rafts, pontoons, landing mats, balloons, and the like, which devices require a fast fill of relatively large volumes at relatively low pressures.

Inflatable devices of the general type referred to are usually packaged in relatively small size packages which devices, when needed, are quickly and easily opened. In many cases it is desirable that the inflatable devices be rapidly inflated in case of an emergency such as in a forced landing at sea of an aircraft. Inflation of these pneumatic devices is accomplished by the opening of a discharge valve on the small volume, high pressure, fluid bottle or container to permit the stored pressurized liquid or gas to escape from the bottle and expand into the inflatable device. When the pressurized gas or liquid enters the inflatable device it expands to provide a larger volume of relatively low pressure gas that properly inflates the inflatable device. It is the time interval between the release of the high pressure gas from the bottle or container and the complete inflation of the inflatable device that is critical, particularly in emergencies.

It is a primary object of this invention to provide a relatively small volume pressure fluid container or bottle for quickly and safely inflating a relatively large volume inflatable device.

It is another object of this invention to provide a relatively small volume pressure fluid container with valve means that will function as a two-stage discharge means such that on initial manual opening of the discharge valve a relatively small volume of high pressure gas is slowly discharged at a rate sufficient to expand the inflatable device without danger of damage thereto and then after a predetermined expansion and filling of the inflatable device a second dump valve is automatically activated to quickly fill the inflatable device to the desired pressure.

It is still another object of this invention to provide a two-stage quick discharge valve means for a pressure bottle or the like that functions as a closed system so as to permit its use in rough seas or the like without danger of filling the inflatable device with water or any other type of liquid that might surround the inflatable device during its filling operation.

Other objects and advantages of this invention will become readily apparent from a reading of the following description and a consideration of the related drawings wherein:

FIG. 1 is an end elevational view of a life raft having a pair of pressure bottles embodying this invention as the raft inflating means;

FIG. 2 is an enlarged sectional elevational view of the discharge valve used on the head ends of the pressure bottles shown in FIG. 1;

FIG. 3 is an enlarged sectional elevational view of the differential pressure operated automatic dump valve used on the bottom end of each of the pressure bottles shown in FIG. 1; and

FIG. 4 is a fragmentary sectional elevational view of the dump valve of FIG. 3, the view being taken along the line 4—4 of FIG. 3.

In pressurizing life rafts, rubber boats, pressure suits

and miscellaneous survival equipment the most popular gas used in the pressure bottle or container is liquid carbon dioxide (CO_2). In liquid form this gas produces an extremely large volume when it is released, as compared to other gases. Usually carbon dioxide (CO_2) is placed in the bottle by pouring in a given weight of liquid then sealing the pressure container and applying additional gas in the form of compressible dry nitrogen. The pressure is built up to approximately 2100 p.s.i. and, with the proper raft attaching head in place, the bottle is ready for use.

One of the reasons why the bottle is pressurized with dry nitrogen gas is to assure an expulsion pressure when the temperature is too low for carbon dioxide (CO_2) to readily gassify.

When the standard pressure bottle B is in place on a life raft 10, or the like, (see FIG. 1) a cable 11, with a stirrup handle 12, is attached to the discharge valve body 15 at the head end of bottle B and the unit is ready for service. A quick, hard pull on the cable 11 will release the discharge valve 15 and permit carbon dioxide, carbon dioxide liquid and dry nitrogen gas, to enter the compartments 23, 24 of the raft 10 and inflate it to approximately 1½ p.s.i. The filling time varies considerably due to the carbon dioxide changing to gas very slowly when the temperature is low. Also, during the release of carbon dioxide the valve discharge passageways are apt to frost up, freeze, or snow shut and in some cases permit the dumping of carbon dioxide snow in piles inside the raft. Snow piles of carbon dioxide produce a cold area on the container fabric and in some instances cause it to crack. One method to prevent snow pile up is to discharge the carbon dioxide thru a cotton mesh bag in order to retard or diffuse it.

The present pressure bottle B has valving and couplings at each of its opposite ends that serve as the attaching means for the pressure bottles as well as the conduits to feed the raft compartments 23, 24. No other connection or gas inlets are provided. There are, of course, the lacing means 21 for holding the bottles B in place on the side of the raft 10. When the above-described bottle arrangement is used, it represents what is known in this art as a closed inflation system for the raft compartments.

Prior to the development of the automatic dump valve 30, shown in FIG. 3, it was common practice to merely use a simple discharge valve 15 at the head end of the pressure bottle B which discharge valve is shown in FIG. 2 and is described in detail in U.S. Patent 2,630,018. For the purposes of this invention it is merely necessary to state that when the cable 11 is pulled by means of the handle 12 cam mechanism in the discharge valve unit 15 is actuated to unseat the stemmed valve 25 and this permits gas and/or liquid in bottle B to discharge through the passageway 26 and ports 27 into the conduit 28 that is connected to the chamber to be inflated. In the example shown in FIG. 1 the conduit 28 is fixedly connected to one of the inflatable ring compartments 23 or 24 of the raft 10. From FIG. 1 it will be noted that one bottle B is connected at its opposite ends to the raft upper compartment ring 23 while the other pressure bottle B is connected at its opposite ends to the raft lower compartment ring 24. If each of the pressure bottles B were to be discharged through only their head end discharge valves 15 then a relatively long period of time would be required to fully inflate the raft 10 because of the small size of the discharge valve porting 25–27. While it might seem that the answer to the slow rate of discharge through valve 15 would be to increase the size of the discharge valve member 25 and the porting 26, 27, still, this cannot be done because then the effort required to open discharge valve 25 against the high bottle pressure becomes prohibitive for the quick easy operation re-

quired for emergency equipment of this type. To provide for faster fill of the pneumatic raft or other device connected to a pressure bottle B there has been developed an automatically operable dump valve 30 that will automatically discharge a large volume of the bottle contents from the bottom end of the pressure bottle B shortly after the small size head end discharge valve 15 has been opened through the normal actuation of the pull cable 11.

From a consideration of FIG. 3 it will be noted that the automatic dump valve 30 is a differential pressure operated valve that is mounted in the bottom end of pressure bottle B and connected to the life raft 10 through an elbow conduit 22. Valve 30 comprises a valve body that may be a unitary structure with a cylinder bore therein or, in the alternative, it may be as shown and consist of an adapter ring 31 connected to the bottle B by welding or brazing 32. Adapter ring 31 has a threaded bore 33 that is adapted to receive the valve body 34. Valve body 34 has a stepped bore 35 that is composed of the large diameter bore L at the right end and the smaller diameter bore S at the left end. Mounted in the stepped bore 35 for reciprocation therealong is the stepped piston 36 that is of cup-like formation. Piston 36 has a cavity 37 therein and adapted to receive a compression spring 38 that normally urges the piston 36 towards the right end of cylinder bore 35 so that piston 36 will seat against the sealing plug 39. Sealing plug 39 is retained in the cylinder bore 35 by a frangible ring 41 that is anchored in place by a conventional type of snap ring 42. Both the sealing plug 39 and the stepped piston 36 carry suitable resilient sealing rings 43 to prevent leakage. The open left end of the piston 36 is arranged to seat on the collared ring 44. Ring 44 has an upstanding annular flange 45 that provides a collar seat for the spring 38. Ring 44 is anchored in the cylinder bore 35 by a snap ring 46.

Extending lengthwise through the valve body 34 from the left end and opening into the bottle B is a bore 48. Bore 48 is connected by a cross bore 49 at its right end to the right end of the piston bore 35. The left end of bore 48 may have an open ended tube 51 telescopically mounted therein. Tube 51 extends towards the head end of the bottle B and is adapted to apply the bottom pressure to the relatively large right end area 52 of the piston 36 to produce a force tending to move the piston 36 towards the left end seat 44. In addition, to the spring 38 acting on the piston 36 tending to move the piston rightwardly, the pressure of the fluid within the bottle B is applied to the smaller left end area 53 of piston 36. The spring pressure plus the fluid pressure on piston area 53 oppose the force developed by the fluid pressure on piston area 52.

When a pressure bottle B (see FIG. 3) is equipped with a more or less conventional discharge valve 15 and this automatic dump valve 30 bottle charging operation is as follows: With negligible pressure in the bottle B the spring 38 will position the piston 36 at the right end of the bore 35 against the seat plug 39. As the bottle B is pressurized the pressure is applied to the opposite end areas 52, 53 of piston 36 and because end 52 has more area than end 53, the force applied to the right end of piston 36 will move the piston leftward against the combined opposing force of the compression spring 38 and the fluid pressure generated force applied to the left end 53 of piston 36. If the bottle is charged at 2100 p.s.i. it can be arranged through proper design of the dump valve parts to have the piston 36 shift to the left so that at full pressurization of the bottle B the piston is just seating on the ring 44 or is positioned just adjacent to ring 44 but spaced about one-sixteenth of an inch (1/16") away from ring 44. Of course the bottle B can be pressurized to a greater pressure than 2100 p.s.i. and such a pressure will merely urge piston 36 firmly against seat 44 so that the seat provides an added safety factory.

When the bottle B is to be discharged for the inflation of a pneumatic device such as the raft 10, it is merely necessary to pull on the handle 12 that will cause cable 11 to unseat the discharge valve element 25 and this permits pressure fluid from the bottle B to flow into the raft compartments 23, 24 at a relatively slow rate, but at a rate that quickly unfolds and expands the inflatable raft 10. As the bottle B discharges through the head end valve 15 and begins to pressurize raft 10, the bottle pressure drops and after a predetermined reduction in bottle pressure, say about a 300 pound drop, the dump valve piston 36 begins to move rightwardly under the influence of the compression spring 38. As the bottle pressure continues to drop the piston 36 moves rightwardly to a position where the enlarged ring portion 58 in the center of bore 35 is uncovered by the left end of piston 36. The enlarged bore 58 provides a dump port for the bottle contents because port 58 is connected to longitudinally extending bore 59 that connects with the elbow coupling 22 that discharges into the associated raft compartment. Once the port 58 is uncovered by the piston 36 then there is large discharge conduit available for fast completion of the inflation of the raft 10. Because the raft has been partially inflated before the dump valve 30 is opened there are no problems of sudden pressurization of the raft that might tear the raft material. Likewise, snow pile-up is prevented and there is no danger of valve frosting or the like. It will also be noted that with this system that will materially reduce the time for inflation and eliminate the former problems associated with fast fill there is also provided a closed system that can be used without danger of entry of some foreign liquid or other material into the pneumatic container during fill thereof.

Certain obvious changes can be made in the disclosed invention without departing from the scope of the claims. Instead of the frangible ring 41 to seat the plug 39, it is possible to make the plug or a portion thereof from frangible material that would fracture and provide an automatic pressure relief valve for the bottle B. It is also possible to substitute a second pressure fluid generated force for the spring 38 to urge the piston 36 rightwardly. A pressure fluid force would be of constant intensity as distinguished from the variable spring generated force.

I claim:

1. In a pressure fluid container, a first discharge valve and a second dump valve each connected by separate ports to the container interior, said second dump valve being automatically operable in response to a reduction in the pressure of the container fluid to dump the pressurized fluid in the container after reduction in the pressure of the contained fluid by a predetermined discharge of the container fluid through said first valve, said dump valve having a relatively greater rate of discharge than said discharge valve and comprising a differential pressure operated valve including a stepped reciprocable piston having relatively large and small ends mounted in a mating stepped piston bore with the conduit means carrying and discharging the pressurized fluid within the container to the opposite ends of said stepped piston, a spring means applied to the small end of the piston acting to urge the piston towards its large end, and a dump port connected to the piston bore adapted to be uncovered by said piston after said predetermined discharge.

2. A pressure fluid dump valve adapted to be mounted in a pressure fluid container having a discharge valve associated therewith, comprising a valve body having a stepped bore extending longitudinally therethrough to provide a relatively small diameter end and a connected relatively large diameter end, a stepped piston mounted in said stepped bore for reciprocation therealong, stop means at each end of said bore to limit the reciprocable movement of said piston, a spring mounted on said valve body at the small end of said piston bore urging said piston towards the large end of said piston bore, a plug closing the large end of said piston bore, a transfer bore in said valve body extending longitudinally thereof, said

transfer bore extending from the end of the valve body containing the small diameter piston bore to a point adjacent the plug at the large diameter end of said piston bore with the transfer bore being connected to said large diameter portion of the piston bore at said point and a dump port connected to said stepped piston bore intermediate the ends thereof, said dump port being arranged to be uncovered by said stepped piston after the piston has moved a predetermined distance from the smaller diameter bore end towards the larger diameter bore end.

3. A pressure fluid dump valve adapted to be mounted in a pressure fluid container having a discharge valve associated therewith, comprising a valve body having a stepped bore extending longitudinally therethrough to provide a relatively small diameter end and a connected relatively large diameter end, a stepped piston mounted in said stepped bore for reciprocation therealong, stop means at each end of said bore to limit the reciprocable movement of said piston, a spring mounted on said valve body at the small end of said piston bore urging said piston towards the large end of said piston bore, a plug closing the large end of said piston bore, a transfer bore in said valve body extending longitudinally thereof, said transfer bore extending from the end of the valve body containing the small diameter piston bore to a point adjacent the plug at the large diameter end of said piston bore with the transfer bore being connected to said large diameter portion of the piston bore at said point and a dump port connected to said stepped piston bore intermediate the ends thereof, said dump port being arranged to be uncovered by said stepped piston after the piston has moved a predetermined distance from the smaller diameter bore end towards the larger diameter bore end, and a dump conduit in said valve body connected to said dump port having a fitting for connection to a pressure fluid operable device.

4. A pressure fluid storage bottle having a discharge valve at one location and an automatically operable dump valve at another location each connected by separate ports to the container interior, said second dump valve being adapted to dump the pressure fluid contents of the bottle after a predetermined discharge of the bottle through said discharge valve, said dump valve comprising a valve body having a stepped bore extending longitudinally therethrough to provide a relatively small diameter end and a connected relatively large diameter end, a stepped piston mounted in said stepped bore for reciprocation therealong, stop means at each end of said bore to limit the reciprocable movement of said piston, a spring mounted on said valve body at the small end of said piston bore urging said piston towards the large end of said piston bore, a plug closing the large end of said piston bore, a transfer bore in said valve body extending longitudinally thereof, said transfer bore extending from the end of the valve body containing the small diameter piston bore to a point adjacent the plug at the large diameter end of said piston bore with the transfer bore being connected to said large diameter portion of the piston bore at said point and a dump port connected to said stepped piston bore intermediate the ends thereof, said dump port being arranged to be uncovered by said stepped piston after the piston has moved a predetermined distance from the smaller diameter bore end towards the larger diameter bore end.

5. A life raft of the inflatable type having a pressure fluid fillable buoyancy compartment, a pressure fluid container having a manually operable discharge valve at one end thereof connected by a first conduit means to said compartment and an automatically operable dump valve at the other end of the fluid container connected by a second conduit means to said compartment, said dump valve being arranged to dump the pressure fluid contents of the container after a predetermined discharge of the container through said discharge valve, said dump valve comprising a valve body having a stepped bore extending longitudinally therethrough to provide a relatively small end and a connected relatively large diameter end, a stepped piston mounted in said stepped bore for reciprocation therealong, stop means at each end of said bore to limit the reciprocable movement of said piston, a spring mounted on said valve body at the small end of said piston bore urging said piston towards the large end of said piston bore, a plug closing the large end of said piston bore, a transfer bore in said valve body extending longitudinally thereof, said transfer bore extending from the end of the valve body containing the small diameter piston bore to a point adjacent the plug at the large diameter end of said piston bore with the transfer bore being connected to said large diameter portion of the piston bore at said point and a dump port connected to said stepped piston bore intermediate the ends thereof, said dump port being arranged to be uncovered by said stepped piston after the piston has moved a predetermined distance from the smaller diameter bore end towards the larger diameter bore end.

6. In a pressure fluid container, a first discharge valve and a second dump valve each connected by separate ports to the container interior, said second dump valve being automatically operable in response to a reduction in the pressure of the container fluid to dump the pressurized fluid in the container after reduction in the pressure of the contained fluid by a predetermined discharge of the container fluid through said first valve, said dump valve having a relatively greater rate of discharge than said discharge valve and comprising a differential pressure operated valve including a stepped reciprocable piston having relatively large and small ends mounted in a mating stepped piston bore with conduit means carrying and discharging the pressurized fluid within the container to the opposite ends of said stepped piston, and a second pressure generated force applied to the small end of the piston acting to urge the piston towards its large end.

7. A pressure fluid dump valve adapted to be mounted in a pressure fluid container having a discharge valve associated therewith, comprising a valve body having a stepped bore extending longitudinally therethrough to provide a relatively small diameter end and a connected relatively large diameter end, a stepped piston mounted in said stepped bore for reciprocation therealong, stop means at each end of said bore to limit the reciprocable movement of said piston, a force applying means mounted on said valve body at the small end of said piston bore urging said piston towards the large end of said piston bore, a plug including frangible portions to provide a pressure relief valve closing the large end of said piston bore, a transfer bore in said valve body extending longtudinally thereof, said transfer bore extending from the end of the valve body containing the small diameter piston bore to a point adjacent the plug at the large diameter end of said piston bore to a point adjacent the plug at the large diameter end of said piston bore with the transfer bore being connected to said large diameter portion of the piston bore at said point and a dump port connected to said stepped piston bore intermediate the ends thereof, said dump port being arranged to be uncovered by said stepped piston after the piston has moved a predetermined distance from the smaller diameter bore end towards the larger diameter bore end.

8. A pressure fluid storage bottle having a discharge valve at one location and an automatically operable dump valve at another location each connected by separate ports to the container interior, said second dump valve being adapted to dump the pressure fluid contents of the bottle after a predetermined discharge of the bottle through said discharge valve, said dump valve comprising a valve body having a stepped bore extending longitudinally therethrough to provide a relatively small diameter end and a connected relatively large diameter

end, a stepped piston mounted in said stepped bore for reciprocation therealong, stop means at each end of said bore to limit the reciprocable movement of said piston, a force generating means mounted on said valve body at the small end of said piston bore urging said piston towards the large end of said piston bore, a plug closing the large end of said piston bore, a transfer bore in said valve body extending longitudinally thereof, said transfer bore extending from the end of the valve body containing the small diameter piston bore to a point adjacent the plug at the large diameter end of said piston bore with the transfer bore being connected to said large diameter portion of the piston bore at said point and a dump port connected to said stepped piston bore intermediate the ends thereof, said dump port being arranged to be uncovered by said stepped piston after the piston has moved a predetermined distance from the smaller diameter bore end towards the larger diameter bore end.

9. In a closed inflation system for inflating an article of relatively large volume such as an inflatable life raft or the like, said system including a pressure vessel normally containing a supply of inflation fluid at a predetermined high pressure; the improvement comprising first normally closed valve means operable when open to place said pressure in fluid communication with the article to be inflated to supply inflation fluid to the article through a first passage, second normally closed valve means operable when opened to place said pressure vessel in fluid communication with said article to supply inflation fluid to said article through a second passage capable of passing fluid from said pressure vessel to said article at a substantially greater rate than said first passage, and pressure responsive means for opening said second valve means after the pressure in said pressure vessel has been reduced from said predetermined high pressure to a selected lower pressure by the opening of said first valve means whereby the article is initially partially inflated by a relatively restricted flow of fluid from said pressure vessel through said first passage and is thereafter rapidly filled to full inflation by the flow of fluid from said pressure vessel through both of said first and second passages.

10. In a closed inflation system as defined in claim 9, the further improvement wherein said pressure responsive means comprises a differential piston member having opposed first and second faces and movable between a first and a second position, said first face having a greater effective area than said second face and being located to drive said piston member toward said first position, conduit means placing said pressure vessel in fluid communication with both faces of said piston whereby the pressure of fluid in said vessel acting on the opposed faces of said piston applies a differential force on said piston urging said piston to said first position, said second valve means comprising a valve head on said piston operable to close said second passage when said piston is in said first position and operable to open said second passage when said piston is in said second position, and spring means resiliently biasing said piston toward said second position with a biasing force less than the differential force applied to said piston when the fluid in said vessel is at said predetermined high pressure and greater than the differential force when the fluid in said vessel is at said preselected lower pressure.

References Cited in the file of this patent

UNITED STATES PATENTS

2,354,286	Whaley	July 25, 1944
2,598,248	Gagnan et al.	May 27, 1952
2,826,337	Ford et al.	Mar. 11, 1958
2,895,640	Becker et al.	July 21, 1959