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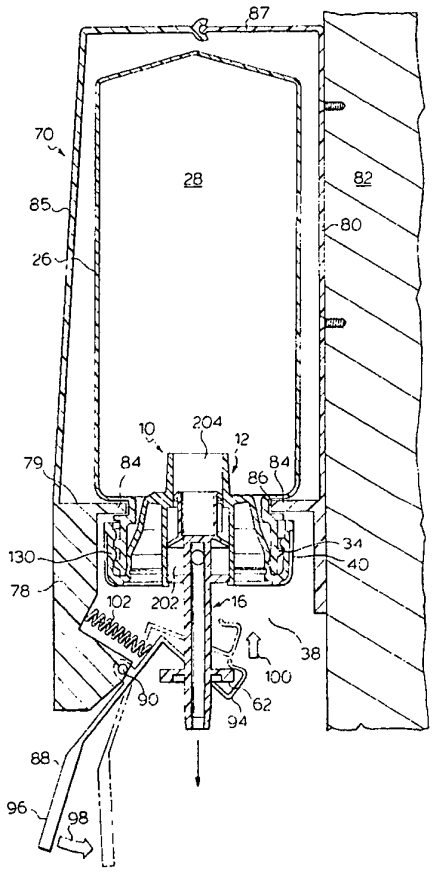
(54) Title: DISPOSABLE PLASTIC LIQUID PUMP

(57) Abstract

A disposable plastic pump for dispensing liquids is disclosed which comprises two basic unitary, preferably all plastic, elements: a chamber forming body having an open outer end and an inner end in fluid communication with a liquid reservoir, and a piston formed to slidably fit into the chamber. The chamber forms two axially adjacent coaxial chambers, an inner chamber of one diameter and an outer chamber of a greater diameter. The piston comprises a stem on which is located two spaced flexing discs each sized to fit in and serving as a one-way valve in the inner chamber and outer chamber, respectively, permitting fluids to flow outwardly past each flexing disc. A sealing disc is located on the stem outwardly of the outermost flexing disc. A passageway is provided from an inlet on the piston between the outermost flexing disc and the sealing disc through which the dispensed liquid flow.



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DISPOSABLE PLASTIC LIQUID PUMP

SCOPE OF THE INVENTION

This invention relates generally to a disposable plastic pump, and more particularly to an inexpensive all plastic, disposable pump assembly for dispensing hand soap.

BACKGROUND OF THE INVENTION

Many pump assemblies are known for dispensing hand soap. Typically even the simplest of these assemblies include at least four separate elements, a chamber forming body, two one-way valves and a piston. These pumps suffer the disadvantage that they have a number of individual parts and costs typically increase with the number of parts and the assembly required.

Known disposable pump assemblies for dispensing hand soap typically include at least some metal parts such as metal balls for one-way valves and metal springs to bias one-way valves closed. The inclusion of metal parts suffers the disadvantage that the pump assemblies can not merely be ground up in plastic grinders for recycling in that the metal parts are not compatible with most plastic grinding machines.

Known hand soap dispensing systems provide replaceable receptacles for liquid soap with permanent pump assemblies to pump soap from the receptacles. This has the disadvantage that the pumps are expensive and after prolonged usage may fail or require cleaning and maintenance.

SUMMARY OF THE INVENTION

To at least partially overcome these disadvantages of known liquid containers and pumps, the present invention provides a pump assembly for dispensing liquids with a novel, unitary construction for a piston so that the pump

will have as few separate parts as possible, preferably fewer than four, which may be easily assembled.

Another object is to provide a unique configuration for an inexpensive disposable piston for a disposable pump which can be injection molded, as a unitary element entirely from plastic yet incorporate one or more one-way valves.

Another object is to provide a disposable plastic pump assembly formed entirely from two or three unitary plastic elements without any metal parts.

Another object is to provide a system for dispensing hand soap comprising a permanent housing and pump activator and a disposable soap reservoir and pump assembly.

Another object is to provide a disposable pump for dispensing liquids, adapted to be used with a disposable fluid container, which may be readily recycled without first requiring disassembly of the parts of the pump prior to crushing or shredding of the disposed container-pump assembly.

The present invention provides an inexpensive, easy to assemble, disposable pump for dispensing liquids, from a reservoir, preferably a disposable reservoir.

The pump comprises two basic elements: a chamber forming body and a piston.

The piston is formed to be slidably received in the chamber and comprises a stem. The piston has at least one flexing element on the stem, which serves as a one-way valve permitting fluid flow only outwardly past the flexing element. A sealing element which forms a substantially fluid impermeable seal between the sealing element and the chamber is located outward on the stem from the outwardmost flexing element. A channel is provided from an inlet on the piston between the outwardmost flexing element and the sealing element to permit fluid flow to an outlet outward of the sealing means.

Liquids are drawn from the reservoir by the outward and inward movement of the piston. On outward movement fluids are drawn from the reservoir, past a first one-way valve device and into the chamber. In subsequent inward movement the first one-way valve device prevents fluid from flowing back into the reservoir. With the outermost flexing element bending to allow liquid to pass outwardly therepast, liquid is pumped out via the channel.

In one embodiment the chamber is a stepped chamber with an inner cylindrical chamber of a reduced diameter compared to an outer cylindrical chamber. Two axially spaced flexing elements are provided on the stem with the innermost flexing element and the stepped cylinder configuration providing a first one-way valve device between an inner end of the chamber and the reservoir.

After exhaustion of the liquids contained in the reservoir, the reservoir is replaced, preferably together with a new pump assembly attached. Preferably both the reservoir and the pump are formed entirely of plastic so as to permit easy recycling of the plastic parts.

The piston is provided with a unique combination of features which permits it to be injection molded from plastic as a unitary element, yet incorporate one or more one-way valve forming features.

The present invention also provides for a system for dispensing liquids having: a disposable plastic element suitable for recycling comprising a disposable liquid reservoir and a disposable pump assembly each formed entirely out of recyclable plastic, and a permanent non-disposable housing for the reservoir and pump assembly including a permanent actuating system to operate the pump assembly. Any non-recycleable or metal parts are incorporated into the permanent housing to ensure the disposable parts can be readily recycled.

In one aspect, the present invention provides a pump for dispensing liquid from a reservoir comprising

piston-chamber forming means having an inner cylindrical chamber and an outer cylindrical chamber, the inner chamber and outer chamber each having a diameter, a chamber wall, an inner end and an outer end, the diameter of the inner chamber being less than the diameter of the outer chamber, the inner chamber and outer chamber being coaxial with the outer end of the inner chamber opening into the inner end of the outer chamber, the inner end of the inner chamber in fluid communication with the reservoir, a piston forming element received in the piston-chamber forming means axially slidable inwardly and outwardly therein, said piston forming element being generally cylindrical in cross-section with a central axially extending hollow stem having a central passageway closed at an inner end and having an outlet proximate an outer end, an inner circular flexing disk extending radially outwardly from the stem approximately inner end, an inner flexing disk having an elastically deformable edge portion approximate the chamber wall of the inner chamber circumferentially thereof, an outer circular flexing disk extending radially outwardly from the stem spaced axially outwardly from the inner flexing disk, the outer flexing disk having an elastically deformable edge portion approximate the chamber wall of the outer chamber circumferentially thereabout, a circular sealing disk extending radially outwardly from the stem spaced axially outwardly from the outer flexing disk, the sealing disk engaging the chamber wall of the outer chamber circumferentially thereabout to form a substantially fluid impermeable seal therewith and sliding of said piston forming element inwardly and outwardly, an inlet located on the stem between the outer flexing disk and the sealing disk in communication with the passageway, the piston forming element slidably received in the piston chamber forming means for reciprocal axial inward and outward movement therein with the inner flexing disk in the inner chamber and the outer flexing disk and sealing disk in the outer chamber, the inner flexing disk substantially preventing

fluid flow in the inner chamber passed the inner flexing disk in an inward direction, the outer flexing disk substantially preventing fluid flow in the outer chamber passed the outer flexing disk in an inward direction, the inner flexing disk elastically deforming away from the chamber wall of the inner chamber to permit fluid flow in the inner chamber passed the inner flexing disk in an outward direction, the outer flexing disk elastically deforming away from the chamber wall of the outer chamber to permit fluid flow in the outer chamber passed the outer flexing disk in an outward direction.

BRIEF DESCRIPTION OF THE DRAWINGS

Further objects and advantages of the invention will appear from the following description taken together with the accompanying drawings in which:

Figure 1 is a partially cut away side view of a first preferred embodiment of a liquid dispenser with the reservoir and pump assembly in accordance with a first aspect of the present invention;

Figure 2 is a partial cross-sectional side view of the dispenser and pump assembly of Figure 1 with the piston in a fully withdrawn portion;

Figure 3 is a partial cross-sectional side view of the dispenser of Figure 1 but with the piston in a fully retracted portion;

Figure 4 is a perspective view of the piston shown in Figure 1;

Figure 5 is a cross-sectional side view of a second embodiment of a liquid dispenser in accordance with the first aspect of the present invention; and

Figure 6 is a cross-sectional side view of a third embodiment of a liquid dispenser in accordance with the first aspect of the present invention;

Figure 7 is an enlarged cross-sectional side view of a preferred embodiment of a liquid dispenser in accordance with a second aspect of the present invention

showing a cover for use in vacuum evacuation; and

Figure 8 is a partial cross-sectional side view of a piston chamber forming body secured to a rigid container in accordance with a third aspect of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Reference is made first to Figures 1 to 3 which show a pump assembly generally indicated 10. Pump assembly 10 is shown best in Figure 2 as comprising two principle elements, a piston-chamber forming body 12 and a piston 16 seen best in Figure 2.

In essence body 12 has a stepped cylindrical chamber 18 having an outer cylindrical chamber 202 and an inner cylindrical chamber 204. The inner chamber 204 is of a diameter less than the diameter of the outer cylindrical chamber 202. Each chamber has cylindrical chamber wall, an inner end and an outer end. The outer chamber 202 and inner chamber 204 are coaxial in the sense of being disposed about the same central axis. The outer and inner chambers 202,204 are axially adjacent each other with the outer end of the inner chamber opening into the inner end of the outer chamber. An annular shoulder 206 closes the inner end of outer chamber 202 about the outer end of the inner chamber.

Piston 16 is axially slidably received in chamber 18 for reciprocal sliding movement inwardly and outwardly of an open end 22 of chamber 18. In the pump assembly 10 shown in Figures 1 to 3, the body 12 not only carries the piston 16 but is secured to a container or reservoir 26, which may be a collapsible or a non-collapsible container, by internal threads 130 on outer cylindrical portion 40 which engage the threaded neck 34 of container 26. With the pump assembly 10 coupled to reservoir 26, reciprocal movement of piston 16 will pump fluid from the reservoir 26 through piston 16.

The body 12 is generally cylindrical in cross-section and symmetrical about its central axis. The chambers 202 and 204 are defined inside the chamber 18 with

an annular wall 208 connecting the outer cylindrical portion 40 to the chamber 18. The wall 208 has circumferential grooves 210 adapted to receive a cover identical to cover 142 shown in Figure 7 as will be described later. The cross-section of body 12 seen in Figures 2 and 3 shows one of a plurality of thin, radially outwardly extending reinforcing flange 212 to assist in supporting the inner chamber 204.

As shown best in Figures 3 and 4, piston 16 is generally cylindrical in cross-section and adapted to be slidably received in chamber 18. Piston 16 is a unitary element formed entirely of plastic preferably by injection molding. Piston 16 has a central hollow stem 46 extending along the central longitudinal axis of the piston 16.

Piston 16 includes an inner cylindrical extension 214 to the stem 46 carrying at its inner end an annular inner flexing disc 216. The inner extension 214 and inner flexing disc 216 are adapted to be received within the inner chamber 204. Inner flexing disc 216 is circular and extends radially outwardly from stem extension 214 with an elastically deformable edge portion engaging the chamber wall of the inner chamber 204 circumferentially thereabout.

A circular resilient flexing disc 48 having an elastically deformable edge is located towards the inwardmost end of the piston 16 and extends radially therefrom. The flexing disc 48 is located along the piston 16 outwardly from the inner flexing disc 216 and is adapted to be received in the outer chamber 202. Outer flexing disc 48 is circular, sized to circumferentially abut the chamber wall of the outer cylindrical chamber 202 substantially preventing fluid flow therebetween.

The inner flexing disc 216 interacts with inner chamber 204 in the same manner that outer flexing disc 48 interacts with outer chamber 202. Each substantially prevents fluid flow in their respective chamber past the flexing disc in an inward direction. Each permits fluid

flow in their respective chamber past the flexing disc in an outward direction by elastically deforming away from their respective chamber wall.

A circular sealing disc 50 is located on the stem 46 spaced axially outwardly from the outer flexing disc 48. The sealing disc 50 extends radially outward from the stem 46 to circumferentially engage the outer chamber wall to form a substantially fluid impermeable seal therebetween. Sealing disc 50 is formed sufficiently rigid so as to resist deformation, maintaining a substantially fluid impermeable seal with the chamber wall on sliding the piston 16 in and out of the chamber 18.

As best seen in Figure 2, piston stem 46 has a central hollow passage 52 extending along the axis of the piston 16 from an inner end located in the stem 46 between the flexing disc 48 and the sealing disc 50, to an outlet 54 at the outer end of the piston 16. A channel 56 passes from inlets 58 located on either side of the stem 46 between the flexing disc 48 and the sealing disc 50, radially inward through the piston 16 to communicate with central passage 52. The channel 56 and central passage 52 permit fluid communication through the piston 16, past the sealing disc 50, between the inlets 58 and the outlet 54.

An outer circular engagement flange 62 is provided towards the outermost end of the stem 46 which extends radially outwardly from about the outlet 54. As discussed later flange 62 may be engaged by an actuating device in order to move the piston 16 in and out of the body 12.

As seen best in Figure 2, annular rim 140 is provided to engage sealing disc 50 and limit full outward movement of piston 16 in normal pumping operation. As shown in Figure 3, the engagement of annular shoulder 206 by outer flexing disc 48 preferably limits full inward movement of piston 16 in normal pumping operation.

Although not shown in the embodiment of Figures 1 to 4 a circular stopping disc may also be provided on the

stem 46 between the flange 62 and the sealing disc 50 extending radially outward from the stem 46. The stopping disc having a radius greater than the radius of the chamber 18 such that the stopping disc limits inward movement of piston 16 by its abutment with the outer end of the chamber 18.

Operation of the pump assembly 10 is now described with reference to Figure 2 showing piston 16 in a fully outward, withdrawn position and Figure 3 showing piston 16 in a fully inward, retracted position, between which positions the piston 16 is reciprocated in pumping. As is known to persons skilled in the art, the volume 218 of fluid in chamber 18 between inner flexing disc 216 and outer flexing disc 48 varies with axial movement of piston 16. In Figure 2, this volume 218 is a maximum in that the outer flexing disc 48 is axially located farthest outwardly in the larger diameter outer chamber 202. In Figure 3, this volume 218 is a minimum in that the outer flexing disc 48 is axially located farthest inwardly in outer chamber 202.

In piston 16 moving inwardly from the withdrawn position of Figure 2 to the retracted position of Figure 3, the volume for the fluid between the two flexing discs decreases, placing such trapped fluid under increased pressure in that inner flexing disc 216 acts as a one-way valve to prevent flow of fluid inwardly past it in inner chamber 204. As a result of this increased pressure, outer flexing disc 48 deflects radially inwardly at its periphery so as to come out of sealing contact with the chamber wall permitting flow of fluid outwardly past it in outer chamber 202 and, subsequently, out outlet 54 via passageway 52.

In piston 16 moving outwardly from the retracted position of Figure 3 to the withdrawn position of Figure 2, the volume 218 for the fluid between the two flexing discs increases, placing the fluid therebetween under reduced pressure in that outer flexing disc 48 acts as a one-way valve to prevent flow of fluid inwardly past it in outer

chamber 204. In the withdrawal stroke, flexing disc 48 remains substantially undeflected and assists in creating suction forces in chamber 18 to draw fluid into chamber 18 past flexing disc 216. As a result of this decreased pressure, inner flexing disc 216 deflects radially inwardly permitting flow of fluid outwardly past it in inner chamber 204.

Repeated pumping action results by repeatedly cycling the pump assembly 16 through the positions in sequence from Figure 2 to Figure 3, then return to Figure 2.

The flexing disc 48 needs, on one hand, to substantially prevent flow therepast in the withdrawal stroke and, on the other hand, deform to permit flow therepast in the return stroke. The disc 48 shown facilitates this by being formed as a thin resilient disc, in effect, having an elastically deformable edge portion near chamber wall.

When not deformed, flexing disc 48 abuts the outer chamber wall to form a substantially fluid impermeable seal. When deformed, as by its edge portion being bent away from wall, fluid may flow past the disc. Disc 48 is deformed when the pressure differential across it, that is, the difference between the pressure on one side and pressure on the other side, is greater than a maximum pressure differential which the disc can withstand without deflecting. When the pressure differential is greater than this maximum pressure differential, the disc 48 deforms and fluid flows past. When the pressure differential reduces to less than this maximum pressure differential, the disc 48 returns to its original shape substantially forming a seal with the outer chamber wall.

As is to be appreciated inner flexing disc 216 is formed on essentially the same principles as outer flexing disc 48, only so as to deform away from the inner chamber wall to permit fluid flow therepast on the withdrawal stroke.

With simple discs 48,216 of thin plastic as shown, the overall configuration of the pump assembly needs to be considered to achieve best results. For example, in a withdrawal stroke, the resistance of fluid flow into chamber 18 past the inner flexing disc 216 compared to the resistance to fluid flow back up channel 56 and passage 52 will affect the relative pressures on each side of the disc 48 and whether the disc 48 will be deflected. Preferably, the pump assembly is to be designed having regard to the viscosity of the fluid, the resistance to flow outwardly past the inner flexing disc 216 and the resistance to flow back inwardly through the piston 16 as well as the relative resiliency of the disc 48 so that in operation, only flexing disc 216 permits fluid flow therepast in the outward stroke, and only flexing disc 48 permits fluid flow therepast in the return stroke.

The inner flexing disc 216 together with the stepped, two-diameter cylinder configuration of chamber 18, in effect, provide an inner one-way valve structure serving the function of one-way valve which permits only outward flow of fluid 28 from the reservoir 26 into the chamber 18.

Discs 48,216 may be designed to resist deformation in one direction compared to the other so as to assist in achieving the desired operation.

Reference is now made to Figure 1 which shows a liquid soap dispenser generally indicated 70 utilizing pump assembly 10 and reservoir 26 with pump assembly 10 inserted into neck 34 of reservoir 26. Dispenser 70 has a housing generally indicated 78 to receive and support the pump assembly 10 and reservoir 26. Housing 78 is shown with a back plate 80 for mounting the housing, for example, to a building wall 82. A bottom support plate 84 extends forwardly from the back plate to receive and support the reservoir 26 and pump assembly 10. As shown, bottom support plate 84 has a circular opening 86 therethrough. The reservoir 26 sits, supported on plate 79 with its neck 34

extending through opening 86 and secured in the opening as by friction fit, clamping and the like. A cover member 85 is hinged to an upper forward extension 87 of back plate 80, so as to permit replacement of reservoir 26 and its pump assembly 10.

Bottom plate 84 carries at a forward portion thereof an actuating lever 88 journalled for pivoting about a horizontal axis at 90. An upper end of lever 88 carries a hook 94 to engage engagement flange 62 and couple lever 88 to piston 16, such that movement of the lower handle end 96 of lever 88 from the solid to the dotted line position, in the direction indicated by arrow 98 slides piston 16 inwardly in a return, pumping stroke as indicated by arrow 100. On release of lower handle end 96, spring 102 biases the upper portion of lever 88 downwardly so that the lever 88 draws piston 16 outwardly to a fully withdrawn position as seen in solid lines in Figure 1. Lever 88 and its inner hook 94 are adapted to permit manually coupling and uncoupling of the hook 94 as is necessary to remove and replace reservoir 26 and pump assembly 10.

In use of the dispenser 70, once exhausted, the empty reservoir 26 together with its attached pump 10 are removed and a new reservoir 26 and attached pump 10 are inserted into the housing. Preferably, the removed reservoir 26 and attached pump 10 is made entirely of recyclable plastic material which may easily be recycled without the need for disassembly prior to cutting and shredding.

Figures 1 to 4 show a plurality of webs 66 provided on inner extension 214 to slidably engage the chamber wall of inner chamber 204 and assist in centering and axially aligning piston 16 in chambers 202 and 204. As is to be appreciated such webs 66 are not necessary but may advantageously be provided. Webs 66 have been shown as axially extending radial flanges, however, many other forms of such locating members may be provided, for example, as a

disc similar to disc 50 but having substantial openings therethrough or discontinuities therein.

Axially extending webs 66 and/or circumferential ribs may also be provided to extend radially from stem 46 to engage the outer chamber wall and assist in maintaining the piston 16 in an axially centered and aligned position when sliding in an out of the chamber 18.

While the preferred embodiment of Figures 1 to 4 show a plastic cylindrical piston-chamber 12 and piston 16, piston-chambers and pistons of other symmetrical and non-symmetrical shapes and materials may also be used.

Although a piston-chamber 12 having threads 36 is preferred, other gripping means, including an outer cylindrical portion 40 having gripping flanges could also be provided on the piston-chamber 12 or elsewhere.

While the preferred embodiment of Figures 1 to 4 shows a channel 56 passing from an inlet 58 on the stem 46 of the piston 16 and connecting with an axially aligned central passage 52, the channel 56 could also be provided permitting fluid communication outward past the sealing disc 50 without connecting with a central passage and without an inlet 58 disposed on the stem 46 of the piston 16.

Reference is now made to Figure 5 which shows a second modified form of the pump assembly of Figures 1 to 3. In Figure 5, piston 16 is identical to the piston in Figures 1 to 4. The container 26 in Figure 5 is a unitary element integrally formed as one piece with the piston-chamber forming body 12. The neck 222 of container 26 has stepped interior cylindrical surfaces forming the outer chamber 202 and inner chamber 204 to otherwise be identical to that as shown in Figures 1 to 3. Operation of the pump in Figure 5 is identical to that in Figures 1 to 3.

The pump assembly of Figure 5 is particularly advantageous when container 26 is collapsible. In this regard, Figure 5 is intended to illustrate a collapsible

container 26 of plastic material similar to known tubes for dispensing fluids such as toothpaste. Container 26 may be formed from plastic by known extrusion, injection molding and/or blowing molding techniques to have an initially open innermost end 224. After the container 26 is filled with fluid, the side walls 226 of the container are then sealed together at seal 228 forming a straight seal extending across the container 26 completely from one side to the other to close the innermost end 224 in a known manner. In this sense, the sealed container 26 is not symmetrical about its central axis proximate end 224. A removable cap 230 is provided to close outlet 54. The unit as illustrated in Figure 5 may be sold filled with liquid and function by itself when manually manipulated without the need for any housing, actuators or springs. A user may hold the container 26 with one hand and, with the other, slide the piston 16 inwardly and outwardly to dispense fluid as required.

Container 26 is shown with its neck 222 and a circular dispensing flange 232 of increased thickness to provide relative rigidity and strength compared to the relatively thin collapsible side walls 226.

Reference is now made to Figure 6 which shows a modified form of the pump assembly of Figures 1 to 3 and most similar to the assembly of Figure 5. In Figure 6, container 26 is substantially the same as that in Figure 5 with the piston chamber forming body integral with the container 26. The container 26 is preferably a cylindrical container having cylindrical side walls 226 and a circular end wall 234 and formed to be relatively rigid as by being formed from materials such as relatively rigid plastic or glass.

Piston 16 is substantially identical to the piston in Figures 1 to 4 with two differences. Firstly, engagement flange 62 is enlarged to have a greater radial extent and to have annular side flange 234. Side flange 234 assists in

retaining helical spring 236 between engagement flange 62 and the depending flange 232 about container neck 222. Such spring 236 biases the piston 16 to the fully withdrawn position. The spring may be formed of metal, although preferably, is a resilient nylon or plastic spring which may be ground and recycled.

Secondly, a flexible catch 238 is provided, preferably as an integral part of piston 16 but possibly as a separate plastic part secured thereto. The flexible catch 238 is shown as an integral part of piston 16 extending inwardly from inner extension 214 as an elongate arm 240 having a catch foot 242 to engage inwardly of the depending flange 232 to more positively prevent movement of piston 16 outwardly beyond the fully withdrawn position shown. Arm 240 is shown with a reduced portion 244 about which the flexible catch may bend to assume the inactive position, the piston 16 may be inserted into the container 26 and, thereafter, the catch inherently assumes the position shown in solid lines. Insofar as it may prove necessary, a one-way valve (not shown) may be provided to prevent a vacuum from being created in the container which could prevent pumping of fluid therefrom.

Reference is now made to Figure 7 which shows an embodiment of a pump in accordance with a second aspect of the invention having a body 12 and piston 16 substantially identical to the body and piston in Figures 1 to 4. In Figure 7 similar reference numerals are used to indicate similar elements to those in the first aspect of the invention shown in Figures 1 to 4.

As seen in Figure 7 the pump assembly 10 is identical in functionality to that in Figure 1. Pump assembly 10 is shown secured to a collapsible plastic container 26 having a threaded neck 34. The pump assembly 10 has body 12 and piston 16. Body 12 is configured with internal threads 130 on outer cylindrical portion 40 for screwing the body onto threaded neck 34.

The piston 16 is identical to that in Figure 4 having stem 46 carrying flexing discs 48,216, sealing disc 50 and webs 66. The stem 46 has passage 52, outlet 54, and inlet 58. Stem 46 extends outwardly as a relatively narrow tube 138 suitable for dispensing fluid. Operation of the pump assembly 10 of Figure 7 is similar to the pump assembly of Figures 1 to 6.

Body 12 is provided at the open end 22 of chamber 18 with an annular rim 140 which extends radially inwardly from the cylindrical walls of the chamber a small extent and presents an axially inwardly directed annular shoulder. This annular rim 140 serves as a stop against which sealing disc 50 abuts to limit axial outward movement of piston 16. The size of rim 140 and the relative resiliency and shape of sealing disc 50 may be selected to permit disc 50 to flex and snap inwardly past rim 140 for easy insertion and to flex and snap outwardly past rim 140 for removal under forces greater than normally to be applied in normal pumping operation of the pump.

Figure 7 also shows a cover 142 which fits in a snap engagement onto body 12 forming an airtight annular seal thereabout. A small hole 144 is provided in the top of cover 142.

In use, in accordance with a second aspect of the present invention, the container 26 is substantially filled with viscous material such as soap or a hand cream or the like. The pump assembly 10 and cover 142 are then applied. With the container preferably in a vertical position and the cover 142 oriented upwardly, a vacuum is applied to hole 144 in the cover 142 which draws air out of the container in that both the sealing disc 216 and flexing disc 48 can deflect to permit gas to pass outwardly under the vacuum. When all the air is withdrawn, the soap-like liquid comes to contact the sealing disc 216. The vacuum pressure required to draw the soap-like liquid past the sealing disc 214 is substantially greater than the pressure

required to draw out gas. The vacuum pressure is selected to be a pressure which will easily draw out the gas but is insufficient to draw out the liquid.

The operation of the pump shown in Figure 7 is as previously described wherein a reduced pressure caused by the withdrawal of the piston 16 causes sealing disc 216 to deflect away from the chamber wall and fluid to flow into chamber 18 past the sealing disc 216. In the withdrawal stroke, flexing disc 48 remains substantially undeflected and assists in creating suction forces in chamber 18 to deflect the sealing disc 216 and draw fluid therepast.

As is in the previous embodiments shown in Figures 1 to 3, the return of piston 16 pressurizes fluid in chamber 18 between the piston and sealing disc 216. This pressure urges the sealing disc 216 to a closed position abutting the side walls of the inner chamber 204. As a result of this pressure, flexing disc 48 deflects its periphery in the manner as that in Figures 1 to 3, so as to come out of sealing engagement with outer chamber wall and permit fluid to flow past disc 48 and out of chamber 18 via passage 52 and channel 56 and passage 52.

Advantages of such a liquid filled evacuated container include:

1. improved drop strength;
2. longer shelf life for degradable products because oxygen in the air is withdrawn;
3. the pump assembly is primed and delivers product on the first pumping of the piston;
4. air pockets are eliminated which, during later use, can enter the pump assembly and temporarily prevent flow of soap from the outlet during pumping which could make a user believe that the

container is empty of soap when it is not.

The particular configuration of the pump assembly is not critical for use in gas evacuation under vacuum. The pump assembly needs to be configured merely so that when a vacuum is being applied, there are one-way valve systems which permit air to be drawn out of the container at a lower vacuum pressure yet requires a substantially higher vacuum pressure to permit the soap to be drawn out past one of the one-way valves.

The piston 16 does not need to be in place to evacuate the air from the container.

The cover 142 is also not essential and a removable vacuum housing could be applied over the body 12 to apply the vacuum. However, it is greatly preferred that some sort of cover be provided particularly with the cover having a hole 144 through which the vacuum can be applied.

Reference is now made to Figure 8 which shows a form of the body 12 illustrated in Figures 1 to 3 and 5 to 7 modified to show a third aspect of the present invention. The body 12 in Figure 8 is essentially identical to the body in Figures 1 to 3 with the exception that an annular groove 146 is provided between inner cylindrical portion 41 and an outer wall 148. The annular bottom 150 of groove 146 has a number of openings 152 therethrough. A resilient flexible annular seal ring 154 is provided secured in groove 146 against its inner side wall 155 by a radially inner major arm 156 of the ring engaging a shoulder on radially outwardly extending boss 158. An outer arm 160 of seal ring 156 engages the outer wall 159 of groove 146 and is adapted to flex radially inwardly to form a one-way valve. This one-way valve structure of Figure 8 is adapted to permit use of the pump assembly 10 of Figures 1 or 6 with a rigid non-collapsible container 26 whose neck is only partially shown in Figure 8.

In use with the bottle inverted, on pumping soap from the non-collapsible container 26, a vacuum comes to be created in the container which would, if not decreased, prevent further pumping. The annular seal ring 154 functions by deflection of outer arm 160 to permit air to enter the container via openings 152 when a vacuum is created in the container. The seal ring 154 prevents flow of liquid out of the container via openings 152.

As is to be appreciated, the annular seal ring 154 may be made of any suitable flexible material including plastic, rubber or nylon, but is preferably formed from the same material as body 12 and piston 16 so as to facilitate recycling.

While Figure 8 is described with reference to the aspect of the invention shown in Figures 1 to 3, it is to be apparent that the sealing ring 154 and corresponding modifications to the pump assembly could equally be incorporated in soap dispensers which use more conventional pump assemblies.

Although the disclosure describes and illustrates a preferred embodiment of the invention, it is to be understood that the invention is not limited to these particular embodiments. Many variations and modifications will now occur to those skilled in the art.

WHAT I CLAIM IS:

1. A pump for dispensing liquid from a reservoir comprising:

piston-chamber forming means having an inner cylindrical chamber and an outer cylindrical chamber, the inner chamber and outer chamber each having a diameter, a chamber wall, an inner end and an outer end,

the inner chamber and outer chamber being coaxial with the outer end of the inner chamber opening into the inner end of the outer chamber, the inner end of the inner chamber in fluid communication with the reservoir,

the piston-chamber forming means characterized by the diameter of the inner chamber being less than the diameter of the outer chamber,

a piston forming element received in the piston-chamber forming means axially slidable inwardly and outwardly therein,

said piston forming element being generally cylindrical in cross-section with a central axially extending hollow stem having a central passageway closed at an inner end and having an outlet proximate an outer end,

an inner circular flexing disc extending radially outwardly from the stem proximate the inner end, the inner flexing disc having an elastically deformable edge portion proximate the chamber wall of the inner chamber circumferentially thereabout,

an outer circular flexing disc extending radially outwardly from the stem spaced axially outwardly from the inner flexing disc, the outer flexing disc having an elastically deformable edge portion proximate the chamber wall of the outer chamber circumferentially thereabout,

a circular sealing disc extending radially outwardly from the stem spaced axially outwardly from the outer flexing disc, the sealing disc engaging the chamber wall of the outer chamber circumferentially thereabout to form a substantially fluid impermeable seal therewith on

sliding of said piston forming element inwardly and outwardly,

an inlet located on the stem between the outer flexing disc and the sealing disc in communication with the passageway,

the piston forming element slidably received in the piston-chamber forming means for reciprocal axial inward and outward movement therein with the inner flexing disc in the inner chamber and the outer flexing disc and sealing disc in the outer chamber,

the inner flexing disc substantially preventing fluid flow in the inner chamber past the inner flexing disc in an inward direction,

the outer flexing disc substantially preventing fluid flow in the outer chamber past the outer flexing disc in an inward direction,

the inner flexing disc elastically deforming away from the chamber wall of the inner chamber to permit fluid flow in the inner chamber past the inner flexing disc in an outward direction,

the outer flexing disc elastically deforming away from the chamber wall of the outer chamber to permit fluid flow in the outer chamber past the outer flexing disc in an outward direction.

2. A pump as claimed in claim 1 further comprising:

engagement means on the piston for engagement to move the piston forming element inwardly and outwardly.

3. A pump as claimed in claim 2 wherein:

said piston forming element extends outwardly from the outer end of the outer chamber, and

said engagement means is on said stem outward of the piston-chamber forming means.

4. A pump as claimed in claim 3 wherein:

the engagement means comprises a circular flange

extending radially outwardly from said stem.

5. A pump as claimed in claim 4 including means to limit inward movement of the piston forming element by abutment with the piston-chamber forming means.

6. A pump as claimed in claim 1 including locating means on said stem extending radially outwardly from the stem to engage the chamber wall of at least one of the inner chamber and outer chamber and guide the piston forming element in axially centered alignment within the inner end of the outer chamber in sliding within the piston-chamber forming means.

7. A pump as claimed in claim 6 wherein the locating means comprises a plurality of axially extending webs.

8. A pump as claimed in claim 7 wherein the axially extending webs are provided between the inner flexing disc and the outer flexing disc for engagement with the chamber wall of the inner chamber.

9. A pump as claimed in claim 1 wherein stop means are provided proximate the outer end of the outer chamber extending radially inwardly from the chamber wall of the outer chamber to engage the sealing disc and limit the axial sliding of the piston-forming element outwardly.

10. A pump as claimed in claim 9 wherein said stop means is adapted to permit said sealing disc to pass inwardly therepast and to pass outwardly therepast under forces greater than that required for reciprocal inward and outward movement of the piston forming element within the piston-chamber forming means to pump fluid.

11. A pump as claimed in claim 1 wherein the piston forming element consists of a unitary element formed

entirely of plastic by injection molding.

12. A pump as claimed in claim 5 wherein the piston forming element consists of a unitary element formed entirely of plastic by injection molding.

13. A pump as claimed in claim 1 wherein:

the inner end of the outer chamber comprises an annular shoulder opening into the outer end of the inner chamber,

said outer flexing disc engaging said annular shoulder to limit inward sliding of the piston forming element into the piston-chamber forming means.

14. A pump as claimed in claim 1 wherein said piston-chamber forming means comprises the neck of a container forming the reservoir.

15. A pump as claimed in claim 14 wherein the container comprises the unitary element.

16. A pump as claimed in claim 15 wherein said unitary element is formed entirely of plastic or entirely of glass.

17. A pump as claimed in claim 1 wherein said piston-forming means comprises a unitary element molded entirely of plastic by injection molding and adapted for securing to a container forming said reservoir.

FIG. 1.

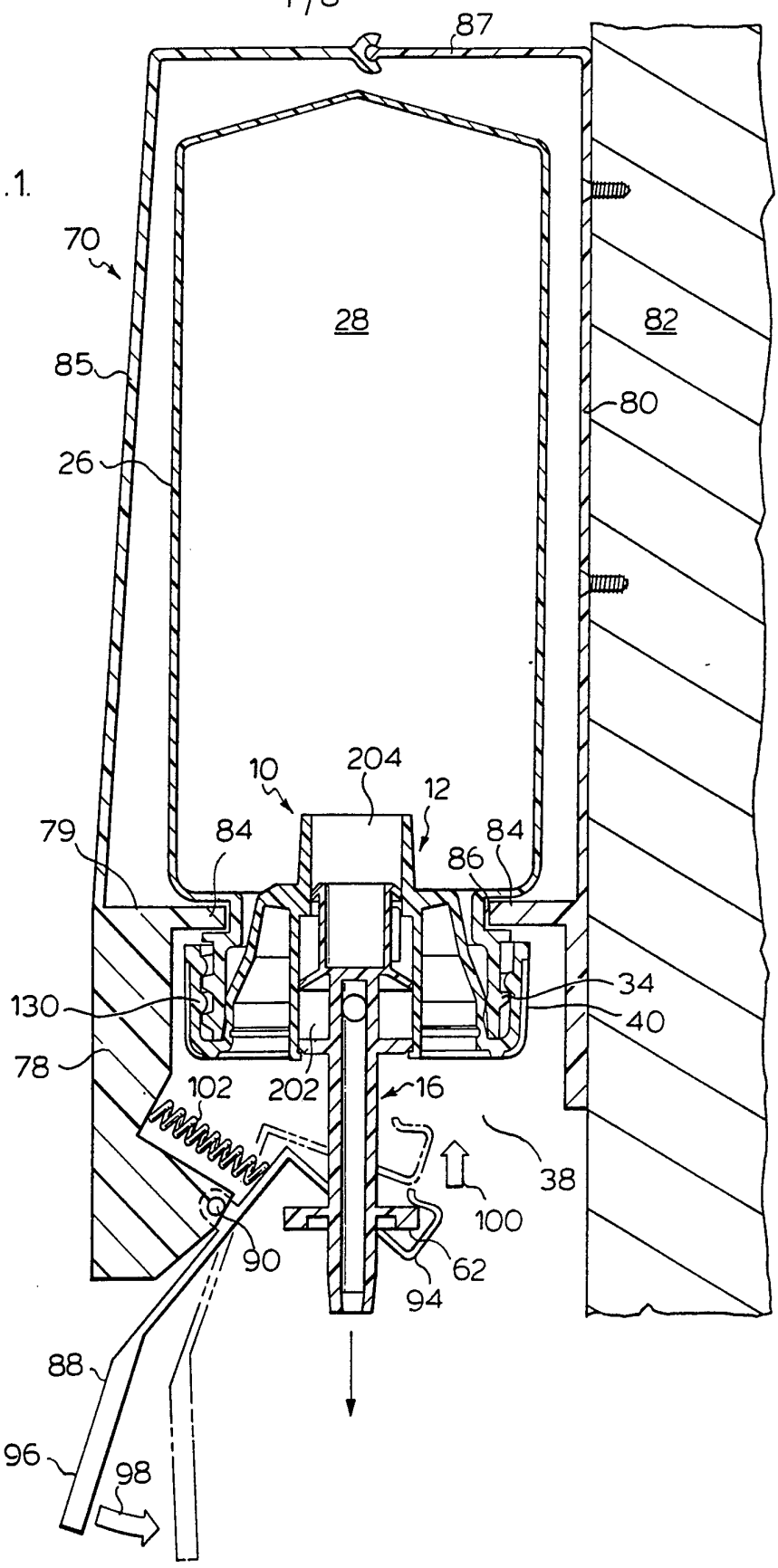
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FIG. 2.

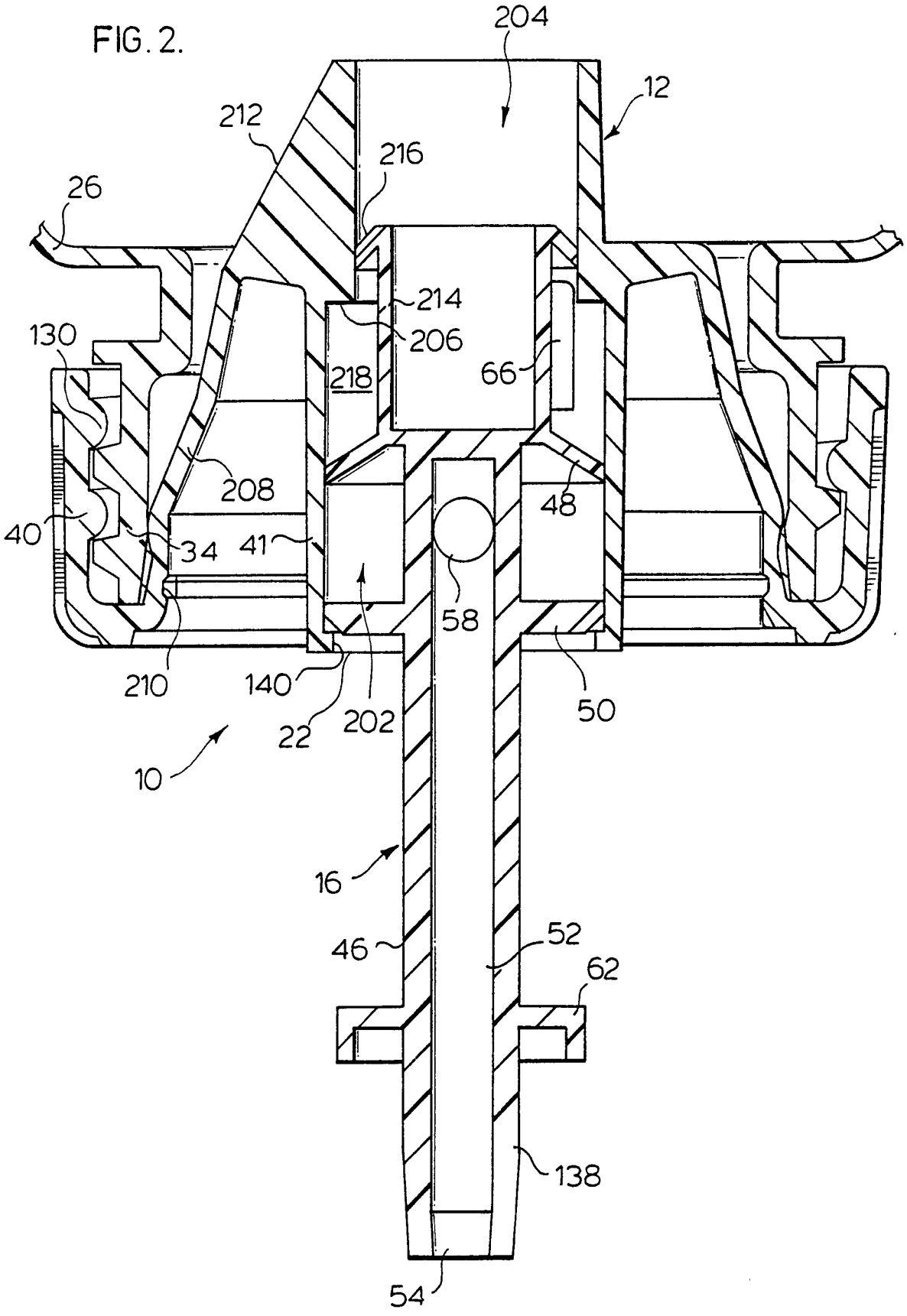
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FIG.3.

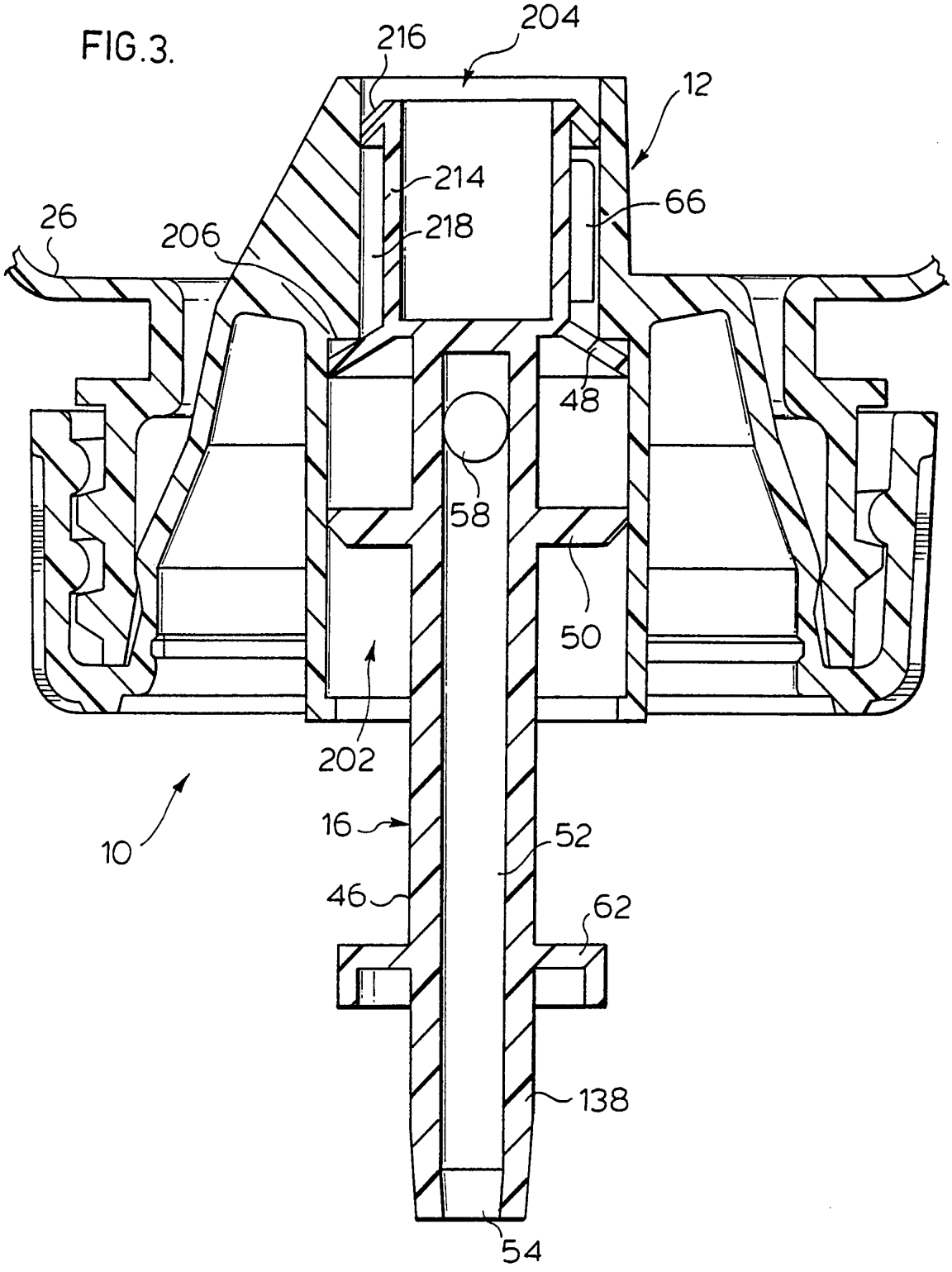
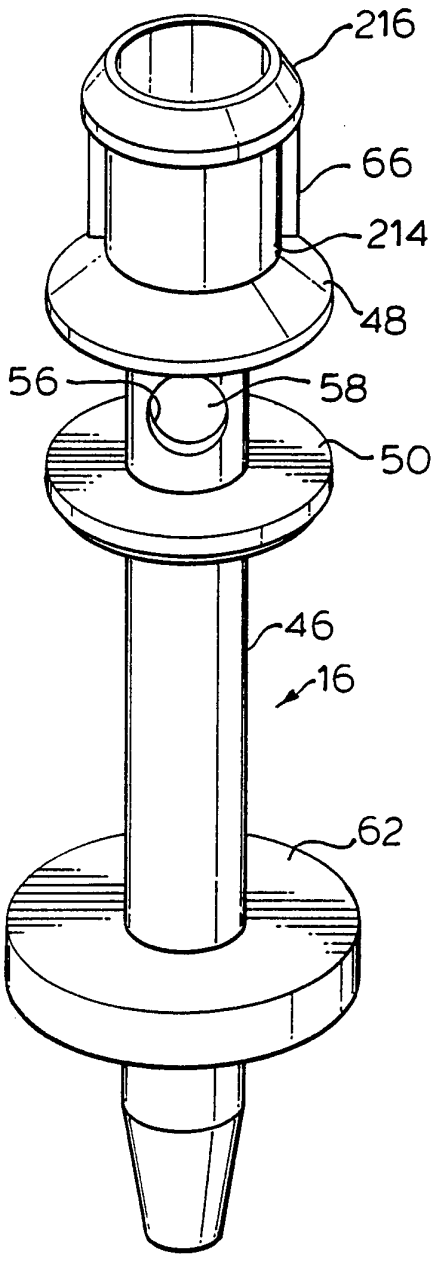


FIG. 4.



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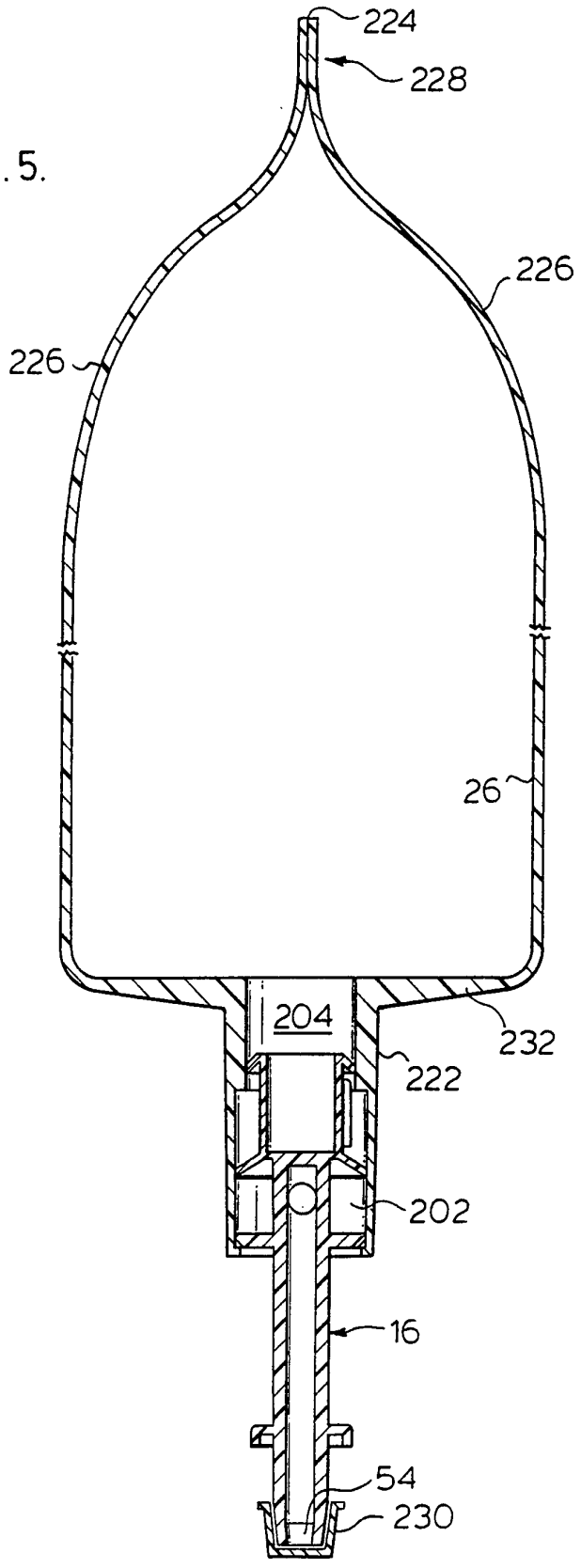

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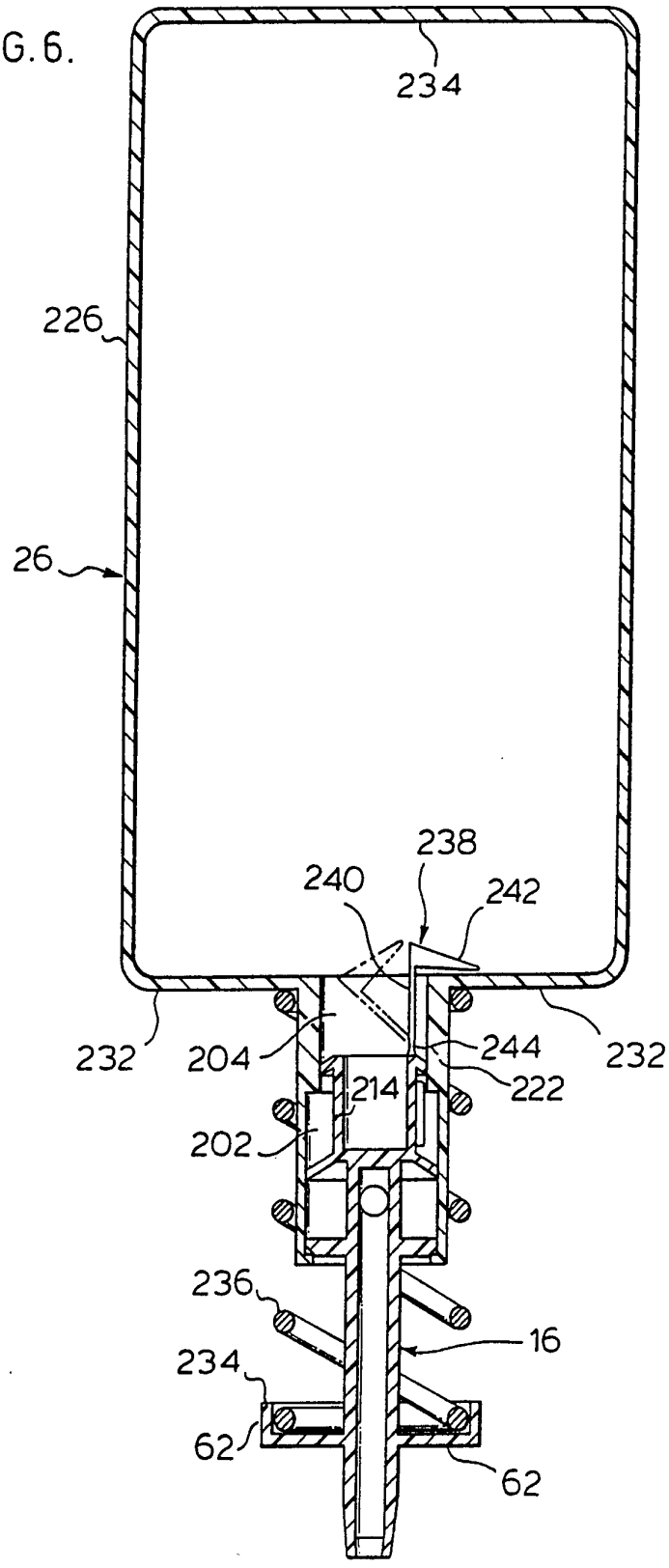
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FIG. 7.

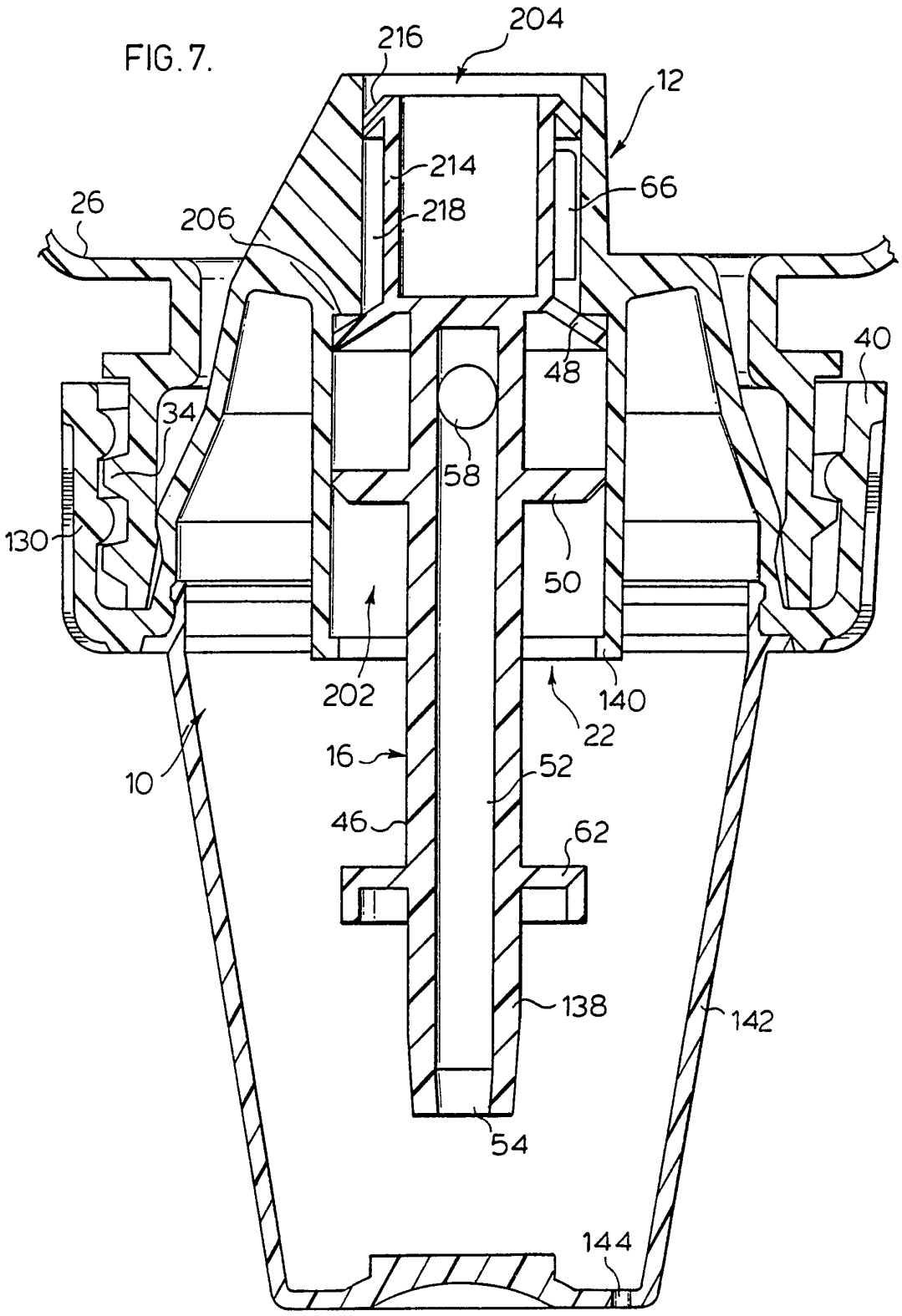
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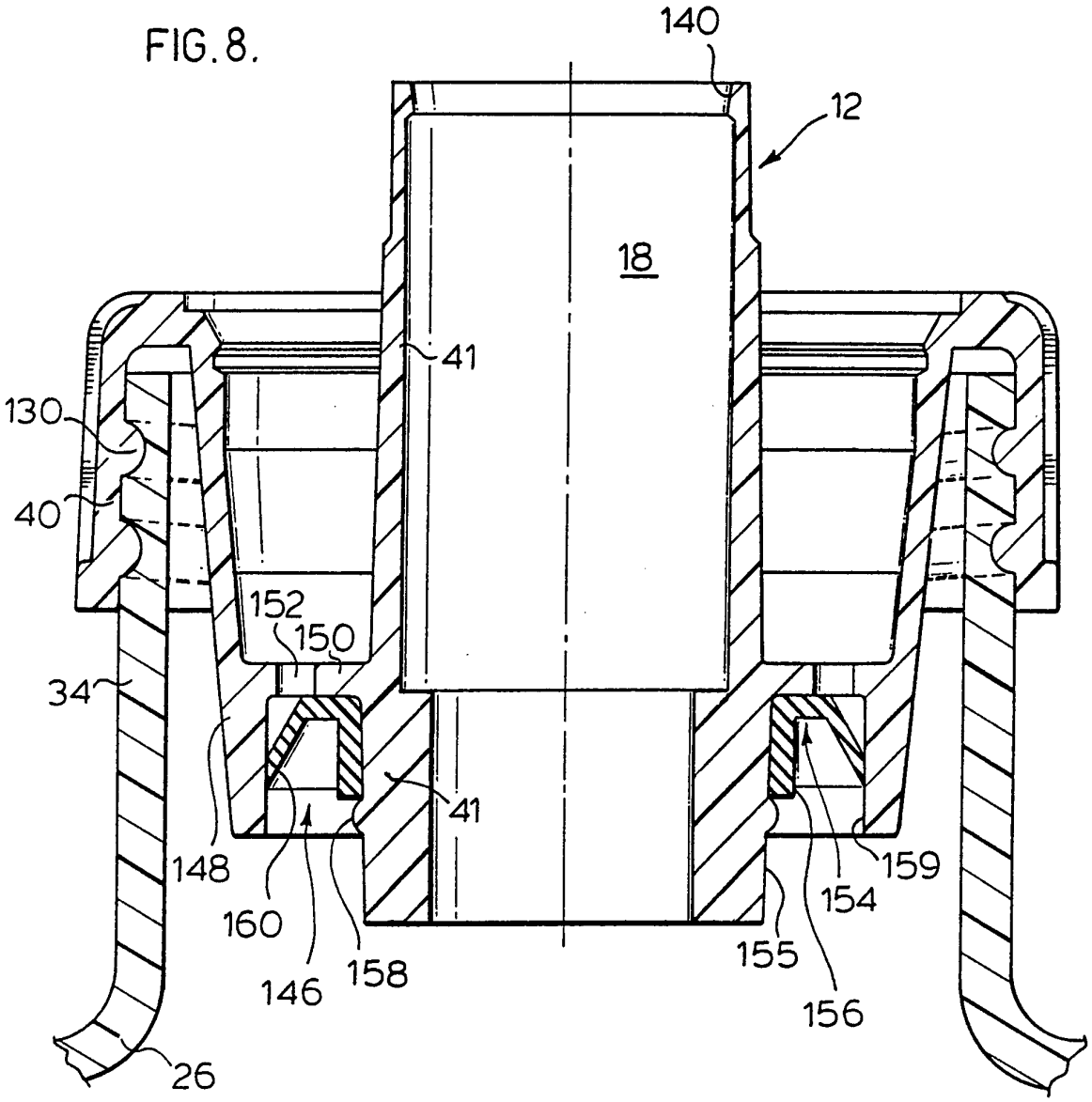
FIG. 8.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INTERNATIONAL SEARCH REPORT

Intern al Application No
PCT/CA 93/00495

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 F04B21/04 A47K5/12 F04B9/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 F04B A47K G01F B67B B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,A,39 26 855 (BOBRICK) 22 February 1990 see column 2, line 33 - column 3, line 21; figures 1,2 ---	1
A	FR,A,2 315 018 (BROILLIARD) 14 January 1977 see page 2, line 20 - page 4, line 1; figures 1,3,4 ---	1
A	FR,A,2 314 110 (ARMANDON) 7 January 1977 see figure 1 ---	1
A	US,A,4 493 440 (VON BUELOW) 15 January 1985 see figures 2,3 ---	1
A	DE,A,15 48 946 (ERMECKE) 29 October 1970 ---	1
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 February 1994	04. 03. 94
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Authorized officer Bertrand, G

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	US,A,5 165 577 (OPHARDT) 24 November 1992 see the whole document -----	1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter nal Application No
PCT/CA 93/00495

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		WO-A- 8500798	28-02-85
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