Feb. 8, 1966 N. A. ZEPELL 3,233,594

FLUID CONTAINER

Original Filed April 28, 1961 2 Sheets-Sheet 1

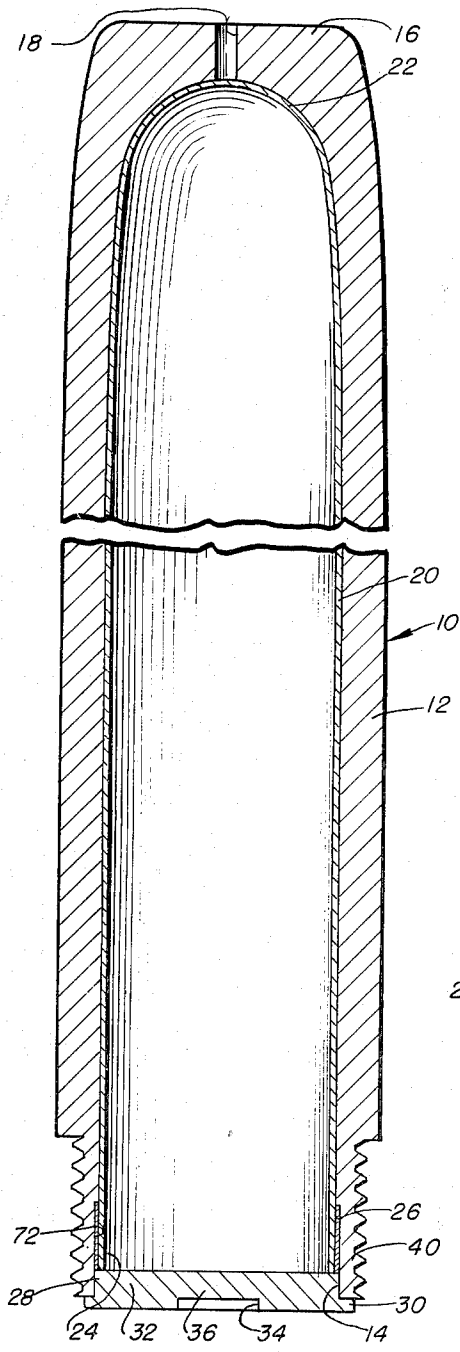


FIG. 1

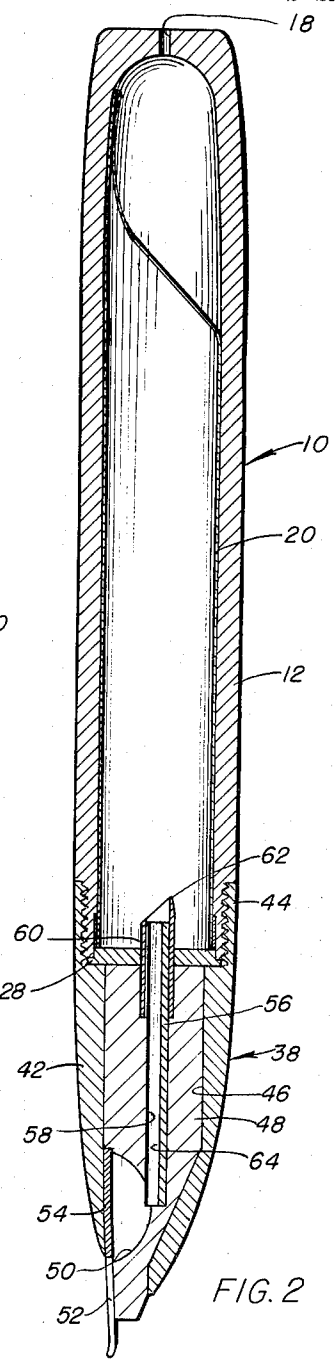


FIG. 2

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FLUID CONTAINER

Original Filed April 28, 1961 2 Sheets-Sheet 2

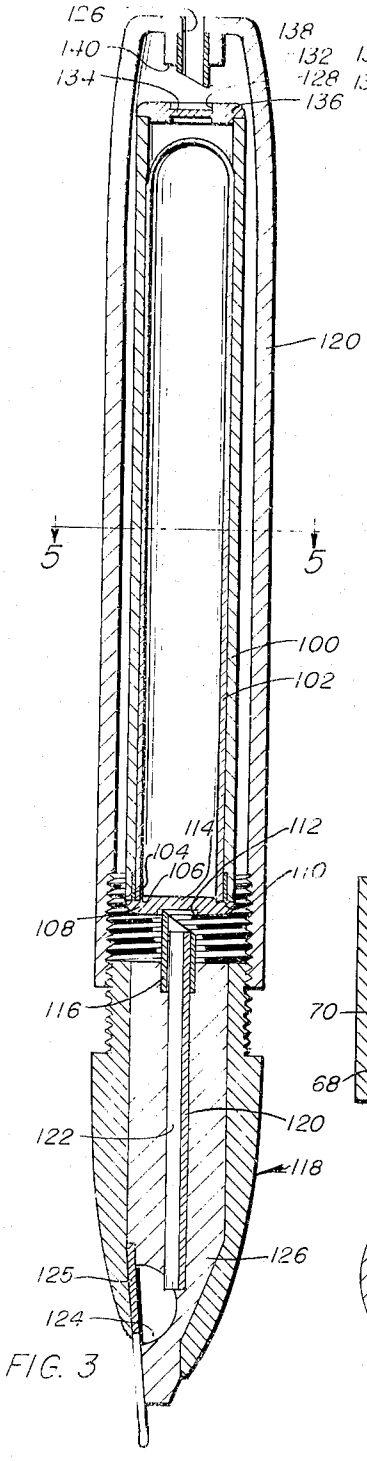


FIG. 3

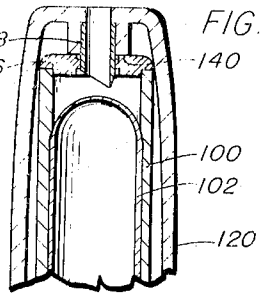


FIG. 4

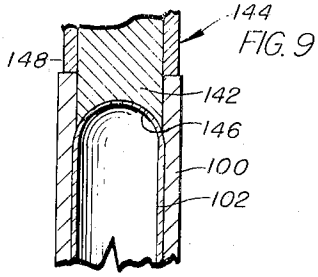


FIG. 9

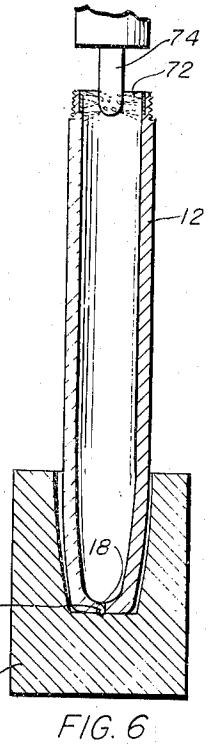


FIG. 6

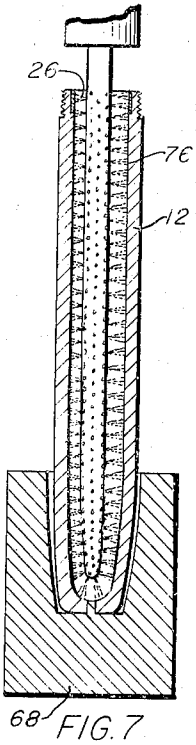


FIG. 7

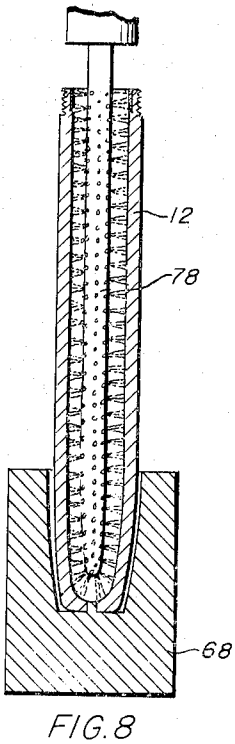


FIG. 8

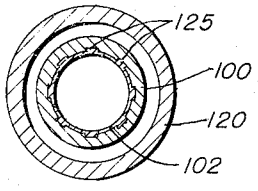


FIG. 5

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United States Patent Office 3,233,594 Patented Feb. 8, 1966

3,233,594

FLUID CONTAINER

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Continuation of application Ser. No. 106,312, Apr. 28, 1961. This application Apr. 24, 1964, Ser. No. 363,678
3 Claims. (Cl. 120—45.4)

This application is a continuation of application Serial Number 106,312, filed April 28, 1961, now abandoned. The invention relates to a container for liquids, and more particularly to a fluid reservoir having a wall member which is displaceable to reduce the capacity of the reservoir in response to the withdrawal of fluid therefrom.

More particularly, this invention pertains to a fluid container, comprising a flexible wall member defining a reservoir for receiving a column of fluid, and a body portion releasably supporting the flexible wall member, the flexible wall member being displaceable relative to the body portion to reduce the volumetric capacity of the reservoir in response to the withdrawal of fluid therefrom.

The reservoir of the usual fountain pen or similar implement remains unchanged as to capacity during normal use—air entering the reservoir to replace fluid as it is withdrawn during writing. Because of the difference in density between air and liquid, the air entering the reservoir rises above the writing fluid and remains thereabove regardless of the position in which the fountain pen subsequently may be held.

The air thus present in the reservoir of a writing implement will expand or contract if subjected to changes in temperature and/or atmospheric pressure.

A decrease in atmospheric pressure or an increase in temperature easily may cause an undesirable condition in the usual pen should it be positioned point downwardly, as in writing. Under these conditions, a quantity of fluid, equal to the increase in air volume, will be forced from the reservoir and into the expansion chambers of the feed. If such expansion chambers are not of sufficient capacity, a portion of this fluid may drip from the implement into the cap or blot the writing surface or soil the user's hands or clothing. This problem of expansion is encountered particularly during air travel, in which great extremes of temperature and pressure are encountered in relatively short periods of time. However, if a pen is positioned point upwardly when the above described expansion of air occurs, the excess air in the reservoir will escape readily through the feeding passageways without causing leakage.

In addition, as is well understood in the art, present day fountain pens are limited as to capacity because of the above described problem of expansion of air which may be trapped above the fluid. This factor requires relatively frequent refilling of the pen on the part of the user.

These problems long have been recognized in the art, and a number of proposals have been made for their solution. For example, it has been proposed to use valves to prevent leakage and flooding while still allowing for a large capacity. However, such proposals have not been manufactured commercially because of complications in manufacture and subsequent operation while in the hands of a user. Capillary storage cuts have been used in the feed of a fountain pen to partially compensate for expansion of air in the reservoir, but such an arrangement does not eliminate the problem of expansion nor does it provide for a large controlled fluid capacity.

Accordingly, it is a principal object of this invention to provide a fluid reservoir for a fountain pen or the like,

which reservoir is not subject to leaking and flooding as a result of temperature or barometric pressure changes.

Another object of this invention is to provide a fluid reservoir which has a large capacity but which is not affected by temperature or barometric pressure fluctuations.

A further object of this invention is to provide a fluid reservoir which has a flexible wall member adapted to follow the fluid and reduce the volumetric capacity of the reservoir as the fluid is withdrawn therefrom.

A still further object of this invention is the formation of a reservoir having a body portion releasably engaging a flexible wall member of the above described character, which wall member may be formed directly within the body portion, thereby eliminating the necessity of any assembly thereof.

Yet another object of this invention is the provision of a fountain pen reservoir of the above character which is furnished in the form of a cartridge unit.

Further and additional objects of this invention will be apparent from the following description when taken with the accompanying drawings.

In accordance with one embodiment of the invention the fountain pen comprises a fluid container and a writing unit assembly mounted forwardly thereof, the fluid container having a vented hollow body portion and a film-like layer of flexible material forming a flaccid sack engaging and releasably adhering to the interior surface of the body portion. The interior surface of said sack defines a writing fluid reservoir, and the unit assembly has conduit means providing the sole fluid lead or leads from said writing fluid reservoir. The conduit means is small enough in cross-section to prevent rearward movement of air therethrough into the reservoir while there is writing fluid within the conduit; that is, air will not bubble through to the reservoir as it does in the usual fountain pen. The adherent attachment of the sack to the interior surface of the body portion is sufficient to resist separation thereof and the consequent free discharge of writing fluid through the conduit under the influence of the normal weight of said column. However, the sack is separable from and displaceable within the body portion to reduce the volumetric capacity of the reservoir in response to forcible withdrawal of writing from the conduit by capillary action as during writing.

In the drawings:

FIGURE 1 is a greatly enlarged broken longitudinal sectional view of a cartridge barrel unit embodying a preferred form of the present invention;

FIG. 2 is a reduced longitudinal sectional view similar to FIG. 1 of the cartridge barrel unit thereof, assembled with the writing unit of a fountain pen, with the fluid supply being partially depleted;

FIG. 3 is a longitudinal sectional view of another embodiment of the present invention, showing a cartridge unit partially assembled with a fountain pen;

FIG. 4 is a fragmentary sectional view of the rearward portion of FIG. 3, showing the venting of the cartridge unit;

FIG. 5 is a sectional view along the line 5—5 of FIG. 3;

FIGS. 6, 7 and 8 are views in longitudinal cross section, showing steps in the manufacture of the cartridge barrel unit of FIG. 1; and

FIG. 9 is a fragmentary sectional view of the rearward portion of the cartridge unit of the embodiment of FIG. 3, showing the holder or carrier utilized during formation of the flexible wall member.

Referring now to the drawings and particularly to FIGS. 1 and 2 thereof, there is provided a fountain pen cartridge unit **10** having a body or support portion **12** molded or otherwise formed of a durable, relatively

rigid material such as any one of a number of well-known plastics or metals. While other configurations may be used, the body portion **12** preferably is generally cylindrical, having an open forward end **14** and a semi-spherical closed end **16**. The closed end **16** is provided with an aperture **18** defining a vent passage between the exterior and the interior of the body portion **12**.

Disposed within and releasably supported by the body portion **12** is a flexible or flaccid wall member **20** which may be formed of any one of a number of materials, as will be indicated in more detail herebelow. The wall member **20** is slightly adherent to the body portion **12**, and preferably relatively thin. It is shown in the drawings as being proportionately thicker than it normally would be in actual practice, in order to clearly disclose the character thereof. Generally, the wall member may range between .001" to .010" in thickness, although it is understood that the thickness thereof is not to be limited to this range as it may be varied depending upon the material from which it is formed and the fluid feeding characteristics desired.

In this embodiment of the invention, the flexible or flaccid wall member **20** is shown in the general shape of the usual cylindrical ink reservoir sac, having a closed end **22** and an open end **24**. The closed end **22** is positioned at the closed end **16** of the body portion **12**, with its open end **24** being positioned at the open end **14** of the body portion. Accordingly, the flexible wall member **20**, in effect, forms a liner within the body portion to provide a laminated reservoir section. Disposed within the body portion **12** adjacent its forward end **14** is a thin band of adhesive or primer **26** which forms a permanent bond between the body portion **12** and wall portion **20** adjacent their forward ends **14** and **24**, respectively.

The reservoir thus defined by the interior surface of the flexible wall member **20** is intended to be filled with a liquid, such as an ink of the type used in pens. Therefore, in order to close the forward end of the body portion **12** and wall portion **20**, there is provided means comprising a closure disc **28** having a flange **30** and a rearwardly extending center portion **32**. The flange **30** is bonded to the forward end **14** of the body portion **12** as by heat sealing. The closure disc **28** is provided with a centrally disposed circular recess or discharge **34** which defines a thin diaphragm **36** pierceable readily by a pointed tubular member such as those used in present day cartridge type fountain pens.

The outer surface of the flexible wall member **20** is engaged in intimate contact with the interior surface of the body portion **12** throughout the entire surface area thereof. When thus engaged, the flexible wall member **20** is in an unstressed or neutral condition and exerts no appreciable pressure on the liquid disposed therein. Accordingly, at no time, does it have a tendency to force fluid from the reservoir even when the reservoir is open and in use in a fountain pen or similar implement. In fact, because of the slight adherent attraction between the wall member **20** and the body portion **12**, the wall member, as outlined in more detail hereinbelow, will tend to create a slight negative pressure in the reservoir (a pressure below normal air pressure) as fluid is withdrawn through the capillary feed channels of a fountain pen or similar implement.

The embodiment of FIG. 1 is shown as being included in a cartridge barrel unit intended for assembly with a fountain pen writing unit **38** as illustrated in FIG. 2. For this reason, the exterior surface of the body portion **12** is provided with a threaded area **40**, or similar means, adjacent its forward end to allow direct attachment to the fountain pen writing unit **38**. Thus, the cartridge barrel unit **10** serves as the exterior barrel as well as the fluid reservoir.

The writing unit **38** includes a generally cylindrical gripping portion **42** which is formed preferably of an attractive and durable material matching or complementing that of the body portion **12**. The gripping portion **42** includes a rearwardly extending collar **44** which is detachably engageable with the threaded area **40** of the body portion **12**. Frictionally retained within the central bore **46** of the gripping portion **42**, is a feed bar **48** having a capillary feed fissure **50** disposed adjacent its forward end for fluid communication with the feed slit **52** of the writing element or pen point **54**. And, as indicated in FIG. 2, the pen point **54** is frictionally maintained within the gripping portion **42** by the feed bar **48**.

To provide communication between the capillary fissure **50** and the reservoir, there is provided an insert **56** positioned in an axial feed aperture **58** which extends from the fissure **50** through the rearward end of the feed bar **48**. This insert extends rearwardly beyond the feed bar **48** and terminates within a generally cylindrical pierce tube **60** having a pierce point **62** defined by a tapered upper end. Provided by the insert **56** is a capillary passage **64** arranged for the movement of fluid from the reservoir to the feed fissure **50**, from where such fluid subsequently is transferred to the slit **52** of the pen point **54** for deposit during writing.

One of the features of the present invention is the elimination of the necessity of providing the usual comb cuts in order to retain fluid which might be forced from the reservoir of a pen as a result of atmospheric pressure or temperature changes.

In addition, there is no need to provide any type of passage for the exchange of air between the feed and reservoir since the flexible wall member **20** is displaced within the body portion **12** to follow the ink as it is withdrawn during writing and thereby reduce the volumetric capacity of the reservoir. These features eliminate the possibility of the entry of air into the reservoir, and the difficulties attendant thereto, as well as greatly reducing the complexity and cost of manufacturing the feed bar and its associated parts.

The heretofore described fountain pen construction is used by an individual in the same manner as any other fountain pen. Thus, it does not require any special handling or attention on the part of the owner. When the implement is in writing use, fluid is withdrawn from the reservoir, as defined by the interior surface of the flexible wall member **20**, through the capillary passage **64** and the feed fissure **50**, whereafter it is transferred to the feed slit **52** of the pen point **54**, and then deposited on a writing surface, such as paper. As the flexible wall member **20** follows the diminishing supply of ink, it gradually is disengaged from the interior surface of the body portion **12**, air pressure being exerted on its exterior surface through the vent **18** of the body portion **12**.

The attraction between the flexible wall member **20** and the body portion **12** prevents separation of the wall member and body portion except as a result of a slight negative pressure created in the reservoir upon the withdrawal of fluid through the capillary passage **64** of the insert **56** and the feed fissure **50** of the feed bar **48**. While these capillary channels are capable of producing only limited amounts of force, such force is sufficient, in combination with air pressure, to draw the flexible wall member away from the body portion **12** as represented in FIG. 2 of the drawings.

Since only the substantially empty displaced portion of the wall member **20** is unsupported within the body portion **12**, the weight of the remaining column of fluid does not cause any kinking or creasing of the still-filled portion of the wall member **20**, thereby preventing entrapment of part of the fluid behind a crease, or premature stoppage of the flow of fluid.

In the present invention, it is preferred to form the flexible wall member **20** directly in the body portion **12** thereby eliminating the expense of subsequent assembly of the individual parts.

The amount of attraction between the wall member

and body portion may be controlled in several ways, such as by the selection of materials to be used in the body portion and wall member, by providing slight irregularities such as grooves or a "pebble" surface on the interior of the body portion, or by using a release agent between the body portion and wall member should the materials used therein exhibit a greater amount of attraction than is necessary.

Formation of the flexible wall member **20** within the body portion **12** may be accomplished by any one of several methods, such as by spraying the material of the wall member within the body portion, or by a procedure known as "slush" molding, which involves filling the body portion with a liquid plastic or rubber compound which is subsequently emptied except for a thin layer adhering to the interior wall of the body portion. The particular process chosen depends somewhat upon the material used in forming the flexible wall member **20** as certain materials lend themselves best to certain processes of handling, as is recognized readily by those in the plastic and rubber fabricating field.

The embodiment of FIG. 1 may be formed by a three-step process such as that shown in FIGS. 6, 7 and 8 of the drawings. This is a process by which the materials are sprayed within the body portion **12** as it is carried from station to station on an automated indexing machine. The body portion **12** is first inserted into a holder or carrier **68** which is provided with a centrally disposed plug **70** adapted to extend into and close the vent **18**, thus providing a substantially unbroken interior wall on the closed end **16** of the body portion **12**.

The body portion **12** is moved to the first station on the indexing machine as represented in FIG. 6, where a thin layer of a liquefied adhesive or primer is sprayed on the interior surface of the body portion **12** to coat an annular recess **72** formed adjacent its open forward end **14**. The spraying is accomplished by forcing the adhesive or primer through a plurality of small apertures disposed around the periphery of a dispensing nozzle **74**.

The body portion **12** is then moved to the next station, as illustrated by FIG. 7, at which time an elongated dispensing nozzle **76** is inserted therein. The nozzle **76** is provided with a plurality of minute apertures spaced over its entire surface so that a liquid material may be forced therethrough to provide an even coating of material on the interior surface of the body portion **12**. For this particular step, a liquified silicon rubber has been found to give good results not only from the standpoint of ease of application but of subsequent performance as the flexible wall member **20** in the completed reservoir. Following the second step, it may be desirable to rotate the carrier **68** for a short time in order to insure retention of an even thickness of material as it takes its initial "set." Thus, the finished flexible wall member **20** will exhibit a uniform thickness throughout its length.

The third step in the procedure as represented by FIG. 8, involves the application of a catalyst to the thin layer of silicon rubber as formed during the second step, in order to complete its vulcanization. As in the case of step 2, the catalyst is sprayed evenly over the layer of silicon rubber through a plurality of apertures spaced over the surface of an elongated dispensing nozzle **78**. After application of the catalyst, the body portion **12** may be removed from the carrier **68** and prepared for further handling by the manufacturer.

It is to be understood that various materials other than silicon rubber are useful in this invention, such as relatively resilient or elastic materials dissolved in a volatile vehicle, as well as materials such as latex dispersed in water. Such materials, of course, may require a different method of application than that hereinabove described, as will be understood readily by those in the art.

After the formation of the flexible wall member **20** has been completed the cartridge unit may then be filled with ink or a similar liquid substance, and the open end thereof sealed with the closure disc **28** as described heretofore.

After the complete supply of writing fluid has been depleted from the cartridge barrel unit **10**, and the flexible wall member **20** completely collapsed, it may be discarded and replaced by a fresh, factory filled unit. However, under certain circumstances, it may be desirable to refill the reservoir, which refilling may be done merely by forcing fluid under a light pressure through the above described fluid passages **50** and **64**. The pressure used in forcing the fluid through these channels is sufficient to cause distention of the flexible wall member **20** into its original intimate contact with the interior surface of the body portion **12**.

It is understood that the term *distention*, as used herein, does not indicate any stretching or inflation of the flexible wall portion **20** but merely the positioning thereof in its unstressed, neutral position.

The embodiment of FIG. 3, similar basically to the embodiment of FIG. 1 is shown as being disposed in and partially assembled with a fountain pen having a writing unit assembly identical to that described hereinabove. This modification includes a body portion or support **100** which is formed preferably of a semi-rigid material such as polyethylene. Formed within the body portion **100**, in the manner described heretofore with respect to the embodiment of FIGS. 1 and 2, is a flexible or flaccid wall portion **102**. As will be understood from the foregoing discussion of the embodiment of FIG. 1, the flexible wall member is releasable from and displaceable within the body portion **100** to follow the ink and reduce the volumetric capacity of the reservoir as fluid is withdrawn therefrom during writing.

The forward ends **104** and **106** of the body portion **100** and wall member **102**, respectively, are closed by a seal disc **108** molded of polyethylene or similar material and provided with a flange **110** bonded to the body portion **100** at its open forward end **104**. The seal disc **108** is provided with an annular recess **112** defining a fluid discharge which is closed by a thin diaphragm member **114** which is readily pierceable by the pierce tube **116** of the writing unit assembly **118**. The insert **120** disposed within the pierce tube **116** provides a fluid passage **122** for communication between the interior of the cartridge unit and a fluid feed path **124** formed in the forward portion of the feed bar **126**. Thus, after completing assembly of the pen illustrated in FIG. 3 and during writing use thereof, fluid will be drawn from the reservior, through the insert passage **122** and into the feed path **124**, for transfer to the pen point and subsequent deposit on a writing surface.

As clearly shown in FIG. 5 of the drawing, the body portion **100** is provided with a plurality of longitudinally extending grooves **125** around its interior surface, in order to provide a larger area of contact and a greater amount of adhesive attraction between the body portion **100** and the flexible wall member **102**.

In order to allow displacement of the flexible wall portion **102** within the body portion **100** as fluid is withdrawn from the reservoir during writing, air vent passages **126** and **128** are provided through the rearward end of the pen barrel **120** and the body portion **100**, respectively. The vent **126** through the pen barrel **120** is defined by a tubular element **138** provided on its forward end with a pierce point **132**. The pierce point is adapted to break a diaphragm **134** which is formed in a second seal disc **136** to close the vent **128** except upon assembly of the cartridge unit with the fountain pen. One of the purposes of providing the diaphragm **134** is to prevent inadvertent damage to the flexible wall member **102** as by the insertion of a pin or other sharp instrument through the vent **128** prior to use of the cartridge unit.

In order to eliminate any possibility of rupture of the flexible wall member **102** by the pierce point **132**, the rearward end of the barrel **120** is provided with an in-

ternally disposed forwardly facing shoulder **140** which surrounds the tubular element **138** and which abuts the rearward or outwardly facing surface of the second seal disc **136** thereby limiting the amount of movement of the pierce point **132** through the vent **128** during assembly of the barrel with the writing point assembly. This feature is best shown in FIG. 4 of the drawings.

During formation of the flexible wall member **102** within the body portion **100**, it is necessary to provide temporarily a closure member **142**, see FIG. 9, which conveniently may comprise a part of the holder or carrier **144**. The closure member **142** is sized so as to fit snugly within the rearward end of the body portion **100** and includes a generally semi-spherical concave surface **146** in its lower end thereby forming a wall portion against which the material of the flexible member **102** is sprayed.

Prior to insertion of the closure member **142**, the lower end **146** preferably is coated with a release agent so that it will readily separate from the rearward end of the flexible wall member **102** after formation thereof. For the purpose of ejecting the body portion **100** after completion of the wall member **102**, the carrier or holder **144** is provided with a ring **148** which is reciprocally movable relative to the closure member **142** and sized to act against the rearward edge of the body portion **100**.

The steps of formation of the wall member **102** within the body portion **100** may be accomplished in substantially the same manner as that described previously with respect to the emobdiment of FIG. 1. Accordingly, a discussion of the steps involved will not be repeated at this time.

It is to be understood that although only two embodiments of a fluid reservoir are illustrated and described herein for use with a fountain pen, this invention is not to be limited thereto as modifications thereof may be provided and, likewise, the invention may be utilized in connection with devices such as liquid adhesive dispensers and the like. Also, it is apparent that the flexible wall portion may be formed by methods other than the one specifically described herein.

Accordingly, this invention is not to be limited to the embodiments described hereinabove, and it is contemplated, by the appended claims, to cover any such modifications as fall within the true spirit and scope of this invention.

I claim:

1. A fountain pen comprising a fluid container and a writing unit assembly mounted forwardly of said fluid container, said fluid container having a vented hollow body portion and a film-like layer of flexible material forming a flaccid sack engaging the interior surface of said body portion, the interior surface of said sack defining a writing fluid reservoir, the exterior surface of said sac having an adhesive quality causing it to releasably stick to the interior surface of said body portion, said writing unit assembly having conduit means providing the sole means for fluid passage from said writing fluid reservoir, said conduit means being small enough in cross-section to prevent passage of air therethrough into said reservoir while writing fluid is disposed within said conduit means, the adherent attachment of said sack to the interior surface of said body portion being sufficient to resist separation thereof and the consequent free discharge of writing fluid through said conduit means under the influence of the normal weight of the fluid in the reservoir, and said sack being separable from and displaceable within said body portion to reduce the volumetric capacity of said reservoir in response to withdrawal of writing fluid from said conduit by capillary action.

2. In a fountain pen, a writing fluid container comprising a hollow body member and a flexible wall member formed as a continuous film within and substantially covering the interior surface of said hollow body member, the interior surface of said wall member defining a reservoir for receiving a column of writing fluid, the exterior surface of said wall member having an adhesive quality causing it to releasably stick to the interior surface of said body member, and capillary means for forcibly withdrawing writing fluid from said reservoir while preventing the entry of air thereinto, said container having a means providing atmospheric venting to the exterior surface of said wall member, the adherent attachment of said wall member to the interior surface of said body member being sufficient to resist separation thereof and the consequent free discharge of writing fluid through said capillary means under the influence of the normal weight of the column of writing fluid in the reservoir, the exterior surface of said wall member being progressively detached from the interior surface of said body member to reduce the volumetric capacity of said reservoir in response to the withdrawal of writing fluid from said reservoir by said capillary means.

3. In a fountain pen, a writing fluid container comprising a hollow body member and a flexible wall member formed as a continuous film within and substantially covering the interior surface of said hollow body member, the interior surface of said wall member defining a reservoir for receiving a column of writing fluid, the exterior surface of said wall member having an adhesive quality causing it to releasably stick to the interior surface of said body member, and capillary means for forcibly withdrawing writing fluid from said reservoir while preventing the entry of air thereinto, said container having a means providing atmospheric venting to the exterior surface of said wall member, the interior of said body member being provided with a surface conformation and finish which will cause said wall member to be adherently attached thereto sufficient to resist separation therefrom and the consequent free discharge of writing fluid through said capillary means under the influence of the normal weight of the column of writing fluid in the reservoir, but which will nevertheless permit the exterior surface of said wall member to be progressively detached therefrom against the resistance of the force of adhesion between said exterior surface and the interior surface of said hollow body member to reduce the volumetric capacity of said reservoir in response to the forcible withdrawal of writing fluid from the reservoir by said capillary means.

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