June 8, 1954

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2,680,439

HIGH-PRESSURE INJECTION DEVICE

Filed Sept. 8, 1948

2 Sheets-Sheet 1

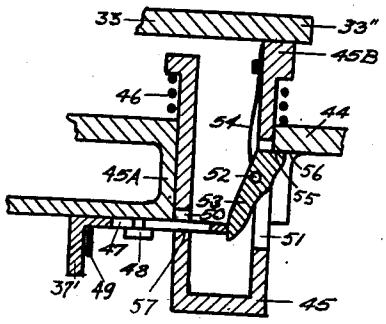

FIG-3

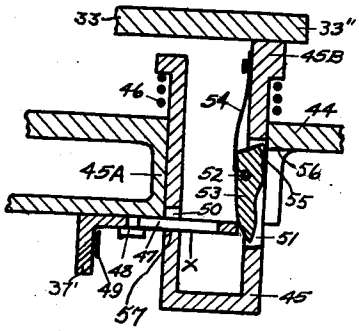

FIG-4

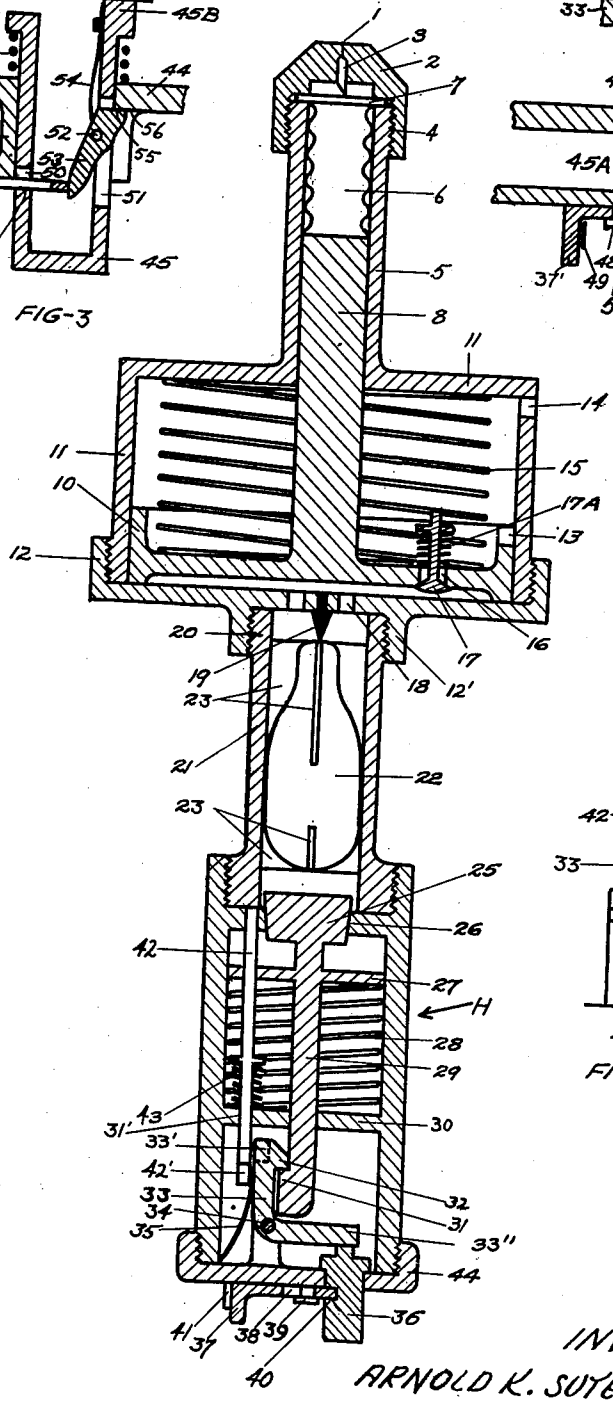

FIG-1

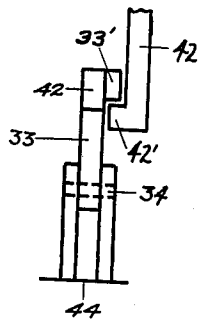

FIG-2

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2 Sheets-Sheet 2

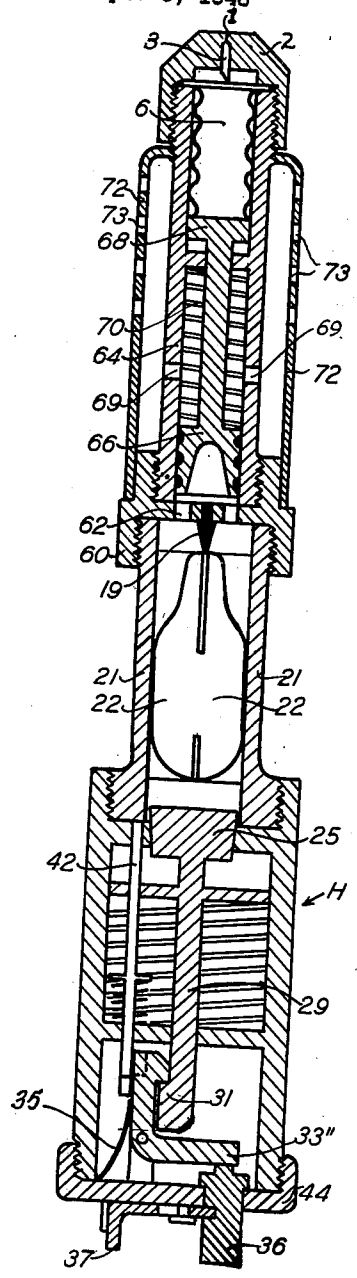

FIG. 5

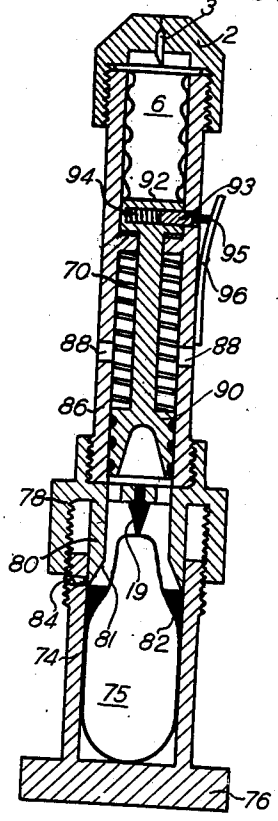

FIG. 6

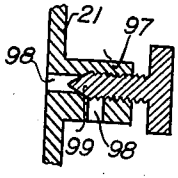

FIG. 8

FIG. 7

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HIGH-PRESSURE INJECTION DEVICE

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21 Claims. (Cl. 128—173)

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This invention is a high pressure injection device for injecting a medicament, serum, vaccine, hormone, drug, anaesthetic or the like into animate or inanimate bodies.

The principal object of the invention is to provide an improved device of this character where the substance injected is subjected to very high pressure and is ejected through a very fine nozzle so that the substance being injected enters the body without forming a puncture, of the type formed by a hypodermic needle.

Another important object of the invention is to provide an apparatus wherein gas is released at very high pressure from a suitable cartridge, this gas operating a piston for generating the requisite pressure, which is used to eject the medicament or the like through a fine orifice. The high pressure exerted ejects the medicament in a very fine stream at very high velocity, the kinetic energy of which causes the stream to enter the body, the stream forming a microscopic puncture which is scarcely visible.

In the preferred embodiment of the invention, two interconnecting pistons are provided of different size. Gas pressure released from a suitable cartridge is applied to a large piston, which piston in turn operates a smaller piston of smaller area, thereby increasing the pressure in the ratio as expressed by the area of the larger piston with respect to the area of the smaller piston.

The cartridge used may conveniently be charged with carbon dioxide or air or other gases under high pressure and this cartridge is loaded into the device, mechanism being provided for puncturing the cartridge and releasing the gas for actuating the pistons, as above described.

The puncturing of the cartridge is preferably accomplished by a hammer which is released by a trigger button, safety latch means being provided for preventing accidental and inadvertent operation of the button, all of which will be described in more detail below.

In order to reload the device, it is partly disassembled and safety means are provided for preventing accidental operation until the device has been completely reassembled.

The medicament to be injected is conveniently loaded into the device in a capsule which may be hermetically sealed for preventing any contamination, this capsule being ruptured by the smaller piston, which rupture may be aided by a hollow spike, as will be described, for injecting the medicament through the fine orifice.

In a modified form of the invention, only one piston is used, the gas pressure acting directly on this one piston to crush the capsule and eject the medicament.

In another modification, the gas cartridge is punctured by rotating the breech containing it, to force the cartridge against a rupturing spike,

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the released gas acting on that form of the invention using either one or two pistons.

Further advantages of structure and operation will be described in connection with the accompanying drawings, wherein:

Fig. 1 is a longitudinal cross section through the pressure injection device of the present invention;

Fig. 2 is a side elevation looking toward the right of elements shown at the bottom of Fig 1;

Fig. 3 is a vertical cross section of a modification of a safety latch;

Fig. 4 is a view similar to Fig. 3 showing the parts in another position;

Fig. 5 is a longitudinal sectional view of a modification using one cylinder.

Fig. 6 is a longitudinal sectional view of another modification, using one cylinder and a modified means for puncturing the cartridge;

Fig. 7 shows side and top views of the rupturing spike; and

Fig. 8 is a sectional view of an escape valve.

Referring now to these drawings, the invention comprises an injection nozzle 2 provided with a very fine orifice 1 for the injection at high velocity of any desired fluid or medicament into the human body. Hollow spike or needle 3, conveniently formed from the end of a hypodermic needle, provides a passage for the fluid to the orifice 1.

The nozzle 2 is threaded at 4 to the end of a small cylinder 5. The upper end of cylinder 5 is adapted to contain capsule 6 for containing the medicament. This capsule is conveniently provided with an end flange 7, which flange holds the capsule in position, as shown in Fig. 1.

Cylinder 5 is provided with a small, high pressure piston 8 which is interconnected with and conveniently integral with a larger piston 10 working in a larger cylinder 11. Cylinder 11 is provided with a head or cap 12.

Piston 10 and cylinder wall 11 are provided with apertures 13 and 14 respectively, adapted to come into registry to form an exhaust port, as will be described.

The large piston 10 is spring pressed downwardly by the spring 15. The head of piston 10 is provided with a valve opening 16 controlled by a downwardly opening valve 17, urged upwardly to the closed position by a spring 17A. The cap 12 of the large cylinder is provided with inlet apertures 18 adjacent a rupturing spike 19.

Threaded to the underside of cap 12, in an internally threaded nipple 12', is a breech member 21, the upper end of which is threaded as at 20 to engage with nipple 12'. Breech member 21 is adapted to contain a gas emitting or gas releasing cartridge 22, the gas being released when it is punctured by the spike 19. Cartridge

22 is provided with guide fins 23, primarily for convenience in unloading the spent capsule.

The cartridge 22 is adapted to contain gas, such as air or carbon dioxide for example, under high pressure.

When the cartridge 22 is ruptured or fired, high pressure gas is released and travels through apertures 18, forcing the large piston upwardly against spring 15, thereby applying a greatly multiplied pressure against the smaller piston 8. This crushes the capsule 6, the spike 3 puncturing the upper end of the capsule so that the contents thereof are ejected at a very high pressure and velocity through the fine aperture 1.

When the piston reaches the upper end of its stroke, valve 17 makes contact with cylinder head 11, opens, and exhaust apertures 13 and 14 come into registry, and the gas is released through apertures 16, 13 and 14 and spring 15 returns the pistons to their original positions.

Hammer mechanism, trigger release mechanism for the hammer and safety latches for the trigger and hammer mechanism will be now described.

Detachably threaded onto the lower end of breech member 21 is a housing indicated generally at H. This housing is provided in its upper portion with an inwardly extending flange 26, apertured to provide a seat for the hammer 25. The stem 29 of the hammer is provided with a flange 27 providing an upper bearing for a spring 28 for urging the hammer upwardly.

The lower portion of the stem 29 of the hammer passes through a guide flange 30 carried by the housing, stem 29 being squared where it passes through the flange to prevent its twisting.

The lower end of the hammer is provided with a latching shoulder 31 adapted to be engaged and held by the nose 32 of the sear 33, which sear is pivoted at 34. The sear is normally urged to latching position with the hammer by the flat spring 35. The sear is released from the trigger by a push button 36.

In order to prevent accidental operation of the push button, a safety latch 37 is provided which is slotted at 38, the slot engaging a guide pin or rivet 39. The right hand end of the latch 37 is adapted to engage in a notch 40 in the push button and is normally held in latching position by a flat spring 41. Positive movement of the latch to the left against spring 41 is necessary before the push button 36 can be operated. When so operated, the hammer is released, spring 28 forcing the hammer 25 upward, in turn forcing the cartridge against spike 19, thereby releasing high pressure gas to operate the pistons, as already described.

When the high pressure gas is released the recoil or reaction causes the cartridge to move downward in the breech member 21 against hammer 25 causing this and parts 27 and 29 to move downward, compressing spring 28. Nose 32 of sear 33 drops over latching shoulder 31 because of the tension of spring 35. The trigger mechanism is now cocked for another injection. As tapered hammer 25 moves downward it seats on tapered seat 26, preventing escape of gas.

After the gas has been released from the cartridge 22, housing H is unscrewed, the spent cartridge removed and a fresh one inserted in the breech 21. The fins 23 provide convenient gripping points for pliers for this purpose.

A further safety latch is provided for preventing the operation of the hammer before the housing H has been completely reassembled with the breech 21. This safety latch comprises a vertically slidable rod 42 which passes through upper and lower flanges 27 and 30, being squared where it passes through one or both flanges, in order to prevent its twisting. This rod is urged upwardly by spring 43. The lower end of the rod 42 is provided with a lateral off-set 42' which is adapted to move in and out of the path of a lug 33' on sear 33. When the parts are disassembled, latch rod 42 is moved upwardly by spring 43 so that lugs 42' and 33' are in engagement so that sear 33 cannot be operated to release the hammer. This would be the position when the parts are disassembled. When the parts are completely assembled, rod 42 is pushed downwardly, the described lugs are disengaged and as far as the safety rod is concerned, the sear 33 may be operated to release the hammer, subject further of course to manual release of the latch 37.

Referring now to the modified safety latch shown in Figs. 3 and 4, trigger button 45 movable in guide 45A is provided with an extension 45B adapted to contact the lower arm 33'' of sear 33, being urged toward the sear by a light spring 46. Latch member 37' has a slot 47 in which is engaged a guide pin 48; latch 37' is normally urged to the left by a flat spring 49. Latch 37' engages in a slot 50 in button 45.

One side of button 45 is slotted as at 51 and pivoted on pin 52. In this slot is a catch 53, this catch being engaged by a spring 54 to move it clockwise, to engage an edge of cap 44; when moved counterclockwise, catch 53 is disengaged, as in Fig. 4.

This latch mechanism operates as follows: The recoil from discharge forces the hammer and sear arm 33'' downwardly, spring 54 turns catch 53 to engage 44, as in Fig. 3. This prevents further discharge, even if pressure is maintained on button 45. To release latch mechanism for the next discharge the latch 37' is moved to the right through slot 50 in button 45 (Fig. 3) against catch 53. This causes catch 53 to rotate about pin 52 and at the same time to slightly compress spring 46 and make button 45 move down slightly. As edge 55 of catch 53 clears lower edge 56 of 44, the slight compression of spring 46 is relieved and button 45 moves back to the previous position. The edge 55 of catch 53 is now above the lower edge 56 of cap 44, as indicated in Fig. 4 and cannot rotate back under the spring pressure of 54 to the position indicated in Fig. 3. To complete discharge the latch 37' is moved all the way to the left so that it is completely disengaged both from slot 50 and from shoulder 57 on button 45. The button can now be pushed in to effect the discharge.

The purpose of this device is to insure a positive engagement of catch 53 upon recoil of the gas cartridge from the previous discharge and to prevent a repeated discharge of the hammer mechanism by failure of the operator to remove his finger from the catch 37' and button 45.

In the modification shown in Fig. 5, only a single cylinder is used, instead of the two cylinders of Fig. 1. Cap member 60, threaded onto breech 21, carries a rupturing spike 19 and gas escape holes 62. Cap member 60 is threaded to receive a cylinder 64, containing a piston 66. The upper end 68 of the piston bears against capsule 6. In operation, when the cartridge is ruptured by being driven against spike 19, the gas drives piston 66 up to rupture the capsule 6 and eject the medicament in a fine high pressure stream at 1. By this time, the piston has cleared

exhaust ports 69 and is returned to its original position by spring 70. A cover 72, provided with gas exit apertures 73, acts as a muffler of the sound of the gas.

In the modification of Fig. 6, a different cartridge rupturing device is shown, not using the trigger released hammer of Figs. 1 and 5. In this form breech member 74 for the gas cartridge 75, having a knurled lower end 76, is threaded onto a cap member 78, having an internal sleeve 80 having its lower edge beveled and sharpened at 81 to bite into a gasket 82. Just above the gasket is a gas escape hole 84.

Member 78 also has threaded into its upper part a cylinder 86, having gas exit holes 88 and a piston 90, bearing at its upper end against capsule 6. The end 92 of the piston is provided with a bolt or latch 93, pushed outwardly by spring 94, against stud 95, carried on leaf spring 96. This form operates as follows: Breech 74 is rotated by turning its knurled lower end 76 to raise the breech to cause the sharp edge 81 to bite into the gasket and prevent escape of gas through the hole 84 and through the screw threads. Then the spike 19 ruptures the cartridge and gas pressure is applied to the piston. At this stage, however, the piston is locked by bolt 93. Pressure on spring 96 pushes in the bolt to release the piston, whereupon it moves up to crush the capsule and eject the medicament. The piston is returned by spring 70 and gas escapes through holes 88. When the breech is unscrewed, the hole 84 is uncovered and gas escapes therethrough.

A muffler sleeve like 72, Fig. 5, could be used with Fig. 6.

Referring to Fig. 7, the spike 19 is corrugated or grooved to facilitate the escape of gas through the grooves.

While the several forms of the invention have been described in some detail, it should be understood that the invention is not limited to the precise details shown, but may be carried out in other ways within the scope of the following claims.

I claim as my invention:

1. A high pressure injection device comprising a cylinder, an injection nozzle, having a fine orifice, cooperating with the cylinder, a piston in said cylinder for forcing fluid out said nozzle, a gas cartridge carried by the injection device, manually controlled means for releasing gas from said cartridge into said cylinder for operating said piston, and a safety latch for preventing accidental operation of said manually controlled gas releasing means.

2. A high pressure injection device comprising a cylinder, a nozzle having a fine orifice cooperating with the cylinder, a piston in said cylinder for forcing fluid out said nozzle, a breech member connected with said cylinder, for receiving a gas cartridge, a trigger housing connected with said breech member, and manually operated trigger means in said housing for effecting the release of gas from said gas cartridge.

3. A high pressure injection device comprising a cylinder, a nozzle having a fine orifice cooperating with the cylinder, a piston in said cylinder for forcing fluid out said nozzle, a breech member connected with said cylinder, for receiving a gas cartridge, a trigger housing connected with said breech member, manually operated trigger means in said housing for effecting the release of gas from said gas cartridge, and safety latch means for preventing accidental operating thereof.

4. A high pressure injection device comprising a cylinder, a nozzle having a fine orifice cooperating with the cylinder, a piston in said cylinder for forcing fluid out said nozzle, a breech member connected with said cylinder, for receiving a gas cartridge, a trigger housing detachably connected to the breech member for reloading the breech, trigger mechanism in said housing, and safety means cooperating with said trigger mechanism for preventing accidental operation thereof.

5. A high pressure injection device, comprising a cylinder, a fine injection nozzle cooperating with said cylinder, a piston in said cylinder for forcing fluid out of said nozzle, a breech member, operatively connected with said cylinder, for receiving a gas cartridge, a hammer adapted to strike the cartridge for effecting the release of gas therefrom, and trigger means for releasing said hammer.

6. A high pressure injection device, comprising a cylinder, a fine injection nozzle cooperating with said cylinder, a piston in said cylinder for forcing fluid out of said nozzle, a breech member, operatively connected with said cylinder, for receiving a gas cartridge, a hammer adapted to strike the cartridge for effecting the release of gas therefrom, trigger means for releasing the hammer, and safety latch means for preventing accidental operation of said trigger means.

7. A high pressure injection device, comprising a cylinder, a fine injection nozzle cooperating with said cylinder, a piston in said cylinder for forcing fluid out of said nozzle, a breech member, operatively connected with said cylinder, for receiving a gas cartridge, a hammer adapted to strike the cartridge for effecting the release of gas therefrom, and trigger means for releasing said hammer, and engageable with the hammer on its recoil to hold it in cocked position for the next operation.

8. A high pressure injection device, comprising a cylinder, a fine injection nozzle cooperating with said cylinder, a piston in said cylinder for forcing fluid out of said nozzle, a breech member, operatively connected with said cylinder, for receiving a gas cartridge, a hammer adapted to strike the cartridge for effecting the release of gas therefrom, trigger means for releasing said hammer, and engageable with the hammer on its recoil to hold it in cocked position for the next operation, and safety latch means for preventing accidental operation of said trigger.

9. A high pressure injection device, comprising a cylinder, a fine injection nozzle cooperating with said cylinder, a piston in said cylinder for forcing fluid out of said nozzle, a breech member operatively connected with said cylinder, adapted to contain a gas cartridge, a trigger housing, detachably connected with said breech member for cartridge reloading, trigger mechanism in said housing, and a safety latch cooperating with said trigger mechanism for preventing accidental operation thereof until the trigger housing and breech member have been completely reassembled, following a reloading operation.

10. A high pressure injection device, comprising a cylinder, an injection nozzle having a fine orifice cooperating with said cylinder, a piston in said cylinder for forcing fluid at high pressure out of said nozzle, a sealed gas cartridge carried by said injection device and containing gas under high pressure, a spike mounted adjacent said cartridge, means for moving the gas cartridge and spike into rupturing engagement, the side of said cylinder

being provided with a lateral exhaust port normally sealed against gas escape by said piston, said exhaust port being positioned so as to be cleared by said piston after it has completed its fluid expelling stroke, for thereby providing a lateral passage through the side wall of said cylinder for the escape of residual high pressure gas.

11. A high pressure injection device, comprising a cylinder, an injection nozzle having a fine orifice cooperating with said cylinder, a piston in said cylinder for forcing fluid at high pressure out of said nozzle, a sealed gas cartridge carried by said injection device and containing gas under high pressure, a spike mounted adjacent said cartridge, means for moving the gas cartridge and spike into rupturing engagement, the side of said cylinder being provided with a lateral exhaust port normally sealed against gas escape by said piston, said exhaust port being positioned so as to be cleared by said piston after it has completed its fluid expelling stroke, for thereby providing a lateral passage through the side wall of said cylinder for the escape of residual high pressure gas, and a cover surrounding and spaced from said cylinder and provided with gas escape apertures, for venting gas released from said exhaust port.

12. A high pressure injection device, comprising a cylinder, an injection nozzle having a fine orifice cooperating with said cylinder, a piston in said cylinder for forcing fluid at high pressure out of said nozzle, a sealed gas cartridge carried by said injection device and containing gas under high pressure, a spike mounted adjacent said cartridge, means for moving the gas cartridge into rupturing contact with said spike, the side of said cylinder being provided with a lateral exhaust port normally sealed against gas escape by said piston, said exhaust port being positioned so as to be cleared by said piston after it has completed its fluid expelling stroke, for thereby providing a lateral passage through the side wall of said cylinder for the escape of residual high pressure gas, and a spring, operatively connected with said piston, and adapted to be compressed on the power stroke of the piston, for restoring the piston to its original position after the release of the gas pressure through said lateral exhaust port.

13. A high pressure injection device, comprising a cylinder, an injection nozzle having a fine orifice cooperating with said cylinder, a piston in said cylinder for forcing fluid at high pressure out of said nozzle, a sealed gas cartridge carried by said injection device and containing gas under high pressure, a spike mounted adjacent said cartridge, and a spring actuated hammer for effecting rupturing contact of said cartridge and spike, the side of said cylinder being provided with a lateral exhaust port normally sealed against gas escape by said piston, said exhaust port being positioned so as to be cleared by said piston after it has completed its fluid expelling stroke, for thereby providing a lateral passage through the side wall of said cylinder for the escape of residual high pressure gas.

14. A high pressure injection device, comprising a cylinder, an injection nozzle having a fine orifice cooperating with said cylinder, a piston in said cylinder for forcing fluid at high pressure out of said nozzle, a sealed gas cartridge carried by said injection device and containing gas under high pressure, a spike mounted adjacent said cartridge, a spring actuated hammer for effecting rupturing contact of said cartridge and spike, the side of said cylinder being provided with a lateral exhaust port normally sealed against gas escape by said piston, said exhaust port being positioned so as to be cleared by said piston after it has completed its fluid expelling stroke, for thereby providing a lateral passage through the side wall of said cylinder for the escape of residual high pressure gas, and a manually operated trigger for releasing said hammer.

15. The combination as set forth in claim 14, further including a safety latch for securing said trigger against accidental release.

16. A high pressure injection device, comprising a cylinder, an injection nozzle having a fine orifice connected with said cylinder, a piston in said cylinder; a breech member detachably connected at one end with said cylinder and adapted to contain a sealed gas cartridge; a housing detachably connected with the other end of said breech member; a spike for rupturing said gas cartridge; and a spring operated hammer mounted in said housing for driving the gas cartridge and spike into engagement.

17. A high pressure injection device, comprising a cylinder, an injection nozzle having a fine orifice connected with said cylinder, a piston in said cylinder; a breech member detachably connected at one end with said cylinder and adapted to contain a sealed gas cartridge; a housing detachably connected with the other end of said breech member; a spike for rupturing said gas cartridge; a spring operated hammer mounted in said housing for driving the gas cartridge and spike into engagement, and a manually operated trigger for releasing said hammer.

18. The combination as set forth in claim 16, further including a second and smaller cylinder acting to connect said first cylinder with said injection nozzle, and a second and smaller piston carried by said first piston and movable in said second and smaller cylinder.

19. The combination as set forth in claim 16, further including a second and smaller cylinder acting to connect said first cylinder with said injection nozzle, a second and smaller piston carried by said first piston and movable in said second and smaller cylinder, and a safety latch cooperating with said spring-operated hammer for preventing accidental release thereof.

20. The combination as set forth in claim 16, wherein said cylinder is provided with an exhaust port and wherein said piston is provided with a one-way valve adapted to be opened on completion of the piston stroke, for allowing gas to pass through the valve and out of said exhaust port.

21. The combination as set forth in claim 16, wherein said cylinder is provided with a lateral exhaust port and wherein said piston is provided with a one-way valve adapted to be opened on completion of the piston stroke, said piston further having an aperture adapted to register with said exhaust port on completion of the piston stroke.

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