

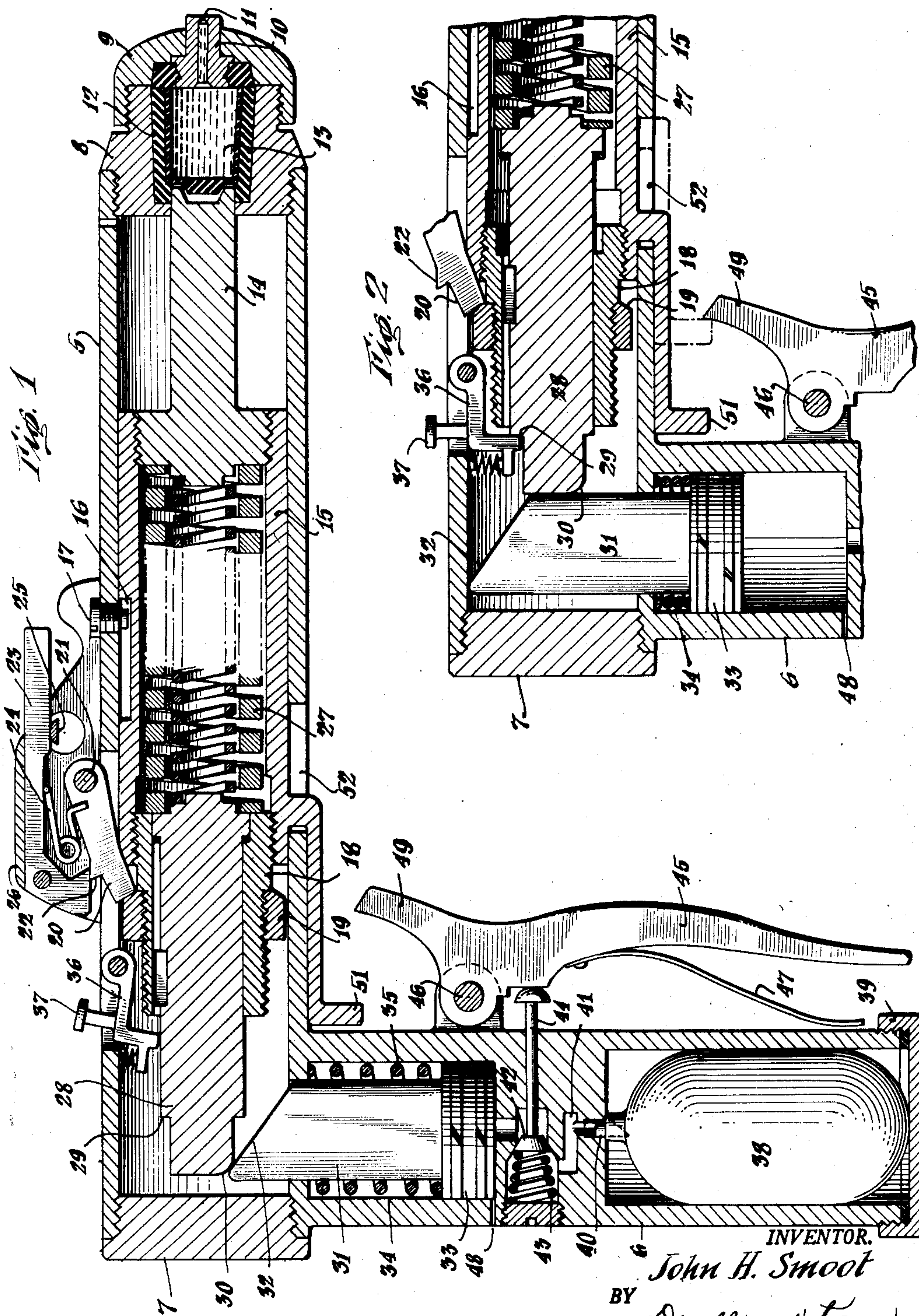
Sept. 29, 1953

J. H. SMOOT  
INJECTION DEVICE

2,653,602

Filed June 17, 1950

2 Sheets-Sheet 1



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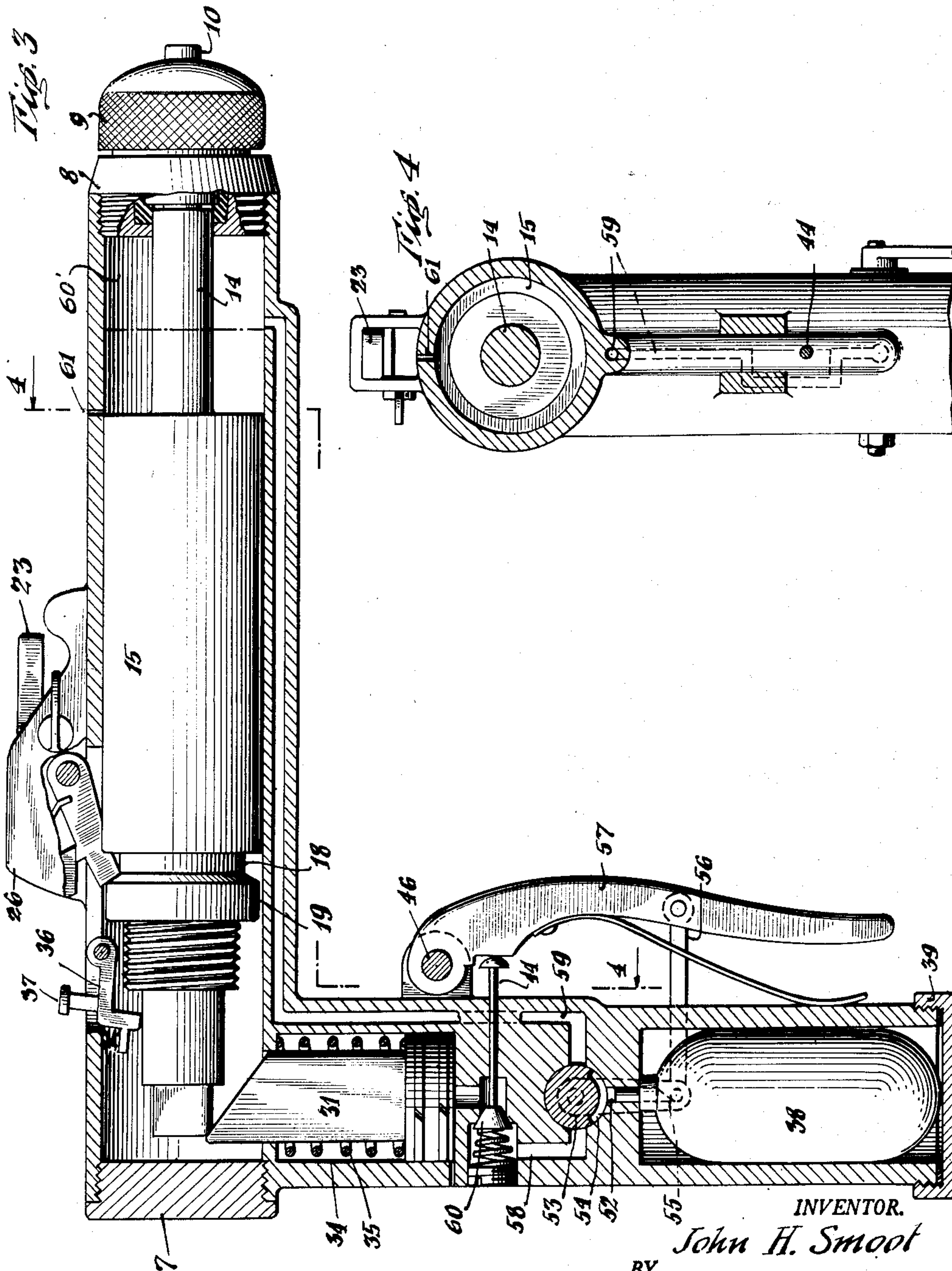
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## UNITED STATES PATENT OFFICE

2,653,602

## INJECTION DEVICE

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This invention relates to a structurally and functionally improved injection device of the hypodermic type and especially an apparatus by means of which medicament may be injected below the epidermis without the necessity of employing a skin-penetrating needle.

It has heretofore been proposed to provide various types of hypodermic injection devices operating under the velocity injection principle whereby a sufficiently fine stream of medicament is expelled under a force such that it will penetrate the skin and lodge in underlying tissues. In many of these devices it has been necessary to potentialize or "cock" the apparatus manually against the tension of an accumulator which might be in the form of a spring or of a body of fluid under pressure. Such potentializing has at best required the expenditure of considerable time and effort. In the case of a relatively weak person, the achievement of this result has been difficult if not impossible, especially if it was necessary to utilize the apparatus a number of times.

It is an object of the invention to furnish a structure as part of a hypodermic injection device and by means of which a power cocking of the apparatus will be feasible. Accordingly, the difficulties heretofore encountered will be overcome and the apparatus will be ready for re-use with the elapse of only a small interval of time after it has once been discharged.

A further object is that of providing a device of this type and in which a structure may be included such that the operator will be able, without substantial effort, to reset the device prior to the cocking operation. Therefore, it will not be necessary to even perform this operation manually.

An additional object is that of providing a hypodermic injection device by means of which the foregoing results are achieved, and which apparatus would embody relatively few parts each individually simple and rugged in construction; such parts being capable of ready assemblage and operating over long periods of time with freedom from all difficulties.

With these and other objects in mind reference is had to the attached sheets of drawings illustrating practical embodiments of the invention and in which:

Fig. 1 is a sectional side view of one form of apparatus and illustrating the parts in an initial position;

Fig. 2 is a fragmentary view of certain of the mechanism as shown in Fig. 1 but illustrating the parts in a different position;

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Fig. 3 is a view similar to Fig. 1 but showing an alternative form of apparatus; and

Fig. 4 is a transverse sectional view taken along the lines 4—4 and in the direction of the arrows as indicated in Fig. 3.

Referring primarily to Figs. 1 and 2 the numeral 5 indicates the body of the device from which a handle 6 may extend. The rear end of body 5 may be closed as at 7. Its forward end provides a medicament chamber and an ejection orifice therefor. Conveniently, as illustrated, this chamber may be embodied in a plug 8 connected to body 5 by screw threads and which plug in turn supports a cap 9. The latter is formed with an opening through which a nozzle 10 may project. The discharge end 11 of this nozzle may be defined by an orifice of, for example, .002" to .003". The plug 8 is conveniently lined with resilient or backing material 12. A medicament-containing ampule which may be in the form of a rubber sack 13 is disposed in contact with this lining and mounts nozzle 10. The capacity of the ampule should be such as to provide the desired body of medicament to be injected. Again, for example, it may be 1 cc.

Cooperating with the base of the ampule to effect injection of medicament through the orifice 11 is a plunger 14. This plunger is carried by the forward end of a tube 15 slidably mounted within body 5. Tube 15 may be formed with an axially extending groove 16 within which the end of a guiding pin 17 carried by body 5 may ride to prevent rotation of the tube. The rear end of the tube mounts a sleeve 18. This sleeve is conveniently formed with threads which adjustably support a retaining member in the form of a ring 19 having an angular forward face. Engaging this face when the parts are in the positions shown in Figs. 1 and 2 is a trigger mechanism. This may include a rearwardly extending pawl 20 pivoted as at 21 and provided with a projection 22. A trigger which is manually shiftable may be provided by a pivotally supported lever 23 having an arm cooperable with projection 22; a spring 24 being arranged to act against this lever and the pawl 20. A shaft 25 acting as a "safety" is disposed adjacent lever 23. This shaft, together with the parts just described, is mounted by an extension 26 which may form a part of body 5.

The ejection of medicament at the desired velocities requires the use of considerable force. Therefore, an accumulator structure is preferably employed. This structure in the embodiment illustrated in Fig. 1 has been shown as including a pair of springs 27. As is apparent ac-



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cumulators embodying other forms of power might be utilized in lieu of these springs. If springs are employed, then they may be pre-tensioned to around 200 pounds when disposed with the parts in the positions shown in Fig. 1. When tensioned to their fully compressed state, as in Fig. 2, they may react with a force of around 290 pounds. To thus compress them sleeve 18 may slidably mount a cocking plunger 28 which has its inner end operatively bearing against the assembly of the accumulator. When this plunger is shifted from the position shown in Fig. 1 to that illustrated in Fig. 2, then the accumulator will be fully potentialized.

The foregoing structure is illustrative of my present invention. It represents one form of injection apparatus as heretofore developed and employing an accumulator structure suitable for achieving the desired injections. With the exception of the combination involved and certain more or less detailed configurations of plunger 28 it forms no part of the present concept which is dedicated to the provision of power mechanisms under the control of the operator. As afore brought out, the present invention has to do with the potentializing or cocking of the apparatus as will be hereinafter described.

Thus, the end of plunger 28 which extends to the rear is conveniently formed with a detent in the form of a flange 29. The extreme rear portion of the plunger may terminate in a rounded surface such as 30. Cooperating with that surface is a rod or member 31 which has its forward face inclined as at 32 to provide a cam surface cooperable with surface 30. Rod 31 terminates in or is connected to a piston 33 which slidably moves in a cylinder 34 forming a part of the handle 6. A spring 35 normally maintains rod 31 and piston 33 in the position shown in Fig. 1. As will be apparent when these parts are projected against the action of spring 35 cam surface 32 will ride against surface 30 to thus project plunger 28 to the position shown in Fig. 2.

To maintain the plunger 28 in that position a retaining unit conveniently in the form of a spring pressed pivoted catch 36 is employed. The mounting of this catch may be upon body 5 and an actuator 37 conveniently extends from the catch beyond the surface of that body so that this part may be shifted. With plunger 28 projected to the position shown in Fig. 2 it will be apparent that the forward or inner end of that member bearing against the structures of the accumulator will have compressed or potentialized that accumulator to a maximum extent. In the embodiment illustrated this will partake of a full compression of the springs 27. Under these circumstances and as also shown in Fig. 2, the pawl 20 bears against the forward face of ring 19 to thus prevent a release of the parts.

Now with a view to providing a structure by means of which plunger 31 may be power projected, a flask 38 of compressed gas is employed. This may be in the form of a more or less conventional CO<sub>2</sub> cartridge. The outer end of handle 6 presents a chamber for the accommodation of this flask and mounts a tightening and closing cap 39. As the latter is brought to fully seated position it will force flask 38 inwardly against the pointed cannula 40 to thus perforate the seal of the flask. A passage 41 is also formed in the handle so that gas under pressure may be conducted to the cylinder 34 to thus effect a projection of piston 33 and the plunger 31 extending therefrom.

In order to control the flow of gas a valve 42

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may be interposed within passage 41. This valve, as shown, is normally maintained in seated position by the pressure of the gas as well as by means of spring 43. A stem 44 extends from the body of the valve to a point beyond the surface of handle 6. An actuating lever for this stem has been indicated at 45 and is pivotally supported as at 46. It may normally be urged to a position at which the valve is closed by spring 47 which will supplement the action of spring 43. A vent 48 of extremely reduced diameter may extend from the cylinder 34. As shown, and if desired, lever 45 may be continued beyond pivot 46 as at 49 and under certain conditions be cooperative with an extension 51 projecting from tube 15 through a slot 52 in body 5.

As will be understood an operator desiring to effect a cocking of the accumulator and with the parts positioned as shown in Fig. 1 may simply rock lever 45 around its pivot against the action of spring 47. Under these circumstances compressed air or gas will flow through passage 41 into cylinder 34. It will serve to project rod 31 and cause the surface 32 of the same to cooperate with surface 30 of plunger 28. This will cause the latter to be shifted from the position shown in Fig. 1 to that illustrated in Fig. 2. When so shifted the latch 36 will retain plunger 28 projected which—as afore brought out—will potentialize the accumulator. Upon the release of lever 45 valve 42 will reseal to interrupt further flow of the compressed gas or air. Under these circumstances spring 35 will return the rod and piston to the position shown in Fig. 1. This will be because the fluid and the pressure will escape through vent 48. As afore brought out the diameter of this vent is relatively small. Accordingly the amount of air or gas escaping through the same when the valve is open will be inappreciable. However, a slow escape may occur so that the piston and rod will be returned to their normal positions in a few seconds.

In lieu of this valve arrangement other structures may in certain instances preferably be employed. For example, as shown in my prior application for United States Letters Patent Serial No. 5,540, filed January 31, 1948 for "Injection Device," a valve assembly which is suitable for the present purpose may be employed. As will also be understood the surfaces which provide for the shift of motion of rod 31 with respect to plunger 28 might be replaced by any suitable transmitting mechanism; the present cam surfaces having been illustrated for the sake of simplicity of showing. Additionally the power mechanism as embracing the cartridge 38, valve assembly, piston, etc. need not necessarily be contained in a handle portion 6 extending perpendicular to the axis of body 5. This is merely one convenient manner of providing for the complete assembly.

Now with the parts disposed as described it will be understood that an operator might conveniently bring the end of nozzle 10 to a point adjacent the area to be injected. Thereupon by shifting lever 23 after releasing the safety shaft 25, the pawl 20 may rock upwardly. Under these circumstances the entire tube 15 will shift to the right as viewed in Fig. 1. This will be because a rearward shift of plunger 28 is prevented by latch 36. With such movement of tube 15 plunger 14 will be projected with considerable force to expel the medicament within ampule 13 at high velocity and in the form of a fine stream from orifice 11. Therefore, the epidermis will be



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penetrated by the medicament; the discharge continuing until all the medicament within the ampule has been exhausted. As shown in Fig. 2 and indicated in dotted lines, extension 51 will be adjacent the upper arm 49 of the lever 45 under these circumstances. An operator desiring to effect a reloading of the apparatus may readily do so by swinging that lever in a counterclockwise direction as viewed in Figs. 1 and 2 so as to engage extension 51 and retract the same together with tube 15 and its associated parts. Prior to this shifting latch 36 may be rocked to inoperative position by grasping the manipulating portion 37 and raising the same which will clear the latch from the flange 29. With such rearward shifting of the parts plunger 14 will be withdrawn from the medicament-contained compartment. Pawl 20 will ride over the surfaces of the elements as they are shifted rearwardly and will finally reach a position at which it braces against the forward face of ring 19. The loading cap 9 may now be removed and a fresh ampule placed in the medicament chamber after which the loading cap may be reapplied. The device is now ready for potentializing or cocking as previously described.

In Figs. 3 and 4 an apparatus has been shown which corresponds generally to that heretofore described in connection with Figs. 1 and 2. Therefore, the same reference numerals have been largely employed to designate corresponding parts. However, in this form of apparatus the passage 52 leading from the compressed air or gas flask has interposed in it a valve 53. For the sake of simplicity of illustration this valve has been shown as embracing a rotatably mounted body formed with a channel 54. A crank arm 55 extends from the valve body and is link connected as at 56 with a pivotally mounted spring pressed handle 57. According to the position of this valve body fluid under pressure may flow through either channel 58 or 59. A spring pressed valve 60 corresponding to valve 42 is interposed in channel 53 which is continued through to the cylinder 34. Channel 59 may conveniently extend to a point adjacent the forward end of body 5 which in this embodiment is in the form of a cylinder 60'. The tube 15 functions as a piston. Therefore, when fluid under pressure is admitted in the forward end of the body, tube 15 will be power retracted together with all parts associated with the same.

In common with the structure shown at 48 in Fig. 1, a spring pressed valve 60 is provided with an actuating stem 44. Also a vent 61 may be furnished through the wall of the body to prevent entrapped fluid from preventing proper movement of the parts. The diameter of the vent in Fig. 3 should be materially reduced so that a power retraction of the tube as afore described will not be prevented because of too rapid escape of the pressure fluid. Again in this form of apparatus it is in many respects preferred to employ a valve mechanism as disclosed in my aforementioned earlier application. An obvious modification and extension of that valve mechanism may be resorted to in order to assure a proper flowing of the gas under pressure from within the forward end of body 5.

In operating a device of the type shown in Figs. 3 and 4 the same sequence of procedure may be resorted to in order to achieve a cocking of the apparatus and a firing of the same. In this connection it will be understood that an operator may simply swing handle 57 in a counter-

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clockwise direction so that the valve 53 permits a flow of fluid under pressure through branch 59 into the cylinder furnished adjacent the forward end of body 5. Under these circumstances the tube 15 and its associated parts will be retracted from the position shown in dot and dash lines in Fig. 3 to that shown in full lines in that figure. A fresh ampule may be placed in position. Thereupon a shifting of the lever or handle 57 in a clockwise direction will cause link 56 to rotate valve 53 so that the latter affords communication between passage 52 and branch 58. This will cock the device.

Thus, among others, the several objects of the invention as specifically afore noted are achieved. Obviously numerous changes in construction and rearrangement of the parts may be resorted to without departing from the spirit of the invention as defined by the claims.

I claim:

1. In a device for injecting liquid medicament, in combination, a hollow body providing a medicament chamber adjacent one of its ends, a pressure accumulator movably mounted within said body, means providing a surface extending from said accumulator and projectable therewith to move into said chamber and expel medicament therefrom, manually releasable latch means carried by said body and connectable with said accumulator for maintaining the same in retracted position, means movably connected with said accumulator and projectable with respect thereto to increase the pressure therein while said accumulator is maintained in such position, power means for operating said pressure increasing means and manually operated means for controlling said power means.

2. In a device for injecting liquid medicament, in combination, a hollow body providing a medicament chamber adjacent one of its ends, a pressure accumulator movably mounted within said body, means providing a surface extending from said accumulator and projectable therewith to move into said chamber and expel medicament therefrom, manually releasable latch means carried by said body and connectable with said accumulator for maintaining the same in retracted position, means movably connected with said accumulator and projectable with respect thereto to increase the pressure therein while said accumulator is maintained in such position, further latching means for retaining the pressure increasing means in projected position, power means for operating said pressure increasing means and manually operated means for controlling said power means.

3. In a device for injecting liquid medicament, in combination, a hollow body providing a medicament chamber adjacent one of its ends, a pressure accumulator movably mounted within said body, means providing a surface extending from said accumulator and projectable therewith to move into said chamber and expel medicament therefrom, manually releasable latch means carried by said body and connectable with said accumulator for maintaining the same in retracted position, means movably connected with said accumulator and projectable with respect thereto to increase the pressure therein while said accumulator is maintained in such position, further latching means for retaining the pressure increasing means in projected position, releasing means for said further latching means accessible from the exterior of said body, power



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means for operating said pressure increasing means and for controlling said power means.

4. In a device for injecting liquid medicament, in combination, a hollow body providing a medicament chamber adjacent one of its ends, a pressure accumulator movably mounted within said body, means providing a surface extending from said accumulator and projectable therewith to move into said chamber and expel medicament therefrom, manually releasable latch means carried by said body and connectable with said accumulator for maintaining the same in retracted position, a plunger extending from within said accumulator to a point beyond the exterior of the same and movable with respect to said accumulator, said plunger upon being projected with respect to said accumulator increasing the pressure therein while such accumulator is maintained in retracted position and power means acting against said plunger for projecting it with respect to said accumulator.

5. In a device for injecting liquid medicament, in combination, a hollow body providing a medicament chamber adjacent one of its ends, a pressure accumulator movably mounted within said body, means providing a surface extending from said accumulator and projectable therewith to move into said chamber and expel medicament therefrom, manually releasable latch means carried by said body and connectable with said accumulator for maintaining the same in retracted position, a plunger extending from within said accumulator to a point beyond the exterior of the same and movable with respect to said accumulator, said plunger upon being projected with respect to said accumulator increasing the pressure therein while such accumulator is maintained in retracted position, power means acting against said plunger for projecting it with respect to said accumulator, said plunger being formed with a detent surface and a further latch movably carried by said body and cooperating with said detent surface.

6. In a device for injecting liquid medicament, in combination, a hollow body providing a medicament chamber adjacent one of its ends, a pressure accumulator movably mounted within said body, means providing a surface extending from said accumulator and projectable therewith to move into said chamber and expel medicament therefrom, manually releasable latch means carried by said body and connectable with said accumulator for maintaining the same in retracted position, a plunger extending from within said accumulator to a point beyond the exterior of the same and movable with respect to said accumulator, said plunger upon being projected with respect to said accumulator increasing the pressure therein while such accumulator is maintained in retracted position, power means acting against said plunger for projecting it with respect to said accumulator, a power projected rod carried by said body and means operatively coupling said rod to project said plunger upon said rod being projected.

7. In a device for injecting liquid medicament, in combination, a hollow body providing a medicament chamber adjacent one of its ends, a pressure accumulator movably mounted within said body, means providing a surface extending

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from said accumulator and projectable therewith to move into said chamber and expel medicament therefrom, manually releasable latch means carried by said body and connectable with said accumulator for maintaining the same in retracted position, a plunger extending from within said accumulator to a point beyond the exterior of the same and movable with respect to said accumulator, said plunger upon being projected with respect to said accumulator increasing the pressure therein while such accumulator is maintained in retracted position, power means acting against said plunger for projecting it with respect to said accumulator, a power projected rod carried by said body, said body being formed with a cylinder, a projectable piston and rod lying within and extending from said cylinder, means for operatively coupling said rod with said plunger to project the latter upon the former being projected and control means governing the projection of such piston.

8. In a device for injecting liquid medicament, in combination, a hollow body providing a medicament chamber adjacent one of its ends, a pressure accumulator movably mounted within said body, means providing a surface extending from said accumulator and projectable therewith to move into said chamber and expel medicament therefrom, manually releasable latch means carried by said body and connectable with said accumulator for maintaining the same in retracted position, means movably connected with said accumulator and projectable with respect thereto to increase the pressure therein while said accumulator is maintained in such position, power means for operating said pressure increasing means, further power means for retracting said pressure accumulator and manually operated means for controlling said power means.

9. In a device for injecting liquid medicament, in combination, a hollow body providing a medicament chamber adjacent one of its ends, a pressure accumulator movably mounted within said body, means providing a surface extending from said accumulator and projectable therewith to move into said chamber and expel medicament therefrom, manually releasable latch means carried by said body and connectable with said accumulator for maintaining the same in retracted position, means movably connected with said accumulator and projectable with respect thereto to increase the pressure therein while said accumulator is maintained in such position, power means for operating said pressure increasing means, said body providing a cylinder, said pressure accumulator providing a piston movable within said cylinder and means associated with said body for conducting fluid into said cylinder to forcibly retract said pressure accumulator.

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