Sept. 29, 1953 G. N. HEIN, JR. 2,653,604

INJECTION DEVICE

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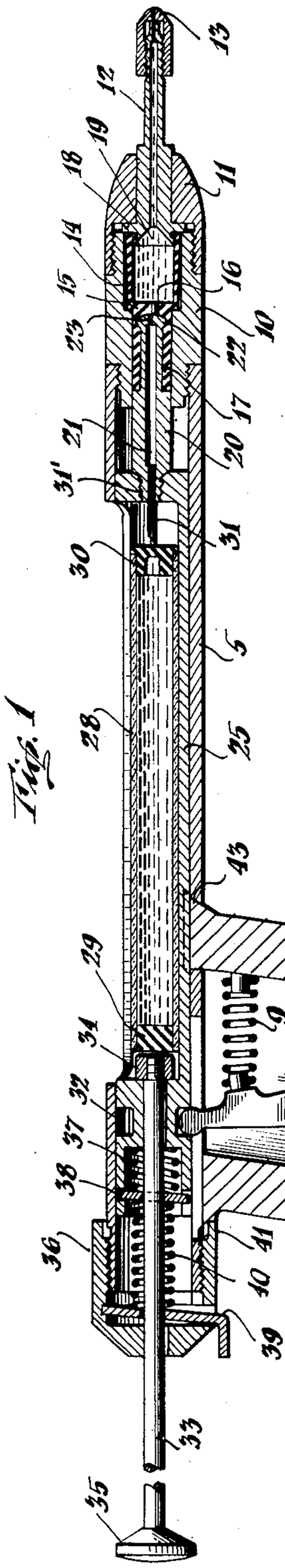

Fig. 1

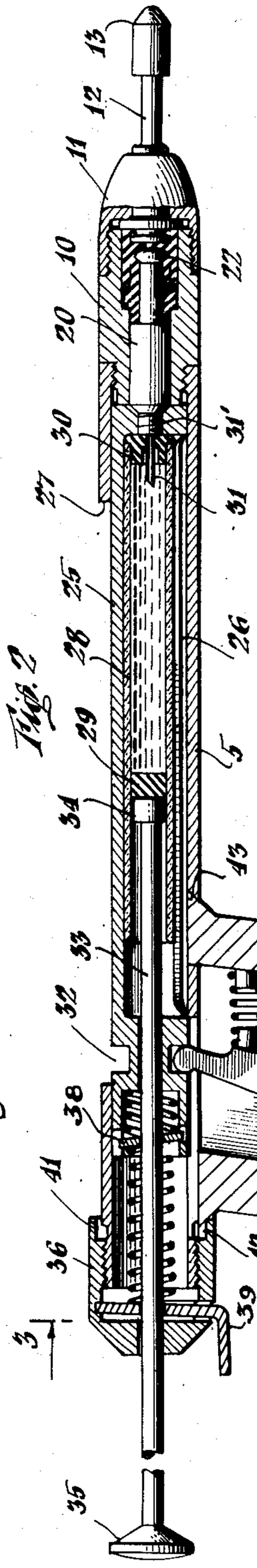

Fig. 2

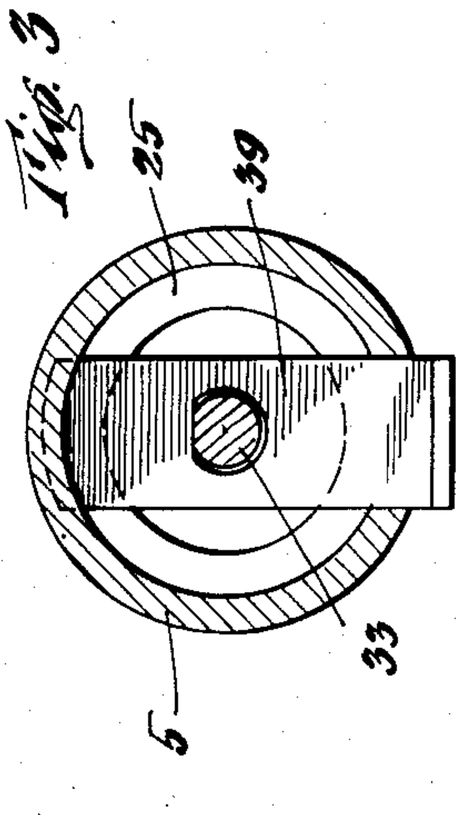

Fig. 3

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INJECTION DEVICE

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11 Claims. (Cl. 128—173)

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This invention relates to a structurally and functionally improved injection device especially intended for the hypodermic injection of medicaments without it being necessary to employ a skin-penetrating needle to effect such injections.

The present application is to be regarded as a continuation in part of my earlier application for United States Letters Patent on "Injection Apparatus" filed on August 3, 1950, and identified under Serial Number 177,389.

It is a primary object of the invention to provide an apparatus of this character which may readily be handled by a physician or other user and by means of which a successive series of injection may rapidly be given without any necessity of re-loading the apparatus.

A further object is that of providing a mechanism of this character which will be of extremely simple design, the parts of which will be relatively few in number and of a rugged nature such that they may be readily produced and assembled to furnish a unitary apparatus operating over long periods of time with freedom from all difficulties.

With these and other objects in mind, reference is had to the attached sheet of drawings illustrating one practical embodiment of the invention and in which:

Fig. 1 is a sectional side view of the apparatus and showing the parts of the same in one position;

Fig. 2 is a similar view but showing the parts in a different position; and

Fig. 3 is a transverse sectional view taken along the lines and in the direction of the arrows as indicated in Fig. 2.

In these views the numeral 5 indicates the body of the device which is preferably tubular. Extending from this body is a handle 6 by means of which the apparatus may readily be manipulated. It is preferred that the parts be manually powered although other sources of power might be employed. Therefore a lever 7 is pivotally supported as at 8 within the handle 6. This lever is normally maintained in the position shown in Fig. 1 by a spring 9. In accordance with the disclosure of the application of which the present is a division, the lever 7 may have attached to its outer end (not shown) a suitable force transmitting element conveniently powered by a foot treadle or otherwise. In any event operation of the lever or other suitable driving element serves to cause an actuation of the apparatus in a manner hereinafter brought out.

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Adjacent its forward end the tubular body defines or mounts a medicament chamber as also hereinafter described. In order to render the parts accessible for cleaning, adjustment, etc. it is preferred that the chamber be defined within the body of an extension 10 and a cap 11 applied thereto. All of the parts as described are preferably formed of metal. The connection between the cap and the extension and in turn between that extension and body 5 is conveniently achieved by screw threads. Cap 11 is formed with an opening extending through to its outer face. Positioned within this bore is a tube 12 which mounts at its outer end a nozzle 13. The latter defines a discharge orifice which may have a diameter of, for example, from .002" to .01". Ordinarily it will be on the order of .005". In any event, the orifice will define a jet of liquid which, under adequate pressure, will move with a velocity and have a fineness such that it will penetrate the epidermis without the aid of a skin-piercing needle and will embed itself in underlying tissues to the desired depth.

As afore stated the forward end of the assembly defines a medicament chamber. This chamber will have a capacity corresponding to the volume to be dispensed in a single injection. The walls of the chamber proper are provided by a cup 14 formed of a suitable rubber or resilient material. The base 15 of this cup is formed with a perforation 16 which is conveniently slightly off center. Beyond the base this portion of the assembly is continued in the form of a rubber or somewhat flexible sleeve 17. The forward end of the cup clips onto the base portion of tube 12 at a point beyond the inner end of a flange 18 formed at the rear of said tube. That flange is conveniently disposed and clamped between the adjacent faces of extension 10 and cap 11. As shown, tube 12 may have its rear end flared as at 19 within the space defined by cup 14. This flaring continues in the form of the tube bore which communicates with nozzle 13.

As illustrated, the rear portion of extension 10 is formed with a bore such that sleeve 17 may be accommodated therein. This sleeve terminates short of the rear face of that extension. A stem 20 provided with a passage 21 is slidably mounted by the faces of the rear bore portion of extension 10. Adjacent its forward end the stem is reduced so that sleeve 17 may be extended over the same. At its extreme forward end stem 20 may terminate in a head portion 22. The surfaces of the latter, as well as the adjacent surfaces of the stem proper will be frictionally engaged by the

surfaces of sleeve 17. Therefore, an accidental displacement of these parts with respect to each other will be prevented. Accordingly, when stem 20 is reciprocated it will carry with it sleeve 17 and the base portion of cup 14. With opening 16 off center the forward outlet 23 of passage 21 is conveniently disposed centrally of the stem for purposes hereinafter brought out.

Mounted for reciprocation within the tubular body 5 is an actuating and supporting member 25. This member is formed with an opening 26 in its side wall. This opening may extend throughout approximately 100 degrees of the tubular body 25. A similar opening 27 is formed in the upper side wall of body 5. When these openings are aligned an ampule 28 containing medicament may be inserted into the body of the device and removed therefrom. As the actuating and supporting member 25 is rotated with respect to body 5 to the position shown in Fig. 2, then the opening 27 will be obstructed. The rear end of ampule 28 is closed by a piston type stopper 29. Its forward end may be closed by a stopper 30 having a head portion and a recess in its plug. Extendible through that head portion and into the recess is the pointed end of a needle or cannula 31 connected with passage 21 of stem 20. Adjacent this needle that stem may be connected to the actuating and supporting member 25 as by screw threads indicated at 31'.

In order to connect member 25 with lever 7 or other suitable operating mechanism that member may be formed with a groove 32 adjacent its rear end and into which the inner end of the lever extends. Therefore as that lever is rocked around its pivot 8 it will cause reciprocation of member 25. Extending through a bore in the rear end of member 25 is a rod 33. Adjacent the inner end of this rod a head 34 may be mounted. This head should have a diameter such that it is capable of bearing against stopper 29 and into the bore of ampule 28. The rear end of rod 33 extends beyond the rear of the main assembly and may mount a knob 35. To close that end of the assembly a cap 36 is mounted by threads or otherwise upon the rear end of body 5. The inner end of member 25 is recessed and a spring 37 is positioned within this recess to bear against a clutch plate 38. The latter is formed with an opening generally circular in configuration but flattened adjacent its upper end as shown in Fig. 3. Through this opening rod 33 extends. This rod, as also shown in Fig. 3, is similarly flattened. The upper end of clutch plate 38 extends into a recess or opening in the tubular rear end portion of member 25 and has rocking bearing therein. Its opposite end extends into a notch formed in that end portion.

Within the tubular body 5 at a point adjacent its rear end and also within the space defined by cap 36 a second clutch assembly is provided. This includes a plate or strip 39 similar to the element 38. A spring 40 is interposed between plates 38 and 39. The upper edge of plate 39 is pivotally supported within a recess formed in cap 36. Its opposite end may terminate in a portion suitable for engagement by the operator's finger and extend through an opening in cap 36 beyond the outer surface of the latter.

As particularly shown in Fig. 2 the forward edge of cap 36 terminates in a flange portion 41 extending in spaced relationship to the outer surface of body 5. The rear edge of handle 6 may terminate in a projection 42 having a width slightly less than the spacing of flange 41 from

the surface of body 5. Therefore the extension of projection 42 may ride into that space. The forward edge of handle 6 terminates in an extended portion having its side walls projected as indicated at 43 to extend into undercut recesses formed in the barrel or body 5 of the unit. It is therefore apparent that as cap 36 is tightened it will bear against the rear edge of body 5 and draw the same rearwardly with respect to handle portion 6. Therefore the projecting portions 43 will be firmly seated within the recesses provided for their reception in the under face of body 5. Simultaneously the flange portion 41 will completely override the projecting part 42. Therefore handle 6 will be coupled against movement with respect to body 5. However, by simply loosening cap 36 the handle may be detached. It is of course apparent that various other coupling structures might be employed. If desired, the handle or portions of the same might be intergrally formed with body 5. However it is preferred that the parts be capable of dis-assembly as previously described.

In operation it will be appreciated that member 25 may be rotated to the position shown in Fig. 1. Thereupon an ampule 28 formed of glass or other suitable material and provided with stoppers as afore described is dropped into the bore of member 25. That member may now be rotated to the position shown in Fig. 2 in which opening 27 is obstructed. During this manipulation of the parts rod 33 will have been retained in retracted position as shown in Fig. 1. If, now, an operator projects rod 33 its head 34 will primarily engage stopper 29. Due to the body of liquid within the ampule, stopper 30 will be forced against the inner end of needle 31 to a point where that needle penetrates the stopper so that its bore is in comunication with the interior of the ampule. This has been illustrated in Fig. 2. If force is applied to lever 7 or the other operating mechanism for the actuating member 25, that member will be moved forwardly or to the right as viewed in Figs. 1 and 2. In such movement it will carry with it ampule 28. Also rod 33 will be moved in synchronism with these parts due to the provision of clutch plate 38. As will be understood that element will bind against the surfaces of rod 33 and being carried by member 25 will accordingly shift the rod to the right as in Figs. 1 and 2. Under these circumstances clutch plate 39 will in effect be inoperative and simply permit rod 33 to slide through its aperture.

Now when lever 7 has reached its limit of clockwise movement and is permitted to move in a counterclockwise direction under the influence of spring 9, then member 25 will move to the left as viewed in Figs. 1 and 2. However, rod 33 will be held stationary incident to the cooperation of clutch member 39 therewith. Therefore the head portion 34 of this rod will advance within the bore of ampule 28 during this movement of the parts. With such advance the liquid expelled by the movement of piston 29 will pass through the bore of cannula 31 through passage 21 and thence through openings 23 and 16 into the body of flexible cup 14. The relative proportioning of the parts should be such that not alone will this cup be filled but actually medicament will flow into and through the bore of tube 12 and likewise through the orifice of nozzle 13 thereby voiding all air. In any event, the medicament chamber is now filled with liquid.

In other words the device is charged and ready for operation.

If an operator brings the nozzle 13 to a position overlying the area to be injected and with the surface of the nozzle preferably in contact with the epidermis a second movement of the lever 7 in a clockwise direction will again result in the actuating and supporting member 25 moving to the right as viewed in Figs. 1 and 2. Under these circumstances and as afore described, no relative movements will occur between the head 34 and ampule 28 such as would cause a further expulsion of medicament from the ampule into the medicament chamber defined by cup 14. Rather with stem 20 projecting towards nozzle 13 any further flow of medicament through openings 23 and 16 will be prevented. This will be because of the off-center disposition of these openings with respect to each other and the fact that movement of stem 20 causes the creation of pressure within the medicament chamber. Therefore back pressure exists which will react on the base 15 of the cut and cause an interruption of communication between passages 23 and 16. Accordingly with an expulsion movement or collapse of the cup the medicament therein will be expressed under high pressure through the bore of tube 12 and the orifice of nozzle 13 to achieve the desired injection.

During this operation of the parts the side walls of cup 14 will fold upon themselves as shown in Fig. 2. In other words, they will invert onto sleeve 17 as the latter is projected with stem 20 into the body of the cup. As will be understood during this pressure stroke sleeve 17 and the outer portion of stem 20 will advance. In such advance the sleeve will expand radially thereby preventing rearward distention of the walls of cup 14. A counter-clockwise movement of lever 7 will now cause a retraction of the stem 20 and—as afore described—a simultaneous ejection of medicament from ampule 28 into the medicament chamber defined by cup 14 as the latter is expanded to its fully distended position. Therefore the medicament chamber will again be filled with liquid and that liquid will extend free from voids through to the orifice of the nozzle 13.

Conveniently ampule 28 may embody a capacity five to ten times that of the medicament chamber. Therefore the foregoing operation may be repeated a corresponding number of times without any necessity of recharging the apparatus. When the contents of the ampule have been exhausted then head 34 will have forced piston stopper 29 to a point at which it is adjacent the forward end of the ampule. Under these circumstances clutch 39 may be manually released by swinging the finger-contacting portion of the same and thus bringing the edges of the plate or strip 39 to a point where they clear the adjacent surfaces or rod 33. Due to the fact that spring 40 bears against clutch plate 38 the swinging of element 39 in the manner described will cause plate 38 to also assume a position perpendicular to the axis of rod 33. Now by grasping knob 35 rod 33 may be retracted to withdraw head portion 34. Thereupon, by rotating member 25 with respect to member 5, openings 26 and 27 may be aligned. Accordingly, with head 34 now clear of the rear end of the ampule the latter may be lifted clear of the device. With the insertion of a fresh ampule and the repetition of the procedure as heretofore described a second series of successive injections may now be resorted to.

Thus, among others, the several objects of the invention as specifically afore noted are achieved. Obviously numerous changes in construction and rearrangement of the parts might be resorted to without departing from the spirit of the invention as defined by the claims.

I claim:

1. An injection device including in combination a hollow body defining adjacent one of its ends a medicament chamber having a discharge opening, means movably carried by said body and cooperable with said chamber to expel medicament therefrom through said discharge opening, a mounting to receive a medicament reservoir, means furnishing a passage for liquid between such chamber and said reservoir, shiftable means cooperable with said reservoir for causing a transfer of medicament therefrom to said chamber through said passage, said body movably supporting said mounting, means for connecting said expelling means and mounting to move in unison and manually controlled means for moving said expelling and mounting means.

2. An injection device including in combination a hollow body defining adjacent one of its ends a medicament chamber having a discharge opening, means movably carried by said body and cooperable with said chamber to expel medicament therefrom through said discharge opening, a mounting to receive a medicament reservoir, means furnishing a passage for liquid between such chamber and said reservoir, shiftable means cooperable with said reservoir for causing a transfer of medicament therefrom to said chamber through said passage, said body movably supporting said mounting, means for connecting said expelling means and mounting to move in unison, manually controlled means for moving said expelling and mounting means in one direction to effect expulsion of medicament from said chamber and means effective upon movement of the parts in another direction to cause transfer of medicament from said reservoir to said chamber.

3. An injection device including in combination a hollow body defining adjacent one of its ends a medicament chamber having a discharge opening, means movably carried by said body and cooperable with said chamber to expel medicament therefrom through said discharge opening, a mounting to receive a medicament reservoir, means furnishing a passage for liquid between such chamber and said reservoir, shiftable means cooperable with said reservoir for causing a transfer of medicament therefrom to said chamber through said passage, said body being formed with an opening and said mounting means being movable with respect thereto to a position such that a reservoir carried by said mounting may be withdrawn through said opening.

4. An injection device including in combination a body formed with a medicament chamber adjacent one of its ends, a mounting supported for movement with respect to said body, means for shifting said mounting, the latter being adapted to receive a medicament reservoir, means connected to move with said mounting and projectible in the direction of said chamber for causing an expulsion of medicament from the latter, means supported by said body and cooperable with said reservoir to cause a transfer of liquid from the latter to said chamber and means for

automatically operating said last named means upon said mounting being moved in a direction away from said chamber.

5. An injection device including in combination a body formed with a medicament chamber adjacent one of its ends, a mounting supported for movement with respect to said body, means for shifting said mounting, the latter being adapted to receive a medicament reservoir, means connected to move with said mounting and projectible in the direction of said chamber for causing an expulsion of medicament from the latter, means supported by said body and cooperable with said reservoir to cause a transfer of liquid from the latter to said chamber clutch means carried by said body and cooperable with said last-named means for causing movement of the same with respect to said reservoir and such movement effecting transfer of medicament from the latter to said chamber.

6. An injection device including in combination a body formed with a medicament chamber adjacent one of its ends, a mounting supported for movement with respect to said body, means for shifting said mounting, the latter being adapted to receive a medicament reservoir, means connected to move with said mounting and projectible in the direction of said chamber for causing an expulsion of medicament from the latter, means supported by said body and cooperable with said reservoir to cause a transfer of liquid from the latter to said chamber clutch means carried by said body and cooperable with said last-named means for causing movement of the same with respect to said reservoir, such movement effecting transfer of medicament from the latter to said chamber and check valve means for preventing a return flow of the medicament from said chamber.

7. An injection device including in combination a body formed with a medicament chamber adjacent one of its ends, a mounting supported for movement with respect to said body, means for shifting said mounting, the latter being adapted to receive a medicament reservoir, means connected to move with said mounting and projectible in the direction of said chamber for causing an expulsion of medicament from the latter, means supported by said body and cooperable with said reservoir to cause a transfer of liquid from the latter to said chamber clutch means carried by said body and means whereby said last-named means may be manually shifted.

8. An injection device including in combination a hollow body, a cup-shaped flexible unit disposed adjacent one end of said body, a mounting disposed for movement with respect to said body, means connected with said mounting for moving the same in the direction of said chamber and away from the latter, a stem carried by said mounting and bearing against the base of said cup to invert the latter and expel the contained medicament upon said mounting being moved towards said chamber, said mounting supporting a medicament containing reservoir, means providing a liquid passage extending between said reservoir and said cup and means for automatically effecting a transfer of medicament through said passage from said reservoir to said cup upon said mounting being moved away from said cup.

9. An injection device including in combination a hollow body, a cup-shaped flexible unit disposed adjacent one end of said body, a mounting disposed for movement with respect to said body, means connected with said mounting for moving the same in the direction of said chamber and away from the latter, a stem carried by said mounting and bearing against the base of said cup to invert the latter and expel the contained medicament upon said mounting being moved towards said chamber, said mounting supporting a medicament containing reservoir, means providing a liquid passage extending between said reservoir and said cup, means for automatically effecting a transfer of medicament through said passage from said reservoir to said cup upon said mounting being moved away from said cup and check valve means connected to said passage for preventing a return flow of such medicament.

10. A cup for use in an injection device and to provide a medicament chamber therefore, said cup comprising a flexible body including side walls and a base portion, a sleeve extending rearwardly from the outer face of said base portion and the bore of said sleeve being adapted to receive and frictionally engage with a stem forming a part of said device.

11. A cup for use in an injection device and to provide a medicament chamber therefore, said cup comprising a flexible body including side walls and a base portion, a sleeve extending rearwardly from the outer face of said base portion, the bore of said sleeve being adapted to receive and frictionally engage with a stem forming a part of said device and said cup base being formed with an opening through which liquid medicament may pass from said stem into said cup.

GEORGE N. HEIN, JR.

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