April 3, 1951 J. H. SMOOT 2,547,099

INJECTION DEVICE AND AMPOULE

Filed March 11, 1948 2 Sheets-Sheet 1

Fig. 1

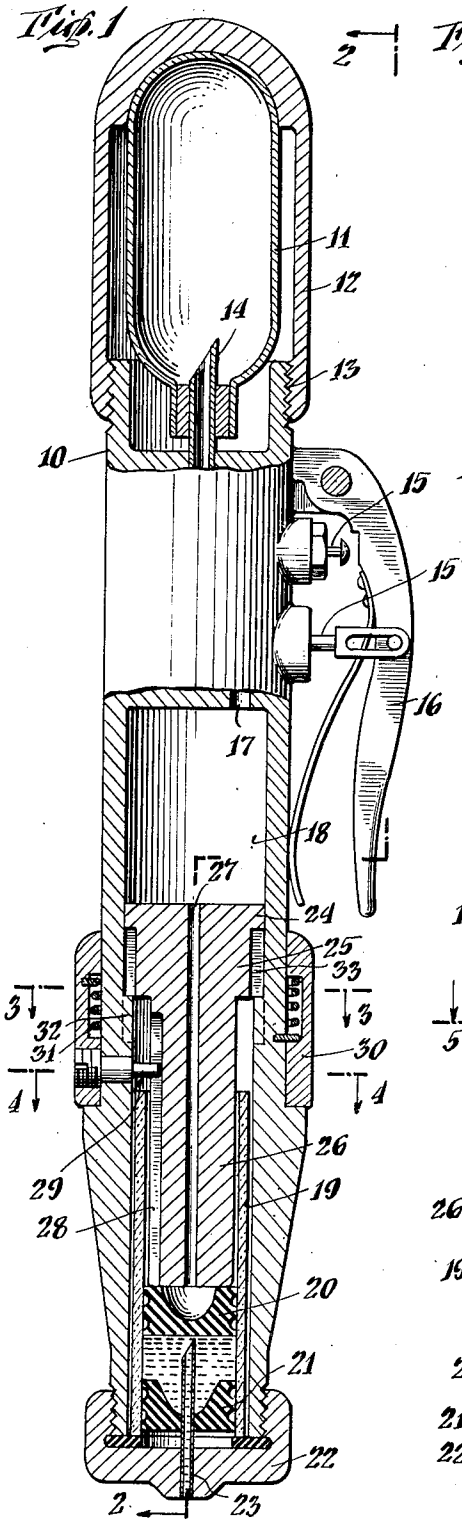

Fig. 2

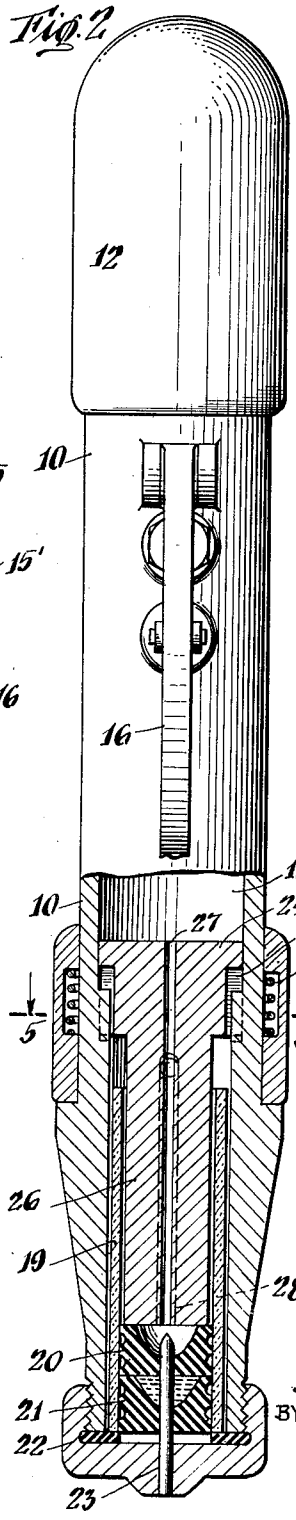

Fig. 3

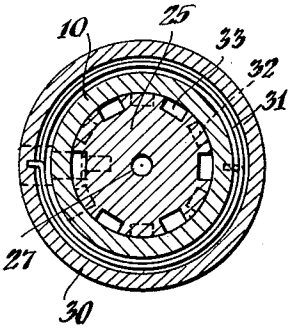

Fig. 4

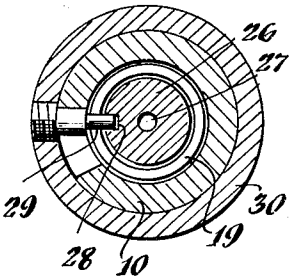

Fig. 5

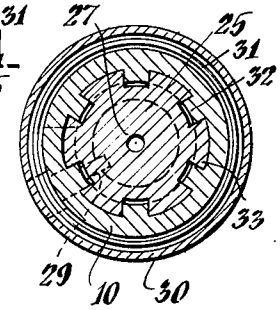

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Fig. 6

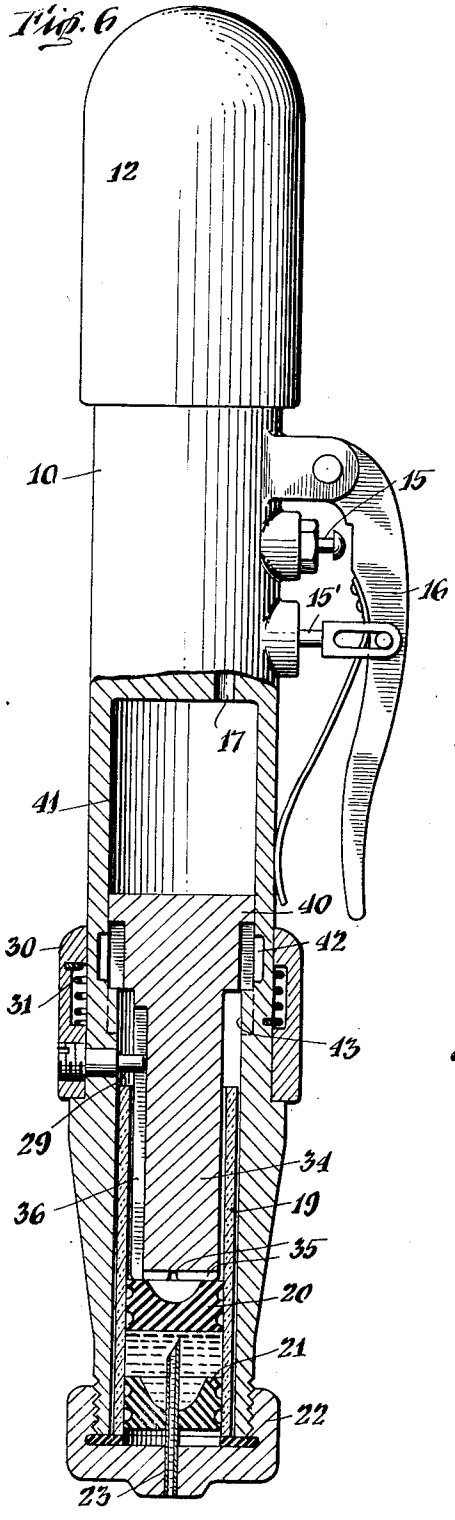


Fig. 8

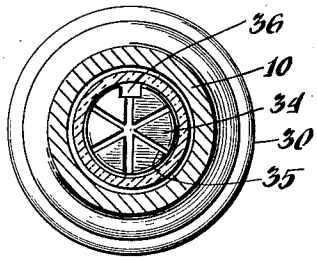


Fig. 7

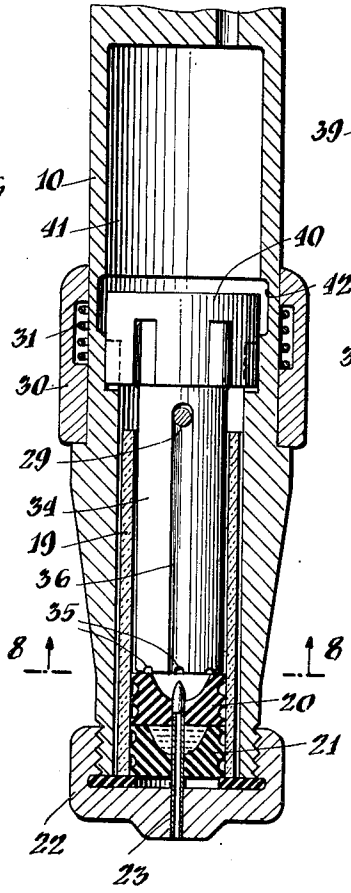
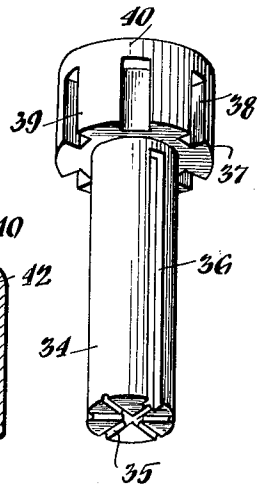


Fig. 9



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UNITED STATES PATENT OFFICE

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INJECTION DEVICE AND AMPOULE

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Application March 11, 1948, Serial No. 14,332

13 Claims. (Cl. 128—173)

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This invention relates to a structurally and functionally improved hypodermic injection device, as well as an ampule for use in connection therewith; and especially applies to that class of apparatus in which hypodermic injections of medicament are made without employing a skin and tissue-piercing needle.

In apparatus of the class referred to, it is understood that the medicament is expelled at high velocity from an orifice and in a sufficiently fine stream so that the medicament may pierce the skin and lodge within the underlying tissues. If a single or multiple orifice of this type be formed in the liquid-containing capsule or cartridge, then after the injection, the latter may be discarded. If the orifice be formed in a unit of the substantially permanent assembly, then, after the apparatus has been used, difficulty may be experienced incident to the medicament clogging that orifice.

Under such circumstances a subsequent use of the device becomes impossible until the orifice has been cleaned or cleared. Such cleaning may be quite time-consuming and expensive. If a solution of the problem is attempted by having the orifice forming a part of the device which is to be thrown away after, for example, a single use, this procedure may be similarly expensive and otherwise unsatisfactory.

With the foregoing in mind, it is a primary object of the invention to furnish, in an apparatus of this type, a structure such that the physician or other operator may readily clean or clear the bore of the orifice after an injection has been completed.

A further object is that of providing a mechanism which may not be accidentally operated with possible injury to the patient.

Another object of this invention is that of furnishing an injection device embodying these advantages, and in which the desired clearing operation may be performed with minimum effort and skill on the part of the operator.

Thus, an injection apparatus is furnished in which the discharge orifice may be formed in a part of the device which is incorporated in the permanent assembly of the same. Accordingly, this part will not have to be frequently replaced, but may be employed in connection with a large number of injections. Also, the physician or other operator may lay aside the apparatus without concern that the medicament will coagulate or otherwise clog within the bore.

An additional object is that of furnishing an apparatus of this character which will embrace relatively few parts, each individually rugged and simple in construction and operating over long periods of time with freedom from all difficulty.

A still further object is that of providing an ampule which will embody a structure such that

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it will be feasible to clear the injection orifice of medicament, after an injection has once been completed, regardless of whether that orifice be disposed in the ampule or cartridge per se, or whether it be embodied in the injection unit.

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 fragmentary sectional side view of an injection device and showing the parts of the same in one position;

Fig. 2 is a partly sectional side view taken along the lines 2—2 and in the direction of the arrows indicated in Fig. 1;

Figs. 3 and 4 are transverse sectional views taken along the lines 3—3 and 4—4 respectively and in the direction of the arrows as also indicated in Fig. 1;

Fig. 5 is a transverse sectional view taken along the lines 5—5 and in the direction of the arrows as indicated in Fig. 2;

Fig. 6 is a view similar to Fig. 2, but showing an alternative form of construction;

Fig. 7 is a fragmentary sectional view of the lower portion of the device as shown in Fig. 6, but illustrating the parts in a different position from that shown in the preceding view;

Fig. 8 is a transverse sectional view taken along the lines 8—8 and in the direction of the arrows as indicated in Fig. 7; and

Fig. 9 is a bottom perspective view of the plunger assembly as shown in Figs. 6 and 7.

In these views the numeral 10 indicates the body of the device which depends for its actuation on a source of compressed fluid such as air or preferably CO_2 under substantial compression and preferably in liquid form. This source conveniently takes the form of a flask 11 enclosed within a cap 12 mounted by threads 13 upon the body 10. A cannula 14 is mounted by the body of the device and acts to penetrate the neck of the flask 11 as the cap 12 is tightened. The source of pressure may embrace numerous different gases which are compressible and capable of being maintained under pressure. This fluid may be stored in the apparatus in any desired manner; a unit such as a flask 11 being in many respects most convenient and preferred.

In any event, a flow of gas may be controlled and vented by suitable valve assemblies, the actuating stems of which have been indicated at 15 and 15' and which are operated, for example, by a handle 16. For a disclosure of one form of this mechanism reference is had to the co-pending application for United States Letters Patent in the names of Errol R. Lawshe and John H. Smoot on Hypodermic Injection and Ampule, filed on January 30, 1948, and identified under Serial Number 5,336. Subject to the control

exercised by the valve mechanism, gas under pressure may flow from passage 17 into cylinder 18 forming a part of body 10.

The body 10 also provides a medicament-receiving chamber which in the presently visualized embodiment accommodates the medicament within a cartridge or ampule. The latter has been shown as including a body 19 formed of any suitable material, and the opposite ends of which are closed by stoppers 20 and 21. Stopper 20 is capable of movement within the bore of body 19 and may thus function as a piston. The lower end of the medicament-receiving chamber is defined by a cap 22 which may mount a piercing cannula 23. The bore of the latter may be substantially constant throughout its entire length, or else may be constricted adjacent its outer end to define an aperture of minute cross-sections such that a proper injection orifice is presented. In any event it will be understood that the length of the cannula 23 is such that it may penetrate stopper 21 for example, as cap 22 is tightened; the medicament being forced into the bore of the cannula during such tightening to expel any contained air.

In the form of apparatus shown in Figs. 1 to 5 inclusive a plunger-piston unit is disposed for movement within the cylinder 18. This unit as shown conveniently includes a head or piston portion 24, an adjacent skirt portion 25 and a plunger part 26. The diameter of the latter should be such that it may freely enter the bore of body 19. Also the body of this plunger-piston unit is formed with a longitudinally extending bore 27.

The face of the plunger portion 26 may also be formed with a longitudinally extending groove 28. A pin 29 may extend into this groove and outwardly from the same through a slot formed in the body 10 as especially shown in Fig. 4. The outer end of the pin may be secured to a collar 30 rotatably encircling the body of the device. This collar is normally maintained in a predetermined position by, for example, a spring 31.

Adjacent the point at which skirt 25 extends when the plunger has completed its medicament-expelling stroke the inner face or bore of body 10 is conveniently formed with a series of inwardly extending ribs 32. These ribs are arranged in the form of an annular series and are spaced a distance such—that with the parts properly aligned—similar ribs or keys 33 formed in the outer space of the skirt portion 25 may align therewith. In other words, if a projection of the piston-plunger unit is attempted beyond this point, such projection will be prevented incident to the end edges of ribs 32 and 33 coming into engagement with each other. Such a relationship of the parts is normally assured by the spring 31 or equivalent collar-maintaining member. When, however, the collar 30 is rotated so as to rotate the piston and plunger, the ribs or keys of the latter will align with the spaces intervening the ribs or keys 32 of body 10. Under these circumstances, these parts may be telescoped, or in other words, the plungers may be further projected. Assuming that retraction of the parts occurs to a point where the ribs clear each other, as shown in Fig. 1, then, for example, the spring 31 will reestablish substantial registry between the ribs to prevent projection of the plunger beyond a certain point.

In using an apparatus embodying the structure shown in Figs. 1 to 5, it will primarily be assumed that a source of gas under pressure has been incorporated in the apparatus and that the medicament-receiving chamber has had an ampule or cartridge positioned therein. With such positioning, the stopper 20 being adjacent the upper end of body 19, it is apparent that the piston 24 will have been shifted to a position adjacent the upper end of cylinder 18. Likewise, and as afore brought out, the cannula 23 in effecting penetration of the stopper 21 will have been filled with medicament so that there will be no danger of injecting air into a patient. Thereupon, the outer face of cap 22 is brought into contact with the skin of the patient at a point overlying that at which the tissues are to be injected. Upon the handle 16 or its equivalent being actuated, the compressed gas will flow into cylinder 18. This will serve to project the piston 24 and the plunger 26. The outer end of the latter being in contact with the outer surface of stopper 20, it follows that the compressed gas may not escape through bore 27. It also follows that stopper 20 will act as a piston in its projection through the bore of body 19 to expel medicament at high velocity from the injection orifice. Thus, the desired ejection will occur and this operation will continue until the parts reach the position shown in Fig. 1. In that position the ends of ribs or keys 32 and 33 will move into abutting relationship and the desired quantity of medicament will have been injected.

Now with a view to clearing or cleaning the orifice defined by the bore of cannula 23 or other proper portion, the physician will primarily remove the device from contact with the skin of the patient. Thereupon the operator using the apparatus will turn ring or collar 30. With such turning, and as afore described, the ribs 33 will align with the spaces between the ribs 32. Therefore, the stop structure will be rendered inoperative and the piston and plunger assembly may be further projected. Conveniently this projection may be effected by further actuation of the handle 16 or its equivalent. In this connection it will be borne in mind that the valve assembly is preferably of a nature such that a vending operation will occur when the handle 16 is initially released. This will permit the pressure within cylinder 18 to be relieved so that no difficulty will be experienced in turning the collar 30. In any event, with the further projection of the piston, the inner end of cannula 23 is caused to penetrate stopper 20 as the latter is projected from the position shown in Fig. 1 to that shown in Fig. 2. With such penetration, gas under pressure is free to flow from cylinder 18 through bore 27 to the inner cannula end. Therefore, it will flow through the bore of the cannula and beyond the orifice which defines the injection jet. With such flow it is obvious that any residue of medicament within this bore and orifice will be ejected and that the bore will be cleared and cleaned for a subsequent injection operation. All that will be necessary in the latter connection will be for the operator to remove the cap 22 and replace the exhausted ampule or cartridge with a fresh ampule. This will shift the parts to the position initially described.

In the form of apparatus shown in Figs. 6 to 9 inclusive, it will be noted that the plunger-piston unit includes a stem on plunger portion 34 preferably formed adjacent its outer end with a plurality of grooves 35. Similar to the construction afore described, this plunger may also be formed with a longitudinally extending groove or guide 36, a skirt portion 37 formed with an annular series of slots or grooves 38 to provide

intervening ribs 39 and a piston portion proper indicated at 40. Reference numerals heretofore utilized in connection with Figs. 1 to 5 have been employed to designate similar parts shown in the latter figures; the construction—if desired—being more or less identical. However, it will be noted, as especially shown in Figs. 6 and 7, that the inner face of the cylinder 41 is formed adjacent, but above, that point at which the annular series of ribs 43 are provided, with a channel or duct 42. Therefore, access to the channel or duct 42 is still obstructed by the piston portion 40 when the latter has completed its working stroke. Accordingly, gas under pressure will not be free to flow into this channel at that time. Such flow will only be possible when the piston has moved to a point beyond that illustrated in Fig. 6.

Therefore, assuming that the apparatus is being used, the technique of procedure will be substantially identical with that heretofore outlined in connection with Figs. 1 to 5 inclusive. In common with the structure shown in the earlier figures, the upper stopper 20 is preferably of such configuration that its upper face presents a recess. After the injection has been completed and with the parts in the position shown in Fig. 6, the device is removed or pointed in a direction where no injury to the patient or bystander may result. Thereafter the ring or collar 30 is rotated so that the grooves or recesses 38 of the piston skirt 37 are aligned with the ribs 43 formed in the body of the apparatus. Under these circumstances, the admission of gas under pressure into the cylinder 41 by further actuation of the valve mechanism, will result in the piston-plunger being further projected. With such projection the piston portion 40 will clear the channel 42 as shown in Fig. 7.

Therefore, gas under pressure may now flow into the channel and so into the space intervening the ampule or cartridge body and the plunger 34 including, of course, the space defined by channel 36. This gas will now flow into the grooves 35. With the cannula 23 having pierced the upper stopper 20, access to the bore of the cannula and the ejection orifice will be unobstructed. Accordingly, the gas will flow through these bores and clear and clean the same. Upon removing the cap 22 the discharged ampule or cartridge may be withdrawn and a fresh cartridge may be inserted.

As the new cartridge is inserted, the plunger-piston will be retracted. In common with the earlier construction, as the ribs in the skirt of the piston clear the ribs 43 in the inner face of the body 10 the spring 31 will rotate the parts to initial position. The piston is now moved to a point at which it is adjacent the upper end of the cylinder. With the cap reapplied the parts will be ready for a subsequent operation.

With regards to the ampule, it will be understood that a unit has been shown in the accompanying drawings which involves a somewhat preferred design. That ampule or cartridge permits access to the injection orifice of the apparatus incident to the employment of a piston-stopper which has its upper face recessed so that the cannula may pierce the same. With a view to avoiding unnecessary illustration, only this type of ampule or cartridge has been shown. It will be appreciated that numerous other forms of unit may be employed so long as the upper face of the same presents a configuration such that communication could be established between the source of compressed gas and the ejection orifice. In fact, under certain lay-outs of the apparatus where a radically different ampule was employed or where—under certain conditions—even no ampules were utilized, it would still be feasible to obtain the benefits of the present teachings. However, as afore brought out, it is preferred that an ampule be utilized and that this cartridge be generally of the type shown. It will be understood that any suitable actuating fluid may be employed in lieu of gases under pressure. Also, the actuating fluid may act directly on the discharge orifice as afore-described or else may in turn cause a flow or expulsion of air through that orifice.

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. A hypodermic injection assembly, including in combination, means providing an injection orifice for the discharge of medicament at skin-penetrating velocity, manually controlled means whereby fluid pressure may effect such discharge, further manually controlled means for passing fluid under pressure from within said assembly through said orifice to clear the same and means for normally locking said fluid passing means against operation.

2. A hypodermic injection assembly, including in combination, a body presenting a medicament-receiving chamber, means providing a wall formed with an orifice through which medicament is discharged at skin-penetrating velocity, a piston unit movable within said body, manually operated means for controlling a flow of gas under pressure to cooperate with said piston and cause the same to expel medicament from said chamber through said orifice and further manually operated means whereby gas under pressure may be caused to also flow through said orifice.

3. A hypodermic injection assembly, including in combination, a body presenting a medicament-receiving chamber, means providing a wall formed with an orifice, through which medicament is discharged at skin-penetrating velocity, a piston unit moveable within said body, manually operated means for controlling a flow of gas under pressure to cooperate with said piston and cause the same to expel medicament from said chamber through said orifice, further manually operated means whereby gas under pressure may be caused to also flow through said orifice, and means for normally preventing an operation of said last-named means.

4. A hypodermic injection assembly, including in combination, a body presenting a medicament-receiving chamber, means providing a wall formed with an orifice, through which medicament is discharged at skin-penetrating velocity, a piston unit moveable within said body, manually operated means for controlling a flow of gas under pressure to cooperate with said piston and cause the same to expel medicament from said chamber through said orifice, means for arresting movement of said piston-unit, further manually operated means for rendering said last-named means inoperative, and said assembly being formed with passages for the flow of gas to said orifice.

5. An injection device, including in combination, a body formed with a cylinder and a medic-

ament-receiving chamber, having a discharge orifice, a piston moveable within said cylinder and cooperating with said chamber to effect a discharge of medicament through said orifice at skin-penetrating velocity, means for arresting the movement of said piston at a predetermined point, and said piston being formed with a passage through which gas under pressure may flow to said orifice.

6. An injection device, including a body formed with a cylinder, a medicament-receiving chamber, and an orifice extending therefrom and through which medicaments may be discharged, a piston moveable within said cylinder and cooperating with said chamber to effect such discharge, means for arresting the movement of said piston at a predetermined point, means for rendering said arresting means inoperative, said body being formed with a passage short of such point, and said piston being formed with a communicating passage such that gas may flow from said cylinder through said chamber and through said orifice.

7. A device for projecting medicament in a sufficiently fine stream and under velocity such that it will hypodermically inject tissues without the aid of a skin-penetrating needle, said device including a body providing a medicament receiving chamber, a passage for conducting driving fluid under pressure, manually operable means for controlling the flow of said fluid through such passage, movable pressure transmitting means interposed between said passage and chamber to project medicament from the latter, and further manually operable means to cause a flow of such driving fluid through said chamber.

8. A device for projecting medicament in a sufficiently fine stream and under velocity such that it will hypodermically inject tissues without the aid of a skin-penetrating needle, said device including a body providing a chamber to receive a medicament-containing ampule, a passage for conducting gas under pressure, manually operable means for controlling the flow of gas through said passage, said body being formed with a cylinder connected to said passage, a piston movable within said cylinder to project the medicament from the ampule within said chamber, and manually controlled means for causing a flow of gas from said passage past said piston and through said chamber.

9. A device for projecting medicament in a sufficiently fine stream and under velocity such that it will hypodermically inject tissues without the aid of a skin-penetrating needle, said device including a body providing a chamber to receive a medicament-containing ampule, a passage for conducting gas under pressure, manually operable means for controlling the flow of gas through said passage, said body being formed with a cylinder connected to said passage, a piston movable within said cylinder to project the medicament from the ampule within said chamber, said piston being formed with a bore through which gas may flow, and releasable stop means for arresting the movement of the piston at a point short of its limit of projection.

10. A device for projecting medicament in a sufficiently fine stream and under velocity such that it will hypodermically inject tissues without the aid of a skin-penetrating needle, said device including a body providing a chamber to receive a medicament-containing ampule, a passage for conducting gas under pressure, manually operable means for controlling the flow of gas through said passage, said body being formed with a cylinder connected to said passage, a piston movable within said cylinder to project the medicament from the ampule within said chamber, said device being formed with a passage extending from said cylinder to said chamber whereby gas may be caused to flow through the latter upon said piston being fully projected and releasable stop means disposed to prevent such projection of the piston.

11. A device for projecting medicament in a sufficiently fine stream and under velocity such that it will hypodermically inject tissues without the aid of a skin-penetrating needle, said device including a body providing a medicament receiving chamber, an ampule within said chamber and including a medicament-containing body sealed at its ends by stoppers, a cap closing one end of said chamber, a cannula mounted by said cap and extending inwardly of said chamber to penetrate the outermost of the stoppers of said ampule, a passage for conducting fluid under pressure toward said chamber, manually operable means for controlling the flow of fluid through such passage, movable pressure transmitting means interposed between said passage and chamber to cause movement of the innermost ampule stopper and thus project medicament through said cannula, means for arresting the movement of said pressure transmitting means, and means whereby said last named means may be released to cause the cannula to pierce the innermost stopper of the ampule so that liquid under pressure may flow from said passage through the bore of said cannula.

12. A hypodermic injection device including a body formed with a medicament-receiving chamber and an orifice extending from said chamber through which medicament may be discharged therefrom, means to cause an expulsion of medicament from said chamber, means within said body whereby said orifice may be cleared and means movably mounted by said body for controlling the operation of said clearing means.

13. A hypodermic injection device including a body formed with a medicament-receiving chamber and an orifice extending from said chamber through which medicament may be discharged therefrom, means to cause an expulsion of medicament from said chamber, means within said body whereby said orifice may be cleared, means movably mounted by said body for controlling the operation of said clearing means and means for normally maintaining said controlling means in inoperative position.

JOHN H. SMOOT.

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