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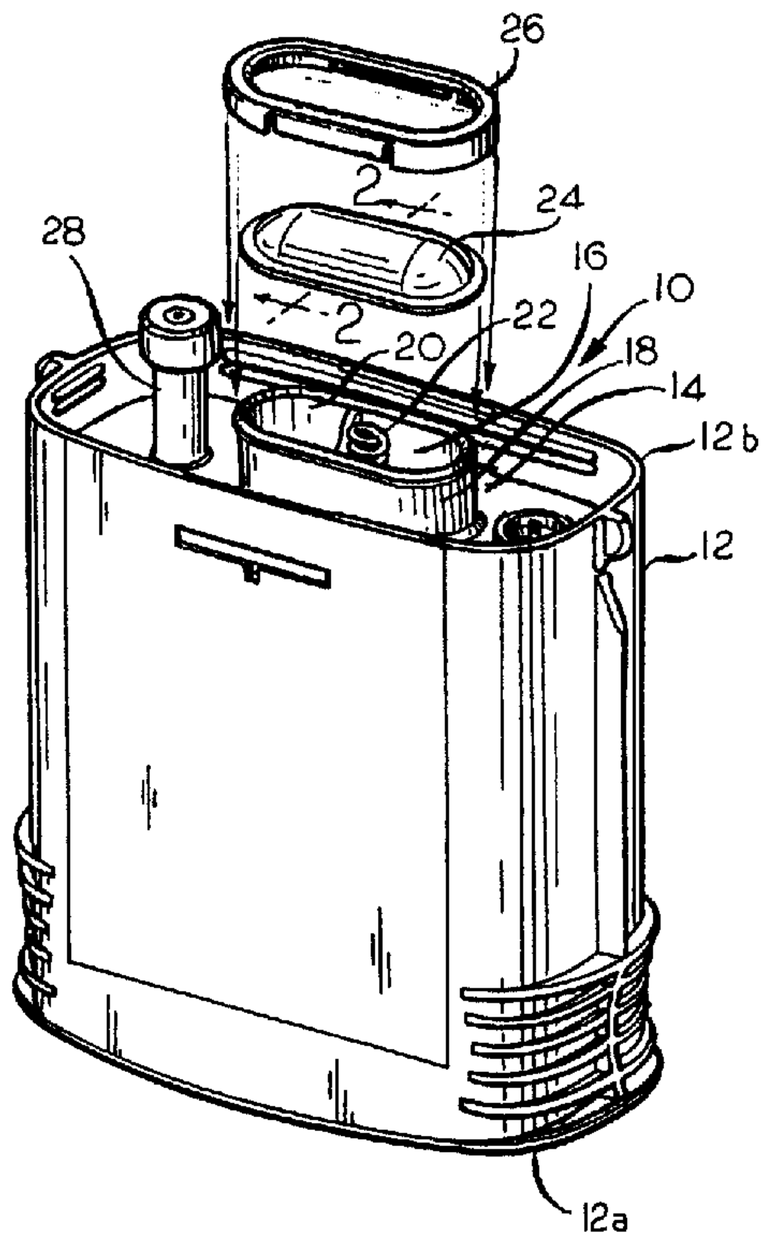
(54) **DISPOSITIF DE CONFINEMENT ET DE DISTRIBUTION DE LIQUIDE**

(54) **LIQUID CONTAINMENT AND DISPENSING DEVICE**



(57) A diaphragm 24 for attaching to a free edge of a perimetrical wall 18 of a pumping chamber 16 of a chassis 12 of a liquid containment and dispensing device 10, said diaphragm being preshaped to have a raised central portion 24a surrounded by a planar edge portion 24b. The raised central portion of the diaphragm permits the diaphragm, when secured to a free edge of the perimetrical wall, to flex with respect to the pumping chamber without leading to the formation of wrinkles in the planar edge portion. The diaphragm has an innermost layer 24c of LDPE, and the planar edge portion thereof is secured by heatstaking to the free edge of the perimetrical wall of the chassis, which is formed by molding from a plastic material. An aluminum crimp ring 26 is provided to tightly retain the planar edge portion of the diaphragm against the free edge of the perimetrical wall of the chassis.

ABSTRACT

A diaphragm 24 for attaching to a free edge of a perimetrical wall 18 of a pumping chamber 16 of a chassis 12 of a liquid containment and dispensing device 10, said diaphragm being preshaped to have a raised central portion 24a surrounded by a planar edge portion 24b. The raised central portion of the diaphragm permits the diaphragm, when secured to a free edge of the perimetrical wall, to flex with respect to the pumping chamber without leading to the formation of wrinkles in the planar edge portion. The diaphragm has an innermost layer 24c of LDPE, and the planar edge portion thereof is secured by heatstaking to the free edge of the perimetrical wall of the chassis, which is formed by molding from a plastic material. An aluminum crimp ring 26 is provided to tightly retain the planar edge portion of the diaphragm against the free edge of the perimetrical wall of the chassis.

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LIQUID CONTAINMENT AND DISPENSING DEVICE

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention relates to a liquid containment and dispensing device. More particularly, this invention relates to a liquid containment and dispensing device with a self-contained pump. The device of this invention is useful for containing and dispensing printing ink in an ink jet printer.

2. DESCRIPTION OF THE PRIOR ART

Pending U.S. Patent Application Serial No. 08/429,987, now U.S. Patent 5,784,087 the disclosure of which is incorporated herein by reference, and published European Application EP 0 741 038 A2, which claims priority based on the aeforesaid U.S. Patent Application, describe a liquid containment and dispensing device with a self-contained pump that was developed for use in containing and dispensing printing ink in an ink jet printer. The pump of the aforesaid device includes a linearly acting pumping member that reciprocates within a pumping chamber, which is defined by a perimetrical wall, and the pumping chamber is covered by a thin, flexible diaphragm, which is fabricated from a laminate of thin films. The diaphragm is then heat-staked to a free edge of the perimetrical wall that surrounds the pumping chamber.

The use of a flexible diaphragm fabricated from a laminate of films requires great care in its heat staking to the perimetrical wall of a pumping chamber, however, due to the tendency of such a diaphragm to form wrinkles around its outside as

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sufficient material is left in the central portion of the diaphragm to permit it to flex sufficiently to accommodate the pumping motion of the pumping member. Further, the use of heat-staking to secure the diaphragm to the perimetrical wall also requires great care in the control of the temperatures used in the heat-staking operation, as excessively high temperatures can degrade the thin films used in the diaphragm, while excessively low temperatures can result in a poor quality seal between the diaphragm and the perimetrical wall.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a liquid containment and dispensing device, especially a liquid containment and dispensing device that is useful in containing and dispensing printing ink in an ink jet printer, with a pumping chamber cover that does not tend to wrinkle around its outside, where it is joined to a free edge of a perimetrical wall of the pumping chamber. Further, the invention as described above incorporates a crimped metallic ring to help secure the pumping chamber cover to the free edge of the perimetrical wall of the pumping chamber to augment the seal that is formed therebetween by heat-staking.

The elimination of wrinkles in the pumping chamber cover according to the present invention is obtained by pre-shaping a sheetlike cover material by a thermoforming operation, to thereby provide a domed configuration to a central portion of the cover that results in sufficient flexibility to accommodate the reciprocation of a pumping element without requiring excessive material in the surrounding portion of the cover. In the preferred embodiment of the present invention, the cover is formed from a

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sheetlike material that is a thin laminate of two or more polymeric films, with a suitable adhesive between adjacent layers of such laminate to prevent delamination of the layers thereof. At least one of the films is a material with good resistance to oxygen and moisture vapor transmission, such as ethylene vinyl alcohol copolymer (EVOH), which is preferably used in the interior of the laminate, with an innermost layer of a low density polyethylene (LDPE), which has good flexibility and bonds well to the perimetrical wall of the pumping chamber when the wall and the liquid containment and dispensing device chassis of which it is a part is formed from polyethylene by injection molding. The outermost layer of the pumping chamber cover is then formed from a high heat resistant polymer such as nylon (a polyamide material) for good resistance to abrasion and to prevent the film structure from sticking to the heat staking die.

Accordingly, it is an object of the present invention to provide an improved liquid containment and dispensing device of a type that has a self-contained pump. More particularly, it is an object of the present invention to provide a liquid containment and dispensing device as described above that has utility in containing and dispensing printing ink in an ink jet printer.

It is also an object of the present invention to provide an improved pumping chamber cover for use in a liquid containment and dispensing device of the type described above.

For a further understanding of the present invention and the objects thereof, attention is directed to the drawing and the following brief description thereof, to

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the detailed description of the preferred embodiment of the invention and to the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 is an exploded, perspective view of a liquid containment and dispensing device according to the preferred embodiment of the present invention;

Fig. 2 is sectional view, at an enlarged scale, taken on line 2-2 of Fig. ; and

Fig. 3 is a fragmentary view, at a further enlarged scale, of the element illustrated in Fig. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A liquid containment and dispensing device according to the preferred embodiment of the present invention is indicated generally by reference numeral 10 in Fig. 1. The liquid containment and dispensing device 10 is made up of a hard protective shell 12 that is closed at an end 12a, which will be the upper end when the device 10 is installed, for example, in an ink jet printer. A molded plastic chassis 14 is installed in an opposed, open end 12b of the shell 12, and the chassis 14 has a pumping chamber 16 defined and surrounded by a perimetrical wall 18, which is formed integrally with the chassis 14.

A pumping element 20, shown fragmentarily, is positioned within the pumping chamber 16 and is reciprocable therein, a coil spring 22 being provided to bias the pumping element 20 away from the closed end 12a of the shell 12. The pumping chamber 16 is closed by a cover or diaphragm 24, whose outer portion is heat-staked to a

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free edge of the perimetrical wall 18 that surrounds the pumping chamber 16. The diaphragm 24 is then further secured to the perimetrical wall 18 by an aluminum crimp ring 26 to further ensure that the seal between the diaphragm 24 and the perimetrical wall 18 remains secure throughout the life of the ink containment and dispensing device 10.

Ink or other liquid is dispensed from the liquid containment and dispensing device 10 by deflecting the central part of the diaphragm 24 to deflect the pumping element 20 within the pumping chamber 16, against the force of the coil spring 20, to thereby pump the liquid from a flexible pouch (not shown), which is secured to the underside (in the illustrated arrangement) of the chassis 14 through a fluid outlet portion 28 of the chassis 14. As thus far described, the liquid containment and dispensing device 10 functions in the manner described in the aforesaid Serial No. 08/429,987 (EP 0 741 038 A2), except that the device of such reference does not disclose the use of a crimp ring corresponding to the crimp ring 26 of the device 10 of Fig. 1.

The device 10 of Fig. 1 differs further from the device of the aforesaid reference in that the diaphragm 24 is preshaped, for example, by a thermoforming operation, to provide it with a domed central portion 24a and a planar surrounding edge portion 24b, which is the portion that is heat-staked to the perimetrical wall 18 on the chassis 14. The diaphragm 24, thus, has sufficient excess material in its central portion 24a without requiring excess material in its surrounding edge portion 24b to be able to flex as required during the pumping of ink or other liquid from the device 10, as described above. Such excess material can lead to wrinkling in an otherwise planar diaphragm, which can complicate the problem in properly heat-staking a diaphragm to

the free edge of a perimetrical wall of a liquid containment and dispensing device of the type described. Such wrinkling can also cause premature failure of the diaphragm material as a result of the flexing cycle.

As is shown in Fig. 2 and even more clearly in Fig. 3, the diaphragm 24 is formed from a lamination of layers of polymeric materials of various compositions. The layers include an innermost layer 24c of any member of the polyethylene material family, such as LDPE, LLDPE, HDPE, metallocene PE, ethylene vinyl acetate and ethylene ethyl acrylate or blends thereof, preferably with a density in the range of 0.880g./cc.-0.964g./cc. Any such material has good strength and flexibility and heat-stakes well to the perimetrical wall of the chassis 14 when the chassis 14 is formed of polyethylene. The diaphragm 24 also includes an intermediate layer 24d of a material with good resistance to gas and moisture vapor transmission, such as nylon and nylon co-polymers, PVDC and EVOH, which is the preferred material. The diaphragm 24 also includes an outermost layer 24e of a polymer selected for high melt temperature, abrasion resistance and flex life, such as nylon and nylon co-polymers and polypropylene. Since the material of the layers 24c, 24d, 24e, as described, do not bond well to one another, preferably layers 24f, 24g of an adhesive are provided between adjacent layers of the diaphragm 24 to prevent the layers 24c, 24d, 24e from delaminating in service.

The diaphragm 24, as described, is preferably produced by co-extrusion because adhesives used in co-extrusion are usually higher in molecular weight than those used in laminated composites, such higher molecular weight adhesives being less susceptible to being dissolved by aggressive printing inks.

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While Figs. 2 and 3 may create the impression that the diaphragm 24 has substantial thickness, in practice, for a diaphragm 24 for a device 10 that is designed to contain 500 ml. of printing ink, a standard size, the diaphragm 10 will have a total thickness of the order of 5 mils (0.005 in.).

Although the best mode contemplated by the inventor for carrying out the present invention as of the filing date hereof has been shown and described herein, it will be apparent to those skilled in the art that suitable modifications, variations and equivalents may be made without departing from the scope of the invention, such scope being limited solely by the terms of the following claims and the legal equivalents thereof.

What is claimed is:

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1. A liquid containment and dispensing device comprising:

a shell having an open end and an opposed end. A chassis positioned within said open end of said shell, said chassis having a perimetrical wall defining a pumping chamber, said perimetrical wall having a free edge;

a pumping element positioned within said pumping chamber, said pumping element being reciprocable within said pumping chamber;

means for biasing said pumping element away from said opposed end of said shell; and

a flexible diaphragm covering said pumping chamber, said flexible diaphragm being preshaped to have a raised central portion and a surrounding planar edge portion, said surrounding edge portion being sealingly joined to said free edge of said perimetrical wall.

2. A liquid containment dispensing device according to Claim 1 wherein said chassis is formed from a plastic material by molding, wherein said diaphragm is formed from a sheetlike co-extrusion or laminate comprising an innermost layer of a plastic material that is heatstakable to said chassis, and wherein said surrounding edge portion of said diaphragm is sealingly joined to said free edge of said perimetrical wall by heatstaking without the formation of wrinkles in said surrounding edge portion of said diaphragm.

3. A liquid containment and dispensing device according to Claim 2 wherein said sheetlike laminate further comprises an outermost layer and an intermediate

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layer, said intermediate layer having good resistance to transmission of oxygen and moisture vapor

4. A liquid containment and dispensing device according to Claim 3 wherein said intermediate layer is selected from the group consisting of nylon, nylon co-polymers, PVDC and EVOH.

5. A liquid containment and dispensing device according to Claim 4 wherein said outermost layer is selected from the group consisting of nylon, nylon co-polymers and polypropylene.

6. A liquid containment and dispensing device according to Claim 3 and further comprising:

a first layer of an adhesive between said innermost layer and said intermediate layer.

7. A liquid containment and dispensing device according to Claim 6 and further comprising:

a second layer of adhesive between said intermediate layer and said outermost layer.

8. A liquid containment and dispensing device according to Claim 2 and further comprising:

a thin aluminum crimp ring securely retaining said surrounding edge portion of said diaphragm against said free edge of said perimeterical wall.

9. A liquid containment and dispensing device according to Claim 2 wherein said plastic material of said chassis consists essentially of polyethylene and

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wherein said plastic material of said innermost layer of said diaphragm is selected from the group consisting of members of the polyethylene family

10. A liquid containment and dispensing device according to Claim 7 wherein said diaphragm has a total thickness, measured in a direction extending perpendicularly of said planar edge portion, of not substantially greater than 5 mils.

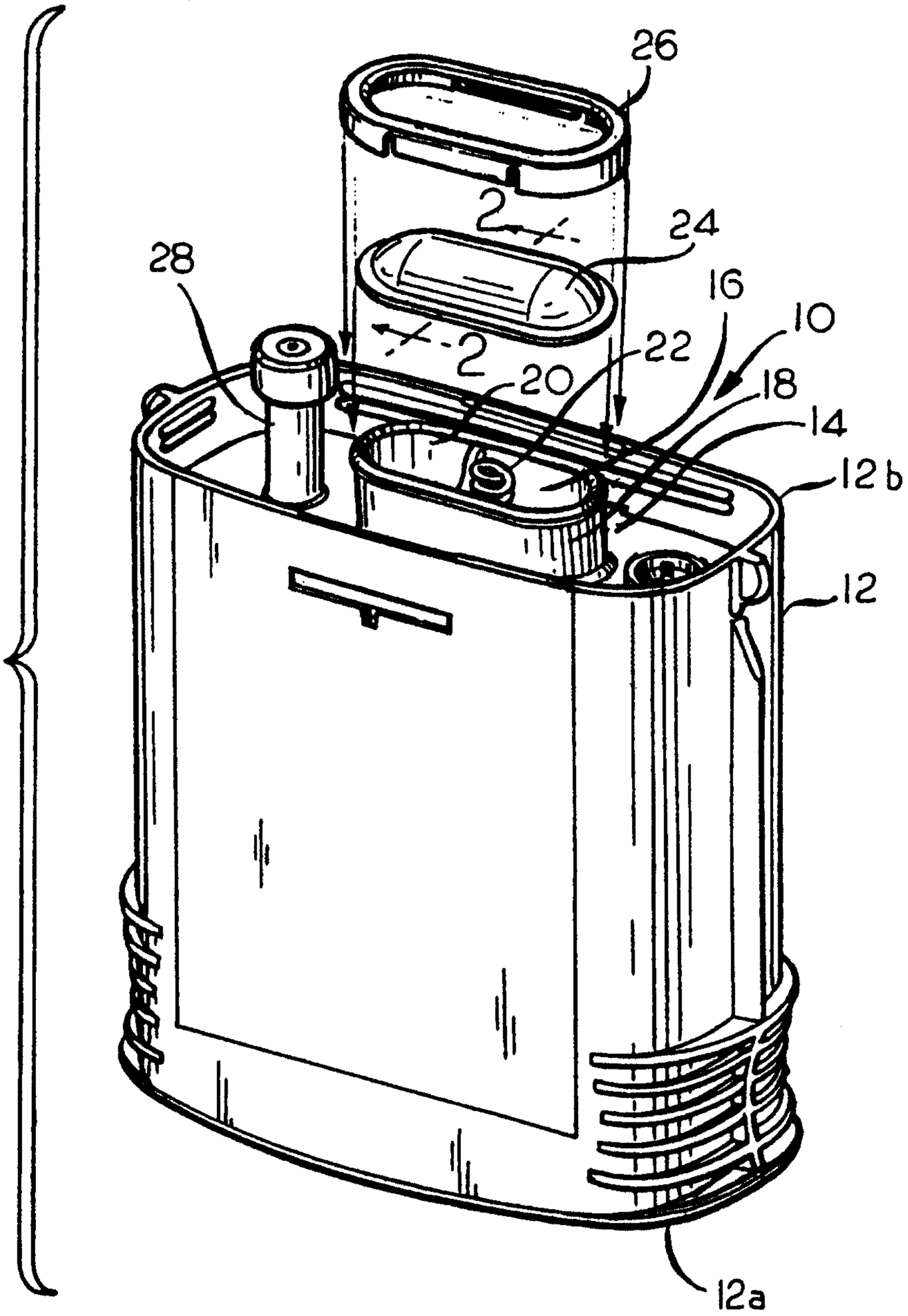

FIG. 1

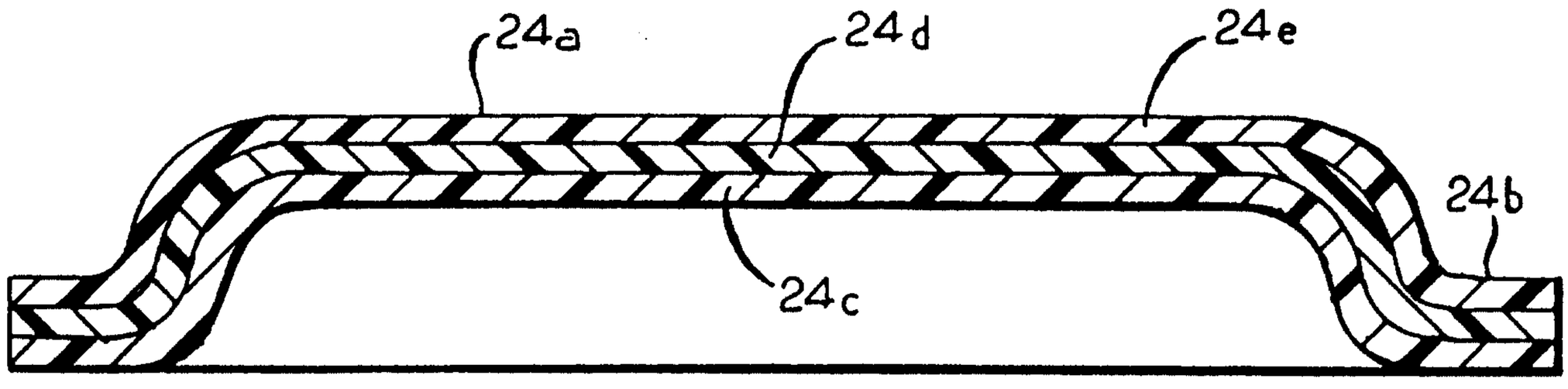

FIG. 2

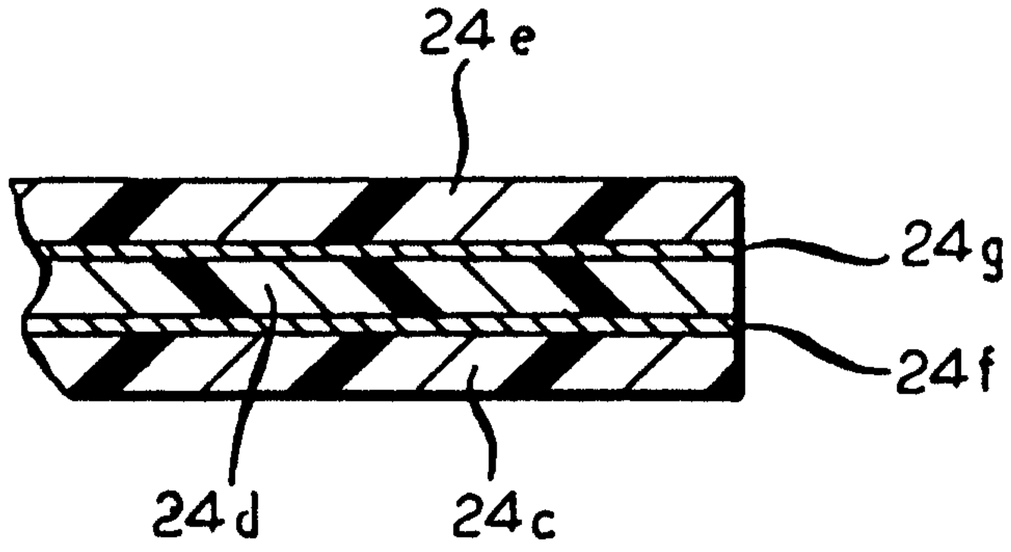

FIG. 3