

June 1, 1954

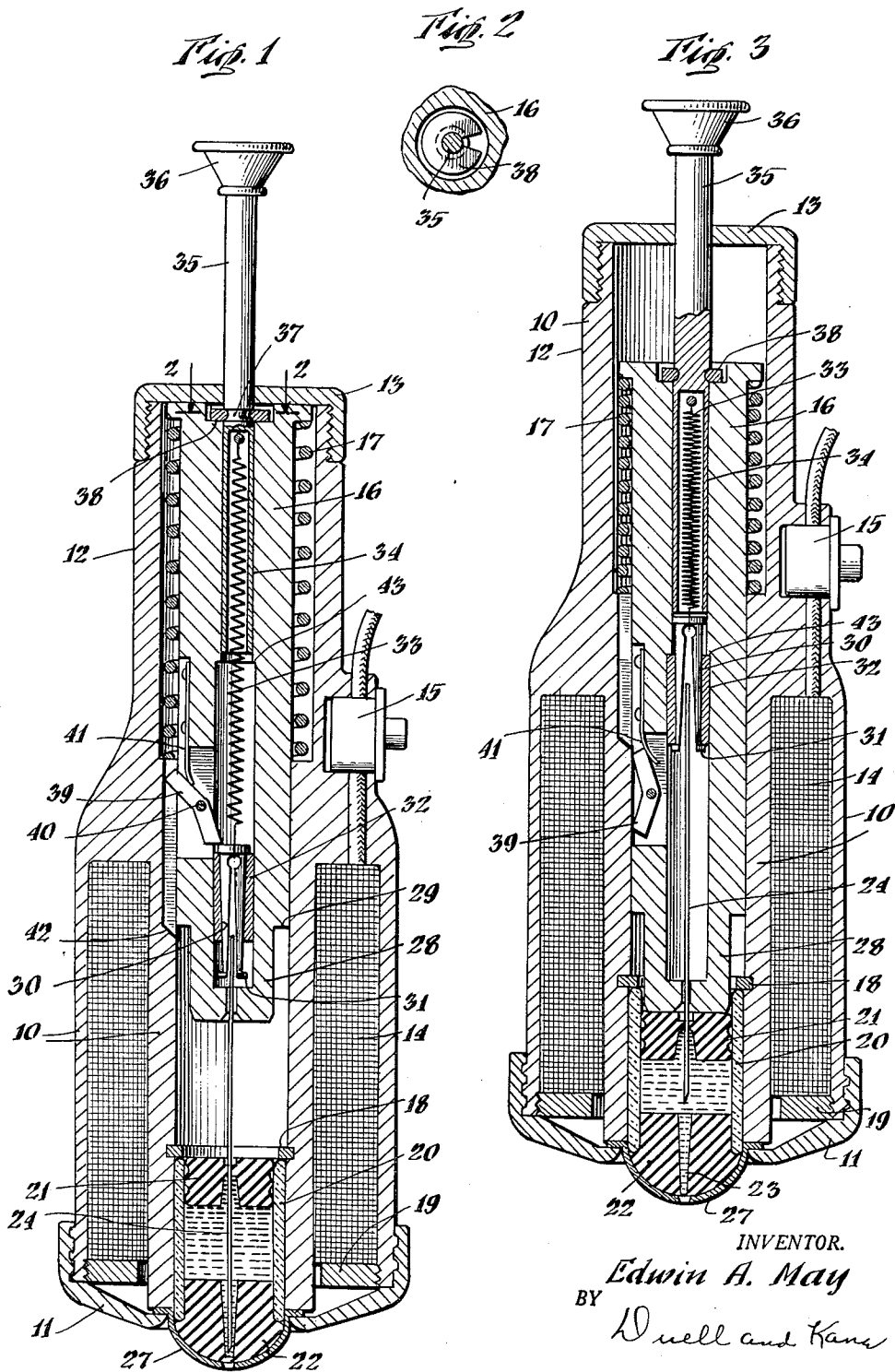
E. A. MAY

2,679,843

INJECTION APPARATUS

Filed Jan. 17, 1950

3 Sheets-Sheet 1



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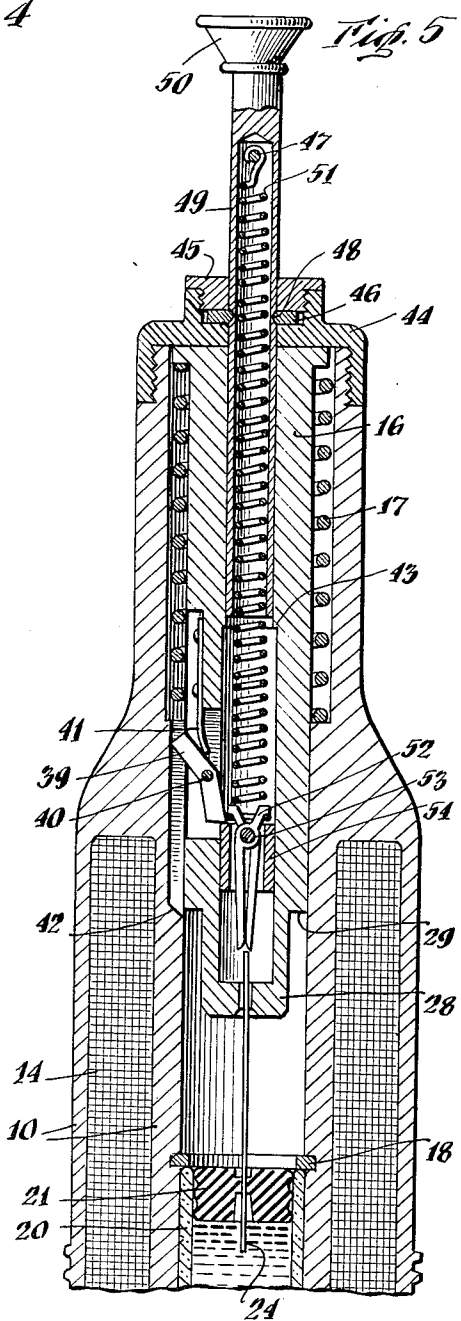
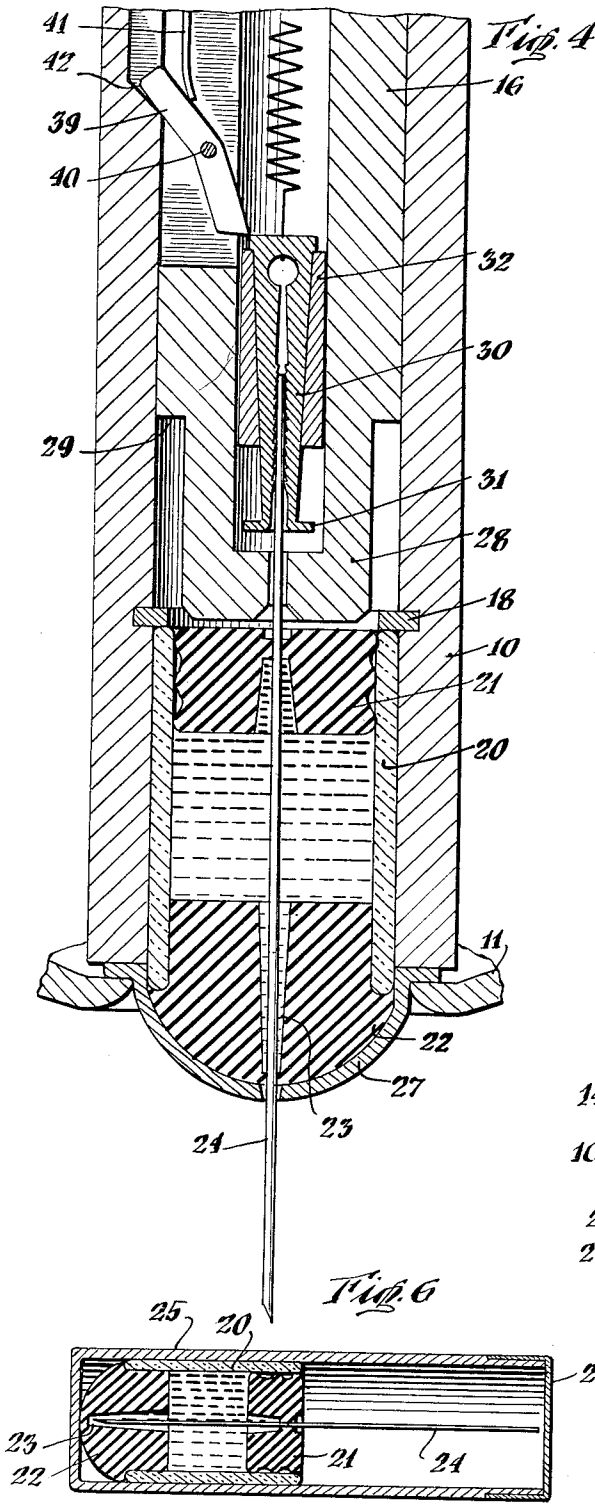
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

Fig. 7

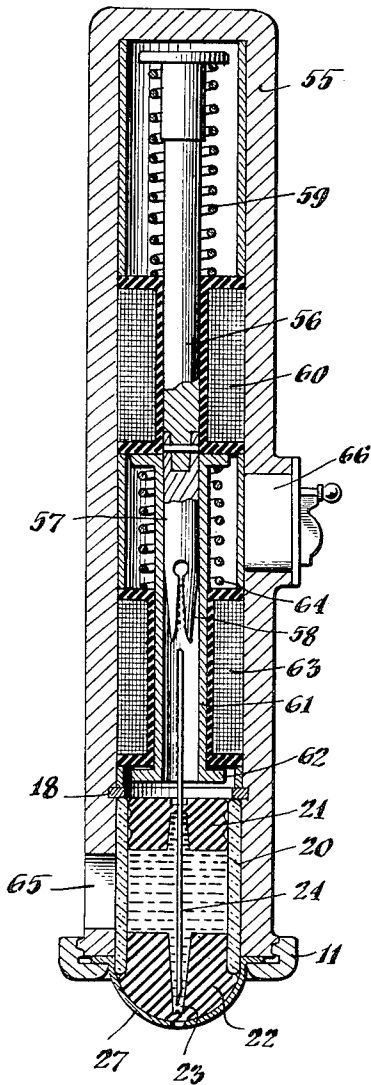


Fig. 8

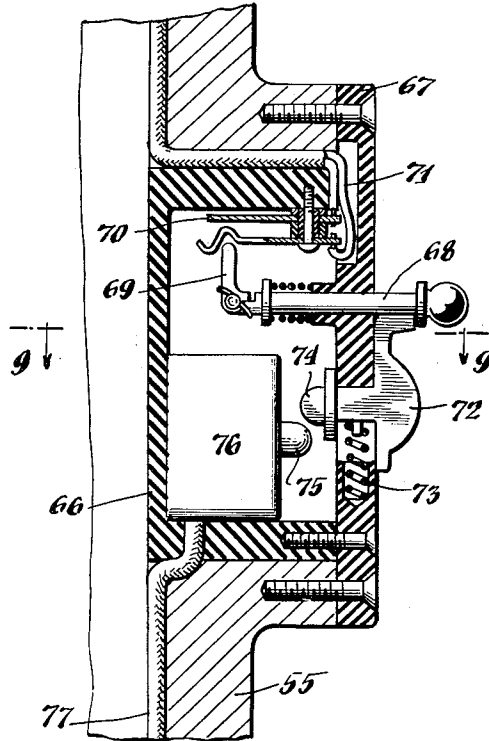
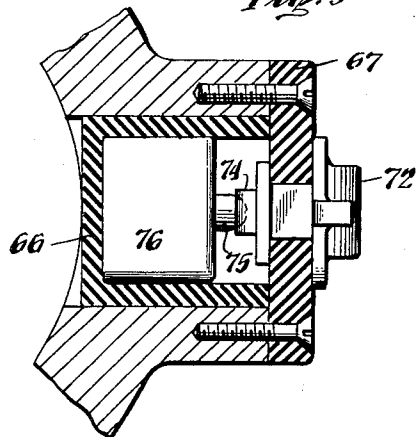


Fig. 9



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INJECTION APPARATUS

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Application January 17, 1950, Serial No. 139,052

9 Claims. (Cl. 128—173)

1

This invention relates to a structurally and functionally improved apparatus for the hypodermic injection of medicaments.

It is an object of the invention to furnish a device of this type by means of which a solution or medicine may be injected into a patient with substantially no pain being experienced by that patient; the apparatus being of relatively simple design, capable of ready operation by the physician or technician and all necessary parts of the assembly being capable of ready sterilization so that injections may be effected with no danger of infection resulting.

A further object is that of furnishing an assembly of parts which contain the solution or medicament and which parts will be sterile and capable of being readily placed in operative association with the remainder of the apparatus by the person using the latter; the removal of the used assembly being also readily achieved by a relatively unskilled person.

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 with the parts in their initial positions;

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

Fig. 3 is a view similar to Fig. 1 but illustrating the disposition of the elements when the device is partially discharged;

Fig. 4 is an enlarged fragmentary view showing the positions which the several units of the device assume at a stage intermediate those illustrated in Figs. 1 and 3;

Fig. 5 is a fragmentary sectional view of the upper portion of an alternative form of apparatus;

Fig. 6 is a sectional side view of one form of ampule assembly which may be provided;

Fig. 7 is a view similar to Fig. 1 but showing a further alternative form of apparatus;

Fig. 8 is an enlarged fragmentary view showing a control which may form a part of the unit as shown in Fig. 7; and

Fig. 9 is a transverse sectional view taken along the lines 9—9 and in the direction of the arrows as indicated in Fig. 8.

As shown in Figs. 1 to 4, the apparatus may include a casing 10 to the forward end of which a loading cap 11 is attached. Such attachment is conveniently provided by a relatively coarse thread, a bayonet coupling or other suitable con-

2

nection by means of which the parts may readily be attached or detached and which, when coupled, serves to prevent an accidental displacement of the parts. The body 10 is furnished with a rearward extension 12 and its outer end is closed by a cap 13. All of these several units are preferably formed of suitable metal although other materials might be employed.

Within the casing 10 and preferably adjacent the lower or inner end of the same, there is provided an electromagnet 14, the energization of which is controlled by a switch disposed within a casing 15 and from which an actuator extends outwardly beyond the casing face. Electromagnet 14 controls the shifting of an armature 16 which is normally maintained in retracted position by a spring 17. Adjacent that end of the casing which is defined by the loading cap 11 a medicament chamber is furnished. In view of the fact that it is preferred, according to the present teachings, to have the medicament within a replaceable ampule assembly, the inner end of the chamber may be defined by a stop member in the form of a ring 18 which limits inward movements of the ampule. The loading cap 11 is furnished with an opening through which the outer end of the ampule assembly may extend.

The preferred form of that assembly is shown in its packaged condition in Fig. 6. In that view the numeral 20 indicates an ampule or tube, preferably of glass, although other suitable materials which are inert to the solution or medicament employed, might be utilized. One end of this ampule is closed by a stopper 21 which is preferably formed with aligned recesses in its opposite faces and is of the piston type. The opposite end of the ampule is closed by a stopper 22 which, as shown, may be shouldered to extend outwardly in overlapping relationship with respect to the edge of the ampule body 20 and which preferably is formed with a recess 23 in its inner face. This recess has a depth slightly less than the depth of the stopper 22. A stylet or epidermis penetrating element 24 extends through the stopper 21 into the recess 23. A casing 25 may enclose the assembly and be provided with a cap 26. The medicament is contained within the ampule between stoppers 21 and 22. The stylet and other parts of the assembly are, of course, sterilized. This sterilization is maintained until the physician or technician opens the container 25 and removes the assembly therefrom. It is in many respects preferred that in the interests of maintaining the parts sterile, the pointed end of the stylet be disposed as illustrated rather than being

packaged to have the stylet extend through to the outer face of stopper 22. Of course in lieu of glass the ampule body 20 might be formed of a suitable metal such as stainless steel.

As will be apparent from an examination of Figs. 1, 3, and 4, the medicament chamber of the apparatus has an area such that it accommodates the ampule assembly. When the loading cap 11 is applied, that assembly will be firmly maintained in position adjacent the inner or lower end of the device. Also as shown in these views, a shell 27 conveniently of metal may extend beyond the outer face of stopper 22. This shell may either be considered as forming a part of the ampule assembly, although it has not been so shown in Fig. 6, or else may be a part of the permanent apparatus. In the latter instance, it can—with suitable sterilization—be repeatedly re-used.

The inner or lower end of armature 16 terminates in a preferably reduced portion 23, the diameter of which is substantially equal to or slightly less than the diameter of piston stopper 21. A shoulder 29 may be provided adjacent the reduced portion 23 and contact with the stop or ring 18 to arrest inward movement of the armature. The length of the reduced portion 23 is conveniently equivalent to the distance through which stopper 21 may be shifted in order to contact the inner face of stopper 22. It is preferred that armature 16 be hollow and formed with an opening in the face of its reduced portion 23 and through which the rear end of stylet 24 may extend.

As shown especially in Fig. 4, the bore of the armature slidably mounts an assembly of gripping jaws 30. The latter in Figs. 1 to 4 are preferably integral with each other and are formed of resilient material. They define a socket or gripping chamber, the inner face of which is formed with teeth. The jaws may terminate in outwardly extending flange portions 31. This assembly is encircled by a constricting sleeve 32; the adjacent faces of the sleeve and assembly being conveniently tapered as shown so that when the sleeve is in the position illustrated in Fig. 4, the jaws will define a receiving chamber of minimum area. A spring 33 of the constricting type has one end secured to the jaws 30 or parts adjacent the same. Its opposite end is attached within the outer or upper end of a tube 34. This tube is continued in the form of an actuating rod 35 extending through and beyond the cap 13. Adjacent the free end of the rod, a knob 36 is secured which conveniently is formed with outwardly flaring surfaces. Rod 35 is formed with a groove 37 which is especially shown in Fig. 1, is encircled by a spring washer 38.

A latch 39 is pivotally mounted by armature 16 as at 40. A spring 41 bears against one end of this latch so that its second end or arm is normally urged inwardly. The bore of the casing is formed with a cam or inclined surface 42 for cooperation with the outer arm of latch 39. At this time it is also to be noted that the bore of armature 16 is preferably formed with a shoulder 43 adjacent the lower or inner end of tube 34. The armature bore beyond the shoulder 43 is of adequate diameter to accommodate the tube 34. Also it will accommodate the base end of the chuck jaw assembly 30.

Considering the operation of the device as shown in Figs. 1 to 4, it will be assumed that the parts are in their initial position as shown in Fig. 1. To obtain this result the loading cap

11 or its equivalent will have been dismantled and the ampule assembly will have been inserted into the medicament chamber. Under such insertion the stylet 24 will have its inner or rear end pass through the opening in the lower face of the extension or reduced portion 28 of the armature to a point at which it is received in the space defined by the jaws 30. The inner end of the stylet or needle is now gripped by the chuck incident to a manipulation of the parts as hereinafter described. Either previously or at this time the loading cap will have been remounted. At the time of remounting a sterile shell or outer element 27 will have been positioned in operative relationship to the ampule assembly as shown in Fig. 1 and in the event that this outer member did not already form a part of the assembly.

The physician having determined the area to be injected, he will dispose the apparatus in line with that area and with the element 27 contacting the same. At this time it will be appreciated that in lieu of the convex shape incorporated in that element, different configurations might be employed and which are best suited to intimately contact the surface of the patient's skin. In any event with the actuator of switch 15 now operated, armature 16 will be rapidly projected against the action of spring 17. In such projection it will carry with it the rod 35, tube 34 and jaw assembly 30. Therefore, stylet 24 will likewise be projected to penetrate that portion of stopper 22 which intervenes between the base of recess 23 of the latter and its outer face. Of course if penetration or perforation of this stopper has been resorted to at the time of manufacture of the ampule assembly, then the stylet need not break through the stopper end wall.

As the stylet projects its outer end will penetrate the epidermis and the underlying tissues to the desired depths. Such depths will depend upon the length of the stylet and the proportioning of the several parts of the apparatus. As the armature 16 projects it carries with it the latch 39, the inner arm of which overlies the chuck assembly. This prevents the latter from being retracted by the action of spring 33. When the outer arm of latch 39 reaches a position corresponding to the depths to which the stylet is to be imbedded or penetrated into the flesh of the patient, cam surface 42 will be engaged and the outer arm of the latch will be rocked inwardly against the action of spring 41. This position of the parts has been shown in Fig. 4. Consequently the inner end of latch 39 will be retracted to clear the clutch assembly and the latter will be free to move rearwardly under the influence of spring 33.

With the chuck jaws 30 free from restraint by the latch 39 the latter moves rearwardly or upwardly thus retracting the stylet 24. It will be appreciated that the tension spring 33 need not exert material force to effect this result because the stylet will ordinarily involve a dimension of around .015". Therefore, its frictional contact with the tissues and the surfaces of stoppers 22 and 21 will be negligible. The retraction of the parts will continue until they have reached the positions shown in Fig. 3. In that view it will be observed that the point of the stylet has been withdrawn wholly into the ampule assembly and the chuck jaws have had their face portions enter into the bore beyond the shoulder 43. Consequently, the sleeve or collar 32 will have been engaged by the shoulder and have moved relatively to the jaws to a point where its further movement is prevented by engagement with the

5

6

flange or stop portion 31. Under these circumstances and due to the resiliency of the jaw assembly, the end of the stylet will be released. This will, of course, occur only after the stylet has been completely withdrawn to a position where its pointed end portion is preferably wholly within the body of the ampule as shown in Fig. 3.

Switch 15 is of that type which when once closed will have a delayed release or opening. Thus, even if the physician only operates the actuator of the switch for an instant, the circuit through the electro-magnet 14 will remain closed for a substantial period of time. This may be approximately one to two seconds. Therefore, armature 16 will continue to advance despite the retraction of the stylet. In such advance its forward portion 28 will engage the piston stopper 21 and advance the latter through body 20. Consequently medicament will be expressed under pressure through the recess 23 which has now become a bore and through the shell or supporting element 27 if the latter is employed. With the parts properly disposed with respect to the surface of the patient's skin, the fluid will therefore be forced into the hole which has been formed through the epidermis and the flesh by the projection of the stylet 24. When stopper 21 engages stopper 22, further expulsion of the medicament will cease. The parts are preferably so proportioned that at this time the shoulder 29 of the armature will engage against stop ring 18 in order to arrest further advance of the parts.

Thereafter, either by release of the actuator of switch 15 or due to the fact that the mechanism which controls the interval of switch 15 has opened, magnet 14 will be de-energized. Due to the operation of the detent structure involving groove 37 and washer 38, rod 35 will also be shifted to the position shown in that figure. Spring 17 will thereupon return the armature 16 to the position shown in Fig. 1. Loading cap 11 may now be dismantled and the spent ampule assembly withdrawn. Stylet 24 will be removed with such withdrawal due to the fact that the jaws 30 are opened and no longer grip the same. If a shell element such as 27 is employed, this may be salvaged and sterilized for re-use. The stylet may likewise be cleaned and sterilized. However, it will ordinarily be discarded as part of the ampule assembly.

The device may now be reloaded. In such reloading a fresh ampule assembly of the type shown in Fig. 6 is used. The stylet 24 is introduced through the opening in the base of the reduced portion 28. The loading cap is now again mounted upon body 10. Knob 36 is now projected. Such projection will cause the detent structure to become inoperative. Tube 34 will shift downwardly with respect to armature 16 and project through the bore of the same below shoulder 43. Under these circumstances, the chuck assembly will also be projected. That assembly will be loosely encircling the rear end of the stylet. Therefore, the projection of the parts will primarily result in the jaws shifting towards the pointed end of the stylet. This will assure a substantial overlap of the rear end of that stylet by the chuck. Due to the frictional engagement existing between sleeve 32 and the walls of the armature bore that sleeve will now shift rearwardly with respect to the jaws thereby closing them. This closing will cause the stylet to be firmly gripped. Continued projection will cause sleeve 32 to override latch 39. Conse-

quently the chuck assembly will be maintained in projected position. Thereafter, knob 36 and rod 35 may be retracted until the detent or clutch become operative. Under these circumstances the parts will be in the position shown in Fig. 1. Due to the flared structure of knob 36 there will be no likelihood of an operator becoming injured incident to having his finger in the way of the knob when the device is energized and the armature is projected.

A structure may be provided in which the knob and parts directly connected therewith do not move with respect to the body of the apparatus excepting only during loading operations. Such an arrangement of parts has been shown in Fig. 5 in which structures substantially identical with those heretofore described have been identified by similar numerals. However, in this form of device it will be noted that in lieu of the end cap 13 for the casing 10 an end cap 44 is provided which in turn supports a second cap or plug member 45. Between these units a clutch or detent member in the form of a split ring 46 is disposed. This cooperates with a groove 48 formed in a sleeve or tube 49 having at its outer end a knob 50. A tension spring 51 has its upper end secured as at 47 adjacent the outer end of the tube bore. Its lower end is coupled with the inner arms of a pair of jaws 52 which are pivotally interconnected as at 53. This pivot is preferably mounted by a tube section or collar 54 with which the latch 39 cooperates.

As is apparent with an apparatus of this nature energization of the electro-magnet causes movement of the armature 16 to project the stylet as afore-described in connection with Figs. 1 to 4. During such projection the stylet will be firmly gripped by the jaws providing the chuck. Under such movement of the parts the tension on spring 51 will be increased. When latch 39 releases the collar 54 the latter will move upwardly with the jaws and carry with it the stylet. During these several movements, tube 49 will not shift in that it is held by the clutch furnished by the split ring 46.

As the spring 51 shifts the parts to their upper limit of movement, the extended or arm portions of the jaws 52 will strike against the shoulder 43. This will result in an opening or pivoting of the jaws and release of the stylet. As the ampule assembly which has been discharged is removed and a new assembly positioned as heretofore described, then an operator may cock the device. This is achieved by exerting thrust against knob 50 to an extent such that the detent structure provided by the clutch 46 releases. Therefore, tube 49 may be projected carrying with it the jaw or chuck assembly to a point at which the rear end of the stylet enters the space defined by those jaws. With such movement of the parts the spring 51 will be tensioned to an increasing extent. Finally the latch 39 will overlie the collar 54 of the chuck assembly and retain the latter as shown in Fig. 5. Thereupon tube 49 may be retracted to a point where the parts assume positions as shown in that figure. Under these circumstances the tension exerted by spring 51 acts against the rear arms or extensions of the jaws to thus bring their gripping surfaces into contact with the stylet so that the apparatus is again ready for operation. As will be apparent in this type of device, no movement of the tube 49 occurs excepting only when it is manually shifted by the operator.

In the form of apparatus shown in Fig. 7, a casing 55 conveniently of metal is employed. Within the latter an armature 56 is slidably mounted. This armature in accordance with conventional technique is preferably of iron. A portion 57 provides at its end jaws 58. These may correspond to the jaw assembly shown in Figs. 1 to 4 or in Fig. 5. The part 57 is preferably constructed of brass or some other material which is not subject to magnetic attraction. A spring 59 may normally maintain armature 56 in raised or retracted position. An electro-magnet 60 is disposed in operative relationship to the armature.

A second armature 61 is disposed within casing 55 and is hollow to slidably receive the extension or portion 57. The lower end of armature 61 may terminate in a flange portion 62 having a diameter substantially equal to or slightly less than that of piston stopper 21. An electro-magnet 63 controls the projection of armature 61. A spring 64 normally maintains that armature in retracted position. In this form of device an ampule of the type heretofore described is employed and has been shown with its parts identified by similar numerals. Adjacent the ampule assembly, an opening 65 may be formed in body 55 which serves as a window through which the interior of the ampule may be viewed if the latter has body 20 formed of transparent material. The operation of the unit as illustrated is governed by a control generally indicated at 66.

The structure embodied in this control has been shown in detail in Figs. 8 and 9. In these views the numeral 66 indicates a casing, the face of which is closed by a cover 67. A spring pressed plunger 68 is mounted by that cover and supports on its inner end a spring-biased latch 69. The latter cooperates with a switch 70 from which leads 71 extend to the electro-magnet 60 and a power source. Slidably mounted by cover 67 is an actuator 72, the motion of which is resisted by a spring 73. A preferably square shank extends from this actuator through an opening in the cover and carries at its inner end an element 74. The latter is engageable with an actuating element 75 controlling the mechanism of a switch within casing 76. This switch in common with the switches forming part of the units illustrated in Figs. 1 to 5 inclusive, is preferably of the "hold-in" type. In other words, after its actuating element 75 is once operated, the mechanism of the switch will remain closed for a desired interval of time. Extending from this switch is a lead 77 connected to electro-magnet 63 and a source of current supply.

If the apparatus is combined with an ampule assembly as shown in Fig. 7, it is apparent that by shifting actuator 72 downwardly, as viewed in Fig. 8, the spring pressed plunger 68 will be projected to cause its latch 69 to close the elements of switch 70. Thereafter these elements will open as the spring which projects plunger 68 carries the latch 69 beyond the switch 70. This will cause a rapid projection of armature 56 and the stylet 24. Thus, an opening or bore will be formed through the epidermis into the underlying tissue. Due to the afore-described interruption of the circuit by the opening of the elements of switch 70, this action will be followed by an immediate retraction of the armature and stylet due to the action of spring 59.

Continued movements of actuator 72 will cause element 75 to be shifted to close the mechanism

of the switch within casing 76. When this occurs, electro-magnet 63 will be energized to cause a shifting of armature 61. The lower end of the armature will bear against piston-stopper 21 to express medicament through the orifice which was formed in stopper 22 by the stylet 24. Due to the fact that the mechanism of switch 76 remains closed for an appreciable interval of time, energization of electro-magnet 63 will continue for a period adequate to assure that stopper 21 has shifted to a position at which substantially all fluid has been exhausted from the ampule assembly.

As the armature 56 is retracted, it carries with it the stylet 24. Thereupon it releases that stylet by an action of the mechanism similar to that heretofore described in connection with the earlier figures. With the medicament discharged, loading cap 11 may be dismantled, the spent ampule may be discarded and a new ampule disposed within the medicament chamber of the unit. In the interim, actuator 72, under the influence of spring 73, will have returned to a position at which it engages the side face of spring pressed plunger 68 when the pressure of the operator's finger on the actuator is once released. Conveniently at this time the operator will have retracted spring pressed plunger 68 which, when it is fully retracted, will permit actuator 72 to reach its fully retracted position as shown in Fig. 8. By this construction there will be no danger of an accidental and undesired projection of the stylet occurring.

From the foregoing it will be understood that in the several illustrated forms, an apparatus is furnished which may be used on a patient with the latter either experiencing no pain or else a very reduced level of pain. This is because of the speed of operation with which the opening or bore is formed through the epidermis into the tissue and the speed with which the stylet or needle is withdrawn from that opening. Moreover, the small diameter of the stylet or needle will additionally serve to minimize the pain. The formation of the desired medicament-receiving bore in the flesh is followed immediately by the discharge of medicament under pressure into that bore; the entire operation being automatic. An operator will only have to instantaneously operate the control for the apparatus if the latter be of the "hold-in" type as heretofore described. The ampule assembly may be delivered to the physician in completely sterile condition and thereupon discarded. No parts of the apparatus require sterilization excepting only if a shell such as 27 is employed and salvaged or if the stylet is reused. In that event sterilization is a relatively simple matter.

Thus, among others, the several objects of the invention as specifically aforementioned are achieved. Obviously 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. An injection apparatus including a casing formed with an opening, needle clutching means within said casing comprising a plurality of jaws of resilient material integral with each other, power means for moving said jaws and a needle gripped thereby to project the latter through said opening and to thereupon retract said needle, means functioning upon said retraction to release said jaws from gripping engagement with said needle and means movable with said jaws

for reestablishing the gripping relationship of the latter.

2. An injection apparatus including in combination a hollow body, a projectible assembly within the same, needle gripping means forming a part of said assembly, means for moving said assembly to project a needle mounted by said gripping means to a point beyond said casing, means for retracting said gripping means and releasing means carried by said body and cooperative with said gripping means for rendering the latter inoperative to retain a needle after said retracting means has withdrawn said gripping means a predetermined distance.

3. An injection apparatus including in combination a hollow body, a projectible assembly within the same, needle gripping means forming a part of said assembly, means for moving said assembly to project a needle mounted by said gripping means to a point beyond said casing, means and connected to said gripping means and disposed within said body for retracting said gripping means with respect to the same and releasing means connected to shift with said moving means during the projection of said needle to disconnect said gripping means from said moving means and rendering said retracting means operative.

4. An injection apparatus including in combination a hollow body, a projectible assembly within the same, needle gripping means forming a part of said assembly, means for moving said assembly to project a needle mounted by said gripping means to a point beyond said casing, means for retracting said gripping means, means within said body for rendering said gripping means inoperative and releasing a needle gripped thereby after said retracting means has withdrawn it a pre-determined amount, a support for a medicament chamber associated with said body and said assembly moving adjacent said support to expel medicament from a chamber associated therewith.

5. An injection apparatus including in combination a casing, a releasable ampule support associated with said casing, means projectible within said casing to cooperate with an ampule mounted by said support to expel medicament therefrom, needle projecting and retracting means, needle gripping means carried by said latter means, control means operable to assure an initial projection and retraction of said needle means, means for rendering said gripping means inoperative to retain a needle upon retraction having been completed and means for causing an operative association of said projecting means with a supported ampule.

6. An injection apparatus including in combination a casing, a releasable ampule support associated with said casing, means projectible within said casing to cooperate with an ampule mounted by said support to expel medicament

therefrom, needle projecting and retracting means supported by said casing, control means operable to assure an initial projection and retraction of said latter means and a subsequent operative association of said projecting means with a supported ampule, a medicament and needle containing ampule associated with said support and needle gripping means forming a part of said needle projecting and retracting means.

7. An injection apparatus including in combination a tubular body having an open end, a needle-gripping chuck projectible within said body for moving a needle beyond the open end of the same, power means connected to said chuck for effecting such projection, means also connected to said chuck for effecting retraction thereof and means forming a part of said apparatus and cooperative with said chuck during such retraction for automatically releasing a needle gripped thereby.

8. An injection apparatus including in combination a tubular body having an open end, a needle-gripping chuck projectible within said body for moving a needle beyond the open end of the same, power means connected to said chuck for effecting such projection, means also connected to said chuck for effecting retraction thereof, a latch interposed between and providing the connection of said power means and chuck, means carried by said body and cooperative with said latch during the operation of said power means to release said latch and cause said retracting means to withdraw said chuck and means forming a part of said apparatus and cooperative with said chuck during such retraction to automatically release a needle gripped thereby.

9. An injection apparatus according to claim 19 and in which said needle-gripping means comprises a pair of jaws pivotally coupled to each other and means disposed adjacent said jaws and shiftable with respect to the same to cause them to assume a gripping position.

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