United States Patent

Tibbs

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[54] **PAINLESS INJECTION DEVICE WITH POWERED PLUNGER**

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[21] Appl. No.: **98,400**

[52] **U.S. Cl.** ..... **128/218 F**

[51] **Int. Cl.** **A61m 5/22**

[58] **Field of Search** ..... 128/218 A, 218 F, 218 R

[56] **References Cited**

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Primary Examiner—Channing L. Pace

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[57] **ABSTRACT**

An injecting device for a hypodermic syringe including, in a first form of the invention disclosed, structure for supporting a syringe and projecting the needle of the syringe into a skin tissue area against which a predetermined portion of the device has been placed. Structure is also provided for advancing the plunger of the syringe relative to the barrel portion thereof after the syringe has been projected in order to force the needle thereof into the skin tissue. A second form of the invention includes not only structure for accomplishing these same functions but also additional structure for slightly retracting the plunger of the syringe relative to the barrel portion thereof during the latter portion of the stroke of the syringe during projection of the latter as the syringe needle penetrates the adjacent skin tissue to produce aspiration for detecting whether the needle has penetrated a blood vessel.

11 Claims, 13 Drawing Figures

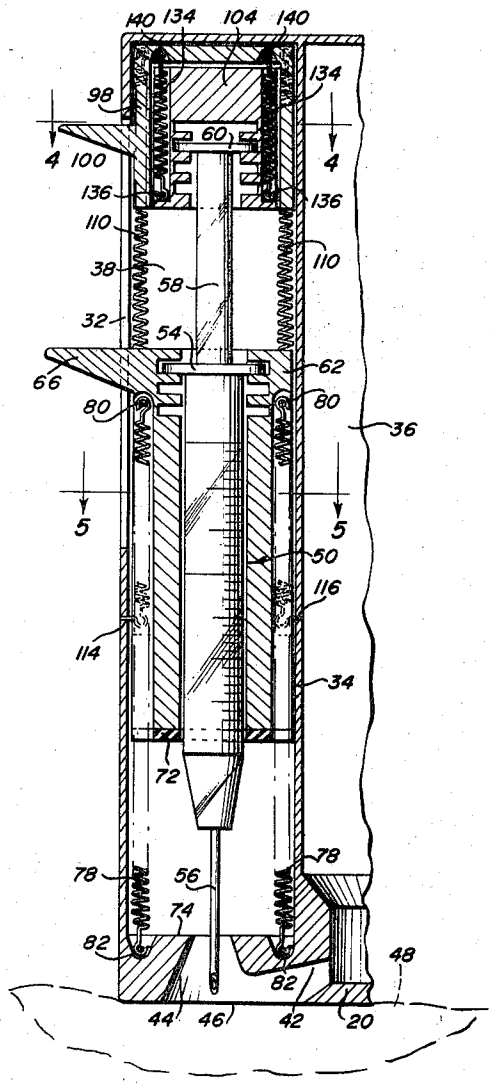

Fig. 1

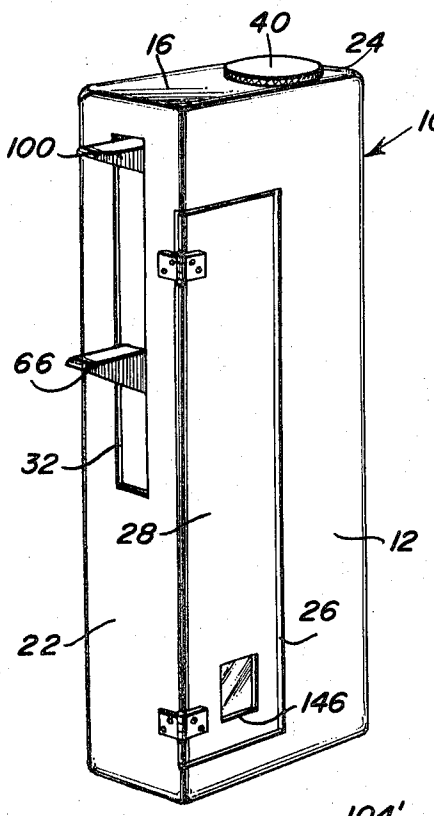

Fig. 8

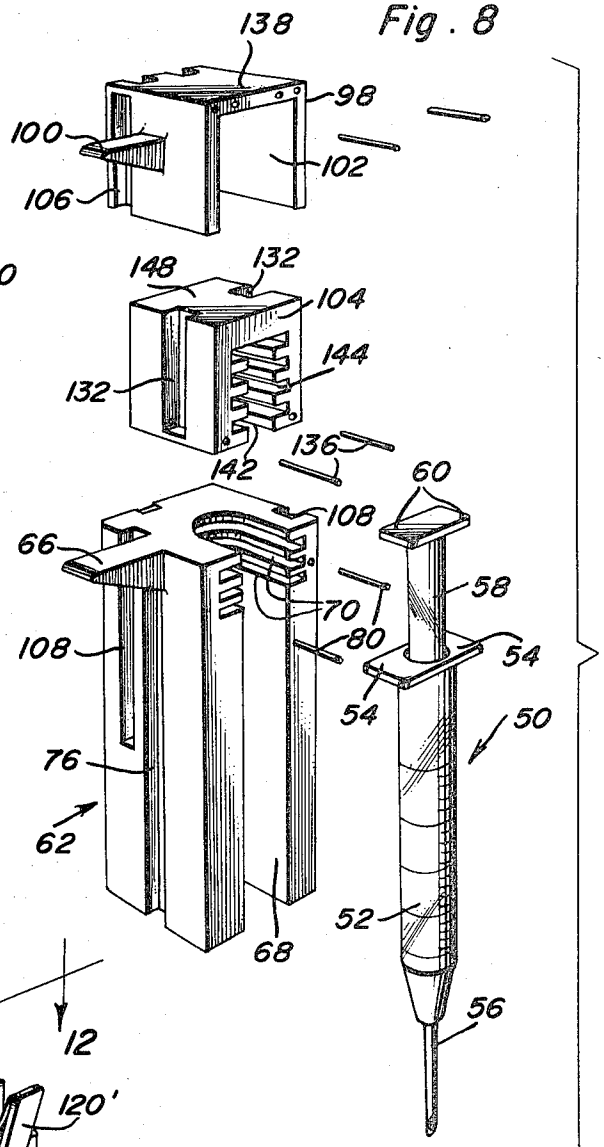

Fig. 10

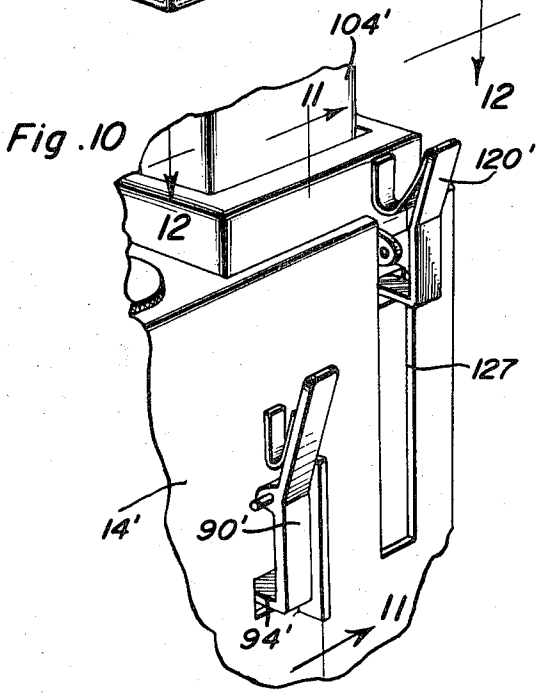

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Fig. 2

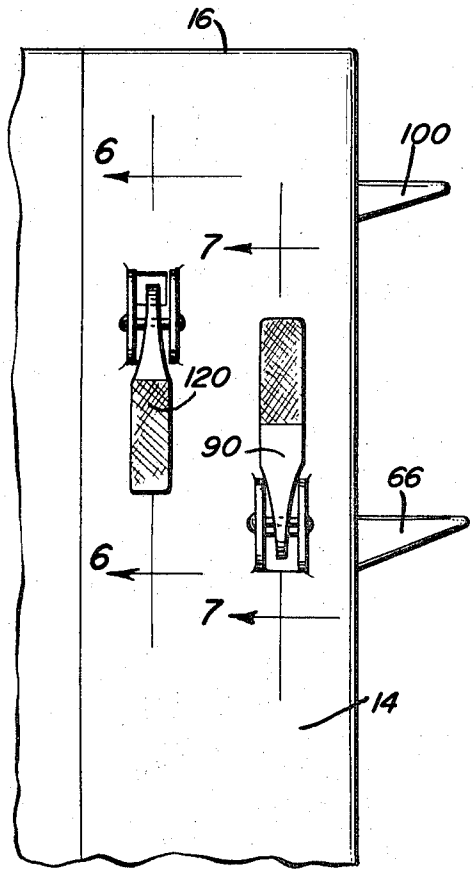

Fig. 6

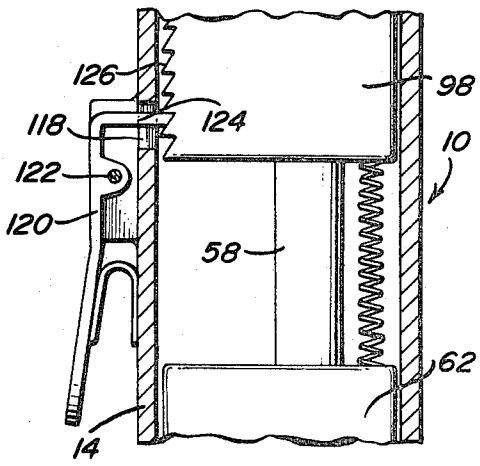

Fig. 7

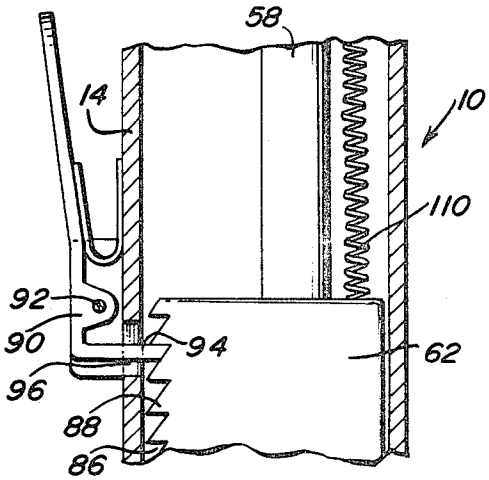

Fig. 11

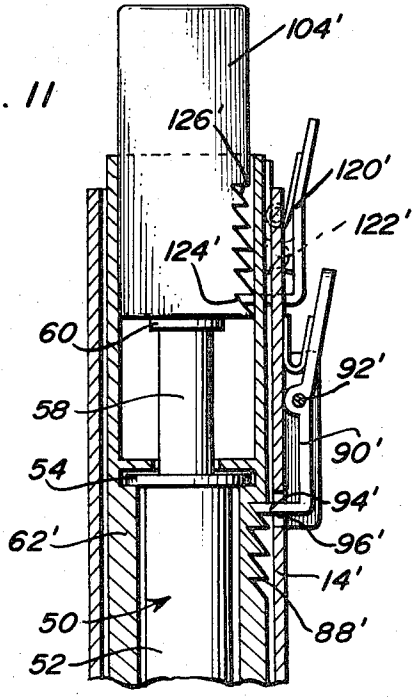

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Fig. 3

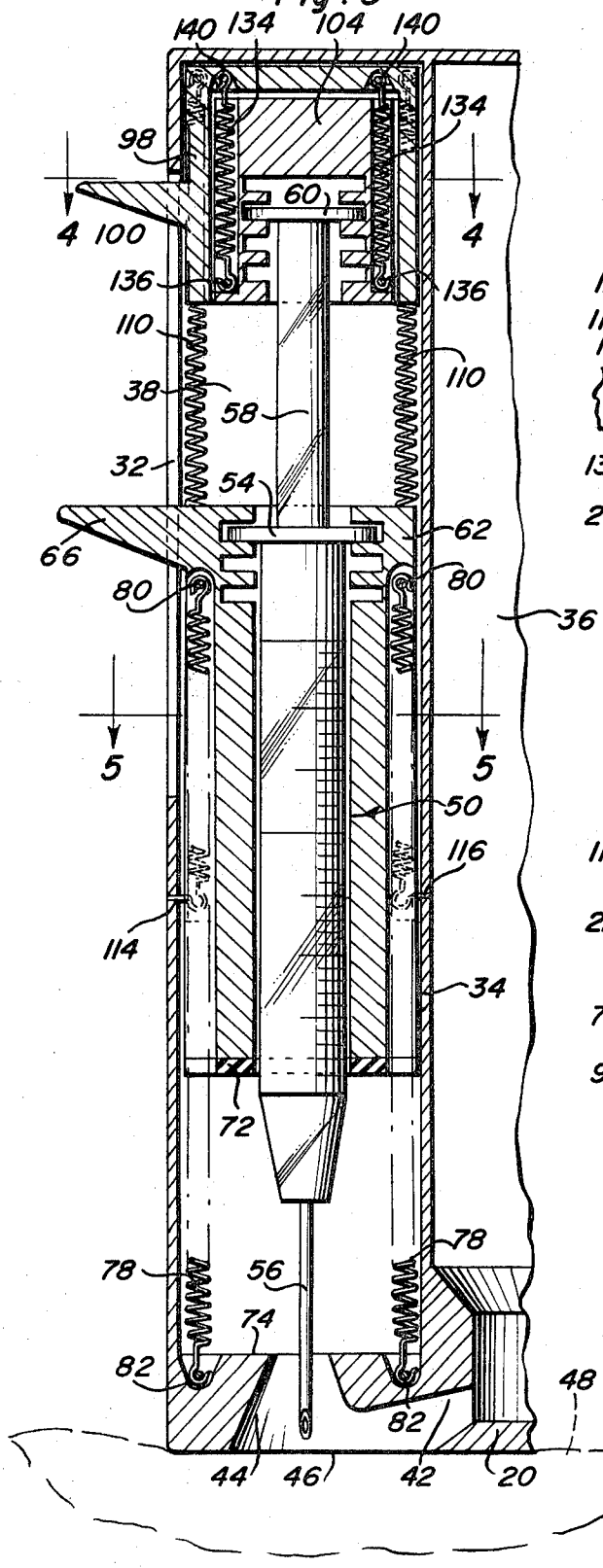

Fig. 4

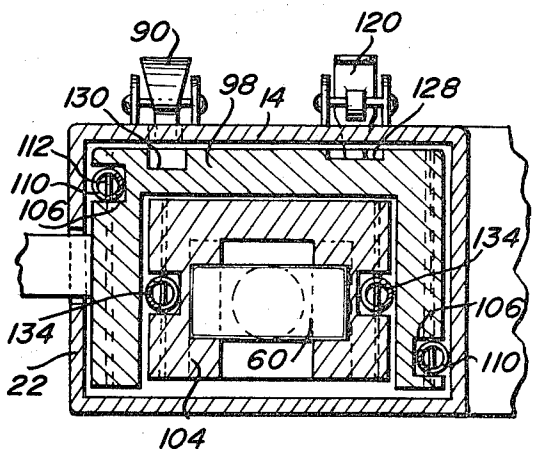

Fig. 5

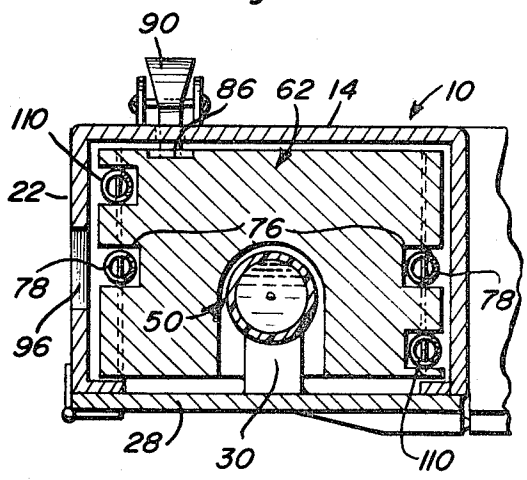

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Fig . 9

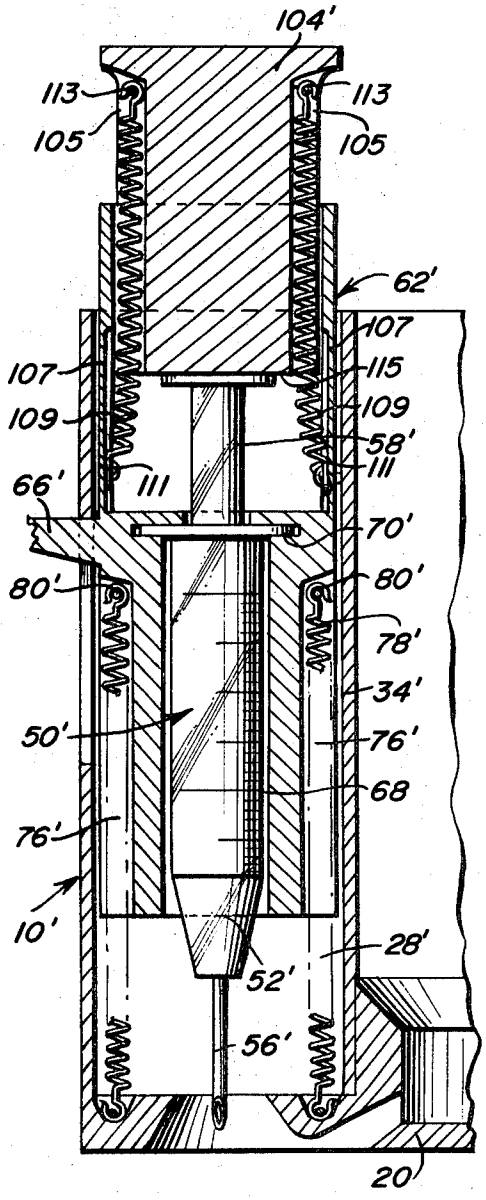


Fig . 13

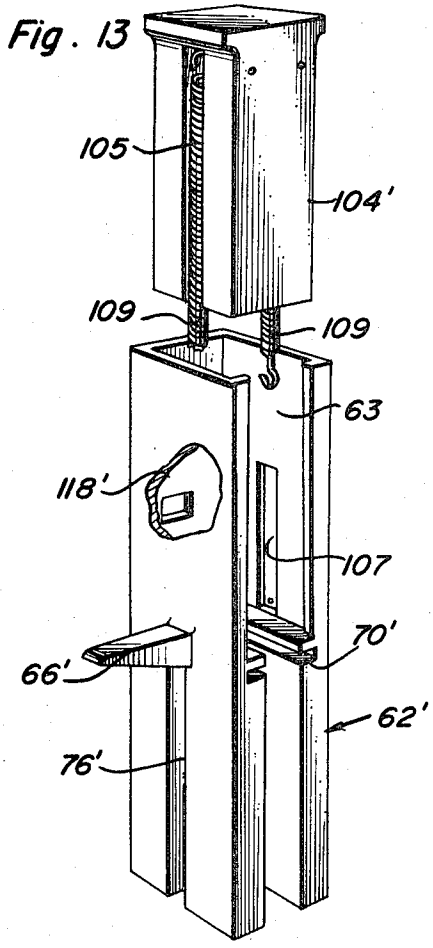
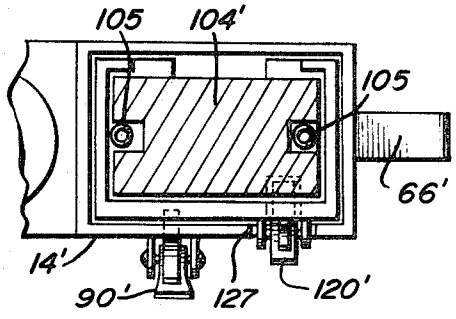


Fig . 12



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PAINLESS INJECTION DEVICE WITH POWERED PLUNGER

This application comprises a continuation-in-part of my copending U. S. application Ser. No. 8,366 filed Feb. 3, 1970, for Painless Injection Device, now U. S. Pat. No. 3,605,742, dated Sept. 20, 1971.

This invention relates to hypodermic injection of fluids through the needle of a plunger operated syringe and more specifically to a new and useful support, projecting and operating device for hypodermic syringes specifically designed to minimize pain, discomfort and psychological trauma commonly associated with hypodermic syringes. The invention provides means for not only supporting and projecting a hypodermic syringe toward skin tissue to be injected subsequent to the external surface of the injection site being desensitized, but also includes operating features whereby aspiration may be produced and subsequent advancement of the plunger relative to the barrel portion of the syringe may be gradually accomplished in a smooth even manner by mechanical means.

The present invention consists of a mechanical device operable to removably receive and support a conventional type of hypodermic syringe, preferably of the disposable type, and to support the syringe for mechanical projection over a given distance, aspiration of the syringe during the latter part of the projection stroke thereof and subsequent advancement of the plunger portion of the syringe in order to enable a medical technician or physician to inject fluids into the subcutaneous and muscular tissues under the skin of a patient by a more desirable method. Thus, the injection device of the present invention embodies various desirable injection techniques which prior art devices do not incorporate in a single instrument.

In accordance with the present invention, a conventional hypodermic syringe is inserted through an access opening provided therefor in an elongated housing with the barrel of the syringe being received within a slidable holder for projecting the syringe and the needle supported therefrom by spring operated means through a skin tissue surface engaging end of the housing. A latch mechanism is provided and operable to retain the holder in a cocked retracted position with the hypodermic needle completely enclosed within the housing and upon release of the latch mechanism, the holder and the syringe with its supported needle is rapidly advanced to a limit position with the needle projecting outwardly of the skin tissue or surface engaging end of the housing. A slidable holder for the enlarged free end of the piston of the hypodermic syringe is also slidably mounted in the housing and engaged with the enlarged end of the piston. The piston holder is coupled to an anchor member by elastically extensible means and final movement of the syringe barrel or cylinder and the needle supported therefrom to its fully projected position is coupled with relative movement between the syringe barrel and piston whereby aspiration is produced. Further, the anchor for the syringe piston is also slidable in the housing and is spring operated and provided with its own latch mechanism for its retention in a cocked retracted position whereby release of the anchor latch mechanism will serve to advance the syringe piston in order to discharge the fluid contents of the syringe through the needle thereof.

The end surface of the housing through which the needle of the syringe is projectable defines an outwardly opening recess and the discharge nozzle of a compressed gas chamber is communicated with the recess for discharging expanding, and thus heat absorbing, gas into the recess for desensitizing the skin tissue area with which the needle of the hypodermic syringe is aligned prior to projection of the syringe and the needle supported therefrom.

The main object of this invention is to provide a mechanical support apparatus for a hypodermic syringe operable to initially support the syringe with its needle closely adjacent an injection site and to thereafter function to project the syringe toward the injection site for penetration of the needle of the syringe into the injection site skin tissue.

Another object of this invention, in accordance with the immediately preceding object, is to provide an apparatus which, during final movement of the supported syringe toward the injection site, will be operative to effect aspiration of the hypodermic syringe.

Yet another object of this invention is to provide an apparatus in accordance with the preceding objects and which will be operable, after aspiration of the syringe, to mechanically advance the piston portion of the syringe in order to discharge the liquid contents thereof through the needle of the syringe.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a perspective view of the invention as seen from the exterior thereof;

FIG. 2 is an enlarged fragmentary elevational view of the invention as seen from the back side of FIG. 1;

FIG. 3 is an enlarged fragmentary vertical sectional view of the hypodermic syringe supporting and operating portion of the invention;

FIG. 4 is an enlarged horizontal sectional view taken substantially upon a plane indicated by the section line 4—4 of FIG. 3;

FIG. 5 is an enlarged horizontal sectional view taken substantially upon the plane indicated by the section line 5—5 of FIG. 3;

FIG. 6 is a fragmentary enlarged vertical sectional view taken substantially upon the plane indicated by the section line 6—6 of FIG. 2;

FIG. 7 is an enlarged fragmentary vertical sectional view taken substantially upon the plane indicated by the section line 7—7 of FIG. 2;

FIG. 8 is a perspective view of some of the disassembled parts associated with the invention and with a disposable type hypodermic syringe in exploded position;

FIG. 9 is a vertical sectional view similar to FIG. 3 but of a modified form of the invention;

FIG. 10 is a fragmentary perspective view of the upper portion of the housing of the modified form of the invention as seen from the rear of FIG. 9;

FIG. 11 is an enlarged fragmentary vertical sectional view taken substantially upon the plane indicated by the section line 11—11 of FIG. 10;

FIG. 12 is a horizontal sectional view taken substantially upon the plane indicated by the section line 12—12 of FIG. 10; and

FIG. 13 is a perspective view of some of the disassembled parts associated with the modified form of the invention.

Referring now more specifically to the drawings, the numeral 10 generally designates a vertically elongated housing including front and rear walls 12 and 14, top and bottom walls 16 and 18 and opposite side walls 20 and 24.

The front wall 12 has an access opening 26 formed therein provided with a hinged closure 28 including an inwardly projecting guide abutment 30 on its inner surface, see FIG. 5. The side wall 22 has an upstanding slot 32 formed therein and the interior of the housing 10 includes a front to rear extending partition 34 dividing the interior of the housing 10 into first and second compartments 36 and 38. The top wall 16 has an access opening (not shown) formed therein closed by removable plug 40 and access to the compartment or chamber 36 may be gained by removal of the plug 40. The chamber 36 is designed to receive a pressurized container such as that disclosed in my co-pending U. S. application Ser. No. 8,366 and accompanying means is provided for opening the outlet valve of such a container to direct a discharge of the pressurized fluid therein through the passageway or port 42 which communicates with an opening 44 formed through that portion of the bottom wall 20 defining the bottom of the chamber 38 whereby the discharged fluid will be directed toward the zone 46 of the skin tissue 48 against which the bottom wall 20 of the housing 10 is placed preparatory to injection operations, see FIG. 3.

With attention now invited more specifically to FIG. 8 of the drawings, there may be seen a conventional form of disposable syringe referred to in general by the reference numeral 50. The syringe 50 includes a barrel 52 having diametrically opposite finger engaging tabs 54 at one end and supporting a hypodermic needle 56 at its other end. A syringe piston or plunger 58 is telescoped into the end of the barrel 52 remote from the needle 56 and also includes diametrically opposite finger engageable tabs 60.

A syringe barrel holder referred to in general by the reference numeral 62 is slidably disposed in the compartment or chamber 38 and includes an outwardly projecting finger engageable tab or projection 66 on its upper end which is slidably received in the slot 32. The front side of the syringe barrel holder 62 is provided with a forwardly opening through slot 68 and vertically spaced internal grooves 70 are also formed in the holder 62 and open into the slot 68. The barrel 52 is receivable in the slot 68 with the tabs 54 received within one of the grooves 70 and the lower end of the holder 62 is provided with a resilient end member 72 for butting the inner upwardly facing surface 74 of the bottom wall 20 about the upper end of the opening 44.

The sides of the holder 62 include vertical slots 76 in which the upper ends of a pair of expansion springs 78 are anchored by means of pins 80 and the lower ends of the expansion springs 78 are anchored in the bottom wall 20 as at 82. Thus, the holder 62 is yieldingly biased downwardly in the chamber or compartment 38 and the guide abutment 30 guidingly engages the barrel 52 of the syringe 50 during its vertical movement in the housing 10.

The rear side of the holder 62 has a vertically extending groove 86 formed therein provided with downwardly facing ratchet teeth 88, see FIGS. 4 and 7 and a holder latching lever 90 is pivotally supported from the rear wall 14 as at 92 and includes a dog tooth 94 projectable through an opening 96 in the rear wall 14 for engagement with the teeth 88 in order to releasably retain the holder 62 in a raised retracted or cocked position against the biasing action of the springs 78.

A syringe plunger holder 98 is also slidably supported within the chamber or compartment 38 in an upper portion thereof and includes an outwardly extending projection 100 which is also slidably received in the slot 32. The holder 98 is provided with a forwardly and downwardly opening recess 102 in which an anchor block 104 is slidingly received for vertical shifting relative thereto and the holder 98 includes opposite side upstanding grooves 106, see FIG. 4 and 8 which are vertically registered with corresponding grooves 108 formed in the upper portion of the holder 62. A pair of elongated expansion springs 110 have their upper and lower ends received in the grooves 106 and 108, respectively, and the upper ends of the springs 110 are anchored in the upper ends of the grooves 106 by means of pins 112 while the lower ends of the springs 110 are anchored to the side wall 32 as at 114 and the partition 34 as at 116, see FIG. 3.

The rear wall 14 has a second opening 118 formed therein and a locking lever 120 is pivotally supported from the rear wall 14 as at 122 and includes a dog end 124 projectable through the opening 118 for engagement with downwardly opening ratchet teeth 126 formed in a groove 128 in the rear side of the holder 98. The rear side of the holder 98 includes a further deeper groove 130 registered with the groove 86 and in which the dog 94 is received when the holder 98 moves downwardly in the compartment 38 in registry with the dog 94.

The abutment block 104 includes opposite side grooves 132 in which all but the upper ends of a pair of short expansion springs 134 are received and the lower ends of the springs 134 are anchored in the lower ends of the grooves 132 by means of pins 136 while the upper ends of the springs 134 are anchored to the upper wall 138 of the holder 98 as at 140. In addition, from FIG. 3 and 8 of the drawings, it may be seen that the abutment block 104 defines a downwardly and forwardly opening slot 142 provided with vertically spaced pairs of inner grooves 144 for receiving the tabs 60 of the plunger or piston 58.

In operation, after the proper amount of fluid has been drawn into the barrel 52 of the syringe 50, the closure 28 is opened and the syringe 50 is placed within the housing 10 with the barrel 52 having its tabs 54 supported from a selected groove 70 after both the holder 62 and the holder 98 have been upwardly displaced toward and latched in retracted positions. Of course, the tabs 60 of the piston or plunger 58 are received in a corresponding pair of the grooves 144. Then, the closure 28 may be closed so as to engage the free end of the guide abutment 30 with the barrel 52. Thereafter, the housing 10 has its end wall 20 applied to the skin or

tissue 48 about the zone 26 and suitable quantities of desensitizing fluid may be discharged through the passage 42 into the opening 44 so as to desensitize the tissue in the zone 46. Thereafter, the locking lever 90 have its upper end displaced inwardly toward the rear wall 14 whereupon the holder 62 will be released for downward movement under the biasing action of the spring 78 to project the syringe downwardly 50 until the resilient end member 72 abuts the inner surface of the end wall 20 and the needle 56 has penetrated the tissue 48 to the desired depth.

Inasmuch as the piston or plunger 58 is frictionally received within the barrel 52 and a partial vacuum is created within the barrel 52 below the plunger 58 to resist upward movement of the plunger 58 relative to the barrel 52, initial downward movement of the barrel 52 tends to carry the plunger 58 downwardly with the barrel 52 independently of any relative movement between the plunger 58 and the barrel 52. However, downward movement of the plunger 58 causes downward movement of the abutment block 104 and thus expansion of the springs 134. Initial expansion of the spring 134 is ineffective to cause relative displacement between the plunger 58 and the barrel 52. Thus, inasmuch as the tip of the needle 56 is initially positioned immediately above the tissue 48, the needle tip penetrates the tissue 48 during initial downward movement of the holder 62 and before any relative movement between the plunger 58 and barrel 52 can occur. However, as the barrel 52 is displaced downwardly toward its lower limit position, the increase in the tension of the springs 134 is sufficient to cause the plunger 58 to lag behind the barrel 52 in its downward movement and therefore aspiration of the syringe occurs in order that logging of the tip of the needle 56 within a vein may be readily observed through the viewing window 146 formed in the closure 28 as blood is drawn into the needle end of the transparent barrel 52.

Subsequent to downward movement of the holder 62 to its limit position and the resultant aspiration of the syringe 50, the lever 120 may have its free end urged toward the rear wall 14 thereby enabling downward movement of the holder 98 in the compartment 38 under the biasing action of the springs 110 whereupon the upper wall 138 of the holder 98 will contact the upper surface 148 of the abutment block 104 to urge the latter, and the plunger 58 supported therefrom, downwardly within the housing 10 relative to the holder 62 and barrel 52. This of course will cause the fluid within the barrel 52 to be injected through the needle 56.

With attention now invited more specifically to FIGS. 9–13 of the drawings, there will be seen a modified form of the invention including many components which are similar to that form of the invention illustrated in FIGS. 1–8 and which therefore are designated by corresponding prime reference numerals.

The holder 62′ disposed in the compartment 28′ of the housing 10′ includes a syringe barrel receiving slot 68′ provided with internal grooves 70′ and thus is capable of supporting the syringe 50′ corresponding to the syringe 50.

However, the holder 62′ includes an upper extension defining an upwardly opening guide compartment 63 in which an abutment member 104′ provided with opposite side grooves 105 is slidably received. The side walls of the upwardly extended portion of the holder 62′ defining the compartment or chamber 63 are provided with shallow grooves 107 with which the lower ends of the grooves 105 are registered and in which the lower ends of a pair of expansion springs 109 are anchored as at 111. The upper ends of the springs 109 are anchored in the upper ends of the grooves 105 by means of anchor pins 113 and the undersurface 115 of the abutment block 104′ abuts the upper end of the plunger 58′.

The rear wall 14′ of the housing 10′ has an opening 96′ formed therethrough and a locking lever 90′ is pivotally supported from the rear wall 14′ as at 92′ and includes a dog end 94′ projectable through the opening 96′ and engageable with the downwardly opening ratchet teeth 88′ formed in the holder 62′. A pair of expansion springs 78′ have their upper ends received in grooves 76′ formed in the holder 62′ and anchored to the holder 62′ as at 80′ whereupon the holder, except when held in a cocked position by means of the locking lever 90′, is spring urged downwardly by the springs 78′. In addition, the abutment block 104′ is provided with downwardly facing ratchet teeth 126′ engageable by a dog end 124′ of a lever 120′ pivotally supported from the holder 76′ as at 122′. The rear wall 14′ additionally includes a slot 127 therein through which the lever 120′ is slidable, see FIG. 12. Accordingly, while the housing 10′ may also be provided with desensitizing means such as that disclosed in my co-pending U. S. application Ser. No. 8,366, operation of the form of the invention illustrated in FIGS. 9–13 is generally similar to that form of the invention illustrated in FIGS. 1–8. The housing 10′ has its end wall 20′ placed against skin tissue which is to be penetrated by the needle 56′ of the syringe 50 after the holder 62′ and the abutment block 104′ have been latched in their retracted positions and the syringe 50′ has been supported from the holder 62′. Thereafter, the contact zone to be penetrated by the needle 56′ may be desensitized and the lever 90′ may have its free end urged toward the rear wall 14′ in order to release the holder 62′ before downward movement under the biasing action of the spring 78′ so as to penetrate the tissue with the needle 56′. Of course, inasmuch as the abutment block 104′ is coupled to the holder 62′ through the latch 120′, the abutment block 104′, holder 62′, syringe barrel 52′ and plunger 58′ all move downward without relative rotation occurring therebetween. After the holder 62′ has reached its lowermost limit position, the free end of the lever 120′ may be urged toward the rear wall 14′ so as to release the abutment block 104′ for downward movement relative to the holder 62′ under the biasing action of the springs 109. This of course will cause the plunger 58′ to be shifted relative to the barrel 52′ and thus the fluid within the barrel 52′ to be injected through the needle 56′.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. In combination, a support, a syringe barrel holder mounted on said support for reciprocal shifting along a predetermined path relative to said support in opposite first and second directions for projecting and retracting, respectively, a needle carried by a syringe mounted on said holder, a syringe plunger holder supported from said barrel holder for reciprocal shifting along said path relative to said barrel holder, means yieldingly biasing said holders in said first direction, first and second deactivatable means for retaining said barrel and plunger holders, respectively, against movement in said first direction relative to said support, said second means including means for yieldingly resisting movement of said plunger holder in said first direction as said barrel holder is moved in said first direction.

2. The combination of claim 1 wherein said second means includes means for freely releasing said plunger holder for movement in said first direction subsequent to movement of said barrel holder in said one direction.

3. The combination of claim 2 wherein said support includes surface means disposed about a target zone centrally through which the free end of said needle is lengthwise advanced during movement of said barrel holder in said first direction, and fluid discharge means carried by said support and operable to discharge fluid toward said zone from a discharge point spaced in said second direction from said zone.

4. The combination of claim 1 wherein said barrel holder includes means for supporting said syringe barrel in adjusted shifted positions along said path relative to said barrel holder.

5. The combination of claim 1 wherein said plunger holder includes means for supporting said syringe plunger in adjusted shifted positions along said path relative to said plunger holder.

6. The combination of claim 5 wherein said barrel holder includes means for supporting said syringe barrel in adjusted shifted positions along said path relative to said barrel holder.

7. In combination, a support, a syringe barrel holder on said support for reciprocal shifting along a predetermined path relative to said support in opposite first and second directions for projecting and retracting, respectively, a needle carried by a syringe mounted on said holder, a syringe plunger holder supported from said barrel holder for reciprocal shifting along said path relative to said support, means yieldingly biasing said holders in said first direction, and first and second deactivatable means for retaining said barrel holder and plunger holder against movement in said first direction relative to said support and barrel holder, respectively, said support including surface means disposed about a target zone centrally through which the free end of said needle supported from a hypodermic barrel carried by said barrel holder is lengthwise advanced during movement of said barrel holder in said first direction, and fluid discharge means carried by said support and operable to discharge fluid toward said zone from a discharge point spaced in said second direction from said zone.

8. In combination, a support, a syringe barrel holder mounted on said support for reciprocal shifting along a predetermined path relative to said support in opposite first and second directions for projecting and retracting, respectively, a needle carried by a syringe mounted on said holder, a syringe plunger holder supported from said barrel holder for reciprocal shifting along said path relative to said plunger holder, means yieldingly biasing said holders in said first direction, and first and second deactivatable means for retaining said barrel holder and plunger holder against movement in said first direction relative to said support and plunger holder, respectively, the first mentioned means including first and second spring means operatively connected between said support and barrel holder and between said barrel holder and plunger holder, respectively, said support including surface means disposed about a target zone centrally through which the free end of said needle is lengthwise advanced during movement of said barrel holder in said first direction, and fluid discharge means carried by said support and operable to discharge fluid toward said zone from a discharge point spaced in said second direction from said zone.

9. In combination, a support, a syringe barrel holder mounted on said support for reciprocal shifting along a predetermined path relative to said support in opposite first and second directions for projecting and retracting, respectively, a needle carried by a syringe mounted on said holder, a syringe plunger holder supported from said barrel holder for reciprocal shifting along said path relative to said barrel holder, means yieldingly biasing said holders in said first direction, first and second deactivatable means for retaining said barrel and plunger holders, respectively, against movement in said first direction relative to said support, said barrel holder including means for supporting said syringe barrel in adjusted shifted positions along said path relative to said barrel holder.

10. In combination, a support, a syringe barrel holder mounted on said support for reciprocal shifting along a predetermined path relative to said support in opposite first and second directions for projecting and retracting, respectively, a needle carried by a syringe mounted on said holder, a syringe plunger holder supported from said barrel holder for reciprocal shifting along said path relative to said barrel holder, means yieldingly biasing said holders in said first direction, first and second deactivatable means for retaining said barrel and plunger holders, respectively, against movement in said first direction relative to said support, said plunger holder including means for supporting said syringe plunger in adjusted shifted positions along said path relative to said plunger holder.

11. The combination of claim 10 wherein said barrel holder includes means for supporting said syringe barrel in adjusted shifted positions along said path relative to said barrel holder.

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