June 22, 1943. M. L. LOCKHART 2,322,245

HYPODERMIC INJECTOR AND METHOD OF USE THEREOF

Filed April 26, 1941 2 Sheets-Sheet 1

Fig. 1.

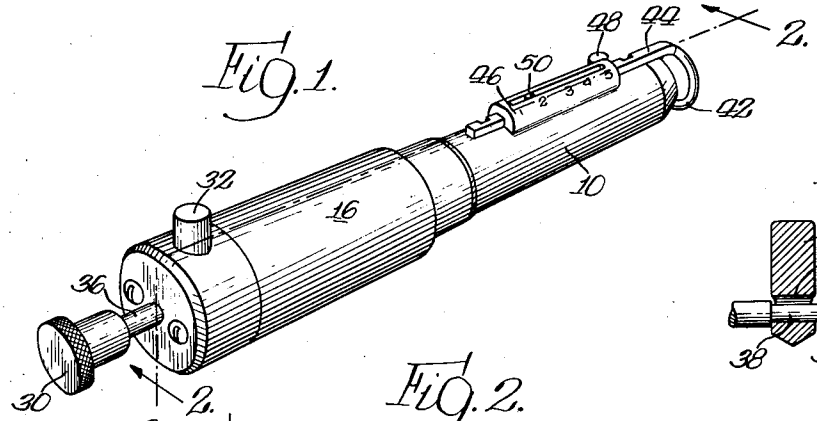


Fig. 3.

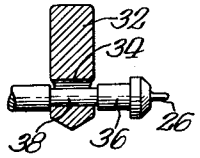


Fig. 2.

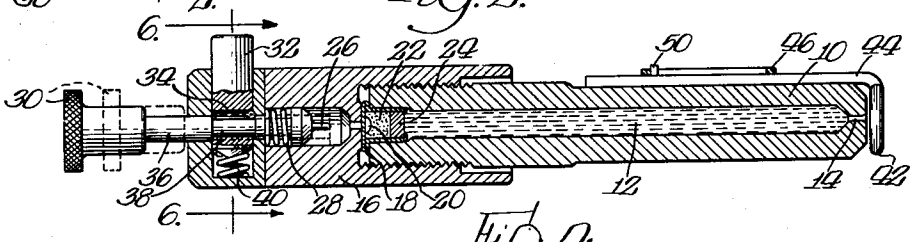


Fig. 4.

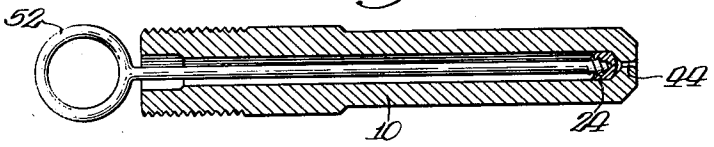


Fig. 5.

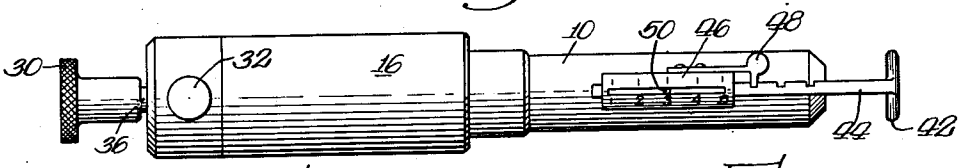


Fig. 7.

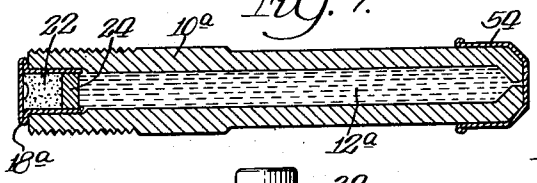


Fig. 8.

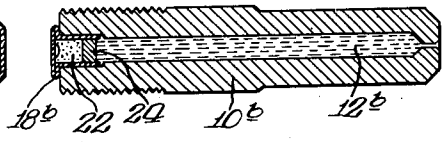
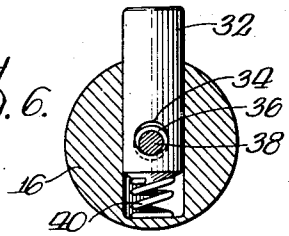


Fig. 6.



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June 22, 1943. M. L. LOCKHART 2,322,245

HYPODERMIC INJECTOR AND METHOD OF USE THEREOF

Filed April 26, 1941 2 Sheets-Sheet 2

Fig. 9.

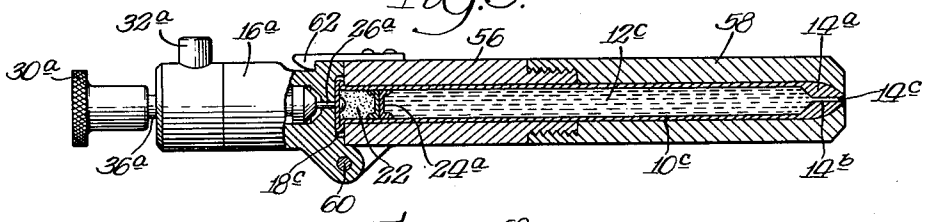


Fig. 9a.

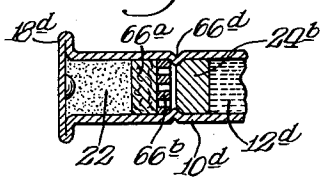


Fig. 10.

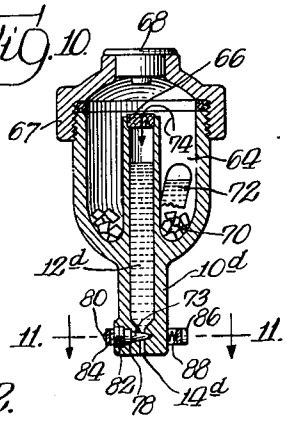


Fig. 11.

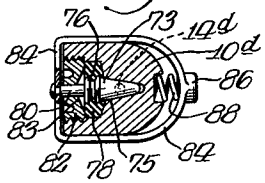


Fig. 12.

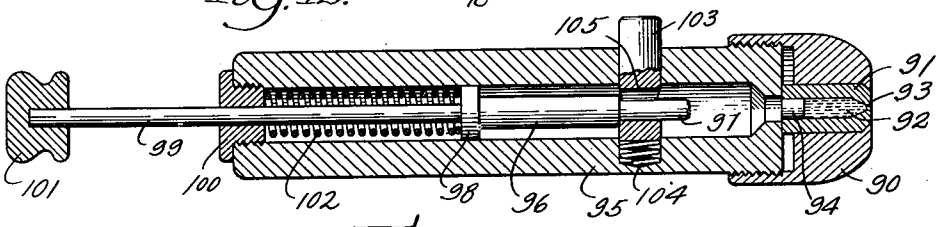


Fig. 13.

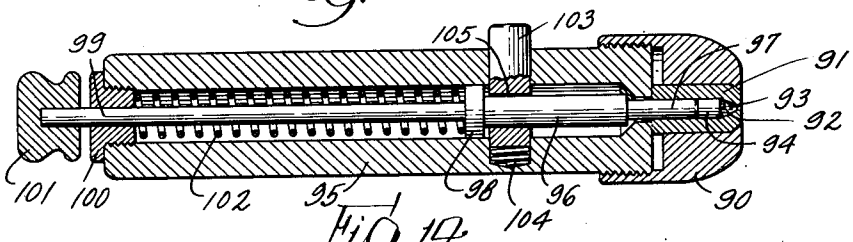
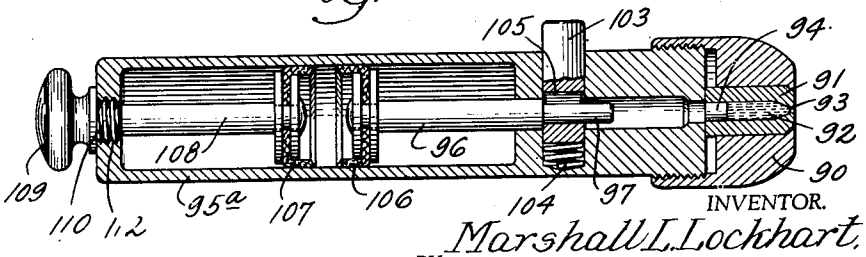


Fig. 14.



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Patented June 22, 1943 2,322,245

UNITED STATES PATENT OFFICE

2,322,245

YPODERMIC INJECTOR AND METHOD OF USE THEREOF

Marshall L. Lockhart, Ossining, N. Y.

Application April 26, 1941, Serial No. 390,598

21 Claims. (Cl. 128—215)

My present invention relates to a hypodermic injector which does not require the use of a hollow needle to accomplish injection, this application being a continuation in part of my application Serial No. 69,119, filed March 16, 1936.

One object of the invention is to provide a hypodermic injector of simple, durable and inexpensive construction.

A further object is to provide a hypodermic injector which eliminates the necessity of using a hollow needle and the usual type of syringe in conjunction therewith, yet which effectively injects liquids or medicants, such as novocain, antiseptic or the like into animal tissue, leaving only a microscopic scratch on the surface of the tissue.

More particularly, it is my object to provide a hypodermic injector containing the liquid to be injected and a charge of material which is capable of generating a predetermined high pressure within the container which exceeds approximately 30 atmospheres or 400 pounds per square inch, by suitable means, such as chemical reaction, to displace the liquid from the container through a discharge orifice, such orifice being so minute that the liquid is vaporized or atomized so finely that it can pass through animal tissue leaving holes therethrough large enough to be seen only through a microscope, thus eliminating the risk of infection, fright, pain, etc. of the usual hypodermic needle, the only feeling of the patient being the sensation of a slight breeze blowing against the skin as the injection takes place.

Still a further object is to provide an injector for liquids, such as medicants or the like, which is capable of causing controlled hypodermic injection to any depth desirable, which is regulated by the charge of material used in the injector or the mechanism of the injector itself to provide the chemical reaction or other means for discharge of the liquid, the higher the pressure generated, the deeper the resultant injection.

Still another object is to further regulate the depth of injection by means of a depth gauge on the injector which is operable to space the discharge orifice at various distances from the tissue into which the liquid is to be injected, as obviously injection occurs deeper when the discharge orifice is closer to the tissue.

Another object is to provide a hypodermic injector wherein a predetermined and substantially instantaneous build-up of pressure may be secured for the purpose of predetermining the force of ejection of the liquid, thus securing precision control of dosage and administration of the liquid to the hypodermic location desired.

Still a further object is to provide modifications of the invention which make it suitable from a commercial standpoint, and make it possible to provide a physician with different quantities of liquid to be injected, and to provide a readily selectable supply of injections to suit his particular needs.

Still a further object is to provide a method of hypodermic injection which comprises the steps of encloseing fluid to be hypodermically injected in a container having a movable wall and a small discharge opening, placing the container adjacent a portion of the body into which the fluid is to be injected with the discharge end of the opening located exteriorly relative to the body and so moving the wall as to expel the fluid through the discharge opening with sufficient force to cause the expelled liquid to remain in a continuous stream, whereby it will pierce the epidermis and hypodermically inject itself without the use of an end guide between the opening of the container and the epidermis and will enter the tissue beneath the epidermis.

With these and other objects in view, my invention consists in the combination, construction and arrangement of the various parts of my device and in the practice of my method whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in the accompanying drawings, in which

Figure 1 is a perspective view of a hypodermic injector embodying my invention;

Figure 2 is a vertical, longitudinal, sectional view of the same on the line 2—2 of Figure 1;

Figure 3 is a view of the firing pin and firing pin latch shown at the left end of Figure 2, in order to show the coaction thereof with each other better than it is illustrated in Figure 2 in connection with the other details of the injector;

Figure 4 is a sectional view through the liquid cylinder of the injector showing it removed from the head, and a tool being utilized for withdrawing a follower from the cylinder;

Figure 5 is a plan view of the injector;

Figure 6 is a sectional view on the line 6—6 of Figure 2, showing the parts on an enlarged scale;

Figures 7 and 8 are sectional views through different sizes and styles of cylinders, which can be used with the same head shown in Figures 1, 2 and 5;

Figure 9 shows a further modification in which the charge of material to provide the chemical reaction and the container for the liquid are a unit

insertable into a holder, which thereby provides an injector of slightly modified form when compared with the one illustrated in Figure 2;

Figure 9*a* is an enlarged sectional view through a pressure generating insert including a filter;

Figure 10 is a sectional view through another modified type utilizing chemical reaction of certain crystals and a liquid to generate the necessary pressure for expelling the injection liquid;

Figure 11 is an enlarged sectional view on the line 11—11 of Figure 10, showing a control valve for the injector;

Figure 12 is a longitudinal sectional view through another modified form of my invention showing a spring to effect the build-up of pressure necessary to force the hypodermic liquid from the injector with injection force, the spring being shown in contracted position as when the device is "cocked."

Figure 13 is a similar sectional view of a part of Figure 12 showing the spring released and having effective discharge of the liquid, and

Figure 14 is a similar sectional view of a modified form wherein compressed air is used as the propelling force.

On the accompanying drawings, I have used the reference numeral **10** to indicate a cylinder for containing liquid **12** to be injected. One end of the cylinder **10** is provided with a discharge orifice **14**, which is of very minute size. I have found that between .001 and .006 inch are suitable sizes for the purpose, although other sizes, of course, can be used to fit the particular requirements of the injection to be made. The size of the discharge orifice **14** is much smaller than the area within the cylinder **10**, which area is illustrated about full size in Figure 2, whereas the orifice **14** is necessarily enlarged in order to show up on the drawing.

The other end of the cylinder **10** is threaded for reception in a head **16**. The head **16**, when in position as shown in Figure 2, encloses a cartridge **18** and seals it relative to the threaded end of the cylinder **10**. The cartridge **18** is provided with the usual percussion cap **20** and explosive **22**. At **24** wadding or a piston of rubber, fiber or the like, designed to slidingly and sealingly fit the bore of the cylinder **10**, is provided. This serves as a follower behind the liquid **12** when the explosive **22** is ignited and forces the piston **24** along the bore, thus displacing the liquid through the discharge orifice **14**, and a means for isolating impurities of the chemical reaction from the liquid.

For firing the cartridge **18**, any desired type of firing pin can be utilized. By way of illustration, I show a slidably mounted firing pin **26** urged in firing direction by a spring **28**. A knob **30** is provided for retracting the firing pin, and a latch **32** is provided for retaining the pin in retracted position.

The latch **32** is provided with an opening **34** slightly larger than the diameter of the stem **36** of the firing pin. This stem has a reduced portion **38** which, when it registers with the opening **34**, permits the latch **32** to be forced upwardly by a spring **40** to the latching position shown in Figures 2, 3 and 6. Thereafter, upon pressure inwardly on the latch **32**, the firing pin will be released and the spring **28** will cause it to strike the cap **20**, the sudden jar against the cap causing the usual chemical reaction and resultant heat which ignites the explosive **22**. The explosive thereupon expands, creating a pressure of thousands of pounds per square inch, which displaces the liquid **12** along the cylinder **10**, the time of displacement varying over a period of two or three seconds because of the small size of the orifice **14** preventing any possibility of an instantaneous discharge of the liquid.

In my mentioned of thousands of pounds per square inch pressure being created, I do not wish to infer that pressures below a thousand pounds per square inch are unsuitable. I have found that for certain types of hypodermic injection, pressures in excess of 30 atmospheres or about 400 pounds per square inch are sufficient. Pressures below this level, however, are below the level of utility, as they do not produce the desired penetration of the liquid through the skin with any assurance of accurate control of dosage and administration.

With a pressure of 10,000 pounds per square inch, liquid displacement through an orifice of .004 of an inch can penetrate most animal tissue to a depth of 4 inches. Accordingly, if it is desirable to penetrate to a less depth, a smaller charge of explosive can be utilized or the depth of penetration can also be decreased by spacing the discharge orifice from the surface of the tissue.

To facilitate such spacing as desired, and to steady the injector while injection is being made, a depth gauge can be provided, such as illustrated at **42**. This gauge comprises a ring through which the discharge stream from the orifice can pass, the ring being carried by a rod **44** slidable in a boss **46** on the cylinder **10**. A suitable spring latch **48** may be provided for retaining the depth gauge in adjusted positions. The gauge may also be provided with an indicator pin **50** cooperable with a scale of indicia indicated as **1**, **2**, **3**, **4** and **5** on the boss **46**.

After an injection is completed, the piston **24** may be withdrawn in a suitable manner. In Figure 4, I show a tool **52**, somewhat similar to a cork screw, for this purpose. When the cylinder **10** is to again be used for an injection, it can be sterilized, filled with the liquid to be injected, and then a fresh cartridge **18** placed in position.

The discharge orifice **14** is so minute that ordinary liquid, due to capillary action, cannot get through it, although a minute quantity of vaseline can be smeared across the discharge orifice to positively prevent any discharge, except when the cartridge is fired.

The physician may be provided with a plurality of different sizes of cylinders **10** for injecting different quantities of medicant, and with different sizes of cartridges for different depths of penetration.

As an alternative method, the cylinders can be supplied as shown at **10*a*** and **10*b*** in Figures 7 and 8, which are already filled with the liquid, indicated at **12*a*** and **12*b***. The cylinders **10*a*** and **10*b*** are interchangeable in the head **16**, and each carries its own cartridge as **18*a*** and **18*b***. These cylinders can be sterilized before they are filled at a central distributing point, and provided, if desired, with a cap **54** of rubber or collodion, which can be removed just prior to the injection being made.

To obviate the expense of making cylinders such as shown in Figures 7 and 8 (which can be returned for a refund if found feasible), a cylinder such as indicated at **10*c*** in Figure 9 can be used. This is a complete unit in itself, having a cartridge **18*c*** and a discharge orifice end **14*a*** provided with a discharge orifice **14*b***. The outer

end of the orifice can be plugged as indicated by the shading at 14c with paraffin or the like, and the container 10c can be made of relatively thin material, such as sheet metal. At 24a, I illustrate a follower of cup leather type which would provide a very effective seal against the gases of explosion and the liquid being mixed with each other.

For the relatively thin cylinder 10c, I provide a holder comprising a relatively thick cylinder 56 and an extension cylinder 58. The cylinder 58 has a reduced bore at its forward end to fit the reduced end 14a of the cylinder 10c. This properly prevents any expansion of the cylinder 10c forwardly through the cylinder 58, and reinforces the thin cylinder 10c against explosion upon the cartridge end 18b thereof being fired.

Various lengths of extension cylinders 58 to accommodate different quantities of injection liquid can be provided for use with one size of cylinder 56 and head 16a. Figures 7 and 8 illustrate two of such different quantities.

The cylinder 56 is provided with a head 16a similar in construction to the head 16, shown in Figure 2, except that it is illustrated as being hinged at 60 to the cylinder 56 and latched in position by a spring catch 62. This facilitates connection of the parts together without the necessity of having to screw them together as in Figure 2.

In Figure 9a, a modified cartridge 18d is illustrated in which, instead of the follower 24a of Figure 9, I show a disk-like follower 24b with a filter 66a therein of suitable material to prevent any mixing of the residue from the explosive with the liquid 12d in the cylinder 10d. The filtering material is retained against expulsion by a perforated retainer plate 66b held in position as by a bead 66d formed in the cylinder.

In Figure 10, I show a modified construction in which a cylinder 10d has a chamber 64 surrounding it. The cylinder is provided with a discharge orifice 14d through which the liquid 12d is to be discharged. A filter 66 of porous rock, chamois skin or the like is provided between the chamber 64 and the liquid 12d in the cylinder 10d. A cap 67 is provided for the chamber 64 and the cap carries a pressure gauge 68.

Chemicals such as sodium, calcium or a mixture of the two are placed as at 70 in the chamber 64. A capsule 72 of water is also placed in the chamber, and while the cap 67 is being screwed into position, the capsule will be dissolved by the water, and the water will flow out onto the crystals 70, whereupon a harmless (hydrogen) gas will be generated and will flow as indicated by the arrow 74 through the filter 66 to displace the liquid 12d.

In Figure 11, I illustrate a control valve 73 for the orifice 14d. This valve is normally seated in a seat 75. The valve 73 is provided with a grooved portion 76 vulcanized in a rubber or other resilient packing 78. The packing 78 is retained in position by a follower nut 82.

The valve 73 is provided with a stem 80 connected with a bail 84. A spring 88 engages the bail to normally urge the valve toward closed position. The valve may be opened by pressing on a button 86 on the bail, which backs the valve 73 off the seat 75, whereupon the packing washer 78 bends into a concave inner face 83 of the backing nut 82.

The pressure gauge 68 serves to indicate when the pressure has been built up to that desired for discharge of the liquid, whereupon the valve 86 may be opened and the flow of injecting liquid controlled as desired.

In Figures 12 and 13, I illustrate an impact type of mechanism for accomplishing injection. A holder 90 may be provided for a container 91 in which the hypodermic liquid 92 is held. The discharge orifice is indicated at 93 and the follower for the liquid at 94. The holder 90 is removably positioned with relation to a cylinder 95 in which a plunger 96 is slidably mounted. The plunger has a reduced portion 97 and a head 98. A stem 99 extends from the head 98 through a cap nut 100 in the outer end of the cylinder 95. An actuating knob 101 is mounted on the stem 99. A spring 102 is interposed between the plunger head 98 and the cap nut 100.

A latch pin 103 is slidably mounted transversely in the cylinder 95 and is biased to the latching position shown in Figure 12 by a spring 104. The plunger 96 and its reduced end 97 are adapted to move through a bore 105 in the latch pin 103.

In the operation of the type of device shown in Figure 12, the knob 101 may be grasped and pulled outwardly from the position of Figure 13 to the position of Figure 12. The spring 104 will cause the latch 103 to assume the position illustrated in Figure 12, serving as a stop for the shoulder of the plunger 96, where it is cut down to form the reduced part 97.

Whenever the latch pin 103 is pushed inwardly as to the position of Figure 13, the plunger 96 will be released as soon as the opening 105 registers with it and the spring 102 will expand, thereby causing the reduced end 97 to strike the follower 94 and then force it forwardly in the bore of the container 91. This will cause the hypodermic liquid 92 to be displaced through the orifice 93 with sufficient force to accomplish hypodermic injection. Such force, as already mentioned must be in excess of 400 pounds per square inch, produced on the plunger 94 and consequently on the liquid 93, before injection to a hypodermic position can be successfully accomplished.

In Figure 14, there are many parts similar to those described in Figures 12 and 13 and they bear the same reference numerals. Other parts involved will now be described.

The plunger 96 carries a piston 106 slidable in a cylinder 95a which is larger than the one shown in Figure 12. Means is provided for building up a charge of highly compressed air in the cylinder 95a and may consist of a second piston 107, a piston rod 108 therefor and a knob 109 for operating the piston. The knob 109 has a threaded part 110 adapted to coact with threads 112 of the cylinder 95a.

In the operation of Figure 14, the knob 109 is unscrewed at 110—112, and the piston 107 pulled outwardly, which also pulls the piston 106 outwardly, causing it to be locked as illustrated. The piston 107 is then pushed inwardly and locked in its inward position by engaging the threads 110 with the threads 112. This confines a charge of highly compressed air between the pistons 106 and 107 whereby, upon depression of the latch pin 103, the plunger 96 is released so that the air acting on the piston 106 will force the plunger forwardly and result in the reduced portion 97 of the plunger striking the follower and propelling it forwardly.

My hypodermic injector eliminates the necessity of puncturing the tissue in order to inject a medicant into it. It also eliminates the pain

and fright attendant on an injection of the needle type.

The method involved comprises the steps of enclosing the fluid to be hypodermically injected in such manner that a movable wall of the container for the liquid may be relatively quickly forced into the container by the generation of a great expansive force or the sudden release of an expanding force, such as a spring or compressed air, with the utilization of impact also, if desired, as in the forms of the invention shown in Figures 12, 13 and 14.

When pressure generating chemicals are used, they can be selected of either slow or quick acting type to provide different types of injection. With a slow acting chemical or powder, the pressure will be more even throughout the injecting operation, as the pressure builds up while the space in the cylinder is expanding, due to the liquid being displaced. With a quick acting chemical or powder, the pressure is built up at the beginning of the injection and as the liquid is displaced the pressure decreases, so that injection at first is deeper and as the operation continues, it is less deep. In some cases this is desirable in order to distribute the injected liquid throughout different depths in the tissue.

The size of the orfice and the time of liquid discharge can be so regulated that the injector can be used for various purposes. For ordinary hypodermic injections, a minimum period of time for injection is desirable, provided the injector meets other necessary requirements. In other cases, such as when it is desirable for a dentist to spray the entire gums of a patient with a local anesthetic, the time of discharge can be extended over a time period of three or four seconds, which would give the dentist sufficient time to spray the injecting liquid over the entire surface of the gums by moving the injector relative to the gums while injection is taking place.

One of the most important results of the use of my hypodermic injector is the elimination of the possibility of infection from unsterile needles and openings formed in the tissue, which provide an entrance for bacteria.

It is thus obvious that a predetermined high pressure may be secured to effect a predetermined force of ejection of the liquid and a resultant control of dosage and administration. Unsuccessful attempts have heretofore been made to accomplish hypodermic injection. I have found it necessary to provide an injector capable of exerting at least 400 pounds per square inch on the liquid in order to force it from the discharge orifice 14 with sufficient force to remain in the form of a stream of liquid that passes through the epidermis without merely striking it and being deflected by it. When a force of this magnitude or greater is produced, chemical reaction (explosive or otherwise) by impact produced by springs, compressed air or the like, or by any other means, then injection to a hypodermic position is possible with assured precision in dosage. By the use of a fine orifice of a few thousandths of an inch, such high pressure exerted on the liquid confines it to a fine streamlike form so that it all passed through the skin to the tissue therebeneath without stray droplets at the edges of the stream being deflected by the skin and thereby failing to enter to the desired subcutaneous position. The force of ejection may be predetermined by the proper selection of chemicals and design of structure of the injector.

Various modifications such as those illustrated and others can be made in my hypodermic injector without departing from the real spirit and purpose of my invention and without departing essentially from the method of injection herein disclosed. It is my intention, therefore, to cover by my claims any modified forms of structure or use of equivalents which may be reasonably included in their scope.

I claim as my invention:

1. In a hypodermic injector, a container for liquid to be hypodermically injected, liquid therein, said container having a minute discharge orifice from which the liquid is discharged without the use of a guiding needle, a charge of material confined within said container for generating high pressure by explosive chemical reaction to displace the liquid from said container through said discharge orifice with sufficient velocity to effect self-injection thereof and a filter between said charge of material and the liquid to prevent particles of the charge from being displaced along with the liquid.

2. In a hypodermic injector, a container for liquid to be hypodermically injected, liquid therein, said container having a minute discharge orifice for the liquid, a charge of material confined within said container for generating sufficiently high pressure by chemical reaction to displace the liquid from said container through said discharge orifice with self-injecting force, said container being formed of relatively thin material and a reinforcing holder receiving said container, said container snugly fitting within said holder and thereby being retained against explosion as a result of the high pressure generated therein, and said container having a blunt end surrounding said discharge end of said orifice and capable of preventing insertion of said discharge end to a subcutaneous position.

3. In a hypodermic injector, a container for liquid to be hypodermically injected, liquid therein, said container having a minute discharge orifice for the liquid, a charge of material confined within said container for generating high pressure by explosive chemical reaction to displace the liquid from said container through said discharge orifice with sufficient force to be self-injected without the use of a hypodermic needle, and a depth gauge on said container for variably spacing the part thereof having said discharge orifice from animal tissue into which the injection is to be made.

4. In a hypodermic injector, a container for liquid to be hypodermically injected, liquid therein, said container having a minute discharge orifice for the liquid surrounded by a blunt discharge end and a charge of material confined within said container for generating sufficiently high pressure by explosive chemical reaction to thereby displace the liquid from said container through said discharge orifice with sufficiently high velocity to cause the liquid to form a fine stream-like discharge and inject itself without the aid of a hollow needle when said orifice is located exterior of the epidermis in which the injection is to be made.

5. In a hypodermic injector, a container for liquid to be hypodermically injected, liquid therein, said container having in one end thereof, a minute discharge orifice for the liquid, said end being of sufficient area to prevent insertion to a subcutaneous position, said container having a cylindrical bore for the liquid, a follower therein behind the liquid, and means confined within said container for generating high pressure by

explosive chemical reaction to move said follower and thereby displace the liquid along said cylinder bore with a predetermined force toward and through said discharge orifice sufficient to cause the liquid to puncture the epidermis and inject itself therebeneath as a result of such force.

6. In a hypodermic injector, a cylindrical container for liquid to be hypodermically injected, liquid therein, said container having a minute discharge orifice at one end thereof, said container being so constructed and arranged that said discharge orifice remains exterior of the skin, an explosive cartridge in the other end thereof, a head coacting with said other end to enclose said cartridge and seal it relative to said container and means carried by said head for firing said cartridge by percussion, the gases of explosion thereby produced forcibly displacing the liquid from said container through said discharge orifice and causing injection of the liquid without guide means between the discharge orifice and the tissue under the skin.

7. In an injector of the character described, a cylinder for liquid, liquid therein, said cylinder having a discharge orifice at one end thereof and being constructed to permit only an external location of said discharge orifice relative to the body in which injection is to be made, an explosive cartridge in the other end thereof, a follower between the explosive in said cartridge and the liquid, and means for firing said cartridge, the gases of explosion thereby produced moving said follower and thereby displacing the liquid from said cylinder through said discharge orifice and causing injection of the liquid as a result of such displacement while the orifice remains exterior of the epidermis through which injection is being made.

8. In a hypodermic injector, a container for liquid to be hypodermically injected, liquid therein, said container having a discharge orifice from which the liquid is discharged without the aid of a guiding needle, said orifice being of minute size relative to said container for the liquid, means for generating high pressure in said container to displace the liquid therefrom through said minute discharge orifice in a stream and with sufficient force to cause it to puncture the skin and inject itself therethrough and into the tissue therebeneath.

9. In a hypodermic injector, a container for liquid to be hypodermically injected having a chamber for said liquid, a minute discharge orifice connecting one end of said chamber to the atmosphere, a second chamber sealed relative to the atmosphere adjacent another end of said first chamber, a follower separating said chambers, an explosive chemical in said second chamber having when exploded a sudden great expansive force, said hypodermic liquid initially filling said first chamber and subject to expulsion by displacement from its chamber when subjected to said expansive force, said liquid upon expulsion having the shape of an elongated stream of minute diameter moving with skin penetrating force outwardly from said orifice.

10. A hypodermic injector for injecting hypodermic liquid beneath the skin comprising a tubular container having a chamber therein for hypodermic liquid and a second chamber having a charge of explosive material therein adapted when exploded to generate a sudden force of magnitude in excess of 30 atmospheres, a broad blunt end on said container incapable of penetrating the skin and a minute orifice between the first chamber and said blunt end comprising a source for a stream of said hypodermic liquid of minute cross section directed from said first chamber through the skin.

11. A hypodermic injector comprising a container having a cylindrical sided chamber therein and a quantity of hypodermic liquid initially in said chamber, said container havng a second chamber sealed relative to the atmosphere and a plunger separating said chambers having a snug sliding fit relative to the cylindrical sides of said first chamber sealing the contents of one from the contents of the other, a charge of explosive material initially held in said second chamber having when exploded a suddenly expanded volume substantially filling both chambers, said container having an orifice communicating between the first chamber at the side remote from said plunger and the atmosphere having a cross sectional area much smaller than the cross sectional area of said first cylindrical sided chamber, said liquid upon explosion of said explosive material having a streamlike form of high velocity projecting outwardly from the orifice.

12. A hypodermic injector for injecting a liquid beneath the surface of skin comprising in operation a container having a chamber containing hypodermic liquid and a blunt end thereon incapable of itself penetrating the skin to be treated, and directed toward and spaced exteriorly to the skin a minute orifice in said blunt end adapted to pass said liquid from the chamber to the skin, said fluid being initially in a form substantially filling the chamber and having under operation the form of a stream of liquid minute in cross-section extending through the atmosphere from the orifice to a location through and beneath the skin, and a propelling medium in said contain a having in operation an instantaneous great driving force exceeding 400 pounds per square inch and operable upon the liquid in the container with force sufficient to pass it from the orifice through the atmosphere into the skin.

13. In a hypodermic injector, a container for liquid to be hypodermically injected, liquid therein, said container having a minute discharge orifice for the liquid, means for generating predetermined high pressure in said container to displace the liquid therefrom through said minute discharge orifice and through the atmosphere intervening between said container and the skin to be administered in stream-controlled dosage with sufficient force to cause it to puncture the skin and inject itself therethrough with predetermined force of injection into the tissue therebeneath.

14. The method of hypodermic injection which comprises the steps of enclosing fluid to be hypodermically injected in a container having a movable wall and a small discharge opening spaced from said wall, placing said container adjacent a portion of the body into which the fluid is to be injected with the discharge end of said opening located exteriorly relative to the body and so moving said wall as to expel said fluid through said discharge opening with sufficient force to cause the expelled liquid to remain in a continuous stream of liquid under force whereby it will pierce the epidermis and hypodermically inject itself through the epidermis on said portion of the body without the use of any guide between the opening of said con-

tainer and the epidermis and cause it to enter the tissue beneath said epidermis.

15. The method of hypodermic injection which comprises the steps of explosively producing a pressure in excess of 400 pounds per square inch and utilizing such pressure to displace liquid to be hypodermically injected with sufficient force to cause the displaced liquid to remain in a continuous stream that will pierce the epidermis and hypodermically inject itself and enter the tissue beneath said epidermis with precision of dosage assured.

16. In a method of hypodermic injection, the steps of effecting expulsion of liquid to be hypodermically injected in a fine stream-like formation by the generation by explosion of a force that effects displacement of the liquid, the magnitude of such force being sufficient to hypodermically inject the liquid through said epidermis by first puncturing the epidermis solely as a result of the fine stream-like form of the liquid and causing it as a result of such force to enter the tissue therebeneath through the puncture in the epidermis.

17. The method of hypodermic injection which comprises the steps of enclosing liquid to be hypodermically injected in a container having a small discharge opening located exteriorly relative to a portion of the body into which the liquid is to be injected, and expelling the liquid with sufficient force to cause the expelled liquid to remain in a continuous stream of liquid under force whereby it will pierce the epidermis and hypodermically inject substantially all of itself through the epidermis on said portion of the body without the use of any guide between the opening of said container and the epidermis and cause it to enter the tissue beneath said epidermis.

18. In a method of hypodermic injection, the steps of enclosing liquid to be hypodermically injected into a portion of a body with no means of connection between the container and the body, and effecting expulsion of the liquid in a fine streamlike discharge under sufficient force to hypodermically inject it through said epidermis by first puncturing the epidermis solely as a result of the fine streamlike discharge of liquid and cause it as a result of such force to enter the tissue therebeneath through the puncture in the epidermis.

19. The method of hypodermic injection which comprises the steps of enclosing liquid to be hypodermically injected into a portion of a body and suddenly expelling the liquid with sufficient force to cause the expelled liquid to remain in a continuous stream at skin penetrating speed to pierce the epidermis and hypodermically inject itself therethrough and enter the subcutaneous tissue beneath the epidermis.

20. A capsule of the kind described comprising a body member having a chamber therein, liquid received in said chamber, a discharge orifice leading from said chamber, the discharge end of said body member being of such size that it is incapable of penetrating through epidermis, a rubber follower for the liquid, a pressure generator behind the follower and capable in operation of exerting a force in excess of 400 pounds per square inch on said follower to expel said liquid to a subcutaneous position without a guiding needle, and means for connecting said body member with an operating mechanism for said pressure generator.

21. A hypodermic capsule comprising a body member having a chamber for receiving liquid and a discharge orifice for the liquid and of substantially smaller cross section than the cross section of said chamber, said body member, at said discharge orifice, being relatively large and blunt to prevent location of said orifice at a subcutaneous position, a follower for the liquid and a pressure generator in said chamber capable of substantially instantaneously generating a force in excess of 400 pounds per square inch to cause self injection of the liquid with relation to epidermis closely adjacent said orifice, and means for connecting an operating device for said pressure generator with said body member.

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