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LIQUID CONTAINER, MANUFACTURING METHOD, INK JET CARTRIDGE, AND INK JET RECORDING APPARATUS

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(57) A liquid container (100) includes a polyhedron outer wall (101) having a substantial air vent (105) and having a corner portion defined by extensions of two surfaces thereof; an inner wall (102) forming a liquid containing portion for containing liquid therein, the inner wall (102) including an outer surface having a shape equivalent or similar to an inner shape of the outer wall (101), and having a corner portion corresponding to the corner portion of the outer wall (101); a liquid supply portion (103) for supplying the liquid from the liquid containing portion (100) to outside; wherein the inner wall (102) and outer wall (101) have major surfaces having maximum areas and not provided with the liquid supply portion (103); wherein when the liquid is discharged through the liquid supply portion (103), the inner wall (102) deforms such that at least one of angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of the inner wall (102) of the liquid container (100) and sides adjacent thereto, decreases, and such that angles formed between the sides forming the decreasing angle and sides which are adjacent to the decreasing angle forming sides and which are not the decreasing angle forming sides, increases.

Liquid Container, Manufacturing Method, Ink Jet Cartridge,  
and Ink Jet Recording Apparatus

Abstract

5 A liquid container (100) includes a polyhedron outer wall (101)  
having a substantial air vent (105) and having a corner portion defined by  
extensions of two surfaces thereof; an inner wall (102) forming a liquid  
containing portion for containing liquid therein, the inner wall (102)  
including an outer surface having a shape equivalent or similar to an inner  
10 shape of the outer wall (101), and having a corner portion corresponding to  
the corner portion of the outer wall (101); a liquid supply portion (103) for  
supplying the liquid from the liquid containing portion (100) to outside;  
wherein the inner wall (102) and outer wall (101) have major surfaces  
having maximum areas and not provided with the liquid supply portion  
15 (103); wherein when the liquid is discharged through the liquid supply  
portion (103), the inner wall (102) deforms such that at least one of angles  
formed between one side constituting a polygonal shape in a plane  
perpendicular to the major surface of the inner wall (102) of the liquid  
container (100) and sides adjacent thereto, decreases, and such that angles  
20 formed between the sides forming the decreasing angle and sides which are  
adjacent to the decreasing angle forming sides and which are not the  
decreasing angle forming sides, increases.



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Invention Title: Liquid Container, Manufacturing Method, Ink Jet  
Cartridge, and Ink Jet Recording Apparatus

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

LIQUID CONTAINER, MANUFACTURING METHOD,  
INK JET CARTRIDGE, AND INK JET RECORDING APPARATUS

FIELD OF THE INVENTION AND RELATED ART

5           The present invention relates to a liquid  
accommodating container for supplying liquid out with  
a negative pressure to a recording station such as a  
pen, ink ejection portion or the like, a manufacturing  
method for the container, an ink jet cartridge  
10 containing the container portion and an ink jet  
recording head portion, and an ink jet recording  
apparatus.

          A container for accommodating liquid is known  
wherein the liquid is supplied out of the container  
15 while maintaining a negative pressure within the  
container. Such a container performs appropriate  
liquid supply for the liquid using portion such as a  
nib or tip of a pen or recording head connected to the  
container, by the negative pressure produced by the  
20 container per se.

          Various liquid accommodating containers of  
this type are used, but the usable ranges thereof are  
rather limited. One of the reasons for this is that  
there has not been a one which is easy to manufacture  
25 and which is a simple in structure.

          For example, in the field of the ink jet  
recording requiring a proper negative pressure

property, a container having a sponge therein as a generation source for the negative pressure or a bladder-like container having a spring providing force against an inward deformation due to the consumption  
5 of the ink, as disclosed in Japanese Laid Open Patent Application No. SHO- 56-67269, Japanese Laid Open Patent Application No. HEI- 6-226993, for example. U. S. Patent No. 4, 509, 062 discloses an ink accommodation portion of rubber having a conical  
10 configuration with a rounded top having a smaller thickness than the other portion. The round thinner portion of the circular cone portion provides a portion which displaces and deforms earlier than the other portion. These examples have been put into  
15 practice, and are satisfactory at present. However, the negative pressure generating mechanisms described above is relatively expensive, and therefore, does not suit for the writing devices such as markers, plotters having writing tips. The use of the complicated  
20 negative pressure generating mechanism is not desirable since it result in bulkiness of the writing device. In writing devices, the use is made with a felt capable of generating a negative pressure and of introducing the air from the tip to permit supply of  
25 the ink thereto. The main problem of this type of the gas-liquid exchange structure for the ink supply is the ink leakage at the tip. In order to solve this

problem, an ink retaining mechanism has been proposed wherein a great number of fins are formed at predetermined intervals between the tip and the liquid accommodating container extending in a direction  
5 perpendicular to the ink supply direction, for the purpose of preventing the ink leakage by retaining the ink which is going to leak upon the ambient condition change or the like. However, such a mechanism results in a relatively large amount of non-usable ink  
10 remaining in the container.

The ink supplying system of such writing devices, generally uses an open type, which leads to evaporation of the ink, with the result of reduction of the usable amount of the ink. Therefore, ink  
15 evaporation suppression by using substantial sealed type is desirable.

The description will be made briefly about the substantially sealed type in the ink jet recording. When a negative pressure generation source  
20 is not used in an ink supplying system, the ink is supplied using the level difference relative to the ink using portion(ink ejection head), that is, the static head difference. This does not require any special condition in the ink accommodation portion,  
25 and therefore, a simple ink accommodation bladder is used in many cases.

However, in order to use a closed system, the

ink supply path has to extend between the ink accommodation bladder to the ink using portion(ink ejection head) thereabove with the result that long ink supply tube is required, so that system is bulky.

5 In order to reduce or eliminate the static head difference of the ink supply path, an ink container capable of providing the ink ejection head with a negative pressure, has been proposed and put into practice. Here, a term "head cartridge" is used to  
10 cover an unified head and ink container.

The head cartridge is further classified into a type wherein the recording head and the ink accommodating portion are always unified, and a type wherein the recording means and the ink accommodating  
15 portion are separable, and are separately mountable to the recording device, but are unified in use.

In either structure, the connecting portion of the ink accommodating portion relative to the recording means is provided at a position lower than  
20 the center of the ink accommodating portion in order to increase the usage efficiency of ink accommodated in the ink accommodating portion. In order to stably maintain the ink and to prevent the ink leakage from the ejection portion such as a nozzle in the recording  
25 means, the ink accommodating portion in the head cartridge is given a function of generating a back pressure against the ink flow to the recording means.



The back pressure is called "negative pressure", since it provides negative pressure relative to the ambient pressure at the ejection outlet portion.

In order to produce the negative pressure,  
5 the use may be made with capillary force of a porous material or member. The ink container using the method, comprises a porous material such as a sponge contained and preferably compressed in the entirety of the ink container, and an air vent for introducing air  
10 thereinto to facilitate the ink supply during the printing.

However, when the porous material is used as an ink retaining member, the ink accommodation efficiency per unit volume is low. In order to  
15 provide a solution to this problem, the porous material is contained in only a part of the ink container rather than in the entirety of the ink container in a proposal. With such a structure, the ink accommodation efficiency and ink retaining  
20 performance per unit volume is larger than the structure having the porous material in the entirety of the ink container.

From the standpoint of improving the ink accommodation efficiency, the bladder-like container  
25 using or not using the spring, or the ink accommodating container of rubber is usable.

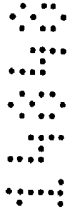
Such an ink container is widely used now.

However, further improvement is desired.

For example, further increase of the ink accommodation efficiency is desirable. More particularly, a larger amount of the ink is desired to be contained in the same volume of the container. The smaller number of parts constituting the ink container  
5 and simpler container are desirable.

### SUMMARY OF THE INVENTION

It is an object of the present invention to ameliorate one or more disadvantages of the prior art.



10

According to one aspect of the present invention there is provided a liquid container comprising:

a polyhedron outer wall having an air vent and having a corner portion defined by extensions of two surfaces thereof;

15

an inner wall forming a liquid containing portion for containing liquid therein, said inner wall including an outer surface having a corner portion corresponding to the corner portion of said outer wall;



a liquid supply portion for supplying the liquid from the liquid containing portion to outside;

wherein said inner wall and outer wall have major surfaces having maximum areas at a side other than a side provided with said liquid supply portion;

5 wherein at least one of angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of said inner wall of said liquid container and sides adjacent thereto is larger than 0 degree and smaller than 90 degrees; and

10 wherein angles formed between the sides forming said angle which is larger than 0 degree and smaller than 90 degrees and sides which are adjacent to said sides forming said angle and which do not form said angle, are larger than 90 degrees and smaller than 180 degrees.



According to another aspect of the present invention there is provided a liquid container for ink jet recording comprising:

an outer wall provided with an air vent;

an inner wall forming a liquid containing portion for containing liquid therein;

5 a liquid supply portion for supplying the liquid from the liquid containing portion to outside;

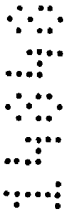
wherein said inner wall and outer wall have major surfaces having maximum areas at a side other than a side provided with said liquid supply portion;

10 wherein at least one of angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of said inner wall of said liquid container and sides adjacent thereto is larger than 0 degree and smaller than 90 degrees; and



wherein angles formed between the sides forming said angle which is larger than 0 degree and smaller than 90 degrees and sides which are adjacent to said sides forming said angle and which do not form said angle, are larger than 90 degrees and smaller than 180 degrees.

5 According to still another aspect of the present invention there is provided a liquid ejection head cartridge having a liquid container for containing liquid and a liquid ejection recording head connected to a liquid supply portion of said liquid container, comprising:



10

said liquid container including:

an outer wall provided with a liquid accommodating container air vent;

an inner wall forming a liquid containing portion for containing liquid therein;

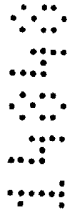


a liquid supply portion for supplying the liquid from the liquid containing portion to outside;

wherein said inner wall and outer wall have major surfaces having maximum areas at a side other than a side provided with said liquid supply portion;

5 wherein at least one of angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of said inner wall of said liquid container and sides adjacent thereto is larger than 0 degree and smaller than 90 degrees; and

10 wherein angles formed between the sides forming said angle which is larger than 0 degree and smaller than 90 degrees and sides which are adjacent to said sides forming said angle and which do not form said angle, are larger than 90 degrees and smaller than 180 degrees.



According to another aspect of the present invention there is provided a liquid ejecting recording apparatus, comprising:

a liquid ejection head cartridge;

said liquid ejection cartridge including:

- 5 a liquid container including an outer wall provided with an air vent; an inner wall forming a liquid containing portion for containing liquid therein; a liquid supply portion for supplying the liquid from the liquid containing portion to outside; wherein said inner wall and outer wall have major surfaces having maximum areas at a side other than a side provided with said liquid supply portion; wherein at least one of



angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of said inner wall of said liquid container and sides adjacent thereto is larger than 0 degree and smaller than 90 degrees; and wherein angles formed between the sides forming said angle which is larger than 0 degree and smaller than 90 degrees and sides which are adjacent to said sides forming said angle and which do not

5 form said angle, are larger than 90 degrees and smaller than 180 degrees; and a liquid ejection head connectable with the liquid supply portion of said liquid container;

said apparatus further comprising a carriage for scanning motion, said carriage is capable of detachably mounting said cartridge.





According to still another aspect of the present invention there is provided a method for manufacturing a liquid container, the method comprising the steps of:

preparing a liquid container including an outer wall provided with an air vent; an inner wall forming a liquid containing portion for containing liquid therein; a liquid  
5 supply portion for supplying the liquid from the liquid containing portion to outside; wherein said inner wall and outer wall have major surfaces having maximum areas at a side other than a side provided with said liquid supply portion; wherein at least one of angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of said inner wall of said liquid container and sides adjacent thereto  
10 is larger than 0 degree and smaller than 90 degrees; and wherein angles formed between the sides forming said angle which is larger than 0 degree and smaller than 90 degrees and sides which are adjacent to said sides forming said angle and which do not form said angle, are larger than 90 degrees and smaller than 180 degrees;



separating the inner wall and the outer wall by pressure reduction of the liquid containing portion;

supplying the liquid into said liquid containing portion.

5 **BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is a schematic view of an ink container according to an embodiment of the present invention, wherein (a) is a sectional view, (b) is a bottom view, and (c) is a perspective view.



10 Figure 2 is a schematic view showing deformation resulting from ink discharge of an ink container shown in Figure 1.



Figure 3 is a schematic view of an ink container according to another embodiment of the present invention, wherein (a) is a sectional view, (b) is a bottom view, and (c) is a side view.



15 Figure 4 is schematic perspective views showing examples of other ink containers wherein the present invention is used.



Figure 5 is a view illustrating the definition of an angle at a corner portion of a liquid accommodating container according to the present invention.



Figure 6 is an illustration showing an



advantage of provision of rounding at a corner portion of an ink container according to the present invention.

Figure 7 shows ink container manufacturing steps of an embodiment of the present invention.

Figure 8 is a flow chart showing an ink container manufacturing process according to an embodiment of the present invention.

Figure 9 shows manufacturing steps for an ink container of the present invention using injection blow molding.

Figure 10 shows manufacturing steps of an ink container of the present invention using double wall blow molding.

Figure 11, (a) is a schematic perspective view showing a recording head connectable with the ink container of the present invention, and (b) is a schematic sectional view showing a connection state between the recording head and ink container.

Figure 12 is a schematic view showing an ink jet recording apparatus carrying an ink container according to an embodiment of the present invention.

Figure 13 shows a negative pressure property of an ink container of an embodiment of Figure 1.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following the description will be made

as to an ink container usable with ink jet recording,  
as an example, but the present invention is applicable  
to a recording pen or a liquid accommodating container  
using negative pressure to properly supply liquid to  
5 the outside.

(Operational principle)

Referring to Figures 1, 2, 5 and 13, the  
description will first be made as to a mechanism of  
stabilized negative pressure production and  
10 maintenance thereof which is one of the features of  
the present invention.

Figure 1 ((a) -(c), ) shows a structure of an  
ink container according to an embodiment of the  
present invention, wherein (a) is a sectional view,  
15 (b) is a side view, and (c) is a perspective view.  
Figure 2 is sectional views taken along A-A in Figure  
1, (a), and shows the change when the ink in the ink  
container is discharged from an ink supplying portion  
of ink container after it is filled with the ink ((a)  
20 - (d)) Figure 5, ((a) -(c)) illustrates an angle of  
a corner portion of the ink container of the present  
invention. The ink container of this embodiment is  
manufactured through a direct blow molding, with which  
an inner wall and an outer wall of the ink container  
25 are simultaneously molded through one step.

The ink container 100 of Figure 1 contains  
the ink in a zone (ink accommodating portion) enclosed

with an inner wall 102 separable from an outer wall 101 forming an outer shell. The outer wall 101 has a thickness sufficiently larger than the inner wall 102, and therefore, it hardly deforms even when the inner wall 102 deforms due to discharging of the ink. The outer wall is provided with an air vent 105. The inner wall has a welded portion (pinch-off portion) 104, and the inner wall is supported by and engaged with the outer wall at the welded portion.

The ink container 100 of Figure 1 comprises a substantially quadratic prism portion having a parallelogram bottom surface and a cylindrical ink supplying portion 103 connected thereto, as a curved portion. The ink container has a small curved or rounded portion (R) at a portion corresponding to the edge lines of the prism shape. Here, the portion of the container adjacent the crossing portion between two surfaces preferably two flat surfaces or the crossing portion of the extensions of the surfaces, are called a "corner portion". The surfaces having the maximum area among the surfaces defined by the corner portion in each of the inner and outer walls, are faced to each other at both of the lateral sides of the ink supplying portion 103.

In Figure 1, (b),  $\theta$  and  $\phi$  are angles formed between outer walls constituting the corner portion of the ink container, more particularly, they are angles

formed at the crossing portion of extensions of two surfaces, as shown in Figure 5, (a), (c). Angle  $\theta$  is larger than 90 degrees, and angle  $\phi$  is smaller than 90 degrees. In this embodiment,  $\theta$  is approx. 140  
5 degrees, and  $\phi$  is approx. 40 degrees. The angle of the outer wall can be easily controlled since the manufacturing of the ink container carried out on the basis of the outer wall, as will be described hereinafter. The inner wall is formed so as to be  
10 corresponding to the outer wall, and therefore, the angles of the inner wall upon the start of use (initial state) are substantially the same as the angles of the corresponding portions of outer wall. The ink container of this embodiment has a  
15 substantially prism configuration, and when it is cut along a plane parallel to the bottom surface, as shown in Figure 2, the surface taken along the plane has a substantially parallelogram configuration. At least one of the angles formed between one side and adjacent  
20 side of the polygonal shape is larger than 0 degree and less than 90 degrees, and the angles formed between said two sides and the sides which are different from the two sides and which are adjacent said two sides, are larger than 90 degrees and smaller  
25 than 180 degrees, respectively. The cutting plane is perpendicular to the maximum area surfaces.

The ink supplying portion 103 is connected

with an unshown ink jet recording means through an ink discharge permission member 106 having an ink leakage preventing function capable of preventing leakage of the ink when small vibration or external pressure is  
5 imparted to the container. At the ink supplying portion 103, the inner wall and the outer wall are not easily separated from each other by the ink discharge permission member 106 and another structure therearound. The size of the ink supplying portion is  
10 sufficiently small as compared with the ink accommodating portion, and therefore, the ink supplying portion is not easily collapsed even when the deformation of the inner wall resulting from the discharge of the ink. Therefore, even when the ink is  
15 completely consumed, the inner wall and the outer wall are not deformed at the ink supplying portion and maintain the initial state.

Since Figure 1 is a schematic view, it seems that space exists between the outer wall 101 and the  
20 inner wall 102 of the ink container. But, it will suffice, if they are separable, and the inner wall and the outer wall may be in contact with each other, or may be spaced with a small gap. In any case, the corner portion of the inner wall is disposed at a  
25 position at least corresponding to the corner portion of the outer wall along the configuration of the inner surface of the outer wall 101, in the initial state

shown in Figure 2 (a).

In Figure 2, designated by 10 is the ink. In Figure 2, (a), the position of the corresponding ink supplying portion 103 is indicated by broken line, but  
5 in Figure 2, (b) -(d), the position of the ink supplying portion is omitted for better understanding of the deformation of the inner wall.

When the ink is ejected from the ink jet recording head of the ink jet recording means, the ink  
10 is consumed from the ink accommodating portion, and the maximum area sides of the inner wall 102 of the ink container begins to deform at the central portions thereof in the direction of reducing the volume of the ink accommodating portion.

15 The corner portion  $\alpha 1$  shown in Figure 1, (c) among the corner portions of the outer wall, limits the movement of the corner portion  $\alpha 2$  of the inner wall to keep the positional relation therebetween. On the other hand, the corner portion  $\beta 2$  of the inner  
20 wall is disengaged from the correspondence corner portion of the outer wall to suppress the deformation of the inner wall. In other words, as regards the polygonal shape on the cutting plane (in the case of Figure 2, the cutting plane parallel to the bottom  
25 surface) perpendicular to the maximum area surface of the ink container inner wall, the deformation occurs such that one ( $\phi$ ) of the angles formed between a side



and a side adjacent thereto is reduced, and that angles ( $\theta$ ) formed between the sides forming said angle and the sides adjacent thereto, are increased.

This occurs because the angles of the  
5 polygonal shape formed in the cutting plane are different, and therefore, the forces applied resulting from the ink discharge at the angle reducing corner ( $a_2$ ) and the angle increasing corners ( $a_1$ ) of the inner wall, are different. As a result, the above-  
10 described position variation of the corner portion  $a_2$  hardly occurs, and therefore, the ink accommodating portion receives the deforming force due to the ink consumption and the restoring force in the direction of the initial shape, by which the negative pressure  
15 is stabilized.

At this time, the air is introduced through an air vent 105 into between the inner wall 102 and the outer wall 101, so that deformation of the inner wall is not impeded, and therefore, the stabilized  
20 negative pressure is maintained during the use or consumption of the ink. Thus, the space formed between the inner wall and the outer wall, is in fluid communication with the ambience through the air vent 105. Thereafter, the ink is retained in the ink  
25 accommodating portion by the balance between the force provided by the inner wall and the force provided by the meniscus formed at the ejection outlet of the

recording head.

Furthermore, when quite a large amount of the ink is discharged out of the ink accommodating portion, and therefore, the ink accommodating portion is further deformed (Figure 2, (c)), the welded portion 104 also functions as a deformation limiting portion for the inner wall so that disengagement of inner wall from the outer wall is suppressed at the side having the supply port and the side faced thereto. As a result, the positional relation between the corner portion  $\gamma 1$  of the outer wall in the side having the supply port and the corner portion  $\gamma 2$  of the inner wall, is maintained, and therefore, the supply port portion is not plugged by the adjacent internal wall surface. The corner portion  $\beta 2$  of the inner wall disengaged from the corner portion of the outer wall, is brought into contact to the maximum area surface opposing thereto. The contact portion increases in its area by the further consumption of the ink.

Sooner or later, the ink ejection becomes not possible from the ink jet recording head. This state is shown in Figure 2, (d) (final state). With this state, the contact portion of the ink accommodating portion is generally as large as the entirety of the ink accommodating portion. Depending on the thickness of the inner wall, the welded portion 104 may be

separated from the outer wall. In this case, the direction of the deformation is limited since the welded portion 104 has a certain length in a direction as shown in Figure 1, (a) and (b). Therefore, even  
5 when the welded portion is disengaged from the outer wall, the deformation is not irregular but is balanced.

The foregoing is the description of the change when the ink container of the present invention  
10 is filled with the ink, and the ink is discharged from the ink supplying portion thereafter. The deformation starts at the maximum area surfaces, and the order of the deformations of various parts of the inner wall is positively determined by the provisions of the corner  
15 portion of the inner wall disengageable from the corresponding corner portion of the outer wall and the corner portion of the inner wall which is maintained, in the positional relation, with the corner portion of the outer wall.

In the foregoing description, with respect to  
20 at least one of the cutting planes perpendicular to the maximum area surface of the inner wall of the ink container, the deformation occurs such that angle formed between one side constituting the substantially  
25 polygonal shape in the cutting plane, reduces or increases. Here, the angle of the inner wall, as shown in Figure 5, (b), is defined as the angle  $\theta_2$  formed at



the crossing point between the extensions of the substantially flat surface portions of the inner wall. Therefore, even if the angle  $\theta_1$  formed in the neighborhood of the corner portion hardly changes from the angle  $\theta$  of the initial state, it will suffice if the  $\theta_2$  changes.

Figure 13 shows a relation between the ink use amount from the ink accommodating portion and the negative pressure of the ink container in the present invention. Figure 13 is a graph showing the negative pressure property of the ink container of Figure 1 embodiment, wherein the abscissa represents the ink discharge amount to the outside, and the ordinate represents a total negative pressure.

In the ink jet recording apparatus usable with the ink container, the preferable and practical range of the total negative pressure in the ink container is approx. -50 to -200mmAq (gauge pressure). Figure 13 shows a result of the experiment carried out with the following conditions:

- thickness of the outer wall: 1mm
- thickness of the inner wall: 150 $\mu$ m
- the surface area of the inner wall: 40cm<sup>2</sup>
- material of the outer wall: biimpact polystyrene resin material
- resin material of the inner wall: polyethylene resin material having an elastic modulus

lower than that of the biimpact polystyrene.

It will be understood that ink container of this embodiment has sufficient functions to produce a stabilized negative pressure which is a condition peculiar to the field of the ink jet recording. It has been confirmed that performance is not influenced by external vibration. In addition, substantially the similar properties are exhibited even when the consumption amount of the ink per unit time is severer than a normal recording.

(Configuration of the container)

The description will be made as to the configuration of the liquid accommodating container to which the present invention is applicable. As shown in Figure 1, in the liquid accommodating container of the present invention, the corner portions of the inner wall 102 are so located that they correspond to the corner portions of outer wall 101, following the configuration of the outer wall 101. In Figure 1, (a), the inner wall and the outer wall are shown without the ink supplying portion 103 for better understanding. When the ink supplying portion is provided at a position faced to the welded portion 104 of the side surface of the ink container, another welded portion existences adjacent the ink supplying portion.

The inner wall has the outer surface having

an equivalent or similar shape as the inner surface of the outer wall, and has the corner portions corresponding to the corner portions of the outer wall, by which the dead space having existed at the initial state in a conventional container having a casing and a bladder-like container therein, can be removed, so that ink accommodation capacity per unit volume can be increased, namely, the ink accommodation efficiency can be increased. By the provision of the air vent, the negative pressure can be limited within a desired range independently of the consumption amount of the ink per unit time since the liquid accommodating portion can easily deform when the liquid such as ink accommodated in the ink accommodating portion(liquid accommodating portion) is supplied to the outside.

A liquid container of this embodiment includes a polyhedron outer wall provided with a substantial air vent and corner portions constituting the polyhedron; an inner wall forming a liquid containing portion for containing liquid therein, said inner wall including an outer surface having a shape equivalent or similar to an inner shape of said outer wall and corner portions corresponding to the corner portions of the inner wall; a liquid supply portion for supplying the liquid from the liquid containing portion to outside. The present invention is not

limited to the container of a quadratic prism shape having a parallelogram cross-section, as shown in Figure 1.

The present invention provides a liquid  
5 container comprising a polyhedron outer wall having a substantial air vent and having a corner portion defined by extensions of two surfaces thereof; an inner wall forming a liquid containing portion for containing liquid therein, said inner wall including  
10 an outer surface having a shape equivalent or similar to an inner shape of said outer wall, and having a corner portion corresponding to the corner portion of said outer wall; a liquid supply portion for supplying the liquid from the liquid containing portion to  
15 outside; wherein said inner wall and outer wall have major surfaces having maximum areas and not provided with said liquid supply portion; wherein when the liquid is discharged through said liquid supply portion, said inner wall deforms such that at least  
20 one of angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of said inner wall of said liquid container and sides adjacent thereto, decreases, and such that angles formed between the sides forming the decreasing  
25 angle and sides which are adjacent to the decreasing angle forming sides and which are not the decreasing angle forming sides, increases. According to this, a

predetermined one of ones of the inner wall corner portions are disengaged from the corresponding corner portion or portions, so that way of collapse of the inner container is regulated. In other words, the deformation starts at the maximum area surface or surfaces of the inner wall, and at one or ones of the corner portions of the inner wall, the inner wall are disengaged from the corner portion or portions of the outer wall, and at another one or ones of the corner portions of the inner wall are maintained at a predetermined positional relation relative to the corresponding corner portion or portions of the outer wall, so that order or way of deformation of various parts of the inner wall is regulated.

Figure 3 and 4, (a) -(d), show other embodiments of the ink container.

Figure 3 shows an ink container according to another embodiment of the present invention, wherein (a) is a sectional view, (b) is a bottom view, and (c) is a side view. In this embodiment, the container 110 has a substantially parallel hexahedron configuration, and the bottom surface of the container, the side having an ink supply port 113, and the side surface, are not perpendicular. Therefore, the corner portion constituting the surface of inner wall 112 having the welded portion 114, is also easily disengaged from the corresponding corner portion of the outer wall 111 in





accordance with the discharge of the ink. This is different from Figure 1 embodiment. Thus, according to the present invention, the occurrence of the insufficiently collapsed portion at the final state, is minimized by its configuration. Additionally, the configuration is considered as permitting smooth deformation of the inner wall since the negative pressure is maintained in the desired range.

Figure 4, (a) -(d), shows further embodiment of the ink container. Figure 4, (a) shows a pentagonal prism configuration ink container; and Figure 4, (b) shows a hexagonal prism configuration ink container. These ink containers, similarly to the ink container of Figure 1, include corner portions of the outer walls from which the correspondence corner portions of the inner wall are disengaged in accordance with the consumption of the ink. As shown in Figure 4, (c), it is not necessary that bottom surface of the container, the surface having the ink supply port and the side surface, are perpendicular. As shown in Figure 4, (d), the configuration is not limited to prism shape. In the ink container having a portion where the corner portion is formed by three perpendicular sides among the above-described ink containers, the corner portion of the inner wall is not easily separated from the correspondence corner portion of the outside when the inner wall deforms as



a result of the use of the ink. The corner portions may be rounded. In this case, the angle is defined as an angle formed between the sides constituting a cross-section by the outer wall, as shown Figure 5, (c). Particularly when the portion at which the corner portion angle increases when the inner wall collapses by the consumption of the ink, is rounded (R) as shown Figure 6, (a), the final state is as shown in Figure 6, (b). When the rounding is not provided, as shown Figure 6, (c), the final state is as shown in Figure 6, (d). In the former case, the insufficiently collapsed portion at the final state is smaller. Additionally, the rounded portion is effective to promote the deformation of the ink container. For these reasons, the rounding is desirable. By employing the small curved surface configuration as the configuration of the corner portion in this manner, the corner portions and the crossing portions between the surfaces can be formed stably with small thickness, when the container is manufactured by molding a material while expanding a parison of the material to the metal mold in the manufacturing step which will be described hereinafter. Additionally, occurrence of pin holes can be minimized by employing the small curved surface in the corner portion and the crossing portion in this manner. Furthermore, in the foregoing embodiment, the



use is made with the polyhedron configuration. Noting the corner portion of inner wall which is disengaged from the corresponding corner portion of outer wall, it is located faced to the maximum surface area side.

5 If this is satisfied, the container is not limited to a polyhedron container, but it may be of bladder-like shape having a curved surface. With such a container having the curved surface configuration, it would be difficult to define the disengageable corner portion.

10 In such a case, the portion where the curved surface is not continuous is defined as a bent portion, and the surface enclosed by the bent portions, is defined as a surface, and what is necessary is that bent portion of the inner wall disengaged from the

15 corresponding bent portion of outer wall, is faced to the maximum area surface.

Among the foregoing embodiment of the present invention, an aspect ratio of a figure constituted by the outer wall in a particular cutting plane is remote

20 from 1, namely, the ink container is flat and thin. The cross-sectional configuration is closer to the square when the aspect ratio is closer to 1, and the deformation of the inner wall is more limited by the outer wall, and therefore, a larger amount of the ink

25 may remain unusably even at the central portion of the ink container at the final state. However, if the container is too flat, the capacity thereof is too



small. Therefore, it is desirable that aspect ratio is determined in consideration of the conditions of the ink jet recording head or the ink jet recording apparatus with which it is used.

5 In the above-described embodiments, the surface having the ink supply port is faced to the bottom surface, but this is not limiting, and may be determined in accordance with the configurations of the ink jet recording head unit and the carriage for  
10 carrying it, as will be described hereinafter.  
(molding resin material)

The description will be made as to resin material of the ink container of the present invention. The ink container of the present invention  
15 is constituted by an inner wall containing the ink and an outer wall covering the inner wall(double wall structure). Therefore, the material of the inner wall preferably exhibits a flexibility, a high hydrophilicity and a low permeability for gasses. The  
20 material of the outer wall preferably has a high strength.

It is possible to constitute both of the inner wall and the outer wall from the same resin material which satisfy all of such properties.  
25 Generally, however, it is preferable to form the inner wall and the outer wall from other materials, since then larger choice of the material is usable, and the

materials which are not bonded to each other are preferable from the standpoint of easy container manufacturing, as will be described hereinafter.

The container according to Figure 1  
5 embodiment, was manufactured using polypropylene resin material, polyethylene resin material and Noryl, as molding resin materials. The Noryl resin hardly has a crystalline structure, and is non-crystaline, but the polypropylene resin material and the polyethylene  
10 resin material have the crystal property.

Generally, noncrystalline resin has a smaller coefficient of thermal contraction, and crystalline resin has a larger coefficient of thermal contraction.

Plastic material such as polystyrene,  
15 polycarbonate, polyvinyl chloride, and the like, may be listed as noncrystalline materials. Polyacetal, polyamide, and the like, may be listed as crystalline material since each of them forms crystalline structure by a certain ratio when placed in a specific  
20 environment.

Polyacetal, polyamide, and the like, may be listed as crystalline material since each of them forms crystalline structure by a certain ratio when placed in a specific environment. On the other hand,  
25 noncrystalline plastic has a glass transition temperature, but no distinct melting point.

The mechanical strength, specific volume,

specific heat, coefficient of expansion, or the like,  
of plastic material suddenly changes at the glass  
transition point or the melting point. This property  
of plastic material can be utilized to create such  
5 material combinations that improve the separability of  
the inner shell resin from the outer shell resin. For  
example, when Noryl resin, which is noncrystalline, is  
used for the outer shell or wall, and polypropylene  
resin, which is crystalline, is used for the inner  
10 shell or wall, the outer shell will be provided with  
mechanical strength, and the inner shell will be  
provided with flexibility and a larger coefficient of  
thermal contraction.

A polymer whose molecular structure comprises  
15 only C-C bonds and C-H bonds is called a nonpolar  
polymer, whereas a polymer whose molecular structure  
comprises a large amount of polar atoms such as O, S,  
N or halogen is called polar polymer. Polar polymer  
displays larger intermolecular cohesive force;  
20 therefore, polar polymer resin displays stronger  
bonding force.

This property of polymer resin can be used to  
improve the separability of resin material; a  
combination of two nonpolar resins, or a combination  
25 of a nonpolar resin and a polar resin, can be used to  
improve the separability of one resin material from  
the other resin material. In the preceding

embodiments, the outer wall and the inner wall were described as a wall with single layer walls. However, these walls may be given a laminar structure comprising multiple layers of different materials in order to improve shock resistance. In particular, damage which occurs when an ink container is transported or installed, or in the like situations, can be prevented by giving the outer wall the multi-layer wall structure.

As for the material for the inner wall of the ink container in accordance with the present invention, polyethylene resin, polypropylene resin, and the like, are usable as described above, and their tensile elastic modulus are preferred to be within a range of 150 - 3000 kgf/cm<sup>2</sup>. In this range, proper materials not limited to the resin materials are selectable with proper configuration and thickness so as to provide a desired negative pressure producing property.

(Manufacturing method)

The description will be made as to the manufacturing method for the ink container of the present invention. The ink container proposed by the present invention employs a double structure composed of formable resin material. The outer wall is rendered thicker for strength, whereas the inner wall is rendered thinner for flexibility so that it can

accommodate the volumetric change of the ink held therein. The material for the structural walls of the inner wall is preferably ink resistant, and the material for the structural walls of the outer wall is preferred to have shock resistance or the like properties.

In this embodiment, a method using blow molding is employed so that structural walls of the ink container can be formed without drawing the resin materials. Therefore, the inner wall of the ink container, which constitutes the ink holding portion, is enabled to substantially omnidirectionally withstand the load. As a result, no matter which direction the ink remaining in the inner wall shifts after the ink contained in the inner wall is consumed by a certain amount, the inner wall can reliably retain the ink, thus further improving the overall durability of the ink container.

As for the choice of blow molding, injection blow molding, direct blow molding, double wall blow molding, and the like are available.

In this embodiment, any of the blow molding methods are usable. Here, the manufacturing method will be described, taking the direct blow molding method as an example.

Figure 7, (a) -(d), shows ink container manufacturing steps according to this embodiment, and



Figure 8 is a flow chart showing the ink container manufacturing process.

In Figure 7, a reference numeral 301 designates a main accumulator for supplying the resin material for the inner wall; 302, a main extruder for extruding the inner wall resin; 203, an auxiliary accumulator for supplying the resin material for the outer wall; and 204 designates an auxiliary extruder for extruding the outer wall resin.

The inner wall resin and the outer wall resin are supplied simultaneously to the die 306 through a ring 305, so that integral parison 307 is formed. The parison 307 is molded by metal molds 308 sandwiching the parison 207 and the air nozzle 309 for injecting the air from the upper part, as shown in Figure 7, (b) to (d). Referring to Figure 8, the ink container manufacturing process will be described in detail.

The inner resin material and the outside resin material are supplied (steps S401 and S402) to extrude the parison 307 (step S403)).

In this embodiment, the resin materials are supplied in the manner that inner resin material for the inner wall and the outer resin material for the outer wall are in contact with each other. However, the contact surfaces thereof are of materials not bonded to each other by selection of the materials of the surfaces, so that resin materials are not fused to

each other. In the supply of the inner and outer resin materials, they may be contacted entirely, or partly. In this case, the resin materials for the inner and outer wall are selected so that mutually facing surfaces of the respective walls do not adhere to each other or so that they are separable by adding a proper chemical compound to one of the resin materials when the resin material is supplied to the mold, for example. When it is necessary to use materials belonging to the same group for the sake of the liquid contact related properties or the configuration of the ink container, the inner shell wall and the outer shell wall are given a laminar structure, wherein various resin materials are injected so that different materials are exposed on the mutually facing surfaces of the respective shells.

It is ideal to mold the inner shell so that wall thickness becomes even throughout the shell, but the wall thickness may be locally reduced so that wall can easily accommodate the change in internal pressure. The method for partially reducing the wall thickness is optionally selected depending on the internal structure of the liquid container, and the wall thickness is reduced in the direction parallel to the direction in which the resins are injected into the die.

A die (metallic die) 308 is placed so as to

be prepared for enclosing the parison 307, as shown in Figure 7, (c), and then is moved to enclose the parison 307 as shown in Figure 2(c) (step S404). At this time, the inner wall and the outer wall are

5 closely contacted without gap therebetween, however, it is desirable that welded portion (pinch-off portion) does not exist in the maximum surface area side of the liquid accommodating container, by for example designing such that mold dividing direction of the

10 mold is in parallel with the maximum area side. By the provision of the small curved surface at the corner portion, the manufacturing of the metal mold is made easier, thus improving the productivity, and therefore, the cost of the ink container manufacturing

15 is substantially lowered.

Subsequently, as shown in Figure 7, (c), the air is injected through the air nozzle 309, and the blow molding is carried out to the shape of the mold 308 (step S405). As is contrasted to a conventional

20 blow molding products, by selecting the inner and outer materials which do not show adhesiveness relative to each other, the wall are not easily adhered to each other, and a double wall structure can be provided. Further, when the die temperature is

25 kept within a range of  $\pm 30$  °C from a reference temperature while molding, difference in the wall thickness among the ink containers can be reduced

during the manufacturing; therefore, such a temperature control is preferable.

Subsequently, the inner and outer wall are separated in the portion other than the ink supplying portion(step S406). The separation between the inner wall and the outer wall, may be carried out by reducing the pressure in the space defined by the ink container inner wall. As regards a method for the separation between the inner wall and the outer wall other than the pressure reduction, there is a method of using materials having different thermal expansion coefficients (shrinkage rates) for the resin materials of the inner wall and the outer wall. In this case, by the lowering of the temperature of the resin materials after the blow molding, the separation is automatically effected so that number of steps in the manufacturing is reduced. As another method, the inner wall and the outer wall may be separated by external force after molding at a portion where the parison was sandwiched by the dies at the time of the blow molding, and the resulting gap may be communicated with the ambient air, so that gap may be used as an air vent. This is preferable in the case of the ink accommodating container for the ink jet recording, since the number of the manufacturing steps can be reduced.

In this manner, the inner wall is separated

from the outer wall, and thereafter, the ink is injected. Before the ink injection, the ink accommodating portion may be expanded by compressed air to provide the same shape as in the initial stage  
5 of the container, and then the ink injection may be carried out. In addition, when the ink accommodating portion is expanded into the initial state shape, the ink may be injected by pressurization.

The amount of the ink injected is preferably  
10 approx. 90-95% of the volume of the ink accommodating portion, since then the ink leakage can be prevented even upon ambient condition variations, such as temperature and/or pressure variations, or even upon external force exerted thereto. What is desirable  
15 here is that ink amount is finally 90%, and therefore, the ink may be filled into the container to 100%, and then, 5% -10% of the ink is extracted. The extraction of the ink may be carried out by exerting external force to the outer wall of the ink container. In this  
20 case, too, an air vent can be simultaneously provided by the gap provided by the separation. After the injection of the ink in this manner, the ink discharge permission member is mounted (step S408).

In the blow molding, the parison 307 is  
25 processed while it as a substantial viscosity, and therefore, neither of the inner wall resin material and the outer wall resin material has an orientation

property. In the case that inner resin material and the outer resin material are supplied into the mold without contact from the beginning, the outer resin material is sucked in the mold, and thereafter, air is  
5 fed into between the inner and outer resin materials, and then, the blow molding is carried out. In this case, the resin materials may be the same materials, thus permitting selection of the resin materials form wider range.

10 The ink container is molded so that thicknesses  $t$  and  $T$  of the inner wall resin and the outer wall resin, respectively, before the blow molding, become smaller than the thicknesses  $t_1$  and  $T_1$  of the inner wall resin and the outer wall resin,  
15 respectively, after the blow molding. According to an aspect of the present invention, the ink container is molded so that relationship in thickness between the outer wall resin and the inner wall resin materials satisfy the following formula:

20 
$$T > t_1, \text{ and } T_1 > t_1$$

The employment of blow molding can reduce the number of manufacturing steps and the number of the components, which in turn can improve yield, and also allows the inner wall 102 to be formed in such a  
25 manner that edges and corners of the inner wall 102 are set in those of the outer wall 101 in an orderly manner.

In this embodiment, the use is made with the direct blow molding method, but other blow molding methods are usable. Referring to Figure 9 and 10, the description will be made as to such manufacturing  
5 processes.

In the case that ink container is manufactured using the injection blow molding, the following steps are carried out. First, the container outer wall is prepared using a preformed  
10 parison(Figure 9, (a)). Into this, the parison for the inner wall is inserted after it is heated (Figure 9, (b)), and the blow molding is carried out (Figure 9, (c)). Then, the inner wall and outer wall are welded with each other to accomplish the container (Figure 9,  
15 (d)).

In this case, a combination of the material of the outer wall and the material of the inner wall may be any if they are weldable with each other. While blow molding, it is important to properly  
20 control the parison temperature. In the case of this method, only one opening is usually provided because of the manufacturing method, and the inner wall and the outer wall are fixed with each other at the opening. Therefore, in the case that space between  
25 the inner wall and the outer wall is communicated with the ambience, an additional step of providing an air vent is necessary. When a double wall blow molding

method is used, the air is first introduced into the inside of the parison to expand it, (Figure 10, (a)), and then, the metal mold is closed to mold the material (Figure 10, (b)). The left and right metal  
5 molds are closed, and then, blowing air is fed into the parison to expand the parison into the shape of the cavity provided by the molds (Figure 10, (c)).

At this time, the adhesiveness to the metal mold can be enhanced by sucking the inside of the  
10 metal mold, using vacuum. The container can be manufactured through this method. When the double wall blow is used, the outer wall is sandwiched by the molds all over the circumference, and therefore, , the inner wall is separated if the resin materials have a  
15 melting property relative to each other. Therefore, the adhesive property between the resin materials are required usually.

However, with the ink container of this embodiment, the inner wall and the outer wall are  
20 separated at other than the supporting portion, and therefore, the adhesive property is not particularly required. The ink accommodating portion is formed by plugging the opening of the container having the double wall structure, with a cap of the same material  
25 as the outer wall.

The air vent for communication between the space between the outer wall and the inner wall with



the ambience, for the pressure adjustment, can be formed by utilizing the injecting portion, as it is, for the introduction of the blowing air.

Thus, the manufacturing of the ink container  
5 using blow molding is advantageous over the  
conventional manufacturing method of the ink container  
using a porous member as a negative pressure producing  
member, in that number of the manufacturing steps is  
smaller. In the case of the ink container using a  
10 porous material, it is generally required to provide  
the ink container with a filter to prevent  
introduction, into the ink jet recording head, foreign  
matter produced in the ink container when the porous  
member is inserted during the manufacturing step, for  
15 example. According to the manufacturing method of the  
ink container using the blow molding, no foreign  
matter is produced in the ink container, and  
therefore, the filter for removing the foreign matter  
from the ink is not necessary. Furthermore, with the  
20 structure of the embodiment, the inner wall on which  
the ink is deposited is separated from the outer wall  
and is of thin material, and therefore, it is easily  
taken out of the outer wall, thus permitting  
classified disposal or classified recycling.

25 In the foregoing, the resin material has been  
described as being continuously supplied, but it is a  
possible alternative that same materials are used for

the inner wall and the outer wall, and a material separable from the inner and outer walls is intermittently supplied into between the parison of the inner wall and the parison of the outer wall, thus making the ink accommodating portion(inner wall) is separable from the casing(outer wall).

In the foregoing, the resin material has been described as being continuously supplied, but it is a possible alternative that same materials are used for the inner wall and the outer wall, and a material separable from the inner and outer walls is intermittently supplied into between the parison of the inner wall and the parison of the outer wall, thus making the ink accommodating portion (inner wall) is separable from the casing (outer wall). Therefore, as will be understood from the manufacturing steps, when the position of the ink supply port is deviated in the surface having the ink supply port, the distance between the parison and the mold is different at some portion, and therefore, distribution of the thickness may occur in the inner wall and the outer wall at the time of the blow molding, in some cases.

In the case of the ink container shown in Figure 1, the parison is supplied in the longitudinal direction of the container, and therefore, there is hardly any need of taking the thickness distribution in the longitudinal direction into the consideration.

But, with respect to the corner portions defined by  $\alpha$ ,  
 $\beta$ , the thicknesses of the inner and outer walls are  
larger toward the supply port. As regards the maximum  
area surfaces, when they are cut along a plane  
5 parallel to the bottom surface, there is a thickness  
distribution. This is because the parison of a  
cylindrical shape is expanded to a prism having a  
parallelogram cross-section, and therefore, the  
thicknesses of the corner portions are smaller away  
10 from the mold surface.

This is effective to positively determine the  
order of portions of collapses of the ink container  
since it is one of the factors to make the corner  
portion  $\beta 2$  adjacent the side having the ink supplying  
15 portion less easily disengageable from the  
corresponding outer wall.

(OTHER EMBODIMENTS)

Other embodiments of the present invention  
will be described. The following embodiments are  
20 applicable to any of the liquid accommodating  
containers of the foregoing embodiments.

(Ink discharge permission member)

The ink discharge permission member (liquid  
discharge permission member) indicated by 106 in  
25 Figure 1, has an ink leakage preventing function by  
which when small vibration is imparted to the  
connecting portion for the ink jet head or when the

external pressure is imparted to the container, the leakage of the ink from the ink supplying portion is prevented. In the embodiment shown in Figure 1, the use is made with unidirectional fibrous having an ink  
5 absorbing function and therefore having meniscus retaining force. It virtually seals the ink holding portion, and when the ink tapping member of the ink jet head is inserted into the ink supply port, it enables the ink within the ink holding portion to be  
10 fed out while maintaining the airtight condition.

Depending on how the ink container 100 and the ink jet head are joined, the ink releasing member 106 as a member activatable by contact pressure may be replaced with a rubber plug, a porous material, a  
15 valve, a filter, a resin piece, or the like.

(Pinch-off portion)

The configuration of the pinch-off portion(104 in Figure 1, for example), is determined by the mold used in the manufacturing method of the  
20 blow molding. Therefore, in Figure 10, (b), the supporting portion 104 has a waveform configuration, but it may be straight if the ink supply port portion 103 is easily taken out of the mold during the manufacturing step. The length is not limited to this  
25 embodiment, and may be different.

When the direct blow molding method is used, the inner wall can be supported at a plurality of

portions including the ink supply port portion without difficulty, but it is not inevitable to support it at a plurality of portions. The provision of the pinch-off portion is not inevitable if an irregular  
5 deformation of the inner wall can be prevented.

(Air vent)

The air vent indicated by 105 in Figure 1, for example, functions to introduce the air into between the inner wall and the outer wall when the  
10 inner wall forming the ink accommodating portion is deformed by the decrease of the volume in accordance with the consumption of the ink. In the embodiment shown in Figure 1, the materials of the inner wall 102 and the outer wall 101 are not adhesive to each other,  
15 so that inner wall 102 can be easily separated from the outer wall 101 by application of the external force, and the resulting small gap is used as an air vent. Here, although the inner wall 102 is separated from the outer wall 101, the gap therebetween is as  
20 small as several microns to several tens microns, and therefore, the inner wall 102 is sufficiently supported by the outer wall 101. As for an example of the method for forming the gap, the inner wall is separated from the outer wall as has been described  
25 hereinbefore using residual stress or the like occurring as a result of use of different materials for the outer wall and the inner wall.

The air vent may be provided by forming a hole at a proper position of the outer wall of the ink container, without use of the gap at the welded portion provided by the external force as in this  
5 embodiment. Furthermore, as shown in Figure 2, a valve 117 which can open to the outside may be formed in the outer wall 111 of the ink container. Such a valve function to assist the balance of the pressure to the ink container inner wall, and also functions to  
10 quickly absorb the pressure change upon occurrence of abrupt pressure change when the ink container is let fall.

(Liquid ejection head cartridge)

The description will be made as to connection  
15 of the ink container of the present invention to a recording head. Figure 11, (a) shows a recording head as a recording means connectable with the ink container according to any embodiment of the present invention, and Figure 11, (b) is a cross-sectional  
20 view showing the connection between the recording head and the ink container.

In Figure 11, (a), designated by 701 is a recording head unit as the recording means, and integrally includes black, yellow, cyan and magenta  
25 recording heads to permit full-color printing.

The recording head unit uses an electrothermal transducer which generates thermal

energy for causing film boiling in the ink in response to an electric signal. Designated by 702 is an ink supply tube as an ink introduction portion for introducing the ink to the respective recording heads, and an end of the ink supply tube 702 is provided with a filter 703 for trapping bubbles or foreign matters.

When the above-described ink container 100 is mounted to the recording head unit 701, the ink supply tube 702 is connected to the press-contact member 106 provided in the ink container 100 to permit the ink supply.

After the ink container mounting, the ink is introduced into the recording head from the ink container to establish the ink communication state. Thereafter, during printing operation, the ink is ejected from the ink ejection portion 704 provided in the recording head so that ink in the ink container inner wall 102 is consumed.

In the foregoing, the ink container is disconnectably connectable with the liquid ejection recording head, but it may be integral with the liquid ejection recording head.

The liquid to be ejection is not limited to the ink, but may be processing liquid which reacts with the ink on the recording material.

(Recording device)

Lastly, an ink jet recording apparatus in

which the ink container in accordance with the present invention is mounted for recording will be described. Figure 12 shows an example of an ink jet recording apparatus carrying the ink container according to an embodiment of the present invention of Figure 1. In 5 Figure 12, the head unit 401 and the ink container 100 are securedly but removably mounted on the carriage provided on the main assembly side of the ink jet recording apparatus, with the use of an unillustrated 10 positioning means. The forward and backward rotation of a driving motor 5013 is transmitted to a lead screw 5004 through driving force transmission gears 5011 and 5009, rotating the lead screw 5004. The lead screw 5004 is provided with a helical groove which engages 15 with an unillustrated pin provided on the carriage. With this arrangement, the carriage is reciprocally moved in the longitudinal direction of the apparatus.

A reference numeral 5002 designates a cap for capping the front surface of each recording head 20 within the recording head unit. Also, it is used for restoring the recording head performance, the ink is sucked through the opening of the cap by an unillustrated sucking means. The cap 5002 is moved by the driving force transmitted through a gear 5008 and 25 the like, being enabled to cover the ejection surface of each recording head. Adjacent to the cap 5002, an unillustrated cleaning blade is disposed so as to be



movable in the vertical direction of this drawing.  
The configuration of the blade is not limited to the  
form depicted in the drawing, and needless to say, any  
known cleaning blade is compatible with the present  
5 invention. The apparatus is structured so that  
appropriate operation among the capping, cleaning, and  
performance recovery sucking operations is performed  
at a pertinent position by the function of the lead  
screw 505 when the carriage is at its home position,  
10 it is also needless to say that any structure is  
compatible with the present invention as long as the  
structure can enable a proper operation to be  
performed with known timing.

When the recording head unit is mounted on  
15 the carriage, the connection pad 4502 of the recording  
head unit is connected to the connection pad 531 of a  
connection plate 5030 provided on the carriage,  
whereby electrical connection is established. This  
connection occurs as the connection pad 5030 is  
20 rotated about its axis. Since this electrical  
connection is established without using a connector,  
the recording head is not subjected to unnecessary  
force.

According to this embodiment, as shown in  
25 Figure 12, the carriage bottom surface portion has a  
configuration corresponding to a part of the outer  
surface of the ink container outer wall so as to

permit assured support for the ink container. To further assure the support for the ink container, a groove of a shape corresponding to the ink container is provided in the connecting plate 5030 so that  
5 connecting plate 5030 is rotatable about a predetermined axis to confine the upper part of the ink container.

As described in the foregoing, according to the present invention, the liquid supply is possible  
10 with stabilized negative pressure.

By using the blow molding for the manufacturing thereof, the hermeticity is better than an ink container manufactured by welding and boding a plurality of parts. Additionally, no foreign  
15 matter is produced therein during the manufacturing step, so that necessity for the filter for the foreign matter may be eliminated. No liquid retaining material such as sponge is necessary in the liquid accommodating portion, so that liquid which can be  
20 retained in the container is selectable from wider range, and the liquid accommodation capacity is large. Further, the number of ink container components is reduced; therefore, it is possible to reduce the number of quality control provisions, to simplify the  
25 ink container manufacturing process, and to easily meet a practical level of accuracy required with manufacturing the ink container. As a result, it is

possible to provide an inexpensive ink container  
manufacturable with a preferable yield.

When the container is used for a liquid  
supply system using a static head difference, the size  
5 of the entire apparatus can be reduced.

While the invention has been described with  
reference to the structures disclosed herein, it is  
not confined to the details set forth and this  
application is intended to cover such modifications or  
10 changes as may come within the purposes of the  
improvements or the scope of the following claims.



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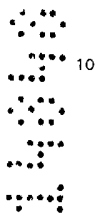
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The claims defining the invention are as follows:

1. A liquid container comprising:

a polyhedron outer wall having an air vent and having a corner portion defined  
5 by extensions of two surfaces thereof;

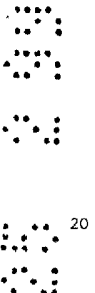
an inner wall forming a liquid containing portion for containing liquid therein,  
said inner wall including an outer surface having a corner portion corresponding to the  
corner portion of said outer wall;



a liquid supply portion for supplying the liquid from the liquid containing  
10 portion to outside;

wherein said inner wall and outer wall have major surfaces having maximum  
areas at a side other than a side provided with said liquid supply portion;

wherein at least one of angles formed between one side constituting a  
15 polygonal shape in a plane perpendicular to the major surface of said inner wall of said  
liquid container and sides adjacent thereto is larger than 0 degree and smaller than 90  
degrees; and



wherein angles formed between the sides forming said angle which is larger  
20 than 0 degree and smaller than 90 degrees and sides which are adjacent to said sides  
forming said angle and which do not form said angle, are larger than 90 degrees and  
smaller than 180 degrees.

2. A container according to claim 1, wherein an outer side of said inner  
wall is all separated physically from said outer wall except for a portion which is  
closely contacted to said outer wall.

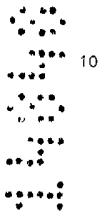
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3. A container according to claim 1, wherein a pinch-off portion said  
inner wall is pinched by said outer wall, is provided at a portion other than the major  
surfaces.



4. A container according to claim 3, wherein a plurality of such pinch-off portions are provided at opposite positions.

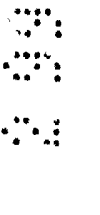
5 5. A container according to claim 1, wherein said liquid supply portion is provided with a liquid discharge permission member.



6. A container according to claim 1, wherein said liquid container is of substantially parallel hexahedron configuration.

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7. A container according to claim 1, wherein said outer wall covers said inner wall with a space therebetween.



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8. A container according to claim 1, wherein said liquid containing portion contains liquid, and said liquid supply portion is provided with a liquid discharge permission member.



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9. A container according to claim 1, wherein the corner portions of said inner wall and said outer wall are curved.

10. A container according to claim 1, wherein said inner wall and said outer wall are of resin materials, and the resin material of the inner wall and the resin material of the outer wall have different heat contraction rates.

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11. A container according to claim 1, wherein said inner wall and said outer wall are of resin materials, and the resin material of said inner wall is of crystal property, and the resin material of said outer wall is of non-crystal property.



12. A container according to claim 1, wherein at least one of resin materials constituting said inner and outer walls, is non-polar.

13. A liquid container for ink jet recording comprising:  
5 an outer wall provided with an air vent;  
an inner wall forming a liquid containing portion for containing liquid therein;  
a liquid supply portion for supplying the liquid from the liquid containing portion to outside;

10 wherein said inner wall and outer wall have major surfaces having maximum areas at a side other than a side provided with said liquid supply portion;

15 wherein at least one of angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of said inner wall of said liquid container and sides adjacent thereto is larger than 0 degree and smaller than 90 degrees; and

20 wherein angles formed between the sides forming said angle which is larger than 0 degree and smaller than 90 degrees and sides which are adjacent to said sides forming said angle and which do not form said angle, are larger than 90 degrees and smaller than 180 degrees.

25 14. A liquid ejection head cartridge having a liquid container for containing liquid and a liquid ejection recording head connected to a liquid supply portion of said liquid container, comprising:

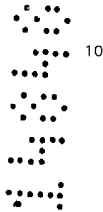
30 said liquid container including:  
an outer wall provided with a liquid accommodating container air vent;  
25 an inner wall forming a liquid containing portion for containing liquid therein;  
a liquid supply portion for supplying the liquid from the liquid containing portion to outside;



wherein said inner wall and outer wall have major surfaces having maximum areas at a side other than a side provided with said liquid supply portion;

wherein at least one of angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of said inner wall of said liquid container and sides adjacent thereto is larger than 0 degree and smaller than 90 degrees; and

wherein angles formed between the sides forming said angle which is larger than 0 degree and smaller than 90 degrees and sides which are adjacent to said sides forming said angle and which do not form said angle, are larger than 90 degrees and smaller than 180 degrees.



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15. A container according to claim 14, wherein said liquid ejection recording head is detachably mountable relative to said liquid accommodating container.

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16. A liquid ejecting recording apparatus, comprising:  
a liquid ejection head cartridge;  
said liquid ejection cartridge including:



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a liquid container including an outer wall provided with an air vent; an inner wall forming a liquid containing portion for containing liquid therein; a liquid supply portion for supplying the liquid from the liquid containing portion to outside; wherein said inner wall and outer wall have major surfaces having maximum areas at a side other than a side provided with said liquid supply portion; wherein at least one of angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of said inner wall of said liquid container and sides adjacent thereto is larger than 0 degree and smaller than 90 degrees; and wherein angles formed between the sides forming said angle which is larger than 0 degree and smaller than 90

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degrees and sides which are adjacent to said sides forming said angle and which do not form said angle, are larger than 90 degrees and smaller than 180 degrees; and

a liquid ejection head connectable with the liquid supply portion of said liquid container;

5 said apparatus further comprising a carriage for scanning motion, said carriage is capable of detachably mounting said cartridge.

17. A method for manufacturing a liquid container, the method comprising the steps of:



10 preparing a liquid container including an outer wall provided with an air vent; an inner wall forming a liquid containing portion for containing liquid therein; a liquid supply portion for supplying the liquid from the liquid containing portion to outside; wherein said inner wall and outer wall have major surfaces having maximum areas at a side other than a side provided with said liquid supply portion; wherein at least one of  
15 angles formed between one side constituting a polygonal shape in a plane perpendicular to the major surface of said inner wall of said liquid container and sides adjacent thereto is larger than 0 degree and smaller than 90 degrees; and wherein angles formed between the sides forming said angle which is larger than 0 degree and smaller than 90 degrees and sides which are adjacent to said sides forming said angle and which do not  
20 form said angle, are larger than 90 degrees and smaller than 180 degrees;



separating the inner wall and the outer wall by pressure reduction of the liquid containing portion;

supplying the liquid into said liquid containing portion.

25 18. A liquid container substantially as hereinbefore described with reference to the accompanying drawings.





19. A liquid ejection head cartridge substantially as hereinbefore described with reference to the accompanying drawings.

20. A liquid ejecting recording apparatus substantially as hereinbefore  
5 described with reference to the accompanying drawings.

21. A method for manufacturing a liquid container substantially as hereinbefore described with reference to the accompanying drawings.

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DATED this Twenty-fifth Day of February 1999

**Canon Kabushiki Kaisha**

Patent Attorneys for the Applicant

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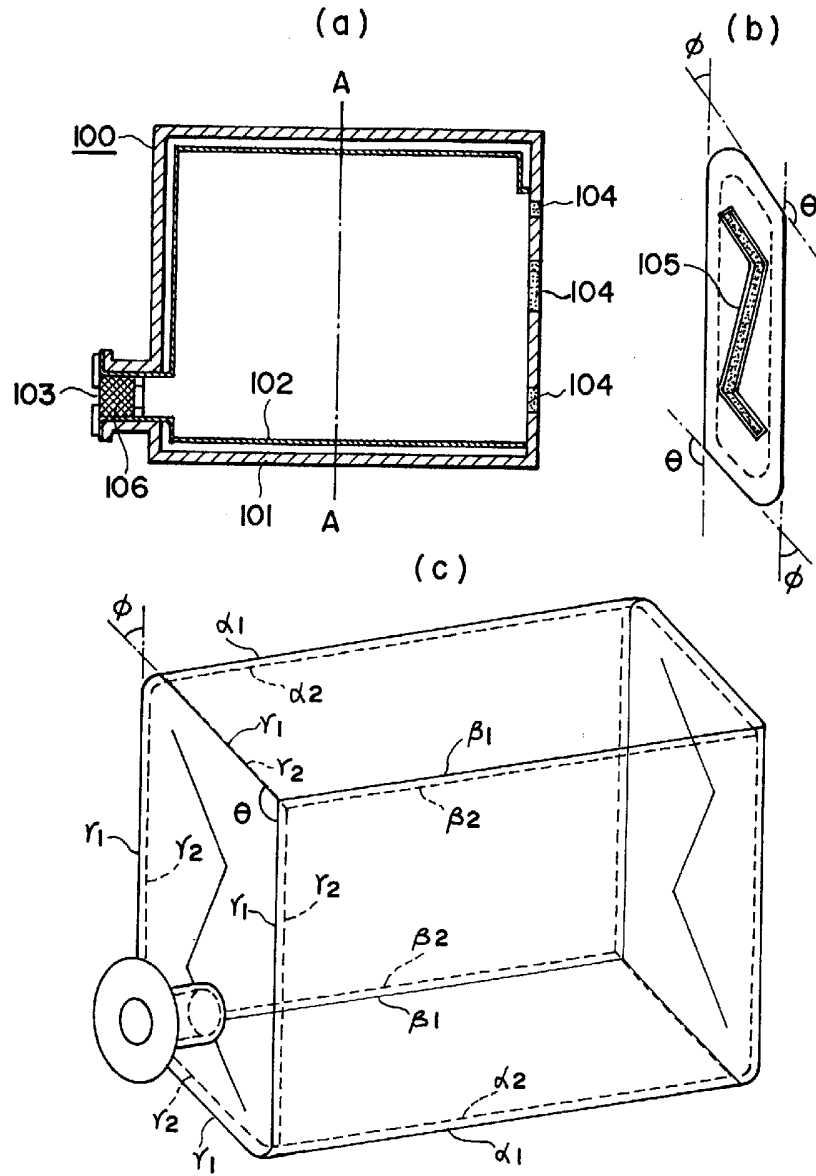


FIG. 1

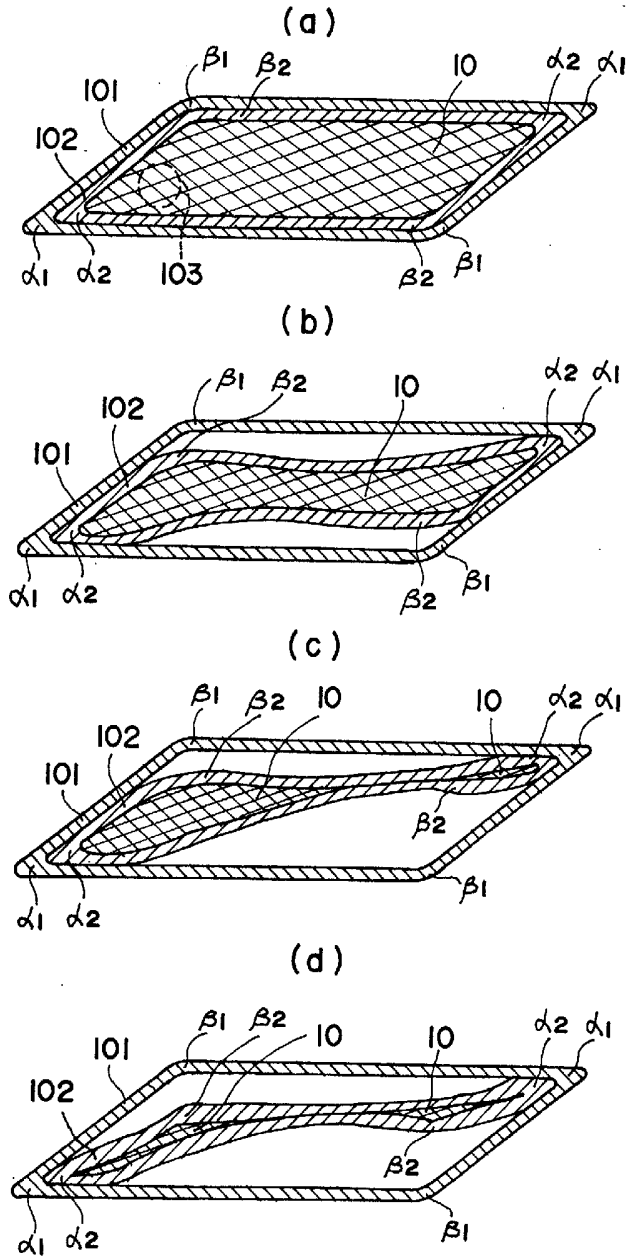


FIG. 2

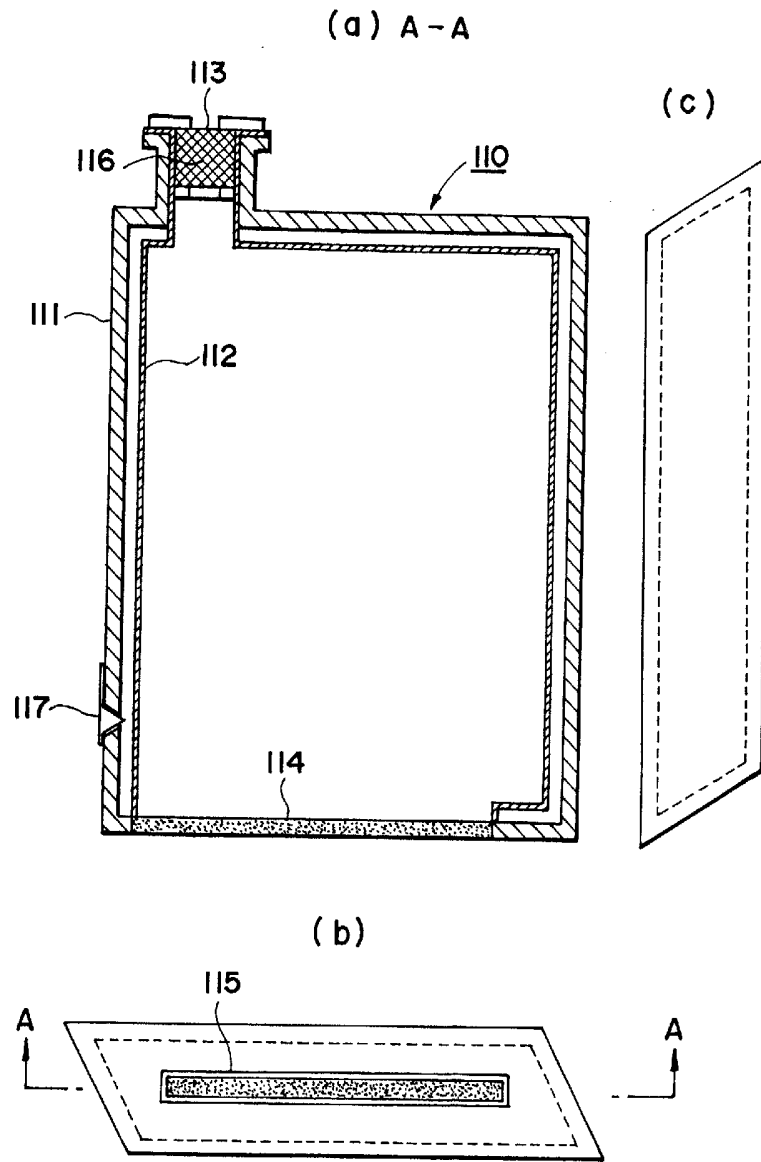
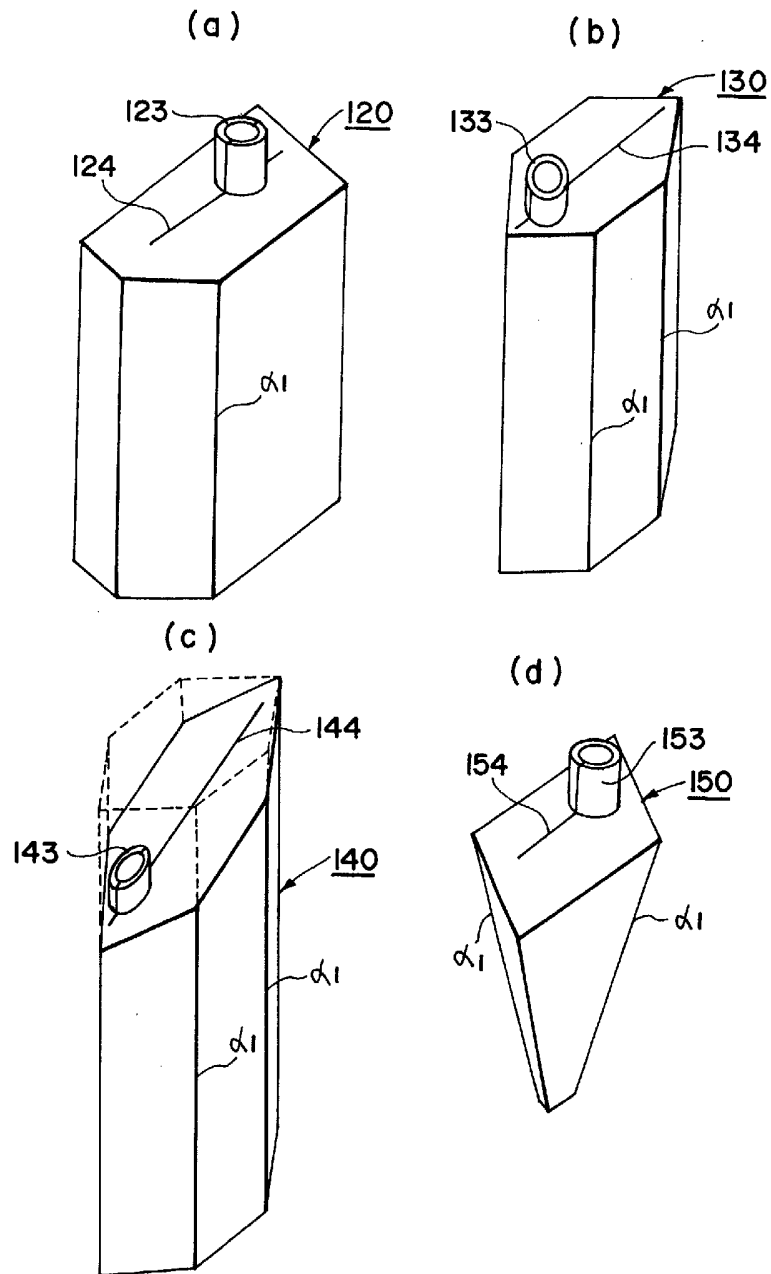


FIG. 3



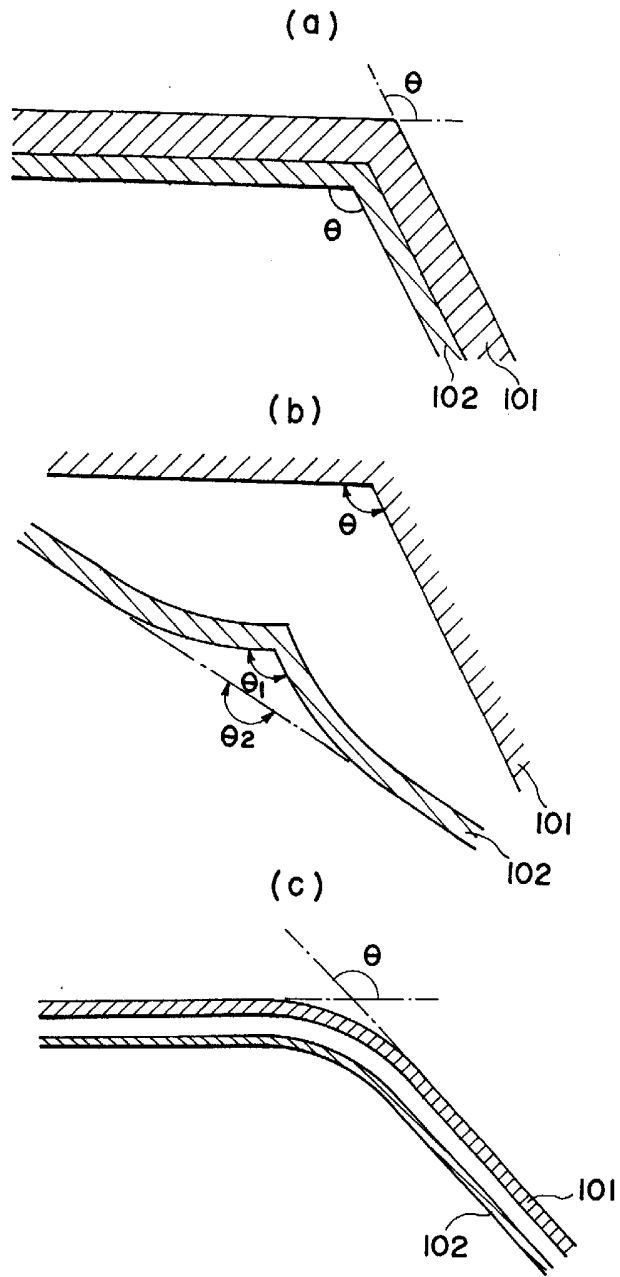


FIG. 5

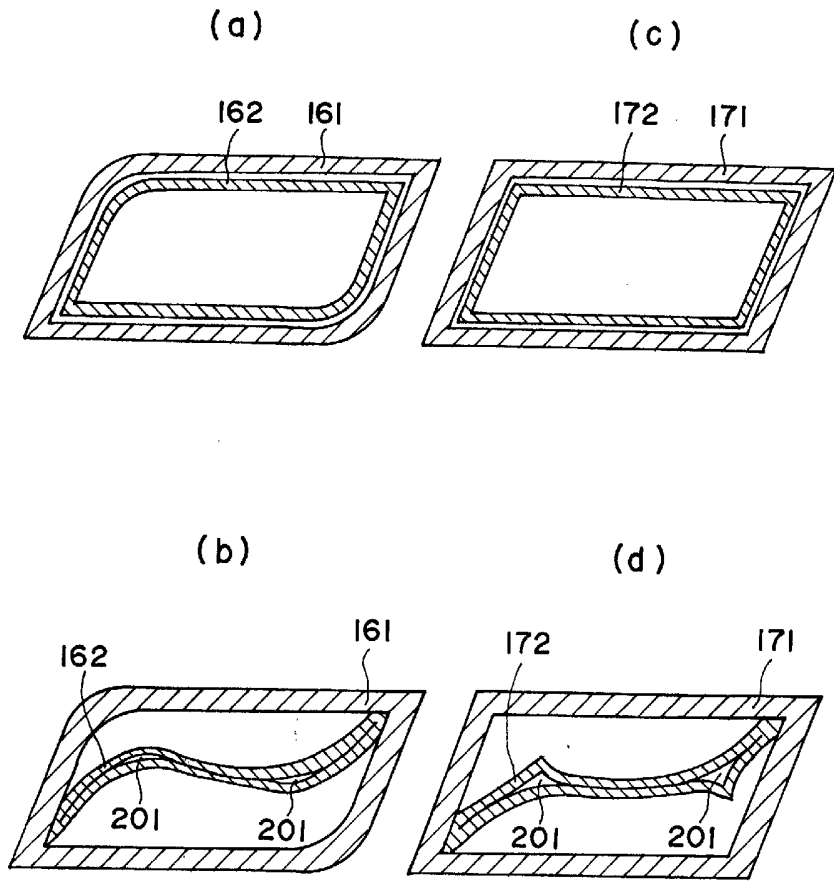


FIG. 6

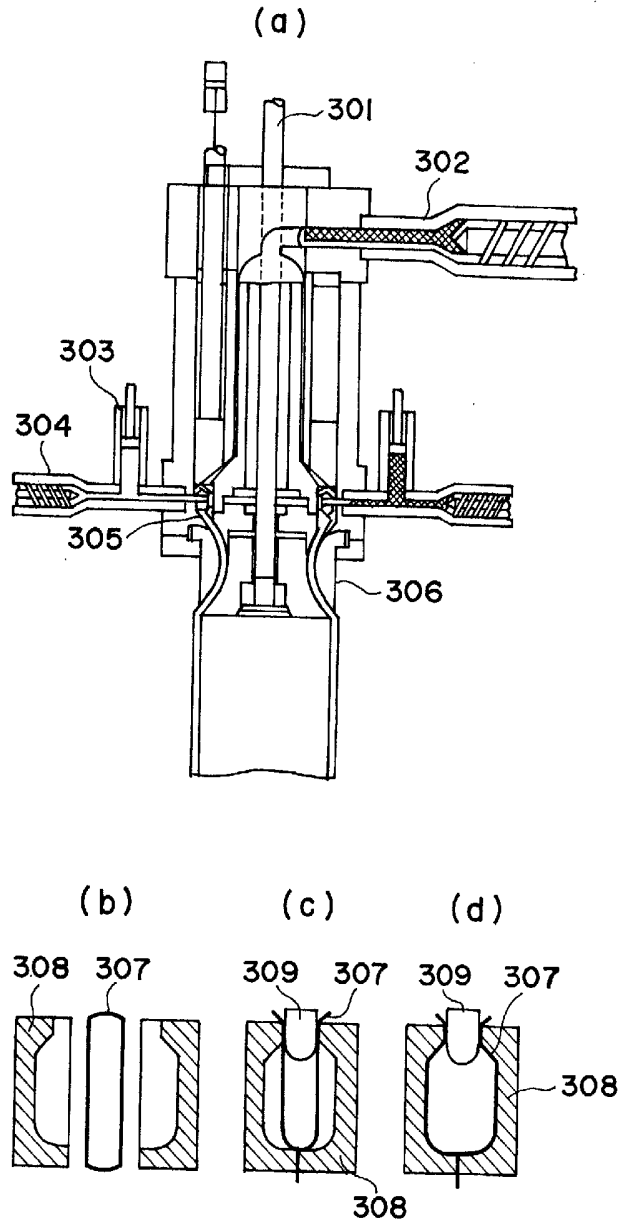


FIG. 7



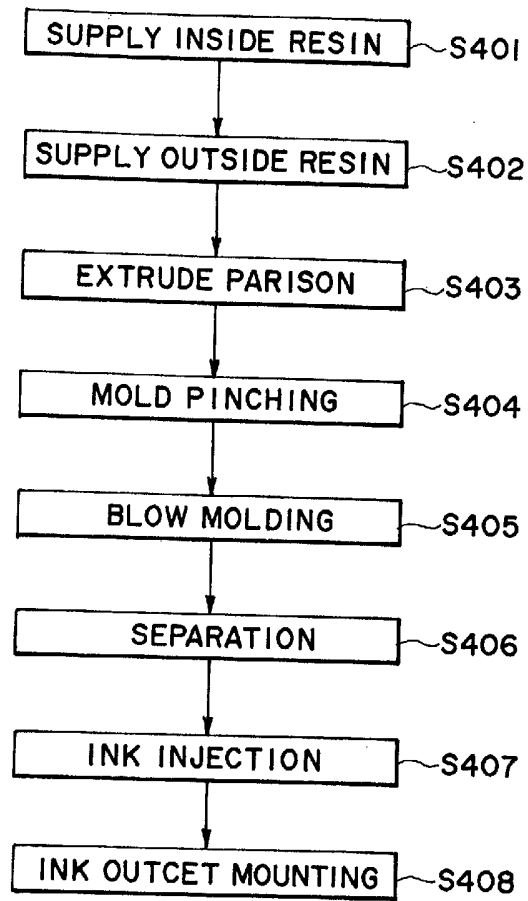


FIG. 8

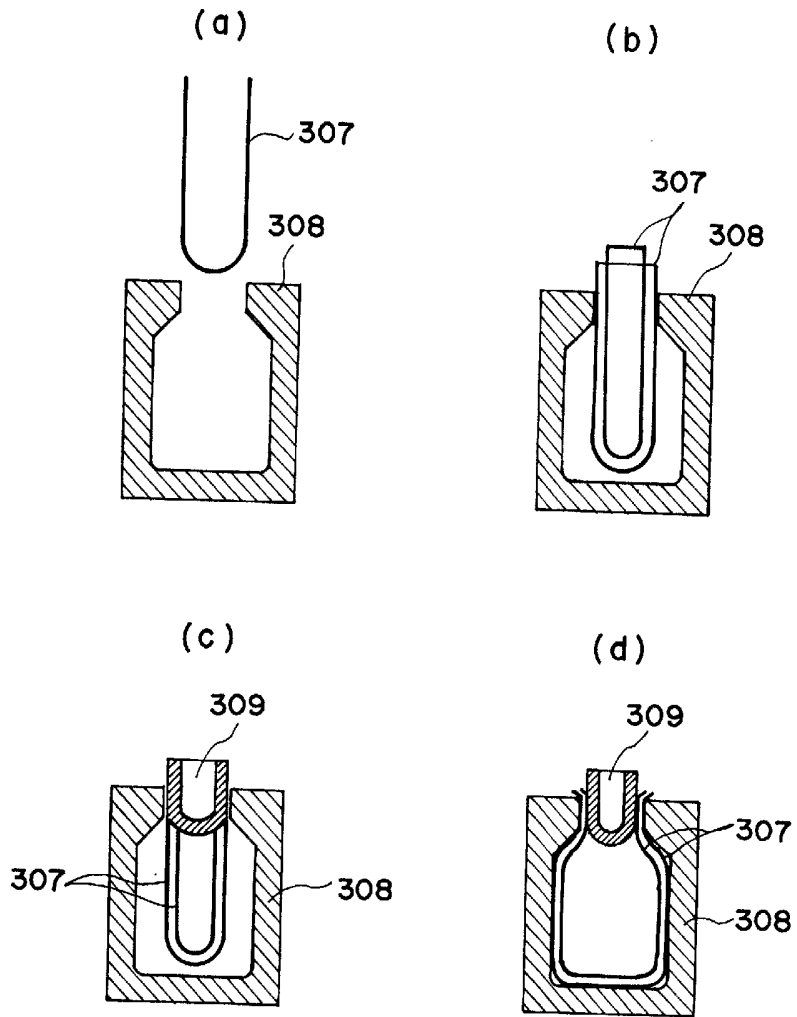


FIG. 9

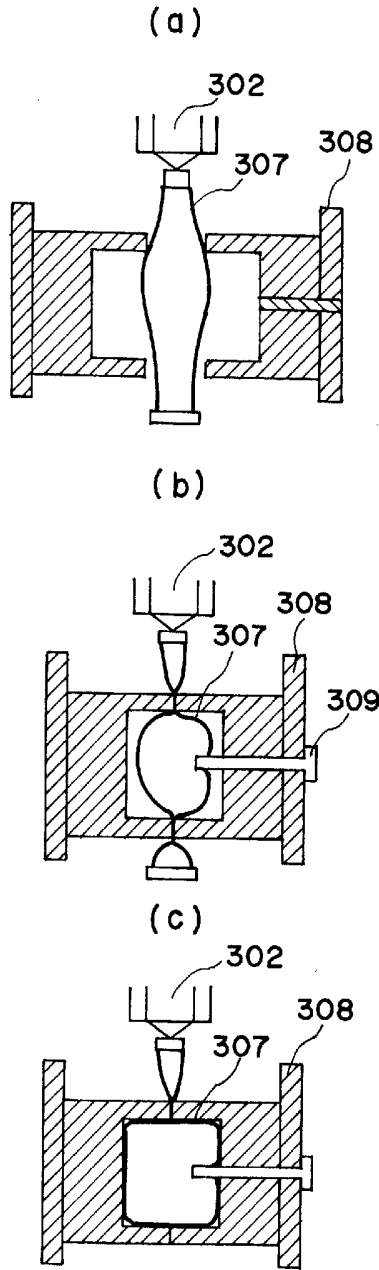


FIG. 10

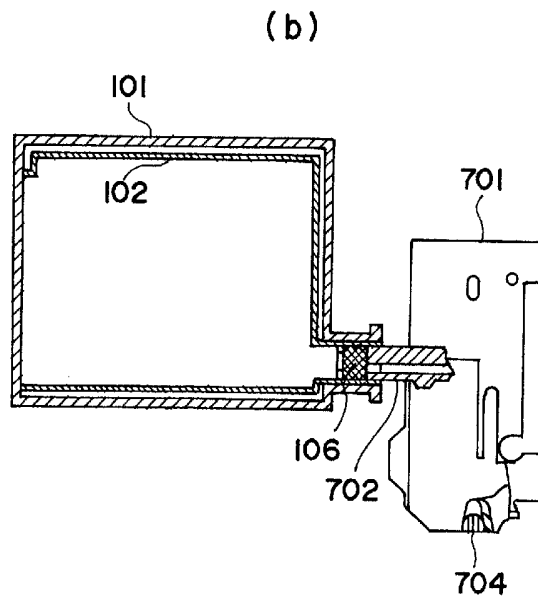
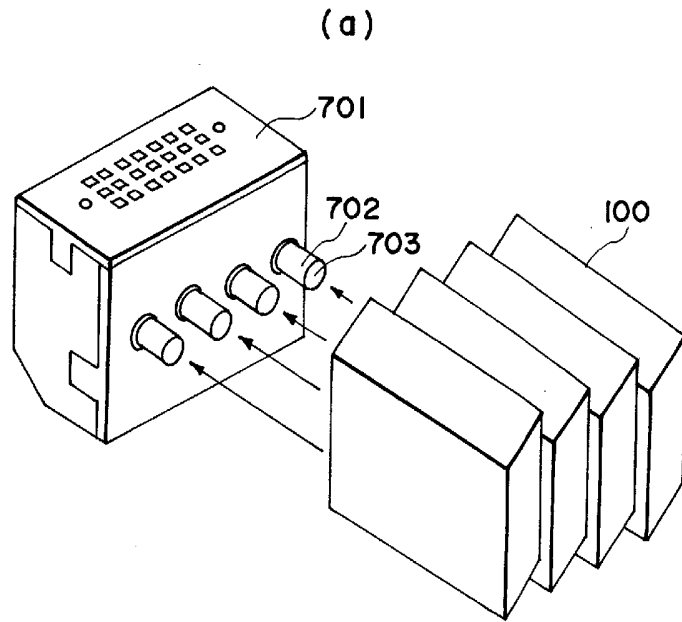


FIG. II

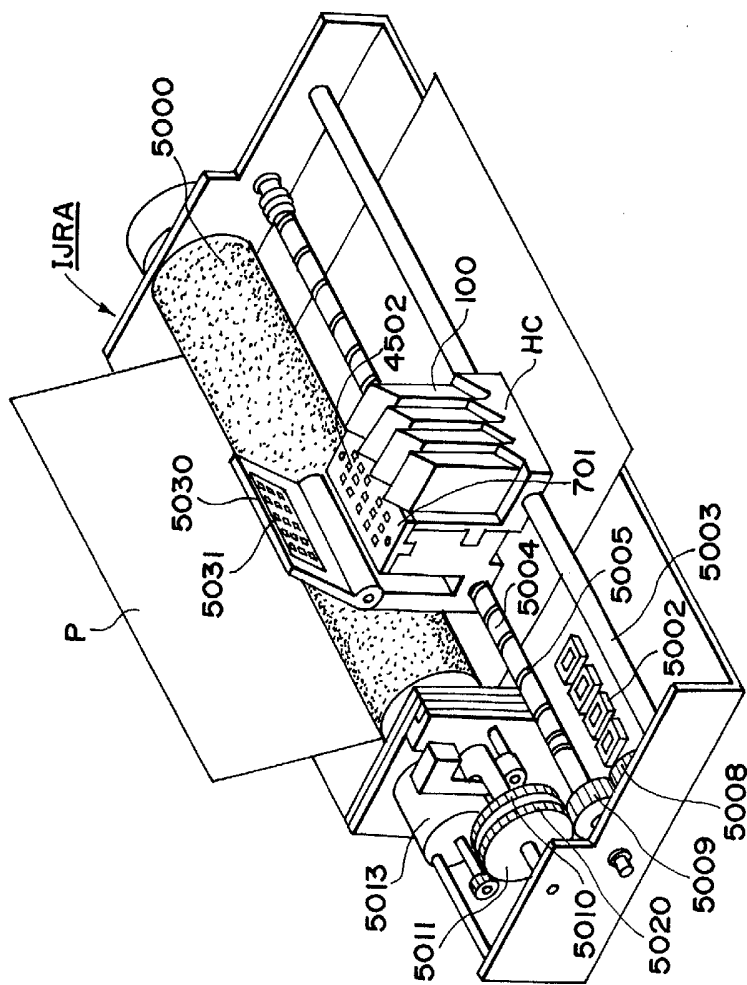


FIG. 12

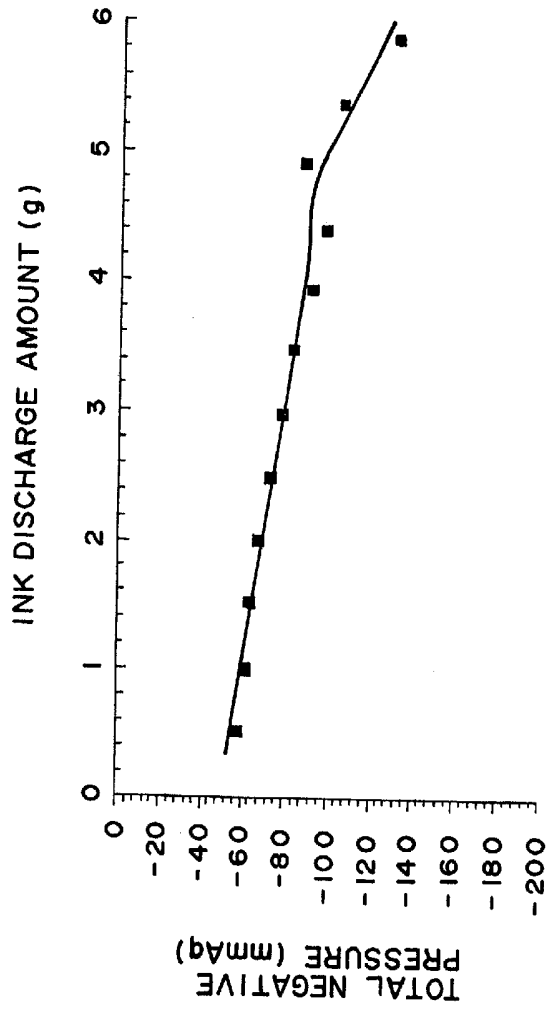


FIG. 13