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HYPODERMIC SYRINGE

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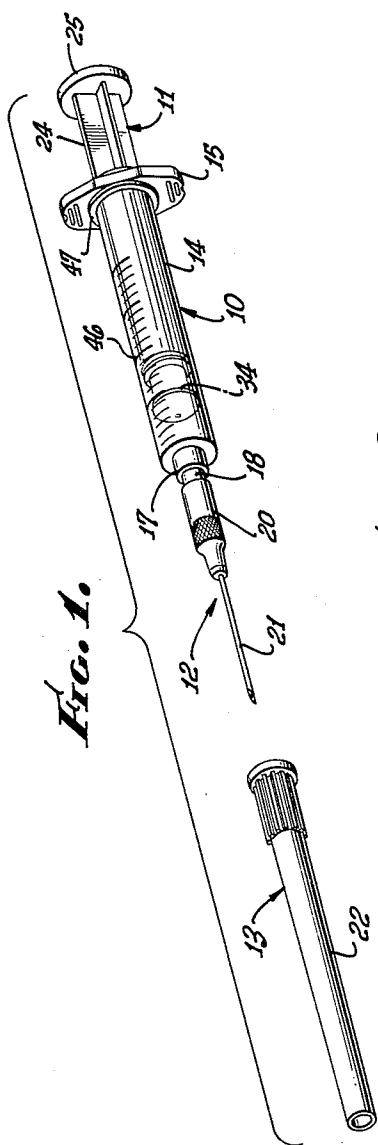


Fig. 1.

Fig. 2.

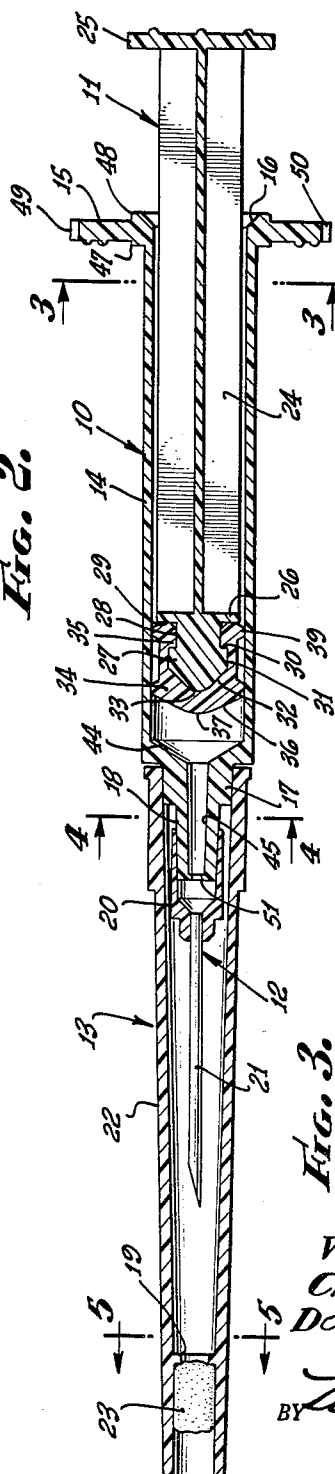
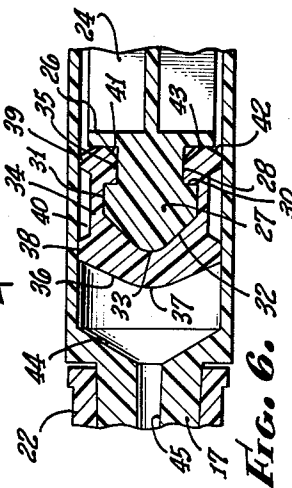


Fig. 3.

Fig. 4.

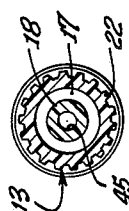


Fig. 4.



Fig. 5.

Fig. 6.



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HYPODERMIC SYRINGE

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6 Claims. (Cl. 128—218)

This invention has to do generally with hypodermic syringes, and is directed particularly to improvements in plastic syringes characterized by their low cost and therefore practicability for being discarded after single use.

Contemplating use of the present syringe in the treatment of human patients, the invention has for its general object to embody in the syringe various features and advantages that will assure safe and accurate use notwithstanding its low cost construction.

Structurally, this type of syringe comprises a thin transparent plastic barrel adapted to carry a detachable needle and its protector, and a plunger working through an open or entrance end of the barrel and carrying at its inner end a sealing head or stopper visible in relation to graduations on the barrel and operable to effect fluid displacement into and out of the barrel through its discharge passage communicable with the needle.

Certain major objects of the invention are directed to improvements in the stopper form and association with the plunger, as well as the relation of the stopper to the internal barrel configuration, all to the end of assuring, without sacrifice of essential simplicity, low cost and facility for machine assembly, fluid-tight seal between the stopper and barrel wall, accurate readability of the stopper position, and complete displaceability of all fluid from the barrel.

In accomplishment of these objectives the invention preferably utilizes a thimble-like stopper having a snap-on association with the plunger tip and internally conformed to certain shape characteristics of the tip to assure such support and force transmission to the sealing peripheries of the stopper as will maintain a complete seal against the barrel through all positions and movements of the plunger.

Another major object of the invention is directed to an improvement in the barrel material and dimensions assuring a significant improvement in resistance to medicaments with which the syringe may come in contact.

The invention has additional features and objects, all of which together with the details of a preferred though illustrative embodiment, will be understood to best advantage from the following detailed description of the accompanying drawing in which:

FIG. 1 is a perspective showing of the complete syringe assembly with the protector removed from the needle;

FIG. 2 is a longitudinal cross-sectional showing of the assembly with the needle protector applied to the barrel;

FIGS. 3, 4 and 5 are cross-sectional views taken respectively on lines 3—3, 4—4 and 5—5 of FIG. 2; and

FIG. 2 is a fragmentary enlargement of the plunger tip and opposed barrel end.

As illustrated, the complete syringe assembly comprises the combination of a barrel generally indicated at 10 containing a reciprocable plunger 11 operable to displace fluid from the barrel through a removable needle 12 normally enclosed within a tubular protector 13.

The barrel 10 is formed with a straight cylindrical body 14 having within the terminal flange 15 an open entrance end into which insertion of the plunger 11 is facilitated by beveling the barrel mouth at 16. At its oppo-

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site end, the barrel has a reduced diameter neck 17 to receive the protector 13, and a further reduced shank 18 onto which the hub 20 carrying the hypodermic cannula 21 has a tightly snug fit. The protector 13 comprises a tapered plastic tube 22 removably fitted to the barrel neck 17 and containing a cotton plug 23 held in place by an annular flange 19.

The barrel 10 may be made of polystyrene, poly-alpha-methylstyrene (Cymac), cellulose acetate, methyl methacrylate, or rigid polyvinyl chloride. The wall thickness of the body 14 is preferably between about 0.040 and 0.070 inch thick. Wall thicknesses less than 0.040 are too brittle for use and tend to develop stresses and craze marks. Such materials are transparent, can be easily marked with available printing inks and can be sterilized by ethylene oxide or other gases suitable for relatively low temperature sterilization. Serious problems arise, however, because these materials can be attacked by solvents and certain medicaments. Thus, there is a possibility that materials in contact with a plastic syringe could dissolve a portion of it with consequent danger to a patient.

Another problem also arises in attempting to fasten the needle 12 onto the shank 18. Since polystyrene is a relatively rigid material, the needle 12 must be driven onto the shank 18 with considerable force to be sure that it will not come loose during transport. Such forces however, cause stresses and crazing of the shank 18, which then allow the needle to come loose.

Polypropylene is resistant to practically all solvents and medicaments and to temperatures needed for steam sterilization. It would therefore be an ideal material from which to make the barrel 10, except that it is generally too opaque for the contents of the syringe or the front of the stopper 34 to be easily seen through the barrel wall.

We have found that a suitable polypropylene barrel can be made by reducing the wall thickness to 0.015 to 0.025 inch, and preferably to 0.018 to 0.22 inch. This thin barrel is nearly transparent, strong enough to hold the pressures developed in a syringe and the needles can be forced onto shank 18 without causing crazing. The surprising clarity of the barrel is apparently due partly to the thinner wall and partly to the rapid cooling of the thin barrel which, we believe, keeps the plastic in an amorphous state. If the barrel wall is less than 0.015 inch, the syringe feels flimsy. If the wall thickness is greater than 0.025 inch, the syringe is too opaque for convenient inspection of its contents.

The outer or handle extent of the plunger 11 is shown to be formed of centrally integrated straight webs 24, typically four, terminating outside the barrel at the end plate or disc 25. The webs 24 are preferably only slightly smaller than the inner diameter of the body 14 so that they keep the plunger aligned with the plunger tip and stopper. Inwardly the webs terminate at a circular stopper back-up plate 26 beyond which the plunger has a reduced diameter tip 27. As will be understood, all the plunger parts mentioned are integrally molded of plastic which may be the same as or different from the plastic composition of the barrel 10. Referring more particularly to the plunger tip 27, the latter contains an annular groove 28 defined by shoulder 29 of the back-up plate 26 and a smaller diameter shoulder 30 beyond which the head of the tip may extend substantially straight at 31 to a forwardly tapered surface 32 merging to a centrally rounded end or nose 33.

The plunger tip carries an elastomeric stopper 34 formed preferably of solvent-resistant rubber, the interior configuration of which corresponds to the shape of the plunger tip 27 so that the stopper may be applied

thereto by end pressure over the tapered surface 32 to cause the annular internally flanged portion 35 of the stopper to snap into and be releasably retained in the groove 28. Externally the stopper presents a tapered end surface 36 merging to the rounded center at 37 and extending outwardly to form one side of the seal ring 38. The stopper has an integrally formed rear seal ring 39 and is annularly recessed at 40 between and to form the opposed inner surfaces of the seal rings. It will be noted that the inner end faces of the stopper 34 and seal ring 39 are annularly beveled at 41 and 42 to provide for reduced area contact at 43 between the stopper and plate 26 so that pressure applied by the plate to the stopper tends to displace the rubber and ring 39 outwardly into tight sealing engagement with the barrel wall, and simultaneously to radially contract and maintain sealing engagement of the stopper portion 35 with the base and forward shoulder of groove 28. The tapers at 41 and 42 may be respectively in the order of 45° and 60° in relation to the plunger and barrel axis.

It will also be noted that the rear seal ring 39 is located at the rear of the stopper, substantially behind the shoulder 30 of the plunger tip 27. When the plunger is pulled back to draw fluid into the syringe, the shoulder 30 pushes against the annular portion 35 of the stopper, forcing the seal ring 39 outwardly into tight sealing engagement with the barrel wall. Moreover, inward pressure of the barrel wall against the seal ring 39 holds the annular portion 35 of the stopper down against the shoulder 30 of the plunger tip, thus holding the stopper securely on the plunger tip.

The inner end of the barrel chamber is defined by forwardly tapered annular shoulder 44 merging to the axially aligned fluid discharge passage 45. It will be observed that the shoulder 44 extends at lesser angularity to the barrel axis than the tapered end surface 36 of the stopper. Typically this angularity of the barrel shoulder 44 may be at about 60° and the stopper taper 36 about 67.5°.

Considering the angular relation of the tapered tip surface 32 (at about 45°) to the end surface 36 of the stopper, the effect of endwise plunger thrust acting to discharge fluid from the barrel is to displace the rubber forwardly and outwardly from the tip face 32 and thus press the seal ring 38 into fluid-tight engagement with the barrel wall. A particular feature of the invention is the correlation between the tapered end of the stopper and barrel shoulder 44 which arises by reason of their difference in angularities. As the stopper is pressed toward the end of the barrel, the outer periphery of surface 36 first engages the outermost extent of shoulder 44. Then as additional force is applied and the stopper advancement continues, the rubber is displaced to progressively radially inwardly engage the remainder of the barrel shoulder 44 to the final position at which the rounded nose 37 of the stopper fits within the mouth of the discharge passage 45. In this manner the syringe operates with complete assurance that all fluid will have become completely discharged from the barrel in advancement of the stopper when it becomes fully seated. When the additional force on the stopper is released, the resilience of the rubber displaces the stopper rearwardly until only the outer periphery of surface 36 is in contact with shoulder 44. This displacement draws fluid through the needle 12 into passage 45. In this manner "flashback" can be easily observed so that the operator knows whether or not the needle is in a patient's vein.

The described stopper construction and its relation to the plunger tip and barrel shoulder, afford various additional advantages such as easing the required plunger pull-out force without leakage, better grip when the stopper is under vacuum, and the avoidance of any consequential tendency for the stopper to pull away from the plunger. By reason of the tapered end configuration of the stopper and the associated tapered barrel

shoulder, the stopper will force the removal of all air bubbles in addition to expelling all medicine. The taper given the stopper tip facilitates easier reading in relation to the barrel graduations at 46 and gives, as viewed through the barrel, a generally flat appearance to the plunger tip. The shape and arrangement of the seal rings 38 and 39 afford the narrowness of barrel engagement that will give finer line registration with the graduation marks, allow squeegee-like action of the rings with less compression of the rubber and consequently minimize friction, all with the assurance of complete fluid sealing.

To facilitate automatic assembly of the syringe, the barrel 10 is further provided with an annular boss 47 adjacent the junction of flange 15 with the body 14. This boss 47 is adapted to fit the track of an assembly machine and to carry the barrel 10 during the automatic operations. A second annular boss 48 on the outer surface flange 15 shields the edge of flange 15 from contact with the assembling equipment or with any cover over the track.

The extremities of flange 15 are provided with indentations 49 and 50. By locating the gates of the mold at these indentations, flange 15 is provided with a smooth outer contour. At the opposite end of the barrel 10, the discharge passage 45 has an annular flange 51. The parting line of this end of the mold is located on the inner end of flange 51 so that any flash which may occur is located within the passage 45, shielded from the outer package (not shown) of the syringe.

We claim:

1. A hypodermic syringe comprising a transparent wall barrel having an entrance end and an outlet end adapted to receive a detachable needle and containing an axial discharge passage for fluid delivery to the needle, an elongated plunger insertable and reciprocable within the barrel through its entrance and having an inner reduced tip, an elastomeric barrel-engaging stopper on said reduced tip of the plunger, the inner end of the barrel having an annular shoulder tapering at acute angularity to the barrel axis toward said discharge passage and the end annular surface of the stopper being tapered acutely to the barrel axis in the same direction but at greater angularity to the barrel axis so that upon advancement of the plunger to its innermost position said end tapered stopper surface engages the tapered barrel shoulder progressively radially inwardly to correspondingly displace last remaining fluid from the barrel and the central end surface of the stopper engages the mouth of said discharge passage in the fully advanced position of the plunger.

2. A syringe according to claim 1, in which said stopper has peripheral axially spaced integral forward and rear seal rings respectively adjacent its tapered surface and the opposite end of the stopper, the front face of said forward seal ring being a tapered continuance of said tapered end surface of the stopper.

3. A hypodermic syringe comprising a transparent wall barrel having an entrance end and an outlet end adapted to receive a detachable needle and containing an axial discharge passage for fluid delivery to the needle, an elongated plunger insertable and reciprocable within the barrel through its entrance end and having an inner reduced tip, an elastomeric barrel-engaging stopper on said reduced tip of the plunger, the inner end of the barrel having an annular shoulder tapering toward said discharge passage and the end annular surface of the stopper being tapered in the same direction but at greater angularity to the barrel axis so that upon advancement of the plunger to its innermost position said end tapered stopper surface engages the tapered barrel shoulder progressively radially inwardly to correspondingly displace last remaining fluid from the barrel, said plunger tip having an end surface tapered forwardly at lesser angularity to the barrel axis than said tapered stopper surface.

4. A hypodermic syringe comprising a transparent wall

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barrel having an entrance end and an outlet end adapted to receive a detachable needle and containing an axial discharge passage for fluid delivery to the needle, an elongated plunger insertable and reciprocable within the barrel through its entrance end and having an inner reduced tip, an elastomeric barrel-engaging stopper on said reduced tip of the plunger, the inner end of the barrel having an annular shoulder tapering at acute angularity to the barrel axis toward said discharge passage and the end annular surface of the stopper being tapered acutely to the barrel axis in the same direction but at greater angularity to the barrel axis so that upon advancement of the plunger to its innermost position said end tapered stopper surface engages the tapered barrel shoulder progressively radially inwardly to correspondingly displace last remaining fluid from the barrel, said plunger tip having an annular groove defined by a forward small diameter shoulder and a rear larger diameter shoulder, said stopper including an internal annular elastomeric projection radially expansible with the stopper over said

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tip to enable said projection to snap into and be releasably retained within said groove.

5. A syringe according to claim 4, in which the end of the stopper adjacent said larger diameter shoulder is annularly tapered both internally and externally toward the larger diameter shoulder.

6. A syringe according to claim 4, in which the diameter of said larger shoulder corresponds substantially to the maximum plunger diameter within the barrel and is directly engaged by the inner end of said stopper.

References Cited in the file of this patent

UNITED STATES PATENTS

877,946	Overton	Feb. 4, 1908
2,574,964	Eisenstark	Nov. 13, 1951
2,602,447	Kollsman	July 8, 1952
2,629,376	Gallice	Feb. 24, 1953
2,860,635	Wilburn	Nov. 18, 1958
2,895,773	McConnaughey	July 21, 1959