Feb. 2, 1954 H. N. PERELSON 2,667,986

SELF-SEALING DISPENSING DEVICE

Filed Dec. 22, 1951

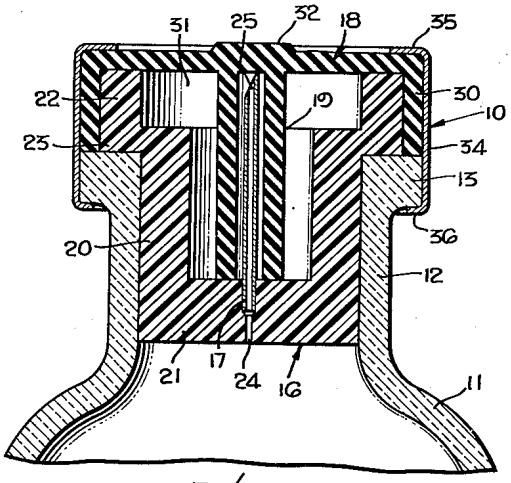

FIG. 1.

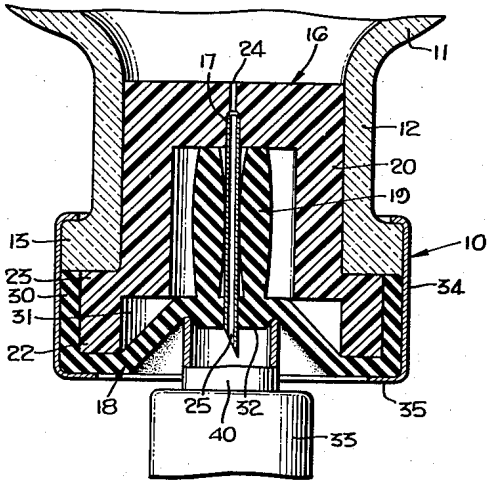

FIG. 2.

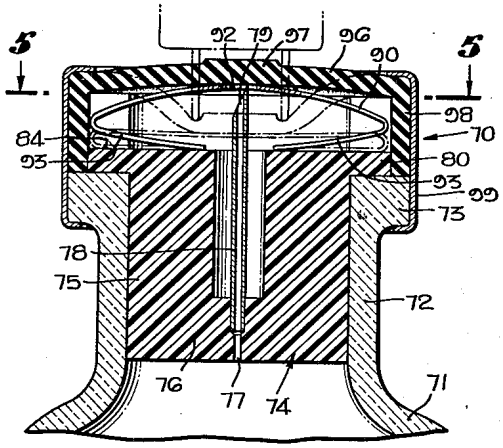

FIG. 4.

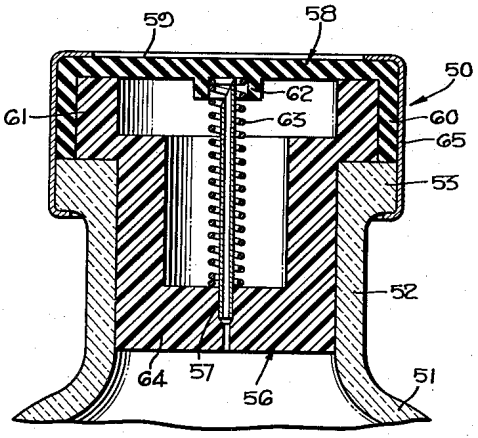

FIG. 3.

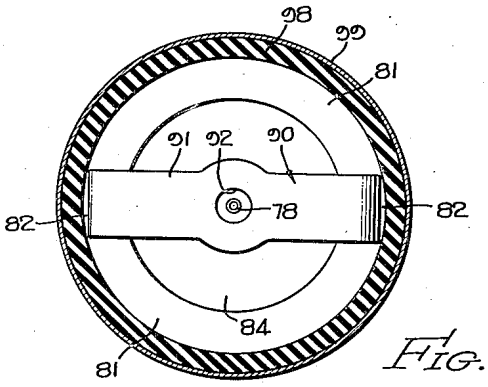

FIG. 5.

HAROLD H. PERELSON,
INVENTOR.

BY

ATTORNEY

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SELF-SEALING DISPENSING DEVICE

Harold N. Perelson, Los Angeles, Calif.

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11 Claims. (Cl. 215—48)

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This invention relates to a closure for vials and the like and particularly to such a closure embodying a self-sealing dispensing device which is especially useful in dispensing serums and the like from a vial into a hypodermic syringe.

A practice commonly followed for transferring serum or other liquid from a vial into a hypodermic syringe is to provide the vial with a stopper embodying a resilient diaphragm which is impaled upon the needle of the syringe and then the syringe piston retracted to suck serum from the bottle through the syringe needle and into the syringe. This practice has certain disadvantages in that it dulls the hypodermic needle thereby making more painful the penetration of the patient's body by the needle. It has the further disadvantage of subjecting the contents of the vial to the possibility of contamination by syringe needles inserted into the vial.

It is an object of the present invention to provide a self-sealing dispensing device suitable for stoppering a vial which will permit a liquid to be readily dispensed from said vial to a syringe but which will eliminate the disadvantages above pointed out.

A prior device which sought to achieve said object and which is shown in U. S. Letters Patent No. 2,342,215, embodied a needle in the stopper upon which a covering diaphragm is impaled by pressing the mouth of the syringe thereagainst in order to produce a communication between the interior of the vial and the syringe for drawing a charge of liquid from the vial into the syringe. The diaphragm in said device had a mouth frictionally receiving the syringe neck to accomplish the stripping of the diaphragm from the needle when the syringe was withdrawn from contact with the stopper.

It is another object of the invention to provide an improvement over this prior device.

It is also an object of the invention to provide a self-sealing dispensing device suitable for stoppering a vial and operating in a similar manner to the above described patented device but in which the diaphragm is of relatively, thin, simple construction and which will not depend upon friction between the syringe neck and the diaphragm, when withdrawing said syringe from contact with the latter, in order to assure that the diaphragm will be quickly stripped from the needle of the device.

It is another object of the invention to provide a self-sealing dispensing device suitable for serving as a vial stopper and embodying a hollow needle mounted on said stopper and enclosed by

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a diaphragm mounted on said stopper so that the diaphragm may be impaled on said needle by pressing a syringe neck against said diaphragm, and in which device a separate resiliently expansive element is provided between the stopper and the diaphragm and upon which element preponderant dependence is placed for supplying the force needed to strip the diaphragm from the needle quickly enough to prevent contamination of the latter or leakage therefrom when the syringe is withdrawn.

This application is a continuation-in-part of my co-pending application for U. S. Letters Patent, Serial No. 32,419, filed June 11, 1948, on a Hermetically Sealed Fluid Dispenser, now abandoned.

The manner of accomplishing the foregoing objects as well as further objects and advantages will be made manifest in the following description taken in connection with the accompanying drawing in which

Fig. 1 is an enlarged vertical sectional view taken on the axis of a preferred form of the present invention.

Fig. 2 is a view similar to Fig. 1 with the invention inverted and showing the diaphragm of the device impaled upon the hollow needle thereof by the application of the neck of a hypodermic syringe, as when utilizing the invention to deliver a charge of liquid to said syringe, and illustrating the compression of a tubular rubber spring located between the stopper base and the diaphragm to build up an expansive force in said spring which will quickly strip the diaphragm from the hollow needle when pressure of the syringe against said diaphragm is relaxed.

Fig. 3 is a view similar to Fig. 1 showing a modified form of the invention in which the expansive element depended upon for stripping the diaphragm from the hollow needle comprises a coil spring which is centered on the hollow needle.

Fig. 4 is a view similar to Fig. 1 and illustrates a second modified form of the invention in which a still different form of spring element is provided by the stopper base of the diaphragm for compression between the base and a central portion of the diaphragm when the latter is impaled on the upper pointed end of the hollow needle of the device so as to quickly strip the diaphragm from the needle when the pressure of the syringe against said diaphragm is relaxed.

Fig. 5 is a horizontal sectional view taken on the line 5—5 of Fig. 4 giving a view of the spring element embodied in the second modified form of the invention.

Referring specifically to the drawings, the preferred embodiment of the invention illustrated in Figs. 1 and 2 is seen to comprise a stopper 10 for a bottle 11 having a neck 12 on the upper end of which is formed a radial flange 13.

The stopper 10 includes a base 16, a hollow needle 17, a diaphragm 18 formed of resilient material such as soft rubber or a synthetic equivalent thereof, and a resiliently expansive element 19 located between said base and said diaphragm.

The base 16 is preferably formed of a relatively rigid plastic material and includes a hollow plug 20 which fits within the bottle neck 12. The plug 20 has a bottom wall 21 and an outwardly offset annular wall 22 at its upper end, a lower shoulder 23 of which rests on top of the bottle neck 12 when the plug 20 is in place. The bottom wall 21 of the plug 20 has an axial hole 24, in an upper counter-bored portion of which the lower end of the hollow needle 17 is pressed to provide a permanent mounting of said needle therein with the passage in said needle communicating through hole 24 with the interior of the bottle 11.

The needle 17 is thus permanently mounted axially on the bottom wall 21 of the plug 20 and has a sharply pointed upper end portion 25 which terminates approximately at the level of the upper edge of wall 22.

The diaphragm 18 is preferably flat and thin and of a highly flexible character, and overlies wall 22 so as to rest on the upper edge of this. A peripheral wall 30 is molded integral with said diaphragm which snugly conforms to the outer face of the wall 22 so as to form a closed chamber 31 between the base 16 and the diaphragm 18. The upper face of the diaphragm 18 may be flat or it may have a boss 32 formed centrally thereon for the purpose of centering a syringe 33 with respect to the stopper 10.

The resiliently expansive element 19 preferably comprises a tube formed of the same material as in diaphragm 18 and molded integral therewith so that said tube extends downwardly from said diaphragm concentric therewith and surrounding the hollow needle 17, with the lower end of said element either very close to or engaging said bottom base wall 21 as shown in Fig. 1.

The stopper 10 is preferably permanently secured to the bottle 11 by a metal ferrule 34 having an upper flange 35 which extends inwardly over the diaphragm 18 and wall 22 and a lower flange 36 which is rolled inwardly beneath the bottle neck flange 13 after the stopper 10 and ferrule 34 have been assembled on the bottle 12 as shown in Fig. 1.

The stopper 10 has particular utility in hermetically closing vials for holding serums and other liquids injected hypodermically, and offers a means of dispensing serum from the vial into a hypodermic syringe such as the syringe 33 in a manner illustrated in Fig. 2 and which will now be described.

Assuming that the bottle 11 is a serum vial, this is inverted and may be so held in a clamp or other support (not shown). The exposed surface of the diaphragm 18 is now sterilized as by wiping this with a piece of cotton saturated with alcohol after which the hypodermic syringe 33, with its piston pushed entirely inward, is inverted and the neck 40 of the syringe is applied upwardly to the diaphragm 18 so as to be centered relative thereto by fitting the neck 40 over the boss 32. A pressure is then exerted upwardly through the syringe 33 to the diaphragm 18 depressing the latter as shown in Fig. 2 and thereby impaling said diaphragm on the pointed end portion 25 of the hollow needle 17.

Due to its location between the base 16 and the diaphragm 18 the resilient expansive element 19 is compressed by depression of said diaphragm causing said element to assume a shortened and laterally expanded shape as shown in Fig. 2, owing to its length being decreased by substantially the distance said diaphragm is depressed. This compression of expansive element 19 builds up a substantial resilient expansive force in said element opposing the pressure of the syringe 33 against said diaphragm.

With the syringe 33 so related to the stopper 10, the piston of the syringe 33 is retracted to suck from the vial 11 a load of serum which flows through the hollow needle 17 into the syringe.

As soon as this has been accomplished, the syringe is lowered from the position in which it is shown in Fig. 2 as rapidly as is consistent with preventing the spilling of serum from the inverted syringe. The diaphragm 18 tends to resume its normal shape but the friction between the needle and the diaphragm opposes this. It is to be noted that the axial force exerted by the diaphragm alone is insufficient to strip the central portion of the diaphragm from the pointed end 25 of the needle 17 with sufficient rapidity to cause this stripping to keep pace with the normal speed with which a person withdraws the syringe downwardly away from the diaphragm 18 after filling said syringe.

It is necessary, therefore, to amplify the stripping force supplied by the diaphragm itself in order to prevent accidental leakage of liquid from the needle or contamination of the latter by the removal of the syringe from contact with said diaphragm before the stripping of said diaphragm from the point of said needle is accomplished. Such an amplifying force is provided by the expansive element 19. The expansive energy stored up in this element, when it is compressed by the diaphragm 18 as shown in Fig. 2, results in this element exerting such a substantial axial pressure outwardly against the central portion of the diaphragm 18, that the addition of this force to the axial force exerted by the tendency of the diaphragm 18 to resume its normal shape, produces a combined axial force which strips the diaphragm 18 from the pointed end 25 of the needle so quickly that whenever the minimum degree of care is exercised in withdrawing the syringe 33 downwardly after filling the same, the diaphragm will have been stripped from the pointed upper end 25 of the hollow needle 17 before contact is broken between the diaphragm and the syringe.

It is thus seen that with the construction of the present invention, the diaphragm 18 may be made very thin and flexible in character so that it will exert a relatively light axial force on the middle portion of the diaphragm tending to strip this from the needle 17, while major dependence is placed upon the expansive element 19 to provide practically the entire axial force required to strip the diaphragm from the needle with such speed as to insure that the diaphragm will remain in contact with the neck 40 of the syringe 33 until the diaphragm 18 has been stripped from the extremity of the pointed end 25 of said needle.

In Fig. 3 a modified form of the invention is shown comprising a stopper 50 which is adapted

to stopper a bottle 51 having a neck 52 with a radial flange 53, said stopper including a base 56 which is substantially like base 16 and has a hollow needle 57 which is substantially like needle 17. Stopper 50 also includes a diaphragm 58 which is like the diaphragm 18 excepting that its upper surface 59 is entirely flat which is to illustrate that it is not essential to have the diaphragm of the invention equipped with a boss 32, although such a boss serves a very useful function in permitting a person using the invention to center the neck 40 of the syringe 33 in concentric relation with the hollow needle of the stopper by the sense of feeling, thus eliminating the necessity of paying particular attention to the matter of getting the syringe co-axially related with the stopper before employing the latter to dispense a load of serum into the syringe.

The diaphragm 58 has a peripheral wall 60 molded integral therewith which surrounds an annular offset wall 61 formed on the upper end of the base 56. Also molded integral with the diaphragm 58 is a short, downwardly extending nipple 62 which receives and centers the upper end of an expansive element 63 which comprises a wire spring coiled about the needle 57 with its upper end disposed close to or engaging the diaphragm 58 and with its lower end resting on a bottom wall 64 of the base 56. The stopper 50 is secured permanently on the vial or bottle 51 by a ferrule 65 which is identical in construction with ferrule 34.

The mode of operation of the stopper 50 in delivering a load of serum from a vial to the hypodermic syringe 33 is identical to that of stopper 10 as above described. In other words the vial of bottle 51 is inverted and the neck 40 of syringe 33 pressed against the diaphragm 58 with the syringe in centered relation to the stopper 50 thereby impaling the diaphragm 58 on the hollow needle 57 and compressing the spring 63. The expansive force stored in the spring 63 by this compression causes it to supply a preponderent portion of the axial force applied to the diaphragm 58 tending to strip this from the needle 57 as pressure of the syringe against the diaphragm 58 is relaxed incidental to the removal of the syringe from contact with this diaphragm.

A second modified form of the invention, as illustrated in Figs. 4 and 5, comprises a stopper 70 which is employed in stoppering a vial or bottle 71 having a neck 72 from the upper end of which a flange 73 extends radially outwardly.

The stopper 70 includes a base 74 which is formed of the same material as base 16, this base including a hollow plug 75 which fits within the neck 72 of the bottle 71 and has a bottom wall 76 in which a central hole 77 is formed, in an upper counter-bored portion of which a hollow needle 78, having a pointed upper end 79, is pressed to permanently mount said needle in said base. The upper end of the plug 75 has a radial extension 80 which overlies and engages the upper end of bottle neck 72 and from which two arcuate peripheral walls 81 extend upwardly, these being separated by slots 82. The slots 82 extend downwardly to the level of an upper face 84 of the plug 75. Resting on the face 84 with its opposite ends extending into slots 82 is an expansive element 90 comprising an elliptical leaf spring including an upper bow 91 the central portion of which is enlarged and has a hole 92, and lower wings 93 which are bent

downwardly and inwardly from opposite ends of the bow 91.

Covering the upper end of the base 74 is a diaphragm 96 which is preferably thin and of relatively resilient rubber or a synthetic equivalent, this diaphragm being molded flat and having a syringe centering boss 97 extending upwardly from the upper surface thereof and also having a peripheral wall 98 molded integral therewith extending downwardly to snugly embrace the walls 81. The entire stopper 70 is held in place on the bottle neck 72 by a ferrule 99 which is identical with the ferrule 34.

The manner in which the stopper 70 is actuated by the application of a syringe 33 thereto is illustrated in broken lines in Fig. 4, it being understood that vial 71 and syringe 33 are both inverted when the stopper 70 is thus actuated to deliver a load of serum or other liquid from the vial 71 to the syringe 33. As indicated in broken lines in Fig. 4, a depression of the diaphragm 96 by the application thereto of the neck 40 of the syringe 33 in centered relation with boss 97 depresses the diaphragm 96 and the middle portion of the expansive element 90 so as to cause the pointed end 79 of the needle 78 to extend through the hole 92 in said element and impale the diaphragm 96 on said needle. The expansive element 90 is compressed by this depression of the diaphragm 96 so as to exert a substantial expansive pressure against the middle portion of the diaphragm 96 while said diaphragm is so depressed, as shown in broken lines in Fig. 4. This pressure of the expansive element 90 is sufficient to cause the diaphragm 96 to remain pressed against the neck 40 of the syringe 33 when the pressure of the latter against said diaphragm is relaxed so that contact of the syringe 33 with said diaphragm is not broken until the latter has been completely stripped from the pointed upper end 79 of the hollow needle 78. The bent ends of the element 90 are disposed sufficiently close to the resilient wall 98 so as to keep the hole 92 in said element always substantially concentric with the needle 78 so that, whenever the stopper 70 is actuated to draw a load of liquid into a hypodermic syringe, the needle point 79 will always pass freely through hole 92.

When the element 90 is in its fully compressed position as shown in broken lines in Fig. 4, the bent ends thereof may extend slightly into the resilient wall 98 which, of course, aids in centering the element 90 with respect to the needle 78 when this element is allowed to expand to its normal shape as shown in Fig. 4. While this view shows the element 90 as normally shaped to hold the diaphragm 96 in slightly arched shape, this is not essential to the invention and the modified form of the invention embodied in the stopper 70 may perform its function equally well with the diaphragm 96 normally completely flat as shown in the stopper 10 or stopper 50 and described hereinabove.

While for illustrative purposes the present invention has been described hereinabove as embodying a diaphragm made of resilient material which of itself exerts a force resisting the depression of the diaphragm and aiding in stripping the diaphragm from the needle when the diaphragm is released, it is quite practical in the present invention to utilize a diaphragm so thin and flexible that the diaphragm itself exerts practically no force tending to strip the central portion of the diaphragm from the needle,

when the force impaling the same on said needle is relaxed. In such a form of the invention the entire force employed for stripping the central portion of the diaphragm from the needle would be supplied by the internal resilient element which is subject to compression between the base and the diaphragm substantially throughout the movement imparted to the diaphragm in order to impale the same on said needle.

Indeed, one of the advantages of the present invention is the economy resulting from the fact that there is no need for the diaphragm itself to contribute any substantial portion of the axial force required to strip the central portion of the diaphragm from the needle so that this diaphragm may be made exceedingly thin and yet perform its principal functions of hermetically enclosing the needle and positioning a thickened central portion of the diaphragm so that this may be readily impaled on the needle and then as quickly stripped therefrom by the energy stored up in the expansive element during the impaling movement.

The claims are:

1. A self-sealing dispensing device, comprising a rigid stopper adapted to fit within the neck of a bottle and having a central bore and a substantially flat bottom wall, a hollow needle axially mounted within said wall and communicating through said wall with the space therebeneath, said needle extending axially a substantial distance above said stopper wall, an imperforate deformable cap of flexible resilient material mounted on the upper end of said stopper in close fitting engagement therewith, said cap including an integral depressible diaphragm closing the space between said stopper and said cap and overlying the upper end of said needle, and an integral tubular extension depending from said diaphragm and surrounding said needle in spaced relation thereto, the bottom end of said tubular extension terminating in close proximity to the upper surface of a central portion of said flat bottom wall of said stopper located beneath the bottom end of the tubular extension, said diaphragm being adapted to be impaled upon the upper end of said needle to cause the latter to penetrate the diaphragm for the delivery of liquid through said needle, the bottom end of said tubular cap extension engaging said stopper wall when said diaphragm is depressed and before said needle completely penetrates said diaphragm, further depression of said diaphragm, to completely force the needle therethrough, compressing and deforming said extension against said wall to build up a counterpressure in said extension exerted against said diaphragm, said counterpressure operating to expand said tubular extension and strip the diaphragm from the upper end of said needle when the pressure on the diaphragm is released.

2. A self-sealing dispensing device comprising a stopper adapted to fit the neck of a bottle, said stopper having a rigid base, a hollow needle mounted upon said base and connecting through the latter with the space therebeneath, a pointed end portion of said needle extending upward out of said base, an imperforate deformable diaphragm of resilient material mounted on and uniting with said base to completely enclose said needle, said diaphragm overlying the pointed end of said needle in a position to be impaled on said needle when depressed, and a resiliently expansive element disposed between said base and said diaphragm with its opposite ends adjacent respectively to said base and said diaphragm before said diaphragm is so depressed, the depression of said diaphragm as aforesaid to impale the latter on said needle developing a resiliently expansive force in said element which is applied to said diaphragm adjacent said needle with the effect of quickly stripping said diaphragm from the pointed end of said needle when said diaphragm is released from the pressure by which it had been depressed.

3. A combination as in claim 2, in which said expansive element is tubular in form and surrounds said needle.

4. A combination as in claim 3 in which said tubular expansive element is formed of soft rubber.

5. A combination as in claim 4 in which said tubular soft rubber element is supported by said diaphragm at the end of said element adjacent thereto.

6. A combination as in claim 5 in which said element is molded with and forms an integral part of said diaphragm.

7. A combination as in claim 2 in which said element comprises an expansive spring unconnected with said diaphragm and assembled between said base and said diaphragm in normally fully expanded condition with its opposite ends closely adjacent respectively to said base and said diaphragm.

8. A combination as in claim 2 in which said expansive element comprises a coiled expansive spring which is assembled between said base and said diaphragm with said spring coiled about said needle in normally fully extended condition and with its opposite ends closely adjacent respectively to said base and said diaphragm.

9. A combination as in claim 2 in which said expansive element comprises a leaf spring, an upper portion of which is positioned close to a central portion of said diaphragm and is apertured to receive the pointed end of said needle, terminal portions of said spring engaging said base in symmetrical relation with said needle with said spring normally in fully expanded condition.

10. A self-sealing dispensing device comprising a stopper adapted to fit the neck of a bottle, said stopper having a rigid base, a hollow needle mounted upon said base and connecting through the latter with the space therebeneath, a pointed end portion of said needle extending upward out of said base, an imperforate deformable diaphragm of resilient material mounted on and uniting with said base to completely enclose said needle, said diaphragm overlying the pointed end of said needle in a position to be impaled on said needle when said diaphragm is depressed, and a resiliently expansive element disposed between said base and said diaphragm and positioned to be compressed between said diaphragm and said base practically throughout the entire axial movement of said diaphragm to effect said depression thereof, the compression of said element developing an expansive force in said element which is operative when the outside pressure against said diaphragm is relaxed, to quickly strip said diaphragm from the pointed end of said needle.

11. A self-sealing dispensing device comprising a stopper adapted to fit the neck of a bottle, said stopper having a rigid base, a hollow needle mounted upon said base and connecting through the latter with the space therebeneath, a pointed end portion of said needle extending upward out

of said base, an imperforate deformable diaphragm of resilient material mounted on and uniting with said base to completely enclose said needle, said diaphragm overlying the pointed end of said needle in a position to be impaled on said needle when depressed by the open neck of a syringe applied thereto concentric with said needle, and a resiliently expansive element disposed between said base and said diaphragm and positioned to be compressed by said diaphragm when the latter is so depressed, said compression developing such a counter-expansive force in said element when complete penetration of said diaphragm by said needle is accomplished that said counter-expansive force comprises a preponderant portion of the forces operating in opposition to the depression of said diaphragm

whereby said forces are of a combined magnitude to quickly strip said diaphragm from the pointed end of said needle, when the pressure applied by said syringe is relaxed, so as to cause said diaphragm to normally remain in covering relation with said open neck of said syringe until after said diaphragm has been stripped from the pointed end of said needle.

HAROLD N. PERELSON.

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