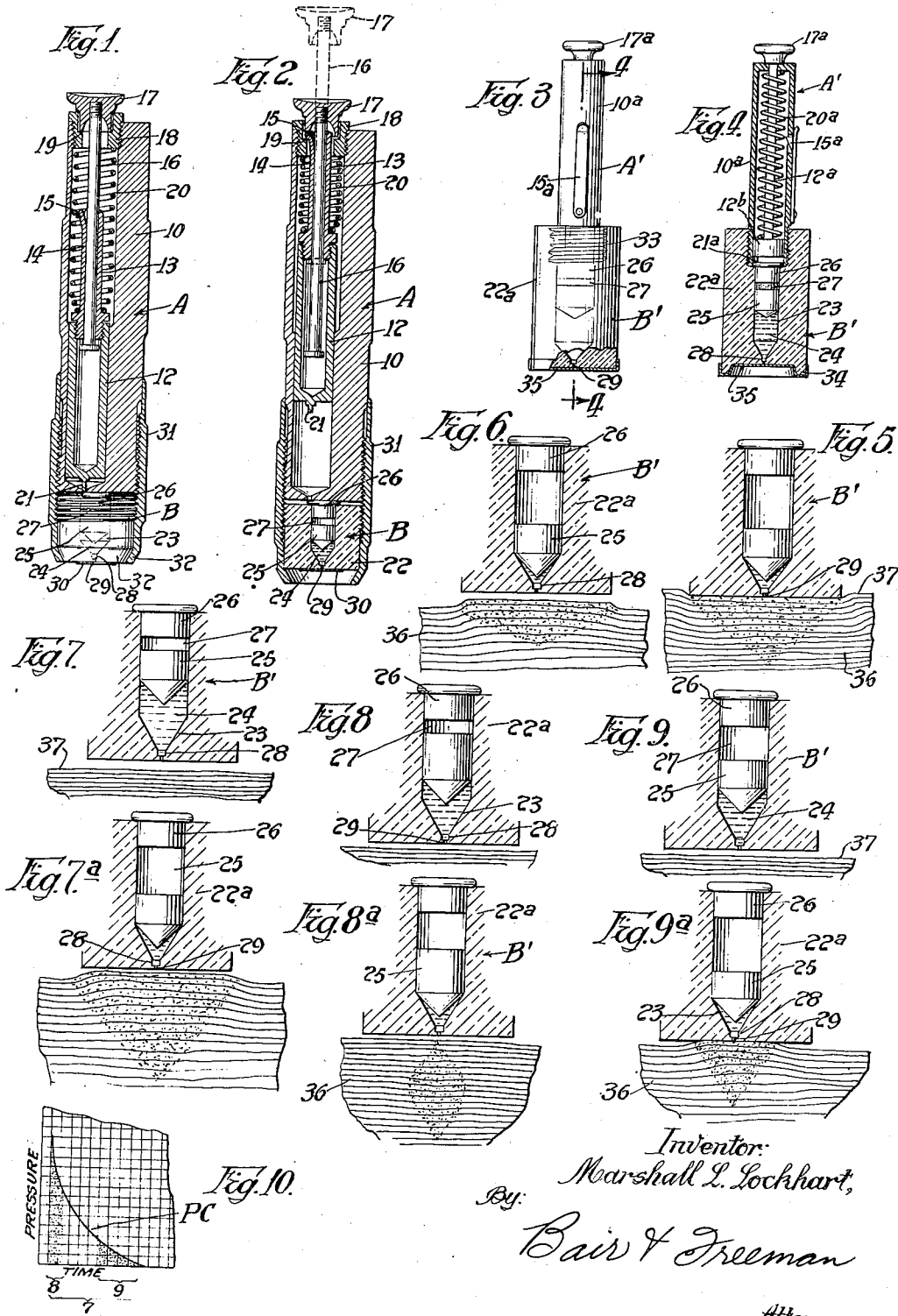


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HYPODERMIC INJECTOR

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HYPODERMIC INJECTOR

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8 Claims. (Cl. 128—215)

My present invention relates to a hypodermic injector which is capable of making hypodermic injections without the use of a hollow needle for piercing the skin to a subcutaneous position. This application is a continuation in part of my copending applications, Serial No. 69,199, filed March 16, 1936, and Serial No. 390,598, filed April 26, 1941.

One object of the present invention is to provide certain improvements over and above the hypodermic injector shown in my copending application which make the injector much superior, from commercial and operating standpoints, because of certain characteristics which will appear in detail in the following specification.

Another object is to provide a container for the liquid to be hypodermically injected, which container is transparent so that the condition and quantity of the liquid therein can be readily observed by the operator before an injection is made. The container for the liquid is in the form of a capsule which can be readily connected with an operating mechanism for a pressure generator, the generator being provided integral with the capsule, the operating mechanism thereby being readily associated with successive capsules for successive injection operations.

Another object is to provide a capsule which, although transparent, has the necessary strength to contain the relatively high pressure generated therein without danger of fracture or explosion.

Still another object is to provide a capsule (preferably transparent) which can be threadedly mounted on the operating mechanism and a modified form of capsule which can be made still more inexpensively by omitting the threads, the operating mechanism being designed to receive and retain the modified form of capsule in a holder and in proper position for operation of the generating mechanism thereof, the holder being opaque to conceal the flash of the pressure generator.

Another object is to provide a hypodermic injector of the general type herein disclosed which eliminates the necessity of any special technique for the different kinds of hypodermic injections, the injector being so designed that its discharge opening is either in contact with the skin or at the proper distance therefrom for the type of injection required, the particular hypodermic liquid and the purpose for which the injection is to be made.

Another object is to provide capsules which can be so designed and assembled that various types and degrees of penetration are made possible

when the discharge end of the capsule or its operating mechanism or holder are placed against the area of the skin through which the injection is to be made.

5 A further object is to provide a capsule in which a follower for the hypodermic liquid is formed of white rubber so that any passage of explosive chemicals around its edge may be readily observed through the transparent capsule.

10 Still a further object is to provide a capsule which can be readily sterilized and sealed after sterilization and thus retained sterile until its time of use.

15 With the foregoing objects in view, in the accompanying drawings I have shown preferred embodiments of my invention. These drawings are not intended to be exhaustive and are not to be taken as limiting of the invention, but on the contrary are chosen with a view to illustrating my invention so that others skilled in the art may apply it under varying conditions of practical use and may make such modifications and changes therein as such conditions may make desirable.

In the drawing:

Figure 1 is a longitudinal sectional view through a hypodermic injector embodying my invention, the capsule therein being shown in elevation;

30 Figure 2 is a similar sectional view including the capsule in section with a plunger mechanism in set position, a retracting element therefor being shown in a dotted position for retraction and in a solid position for releasing the plunger mechanism;

35 Figure 3 is an elevation of a modified form of hypodermic injector;

Figure 4 is a longitudinal sectional view as taken on the line 4—4 of Figure 3;

40 Figure 5 is a diagrammatic magnetic view showing the action of the hypodermic spray when pressed tightly against the skin;

Figure 6 is a similar view showing the action when the injector is held a short distance from the skin;

45 Figure 7 is a diagrammatic view showing the relative proportions of the parts when it is desirable to produce a relatively large volume, deep hypodermic injection, utilizing the full pressure of the pressure generating mechanism;

50 Figure 7a is a similar view showing the pattern of the injection resulting from the operation of the injector of Figure 7;

Figure 8 is a diagrammatic view showing the relative proportions of the injector for produc-

ing a deep spray with a small amount of hypodermic liquid, and utilizing only the initial portion of the pressure generated;

Figure 8a is a similar view showing the pattern of the injection made by the injector of Figure 8;

Figure 9 is a diagrammatic view showing the proportion of the parts of an injector designed for injecting a small amount of liquid and utilizing only the low pressure portion of the pressure generated by the pressure generator;

Figure 9a is a similar view showing the type of injection pattern produced thereby, and

Figure 10 is a graph showing the pressure curve of the pressure generator and indicating the portions thereof used for producing the injector patterns of Figures 7a, 8a and 9a.

My hypodermic injector includes an operating mechanism indicated generally at A and a capsule indicated generally at B. The operating mechanism A includes a body 10 formed of metal or the like and having a longitudinal bore there-through. Slidable in the bore is a tubular plunger 12 having a tubular extension 13. The extension 13 includes a spring blade 14 having a catch or hook 15 thereon.

Telescopically associated with the plunger 12 and its extension 13 is a retracting rod 16 terminating in a knob 17. A sleeve 18 surrounds the rod 16 and is provided with a shoulder 19. Interposed between the bushing 18 and the upper end of the tubular plunger 12 is a spring 20. The plunger 12 terminates in a firing pin 21 which extends through the lower end of the body 10 when the plunger is in lowered position.

The capsule B comprises a body 22 formed of transparent material such as polystyrene, lucite, or the like. The body 22 is provided with a bore 23, the actual size of which is shown in Figure 2, whereas Figure 1 shows the size that it appears to be, due to the magnifying power of the body 22 which is cylindrical in cross section. In the bore 23, the hypodermic liquid 24 is placed and behind it I provide a follower 25. The follower 25 is preferably made of white rubber of slightly larger diameter than the bore, so that it is a squeeze fit to provide an effective seal between the liquid and the space in the bore 23 above the liquid. Before insertion, the follower 25 is dipped in paraffin at 300° Fahr. to sterilize it and to lubricate its surface to facilitate entry into the bore 23. The paraffin also subsequently facilitates movement of the follower along the bore when an injection is made.

Above the follower 25 I insert a rim fire blank cartridge 26 with a space 27 between it and the follower. At the lower end of the bore 23 there is a restriction at 28 which terminates in a minute discharge orifice 29 in the neighborhood of .005 of an inch in diameter. A disc 30 of suitable adhesive material may be provided for covering the discharge end of the capsule body 22.

For holding the capsule B with respect to the mechanism A, I provide a sleeve 31 threaded on the body 10. The sleeve 31 has an inclined annular flange 32 at its lower end adapted to be engaged by the lower peripheral edge of the body 22 so that the lower end of the body is either at or beyond the lower end of the sleeve 31, as shown in Figure 1, or spaced upwardly therefrom, as shown in Figure 2, for a purpose which will hereinafter appear.

In Figure 3, I illustrate a modification in which the capsule B', instead of being retained in a hold-

er sleeve as at 31 in Figure 1, is threaded as indicated at 33 to coact with the threads on an operating mechanism A'. The mechanism A' is much smaller than the mechanism A and is particularly designed for carrying in a kit, such as by soldiers when on battlefields. Aside from the screw threads at 33, the capsule B' is substantially similar to the capsule B.

The operating mechanism A' includes a plunger rod 12a having an enlarged head 12b. The rod is slidable in the cylindrical body 10a. A firing pin 21a projects from the head 12b for firing the cartridge 26. A spring 20a is provided and a latch 15a serves to engage under the head 12b when the pin 12a is pulled outwardly by its knob 17a.

The capsule B' may be flat on its lower end, as in Figure 3, or have an annular projection 34 as shown in Figure 4. The purpose of the projection 34 is to space the discharge end of the capsule body 22a away from the skin which contacts with the projection 34 when it is placed there-against for the purpose of making an injection. At 35, I indicate a covering of material to retain sterility of the discharge end of the capsule. Such covering may be provided by dipping the capsule in rubber cement or similar material.

The operating mechanism A of Figure 1 is less awkward to hold and easier to operate than the kind shown in my copending application. In operating the mechanism A, the knob 17 is pulled out to the dotted position of Figure 2 to effect latching of the catch 15 on the shoulder 19. The rod 16 may then be pushed inwardly to the full line position of Figure 2, which eliminates the bad psychological effect on the patient produced with the device of my copending application, wherein the retracting pin remains in its outer position until released and then plunges toward the patient's arm. After the full line position of Figure 2 is assumed, it is merely necessary to press the knob 17 a little further inwardly so that its inner end engages the catch 15 and releases it from the shoulder 19.

The plunger 12 and its extension 13 are there-upon forced inwardly by the spring 20, but there is no visible indication of such movement. Psychologically, this is a considerable improvement in the operating mechanism. The present operating mechanism also eliminates any exposed moving parts, the operation of which could be interfered with, and reduces the expense of manufacture to some extent.

Although it is desirable, from the standpoint of the operator, to see the condition of the hypodermic liquid 24, the flash occurring by firing the cartridge 26 is somewhat disturbing to the patient. Accordingly, by making the body 22 in the form shown in Figures 1 and 2, so that it can be enclosed in an opaque sleeve 31 such as one made of metal, the flash of the cartridge cannot be seen.

By providing the flange at 32, the discharge end of the capsule may be positioned as desired with respect to the skin-engaging plane of the sleeve 31 (see Figures 1 and 2 for comparison), in a very simple manner. The quantity of the liquid injected, of course, can be readily predetermined by the length of the body 22 and the relative sizes of the bore 23, cartridge 26 and follower 25, in an obvious manner. Also, the space at 27 can be varied, all of which variations enter into predetermination of the kind and quantity of discharge from the capsule when the hypodermic injection is made. The sleeve 31, it

will be noted, has a long threaded connection with the body 10 so as to accommodate different lengths of capsules.

The discharge end of the injector is always held against the skin and there is no necessity for the operator to hold it away from the skin, inasmuch as any injection that calls for spacing from the skin can be taken care of by the foregoing described relation of capsule B and sleeve 31. As obvious from an inspection of Figures 2 and 4, such gauging of the discharge end of the injector from the skin can be taken care of by inherent construction of the capsule itself without using a holder sleeve such as 31.

In making hypodermic injections with my injector, the distance the discharge orifice is held from the patient's arm radically changes the nature of the injection. In Figures 5 and 6, two different patterns of injections are shown by stippling, both made from capsules having equal amounts of liquid therein, the same size of pressure generators 26 and in other respects being of similar dimensions. The full force of the explosion which generated the pressure has been utilized, so that as the cork 25 is forced down the bore 23 the pressure becomes proportionately less and less, as indicated by the pressure curve PC in Figure 10. In some cases, the last drop or two may not be forced into the tissue at all but remains on the surface.

Figure 5 shows the manner in which the fluid is deposited in the tissue 36 beneath the skin 37, when the discharge orifice is placed tightly against the patient's skin. It will be noted that the pattern of the deposited liquid is quite similar to a short, inverted cone. The actual depth would vary somewhat, depending upon the pressure generated.

Figure 6 shows the pattern resulting from injecting the fluid into the tissue when the discharge orifice of the capsule is held slightly away from the skin. Several drops of the liquid remain on the surface in an injection of this type, the amount varying directly with the distance the discharge orifice is held from the skin. Also, the deposited liquid makes the skin bulge up slightly around the point of injection.

By taking a similar capsule in which there is a given space at 27, as in Figure 7, and a given quantity of liquid 24, and placing the discharge end of the capsule closer to the skin than is shown in Figure 6, a deeper injection with less liquid remaining on the skin surface may be made, as illustrated in Figure 7a. In this case, the entire pressure curve PC of Figure 10 has been utilized. At the beginning, when the pressure is at maximum, caused by instantaneous generation of pressure by explosion of the contents of the generator 26, the follower 25 immediately starts moving downward to expel the liquid and continues during the entire expansion of the contents of the cartridge 26 as indicated by the bracket 7 of Figure 10.

In Figure 8, a longer follower has been used, thus giving less room for liquid and a relatively small pattern is formed, as in Figure 8a. The shape of this pattern is occasioned by using only the first part of the pressure curve indicated by the bracket 8 in Figure 10, since the liquid has been all expelled by the time the pressure has reduced only slightly. Thereafter, the remaining pressure is dissipated in the form of radiation of the heat generated as a result of the explosion of the contents of the cartridge 26, without accomplishing any further function.

In Figure 9, it will be noted there is a large space at 27 which absorbs the initial pressure so that only the part of the pressure curve indicated by the bracket 9 in Figure 10 is utilized to form the pattern of Figure 9a. Here again a relatively small quantity of fluid has been injected.

From the foregoing it is obvious that by varying the space at 27, by varying the volume of the bore 23 in which liquid is contained, and by varying the size of the pressure generator 26 so that the pressure curve of Figure 10 may be spread over a longer or shorter period of time, it is possible to produce injection to the desired depth in the tissue. Thus, by designing the capsule B or B' properly at its discharge end, the physician can always place the injector against the skin without any thought as to whether the pattern and/or depth of injection required makes it necessary to have the discharge end at different distances from the skin. The necessary requirements can all be worked out beforehand and the capsules filled with the proper amount of the proper drug and provided of the proper shape at the factory, before the capsules are distributed to physicians.

Having described specific embodiments of my invention together with the operation thereof, I desire it to be understood that these forms are selected merely for the purpose of facilitating disclosure of the invention rather than for the purpose of limiting the number of forms which it may assume. It is to be further understood that various modifications, adaptations and alterations may be applied to the specific forms disclosed to meet the requirements of practice without in any manner departing from the spirit and scope of the present invention except as set forth in the claims appended hereto.

I claim as my invention and desire to secure by Letters Patent of the United States:

1. A hypodermic injection capsule comprising a transparent body of sufficient thickness to withstand an explosively generated force, said body having a bore therein and a minute discharge orifice connected with said bore, liquid received in said bore, a follower for the liquid, and explosively operated pressure generator behind said follower, said generator being spaced in said body from said follower whereby the space in said body between the generator and the follower receives the initial pressure generated by said generator, said body having means for connecting it with an operating mechanism for said pressure generator.

2. A hypodermic injection capsule comprising a body member having a discharge orifice and a bore communicating therewith, said body member being relatively large and blunt at said discharge orifice to permit only external location thereof relative to body tissue into which an injection is to be made, liquid received in said bore, said body member being formed of transparent material through which the quantity and quality of said liquid may be observed, a follower for the liquid, a pressure generator operative to provide a substantially instantaneous build-up of pressure against the follower which is high enough to effect self injection of said liquid with respect to said body tissue, said body member being relatively thick to withstand such build-up of high pressure, and means for detachably connecting said body member with an operating mechanism for said pressure generator.

3. A hypodermic injector comprising a capsule and a holder, said capsule comprising a body of transparent material having a blunt end incapable

of penetration to a hypodermic position in animal tissue and provided with a discharge orifice, said holder being opaque and enclosing said body, said body having a chamber, liquid therein to be hypodermically injected, a follower for the liquid and a pressure generator containing a propelling medium which, in operation, has an instantaneous, relatively great driving force sufficient to eject said liquid from said body with a sufficiently high velocity to effect penetration thereof to a subcutaneous position due solely to such velocity, and means for connecting an operating device for said pressure generator with said holder, the discharge end of said body being associated with said holder to space said discharge orifice a predetermined distance from the plane of the end of the holder and thereby from the skin of a patient against which said end of said holder is engaged.

4. In a hypodermic injection capsule, a unit comprising a body member having a blunt end incapable of penetration through skin, said body member having a bore therein, a discharge orifice communicating with said bore and having its discharge end terminating at said blunt end, liquid received in said bore, a follower for the liquid, a pressure generator for generating a momentary predetermined high pressure for propelling the follower toward said discharge orifice with sufficient force to displace said liquid from said orifice with self-injection force as a result of such displacement when the generator is operated, said body member having a space therein between said follower and said pressure generator, and means for connecting said body member with an operating mechanism for said pressure generator.

5. A hypodermic capsule comprising a body of transparent material having a chamber for receiving liquid and a blunt discharge end for direction toward and spacing from and exterior of the skin, said body having an orifice for discharge of the liquid with sufficient velocity to effect self-injection thereof without the use of a guiding needle, a follower for the liquid, a pressure generator in said chamber, means for connecting an operating device for said pressure generator with said body, and means secured to the blunt discharge end of said body for sealing said discharge orifice after sterilization of said body.

6. In a hypodermic injector, an operating mechanism including a casing, a holder threadedly mounted on one end of said casing and hav-

ing a shouldered end, a capsule body having a small orifice and a blunt end at which said orifice terminates, said blunt end preventing positioning of the discharge end of said orifice at a subcutaneous position, liquid in said capsule body for discharge therefrom through said orifice, said capsule body being received in said holder and having a part to abut the shoulder thereof to locate the discharge end of said capsule body a predetermined distance relative to the end of the holder and thereby externally at a predetermined distance relative to the surface of the skin against which said end is placed, and means to expel said liquid with sufficient velocity to effect self-injection of the liquid to a subcutaneous position without the use of a hollow needle.

7. In a hypodermic injector, an operating mechanism including a casing having a skin contacting end and a stop element, a capsule body adapted for connection to said casing and engagement with said stop to locate the discharge end of said capsule a predetermined distance relative to said end of said casing and thereby externally relative to the surface of the skin against which said casing is placed, said capsule body containing liquid and having a small orifice for discharge of the liquid, said orifice terminating at said discharge end of said capsule, and means for expelling said liquid from said capsule through the discharge orifice thereof with sufficient force to cause injection of the liquid through the skin without the use of a needle for the discharge orifice extending through the skin.

8. A hypodermic injector capsule mechanism including a pressure generating element, a body of transparent material receiving said pressure generator and a charge of liquid, a follower for the liquid located at the discharge end of said pressure generator, said body having a minute discharge orifice through which the liquid is to be discharged upon operation of the pressure generator, said body having a blunt discharge end surrounded by a peripheral projection adapted to space said discharge end externally from the surface of the skin against which said peripheral projection engages, said pressure generator upon operation discharging said liquid from said body through said discharge orifice with sufficient velocity to effect self-penetration thereof through the skin without the use of a hypodermic needle.

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