July 28, 1959 A. R. HENDRY 2,896,840

AIR BULB FOR ATOMIZERS AND METHOD OF MAKING SAME

Filed Nov. 20, 1956

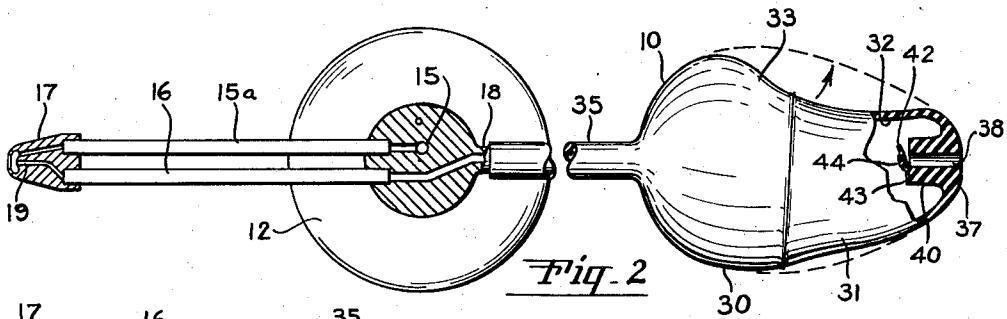



Fig. 2

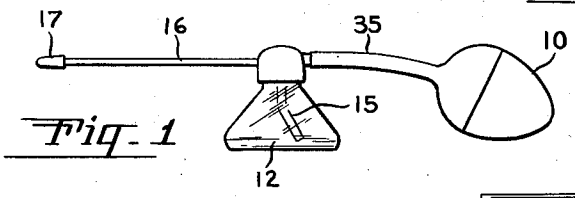



Fig. 1

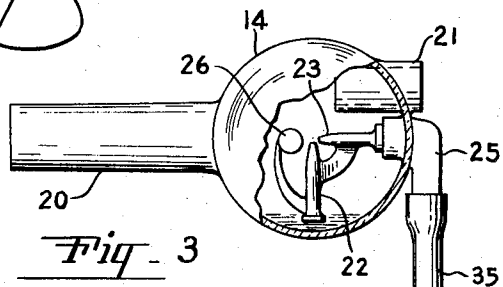



Fig. 3

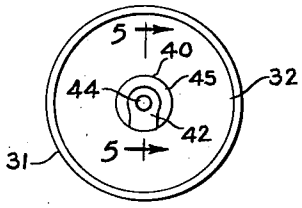



Fig. 4

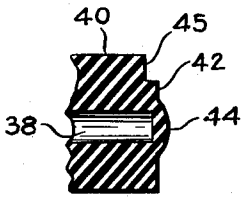



Fig. 5

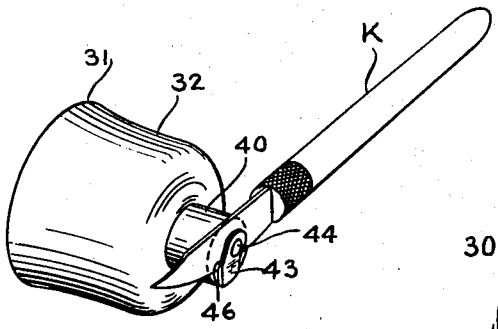



Fig. 6

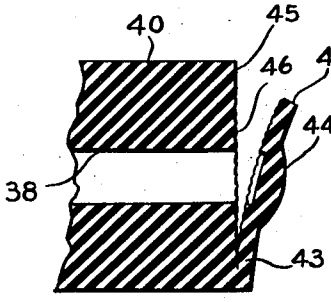



Fig. 7

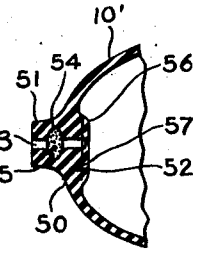
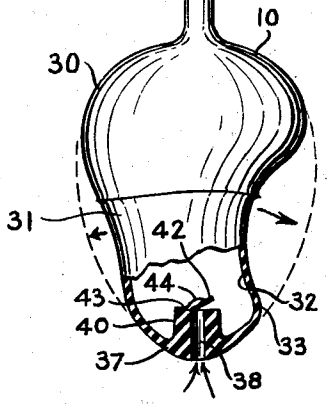



Fig. 8




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# AIR BULB FOR ATOMIZERS AND METHOD OF MAKING SAME

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2 Claims. (Cl. 230—169)

This invention relates to improvements in air bulbs for supplying pressured air to atomizer receptacles or the like, and a method of making the air bulbs and is a continuation-in-part of my applications, Serial No. 277,327, filed March 18, 1952 and Serial No. 309,267, filed September 12, 1952, both abandoned.

Air bulbs heretofore used with atomizers, nebulizers, and the like, have been found to be objectionable for various reasons, one of which is their inability to function properly after a short period of usage. Such difficulty arises principally from the backflow of fluid into valve structures utilized in connection with the bulbs. Such fluid is generally sticky, and, upon reaching the valves, will cause them to be rendered partially or wholly inoperative and the bulbs useless for their intended purpose. Another objectionable feature of prior bulbs resides in their method of production or manufacture, in that they are incapable of being mass produced at low cost, this objection arising principally from the manner of molding and the difficult and time consuming, as well as expensive, installation of inlet and outlet valve means for causing air to move in one direction through the bulbs. Metallic ball check valves are ordinarily employed, involving joints and connections subject to air leakage. Flap valves heretofore proposed have proved unsatisfactory, being subject to sticking so that they would not open properly and subject to distortion when the bulb is compressed, so that they would not seat properly.

The present invention has as its general object to provide an air bulb for atomizers or the like which is more efficient in operation than devices heretofore known, which will have a long life of satisfactory performance and which is economical to manufacture.

More specifically, objects of the invention are to provide an improved air bulb having a flap type check valve at the inlet end and an unobstructed discharge passage at the opposite end having a pipe and orifice friction greater than the orifice friction at the inlet to cause rapid filling of the bulb through the inlet valve and prevent backflow of air or liquid into the bulb from the discharge passage; to provide an air bulb having an improved flap valve structure and seat therefor; to provide an air bulb having an inwardly projected valve seat which is non-distortable to maintain its configuration when the bulb is compressed for assuring a positive seating of the valve regardless of the manner in which the bulb is compressed; and to provide an improved flap valve construction.

A further object is to provide an improved method for making an air bulb and flap valve of the type described.

The present invention comprises an air bulb which may be used for a multitude of different purposes, but its most common use, and as shown and described herein, is in connection with atomizer or nebulizer receptacles wherein said bulb supplies pressure thereto to produce a spray or vapor. The air bulb embodying the instant invention is molded from rubber and is made initially in two parts or halves which meet in a transverse plane at substantially the largest diameter of the finished bulb.



One half of the bulb has an inlet orifice or passage controlled by a flap valve, and the other half is provided with a tube having a central unobstructed passage communicating with the interior of the bulb. The tube is connected to the atomizer or nebulizer for aspirating liquid therefrom by pressured air supplied from the bulb. The flap valve which controls the flow of air through the inlet orifice allows air to pass through the bulb in only one direction, said valve preventing the escape of air through the inlet orifice when the bulb is compressed and permitting air to enter through said inlet orifice when the bulb is released and is expanding.

In the manufacture of the bulb the valve is molded as an integral part of an inward projection and is formed by a transverse cut which extends substantially through the projection but stops short sufficiently to provide a hinge for the valve. This valve is sufficiently thin and flexible to readily lift off its seat upon the creation of a vacuum within the bulb, and because it is cut from the projection it will conform exactly to its seat to provide a positive seal, the inlet orifice extending substantially through the projection into the plane of the cut, thereafter to be opened and closed by the operation of the valve.

The product and method of the invention will be better understood and additional objects and advantages will become apparent from the following description taken in connection with the accompanying drawings which illustrate preferred forms of the device. It is to be understood, however, that the invention may take still other forms and that all such modifications, and variations within the scope of the appended claims which will occur to persons skilled in the art are included in the invention.

In the drawings:

Figure 1 is an elevational view of an atomizer utilizing the present air bulb as a part thereof;

Figure 2 is an enlarged plan view of the atomizer with some parts being shown in section and some parts being broken away;

Figure 3 is an elevational view of a nebulizer using the present bulb, with some parts being broken away;

Figure 4 is an end elevational view of the inlet or valve end of the bulb, looking into the bulb;

Figure 5 is an enlarged fragmentary view of the valve boss, taken on the line 5—5 of Figure 4;

Figure 6 is a perspective view of the inlet or valve end of the bulb turned inside out and showing the operation of cutting the valve flap;

Figure 7 shows the boss of Figure 5 after the valve flap has been cut, the flap being lifted off its seat; and

Figure 8 is a fragmentary sectional view of a modified form of the invention.

In order to appreciate the advantages of the invention, it will first be necessary to describe the construction and operation of certain common devices with which it is used.

Referring to the drawing, the numeral **10** designates a preferred air bulb structure of the present invention. In Figures 1 and 2 the bulb **10** is shown mounted on an atomizer receptacle **12**, and in Figure 3 the bulb is shown mounted on a nebulizer receptacle **14**. The atomizer shown in Figures 1 and 2 is of a type in common use, having a vertical liquid suction tube **15** extending almost to the bottom of the receptacle and connected with a horizontal spray tube **15***a* having a nozzle **17** on its outer end. An air tube **16** is equipped with a connector fitting **18** at one end at its other end is connected with a reduced orifice passage **19** in the nozzle **17** adjacent a similar discharge orifice for the liquid tube **15***a*.

The nebulizer receptacle **14** of Figure 3 has an outlet spout or nozzle **20** on one side through which vapor is ejected and has an air inlet or breather tube **21** on its opposite side. Mounted in the receptacle **14** is a vertical

liquid suction tube 22 and a horizontal nozzle 23 having a very small discharge orifice located to direct pressured air across the top of the suction tube 22. Nozzle 23 communicates with a connecting tube 25. This air stream draws up liquid from the suction tube 22 and directs it against a glass ball 26 which breaks up the droplets of liquid into an air-suspended vapor for producing a slow moving cloud-like ejection from the spout 20. The nebulizer is especially intended for medicinal preparations to be inhaled into the nasal and throat passages in a more finely divided condition than can be produced by an ordinary atomizer, as shown in Figure 2.

The air bulb 10, which is the subject of the present invention, is formed of two halves or parts 30 and 31, the numeral 32 designating the inside surface of the bulb parts and the numeral 33 designating the outside surface. The two parts are molded separately and then vulcanized together at their meeting edges in a final operation to form the completed bulb. The bulb halves are made of a suitable flexible and resilient rubber which is readily distorted by squeezing in the hand to the positions shown in Figures 2 and 3 for producing a discharge of pressured air.

The bulb half 30 has an integral tubular stem 35 which provides a convenient means of attachment to the connector tubes 18 or 25 of the atomizer or nebulizer receptacles, respectively, as shown in the drawings, the end of this stem being flexed sufficient to fit tightly on said tubes. The other half 31 of the bulb is provided with a thickened end portion 37 having a central aperture or hole 38 forming an inlet orifice. This end portion has an inward projection or boss 40, the inner end of which is disposed a substantial distance from the end of the bulb. Molded as a part of the projection 40 is a thin extension or step 42 adapted to form a flap valve. The hole 38 extends from the outer end of the thickened end portion 37 inwardly to a point substantially through the projection 40, terminating in the extension 42. Before the two halves of the bulb are vulcanized together in a final operation, the greater part of the extension 42 is transversely cut from the projection 40 in the plane of the end face 45 of said projection to form a thin disc or flap seated on said end. The cut which severs the extension extends substantially therethrough but stops short sufficiently to provide a hinge 43 for the valve 42, said valve being flexible so that it may readily lift off its seat when a vacuum is created in the bulb.

The extension or valve 42 has a thickened center portion 44 forming a short boss for reinforcing the valve across the orifice 38 to prevent collapse of the valve upon the existence of pressure within the bulb. Hole 38 extends slightly beyond the plane of end face 45 and substantially into boss 44, the latter thereby providing a substantially uniform thickness of material in the valve flap. As best seen in Figure 4, the valve 42 has a smaller transverse dimension than the projection 40 whereby said valve is protected by the projection from engagement with the side walls of the bulb when the bulb is compressed.

The pipe friction in tubes 35 and 16, or 35 and 25, plus the orifice friction at 19 or 23, act as a check to restrain the backflow of air to the bulb as the bulb is expanding after being compressed. As only a very small amount of air in the stem 35 returns to the bulb when the bulb is expanding, any mist or vapors sucked back into the discharge orifice will not travel far enough through the tubes to reach the bulb by the time the quick acting inlet valve is wide open to immediately relieve the vacuum and stop the backflow. The quick and wide opening of the valve thus permits the use of an unobstructed passage at the forward end of the bulb and obviates the necessity for a check valve in the discharge passage. When a conventional ball check type of valve is used at the inlet, the opening thereof by re-expansion of the bulb is not quick enough or wide enough to prevent excessive backflow through the discharge tube and orifice without an outlet check valve. Excessive backflow draws mist and vapors back into the bulb causing the valves to stick and rendering the whole device useless.

In Figures 2, 3 and 7 the valve is just starting to open upon release of the squeezed bulb. As air rushes in through inlet 38 the valve opens wide so that it offers no obstruction in the inlet passage.

The projection 40 extends a substantial distance into the interior of the bulb and, therefore, if a small amount of liquid should get into the bulb, it will not run into the valve and inlet orifice. The valve will thereby always remain dry and operable and will not adhere to its seat to cause non-functioning thereof. As stated hereinbefore, the extended projection 40 also spaces the valve 42 sufficiently inwardly and forms a protection therefor so that when the bulb is compressed the valve will not be distorted in any way. Further, the mass of rubber in projection 40 is sufficiently long and thick to render it relatively rigid in comparison with the flexibility of the thin walls of the bulb so that the valve seat is not distorted to cause leakage when the bulb is squeezed.

In the method of forming the present bulb, the two parts 30 and 31 are molded separately as described. Upon removal from the mold the part 31 is turned inside out and a cut 46 is made by a knife K, Figure 5, between the projection 40 and the extension step 42 to form the valve, using end surface 45 as a guide for the knife. This cut is made in continuation of the plane of the end wall 45 of the projection 40 and, after intersecting hole 38, extends substantially through the extension 42 so that said extension readily bends relative to the projection. The uncut portion forms a hinge 43 for the valve. The method described produces a valve which conforms exactly to its seat so that a tight seal is provided between said valve and its seat when pressure exists within the bulb. Even though great care is not taken in making the cut 46, the mating surfaces will, nevertheless, match perfectly. It is found that the irregular serrations formed by the knife strokes, which are greatly exaggerated in Figure 7, form a better air seal than two smooth, flat surfaces which have not been cut apart.

After the cut has been made the part 31 is turned right side out and the edges of the bulbs are then vulcanized together to form an integral structure wherein the valve flap is integral with the bulb.

In some cases the knife marks may form relatively large ridges and valleys and in other cases they may be almost microscopic in size, but the size of the irregularities is not important as long as no material is removed in the cutting operation. The nature of the irregularities depends upon the condition of the knife blade and the technique of the operator. The cut may be made in one stroke or several.

When the bulb is squeezed, the air pressure therewithin presses the flap against its seat in a perfect fit which cannot be obtained in any other known way. The fit of the flap against its seat is found to be absolutely air tight, an achievement heretofore never attained in a dry flap valve which will provide an unobstructed air passage when open wide. The relative rigidity of the boss 40 and its considerable length inwardly of the bulb effectively isolates the seat from strains in the material when the bulb is squeezed whereby the most extreme deflection of the bulb wall is not transmitted in any degree to the seat to produce distortion which would cause leakage. Metallic valve units have heretofore been employed for this purpose which are subject to the disadvantages hereinabove pointed out.

Figure 8 shows a modified form of bulb 10' having a thickened inlet end portion 50 with an outward projection or boss 51 and an inward projection 52. The boss 51 is provided with an inlet orifice or passage 53 extending through a chamber 54 containing filter material 55. In this embodiment, the inward projection is of less length than in the Figure 1 embodiment, but, similar

to that embodiment the inlet orifice extends from the outer end of the member **51** inwardly and terminates short of the inner surface. A flap valve **56** is formed by making a cut **57** in the inner boss **52** in the manner described in connection with Figure 6, the cut for the embodiment of Figure 8 being substantially coplanar with the inner surface of the bulb, the bulb being turned inside out and its inner surface utilized as a guide for the knife. The cut extends substantially through the boss **52** but stops short sufficiently to provide a hinge **57** for the valve **56**, this cut intersecting the passage **53** whereupon the flow of air through said orifice is controlled by the valve. The method of forming the bulb half shown in Figure 8 is the same as that described above, and this half is vulcanized to a half identical to the part **30** in Figure 2.

In the present invention there is thus provided an improved method for forming air bulbs, including the step of turning a bulb half inside out and cutting a valve flap from an integral part of the bulb so that the perfectly matching cut surfaces seat against each other when the valve is closed. It may be mentioned in this connection that after the cutting operation the valve flap tends to spring closed and does not hang open, as shown in Figure 7 for convenience of illustration.

In this method of making the bulbs, the valve comprises an integral part thereof and is formed along with the manufacture of the bulbs, obviating the necessity for providing separate valve parts and making joints which are subject to leakage. In addition to the facility and economy in manufacturing, the bulbs of the present invention are efficient in operation. This efficiency results from the quick and wide open valve characteristics and the absence of a valve in the outlet passageway where it would be particularly subject to sticking. The projection **40**, while being formed of the same rubber material as the rest of the bulb, is sufficiently thick to be substantially non-distortable whereupon it will always provide a true seating surface for the valve regardless of the manner in which the bulb is squeezed. The thickened projection **40**, in addition to providing a good seat for the valve, also protects the valve from interference by the walls of the bulb. The valve itself is sufficiently thin to be readily responsive to pressure differentials between the inside and outside of the bulb and to permit air to rush in quickly through the whole cross-sectional area of inlet orifice **38** and prevent objectionable backflow of air or fluid into the bulb. The pipe friction of the combined length of the stem of the bulb and communicating tubes and the orifice friction of the nozzles of the atomizer or nebulizer have a higher impedance to air flow than the orifice friction of inlet **38** to substantially prevent the backflow mentioned without the use of check valves in the stem.

The present valve construction is also employed to advantage in other types of compressible chamber air pumps and in other organizations requiring valves. It is especially well suited for small hand pumps used for pumping air into inflatable devices.

Having now described my invention and in what manner the same may be used, what I claim as new and desire to protect by Letters Patent is:

1. A compressible molded rubber air bulb having a rounded shape and adapted, after being squeezed and released, to return to said rounded shape by the resilience of the rubber to produce suction, said bulb having inlet and outlet end portions vulcanized together, said inlet end portion having an inwardly extending boss molded integrally therewith, said boss being provided with a passageway opening through the outer wall of said bulb and extending inwardly to a point short of the inner end of said boss, the inner end of said boss being cut transversely substantially therethrough but leaving an uncut portion to provide an integral flap valve at the inner end of said passage, said uncut portion of said flap valve forming a hinge for said valve, said boss having a transverse thickness sufficient to cause it to be substantially rigid under squeezing pressure applied to the bulb and said valve being sufficiently thin to be flexible for opening and closing against said boss, the movable edges of said valve being spaced from the sides of said boss and guarded thereby from the sides of the bulb when the bulb is squeezed, said boss projecting into the interior of the bulb a sufficient distance to space said valve from the end of the bulb, and said outlet portion having an air outlet passage therein.

2. A compressible molded rubber air bulb for a single valve atomizer and the like having a rounded shape and adapted, after being squeezed and released, to return to said rounded shape by the resilience of the rubber to produce suction, said bulb having inlet and outlet end portions vulcanized together, said inlet end portion having an inwardly extending boss molded integrally therewith, said boss being provided with a passageway opening through the outer wall of said bulb and extending inwardly to a point short of the inner end of said boss, the inner end of said boss being cut transversely substantially therethrough but leaving an uncut portion to provide an integral flap valve at the inner end of said passage, said uncut portion of the boss forming a hinge for said valve, said boss having a transverse thickness sufficient to cause it to be substantially rigid under squeezing pressure applied to the bulb and said valve being sufficiently thin to be flexible for opening and closing against said boss, the movable edges of said valve being spaced from the sides of said boss and guarded thereby from the sides of the bulb when the bulb is squeezed, said boss projecting into the interior of the bulb a sufficient distance to space said valve from the end of the bulb, said outlet end portion of the bulb including an elongated tube molded integrally therewith, and having an unobstructed air discharge passage therethrough.

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