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INFLATING APPARATUS

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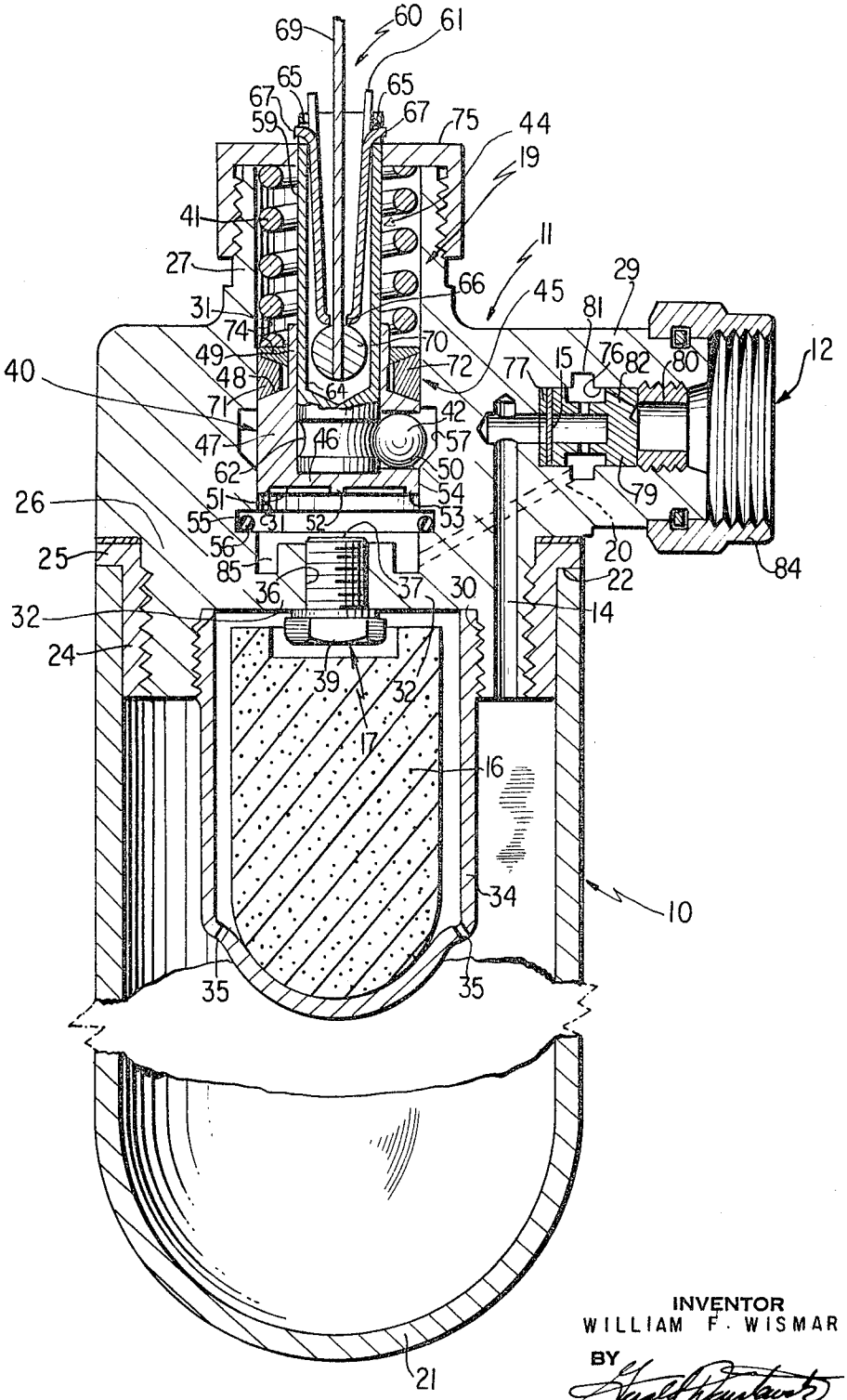

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INFLATING APPARATUS

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The present invention relates to apparatus for inflating an inflatable device, and more particularly to pyrotechnically operated inflating apparatus with provision for venting the inflatable device when the apparatus is in its unoperated condition.

In prior pyrotechnically operated inflating apparatus, the interior of the inflatable device connected to the apparatus was sealed from the atmosphere when the apparatus was in its unoperated condition and the inflatable device was deflated. The inflatable device was normally connected to the inflating apparatus at ground level and a small quantity of air was trapped within the device when the connection was made.

When the assembled unit (inflating apparatus and inflatable device, was placed in an aircraft or the like and transported to an elevation where the ambient pressure was substantially less than that at ground level, the air trapped within the inflatable device expanded which resulted in an undesirable partial inflation of the device.

Accordingly, the primary object of the present invention is to provide pyrotechnically operated inflating apparatus which is capable of venting the interior of the inflatable device when the apparatus is in its unoperated condition.

Another object is to provide such apparatus wherein the flow path for venting the inflatable device is closed off upon operation of the apparatus to effect the inflation of the inflatable device.

Another object is to provide such apparatus wherein the firing of a pyrotechnic charge and the closing of the venting flow path are accomplished simultaneously by the same mechanism.

Another object is to provide such apparatus wherein the venting flow path is locked in the closed condition when the apparatus is operated.

A further object is to provide such apparatus which is simple, reliable, and inexpensive to manufacture.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In accordance with the present invention, the foregoing objects are generally accomplished by providing inflating apparatus which comprises a container of fluid medium under pressure having an opening at one end, a control head closing the opening and having an outer surface in communication with the atmosphere and having an inner surface in communication with the interior of the container, bore means in the control head extending inwardly from the outer surface toward the inner surface and having an outer end in communication with the atmosphere and having an inner end, a pyrotechnic charge in communication with the interior of the container, a percussion actuated igniter at the inner end of the bore for igniting the charge, an impacting member in the bore for actuating the igniter, spring means for urging the impacting member toward the igniter, locking means for normally holding the impacting member spaced from the igniter, pull cable operated trigger means for releasing the locking means, a charge of pressurized fluid medium in the container, outlet port means on the control head for attaching an inflatable unit, a first passageway through the

control head having a first end in fluid flow communication with the interior of the container and having a second end in fluid flow communication with the outlet port means, a burst disc in the first passageway for releasing the fluid medium when the pressure within the container is increased by the burning of the pyrotechnic charge, a second passageway through the control head having a first end in fluid flow communication with the bore and having a second end in fluid flow communication with the first passageway means downstream of the burst disc, and means for sealing the first end of the second passageway from the atmosphere when the impacting member is released from its normal position.

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawing, forming a part of the specification, wherein:

The single figure of the drawing is a longitudinal sectional view of apparatus in accordance with the present invention in its unoperated condition.

Referring to the drawing in detail, inflating apparatus is shown which generally comprises a container **10** for storing a refrigerant such as liquid carbon dioxide or the like under pressure, a control head **11** for controlling the operation of the apparatus, an outlet port **12** on the control head for attaching an inflatable device such as a life raft (not shown), an outlet passageway **14** extending through the control head from the interior of the container to the outlet port **12**, a burst disc **15** in the passageway **14** for normally preventing the carbon dioxide from flowing to the outlet port, a pyrotechnic charge **16** within the container for increasing the pressure within the container to cause the disc **15** to rupture and effect inflation of the inflatable device, a percussion actuated explosive device **17** for igniting the pyrotechnic charge, a firing mechanism **19** for actuating the explosive device **17**, and a venting passageway **20** in the control head for venting the inflatable device to the atmosphere before the firing mechanism is actuated.

The container **10** has an outlet **22** and an internally threaded sleeve **24** having an outwardly extending flange **25** fitted into the outlet **22** and welded in place to receive the control head **11**.

The control head **11** is generally cylindrical and has an externally threaded cylindrical lower portion **26** threaded into the sleeve **24** to close the outlet **22** of the container **10**, an externally threaded cylindrical upwardly extending formation **27**, and a laterally extending formation **29** carrying the outlet port **12**. The control head is also provided with an upwardly extending internally threaded bore **30** in the lower portion **26** and a bore **31** extending downwardly through the upper formation **27** toward the bore **30**. A wall member **32** separates the bores **30** and **31**.

The pyrotechnic charge **16** is positioned within an elongated housing **34** which is threaded into the bore **30** and is provided with orifices **35** through which the gases generated by the burning of the pyrotechnic charge pass into the container.

An internally threaded hole **36** extends through the wall member **32** and the igniter **17** is threaded into the hole **36** from the lower side, and has an impact sensitive end **37** extending into the bore **31** and a flash producing end **39** in the bore **30** facing the pyrotechnic charge **16**.

The firing mechanism **19** includes a cylindrical impacting member **40**, a coil spring **41** for driving the impacting member against the upper end **37** of the igniter **17**, three locking balls **42** (only one of which is shown) for locking the impacting member in the position shown in the drawing, a pull cable operated trigger mechanism **44** for effecting the release of the impacting member, and a

latch mechanism 45 for latching the impacting member when it reaches the bottom of the bore 31.

The impacting member 40 is generally cup shaped, and has a bottom wall 46, a thick lower side wall section 47 provided with a downwardly and outwardly sloping surface 48, and a thin upper side wall section 49. The lower section 47 has an outside diameter slightly smaller than the diameter of the bore 31, and the upper wall section 49 has a substantially smaller outside diameter.

The lower wall section 47 is provided with three equally spaced lateral openings 50 (only one of which is shown) for receiving the locking balls 42, and the lower surface 51 of the bottom wall 46 has a central projection 52 for firing the igniter 17 and an annular projection 53 at the outer edge thereof. An unbroken annular surface 54 is provided between the openings 50 and the bottom of the projection 53. An annular recess 55 is provided in the wall of the bore 31 and an O ring 56 is positioned in the recess 55 to cooperate with the surface 54 and provide a seal between the impacting member 40 and the bore 31 when the impacting member 40 moves into contact with the igniter 17.

The locking balls 42 have a diameter greater than the thickness of the side wall section 47 so that they extend past the outer surfaces of the wall into an annular recess 57 provided in the wall of the bore 31.

The trigger mechanism 44 includes a cylindrical release member 59 extending into the cup-shaped impacting member 40, a pull cable assembly 60, and a connector 61 for attaching the pull cable assembly 60 to the release member 59.

The release member 59 has an annular recess 62 adjacent the lower end thereof into which the balls 42 extend, a bore 64 for receiving the connector 61, and a pair of lateral holes 65 at the upper end thereof for locking the connector to the release member. The pull cable connector 61 is generally cup-shaped and has a hole 66 in the bottom wall thereof and has a side wall which tapers outwardly toward the open end and is provided with a pair of tabs 67 adjacent the upper edge which fit into the holes 65 of the release member 50 to lock the connector to the release member.

The pull cable assembly 60 includes a cable 69 extending through the hole 66 in the connector 61, and a ball 70 secured to the end of the cable 69 beneath the connector. The other end of the cable is provided with a handle (not shown) for manually pulling the cable.

The latch mechanism 45 includes two half ring members 71 and 72 having an inwardly facing wedge shaped cross-section, and a washer 74 having an outwardly and upwardly sloping lower surface resting on the upper surface of the ring members 71 and 72. An end cap 75 is threaded onto the upper formation 27 of the control head, and the spring 41 acts against the end cap and the washer 74. The cap 75 is provided with an aperture through which the release member 59 extends.

The outlet port 12 is provided with a bore 76, and the burst disc 15 is positioned within the bore between a washer 77 and a ported plug 79. An annular nut 80 is threaded into the bore 76 to clamp the burst disc between the washer 77 and the plug 79. The bore 76 is provided with an annular recess 81, and the plug 79 is provided with a metering orifice 82 and is ported to place the recess 81 and the orifice 82 in fluid flow communication with the downstream side of the burst disc 15. A swivel nut 84 is provided on the extension 29 to attach the inflatable device to the control head in communication with the outlet port 12.

The bore 31 in the control head is provided with an annular extension 85, and the venting passageway 20 extends through the control head to interconnect the extension 85 with the recess 81.

In operation, an inflatable device is attached, in its deflated condition, to the outlet port 12. When the inflating apparatus is in the unoperated condition shown in the drawing, the balls 42 lock the impacting member 40 in the retracted position, and the passageway 20 and the clearance between the parts of the firing mechanism 11 provide fluid flow communication between the interior of the bag and the atmosphere.

Although the inflatable device is in its deflated condition, some air remains therein. The inflatable device would normally be connected to the inflating apparatus at ground level, so that the air within the device when this connection is made is at the ground level pressure. As the device is moved to a higher elevation, for example, in an airplane, the air in the inflatable device expands and flows to the atmosphere through the flow path formed by the passageway 20, the clearance between the member 40 and the wall of the bore 31, and the clearance between the member 59 and the opening in the cap 75.

To operate the inflating apparatus and effect the inflation of the inflatable device secured thereto, the cable 69 is pulled to withdraw the release member 59 from the control head 11. The action of the spring 41 then forces the balls 42 inwardly out of the recess 57 to unlock the impacting member 40 whereupon the projection 52 strikes the igniter 17. The surface 54 of the member 40 is then in contact with the O ring 56, and the spring 41, acting through the sloping surfaces of the washer 74, the half ring members 71 and 72, and the member 40, forces the half ring members 71 and 72 into the recess 57 to lock the impact member 40 in this position.

The impact of the projection 52 against the end 37 of the igniter 17 causes the igniter to detonate and produce a flash at the end 39 thereof which causes the pyrotechnic charge 16 to ignite. The charge 16 then burns to produce hot gases which heat the liquid carbon dioxide and convert it to a gaseous state thus increasing the pressure within the container 10 to a value which causes the burst disc 15 to rupture.

The gaseous carbon dioxide and the gases produced by the burning charge 16 then flow through the passageway 14 and the outlet port 12 into the inflatable device to effect the inflation thereof.

Since the impact member 40 is in sealing relationship with the O ring 56, there is no loss of the inflating gases through the venting passageway 20, and the latch 45 prevents the pressure at the outlet port from moving the impact member 40 against the action of the spring 41 to re-establish a flow path to the atmosphere.

It will be seen from the foregoing description that the present invention provides a simple, efficient, and inexpensive pull cable operated pyrotechnically inflating apparatus which incorporates therein a venting passageway which is open to vent the interior of the inflatable device when the apparatus is in its unoperated condition and which is closed and locked in the closed condition upon operation of the apparatus.

As various changes may be made in the form, construction and arrangement of the parts herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in any limiting sense.

I claim:

1. Inflating apparatus comprising a container for a fluid medium having an outlet opening, a control head closing said opening and having an outer surface in communication with the atmosphere and having an inner surface in communication with the interior of said container, bore means in said control head extending inwardly from said outer surface toward said inner surface and having an outer end in communication with the atmosphere and having an inner end, a pyrotechnic charge in fluid flow communication with the interior of said container, a percussion actuated igniter at said inner end of said bore for igniting said charge, an impacting member in said bore for actuating said igniter, spring means

for urging said impacting member toward said igniter, locking means for normally holding said impacting member spaced from said igniter, pull cable operated trigger means for releasing said locking means, a charge of pressurized fluid medium in said container, outlet port means on said control head for attaching an inflatable unit, a first passageway through said control head having a first end in fluid flow communication with the interior of said container and having a second end in fluid flow communication with said outlet port means, a burst disc in said passageway for releasing the fluid medium when the pressure within said container is increased by the burning of said pyrotechnic charge, a second passageway through said control head having a first end in fluid flow communication with said bore and having a second end in fluid flow communication with said first passageway means downstream of said burst disc, and means for sealing said first end of said second passageway from the atmosphere when said impacting member is released from its normal position.

2. Apparatus according to claim 1, including latching

means actuated by the movement of said impacting member for latching said sealing means in the sealed condition.

3. Apparatus according to claim 2, wherein said sealing means includes a sealing member in said bore and a formation on said impacting member substantially filling said bore and having an unbroken outer surface for cooperating with said sealing member to provide a seal across said bore.

4. Apparatus according to claim 3, wherein said sealing member is positioned between said inner end of said bore and said impacting member in its normal position, and said first end of said second passageway is positioned between said inner end of said bore and said sealing member.

No references cited.

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