June 25, 1963 R. P. DUNMIRE 3,094,988

HYPODERMIC AMPOULES

Filed Sept. 18, 1961 2 Sheets-Sheet 1

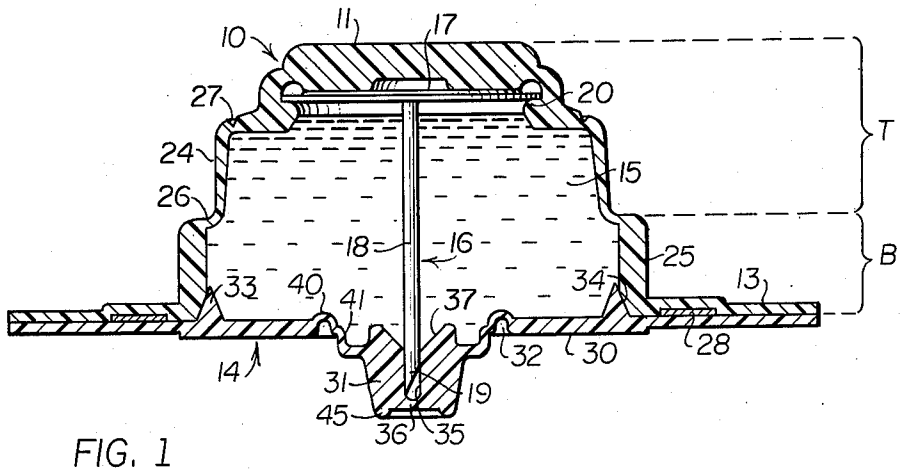


FIG. 1

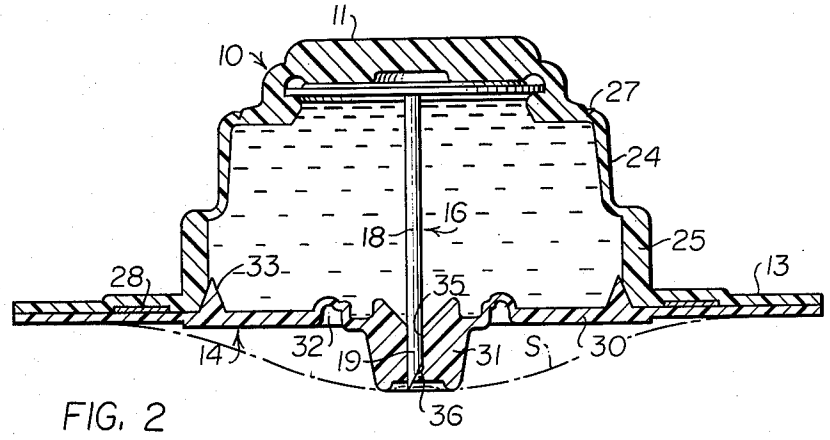


FIG. 2

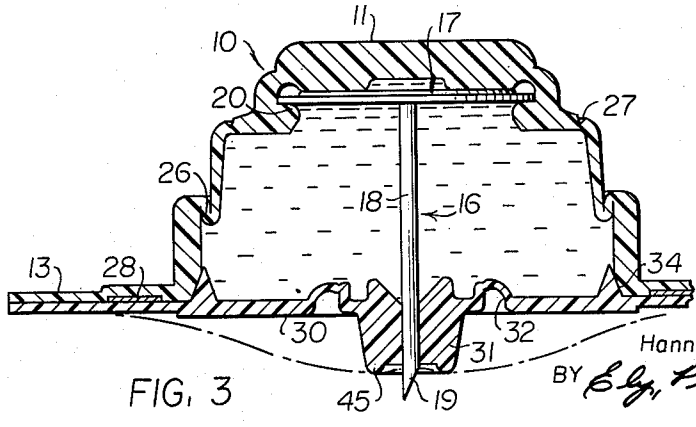


FIG. 3

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June 25, 1963 R. P. DUNMIRE 3,094,988

HYPODERMIC AMPOULES

Filed Sept. 18, 1961 2 Sheets-Sheet 2

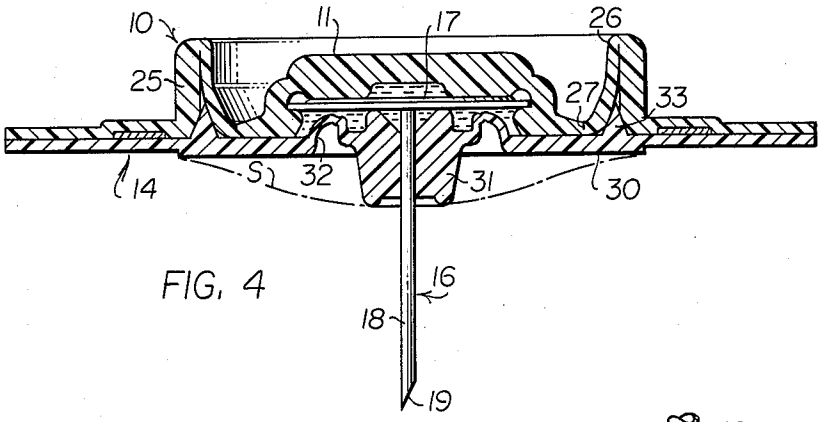


FIG. 4

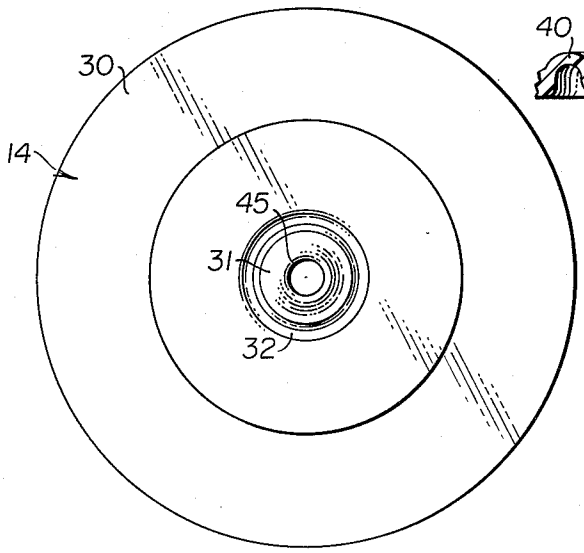


FIG. 5

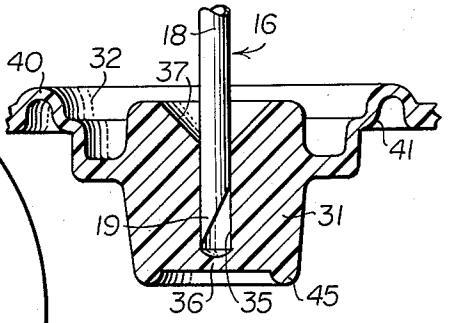


FIG. 6

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United States Patent Office 3,094,988 Patented June 25, 1963

3,094,988

HYPODERMIC AMPOULES

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Filed Sept. 18, 1961, Ser. No. 139,000
11 Claims. (Cl. 128—216)

This invention relates generally to hypodermic injection devices, and more specifically to improvements in disposable hypodermic ampoules of the type disclosed in my U.S. Patents 2,696,212 and 2,769,443, granted December 7, 1954, and November 6, 1956, respectively.

As disclosed in the above-identified patents, the basic construction of my hypodermic ampoule or syringe preferably comprises a body having the general form of an inverted, cup-shaped shell and a disk-like diaphragm peripherally sealed to the body across its mouth to define a collapsible reservoir for containing a prescribed volume of hypodermic liquid. Contained entirely within the sealed ampoule body is a hypodermic needle having a cannula with a pointed discharge end, the needle cannula being disposed in axial alignment with the body and with the pointed end extending toward, but terminating short of the lower end wall or diaphragm. The butt end of the needle is secured adjacent the inner, upper end wall surface of the inverted, cup-shaped shell, and an opening into the butt end of the needle is exposed to the hypodermic liquid so that the liquid can flow freely into and through the needle during the administration of an injection.

In use, the ampoule is positioned with the diaphragm against the skin and pressure is applied to the top of the ampoule to collapse it axially inwardly. When collapsing pressure is initially applied, the pointed end of the hypodermic needle is forced downwardly to pierce the diaphragm. Further pressure results in the needle being inserted through the skin and the ampoule body being collapsed to discharge the hypodermic liquid through the needle into or under the skin.

While the basic construction of my above-described hypodermic ampoule is fundamentally sound and its use relatively simple, certain problems were found to exist in its manufacture and in the practical administration of a hypodermic injection which had to be solved in order to obtain complete acceptance of the ampoule by the medical profession.

One of these problems heretofore existing in the use of the hypodermic ampoule was the possible occurrence of a "hydraulic lock" making it virtually impossible to initially collapse the ampoule body to force the hypodermic needle through the diaphragm. This phenomenon of the hydraulic lock may be explained by the fact that the ampoule is desirably filled very near to capacity with the hypodermic liquid. Thus, it was possible for the initial collapsing movement of the top of the ampoule toward the diaphragm to increase the internal hydraulic pressure sufficiently to distort the diaphragm away from the point of the needle in order to compensate for the decrease in volume. Depending upon the amount of such distortion of the diaphragm, it could prevent puncturing of the diaphragm, and thereby prevent further collapsing of the ampoule to complete an injection. Unless the distance through which the hypodermic needle had to travel before piercing the diaphragm and relieving internal pressure was small (e.g., under .015 of an inch in an ampoule having a volume of one cubic centimeter filled to 90% of capacity), it was possible for a hydraulic lock to cause rupturing of the peripheral seal between the diaphragm and the body, or even rupturing of the body itself, before an injection could be made. Even when the ampoules were not ruptured, it was found that in some instances an excessively great force was required to effect an injection.

The problem of preventing a hydraulic lock within the ampoule by providing for a minimum needle travel is complicated, however, by considerations of avoiding accidental piercing of the diaphragm and by practical limitations on its minimum thickness. More particularly, it is desirable to allow some clearance and consequent relative movement between the point of the needle and the diaphragm; otherwise, the needle may be inadvertently thrust through the diaphragm during handling of the ampoule prior to actual use. Further, from the standpoints of required strength of the ampoule to resist bursting and practical methods of manufacture, the thickness of the diaphragm cannot be less than approximately .010 inch, which thickness is a part of the distance the needle must travel before complete penetration of the diaphragm. It will thus be apparent that the desirability of providing clearance between the needle and diaphrgam and the necessity of employing a diaphragm having a certain minimum thickness are opposed to providing as short a needle travel as possible in order to avoid a hydraulic lock.

Another problem associated with the use of hypodermic ampoules as described in my above-identified patents was the establishment of an effective liquid seal between the diaphragm and the skin. Such a seal is necessary to the proper functioning of the ampoule since, if intimate contact is not maintained between the skin and that portion of the diaphragm that is pierced by the hypodermic needle, some of the hypodermic liquid may squirt over the skin before the needle has been inserted therein. The loss of hypodermic liquid by such leakage cannot be tolerated since the amount of liquid which is injected is obviously critical and must be closely controlled. Moreover, occurrence of this squirting action has been found to make the insertion of the needle into the skin more difficult.

It also is necessary to maintain a leakproof seal between the diaphragm and the needle where the needle penetrates the diaphragm during the injection so that a loss of the hypodermic liquid by leaking from the ampoule body around the periphery of the needle is prevented. This problem is made particularly difficult and troublesome because the relatively small cannular opening afforded by the hypodermic needle, as compared to the volume of liquid required to be exhausted in a brief period of time, contributes to the buildup of hydraulic pressure in the ampoule which, in turn, tends to force the liquid to seep through the puncture in the diaphragm around the needle. The prevention of leakage during an injection is further complicated by the fact that the length of the seal which could heretofore be provided between the needle and the diaphragm was necessarily limited by the need for a diaphragm which is as thin as possible so as to be punctured by a short needle travel.

Inasmuch as the hypodermic ampoules to which the present invention relates are provided with hypodermic needles of fairly short length, an injection cannot be administered effectively unless the needle is guided to enter the skin in a substantially perpendicular position without canting or cocking. If this is not accomplished so that the hypodermic liquid reaches the tissue under the skin, the full effectiveness of the injection may not be realized, this being particularly likely when the injection is administered by a relatively unskilled person. When the needle enters the skin at an angle, there is also the possibility that the skin will be painfully torn.

Other problems associated with the hypodermic ampoule construction as disclosed in my above-identified patents are related to its manufacture and assembly and will be more fully discussed in connection with the detailed description of the present invention.

This invention is particularly concerned with improvements in the construction of the diaphragm for hypodermic ampoules of the type heretofore described, and has for its main objective the provision of a diaphragm construction which effectively overcomes the above-discussed limitations and problems associated with the hypodermic ampoules disclosed in my U.S. Patents 2,696,212 and 2,769,443.

A more specific object of the invention is to provide a diaphragm construction which will always prevent the creation of a hydraulic lock when collapsing pressure is initially applied to force the hypodermic needle through the diaphragm.

Another object of the invention is to provide an improved diaphragm for a hypodermic ampoule which effectively prevents any significant loss of hypodermic liquid due to leakage at the instant of initiation of the injection, as well as during its administration.

A further object of the invention is to provide an improved hypodermic ampoule construction in which the needle is guided for insertion substantially perpendicularly into the skin.

Still another object of the invention is the provision of a diaphragm possessing all of the characteristics described above and which additionally facilitates a safe, economical, and advantageous method of filling and assembling the ampoule.

Still another object of the invention is to provide a diaphragm construction having the above-described attributes and which is also economical and practical to manufacture.

As contemplated by the invention, the improved ampoule diaphragm is formed with an integral, relatively rigid, generally cylindrical portion which constitutes a liquid sealing and needle guiding gland. This novel gland formation has an axial needle passage that is closed at one end by a thin, easily puncturable wall. When the ampoule body, diaphragm, and needle are assembled, a portion of the cannula of the needle adjacent its pointed end is slidably constrained in the needle passage of the gland with an interference fit and with the tip of the needle normally spaced from the puncturable wall at the end of the passage.

Because of the rigidity of the gland and the length over which it contacts the needle, an effective fluid seal is maintained around the cannula of the needle under the hydraulic pressures created during evacuation of the ampoule. At the same time, the needle movement is guided by the gland during the injection. This guided movement of the needle minimizes the possibility of its being cocked and inserted at an oblique angle to thereby tear the skin and/or fail to penetrate the skin to the required depth for an effective injection.

As further contemplated by the invention, the gland is surrounded by a thin, flexible wall portion which affords a bellows-like flexing action permitting movement of the gland axially inwardly of the ampoule to initiate relative penetrating movement of the needle through the puncturable wall of the gland when the ampoule is pressed against the skin. By reason of this movement of the gland, the hypodermic needle itself need only be moved a slight distance to pierce the diaphragm and relieve hydraulic pressure initially created within the ampoule. Consequently, it is possible to afford sufficient clearance between the tip of the needle and puncturable wall of the gland to avoid accidental puncture during handling of the ampoule, and, at the same time, to prevent the creation of a hydraulic lock during initiation of an injection.

In the preferred construction of the diaphragm, the flexible wall portion around the gland has at least one annular corrugation. As will hereinafter be made more apparent, the corrugated formation permits the gland to tilt sufficiently relative to the ampoule body to maintain a liquid seal with the skin when the ampoule itself is axially canted by as much as 20° from the perpendicular,

thereby assuring a reliable injection even though carelessly administered.

The diaphragm comprising the invention also includes an annular, axially inwardly directed sealing rib or flange which is adapted to be tightly nested within the mouth of the ampoule body. During filling and assembly of the ampoule, this flange aids in locating the diaphragm with respect to the ampoule body so that the discharge end portion of the hypodermic needle can be quickly and accurately inserted within the needle passage of the gland. This flange also forms a temporary liquid seal for preventing the hypodermic liquid from spilling from the ampoule body prior to permanently sealing the diaphragm and body together at their peripheries.

Other objects, features, and advantages of the invention will become apparent from the following detailed description and the accompanying drawings.

In the drawings:

FIGURE 1 is a vertical cross-sectional view of a hypodermic ampoule embodying the diaphragm construction of the present invention;

FIGURES 2 and 3 are vertical cross-sectional views of the ampoule in use and illustrate successive stages in its evacuation;

FIGURE 4 is another vertical cross-sectional view of the ampoule in use and illustrates its configuration after the injection has been completed but before its removal;

FIGURE 5 is a bottom plan view of the ampoule illustrated in FIGURE 1; and

FIGURE 6 is a fragmentary cross-sectional view of a portion of the ampoule diaphragm and needle.

Reference is first made to FIG. 1 which illustrates a preferred construction of a hypodermic ampoule device. As shown, the hypodermic ampoule has a body portion **10** in the general form of an inverted cup-shaped shell defined by an upper end wall **11** and a circumferentially extending side wall. A peripheral, outwardly directed flange **13** integrally extends around the open end or mouth of the body **10**, and to this flange **13** is peripherally sealed the disk-like diaphragm **14** of the invention so as to close the mouth of the body and form a fluid reservoir for containing a hypodermic liquid **15**.

A hypodermic needle **16**, which preferably is of the type disclosed in the copending application of R. P. Dunmire, et al. Serial No. 158,944, filed December 8, 1961, is mounted entirely within the ampoule. The circular base or butt end **17** of the needle is clamped adjacent the inner surface of the upper end wall **11** by an annular, radially inwardly directed rib **20** so that the needle cannula **18** is disposed in axial alignment with the ampoule and has its pointed, discharge end **19** extending downwardly in position to be forced through the diaphragm **14**. A cannula opening (not shown) is formed through the needle base **17** so that the hypodermic liquid **15** can be evacuated from the ampoule through the needle after it has pierced the diaphragm.

As more specifically described in my copending application Serial No. 138,999, filed September 18, 1961, the body portion **10** is constructed so that at least 90% of the hypodermic liquid **15** can be discharged from the ampoule when subjected to a collapsing force of not more than 10 or 12 pounds. Provision is also made to prevent the ampoule body from elastically expanding back toward its original shape after it has once been collapsed, thereby avoiding the creation of a vacuum tending to suck or aspirate the hypodermic liquid back into the body.

To these ends, the preferred ampoule body construction **10** includes a top section T defined by a flexible portion **24** of the circumferential side wall and a bottom section B of larger diameter defined by a relatively rigid and inflexible portion **25** of the side wall. The portion **24** of the side wall defining the top section T is tapered from a maximum thickness at its upper end to a minimum thickness at its lower end, while the portion **25** of the side wall that defines the bottom section B has a thick-

ness approximately twice the maximum thickness of the top side wall portion 24. The top and bottom body portions T and B, respectively, are integrally connected by a shoulder portion 26 which is no thicker, and may be slightly thinner, than the minimum thickness of the top side wall portion 24. This shoulder 26 defines the location of a primary hinge about which the circumferential side wall of the ampoule is folded to initiate collapsing thereof by a progressive inverting movement of the top section downwardly within the bottom section when axial pressure is applied to the ampoule.

The preferred body construction 10 is further disclosed in my copending application Serial No. 138,999, as including a circumferential notch 27 around the upper end wall 11. This notch defines the location of a secondary hinge which permits the top body section T to be inverted and nested within the bottom section B with the upper end wall of the ampoule locked against the diaphragm 14.

The hypodermic ampoule, including the body 10 and the diaphragm construction 14, may be made of any flexible material which is inert and retains its strength when exposed to the hypodermic liquid 15 and which will not rupture and/or tear as the ampoule is collapsed. Suitable materials include tough, but yet relatively flexible elastomeric compounds, including plastics such as polyethylene and various other polyvinyl compounds and the like; plastic coated metal foils; and uncoated metal foils which may be joined to form a leakproof liquid seal.

When, as in the preferred embodiment of the invention, the ampoule is made of plastic and the body 10 and diaphragm 14 are joined by heat sealing, the circumferential flange 13 is preferably formed with an annular groove in which is seated a heat conducting metal ring 28. As more fully explained in my copending application Serial No. 252,272, filed January 15, 1963, the metal ring 28 facilitates a quick and localized application of heat to effect the heat sealing of the body flange 13 and diaphragm 14 so as to prevent the hypodermic liquid from being deleteriously affected by the heat and the material of the ampoule from being seriously weakened from overheating.

When administering an injection, the ampoule is positioned with the diaphragm 14 against the skin, and axially, inwardly directed pressure is applied to the upper end wall 11. As illustrated in FIG. 2, the initial application of pressure initiates relative penetrating movement of the needle 16 through the diaphragm. Continued application of pressure (FIG. 3), results in the hypodermic needle being inserted into the skin S and causes the side wall of the ampoule to fold about the shoulder 26 to initiate collapsing thereof.

With still further application of pressure, the side wall portion 24 of the body section T is forced to progressively roll downwardly on itself until the top section T is substantially inverted and telescoped within the bottom section B. Thereupon, the secondary hinge notch 27 is closed and the top body section is completely turned inside out so that the upper end wall 11 is bottomed and locked against the diaphragm 14 (FIG. 4), thus discharging substantially all of the hypodermic liquid through the needle.

Referring now to the detailed, preferred construction of the diaphragm 14, its generally disk-like configuration is shown to be defineed by a substantially flat, annular outer portion 30, a generally cylindrical inner portion 31, and a relatively thin and flexible, annular, intermediate portion 32 connecting the inner and outer portions to permit relative movement therebetween.

The annular outer portion 30 of the diaphragm is heat-sealed to the flange 13 of the body 10 adjacent the inner and outer edges of the ring 28 to form a leakproof and moisture-proof seal. In this assembled position, the diaphragm extends across the mouth of the ampoule body to form a lower end wall opposite the upper end wall 11.

To facilitate filling and assembling the ampoule, the outer portion 30 of the diaphragm is preferably formed with an integral, annular rib 33 which extends above the upper surface of the diaphragm, as viewed in the drawings. This rib 33, which may be of trianguloid cross-section, is formed on a diameter slightly exceeding the inner diameter of the open bottom or mouth of the ampoule body so that the rib may be snugly nested within the mouth of the body 10 with an interference fit.

When assembling and filling the ampoule, the base 17 of the needle 16 is snapped beneath the rib 20 of the body 10, and the body is filled with the hypodermic liquid 15 while in an inverted position from that shown in the drawings. During the subsequent step of applying the diaphragm 14, the rib 33 of the diaphragm may be pressed into the mouth of the body so that the sloping, radially outer surface 34 of the rib engages a portion of the inner surface of the circumferentially extending wall of the body. The interference fit of the rib within the mouth of the ampoule body forms a temporary liquid seal, permitting the ampoule to be transported to a heat-sealing station without spilling and/or contaminating the hypodermic liquid 15. Another advantageous function of the rib 33 is to center the diaphragm with respect to the hypodermic needle 16 so that a portion of the needle adjacent its tip may be extended into the inner diaphragm portion 31.

The generally cylindrical inner portion 31 of the diaphragm 14 constitutes a needle guiding and liquid sealing gland having an axial needle passage 35 extending into the upper end of the gland from inside the ampoule body 10. As shown most clearly in FIG. 6, the needle passage 35 terminates short of the opposite, lower end of the gland to form a relatively thin, easily puncturable wall 36 which normally closes the bottom or lower end of the passage. In order to facilitate entry of the pointed discharge end 19 of the hypodermic needle into the passage 35 when the rib 33 of the diaphragm is pressed into the mouth of the body 11, the upper inner end of the gland may be recessed, as generally designated by reference number 37.

As previously discussed, the diameter of the passage 35 is slightly less than that of the needle cannula 18 so that the needle may be disposed with a portion of its cannula slidably constrained within the passage with an interference fit. In order to maintain this sliding interference fit of the needle 16 within the passage 35 under the hydraulic pressures created by collapsing the body 10, the wall thickness of the gland is made relatively thick as compared to the rest of the diaphragm so that the gland is a relatively rigid body resistant to deformation.

The axial distance over which the gland 31 engages the needle 16 is sufficiently great to maintain an effective liquid seal around the needle cannula 18 after the needle has penetrated the thin wall 36 at the bottom of the passage 35, thereby preventing the hypodermic liquid from seeping through the punctured diaphragm around the periphery of the needle. In general, in a device designed for relatively shallow, subcutaneous injections, the axial length of this seal after the needle has punctured the diaphragm wall 36 may be approximately three to five times the diameter of the cannular 18 of the needle.

Referring particularly to FIGS. 1 and 6, it will be seen that, in the normal assembled position of the needle, its pointed discharge end 19 is spaced from the puncturable wall 36 at the bottom of the passage 35. The purpose of this clearance is to allow for a certain amount of relative movement between the needle 16 and the diaphragm 14 before the pointed end 19 of the needle can contact and begin to penetrate the thin wall 36. In this way, the diaphragm is protected against accidental puncture during shipping, storing, and handling of the ampoule prior to actual use.

To prevent the formation of a hydraulic lock during initiation of an injection, the lower or bottom end of the gland 31 is normally disposed below the lower surface

of the outer annular diaphragm portion 30, desirably by a distance at least equal to the space between the end 19 of the hypodermic needle and the puncturable wall 36, so that relative movement of the needle into contact with the puncturable wall can be effected merely by pressing the bottom of the gland 31 against the skin to move the gland axially inwardly of the ampoule body 10. In the preferred construction of the diaphragm 14, the normal projection of the bottom or lower end of the gland below the diaphragm portion 30 is made great enough to assure complete penetration of the wall 36 by the needle end 19 when the gland is inwardly moved with respect to the ampoule body by pressure of the gland against the skin.

In order to provide for relative movement between the gland 31 and the outer diaphragm portion 30 so that the gland may be moved inwardly of the ampoule body, the connecting, annular, intermediate diaphragm portion 32 is made as thin as possible to exhibit a high degree of flexibility and still resist rupturing and tearing during the administration of an injection. Because of the flexibility afforded by this part of the diaphragm, which preferably is thinner than the thinnest wall section of the ampoule body 10, the gland 31 usually may be moved to initiate penetration of its wall 36 with an applied force of not more than one or two pounds.

As most clearly illustrated in FIG. 6, the intermediate diaphragm portion 32 is preferably formed with one or more annular corrugations 40 and 41 to give it a bellows-like action, permitting axial movement of the gland 31. The provision of at least one annular corrugation also permits the gland 31 to be axially canted with respect to the ampoule body 10 if the ampoule body should not collapse uniformly and the needle should be tipped out of its desired axial alignment with the ampoule. This is of advantage in assuring a reliable injection, even though carelessly administered, since the bottom of the gland will remain seated in liquid sealing contact with the skin when its axis is cocked at an angle of as great as 20 degrees from a perpendicular to the skin.

Reference is now made to FIGS. 2, 3, and 4, which illustrate progressive stages of deformation of the diaphragm 14 as the ampoule is collapsed to administer an injection. As generally described above, the ampoule is used by seating the diaphragm against the skin and applying axial pressure to the upper end wall 11 to force the hypodermic needle through the diaphragm into the skin and discharge the hypodermic liquid.

When pressure is first applied to the upper end wall 11, the bottom or lower end of the gland 31 is pressed against the skin S and the gland is caused to move inwardly of the ampoule (FIG. 2) because of the relative flexibility of the intermediate portion 32 of the diaphragm as compared to the rest of the ampoule. The amount of hypodermic liquid displaced by the slight inward movement of the gland is small and may be accommodated by a slight downward flexing (not shown) of the outer annular portion 30 and/or part of the intermediate diaphragm portion 32. In this manner, penetration of the pointed discharge end 19 of the needle through the wall 35 is initiated without creating a high internal hydraulic pressure and a consequent hydraulic lock.

Continued application of pressure to the top of the ampoule (FIG. 3) produces additional inward movement of the gland 31 and also initiates collapsing of the ampoule body 10 about the hinge 26 and downward movement of the needle 16 through the gland so that the pointed discharge end 19 of the needle is inserted into the skin S. Because of the freedom of movement which is afforded to the gland by the corrugated construction of the intermediate diaphragm portion 32, the lower end of the gland is firmly seated against the skin even though the pressure on the ampoule is off-center so as to cock the entire ampoule and tilt its axis at an angle to a perpendicular to the normal plane of the skin. This seating action of the gland against the skin and the guided movement of the hypodermic needle through the passage 35 makes it possible to insert the needle substantially perpendicularly into the skin even under these conditions, without an undesirable squirting of the hypodermic liquid over the skin after the discharge end 19 of the needle has penetrated the gland wall 36.

If desired, the lower end of the gland may be formed with a depending, skin-contacting, annular rib 45. As shown in FIG. 3, this rib acts to depress the skin so that the skin bulges upwardly within the confines of the rib, as generally designated by reference numeral 46, into closer proximity to the wall 35, but short of contact therewith. By holding the skin so that it is slightly out of contact with the gland at the point where the skin is to be punctured, the danger of contaminating this area and resultant infection are minimized.

As illustrated in FIG. 4, the injection is completed by a continued application of force to the upper end wall of the ampoule to cause its side wall portion 24 to roll on itself until the upper body section T is completely inverted and the upper end wall is locked against the diaphragm 14 by closing of the secondary hinge notch 27. In this finally collapsed configuration of the ampoule body, the base 17 of the needle 16 is against the upper end of the gland 31, thus assuring that substantially all of the hypodermic liquid has been discharged.

It will be apparent from the foregoing that the diaphragm construction of the invention contributes in many ways to a reliably functioning hypodermic ampoule and permits the administration of an injection with a minimum of applied force and with substantially no leakage of the hypodermic liquid.

In addition to these advantages, the formation of the gland 31 facilitates injection molding of the plastic diaphragm. More particularly, the relatively large mass of the gland acts as a "riser" which permits the relatively thin portions 30 and 32 of the diaphragm to be perfectly formed in high speed, injection molding machines with a minimum amount of scrap.

The terms "upper," "lower," "bottom," "top," and so forth have been used herein merely for convenience in the foregoing specification and in the appended claims to describe the hypodermic ampoule and its parts as orientated in the drawings. It is to be understood, however, that these terms are in no way limiting to the invention since the ampoule may obviously be disposed in many different positions when it is used.

It will be further understood that the foregoing detailed description of a preferred embodiment of the invention is merely intended to be illustrative and that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically shown and described.

What is claimed is:

1. In a hypodermic device including a collapsible, generally cup-shaped body defined by an upper end wall and a circumferentially extending side wall, a diaphragm peripherally sealed to said body across its mouth to form a lower end wall, and a hypodermic needle having a cannula with a pointed discharge end axially disposed within said body in position for said pointed discharge end to be thrust through sad lower end wall by movement of said upper and lower end walls toward each other and a butt portion in liquid communication with the interior of the sealed body; an improved diaphragm construction comprising an outer portion, an inner portion, and a thin, relatively flexible intermediate portion connecting said inner and outer portions to permit relative movement therebetween, said inner portion having a needle passage extending into its upper surface and terminating short of its lower surface, said hypodermic needle having a portion of its cannula slidably constrained within said passage forming a peripheral liquid seal around the cannula portion with said pointed discharge end of said needle normally spaced from the

terminating end of said passage, whereby inward movement of said inner portion of said diaphragm relative to said outer portion and said body will initiate penetrating movement of the pointed end of said needle toward and through said diaphragm.

2. The combination of claim 1 wherein the lower surface of said inner portion of said diaphragm is disposed below the lower surface of said outer portion of said diaphragm a distance at least equal to the space between the pointed discharge end of said needle and the terminating end of said passage.

3. The combination of claim 1 wherein the flexible intermediate portion of said diaphragm has a corrugated formation around the inner portion of said diaphragm permitting said inner portion and needle passage to be axially canted with respect to said body.

4. The combination of claim 1 including a rib integrally extending above the upper surface of said diaphragm, said rib being engaged within the mouth of said body with an interference fit against a portion of the inner surface of said side wall.

5. The combination of claim 2 wherein the length of the needle passage slidably constraining said needle plus the distance between the terminating end of the passage and the lower surface of the inner portion of said diaphragm is three to five times the diameter of the cannula of said needle.

6. In a hypodermic device including a generally cup-shaped body defined by an upper end wall and a circumferentially extending side wall, a disk-like diaphragm peripherally sealed to said body across its mouth to form a lower end wall, and a hypodermic needle having a cannula with a pointed discharge end axially disposed within said body in position for said pointed discharge end to be thrust through said lower end wall by movement of said upper and lower end walls toward each other and a butt portion in liquid communication with the interior of the sealed body; an improved diaphragm construction comprising a substantially flat, annular, outer portion, a generally cylindrical inner portion, and a relatively thin, flexible, annular, intermediate portion connecting said inner and outer portions to permit relative movement therebetween, said generally cylindrical inner portion of said diaphragm constituting a needle guiding and liquid sealing gland having a passage extending axially into the upper end of said gland from inside said body and terminating short of the opposite, lower end of said gland to form a thin, easily puncturable wall closing the bottom of said passage, said hypodermic needle being disposed with a portion of its cannula slidably constrained within said passage with an interference fit forming a peripheral liquid seal around the cannula portion and with said pointed discharge end normally spaced from said thin, puncturable wall, whereby movement of said gland inwardly of said body will initiate penetrating movement of the pointed end of said needle toward and through the thin, puncturable wall of said gland.

7. In a hypodermic device including a collapsible, generally cup-shaped body defined by an upper end wall and a circumferentially extending side wall, a disk-like diaphragm peripherally sealed to said body across its mouth to form a lower end wall, and a hypodermic needle having a cannula with a pointed discharge end axially disposed within said body in position for said pointed discharge end to be thrust through said lower end wall by movement of said upper and lower end walls toward each other and a butt portion in liquid communication with the interior of the sealed body; an improved diaphragm construction comprising a substantially flat, annular outer portion, a generally cylindrical inner portion, and a relatively thin, flexible, annular, intermediate portion connecting said inner and outer portions to permit relative movement therebetween, said generally cylindrical inner portion of said diaphragm constituting a needle guiding and liquid sealing gland having a passage extending axially into the upper end of said gland from inside said body and terminating short of the opposite, lower end of said gland to form a thin, easily puncturable wall closing the bottom of said passage, said hypodermic needle being disposed with a portion of its cannula slidably constrained within said passage with an interference fit forming a peripheral liquid seal around the cannula portion and with said pointed discharge end normally spaced from said thin, puncturable wall, said gland having its lower end disposed below the lower surface of said substantially flat, annular outer portion of said diaphragm for a distance approximating the space between the pointed discharge end of said needle and said thin, puncturable wall, and said flexible intermediate portion of said diaphragm including an annular corrugation permitting relative movement between the inner and outer portions of said diaphragm and inward axial movement of said gland relative to said body for initiating penetrating movement of said pointed discharge end of the hypodermic needle toward and through said thin, puncturable wall.

8. The combination of claim 7 including an annular rib integrally extending from the upper surface of said substantially flat, annular outer portion of said diaphragm, said rib being formed on a diameter slightly greater than the inner diameter of said body at its mouth and being engaged within said mouth of said body with an interference fit against a portion of the inner surface of said circumferentially extending side wall.

9. The combination of claim 7 wherein said gland is a relatively rigid body and wherein the length of the passage slidably constraining said needle plus the thickness of said puncturable wall at the bottom of said passage is approximately three to five times the diameter of the cannula of said needle.

10. A disk-like diaphragm particularly suitable for use in hypodermic devices of the type described comprising a generally flat, annular, outer portion, a generally cylindrical inner portion having one end projecting axially downwardly beyond said outer portion, and a relatively flexible, annular, intermediate portion connecting said inner and outer portions to permit relative movement therebetween, said inner portion constituting a relatively rigid body having a passage extending axially downwardly therein from an upper end thereof toward but short of the projecting end thereof to a thin wall adjacent said projecting end that closes the lower end of said passage, said flexible intermediate portion having an annular corrugation permitting said inner portion to be axially canted with respect to the axis of the diaphragm, and a concentric, annular rib integrally extending upwardly from the upper surface of the annular, outer portion of the diaphragm and being disposed radially inwardly of the periphery of said outer portion.

11. A disk-like diaphragm particularly suitable for use in hypodermic devices of the type described, comprising a generally flat, annular outer portion, a relatively thick inner portion, and a relatively flexible intermediate portion connecting said inner and outer portions to permit relative movement therebetween, said inner portion constituting a relatively rigid body having one end projecting axially downwardly beyond the outer portion and having a passage extending axially downwardly into said body toward but short of its projecting end to leave a relatively thin wall adjacent said projecting end that closes the lower end of said passage, and an integrally formed, concentric, annular rib extending upwardly from a flat marginal surface of the annular, outer portion of the diaphragm, and being disposed radially inwardly of said flat marginal surface.

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