United States Patent

Schwartz

[15] **3,659,749**

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[54] INTERMIXING SYRINGE

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[21] Appl. No.: **32,695**

[52] **U.S. Cl.**.....**222/145,** 128/218, 222/386

[51] **Int. Cl.**.....**B67d 5/12**

[58] **Field of Search**.....222/129, 145, 213, 387, 389, 222/470, 490, 494, 491, 565, 386, 541, 495; 128/218 M, 218 NV, 220

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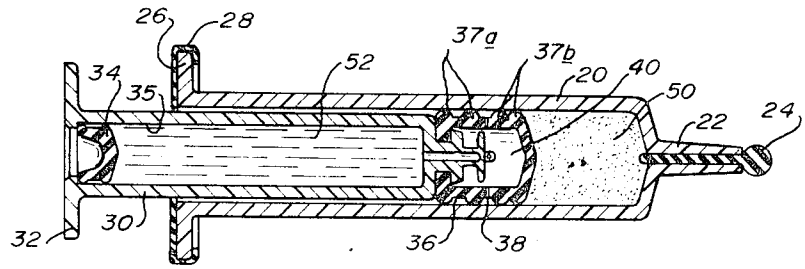
[57] **ABSTRACT**

An intermixing syringe provides means for the isolated storage of two components prior to their being mixed which is usually just before injection of the product. This syringe has an outer barrel and a hollow plunger slidable therein with the barrel portion forward of the piston providing one chamber and the plunger providing the other chamber. The plunger is provided with a piston having spaced, ring-like sealing surfaces and a fluid passageway extending from the interior of the plunger to the outer piston surface. The barrel of this syringe is formed with a straight-bored inner surface and includes no undercuts. The forward most sealing surfaces or end of the plunger piston is disposed to be moved from a sealing condition into a fluid flow or conducting condition to permit flow into the forward portion of the barrel.

13 Claims, 16 Drawing Figures



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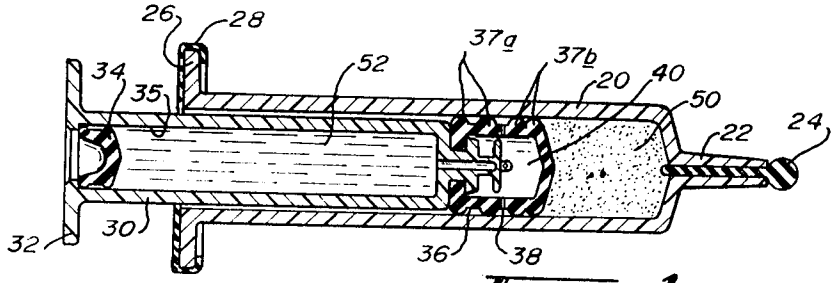

Fig. 1

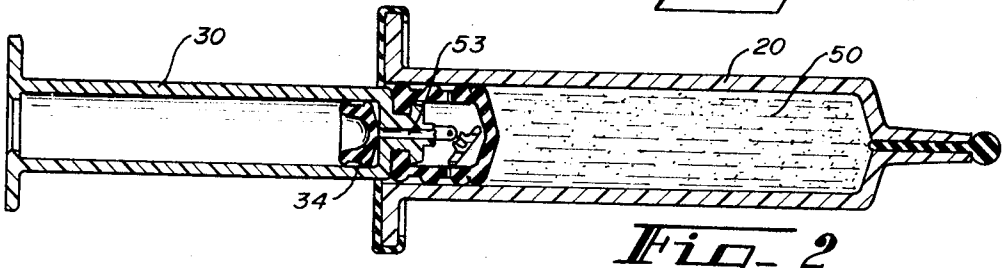

Fig. 2

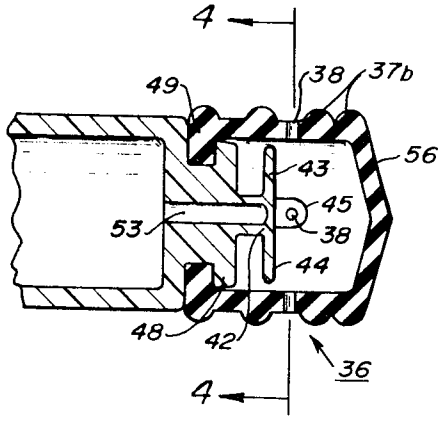

Fig. 3

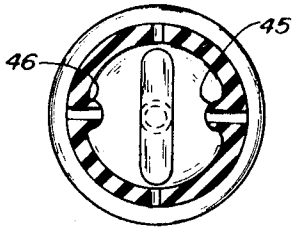

Fig. 4

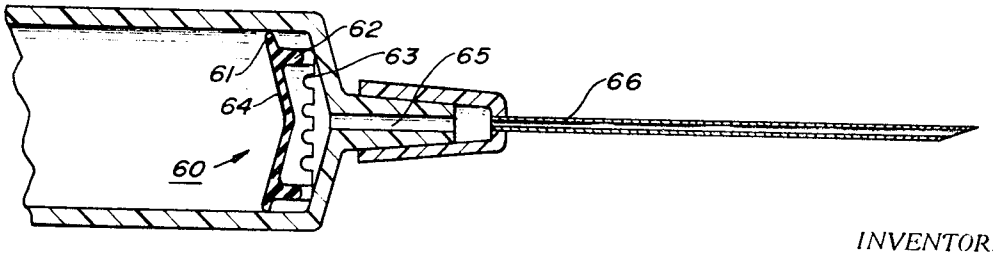

Fig. 5

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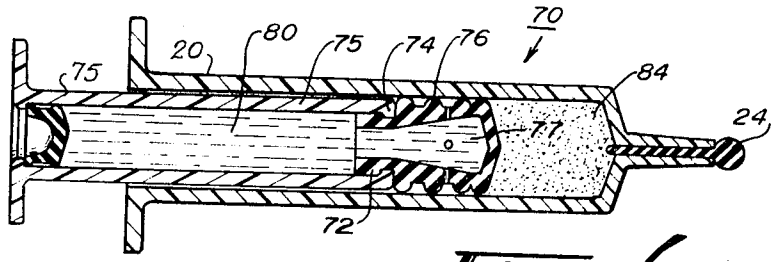

Fig. 6

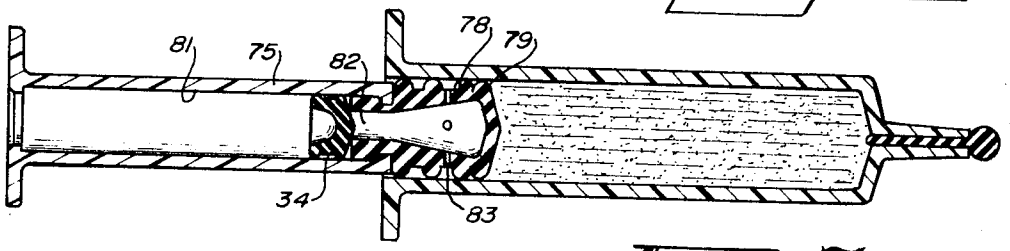

Fig. 7

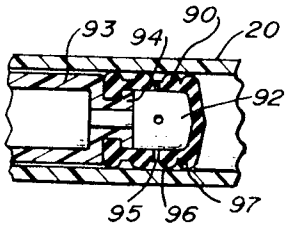

Fig. 8

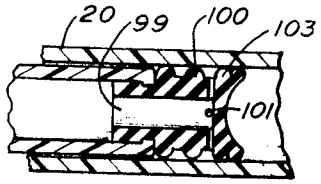

Fig. 9

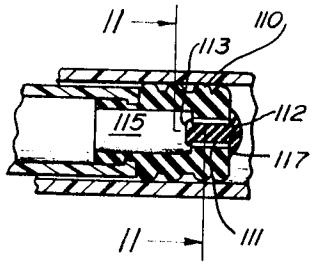

Fig. 10

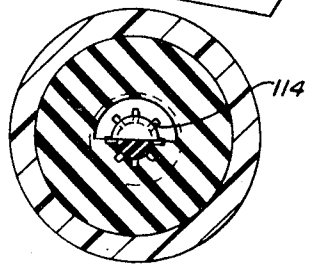

Fig. 11

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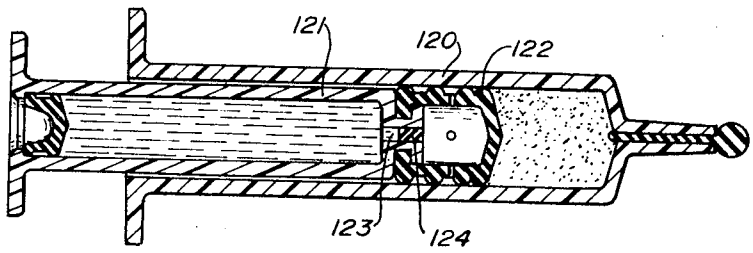

Fig_12

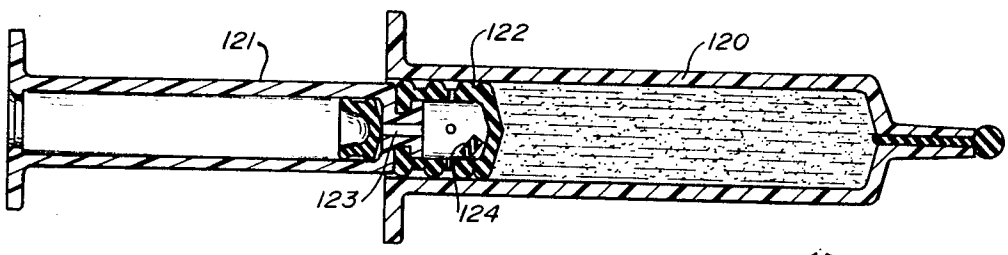

Fig_13

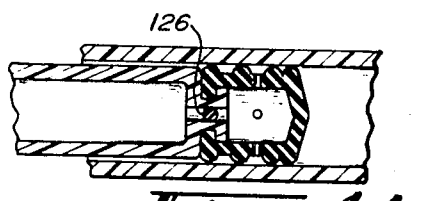

Fig_14

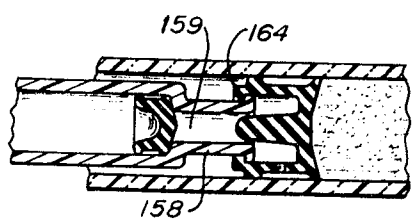

Fig_16

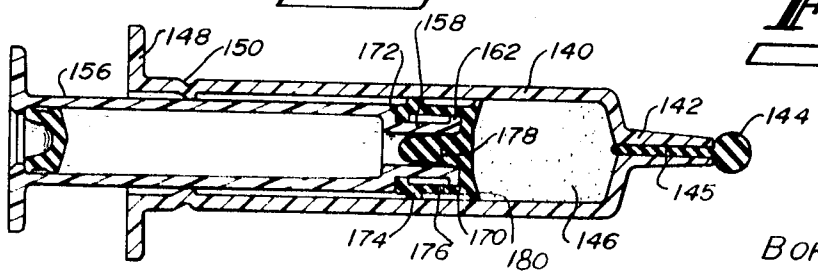

Fig_15

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INTERMIXING SYRINGE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the general class of Surgery and more particularly to the subclass of syringes.

2. Description of the Prior Art

Syringes are well known in the general field of surgery and those for storing and intermixing various ingredients are represented in patents as to PIERICK, U.S. Pat. No. 3,279,654 of October, 1966; to BROWN, U.S. Pat. No. 2,591,046 of April, 1952, and to CAMBER, Great Britain, No. 746,057 of January 1959. These and other patents use gravity to induce a flow of one component from one chamber to another. This method of transfer is often uncertain and sometimes is incomplete. Many require an exact manipulation of the syringe by the user who may not have the required skill or training. The precise and exact mixing of the various components comprising some of the new medicants is an absolute necessity. Ease of mixing by a potential administrator of the medicant is necessary and desirable, and such a manipulative device is an object of this invention.

In my U.S. Pat. No. 3,464,412 which issued on Sept. 2, 1969, I used the principle of reduced pressure to draw the fluid from the hollow plunger to and through a fluid passageway in the side of the piston and then through an undercut or relief formed in the bore of the barrel. The forward sealing rings of the piston were rendered ineffective as sealing means as they were brought in way of the undercut portion or portions in the barrel and the fluid flowed past these rings to the forward compartment in the barrel. In the present invention, undercuts are not provided however, the forward sealing means is rendered selectively ineffective by designing the piston so that a determined level of reduced pressure, when developed in the forward portion of the barrel, causes the forward sealing means of the piston to be displaced inwardly sufficiently to permit fluid from the plunger to flow past the piston sealing means.

The syringe of the present invention provides a means for bringing the forward portion of the barrel of the syringe into a condition of reduced pressure. At a determined level of reduced pressure, a flow conducting portion of the piston of a hollow plunger is brought into a fluid passing condition so that fluid flows from the plunger. This fluid which is stored in the plunger is sucked from the plunger interior to flow past the piston into the forward housing chamber to provide a controlled mixing of the stored ingredients.

SUMMARY OF THE INVENTION

This invention provides a syringe-type apparatus having an outer housing or barrel of generally tubular construction which is formed with an open rear end and a restricted forward end. This forward end has an aperture or passageway through which the mixed medicant or fluid and the like is expelled from the syringe, usually to and through a needle. The plunger is slidable in the bore of the barrel and is formed with a hollow interior. Its forward end is provided with a piston having a fluid-flow passageway extending from the outer surface of the piston to the interior of the piston and plunger. The inner surface of the barrel portion of the outer housing is a straight bore in which the piston is slidable. The forward end of the piston is provided with sealing rings or a one-way valve disposed to permit forward fluid flow from the piston to the barrel but no rearward or reverse fluid flow. A fluid passageway from the interior of the plunger to and around at least one of the sealing rings or through a one-way valve to the foreportion of the housing permits the two stored components to be mixed. As a storage syringe the plunger may store a determined fluid supply which is transferred to the barrel for injection at the time of use.

In the embodiments of this invention the syringe is arranged primarily as an intermixing syringe with one ingredient stored in the foreportion of the barrel and another ingredient which is fluid is stored in the hollow plunger member of the syringe. The several embodiments all have pistons with ring-type sealing surfaces and in all but one embodiment one end of the fluid-flow passageway is through the piston wall rearwardly of the forward sealing ring of the piston. When the fluid-flow path is around the forward sealing ring, the arrangement of the sealing surfaces on the plunger piston is made so that when the forwardmost ring is brought into a fluid-flow condition at least some of the remaining sealing surfaces of the piston seal the housing bore of the barrel so as to prevent flow of fluid or atmosphere to and from the open end of the barrel to the plunger interior or to the foreportion of the barrel.

It is an object of this invention to provide an intermixing syringe assembly in which two medicants may be isolated for storage and which at a determined time and by manipulative action are mixed usually immediately prior to the use of the medicant. The intermixing of the components is accomplished when the plunger is manipulated to move the plunger and piston outwardly from a forward position so that the forward portion of the barrel is brought into a condition of reduced pressure. At a determined level of reduced pressure or position of the piston of the syringe a portion of the piston is brought into a fluid-passing condition so that the fluid stored in the plunger is caused to be sucked into the reduced pressure forward portion of the barrel whereat the components are mixed.

It is a further object of this invention to provide an intermixing syringe wherein two components of the medicant are isolated for storage and, at the time of mixing, the ingredients are brought into comingle relationship with each other by the passage of fluid from the plunger through a one-way valve formed in the forward wall portion of the piston.

INTENT OF THE DISCLOSURE

There has been outlined rather broadly the most important features of the various embodiments of the syringe apparatus of this invention in order that the present contribution to the art may be more fully appreciated. Those persons skilled in this art will appreciate that the concept on which the present disclosure is based may be utilized to provide the basis for other syringe devices similarly carrying out the purposes of this invention. The chosen embodiments of the syringe are provided for the purposes of illustration and description of the principles of this invention and are shown in the accompanying drawings forming a part of the specification wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 represents a sectional view of a two-compartment intermixing syringe adapted to store two components in an isolated condition;

FIG. 2 represents the syringe of FIG. 1 with the two medicant components in a mixed condition in the barrel portion of the syringe;

FIG. 3 represents an enlarged sectional view of the piston end of the plunger of FIG. 1 and showing in detail the construction of the piston;

FIG. 4 represents a sectional end view of the piston and plunger of FIG. 1, the view taken on the line 4—4 of FIG. 3;

FIG. 5 represents an enlarged sectional side view of a syringe barrel and a filter member disposed therein;

FIG. 6 represents a sectional view of an alternate two-compartment intermixing syringe embodiment with the two medicant components stored in an isolated condition;

FIG. 7 represents the syringe of FIG. 6 with the two medicant components in mixed condition;

FIG. 8 represents a sectional view of an alternate or modified piston construction of the piston shown in FIG. 6;

FIG. 9 represents a sectional view of yet another alternate or modified piston construction of the piston of FIG. 6;

FIG. 10 represents a sectional view of yet another alternate piston construction in which a one-way valve is provided in the forward end or wall of the piston;

FIG. 11 represents a sectional view of the piston and outer barrel with the view taken on the line 11—11 of FIG. 10;

FIG. 12 represents a sectional view of yet another embodiment of a two-compartment syringe with the two medicant components stored in an isolated condition;

FIG. 13 represents the syringe of FIG. 12 but with the two medicants now in a mixed condition;

FIG. 14 represents a fragmentary sectional side view of yet another alternate construction of a piston end of a syringe similar to the piston of FIG. 12;

FIG. 15 represents a sectional side view of yet another two-compartment syringe construction with the two medicant components stored in an isolated condition, and

FIG. 16 represents a fragmentary sectional view of the syringe of FIG. 15 with the piston moved to a forwardly position to permit the fluid portion to flow to the forward compartment and the medicant components to become mixed.

In the following description and in the claims various details will be identified by specific names for convenience; these names, however, are intended to be generic in their application. Corresponding reference characters refer to like members throughout the several figures of the drawings.

The drawings accompanying, and forming part of, this specification disclose certain details of construction of the several syringes for the purpose of explanation of the broader aspects of the invention, but it should be understood that structural details may be modified in various respects without departure from the concept and principles of the invention and that the invention may be incorporated in other structural forms than shown.

DESCRIPTION OF THE SEVERAL EMBODIMENTS

Syringe of FIGS. 1 through 4

Referring now to the syringe as shown in FIGS. 1 through 4 it is to be noted that this syringe assembly includes an outer barrel **20** having a restricted front end having a hub **22** which is adapted to receive and removably seat a needle not shown in these views. Through this end is provided a passageway which is plugged or closed to the passage of air and/or powder by a resilient stopper or plug **24**. The open rear end of this outer barrel is provided with a flange **26** for gripping by the operator. A dust shield in the form of a flanged rubber diaphragm **28** is disposed to snugly grip the flange **26**. In the center of the diaphragm there is formed an aperture through which a hollow plunger **30** is slidable. On the rear end of the plunger **30** there is formed a flange **32** which is gripped by the operator for moving the plunger in the barrel. Carried in the interior of the plunger is a slidable piston or plug **34** which is slidable along the full length of the interior bore **35** of the plunger.

Carried on the front end of the plunger **30** is a piston **36** which, in this embodiment, is formed so that its rear portion provides a pair of spaced circular sealing surfaces or ring portions **37***a*. The forward portion of this piston is also provided with close-spaced like-sized sealing surfaces or ring portions **37***b*. At least one fluid aperture **38** is formed in and through the sidewall of the piston **36** to provide passageway from the interior **40** to the outer surface of the piston. The forward end of the plunger **30** is provided with a sealed and reduced glass end **42** which is formed to also provide wing members **43** and **44**. These wing members are adapted to engage lugs **45** and **46** formed in the piston interior **40**, FIGS. **3** and **4**. A shoulder **48** formed on the glass end of the plunger **30** is sized to engage and retain an inturned collar portion **49** of the piston.

Use and Operation of the Syringe of FIGS. 1 – 4

The two-compartment syringe in the assembled condition of FIG. **1** provides an isolated storage for a powdered medicant **50** which is retained in the forward end of the outer barrel **20**. A fluid medicant **52** is stored within the bore of the moveable plunger **30**. To intermix the medicant components **50** and **52** at the desired time of use, the plunger **30** is drawn from the stored condition of FIG. **1** outwardly or rearwardly to the position and condition of FIG. **2**. The plunger **30** at this outer condition is now rotated so that the end **42** within the piston **36** is broken off when and as the flange portions **43** and **44** of the glass end are caused to engage the wing portions **45** and **46** of the piston. This breakage occurs as the glass end exceeds its limit, causing the end to be broken off and allowing the fluid **52** to pass from plunger **30** to and through passageway **53** and into the interior **40** of the piston. As and when the plunger **30** is pulled from its position in FIG. **1** to its position in FIG. **2** the forward interior portion **50** of the outer barrel **20** comes to a condition of reduced pressure. The fluid in area **40** of the piston flows through the passageway **38** into the reduced pressure area of the outer barrel **20** whereupon the fluid and the powder are mixed.

Flow from the interior of piston **36** to the portion **50** of the barrel is accomplished by the novelty of design of the forward sealing portion of the piston. The forward wall **56** of the piston **36** is formed or molded so as to be bowed forwardly when a condition of reduced pressure is applied to the outer surface of this wall and tending to accentuate the bow of the wall. This reduces the ability of the sealing rings **37***b* to seal the bore of the barrel **20**. A small amount of deflection is sufficient to permit fluid to flow forwardly past these sealing rings **37***b* and into the barrel. Positive pressure rearwardly against wall **56** tends to flatten the wall **56** and to urge rings **37***b* against the bore of barrel **20** as the piston **36** is moved forwardly. When the fluid passageway is established the fluid medicant component **52** flows to the reduced pressure area ahead of the forward part of the piston **36** and into the outer barrel **20**. As the fluid **52** is drawn forwardly atmospheric pressure causes piston or plug **34** to slide forwardly to the forward end of the bore **35** of the plunger **30**. The rubber diaphragm **28** provides a snugly engaging shield to insure that the outer surface of plunger **20** is maintained in a sterile condition during and while it is in the stored forward position.

Filter of FIG. 5

Referring next to FIG. **5** it is to be noted that a filter in the form of a rubber diaphragm or disc **60** is shaped so as to have an outer peripheral portion **61** sized to be a sliding fit in the bore of the barrel of the syringe. This filter is disposed in the barrel of the syringe so that the center portion of the diaphragm in its mounted condition is concave towards the forward end of the syringe. A circular, forwardly extending rim portion **62** is formed on the diaphragm and is spaced a short distance from the outer periphery **61** of the filter member. In the rim portion **62** there are formed a series of scallops **63** providing a plurality of fluid passageways through which the fluid may pass by the rim portion **62**. In use, as the plunger and piston is pushed forwardly, the center concave portion **64** of the diaphragm **60** is caused to deflect inwardly causing a fluid passageway in the form of a thin gap adjacent the inner wall of the barrel to be provided. Through this thin gap the fluid will pass around the outer surface **61** and through the passageways **63** thence to and through a fluid passageway **65** formed in the forward end of the syringe and then out through a needle **66** or the like.

Syringe of FIGS. 6 and 7

Referring next to the syringe of FIGS. **6** and **7** there is shown an alternate embodiment wherein a syringe **70** is similar in construction to the syringe of FIGS. **1** through **4** except that the piston is made as a complete rubber member. This piston provides the fluid seal between the outer barrel **20** and plunger. This piston has a collar portion **72** which is adapted to fit within a neck or inturned flanged end portion **74** of a plunger **75**. Forward of the plunger, the piston portion **76** has an interior chamber **77** which tapers forwardly and outwardly so that the forward portion of the piston tends to collapse as the plunger **75** is drawn backwardly to cause a reduced pres-

sure to be developed in the forward portion of the barrel **20**. Plug **24** insures that the forward end of the barrel is sealed to prevent unwanted air to enter the interior of the barrel.

Use and Operation of the Syringe of FIGS. 6 and 7

As the plunger **75** is drawn from the position of FIG. **6** to the position of FIG. **7** and with plug **24** is place, the pressure in the forward portion of barrel **20** becomes reduced below atmospheric pressure. At a point near the position of FIG. **7** a limit condition is reached whereat the forward face or wall of the piston slightly collapses so that ring sealing members **78** and **79** no longer provide a fluid seal for the forward portion of the plunger. When this occurs the fluid **80** in the barrel portion **81** flows forwardly and passes through rear passageway **82** of the piston into chamber **77** and then through aperture **83** into the reduced pressure area in the barrel whereat it is mixed with powdered medicant **84** stored in this forward portion of the barrel. As the fluid **80** flows from the plunger and into the forward barrel, the sliding piston seal **34** as in FIG. **2** slides forwardly to collar portion **72**.

Piston of FIG. 8

An alternate embodiment and construction to the piston shown in FIGS. **6** and **7** is shown in FIG. **8** wherein the piston is formed with an interior larger than that in FIG. **6**. As shown, a piston **90** has an interior area or chamber **92** whose diameter snugly engages a plunger **93** having an outwardly extending shoulder or collar **94**. At least one transverse fluid passageway **95** is formed within the sidewall of piston **90** so that as the plunger is drawn backwardly in an outer barrel **20**, the reduced or negative pressure formed in the forward portion of the barrel **20** causes the two forward sealing members or rings **96** and **97** of the piston to slightly collapse inwardly enough to permit fluid from the bore of plunger **93** to pass by these forward sealing rings. After the fluid from within the plunger **93** passes through the passageway **95** and past rings **96** and **97** it flows turbulently into the forward portion of the barrel.

In the manner of the piston of FIG. **6** the use of a syringe having the piston **90** mounted on a plunger **93** contemplates that the forward sealing ring portions **96** and **97** are collapsed by reduced pressure a sufficient amount to permit fluid to bypass these rings when and as the negative pressure in the barrel is sufficient to draw the forward end wall of the piston a small amount forwardly.

Piston of FIG. 9

An alternate embodiment of a piston construction is shown in FIG. **9** in which instead of the enlarged chamber area **77** of FIG. **6** a smaller interior passageway **99** is formed in piston **100**. This passageway, as shown, is contemplated to be of a regular or straight diameter. Transverse fluid passageways **101** are formed in the sidewall of the piston at a position adjacent the inner end of the passageway **99**. The forward face portion of the piston **100** is made concave so as to permit ready deformation of the sealing ring portion **103** as the plunger and the mounted piston **100** is drawn rearwardly. As and when the piston **100** is moved forwardly the concave surface causes a thrust or outward pressure to be applied to the sealing surfaces **103** so that they are caused to more tightly engage the inner surface of the outer barrel **20**.

In the manner of the pistons of FIGS. **2**, **6** and **8** as shown and described above, the piston **100** of FIG. **9** contemplates that under the influence of reduced pressure the sealing surface rings **103** will be at least locally deflected to permit forward fluid bypass past these rings while in the reverse motion and no reduced pressure, the forward pushing of piston **100** and pressure against the concave face will cause the rings **103** to be urged outwardly against the inner surface of the barrel **20**.

One-Way Valve of Piston of FIGS. 10 and 11

Referring next to the embodiment of the piston of FIG. **10** it is contemplated that a one-way valve is formed in the forward wall portion of the resilient piston. In this piston assembly there is provided a molded piston member **110** having a passageway **111** formed in and through the forward wall. A resilient plug **112** or seal member has a rear skirt or enlarged portion **113** which is slightly larger in diameter than the bore of passageway **111**. A series of flutes **114** are formed in the wall of the passageway **111** to provide conductors for flow of fluid from the interior **115** of the piston to and past the forward face of the piston **110**. The rear skirt **113** only partially covers the fluted passageways **114**, however, a forward button portion of plug **112** has an outer thin rim portion **117** which is made sufficiently resilient so that it can be deflected outwardly to allow fluid to flow forwardly past it. This flow occurs when reduced pressure is produced in the barrel portion forwardly of the piston. However, when the pressure is applied to the forward button by moving piston **110** forwardly in the syringe the thin portion **117** of the button is pushed tightly against the face of the piston and over the fluted portions **114** to seal the flutes from passage of the fluid.

Use and Operation of Piston of FIGS. 9 and 10

In use, the piston of FIGS. **9** and **10** as it is moved by and with the plunger is a one-way valve. When the piston is drawn rearwardly the forward portion of the barrel, with the stopper **24** in place as in FIG. **1**, develops a reduced or negative pressure as in FIG. **1**. At a certain limit of reduced pressure the ability of the thin portion **117** of plug **112** to retain fluid from a forward flow is overcome and the fluid from interior **115** flows along the flutes **114** and around the deflected thin portion **117** and into the forward portion of outer barrel **20**. After the medicant components and the like have been mixed, the stopper **24** is removed from the forward passageway of the barrel and after a needle is mounted on the hub the piston may be moved forward for ejection of the mixed components from the syringe. The thin cover **117** as the piston moves forwardly covers the flutes and seals the piston against reverse flow through passageway **112**.

Syringe of FIGS. 12 and 13

Referring next to FIGS. **12** and **13** it is to be noted that an outer housing or barrel **120** carries a plunger **121** provided with the resilient piston **122** similar to the piston **36** of FIG. **1**. However, in this particular embodiment the lugs **45** and **46** are omitted. In bore **123** formed in the forward end of plunger **121** is mounted a resilient plug **124** which is adapted to seal the passageway or bore **123** against any passage or flow of fluid. When a reduced pressure in the forward portion of the barrel **120** is produced and reaches a determined limit, the plug **124** is drawn forward by this reduced pressure and is dislodged from the passageway **123**. The plug, as it is drawn forwardly, falls into the interior of the piston **122** as in FIG. **13**.

Use of Piston of FIGS. 12 and 13

In the manner of the syringe of FIG. **1**, the syringe of FIG. **12** is manipulated to draw the piston and plunger rearwardly to develop a negative pressure in the forward barrel portion. As and when a determined negative pressure is developed the forward ring portions of the plunger permit a negative pressure to develop in the cavity of the piston and the plug **124** is drawn from bore **123** to fall into the interior of the piston. With bore **123** now open the fluid flows from the plunger into the chamber of the piston, through the passageways in the sidewall and past the forward sealing rings and finally into barrel **120** as in the manner of FIG. **1**. It is also contemplated that if plug **124** is not dislodged as planned, the piston **34** may be urged forwardly to develop forward thrust on the plug.

Piston and Plunger of FIGS. 15 and 16

Referring finally to the syringe of FIGS. 15 and 16 there is provided a syringe having an outer housing or barrel 140 having a conventionally formed forward end 142 and a resilient stopper 144 fitted into passageway 145 to make said passageway both fluid and airtight. In this forward end of this syringe a dry medicant 146 may be stored. Outer housing 140 has a flanged rear end 148 and forwardly thereof is a reduced portion 150 formed so as to provide an inner diameter shoulder of a size which slidably guides the outer diameter of a plunger 156. The forward portion of this plunger has an extended neck portion 158 with an inner diameter passageway 159 therethrough providing for a passage for fluid. This inner diameter passageway may be slightly tapered or have a rounded outer or forward end. This forward end also is formed with a shoulder or outwardly extending flange portion 162. A rubber piston 170 is mounted on this forward end and is formed with an inwardly directed flange portion 172 sized so as to be slidable on the outer surface of the extended neck portion 158.

An outer ring-type seal 174 is formed on the rear portion of piston 170 while a short distance forwardly of this seal at least one passageway 176 is formed in the sidewalls of the piston. A plug portion 178 is formed on and attached to the inner end wall of this piston. This plug portion is tapered and has a rounded end adapted to slidably engage and seal the passageway 159 when the piston is positioned in the condition of FIG. 15. When the fluid-carrying plunger 156 is drawn backwardly from the position of FIG. 15 the outer sealing portion 174 of the piston is disposed to engage the reduced portion 150 of the barrel. The forward ring 180 provides a deflectable seal of the piston as in the manner of the other pistons above described.

Use and Operation of Syringe of FIGS. 15 and 16

It is contemplated that in operation as piston 170 is drawn rearwardly from the position of FIG. 15 to the position of FIG. 16, a condition of reduced pressure is produced in the forward portion of the outer barrel 140. This condition tends to draw the piston 170 from its sealing condition to the condition of FIG. 16 whereupon the piston slides forwardly upon the reduced neck portion 158 and opens the fluid passageway for fluid flow through 159 and then through the passageway 176 and past forward ring 180. If the plunger portion 178 is seated in the passageway 159 too tightly or is not dislodged by the reduced pressure in the forward portion of the barrel, the engagement of the shoulder 174 with the shoulder 150 in the barrel insures that the piston 170 is removed to the condition of FIG. 16 as plunger 156 is pulled rearwardly.

It is to be further noted that after the fluid transfer from plunger 156 to the fore portion of barrel 140 the stopper 144 is removed and a needle in the manner of FIG. 5 is mounted on the hub. When the plunger is moved forwardly to expel the mixed medicant from the syringe the piston 170 moves rearwardly on the reduced neck portion 158 to the condition of or substantially the condition of FIG. 15 whereupon the sealing action of ring 174 insures that the fluid is expelled by the piston 170 without fluid flow into the plunger or passageway 159.

Although reduced portion 150 is shown as formed in the barrel body, this may be eliminated and instead a stop member disposed to positively engage the plunger ring 174 may be made as a separate member and be attached to the rear of the housing. It is only necessary that the piston be engaged and positively moved to the condition of FIG. 16 to effect fluid flow.

It is further noted that although the above-described embodiments are primarily contemplated as being used for an intermixing syringe, the syringe may also be used as a fluid storage device. To avoid the necessity of shipping a syringe with the barrel having a determined quantity of fluid stored therein and with the plunger extending great distance from the barrel the above-described syringes may be used as shown as fluid storage devices. When so used the plunger is filled with fluid as shown but instead of a powder being stored in the fore portion of the barrel the piston is brought to the extreme forward position after which the stopper is mounted in the hub passageway. To transfer the fluid from the plunger to the barrel, the plunger is drawn rearwardly in the manner of an intermixing operation after which the fluid flows to the barrel from which it is expelled in the usual manner.

TERMS

The work "barrel" as above used is contemplated as being the outer housing of a syringe and as shown is of plastic, glass or other material compatible with the product being stored.

"Piston" as above shown is contemplated as being of rubber or other resilient material which will have sealing surfaces sized to resiliently and frictionally engage the bore of the barrel.

"Plunger" as above used is a hollow tubular member of glass, plastic or other material compatible with the product being stored.

As cost is an essential consideration, the material used in the several components will be made to satisfy storage criteria, manufacturing and tooling cost and aesthetic appearance.

Terms such as "up," "down," "bottom," "top," "front," "back," "in," "out" and the like are applicable to the embodiments shown and described in conjunction with the drawings. These terms are merely for the purposes of description and do not necessarily apply to the position in which the several embodiments of the syringes may be constructed or used.

The conception of the intermixing syringe and its many applications is not limited to the specific embodiments shown but departures therefrom may be made within the scope of the accompanying claims and without sacrificing its chief advantages and protection is sought to the broadest extent the prior art allows.

What is claimed is:

1. An intermixing syringe for the isolated storage of at least two medicant portions and the like, the syringe including an outer housing in whose interior front end is stored one of the medicant portions and a hollow plunger in whose bore there is a slidable piston and in its hollow portion of the plunger is the isolated storage of the other stored medicant portion, the syringe including means whereby the medicant portion carried by the plunger may be transferred from the hollow plunger to the interior front end of the outer housing for the mixing of the portions in the front end of the outer housing, the syringe having means for bringing the stored medicant portion in the plunger into the front end of the outer housing and the front end of the same housing portion into a condition of reduced pressure, the syringe comprising: (a) an outer housing of generally tubular configuration having an open rear end extending into an inner bore of a generally constant cross section, the housing having a front partially closed other end with a discharge passageway therethrough; (b) removable means for closing the passageway of the partially closed front end of the housing so as to prevent the passage of air, fluids and the like; (c) a plunger having a main portion of generally tubular configuration and sized to easily move axially in the bore of outer housing without sealing of the bore of the housing; (d) a movable piston providing for the closing of the rear end of the plunger and the hollow portion thereof to the passage of air, fluid and the like, said movable piston slidable within and through the length of an interior bore formed in the plunger and providing therewith a fluid-tight sealing means, and (e) a resilient piston adapted for mounting on and closing the front end of the plunger, said piston formed with a plurality of ring-like sealing surfaces sized so as to be slidable in the bore of the housing while engaging said bore in a fluid-flow sealing manner, the piston having at least one flow passageway formed therein with one end of the passageway open to the interior of the plunger and the other end terminating at the

piston outer surface and between adjacent ring-like sealing surfaces, said piston further formed so that under the influence of a reduced pressure developed in the forward portion of the outer housing those ring-like sealing surfaces forward of the formed flow passageway are deflectable forwardly from a sealing condition to a fluid-flow forwardly condition permitting the fluid in the plunger to flow through said passageway and past those forward sealing surfaces and into the forward housing portion when said forward housing portion is brought to a condition of reduced pressure as developed by the rearward movement of the plunger in the outer housing.

2. An intermixing syringe as in claim 1 in which the piston is made of rubber with an interior chamber which is formed so as to taper forwardly and outwardly so that the forward portion of the piston will tend to collapse inwardly and forwardly under the influence of a small amount of pressure exerted on the rear of the piston.

3. An intermixing syringe as in claim 1 in which the piston is made of rubber with an enlarged interior portion terminating in a forward wall formed with a small forward bulge which is caused to collapse partly in its support of the forward sealing rings said collapse being induced by a small amount of pressure applied to said forward of the piston.

4. An intermixing syringe as in claim 1 in which the piston is made of rubber with its forward face made with a concave surface extending rearwardly causing the forward face to collapse in its support of the forward sealing rings under the influence of the flow of fluid past the rings.

5. An intermixing syringe as in claim 1 in which the forward end of the plunger is made with a small bore in which the medicant in the plunger is a fluid and there is provided a resilient plug adapted to seal the bore against fluid flow until the plug is displaced by a determined pressure from the fluid in the plunger and in which the piston is made with an enlarged interior sized to freely accept and retain the displaced plug.

6. An intermixing syringe as in claim 5 in which the plug is a cylindrical rubber member of determined length which is at least as long as the diameter of the plug.

7. An intermixing syringe as in claim 5 in which the plug is a rubber ball of determined diameter which is slightly larger than the forward bore in the plunger.

8. An intermixing syringe as in claim 1 in which the forward end of the plunger is made with a bore of determined reduced diameter extending through an extended neck portion formed to provide an outer cylindrical surface of determined extent which is terminated at a forward flanged end, and in which the piston is a slidable member on the outer surface of the neck portion of the plunger, said piston being formed with a rear inwardly directed flange portion sized to be slidable on the cylindrical neck outer surface, said piston adjacent the inwardly directed flange portion having an enlarged inner bore of determined extent and slidable on the forward flanged end of the plunger neck, this forward end of the enlarged inner bore terminating in a wall in which there is formed a plug member which is sized and positioned to be a sealing fit in the reduced bore in the plunger neck when the slidable piston is moved to a rear position on the neck, and in which the plug is displaced from the bore to a fluid flow condition when the piston is moved to a forward position on the neck of the plunger.

9. An intermixing syringe as in claim 8 in which the forward portion of the neck bore is tapered outwardly and in which the plug is also made with a similar taper.

10. An intermixing syringe as in claim 8 in which the piston has an outer rear ring-like portion slidable in the bore of the housing and in which there is provided a reduced portion carried by the rear end of the housing, said reduced portion disposed to engage the outer rear ring-like portion of the piston as it is drawn rearwardly in the housing enabling the neck of the plunger to be drawn rearwardly in the piston until the forward flange of the piston becomes a stop to further movement of the plunger neck in the piston.

11. An intermixing syringe as in claim 1 in which the forward end of the plunger is sealed to prevent fluid flow until the plunger is rotated in the piston and in which interior of the piston is provided with inwardly extending wing portions disposed to cooperatively engage extending flange portions formed on the forward end of the plunger when the plunger is rotated to cause the flange portions to engage the wing portions and break the sealed forward end of the plunger.

12. An intermixing syringe as in claim 11 in which at least the plunger's forward end is made of glass.

13. An intermixing syringe as in claim 11 in which the forwardmost portion of the housing is provided with a filter, said filter being made of a resilient material such as rubber and in which in its mounted condition in the housing the outer diameter is a light press fit against the bore until fluid pressure is exerted against a concave center portion whereupon the disc is bowed sufficiently to cause the rim portion to be moved from its engagement with the wall to permit a fluid flow around at least a portion of the outer diameter and through the scallops in the rim portion.

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