

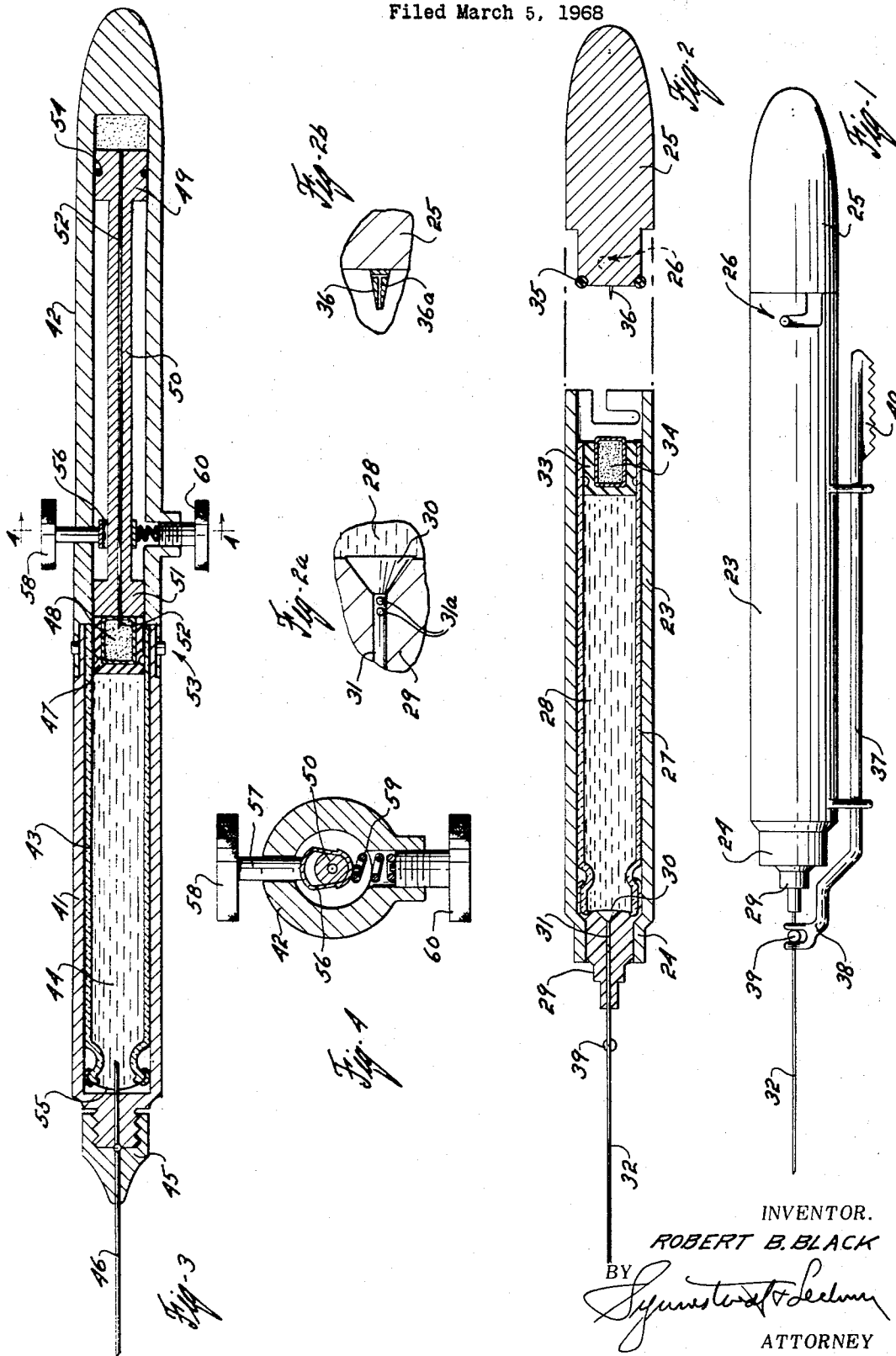
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GAS ACTUATED HYPODERMIC SYRINGE

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1

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GAS ACTUATED HYPODERMIC SYRINGE

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ABSTRACT OF THE DISCLOSURE

Hypodermic syringe adapted to be actuated by fluid pressure power means for effecting the delivery of liquid material from the syringe through the needle, the syringe being adapted to receive a disposable cartridge containing the liquid to be injected and having a closure at one end adapted to be punctured by the hypodermic needle and having a free piston at its other end, mechanism being provided for controllably delivering the fluid pressure to the free piston. The fluid pressure power means includes a capsule of pressure fluid or propellant arrangement to apply pressure to the free piston for effecting the injection.

The present application is a continuation-in-part of my applications Ser. No. 509,517 filed Nov. 24, 1965, and Ser. No. 559,703, filed Apr. 28, 1966, both now abandoned.

This invention relates to hypodermic syringes for injecting pharmaceuticals or other liquids into tissues, veins, or arteries. The invention is concerned with several important improvements including a novel arrangement for manual control of the syringe, and a novel power means for ejecting the contents of the syringe to supplant the hand force customarily employed for this purpose.

Although various features of the invention have wide applicability in the fields of medicine and dentistry, one use in which the invention is especially advantageous is for the administration of local anesthetic in connection with dentistry.

It is recognized that the use of hypodermic syringes, notably in the field of dentistry, presents a number of problems, some of which are psychological and some physical. Indeed, in the field of dentistry, although the hand actuated syringe is almost universally used throughout the world, nevertheless such a syringe remains a symbol of fear and pain to many patients. In many cases this results in over stimulation of the adrenals which in many instances has caused the patient to go into syncope with the loss of consciousness even before being touched by the syringe.

In addition to adverse psychological factors of the well-known hand operated syringe, the hand operated syringe also has certain definite physical disadvantages. For example, the "spread grasp" of the hand required for expelling the material being administered by the syringe is not conducive to steady control of the instrument with respect to needle insertion in the tissue. For this reason, many operators prefer to initially employ the "pen grasp" during insertion in the tissue for more precise control, after which the operator must change the position of his hand to assume the "spread grasp" in order to accomplish the injection. It is difficult to make this transition from one grasp to the other without moving or twisting the syringe. Such movements of the hand in changing from one grasp to the other produces unfavorable psychological reaction as well as physical discomfort to the patient, and can, in fact, be quite painful if the instrument is not carefully controlled. Moreover,

2

the "spread grasp" is conducive to unintentional squirting or dripping of the medicine or anesthetic prior to the time that the needle is actually introduced into the tissue which is definitely undesirable because of the bitter and disagreeable taste of anesthetic solutions.

A major object of the present invention is to eliminate the foregoing disadvantages of the prior art manually operated syringe. Thus, the invention contemplates the provision of a syringe which does not even resemble in general appearance the well-known hand actuated syringe, thereby eliminating much of the adverse psychological influences above referred to.

In addition, the instrument provided in accordance with the present invention incorporates power actuating means in place of the hand actuated plunger of the prior art syringes, thereby eliminating the necessity for employment of the basically awkward "spread grasp" required with prior syringes.

It is also an object of the present invention to provide a hypodermic syringe which may conveniently be held in the "pen grasp" for both insertion of the needle into the tissue and the control of the instrument during the injection, and for this purpose the instrument of the present invention preferably incorporates a control element located intermediate the ends of the instrument and operable by a finger of the hand (i.e., either by the thumb or by one of the other four digits of the hand) without requiring shift of the hand from one position to another.

A still further object of the invention is to provide a syringe in which it is unnecessary to utilize an elongated plunger or piston rod to transmit the force applied by the hand of the doctor to the ejecting piston in the cartridge. With existing designs plungers of this type often contact the ejecting piston unevenly, and therefore result in the application of greater force to one side of the ejecting piston than the other, causing the walls of the ejecting piston to vibrate during its travel down the cartridge, resulting in what patients describe as a "scrunchy" sound. The present invention completely eliminates this problem.

A still further object is to provide a finger control for a hypodermic syringe which provides for starting and stopping of the power means and thus of the flow of the injection liquid in the syringe, as well as for precise control over the rate of flow of the pharmaceutical into the tissue.

How the foregoing objects and advantages are obtained, together with others which are explained later, will appear more fully from the following description referring to the accompanying drawings in which:

FIGURE 1 is an elevational view of one preferred form of hypodermic syringe constructed according to the present invention;

FIGURE 2 is a longitudinal sectional view through the parts of the instrument of FIGURE 1 but illustrating two portions of the apparatus separated from each other;

FIGURES 2a and 2b are enlarged fragmentary views of certain details shown in FIGURE 2;

FIGURE 3 is a longitudinal sectional view through another form of instrument construction according to the present invention; and

FIGURE 4 is an enlarged transverse sectional view taken as indicated by the section line 4—4 on FIGURE 3.

In connection with the embodiments illustrated in the drawings it is mentioned that those embodiments are especially suited to types of injections which do not require initial aspiration, examples of such types being the administration of certain local anesthetics for instance in

dentistry, and various intramuscular injections, for instance, in the administration of insulin.

Turning first to the embodiment illustrated in FIGURES 1 and 2, as there shown it will be seen that the instrument comprises an elongated tubular housing 23, having a reduced but open ended portion 24 toward one end thereof and having a cap 25 adapted to be inserted in the opposite end thereof and to be secured in position by means of a bayonet connection indicated generally at 26. This instrument is adapted to receive a cartridge of special form, having a cylindrical wall 27 forming a chamber to receive the material 28 to be injected, the cartridge having at one end a cap 29 with a central discharge port therethrough. The inner end of this discharge port is flared toward the interior of the cartridge and a conical valve member 30 having a hollow stem 31 is positioned within the discharge passage of the fitting 29, this stem being of smaller diameter than that of the discharge passage so as to permit the flow of the injection material or liquid 28 through the multiple openings 31a (see FIGURE 2a) and through the stem 31 and into and through the needle 32 when the valve member 30 is unseated.

Toward its opposite end, the cartridge is provided with a piston 33 having a puncturable capsule indicated at 34 in which is placed a charge of fluid for developing the actuating pressure. As illustrated, this capsule is connected to and preferably recessed in the free piston 33, so that it constitutes a part of the cartridge. The cap 25 is provided with a sealing O ring 35 adapted to engage the inner end of the cylindrical wall 27 of the cartridge and thereby establish a pressure tight chamber behind the piston 33. The cap 25 also has a puncture point 36, as shown in FIGURE 2b, positioned so that upon connection of the bayonet joint of the cap and housing the point will puncture the wall of the capsule 34, thereby releasing the pressure to react between the free piston and the cap and thus provide the force for advancement of the piston 33 against the material 28. The point 36 desirably has passages as indicated at 36a to provide for delivery of the operating gas from the capsule 34 into the chamber behind the piston 33.

As seen in FIGURE 1, this instrument also includes a longitudinally shiftable control element 37 having a forked end 38 adapted to engage the ball 39 on the needle 32. The control element 37 also has a knurled thumb or finger surface 40 by which the control may be shifted longitudinally of the syringe. By the control arrangement described, upon shifting the needle 32 inwardly the valve 30 is lifted from its seat and the pressure established behind the piston 33 will then cause material 28 to flow through the discharge duct in the fitting 29 and into the hypodermic needle and thence into the tissue for the purpose of the injection. If desired the control 40 may then be shifted to move the needle outwardly, thereby permitting the valve 30 to reseat, and in this way control of the flow is provided so that the injection material may be delivered in increments. This may be used to permit the making of multiple injections from a single cartridge.

Another form of instrument is illustrated in FIGURES 3 and 4. Here the elongated housing is made up of two elongated pieces 41 and 42. The housing member 41 serves to provide a chamber for the reception of a cartridge having a cylindrical wall 43 defining a chamber for a material to be injected as indicated at 44. The member 41 has a threaded cap 45 cooperating to mount the needle 46 at the end of the syringe.

The cartridge is provided with a free piston 47 at its opposite end and, as in the embodiment shown in FIGURE 2, this free piston is provided with a capsule 48 containing a charge of the propellant material.

The part 42 of the housing serves to define a cylinder in which the piston 49 is adapted to reciprocate. The piston has a stem or rod 50 having an abutment 51 at

the end opposite to the piston 49, and a tubular puncturing element 52 extends through the piston 49, piston rod 50 and abutment 51 to project at the end adjacent to the chamber 48, so that when the housing parts are assembled, as by the bayonet connection indicated generally at 53, the tube 52 will puncture the wall of the chamber 48 and penetrate to the interior, thereby permitting the escape of the propellant through the tube 52 to the cylinder chamber at the opposite end of the piston 49. Piston 49 is provided with a sealing ring 54 so that the fluid pressure in the righthand end of the cylinder (when viewed as in FIGURE 3) will urge the piston 49 to the left end, thus forcing the abutment 51 against the floating piston 47 of the cartridge which latter, in turn, will force the material 44 to be injected into the inlet end of the needle 46 which has penetrated diaphragm 55, and thereby provide for delivery of the material to be injected.

The puncturing of the diaphragm 55 by the inlet end of the needle 46 may be accomplished either at the time of insertion of the cartridge into the housing part 41, or may be accomplished at the time of connecting the bayonet joint 53 concurrently with puncturing of the wall of chamber 48 by the tubular element 52.

In any event, the positioning of the interconnected piston 49, piston rod 50, and abutment 51, and thus also the position of the floating piston 47, may be controlled by means of a friction clamping device shown in both FIGURES 3 and 4. From FIGURE 4 it will be seen that the piston rod 50 is not circular but has somewhat flattened and inclined side faces adapted to cooperate with a wedge-shaped yoke 56 which is connected to the lower end of the stem 57 of a pushbutton 58. The yoke surrounds the piston rod 50 and a compression spring 59 below the yoke is adapted to urge the yoke upwardly into frictional engagement with the piston rod 50. The urging pressure of the spring 59 may be adjusted by means of the knurled adjusting screw 60.

The mechanism just described provides complete control over the starting, stopping, or rate of travel of the piston and thus the anesthetic flow.

It is to be noted in connection with both embodiments of the instrument illustrated that provision is made for operation or control with the instrument held in the hand by the pen type grip. Thus the control may be operated by engagement of the control element by the thumb or one or more of the other fingers. In both embodiments illustrated and described the control element is positioned in general in a region intermediate the ends of the elongated instrument, thereby providing ready accessibility by a finger or fingers of the hand in which the instrument is held. And in both cases, no change in position of the instrument is needed for insertion of the needle and for subsequent actuation to deliver the injection.

In the embodiments illustrated, and especially in the embodiment of FIGURES 3 and 4, the cartridge employed may be quite similar to certain cartridges already widely known and available.

In FIGURES 1 and 2 there is shown an arrangement utilizing a unitized needle-cartridge assembly having a rubber free piston modified at the righthand end to contain or mount the rupturable propellant capsule 34, and modified at the lefthand end by replacing the rubber diaphragm with a needle valve assembly 29, 30 and 31. As above noted, the needle here is also provided with an actuating ball 39.

In connection with the instrument of FIGURES 3 and 4, the only change in the cartridge needed as compared with cartridges now readily available is the mounting of the rupturable capsule 47 containing the propellant 48 on or recessed within a standard rubber free piston.

Cartridges available in a variety of forms and containing a variety of materials may be used, many of such cartridges having either a glass or plastic case, with a

well-known type of rubber diaphragm for needle puncturing, and having a free piston at the opposite end.

With respect to the actuating or pressure fluid to be employed in the capsules, this fluid may comprise one of the well-known synthetic fluorocarbons having a low boiling point, for instance monochlorodifluoromethane, a source of which is known to the trade as "Freon 22" marketed by E. I. du Pont de Nemours & Co. Certain other Freon gases may also be used, as may also certain Genetrons (General Chemical Div.) and Ucons (Carbide and Carbon Chemicals Co.). Another specific example of an appropriate material is dichlorodifluoromethane which is available under the trade name Freon 12 (E. I. du Pont de Nemours & Co.).

Various of these fluorocarbons are colorless, almost odorless, nonflammable and virtually non-toxic so they are highly suitable to use in the medical field without hazard.

I claim:

1. A hypodermic syringe comprising an elongated housing having an open end; a cartridge adapted to be inserted through said open end; a hypodermic needle at the opposite end of the housing; a free piston in the cartridge near the end adjacent the open end of the housing; said piston forming a chamber between itself and the needle end of the cartridge; said chamber containing the material to be administered through the needle; a rupturable propellant containing capsule on the other side of the piston; an elongated closure member for the open end of the housing, said closure member, when applied, being adapted to rupture the capsule and free the propellant; an elongated piston enclosed in the closure member and having a conduit therein for delivering the propellant to the rear of the elongated piston whereby to drive it against the free piston in the cartridge and thereby discharge the material to be injected; means for effecting communication between the needle and the material chamber whereby the material is discharged through the needle upon movement of the piston toward the needle under the influence of the propellant; and brake mechanism for controlling the movement of the elongated piston and therefore the discharge of the material to be injected.

2. A hypodermic syringe comprising an elongated housing formed of first and second separable and interengageable parts, the first part having a chamber for receiving a disposable injection liquid cartridge having at one end a closure adapted to be penetrated by a hypodermic needle and having a free piston exposed at the other end, means for mounting a hypodermic needle in position to penetrate said closure, fluid pressure power means for advancing the free piston of the cartridge including a fluid pressure chamber formed in the housing behind the free piston, a capsule of expandable pressure fluid having a wall rupturable to communicate the fluid pressure to said fluid pressure chamber, means for rupturing said capsule wall, and manual control means providing for selective incremental delivery of said liquid from the cartridge under the influence of pressure fluid.

3. A syringe according to claim 2 in which said fluid pressure chamber is defined in part by a power piston and in which said power piston is operatively interposed between the free piston and the pressure fluid in the fluid pressure chamber.

4. A syringe according to claim 3 in which the manual control means comprises a controllable brake for the power piston.

5. A syringe according to claim 3 in which the means for rupturing the capsule wall comprises a wall puncturing element mounted on the power piston.

6. A syringe according to claim 2 in which said fluid pressure chamber is defined in part by said free piston.

7. A syringe according to claim 6 in which the manual control means comprises a controllable valve for regulating the delivering of the injection liquid from the cartridge.

8. A syringe according to claim 2 in which the pressure fluid capsule is mounted on the free piston to thereby form a part of the disposable cartridge.

9. A syringe according to claim 2 in which the means for rupturing the capsule wall comprises an element adapted to penetrate said wall when parts of the housing are interengaged with each other.

10. A hypodermic syringe comprising an elongated housing formed of first and second separable and interengageable parts, the first part having a chamber for receiving a disposable injection liquid cartridge having at one end a closure adapted to be penetrated by a hypodermic needle and having a free piston exposed at the other end, means for mounting a hypodermic needle in position to penetrate said closure, fluid pressure power means for advancing the free piston of the cartridge including a fluid pressure chamber formed in the housing behind the free piston, a power piston operatively interposed between said free piston and the pressure fluid in said chamber, the power piston having an elongated stem, and manual control means comprising a brake in the form of a yoke embracing the piston stem, the brake being biased to brake-applied position and being releasable to provide for selective incremental delivery of the injection liquid from the cartridge under the influence of the pressure fluid acting through the power piston against the free piston of the cartridge.

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