HAND POWERED HYPODERMIC JET INJECTOR GUN

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UNITED STATES PATENTS

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ABSTRACT

A hand powered hypodermic jet injector gun has a hollow housing with a depending handle formed with a cavity containing a working fluid. A first chamber in the housing receives the working fluid from the cavity via a hand pump and one-way valves. A piston and coil spring in the chamber are retracted by the working fluid entering the chamber thus to cock the gun. A piston rod attached to the piston is slidably in a muzzle to eject medicament from a second chamber in the muzzle via a nozzle thereon. The muzzle is slidably adjustable by a rotatable coupling ring on the housing of the gun to adjust the volume of the second chamber. A trigger at the hand operates another one-way valve for releasing the working fluid from the first chamber allowing the spring to expand and move the piston rod for ejecting the medicament from the second chamber.

13 Claims, 4 Drawing Figures
HAND POWERED HYPODERMIC JET INJECTOR GUN

This is a continuation, Ser. No. 114,871, filed Feb. 12, 1971 now abandoned.

This invention concerns an improved hand powered hypodermic jet injector and more particularly involves a medical injector having improved means for adjusting the volume of dosage injected and for ejecting the medicament.

Jet injectors heretofore known have generally employed an external source of hydraulic pressure to eject the medicament, such as described in my prior U.S. Pat. No. 3,057,349. The need has existed for a hand powered jet injector which can be operated with a local rather than an external source of hydraulic pressure, and one in which the volume of dosage or quantity of medicament injected is readily adjustable.

According to the invention, there is provided a hypodermic jet injection gun which is well balanced and may be operated and comfortably held by an operator in one hand, leaving the operator's other hand free to swab or grasp the patient. The device is noiseless and free from recoil and may be quickly and easily disassembled, and efficiently sterilized by autoclaving or other means. It can be readily serviced by use of conventional hand tools without the need for specially adapted tools or devices. The device is ideal for use in isolated areas, or places where a portable instrument of this type is required and is easy to use, requiring no particular skill, with relatively simple components which are readily replaced if necessary. With this device only the inoculating fluid goes below the skin level of the patient and thus it is relatively easy to insure sterile operating conditions since only the nozzle of the instrument contacts the skin of a patient.

The hand powered hypodermic injection gun employs a hand operated hydraulic pump which cocks the gun by retracting an ejection piston and compressing a spring in the body of the gun. The handle of the gun contains a reservoir of hydraulic fluid. A valve operating trigger is operated to permit passage of the fluid from the cocking chamber back to the reservoir while the spring expands and advances the ejection piston. The ejection piston passes through a discharge chamber containing the medicament which is discharged in a fine jet from a nozzle. The volume of the discharge chamber is adjustable by the setting of a rotatable coupling ring mounted on the barrel of the gun. A scale inscribed on the barrel of the gun indicates the volume of the discharge chamber. Also mounted on the barrel of the gun and supported by a novel adjustable stand is a container of fluid medicament which is fed automatically into the discharge chamber. The stand is adjustable for supporting containers of different sizes and for protecting the needle which punctures the container.

Accordingly it is a principal object of the present invention to provide a portable hypodermic jet injection device which may be used in isolation without the use of an external power source.

It is another object of the present invention to provide a portable hypodermic jet injection device wherein the dosage may be easily adjustable.

It is still another object of the present invention to provide a portable hypodermic jet injection device wherein the dosage is set in a sterile manner by simply rotating a ring mounted on the barrel of the gun.

These and other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which:

FIG. 1 is a front view of a hand powered hypodermic injection gun embodying the invention;
FIG. 2 is a vertical transverse sectional view taken along line 2—2 of FIG. 1;
FIG. 3 is a vertical, longitudinal sectional view taken along line 3—3 of FIG. 2; and
FIG. 4 is a top plan view of the gun.

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout, there is illustrated a hypodermic injection gun generally designated as reference numeral 9 comprising a handle 10 in which is a cavity 12 (FIG. 2) defining a reservoir for oil or other hydraulic fluid 14. The cavity 12 is closed by a plate 16 and a diaphragm 18 and they are secured by four screws 20 at one side 21 of the handle 10. The diaphragm 18 compensates for expansion or contraction of the fluid 14. A resilient pad 17 is secured to the bottom of the handle 10 and may be used to support the gun when the gun is cocked in a manner to be hereinafter described.

The fluid can be pumped out of the reservoir 12 by a plunger or piston rod 22 movable axially upwardly in a tubular chamber 24 formed in a side 23 of the handle 10 opposite the side 21. A fitting 26 screwed into the upper end of a chamber 24 serves as a guide for the piston rod 22 which carries a knob 27 adapted to be grasped for reciprocating the rod 22 axially in the chamber 24. The bottom end of the chamber 24 communicates with the cavity 12 via a narrow passage 28 opening into a bore 30 containing a conventional spring loaded ball check valve 32. A passage 34 in a valve core 35 is normally closed by the ball valve 32 and is in communication at opposite ends respectively with the bore 30 and with a further passage 38 which leads into the cavity 12.

The fluid 14 which is drawn into the chamber 24 passes into a transverse bore 40 in the handle 10 when the piston rod 22 is moved axially downwardly. The bore 40 is normally closed by a ball valve 42 and a spring 44 retained by a screw 46 in the side 21 of the handle 10. A passage 47 for the hydraulic fluid 14 opens into the side of bore 40 (FIG. 3) and in turn communicates with a chamber 48 in the gun 9 via a vertical passage 49. The chamber 48 extends axially horizontal and slidably contains a piston 50. One end of a massive coil spring 52 bears against the piston 50 and the other end bears on a screw 54. The head 55 of the screw is exposed and can easily be removed by hand or by a wrench when required. A sealing ring 56 in a groove 58, around the piston 50 prevents leakage of fluid 14 beyond the piston.

The piston 50 is integral with an axial shaft 60 having a central threaded bore 62. The shaft 60 is slidably disposed in a bore 64 which communicates with the cylindrical chamber 48. An externally threaded hollow nipple 66 is screwed into a threaded seat 68 at the left end of the bore 64 to guide movement of the shaft 60. A radial flange 72 of the nipple 66 bears against the left end of the handle 10. A sealing ring 74 engaged in a groove 75 around the shaft 60 seals the bore 64 against
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A piston rod 80 serves as an ejector for a liquid medicament 82 stored in a container 84. The piston rod 80 has a threaded right end 83 which is screwed into the central bore 62, in the shaft 60. A rear radial flange 85 on the rod 80 bears against the left end of the shaft 60. The left end of the rod 80 extends into a cylindrical muzzle 90 slidingly engaged in the passage 70 of the nipple 66. A sealing ring 86 in a groove 88 around the rod 80 seals the medicament 82 in a chamber 100. The forward portion of the muzzle 90 is adapted to receive a closure member 102 which is held firmly in place at the end of the muzzle 90 by a nozzle cap 104 which is threadedly engaged to the exterior of the muzzle 90. The chamber 100 is defined as the volume between the closure member 102 and a conical tip 106 of the rod 80 in the muzzle 90. A head 110 of the rod 80 is smaller in diameter than a bore 112 of the muzzle 90 thereby providing a narrow circumferential clearance or passage 108 surrounding the head 110.

The closure member 102 is provided with a ball check outlet valve 101 and carries appropriate sealing rings. At its forward extremity, the nozzle cap 104 carries a sapphire orifice insert 105 which is bored to a very close tolerance and which determines the diameter of the jetstream of the medicament 82.

After the spring 52 is compressed and the gun is cocked as will hereinafter be described, the volume of the chamber 50 can be adjusted by means of a cylindrical coupling ring 114 rotatably engaged on the externally threaded left end of the nipple 66. The ring 114 has a circumferential radial flange 116 engaging a radial flange 118 formed on the muzzle 90. Thus, by rotating the ring 114, the muzzle 90 will be axially retracted or extended with respect to the nipple 66, and will thereby vary the spacing between the tip 106 of the piston rod 80 and a corresponding conical wall 101 of the closure member 102.

The muzzle 90 is prevented from rotating by a bracket 120 which also serves as a support for the container 84. The vertical bracket 120 includes a flat horizontal arm or strip 122 screwed or welded to a rectangular saddle 124 which bears on the muzzle 90. The muzzle 90 has an integral internally threaded cup 126 into which is screwed a fitting 128 which is centrally bored to carry a medicament inlet ball valve 130 adapted to seat on a medicament tube 131 leading to the medicament chamber 100 when the chamber 100 is being filled with medicament. When the medicament in chamber 100 is discharged the inlet ball valve 130 seals a seat 128a and prevents the medicament from returning to the container 84. A screw 132 in the end of the saddle 124 bears against the fitting 128 to secure it thereto. The right end of the bar 122 is bifurcated to form a slot 134 defining a pair of fingers 136. A member such as a screw 138 extends through the slot 134 between the fingers 136 and is engaged in a threaded hole 140 in the top of the gun 9. By this arrangement the screw 138 holds the bracket 120 in a vertical position. The volume of the chamber 100 and hence the dosage is determined by the relative positions of the muzzle 90 and the rod 80 and can be indicated by a scale 135 inscribed on top of the gun (FIG. 4) near the end of the bar 122. If desired a window 133 may be provided at the rear of the gun 9 and symbols such as those at 135 may be provided thereat whereby the position of the piston 50 with respect to the symbols would represent the dosage or volume of the chamber 100.

The medicament 82 is drawn from the container 84 which may be a cylindrical bottle having a neck 150 in which is a rubber stopper 151 held by a ring 152. The stopper 151 bears on the upper end of the fitting 128. A tube assembly 154 extends upwardly from the fitting 128 and is adapted to penetrate the stopper 151 by a needle-like tip 155 extending above the tube 154. The tube 154 conveys air into the container 84 via an air hole 158 in the fitting 128, which communicates with the atmosphere. A tube 156 smaller in height then the tube 155 passes the medicament 82 around the inlet valve 130 through the medicament tube 131 via a series of slots 129 at the rear end of the tube. The container 84 is supported in axial vertical position by a generally U-shaped bracket 166 having a vertical arm 168 engaged in a clamp 170 by a screw 172. The clamp is carried by an upright bar 174 welded to the top of the bar 122. A shorter hollow arm 176 of the bracket 166 carries a knob 180 which bears on the upper end of the inverted container 84. The arm 176 and the arm 168 have a threaded socket which is adapted to engage the screw tip 182a of an auxiliary extension 182. The auxiliary arm extension 182 as shown in FIG. 3 is coupled to the arm 168, and in this position if a larger bottle 84 of medicament is to be used the bracket 166 may be raised by opening the screw 172. Alternately, when the gun is not to be used the extension arm 182 is threaded into the knob 180 and the bracket assembly is then lowered such that the arm extension 182 covers the tip 155 which is thereby protected (FIG. 3).

The discharge of medicament is effected by axial movement of the rod 80 to the left as viewed in FIG. 3, by retracting a trigger 200 which is pivotally mounted to the gun just in front of the handle 10. A valve stem 202 is moved rearwardly by retraction of the trigger 200. The stem 202 is slidable mounted in a valve insert 204 screwed into a valve fitting 206. The valve fitting is set in a bore 208 and has a lateral passage 210 which communicates at one end with the chamber 12 via a passage 214 in the handle 10. The other end of the bore 208 communicates with a bore 216 in the fitting 55. The valve stem 202 contacts a ball valve 218 biased against the fitting 208 by a spring 220 in the handle 47. By this arrangement the ball valve 218 normally blocks the passage 214 so that no hydraulic fluid can pass from the chamber 48 and the passage 49 to the chamber 12 via the passage 214. When the trigger 200 is retracted to the right or pivoted counterclockwise around the pin 201 as viewed in FIG. 3, the valve stem 202 is retracted so that the ball valve 218 clears the passage 49 and the hydraulic fluid can pass around a narrow portion 202 of the stem 202 to the passage 214.

In operation of the jet injector, the knob 27 is grasped and the pump rod 22 reciprocated several times. This will draw the hydraulic fluid 14 by suction out of the chamber 12 via the passages 28, 34 and 38 to the passage 24. From passage 24 the fluid 14 is forced by reciprocation of the rod 22 into the chamber 48 via the passages 40, 47 and 49. This causes retraction of the piston 50, the shaft 60 and the rod 80 and compression of the spring 52. The amount that the piston 50 is retracted is determined by the distance D shown in FIG. 3, i.e., the distance between the end 50a of the piston 50 and the edge 54a of the screw 54 when
the gun is uncocked. By design this distance D is also the distance between the rear edge 114a of the ring 114 and the front edge 72a of the radial flange 72. As the piston 50 is retracted a gap appears between the edge 90a of the muzzle 90 and the edges 85a of the radial flange 85. Correspondingly, the distance D between the end 50a and the edge 54a decreases so that when the end 50a abuts the edge 54a the distance between the edges 90a and 85a are at the distance D and the gun is fully cocked. In addition as the piston 50 moves to the right (as viewed in FIG. 3) the medicament flows freely into the slots 129 through the medicament tube 131 to fill the chamber 100. The gun is now cocked. With the spring in the cocked position, the gun may be easily primed and purged of air by merely rotating the ring 114 in one direction and the other. That is when the ring 114 is rotated so that the muzzle 90 moves longitudinally to the right as viewed in FIG. 3 the volume of chamber 100 is decreased thereby forcing any medicament therein to be ejected through the nozzle cap 104. When the ring 114 is rotated so that the muzzle 90 moves longitudinally to the left as viewed in FIG. 3 the volume in chamber 100 increases and is filled with medicament. After the gun is primed the dosage is set by rotating the ring 114 so that the edge of the arms 136 is aligned with the proper numeral on scale 135. After the gun has been fired the dosage may also be checked at window 133 (FIG. 4) by observing the alignment of the edge 50a with numerals of the scale. The gun may now be cocked as hereinbefore described and the nozzle cap 104 placed in contact with the patient's body and trigger 200 may be retracted. This will enable the release of the hydraulic fluid from chamber 48 via passages 49, 47 and 214. The spring 52 will expand and the rod 80 will be driven to the left to the position where the edge 85A is stopped by the muzzle end 90A as shown in FIG. 3, while the medicament is forced forcibly in a fine jet via the nozzle cap 104.

Each time the jet injector gun is used, it is necessary to reciprocate the pump rod 22 to cock the gun and in doing so the chamber 100 is filled with medicament. That is, each time the piston 50 is retracted thereby moving the pump rod 80 to the right which creates a vacuum within the chamber 100 and causes the medicament to be drawn into the chamber 100 in an amount predetermined by the distance which the piston 50 and thus piston 80 is set to move. The medicament is withdrawn from the container 84 through the seat 128a and through the medicament tube 131 via the slots 129. The check outlet valve 101 serves to prevent the entry of any air or suck-back of any fluid during the loading cycle of the medicament chamber with the spring pressure on this valve sufficiently light to be easily overcome during the firing or ejection cycle. The aforementioned structure and operation of the inlet valve 130, medicament tube 131, slots 129, closure member 102 and nozzle cap 104 are the same as those disclosed and described in my aforementioned U.S. Pat. No. 3,057,349.

It will be noted that no external source of hydraulic power is required the jet injector gun is entirely hand powered. For normal usage only nozzle cap 104 need be swabbed with a disinfectant. Occasionally the entire gun can be taken apart for cleaning and sterilization of parts. The gun requires no particular skill to adjust, operate or assemble and disassemble. It should be noted that whenever the dosage is changed, the change in the medicament chamber (the volume between the conical walls 101 and the tip 106 of the piston 80) is such that a minimum dead end space is maintained, i.e., conical wall 101, is moved rather than moving the tip of the piston 80 thereby providing easier priming (removal of entrapped air) and also minimizing the amount of fluid remaining in the chamber between strokes. It fulfills a long felt need in the medical field for a reliable, portable, hand powered hypodermic jet injector.

It should be understood that the foregoing relates to only a preferred embodiment of the invention, and that it is intended to cover all changes and modifications of the example of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

The invention claims:

1. In a hydraulic powered jet injector instrument of the type having a housing with a hydraulic chamber, a hydraulic piston reciprocally mounted in said hydraulic chamber and rigidly connected to a medicament piston and wherein a spring means biases said hydraulic piston in one direction in said hydraulic chamber, the improvement comprising:

a nozzle slidably mounted at one end thereof to said housing, and extending partially within said hydraulic chamber, the second end of said nozzle extending sufficiently into said hydraulic chamber to act as a stop for said hydraulic piston, a nozzle means on the other end of said nozzle for ejecting said medicament; said nozzle means, said nozzle and said medicament piston defining a medicament chamber, and an adjustable coupling means operatively coupling said nozzle and said housing for adjusting the volume discharged from said medicament chamber.

2. In a hydraulic powered jet injector instrument as defined in claim 1, wherein said adjustable coupling means comprising a rotatable ring threadedly engaged on said housing and having an internal first radial flange, said nozzle having an external second radial flange engageable by said first radial flange, whereby the axial position of said nozzle with respect to said housing is determined by the rotational position of said ring.

3. A hand powered jet injector instrument comprising:
a hollow housing; a handle depending from said housing, said handle being formed with a cavity for containing a fluid, said housing being formed with a first chamber communicating with said cavity for receiving said fluid therefrom; a hand operated pump on said housing arranged to pump said fluid from said cavity into said chamber; a piston movable axially in said chamber and retracted by fluid pumped into said chamber; a coil spring in said chamber adapted to be compressed by said piston when said piston is retracted in said chamber; a muzzle slidably mounted at one end thereof to said housing, and extending partially within said chamber, said one end of said muzzle extending suffi-
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4. A hand powered jet injector instrument as defined in claim 3, further comprising:
   a manually operable trigger carried by said housing;
   and
   one-way valve means operated by said trigger, said valve means controlling return of fluid from said first chamber to said cavity to permit said spring to expand and move said piston and said piston rod axially to eject said medicament from said chamber.

5. A hand powered jet injector instrument as defined in claim 3, further comprising:
   a container of medicament;
   a support means for holding said container onto said muzzle;
   said support means including a passage communicating with said second chamber for passing said medicament from said container into said second chamber.

6. A hand powered jet injector instrument as defined in claim 5 further comprising:
   a manually operable trigger carried by said housing;
   and
   one-way valve means operated by said trigger, said valve means controlling return of fluid from said first chamber to said cavity to permit said spring to expand and move said piston and said piston rod axially to eject said medicament from said second chamber.

7. A hand powered jet injector instrument as defined in claim 3, wherein said adjustable coupling means comprising:
   a rotatable ring threadedly engaged on said housing and having an internal first radial flange;
   said muzzle having an external second radial flange engageable by said first radial flange, whereby the axial position of said muzzle with respect to said housing is determined by the rotational position of said ring.

8. A hand powered jet injector instrument as defined in claim 7, further comprising:
   a container of medicament;
   a support means for holding said container onto said muzzle;
   said support means including a passage communicating with said second chamber for passing said medicament from said container into said second chamber.

9. A hand powered jet injector instrument as defined in claim 8 wherein said support means further comprises:
   a bar having a saddle at one end engaged with said muzzle; and
   a guide means on said housing engageable with the other end of said bar for preventing said muzzle from rotating with respect to said housing.

10. A hand powered jet injector instrument as defined in claim 9 wherein said saddle includes a fitting engaged in said saddle and having a passage communicating with said second chamber for passing said medicament from said container into said second chamber.

11. A hand powered jet injector instrument as defined in claim 9, further comprising a bracket on said bar adjustably engaging said container to hold the same in place while passing said medicament into said second chamber.

12. A hand powered jet injector instrument as defined in claim 11, further comprising:
   a manually operable trigger carried by said housing;
   and
   one-way valve means operated by said trigger, said valve means controlling return of fluid from said first chamber to said cavity to permit said spring to expand and move said piston and said piston rod axially to eject said medicament from said second chamber.

13. A hand powered jet injector instrument as defined in claim 12, further comprising other one-way valve means in said handle and said housing arranged to permit passage of said fluid from said cavity to said first chamber when said pump is operated, said pump comprises a further passage formed in said housing and a pump rod axially slidable in said further passage, said further passage extending between said first chamber under control of said other one-way valve means.

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