June 28, 1960 G. E. LARDNER 2,942,614

INFLATION VALVE

Filed Nov. 3, 1958

Fig. 1

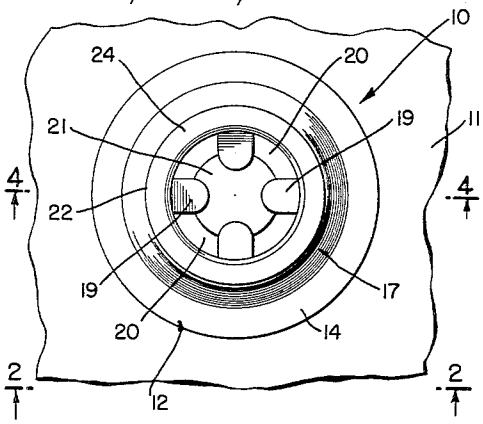


Fig. 2

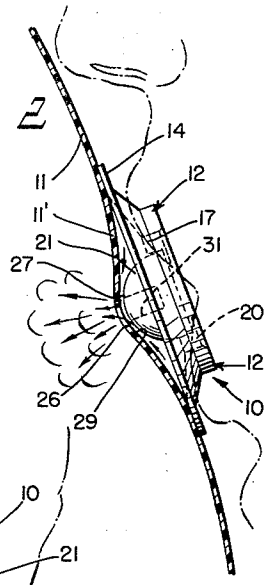
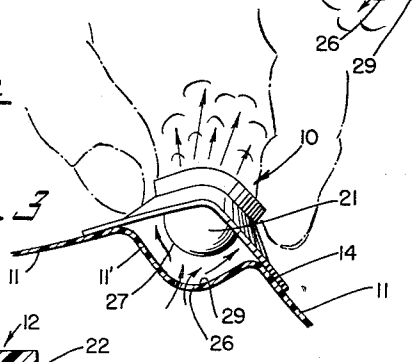


Fig. 3



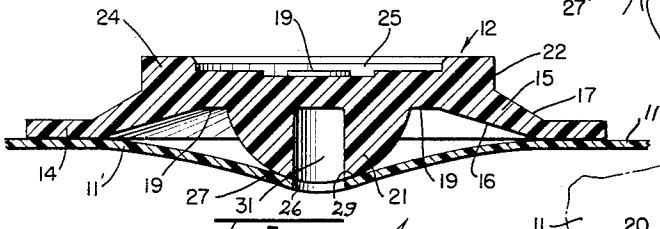


Fig. 4

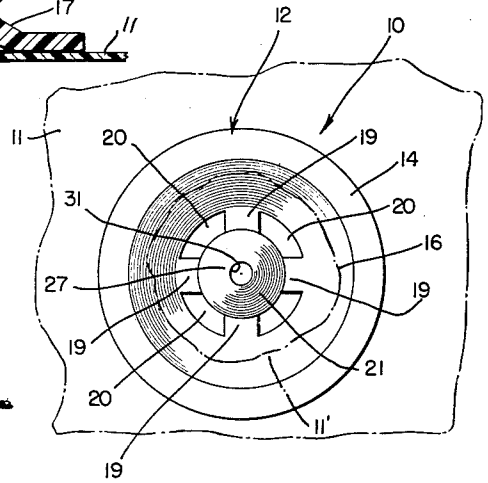


Fig. 5

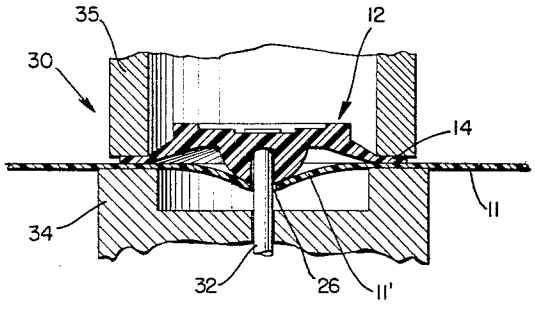


Fig. 6

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INFLATION VALVE

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9 Claims. (Cl. 137—223)

This invention relates to a valve, such valve being advantageously employed with inflatable articles having flexible side walls of relatively thin sheet-like or film material.

The invention has among its objects the provision of an improved novel valve of the type indicated which is simple, rugged, and is economical to make.

A further object of the invention is to provide a valve which is easily manipulated selectively to inflate or deflate the article with which it is employed.

Yet another object of the invention is the provision of a valve which is characterized by its ease of manufacture and assembly on an inflatable article.

Still another object is the provision of a valve which is of low height or profile, and which is of relatively small diameter.

A further object is to provide a valve which conforms to a substantial extent to the outer contour of an article having a curved side wall without disturbing the sealing effect of the valve.

Another object is the provision of a valve which is particularly characterized by the ease with which it is maintained free from foreign material between the sealing surfaces thereof.

The above and further objects and novel features of the invention will more fully appear from the following description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views—

Fig. 1 is a view in plan of a valve made in accordance with the invention and a fragment of the side wall of an inflatable article to which it is attached;

Fig. 2 is a view in side elevation of the valve and in section through the side wall of the article in the vicinity of the valve of Fig. 1, the article being shown in the act of being inflated, the section being taken along the line 2—2 of Fig. 1;

Fig. 3 is a view partially in side elevation and partially in section generally similar to Fig. 2 but showing the valve as it is being manipulated to deflate the article;

Fig. 4 is an enlarged view in axial section through the valve of Figs. 1, 2, and 3, the section being taken along line 4—4 of Fig. 1;

Fig. 5 is a view in bottom plan of the valve of Fig. 1, a central fragment of the film forming the inner element of the valve being broken away, for clarity of illustration the film portions 11 and 11' in this figure being assumed to be perfectly transparent; and

Fig. 6 is a somewhat schematic view in vertical axial section through an apparatus for assembling a plate-like member upon a portion of the side wall of an inflatable article to form a valve in accordance with the invention.

The valve of the present invention is primarily adapted for use with a thin, flexible walled inflatable hollow article to which it is attached, whereby the article may be inflated and deflated therethrough. The valve of the invention may, however, be employed to advantage in a wide variety of other applications, and for other purposes. The valve of the invention is particularly of advantage, and the drawings show such construction, when one member of the valve is formed of a portion of the film forming the thin flexible side wall of the inflatable article.

It has previously been proposed to make two-part inflation valves, mounted on the side wall of an inflatable article, wherein one member of the valve is formed by a portion of the side wall of the article. Such prior valves have been relatively impositive in action, however, since the sealing zone between the valve members was of marked extent, and the pressure within the inflatable article was not employed advantageously to maintain the valve in sealed condition. In such prior valves the holes in the inner valve element, formed of a portion of the side wall of the article, through which the space between the inner and outer valve elements communicated with the interior of the article, were located relatively close to the annular sealing zone between the two valve elements. As a result, foreign particles gaining entry into the space between the valve elements tended to become pinched between the valve elements near the annular sealing zone, and thus to prevent the proper sealing engagement of the valve elements. Also, because the space between the valve elements was shallow, it was quite difficult, especially in view of the aforesaid pinching action of the elements adjacent the sealing zone, to remove foreign particles from the space between the valve elements.

Additionally, in such prior valves the outer hole through the outer valve element was relatively large, whereas the inner holes, through the inner valve element, were relatively small. Thus larger particles, passing inwardly through the outer hole, could not escape into the interior of the article through the inner holes. Instead, they were trapped within the space between the valve elements and tended to prevent proper sealing between the elements, in the manner outlined above.

As a result of the sealing difficulties encountered with such prior valves, it was the practice to coat the confronting surfaces of the valve with a material such as petroleum jelly to improve the seal therebetween. When the inflatable article was used at the seashore, however, the thus coated confronting surfaces of the valve were prone to collect grains of sand, thus aggravating the above outlined difficulties of cleaning the valve, and thus preventing the valve from effectively sealing the article.

Such prior valves, furthermore, were difficult to assemble so that the opening in the outer valve member was positioned at the desired location relative to the openings through that portion of the side wall of the article which formed the inner valve element. Among further difficulties with such prior valves were the facts that to deflate the article a means such as a matchstick had to be employed to thrust the inner valve member into open position, thereby exposing the inner valve member to the danger of being punctured, and that the outer valve member was relatively stiff, did not conform to the contour of the article, was prone to being cracked, split, or permanently deformed when accidentally bent or stepped upon, and was apt to injure the user when, if playing with the article, he were hit in the face with the valve.

The valve of the present invention, particularly in the illustrated preferred embodiment thereof, presents nu-

merous advantages and overcomes the above outlined difficulties encountered with prior valves of the same general type. The valve of the invention may be opened to deflate the article by simple manipulation, as with the fingers. Sealing of the valve is positive, and effective use is made of the pressure within the article to effect such seal. No lubricating or sealing substances is required on the sealing surfaces of the valve element. The valve is flexible; the parts of satisfactory illustrative valves of the invention may have generally the same durometer value as the film forming the side wall of the article. The valve readily conforms to the contour of an article having marked curvature without disturbing the effective seal between the valve elements. The valve may be easily and quickly assembled and sealed in an accurate manner.

The valve of the invention has the hole in the inner valve element which provides communication between the space between the valve elements and the interior of the article located so that it is appreciably spaced from the sealing zone between the valve elements. The valve elements are thus relatively free from each other at the sealing zone therebetween. This, and the fact that the space between the valve elements at the sealing zone is preferably deeper than the diameter of the hole through the inner valve element, effectively prevent foreign particles from being trapped, pinched, or otherwise held in the space between the valve elements. In any event, should foreign particles become temporarily interposed between the sealing zones of the valve elements, they can readily be removed by either further inflation of the article, to blow them into the interior of the article or by partially deflating the article, to blow them out of the valve. To insure the removal of foreign particles from between the valve elements in such cleaning actions, the hole or holes through the outer valve element preferably have generally the same maximum dimension of their minor axis as that of the hole through the inner valve element.

Turning now to the drawings, the preferred embodiment of valve made in accordance with the invention is shown assembled upon and sealed to the side wall **11** of a thin flexible inflatable article, a portion **11'** of which forms a first, inner element of the valve. The second, outer element of the valve is a disc-like annular member generally designated **12**. As shown, member **12** overlies and is edge-sealed to the wall **11** of the article. In a preferred construction wall **11** is made of a thin, flexible plastic material such as film polyethylene, polyvinyl chloride, rubber, etc., and plate-like member **12**, which is appreciably thicker than film **11**, may be molded from a flexible plastic material which may likewise be a suitable flexible resilient material such as polyethylene, polyvinyl chloride, rubber, etc.

Plate-like member **12**, which is annular in form, has an outer annular flange **14** which is sealed to side wall **11** of the article. Inwardly of flange **14**, member **12** is in the form of an inwardly concave, frusto-conical portion **15**, the outer surface **17** of such portion rising somewhat more steeply than the inner surface **16** thereof. The radially inner portion of the body of member **12** is in the form of an annular rim **24** having an upright cylindrical periphery **22** which forms a lip-engaging means through which the article is inflated, as well as providing means whereby the valve may be gripped by the fingers when it is desired to deflate the article. Extending radially inwardly from rim **24** are a plurality of equally angularly spaced (four shown) struts **19** which present openings **20** therebetween. In the embodiment shown, openings **20** are arcuate. They may, however, be of other shapes such as circular.

The struts **19** support a central stem-like member **21** having a convex lower end in the form of a surface of revolution. An annular portion **27** of such lower end cooperates with a central annular portion of member **11'** to seal the valve. Preferably, as shown, the upper surfaces of struts **19** and of stem-like member **21** are depressed somewhat below the upper surface of rim **24** to form a central recess **25**. As a result, the rim protects the struts and stem-like member from damage by chance blows by objects with which the valve may come into contact.

Inner valve member **11'** is provided with a central opening **26** therethrough, as shown in Figs. 2, 3, and 6. Opening **26** preferably has a diameter generally the same as the length of the largest minor axis of openings **20**, for reasons given above. When openings **20** are circular, they preferably have the same diameter as opening **26**. Stem-like member **21** preferably has a downwardly open central blind passage or recess **31** therein having a diameter substantially the same as that of hole **26**. As a result, sealing between the inner end of stem-like member **21** and the upper inner surface of valve member **11'** takes place between a bottom annular zone **27** on member **21** surrounding the lower end of passage **31** and an annular zone **29** on the upper inner surface of valve member **11'**.

Article **11** is inflated by presenting one's lips to rim **24** (Fig. 2) and blowing into the valve. Air enters the space between valve members **11'** and **12** through openings **20** and escapes from such space in a path between the inner confronting surfaces of member **11'** and stem-like member **21**. As will be apparent in the discussion of Fig. 6 below, members **11'** and **12** are assembled on and sealed to each other so that, in the normal relaxed position of valve member **12**, zones **27** and **29** of the valve are substantially in sealing contact. When any substantial pressure has been built up within the inflatable article, such pressure, exerted upon the lower inner surface of valve member **11'**, tends more forcibly to thrust zones **27** and **29** of the valve into sealing contact. Accordingly, the valve functions efficiently as a check valve, throughout the article-inflating operation, whenever the operator ceases to blow into the valve.

When it is desired to deflate the article, the rim **24** of the valve may be grasped between the fingers as shown in Fig. 3 whereby to pinch opposed portions of valve member **12** inwardly toward each other. This causes valve member **11'** to bulge inwardly against the pressure within the article, and the outer valve member **12** to bulge outwardly, to break the seal between zones **27** and **29** at one or more locations. Such open position of the valve is somewhat schematically indicated in Fig. 3.

In Fig. 6 there is shown a preferred apparatus by means of which valve member **12** is located upon wall **11** of the article and is sealed thereto. The assembly fixture there shown, generally designated **30**, has a central guide pin **32** having a diameter slightly smaller than that of hole **26** in wall **11**. Pin **32** extends centrally upwardly within an annular lower sealing die **34**, the upper end of the pin extending somewhat above the upper surface of die **34**. An upper annular die **35**, positioned coaxially of die **34**, is mounted for vertical reciprocation to and away from die **34** by means not shown. When valve element **12** and film **11** are made of polyvinyl chloride, dies **34** and **35** may be in the form of opposed electrodes connected to a source of high frequency heating current, whereby the flange **14** of element **12** and an annular zone of wall **11** may be electronically heat sealed to each other. When valve element **12** and film **11** are made of polyethylene, rubber, and the like, dies **34** and **35** are heated, as by electric resistance elements or the like (not shown).

In assembling the valve, the upper die **35** is retracted, and wall **11** of the still open inflatable article is mounted on the fixture so that the upper end of pin **32** extends through hole **26** in the wall. Thereupon a valve member **12** is placed on the fixture so that the upper end of pin **32** is received in passage **31** in element **12**. As a result the valve element **12** is accurately located upon wall **11**. Thereupon the upper die **35** is advanced into engage-

ment with flange 14 and the dies 34 and 35 to seal the parts together.

Simply by way of illustration, and not by way of limitation, the following dimensions and characteristics of an inflation valve made in accordance with the invention are given.

The wall 11 of the inflatable article was made of polyvinyl chloride and was .010 inch thick. The valve element 12, which was molded of polyvinyl chloride, had an over-all diameter of 1⅛ inches, rim 24 having a diameter of 11/16 inch. The element 12 had a height, from the bottom of flange 14 to the top of rim 24, of 5/32 inch. The stem-like member 21 had a lower convex surface in the form of part of a sphere having a radius of 3/16 inch. The hole 26 in member 11' of the valve had a diameter of 3/32 inch, as did passage 31 in stem-like member 21. The lower end of member 21, in its relaxed condition, lay 3/32 inch beneath the lower surface of flange 14. Surface 17 lay at an angle of 30° with respect to the plane of the lower surface of flange 14; surface 16 lay at an angle of 15° with respect to such plane.

It will be seen, from the manner of assembly of valve element 12 on side wall 11 of the inflatable article, that the zone 29 of valve element 11' tends constantly to be maintained in contact with zone 27 on member 21. This is caused by the pressure exerted on member 11' by member 21 as the latter distends element 11' out of its normal plane, the plane of the lower surface of flange 14. Such sealing pressure is augmented, whenever the article is partially or wholly inflated, by the pressure within the article. Such pressure, acting over the entire area of valve element 11', thrusts it still more forcibly against member 21.

Sealing zones 27 and 29 are of comparatively small radius, and are centrally and symmetrically positioned. The pressure within the article, acting over the entire area of valve element 11', is concentrated on the sealing zones, so that the sealing action of the valve is efficient and forceful.

The central stem-like member 21 is of relatively heavy section, and thus resists deformation, either by the pressure within the inflatable article or by one's fingers when the valve is opened, as in Fig. 3. The radially outer portion of valve element 12, including flange 14, frusto-conical portion 15, and struts 19, are sufficiently firm to resist any marked deformation solely as the result of stresses imposed thereon by valve element 11' when subjected to pressure within the inflatable article. Such outer portion of valve element 12, however, may readily be manually resiliently deformed to open the valve (Fig. 3), and is also resiliently deformed to allow it substantially to conform to the contour of an inflatable article having a curved side wall. In the latter case, the flange 14, portion 15, rim 24, and struts 19 are resiliently deformed as necessary, the stem-like member 21 remaining substantially undeformed and sealingly in contact with zone 29 of valve element 11'.

The valve of the invention displays advantages by reason of its ease of maintenance. The openings 20 are located markedly out of alignment with hole 26 in valve element 11'. As a result, foreign materials, such as dirt and sand, do not tend to remain between sealing surfaces 27 and 29. The passage 31 in member 21, besides aiding in the assembly of the valve, is of value in reducing the area of the member on which foreign material, which might interfere with the functioning of the valve, might lodge.

Although only one embodiment of the invention has been illustrated in the accompanying drawings and described in the foregoing specification, it is to be expressly understood that various changes, such as in the relative dimensions of the parts, materials of which the valve is made, and the like, as well as the suggested manner of use of the valve of the invention and of the media with which the valve is used, may be made therein without departing from the spirit and scope of the invention as will now be apparent to those skilled in the art. Thus, for example, in some uses the valve element 11' may be a member separate from the side wall of the inflatable article, the valve after assembly being then mounted upon an inflatable article, as by forming a hole in the wall of the article with a diameter generally that of the inner edge of flange 14 of element 12, and edge sealing the assembled valve to the side wall of the article at such hole. Further, valve elements 11' and 12 may be edge sealed in various manners other than that described, as, for example, by the use of a suitable adhesive.

What is claimed is:

1. An inflation valve comprising a plate member and a film member, the plate member and at least a portion of the film member being superimposed and sealingly connected at their edges, the two members presenting a space between them, the plate member being elastically deformable and the film member being relatively flexible, the plate-like member markedly exceeding the film member in rigidity the film member having a hole therethrough permitting egress of fluid from the space between the members, the plate member having an opening therethrough permitting the introduction of fluid therethrough into the space between the members, and a stem-like member attached to the plate member, said stem-like member extending into the space between the plate-like and film members and being aligned with and confronting the hole in the film member, the stem-like member having a free end substantially exceeding in cross section the size of the hole in the film member whereby sealingly to contact the film member throughout a zone surrounding the hole, the contacting zone of said stem-like member extending through and beyond the plane of said sealingly connected edges of the plate-like and film members whereby the film member lies extended across the plate-like member with the film member in contact with and inwardly distended by the inner end of the stem-like member when the valve is closed.

2. An inflation valve as claimed in claim 1, wherein the plate-like member markedly exceeds the film member in thickness.

3. An inflation valve as claimed in claim 1, wherein the free end of the stem-like member has a central recess therein which is aligned with and of generally the same diameter as the hole in the film member.

4. An inflation valve as claimed in claim 1, wherein the plate-like member markedly exceeds the film member in thickness, and the hole in the film member is located generally centrally thereof.

5. An inflation valve as claimed in claim 4, wherein the plate-like member has a flat annular outer flange, and the said portion of the film member is sealed to said flange.

6. An inflation valve as claimed in claim 4, wherein the face of the plate-like member which confronts the film member is concave, whereby said space between the film and plate members is annular and extends around the stem-like member.

7. An inflation valve as claimed in claim 6, wherein the hole in the film member is round, and the free end of the stem-like member is generally part-spherical.

8. An inflation valve as claimed in claim 6, comprising a plurality of angularly spaced generally radially extending struts connecting the stem-like member to the body of the plate-like member, the struts presenting openings between them communicating with the space between the plate-like member and the film member.

9. An inflation valve comprising a plate-like member and a film member, the plate-like member being circular in plan, having a flat annular outer flange, and an inwardly concave generally frusto-conical body extending radially inwardly of the flange, the plate-like member and the film member being superimposed and sealingly connected at their edges, the two members presenting a space be-

tween them, the plate-like member being relatively thick and elastically deformable and the film member being relatively thin and relatively flexible, the film member having a hole centrally therethrough permitting egress of fluid from the space between the members, and a central, inwardly extending stem-like member attached at its root to the plate-like member, a plurality of struts connecting the root of the stem-like member to the plate-like member, the struts presenting openings therebetween communicating with the space between the members, said stem-like member extending into the space between the plate-like and film members and being aligned with and confronting the hole in the film member, the stem-like member having a part-spherical free end substantially exceeding in cross section the size of the hole in the film member whereby sealingly to contact the film member throughout an annular zone surrounding the hole, the contacting zone of said stem-like member extending through and beyond the plane of said sealingly connected edges of the plate-like and film members, whereby the film member

lies extended across the plate-like member with the film member in contact with and inwardly distended by the inner end of the stem-like member when the valve is closed, and an upstanding rim on the outer portion of the plate-like member to provide for the grasping and radially inward distortion of the plate-like member by the fingers so as to open the valve.

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