April 20, 1954 G. N. HEIN, JR 2,675,802

INJECTION DEVICE

Filed Dec. 19, 1950

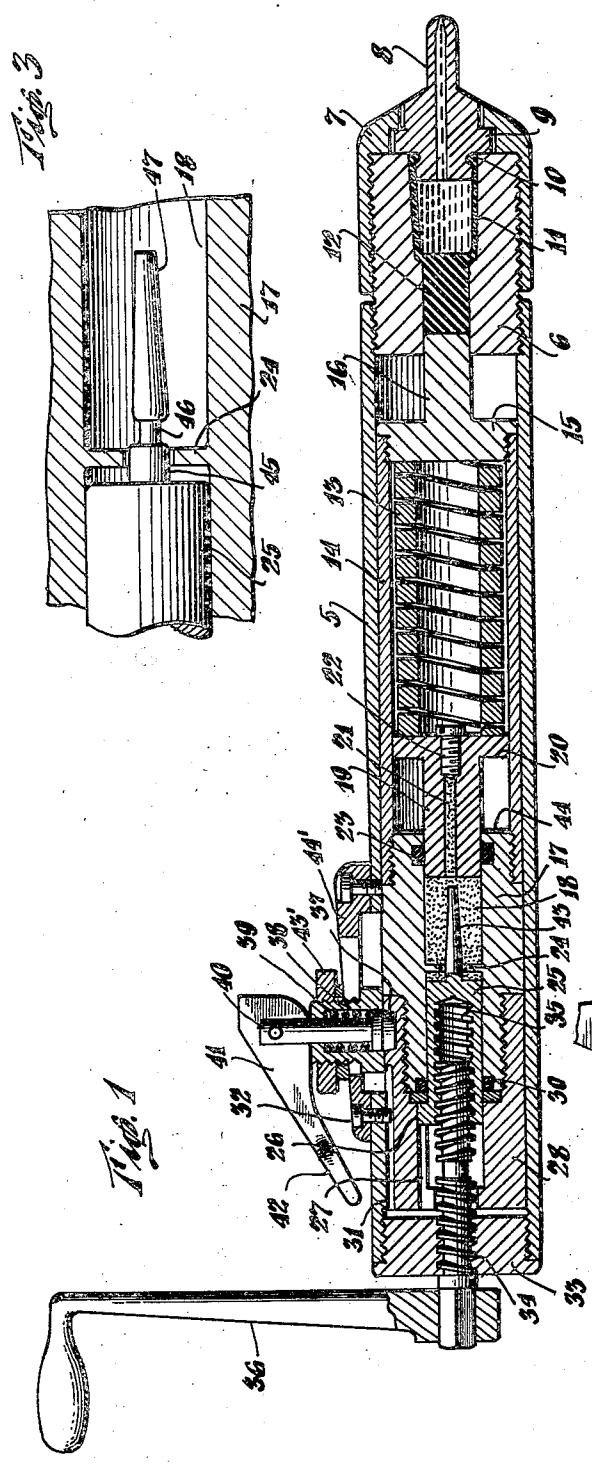

Fig. 1

Fig. 3

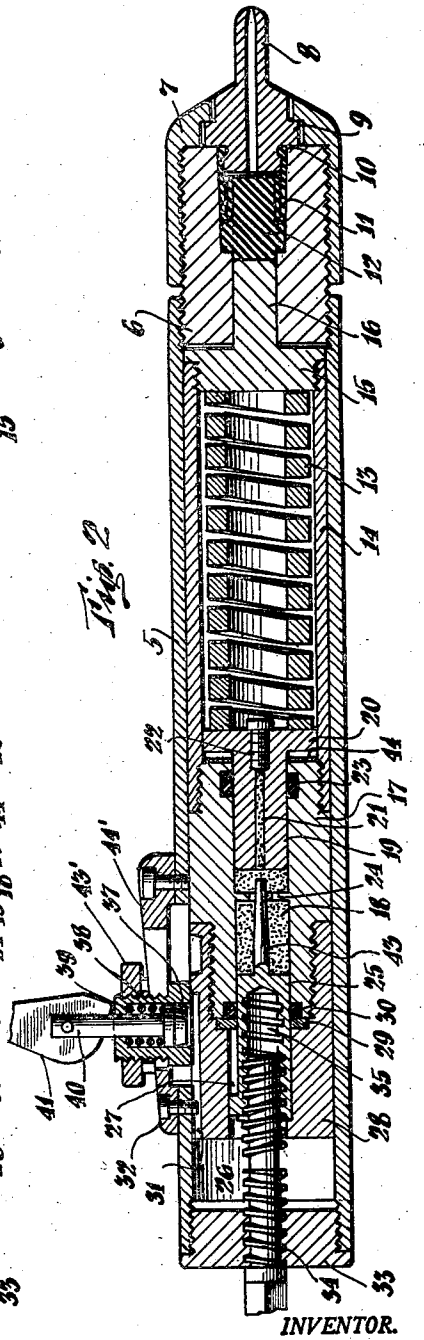

Fig. 2

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Patented Apr. 20, 1954

2,675,802

UNITED STATES PATENT OFFICE

2,675,802

INJECTION DEVICE

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Application December 19, 1950, Serial No. 201,588

8 Claims. (Cl. 128—173)

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This invention relates to a structurally and functionally improved hypodermic injection device and especially an apparatus by means of which medicament may be injected without the use of a skin-piercing needle.

Viewed in one aspect it is a primary object of the invention to furnish a structure embodying improved results over that disclosed in my prior application, Serial Number 113,598 filed on September 1, 1949, and identified as "Hypodermic Injection Apparatus."

By means of the present invention an assembly is provided which causes an expulsion of medicament at velocities and pressures and in a sufficiently fine stream such that skin penetration is effected. Apparatus of this type has been powered under ordinary circumstances by a power accumulator including a spring assembly or gas pressure. As the working stroke has occurred the expulsion force has diminished; this being as a consequence of the drop in pressure of the gas source or the decrease in force generated by the spring assembly as the latter has been expanded. By means of the present teachings it is feasible to maintain the discharge pressures substantially constant throughout the entire working stroke. Accordingly, difficulties are not experienced as a consequence of the generation of high initial pressures and substantially diminished pressures towards the final stages of the expulsion stroke.

Further by means of the present teachings it will be possible to cause the generation of virtually any desired expulsion pressure at any stage of the stroke. Therefore, it becomes feasible to discharge the apparatus without the existence of a high initial potential. Accordingly, a physician or other user is not confronted with the psychological objection of firing the apparatus with a simultaneous noise occurring incident to the release of high pressure and which noise is liable to cause the patient to flinch.

Among other objects of the invention are those of providing an assembly including relatively few parts each individually simple and rugged in construction, such parts being capable of ready assemblage to furnish a compact and comparatively light weight apparatus functioning 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 practical embodiments of the invention and in which:

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

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Fig. 2 is a view similar to Fig. 1 but showing these parts in a different position; and

Fig. 3 is an enlarged fragmentary sectional view showing an alternative arrangement of structure different from that illustrated in Figs. 1 and 2.

In these views the numeral 5 indicates a tubular body which adjacent its forward end may support a unit 6 defining a medicament chamber. Such support is conveniently achieved by screw threads. Likewise by means of screw threads a loading cap 7 is attached to unit 6. This loading cap is provided with a forward opening through which a nozzle member 8 projects. The outer end of this nozzle defines a relatively minute orifice of such reduced diameter that medicament may be expelled therefrom in a sufficiently fine stream to achieve the desired results.

Nozzle 8 has its rear or base end flanged as at 9 so as to be retained by cap 7. It may also be coupled to the member defining the medicament chamber proper. Such coupling is conveniently effected by forming the rearmost portion of nozzle 8 with a recess into which the flange 10 of a flexible cup 11 extends. That cup has a capacity equal to the injection which is to be made. As shown it is tapered towards its base end. Beyond that base it may be continued in the form of an integral extension 12. As is apparent unit 6 is formed with a recess having surfaces conforming to the surfaces of cup 11. Also it is formed with a rearwardly extending bore within which plug 12 may move. In order to avoid unnecessary complications of the drawings, the present apparatus has been illustrated as providing merely for a single injection after which it requires reloading.

Thus the numeral 13 indicates a spring embodying force adequate to achieve the desired expulsion of medicament. This spring will be pretensioned but be capable of further compression. Therefore adequate force will be available throughout the working stroke. The spring is confined within a tube 14 reciprocable within body 5. Adjacent its forward end tube 14 mounts a cap 15 provided with a stem 16. The latter is disposed in line with and is of sufficiently small diameter that it enters the bore of unit 6. Accordingly, its forward end will engage the rear end of plug 12 of the medicament-containing sack or cup.

Secured to the rear end of tube 14 is an assembly preferably including as shown a body 17 formed with a bore 18. The stem 19 of a supporting member 20 projects into this bore and

is conveniently formed with a filling passage 21 normally maintained in closed position by a screw or other obstruction 22. Support 20 bears against the rear end of spring 13 and is slidable within the bore of tube 14. A ring packing 23 may be disposed within a recess formed in communication with the bore of body 17 and to bear against the surfaces of stem 19.

Bore 18 is interrupted by a centrally apertured partition 24. A piston slidably projects into the rear end of the bore and has been identified by the numeral 25. In order to prevent this piston from turning it is conveniently formed with an extension or key 26 riding within a groove or keyway 27 forming a part of sleeve 28. The latter is attached by threads or in any other suitable manner to body 17. A washer or spacing member 29 may be interposed between the abutting surfaces of body 17 and tube 28. Conveniently adjacent the rear end of bore 18 and within that portion which provides a cylinder for piston 25 a further recess may be furnished for the reception of an O or ring shaped packing 30. A turning of tube 28 is prevented in any desired manner. For example, it may be formed with a longitudinally extending groove or keyway 31 into which the end of a bolt 32 carried by body 5 may extend. Thus, it will be still capable of movement longitudinally of body 5. However, due to the fact that it is incapable of rotating, piston 25 will likewise be prevented from rotating incident to the connection existing between these parts and indicated by the numerals 26 and 27.

In order to provide a mechanism for shifting piston 25 and also to properly encase the parts an end cap 33 is mounted at the rear end of body 5. This cap is formed with a central aperture which is threaded. Extending through the aperture and engaging these threads is a shaft 34. The forward end of the shaft extends into a threaded recess 35 formed in the rear face of piston 25. As illustrated, the threads in recess 35 and cap 33 are opposed. The corresponding threads on shaft 34 are likewise opposed. Therefore when this shaft is turned it will not alone rotate with respect to the parts which it contacts but will also have axial movements with respect to those parts. To secure such turning any desired mechanism will be employed. For purposes of illustration a crank 36 has been shown as mounted upon the squared rear end of shaft 34.

A triggering or release mechanism is conveniently provided by forming tube 28 with a recess into which the projecting end portion of a detent 37 extends. The latter may be slidably mounted by a threaded thimble 38 and is spring pressed as at 39. Its stem 40 extends beyond the thimble and pivotally mounts a cam member 41. The latter is provided with an extension 42. A nut 43' is mounted upon the threads of thimble 38', and bears against a washer which, in turn, bears against the face of a slotted guide 44' disposed in an inclined plane and secured against movement with respect to body 5 by screws. The upper face of guide 44' is conveniently provided with graduations with which a suitable projecting part of the triggering mechanism may be aligned. This will be in accordance with the disclosure in the earlier application heretofore referred to and will permit of fractional dosages being injected according to the initial position of the triggering mechanism.

Finally, as shown, the bore 18 is filled with a suitable fluid. This may take the form of grease. The fluid or body of material completely fills the forward portion of bore 18 when the parts are in the position shown in Fig. 1 and extends through the aperture in partition 24 into the rear portion of the bore in advance of piston 25. Its escape past piston 25 or between the surfaces of the bore and stem 19 is prevented by packings 23 and 30. These will be especially effective if they are of the ring or other suitable type and having in mind that the spring 13 is pre-loaded. Accordingly, pressure will always exist against these packings to prevent an escape of the material or fluid. The forward end of piston 25 carries a metering rod 43 which extends through the aperture of partition 24 into the forward portion of bore 18. For purposes of illustration the clearances and configuration of the parts has been somewhat exaggerated. However, this rod has a diameter adjacent its base slightly less than the diameter of the aperture in partition 24. This diameter remains constant as in Figs. 1 and 2 for a distance such that the rod is not reduced until a point well beyond the partition is reached. At that point it extends in these figures in the form of a gradual tapered surface through to the rod end. A body of grease has been indicated as extending at 44. The importance of this body has been somewhat exaggerated for purposes of illustration. It will be apparent that minute quantities of grease or equivalent material might be vented through the packing in which case they will serve as a lubricant.

In use it will be understood that an operator will turn shaft 34 to retract the entire assembly of movable parts to the left of body 5. This will be continued until detent 37 enters the recess formed in the surface of body 28 and under the influence of spring 39 seats within that recess. At that position of the parts loading cap 7 may be removed and an assembly filled with medicament may be introduced into the recess and bore of body 6. Loading cap 7 is now remounted. Shaft 34 is now turned to secure a projection of piston 25. As that piston projects, it will displace the grease or other material through the aperture of partition 24 and into the forward bore portion 18. Incident to such displacement stem 19 acting as a piston will be projected from a position at which the body or head portion 20 moves from a position adjacent the forward end of body 17 to the point shown in Fig. 1. Therefore spring 13 which was initially tensioned will now be under maximum compression. During both retraction of the entire assembly and subsequent projection of piston 25 it will be understood that an accelerated movement of the parts occurs due to the oppositely threaded shaft portions which assure twice the normal axial speed as would otherwise occur.

If the outer end of nozzle 8 is now disposed adjacent the surface to be injected and an operator depresses the release or trigger extension 42, injection will occur. This will be because cam 41 will retract stem 40 against the action of spring 39 to thereby withdraw detent 37 from the recess in sleeve 28. Accordingly, while stem 19 and supporting portion or body 20 remain stationary those parts which are acted upon by the forward end of spring 13 are now released from restraint. Therefore, cap 15, together with stem 16, will be projected. In such projection it will carry with it tube 14 as well as body portion 17 and sleeve 28. This movement of the parts will be permissible because tube 14 is freely slidable within body 5. Sleeve 28 is non-rotatable with

respect to tube 14 but may move longitudinally of body 5 because of keyway 31. Likewise this sleeve may move longitudinally of piston 25 because of the key 26 and keyway 27.

As the stem 16 moves forwardly it will push plug 12 in a similar direction. The diameter of that plug is substantially equal to the base diameter of the cup bore. The body of cup 11 being made of rubber or similar flexible material it therefore follows that the base of the cup will be projected within the bore of the latter. This will cause the side walls of the cup to invert upon themselves as shown in Fig. 2 thereby expelling substantially all liquid within the medicament chamber. During the pressure stroke plug 12 advances and expands radially thereby preventing rearward distention of the walls of cup 11 as shown in Fig. 2.

The foregoing operation does not occur with unrestrained movements of the parts. Rather, it will be borne in mind that as detent 37 is withdrawn from the recess of tube 28, metering rod 43 is in a position at which only a minimum passage of grease or controlling material may pass between its surfaces and the edges of the aperture formed in partition 24. The restraining material must move from the forward end of bore 18 through the aperture into the cylinder portion occupied by piston 25 in order for the parts to move. Therefore, with minimum clearances, only relatively slow movement occurs. As a consequence of this slow movement the release of the detent from the recess in tube 28 is not accompanied by any appreciable noise such as occurs when the full shock of the expulsion force (usually more than 2,000 pounds per square inch) would be immediately released. Therefore, the action of spring 13 is restrained so that, for example, only the required pressure to effect penetration is transmitted to the fluid medicament. Now as the force of the spring is released incident to its expansion, the metering rod 43 is shifting to a position at which its tapered surfaces are passing through the aperture of the partition. Under these circumstances, constantly increasing clearances are presented. Therefore, the material or grease may flow with diminishing restraint from the forward portion of bore 18 to the rear portion of the latter. It will be apparent that by properly proportioning the taper of the metering rod, employing a sufficiently stiff or fluid material, etc. the injection pressure might be maintained constant throughout the entire working stroke.

Considering a fictitious or theoretical requirement, the metering rod might be proportioned as in Fig. 3. In that view such rod includes a base portion 45 of substantially constant diameter, an adjacent reduced portion 46 and a tapered end portion 47. Again the clearance between the parts has been somewhat exaggerated. However, if the triggering mechanism is released and the assembly includes a metering rod of this type, it will be again apparent that the initial movement will not be so violent as to cause a sudden acceleration accompanied by an incidental noise. Rather that initial movement will merely result in the parts shifting so that the reduced portion 46 will enter the aperture of the partition. As will be understood, this will permit for the moment a substantially unrestrained flow of the grease, fluid or other material through the aperture of the partition. Therefore, the full force of spring 13 will thereafter act for a brief instant to expel medicament from the cup 11.

Accordingly, the velocity of discharge of the medicament will be at a maximum rate. This may serve, for example, to pierce a relatively resistant epidermis. Having effected this piercing by the jet or medicament, pressures may thereupon be reduced. Such reduction will occur as the tapered portion enters the aperture. Thereupon, due to the fact that the metering rod 43 moves in synchronism with the shiftable assembly, these tapered surfaces will serve to maintain a substantially constant pressure throughout the remainder of the expulsion stroke. It is apparent, by suitably configuring the rod or other equivalent structure, that virtually any desired type of working stroke will result.

Thus, among others, the several objects of the invention as specifically aforenoted 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. A hypodermic injection device comprising a body formed with a medicament chamber having a discharge opening, a source of motive power slidably mounted within said body to expel medicament from said chamber, means within said body to provide connected and otherwise closed compartments from one of which flowable material is transferred to the other, relatively movable means acting against and shifting material from one compartment to the other, means responsive to such shift to potentialize the source of motive power to expel medicament, releasable latch means for normally preventing an expulsion of medicament, metering means movable with respect to said compartments and extending into the connection between the same for controlling the flow of material from one to the other compartment and said metering means presenting a passage which is adjustable in area and being connected to shift with said power source.

2. An injection device including in combination a body, means adjacent one end of said body defining a medicament-receiving chamber, a plunger slidably mounted by said body and projectable towards said chamber for expelling medicament therefrom, a compressible pressure accumulator disposed within said body and connected to said plunger to project the latter upon expansion of said accumulator, manually operable leverage means movably mounted by said body and coupled to said accumulator for compressing the same, means forming a part of said device providing spaces and a passage for fluid flow as said plunger projects and valve means automatically regulating the speed of such flow as said plunger projects to control the movement of said plunger.

3. An injection device including in combination a body, means adjacent one end of said body defining a medicament-receiving chamber, a plunger slidably mounted by said body and projectable towards said chamber for expelling medicament therefrom, a compressible pressure accumulator disposed within said body and connected to said plunger to project the latter upon expansion of said accumulator, manually operable leverage means movably mounted by said body and coupled to said accumulator for compressing the same, means forming a part of said device providing spaces and a passage for fluid flow as said plunger projects and variable meter-

ing means automatically regulating the speed of such flow through said passage and from one space to the other as said plunger projects to thereby control the movement of said plunger.

4. An injection device including in combination a body, means adjacent one end of said body defining a medicament-receiving chamber, a plunger assembly slidably mounted by said body and projectable towards said chamber for expelling medicament therefrom, a compressible pressure accumulator disposed within said body and connected to said plunger to project the latter upon expansion of said accumulator, manually operable leverage means movably mounted by said body and operatively coupled to said accumulator for compressing the same, said plunger assembly including spaces connected by a passage through which fluid flows from one space to the other as said plunger projects and valve means mounted by said body and cooperative with said passage to regulate the speed of fluid flow therethrough and thereby control the movement of said plunger as the latter projects.

5. An injection device including in combination a body, means adjacent one end of said body defining a medicament-receiving chamber, a plunger assembly slidably mounted by said body and projectable towards said chamber for expelling medicament therefrom, a compressible pressure accumulator disposed within said body and connected to said plunger to project the latter upon expansion of said accumulator, manually operable leverage means movably mounted by said body and operatively coupled to said accumulator for compressing the same, said plunger assembly including spaces connected by a passage through which fluid flows from one space to the other as said plunger projects, valve means extending into said passage to automatically regulate the speed of fluid flow therethrough as said plunger projects to thereby control the movement of the latter and means connecting said valve means with said leverage means to shift in response to the movement of the latter.

6. An injection device including in combination a body, means adjacent one end of said body defining a medicament-receiving chamber, a plunger assembly slidably mounted by said body and projectable towards said chamber for expelling medicament therefrom, a compressible pressure accumulator disposed within said body and connected to said plunger to project the latter upon expansion of said accumulator, said assembly providing a space to receive fluid material, manually operable leverage means movably mounted by said body, a piston shifted by said leverage means and acting against the material in said space to displace the same, means shifted by such displacement to compress said accumulator to potentialize said plunger for projection, releasable means for preventing such projection and metering means connected to said piston and cooperating with the fluid material

to govern the flow thereof after the release of said means and during plunger projection.

7. An injection device including in combination a body, means adjacent one end of said body defining a medicament-receiving chamber, a plunger assembly slidably mounted by said body and projectable towards said chamber for expelling medicament therefrom, a compressible pressure accumulator disposed within said body and connected to said plunger to project the latter upon expansion of said accumulator, said assembly providing a space to receive fluid material, manually operable leverage means movably mounted by said body, a piston shifted by said leverage means and acting against the material in said space to displace the same, means shifted by such displacement to compress said accumulator to potentialize said plunger for projection, releasable means for preventing such projection, such space providing a restricted portion intermediate its ends and valve means connected to said piston and extending to a point adjacent said restricted portion to govern the flow of fluid material through said space after release of said preventing means and during plunger projection.

8. An injection device including in combination a body, means adjacent one end of said body defining a medicament-receiving chamber, a plunger assembly slidably mounted by said body and projectable towards said chamber for expelling medicament therefrom, a compressible pressure accumulator disposed within said body and connected to said plunger to project the latter upon expansion of said accumulator, said assembly providing a space to receive fluid material, manually operable leverage means movably mounted by said body, a piston shifted by said leverage means and acting against the material in said space to displace the same, means shifted by such displacement to compress said accumulator to potentialize said plunger for projection, releasable means for preventing such projection, such space providing a restricted portion intermediate its ends, valve means connected to said piston and extending to a point adjacent said restricted portion to govern the flow of fluid material through said space after release of said preventing means and during plunger projection and said valve means presenting variable surfaces between which and said restricted portion said flow of fluid material occurs.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,295,849	Kayden	Sept. 15, 1942
2,380,534	Lockhart	July 31, 1945
2,397,051	Scherer	Mar. 19, 1946
2,470,298	Fields	May 17, 1949
2,605,763	Smoot	Aug. 5, 1952