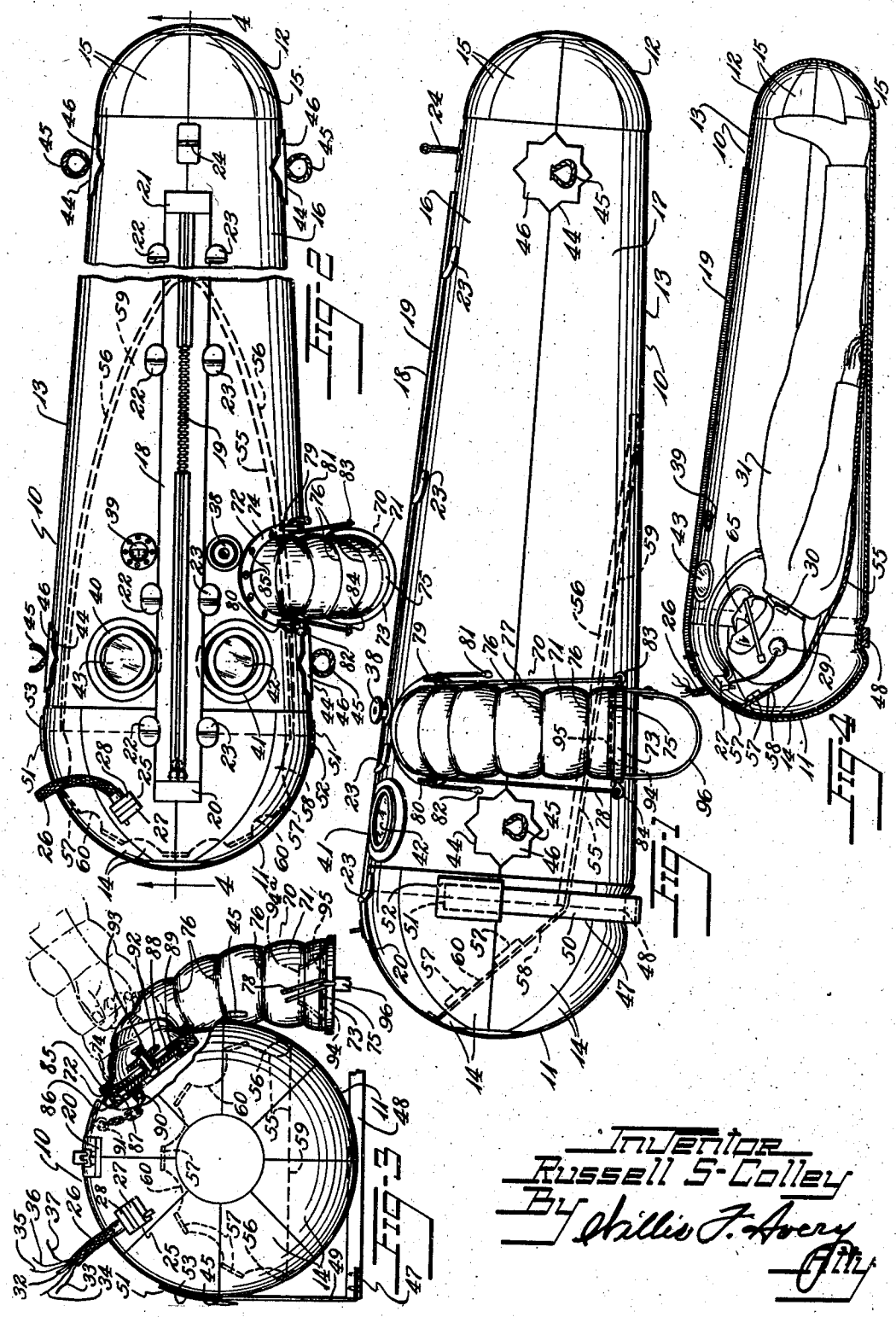
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INFLATABLE PROTECTIVE CONTAINER

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INFLATABLE PROTECTIVE CONTAINER

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This invention relates to inflatable containers for enclosing and protecting bodies and especially to such containers for the recumbent bodies of incapacitated persons.

Objects of the invention are to provide for wholly enclosing and protecting bodies at a desired pressure; to provide for supporting animate bodies in recumbent positions in inflatable containers; to provide for suspending and maintaining such bodies in a desired postural condition in such containers; to provide for protecting disabled animate bodies at high altitudes; to provide for accessibility in the container when open; to provide for effective sealing of the container when closed; to provide light weight, portability and compactness together with convenience of use; and to provide simplicity of construction, convenience of manufacture and effectiveness of operation.

Further objects of the invention are to provide for treating animate bodies in the containers, to provide access to the container when same is in an inflated condition, and to provide for admitting a body to the inflated container.

These and other objects and advantages of the invention will be apparent from the following description.

In the accompanying drawing which forms a part of this specification and in which like numerals are employed to designate like parts throughout the same,

Fig. 1 is a side elevation of an inflatable container in the inflated condition as disposed on a supporting surface and constructed in accordance with and embodying the invention.

Fig. 2 is a plan view of the top of the container, parts being broken away,

Fig. 3 is an end view looking toward the larger end portion of the container, broken lines showing partially an airlock sleeve structure under pressure for enclosing an arm of an attending person, parts being broken away, and

Fig. 4 is a sectional view taken along line 4—4 of Fig. 2 and also showing a recumbent body supported within the container.

The illustrative embodiment of the invention shown in the drawing includes a hollow member or elongated bag 10 having walls of flexible material such, for example, as suitable woven fabric having the desired physical characteristics, such as strength and flexibility, and having a coating or impregnation of resilient rubber or other rubber-like material for rendering the fabric substantially impervious to fluid such as air under pressure and water. The bag 10 comprises closed end portions 11 and 12, which may be rounded in form, for closing the ends of the bag, one of such end portions being desirably of relatively larger extent than the other end portion for accommodating the body of a person at the region of the torso; and the bag also comprises a tubular portion 13, which may be tapered, interconnecting the end portions 11 and 12. The bag 10 is thus capable of wholly enclosing and protecting the body of a human being, for example, and is useful especially for such purposes when it is desirable that the body be maintained and supported in a recumbent postural position as in the case of a disabled person.

For convenience of manufacture the rounded end portions 11 and 12 may be made of a plurality of suitably shaped pieces 14 and 15 of fabric, while the tapered portion 13 may be made of two or more suitaby shaped pieces 16 and 17 of fabric for forming the upper and lower parts respectively of such portion 13. The margins of the adjacent pieces of fabric are in overlying relation and may be sewed, or adhered as by rubber cement, or both, for uniting integrally the respective portions 11, 12 and 13.

The flexible bag 10 is provided with an aperture 18 for permitting access to the interior thereof and for admitting the body, which aperture extends desirably axially along the upper part of the bag a sufficient extent to facilitate disposing such body within the latter while in a recumbent position. The adjacent margins of the aperture 18 may be closed by a slide fastener closure 19 including sealing means and end closure means 20 and 21, the closure 19 being constructed and arranged for withstanding a pressure differential at the two sides of the wall of the bag 10 and may be adapted to withstand dominant pressure at either side of the wall. The slide fastener closure may be arranged for operation from within or outside the bag, or both, if desired, while the sealing means may be disposed within or at the outside, or both, of the bag. Spaced-apart pull tabs 22, 23 and 24 of suitable fabric may be attached to the adjacent margins of the aperture 18 as by a suitable adhesive such, for example, as rubber cement, for promoting ease of operation of the closure 19 throughout its extent during the engaging and disengaging of the slide fastener. Sealing slide closures suitable for this purpose are disclosed in the copending application of Carroll P. Krupp, Serial No. 477,970, filed March 4, 1943.

The container may be inflated by air under pressure conducted through the wall of the flex-

ible bag 10 by a suitable conducting means 25 connected by a flexible hose or conduit 26, to a source of supply of such air, for example, a portable electric power-driven air compressor (not shown), which conducting means 25 may comprise a separable connector structure or junction box arrangement, shown especially in Figs. 2 and 3, mounted on the wall of the bag 10 and preferably at the larger end portion 11 for convenience of use of the container.

The junction box includes a fitting 27 having fluid conduits for conducting the air through the flexible wall and adapted to be engaged by a separable connector member 28 to which the hose 26 is attached. The junction box is provided desirably with a valve structure for preventing the escape of the air from the container when such box is in the disengaged condition. For facilitating the use of the inflatable container in aircraft at high altitudes, it is desirable that the junction box also include an oxygen conduit to supply oxygen for breathing purposes to the occupant in the container and also include electrical conductors for connecting to earphones 29, a throat microphone 30, and an electrically heated suit 31 with which such occupant may be provided for communication and comfort purposes. An oxygen supply hose 32 and electrical connector wires 33 to 37 may be included within the hose 26 for interconnecting with the remotely disposed oxygen supply, communication apparatus, and current supply for the heated suit and to a ground connector. A suitable junction box for these purposes is shown and described in the copending application of Russell S. Colley, and Carroll P. Krupp, Serial No. 445,586, filed June 3, 1942.

A pressure relief valve 38 in communication with the interior of the bag 10 for exhausting air through the wall thereof to the outside of the bag and for maintaining a substantially uniform pressure condition within the latter, is mounted on the wall of the bag, desirably adjacent the larger end portion 11 and in the upper part at 16 of the tapered portion 13 adjacent one of the margins of the aperture 18. A suitable pressure indicating gauge 39 may be mounted on the wall of the bag opposite the pressure relief valve 38 and adjacent the other margin of the aperture 18 and in communication with the interior of the bag for facilitating adjustment of the valve 38 to maintain the internal pressure within the desired range.

Spaced-apart inspection window structures 40 and 41 including, desirably, transparent panes 42, 43 of plastic material may be attached to the margins of apertures in the wall of the container at each side of the aperture 18 and adjacent the larger end portion 11 for permitting observation of the occupant within the container. To facilitate handling the container, especially when in the inflated condition, handles 44 are mounted opposite each other at each end of the tapered portion 13, which handles may comprise grip portions 45 of flexible rope material and patch portions 46 for retaining the frayed fibrous ends of the ropes and for attachment to the wall of the bag 10 as by a suitable adhesive, or by sewing, or both.

The elongated bag 10 in the inflated condition may roll sidewise under changing conditions of the supporting surface such, for example, as tilting of the floor of an aircraft in flight; hence a supporting structure 47 may be provided for stabilizing the bag 10 and preventing such sidewise rolling action. The supporting structure 47 includes a base element 48 of stiff material such, for example, as a bar of wood, which element may be substantially coextensive lengthwise with respect to the maximum transverse width of the large end portion 11, and the structure 47 also includes restraining strap elements 49 and 50 of flexible material suitably secured at one of their ends to the base element 48. The straps extending upwardly from the base element 48 are also attached at the other ends thereof at 51 substantially tangentially to the opposite rounded walls of the end portion 11, as shown especially in Fig. 3, as by sewing, or by a suitable adhesive, or both, which latter ends of the straps may be protected by covering strips 52 and 53 secured thereto and to the walls of the end portion 11 as by a suitable adhesive. The supporting structure 47 may be constructed and arranged such that the lower parts of the rounded end portion 11 and the tapered portion 13 adjacent the base element 48 tend to assume a partially flattened condition for presenting a relatively flat surface against the supporting surface to provide further stability.

It is desirable to provide a supporting means 55 or hammock-like structure suspended within the elongated bag 10 for yieldingly supporting the body, especially the head and torso portions of the body of a disabled person such, for example, as a person having chest or abdominal injuries. Preferably, the hammock-like structure 55 is made of flexible sheet material such, for example, as woven fabric having the desired strength and flexibility characteristics and which fabric may have a relatively thin and substantially impervious coating or impregnation of suitable rubber-like material. The hammock-like structure is attached substantially continuously along its attaching margins 56 to the flexible wall of the bag 10 as by sewing, or a suitable adhesive, or both, such that the suspended structure 55 is maintained in a tensioned condition between its attaching margins under inflation of the container for yieldingly supporting the body.

The hammock-like structure 55 which extends axially along the larger end portion 11 and may extend part way along the tapered portion 13, includes a portion 58 at the end portion 11 for supporting the head of the person and a continuous portion 59 at the tapered portion 13 for supporting the torso or remainder of the body. The portion 58 has, desirably, a scalloped attaching margin suitably secured at spaced-apart positions at 57 to the wall of the end portion 11 while intermediate such positions at 57 the scalloped margin is unattached to the wall for providing a plurality of spaced apertures at 60 whereby the pressure at the two sides of the structure 55 is maintained substantially uniformly identical. Also, the supporting means 55 may be constructed and arranged to support the body in a position of graduated inclination, i. e. the head of the person is supported in a greater inclined position than that of the torso, and the torso is supported in an inclined position relative to the legs, which arrangement facilitates preventing obstruction of the throat of the disabled person by mucus, for example, and provides for yieldingly supporting the body in a relatively comfortable recumbent position.

For facilitating the administration to the needs of the person within the inflated container, especially when such person is in an injured condition, an air-lock structure 70 includ-

ing a tubular sleeve element 71 in communication through a suitable aperture with the interior of the bag may be provided and attached to the wall of the latter desirably adjacent the large end portion 11 and overlying the hammock-like structure 55. The tubular sleeve element 71, which may be of suitable square-woven fabric cut such that the threads of the latter extend diagonally around the sleeve and having a suitable fluid-tight coating or impregnation of rubber material, may be attached at its ends to flanged ring elements 72 and 73 by a suitable adhesive and clamping bands 74 and 75. The tubular sleeve 71 may be provided with a plurality of spaced-apart, circumferentially extending bands 76 of flexible material such, for example as cord material for restricting bulging of the sleeve by virtue of the give of the fabric under inflation to zones intermediate such bands. In this manner the continuity of the longitudinal and transverse stresses in the wall of the sleeve 71 due to the internal pressure is interrupted, thus reducing the inherent rigidity of the inflated sleeve and promoting flexibility of arm movement together with facilitating axial shortening of such sleeve of flexible tensioning cables 77 and 78 oppositely disposed and extending along the sleeve between the ring elements 72 and 73.

One of the ends of each of the tensioning cables 77 and 78 may be attached to an apertured projecting element 79 and 80 which may be integral with the ring element 72, while the other end is unattached and terminates in a suitable pull-tab 81 and 82. The tensioning cables 77 and 78 extend continuously in one or more loops through the apertures in the projecting elements 79 and 80 and the apertures in apertured projecting elements 83 and 84 which may be integral with the ring element 73. This arrangement promotes substantially free sliding movement of the cables through the apertures during the shortening action on the tubular sleeve by the operator while obtaining the desired binding action of such cables to maintain the tubular sleeve in the shortened condition.

The ring element 72 including the tubular sleeve 71 may be mounted on the wall of the bag by means of a suitable adhesive and spaced-apart screw fasteners 85 extending through registering apertures in such wall and engaging threaded apertures in an oppositely arranged flanged ring element 86 positioned and adhered against the inner surface of the wall. The flanged ring element 86 may be provided with circumferentially spaced-apart projections 87 extending substantially parallel with the surface of the ring element 86 abutting the wall of the bag and adapted for engaging in interlocking and overlapping relation with corresponding projections on a cover plate 88 for holding the plate pressed against a sealing ring 89 of suitable rubber material between the ring element 86 and the plate 88 whereby such cover plate 88 detachably closes and seals the wall end portion of the air-lock structure 70, as shown especially in Fig. 3. A chain 90 or other flexible element attached to the cover plate 88 and to a patch element 91 adhered by a suitable adhesive to the wall of the bag may be provided for preventing such plate falling into the bag when in the disengaged condition.

For convenience of manipulating the cover plate 88 from within the tubular sleeve 71, a handle 92 integral with such plate may be provided at the side adjacent such sleeve. A spring loaded bleeder valve 93 may be disposed within an aperture extending through the handle and cover plate for facilitating equalizing the pressure in the sleeve 71 with that pressure in the bag before disengaging the cover plate 88 from the ring element 86.

The other end of the air-lock structure 70 may be closed and sealed against the arm of the operator such, for example, as a medical attendant for the injured occupant of the bag, by a flexible diaphragm 94 of resilient rubber or other rubber-like material having an aperture at 95 for accommodating such arm in sealing relation therewith at the margin 94a of the aperture. The diaphragm 94 may be attached to the ring element 73 by the clamping band 75 and as by a suitable adhesive, and may be positioned between the ring element 73 and the tubular sleeve 71. The diaphragm 94 is flexed inwardly along the sleeve 71, as shown by broken lines in Fig. 3, when the arm is inserted through the aperture at 95 into the sleeve and the margin 94a of the aperture seals against the arm of the operator. An adjustable strap 96 of flexible material such, for example, as leather may be attached to the ring element 73 and is adapted to extend around the shoulder of the operator for preventing accidental separation of the air-lock structure from the arm under the piston-like ejecting action of the inflating pressure on such arm.

The construction of the inflatable container comprising to a large extent flexible material as described hereinabove, promotes conveniently storing or transporting the container in a compactly rolled or folded condition on board the aircraft; while the relatively light weight of the container permits the latter to be carried easily by one person, especially for the folded condition, to the place in the aircraft where the container is to be supported in the inflated condition on the supporting surface such, for example, as the floor of a compartment therein. By virtue of its portability and construction the container may be quickly and conveniently arranged for use prior to or during flight of the aircraft.

In the operation of the inflatable container, it is disposed in a deflated and extended condition upon the supporting surface. The adjacent margins of the aperture 18 are separated by disengaging the slide fastener closure 19 and are spread apart to facilitate placing the body or person within the container such that the head of the person is at the large end portion 11 and the torso and legs of such person extend along the tapered portion 13 toward the end portion 12, as shown especially in Fig. 4. When the container is provided with the hammock-like structure 55, the head of the person rests upon and is supported by the portion 58 thereof and the torso rests upon and is supported by the continuous portion 59, whereby the head is inclined forwardly relative to the torso for the inflated condition of the container.

With the person within the container and overlying the hammock-like structure, the slide fastener closure 19 is engaged throughout its extent thus closing and sealing the adjacent margins of the aperture 18 and enclosing such person wholly within the bag. To conduct the air under pressure from its source of supply into the bag 10 for inflating the latter and maintaining the person at the desired pressure, the separable connector member 28 and its attached hose 26 is connected to the fitting 27 admitting such air

through the wall of the bag 10. The pressure relief valve 38 maintains the desired pressure substantially uniform therein and also exhausts air to the outer atmosphere in accordance with variations in exterior pressures due, for example, to changes in altitude of the aircraft.

On inflation of the bag 10, the hammock-like structure 55 assumes the position shown in the drawing and is in a state of tension between its attaching margins 56 and 57 by virtue of its attachment to the distended and stressed walls of such bag. With the body of the person resting on the hammock-like structure 55 as shown especially in Fig. 4, the weight of such body may cause some sagging action of the hammock-like structure intermediate its margins because of the flexibility and give of the material of both the structure 55 and bag 10 despite the stressed condition thereof and also because of the suspended arrangement of the structure 55 within such bag, which structure thus provides for yieldingly and comfortably supporting the body while conforming to the contour of the latter. The load-stresses due to the weight of the body are transmitted through the attaching margins 56 and 57 of the structure 55 to the flexible walls of the bag, which walls withstand such load-stresses and resist collapsing inwardly by virtue of the inflation pressure within the bag acting thereon, although such walls may bulge outwardly to an additional extent at the region of and below the attaching margins because of such load-stress transmittal.

For further protecting the person within the container during flight at high altitudes, such person may be provided with the set of earphones 29, the microphone 30, the electrically heated suit 31 and an oxygen mask 65, all of which may be connected by suitable conduits and connectors to the fitting 27 at the interior of the bag and thus through the connector member 28 and hose 26 to the oxygen supply, the current supply and the communication apparatus which are disposed exteriorly of the container. However, a separate source of oxygen supply may be disposed within the bag 10 in which case the oxygen mask 65 is connected to such source of supply instead of to the fitting 27.

While the person is within the inflated container, it may be necessary to treat such person by administering medicine or giving a hypodermic injection, for example, in which case the attendant may so treat the person by using the air-lock structure 70 thereby further protecting the occupant of such container. To this end the arm of the attendant is inserted into the non-inflated sleeve 71 through the aperture at 95 in the flexible diaphragm 94 such that the diaphragm is flexed inwardly and is in sealing relation with the arm; and the strap 96 is then positioned around the shoulder for preventing accidental withdrawal of the arm from the sleeve 71 when the latter is in the inflated condition.

The tubular sleeve is then inflated by manipulation of the bleeder valve 93 until the pressure therein is substantially equal to the pressure within the bag, after which the cover plate 88 is disengaged from the ring element 86 by rotating the plate 88 and handle 92 relative to the latter ring element and permitting such cover plate to hang suspended by the chain 90 for convenience of engagement subsequently. When the pressure within the sleeve 17 is equalized relative to the pressure in the bag, the sleeve assumes the form of a series of outwardly bulged ring-like portions which reduces its rigidity and facilitates bending and axial movement thereof for shortening the length of such sleeve to permit positioning the hand and arm of the attendant within the bag. The length of the tubular sleeve 71 is decreased the desired amount by grasping and pulling the pull-tabs 81 and 82 thus placing the cables 77 and 78 in a tensioned condition such that the sleeve is shortened by a relative axial collapsing action of the bulges thereof. A snubbing action of the cables 77 and 78 against the projecting elements 79 and 80, and 83 and 84 facilitates maintaining the sleeve in its axially collapsed condition.

To return the sleeve 71 to its extended condition preparatory to withdrawing the arm, the tension of the cables is released and the cover plate 88 is engaged in sealing relation with the ring element 86, after which the strap 96 is removed from around the shoulder. The arm may then be withdrawn from the sleeve through the aperture in the flexible diaphragm 94 thereby releasing the pressure within the sleeve. The bleeder valve 93 prevents the escape of the air under pressure from within the bag.

In this manner the person within the container may receive medical or other treatment despite being wholly enclosed therein and under fluid pressure.

The inflatable container described hereinabove is suitable, especially, for effectively protecting and supporting the body of a person in a recumbent position during flight in aircraft at high altitudes. It may be used for relieving persons suffering from aeroembolism or "bends" without necessitating descent to lower altitudes. Also, it may be useful especially for protecting persons having chest or abdominal injuries against hemorrhages during the transportation of such incapacitated persons in aircraft, which aircraft may, of necessity, fly at high altitudes. The container may even be used as flotation apparatus within the aircraft when the latter may be forced to land in an emergency on the water and thus assist in preventing the sinking of the aircraft.

Variations may be made without departing from the scope of the invention as it is defined in the following claims.

I claim:

1. An inflatable container for protecting a body, said container comprising a closed hollow member including wall portions for enclosing said body, body-supporting means suspended from said wall portions within said hollow member for yieldingly supporting said body, and means for access of the hand of an attendant to said hollow member, the access means including means for holding the hand against outward removal under its tendency to be ejected by air pressure within the container.

2. An inflatable container as defined in claim 1 in which the means for access comprises an air-lock structure in communication with said hollow member and holding means exterior of said air-lock structure.

3. An inflatable container for protecting a body, said container comprising a closed hollow member for enclosing said body, a sub-chamber in communication with said hollow member for admitting a second body to the latter member, detachable closing and fluid sealing means for closing and sealing said chamber at the wall of said hollow member, sealing entry means in said sub-chamber at a position spaced from said

closing means, and means for holding said second body from removal from said sub-chamber under predominant pressure within said member.

4. An inflatable container for protecting a body, said container comprising a closed hollow member including flexible wall portions for enclosing said body, body-supporting means suspended directly from said flexible wall portions within said hollow member for supporting said body yieldably from said flexible wall portions, means for access of the arm of an attendant to said hollow member, the latter said means including means for separably engaging the shoulder of said attendant to hold the arm against outward removal under its tendency to be ejected by predominant air pressure within the container, and means for inflating said hollow member to effect a suspended condition of said body supporting means by the inflation of said member for supporting said body yieldably by virtue of the flexibility of said wall portions and the distending force on said wall portions under said inflation.

5. An inflatable container for protecting a body, said container comprising an elongated closed hollow member including flexible wall portions for enclosing said body, said hollow member having an elongated aperture in the flexible wall thereof and extending longitudinally along said hollow member for admitting said body, fluid-sealing slide fastener means at the margins of said elongated aperture for separably uniting and closing said margins, body-supporting means suspended directly from said flexible wall portions within said hollow member for supporting said body yieldably from said flexible wall portions, means for inflating said member to effect a suspended condition of said body-supporting means by the inflation of said hollow member for supporting said body yieldably by virtue of the flexibility of said wall portions and the distending force on said wall portions under said inflation, a tubular sleeve element including a plurality of outwardly bulged annular portions contiguous with one another and means disposed circumferentially between adjacent annular portions for restricting outward bulging of said sleeve element to said annular portions for facilitating flexing of said sleeve element, said sleeve element being in communication with said hollow member and mounted on the wall thereof above said body-supporting means, a detachable closing structure including fluid-sealing means mounted on said wall for closing said sleeve element at said wall, a ring structure including an apertured diaphragm of resilient rubber-like sheet material attached to said sleeve element at a position spaced from said closing structure for entry of a second body to said sleeve element, the margin of the aperture in said diaphragm being capable of sealing relation with said second body by virtue of the resiliency of said material, means exterior of said sleeve element for adjustably limiting the length of said sleeve element, and means for preventing ejection of said second body under inflation pressure within the container.

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