ASPIRATING CARTRIDGE SYRINGE WITH GAS ACTUATION

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[Diagram of aspirating cartridge syringe]
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1 Claim

ABSTRACT OF THE DISCLOSURE

Hypodermic syringe adapted for use with a cartridge containing the fluid to be injected and being of the type having a free piston engageable by an actuating plunger in the syringe, the plunger having at least one and preferably two straight fins projecting thereto axially to penetrate the free piston and provide a frictional grip with the piston providing for retraction of the piston in order to effect aspiration into the cartridge before making an injection, the pin or pins being substantially free of lateral projections or bars to provide for withdrawal thereof from the piston.

The present application is a continuation-in-part of my prior application Ser. No. 559,703, filed Apr. 28, 1966, now abandoned.

This invention relates to hypodermic syringes and the invention is particularly concerned with a syringe of the type adapted to receive a piston-cylinder cartridge and in which provision is made for alternative relative advancement and withdrawal of the piston with respect to the cylinder, in order to provide alternatively for aspiration through the needle and for expulsion of the material to be injected from the cartridge through the needle.

In equipment of the kind mentioned, the piston is ordinarily formed of a soft material, such as rubber, and is advanced into the cylinder by an actuating element or plunger for the purpose of making the injection. Moreover, means are provided for fastening the piston to the actuating element so that when the actuating element is withdrawn, the piston is also retracted. Retraction of the piston effects the aspiration, and with a cartridge cylinder formed of transparent material, the aspiration of blood or of liquid through the needle into the cartridge cylinder may readily be observed.

Various forms of mechanism have been proposed for interconnecting the piston and the actuating element, certain of such devices comprising bars, or being of harpoon-like shape, adapted to penetrate the rubber of the piston and thereby interlock with the rubber to provide for withdrawal of the piston from the cylinder and thus aspiration. The use of cork screw shaped, or twisted elements, has also been proposed.

Various of these prior devices are usable but are subject to certain difficulties and disadvantages including the fact that the arrangement thereof commonly results in some appreciable stretching or distortion of the rubber of the piston upon the withdrawal motion of the actuating element, so that the withdrawal motion of the piston lags behind the withdrawal motion of the actuating element. Moreover, the aspirating action tends to become indefinite when the withdrawal motion of the piston lags behind the withdrawal motion of the actuating element. With certain of the prior arrangements employing bars or harpoon type structures, the rubber of the piston tends to become distorted in a manner impairing the seal or altering the fit of the piston in the cylinder.

Still further, with certain of the prior arrangements employing curved or corkscrew type of piston retracting projections, it is necessary to relatively rotate the cartridge and the actuating plunger in order to cause the corkscrew projections to enter the rubber of the piston. Since friction alone restrains relative turning of the piston and cylinder of the cartridge the manual rotation of the cartridge cylinder is not always fully communicated to the piston, with the result that the connection between the actuating plunger and the piston may be impaired.

The present invention provides a novel piston retractor arrangement constructed to overcome various of the difficulties encountered with prior arrangements. Thus, with the arrangement of the present invention the connection between the actuating plunger and the piston provides a secure connection as a result of a firm frictional grip, which does not require relative rotation of the cartridge piston and the plunger hooks or bars, and which, moreover, ensures that the piston will closely follow the motion of the actuating plunger, without any appreciable lag. Also, the arrangement of the invention substantially eliminates any distortion of the rubber of the piston to an extent impairing the seal or fit of the piston in the cylinder.

How the foregoing objects and advantages are obtained, together with others which will occur to those skilled in the art will be clear from the following description referring to the accompanying drawing in which:

FIGURE 1 is a longitudinal sectional view through a hypodermic syringe embodying the improvements of the present invention;

FIGURE 2 is a fragmentary view of the left end portion of the instrument of FIGURE 1 and illustrating the insertion of a hypodermic needle;

FIGURE 3 is a longitudinal sectional view similar to FIGURE 1 but illustrating certain of the parts in a different position;

FIGURE 4 is a transverse sectional view taken as indicated by the section line 4—4 on FIGURE 3; and

FIGURE 5 is a longitudinal sectional view of the right hand end portion of the instrument, with certain parts in still another position, as compared with FIGURES 1 and 3.

In connection with the embodiment illustrated in the drawing, it is first to be noted that the instrument there shown is of the general type disclosed in my copending application above identified, i.e., the instrument is of the type incorporating a power actuating means by gas pressure. Moreover the instrument illustrated in the drawing of the present application is similar to the instrument shown in FIGURES 11 to 15 of my copending application referred to.

As seen particularly in FIGURES 1 and 2, the instrument includes tubular members 6 and 7 having telescopically interfitting parts 8 and 9, preferably with a bayonet type connection of the kind referred to in the above mentioned copending application.

The tubular member 6 has a cylindrical chamber there-in adapted to receive a cartridge comprising a cylinder 10 having a free piston 11 in one end and having a puncturable diaphragm 12 in the other end.

The left end of the member 6 is provided with a threaded cap 13 adapted to receive a cup 14, the cup being shiftable within the member 13 and being normally urged toward the right as viewed in FIGURES 1 and 3 by means of a coil spring 15, the range of movement of the cup being shown by comparison of FIGURE 1 and 3.

The tubular member 7 of the assembly is adapted to receive the piston 16 having a sealing ring 17 toward its right hand end. Moreover, the right hand end of the tubular member 7 has a cap 18, this cap being adapted to
contain a charge of pressure fluid for the purpose of actuating the piston 16 when the instrument is in use. Aplug 19, formed of material which may be penetrated by a charging needle, is provided at the extremity of the cap 18, so that when needed, additional pressure fluid may be introduced into the pressure chamber.

When the pressure chamber is charged, the pressure thereof will act against the righthand end of the plunger 16, so that the left end of the plunger 16 will be raised.

The lefthand end of the plunger 16 carries an abutment element 20 through which motion of the plunger to the left is transmitted to the rubber piston 11 of the cartridge placed in the syringe, and in this way the pressure of the fluid in the cap 18 serves to advance the piston 11 in the cylinder 10 in order to expel the material in the cylinder and thus effect injection by the syringe.

The motion of the plunger 16 is adapted to be controlled by a brake 21 (see also FIGURES 3 and 5) of semi-cylindrical shape positioned on the under-side of the plunger 16 and mounted in a bore provided in a cylindrical part 22 formed on the lower side of the tubular member 7. This brake shoe 21 is urged upwards against the lower surface of the piston 16 by means of compression spring 23 which reacts against an adjustable screw plug 24.

The brake shoe 21 is controlled by a brake rod 25 which extends upwardly through an axial slot formed in the plunger 16, the upper or free end of the brake rod 25 being exposed outside of the tubular member 7 in position to be contacted by the operating element or lever 26. When the lever 26 is pressed downwardly, for instance as illustrated in FIGURE 5, the brake rod 25 is depressed, thereby displacing the brake shoe 21 from the lower surface of the piston 16, and thus releasing the plunger for movement toward the left when viewed as in FIGURES 1, 3, and 5, under the influence of the pressure fluid behind the plunger.

The brake shoe 21 is mounted by means of a pivot 27 the ends of which are supported in aperture 28—28 projecting from the tubular member 7.

Lever 26 is further provided with an actuating finger 29 which is received in a socket formed at the upper side of a push rod 30 which is mounted for reciprocation or shifting movement lengthwise of the instrument within a groove or slot formed in the inner surface of the tubular member 7. Preferably the push rod 30 and the slot in which it works are so shaped as to restrain outward dislodgement of the pushrod, while permitting its longitudinal motion.

The push rod 30 is positioned so that its lefthand end will engage the righthand end of the cylinder 10 of the cartridge inserted into the tubular member 6. The purpose of this arrangement will be described shortly below.

Attention is now called to the lefthand end of FIGURE 2 where there is shown a hypodermic needle 31 mounted by means of a cap 32, with the inner end of the needle 31 penetrating the diaphragm 12 at the left end of the cartridge. Attention is also called to the fact that the tubular member 6 is provided with an elongated aperture 33 in a sidewall thereof through which the cartridge is visible. With the cylinder 10 of the cartridge formed of transparent material, as is customary, the aperture 33 in the tubular member 6 serves, in effect, as a window through which the interior of the cartridge may be observed.

Attention is now called to the fact that the abutment 20 at the end of the plunger 16 is secured to the plunger by a threaded shank 34 received in a complementarily threaded aperture in the end of the plunger 16.

According to the present invention, a novel arrangement of elements is provided for establishing interengagement under the abutment 20 with the rubber piston 11. In the embodiment illustrated in the drawings, this purpose is served by two pins 35 projecting from the element 26, the positions of these pins appearing clearly in FIGURE 4, in which, for the sake of illustration, the rubber piston 11 has been omitted.

When the instrument is prepared for use, the cartridge comprising the charged material with the free piston 11 therein is placed into the open righthand end of the tubular part 6 prior to assembly of the tubular parts 6 and 7. The two tubular parts of the instrument are then brought together and assembled by telescoping the portions 8 and 9 to the parts 6 and 7. The parts 37 and 38 of the bayonet joint above mentioned. The telescoping of the parts 6 and 7 will cause the pins 35 to enter the rubber of the piston 11, and in this condition of assembly, the parts appear as they are shown in FIGURE 1.

The hypodermic needle 31 is then inserted and fastened in place by means of the screw cap 32, and during this insertion the inner end of the needle penetrates the diaphragm 12, and the instrument is now ready for use.

When used, the needle is of course inserted to or into the target area of the tissue, and in doing this, the instrument may be handled by employing the "pen grasp" with the instrument lying in the first and second fingers of the hand and with a finger or thumb overlying the actuating lever 26, all in the manner fully described in the copending application above referred to. The operating element or lever 26 may then be actuated, for instance by the thumb, or within the grasp of the hand without requiring shift in position of the hand. The initial motion of the lever 26, for instance the motion from the position shown in FIGURE 1 to the position shown in FIGURE 3 will shift the push rod 30 to the left and thereby shift the cylinder 10 of the cartridge to the left, for instance from the position shown in FIGURE 1 to the position shown in FIGURE 3, the spring 15 being compressed during this action. Moreover, at this time, because of the penetration of the pins 35 in the rubber of the free piston 11, a firm frictional grip is established between the piston itself and the element 20, in consequence of which the piston does not follow the cylinder but is retained in substantially its initial position. The action just described results in reduction of pressure within the cartridge and, in consequence an aspiration effect through the needle 31 into the left end of the cartridge. In the event that the needle has been positioned in a blood vessel, for instance in a vein, this aspirating effect will draw into the cartridge a small globule of blood, as indicated at B in FIGURE 3. This globule is visible through the transparent cylinder 10 and through the window 33 in the tubular member 6, and therewith the operator is warned of the positioning of the needle within a blood vessel.

The instrument may be employed for various different purposes, and for some of such purposes it is desired that the needle be positioned within a blood vessel and for others of which it is not desired that the needle be positioned within a blood vessel. In the former case, the aspiration of the globule of blood will at once advise the operator that the needle is properly positioned to proceed with the injection. In the latter case, the aspiration of the globule of blood will advise the operator that the needle is not properly positioned, and the operator may then release the lever 26 and thereafter reposition the needle so as to locate it in the tissue exteriorly of the blood vessels prior to making the injection.

In the event of either type of use, after the operator has determined that the needle is positioned as intended, the operator may then further depress the lever 26, in consequence of which the brake rod 25 is engaged and displaced, thus releasing the braking action of the brake shoe 21 against the piston 16, so that the piston will be moved under the action of the free piston 11 and the pressure behind it, thereby advancing the free piston 11 into the cylinder 10 of the cartridge and thus injecting the charge of the cartridge through the needle into the target area.
If desired the operator may use the instrument shown in the drawing for making several injections from one cartridge, the quantity of material injected being readily controlled by release and reengagement of the brake shoe 21. The instrument will always automatically aspirate before each injection. A spent cartridge may readily be removed by separation of the two tubular parts of the instrument 6 and 7, thereby permitting ready removal of the spent cartridge from the open end of the tubular member 6. The free piston 11 of a spent cartridge may also readily be removed from the pins 35, such removal not requiring a twisting motion, as with certain prior devices.

The arrangement of the pins 35, including the fact that several straight pins of relatively small diameter are preferably employed makes possible the penetration of the pins into the rubber of the free piston 11 without any extensive distortion of the rubber of the piston, such as would impair the fit or seal of the piston 11 within the cylinder 10. Moreover, the employment of a plurality of the piston penetrating pins, especially with two or of three such pins, produces an interconnection between the free piston itself and the actuating elements 20 and 16 which virtually eliminates lag between the motion of the actuating elements and the motion of the free piston, this being of importance, in the operation of an aspirating type of hypodermic syringe, as it is mentioned hereinafter.

It will be noted from the drawing that the two pins of the embodiment illustrated are located at some appreciable distance from the circumference of the piston. I have found that it is preferred, when employing two pins, to position the pins not more than about ½ of the radius of the piston from the center thereof. For instance with a typical piston of ¾ inch diameter, the pins are preferably not more than about 3/16 inch from the center, for instance at about 3/8 inch of an inch. While I presently prefer the employment of two pins as above described, three pins also serve the purpose quite well and may be similarly positioned with reference to the center of the piston.

A single straight pin may also be utilized, in which event the pin is preferably placed at the center of the piston and also is preferably of somewhat larger diameter than when employing two or three pins.

In a typical case where the free piston of the cartridge is .25 inch diameter, and where two or more pins are employed the pins are desirably of about 0.024 inch in diameter. Where a single pin is used its diameter may desirably be about 0.030 inch.

After use of the instrument, during which the plunger or actuating element 16 will be moved through a substantial stroke toward the left as viewed in the drawing, the pressure fluid in the instrument may be recycled by forcing the plunger 16 into the tubular member 7, i.e., toward the right as viewed in the drawing. This will cause the gas to be recycled to liquid phase in the chamber just ahead of the cap 18, so that the instrument becomes ready for another use, after the insertion of another cartridge into the tubular member 6.

The means or mechanism employed for the purpose of forcing the plunger 16 back into the tubular member 7 forms no part of the present invention per se, but it may be here noted that a mechanism for this purpose may conform with that disclosed in FIGURE 10 of my co-pending application above identified.

For use as an actuating fluid or propellant, certain Freon gases may be used, such as monochlorodifluoro-methane, a source of which is known to the trade as "Freon 22" marketed by E. I. du Pont de Nemours & Co. This material, introduced initially in liquid form will establish an internal pressure within the cartridge, i.e., behind the free piston 11, which pressure will be approximately 135 p.s.i. at 76° F. Other fluids which may be employed as propellants are certain Genetrons (General Chemical Div.) and Uconos (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.

As with the instrument shown in FIGURES 11 to 15 of my copending application above identified, the instrument of the present application provides for effecting aspiration in advance of making an injection. Indeed this instrument assures that aspiration will be effected in advance of injection. Moreover with the arrangement of the present invention the aspiration is effected with definiteness and assurance, especially since the straight pin arrangement greatly diminishes the lag between the aspirating motion of the piston and the motion of the actuating mechanism.

The instrument of the invention is capable of use with cartridges of a type now widely available.

I claim:

1. A hypodermic syringe having a chamber for receiving a piston and cylinder type cartridge having a transparent wall and containing material to be injected, the syringe chamber providing for visual observation of the cartridge received therein and having means for mounting a hypodermic needle in position to penetrate the cartridge, and mechanism providing alternatively for relative advancement and withdrawal of the piston with respect to the cylinder of the cartridge received in the syringe chamber, said mechanism comprising an actuating element engageable with the piston and movable axially of the cartridge cylinder for advancing the piston into the cylinder and thus effecting expulsion of the material to be injected from the cartridge through the needle, a piston penetrating pin connected with the piston actuating element and projecting from the actuating element axially of the cartridge cylinder, said pin being straight, free of lateral projections and thus of substantially uniform diameter and providing a frictional grip with the piston effective to retract the piston with respect to the cylinder, means for advancing the cartridge cylinder while retaining the piston actuating element as against advancement with the cylinder to thereby effect relative withdrawal of the piston with respect to the cylinder under the action of said frictional grip and thereby effect aspiration through the needle into the cartridge, and a manually operable control member movable in one direction to sequentially effect operation of said means for advancing the cartridge cylinder and then effect operation of said actuating element to move the piston in the cartridge for expulsion of the material to be injected.

References Cited

UNITED STATES PATENTS
1,971,687 8/1934 Kratz 128—218
2,672,142 3/1954 Melton 178—218
3,224,445 12/1965 Melott 128—218

FOREIGN PATENTS
776,968 11/1934 France.

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