March 3, 1964 A. W. KATH 3,123,070

MULTIDOSE JET INJECTOR

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Fig. 2

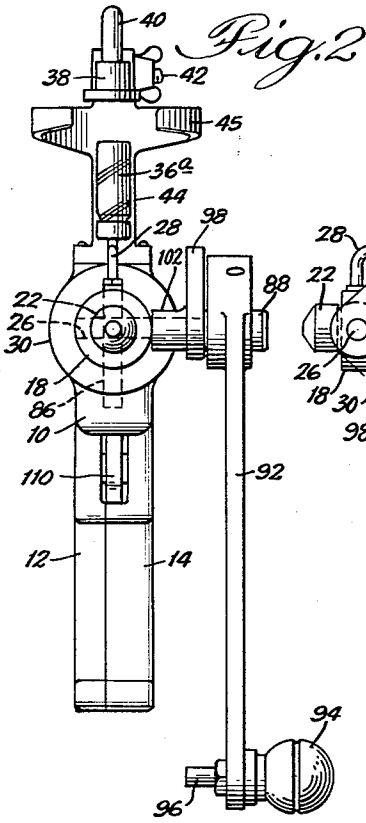

Fig. 1

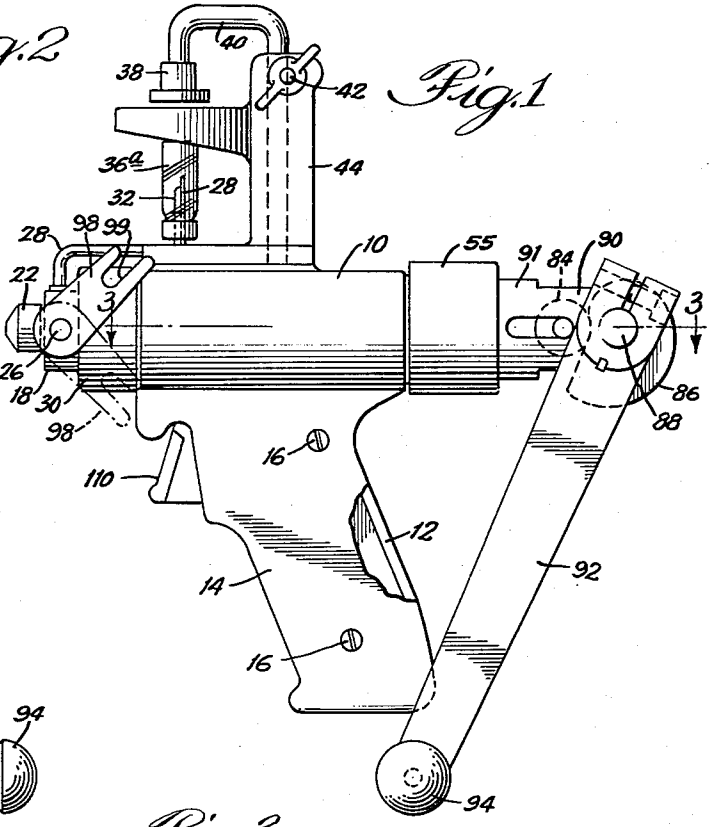

Fig. 3

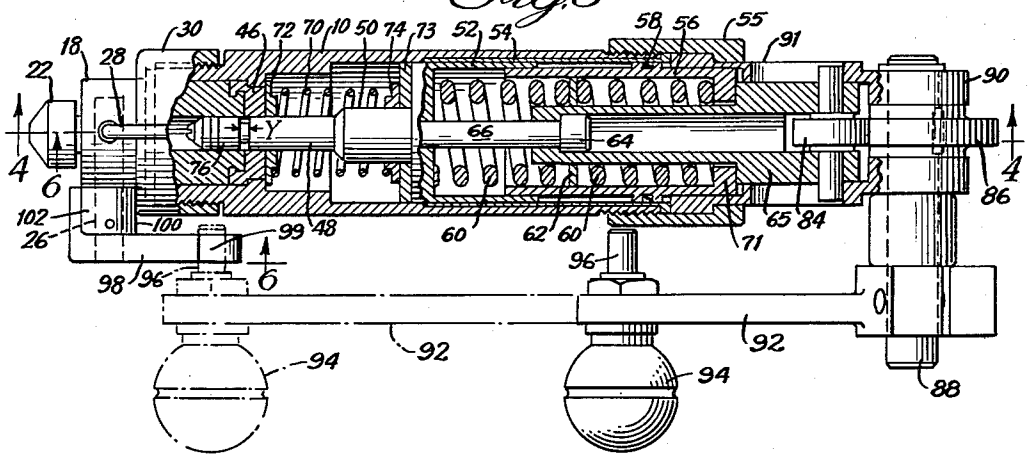

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Fig. 4

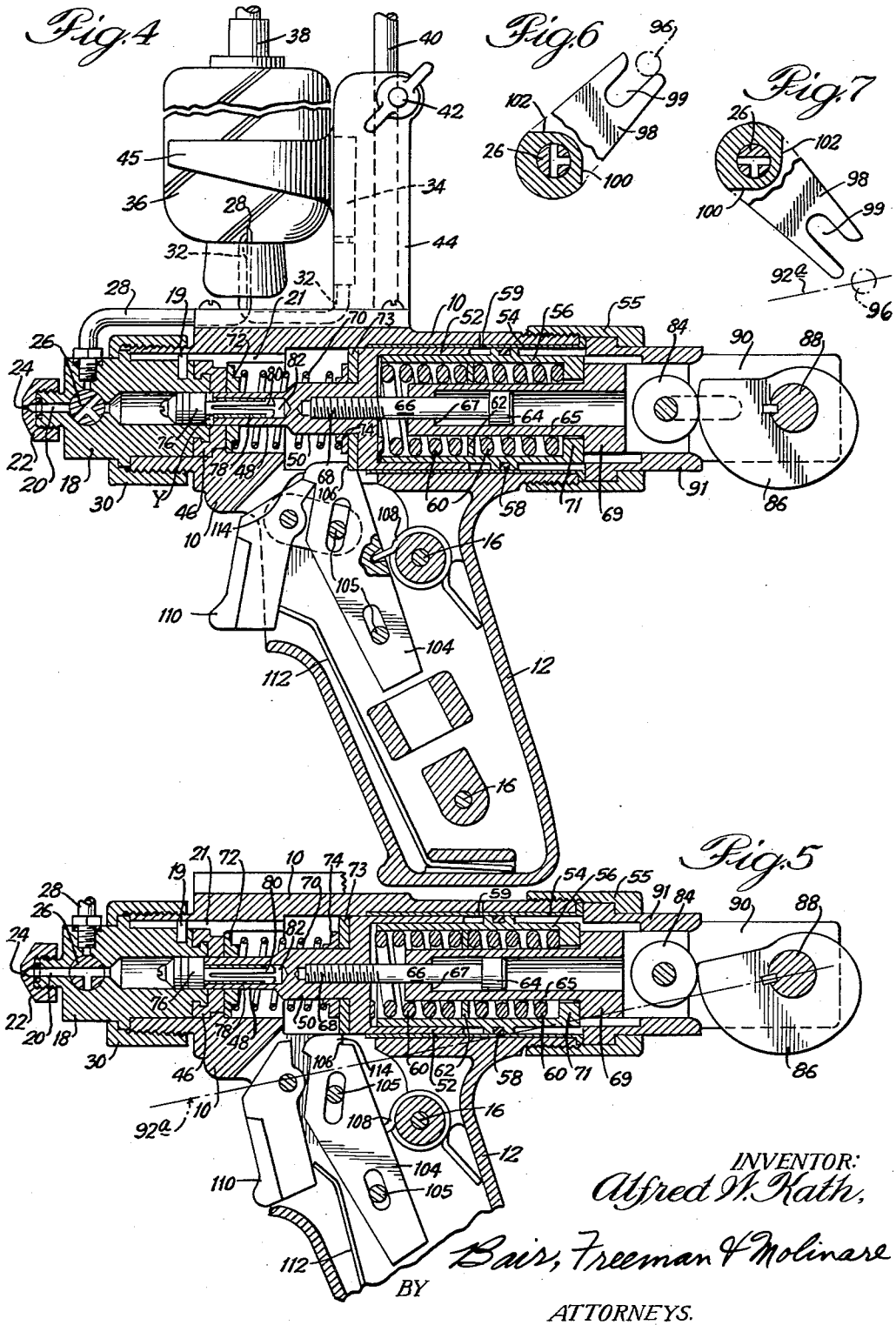

Fig. 6

Fig. 7

Fig. 5

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MULTIDOSE JET INJECTOR

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10 Claims. (Cl. 128—173)

This invention relates to a hand operated hypodermic injector capable of administering one injection after another. In some respects it is similar to the multidose injector of Venditty and Hammer Patent No. 2,928,390 and in other respects similar to the multidose injector of the Venditty and Kath application Serial No. 49,662 filed August 15, 1960 but does not require electric and/or hydraulic power, being instead hand operated as by a crank.

One object of the invention is to provide an injector which will discharge medicament from a tiny orifice in a minute stream or jet by means of springs which are compressed by a crank and which deliver an initial high pressure discharge because of impact which causes the jet stream to distend the skin and force the medicament to a predetermined depth beneath the surface thereof, followed by a lower pressure, steady, follow-through jet as the springs expand for completing transfer of the remaining medicament of the dose at the predetermined depth.

Another object is to provide an improved multiple dose unit which is simple in operation, of sturdy construction and which may quickly be activated by rotation of a crank, and the injection then administered by depression of a trigger whereupon a valve may be adjusted to a filling position and the crank further rotated to initial position for completing the injection cycle. The valve is automatically adjusted to discharge position by rotation of the crank near the completion of the activating operation.

A further object is to provide an assembly in which a precompressed spring is held in precompressed position, and cam and roller means operated by a crank further compresses the spring assembly while it is latched in a predetermined position whereupon release of the latch by depression of a trigger will permit the spring assembly to expand and administer the injection.

Still a further object is to provide a medicament plunger which has a lost motion connection with a spring-driven plunger so that the initial expansion of the spring assembly when the latch is released effects an impact blow against the medicament plunger after which the rest of the expansive force of the spring assembly is utilized to force the medicament plunger forward in its chamber for effecting the completion of the hypodermic injection. The initial high pressure produced by impact produces a very small puncture through the epidermis and the lower pressure, steady, follow-through jet expels the remaining liquid into the underlying tissue through the puncture.

An additional object is to provide against damage produced by shock when dry firing the injector comprising means to trap air ahead of the expanding spring assembly and relieve the air slowly through an air bleeder hole.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my multidose jet injector, whereby the objects above contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in detail on the accompanying drawings, wherein:

FIG. 1 is a side elevation of a hypodermic injector embodying my present invention showing the parts in an initial position.

FIG. 2 is a front elevation thereof.

FIG. 3 is an enlarged plan view partly in section on the line 3—3 of FIG. 1 showing internal details of construction and operation, the parts being in an initial or "at rest" position.

FIG. 4 is a vertical sectional view on the line 4—4 of FIG. 3 showing the spring assembly compressed and the medicament valve partially operated from the refill position of FIGS. 1, 2 and 3.

FIG. 5 is a similar view showing the crank rotated to a position for completing the movement of the valve to medicament discharge position, and a spring plunger released for starting the injection operation.

FIG. 6 is a sectional line on the line 6—6 of FIG. 3 showing details of the valve, and

FIG. 7 is a similar view showing the valve in the FIG. 5 position.

On the accompanying drawings the main body of my injector is shown at 10, being tubular in character and provided with a handle or grip 12. The body 10 and handle 12 are preferably formed integral to prevent any possibility of misalignment of parts as when made separately and connected together. The near side of the handle as shown in FIG. 1 however is open for assembly purposes and a cover plate 14 is, after assembly, secured thereto as by a pair of screws 16.

Referring to FIG. 4, at the left end of the body 10 is a medicament chamber 18 held in position by a retainer nut 30. A pin 19 and a keyway 21 prevent rotation of the medicament chamber 18 relative to the body 10. The medicament chamber has a discharge passageway 20. Cooperating therewith is a discharge nose 22 having a minute discharge orifice 24 from which the jet stream issues during the operation of the injector. A valve 26 is rotatable in the medicament chamber 18 and controls flow of medicament as between the chamber and the discharge passageway 20, and between the chamber and a medicament tube 28 adapted to receive medicament as from a bottle 36. A vent tube 32 extends from a filter 34 into the medicament bottle to replace the medicament flowing therefrom with filtered air.

A hold-down pad 38 is provided for the bottle 36 and supported by a U-shaped rod 40 and a lock screw 42. The rod is slidable in a bracket 44 mounted on the body 10 and may be locked in any desired position by means of the lock screw 42. Bottle-holding arms 45 extend from the bracket 44 to embrace the bottle 36.

The medicament chamber 18 has an extension 46 through which a spring actuated plunger 48 is slidable. The plunger is enlarged as at 50 and further enlarged into a spring cup 52. The spring cup is slidable in a sleeve 54 that lines the body 10 and is held in position therein by a retainer nut 55. A spring barrel 56 is slidable in the cup 52 and has an O-ring seal 58 relative to the sleeve 54. A bleeder hole 59 is provided through the wall of the sleeve 54 and the body 10 for a purpose which will hereinafter appear.

Within the spring barrel 56 is a spring assembly 60 which may be either a single spring, or two springs as illustrated with a spacer washer 62 between them. The spring assembly 60 is precompressed to a predetermined degree and held in that condition by a head 64 on a bolt 66 threaded into the enlargement 50 as at 68. A sleeve 65 slides inside the spring barrel 56 and has a shoulder 67 coacting with the head 64 when the parts are in the position shown in FIG. 3. The sleeve 65 has an enlargement 69 against an inturned flange 71 of the spring barrel 56 to confine the right hand end of the spring assembly whereas the left hand end is confined by the bottom of the spring cup 52.

A refill spring 70 is provided surrounding the spring-actuated plunger 48 and the enlargement 50, and bearing against washers 72 and 74 which in turn bear against

the extension 46 and a latch washer 73 positioned against the spring cup 52.

A medicament plunger 76 is slidable in the medicament chamber 18 and has a shank 80 entering a bore 82 of the plunger 48. A sleeve 78 is secured in this bore and as shown by comparing FIGS. 4 and 5 the shank 80 has some lost motion within the bore 82, being provided with an enlarged head to coact with the sleeve 78 to prevent the shank from being pulled out of the plunger for a purpose which will hereinafter appear. The shank 80 is split in the form of a cross and is of such size that the enlarged head at the right hand end thereof frictionally engages in the bore 82.

The sleeve 65 carries a roller 84 with which a cam 86 is adapted to coact. The cam is mounted on a crank shaft 88 which is rotatable in a pair of arms 90 extending from a sleeve 91 held in position at the right hand end of the body 10 by a retainer nut 55. The sleeve 91 and the arms 90 are thus stationary relative to the body and the handle 12. A crank 92 is secured to the crank shaft 88 and terminates in a crank handle 94 and a valve-actuating pin 96. The pin 96 is adapted to coact with a valve lever 98 for oscillating the valve 26, and the valve lever has a pair of stop shoulders 100 and 102 as shown in FIGS. 6 and 7.

A latch plate 104 is slidably mounted on a pair of pins 105 and biased in an upward direction by a spring 108. The latch plate 104 has a latch shoulder 106 adapted to coact with the latch washer 73 as shown in FIG. 4. Both the latch plate washer 73 and the latch plate 104 are hardened to minimize wear.

A trigger 110 is pivotally mounted in the handle 12 and biased to the position shown in FIG. 4 by a spring 112. The trigger normally coacts with a shoulder 114 on the latch plate 104 also as shown in FIG. 4.

Practical Operation

In the operation of my multidose jet injector, starting with the parts in the positions shown in FIGS. 1, 2, 3 and 6, and assuming the medicament chamber 18 filled with medicament ahead of the plunger 76, the handle 12 is held in the right hand while the left hand rotates the crank 92 counterclockwise in FIG. 1 a little more than approximately 195° whereupon the crank will assume the dot and dash line position shown in FIG. 3 with the pin 96 at the position shown in FIG. 6. Several more degrees of rotation will bring the parts to the position shown in FIG. 4, the cam 86 having moved the roller 84 from the position of FIG. 1 to the position of FIG. 4 and in so doing, imparting further compression to the spring assembly 60 as can be seen by comparing FIG. 4 with FIG. 3. The valve lever 98 in FIG. 4 has been moved about half way from the position shown in FIG. 6 to the position shown in FIG. 7 by reason of the pin 96 engaging in a slot 99 thereof, and the spring assembly is substantially fully compressed. Several more degrees of rotation brings the parts to the position of FIG. 5 with the crank 92 assuming the position indicated by the dot-and-dash line 92^a in FIG. 5. By this time the pin 96 has moved the valve lever 98 to the position shown in FIG. 7 and the valve 26 to the position shown in FIGS. 5 and 7. The spring assembly is still latched in compressed position however as shown in FIG. 4 and ready for the injection.

The nose 22 is now placed in contact with the injection site and the trigger 110 pulled for removing its upper end from under the latch shoulder 114 so that the latch plate 104 will be propelled forwardly and downwardly by the latch washer 73 against the latch shoulder 106 in cooperation with the pins 105 in the slots in the latch plate as shown in FIG. 5. The slots are set at such angles as to permit the pressure of the spring assembly 60 against the latch washer 73 to move the latch plate downwardly against the bias of the spring 108. Thereupon the spring assembly will move the spring cup 52 and the plunger 48 forwardly until the plunger engages the medicament plunger 76, taking up the impact space Y shown in FIG. 4 (and by arrowheads in FIG. 3), so that the initial impact will build up a sudden high pressure surge-like discharge from the orifice 24 sufficient to puncture the epidermis and cause the jet to penetrate to some depth therebeneath. The pressure then drops off when the impact has been spent and thereafter a steady follow-through pressure caused by the expansion of the spring assembly 60 forces the medicament plunger 76 forwardly in the medicament chamber 18 to cause a lower pressure follow-through jet to discharge the medicament through the puncture in the epidermis and the underlying cells and be dispersed at the level to which the impact-produced jet penetrated.

FIG. 5 shows the impact space Y taken up, and when the medicament plunger 76 reaches the forward end of the chamber 18 the spring assembly 60 will be expanded substantially as shown in FIG. 3 but the parts will be in a forward position and ready for retraction to the initial position of FIG. 3. Retraction is accomplished by swinging the valve lever 98 from the position of FIGS. 5 and 7 to the position of FIG. 6 whereupon the handle 92 may be moved from the position 92^a shown in FIG. 5 to the initial position shown in FIGS. 1 and 2, and the solid line position in FIG. 3. This leaves the roller 84 free to be moved from the position of FIG. 5 to the position of FIGS. 1 and 3 in response to expansion of the refill spring 70 which will first take up the play between the enlarged head of the shank 80 and the right hand end of the sleeve 78 and then retract the medicament plunger 76 in the chamber 18 for drawing in another charge of medicament from the bottle 36 through the valve 26. Thereupon the parts are in the initial position and the latch plate 104 is moved upwardly by the spring 108 to relatch its shoulder 106 ahead of the latch washer 73, whereupon the above described cycle may be repeated for another injection.

In FIG. 1, I illustrate how a somewhat smaller bottle 36^a may be used in place of the bottle 36 for only a few injections whereas the bottle 36 would give many injections as for mass injections of soldiers and the like. When my instrument is operated, shock to the parts is eliminated by reason of the resistance to expansion of the springs 60 offered by the medicament in the chamber 18 which can discharge only through the orifice 24. This regulates the speed of travel of the parts as the springs expand, the total time of discharge being approximately one second. Protection against shock if the chamber 18 is empty is provided by the O-ring seal 58 in the sleeve 54 and the bleeder hole 59. The seal acts as a piston and air that is compressed within the spring barrel 56 is forced out of the spring cup 52 and flows to atmosphere through the bleeder hole. The size of the hole is such as to permit operation in a shorter period of time (for example three-fourths of a second) than that required for an injection so as not to slow down the injecting stroke.

From the foregoing description, it is obvious that I have provided a multidose jet injector that can be operated by hand and does not require electric and/or hydraulic power as in the previous patent and application above referred to.

Some changes may be made in the construction and arrangement of the parts of the multidose jet injector herein disclosed without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents which may reasonably be included within their scope.

I claim as my invention:

1. A multidose hypodermic injector comprising a body having therein a medicament chamber terminating in a nose containing an injection orifice, a medicament plunger disposed within said chamber, a spring cup sup-

porting said medicament plunger, a spring barrel slidable relative thereto, a spring in said cup and barrel for advancing said plunger to eject medicament through said orifice, a latch for said spring cup carried by said body, compressing means for said spring to preload it for injection comprising a cam shaft rotatably carried by said body, a cam thereon for moving said spring barrel relative to said body and a lever for rotating said cam shaft and said cam, a valve which in filling position connects said medicament chamber to a source of medicament and in discharge position connects said medicament chamber to said nose and injection orifice, said cam lever engaging said valve to move it from filling position to discharge position upon said cam lever completing its spring compressing movement, and means for releasing said latch.

2. A multidose hypodermic injector comprising a body having therein a medicament chamber terminating in a nose provided with an injection orifice, a medicament plunger movable within said chamber, preloaded spring means for advancing said plunger to eject medicament through said orifice comprising a cup and a barrel telescopically associated and containing said spring means, a latch for said barrel when said preloaded spring means is fully compressed, compressing means for said spring means comprising a cam shaft rotatably carried by said body, a cam thereon for moving said spring barrel relative to said body and a crank for rotating said cam shaft and said cam, a valve for connecting said medicament chamber to a source of medicament or to said nose and injection orifice, said crank engaging said valve to move it from its source of medicament position to its nose and injection orifice positon as said crank approaches its spring fully compressed position, and a trigger to retain said latch in latched position, said trigger being movable to a position releasing said latch.

3. A multidose hypodermic injector comprising a body having therein a medicament chamber terminating in a nose provided with an injection orifice, a medicament plunger movable within said chamber, a spring cup supporting said plunger, a spring barrel slidable in said spring cup, preloaded spring means within said spring cup and said spring barrel for advancing said plunger to eject medicament through said orifice, a latch for said preloaded spring means, said latch being carried by said body and coacting with said spring cup, comprising means for said spring means to preload it for injection comprising a cam shaft rotatably supported by said body, a cam thereon, a roller operatively connected to said spring barrel and engageable by the lobe of said cam for moving said spring barrel in the spring compressing direction and a crank for rotating said cam shaft and said cam, a valve for connecting said medicament chamber to a source of medicament or to said nose and injection orifice, and a trigger for releasing said latch.

4. The injector of claim 3 wherein a lost motion connection is provided between said medicament plunger and said spring cup to provide for an initial impact pressure as between said spring means and said medicament plunger.

5. The injector of claim 2 wherein a lost motion connection is provided between said medicament plunger and said spring cup.

6. An injector instrument comprising a body defining at one end a medicament chamber having a discharge orifice, a plunger carried within said body and entering said medicament chamber, a spring assembly for moving said plunger and thereby expelling medicament through said orifice, said spring assembly comprising a pair of cup-like sleeves telescopically related to each other and slidable in said body, a compression spring contained in said sleeves and connecting means between the cup bottoms to retain said spring preloaded, a latch for said spring assembly and carried by said body to lock said assembly in a position slightly spaced from said plunger when the latter is in retracted position, a roller carried by said spring assembly, a cam shaft rotatably carried by said body and having a cam coacting with said roller, and a lever for rotating said cam shaft and cam for compressing said spring assembly whereby upon release of said latch said spring assembly expands to impart an initial advancing force to said plunger and thereafter continues to apply advancing force for ejecting the medicament.

7. In an injector instrument, a body defining at one end a medicament chamber having a discharge orifice, a plunger movable within said body, and entering said medicament chamber, a roller movable toward said plunger, a spring assembly for moving said plunger and thereby expelling medicament through said orifice, said spring assembly comprising a pair of cup-like sleeves telescopically related to each other and slidable in said body, a compression spring contained in said sleeves and connecting means between the cup bottoms to retain said spring preloaded, said spring assembly being interposed between said plunger and said roller, a latch mounted at a predetermined point on said body adjacent said spring assembly to lock the same in a position with said spring assembly spaced from said plunger when the latter is in retracted position, and a cam carried by said body for engaging said roller and moving it toward said plunger to compress said spring assembly whereby upon release of said latch said spring assembly expands to impart an initial impact force to said plunger and thereafter a continuing advancing force thereto for ejecting the medicament.

8. The instrument of claim 7 which includes a retractor spring between said spring assembly and said body.

9. The instrument of claim 3 which includes a retractor spring operable to move said spring cup to latched position upon the retrograde portion of said cam coacting with said roller.

10. The instrument of claim 7 having a valve and a supply of medicament, said valve in one position supplying medicament to said chamber and in another position allowing medicament to be discharged therefrom through said orifice, said cam having means engaging said valve to change its position from fill to discharge as said cam completes the operation of compressing said spring assembly and being operative to hold said spring assembly compressed until release by said latch.

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