A valve structure provided in the interior space of a flexible inflatable member for maintaining an air-tight seal of the interior space of the flexible inflatable member and for forcing gas into or out of the interior space of the flexible inflatable member without making contact with a valve portion, and a flexible inflatable member provided with the valve structure are disclosed. The valve structure is fixed to a flexible inflatable body so as to constitute a flexible inflatable member. A valve structure is installed in the interior space of the flexible inflatable body so as to force air into or out of the interior space while maintaining air-tight seal of the interior space. The valve structure is provided with a cylindrical-shaped valve body in which one end thereof is blocked with a predetermined thickness and the other end thereof is opened, a valve portion in which the thickness of the blocked portion of the one end is incised from an outer surface of the one end to the inner surface on the interior side of the valve body, and one of confronting surfaces of the incision is movable in the longitudinal direction of the cylindrical-shaped valve body, and an uplifted portion which protrudes from one side of the incision toward the interior space. When the uplifted portion is pressed in the longitudinal direction of the valve body, the one of the confronting surfaces of the incision of the valve portion being in close contact is moved so as to allow a space on the outer surface side of the blocked portion to communicate with the interior space S of the valve body.
DESCRIPTION

VALVE STRUCTURE AND FLEXIBLE INFLATABLE MEMBER PROVIDED WITH THE VALVE STRUCTURE

TECHNICAL FIELD

[0001]

The present invention relates to a valve structure molded of a flexible material, which is provided in a flexible inflatable member for forcing gas into or out of the flexible inflatable member.

BACKGROUND ART

[0002]

In the past, for example, a flexible inflatable member formed of a flexible material is generally provided with a valve structure made of a flexible material for forcing gas such as air into or out of the interior space of the flexible inflatable member.

As an example of such a valve structure, a structure is known which includes an open-ended cylindrical member having a cap member detachably fitted to one end thereof and the other end welded to a flexible inflatable body so as to allow communication between the interior space of
the body and the inside of the cylindrical member, in which a check valve is disposed inside the cylindrical member (see reference numeral 52 in Patent Document 1, for example). However, since such a valve structure is welded to the flexible inflatable body from the outside, the valve structure protrudes out from the flexible inflatable body and looks like a navel from the outside view, thereby spoiling the appearance of the flexible inflatable member. Moreover, when a strong force is applied to the valve structure in the course of using the flexible inflatable member, the welding portion of the valve structure may be separated from the flexible inflatable member, which may possibly break the air-tight seal of the interior space of the flexible inflatable member.

[0003]

As another example, Patent Document 2 discloses a valve structure that is accommodated in the interior space of a flexible inflatable member. Such a valve structure is formed of a tube-like member made of a flexible material that can be squeezed flat. One open end of the tube is fixed to the inner side of an opening portion formed in the flexible inflatable member. In the case in which the interior space of the flexible inflatable member is filled with air, the other open end of the tube is
squeezed flat by the internal pressure so as to make close contact with the flexible inflatable member, thereby acting as a valve and maintaining the air-tight seal of the interior space of the flexible inflatable member.

In the case of forcing air into or out of the flexible inflatable member in the state in which the interior space of the flexible inflatable member is communicated with the outside, a rod-like member is inserted into the close contact portion of the tube from the outside of the flexible inflatable member so as to make a gap in the close contact portion of the tube with the thickness of the rod-like member.

[0004]

However, since the rod-like member comes in direct contact with the close contact portion of the tube at the time of the insertion, flexibility of the close contact portion of the tube may be hampered and the imprint of the rod-like member may remain on the tube, thereby disabling the close contact and thus hampering the air-tightness of the interior space of the flexible inflatable member. In the present application, Patent Document 1 and Patent Document 2 respectively correspond to Japanese Examined Utility Model Application Publication No. 3072193 and Japanese Published Utility Model Application S57-126298.
DISCLOSURE OF THE INVENTION

[0005] An object of the invention is to provide a valve structure provided in the interior space of a flexible inflatable member for maintaining an air-tight seal of the interior space of the flexible inflatable member and for forcing gas into or out of the interior space of the flexible inflatable member without making contact with a valve portion, and to provide a flexible inflatable member provided with the valve structure.

[0006] According to an aspect of the invention, there is provided a valve structure which is fixed to a flexible inflatable body having a predetermined interior space so as to constitute a flexible inflatable member together with the flexible inflatable body, in which a valve portion is installed in the interior space of the flexible inflatable body so as to force air into or out of the interior space while maintaining air-tight seal of the interior space, the valve structure including: a cylindrical-shaped valve body in which one end thereof is blocked with a predetermined thickness and the other end thereof is opened/ a fixing unit which is disposed close
to the other end side of an outer peripheral surface of
the valve body so as to be fixed to the flexible
inflatable body; a valve portion in which the thickness of
the blocked portion of the one end is incised from an
outer surface of the one end to the inner surface on the
interior space side of the valve body, and one of
confronting surfaces of the incision is movable in the
longitudinal direction of the cylindrical-shaped valve
body; and an uplifted portion which protrudes from one
side of the incision toward the interior space, wherein
when the uplifted portion is pressed in the longitudinal
direction of the valve body, the one of the confronting
surfaces of the incision of the valve portion being in
close contact is moved so as to allow a space on the outer
surface side of the blocked portion to communicate with
the interior space of the valve body. A protruding
portion may be provided in an inner peripheral surface
disposed closer to the other end than the uplifted portion
of the valve body so as to swell from the inner peripheral
surface toward the interior space. The incision may be
made oblique in the direction from the outer peripheral
side of the outer surface of the one end toward the center
of the inner surface of the interior space of the valve
body.
According to another aspect of the invention, there is provided a valve structure which is fixed to a flexible inflatable body having a predetermined interior space so as to constitute a flexible inflatable member together with the flexible inflatable body, in which a valve portion is installed in the interior space of the flexible inflatable body so as to force air into or out of the interior space while maintaining air-tight seal of the interior space, the valve structure including: a cylindrical-shaped valve body in which one end thereof is blocked with a predetermined thickness and the other end thereof is opened; a fixing unit which is disposed close to the other end side of an outer peripheral surface of the valve body so as to be fixed to the flexible inflatable body; a valve portion in which the thickness of the blocked portion of the one end is incised from an outer surface of the one end to the inner surface on the interior space side of the valve body, and a pair of confronting surfaces of the incision is movable in a direction perpendicular to the longitudinal direction of the cylindrical-shaped valve body; and a protruding portion which swells from the inner peripheral surface of the interior space toward the interior space, wherein when
the protruding portion is pressed toward the outer peripheral surface, the pair of confronting surfaces of the incision of the valve portion being in close contact is moved so as to allow a space on the outer surface side of the blocked portion to communicate with the interior space of the valve body.

[0008]

A plurality of protruding portions may be arranged at predetermined intervals in the circumferential direction of the inner peripheral surface of the interior space. Alternatively, the protruding portion may be provided continuous in the circumferential direction of the inner peripheral surface of the interior space. The fixing portion of the valve body may be provided with a flange portion that locks the valve structure to the flexible inflatable body, the flange portion extending from an outer peripheral edge of the fixing portion to be continuous in the circumferential direction of the outer peripheral surface. The fixing portion of the valve body may be provided with a locking portion that locks the valve structure to the flexible inflatable body, the locking portion being arranged at predetermined intervals in a direction from the other end to the one end of the valve body and extending from the outer peripheral surface
of the valve body to be continuous in the circumferential direction of the outer peripheral surface of the valve body.

In addition, the flexible inflatable body may have an opening portion penetrating through the inner surface and the outer surface thereof, and the fixing portion of the valve body of the valve structure according to the above aspect may be fitted to the opening portion. The flexible inflatable body may be integrally formed using a rotation molding.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1A to 1C show the configuration of the valve structure of a first embodiment provided in a flexible inflatable body, and Fig. 1A is a side view of the configuration, Fig. 1B is a cross-sectional view of the valve structure and one part of the flexible inflatable body and Fig. 1C is a view showing valve structure from one end side thereof;

Figs. 2A to 2C show the state in which a nozzle is inserted into a valve body of the valve structure of the first embodiment provided in the flexible inflatable body, and Fig. 2A is a sectional view showing the insertion
state of the nozzle, Fig. 2B is a sectional view showing
the guiding state of the nozzle and Fig. 2C is a sectional
view showing the opened state of the valve structure;

Figs. 3A to 3C show the configuration of the valve
structure of a second embodiment provided in the flexible
inflatable body, and Fig. 3A is a side view of the valve
structure, Fig. 3B is a sectional view of the valve
structure and a portion of the flexible inflatable body,
and Fig. 3C is an end view of the valve structure;

Figs. 4A to 4C show the opened state of the valve
structure of the second embodiment provided in the
flexible inflatable body, and Fig. 4A is a sectional view
of the valve structure and a portion of the flexible
inflatable body, Fig. 4B is an end view of the valve
structure and Fig. 4C is a sectional view taken along the
line IV-IV in Fig. 4A;

Fig. 5 is a sectional view showing another example
of fitting the valve structure to the flexible inflatable
body;

Fig. 6 is a sectional view of another exemplary
configuration of a cylindrical portion of the valve
structure;

Figs. 7A to 7D are explanatory views showing another
exemplary configuration of a protruding portion;
Fig. 8 is a perspective view showing the relation between the valve structure and the flexible inflatable body; and

Fig. 9 is a perspective view showing an exemplary usage of the flexible inflatable member.

BEST MODE FOR CARRYING OUT THE INVENTION

[0010]

Hereinafter, a valve structure related to embodiments of the invention will be described with reference to accompanying drawings.

Figs. IA to IC show the configuration of the valve structure 10 of a first embodiment provided in a flexible inflatable body 24, wherein Fig. IA is a side view of the valve structure 10; Fig. IB is a sectional view of the valve structure 10 and a portion of the flexible inflatable body 24; and Fig. IC is an end view of the valve structure 10. Figs. 2A to 2C show the state in which a nozzle 40 is inserted into a valve body 11 of the valve structure 10 of the first embodiment provided in the flexible inflatable body 24, wherein Fig. 2A is a sectional view showing the insertion state of the nozzle 40; Fig. 2B is a sectional view showing the guiding state of the nozzle 40; and Fig. 2C is a sectional view showing...
the opened state of the valve structure 10.

Figs. 3A to 3C show the configuration of the valve structure 10 of a second embodiment provided in the flexible inflatable body 24, wherein Fig. 3A is a side view of the valve structure 10; Fig. 3B is a sectional view of the valve structure 10 and a portion of the flexible inflatable body 24; and Fig. 3C is an end view of the valve structure 10. Figs. 4A to 4C show the opened state of the valve structure 10 of the second embodiment provided in the flexible inflatable body 24, wherein Fig. 4A is a sectional view of the valve structure 10 and a portion of the flexible inflatable body 24; Fig. 4B is an end view of the valve structure 10; and Fig. 4C is a sectional view taken along the line IV-IV in Fig. 4A.

Fig. 5 is a sectional view showing another example of fitting the valve structure 10 to the flexible inflatable body 24. Fig. 6 is a sectional view of another exemplary configuration of a cylindrical portion of the valve structure 10. Figs. 7A to 7D are explanatory views showing another exemplary configuration of a protruding portion. Fig. 8 is a perspective view showing the relation between the valve structure 10 and the flexible inflatable body 24. Fig. 9 is a perspective view showing an exemplary usage of the flexible inflatable member 20.
The air that is forced into or out of the flexible inflatable member 20 by the valve structure 10 related to the invention should be construed to include substantially the entire gases as well as the atmospheric gas components. For example, a gas such as helium is usable in the invention.

First Embodiment

The valve structure 10 of the present embodiment is formed into a substantially cylindrical shape by injection-molding a flexible material such as a resin (for example, silicon) or a rubber. As shown in Fig. 8, the valve structure 10 is used in a state that the structure is fitted to a opening portion 21 formed in the flexible inflatable body 24 (depicted by dotted lines in the drawing) which is formed into a substantially rectangular parallelepiped shape by a spin molding.

As shown in Figs. IA to IC, the valve structure 10 includes a valve body 11 having a cylindrical shape; an fixing portion F that locks the valve body 11 to the flexible inflatable body 24; a valve portion 14 that is used to force air into or out of the flexible inflatable member 20 while maintaining the air-tight seal therein; an
uplifted portion 12c that is provided for opening portion or closing an abutting face of the valve portion 14; and a protruding portion 30 that guides a front end portion 40a of a nozzle 40 along the uplifted portion 12c. In the present embodiment, the fixing portion F includes a flange portion 15 and a locking portion 16.

[0012]
The one end 12 of the cylindrical-shaped valve body 11 is blocked with a predetermined thickness D and the other end 13 is opened. That is, an interior space S that is opened to the other end 13 is formed in the valve body 11.

In the present embodiment, although the valve body 11 is formed in a cylindrical shape having a circular section, the sectional shape is not limited to this but may be an ellipsoidal shape or a rectangular shape.

[0013]
The fixing portion F is disposed in the outer peripheral surface of the valve body 11 closer to the other end 13. In the present embodiment, the fixing portion F includes the flange portion 15 and the locking portion 16.

The flange portion 15 extends outward in a direction perpendicular to the valve body 11 from an outer
peripheral edge 13a of the valve body 11 closer to the other end 13 and is formed into a circular ring shape that is continuous in the circumferential direction. The locking portion 16 is provided in the outer peripheral surface 11a and is displaced from the other end 13 of the valve body 11 by a predetermined gap P toward the one end 12. The locking portion 16 extends outward in a direction perpendicular to the valve body 11 from the outer peripheral surface 11a, while the extension amount of the locking portion 16 being smaller than that of the flange portion 15, and is formed into a circular ring shape that is continuous in the circumferential direction.

[0014]

As shown in Fig. 1B, a peripheral groove 22 is formed in the opening portion 21 of the flexible inflatable body 24 so as to be fitted to the flange portion 15, thereby allowing the valve structure 10 to be fixed and locked to the opening portion 21. In this case, the valve portion 14 is in the installed state in which the valve portion 14 is installed in the flexible inflatable member 20.

The inner surface of the flexible inflatable member 20 corresponding to the peripheral groove 22 forms a mandible portion 23 that protrudes toward the center of
the opening portion 21.

The mandible portion 23 is protruded so as to form a space having a diameter smaller than that of the outer peripheral surface of the cylindrical-shaped valve body 11, while the inner diameter surface thereof has the same thickness as the predetermined gap P. The mandible portion 23 of the flexible inflatable body 24 makes close contact with the outer peripheral surface of the valve body 11, and thus an urging gripping force is applied therebetween. Also, the mandible portion 23 is inserted between the flange portion 15 and the locking portion 16 in a close contact manner, thereby allowing the valve structure 10 to be firmly locked at a predetermined portion of the opening portion 21.

[0015]

In the present embodiment, although the fixing portion F is configured to include the flange portion 15 and the locking portion 16, the fixing portion F may not include the flange portion 15 and the locking portion 16 as long as the tube body 11 is fixedly locked at a predetermined position of the flexible inflatable body 24. In such a case, it is desirable that the opening portion 21 of the flexible inflatable body 24 has a diameter slightly smaller than that of the outer peripheral surface
of the valve body 11. Also, it is desirable that the opening portion 21 has a thickness sufficient to increase the contact area of the opening portion 21 with the valve body 11. With such a configuration, the fixing portion F can make close contact with a large area of the opening portion 21, and thus the urging gripping force of the opening portion 21 can be applied to the fixing portion F. Accordingly, the valve structure 10 can be firmly locked at the predetermined position of the opening portion 21.

[0016]

The valve portion 14 is formed in the one end 12 of the valve body 11. Specifically, the blocking portion of the one end 12 having the thickness D is incised from an outer surface 12a of the one end 12 to an inner surface 12b of the interior space S. In the present embodiment, the incision is made oblique in the direction from the outer peripheral side of the outer surface 12a of the one end 12 of the valve body 11 toward the center of the interior space S of the valve body 11 (see Figs. 1B and 1C).

When the pair of confronting surfaces 14a and 14b made by the incision are in the close contact state (closed valve state), the air-tight seal of the interior space of the flexible inflatable member 20 is maintained.
Meanwhile, when among the pair of confronting surfaces 14a and 14b, the confronting surface 14a disposed closer to the outer surface 12a of the oblique surface of the incision is moved in the longitudinal direction (vertical direction in the drawing) of the valve body 11 (opened valve state), the interior space $S$ of the valve body 11 is made possible to communicate with the space disposed close to the outer surface of the one end 12.

[0017]

The protruding portion 30 is disposed in the inner peripheral surface disposed closer to the other end 13 than the uplifted portion 12c of the valve body 11 so as to swell from the inner peripheral surface toward the interior space $S$. In the present embodiment, three protruding portions 30a, 30b, and 30c are provided around the inner peripheral surface on one side of the incision (i.e., around the inner peripheral surface on the movable confronting surface 14a); and another protruding portion 30d is provided around the inner peripheral surface on the other side of the incision (i.e., around the inner peripheral surface on the confronting surface 14b). These four protruding portions 30a, 30b, 30c, and 30d are arranged at intervals of about 90 degrees around the circumferential direction.
In the present embodiment, the protruding portions 30a, 30b, 30c, and 30d are formed into a rectangular sectional shape, and upper edges thereof are chamfered in a direction toward the interior space S.

[0018]

These four protruding portions 30a, 30b, 30c, and 30d serve as a guide that guides the front end portion 40a of the nozzle 40 to a predetermined position. As an example of the predetermined position, in the present embodiment, the protruding portions 30a, 30b, 30c, and 30d are arranged such that the front end portion 40a of the nozzle 40 is guided toward a substantially central axis of the interior space S by the ends on the inner peripheral side of the protruding portions 30a, 30b, 30c, and 30d. Meanwhile, with the chamfering, the front end portion 40a of the nozzle 40 can be smoothly guided by the protruding portions 30a, 30b, 30c, and 30d without being interrupted by the protruding portions.

The protruding portion 30 (30a, 30b, 30c, and 30d) can be formed by providing protrusions in the mold of the valve structure 10.

In the present embodiment, although the protruding portions 30a, 30b, 30c, and 30d are formed into a rectangular sectional shape, the invention is not limited
to this and the protruding portions may have a different shape. For example, the protruding portions may swell from the circumferential surface of the interior space $S$ in a semi-circular shape.

[0019]

The uplifted portion 12c is formed so as to swell a predetermined length from the inner surface 12b on the one side (on the movable confronting surface 14a side) of the incision toward the interior space $S$. In the present embodiment, the uplifted portion 12c is disposed between the protruding portion 30a and the confronting surface 14a so as to extend over the inner peripheral surface of the valve body 11 in parallel with the confronting surface 14a as seen from a plan view. In addition, the upper surfaces of both ends of the uplifted portion 12c are continuous to the lower ends of the protruding portions 30b and 30c.

[0020]

In the valve structure 10 having such a configuration, in the case in which air is filled in the flexible inflatable member 20, the valve structure 10 is pressed in the direction for closing the incision (valve portion 14) by the air pressure (i.e., in the direction for overlapping the confronting surfaces 14a and 14b with each other) so as to bringing the confronting surfaces 14a
and 14b of the incision (valve portion 14) into close contact with each other. Accordingly, it is possible to maintain air-tight seal of the interior space R of the flexible inflatable member 20.

Meanwhile, in the case in which air is forced into or out of the flexible inflatable member 20, the nozzle 40 is inserted into the interior space S of the valve body 11 from the open, other end 13 of the valve body 11 (see Fig. 2A). In the present embodiment, the nozzle 40 is provided with nozzle opening 40b along the axial line thereof, and a front end portion 40a of the nozzle 40 is formed in a tapered shape.

When the front end portion 40a of the nozzle 40 is inserted to make abutting contact with the protruding portions 30a, 30b, 30c, and 30d, the front end portion 40a of the nozzle 40 is guided by the protruding portions 30a, 30b, 30c, and 30d so as to be positioned close to the center of the interior space S (see Fig. 2B).

[0021]

When the nozzle 40 is further inserted, the outer peripheral portion of the nozzle opening 40b of the nozzle 40 makes abutting contact with the uplifted portion 12c. At this moment, since the front end portion 40a of the nozzle 40 is guided by the protruding portions 30a, 30b,
30c, and 30d, it is possible to prevent the nozzle opening 40b from being inserted into a portion other than the uplifted portion 13c (see reference symbol S1 in Fig. 2B); or to prevent the nozzle opening 40b from making abutting contact with the uplifted portion 12c in such a manner that the nozzle opening 40b is blocked by the uplifted portion 12c.

[0022]
In this manner, the protruding portion 30 (30a, 30b, 30c, and 30d) and the uplifted portion 12c are required to be disposed in such a relation that the protruding portion 30 guides the front end portion 40a of the nozzle 40 so as to enable the front end portion 40a to make abutting contact with the uplifted portion 12c while preventing the nozzle opening 40b of the nozzle 40 from being blocked by the uplifted portion 12c. In the present embodiment, the uplifted portion 12c is provided so as to guide the front end portion 40a of the nozzle 40 toward the substantially central axis of the interior space S of the valve body 11, while the uplifted portion 12c is disposed so as to be displaced from the substantially central axis of the interior space S of the valve body 11.

[0023]
In such a case, when the nozzle 40 is further
inserted, the front end portion 40a of the nozzle 40 pushes out the uplifted portion 12c in the longitudinal direction of the valve body 11.

By the force pushing out the uplifted portion 12c in the longitudinal direction of the valve body 11, a side portion 12d of the valve body 11 closer to the uplifted portion 12c is expanded in the longitudinal direction of the valve body 11, thereby pushing out the one end 12 of the valve body 11 integrally formed with the uplifted portion 12c in the longitudinal direction of the valve body 11.

At this moment, the confronting surface 14a of the valve portion 14 is moved in the longitudinal direction of the valve body 11. With this movement, the close contact (closed valve state) between the confronting surface 14a and the confronting surface 14b of the valve portion 14 is released so as to generate a gap between the confronting surfaces 14a and 14b, thereby allowing the outer surface 12a of the blocked one end 12 of the valve body 11 to communicate with the interior space S and thus making an opened valve state (see Fig. 2C).

[0024]

In the closed valve state of the valve portion 14, since the front end portion 40a of the nozzle 40 is
configured to open the confronting surfaces 14a and 14b of the valve portion 14 by means of the uplifted portion 12c, no foreign materials (such as on or from the front end portion 40a of the nozzle 40) are brought into contact with the confronting surfaces 14a and 14b of the valve portion 14.

Therefore, it is possible to prevent the confronting surfaces 14a and 14b of the valve portion 14 from being roughened or deformed. Accordingly, in the closed valve state of the valve portion 14, it is possible to maintain good close contact state between the confronting surfaces 14a and 14b of the valve portion 14 for a relatively long period.

[0025]

Since the front end portion 40a of the nozzle 40 is formed in a tapered shape, the non-tapered circumferential surface of the nozzle 40 on the other end 13 of the valve body 11 makes close contact with the peripheral portion of the other end 13 so as to block the opening on the other end 13 side of the interior space S.

With such a configuration, air-tight seal of the interior space R of the flexible inflatable member 20 from the outside can be maintained in the close contact portion between the nozzle 40 and the other end 13. Accordingly,
it is possible to fill air into the flexible inflatable member 20 by blowing air into the nozzle opening 40b of the nozzle 40.

[0026]

In the present embodiment, although the front end portion 40a of the nozzle 40 is formed in a tapered shape, the invention is not limited to this and the front end portion 40a may be formed in a different shape as long as the front end portion 40a can push out the uplifted portion 12c. For example, the front end portion 40a of the nozzle 40 may be reduced stepwise in diameter; and the non-diameter-reduced, circumferential surface of the nozzle 40 may make close contact with the other end 13 of the valve body 11. Alternatively, the front end portion 40a and the nozzle 40 may be formed in a constant diameter. In such a case, a close contact member (such as a ring-shaped thin film) may be provided on the other end 13 side of the valve body 11 so as to compensate the diameter difference of the nozzle 40.

As means for forcing air into the flexible inflatable member 20, a solid, rod-like member (not shown) may be used instead of the nozzle 40. In this case, the rod-like member is inserted into the valve body 11 to push out the uplifted portion 12c so as to open the valve
portion 14, while blowing air using an air-blowing pipe in a state in which the pipe covers the opening on the other end 13 side of the valve body 11.

[0027]
To force out the air filled in the flexible inflatable member 20, the nozzle opening 40b of the nozzle 40 is made open to the atmosphere. In the case in which the nozzle 40 is not used, the rod-like member (not shown) is inserted to push out the uplifted portion 12c so as to open the valve portion 14. Accordingly, the valve body 11 on the one end 12a side is allowed to communicate with the interior space s, and thus the air filled in the flexible inflatable member is forced out.

Second Embodiment

[0028]
In the valve structure 10 of the present embodiment, the valve body 11 of the second embodiment has the same outer appearance as that of the valve structure 10 of the first embodiment, except that the valve portion 14 and the opening or closing thereof are different from that of the first embodiment. Accordingly, the following descriptions will be made mainly on the different portions, and descriptions on the outer appearance of the valve body 11
will be omitted.

As shown in Figs. 3A and 3B, inside the valve structure 10, there are provided a cylindrical-shaped valve body 11, a valve portion 14 that is used to force air into or out of the flexible inflatable member 20 while maintaining the air-tight seal therein, and a protruding portion 30 that functions to expand and open the valve portion 14.

[0029]

The one end 12 of the cylindrical-shaped valve body 11 is blocked with a predetermined thickness D and the other end 13 is opened. That is, an interior space S that is opened to the other end 13 is formed in the valve body 11. A portion on the one end 12 side of the interior space S is formed into a tapered shape.

In the present embodiment, although the valve body 11 is formed in a cylindrical shape having a circular section, the sectional shape is not limited to this but may be an ellipsoidal shape or a rectangular shape.

[0030]

The valve portion 14 is formed in the one end 12 of the valve body 11. Specifically, the blocking portion of the one end 12 having the thickness D is incised from an outer surface 12a of the one end 12 to an inner surface
12b of the interior space S.

In the present embodiment, the incision is made to intersect the section of the one end 12 of the valve body 11. By thus providing the incision, the incised portion (valve portion 14) of the one end 12 is made movable in a direction perpendicular to the longitudinal direction of the cylindrical-shaped valve body 11. In addition, the confronting surfaces 14a and 14b of the incised portion (valve portion 14) are brought into close contact with each other in the closed valve state (non-expanded state).

[0031]

The protruding portion 30 is provided in the interior space S of the valve body 11 so as to swell in a semi-circular shape from the inner peripheral surface toward the interior space S. A plurality of protruding portions 30 are arranged at predetermined intervals around the circumferential direction of the inner peripheral surface of the interior space S; and in the present embodiment, four protruding portions 30a, 30b, 30c, and 30d are formed by way of example. The protruding portion 30 can be formed by providing protrusions in the mold of the valve structure 10.

In the present embodiment, although the protruding portions 30a, 30b, 30c, and 30d are formed to swell in a
semi-circular shape, the invention is not limited to this and the protruding portions may have a different shape. For example, the protruding portions may be formed into a rectangular sectional shape.

[0032] In the valve structure 10 having such a configuration, in the case in which air is filled in the flexible inflatable member 20, the valve structure 10 is pressed in the direction for closing the confronting surfaces 14a and 14b (valve portion 14) by the air pressure so as to bringing the confronting surfaces 14a and 14b of the valve portion 14 into close contact with each other. Accordingly, it is possible to maintain airtight seal of the interior space R of the flexible inflatable member 20.

Meanwhile, in the case in which air is forced into or out of the flexible inflatable member 20, the nozzle 40 is inserted from the open, other end 13 of the valve body 11 as shown in Fig. 4A. In the present embodiment, the front end portion 40a of the nozzle 40 is formed in a tapered shape.

In this case, as the front end portion 40a of the nozzle 40 pushes out the protruding portions 30a, 30b, 30c, and 30d toward the outer peripheral surface, the
confronting surface 14a of the valve portion 14 integrally formed with the protruding portions 30a and 30b is pushed toward the outer peripheral surface (in the left direction of the drawing), while the confronting surface 14b of the valve portion 14 integrally formed with the protruding portions 30c and 30d is pushed toward the outer peripheral surface (in the right direction of the drawing). With this movement, the close contact between the confronting surfaces 14a and 14b is released so as to separate the confronting surfaces 14a and 14b from each other, thereby opening the valve portion 14.

[0033]

At this moment, as shown in Figs. 4A to 4C, the inner surface 12b on the interior space S side of the incision is pulled out in the direction (in the horizontal direction in the drawing) for expanding and opening the incision so as to form a hole H in the incision extending from the tapered, front end portion (the inner surface 12b on the interior space S side) of the interior portion S formed in a tapered shape to the outer surface 12a of the one end 12. In such a case, the space on the outer surface side of the one end 12 of the valve body 11 can be in air communication by the hole H between the confronting surfaces 14a and 14b of the valve portion 14.
That is, the size of the hole H can be adjusted with the depth of the incision; and thus the deeper the incision, the larger the size of the hole H in the open valve state becomes. In addition, the size of the hole H can be freely settable in accordance with the size of the flexible inflatable member 20 used and the usage environment.

[0034]

In the closed valve state of the valve portion 14, since the front end portion 40a of the nozzle 40 is configured to open the confronting surfaces 14a and 14b of the valve portion 14 by means of the protruding portions 30a and 30b, no foreign materials (such as on or from the front end portion 40a of the nozzle 40) are brought into contact with the confronting surfaces 14a and 14b of the valve portion 14.

Therefore, it is possible to prevent the confronting surfaces 14a-and 14b of the valve portion 14 from being roughened or deformed. Accordingly, in the closed valve state of the valve portion 14, it is possible to maintain good close contact state between the confronting surfaces 14a and 14b of the valve portion 14 for a relatively long period.

[0035]
In the embodiments described above, when the flexible inflatable body 24 is fitted to the valve body 11, the circumferential groove 22 of the opening portion 21 of the flexible inflatable body 24 is fitted to the flange portion 15 of the valve body 11; and the mandible portion 23 of the circumferential groove 22 formed to protrude toward the inner surface of the flexible inflatable member 20 is inserted between the locking portion 16 and the flange portion 15 of the valve body 11. However, as shown in Fig. 5, the opening portion 21 of the flexible inflatable body 24 may be further provided with a circumferential groove 25 to be fitted to the locking portion 16, in addition to the circumferential groove 22 fitted to the flange portion 15. In this case, the valve body 11 can be firmly locked to the opening portion 21 of the flexible inflatable body 24.

In the present embodiment, although the valve body 11 is formed in a cylindrical shape, the valve body 11 may be formed in a different shape as long as the one end 12 is blocked with a predetermined thickness D and the other end 13 is opened. For example, as shown in Fig. 6, a portion of the valve portion 11 closer to the one end 12 may be formed in a tapered shape.
In the embodiments described above, four protruding portions 30a, 30b, 30c, and 30d are provided in the interior space $S$ of the valve body 11 so as to swell from the inner peripheral surface toward the interior space $S$ to be arranged in the circumferential direction of the inner peripheral surface of the interior space $S$. However, the protruding portions 30a, 30b, 30c, and 30d may be arranged in a different manner.

For example, two protruding portions 30a and 30b may be arranged to be opposed to each other (see Fig. 7A); and three protruding portions 30a, 30b, and 30c may be arranged at predetermined interval around the circumferential direction (see Fig. 7B). Alternatively, only one protruding portion 30a may be provided (see Fig. 7C); or the protruding portion 30 may be provided as a circular ring-shaped protruding portion 30a that is continuous in the circumferential direction of the inner peripheral surface of the interior space $S$ (see Fig. 7D).

Even in these arrangements, the protruding portion 30 can guide the front end portion 40a of the nozzle 40 to the uplifted portion 12c so as to open the valve portion 14 (see the first embodiment). Moreover, the front end portion 40a of the nozzle 40 can push out the protruding portion toward the outer peripheral portion so as to open
Accordingly, the valve body 11 of the present embodiment can be formed using a sol slush molding (rotation molding) as well as the injection molding.

[0037]

According to the valve structure 10 of the embodiments described above, since the valve structure 10 is used in the state in which the valve structure 10 is fitted to the opening portion 21 of the flexible inflatable body 24, the valve structure 10 is not exposed to the outer surface of the flexible inflatable body 24, and thus the appearance of the flexible inflatable member 20 is not spoiled. In addition, even when a strong force is applied to the valve structure 10 in the course of using the flexible inflatable member 20, the valve structure 10 is hardly destroyed. Accordingly, it is possible to prevent the air-tight seal of the interior space R of the flexible inflatable member 20 from being broken.

[0038]

In the embodiments described above, the valve structure 10 is fitted to the flexible inflatable body 24 molded in a substantially rectangular shape. However, the shape of the flexible inflatable body 24 is not limited to
the substantially rectangular shape but may be freely-selectable in accordance with requirement of the usage environment. Since the flexible inflatable body 24 can be formed using a rotation molding, as shown in Fig. 9, the flexible inflatable body 24 may be easily molded in a wedge shape in which one end side is formed with a smaller thickness than other sides.

[0039]

The flexible inflatable member 20 obtained by fitting the valve structure 10 to the flexible inflatable body 24 having the wedge shape as shown in Fig. 9 is particularly useful for caring persons unable to leave their beds (the person will be referred to as a caretaker). As an example of usage thereof, the air-released flexible inflatable member 20 may be placed under the caretaker's body, and air is blown into the valve structure to inflate the flexible inflatable member 20 so as to support and raise the side of the caretaker, thereby helping caregivers to change clothes of the caretaker.

Therefore, the caregiver can easily support and raise the body the caretaker with the help of the flexible inflatable member, which conventionally was performed with the caregiver's own force. Moreover, since the flexible inflatable member can support a wide range of the
caretaker's body, it is possible to prevent a strong force from being applied to only a portion of the caretaker's body and thus relieve the pain of the bedsore-affected caretaker.

[0040]

When the caring is completed, since the air can be easily forced out of the valve structure 10 fitted to the flexible inflatable body 24 in a smooth manner, it is possible to recover the caretaker's body into the pre-caring position without giving pain to the caretaker.

In the example of the usage, although the air-released flexible inflatable member 20 is placed under the caretaker's body and air is blown into the valve structure 10 to inflate the flexible inflatable member 20, the invention is not limited to this. For example, the air-filled, flexible inflatable member 20 may be placed under the body so as to be used as a cushion.

[0041]

As another example of the usage, the flexible inflatable member 20 may be used as an overlapping packaging material. Since the flexible inflatable body 24 is integrally formed using a rotation molding and thus has a high degree of freedom in the appearance, it is possible to mold the overlapping packaging material in conformity
with an object to be packaged.

In this case, at the time of packaging the object to be packaged, air is blown into the valve structure 10 to inflate the flexible inflatable member 20 so as to be usable as the overlapping packaging material. At the time of unpacking, since the air in the interior space R of the flexible inflatable member 20 can be released from the valve structure 10 so as to be foldable into a small size, it is possible to take most of the storage space thereof. Accordingly, the flexible inflatable member 20 folded in a small size can be returned to the original shipping site and then can be reused as an overlapping package material by inflating the flexible inflatable member 20 returned to the shipping site.

[0042]

Unlike the conventional overlapping packaging material which after unpacking was finely cut off and classified as unburnable garbage, the present overlapping packaging material is effectively recycled by being reused without being classified as the unburnable garbage, and thus it is helpful to environmental protection.

In addition, the valve portion 14 of the valve structure 10 is installed in the flexible inflatable body 24. Therefore, even when the surface of the flexible
inflatable member 20 is severely scratched in the course of repeated use, the valve portion 14 is hardly destroyed and the air-tight seal is rarely broken. Accordingly, the flexible inflatable member 20 can be effectively used as the overlapping packaging material.

Since the valve portion 14 is openable and closable without needing to make contact with the valve portion 14, even when the air is repeatedly blown or released in the course of repeated use, it is possible to maintain the air-tight seal of the flexible inflatable member without degrading the functionality of the valve portion 14.

[0043]

The valve structure 10 of the present invention may be applicable to the case in which the flexible inflatable body 24 is integrally formed using other molding methods other than the rotation molding.

According to the present invention, it is made possible to provide a valve structure provided in the interior space of a flexible inflatable member for maintaining an air-tight seal of the interior space of the flexible inflatable member and for forcing gas into or out of the interior space of the flexible inflatable member without making contact with a valve portion, and to provide a flexible inflatable member provided with the
valve structure..
CLAIMS

1. A valve structure which is fixed to a flexible inflatable body having a predetermined interior space so as to constitute a flexible inflatable member together with the flexible inflatable body, in which a valve portion is installed in the interior space of the flexible inflatable body so as to force air into or out of the interior space while maintaining air-tight seal of the interior space, the valve structure comprising:
   a cylindrical-shaped valve body in which one end thereof is blocked with a predetermined thickness and the other end thereof is opened;
   a fixing unit which is disposed close to the other end side of an outer peripheral surface of the valve body so as to be fixed to the flexible inflatable body;
   a valve portion in which the thickness of the blocked portion of the one end is incised from an outer surface of the one end to the inner surface on the interior space side of the valve body, and one of confronting surfaces of the incision is movable in the longitudinal direction of the cylindrical-shaped valve body; and
   an uplifted portion which protrudes from one side of
the incision toward the interior space,

wherein when the uplifted portion is pressed in the longitudinal direction of the valve body, the one of the confronting surfaces of the incision of the valve portion being in close contact is moved so as to allow a space on the outer surface side of the blocked portion to communicate with the interior space of the valve body.

2. The valve structure according to Claim 1, wherein a protruding portion is provided in an inner peripheral surface disposed closer to the other end than the uplifted portion of the valve body so as to swell from the inner peripheral surface toward the interior space.

3. The valve structure according to Claim 1, wherein the fixing portion of the valve body is provided with a flange portion that locks the valve structure to the flexible inflatable body, the flange portion extending from an outer peripheral edge of the fixing portion to be continuous in the circumferential direction of the outer peripheral surface.

4. The valve structure according to Claim 1, wherein the fixing portion of the valve body is provided
with a locking portion that locks the valve structure to
the flexible inflatable body, the locking portion being
arranged at predetermined intervals in a direction from
the other end to the one end of the valve body and
extending from the outer peripheral surface of the valve
body to be continuous in the circumferential direction of
the outer peripheral surface of the valve body.

5. A flexible inflatable member in which a flexible
inflatable body has an opening portion penetrating through
the inner surface and the outer surface thereof, and the
fixing portion of the valve body of the valve structure
according to Claim 1 is fitted to the opening portion.

6. The flexible inflatable member according to
Claim 5, wherein the flexible inflatable body is
integrally formed using a rotation molding.

7. The valve structure according to Claim 2,
wherein the incision is made oblique in the direction from
the outer peripheral side of the outer surface of the one
end toward the center of the inner surface of the interior
space of the valve body.
8. The valve structure according to Claim 2, wherein a plurality of protruding portions are arranged at predetermined intervals in the circumferential direction of the inner peripheral surface of the interior space.

9. The valve structure according to Claim 2, wherein the protruding portion is provided continuous in the circumferential direction of the inner peripheral surface of the interior space.

10. A valve structure which is fixed to a flexible inflatable body having a predetermined interior space so as to constitute a flexible inflatable member together with the flexible inflatable body, in which a valve portion is installed in the interior space of the flexible inflatable body so as to force air into or out of the interior space while maintaining air-tight seal of the interior space, the valve structure comprising:
   a cylindrical-shaped valve body in which one end thereof is blocked with a predetermined thickness and the other end thereof is opened;
   a fixing unit which is disposed close to the other end side of an outer peripheral surface of the valve body so as to be fixed to the flexible inflatable body;
a valve portion in which the thickness of the blocked portion of the one end is incised from an outer surface of the one end to the inner surface on the interior space side of the valve body, and a pair of confronting surfaces of the incision is movable in a direction perpendicular to the longitudinal direction of the cylindrical-shaped valve body; and

a protruding portion which swells from the inner peripheral surface of the interior space toward the interior space,

wherein when the protruding portion is pressed toward the outer peripheral surface, the pair of confronting surfaces of the incision of the valve portion being in close contact is moved so as to allow a space on the outer surface side of the blocked portion to communicate with the interior space of the valve body.

11. The valve structure according to Claim 10, wherein a plurality of protruding portions are arranged at predetermined intervals in the circumferential direction of the inner peripheral surface of the interior space.

12. The valve structure according to Claim 10, wherein the protruding portion is provided continuous in
the circumferential direction of the inner peripheral surface of the interior space.

13. The valve structure according to Claim 10, wherein the fixing portion of the valve body is provided with a flange portion that locks the valve structure to the flexible inflatable body, the flange portion extending from an outer peripheral edge of the fixing portion to be continuous in the circumferential direction of the outer peripheral surface.

14. The valve structure according to Claim 10, wherein the fixing portion of the valve body is provided with a locking portion that locks the valve structure to the flexible inflatable body, the locking portion being arranged at predetermined intervals in a direction from the other end to the one end of the valve body and extending from the outer peripheral surface of the valve body to be continuous in the circumferential direction of the outer peripheral surface of the valve body.

15. A flexible inflatable member in which a flexible inflatable body has an opening portion penetrating through the inner surface and the outer
surface thereof, and the fixing portion of the valve body of the valve structure according to Claim 10 is fitted to the opening portion.

16. The flexible inflatable member according to Claim 15, wherein the flexible inflatable body is integrally formed using a rotation molding.
**INTERNATIONAL SEARCH REPORT**

**International application No**

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**A CLASSIFICATION OF SUBJECT MATTER**

Int.Cl. F16K1/5/20 (2006.01)i, A63H2/7/10 (2006.01)i, F15B1/5/10 (2006.01)i, F16K1/00 (2006.01)i, F16K3/10 (2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

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**B FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. F16K15/20, F16K15/14, A63H27/10, F15B15/10, F16K1/00, F16K13/10

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**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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