

[54] MIXING SYRINGE

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PA. 234, 235, 272, DIG. 28; 206/219, 221;
222/136, 386

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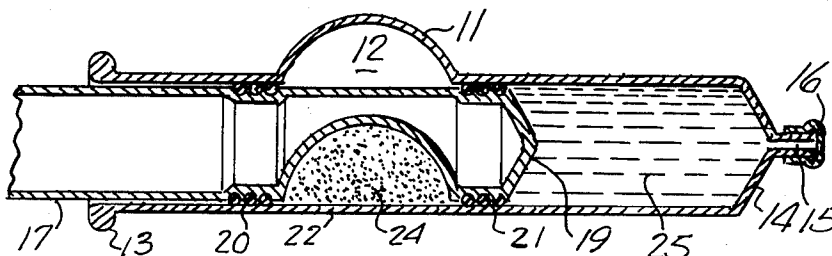
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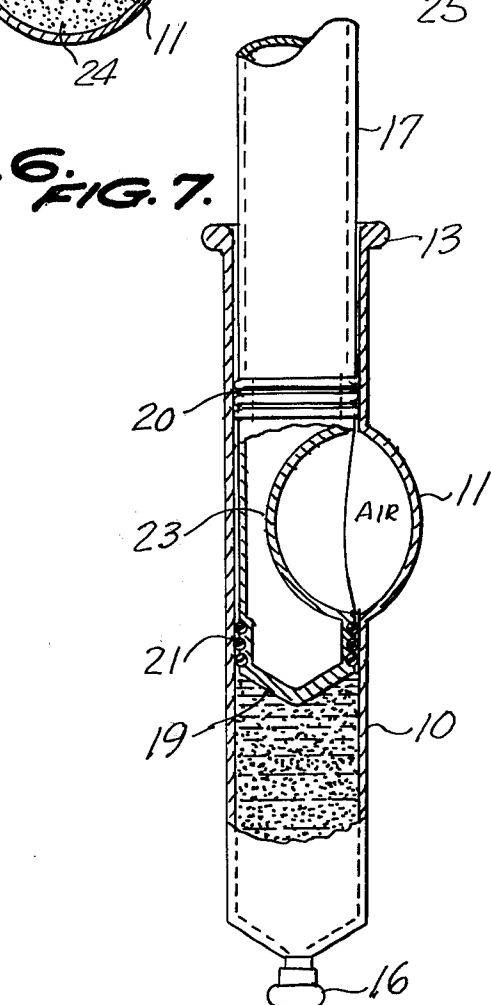
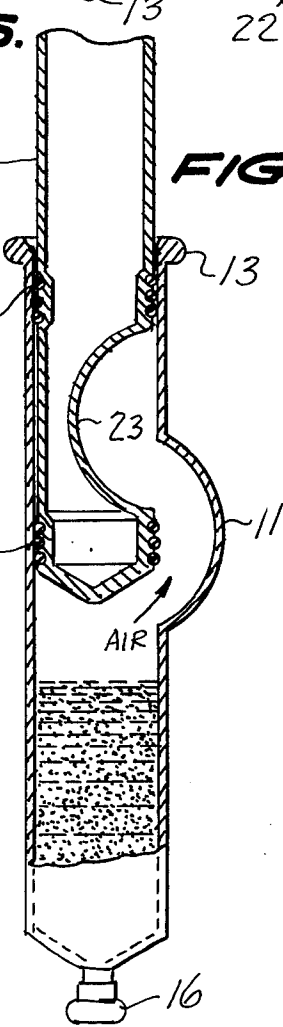
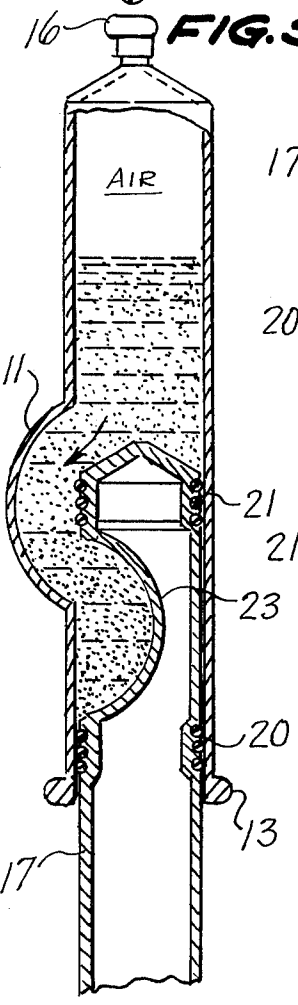
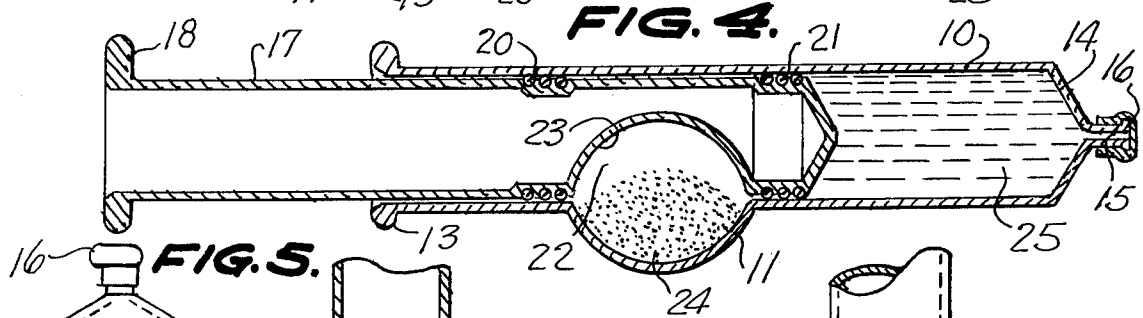
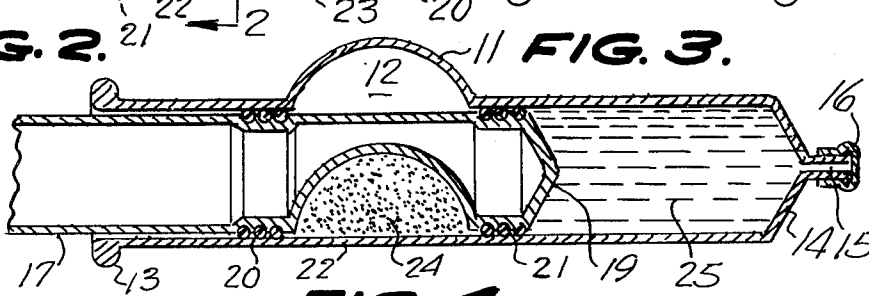
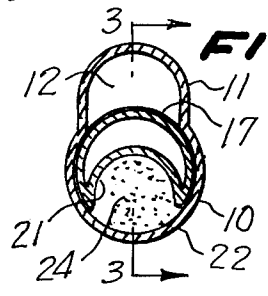
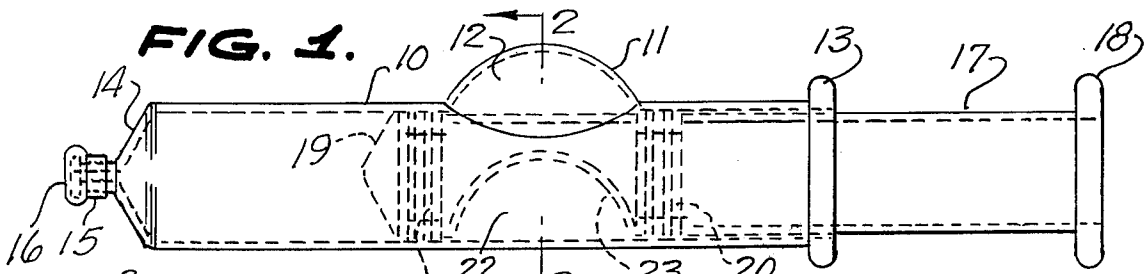
[57]

ABSTRACT

This invention comprises a mixing syringe which has a chamber in both the barrel portion and plunger portion of the syringe. One component to be mixed is placed into the plunger chamber, the plunger slideably inserted into the syringe barrel and rotatably oriented so that the barrel and plunger chambers are not in alignment. At the time of use, a second component is drawn into the syringe, the plunger rotated to align the plunger and barrel chambers, and the plunger withdrawn until the components come into contact and mix.

14 Claims, 7 Drawing Figures





MIXING SYRINGE

This invention relates to a syringe. More particularly, this invention relates to a mixing syringe having a barrel chamber and a plunger chamber, and wherein one of the substances which is mixed in the syringe is contained within the plunger chamber until mixing. When the plunger chamber and barrel chamber are aligned and the plunger extended partially from the barrel, the contained substance mixes with a second substance which has been drawn into the syringe barrel.

There are many uses for mixing syringes in the medical and analytical chemical arts. Generally in the instances when these syringes are used one of the components is not stable in the presence of one or more of the other substances. The substances are therefore mixed just prior to use. As an example, a freeze-dried substance, for instance for use in inoculations, can be placed in the syringe immediately after sterilization of the syringe and maintained in a sterile-dry condition for a period of time. Just prior to use, water or an aqueous solution can be drawn into the syringe for mixing with the freeze-dried substance. After preferably shaking to effect faster dissolution, the solution is ready for use. In another use a sterile liquid can be stored in the syringe and subsequently mixed with a second liquid. There are yet many other uses for a mixing syringe, and particularly for such a syringe which can store a substance to be mixed in a dry and/or sterile state.

Various types of mixing syringes are known in the prior art. U.S. Pat. No. 2,541,621 discloses a syringe wherein a solid tablet or other material can be added to a syringe and dissolved within the syringe. The disadvantages of this syringe are that one of the components is not stored within the syringe and that the syringe will not be antiseptic since the barrel and plunger are exposed to the atmosphere. U.S. Pat. No. 1,456,469, although not a mixing syringe, has an interesting structure. This is a refilling syringe wherein the material to be injected is stored outside of the syringe but enters the syringe through an opening in the barrel wall. The plunger has a longitudinal groove so that added liquid can reach the cannula end of the barrel during filling. However, this syringe will not store a substance and subsequently mix it with another substance.

The mixing syringe of this invention has many advantages over prior mixing syringes and comprises a syringe and plunger, each of which has a chamber section. The barrel chamber is a protruding chamber which extends only partially around the circumferential surface of the barrel and preferably extends less than half the circumferential distance around this surface. Otherwise the shape of this chamber may vary, with a longitudinal elongated shape being preferred. This barrel receives a rotatable plunger at one end, and at the other end has means for the attachment of a conventional cannula. The plunger has two seals or sets of seals, one near each end of the plunger. Intermediate the ends of the plunger and between the seals is an indented plunger chamber. This indented chamber may be of any shape, but like the barrel chamber does not extend around the full circumferential surface of the plunger, and preferably it extends around less than half the circumference of the plunger. Otherwise the shape of this chamber may vary, with a longitudinal elongated shape being preferred. In a specifically preferred embodiment, the shapes of the barrel chamber and

plunger chamber are complementary in that they form a symmetrical space such as an ellipsoid, or ovoid when aligned.

It is therefore a prime object of this invention to set out a mixing syringe which maintains one component to be admixed isolated in an antiseptic condition, but which allows for a fast and easy means of mixing within the syringe and for administration of the admixed substances.

Other objects and advantages of this invention will be apparent during the course of the following detailed description.

FIG. 1 is a side elevation of the syringe in a horizontal orientation.

FIG. 2 is a cross-sectional view of the syringe taken substantially on the line 2—2 of FIG. 1.

FIG. 3 is a vertical cross-sectional view of the syringe taken substantially on the line 3—3 of FIG. 2 showing the barrel chamber and plunger chamber in a non-aligned condition.

FIG. 4 is a vertical cross-sectional view of the syringe similar to that of FIG. 3 showing the barrel chamber and plunger chamber in alignment.

FIGS. 5—7 are vertical cross-sectional views of the syringe similar to that of FIG. 4, illustrating the manipulative steps for mixing substances within the syringe.

In the form of the invention shown in FIG. 1, there is provided a syringe having a barrel 10, preferably of cylindrical formation. The surface of barrel 10 protrudes outwardly at 11 thereby forming barrel chamber 12. This barrel chamber preferably comprises a section of less than half the circumference of the barrel cylinder. The barrel chamber may be of any reasonable shape or size, with a longitudinal extending shape being a preference. This barrel chamber is located distal to the ends of the barrel and preferably near the mid-region. The syringe barrel terminates in a flange 13 at one end which aids in gripping the syringe, and in a sloping bottom wall 14 which terminates in apertured nipple 15 at the other end. Cap seal 16 covers the apertured nipple so that an antiseptic environment can be maintained within the syringe.

The plunger 17 is rotatably and slideably disposed in barrel 10 of the syringe and has a flange 18 at one end and a sloping bottom wall 19 at the other end. The sloping wall of the plunger is complementary with the sloping bottom wall 14 of the barrel. Between the ends of the plunger there are two seals 20 and 21 carried on the plunger. These seals may be O-ring seals or any other equivalent and suitable sealing means. Intermediate the plunger seals is a plunger chamber 22 formed by the indentation of plunger surface 23. This plunger chamber may be of any shape but preferably is longitudinally shaped and comprises less than half the circumference of the plunger. In the embodiment shown in the drawings the barrel chamber and plunger chamber when in alignment form an ellipsoid having its major axis along a projection of the plunger barrel contact surface. The ellipsoid shape is a preferred shape for these chambers.

FIG. 2 shows the syringe in cross-section with the barrel chamber 12 and plunger chamber 22 in a non-aligned condition. On the rotation of the plunger 17 the two chambers can be aligned. FIG. 3 is a vertical cross-section showing one substance 24 stored in plunger chamber 22 and another substance 25 contained in the barrel in the space between the plunger sloping wall and the barrel sloping bottom wall. This component 25

is usually a liquid and is inserted by being drawn up through apertured nipple 15. At this time the cap seal 14 may be replaced with cannula if desired. When the plunger in FIG. 3 is rotated the plunger chamber and barrel chamber can be made to align as shown in FIG. 4. The component 24 is then disposed within the combined plunger chamber-barrel chamber.

FIGS. 5-7 show the manipulative steps for mixing substances 24 and 25 shown in FIG. 4. In a first step the plunger 17 is withdrawn out of the barrel a sufficient distance so that the substances 24 and 25 can intermix. The syringe can be in almost any orientation during this step. Preferably the syringe is held in an upward orientation, that is, as shown in FIG. 5 with the nipple end of the barrel pointing upwardly. In this orientation the substances mix. The syringe can be shaken in order to enhance mixing. After mixing is essentially complete the syringe is oriented as shown in FIG. 6, with the nipple end of the barrel pointing downwardly. In this orientation the mixture flows out the barrel chamber 12 and plunger chamber 22 to a point in the nipple end of the barrel. Air in the syringe occupies the volume of the barrel chamber and plunger chamber. The original source of this air was from the barrel chamber and plunger chamber. The plunger 17 is then pushed downwardly with the syringe maintained in the same orientation as shown in FIG. 7. The mixed substances are now ready for administration or some other use.

The syringe barrel and plunger can be constructed out of glass, metal, plastics or combinations of these materials. These are the usual syringe construction materials. The seals 20 and 21 and cap seal 16 can be fabricated out of rubber or any suitable elastomeric material. Various known techniques can be used to construct the syringe components. The barrel and plunger are constructed separately and then assembled. The syringe can be sterilized by the syringe manufacturer, with a subsequent addition of the contained component 24 to the plunger chamber in an antiseptic atmosphere, or the sterilization can be performed by the user just prior to inserting the contained substance into the plunger chamber.

Various changes in the shape, size and arrangement of parts may be made to the syringe herein shown and described without departing from its scope. Such changes, in order to adopt the syringe to a specific use, are obvious to those in the art.

What I claim is:

1. A syringe capable of storing and mixing substances comprising a barrel having a nipple opening at one end, a plunger receiving opening at the other end, and a chamber formed on the surface of said barrel by the outward protrusion of a section of said surface; a plunger slidably disposed within said barrel, said plunger having seals on an upper and lower portion and between said seals a chamber formed in said plunger by the inward intrusion of a section of the surface of the plunger surface, said plunger being rotatable in said barrel to align said outward protrusion and said inward

intrusion to form a single chamber for mixing of a substance contained within the syringe.

2. A syringe as in claim 1 wherein said outward protrusion on said barrel is a longitudinal shaped section comprising up to half of the circumference of said barrel.

3. A syringe as in claim 2 wherein said inward intrusion on said plunger is a longitudinal shaped section comprising up to half of the circumference of said plunger.

4. A syringe as in claim 3 wherein said barrel chamber and said plunger chamber when aligned form a symmetrical chamber.

5. A syringe as in claim 4 wherein said symmetrical chamber is ellipsoidal in shape.

6. A syringe as in claim 1 wherein there is a cap seal on said barrel at said inlet-outlet opening whereby the internal surfaces of said syringe are maintained antiseptic.

7. A syringe as in claim 1 wherein a solid substance is contained within said chamber formed by said inward intrusion on said plunger.

8. A syringe as in claim 1 wherein said barrel at said nipple opening has a cannula.

9. A method of mixing at least two substances using a syringe comprising:

- providing a syringe having an outward protruding chamber on the barrel portion and an inward intruding chamber on the plunger portion, said plunger being rotatable within and sealing against said barrel portion;
- inserting a first substance into the chamber on said plunger and aligning said plunger so that said plunger chamber is not in alignment with the chamber on said barrel portion;
- drawing a second substance up into the barrel;
- rotating said plunger so that said plunger chamber and said barrel chamber are in alignment; and
- withdrawing said plunger from said barrel a sufficient distance such that the plunger allows mixing of said first and second substances.

10. A method of mixing as in claim 9 wherein during step (e) said syringe is maintained in an upwardly pointing orientation with said plunger being drawn downwardly from said barrel.

11. A method of mixing as in claim 10 wherein after step (e) said syringe is pointed downwardly whereby the mixed substances occupy a space in said syringe adjacent the nipple opening.

12. A method of mixing as in claim 11 wherein said plunger is slid downwardly until it contacts said mixed substances.

13. A method of mixing as in claim 12 wherein said first substance is a solid and said second substance is a liquid.

14. A method of mixing as in claim 9 wherein said first substance is a solid and said second substance is a liquid.

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