July 3, 1956 J. W. H. UYTENBOGAART 2,752,918

HYPODERMIC INJECTION APPARATUS

Filed May 1, 1952 3 Sheets-Sheet 1

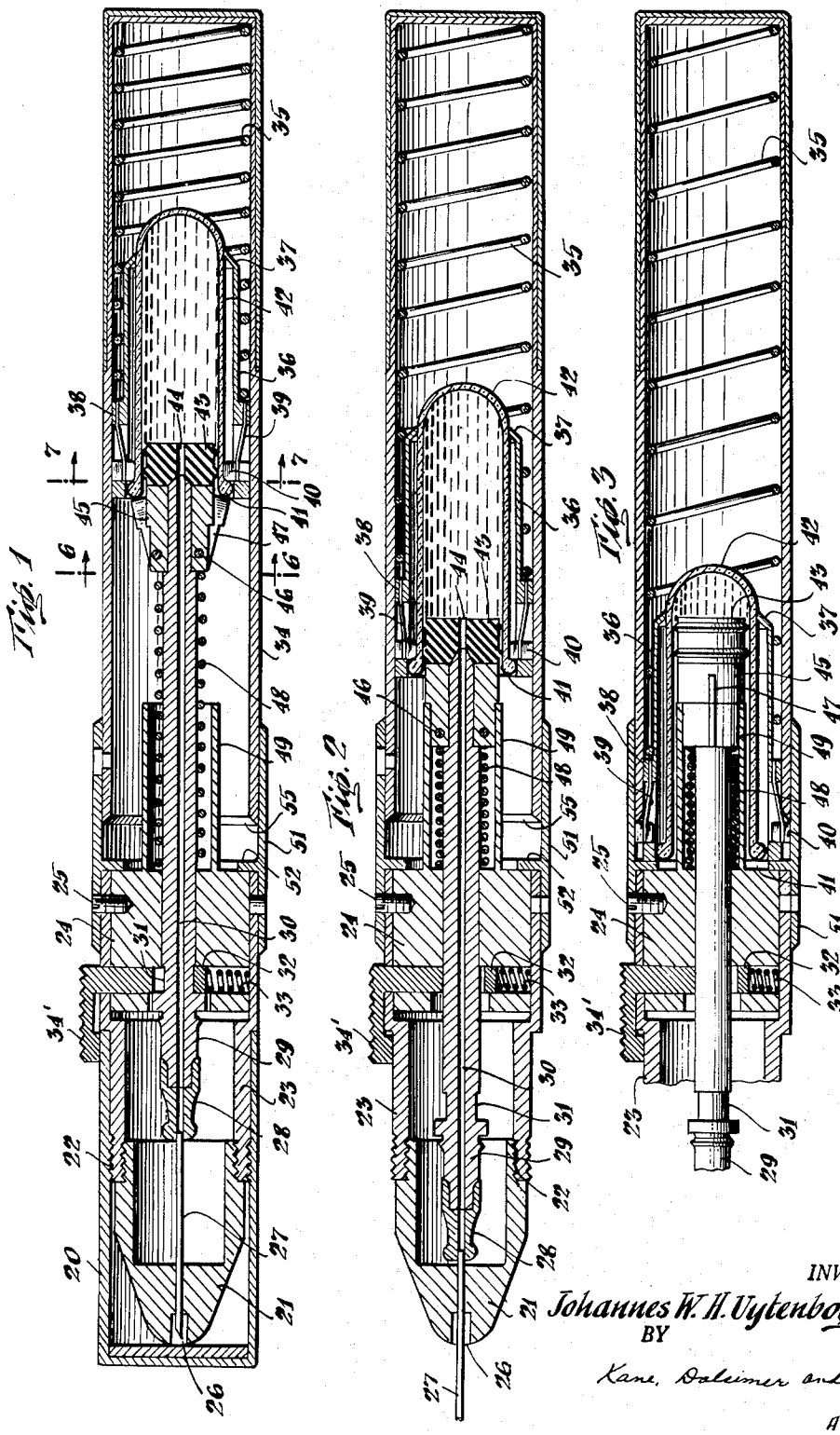

Fig. 1

Fig. 2

Fig. 3

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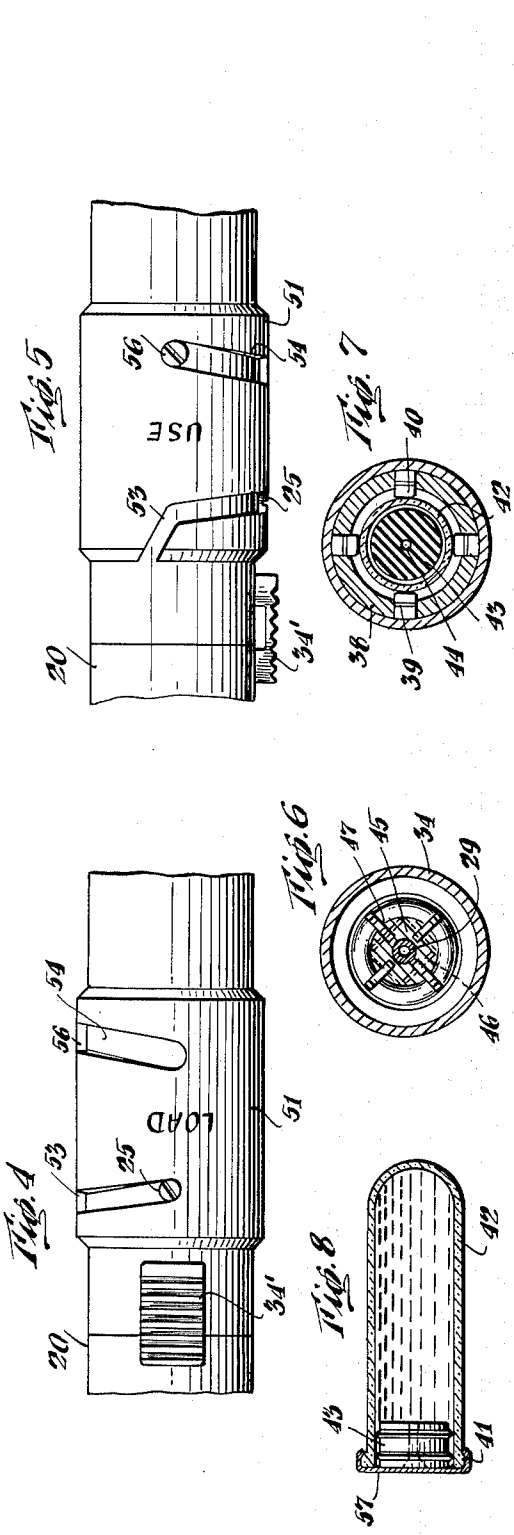
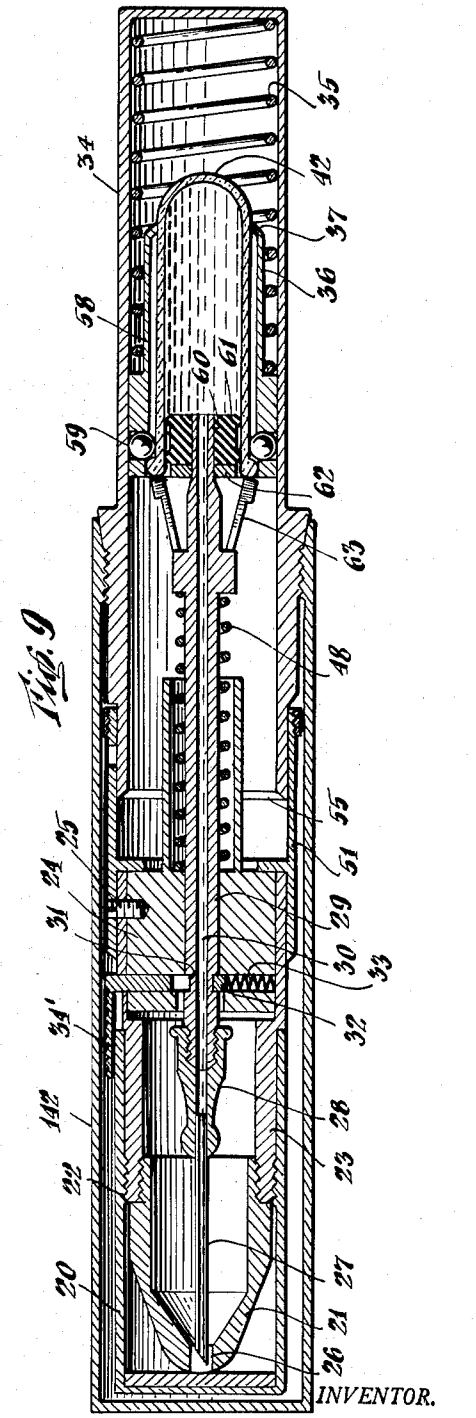
Filed May 1, 1952 3 Sheets-Sheet 2





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HYPODERMIC INJECTION APPARATUS

Filed May 1, 1952 3 Sheets-Sheet 3

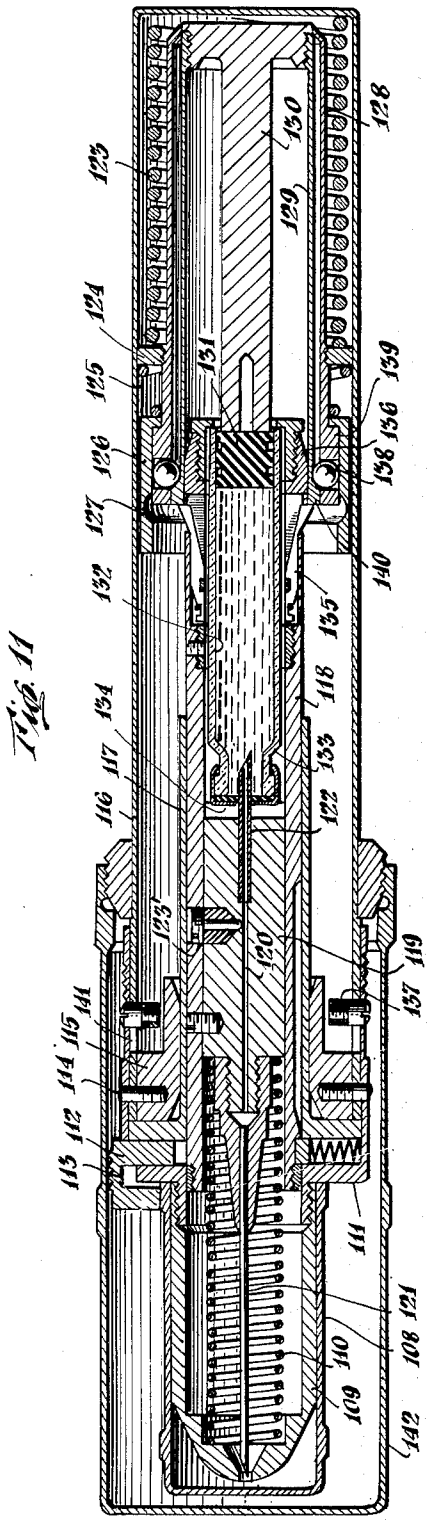

Fig. 11

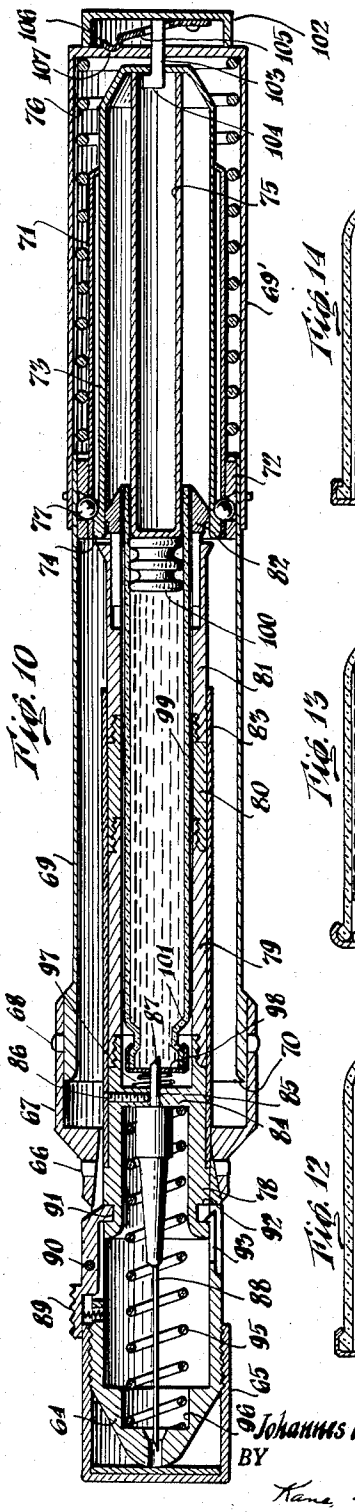

Fig. 10

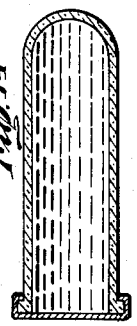

Fig. 14

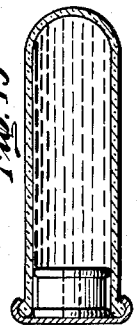

Fig. 13

Fig. 12

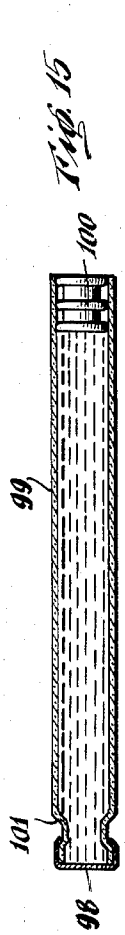

Fig. 15

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HYPODERMIC INJECTION APPARATUS

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Application May 1, 1952, Serial No. 285,389

16 Claims. (Cl. 128—218)

This invention relates to a structurally and functionally improved hypodermic syringe and ampule assembly.

The present application is a continuation-in-part of my prior application for United States Letters Patent on an automatically operated hypodermic syringe filed in the Patent Office on August 17, 1949, and identified under serial number 110,776, now abandoned.

It is a primary object of the invention to furnish an assembly of this nature which will embody a novel structure such that in response to a manual release or firing of the mechanism the epidermis will be penetrated by a needle, medicament will be injected through the bore of that needle and the needle will be automatically withdrawn in a highly desirable and improved manner.

A further object is that of designing a hypodermic syringe which may be readily loaded with or receive an ampule filled with proper medicament and in which the mechanism of the syringe may be easily potentialized to perform the desired sequence of operations as afore outlined.

An additional object is that of providing an apparatus of this nature which will include relatively few parts each individually simple and rugged in construction and capable of ready assemblage to furnish a unitary apparatus 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 the apparatus and showing the same in completely assembled condition;

Fig. 2 is a similar view with the cap removed and the parts projected to effect needle-penetration;

Fig. 3 is a fragmentary sectional view similar to Figs. 1 and 2 but showing the mechanism at substantially the completion of the injection stroke;

Figs. 4 and 5 are fragmentary side elevations showing exterior casing portions indexed substantially 90° with respect to each other;

Figs. 6 and 7 are transverse sectional views taken along the lines 6—6 and 7—7 respectively and in the direction of the arrows as indicated in Fig. 1;

Fig. 8 is a sectional side view of an ampule unit such as may be employed in this assembly;

Fig. 9 is a view similar to Fig. 1 but showing an alternative form of structure;

Fig. 10 is a sectional side view similar to Figs. 1 and 9 but showing a still further form of assembly;

Fig. 11 also corresponds to Figs. 1, 9 and 10 but is illustrative of an additional alternative, and

Figs. 12 to 15 inclusive are sectional side views of ampules involving alternative designs.

Primarily referring to Fig. 1, there is indicated at 20 a housing cap which encloses a nose piece 21 and may have screw threaded connection as at 22 with a sleeve 23. The latter mounts the nose piece 21 again by way of example through screw threads. The rear end of sleeve 23 encloses a body 24 which is secured against

movement with respect thereto by, for example, a set screw 25 and any additional or auxiliary securing means which may be desirable.

Nose piece 21 is conveniently formed adjacent its outer end with a centrally disposed recess 26. Extending forwardly into the latter is a hypodermic needle 27, the body of which is normally housed within the nose piece 21 and sleeve 23. The rear end of this needle is secured to a hub 28 which is in turn mounted on the forward end of a stem 29. That stem is bored as indicated at 30 and this passage preferably communicates and is aligned with the bore of cannula 27. Stem 29 is conveniently notched as at 31. In line therewith, it is encircled by a plate 32 spring pressed as at 33 and terminating in an actuating portion 34' the outer surface of which is conveniently roughened or serrated. It is apparent that when the parts are in their normal position as shown in Fig. 1, plate 32 riding within a slot formed in body 24 will bear against the side of notch 31 and thus prevent any axial movement of stem 29 with respect to sleeve 23.

A second sleeve 34 is disposed to the rear of sleeve 23 and connected thereto in a manner hereinafter described to provide a casing. This sleeve 34 has its end closed and is provided with a spring 35 which has its rear end bearing against that closed portion and its forward end acting against the forward flange of a chuck or ampule-receiving member 36. That member has its rear end preferably constricted as at 37 to provide a guiding portion for engagement with the surface of the ampule. The chuck is formed with openings across which an annular series of springs 39 extend. These springs carry at their outer ends pawls 40. As shown in Fig. 1, they engage to the rear of bead 41 formed at the forward end of an ampule 42. The latter has its rear end closed. It contains medicament and its forward end is obstructed by a piston type stopper 43.

This stopper is provided with a bore 44 and its outer face may be formed with a seat to receive the reduced end portion of stem 29 with the bore 30 of the latter aligning with the bore or opening 44 of the stopper. Adjacent the reduced rear end of stem 29 a plunger portion 45 is mounted. This plunger portion may be formed with longitudinally extending slots pivotally mounting as at 46 a plurality of dogs 47. The latter normally occupy positions at which they extend beyond the surface of the plunger head 45 by means of springs (not shown).

A spring 48 encircles stem 29 and has its opposite ends bearing against the opposed faces of plunger head 45 and body 24. Extending from that body and conveniently integral therewith, is a tube 49. This tube is concentrically disposed with respect to stem 29 and defines a space such that plunger head 45 may be accommodated within its bore. So accommodated, dogs 47 will cam against the rear edge of tube 49 and be swung to retracted position where their outer edges are substantially co-extensive with the adjacent surfaces of plunger head 45. The resistance value of spring 48 is substantially less than that of spring 35. It is to be understood that the expansive force exertable by the latter is sufficient to project the chuck 36 and the parts associated therewith to a point adjacent the rear wall or face of body 24 and to fully compress spring 48.

A collar 51 connects sleeves 23 and 34. This collar has an internal diameter such that it may accommodate the adjacent ends of such sleeves. Body 24 may abut an inwardly extending flange 52 forming a part of the collar. As previously brought out, this body portion is retained against movement with respect to sleeve 23 by securing elements such as 25. The collar is formed with any desirable number of spirally extending slots 53 and 54 to accommodate a corresponding number of these securing elements. In order to avoid unnecessary complication in the

illustration in Figs. 4 and 5, only a single pair of these slots have been shown. As will be noted, they are opposed to each other and slot **53** extends through to the edge of collar **51**. The forward edge of sleeve **34** presents an outwardly beveled surface as at **55**. Rearwardly of that edge, this sleeve mounts one or more securing elements **56** as afore stated. As shown especially in Fig. 5 this securing element rides within slot **54**.

Thus, it is obvious that by rotating the collar from the position shown in Fig. 4 to a position at which the securing element or bolt **25** is in line with the outer end of slot **53**, casing section or sleeve **34** may be detached from sleeve **23**. Under these circumstances, collar **51** will remain attached to the former sleeve. Conversely, if securing element **25** is aligned with the open end of slot or slots **53** and collar **51** is rotated in a reverse direction, the pin or bolts **25** and **56** will cam against the edges of the slots to draw the sleeves towards each other. This action will continue until sleeve **23** and the parts associated therewith are telescoped to a maximum extent within collar **51**. Under those conditions, flange **52** will lie adjacent the rear face of body **24**. The beveled edge **55** of sleeve **34** will be spaced from that flange. With cap **20** enclosing nose piece **21** the rear edge of the former will intervene the sleeve **23** and the extended actuating portion **34'** of latch **32**. Therefore, that latch may not be released to bring its opening to a position at which stem **29** may pass therethrough. Therefore, stem **29** will be retained against movement with respect to the parts therein.

Considering the operation of this mechanism, it will be assumed that the parts thereof are assembled and in the positions shown in Fig. 1 and that ampule **42** is filled with medicament. If now cap **20** is removed from the sleeve **23**, nose piece **21** will be exposed and the recess **26** of the latter can be disposed above the surface of the tissue to be injected. With removal of the cap, the latch may be released. This is achieved by pressing against the actuator portion **34'** to shift the plate **32** to a position at which its orifice is concentrically disposed with respect to the surface of stem **29**. Under these circumstances, spring **35** which is under compression will be free to function as a power means and expand because of the release of restraint against stem **29**.

As spring **35** expands it will shift chuck **36** to the left as viewed in Fig. 1. This will be because the forward end of the spring bears against flange portion **38** of the chuck **36**. The latter together with the contained ampule will move in unison because the inner ends of pawls **40** bear against bead **41** of the ampule by reason of the inward pressure exerted by springs **39** extending through the slots in the forward end of the chuck assembly. The pressure exerted by spring **35** will also be transmitted to stem **29** because of the dogs **47** which bear against the forward edge of the ampule. It follows that cannula **27** will be projected beyond the nose piece and with the parts properly proportioned that projection will result in a penetration of the tissues to the desired depth. This position of the parts has been shown in Fig. 2.

There has been illustrated in that view the fact that dogs **47** have cammed against the rear edge of tube **49** so that these elements are retracted with respect to the actuating head **45** and therefore no longer bear against the outer edge of the ampule. It will be incidentally noted that spring **48** has now been fully compressed incident to the shifting of the parts from the position shown in Fig. 1 to that illustrated in Fig. 2. In any event, with the ampule assembly free to move with respect to actuating head **45**, the latter will cause piston stopper **43** to shift rearwardly within the ampule body. This will result in the liquid medicament within the ampule being expressed through bore **44** of stopper **43** and bore **30** of stem **29** as well as the bore of the cannula. The latter having reached its maximum depth of tissue-penetration, it follows that the medicament will be injected and this action of the parts

will continue until piston stopper **43**, under the urging of spring **35**, reaches a position substantially fully retracted within the body of ampule **42**. This has been shown in Fig. 3.

It will be observed in the latter figure that pawls **40** have ridden in contact with and beyond the bevelled edge portion **55** of the rear sleeve **34**. Therefore they have moved outwardly under the action of springs **39**. This will have caused the inner portion of the pawls to move from positions to the rear of bead **41** of the ampule. In other words, the clutch structure which has heretofore been operative to maintain the ampule in a forward position within the chuck will now become inoperative. Therefore, while the chuck assembly will remain in the projected position shown in Fig. 3, the stem **29** and ampule **42** as well as the parts included in these assemblies will under the urging of spring **48** move rearwardly. This rearward movement will continue until stem **29** has reached its fully retracted position. In such position the needle **27** will be completely withdrawn from the tissues. Also, latch plate **32** under the urging of spring **33** will have shifted to a point at which the notch **31** of the stem accommodates the adjacent plate portions. It follows that no further shifting of the stem and its associated parts will occur with respect to sleeve **23**.

The operator by now turning collar **51** to a position at which the bolt or other projection **25** may be withdrawn from slot **53** will be able to separate sleeve **34** from sleeve **23**. Under these circumstances, the chuck structure will be exposed so that the spent or discharged ampule may be withdrawn and discarded. A fresh ampule is now positioned within the chuck. With the latter shifted rearwardly so that the pawls **40** are beyond the bevelled surface **55**, these pawls will engage to the rear of the ampule bead **41** as shown in Fig. 1. It is to be remembered that stem **29** is maintained in retracted position. Therefore, the operator in reassembling the parts will bring the actuating head **45** to a position in line with the piston stopper **43**. So aligned dogs **47** will bear against bead **41** and by telescopically disposing sleeve **23** with respect to collar **51**, stem **29** will force the chuck rearwardly to a position at which spring **35** is properly compressed. As the collar **51** is rotated through its final stages, to lock the parts, the camming action exerted by slots **53** and **54** will cause a slight retractive movement on the part of piston **43** until further shifting is arrested by the dogs **47** engaging bead **41**. That slight movement will cause liquid medicament to pass through bores **44**, **30** and the bore of the cannula so that air will be evacuated from these passages. With cap **20** again applied in position the relationship of the parts will be reestablished and the apparatus will be ready for a second operation.

As will be understood the specific configuration of the ampule might be varied in numerous particulars as might also its capacity. Preferably the parts of this assembly are properly sterilized and the medicament is placed within the body of the ampule in sufficient quantity to provide the desired dosage. Thereafter, the piston stopper **43** is disposed adjacent the open mouth of the ampule. The sterility of the parts is maintained by providing, for example a cap or protective layer **57** of any suitable material which overlies the face of stopper **43**. It is apparent that prior to placing the ampule in association with the chuck this protective strip or cap is removed and discarded. It will also be apparent that the ampule may be formed of any desired material such as glass and that the stopper thereof is preferably formed of a synthetic or natural rubber. Likewise the several parts of the injecting mechanism may be formed of any desired materials such as suitable metals and/or plastics.

In Fig. 9 an apparatus has been illustrated which largely follows the structure shown in Figs. 1 to 7. For this reason, similar reference numerals have been used to designate corresponding parts. However, as will be seen in this figure, the structure of chuck **58** has been modified

in comparison to the structure of chuck 36. More particularly, instead of being provided with longitudinally extending openings through which springs 39 and pawls 40 extend, the chuck 58 is formed with an annular series of openings within which spheres 59 may be disposed. These openings may be constricted adjacent their inner ends to retain the balls. These spheres bear against the outer surface of the ampule and the inner bore surface of sleeve 34. The rear end of the stem 29 is tapered and reduced as indicated at 60 to extend through the enlarged bore of piston stopper 61. In advance of that stopper, a plate 62 is provided. This is formed with an opening of a diameter adequate to accommodate the reduced end portion of the stem. Therefore, when the stem has penetrated the stopper to the position shown in Fig. 9, further relative movement in a rearward direction is prevented. Also, in lieu of the actuating head 45 and series of dogs 47 a plurality of swinging spring arms or pawls 63 are provided to bear against the outer edge of the ampule.

As will be appreciated the operation of the parts is substantially identical with that heretofore described. Briefly summarized, the main spring will function as a power means to project the chuck and ampule carried thereby from the position shown in Fig. 9 to a position at which the needle has penetrated the tissues to the desired depth. At that moment spring arms 63 will cam against the rear edge of the tube into which spring 48 extends and be swung to retracted positions such that they may enter the tube. So retracted, the pressure of the main spring will be free to project the ampule with respect to stopper 61 which will cause an expulsion of the medicament. At the extreme of this stroke, the clutch structure provided by the spheres 59 will become inoperative because these spheres or balls will have overridden the bevelled edge 55. Therefore, the ampule will be disconnected from the main spring and incident to the action of spring 48 will shift rearwardly as a unit with stem 29 to cause a withdrawal of the needle from the injected tissues.

Now referring to the structure illustrated in Fig. 10, it will be seen that the numeral 64 indicates a nose piece to which a cap 65 may be applied. Pins or projections 66 are carried by collar 67; further slots in that collar cooperating with pins 68 extending from casing assembly 69. These slots are opposed to each other in the manner shown in Figs. 4 and 5 and have open end portions (similar to slot 53) extending through to the edges of the collar. In this manner, casing 69 is detachably coupled with the collar which is in turn detachably coupled to the nose piece. The forward edge of the casing 69 provides a bevelled surface 70 which is spaced from the adjacent rear face of the collar.

A chuck member 71 adjacent the rear end of casing 69 is formed with an outwardly extending flange portion 72. A cup-shaped member 73 is provided with a forward bead or flange 74. This cup member has extending outwardly from its base a piston rod 75. A spring 76 is interposed between flange 72 of the chuck member and the rear end of casing 69'. Flange 72 is formed with an annular series of perforations which receive a corresponding number of spheres or balls 77. As shown, these elements bear against the outer face of cup 73 and the inner face of casing 69, to also engage the bead 74. The openings are tapered in an inward direction so that inward movement of the spheres 77 is limited.

A slidable member preferably embracing a forward section 78, intermediate sections 79, 80 and 81 and a rear headed section terminating in pawls 82, constitutes an ampule receiving chamber. This member might of course be made of a lesser number of sections. However, by providing a plurality of parts, the length of the bore defined may be varied to accommodate ampules of greater or lesser length. The slidable member is encircled by a tube 83 carried by nose piece 64. The forward section 78 of the slidable member conveniently presents a transverse partition 84 provided with a passage 85 the area of which may be varied by projecting and retracting a screw 86 functioning as a valve. Extending from the inner face of partition 84 is a piercing needle 87. Extending from the opposite face of that partition is a mounting portion supporting the hub of a needle 88. The bores of needle 87, passage 85 and cannula 88 are preferably aligned. In any event, they are in communication with each other.

In common with the design of earlier structures it is preferred that the cap 65 embody a safety provision. To this end it underlies the actuating portion 89 of a lever pivotally mounted as at 90 and furnished with a latch portion 91. The latter extends into a groove 92 formed in section 78. Also extending into this groove are one or more pawl elements 93. It will be apparent that with cap 65 in position the actuating portion 89 may not be shifted against the action of its spring. A spring 95 exerting less expansive force than spring 76 is interposed between the outer end of nose piece 64 and partition 84. Conveniently the inner face of the nose piece may be recessed as at 96 to accommodate the end of the spring.

The ampule for use with an apparatus such as has been shown in Fig. 10 has been illustrated in Fig. 15 and has its forward end engageable with the needle 87 as it is slipped into the receiving compartment defined by the slidable member. Preferably and as shown the rear needle 87 may be encircled by a spring 97 offering a minor degree of resistance but nevertheless effective to urge cap 98, which has been penetrated, in a rearward direction to accordingly shift the body of the ampule 99. The latter has its rear end open and receives a piston type stopper 100. Adjacent its forward end the ampule is preferably constricted as indicated at 101. As shown the length of the ampule is such that it may be effectively housed within the slidable member with rod 75 in engagement with the rear face of piston stopper 100. As previously brought out, the parts may be reproportioned and the length of the slidable member may be changed to receive ampules having a lesser or greater length than that illustrated in Fig. 15.

Conveniently at the rear end of the syringe a safety catch is provided. As shown, this will prevent a forward or projecting movement on the part of the chuck assembly and the mechanisms associated therewith. Such catch may take one of numerous different forms. As shown, it embraces a knob 102 rotatably mounted adjacent the outer rear face of casing 69' and provided with a stem 103 extending through an opening in that rear wall and an opening in the adjacent wall of the cup-shaped member 73. Secured to its inner end is a cam 104 which rotates as a unit with the stem and enters through the latter opening. A detent structure may be provided by employing a spring 105 secured to the inner face of cap 102 and bearing into an opening 107 formed in the end wall of the casing. When this spring thus bears, an accidental rotation of the parts will be prevented and the assembly engaged by cam 104 will be secured against movement. However, by simply turning cap 102 the cam may be shifted to released position.

Assuming that such shifting has occurred and the parts are assembled in the manner shown in Fig. 10, then it will be appreciated that an operator may use the apparatus by simply removing cap 65 and disposing the outer end of nose piece 64 in engagement with the epidermis overlying the tissues to be injected. If now actuator 89 is rocked around its pivot 90, latch 91 will be released from groove 92. With such release slidable member 78—81 will be projected under the influence of the power means provided by spring 76. This will occur because the spring is bearing against flange 72 and is in a compressed condition. The clutch structure provided by the balls or corresponding elements 77 will thrust against cup member 73 and especially the bead portion 74 thereof. That bead portion being in line with pawls 82, this thrust will be transmitted to the latter. These pawls forming parts of the sliding member assembly, that member will be shifted

to the left as viewed in Fig. 10. The initial phase of shifting will result in a projection of needle **88** so that the epidermis is pierced and with continued projection, the needle will penetrate the tissues to the desired depth.

Outward movement of the sliding member is of course arrested by the forward end of the same moving to a point in contact with the rear face of the outer wall of nose piece **64**. During the projection of the sliding member, spring **95** will have been compressed. Simultaneously with the needle reaching its full depth of penetration, dogs **82** will have the cam portions adjacent their outer ends ride into engagement with the rear edge of tube **83**. This will release the coupling between these dogs and the chuck assembly. Accordingly with the sliding member stationary and projected to a maximum extent, that chuck assembly may continue to move under the urging of spring **76**.

With the chuck assembly free to move with respect to the sliding member it will carry with it rod **75**, which acting against piston **100**, will shift the latter within the body of ampule **99** to thus express medicament through the bores of needles **87** and **88** and the intervening bore **85** of partition **84**. The speed of injection of the medicament may of course have been regulated by, for example, the valve structure provided by screw threaded member **86** in cooperation with bore **85**. This cooperation of the parts will continue until substantially all medicament has been discharged. Stopper **100** will have moved to a point adjacent the constriction **101** of the ampule and shifted the latter against the action of spring **97**. At that instant flange **72** of the chuck assembly will have reached a point adjacent the central area of collar **67**. Accordingly, the spherical elements **77** will have ridden over edge **70**. This will render inoperative the clutch structure between cup **73** and chuck **71**. Therefore, under the influence of spring **95** the slidable member will now be free to retract thereby withdrawing the needle from the tissues. In such retraction too great a movement of the nose piece will be prevented by the latch **91** and pawls **93** engaging the edge of groove **92**.

With the completion of this sequence of operation collar **67** may be rotated to disconnect casing **69** from nose piece **64**. Due to spring **97**, no difficulty will be experienced in removing the spent ampule from the bore of the sliding member and replacing the same with a fresh ampule. By shifting flange **72** with respect to cup-shaped member **73** spheres **77** may be caused to again assume positions to the rear of bead **74**. Therefore, as dogs **82** engage against the forward edge of cup member **73** they will cause the entire chuck assembly to move rearwardly within casing **69'** to compress spring **76**. This action will continue until pins **66** and **68** enter the bayonet or other slots provided as part of collar **67**. As the latter is rotated around the axis of the assembly a camming action is set up such that the parts are drawn into proper positions. During this movement, it is apparent that rod **75** in engagement with piston **100** will cause a bodily shifting of the ampule, such that needle **87** will penetrate the closure **98** and spring **97** will be compressed. Due to the minor degree of resistance offered by the latter, such shifting and penetration will not cause a movement of the piston in the ampule body. During the final stages of turning of the collar **67** the piston will however be given a slight movement which will result in an expulsion of medicament through the bores of needles **87** and **88** and the intervening bore **84** so that all air will be voided.

In the structure shown in Fig. 11 a cap **108** is preferably employed to protect the nose pice **109**. The latter encloses a spring **110** and has secured to it a sleeve **111**. That sleeve is provided with a space to accommodate a slidably mounted latch plate **112** provided with an actuator **113**. Preferably and in common with the earlier structures the extension **113** may bear against the cap **108** so that when the latter is in position, the latch may not be released against the tension of the spring associated with the same. Sleeve **111** is secured by, for example, bolts **114** to a body portion **115** which is in turn attached to a rearwardly extending casing **116**. Interposed between the body portion **115** and the sleeve is the end flange of a tube **117** which is thus held in position.

The latter slidably accommodates a bored member **118** within which a unit **119** is secured. This is formed with a duct or bore **120** and provides at its outer end a mounting for the hub of a needle **121**. Adjacent its inner end it mounts a piercing needle portion **122**. The bore **120** is aligned with the bore of cannula **121** and **122**. A valve structure controlling the flow of medicament through these bores is conveniently furnished by adjustably mounting a stem **123'** on member **118** and having this stem extend through to bore **120**.

Within the rear end of casing **116** a power means in the form of spring **123** is disposed. The expansive force of this spring is substantially greater than that of spring **110** and may in fact be many times greater. This spring has its rear end bearing against the end wall of the casing and its forward end bears against a ring **124**. A spring **125** is arranged in advance of ring **124** and embodies sufficient strength to maintain a sleeve **126** normally spaced therefrom in the manner shown in Fig. 11. Sleeve **126** is conveniently formed with a recess **127** which may take the form of an annular depression in its inner face. A clutch assembly including an outer collar **128** and an inner cup-shaped member **129** is disposed within the rear end of the casing and provides a stem or rod **130** which bears against the piston stopper **131** of an ampule **132**. The latter in common with the ampule shown in Fig. 15 preferably embraces a constricted portion **133** adjacent its forward end and the open mouth of that latter end is closed by a seal **134**. The overall diameter of the ampule is such that it may be accommodated within the bore of slidable member **118** and have its forward end disposed near the rear end of unit **119**.

Adjacent the rear end of slidable member **118** there are a series of dogs or pawls **135**. These may be secured in any desired position and have their rear ends extending beyond the face of slidable member **118**. To the rear of these dogs the slidable member may mount a retaining assembly **136**. The latter terminates in an apertured member the opening of which has a diameter less than the diameter of ampule **132** but in excess of rod **130**. Accordingly, the ampule will be retained in association with slidable member **118** when the assembly **136** is in position. Adjacent the body **115** and mounted preferably by the casing **116** are a series of stops **137**. These extend into the path of travel of sleeve **126**. It will finally be noted in connection with this portion of the assembly that balls **138** are disposed in an annular series of openings formed in the flange **139** of collar **128** and that cup **129** terminates in an outwardly extending flange **140** the diameter of which is such that it would be engaged by the rear end of pawls **135** when the latter are in their normal position as shown.

Now considering the operation of the apparatus as described and shown in connection with Fig. 11, it will be understood that with the parts in the position illustrated and nose piece **109** exposed, the operator—after bringing that nose piece to the desired position—may press against actuator **113** to thus align the aperture of the latter with respect to the slidable member **118**. Accordingly, the latter is released for movement. Such movement will occur under the action of the power means or spring **123** pressing against ring **124** to shift the chuck assembly including the piston **130** to the left as viewed in this figure. The ampule **132** will be likewise shifted because of the engagement of pawls **135** with the forward bead of edge portion **140** of cup **129**. As needle **121** reaches its fully projected position, spring **110** will be fully compressed. The rear ends of pawls **135** will enter tube **117** and thus be rocked inwardly. Incident to that movement, the

chuck assembly will be freed from exerting thrust against slidable member **118**. With such freeing and under the action of spring **123**, the chuck assembly will be projected with respect to the ampule thus causing piston stopper **131** to discharge medicament through the needle portion **122** and so through the bore of cannula **121**.

This action will continue until sleeve **126** has reached a position in contact with stops **137**. Simultaneously stopper **131** will engage constriction **133** to arrest movement of the chuck. Thereupon spring **123** will continue to urge and move ring **124** and member **128** with respect to sleeve **126**. With that shifting the balls **138** or equivalent members will move into the recess **127**. Therefore, they will be retracted from behind the flange **140**. Accordingly the clutch structure will become inoperative to cause spring **123** to retain sliding member **118** in projected position. Under these circumstances spring **110** will shift that member together with needle **121** and the associated parts rearwardly. This will withdraw the hypodermic needle from the tissues after the completion of the injection stroke.

The couplings between the bolts providing the stops **137** and sleeve **111** may embrace bayonet slots **141** or slots which have openings terminating in the edge portion of one of the parts of the assembly. Of course other coupling means might be employed. In any event after the operation of the apparatus as afore described, casing **116** is detached from the parts associated with the nose piece. The spent ampule **132** is withdrawn by dismounting the outer element of the assembly **136**. A new ampule is placed in position. The reestablishment of the clutch portions involving the chuck assembly, sleeve **126** and associated parts is reestablished by gravity, manually shifting the parts or otherwise in the same manner as in the case of the mechanism shown in the preceding figures. Now as the casing **116** is again connected to the nose piece the ends of pawls or dogs **135** will bear against a flange **140** of cup **129** and force the same rearwardly together with flange **139** of member **128**. This will result in a similar movement on the part of ring or collar **124**. Accordingly, spring **123** will be compressed. This compression will continue until the final stages of tightening of the parts at which time piston rod **130** will project piston stopper **131** to a slight degree, such that air within the bores of the cannula is vented and these bores are filled with liquid medicament.

When the apparatus is not in use, sterilization of the parts may be maintained by introducing any suitable quantity of liquid such as alcohol or suitable fluid vapor within the mechanisms. To this end and as shown especially in Figs. 11 and 9 enclosing caps or shields **142** may be applied. As afore brought out the ampule shown in Fig. 8 is primarily the type for employment in connection with the mechanism shown in Figs. 1 to 3 inclusive. The ampule shown in Fig. 13 is of the type primarily intended in use in connection with apparatus as shown in Fig. 9. The ampule of Fig. 13 corresponds to the one shown in the assembly in Fig. 10 and by modifying the length of the same furnishes an ampule suitable for use in mechanisms such as are shown in Fig. 11. The ampules illustrated in Figs. 12 and 14 exemplify structures which are suitably modified according to the needs of the manufacturer but which will still achieve the functional results desired.

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

I claim:

1. A hypodermic injection apparatus including in combination a body, a support movably associated with said body to mount a hypodermic needle and medicament-containing member operatively connected with each other,

power means within said body and connected with said support for effecting a projection thereof, manually controlled means carried by said body for releasing said support for projection, a cap mounted by said body and said cap—when mounted—obstructing said manual means to prevent such release.

2. A hypodermic syringe for automatically performing injections into human and animal bodies and designed for use with a removable rigid therapeutic-containing ampule, the combination comprising a casing, slidable ampule-carrying means in said casing, needle carrying means provided with a passage from an ampule to a needle carried thereby, therapeutic-expelling means slidably mounted relative to said ampule operable to expel therapeutic from said ampule through said needle, first spring means, means to energize and means to release said first spring means, second spring means engaging said needle-carrying means energizable by forward movement of said needle-carrying means, coupling means to connect automatically said first spring means with the ampule in its slidable ampule-carrying means, the needle-carrying means and the therapeutic-expelling means, so that when said first spring means is released, the ampule-carrying means and needle-carrying means move in a forward stroke energizing said second spring means, the first part of said forward stroke being the needle-inserting stroke, automatic means to disengage at the end of said first part of said forward stroke, the needle-carrying means and to maintain it in its advanced position thereby maintaining the second spring means in energized condition, and to disengage from each other the ampule and its carrying means, the therapeutic-expelling means causing during the second part of the forward movement of said coupling means a relative displacement between said ampule in its carrying means and said therapeutic-expelling means so as to expel therapeutic through said needle, said second part of the forward movement of said coupling means constituting the injection stroke proper, automatic means to disengage at the end of said second part of the forward movement said needle-carrying means from said coupling means releasing thereby said second spring means so as to move backward said needle-carrying means, said movement constituting the needle-retracting stroke; said first spring means consisting of an axial coil spring resting with its rear end against the bottom of a barrel constituting the rear part of the syringe casing, and permanently engaging with its forward end the coupling means, the second spring means consisting of an axial coil spring less powerful than the first one and mounted in opposition thereto, said second spring resting with its forward end against the syringe head forming the removable front part of said syringe casing, and permanently engaging the needle-carrying means with its rear end.

3. A hypodermic syringe as in claim 2 wherein the coupling means to connect automatically the first spring with the ampule in its slidable carrying means, the needle-carrying means, the therapeutic carrying means and the second spring means, includes an annular chuck slidable in the casing of the syringe and having inwardly protruding pawls located in corresponding radial holes of the chuck body, said pawls being urged in outward direction and resting against the inner cylindrical surface of said casing.

4. A hypodermic syringe as in claim 2 having means to stop the chuck at the end of the stroke of the first coil spring consisting of an inwardly extending collar of the intermediate part.

5. A hypodermic syringe as in claim 2 and having a protective cap removably fixed onto the head of the syringe and engaging the releasing means so as to act as a safety catch to prevent the operation of the syringe when said cap is in position.

6. A hypodermic syringe as in claim 5 provided with

a removable cap screw-threadedly mountable on the syringe barrel to enclose hermetically the mechanism.

7. A hypodermic syringe as in claim 2 for use with a rigid tubular ampule open at one end and having adjacent said end an external collar with a straight rear face, wherein the pawls adapted to engage the rear face of said collar are block shaped members slidable in radial holes of the chuck and provided with spring means urging them in outward direction.

8. A hypodermic syringe as in claim 3 having means arresting the forward movement of the needle-carrying means and the therapeutic-expelling means at the completion of the first part of the stroke of the first coil spring comprising a radial extension of the chuck adapted to abut against the rear face of the fixed tubular means.

9. A hypodermic syringe as in claim 8 having therapeutic-expelling means, said means consisting of a piston mounted at the rear end of the rearward tubular extension of the needle-carrying means adjacent the chuck with which said tubular extension is provided, said chuck having a diameter slightly less than the inner diameter of the ampule, said piston having an axial channel forming the prolongation of the channel of said tubular member.

10. A hypodermic syringe as in claim 9 having passage means for therapeutic from the ampule to the needle, said passage means consisting of a tube with a bevelled rear end, said tube extending in a rearward direction from the needle-carrying means so as to pierce the pierceable cap at the front end of the ampule and to penetrate into the ampule when the ampule is inserted into the ampule-carrying means.

11. A hypodermic syringe as in claim 10 having the coupling means engaged by the first coil spring comprising an annular chuck provided with an inwardly flanged sleeve-like extension slidably associated with a tubular member, and having adjacent its front end, an external collar releasably engageable by the pawls of the chuck carrying the therapeutic-expelling means, said pawls being urged in an outward direction against the inner surface of the casing and releasing said tubular member at the end of the forward stroke of the first coil spring by moving into an annular recess in the casing.

12. A hypodermic syringe as in claim 11 having means to arrest the forward movement of the needle-carrying means and of the ampule-carrying means comprising an external collar of the ampule carrying means located between its rear end and the pawls, said collar having its outer diameter greater than the inner diameter of the tubular means so as to abut against the rear face of said means at the end of the first part of the expanding stroke of the first coil spring.

13. A hypodermic syringe as in claim 2 for use with a rigid tubular ampule provided at its front end with a pierceable cap and at its rear end with a slidable piston, the syringe being provided with slidable ampule-carrying means having a rearward tubular extension of the needle-carrying means with passage means for therapeutic from the ampule to the needle including a tube with a bevelled rear end extending in a rearward direction from the needle-carrying means, said syringe further being provided with an annular chuck having an inwardly flanged sleeve-like extension slidably associated with a tubular member carrying the therapeutic-expelling means, said means consisting in a piston pusher projecting in forward direction from the bottom of said tubular member to engage the piston slidably associated with the ampule.

14. A hypodermic injection apparatus including in combination a casing having an open end, a needle-carrying member projectable within said casing towards the open end of the same, an ampule support, clutch means shiftable with and coupling said support to move in unison with said carrying member, a piston-shifting element to cause expulsion of liquid from an ampule carried by said support, power means for projecting said support, element and needle-carrying member as a unit to cause a needle associated with the latter to be exposed beyond said casing, and means connecting said power means with said piston-shifting element to thereupon cause relative movement between said ampule support and piston-shifting element.

15. A hypodermic injection apparatus including in combination a casing having an open end, a needle-carrying member projectable within said casing towards the open end of the same, an ampule support, clutch means shiftable with and coupling said support to move in unison with said carrying member, a piston-shifting element to cause expulsion of liquid from an ampule carried by said support, power means for projecting said support, element and needle-carrying member as a unit to cause a needle associated with the latter to be exposed beyond said casing, means for thereupon arresting further movement of said ampule support and means connecting said power means to said piston-shifting element to thereafter move the latter with respect to said ampule support.

16. A hypodermic injection apparatus including in combination a casing having an open end, a needle-carrying member projectable within said casing towards the open end of the same, an ampule support, clutch means shiftable with and coupling said support to move in unison with said carrying member, a piston-shifting element to cause expulsion of liquid from an ampule carried by said support, power means for projecting said support, element and needle-carrying member as a unit to cause a needle associated with the latter to be exposed beyond said casing, a spring arranged in opposition to said power means to be compressed during the projection of said needle-carrying member, means connecting said power means to cause relative movement between said ampule support and piston-shifting element upon said clutch means being rendered inoperative, means causing a release of said clutch means after the movement between said ampule support and piston-shifting element to disconnect the latter from said power means and said spring functioning finally to effect a retraction of said needle-carrying member.

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