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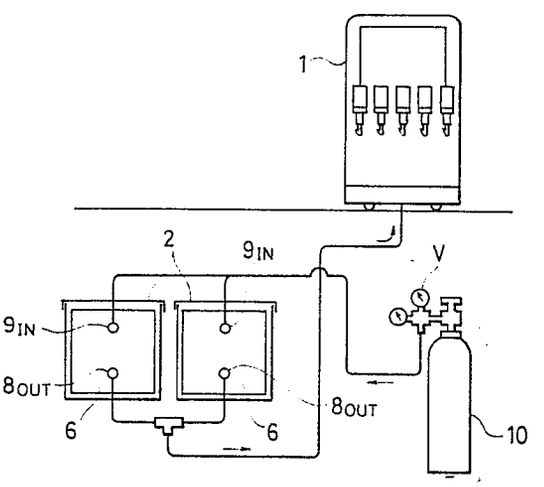
(54) **Bag-in-Box and bag for the Bag-in-Box.**

(57) A bag-in-box having at least two bags housed in an external box. The two bags comprises first and second bags each formed of sheet-like material and flexible. The first bag serves as a container for containing a content therein and the second bag serves as a pressing member expandable upon injection of pressurized fluid thereinto to compress the first bag. The first bag is separated from the second bag and is stacked thereon in the external box. Alternatively, one of the first and second bags is positioned inside the remaining one of the second and first bag. Each of the first and second bags has tubular shape both ends of which are fuse-bonded. Gusset type bag is also available as the first and second bags.

FIG. 1



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Description

BAG-IN-BOX AND BAG FOR THE BAG-IN-BOX

BACKGROUND OF THE INVENTION

The present invention relates to a bag-in-box and a bag for use in the bag-in-box, and more particularly, to a type thereof in which a foldable bag formed of sheet-like material is accomodated in an external box, and to the foldable bag formed of the sheet-like material used in the bag-in-box.

In a conventional paper cup dispenser for dispensing a cup of beverage such as refreshing drinks (juice, cola, etc.) and coffee or the like, a returnable tank which is capable of recovery and reuse is employed for storing therein a sirup or concentration liquid. Fig. 44 shows a conventional dispenser 1 which uses the returnable tank T. The dispenser 1 is connected to the returnable tank T which contains sirup or concentration liquid. The returnable tank T is connected to a gas bottle 10 (carbonic acid gas bottle) through a decompression valve V. Beverage in the returnable tank T is pressurizingly injected into the dispenser by the application of carbonic acid gas into the tank T.

According to the structure, it is rather time-consuming and unecconomical for their recovery of he returnable tank T, re-filling of the beverage thereinto, and cleaning and sterilization thereto. Further, the returnable tank T must be formed of metal for providing fluid tightness and high-pressure resistivity, and therefore, resultant tank becomes costly and heavy.

In order to overcome these drawbacks, a throwaway bag-in-box has been proposed instead of the returnable tank. According to the bag-in-box, a foldable bag or container formed of plastic material is accomodated in a corrugated cardboard box for transporting, depositing and storing a liquid. Such bag-in-box provides light weight structure, long term durability, and easy handling performance, and is inexpensive and convenient for transportation and storage of liquid in comparison with conventional glass bottles, tanks, and tinplate cans. In view of the above, there have been proposals for the applications of the bag-in-box to a variety of industrial fields for transporting and storing liquidized food and chemicals in a bag formed of flexible single film, flexible laminated film, a plurality of laminated films, or composite film, those providing pressure resistivity and chemical resistivity.

Next, a conventional dispenser system utilizing a conventional bag-in-box will be described with reference to Fig. 45. A dispenser 1 is connected, through an aspiration pump P to a bag-in-box 6 filled with sirup or concentration liquid, and the aspiration pump P is connected to a carbonic acid gas bottle 10 through a decompression valve V. The aspiration pump P is actuated by the application of the carbonic acid gas thereto from the gas bottle 10, so that the sirup in the bag-in-box 6 is aspirated and introduced into the dispenser 1.

However, according to this type of system, since the sirup is aspirated and injected by the utilization of negative pressure, which pressure is provided in a fluid path bridging between the bag-in-box 6 and the aspiration pump P, external air is also intaken into the system through a connecting portion and through the bag. As a result, the sirup may be contaminated by microorganism and dust laden in the external air. Accordingly, this aspiration type system has a fatal disadvantage in view of sanitation Further, since the aspiration pump P is employed overall system becomes costly, and periodical inspection and maintenance is requred to the pump and the fluid path for cleaning and sterilizing the same.

SUMMARY OF THE INVENTION

It is therefore, an object of the present invention to overcome the above-described drawbacks and disadvantages and to provide an improved bag-in-box and a bag(s) for the bag-in-box.

Another object of the present invention is to provide such bag-in-box free from contamination of a content in the bag.

Still another object of this invention is to provide the bag-in-box capable of being used as pressuringly discharge the content from the bag, and capable of being assembled to a conventional dispenser unit.

Still another object of this invention is to provide a bag or bags easily assembled in a box of the bag-in-box.

Still another object of this invention is to provide a bag or bags free from application of local stress thereto for proper expansion thereof.

These and other objects of the present invention will be attained by providing a bag-in-box which comprises at least two bags and an external box for housing the bags. The at least two bags include a first bag and a second bag each formed of sheet-like material provided with flexibility and foldability. The first bag serves as a container for containing therein a content, and the second bag serves as a pressing member and is expandable upon injection of pressurized fluid thereinto, whereby the first bag is compressed to discharge the content therefrom. The first bag is separated from the second bag, and the second bag is stacked on the first bag in the external box. Alternatively, one of the first and second bags is housed in the remaining one of the second and first bags.

A combination of two bags is also one of the inventive features of the present invention. In the combination, there is provided a multiple bags having inner and outer bags. The inner bag is formed with an opening which allows a first material to pass therethrough. And the outer bag houses the inner bag and is formed with an opening which allows a second material to pass therethrough. The second material may be the pressurized fluid to discharge the first material in the inner bag therefrom upon injection of the second material into the outer bag. Alternatively, the first and second materials may be

the different kinds of materials. Operator can discharge controlled amounts of first and second materials to obtain optimum mixture.

In the multiple bag, each of the inner and outer bags comprises a tubular film member having one end and other end portions; and fuse-bonded portions fuse-bonding the one and other end portions, respectively. In one embodiment of the multiple bag, the fuse-bonded portion at one end portion of the inner bag is integral with the fuse-bonded portion at said one end portion of the outer bag, and the fuse-bonded portion at the other end portion of the inner bag is integral with the fuse-bonded portion at the other end portion of the outer bag. In the other embodiment, fuse-bonded portion at one end portion of the inner bag is separated from the fuse-bonded portion at one end portion of the outer bag, and fuse-bonded portion at the other end portion of the inner bag is separated from the fuse-bonded portion at the other end portion of the outer bag.

According to a bag of another embodiment, the bag comprises a tubular film member having end edges, and fuse-bonded portions fuse bonding end portions of the tubular film member. The tubular film member comprises a pair of first folding lines defining a front(or upper) wall therebetween; a pair of second folding lines defining a rear(or lower) wall therebetween; and, a pair of third folding lines each defining an internally folded gusset portions each having first and second walls confronting with each other. The first wall confronts the front wall and is defined by the first folding line and the third folding line, and the second wall confronts the rear wall and is defined by the second folding line and the third folding line. The fuse-bonded portion comprises a pair of first fuse-bonding lines and a pair of second fuse-bonding lines. The pair of first-fuse bonding lines obliquely extends from the end edges and from a center of the front wall to the first folding lines. The pair of first fuse-bonding lines fuse-bonds the front wall with the first wall at the end portions. The pair of second fuse-bonded lines obliquely extends from the end edges and from a center of the rear wall to the second folding lines. The pair of second fuse-bonded lines fuse-bonds the rear wall with the second wall at the end portions. With the structure, uniform tensile force is exerted on the fuse-bonding lines during expansion of the bag and after full expansion thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings;

Fig. 1 is a schematic elevation showing a dispenser system which employs a bag-in-box according to the present invention;

Fig. 2 is a cross-sectional view showing a bag-in-box according to a first embodiment of this invention;

Fig. 3 is an exploded view showing the bag-in-box according to the first embodiment;

Fig. 4 is a perspective view showing the bag-in-box according to the first embodiment;

Fig. 5 is a cross-sectional view showing an accomodation state of bags in the bag-in-box according to this invention;

Fig. 6 is a plan view of the bag shown in Fig. 5;

Fig. 7 is a cross-sectional view taken along the line VII-VII of Fig. 6;

Figs. 8 through 10 show bags used in a bag-in-box according to a second embodiment of this invention, and in which, Fig. 8 is a cross-sectional view of the bags, Fig. 9 is a plan view of the bag, and Fig. 10 is a cross-sectional view taken along the line X-X of Fig. 9;

Figs. 11 through 13 show bags used in a bag-in-box according to a third embodiment of this invention, and in which Fig. 11 is a cross-sectional view of the bag, Fig. 12 is a plan view of the bag, and Fig. 12 is a cross-sectional view taken along the line XIII-XIII of Fig. 12;

Figs. 14 through 16 show a fourth embodiment of bags used in a bag-in-box of this invention, and in which Fig. 14 is a cross sectional view of the bags, Fig. 15 is a plan view, and Fig. 16 is a cross-sectional view taken along the line XVI-XVI of Fig. 15;

Figs. 17 through 19 show fifth embodiment of bags used in a bag-in-box of this invention, and in which Fig. 17 is a cross sectional view of the bags, Fig. 18 is a plan view of the bags, and Fig. 19 is a cross-sectional view taken along the line XIX-XIX of Fig. 18;

Figs. 20 through 22 show sixth embodiment of bags used in a bag-in-box of this invention, and in which Fig. 20 is a cross-sectional view of the bags, Fig. 21 is a plan view of the bag, and Fig. 22 is a cross-sectional view taken along the line XXII-XXII of Fig. 21;

Fig. 23 is a cross-sectional view showing a connecting plug connectable to a bag of a bag-in-box according to the present invention;

Fig. 24 is a cross-sectional view showing a connecting plug according to a second embodiment of this invention;

Figs, 25 and 26 are cross-sectional views showing a connecting plug modified to the embodiment shown in Fig. 23, and showing disassembly and assembly of the plug with respect to the bag of the bag-in-box;

Fig. 27 is a cross-sectional view showing a connecting plug according to a third embodiment of this invention;

Figs. 28 through 32 show seventh embodiment of a bag used in a bag-in-box according to this invention, and in which Fig. 28 is a plan view of the bag, Fig. 29 is a cross-sectional view taken along the line XXIX-XXIX of Fig. 28, Fig. 30 is a front view of the bag, Fig. 31 is a side view of the bag, and Fig. 32 is a perspective view of the bag inflated into which a content is filled;

Figs. 33 through 37 show eighth embodiment of a bag used in a bag-in-box according to this invention, and in which Fig. 33 is a plan view of the bag, Fig. 34 is a cross-sectional view taken along the line XXXIV-XXXIV of Fig. 33, Fig. 35 is a front view of the bag, Fig. 36 is a side view of the bag, and Fig. 37 is a perspective view of the bag inflated into which a content is filled;

Fig. 38 is a cross-sectional view showing a

bag-in-box assembling therein bag of one of the embodiments shown in Figs. 28 through 37, and the assembly being applied to a dispenser;

Figs. 39 through 42 show a nineth embodiment of bags used in a bag-in-box according to this invention, and in which Fig. 39 is a plan view of the bags, Fig. 40 is a cross-sectional view taken along the line XXXX-XXXX of Fig. 39, Fig. 41 is a front view of the bag, and Fig. 42 is a side view of the bags;

Fig. 43 is a plan view of a bag modified o the nineth embodiment;

Fig. 44 is a schematic elevation showing a conventional dispenser system which employs a conventional returnable tank; and,

Fig. 45 is a schematic elevation showing a conventional dispenser system which uses a conventional bag-in-box.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first embodiment of a bag-in-box according to the present invention will be described with reference to Figs. 1 through 4.

Fig. 1 show a dispenser system provided with a compression and extraction device which includes a bag-in-box according to the present invention. A dispenser 1 is connected to bag-in-boxes 6 and 6 each housed in pressure resistive containers 2 and 2. Further, a carbonic acid gas bottle 10(pressure source) which is a part of the compression and extraction device is connected to the bag-in-boxes 6, 6 through a decompression valve V.

Fig. 2 shows details of the pressure resistive container 2 and bag-in-box 6 those used in Fig. 1. The bag-in-box 6 includes an external box 7 formed of corrugated cardboard as an armored member, and two bags 8 (first bag) and 9 (second bag) housed in the external box 7. In the box 7, one of the bags 9(upper bag or second bag) is mounted on the other bag 8(lower bag or first bag). The lower bag 8 contains therein a beverage sirup and serves as a liquid container member. The lower bag 8 is formed with an outlet 8_{OUT} connected to the dispenser 1. On the other hand, the upper bag 9 serves as pressurizing or inflatable member to compress the container member 8. The upper bag 9 is formed with a pressure inlet 9_{IN}connected to the carbonic acid gas bottle 10.

Next, liquid extracting process will be described with reference to Figs. 3 and 4, in which the pressure resistive container 2 houses therein the bag-in-box 6, and the bag-in-box 6 is connected to the dispenser 1. As best shown in Fig. 3, the pressure resistive container 2 comprises a main container body 3 and a front lid 4. The main container body 3 has an open end provided with engagement pins 3a, and the front lid 4 has side edges provided with engagement holes 4a. The front lid 4a is formed with bores 4_O 4_Oat positions corresponding to the inlet 9_{IN} and outlet 8_{OUT}. Further, the external box 7 of the bag-in-box 6 is formed with perforations 7a 7a at positions corresponding to the inlet 9_{IN} and outlet 8_{OUT}. The bag-in-box 6 is first inserted into the main container body 3 through it open end so as to position one of the box faces at which the perforations are formed at the open end of the main container body 3, and then the perforations 7a 7a are cut-away, so that the outlet 8_{OUT} and inlet 9_{IN} are exposed to the atmosphere. Thereafter, the front lid 4 is placed on the open end of the main container body 3 and the engagement pins 3a are engaged with the engagement holes 4a to fixedly secure the front lid 4 to the main container body 3. In this case, the outlet 8_{OUT} and the inlet 9_{IN} extend through the bores 4_O and 4_O as shown in Fig. 4. Then, the outlet 8_{OUT} and the inlet 9_{IN} are connected to the dispenser 1 and the carbonic acid gas bottle 10, respectively.

For dispensing sirup from the dispenser 1, pressurized carbonic acid gas at a service pressure of 0.02 to 10 kg/cm^2 is injected from the gas bottle 10 into the pressurizing bag 9. As a result, the bag 9 is gradually inflated to compress the sirup containing bag 8, and the sirup is discharged from the bag 8 under pressure and is introduced into the dispenser 1. Incidentally, four rectangular corner portions at a bottom of the external box 7 are provided with triangular members C as shown in Fig. 2. These space occupying members C are effective for completely discharging sirup out of the sirup containing bag 8 when the bag 9 is inflated.

As described above, accordig to the dispenser system of this invention, pressurizing content extraction system is adopted for discharging the content from the bag-in-box. Therefore, the content is not contaminated by microorganism due to aspiration of ambient air into the system. Thus, the present invention provides advantages in terms of sanitation. Further, according to the present invention, resultant content extraction device provides simple construction, and therefore, ecconomical device results with easy maintenance and inspection.

Next, accomodation of the pressurizing bag 9 into the external box 7 will be described with reference to Figs. 5 through 7. It should be noted that Fig. 2 shows the bag 9 in its inflated condition, whereas the bag 9 in Figs. 5-7 shows its deflated state prior to its service.

As shown in Fig. 5, the lower bag 8 (first bag) contains a content such as sirup, and the upper bag 9 (second bag) is disposed above the lower bag 8. These bags are housed in the external box 7. The upper bag 9 which serves as the pressure applying bag with respect to the bag 8 is folded concentrically as shown in Figs. 6 and 7 prior to gas injection into the bag 9. More specifically, the bag 9 initially has upper and lower walls 11 and 12, and the upper and lower walls are folded concentrically to provide upper circular fold lines 11a and lower circular fold lines 12a as shown in Fig. 6. By the folding, zig-zag cross-section is provided as shown in Fig. 7. Such zig-zag configuration is produced by sandwiching resin films between male and female metal molds and by compressing the molds. Alternatively, injection molding or blow-molding is also available for producing the conentrically folded bag 9.

With the formation of the concentrical folding lines 11a 12a at the upper and lower walls 11 and 12 of the

bag 9, the area defined by outermost four edge lines 9a can be greatly reduced, and therefore, the bag 9 can be easily installed in the external box 7 as shown in Fig. 5. If carbonic acid gas from the gas bottle 10 is injected into the folded bag 9, the folded portions 11a and 12a are gradually stretched and the bag 9 smoothly expands without pressure application to the local portion of the bag 9 until the bag 9 is fully expanded. Therefore, prolonged service life of the bag 9 results. In response to the expansion of the bag 9, the sirup containing bag 8 is subjected to compression, to thereby discharge the sirup therefrom under pressure, to thus supply the sirup to the dispenser 1.

In the embodiment shown in Figs. 5-7, a shape memory alloy is applicable to the inflatable bag 9. For example, wires or webs formed of shape memory alloy are provided in close contact with the concentrically folded lines 11a and 12a. With this structure, concentrically folding configuration can be maintained until the bag 9 is installed in the external box 7. These wires or webs formed of shape memory alloy is fixed to the folded lines 11a 12a after formation of the lines. Alternatively, such wires or webs can be fixed to the lines simultaneous with the formation of the same. In the latter case, the folded portions can be maintained without getting out of their shapes, and formation of the folded lines 11a 12a can be easily performed. Further, in both cases, the shape memory alloy can be deformed and stretched in accordance with the temperature of he gas injected into the bag 9, or the temperature of the content if such alloy is applied to the bag 8, so that the bag 9 or bag 8 expands.

As described above, according to the first embodiment of the present invention, bag area defined by the outer edgelines can be reduced because of the formation of the conentrically folded portions, so that the bag 9 can be easily installed within the external box 7. Further, during gas injection into the bag 9, the concentrically folded portions are gradually stretched and smooth expansion of the bag 9 is attainable. This gradual expansion can prevent the bag 9 from the application of locally excessive pressure, and therefore, the bag 9 is not subjected to any damage. In the embodiment shown in Figs. 5-7, the pressurized bag 9 is initially folded concentrically. However, the material containing bag 8 can be initially folded in the manner the same as that of the pressurized bag 9.

A bag-in-box according to a second embodiment of the present invention will be described with reference to Figs. 8 through 10. In Fig. 8, two bags are assembled in one unit. That is, an inner bag 18 which is adapted to contain a content (a first material) is positioned in an outer bag 19, and pressurized gas (a second material) is injected into a space defined between the inner and outer bags. Incidentally, in Fig. 8, the external box is omitted for simplicity.

The inner and outer bags 18 and 19 are provided with mouthpieces 20 and 21, respectively. The mouthpiece 20 is connected to the dispenser 1, and the mouthpiece 21 is connected to the gas bottle 10. For the formation of the inner and outer bags 18 and 19, two tubular film members having inner diameters different from each other are prepared. The tubular film members are formed of plastic films such as polyethylene films. These two tubular film members are coaxially maintained, and both open ends of each of the tubular film members are thermally fuse-bonded by a heat sealer, so that heat-sealed portions 18a and 19a are provided at both ends of the tubular film members, to thus provide dual bag-shape configurations. In order to connect the mouthpiece 20 to the inner bag 18, both inner and outer bags 18 and 19 are formed with holes to allow the mouthpiece 20 to pass therethrough. Then the two film walls of the inner and outer bags are fuse-bonded with a lower flanged portion 20f of the mouthpiece 20. Further, in order to connect the mouthpiece 21 to the outer bag 19, a hole is formed at the outer bag 18 to allow the mouthpiece 21 to pass therethrough, and the film wall of the bag 19 is fuse-bonded to a flanged portion 21f of the mouthpiece 21.

Material extraction process in the dual type bags of the bag-in-box according to the second embodiment will next be described.

Pressurized carbonic acid gas at a service pressure of 0.02 to 10 kg/cm^2 is injected from the gas bottle 10 into the outer bag 19 which serves as a pressurizing bag. As a result, the bag 19 is gradually inflated to compress the sirup containing inner bag 18, and the sirup is discharged from the bag 18 under pressure and is introduced into the dispenser 1. According to the dual type bags in the second embodiment, the entire outer surface of the inner bag 18(sirup containing bag) is subjected to pressure, so that the content is efficiently discharged therefrom with miminized amount of residual liquid.

In the foregoing embodiments shown in Figs. 1 through 10, carbonic acid gas is used as pressure medium. However, other kind of gas is also available as the pressure medium. Further, according to the second embodiment shown in Figs. 8-10, inner and outer bags serve as liquid container and pressure receiving container, respectively. However, it goes without saying that the opposite arrangement is also available, such that the inner and outer bags serve as pressure receiving container and liquid container, respectively.

A third embodiment according to the present invention will be described with reference to Figs. 11 throu 13. In the third embodiment, open ends at each one side of the tubular film members are thermally sealed together. Remaining construction in the embodiment is the same as that of the second embodiment shown in Figs. 8 thru 10, and accordingly like part and components in the third embodiment are designated by the same reference numerals as those shown in the second embodiment.

A fourth embodiment according to the present invention will be described with reference to Figs. 14-16. In the fourth embodiment, open ends at each one side of the tubular film members are thermally sealed together similar to the third embodiment, and further, one of the longitudinal edge line portion of the inner bag 18 is also fuse bonded with one of the longitudinal edge line portion of the

outer bag 19 as shown by 18S (19S) in Fig. 15. In addition, contrary to the dual locations of the mouthpieces those shown in the second and the third embodiments, a mouthpiece is integrally assembled together at a single location a best shown in Fig. 14. To be more specific, the mouthpiece 22 is integrally provided with a lower flange 23 adapted to be connected to the inner bag 18 and an upper flange 24 adapted to be connected to the outer bag 19. Further, the mouthpiece 22 also includes inner and outer tubular members 25 and 26 in fluid communications with inner and outer bags, respectively, yet fluid communication between the tubular members 25 and 26 is blocked.

The mouthpiece 22 is detachably connected with a plug member 27 as shown in Fig. 14. The plug 27 includes an inner and outer pipes 28 and 29 in fluid communications with the inner and outer tubular members 26 and 26, respectively upon attachment of the plug onto the mouthpiece 22.

The dual bags for use in a bag-in-box shown in Figs. 8 through 16 can be applied to various ways. That is, different kinds of materials are filled in the inner and outer bags 18 and 19 so as to selectively take out the material from the integral dual bag. For example, the inner bag 18 is filled with a raw material sirup, and the outer bag 19 is filled with diluent water. When enjoying drinking, controlled amounts of the sirup and diluent water are discharged from the bags. Therefore, such dual bags are available for a source of mixed-drinks.

Further, the inner bag 18 is filled with a material required to have constant temperature, such as elevated or cooled temperature, and the outer bag 19 is filled with heat insulating material to keep the temperature of the material. Furthermore, if gas or suitable liquid is filled in the outer bag 19, the material filled in the inner bag 18 is subjected to proper cushioning effect.

A fifth embodiment according to this invention will next be described with reference to Figs. 17 throu 19. In this embodiment, a plurality of inner bags 18 (three bags in Fig. 17) are juxtaposedly arranged within an outer bag 19. Each of the inner bags 18 is provided with a mouthpiece 20 each extending through the outer bag wall. Further, the outer bag 19 is provided with a mouthpiece 21.

A sixth embodiment of the present invention will be described with reference to Figs. 20 thru 22. In the sixth embodiment, triple bags are assembled together. That is, there is provided an innermost bag 18A, an inner bag 18B housing the innermost bag 18A therein, and an outer bag 19 housing therein the inner bag 18B. The inside bags 18A and 18B are provided with mouthpieces 20A and 20B, respectively, and the outer bag 19 is provided with a mouthpiece 21. Apparently, the mouthpiece 20A extends through three walls of the bags, the mouthpiece 20B extends through two walls of the bag, and the mouthpiece 21 extends through a wall of the outer bag 19. The embodiments in Figs. 8 through 22 show bags having dual and triple structure. However, more than triple structural bags are also conceivable.

Various embodiments of connecting plugs coupled to a mouthpiece of a bag-in-box will next be described with reference to Figs. 23 thru 27. In a first embodiment shown in Fig. 23, a bag 31 of a bag-in-box is connected with a connecting plug 33. In the drawing, an external box adapted to house the bag 31 is omitted for simplicity. The bag 31 is provided with a mouthpiece 32 which allows a content to pass therethrough, and the connecting plug 33 is attachable to the mouthpiece 32. The connecting plug 33 has a main plug body 44 having a front end portion positioned closer to the bag 31 and a rear end portion positioned away from the bag 31. A distal front end of the main plug body is formed with acute edge 34b. An outer peripheral surface of the front end portion is formed with ribs 34a engageable with grooves 32a formed on an inner peripheral surface of the mouthpiece 32. Each of the rear side faces of the ribs 34a and grooves 32a are directed in substantially radial direction of the main plug body 34. Therefore, upon forcible pushing of the plugs 33 relative to the mouthpiece 32 in its axial direction, the ribs 34a are resiliently engaged with the grooves 32a, and the plug 33 is not disengaged from the mouthpiece 32 because of the radial orientation of the rear side faces of the ribs 34a and the grooves 32a. Normally, an opening of the mouthpiece 32 is sealed by a sealing membrane (not shown). The membrane is separated from the opening by the acute edge 34b upon insertion of the plug 33 into the mouthpiece 32. The other end portion of the main plug body 34 has a fitting portion 35 whose outer peripheral surface is fitted with an inner peripheral surface of a socket 50. The outer peripheral surface of the other end portion is also formed with a locking groove 36 engageable with locking members 53 of the socket 50, and is provided with a sealing member 37 interposed between the plug 33 and the socket 50. Inside the plug 33, there is provided a port P in fluid communication with the socket 50 and a hollow space S for disposing a check valve 46 which control opening and closing of the port P.

The check valve 45 includes a valve body 46, a spring seat 47 and a compression coil spring 48 interposed between the valve body 46 and the spring seat 47, so that the valve body 46 is spring-biased to control opening of the port P.

On the other hand, the socket 50 which is detachably connected to the plug 33 includes a main socket body 51 whose inner peripheral surface 52 is fitted with the fitting portion 35 of the plug 33, balls 53 which are the above-mentioned locking members for locking engagement with the locking groove 36, a sleeve member 54 adapted to urge the balls 53 in radially inward direction of the socket, and a check valve 55 disposed inside the main socket body 51. For connecting the socket 50 to the plug 33, the socket 50 is pushed in its axial direction to allow locking engagement of the balls 53 with the groove 36. These connection is maintained by positioning the sleeve 54 over the balls 53. For the detachment of the socket 50 from the plug 33, the sleeve 54 is displaced to allow the balls 53 to move radially outwardly. The balls 53 can simply ride over a slant side wall of the locking groove 36 in response to the

axial movement of the socket.

Another embodiment (second embodiment) of a connecting plug for use in a bag-in-box will be described with reference to Fig. 24. In this embodiment, a main plug body 34A of a connecting plug 33A is integrally connected to an opening 31A of the bag 31. In other words, the main plug body 34A functions as the combination of the mouthpiece 32 and the main plug body 3 in the embodiment shown in Fig. 23. Remaining structure in Fig. 24 is the same as that shown in Fig. 23.

Still another embodiment of a connecting plug for use in a bag-in-box will be described with reference to Figs. 25 and 26. This embodiment is the modification to the first embodiment shown in Fig. 23. In the still another embodiment, a connecting plug 33B is detachably provided with respect to a mouthpiece 32B because of the formation of resilient locking pawls 38. More specifically, a main plug body 34B has a hollow cylindrical portion 38 in which a plurality of slits 38a are formed defining a plurality of locking pawls 38b therebetween. Each of the locking pawls 38b is resiliently displaceable radially outwardly. Further, a detachable ring 39 is disposed over the locking pawls 38b. On the other hand, a mouthpiece 32B secured to a bag 31 is provided with an outer flange 32f engageable with the locking pawls 38b. Upon insertion of the plug 33B into the mouthpiece 32B, the locking pawls 38b are positioned around the outer flange 32f. If the detachable ring 39 is displaced in its axial direction, the locking pawls 38b is brought into engagement with the outer flange 32f, to thus provide tight coupling between the plug 33B and the mouthpiece 32B as shown in Fig. 26. Further, The plug 33B has a protrusion 34a′ having triangular shape engageable with a triangular recess 32a′ of the mouthpiece 32B. If the detachable ring 39 is moved to restore its original position, the locking pawls 38b expand radially outwardly, so that they are disengaged from the flange 32f.

A third embodiment of a connecting plug for use in a bag-in-box will be described with reference to Fig. 27. In the third embodiment, a main plug body 34C of a plug 33c is directly formed with slits 40a at a front portion thereof, and stepped wedge portions 40 are provided at the front end. The stepped wedge portions 40 each having a step 40b are radially outwardly deformable in their resiliency. Distal front ends of the wedge portions 40 define a circular shape in combination, and a diameter of the circle is slightly smaller than an inner diameter of an opening 32_0 of the mouthpiece 32. With this structure, when the stepped wedge portions 40 are inserted into the mouthpiece 32, the stepped wedge portions 40 are resiliently deformed radially inwardly during their sliding contact with the mouthpiece 32. Immediately upon complete passing of the wedge portions through the mouthpiece 32, the wedge portions 40 radially outwardly expands, so that each of the steps 40b is brought into contact with an inner side face of the mouthpiece 32. Therefore, locking between the plug 33C and the mouthpiece 32 is attainable.

According to the connecting plugs in these embodiments, the connecting plug is immediately connectable and detachable with respect to the socket. Therefore, such types of connecting plugs are available for the bag-in-box of the present invention. Particularly, the connecting plugs according to this invention is connectable with the socket shown in Fig. 23.

Further, the connecting plug according to this invention provide compatible connection with respect to a conventional socket used in a conventional beverage dispenser. Therefore, the plug of this invention is effective for use in the bag-in-box of this invention adapted to be installed in the conventional dispenser system.

Next a seventh embodiment of a bag used in a bag-in-box of this invention will be described with reference to Figs. 28 thru 32. The bag in the seventh embodiment is so called "gusset type" bag.

In the production of the bag of this embodiment, tubular thin plastic film formed of polyethylene is prepared, and two open ends of the tubular film are thermally fuse-bonded by a heat sealer to obtain bag shape. This procedure would be the same as that in the embodiment shown in Fig. 8. However, in the seventh embodiment, the tubular film member is folded along the direction in parallel with an axial direction thereof such that the cross-sectional shape has a combination of M-shape and W-shape as shown in Fig. 29. As a result, a bag 61 has internally folded portions, i.e., gusset portions 63 63 (internal V figure of M figure, and internal inverted V figure of W figure, which V-shape consists of first and second walls 63a and 63b), and external walls 62, 62, i.e., a front (upper) wall 62a and a rear (lower) wall 62b(remaining leg portions of M figure and remaining arm portions of W figure). Further, two external folding lines 64x and 64y of M figure are in alignment with and in contact with or are positioned close to each other. The same is true with respect to two external folding lines 64x and 64y of W figure. The external folding lines 64 includes the pair of first folding lines 64x and 64x defining the front (or upper) wall 62a therebetween, and the pair of second folding lines 64y and 64y defining the rear (or lower) wall 62b therebetween. Thus, the first wall 63a of the gusset portion 63 is defined by the first folding line 64x and the third folding line 63c, and the second wall 63b of the gusset portion 63 is defined by the second folding line 64y and the third folding line 63c. At each of the open edges of the tubular film body, a center point of the upper wall 62 is marked as at 62c. Further, at each of the external folding lines 64, a point 64c is marked. Then, a line 66 connecting between the points 62c and 64c is drawn, and the tubular film body is cut along the lines 65, so that each of the remaining triangular portions 62r are removed. Thereafter, outer wall and confronting internally folded gusset portion 63 are fuse-bonded together by means of a heat sealer along the line 65. That is, a wall 62a is fuse-bonded to a wall 63a along the line 65, and a wall 62b is fuse-bonded to a wall 63b at the line 65. As a result, fuse-bonded portions 66 are provided along the lines 65, and he tubular film body becomes to provide a bag shape having completely confined space. A pair of fuse-bonding portion 66 at the front wall side is referred to a pair of

first fuse-bonding lines and a pair of fuse-bonding portion 66 at the rear wall side is referred to a pair of second fuse-bonding line. The upper wall 62a of the bag body 62 is provided with a mouthpiece 67 through which a content is injected into or discharged from the bag. The mouthpiece 67 has a flange 67f to which a film member is fuse-bonded.

Here, each of the gusset portions or internally folded portions 63 and 63 has an innermost folding line 63c (the pair of third folding lines) as best shown in Fig. 29. If the gusset portions 63 are so folded such that the two innermost folding lines 63c and 63c are in contact with or positioned close to each other, the folded bag 61 will provide a generally square cross-section upon complete inflation of the bag because of the content injection thereinto. On the other hand, if the gusset portions 63 are so folded such that the two innermost folding lines 63c and 63c are spaced away from each other, the folded bag will porivde a generally oblong cross-section upon complete inflation of the bag 61. Further, there is another factor to determine the cross-sectional shape of the inflated bag 61. That is, inclination of the cut-line 65 is also a determinative factor. For example, in Fig. 28, if the length s is equal to the length t, the bag will provide the square cross-section upon inflation, whereas if the length t is larger than the length s, the bag will provide the oblong cross-section upon inflation. Here, the line s extends from the central edge point 62c in a direction parallel with the longitudinal direction of the bag, and the line textends from the point 64c at the externally folded line 64 in a direction parpendicular to the longitudinal direction of the bag 61, and lengths s and t are determined by the intersection of the two lines. Next, operation mode of thus folded gusset type bag 61 will be described.

when the folded bag 61 for use in a bag-in-box is subjected to content injection through the mouthpiece 67, the gusset portions 63 63 are gradually stretched and the internally folded line portions 63c are urged outwardly. As a result, internal V-shaped gusset portions 63 will become substantially flat portions upon complete content injection as shown in Fig. 32, so that two side walls are provided in addition to the alreadly provided upper and lower walls 62a and 62b. With respect to the longitudinal end portions having the fuse-bonded portions 66, each of the end portions is folded generally by 90 degrees at a line connecting between the upper and lower points 64c and 64c in Fig. 28 upon content injection. Upon complete inflation, the four fuse bonded portions 66 will diagonally oriented as shown in Fig. 32. As a result, generally rectangular or cubic bag 61 is obtainable.

During content injection into the bag 61 and after completion of the content injection, tensile stress is uniformly applied to a length of the fuse-bonded protions 66 without application of stress concentration to a specific portion thereof. Further, since the inflated bag 61 will provide rectangular or cubic configuration, the bag is housed in conformance within the internally rectangular or cubic space of the external box (see box 7 in Fig. 3) which protects the bag. As a result, the bag 61 is not subject to excessive local pressure against the external box.

A eighth embodiment of a bag for use in a bag-in-box according to the present invention will next be described with reference to Figs. 33 thru 37. The eighth embodiment also concerns gusset type bag.

Similar to the seventh embodiment shown in Figs. 28-34, a bag 61′ of the eighth embodiment has internally folded gusset portion 63 and 63, and upper and lower walls 62a and 62b. Further, at each end portion of the tubular film body 62A, slanting fuse bonded portions 66 are provided by the manner the same as that of the seventh embodiment. However, in the eighth embodiment, the triangular end portions 62r(Fig.28) are not removed, and open ends of the tubular film body 62A are also fuse-bonded. More specifically, an open end portion 62_0 of the upper wall 62a is fuse-bonded with an open end portion 62_0 of the neighbouring internally folded portion 63a, and open end portion of the lower wall 62b is fuse-bonded with an open end portion of the neighbouring internally folded portion 63b. As a result, another linear fuse bonded portions 68 are provided, and triangular portions 69 each defined by the externally folding line 64, the slanting fuse bonded portion 66 and the linear fuse-bonded portion 68 are provided. Four triangular portions 69 are provided at each longitudinal end portion of the bag 61′.

Similar to the seventh embodiment, the gusset portions 63 are stretched and originally V-shaped gusset portions 63 will be converted into flat shape upon content injection, and further, the four slant fuse-bonded portions 68 will provide diagonal configuration. Furthermore, in the eighth embodiment, the linearly fuse-bonded portion 68 of the upper triangular portions 69 and the linearly fuse-bonded portion 68 of the lower triangular portions 69 become close to each other as shown in Fig. 37. As a result, the upper and lower triangular portions 69 protect the gusset portions 63a′ and 63b′ at longitudinal end portions of the bag 61′. In this paragraph, the terms "upper" and "lower" correspond to the upper side 62a and lower side 62b, respectively.

In this embodiment, uniform tensile stress is applied to each length of fuse-bonded portions 68 without application of stress concentration to a local portion thereof. Further, generally rectangular or cubic bag is obtainable whose shape is in conformance with the internal rectangular or cubic space of the external box.

Fig. 38 shows a bag-in box according to the present invention in which two gusset type bags 61A and 61B those shown in Figs. 28 thru 37 are accomodated, and the assembly is applied to a dispenser. In Fig. 38, a bag 61A(lower bag) containing a sirup is positioned below a bag 61B(upper bag) connected to a pressure source such as carbonic acid gas bottle. These bags 61A and 61B are housed in an external box housed in a pressure resistive container 2 sustainable against pressure from the upper bag 61B. For extracting the sirup from the lower bag 61A, pressurized carbonic acid gas at service pressure of 0.02 to 10 kg/cm^2 is injected into

the upper bag 61B from the gas bottle for expanding the upper bag 61B. In accordance with the gradual expansion of the bag 61B, the lower bag 61A is subjected to gradual compression, so that sirup is pressurizingly discharged therefrom.

A nineth embodiment of bags used in a bag-in-box according to this invention will be described with reference to Fig. 39 thru 43. The embodiment shown in Fig. 43 is a modification to the embodiment shown in Figs. 39-42.

In the nineth embodiment, there is provided dual bags structure 71, in which an inner bag body 72 is assembled in an outer bag body 82, and inner and outer bag bodies 72 and 82 are provided with mouthpieces 77 and 87, respectively for injecting and discharging a content into and from one of the bag bodies.

For providing the inner and outer bag bodies 72 and 82, prepared are two film sleeve members having inner diameters different from each other and each having open ends at both longitudinal ends. Each of the sleeve members are folded in a direction parallel with the axial direction thereof in the manner the same as that in the seventh and eighth embodiments. As a result, internally folded gusset portions 73 and 83 are provided in the inner and outer bag bodies 72 and 82. In this case, external folding lines 74 at the upper wall of the inner bag body 72 is in contact with or positioned close to external folding lines 74 at the lower wall of the inner bag 72. The same is true with respect to the external folding lines 84 of the outer bag body 82. Center points 72c 82c at open edges 72_o and 82_o of the upper walls 82a are defined, and points 74c and 84c are set on the external folding lines 74 and 84. These points 74c and 84c are positioned spaced away from the open edges 72_o and 82_o. Lines 85 (75) are drawn connecting between the point 82c(72c) and point 84c(74c), and the tubular film bodies are subjected to cutting along the lines 85(75). Then, upper wall 72a and confronting gusset wall 73a in the inner bag body 72 are fuse-bonded together by a heat sealer along the line 75. In this case,the upper wall 82a and confronting gusset wall 83a in the outer bag body 82 is also fuse-bonded together by the heat sealer along the line 85. Therefore, these four walls are fuse bonded together to provide a fuse bonded portion 86(76). The same is true with respect to the lower wall 72b (82b) and confronting gusset wall 73b (83b). In other words, the heat-sealed portion 76 of the inner bag body 72 is formed simultaneous and integral with the formation of the heat-sealed portion 86 of the outer bag body 82.

On the other hand, according to a modified embodiment shown in Fig. 43, heat-sealed portions 76′ of an inner bag body 72′ are positioned offset from heat sealed portions 86′ of the outer bag body 82′. That is, in the modified embodiment, the heat sealed portions 76′ are initially formed, and then the heat sealed portions 86′ are formed.

In the nineth embodiment, a mouthpiece 77 extends through film walls 72b and 82b of inner and outer bag bodies 72 and 82 to allow fluid communication with the inner bag body 72. The walls adjacent the mouthpiece 77 are fuse bonded to a flange 77f. Another mouthpiece 87 extends through the film wall 82a to allow fluid communication with the outer bag body 82. The wall adjacent the mouthpiece 87 is fuse-bonded to a flange 87f.

Operation mode attendant to bags having dual structure shown in Figs. 39-43 will be described. Initially, both inner and outer bag bodies 72 and 82 are folded. When contents are injected into inner and outer bag bodies 72 and 82 through the mouthpieces 77 and 87, the gusset portions 73 and 83 are gradually stretched, and internally V-shape-folded gusset portions will become substantially flat shapes. On the other hand, four heat-sealed portions 76 (86) at one end portion of the bag 71 will provide diagonal shape (see for example, Fig. 32). As a result, two rectangular or cubic bags are provided.

The dual bag 71 of gusset type shown in Figs. 39-43 will be applied to various manners. Two kinds of contents can be filled in the bag 71 so as to selectively take out the content from the integral dual bag. For example, the inner bag 72 is filled with a raw material sirup, and the outer bag is filled with diluent water. When enjoying drinking, controlled amount of the sirup and diluent water are discharged from the bag. Therefore, such dual bag is available for a source of mixed-drinks.

Further, the inner bag 72 is filled with liquidized content, and pressurized fluid at pressure of 0.02 to 10 kg/cm^2 is injected into the outer bag 82. Accordingly, the outer bag 82 is gradually expanded to compress the inner bag 72, so that the liquidized content in the inner bag 72 is discharged therefrom. Reversely, the outer bag 82 is filled with the content, and pressurized fluid is applied to the inner bag 72 to discharge the content out of the outer bag 82.

As described above, according to the gusset type bag for use in a bag-in-box of this invention, excessive tensile stress is not locally applied to the bag during the conent injection thereinto or after completion of the injection. Particularly, tensile stress is uniformly distributed along lengths of the fuse-bonded portions. Therefore, resultant bag is sustainable against external pressure, internal pressure and impact force. Therefore, the gusset type bag is particularly available for pressurizingly discharging content therein toward outside.

While the invention has been described in detail and with reference to specific embodiments thereof, it will be apparent for those skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope of the invention.

Claims

1. A bag-in-box comprising:

at least two bags having a first bag and a second bag each formed of sheet-like material, said at least two bags being flexible and foldable; and

an external box for housing said at least two bags, said first bag serving as a container for

containing therein a content, and said second bag serving as a pressing member and being expandable upon injection of pressurized fluid thereinto, whereby said first bag is compressed to discharge said content therefrom.

2. The bag-in-box as defined in claim 1, wherein said first bag is separated from said second bag, said second bag being stacked on said first bag in said external box.

3. The bag-in-box as defined in claim 1, wherein said first bag is positioned inside said second bag.

4. The bag-in-box as defined in claim 1, wherein said second bag is positioned inside said first bag.

5. The bag-in-box as defined in claim 1, wherein at least one of said first and second bags has a plurality of concentrically folded circles and has a zig-zag shape in cross-section prior to injection of one of said content and said pressurized fluid, so that an area defined by external edgelines is reduced, and at least one of said bags having reduced area is installed in said external box.

6. The bag-in-box as claimed in any one of claims 2 through 4, wherein at least one of said first and second bags comprises a gusset type bag which comprises;

a tubular film member having end edges: and

a fuse-bonded portions fuse-bonding end portions of said tubular film member, said tubular film member comprising;

a pair of first folding lines defining a front wall therebetween;

a pair of second folding lines defining a rear wall therebetween; and,

a pair of third folding lines each defining an internally folded gusset portions each having first and second walls confronting with each other, said first wall confronting said front wall and being defined by said first folding line and said third folding line, and said second wall confronting said rear wall and being defined by said second folding line; and said fuse-bonded portion comprising;

a pair of first fuse-bonding lines obliquly extending from said end edges and from a center of said front wall to said first folding lines, said pair of first fuse-bonding lines fuse bonding said front wall with said first wall at said end portions; and,

a pair of second fuse bonding lines obliquely extending from said end edges and from a center of said rear wall to said second folding lines, said pair of second fuse-bonding lines fuse-bonding said rear wall with said second wall at said end portions.

7. The bag-in-box as defined in claim 1, further comprising first and second connecting plugs engageable with sockets and in fluid communication with said first and second bags, respectively, for injecting and discharging said content into and from said first bag, said sockets each including a hollow member having an inner peripheral surafce and a locking member, each of said plug comprising:

one end portion engageable with one of said first and second bags;

the other end portion detachably coupled to said socket, said the other end portion having an outer peripheral surface provided with a fitting portion, a sealing member and a locking portion, and having an inner peripheral surface for defining an internal space, said the other end portion having a distal end formed with a port , said fitting portion being fitted with said inner peripheral surface of said hollow member, said sealing member being interposed between said outer peripheral surface of said plug and said inner peripheral surface of said hollow member, and said locking portion being engageable with said locking member; and

a check valve disposed in said internal space for controlling opening and closing of said port, peripheral surface of said hollow member, and said locking portion being engageable with said locking member.

8. A multiple bag for use in a bag-in-box comprising:

at least one inner bag formed with an opening which allow a first material to pass therethrough; and,

an outer bag housing said at least one bag, said outer bag being formed with an opening which allow a second material to pass therethrough.

9. The multiple bag as defined in claim 8, wherein each of said inner and outer bags comprises a tubular film member having one end and other end portions; and fuse-bonded portions fuse-bonding said one and other end portions, respectively, said fuse-bonded portion at said one end portion of said inner bag being integral with said fuse-bonded portion at said one end portion of said outer bag, and said fuse-bonded portion at said other end portion of said inner bag being integral with said fuse-bonded portion at said other end portion of said outer bag.

10. The multiple bag as defined in claim 8, wherein each of said inner and outer bags comprises a tubular film member having one end and other end portions; and fuse-bonded portions fuse-bonding said one and other end portions, respectively, said fuse-bonded portion at said one end portion of said inner bag being separated from said fuse-bonded portion at said one end portion of said outer bag, and said fuse-bonded portion at said other end portion of said inner bag being separated from said fuse-bonded portion at said other end portion of said outer bag.

11. The multiple bag as defined in claim 8, wherein said at least one inner bag comprises a plurality of bags, said plurality of bags being juxtaposed with one another within said outer bag.

12. The multiple bag as defined in claim 8, further comprising a plurality of bags having

internal volume different from one another, the biggest bag among said plurality of bags being housed in said inner bag, and the second biggest bag among said plurality of bags being housed in said biggest bag, and the same rule being applied correspondingly to the remaining bags.

13. A bag for use in a bag-in-box comprising:

a tubular film member having end edges; and

a fuse-bonded portions fuse-bonding end portions of said tubular film member, said tubular film member comprising;

a pair of first folding lines defining a front wall therebetween;

a pair of second folding lines defining a rear wall therebetween; and,

a pair of third folding lines each defining an internally folded gusset portions each having first and second walls confronting with each other, said first wall confronting said front wall and being defined by said first folding line and said third folding line, and said second wall confronting said rear wall and being defined by said second folding line; and said fuse-bonded portion comprising;

a pair of first fuse-bonding lines obliquly extending from said end edges and from a center of said front wall to said first folding lines, said pair of first fuse-bonding lines fuse-bonding said front wall with said first wall at said end portions; and,

a pair of second fuse-bonding lines obliquely extending from said end edges and from a center of said rear wall to said second folding lines, said pair of second fuse-bonding lines fuse-bonding said rear wall with said second wall at said end portions.

14. The bag as defined in claim 13, wherein said pair of first and second fuse-bonding lines define ends of said tubular member.

5. The bag as defined in claim 13, further comprising third fuse-bonding lines fuse-bonding said end edges of said front wall and said first wall, and a fourth fuse-bonding lines fuse-bonding said end edges of said rear wall and said second wall.

16. The bag as defined in claim 15, wherein said third and fourth fuse-bonding lines define ends of said tubular member.

FIG. 1

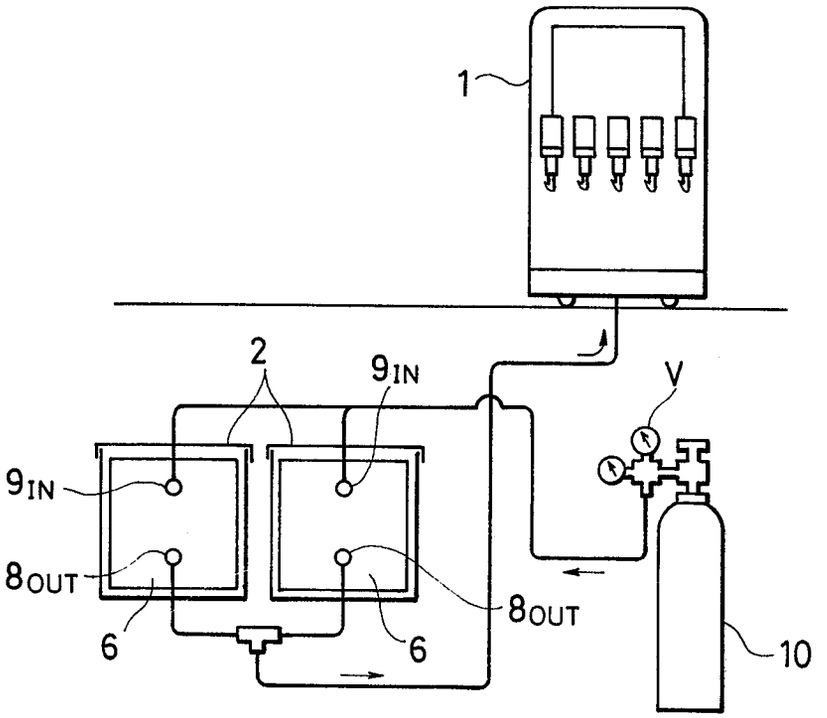

FIG. 2

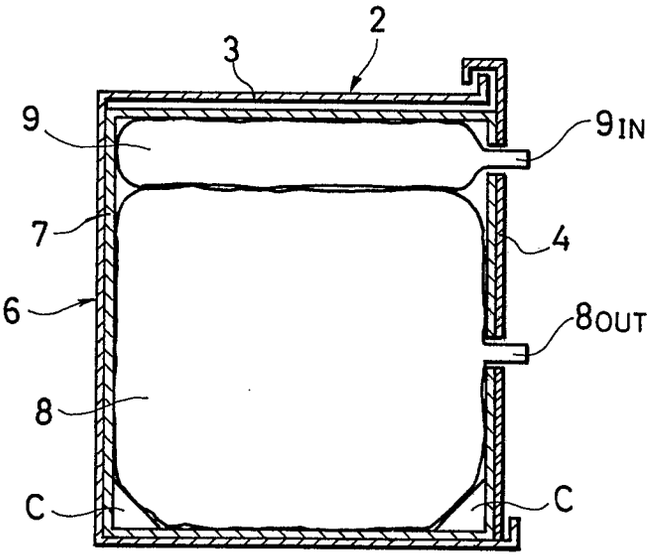

FIG. 3

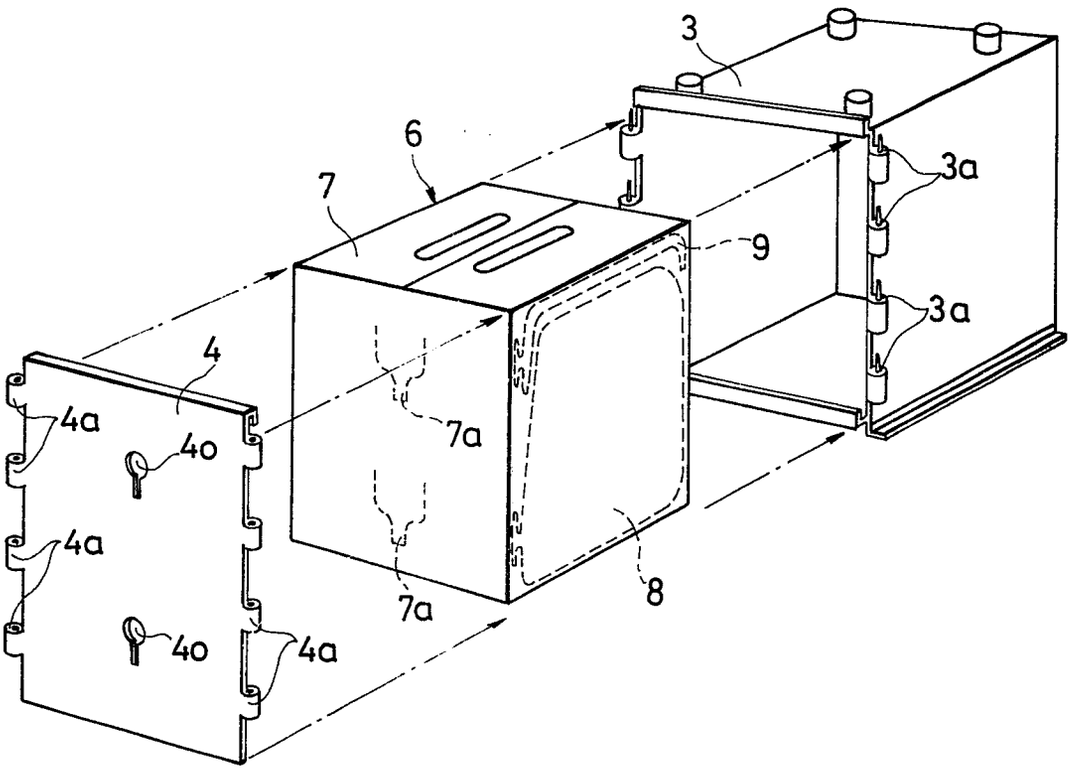

FIG. 4

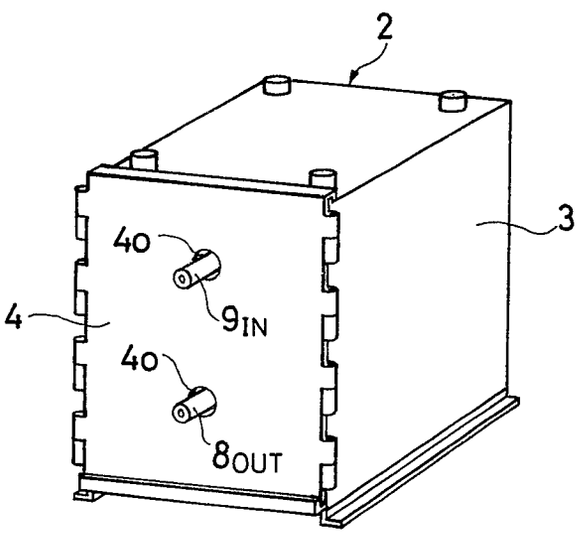

FIG. 5

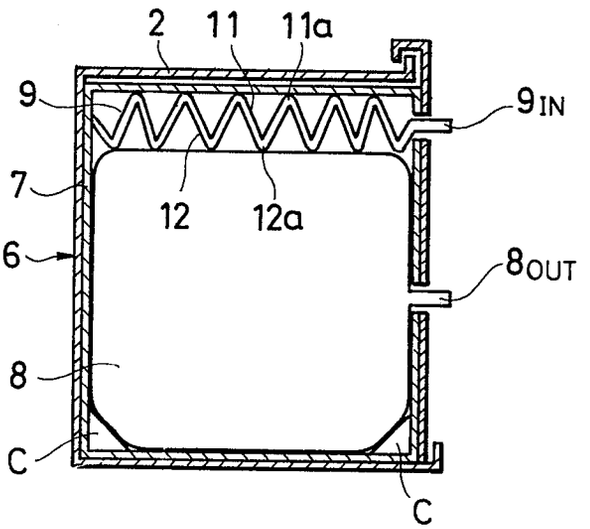

FIG. 6

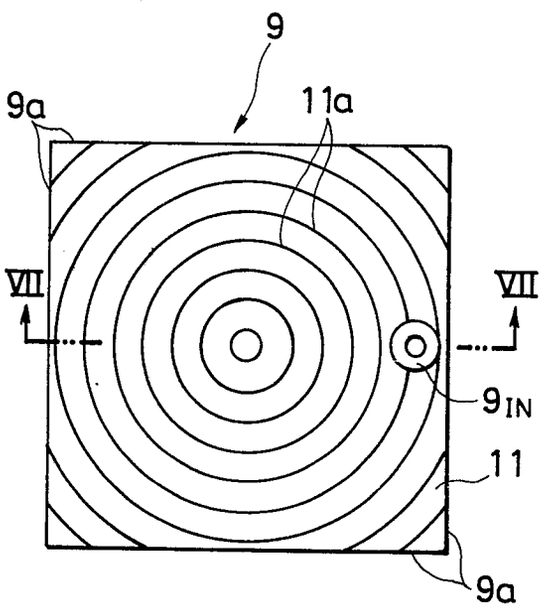

FIG. 7

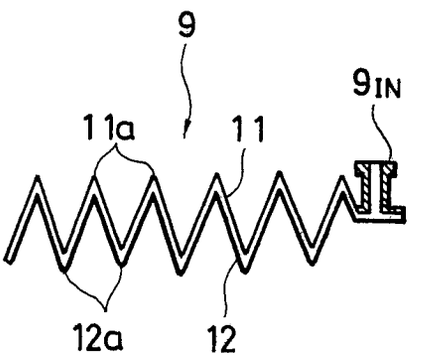

FIG. 8

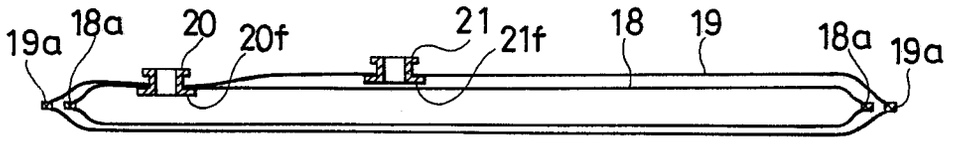

FIG. 9

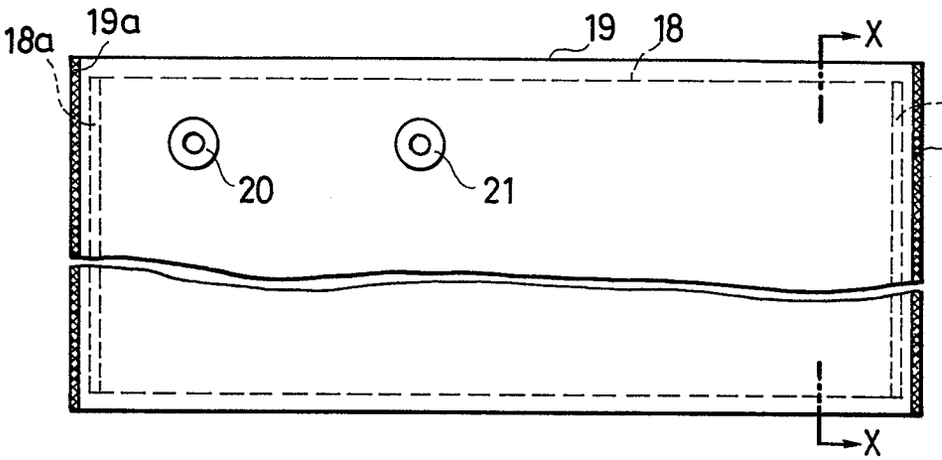

FIG. 10

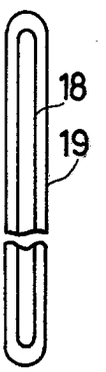

FIG. 11

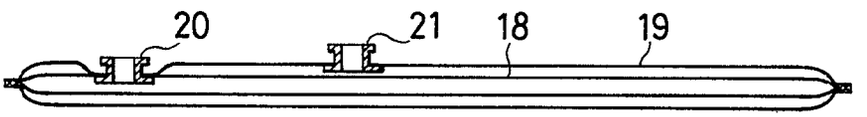

FIG. 12

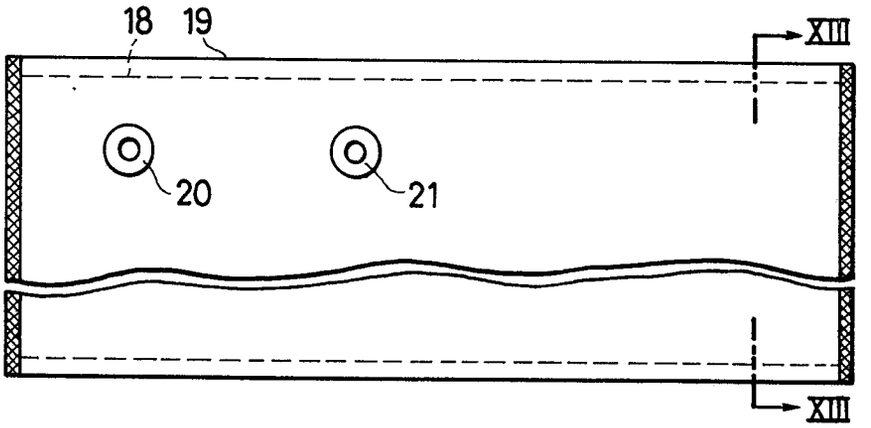

FIG. 13

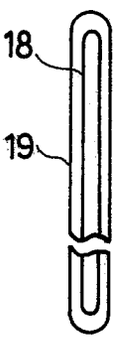

FIG. 14

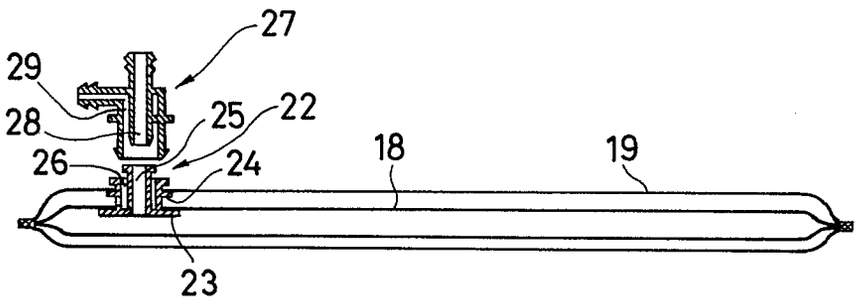

FIG. 15

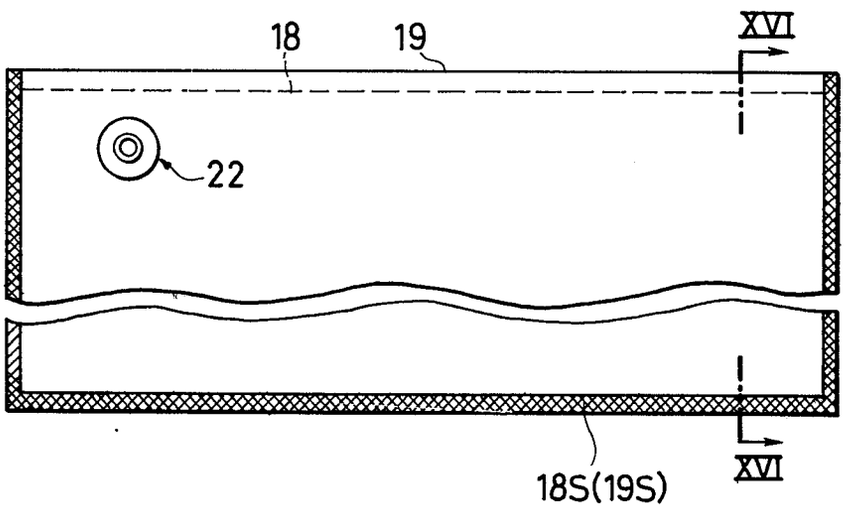

FIG. 16

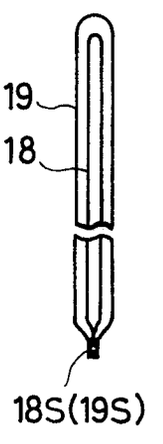

FIG. 17

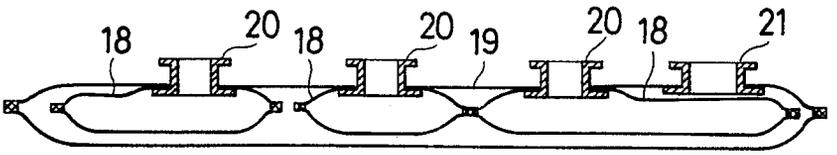

FIG. 18

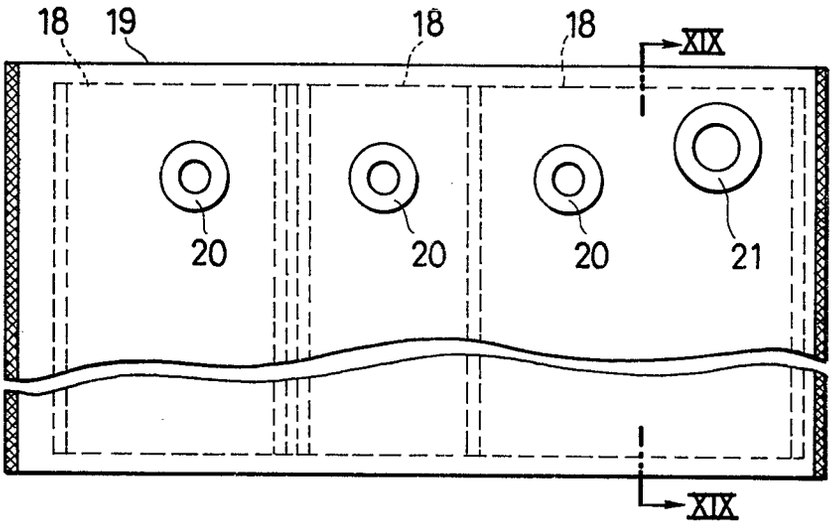

FIG. 19

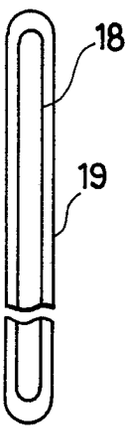

FIG. 20

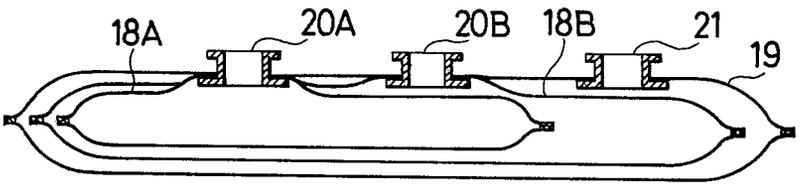

FIG. 21

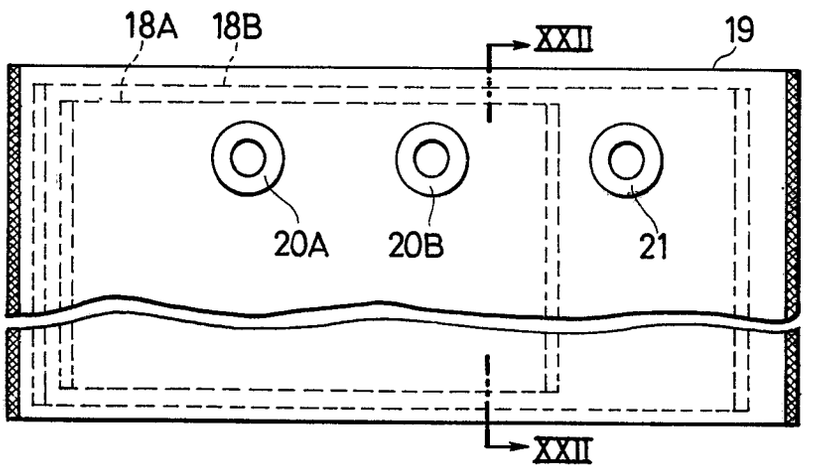

FIG. 22

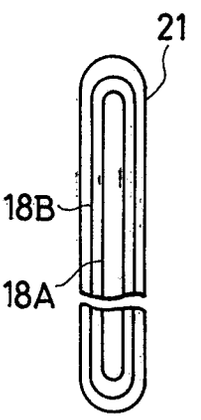

FIG. 23

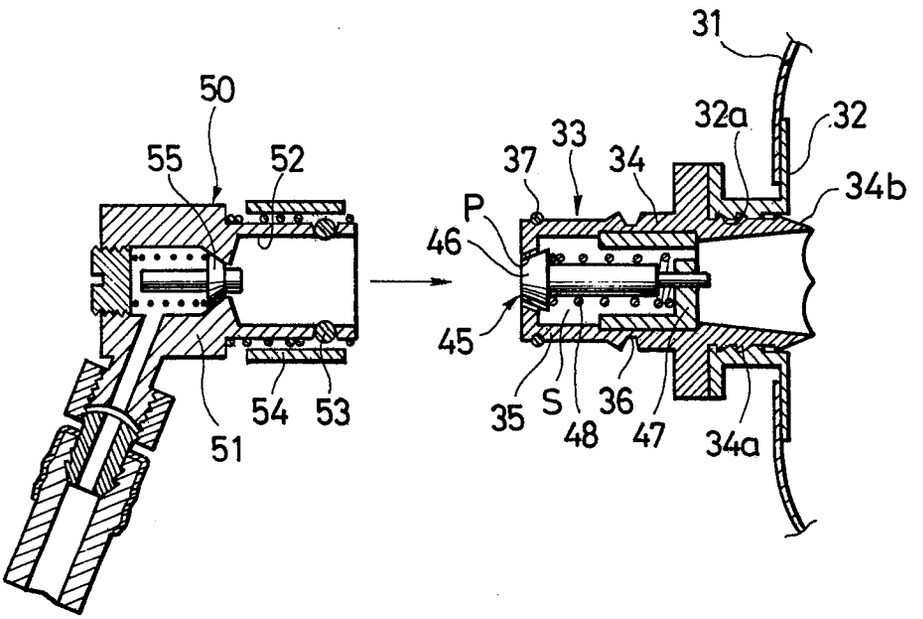

FIG. 24

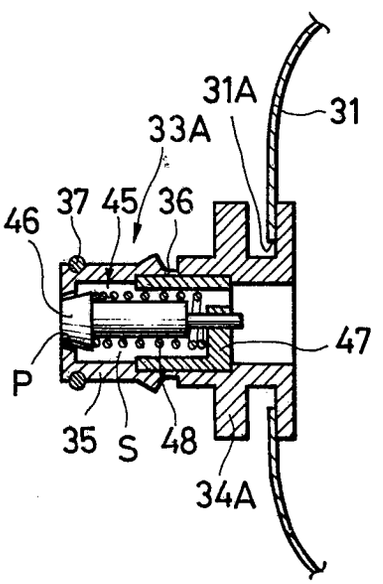

FIG. 25

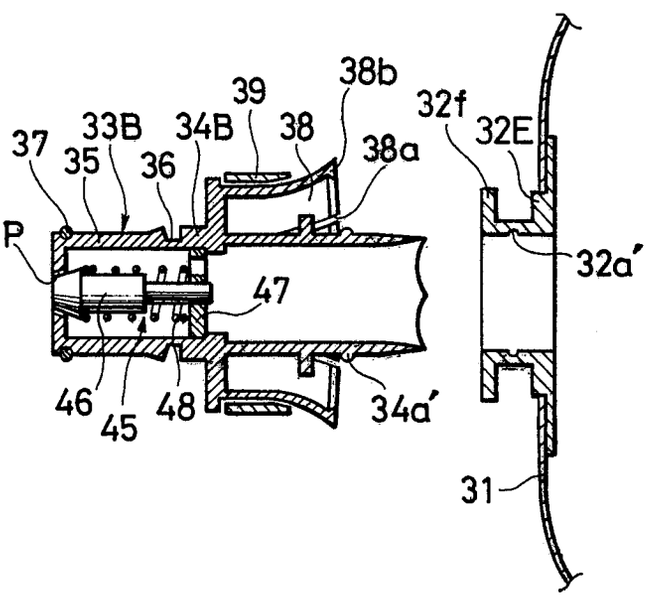

FIG. 26

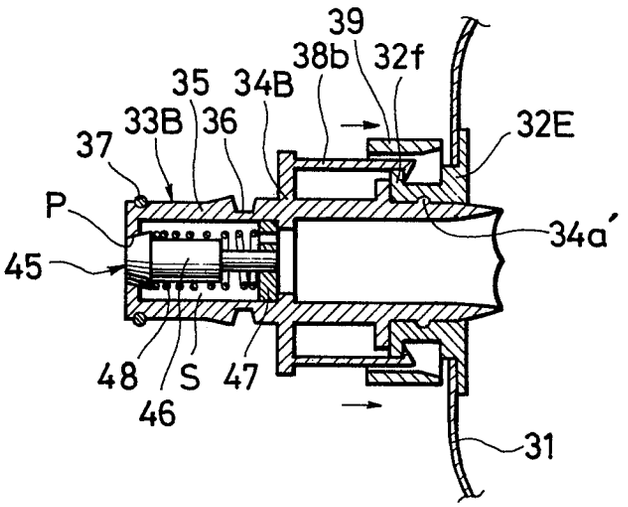
39
38b
32f
35
34B
33B
36
37
32E
P
34a'
45
48
S
47
46
31

FIG. 27

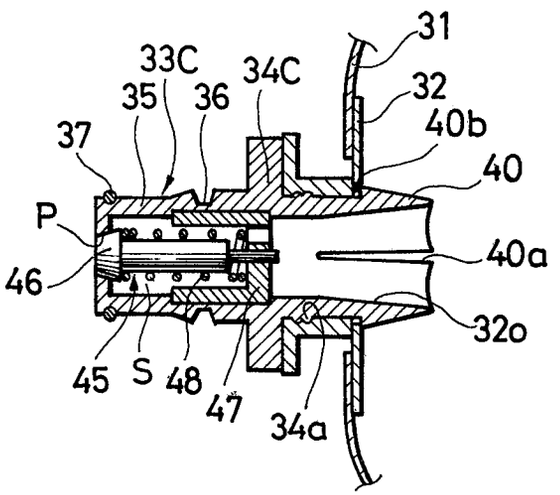
31
33C
34C
35
36
32
40b
37
40
P
40a
46
32o
45
S
48
47
34a

FIG. 28

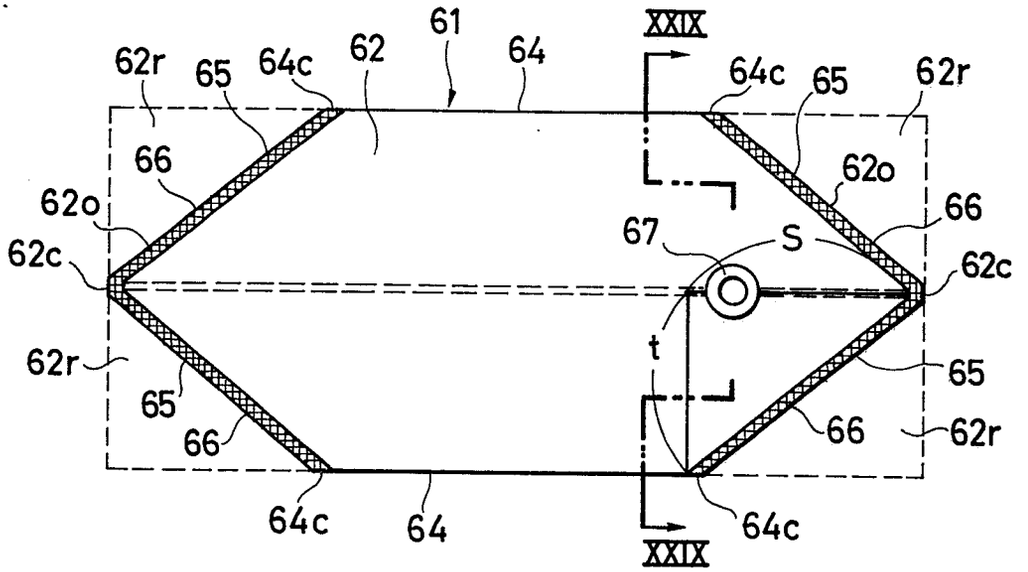
61
XXIX
62r
65
64c
62
64
64c
65
62r
66
62o
62o
66
67
S
62c
62c
t
62r
65
65
66
66
62r
64c
64
64c
XXIX

FIG. 29

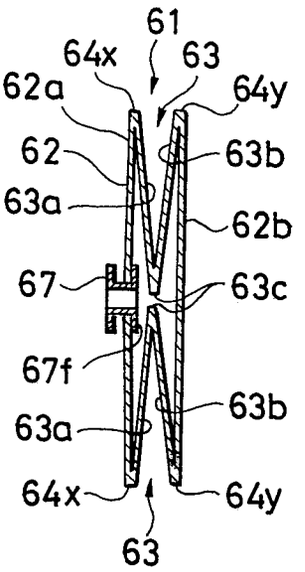
61
64x
63
62a
64y
62
63b
63a
62b
67
63c
67f
63b
63a
64x
64y
63

FIG. 30

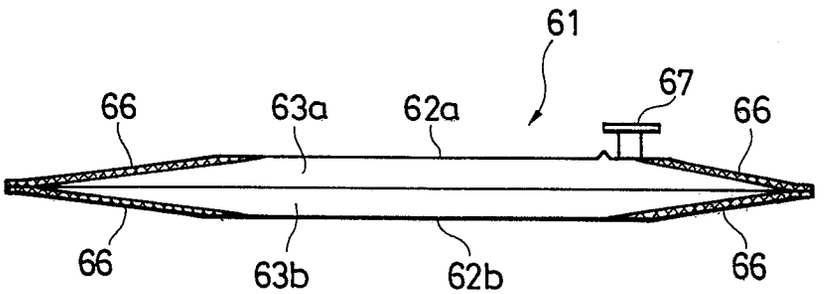

FIG. 31

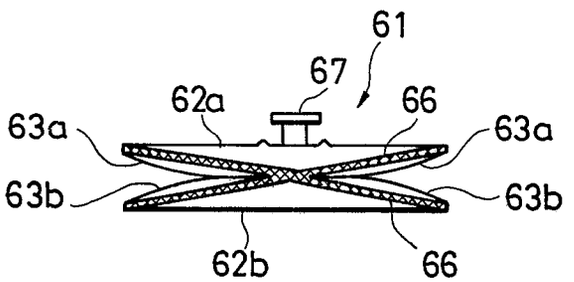

FIG. 32

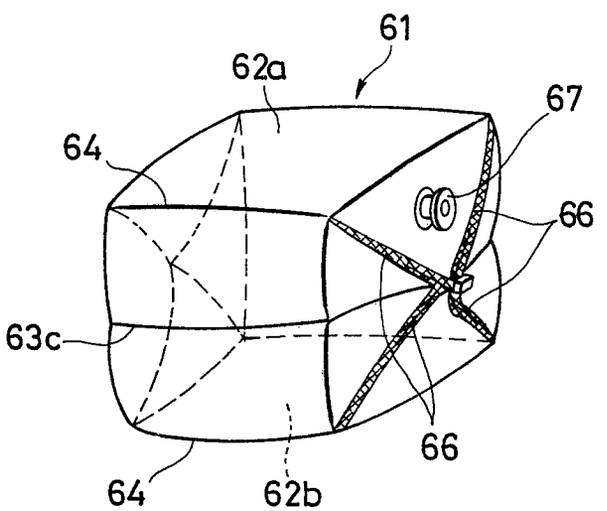

FIG. 33

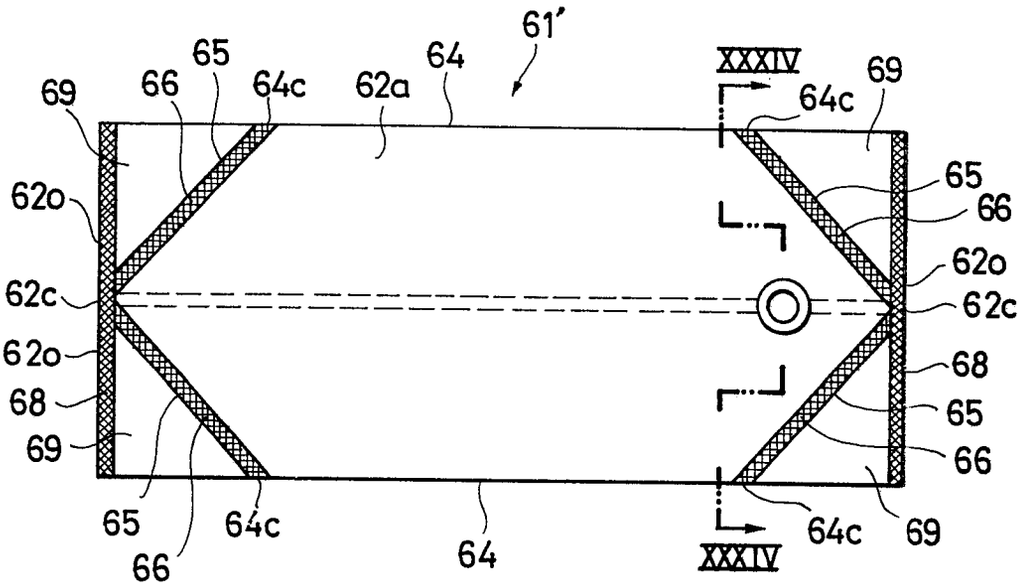
61'
65
64
XXXIV
69
66
64c
62a
64c
69
65
62o
66
62o
62c
62c
62o
68
68
65
69
66
65
64c
64c
69
66
64
XXXIV

FIG. 34

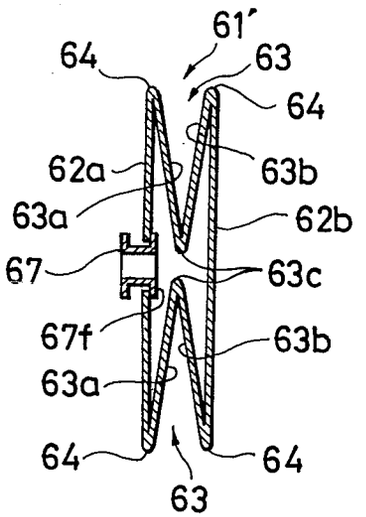
61'
64
63
64
62a
63b
63a
62b
67
63c
67f
63b
63a
64
64
63

FIG. 35

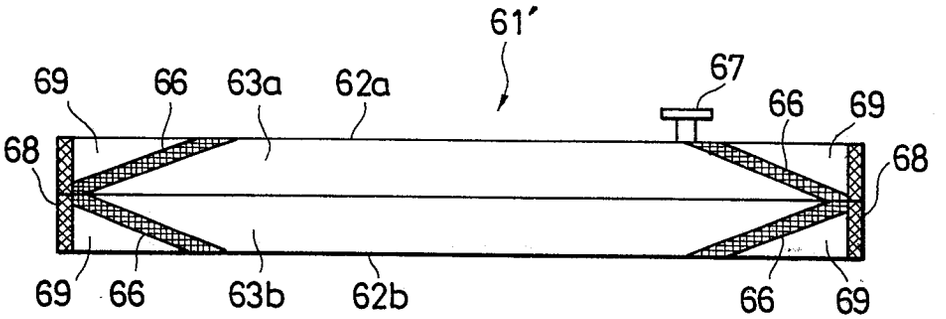

FIG. 36

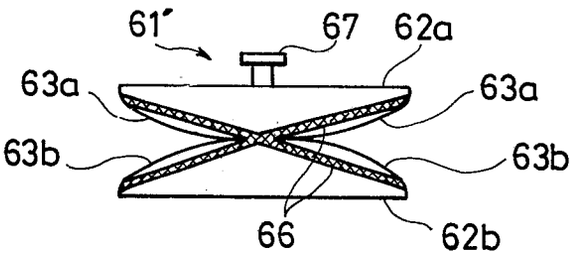

FIG. 37

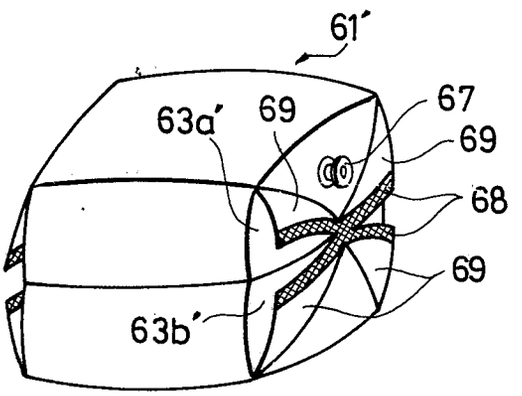

FIG. 38

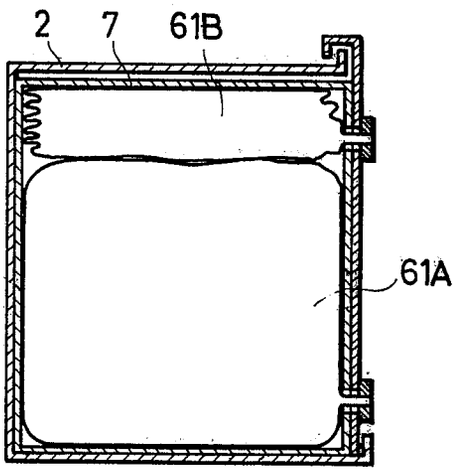

FIG. 39

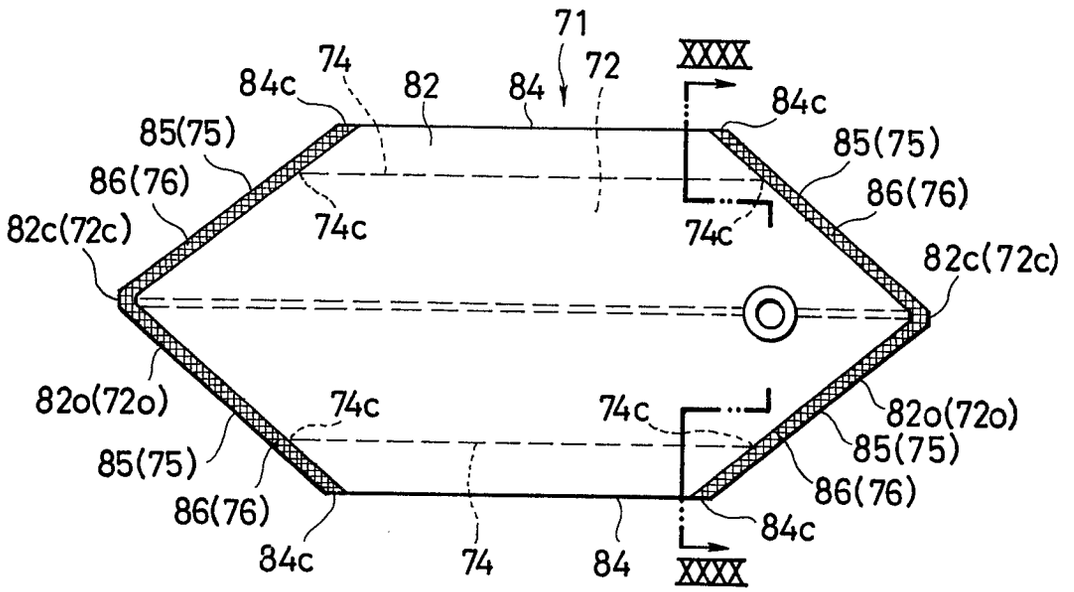
71
74
84c
82
84
72
XXXX
84c
85(75)
85(75)
86(76)
86(76)
82c(72c)
74c
74c
82c(72c)
82o(72o)
74c
74c
82o(72o)
85(75)
85(75)
86(76)
86(76)
84c
84c
74
84
XXXX

FIG. 40

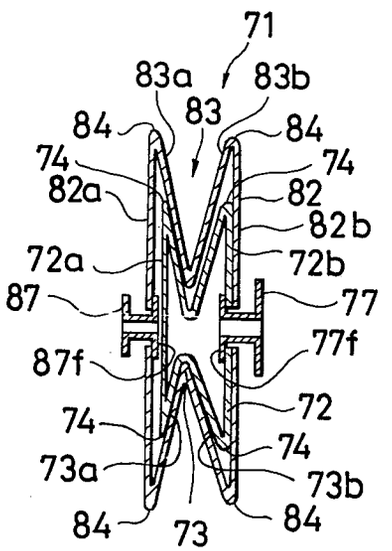
71
83a
83b
83
84
84
74
74
82a
82
82b
72a
72b
87
77
77f
87f
72
74
74
73a
73b
84
84
73

FIG. 41

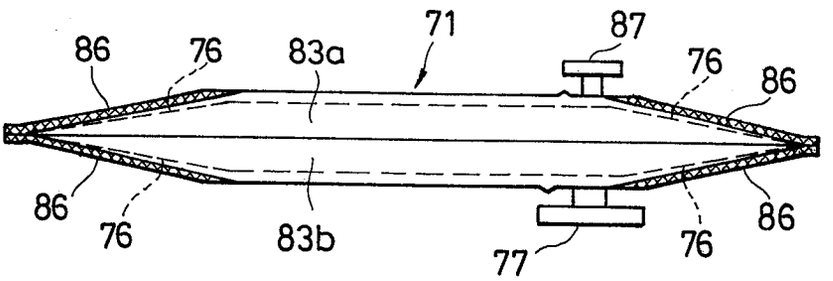

FIG. 42

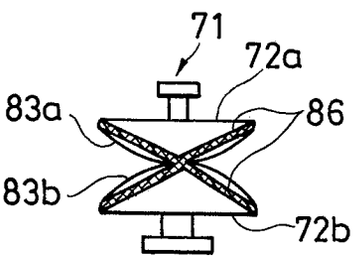

FIG. 43

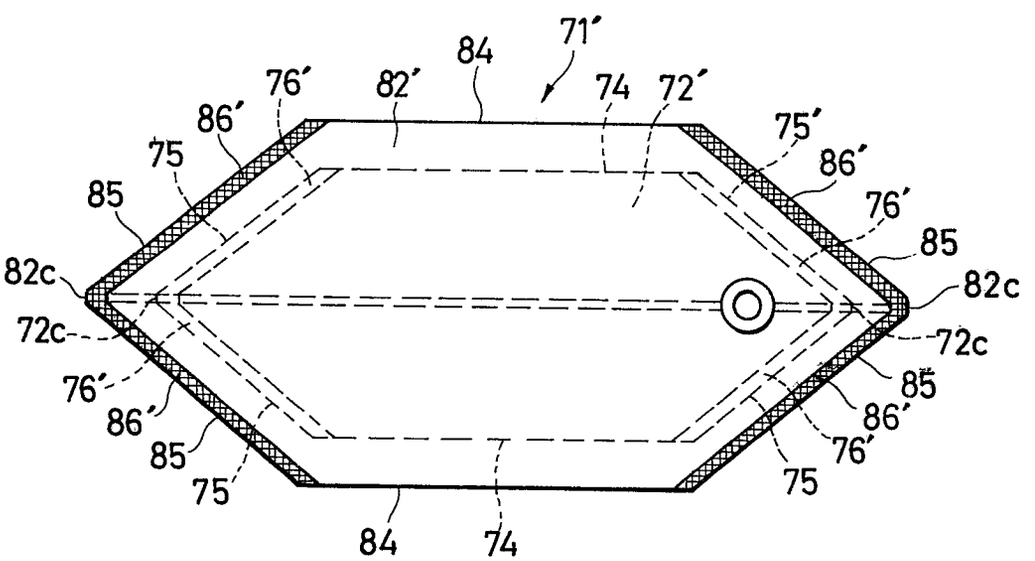

FIG. 44

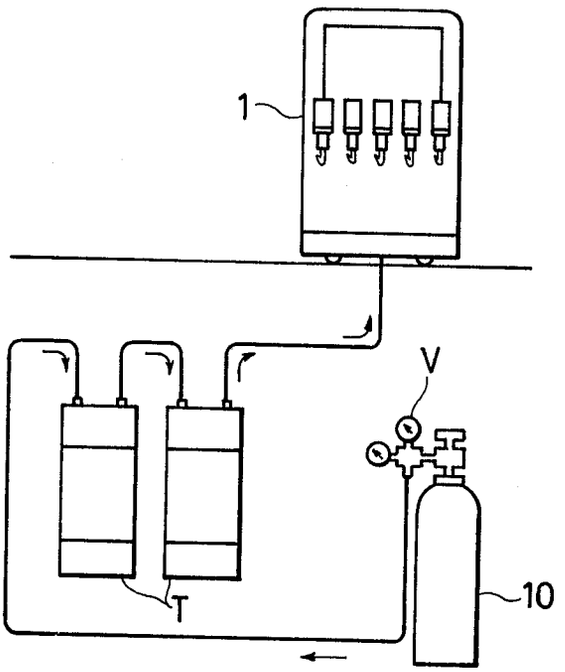

FIG. 45