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(72) KAMP, David C., US
(71) Owens-Illinois Closure Inc., US

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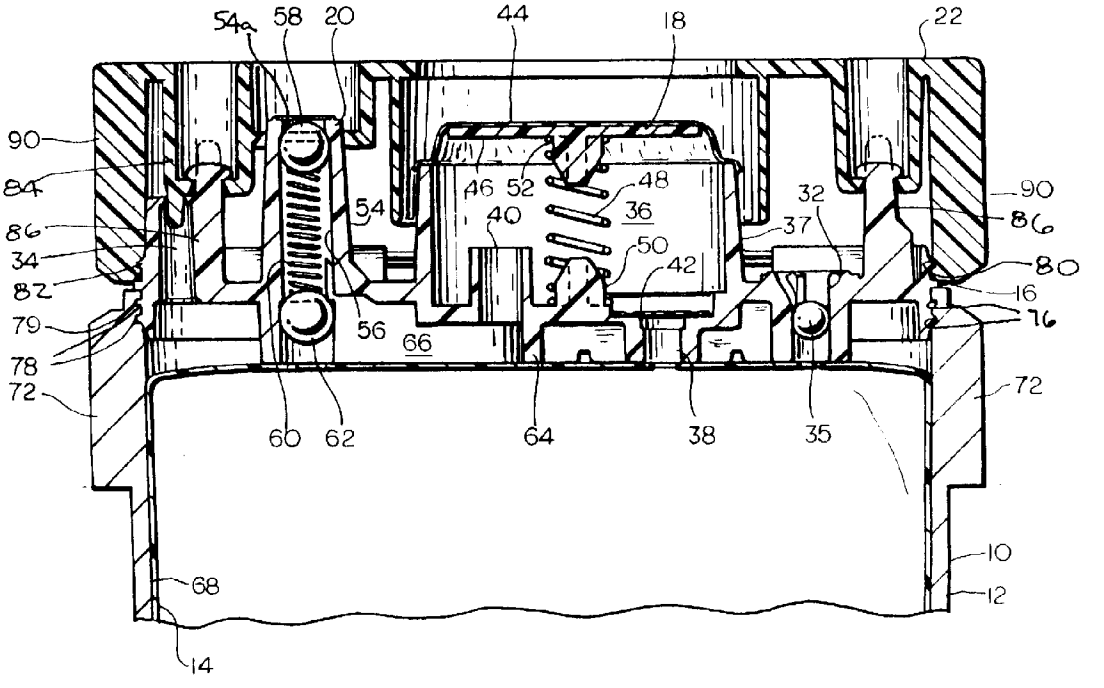
(54) **DISPOSITIF DE CONFINEMENT ET DE DISTRIBUTION DE LIQUIDE AVEC FIXATION AMELIOREE AU CHASSIS D'UN SAC CONTENANT DU LIQUIDE**

(54) **LIQUID CONTAINMENT AND DISPENSING DEVICE WITH IMPROVED ATTACHMENT OF LIQUID CONTAINING POUCH TO CHASSIS**



(57) Dispositif de confinement et de distribution d'encre pour une imprimante à jet d'encre avec un réservoir principal sous forme de sac flexible, lequel est typiquement maintenu à pression ambiante. Le réservoir principal est raccordé à une chambre à volume variable par un clapet de non-retour qui permet à l'encre de passer du réservoir à la chambre et l'empêche de revenir de la

(57) An ink containment and dispensing device for an ink-jet printer is provided with a main reservoir in the form of a flexible pouch, which is typically maintained at ambient pressure. The main reservoir is coupled to a variable volume chamber via a one-way valve which allows the flow of ink from the reservoir to the chamber and prevents the flow of ink from the chamber to the

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chambre au réservoir. La chambre est raccordée à une sortie de liquide qui est normalement fermée pour empêcher l'écoulement de l'encre vers l'extérieur. Cependant, quand on installe la provision d'encre dans une imprimante, la sortie de liquide établit un raccordement liquide entre la chambre et l'imprimante. La chambre fait partie d'une pompe fournie avec la provision d'encre qui peut être actionnée pour faire passer de l'encre du réservoir à l'imprimante. La pompe a un élément de pompage à action linéaire et une membrane souple par-dessus l'élément de pompage, laquelle est imperméable à l'oxygène et à l'humidité de manière à prévenir la dégradation de l'encre à l'intérieur de la chambre.

reservoir. The chamber is coupled to a fluid outlet, which is normally closed to prevent the flow of outward ink. However, when the ink supply is installed in a printer, the fluid outlet establishes a fluid connection between the chamber and the printer. The chamber is part of a pump provided with the ink supply that can be actuated to supply ink from the reservoir to the printer. The pump has a linearly acting pumping member and a flexible diaphragm that overlies the pumping member, the diaphragm being impervious to the transmission of oxygen and moisture therethrough to prevent degradation of the ink within the chamber.

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Abstract of The Disclosure

An ink containment and dispensing device for an ink-jet printer is provided with a main reservoir in the form of a flexible pouch, which is typically maintained at ambient pressure. The main reservoir is coupled to a variable volume chamber via a one-way valve which allows the flow of ink from the reservoir to the chamber and prevents the flow of ink from the chamber to the reservoir. The chamber is coupled to a fluid outlet, which is normally closed to prevent the flow of outward ink. However, when the ink supply is installed in a printer, the fluid outlet establishes a fluid connection between the chamber and the printer. The chamber is part of a pump provided with the ink supply that can be actuated to supply ink from the reservoir to the printer. The pump has a linearly acting pumping member and a flexible diaphragm that overlies the pumping member, the diaphragm being impervious to the transmission of oxygen and moisture therethrough to prevent degradation of the ink within the chamber.

LIQUID CONTAINMENT AND DISPENSING DEVICE WITH IMPROVED ATTACHMENT OF LIQUID CONTAINING POUCH TO CHASSIS

Cross-Reference to Related Application

This application is directed to improvements in the invention of co-pending U.S. patent application Serial No. 08/429,987, an application in which I am named as a joint inventor.

Field of the Invention

This invention relates to a liquid containment device with a self-contained pump for dispensing liquid in small doses of a predetermined volume. More particularly, this invention relates to a replaceable containment device of the foregoing character which is useful in an ink-jet printer for containing a supply of printing ink and for dispensing the printing ink to a printing head upon the actuation of the self-contained pump.

Background and Brief Description of the Invention

A pending U.S. patent application filed by Bruce Cowger and Norman Pawlowski, Jr., for an invention entitled "Ink Supply For An Ink-Jet Printer," describes an ink supply for an ink-jet printer that is separate from the printer ink pen, and can be replaced upon the emptying of the ink supply without the need to replace the printer ink pen. The ink supply of the aforesaid U.S. patent application incorporates a self-contained pumping device for dispensing ink from a pumping chamber, and describes, as an embodiment of such a pumping device, a bellows pump. However, a bellows pump requires a relatively large extended surface of a semi-rigid material, such as a polymeric material, and is subject to a relatively high rate of oxygen and moisture transfer

through the material of the bellows. This oxygen and/or moisture transfer can result in the degradation of the ink within the ink supply, especially in a printer that is used only infrequently. Further, the bellows is subject to leakage at the location of its attachment to another portion of the ink supply. According to the aforesaid pending U.S. patent application Serial No. 08/429,987, these and other problems associated with the use of a bellows can be avoided by the use of a pumping device having a rigid perimetrical wall, preferably formed integrally with the associated chassis structure of the ink supply, with a linearly acting pumping member that is moveable within a pumping chamber defined by the rigid wall to pressurize ink within the pumping chamber, and a flexible moisture and oxygen barrier film heat sealed to an edge of the perimetrical wall in a continuous pattern and overlying the pumping member.

An ink supply according to the aforesaid U.S. Patent application Serial No. 08/429,987 incorporates a pouch fabricated from a sheet of thermoplastic material, and the pouch is attached to the underside of the chassis by heat staking. Thus, the forces acting to displace the pouch from the chassis put the thermoplastic material in tension, whereas the optimum strength of a heat staked joint between a film and a more rigid member occurs when the forces acting on the film tend to peel it from the structure to which it is heat staked.

It has also now been found to be desirable to fabricate the pouch from a co-extruded multiple layer material with an innermost layer formed from a material that is particularly resistant to degradation from contact with ink, such as linear low density polyethylene, supported by an outermost, strength-providing material with good vapor barrier properties

such as polyethylene terephthalate, with a layer of an adhesive, such as silicon dioxide, therebetween. However, in securing the pouch to the chassis according to the teachings of the aforesaid U.S. patent application Serial No. 08/429,987, it was necessary to puncture the pouch at the location of the fill port and the inlet port. This exposes edges of the material to ink, and can lead to degradation of the layers of the pouch that are otherwise not directly in contact with ink.

The aforesaid and other problems with the joint between the flexible pouch and the chassis of the liquid containment and dispensing device of the aforesaid U.S. patent application Serial No. 08/429,987 are overcome by the present invention in which the pouch is fabricated with an open end that is heat staked to an exterior surface of the chassis in an endless pattern. This mode of attachment of the pouch to the chassis also increases the internal volume of the pouch that can be filled with ink for a given overall size of the liquid containment and dispensing device.

Because an ink containment and dispensing device according to the aforesaid U.S. patent application Serial No. 08/429,987 is normally installed in a printer in an inverted orientation, that is, with the chassis positioned below the pouch, there is a potential problem of leakage from the ink outlet due to gravitational forces. Such a problem is overcome, however, in accordance with an embodiment of the present invention in which the outlet is provided with an elastomeric septum.

Accordingly, it is an object of the present invention to provide an improved liquid containing and dispensing device. More particularly, it is an object of the present invention to provide an improved device of the foregoing character that is useful in containing and dispensing ink in an ink-jet printer.

It is also an object of the present invention to provide a liquid containment and dispensing device with improved engagement between a liquid containing pouch of the device and a rigid molded plastic chassis of the device. More particularly, it is an object of the present invention to provide an improved device of the foregoing character that is useful in containing and dispensing ink in an ink-jet printer.

It is also an object of the present invention to provide a printing ink containment and dispensing device with improved resistance to leakage by gravity when installed in an inverted position.

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

Brief Description of the Drawing

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

Fig. 2 is a an exploded view of the device of Fig. 1;

Fig. 3 is a plan view of the device of Figs. 1 and 2 taken on line 3-3 of Fig. 1;

Fig. 4 is a plan view of a component of the device of Figs. 1-3 taken on line 4-4 of Fig. 5;

Fig. 5 is a side view of the component of Fig. 4;

Fig. 6 is a plan view of the component of Figs. 4 and 5 taken on line 6-6 of Fig. 5;

Fig. 7 is a fragmentary sectional view taken on line 7-7 of Fig. 3 and at an enlarged scale;

Fig. 8 is a fragmentary exploded view of a portion of the device of Figs. 1-7;

Fig. 9 is a fragmentary view similar to Fig. 8 showing the elements of Fig. 8 in assembled relationship to one another;

Fig. 10 is a view similar to Fig. 7 of an alternative embodiment of the present invention; and

Fig. 11 is a view similar to Figs. 7 and 10 of another alternative embodiment of the present invention.

Detailed Description of the Preferred Embodiment

An ink containment and dispensing device in accordance with the embodiment of the invention described in the aforesaid U.S. patent application Serial No. 08/429,987 is identified in Fig. 1 by reference numeral 10. The device 10 has a hard protective shell 12 which contains a flexible pouch 14 for containing ink. The shell 12 is attached to a chassis 16, which houses a pump 18 and a fluid outlet 20. A protective cap 22 is attached to the chassis 16 and a label 24 is glued to the outside of the shell 12 and cap 22 elements of the device 10 to secure the shell 12, chassis 16, and cap 22 firmly together. The cap 22 is provided with apertures which allow access to the pump and the fluid outlet.

The device 10 is adapted to be removably inserted into a docking bay (not shown) within an ink-jet printer. When the device 10 is inserted into the printer, a fluid inlet in the docking bay is adapted to engage the fluid outlet 20 to allow ink flow from the device 10 to the printer. An actuator (not shown) in the docking bay is adapted to engage the pump 18. Operation of the actuator causes the pump 18 to provide ink in a series of small doses of a predetermined volume from the flexible pouch 14, through the fluid outlet 20, to the fluid inlet of the docking bay and then to the printer.

The chassis 16 is provided with a fill port 32 at one end and an exhaust port 34 at the other end. Ink can be added to the ink supply through the fill port 32 while

air displaced by the added ink is exhausted through the exhaust port 34. After the ink supply is filled, the fill port 32 is sealed with a ball 35 press fit into the fill port 32.

A pumping chamber 36 having an open bottom is formed on the bottom of the chassis 16 within a rigid perimetrical wall 37, which is preferably formed integrally with the chassis 16. As described in more detail below, the chamber 36 can be pressured to supply ink to the printer without pressurizing the interior of the pouch 14. The top of the chamber 36 is provided with an inlet port 38 through which ink may enter the chamber 36 from the pouch 14 by gravity and/or by a negative pressure within the chamber 36. An outlet port 40 through which ink may be expelled from the chamber 36 is also provided.

A one-way flapper valve 42 located at the bottom of the inlet port 38 serves to limit the return of ink from the chamber 36 to the pouch 14. The flapper valve 42 is a rectangular piece of flexible material. In the illustrated embodiment the valve 42 is positioned over the bottom of the inlet port 38 and is heat staked to the chassis 16 at the midpoints of its short sides. When the pressure within the chamber 36 drops below that in the pouch 14, the unstaked sides of the valve 42 each flex to allow the flow of ink through the inlet port 38 and into the chamber 36. By heat staking the valve 42 to the chassis 16 along an opposed pair of sides, less flexing of the valve 42 is required or permitted than would be the case if the valve 42 were staked only along a single side, thereby ensuring that it closes more securely, and this effect is enhanced by doing the heat staking at the midpoints of the shorter sides, as opposed to the longer sides.

In the illustrated embodiment the flapper valve 42

is made of a two ply material. The outer ply is a layer of low density polyethylene 0.0015 inches thick. The inner ply is a layer of polyethylene terephthalate (PET) 0.0005 inches thick. The illustrated flapper valve 42 is approximately 5.5 millimeters wide and 8.7 millimeters long. Such a material is impervious to the flow of ink therethrough when the valve 42 is in its closed position.

The bottom of the chamber 36 is covered with a flexible diaphragm 44. The diaphragm 44 is slightly larger than the opening at the bottom of the chamber and is sealed around the free edge of the perimetrical wall 37 that defines the chamber 36. The excess material in the oversized diaphragm 44 allows the diaphragm to flex up and down to vary the volume of the chamber 36. In the illustrated device, the displacement of the diaphragm 44 allows the volume of the chamber 36 to be varied by about 0.7 cubic centimeters. The fully expanded volume of the illustrated chamber 36 is between about 2.2 and 2.5 cubic centimeters.

In the illustrated embodiment, the diaphragm 44 is made of a multi-ply material having a layer of low density polyethylene 0.0005 inches thick, a layer of adhesive, a layer of metallized polyethylene terephthalate (PET) 0.00048 inches thick, a layer of adhesive, and a layer of low density polyethylene 0.0005 inches thick. Of course, other suitable materials may also be used to form the diaphragm 44. The diaphragm 44 in the illustrated embodiment is heat staked, using conventional methods, to the free edge of the wall 37 of the chamber 36. During the heat staking process, the low density polyethylene in the diaphragm will seal any folds or wrinkles in the diaphragm 44. The diaphragm 44, thus, is impervious to the transmission of oxygen and moisture therethrough, thereby safeguarding the ink in the chamber 36 from degradation by exposure to any such

substance.

Within the chamber 36 a pressure plate 46 is positioned adjacent the diaphragm 44, the pressure plate 46 serving as a piston with respect to the chamber 36. A pump spring 48, made of stainless steel in the illustrated embodiment, biases the pressure plate 46 against the diaphragm 44 to urge the diaphragm outward so as to expand the size of the chamber 36. One end of the pump spring 48 is received on a spike 50 formed on the top of the chamber 36 and the other end of the pump spring 48 is received on a spike 52 formed on the pressure plate 46 in order to retain the pump spring 48 in position. The pressure plate 46 in the illustrated embodiment is molded of high density polyethylene.

A hollow cylindrical boss 54 extends downward from the chassis 16 to form the housing of the fluid outlet 20, the boss 54 being formed integrally with the chassis 16. A bore 56 of the hollow boss 54 has a narrow throat 54a at its lower end. A sealing ball 58, made of stainless steel in the illustrated embodiment, is positioned within the bore 56. The sealing ball 58 is sized such that it can move freely within the bore 56, but cannot pass through the narrow throat portion 54a thereof. A sealing spring 60 is positioned within the bore 56 to urge the sealing ball 58 against the narrow throat 54a to form a seal and prevent the flow of ink through the fluid outlet. A retaining ball 62, made of stainless steel in the illustrated embodiment, is press fit into the top of the bore to retain the sealing spring 60 in place. The bore 56 is configured to allow the free flow of ink past the retaining ball 62 and into the bore 56.

A raised manifold 64 is formed on the top of the chassis 16. The manifold 64 forms a cylindrical boss around the top of the fill port 32 and a similar boss

around the top of the inlet port 38 so that each of these ports is isolated. The manifold 64 extends around the base of the fluid outlet 20 and the outlet port 40 to form an open-topped conduit 66 joining the two outlets.

The flexible ink pouch 14 is attached to the top of the manifold 64 so as to form a top cover for the conduit 66. In the illustrated embodiment, this is accomplished by heat staking a rectangular plastic sheet 68 to the top surface of the manifold 64 to enclose the conduit 66. In the illustrated embodiment, the chassis 16 is molded of high density polyethylene and the plastic sheet is low density polyethylene that is 0.002 inches thick. These two materials can be easily heat staked to one another using conventional methods and are also readily recyclable.

After the plastic sheet 68 is attached to the chassis 16, the sheet is folded and sealed around its two sides and top to form the flexible ink pouch 14. Again, in the illustrated embodiment, heat staking can be used to seal the perimeter of the flexible pouch 14. The plastic sheet over the fill port 32 and over the inlet port 38 can be punctured, pierced, or otherwise removed so as not to block the flow of ink through these ports.

Although the flexible pouch 14 provides an ideal way to contain ink, it may be easily punctured or ruptured and allows a relatively high amount of water loss from the ink. Accordingly, to protect the pouch 14 and to limit water loss, the pouch 14 is enclosed within the protective shell 12. In the illustrated embodiment, the shell 12 is made of clarified polypropylene, which is sufficiently translucent to permit inspection of the ink within the pouch 14 to determine that an adequate volume of ink remains for proper operation of the printer. A thickness of about one millimeter has been found to provide robust protection and to prevent unacceptable

water loss from the ink. However, the material and thickness of the shell may vary in other embodiments.

The top of the shell 12 has a number of raised ribs 70 to facilitate gripping of the shell 12 as it is inserted in or withdrawn from the docking bay. A vertical rib 72 projects laterally from each side of the shell 12. The vertical rib 72 can be received within a slot (not shown) in the docking bay to provide lateral support and stability to the ink supply when it is positioned within the printer. The bottom of the shell 12 is provided with two circumferential grooves or recesses 76 which engage two circumferential ribs or beads 78 formed on a depending perimetrical wall 79 of the chassis 16 to attach the shell 12 to the chassis 16 in a snap fit.

The attachment between the shell 12 and the chassis 16 should, preferably, be snug enough to prevent accidental separation of the chassis from the shell and to resist the flow of ink from the shell should the flexible pouch develop a leak. However, it is also desirable that the attachment not form a hermetic seal to allow the slow ingress of air into the shell as ink is depleted from the pouch 14 to maintain the pressure inside the shell generally the same as the ambient pressure. Otherwise, a negative pressure may develop inside the shell and inhibit the flow of ink from the pouch. The ingress of air should be limited, however, in order to maintain a high humidity within the shell and minimize water loss from the ink.

In the illustrated embodiment, the shell 12 and the flexible pouch 14 which it contains have the capacity to hold approximately thirty cubic centimeters of ink. The shell is approximately 67 millimeters wide, 15 millimeters thick, and 60 millimeters high. The flexible pouch 14 is sized so as to fill the shell without undue

excess material. Of course, other dimensions and shapes can also be used depending on the particular needs of a given printer.

To fill the device 10, ink can be injected through the fill port 32. As it is filled, the flexible pouch 14 expands so as to substantially fill the shell 12. As ink is being introduced into the pouch, the sealing ball 58 can be depressed to open the fluid outlet and a partial vacuum can be applied to the fluid outlet 20. The partial vacuum at the fluid outlet causes ink from the pouch 14 to fill the chamber 36, the conduit 66, and the bore of the cylindrical boss 54 such that little, if any, air remains in contact with the ink. The partial vacuum applied to the fluid outlet also speeds the filling process. To further facilitate the rapid filling of the pouch, the exhaust port 34 is provided to allow the escape of air from the shell as the pouch expands. Once the ink supply is filled, the ball 35 is press fit into the fill port 32 to prevent the escape of ink or the entry of air.

Of course, there are a variety of other ways which can also be used to fill the present ink containment and dispensing device. In some instances, it may be desirable to flush the entire device with carbon dioxide prior to filling it with ink. In this way, any gas trapped within the device during the filling process will be carbon dioxide, not air. This may be preferable because carbon dioxide may dissolve in some inks while air may not. In general, it is preferable to remove as much gas from the device as possible so that bubbles and the like do not enter the print head or the trailing tube.

The protective cap 22 is placed on the device 10 after the pouch is filled. The protective cap is provided with a groove 80 which receives a rib 82 on the

chassis to attach the cap to the chassis. The cap carries a lug 84 which plugs the exhaust port 34 to limit the flow of air into the chassis and reduce water loss from the ink. A stud 86 extends from each end of the chassis 16 and is received within an aperture in the cap 22 to aid in aligning the cap and to strengthen the union between the cap and the chassis. The free ends of the studs 86, which extend beyond the apertures of the cap 22, are preferably deformed after the cap 22 is in place, for example, by contacting them with a heated tool, to provide a tamper resistant attachment of the cap 22 to the chassis 16. Further, the label 24 is glued to the sides of the device 10 to hold the shell 12, chassis 16, and cap 22 firmly together. In the illustrated embodiment, a hot-melt pressure sensitive or other adhesive is used to adhere the label in a manner that prevents the label from being peeled off and inhibits tampering with the ink supply.

The cap 22 in the illustrated embodiment is provided with a vertical rib 90 protruding from each side. The rib 90 is an extension of the vertical rib 72 on the shell and is received within the slot provided in the docking bay in a manner similar to the vertical rib 72. In addition to the rib 90, the cap 22 has protruding keys 92 located on each side of the rib 90. One or more of the keys 92 can be optionally deleted or altered so as to provide a unique identification of the particular ink supply by color or type. Mating keys (not shown), identifying a particular type or color of ink supply can be formed in the docking bay. In this manner, a user cannot inadvertently insert an ink supply of the wrong type or color into a docking bay. This arrangement is particularly advantageous for a multi-color printer where there are adjacent docking bays for ink supplies of various colors.

In the embodiment of the invention illustrated in Fig. 10, elements corresponding to the elements of the embodiment of Figs. 1 through 9 are identified by a 100 series numeral, the last two digits of which are the digits of the corresponding element of the invention of Figs. 1 through 9.

The ink containment and dispensing device of Fig. 10 is generally identified by reference numeral 110 and, except as hereinafter described, corresponds to the device 10 of Figs. 1 through 9. The device 110 has a hard protective shell 112 which is opened at one end and contains a flexible pouch 114 for containing ink. The shell 112 and an open end of the pouch 114 are attached to a chassis 116 which houses a pump 118 and a fluid outlet 120. A protective cap 122 is attached to the chassis 116. The opposed end of the pouch 114, not shown, is closed.

The device 110 is adapted to be removably inserted into a docking bay, not shown, within an ink-jet printer. When the device 110 is inserted into the printer, a fluid inlet in the docking bay is adapted to engage the fluid outlet 120 to allow ink to flow from the device 110 to the printer. An actuator, not shown, in the docking bay is adapted to engage the pump 118. Operation of the actuator causes the pump 118 to provide ink in a series of small doses of a predetermined volume from the flexible pouch 114, through the fluid outlet 120, to the fluid inlet of the docking bay and then to the printer.

The chassis 116 is provided with a fill port 132. Ink can be added to the ink supply in the pouch 114 through the fill port 132, and after the ink supply is filled, the fill port 132 is sealed with a ball 135 that is press fit into the fill port 132.

A pumping chamber 136 having an open bottom is formed on the bottom of the chassis 116 within a rigid

perimetrical wall 137, which is preferably formed integrally with the chassis 116. As described in more detail below, the chamber 136 can be pressured to supply ink to the printer without pressurizing the interior of the pouch 114. The top of the chamber 136 is provided with an inlet port 138 through which ink may enter the chamber 136 from the pouch 114 by gravity and/or by a negative pressure within the chamber 136.

A one-way flapper valve 142 located at the bottom of the inlet port 138 serves to limit the return of ink from the chamber 136 to the pouch 114. The flapper valve 142 is a rectangular piece of flexible material and is positioned over the bottom of the inlet port 138. When pressure within the chamber 136 drops below that in the pouch 114, the valve 142 flexes to allow the flow of ink through the inlet port 138 into the chamber 136.

The bottom of the chamber 136 is covered with a flexible diaphragm 144. The diaphragm 144 is slightly larger than the opening at the bottom of the chamber 136 and is sealed around the free edge of the perimetrical wall 137 that defines the chamber 136. The excess material in the oversized diaphragm 144 allows the diaphragm to flex up and down to vary the volume of the chamber 136. Within the chamber 136, a pressure plate 146 is positioned adjacent the diaphragm 144, the pressure plate 146 serving as a piston with respect to the chamber 136. A pump spring 148 biases the pressure plate 146 against the diaphragm 144 to urge the diaphragm outward so as to expand the size of the chamber 136. One end of the pump spring 148 is received on a spike 150 formed in the top of the chamber 136, and the other end of the pump spring 148 is received on a spike 152 formed on the pressure plate 146 in order to retain the pump spring 148 in position. The pressure plate 146 in the illustrated embodiment is molded of high density

polyethene.

A hollow cylindrical boss 154 extends downwardly from the chassis 116 to form the housing of the fluid outlet 120, the boss 154 being formed integrally with the chassis 116. A bore 156 of the hollow boss 154 has a narrow throat 154a at its lower end. A sealing ball 158 is sized such that it can move freely within the bore 156, but cannot pass through the narrow throat portion 154a thereof. A sealing spring 160 is position within the bore 156 to resiliently urge the sealing ball 158 against the narrow throat 154a to form a seal and prevent the flow of ink through the fluid outlet 120 when the device 110 is not inserted into a docking bay of a printer.

The flexible ink pouch 114 has an open end 114a positioned adjacent to the chassis 116, the chassis 116 having an endless annular skirt 116a. The inside of the open end 114a of the pouch 114 is heat staked against the outside of the skirt 116a of the chassis 116 in an endless pattern. Thus, any load that tends to separate the pouch 114 from the chassis 116 will tend to peel the open end 114a of the pouch 114 from the skirt 116a of the chassis 116, and the peel strength of plastic films from rigid plastic members is especially strong, especially if the overlap between the open end 114a of the pouch 114 and the skirt 116a of the chassis 116 is sufficient to provide a heat staked area of substantial axial extent.

The head staking of the open end 114a of the pouch 114 to the outside of the annular skirt 116a protects the free edge of the open end 114a of the pouch 114 from contact with ink and degradation that may result therefrom. Of course, insinuations where the contents of the pouch 114 does not pose a risk of degradation any constituent material of the pouch 114, the open end 114a of the pouch 114 may also be heat staked to the interior

of the annular skirt 116a.

When such a multiple layer material is used to form the pouch 114, an adhesive is applied between the innermost layer and the outermost layer, actually between the outermost layer and a layer of silicon dioxide that is deposited on the inside of the innermost layer. In any case, using the construction herebefore described, it is not possible for ink to contact any portion of the pouch 114 except the innermost layer, the edge of the open end 114a of the pouch 114 being protected from contact with ink by virtue of the heat staking of the open end 114a of the pouch 114 to the skirt 116a of the chassis 116.

For optimum service, the pouch 114 is formed from multiple layers, for example, by co-extrusion. When the pouch 114 is formed from multiple layers, it will preferably be provided with an innermost layer that is especially resistant to degradation from contact with ink, and linear low density polyethylene is a particularly good material for such service. The material of the pouch 114 further has an outermost layer of high tensile strength and good oxygen impermeability, such as polyethylene terephthalate or polypropylene.

In the embodiment of the invention illustrated in Fig. 11, elements of Figs. 1 through 9 are identified by a 200 series numeral, the last two digits of which are the two digits of the corresponding element of the invention of Figs. 1 through 9.

The ink containment and dispensing device of Fig. 11 is generally identified as reference numeral 210 and, except as hereinafter described, corresponds to the device 10 of Figs. 1 through 9. The device 210 has a hard protective shell 212, which is open at one end, and contains a flexible pouch 214 for containing ink. The shell 212 and an open end of the pouch 214 are attached

to a molded plastic chassis 216, which houses a pump 218 and a fluid outlet 220. A protective cap 222 is attached to the chassis 216. The opposed end, not shown, of the pouch 214 is closed.

The device 210 is adapted to be removably inserted into a docking bay, not shown, within an ink-jet printer in the same manner as the device 10 of the embodiment of Figs. 1 through 9. When the device 210 is inserted into the printer, a fluid inlet in the docking bay is adapted to engage the fluid outlet 220 to allow ink to flow from the device 210 to the printer, similar to the arrangement of the device of the embodiment of Figs. 1 through 9. An actuator, not shown, in the docking bay is adapted to engage the pump 218. Operation of the actuator causes the pump 218 to provide ink in a series of small doses of a predetermined volume from the flexible pouch 214, through the fluid outlet 220, to the fluid inlet of the docking bay and then to the printer.

The chassis 216 is provided with a fill port 232 at one end. Ink can be added to the ink supply through the fill port 232 and after the ink supply is filled, the fill port 232 is sealed with a ball 235 press fit into the fill port 232. A pumping chamber 236 having an open bottom is formed on the bottom of the chassis 216 within a rigid perimetrical wall 237, which is preferably formed integrally with the chassis 216. As described in more detail below, the chamber 236 can be pressured to supply ink to the printer without pressurizing the interior of the pouch 214. The top of the chamber 236 is provided with an inlet port 238 through which ink may enter the chamber 236 from the pouch 214 by gravity and/or by a negative pressure within the chamber 236.

A one-way flapper valve 242 is located at the bottom of the inlet port 238 and serves to limit the return of ink from the chamber 236 to the pouch 214. When the

pressure to the chamber drops below that in the pouch 214, the valve 242 flexes to allow the flow of ink through the inlet port 238 and into the chamber 236.

The bottom of the chamber 236 is covered with a flexible diaphragm 244. The diaphragm 244 is slightly larger than the opening at the bottom of the chamber, and is sealed around a free edge of the perimetrical wall 237 that defines the chamber 236. The excess material in the oversized diaphragm 244 allows the diaphragm to flex up and down to vary the volume of the chamber 236.

Within the chamber 236, a pressure plate 246 is positioned adjacent the diaphragm 244, the pressure plate 246 serving as a piston with respect to the chamber 236. A leaf-type pump spring 248 biases the pressure plate 246 against the diaphragm 244 to urge the diaphragm 244 outward so as to expand the size of the chamber 236.

A hollow cylindrical boss 254 extends downward from the chassis 216 to form the housing of the fluid outlet 220, the boss 254 being formed integrally with the chassis 216. A bore 256 of the hollow boss 254 has an outlet opening 256a at an end thereof, and the opening 256a is closed by an elastomeric septum 255 frictionally secured thereto. The septum 255 has a narrow slit 255a leading therefrom to permit ink to flow therethrough when the ink is pressurized, but the slit 255a of the septum 255 closes to prevent the leakage of ink through the septum 255 when the ink is pressurized solely by gravity. Further, a sealing ball 258 is positioned within the bore 256. A sealing spring 260 is positioned within the bore 256 to resiliently urge the sealing ball 258 against the interior of the septum 255 and particularly against the portion of the septum 255 that contains the slit 255a.

The liquid containment and dispensing device of the

various embodiments of the present invention has been specifically described as a device for containing and dispensing a supply of printing ink in an ink-jet printer as the preferred embodiment of the invention. However, it is also contemplated that the present invention can easily be adapted to the containment and dispensing of other Newtonian (low viscosity) liquids.

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.

Claims:

1. In a liquid containment and dispensing device having a rigid, generally cup-shaped outer shell with an open end, a chassis secured to the open end of the shell, the chassis having a pumping mechanism with a liquid outlet therefrom, a flexible pouch having an open end and a closed end, the closed end being positioned within the shell, and the open end being in liquid communication with the pumping mechanism, a check valve separating the flexible pouch from the pumping mechanism and permitting liquid flow from the flexible pouch into the pumping mechanism while preventing liquid flow from the pumping mechanism into the flexible pouch to dispense liquid therefrom through the liquid outlet, characterized in that the chassis has a depending perimetrical wall, the open end of the flexible pouch being secured to the perimetrical wall of the chassis in a liquid-tight manner.

2. A liquid containment and dispensing device according to Claim 1 wherein the chassis is formed of a polymeric material, the flexible pouch has at least an innermost portion formed of a polymeric material, and the flexible pouch is secured to the chassis by heat staking.

3. A. liquid containment and dispensing device according to Claim 2 wherein the open end of the flexible pouch is secured to an exterior surface of the perimetrical wall of the chassis.

4. A liquid containment and dispensing device according to Claim 1 wherein the liquid outlet has a free end, the free end of the liquid outlet being closed by an elastomeric septum with a self-closing slit therein.

5. In a liquid containment and dispensing device

having a rigid, generally cup-shaped outer shell with an open end, a chassis secured to the open end of the shell, the chassis having a pumping mechanism with a liquid outlet therefrom, a flexible pouch having an open end and a closed end, the closed end being positioned within the shell, and the open end being in liquid communication with the pumping mechanism, a check valve separating the flexible pouch from the pumping mechanism and permitting liquid flow from the flexible pouch into the pumping mechanism while preventing liquid flow from the pumping mechanism into the flexible pouch to dispense liquid therefrom through the liquid outlet, a liquid outlet being in the form of a tubulation, characterized in that an opening of the tubulation has an annular elastomeric member secured thereto.

6. A liquid containment and dispensing device according to Claim 5 and further comprising:

a sealing member; and

means for resiliently biasing said sealing member into engagement with said elastomeric member.

7. A liquid containment and dispensing device according to Claim 6 wherein said means for resiliently biasing comprises a spring having a first end in engagement with said sealing member and a second end in engagement with said chassis.

8. The method of preventing leakage from a liquid containment and dispensing device having a liquid outlet in the form of a tubulation with a free end, said method comprising:

securing an annular elastomeric member to the free end of the tubulation, the annular elastomeric member having a self-closing slit therein.

9. The method according to claim 8 and further comprising:

resiliently biasing a sealing ball against the portion of the interior of the septum that contains the slit.

10. The method of preventing liquid degradation of a free edge of an open end of a multiple ply flexible pouch containing a liquid, the pouch being in liquid flow communication with a chassis of a liquid containment and dispensing device, said method comprising:

providing the chassis with a depending perimetrical wall; and

securing an endless portion of an interior surface of the open end of the flexible pouch to an exterior surface of the depending perimetrical wall.

11. The method according to Claim 10 wherein the depending perimetrical wall is formed of a thermoplastic material, wherein at least an innermost ply of the flexible pouch is formed of a thermoplastic material, and wherein the flexible pouch is secured to the depending perimetrical wall by heat staking.

FIG. 1

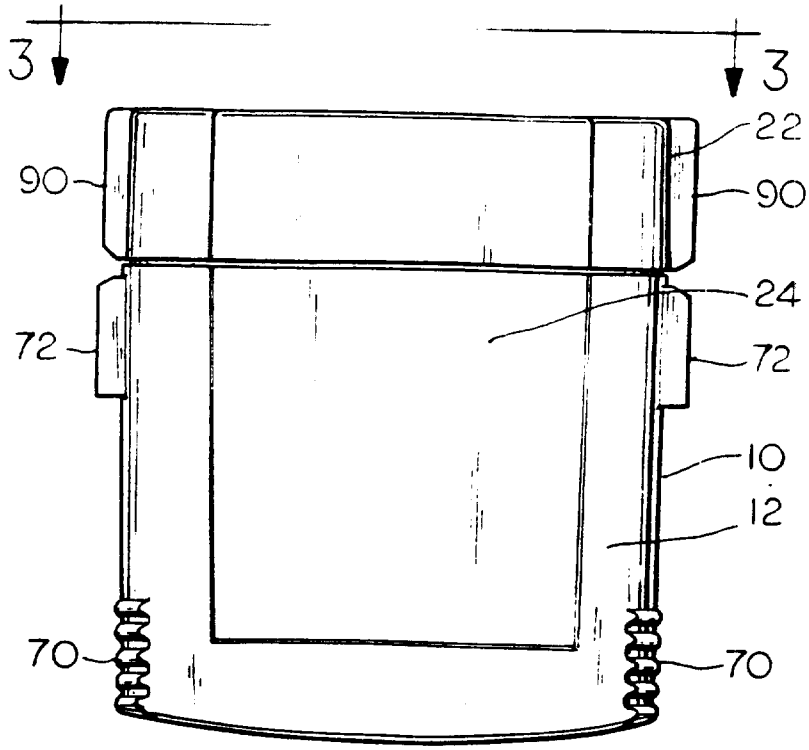
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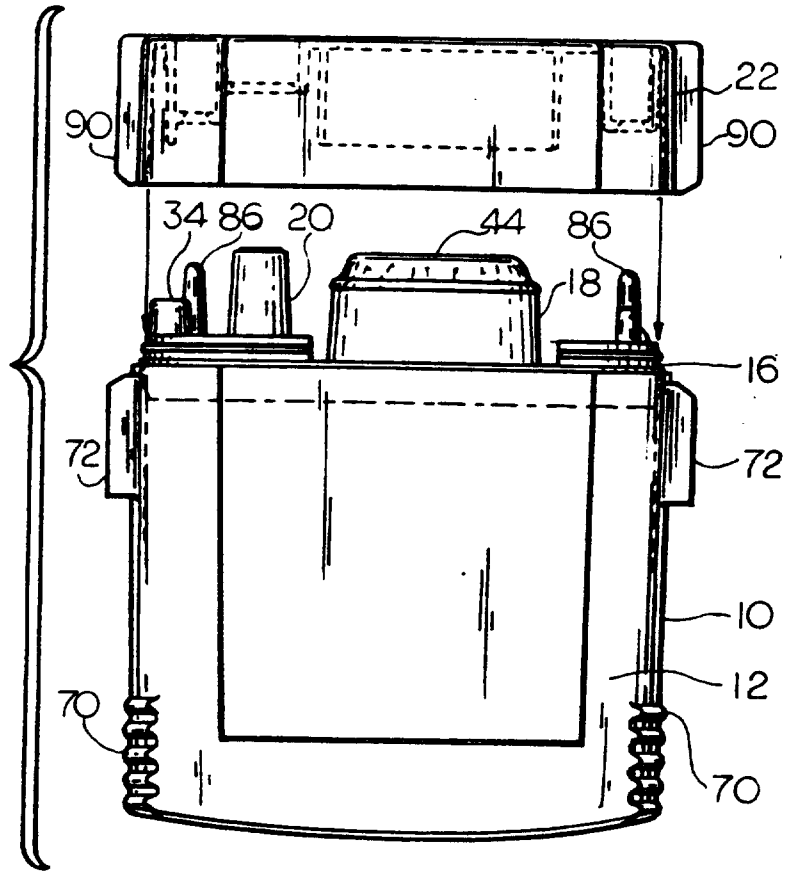
FIG. 2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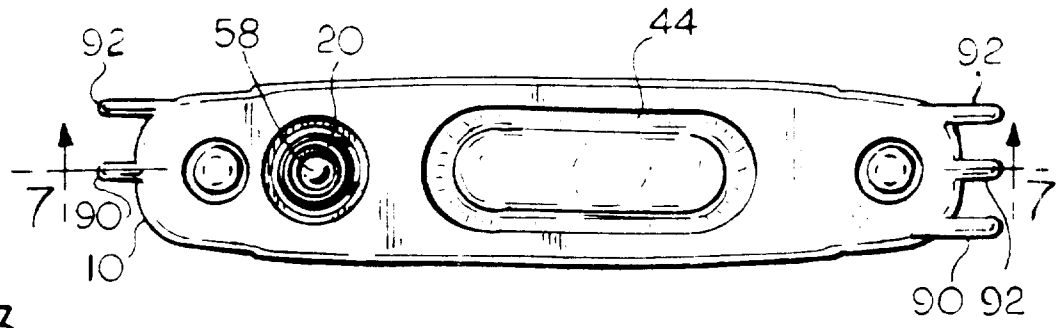

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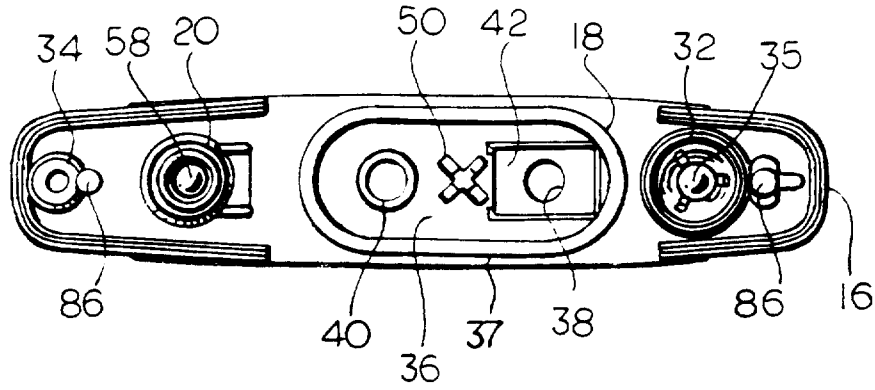

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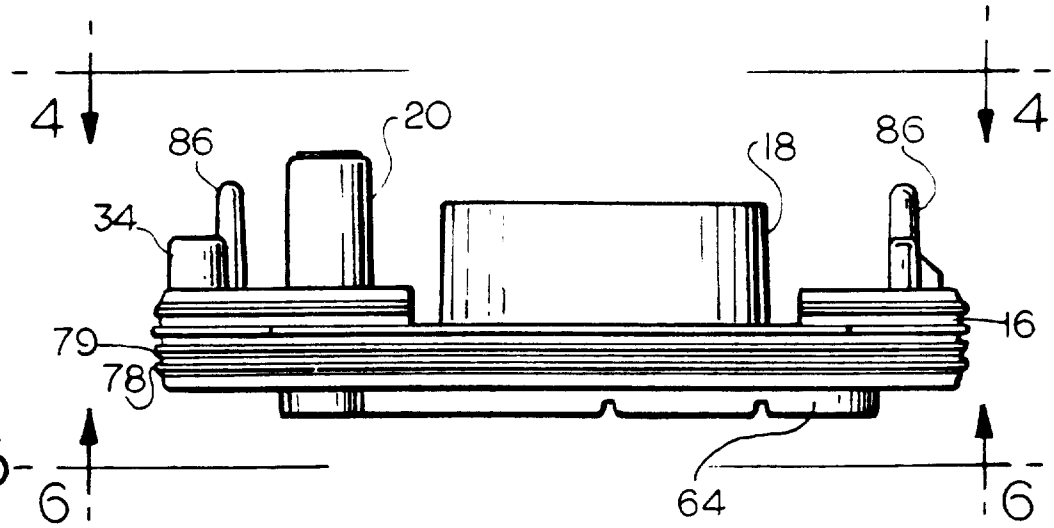

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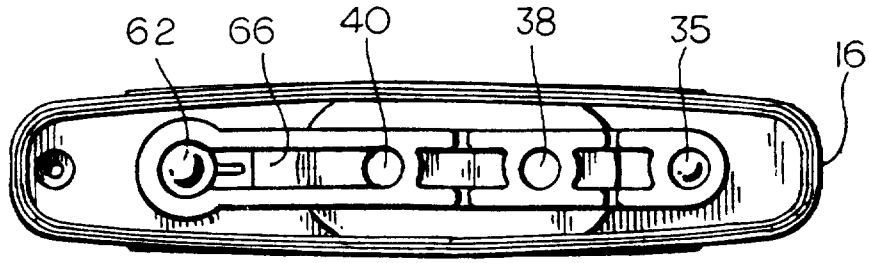

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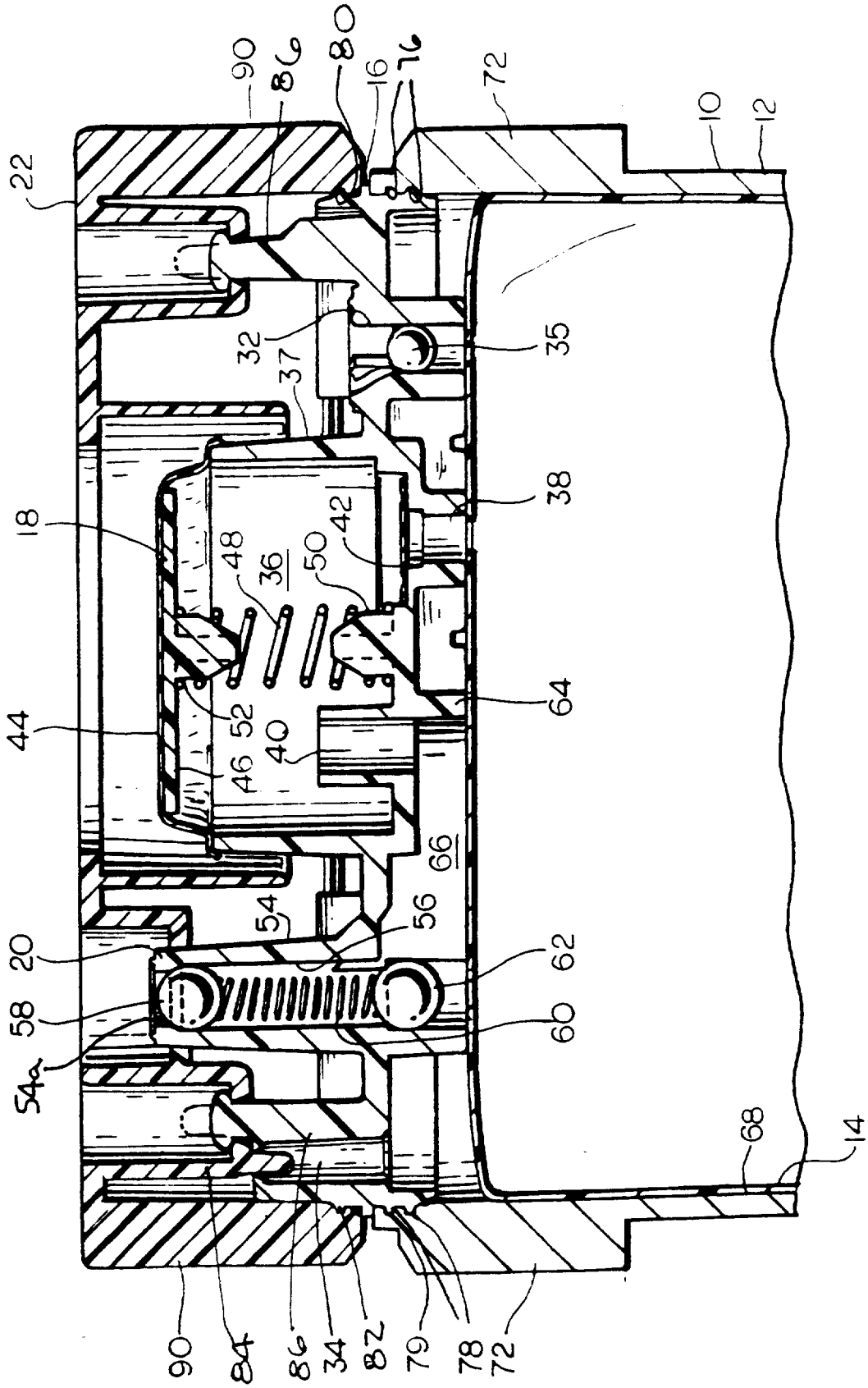
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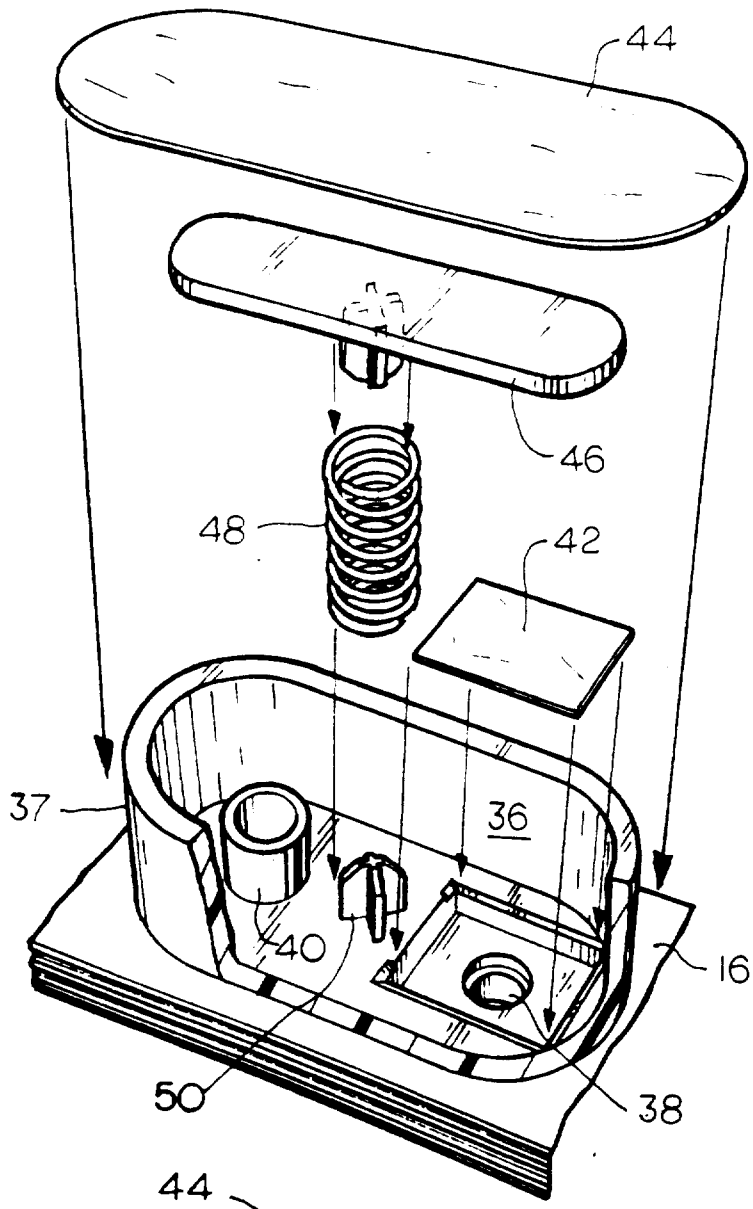
FIG. 7

FIG. 8



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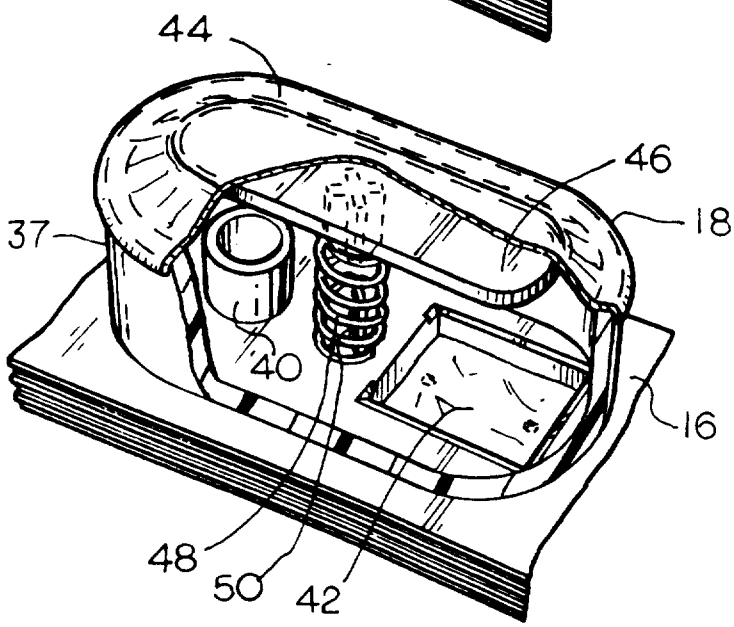

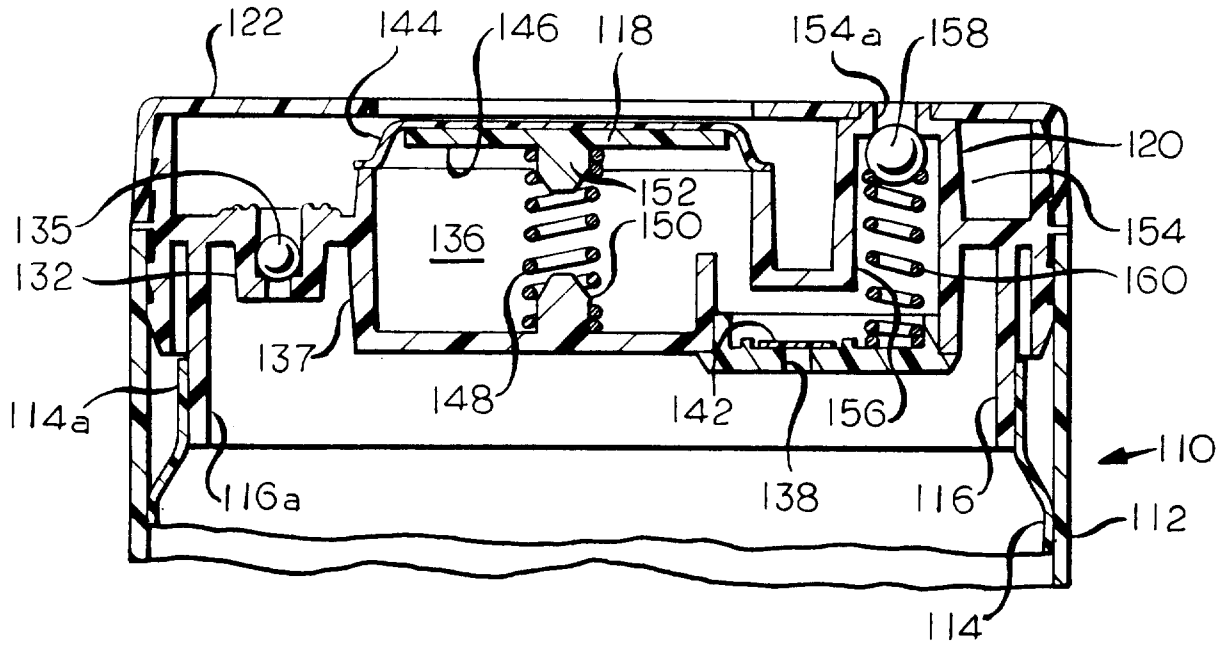
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FIG. 10

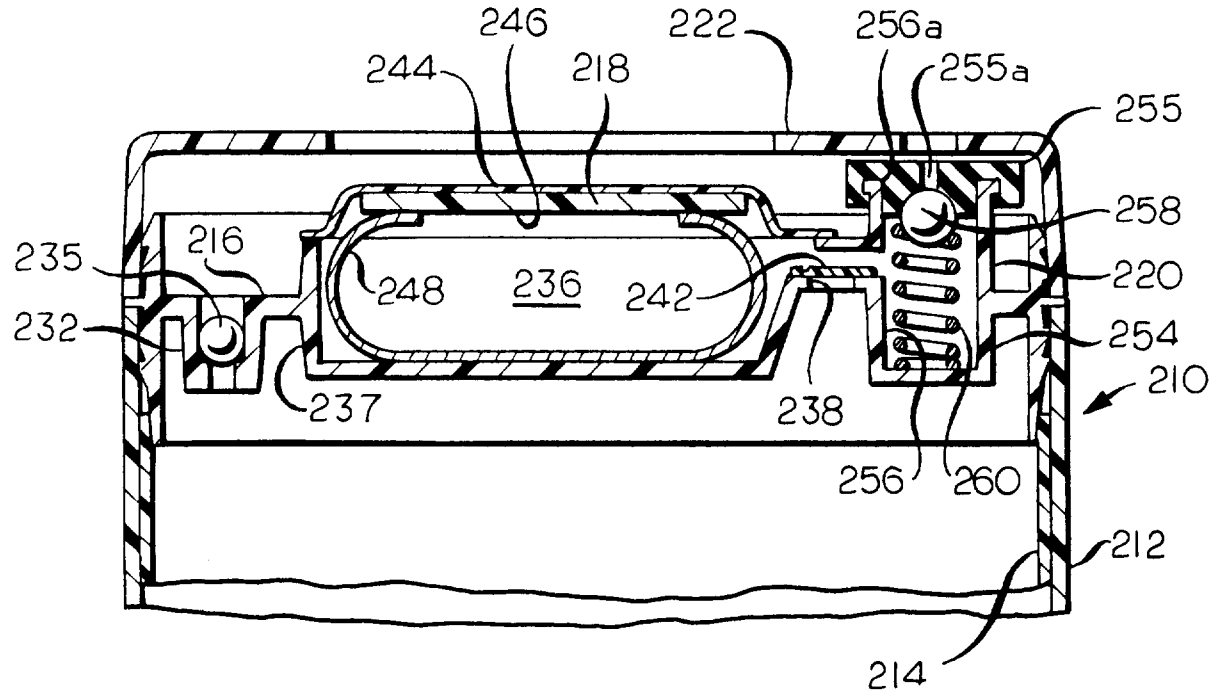
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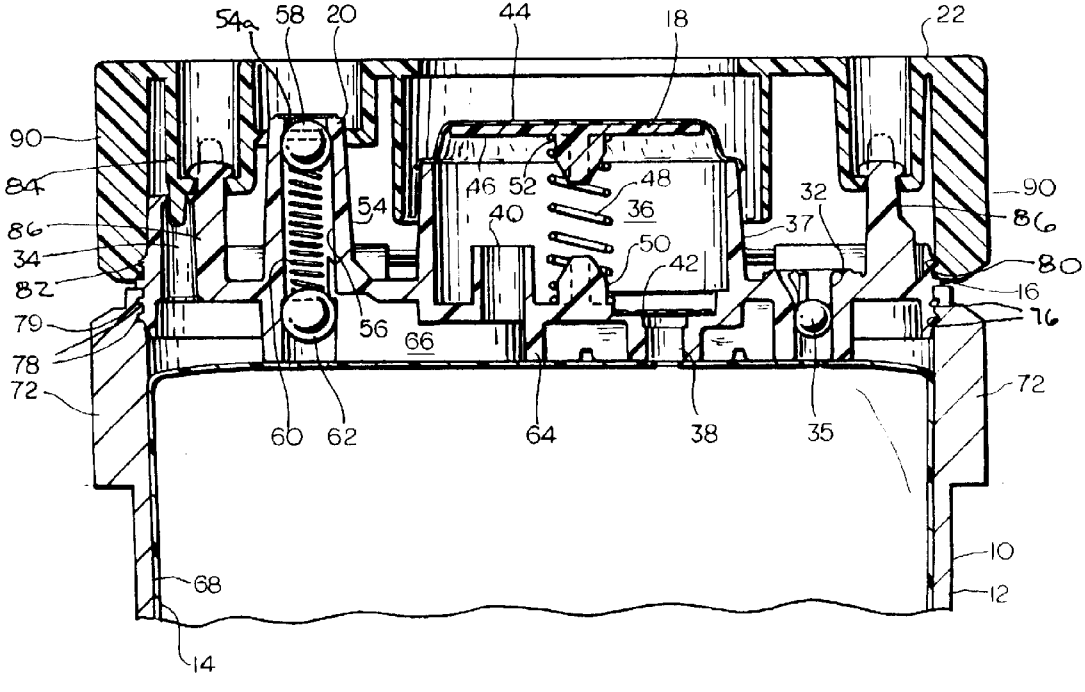
FIG. 11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