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(54) STRUCTURE OF FLUID CONTAINER AND METHOD AND APPARATUS FOR PRODUCING THE FLUID CONTAINER

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(57) **ABSTRACT**

A fluid container for packing a product includes a check valve for each container member. A bonding structure of check-valves to a fluid container and a production method and apparatus of fluid container are disclosed in detail where the check valve is capable of reliably keeping the expansion of the fluid container without any fluid leakage after inflating the fluid container. As the check-valve is bonded to only one of thermoplastic container films, both films of the check-valve are fixed to one of the container films, thereby preventing the reverse flow by tightly closing the check valve. The manufacturing apparatus includes an up-down roller controller which precisely positions the films to form the check valve. The manufacturing apparatus can produce the fluid container with high reliability by having a belt conveyor specially designed for cooling down the heat sealed films before separating from the belt conveyor without damage.

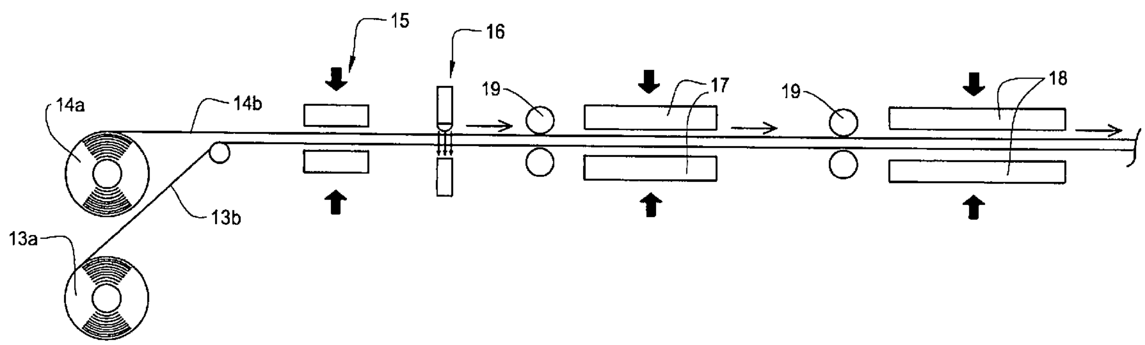
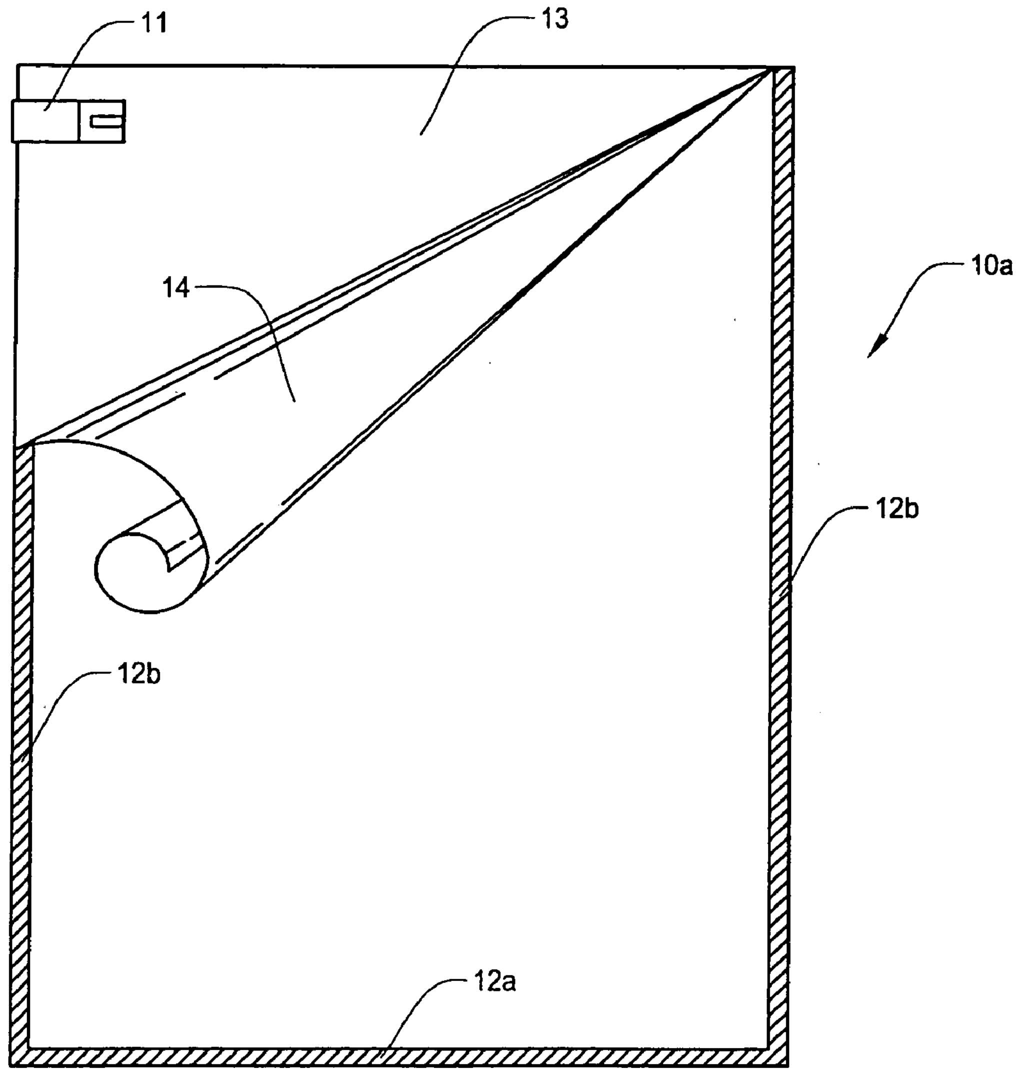
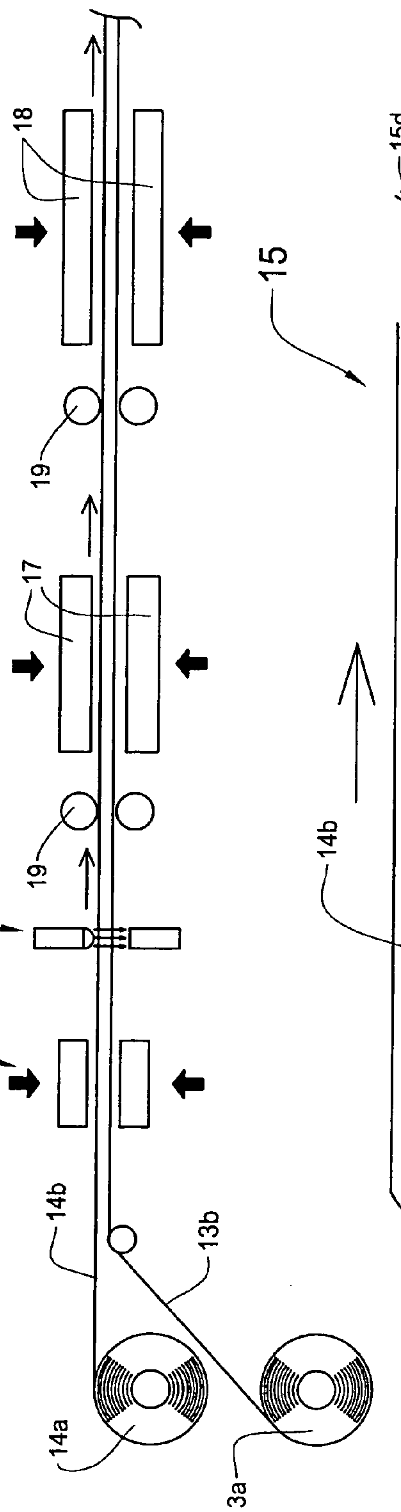


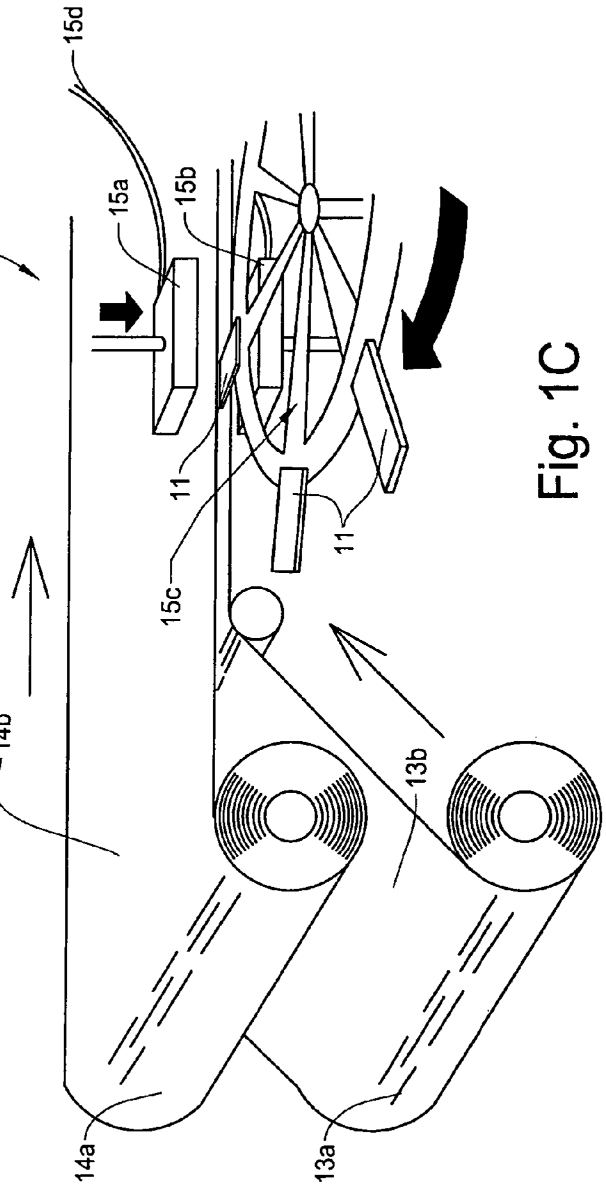
Fig. 1A





18
19
17
19
16
15
14b
13b
14a
13a

Fig. 1B



15d
15
15a
15b
11
15c
11
14b
13b
14a
13a

Fig. 1C

Fig. 2A

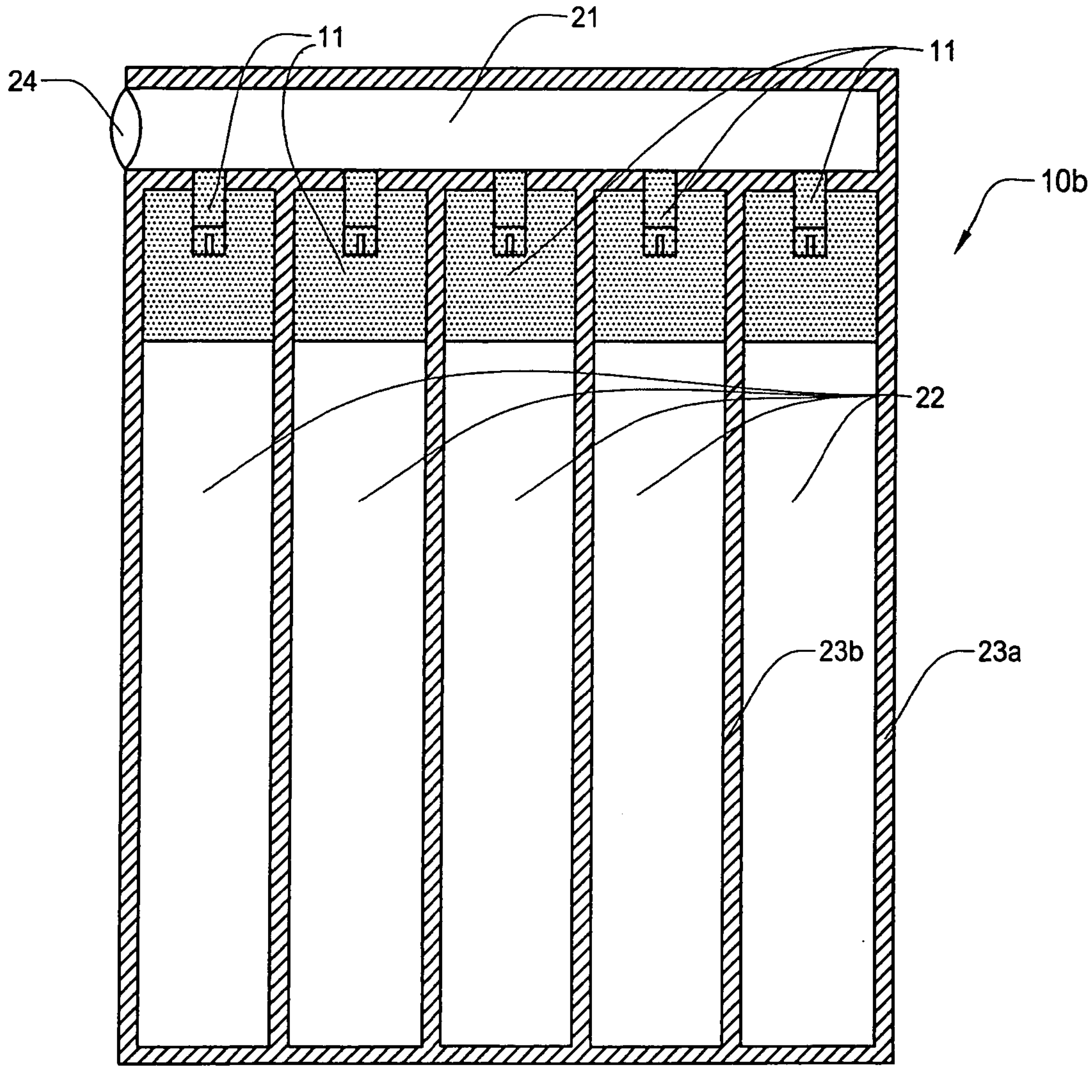


Fig. 2B

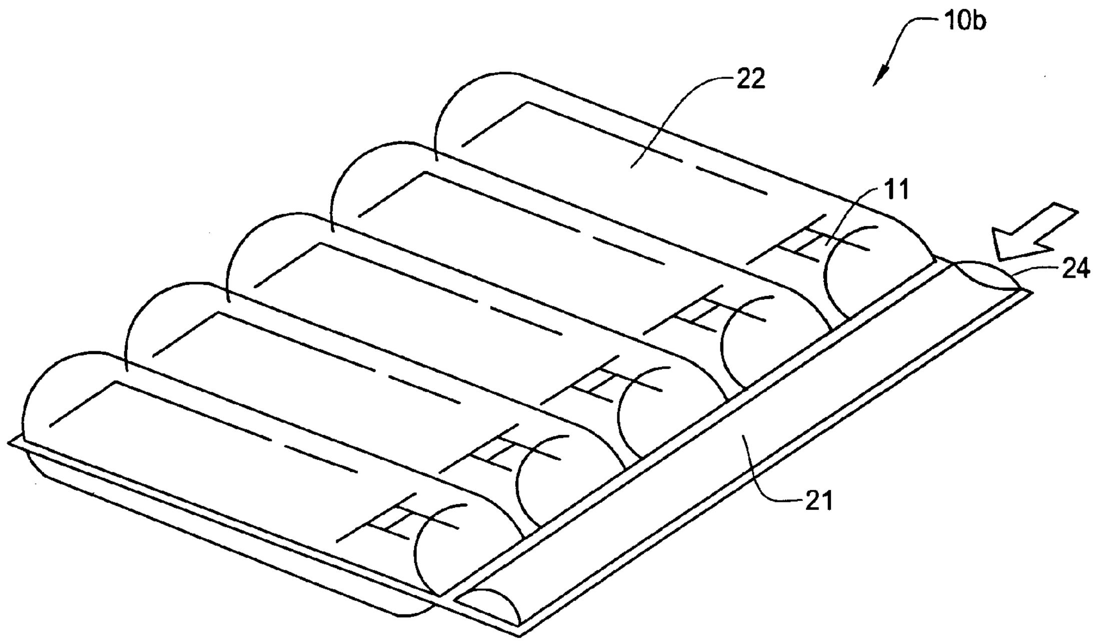


Fig. 2C

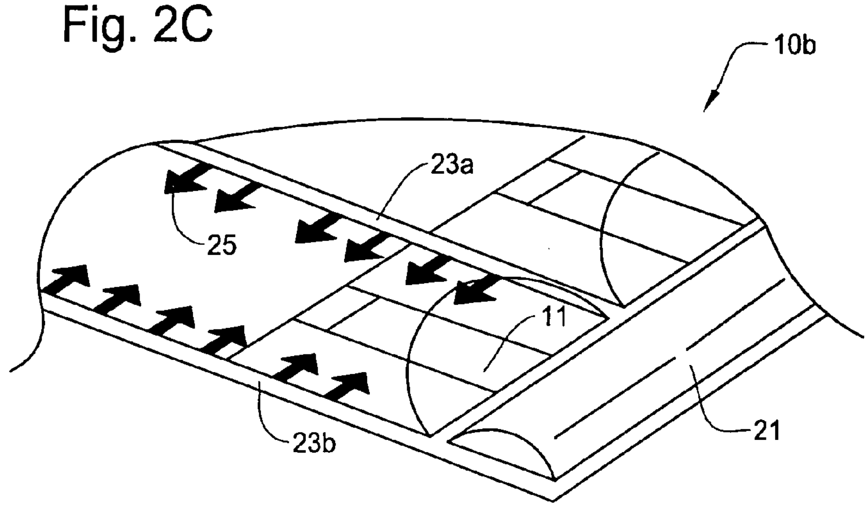


Fig. 2D

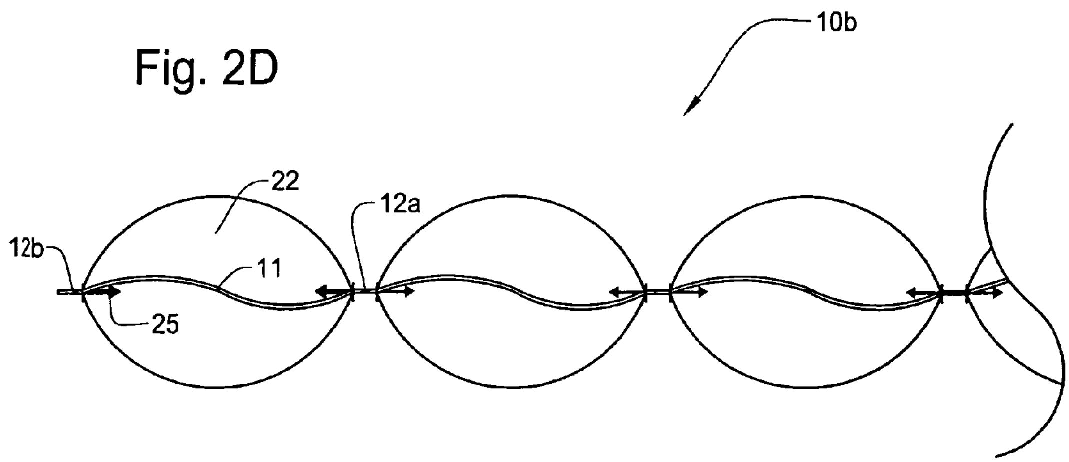


Fig. 2E

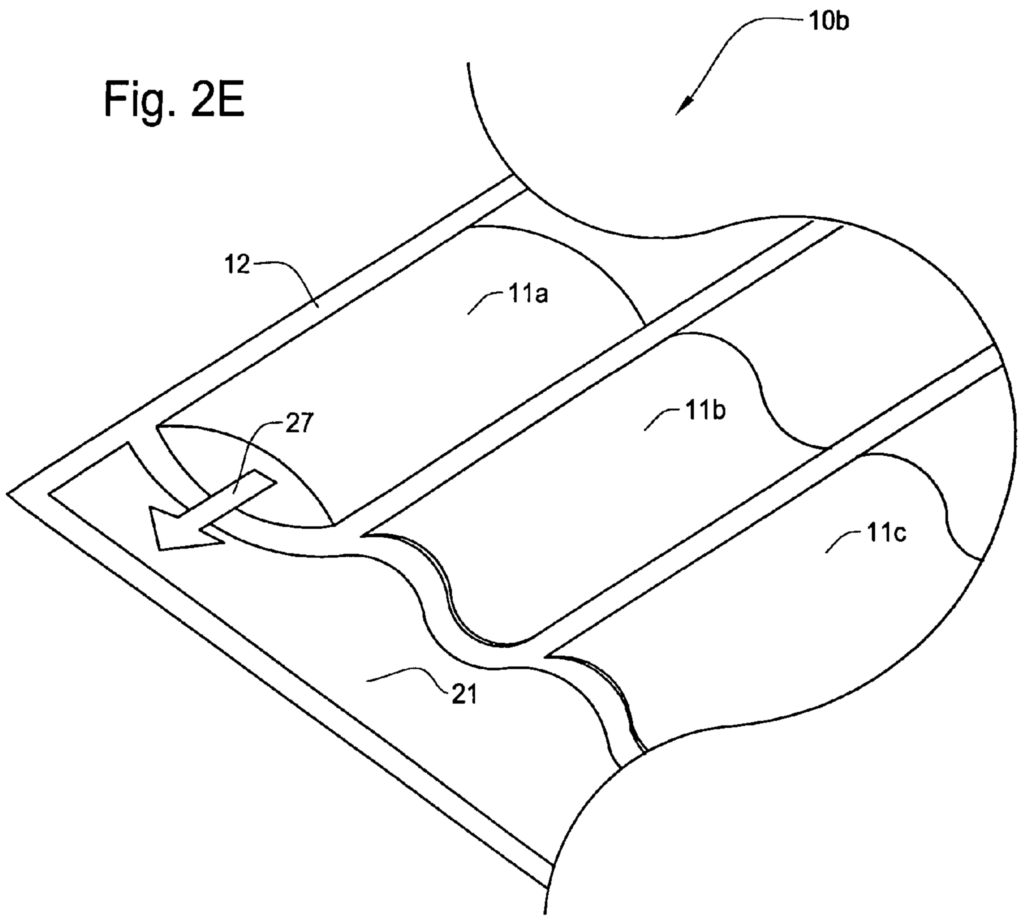


Fig. 3

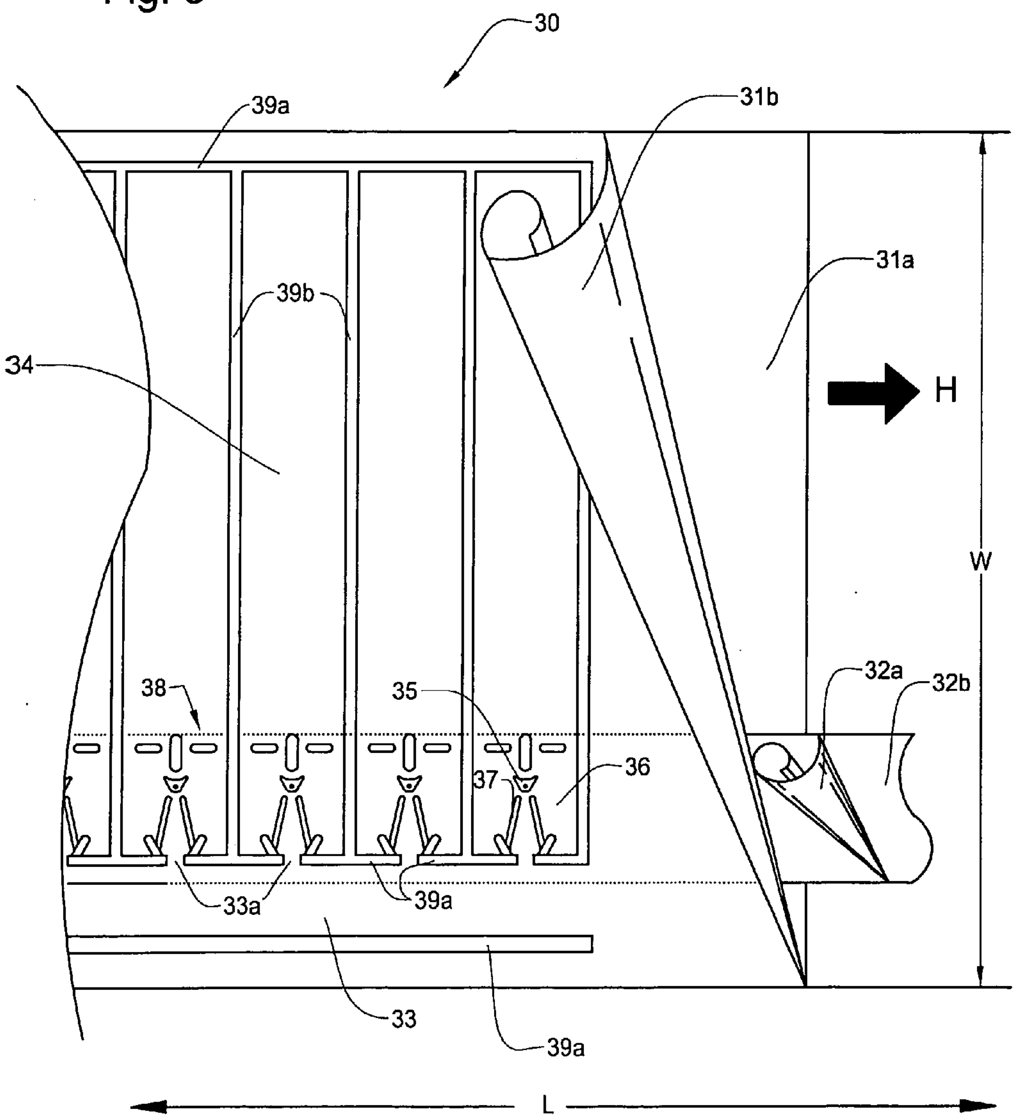


Fig. 4A

Fig. 4B

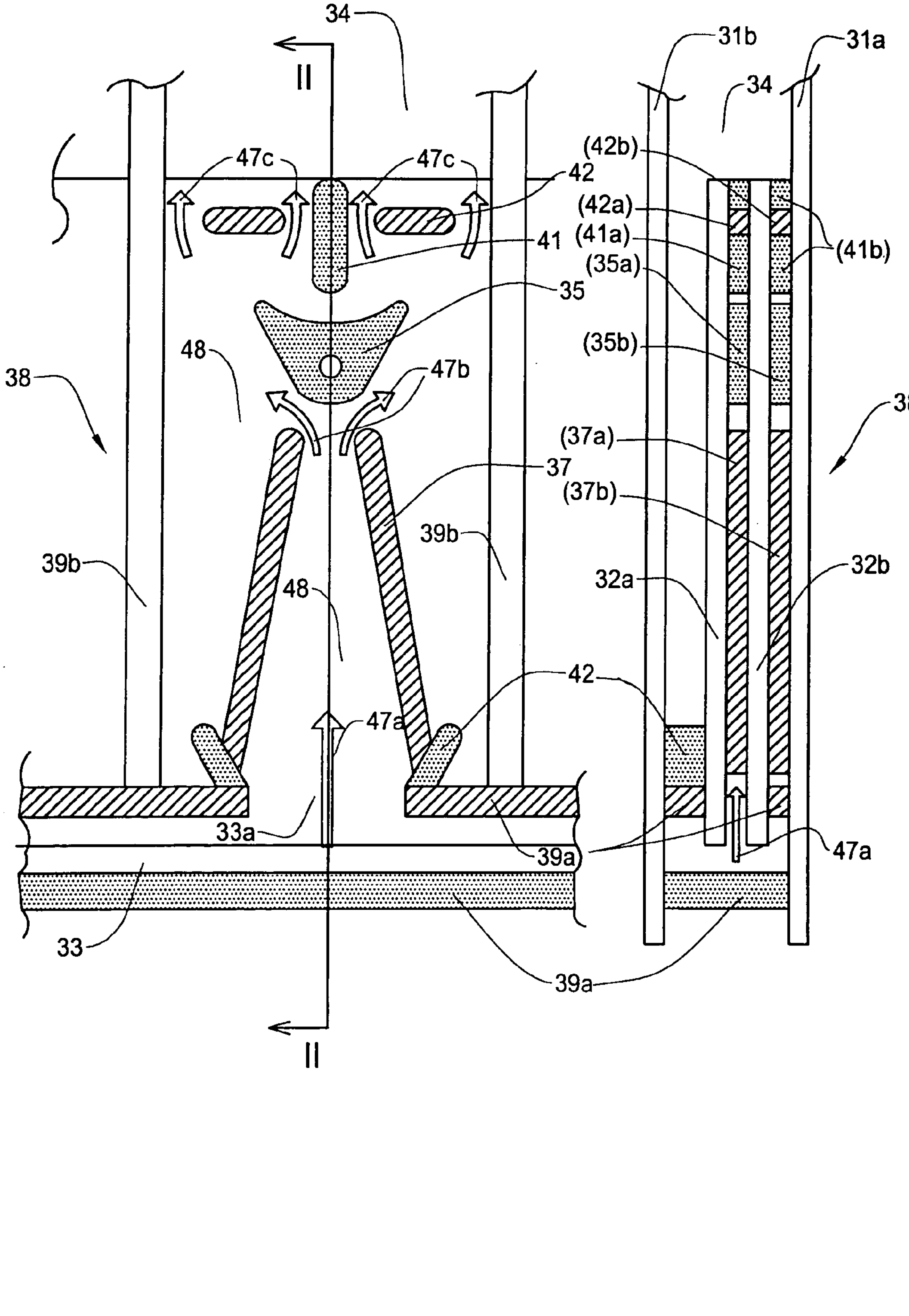

34
II
47c
47c
42
41
35
48
47b
38
37
39b
39b
48
42
47a
33a
39a
33
II
31b
31a
34
(42b)
(42a)
(41a)
(41b)
(35a)
(35b)
38
(37a)
(37b)
32a
32b
47a
39a

Fig.5

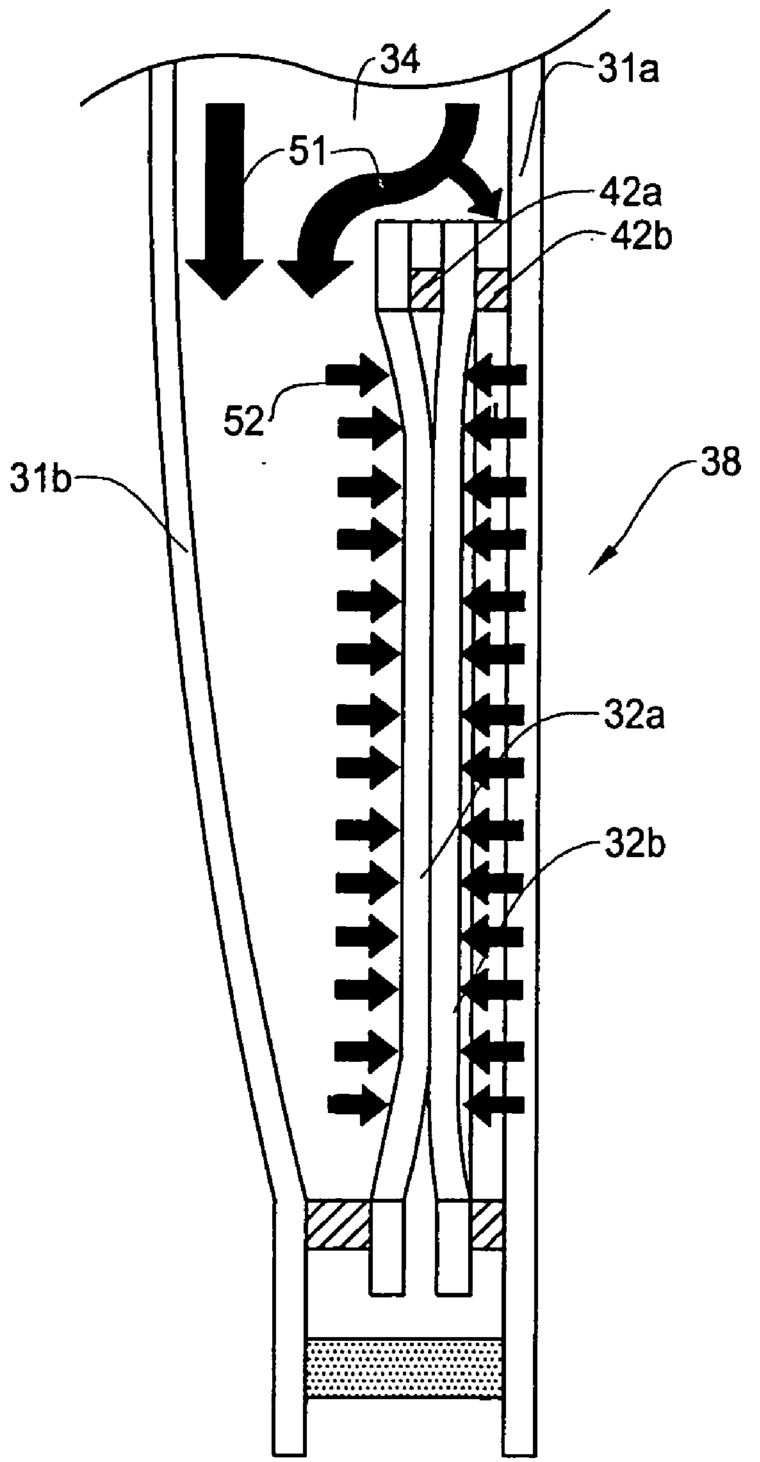


Fig.6A

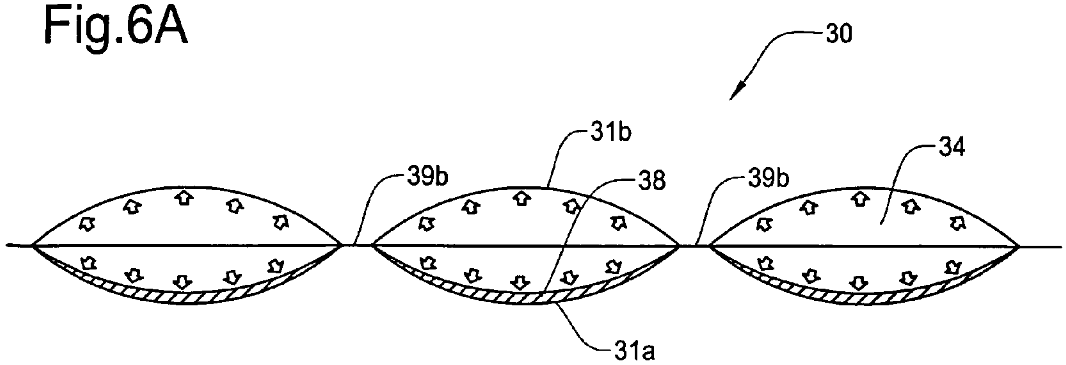
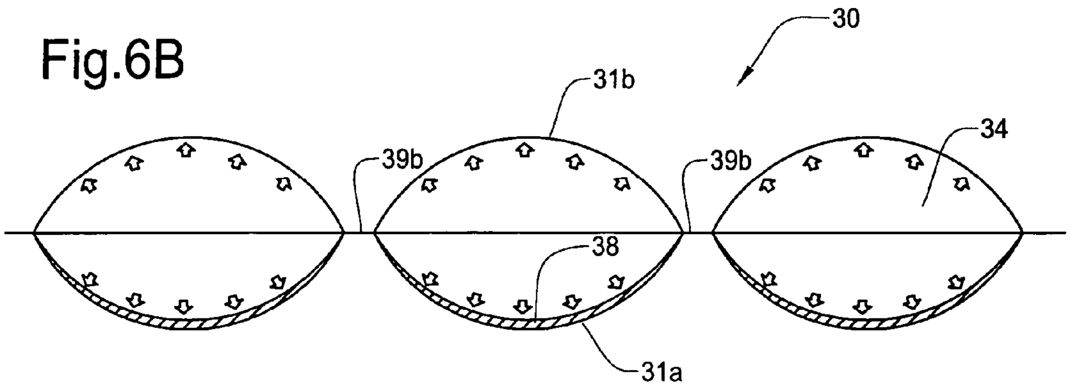


Fig.6B



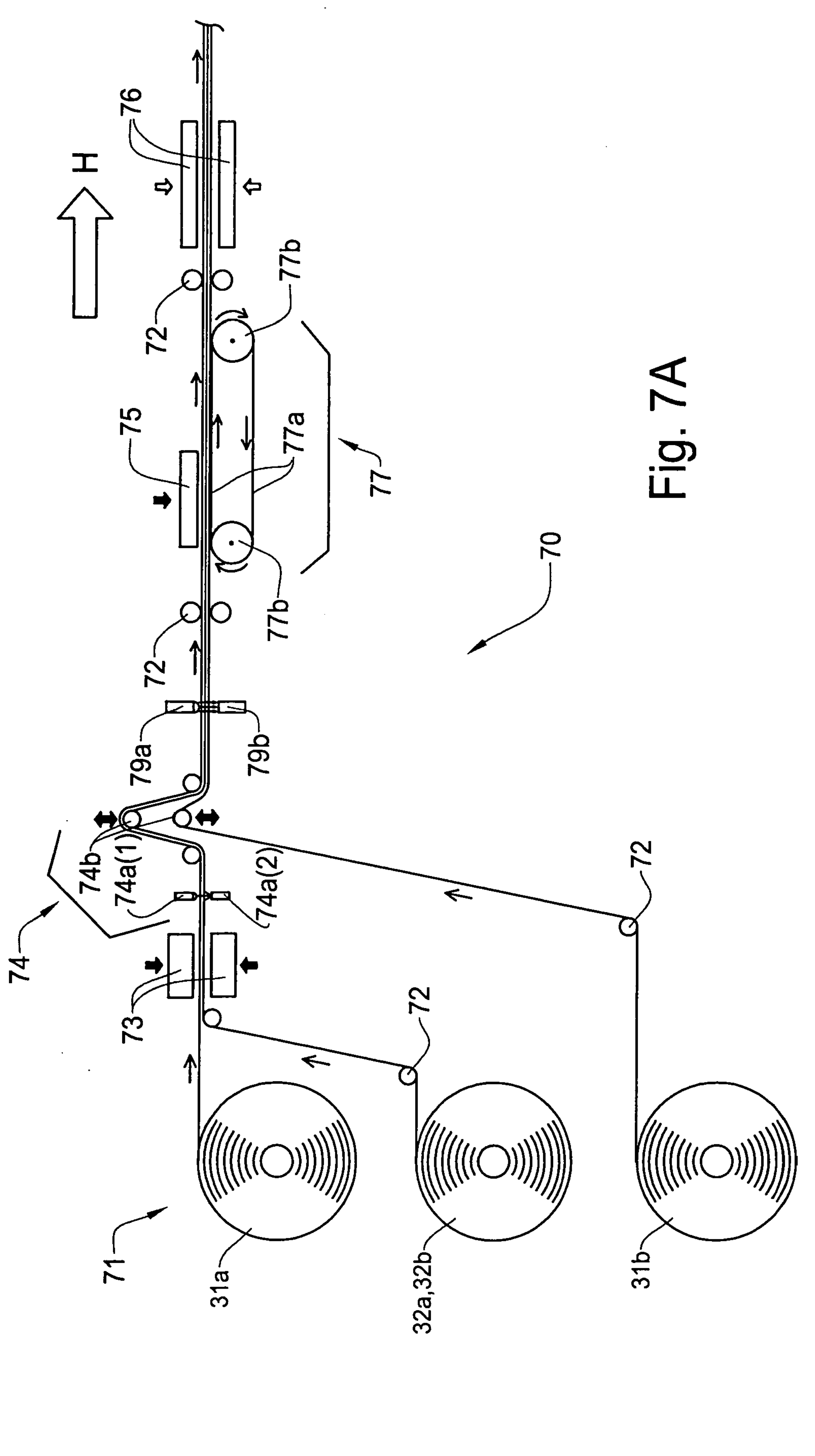

H
76
72
77b
75
77a
77
70
72
77b
79a
79b
74
74b
74a(1)
74a(2)
73
72
72
71
31a
32a,32b
31b

Fig. 7A

Fig.7B

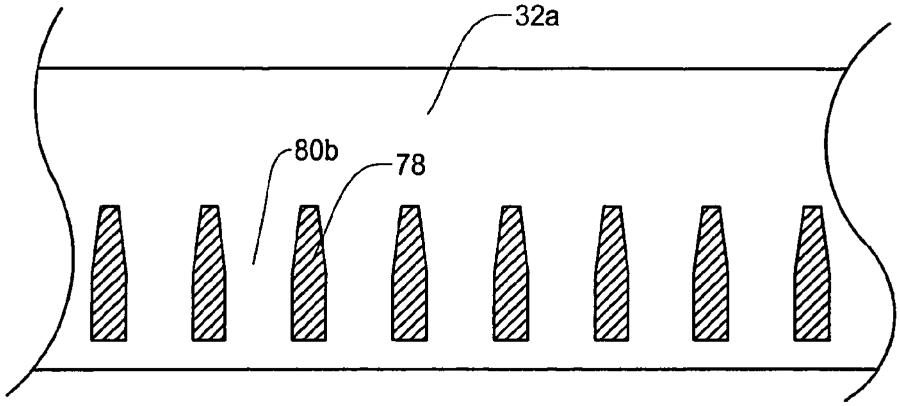


Fig.7C

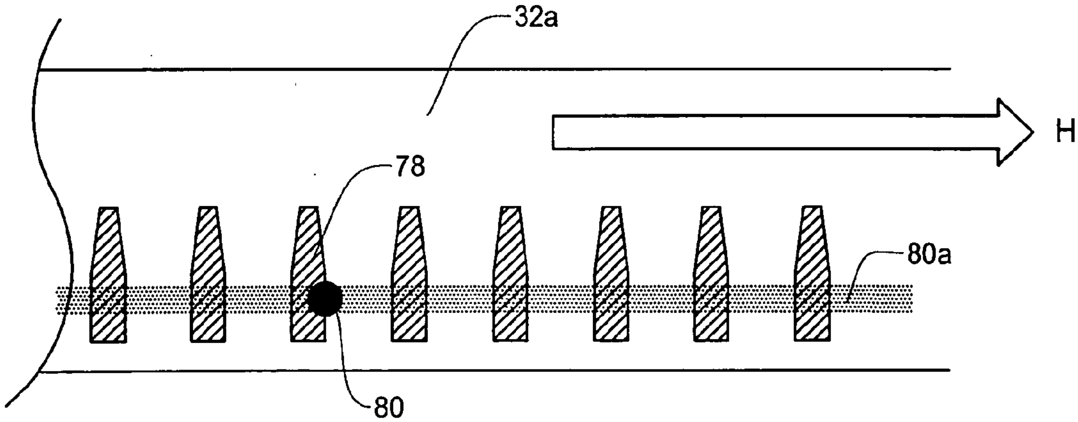


Fig.8A

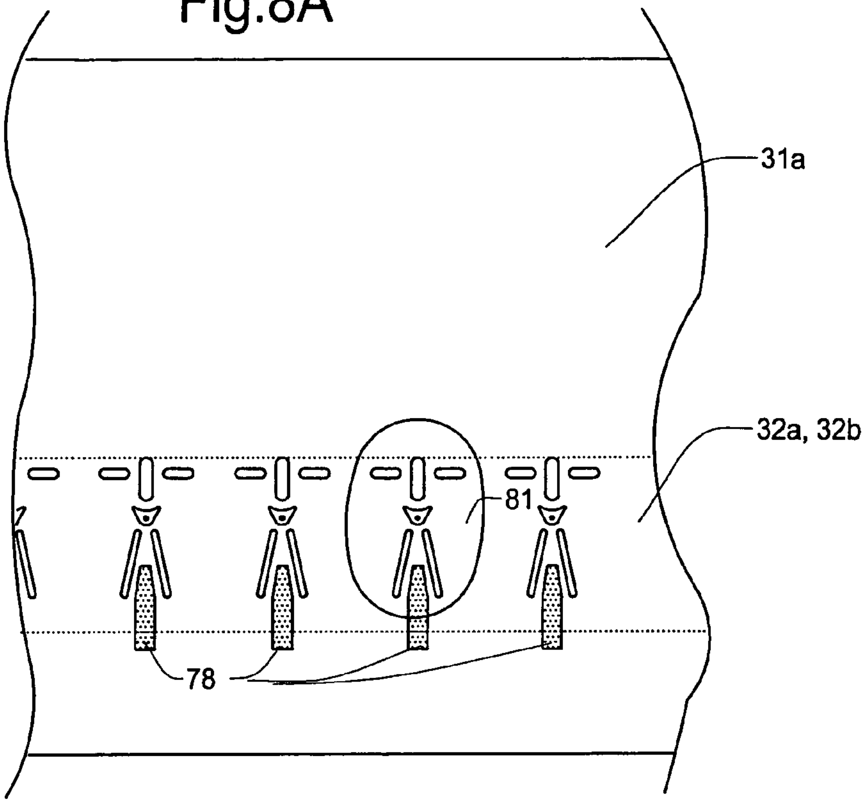


Fig.8B

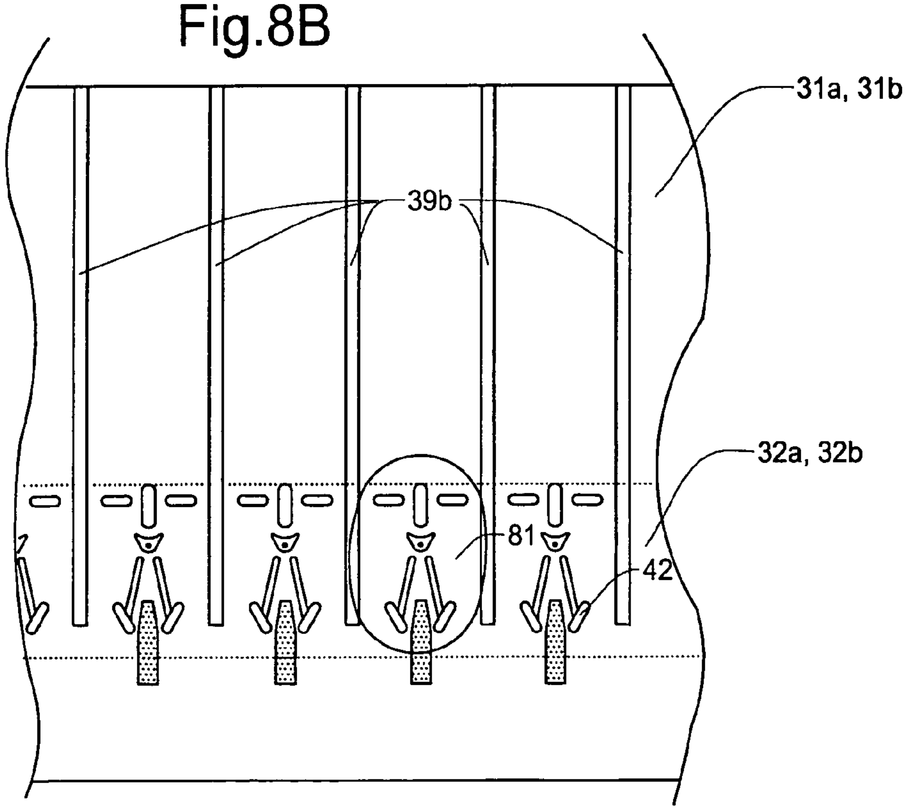


Fig.8C

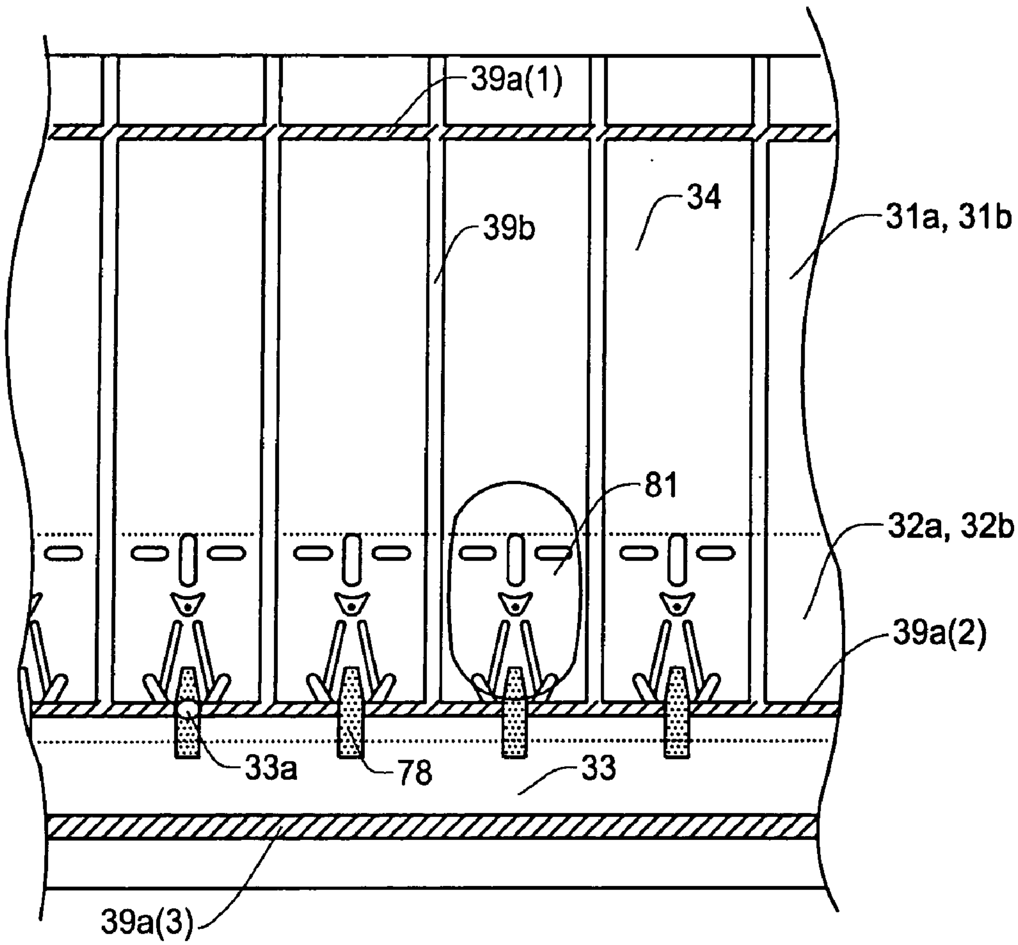


Fig.9A

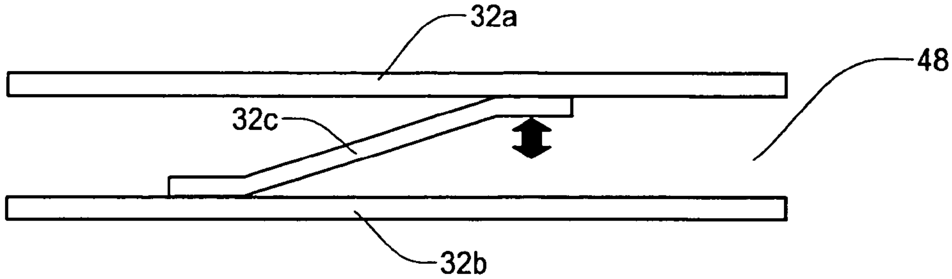
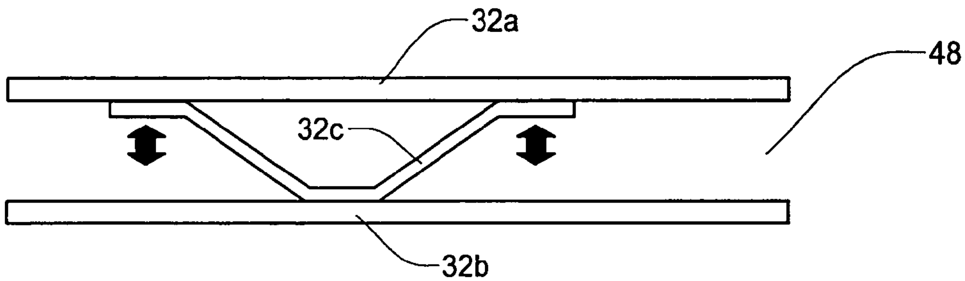


Fig.9B



STRUCTURE OF FLUID CONTAINER AND METHOD AND APPARATUS FOR PRODUCING THE FLUID CONTAINER

FIELD OF THE INVENTION

[0001] This invention relates to a structure of a fluid container and a manufacturing apparatus for producing the fluid container, and more particularly, to a bonding structure of the check valve capable of reliably keeping the expansion of the fluid container without any fluid leakage after inflating the fluid container and to the production method and apparatus to produce the fluid container incorporating the bonding structure of the check valves.

BACKGROUND OF THE INVENTION

[0002] A styroform packing material has been used for a long time for packing commodity and industrial products. Although the styroform package material has a merit such as a good thermal insulation performance, it has also various disadvantages: recycling the styroform is not possible, soot is produced when it burns, a flake or chip comes off when it is snagged because of it's brittleness, an expensive mold is needed for its production, and a relatively large warehouse is necessary to store it.

[0003] Therefore, to solve such problems above, other packing materials and methods have been proposed. One method is a fluid container of sealingly containing a liquid or gas. The fluid container has excellent characteristics to solve the problems in the styroform. First, because the container is made of only thin sheets, it does not need a large warehouse to store it unless the container is inflated. Secondly, a mold is not necessary for its production because of its simple structure. Thirdly, the fluid container does not produce a chip or dust which has adverse effect on precision products. Also, recyclable materials can be used for the films of the fluid container. Further, the fluid container can be produced with low cost.

[0004] **FIG. 1A** shows an example of fluid container in the conventional technology. The fluid container **10***a* is composed of first and second thermoplastic films **13** and **14**, respectively, and a check valve **11**. Typically, each thermoplastic film is composed of three layers of materials: polyethylene, nylon and polyethylene which are bonded together with appropriate adhesive. The first and second thermoplastic films are heat-sealed together around rectangular seal portions **12***a*, **12***b* after the check valve is attached. Thus, one container bag **10***a* sealed with the heat seal portions **12***a*, **12***b* is formed such as shown in **FIG. 1A**.

[0005] **FIG. 1B** shows an example of the manufacturing apparatus for the fluid container, including first and second plastic film stocks **13***a* and **14***a* respectively, a first heat seal device **15** for attaching a check valve **11**, a sensor device **16** to control for supplying elongated plastic films **13***c* and **14***c*, a second heat device **17** for right-left heat seal portions **12***a*, a third heat seal device **18** for upper-lower heat seal portions **12***b*, and film feed rollers **19**.

[0006] Materials for the first and second plastic films are supplied as elongated plastic films **13***b* and **14***b* from the rolled film stocks **13***a* and **14***a* such as shown in **FIG. 1B** or **FIG. 1C**. The sensor device **16** is used to drive the feed rollers **19** and to control a feeding speed of the plastic films by, for example, by sensing marks printed on the elongated plastic film **13***b* or **14***b*.

[0007] **FIG. 1C** shows an example of the first heat seal device **15**, including upper and lower heat seal elements **15***a* and **15***b*, a check valve supplier **15***c*, heater assemblies **15***d* and check valves **11**. The check valves **11** are pre-installed on the check valve supplier **15***c*. After the elongated films **13***b*, **14***b* for one container package are supplied, the check valve supplier **15***c* supplies the check valve **11** between the first and second elongated films **13***b* and **14***b* by rotating about its axis. The heater assemblies **15***d* are embedded in both the heat seal elements **15***a*-**15***b* and maintain the surfaces to contact the films **13***b* and **14***b* at an appropriate fusing temperature of the plastic film. By sandwiching the check valve **11** between the upper and lower heat seal elements **15***a* and **15***b*, the check valve **11** is fused together with both the first and the second plastic film **13***b*, **14***b* and attached at a predetermined position of the fluid container.

[0008] Referring back to **FIG. 1B**, after installation of the check valve **11** at the stage of the first heat seal device **15**, the elongated plastic films **13***b*, **14***b* are fused together to form the right-left heat seal portions **12***a* of the fluid container at the stage of the second heat seal device **17**. Finally, the films **13***b*, **14***b* are fused together to form the upper-lower portions **12***b* at the stage of the third heat seal device **18**, and the fluid container with one check valve shown in **FIG. 1** is produced.

[0009] **FIGS. 2A-2B** show an example of a fluid container **10***b* with multiple container members where each container member is provided with a check valve. A main purpose of having multiple container members is to increase the reliability. Namely, even if one of the container members causes an air leakage for some reason, the fluid container can still function as a cushion of package because other container members are intact. Thus, in order to achieve this purpose, each container member has an independent room which is inflated independently.

[0010] With reference to **FIG. 2A**, this fluid container **10***b* is made of the first and second thermoplastic films which are bonded together around a rectangular periphery **23***a* and further bonded together at each boundary of two container members **22** so that a guide passage **21** and container members **22** are created. When the first and second thermoplastic container films are bonded together, as shown in **FIG. 2A**, the check valves **11** are also attached to each inlet port of the container member **22**. By attaching the check valves **11**, each container member **22** becomes independent from the other. The inlet port **24** of the fluid container **10***b* is used when filling a fluid (typically an air) to each container member **22** by using, for example, an air compressor.

[0011] **FIG. 2B** shows an example of the fluid container **10***b* with multiple check valves when it is filled with the fluid. First, each container member **22** is filled with the fluid from the inlet port **24** through the guide passage **21** and the check valve **11**. To avoid a rupture of the container members by variations in the environmental temperature, the fluid into the container is typically stopped when the container member **22** is inflated at about 90% of its full expansion rate. After filling the fluid, the expansion of each container member is maintained because each check-valve **11** prevents the reverse flow. Typically, the air compressor has a gage to monitor the supplied air pressure, and automatically stops supplying the air to the fluid container **10***b* when the pressure reaches a predetermined value.

[**0012**] The check valve **11** is typically made of two rectangular thermoplastic valve films which are bonded together to form a fluid pipe. The fluid pipe has a tip opening and a valve body to allow a fluid flowing through the fluid pipe from the tip opening but the valve body prevents the reverse flow. More details of the check-valve example are described in the U.S. Pat. Nos. 5,209,264, 4,708,167 and 5,927,336. This type of check valve is produced before manufacturing the fluid container and attached to it such as shown in **FIG. 1C**. Therefore, this type of check valve is often called an out-line valve. On the other hand, a valve which is produced in the process of making a fluid container, is called an in-line valve. Preferably, the present invention is applied to the in-line valve, although the present invention is also applicable to the out-line check.

[**0013**] Fluid containers are becoming more and more popular. However, there are problems to solve, for example, when the fluid container **10***b* is inflated, both sides **23***a* and **23***b* of the check valve body is pressed inwardly by the expansion of the container member **22**. The directions of the pressing force is shown by arrows **25** in **FIG. 2C**. As a result, the check valves **11** become wavy such as shown in **FIG. 2D** although the bonded portion was straight before the fluid container **10***b* is inflated.

[**0014**] As mentioned above, the check valve **11** is typically made of two thermoplastic films. It should be noted that sometimes by the pressure noted above, a gap is created between the thermoplastic films **11***a* and the check-valve **11** of the container member **22**. Thus, the fluid is leaked through the gap as shown in **FIG. 2E**. The leakage of the check valve **11***a* is shown by an arrow **27**. In other words, the reverse flow in the container member corresponding to the check valve **11***a* occurs and the fluid from the container member **22** flows into the guide passage **21** in this example. This is a serious problem of the fluid containers in the conventional technology. As long as there is no gap between the two thermoplastic films, the reverse flow is prevented as shown in the wavy check valves **11***b* and **11***c* of **FIG. 2E**.

[**0015**] There is another problem which is involved in the production of the fluid containers. This problem is related to the installation of the check valves: it is not easy to accurately attach the check valve to each container member of the fluid container film. Therefore, the inaccurate installation of the check valve also sometimes causes a leakage problem.

[**0016**] As described in the foregoing, the fluid container using the check valves is highly useful for packing commodity products and industrial products instead of the styroform packing. However, since there are leakage and other problems in the fluid containers as described above, it is necessary to improve the performance of check valves in the fluid container and the production efficiency for producing the fluid containers to reduce the overall cost.

SUMMARY OF THE INVENTION

[**0017**] It is, therefore, an object of the present invention to provide a structure of fluid container and a method and apparatus for producing the fluid containers with high efficiency and high reliability.

[**0018**] It is another objected of the present invention to provide a bonding structure of an in-line check-valve formed in fluid members of a fluid container, which is capable of reliably keeping the expansion of the fluid container without any fluid leakage after inflating the fluid container.

[**0019**] It is a further object of the present invention to provide a method and apparatus for producing the fluid container having the above bonding structure of the check-valve.

[**0020**] More specifically, one aspect of the present invention is a structure of the fluid container for sealingly containing a fluid and having a check valve of unique structure. The fluid container fluid container is comprised of first and second container films superposed with each other where predetermined portions of the first and second thermoplastic container films are bonded, thereby creating a plurality of container members, and a check valve established at an input of each container member between the first and second container films for allowing a fluid flow of only one predetermined direction, said check valve being formed of first and second check valve films juxtaposed with each other.

[**0021**] The check valve is bonded to one of the first or second container film for tightly closing the check valve when a reverse flow of the fluid is about to occur, thereby preventing the reverse flow. Accordingly, both two films of the check valve are curved in the same manner as one of the container film to which the check valve is bonded when the fluid container is inflated. Thus, the two bonded films of the check valve are tightly sealed and the expansion of the fluid container is reliably maintained after the fluid container is inflated.

[**0022**] Another aspect of the present invention is a method for producing the fluid container having the above noted structure. The method includes the steps of superposing first and second check valve films on a first container film, bonding the first and second check valve films to the first container film for creating a plurality of check valves, superposing a second container film on the first container film while sandwiching the check valves therebetween, and bonding the first container film, the first and second check valve films and the second container film, thereby creating a plurality of container members where the check valve is positioned at each input of the container member.

[**0023**] A further aspect of the present invention is an apparatus for producing the fluid container having the above noted structure. The production apparatus is comprised of means for feeding films which feeds a first container film, first and second check valve films and a second container film, wherein the first and second check valve films are sandwiched between the first and second container films, a feed sensor for detecting a position of a mark printed on either the first or second check valve film to feed the films, an up-down roller controller for adjusting positions of the first container film and the first and second check valve films, means for bonding the first container film and the first and second check valve films, thereby creating check valves, and means for bonding the first container film, the first and second container films and the second container film, thereby creating a plurality of container members and inlet portions of the check valves. The up-down controller adjusts the position of the check valve films by detecting the mark for determining the position of check valve.

[**0024**] According to the present invention, the structure of check valves to be bonded to the fluid container and the production apparatus for producing the fluid containers enable the fluid container of reliably keeping the expansion of the fluid container without any fluid leakage after inflating the fluid container. The up-down roller controller in the manufacturing apparatus for producing the fluid containers can precisely position the films to firmly form the in-line check valve. Also, the belt conveyer in the manufacturing apparatus helps to form the heat seal portions without creases. As a result, the manufacturing apparatus in the present invention can produce the fluid containers of high reliability and low cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] **FIG. 1A** is a schematic diagram showing an example of a typical fluid container in the conventional technology, and **FIGS. 1B-1C** are schematic diagrams showing examples of apparatus for producing the fluid containers in the conventional technology.

[0026] **FIGS. 2A-2E** are schematic diagrams showing a structure of a fluid container having multiple container members with use of check valves in the conventional technology for explaining the problems involved therein.

[0027] **FIG. 3** is a schematic diagram showing an example of a fluid container having a bonding structure of check valves in the present invention.

[0028] **FIGS. 4A-4B** are schematic diagrams showing an example of a bonding structure of the check-valve in the present invention in more detail.

[0029] **FIG. 5** is a schematic diagram showing the cross sectional view of the check valve of the present invention for explaining how the two check valve films in pairs are tightly closed when the reverse flow happens.

[0030] **FIGS. 6A-6B** are schematic diagrams showing the cross sectional view of the check valve of the present invention when the fluid container is inflated.

[0031] **FIG. 7A** is a schematic diagram showing an apparatus for producing the fluid containers having the bonding structure of the check valve in the present invention, and **FIGS. 7B and 7C** are schematic diagrams showing a relationship between a mark on the check valve film and the scanning area of the sensor.

[0032] **FIGS. 8A-8C** are schematic diagrams showing bonding processes to produce the fluid containers including the in-line check valves in the present invention.

[0033] **FIGS. 9A-9B** are schematic diagrams showing cross sectional view of other embodiments of the check valve structure in the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0034] The present invention provides a method and apparatus for producing a fluid container with a reliable structure of check valve. As mentioned in the background of the invention, the check valves for the fluid container in the conventional technology are not reliable when the container is inflated. As shown in **FIG. 2D**, the sealed portions of the check valve are pressed inwardly and the check valve body becomes wavy. As a result, the fluid pipe in the check valve to prevent the reverse flow is easily opened, thereby causing the leakage. Also, the check valve needs to be attached more accurately to the fluid container.

[0035] A check valve in the present invention is designed to solve these problems. To avoid the check valve wavy, the check valve is not bonded to both container plastic films, but to only one of the container plastic films. Also, to increase the accuracy of attaching the check valve to the container members, a check valve having a special structure is used for the fluid container in the present invention. Here, it should be noted that the term "fluid" includes gas and liquid, although sometimes may be referred to as an "air" for simplicity.

[0036] Now, the present invention is described in detail with reference to the accompanying drawings. **FIG. 3** shows an example of structure of a fluid container **30** in the present invention. In this example, the width W of the fluid container **30** is constant. The fluid container **30** is made of four thermoplastic films; two container films **31***a*-**31***b* and two check valve films **32***a*-**32***b*. The two container films **31***a*-**31***b* are used to form an overall fluid container, and the two check valve films **32***a*-**32***b* are used to form in-line check valves **38** in the manufacturing process.

[0037] These films are supplied respectively by the rolled film stocks **31***a*, **31***b* and **32***a*-**32***b* such as shown in **FIG. 7A**. The four films are juxtaposed (laminated) in the order of the first container film **31***a*, first valve film **32***b*, second valve film **32***a* and second container film **31***b* as shown in **FIG. 3**. Then, through three stages of the manufacturing process, the four films **31***a*, **31***b* and **32***a*-**32***b* are bonded (typically heat-sealed) together to make a plurality of container members **34**, a guide passage **33**, and check valves **38**.

[0038] In this example, the fluid (ex., air) is introduced through the guide passage **33** and supplied to each container member **34**, through each check valve **38**. As another optional embodiment of the present invention, the fluid can be directly supplied to each container member **34** through the corresponding check valve **38** without the guide passage **33**. It should be noted that the four elongated plastic films **31***a*-**31***b* and **32***a*-**32***b* are fed in a manufacturing flow direction indicated by an arrow H of **FIG. 3**.

[0039] The container members **34** are rectangularly partitioned by upper-lower seal (bonded) portions **39***a* and right-left seal portions **39***b*. These container members **34** are formed so that they are inflated in a direction vertical with the manufacturing flow direction H. Further, ordinarily, many container members **34** are formed which are aligned in the flow direction H. Although, in this example, the shape of the container member is rectangular, it is not limited to the rectangular and could be any shape which satisfies the customer's specific needs. Also, although the fluid container having multiple container members are shown, it could be composed of a single container member.

[0040] In this example, the check-valve inlet **33***a* is open to the guide passage **33**, and the container member **34** is heat-sealed by the upper-lower and right-left seal portions **39***a* and **39***b*. Thus, each container member **34** is independent from one another except for the guide passage **33**. In this configuration, the fluid can be supplied to inflate the container members **34** through the guide passage **33** and the check valve inlet **33***a*.

[0041] **FIGS. 4A and 4B** show the structure of the check valve **38** of the present invention in more detail where **FIG.**

4A is a top view and **FIG. 4B** is a cross sectional view. **FIG. 4B** shows the cross sectional view of the check valve **38** taken along the line II in **FIG. 4A**. Further, the cross sectional view of **FIG. 4B** shows the case where the fluid is not supplied to the container member **34**.

[**0042**] In **FIGS. 4A and 4B**, reinforcing seal portions **42** are formed near the check valve inlet **33***a* such as shown in **FIG. 4A**. These portions are placed in a manner of contacting each edge of the inlet portion **33***a* such as shown in **FIG. 4A**. The seal portions **42** reinforce a boundary between the guide passage **33** and the container member **34**, and prevent the container member **34** from a rupture when it is inflated. In the present invention, the reinforcing seal portions **42** is not essential and can be omitted.

[**0043**] In the fluid container **30**, the two check valve films **32***a* and **32***b* are juxtaposed (superposed) and sandwiched between the two container films **31***a* and **31***b* near the guide passage **33**, and fixing seal portions **41-42**, **35** and **37**. These fixing seal portions **41-42** are referred to as outlet portions, the fixing seal portion **35** is referred to as an extended (or widened) portion, and the fixing seal portion **37** is referred to as a narrow down portion. These fixing seal portions also form the structure of the check valve **38** and fix the valve to the first container plastic film **31***a* at the same time. The fixing seal portions **35** are made by fusing the check valve plastic films **32***a* and **32***b* only with the first plastic container film **31***a*. As a result of this bonding, the check valve **38** is constructed inside the container member **34**.

[**0044**] As has been described, the check valve **38** is made of the two flexible thermoplastic films **31***a*-**31***b* and a fluid pipe **48** is created between the first check valve film **32***b* and the second check valve film **32***a*. How the fluid passes through the check valve **38** is shown by white arrows indicated by the numbers **47***a*, **47***b* and **47***c*. The fluid is supplied from the guide passage **33** through the fluid pipe **38** to the container member **34**.

[**0045**] In the check valve **38**, the regular fluid relatively easily flows through the fluid pipe **48** although there exist the fixing seal portions **35**, **37** and **41-42**. However, the reverse flow in the valve will not easily pass through the fluid pipe **48**. In other words, if the reverse flow occurs in the fluid pipe **48**, it is prevented because of a pressure of the reverse flow itself. By this pressure, the two surfaces of check valve films **32***a* and **32***b* which face each other, are brought into intimate contact such as shown in **FIG. 5** as will be explained later.

[**0046**] As has been described, in **FIGS. 4A-4B**, the fixing seal portions **35**, **37** and **41-42** also work for guiding the fluid to flow in the check valve **38**. The fixing seal portions are comprised of the portions **41***a*, **42***a*, **35***a* and **37***a* which bond the two check-valve films **32***a* and **32***b* together, and the portions **41***b*, **42***b*, **35***b* and **37***b* which bond the first container film **31***a* and the first check valve film **32***b* together. Accordingly, the fluid pipe **48** in the check valve **38** is created as a space formed between the two check valve films **32***a*-**32***b* which excludes the fixing seal portions **41***a*, **42***a*, **35***a* and **37***a*.

[**0047**] Further in **FIG. 4A**, the fixing seal portion **37** are composed of two symmetric line segments (narrow down portions) extended in an upward direction of the drawing, and a width of the fluid pipe **48** is narrowed down by these portions **37**. In other words, the regular flow can easily pass through the fluid pipe to the container member **34** when it passes through the wide space to the narrow space created by the narrow down portions **37**. On the other hand, the narrow down potions **37** tend to stop the reverse flow from the container member **34** when the fluid goes back through the narrow space created by the narrow down portions **37**.

[**0048**] The extended portion **35** is formed next to the narrow down portions **37**. The shape of the extended portion **35** is similar to a heart shape to make the fluid flow divert. By passing the fluid through the extended portion **35**, the fluid diverts, and the fluid flows around the edge of the extended portion **35** (indicated by the arrow **47***b*). When the fluid enters the container member **34** (forward flow), the fluid flows naturally in the extended portion **35**. On the other hand, the reverse flow cannot directly flow through the narrow down portions **37** because the reverse flow hits the extended portion **35** and is diverted its direction. Thus, the reverse flow cannot practically occur because the flow is not natural. Therefore, the extended portion **35** also functions to prevent the reverse flow.

[**0049**] The outlet portions **41-42** are formed next to the extended portion **35**. In this example, the outlet portion **41**, extended in perpendicular to the (manufacturing) flow direction H, is formed at the upper center of the check valve **38**, and the two outlet portions **42** to extended to the (manufacturing) flow direction H are placed symmetrically with respect to the outlet portion **41**. There are several spaces among these outlet portions **41** and **42**. These spaces constitute a part of the fluid pipe through which the fluid can pass as indicated by the arrows **47***c*. The outlet portions **41-42** are formed as a final passing portion of the check valve **38** when the fluid is supplied to the container member **34** and the fluid diverts in four ways by passing through the outlet portions **41-42**.

[**0050**] Accordingly, the reverse flow from the container member **34** cannot easily pass through the fluid pipe **48**. Thus, the reverse flow is stopped in some degrees by the outlet portions. As has been described, the fluid passing from the guide passage **33** to the container member **34** is relatively smoothly propagated through the check valve **38**. Further, the narrow down portions **37**, extended portions **35** and outlet portions **41-42** formed in the check valve **38** work to prevent the reverse flow.

[**0051**] **FIG. 5** is a cross sectional view showing an effect of the check valve **38** of the present invention. This example shows an inner condition of the check valve **38** when the reverse flow tries to occur in the container member **34**. First, the fluid hardly enters in the fluid pipe **48** because the outlet portions **41** and **42** work for the fluid such that the reverse flow will not easily enter in the outlet portions. Instead, the fluid flows in a space between the second container film **31***b* and the second valve film **32***a* such as indicated by the arrows **51**, and the space is inflated such as shown in **FIG. 5**. By this expansion, the second check valve film **32***a* is pressed to right, and at the same time, the first valve film **32***b* is pressed to left. As a result, the two check valve films **32***a* and **32***b* are brought into tight contact as indicated with the arrows **52**. Thus, the reverse flow is completely prevented.

[**0052**] **FIGS. 6A-6B** are simplified cross sectional drawings of the check valve **38** viewed from the guide passage of the fluid container **30**. **FIG. 6A** shows the condition that the container members are inflated until about a half of the full inflation. **FIG. 6B** shows the condition that the container members **34** are inflated fully by the fluid. The first and second container films **31***a* and **31***b* are inflated such as shown in **FIGS. 6A-6B**, and the check valve **38** is shown by the cross hatching on the first container film **31***a*.

[**0053**] Each container member **34** is chained by the right-left seal portions **39***b*. Because the narrow down portions **37**, extended portion **35** and outlet portions **41-41** in **FIGS. 4B-4C** are placed closely, their bonding force with the first container film **31***a* is strong enough to keep fixing the check valve **38** to the film **31***a* even if the container member **34** is fully inflated. Therefore, the check valves **38** bonded only to the first container film **31***a* are curved along the surface deflection of the container film **31***a*.

[**0054**] In other words, both the two check-valve films forming the check valve **38** are curved in the same direction as that of the first container film **31***a* (the fluid pipe in the check-valve keeps to be closed) while tightly contacting with one another. Thus, **FIGS. 6A-6B** clearly show that the design of the check valves bonded only to one of the container films can effectively prevent the check valve **38** from leaking when the container member **34** is inflated. As shown in **FIG. 5**, since the check valve **38** is tightly closed when the reverse flow about to occur, the reverse flow of the fluid is effectively prevented by the structure of the check valve in the present invention.

[**0055**] Next, the manufacturing process and apparatus for producing the fluid container are described with reference to **FIGS. 7A-7C** and **8A-8C**. **FIG. 7A** shows an example of a preferred embodiment of a manufacturing apparatus for the fluid container in the present invention. As has been described, the check valves are constructed during the manufacturing process of the fluid containers.

[**0056**] The manufacturing apparatus **70** is comprised of a film feeding means **71**, film conveying rollers **72**, a valve heat seal device **73**, an up-down roller controller **74**, a sensor for feeding elongated plastic films **79**, a right-left heat seal (bonding) device **75**, a belt conveyer for right-left heat seal **77**, and an upper-lower heat seal (bonding) device **76**.

[**0057**] The up-down roller controller **74** is provided to the manufacturing apparatus **70** in order to improve a positioning performance of the check valves. The up-down controller **74** moves the rollers **74***b* in perpendicular (upward or downward) to the manufacturing flow direction H in order to precisely adjust a position of the check valve. Also, the belt conveyer **77** is provided to the manufacturing apparatus **70** in order to improve a heat seal performance for forming right-left heat seal portions **39***b* shown in **FIG. 3**.

[**0058**] With reference to **FIG. 7A**, an overall manufacturing process is described. First, the film feeding means **71** supplies elongated check valve films **32***a* and **32***b* which are juxtaposed (superposed) with each other, and the container films **31***a* and **31***b* to the following stages of the manufacturing process. The film conveying rollers **72** at various positions in the manufacturing apparatus **70** guide and send each film forward.

[**0059**] Every time each elongated film is advanced by a length equal to one fluid container in the manufacturing flow direction, heat seal processes are performed at the three stages of the process. The first stage of heat sealing process is done by using the valve heat seal device **73**. This is the process for forming the structure of in-line valve **38**. The position of the valve **38** is precisely adjusted by the up-down roller controller **74**. The detailed method will be explained later with reference to **FIGS. 7B-7C**.

[**0060**] The second stage of the heat sealing process is done by using the right-left heat seal device **75** and the belt conveyer **77** for right-left heat seal. The belt conveyer **77** is used for prevent the right-left heat seal portion from extending. The belt conveyer **77** has two wheels **77***b* and a flexible rubber **77***a* which sticks to the film **31***b* and moves at the same feed speed of the films. Therefore, the belt conveyer **77** keeps the films as is until the seal portion passes the conveyer **77**. Also, the heat seal portions with a high temperature are naturally cured while they are stuck to the rubber **77***a*. As a result, the belt conveyer **77** prevents the right-left seal portions **39***b* extended or crinkled.

[**0061**] The third stage of the sealing process is performed by the upper-lower heat seal device **76**. This is the final heat seal process to produce the fluid container **30**. The fluid containers which are produced in the form of one long sheet may be rolled again, or may be cut and heat-sealed again to make a sack-like form for a cushion of package. Processes of inflating the produced fluid container and packaging the products with the fluid container may be added.

[**0062**] The control processes for supplying the films in the manufacturing machine **70** are discussed with reference to **FIGS. 7A-7C**. Feeding of the elongated films **31***a*-**31***b*, **32***a* and **32***b* is controlled by using the sensor **79** and the film conveying rollers **72**. The sensor **79** is comprised of, for example, a light emitting diode (LED) **79***a* and a photo-receiver **79***b* for sending the light from the LED. The sensor **79** detects an edge between the transparent part **80***b* and a mark **78** which is printed in advance on one of the check valve films **32***a* and **32***b* such as shown in **FIG. 7B**. The sensor **79** causes to drive the film conveying rollers **72** such that each of the elongated plastic films **31***a*, **31***b*, **32***a* and **32***b* in the size of one fluid container is supplied. Thus, the manufacturing apparatus **70** includes a main controller for controlling the overall feeding process of the elongated films **31***a*, **31***b*, **32***a* and **32***b* based on the signals from the sensor **79**.

[**0063**] The manufacturing apparatus **70** also includes a precise control means for precisely positioning the check valves to a position of the printed mark **78** (in **FIG. 7B**) by using the up-down roller controller **74** such as shown in **FIG. 7A**. The up-down controller **74** is configured by a sensor **74***a* and an up-down roller **74***b*. The films are typically transparent and the marks **78** are printed with an appropriate color such as white. The sensor **74***a* is comprised of, for example, a light emitting diode (LED) **74***a*(**1**) and a photo-receiver **74***a*(**2**) for detecting the light from the LED.

[**0064**] The LED **74***a*(**1**) emits a light which passes through the films **31***a* and **32***a*-**32***b* as indicated by the arrow in **FIG. 7A**. If the light passes through the transparent part **80***a* of the film **32***a*, then an energy of the light received by the photo-receiver **74***a*(**2**) will be large. Also, if the light passes through the white mark **78**, the detected light will be small because the light cannot easily pass through the white paint. Therefore, the sensor **74***a* can differentiates the transparent part **80***b* from the white mark **78**.

[**0065**] By using this information, the manufacturing apparatus **70** controls the position of the valve films **32** by driving the up-down rollers **74***b* in perpendicular (upward or downward) to the manufacturing flow direction H such that the light of the LED passes through the edge **80** after the films are supplied in the manufacturing flow direction H such as shown in **FIG. 7C**. In other words, the films always have some tension in the flow direction H. Therefore, if the up-down controller moves the up-down rollers **74***b* upward, then the films are fed forward. In contrast, if the controller moves them downward, then the films are fed backward. In this manner, the position of the films are controlled. In **FIG. 7C**, the shadowed area **80***a* shows an area scanned by the sensor **74***a* while the elongated films **32***a* are sent in the direction H.

[**0066**] With reference to FIGS. **7**A and **8**A-**8**C, the three stages of the heat seal process is described in detail. In general, the heat seal device in each stage **73**, **75** and **76** includes heaters and a stamping die which forms the heat seal portions required in the stage. Each die is heated and maintained at a predetermined temperature to appropriately fuse and bond the films together.

[**0067**] The first container film **31***a* and the check valve films **32***a* and **32***b* are superposed and heat-sealed by the valve heat seal devices **73**, as shown in **FIG. 8A**. The heat seal device includes the heaters and the stamping die, which forms the fixing seal portions **81**. As has been described, the color marks **78** are used to control the position of the container films **31***a* and the check valve films **32***a*-**32***b* such that the fixing portions are formed in the center of the color mark **78**. By forming the fixing seal portions **81**, the check-valve **38** can be created which is fixed to the first container film such as shown in **FIG. 6B**.

[**0068**] On the second stage of the heat sealing process (at the upper right-left heat seal device **75** and lower belt conveyer **77**), the right-left heat seal portions **39***b* are formed by additionally superposing the container film **31***b* and heat-sealing the films **31***a*-**31***b* and **32***a*-**32***b*. The upper right-left heat seal device **75** includes the heaters and the stamping die, which forms the shape of the right-left heat seal portions **39***b*. The fixing portion **42** of the check valve is heat-sealed as needed in this process. As has been described, this heat seal process uses the belt conveyer **77** in **FIG. 7A** which is provided to form the right-left portions **39***b* without creases or wrinkles.

[**0069**] On the third stage of the heat sealing process (at the upper-lower heat seal device **76**), the upper-lower heat seal portions **39***a* (indicated by the shadow area in **FIG. 8C**) are formed by heat-sealing the films **31***a*-**31***b* and **32***a*-**32***b*. The upper-lower heat seal device **76** includes the heaters and the stamping die, which forms the shape of the upper-lower heat seal portions **39***b*. Through the above three stages of the heat sealing process, the fluid container members **34**, the inlet portions **33***a*, the guide passage **33** and the fixed seal portions (in-line valve) **81** are created, and the production of the fluid containers is completed.

[**0070**] As shown in **FIG. 8C**, the inlet portion **33***a* are covered by the mark **78**. Therefore, if heat resist paint is optionally used for printing the mark **78**, the inlet portion **33***a* of the valve **38** will not be bonded together even if the inlet portion **33***a* tries to be heat-sealed with other portions. In this case, the cavity of the inlet portion **33***a* in the stamping die to create the inlet portion is not necessary. Thus, the design of the stamping die becomes simpler if the heat resist paint is used.

[**0071**] The present invention is not limited to the embodiments mentioned above. For example, in the above example, the two check valve films **32***a* and **32***b* are used. However, instead of using the two valve films, one check valve film may be used for the same structure by folding it in two. Also, more than two check valve films may be used for the similar purpose. For example, as shown in **FIG. 9A**, an additional check valve **32***c* is placed between check valve films in pairs **32***a* and **32***b*. The additional check valve film **32***c* is bonded to one of the check valve films (in this example, film **32***b*) and can be brought into tight contact or opened to another check valve (in this example, film **32***a*) in order to prevent the reverse flow in the fluid pipe.

[**0072**] Further, the shape of the check valve film **32***c* is not limited to a particular shape to work for only one check valve sheet such as shown in **FIG. 9A**. It may be a "V" shape to operate as a check valve for both directions such as shown in **FIG. 9B**. Further, as other embodiments of the present invention, such a configuration in which a plurality of the check valve films **32***c* are placed between the check valves **32***a* and **32***b* is also possible.

[**0073**] As has been in the foregoing, the structure of check valves to be bonded to the fluid container and the production apparatus for producing the fluid containers enable the fluid container of reliably keeping the expansion of the fluid container without any fluid leakage after inflating the fluid container. The up-down roller controller in the manufacturing apparatus for producing the fluid containers can precisely position the films to firmly form the in-line check valve. Also, the belt conveyer in the manufacturing apparatus helps to form the heat seal portions without creases. As a result, the manufacturing apparatus in the present invention can produce the fluid containers of high reliability and low cost.

[**0074**] Although the invention is described herein with reference to the preferred embodiments, one skilled in the art will readily appreciate that various modifications and variations may be made without departing from the spirit and the scope of the present invention. Such modifications and variations are considered to be within the purview and scope of the appended claims and their equivalents.

1. (canceled)
2. (canceled)
3. (canceled)
4. (canceled)
5. (canceled)
6. (canceled)
7. (canceled)
8. (canceled)
9. (canceled)
10. (canceled)
11. (canceled)
12. (canceled)

13. A manufacturing apparatus for producing a fluid container for packing a product by sealingly containing a fluid therein, comprising:

means for feeding films which feeds a first container film, first and second check valve films and a second container film, wherein the first and second check valve films are sandwiched between the first and second container films;

a feed sensor for detecting a position of a mark printed on either the first or second check valve film to feed the films;

an up-down roller controller for adjusting positions of the first container film and the first and second check valve films;

means for bonding the first container film and the first and second check valve films, thereby creating check valves; and

means for bonding the first container film, the first and second container films and the second container film, thereby creating a plurality of container members and inlet portions of the check valves;

wherein the up-down roller controller adjusts the position of the check valve films by detecting the mark for determining the position of check valve.

14. A manufacturing apparatus to produce a fluid container as defined in claim 13, wherein the up-down roller controller includes a control sensor and up-down rollers, wherein the control sensor detects the mark and control a feed length of the first container film and the first and second check valve films such that the check valve is formed at a predetermined position of the fluid container by moving the up-down rollers in perpendicular to a feeding direction of the films.

15. A manufacturing apparatus to produce a fluid container as defined in claim 13, wherein said means for bonding the first container film, the first and second check valve films and the second container film, comprising:

means for bonding right-left bonding portions of the first and second container films; and

means for bonding upper-lower bonding portions of the first and second container films.

16. A manufacturing apparatus to produce a fluid container as defined in claim 15, wherein the means for forming right-left bonding portions, comprising:

an upper stamping die for forming the right-left bonding portions at a predetermined temperature by pressing down the upper stamping die on the first container film;

a lower belt conveyer having a rubber belt which is located just under the upper stamping die;

wherein the first container film, the first and second check valve films and the second container film are sandwiched between the upper stamping die and the lower belt conveyer; and

wherein the belt sticks the second container film and moves at the same speed as a feeding speed of the second container film.

17. A manufacturing apparatus to produce a fluid container as defined in claim 13, wherein the feed sensor includes:

a light emitting source; and

a photo receiver which receives a light energy passed through the check valve film and produces a signal corresponding to the light energy.

18. A manufacturing apparatus to produce a fluid container as defined in claim 17, wherein the means for feeding films includes drive rollers which feed the check valve films and container films with a length of one fluid container with use of the signal from the photo receiver of the feed sensor.

19. A manufacturing apparatus to produce a fluid container as defined in claim 13, wherein the means for forming upper-lower bonding portions, comprising:

an upper stamping die for forming the upper-lower bonding portions at a predetermined temperature by pressing down the upper stamping die on the first container film; and

an lower stamping die for forming the upper-lower bonding portions at a predetermined temperature by pressing up the lower stamping die on the second container film.

20. A manufacturing apparatus to produce a fluid container as defined in claim 13, wherein the means for bonding the first container film and the first and second check valve films, includes

an upper stamping die for forming a fixing seal portions at a predetermined temperature by pressing down the upper stamping die on the first container film; and

an lower stamping die for forming the fixing seal portions at a predetermined temperature by pressing up the lower stamping die on the second check valve film,

wherein the first container film and the first and second check valve films are sandwiched between the upper and lower stamping dies forming the fixing seal portions.

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