MULTIPLE INJECTION INOCULATOR INSTRUMENT

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Application July 22, 1952, Serial No. 300,224

11 Claims. (Cl. 128—173)

The present invention relates generally to instruments used medically for the purpose of injecting inoculant into patients, and more particularly to an instrument for effecting jet or spray injection.

This patent application is a continuation-in-part of our copending application Serial No. 147,166 entitled, "Inoculant Injector Instrument," filed March 2, 1950, now Patent No. 2,687,724.

In our copending application we have disclosed an instrument of the character described which could be utilized for effecting high velocity surface injections of inoculant by means of a fluid jet of about .003 inch diameter. That application described two embodiments of the invention; one, which could be utilized only for single shot operation and had to be charged with a new ampule each time it was used; and another, which was provided with a reservoir and means for manually charging the instrument with inoculant from the reservoir after each use thereof, without requiring a new ampule.

It is the primary object of the present invention to provide an inoculant injector instrument of the character described which is provided with a self-charging inoculant supply.

Another object of the invention is to provide an instrument which is capable of multiple-shot operation without requiring charging after each shot.

Still another object of the invention is to provide improved means for preventing leakage or "bleeding" of the inoculant from the instrument.

Other objects and advantages of my invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like numerals are employed to designate like parts throughout the same,

Fig. 1 is a top plan view of an injector instrument embodying the features of our invention;

Fig. 2 is a side elevation of the instrument shown in Fig. 1;

Fig. 3 is a longitudinal cross-sectional view of the instrument taken on line 3—3 of Fig. 1, and

Fig. 4 is a fragmentary enlarged sectional view of the forepart of the instrument shown in Fig. 3.

Referring more particularly to the drawings, the injector instrument is seen to have some resemblance to a pistol in its overall appearance. The principal part of the device is a unitary body 10, which may be a casting, and which includes a grip or butt portion 11 and a barrel portion 12.

The barrel 12 is provided with longitudinally successive bores 13, 14 and 15, and terminates in a threaded opening 16. Threadedly secured in the opening 16 is a plunger guide 17 having an annular recess 18 adapted to receive and retain an ampule or cartridge C providing a chamber from which inoculant may be ejected.

Threadedly secured to the end of the guide 17 is an ampule cap 19 having a disked or concave end 20 and an aperture 21, through which the perforated nose of the ampule projects. The cap 19 serves to secure the ampule and, further, serves to retain the nose of the ampule in spaced relationship to the skin of the patient, as will be described hereinafter.

A plunger rod 22 is slidably mounted in the guide 17 for reciprocal movement. The plunger 22 is hollow, providing a passageway or bore 23 which terminates in a counterbore 24 adapted to receive a ball 25. To the plunger rod 22, midway thereof, is threadedly secured a tubular piston 26 which has a passage through an O-ring 27 with the wall of bore or cylinder 14.

The piston 26 has a pair of diaramatically-opposed projections 28 which ride in keyways 29 in bored 13 and serve to lock the piston against axial rotation. The piston is also provided with a integral extension 30 of reduced diameter which is receoted slidably in the bore 15 and has a filling engagement with an O-ring 31 which is secured in the barrel 12 by a threaded bushing 32.

The forepart of the plunger 22 has threadedly secured thereto an extension or nose 33 which is specially formed to conform to the shape of the ampule C. A gasket 34 is interposed between the nose 33 and the end of plunger 22 and acts both as a seal and also as a retainer for the ball 25. The plunger nose 33 is provided with an axial passageway or bore 35 which communicates with the bore 23 of plunger 22. As best seen in Fig. 4, the nose has a conical molded rubber tip 36 and has lateral ports 37 which provide a passageway between the interior of ampule C and the bore 35. An O-ring 38, which is retained in a circumferential recess on the plunger nose 33, has a filling engagement with the interior wall of the ampule C. Another O-ring 39 acts as a cushion and seal between the ampule and the cap 19.

The other end of plunger 22 is slidably mounted in a cylindrical pump sleeve 40, the end of the plunger extending almost to a tapped opening 41 which is laterally disposed on the sleeve 40. O-ring 42 is circumferentially mounted on the plunger rod 22 and has a filling engagement with the wall of sleeve 40.

The open end of the bore 13 in barrel 12 is closed by means of a cap 43 which is secured to the end of the barrel by means of cap screws (not shown). The cap 43 has a central keyhole slot 44 which permits a circumferential flange 45 on sleeve 40 to traverse the cap 43 when it is turned 90°. The flanged portion 46 of the cap abuts the flange 45 and prevents rearward displacement of the sleeve 40 after the device has been assembled.

A washer 47 is mounted on sleeve 40 and abuts the cap 43. The washer 47 serves as an interpart for one end of a compression coil spring 48, the other end of which bears against the piston 26 thus urging the piston forwardly in the direction of the ampule C.

A second compression coil spring 49 lies between washer 47 and the flange 45 on sleeve 40 and thus yieldably resists forward displacement of the sleeve.

A piston 50 is slidably mounted in the pump sleeve 40 and has provided circumferentially thereof an O-ring 51 which has a filling engagement with the wall of sleeve 40. A rod 52, which is integral with piston 50, extends through an aperture 53 in the closed end 54 of the sleeve 40, and has secured thereto, by means of set screw 55, a cap 56 which abuts the end 54 of sleeve 40. A compression coil spring 57 abuts the piston 50 and the end 54 of sleeve 40 and serves to yieldably maintain the piston in spaced relationship to the end of plunger 22, thereby defining a pump chamber 58 which communicates with the opening 41.

secured to the exterior of the barrel 12 is an L-shaped bottle holder 59 having an arcuate bottle clamp 60 secured to the upper portion thereof. The base of the holder 59 is provided with a slot 61 through which a
A thumb screw 62 extends and is threadedly secured to the barrel 12. The holder 59 is thus slidable along the barrel 12, and can be secured in a selected position by means of thumb screw 62. A stop pin 63 is also secured to the barrel 12 and serves to limit the movement of the holder.

A hollow needle 67 extends upwardly between the arms of element 65 and pierces the cap 68 of bottle 66 so as to be in communication with the incontinent contained therein.

The needle 67 is suitably mounted in a fitting 69 which has a bored 70 and which is threadedly secured into the opening 41 which communicates with pump chamber 58. The bored 70 is enlarged as at 71 to receive a ball check 72 which is retained by a stop 73.

Another hollow needle 74 also extends into the bottle 66 and serves as an atmospheric vent.

The foregoing description relates primarily to structure contained within the barrel 12 of the device. We will now describe the hydraulically actuated cocking and release mechanism which is disposed within the butt 11 of the instrument.

The portion 11 of the body 10 is provided with a cavity 75 which serves as a reservoir for the hydraulic fluid. The reservoir 75 is closed by means of a threaded cap or cover 76.

The butt 11 is also provided with a second cavity 77 which serves as a cylinder in which is slidable mounted a piston 80 having a bifurcated end portion forming ears 79. A suitably formed handle 80 is pivotally connected to the ears 79 of the piston 78 by means of a pin 81, this connection being immediately the ends of the handle. The lower end 82 of the handle is pivotally secured, as by pin 83, to a link 84, which, in turn, is pivotally secured to the butt 11 by pin 85. The link 84 is concealed within the butt in a recess 86 which is large enough to permit free movement of the link.

The piston 78 is provided with a circumferential recess 87 in which is retained a resilient sealing ring 88 which has wiping engagement with the wall of cylinder 77. A compression coil spring 89 is disposed between the piston 78 and the end of cylinder 77 and normally urges the piston to the left as viewed in Fig. 3.

The butt 11 is further provided with a cavity or by-pass chamber 90 which is counterbored as at 91 to form a valve chamber, and is tapped to receive a threaded valve body 92. The valve body, in turn, has a central bore 93 in which is slidable received a valve stem 94, having an extension 95, which extends to the chamber 90. The extension 95 abuts a ball check 96 which is retained in a cage 97 in the chamber 90. A coil spring 98 serves to urge the ball 96 to act on the bore 93.

The bore 93 is counterbored and tapped to receive a sealing ring 99 which is retained by a threaded bushing 100.

A portion of the valve stem 94 extends externally of the butt 11 and abuts a trigger or lever 101 which is pivotally secured to the barrel 12.

The valve body 92 is provided with a portion of reduced diameter, which has a plurality of diametrical openings 102 provided therein. The valve stem extension 95 is of reduced diameter thereby forming a clearance space within the valve body.

A channel or passageway 103 interconnects the bore or cylinder 14 with the chamber 90 and a channel 104 interconnects the chamber 90 and the cylinder 77. A third channel 105 interconnects the valve chamber 91 and reservoir 75, and another channel 106 interconnects reservoir 58 and cylinder 77. The function of these channels will be described hereinafter.

A ball check valve 107 is mounted in the channel 104, intermediate the cylinder 77 and by-pass chamber 90, and another ball check valve 108 is mounted in the channel 106, intermediate the reservoir 75 and cylinder 77.

The operation of the instrument will now be described.

As heretofore stated, the characteristic of the instrument is that the incontinent be ejected from an aperture 109 in the ampule C at high velocity. To attain this velocity it is requisite that a high pressure be developed by the plunger 22. To attain this objective, the spring 48 must have a high energization value, for example, 300 lbs. when fully compressed, as shown in Fig. 3. It will be readily apparent, that, in order to cock the plunger, that is, retract it in opposition to spring 48, a great deal of force would be required. It would normally be considered impossible for the average person to manually retract the plunger. The hydraulic operating means permit this retraction to be accomplished.

With the plunger 22 in a forward position, that is, with spring 48 expanded, the reservoir 75 is filled with a suitable hydraulic fluid such as light mineral oil, so that all the cylinders and passageways are filled completely. After the device has been completely charged with the hydraulic fluid, the reservoir is closed and sealed by means of the cover 76.

The butt portion of the device is grasped in one hand by which the fingers actuating the handle 80 is normally disposed in the dotted line position shown in Fig. 3, due to the urging of piston spring 89.

The piston 78 is then reciprocated in cylinder 77 by means of the compound pivotal movement of handle 80. The link 84, which permits vertical movement of the handle 80, prevents any lateral strain from being imposed on the piston 78 during pivotal movement of the handle.

As the piston 78 is moved to the right, as seen in Fig. 3, it forces the hydraulic fluid past ball valve 107 into channel 104. During this displacement of the fluid, the back pressure in channel 106 causes ball check valve 108 to close, thereby preventing a return flow of the fluid into reservoir 75.

Upon completion of the compression stroke of piston 78, the spring 89 returns the piston to its initial position, and during this movement, the void created in the cylinder 77 causes ball check valve 108 to open, thereby permitting an additional flow of fluid from reservoir 75 through channel 106 into cylinder 77. Although, as the fluid flows out of reservoir 75, a void is created in the reservoir, this void is overcome by the void created by the retraction of piston 78, so that no "vacuum lock" will occur. At the same time, the back pressure in channel 104 causes ball check valve 107 to close, thereby preventing any return flow of the fluid from channel 104 into cylinder 77.

As the fluid pump, of which piston 78 is an element, is operated, the fluid is forced through channel 104, through by-pass chamber 90 and through channel 103 into cylinder 14 where it steadily builds up an increasing pressure. This pressure, acting on piston 26, forces it to the right, as viewed in Fig. 3, thereby retracting plunger 22 to the position shown in Fig. 3.

The fluid pressure also acts upon the ball 96 thereby seating the ball against valve body 92 and urging the stem extension 95 to the left, as viewed in Fig. 3, causing the bore 93 to be closed to passage of the fluid.

The fluid-pumping operation is repeated several times until the spring 48 has been fully compressed. The plunger 22 is thereby in fully cocked position.

The device is then primed with an incontinent by grasping the cap 56 and reciprocating piston 50 until the incontinent spurs from aperture 109 in ampule C. When the operator of the device is certain that all air has been removed from the incontinent and that the device is completely filled, the instrument may be used for jet injection purposes. This is accomplished by pressing the thumb 19 directly against the skin of the patient, the concave surface 20 of the member 19 causing the aperture 109 of the ampule C to be spaced a predetermined dis-
...from the skin surface. The trigger 101 is then retracted causing valve stem 94 and its extension 95 to move rearwardly, causing ball 96 to be displaced. The bore 93 of valve body 91 is thereby opened to the pressure of the hydraulic fluid which is contained in cylinder 14.

The hydraulic fluid flows from cylinder 14 through channel 103, through bore 90, past ball check 96, through valve body apertures 102 and through channel 105, back into the reservoir 75.

The fluid pressure in cylinder 14 is thereby relieved, and spring 48 forces piston 26 and plunger 22 forwardly. During this movement the plunger nose 33 with its conical tip 36 forces the reservoir of inoculant C through a high velocity stream or jet as indicated in Fig. 4. Return flow of the inoculant through the bore 23 of plunger 22 is prevented by means of ball check valve 25.

After the plunger 22 has moved forwardly, as shown in Fig. 4, additional inoculant flows out of bottle 66 through needle 67 and bore 70 of fitting 69, into pump chamber 58. The piston 26 is retracted by the same manipulation of handle 80 previously described above. As plunger 22 is retracted, ball check valve 72 seals bore 70, preventing any return flow of inoculant. The inoculant in pump chamber 58 is thereby forced through bore 23 of plunger 22, through bore 35 of plunges 33, and through the lateral openings 37 into the ampule C. The device is then ready for the performance of another injection.

Multiple shot operation of the device is thus readily accomplished there being no necessity for charging it with inoculant after each injection. The operation resolves itself into pumping handle 80 to effect retraction of plunger 22 and then releasing the spring-pressed plunger by means of trigger 101.

Leakage or bleeding of the inoculant from the ampule C is minimized by the yieldable piston 50, which prevents any sudden surge of inoculant through the plunger 22 by yieldable retracting in response to the retraction of the plunger.

From the foregoing description, it will be readily apparent that we have provided a self-charging multiple injection inoculator instrument, which is particularly useful for the mass inoculation of large groups of people with great rapidity. Although we have throughout this description referred to "inoculant," it is evident that the instrument may be utilized for any liquid medicament or agent. The term "inoculant" is, for purposes of this specification, therefore representative of all such injectable fluids.

It is to be understood that the form of my invention, herewith shown and described, is to be taken as a preferred example of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to, without departing from the spirit of my invention, or the scope of the subjoined claims.

Having thus described my invention, I claim:

1. In an inoculant injector instrument, the combination of an inoculant ejection chamber, a hollow plunger axially movable into said chamber to displace the contents thereof, spring means for advancing said plunger in said chamber, fluid-pressure means for retracting said plunger in opposition to said spring means, means for releasably maintaining said plunger in retracted position, an inoculant reservoir communicating with said hollow plunger, and inoculant metering means disposed in the path of retractive movement of said plunger and, responsive to retraction of said plunger, for replenishing the contents of said chamber.

2. In an inoculant injector instrument, the combination of an inoculant ejection chamber, a hollow plunger axially movable into said chamber to displace the contents thereof, spring means for advancing said plunger into said chamber, a check valve disposed within said hollow plunger to prevent the flow-back of inoculant therethrough, means for retracting said plunger in opposition to said spring means, an inoculant reservoir communicating with said hollow plunger, and inoculant metering means disposed in the path of retractive movement of said plunger and, responsive to retraction of said plunger, for replenishing the contents of said chamber.

3. In an inoculant injector instrument, the combination of an ampule, a cylinder, a hollow plunger slidably in said cylinder and axially movable into said ampule to displace the contents thereof, a piston slidably disposed in said cylinder in spaced aligned relationship to the end of said plunger, said piston and the end of said plunger defining a metering chamber within said cylinder, an inoculant reservoir communicating with said metering chamber, means for advancing said plunger into said ampule, and responsive to retraction of said plunger to displace the inoculant in said metering chamber and direct it through said hollow plunger into said ampule.

4. A combination as defined in claim 3, wherein said piston yieldably enlarges said metering chamber in response to an excess of inoculant therein.

5. A combination as defined in claim 4, including spring means engaging said piston to yieldably maintain it in a fixed position in said cylinder.

6. A combination as defined in claim 5, including a check valve disposed in said hollow plunger to prevent the flow-back of inoculant therethrough from said ampule, and a check valve associated with said reservoir to prevent the flow-back of inoculant thereto from said metering chamber.

7. In an inoculant injector instrument, the combination of a body, an inoculant ejection chamber provided in said body, ejection means slidably mounted in said body and movable forwardly toward said chamber to displace the contents thereof, a second chamber provided in said body in the path of rearward movement of said means, an inoculant reservoir communicating with said second chamber, a fluid passageway between said inoculant ejection chamber and said second chamber, valve means disposed in said fluid passageway to prevent fluid flow from said inoculant ejection chamber toward said second chamber, means for advancing said ejection means toward said inoculant ejection chamber, and means for retracting said ejection means to displace the inoculant in said second chamber and direct it through said passageway into said inoculant ejection chamber.

8. In an inoculant injector instrument, the combination of an inoculant ejection chamber, a cylinder, a hollow plunger slidably mounted in said cylinder and movable forwardly toward said chamber to effect displacement of the contents thereof, a second chamber provided rearwardly of said plunger in communication with the bore thereof, an inoculant reservoir communicating with said second chamber, means for advancing said plunger toward said inoculant ejection chamber, means for retracting said plunger to displace the inoculant in said second chamber and direct it into said inoculant ejection chamber, and means for sealing said bore against counter-flow of inoculant from said inoculant ejection chamber into said second chamber.

9. In an inoculant injector instrument, the combination of an inoculant ejection chamber, a cylinder, a hollow plunger slidably mounted in said cylinder and movable forwardly toward said chamber to displace the contents thereof, valve means disposed between said chamber and the bore of said plunger to prevent communication therebetween during forward movement of said plunger, a second chamber provided in said cylinder in the path of movement of said plunger, an inoculant reservoir communicating with said second chamber, means for advancing said plunger toward said inoculant ejection chamber, means for retracting said plunger toward said second chamber to displace the inoculant therein and direct it into said inoculant injection chamber, and resilient pressure-responsive means bounding said second chamber to expand the same in response to plunger-induced pressure therein.
10. In an inoculant injector instrument, the combination of a body; an inoculant ejection chamber provided on said body, ejection means slidably mounted in said body and movable forwardly toward said chamber to displace the contents thereof, means for advancing said ejection means toward said chamber, means for retracting said ejection means, an inoculant reservoir, means providing a passageway between said reservoir and said chamber, inoculant metering means disposed in the path of retractive movement of said ejection means and responsive to retraction of said plunger to direct inoculant from said reservoir through said passageway into said chamber; and means cooperateable with said passageway to prevent counter-flow of inoculant from said chamber through said passageway.

11. A combination as defined in claim 10, wherein said ejection means is a plunger having an axially extending bore therein; said bore providing said passageway.

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