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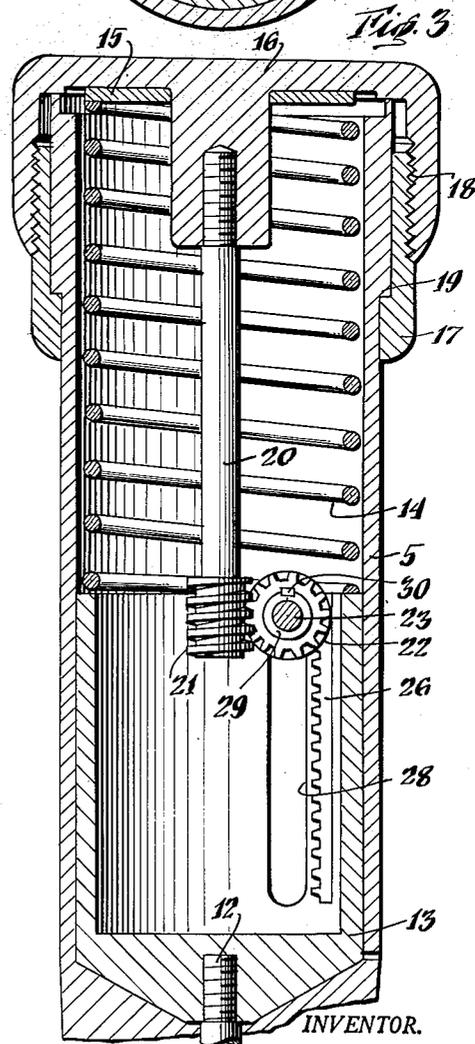
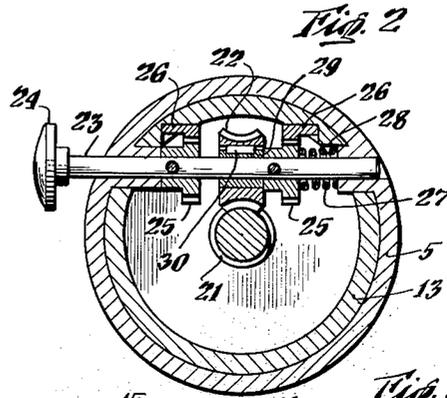
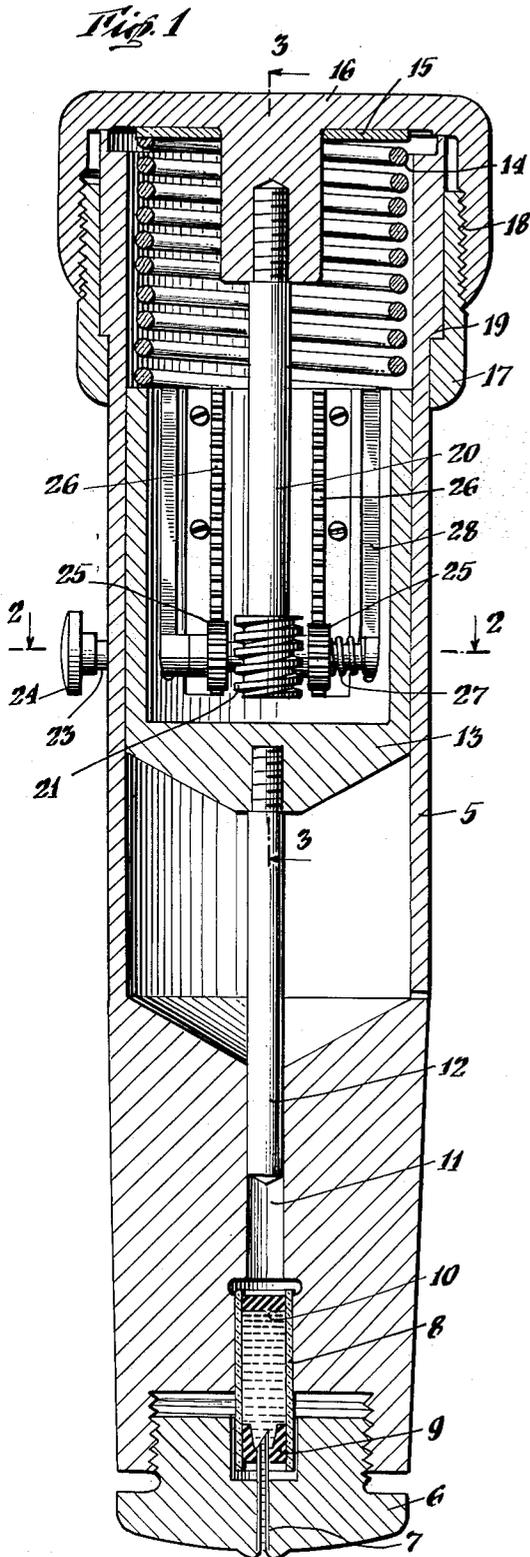
E. A. MAY

2,722,931

INJECTION DEVICE

Filed Jan. 17, 1951

2 Sheets-Sheet 1



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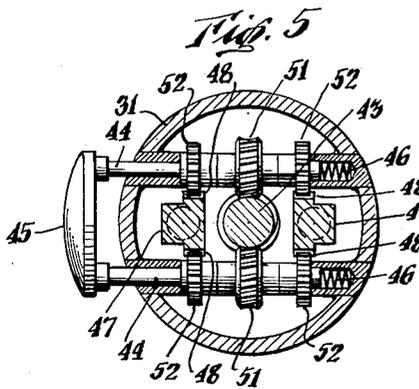
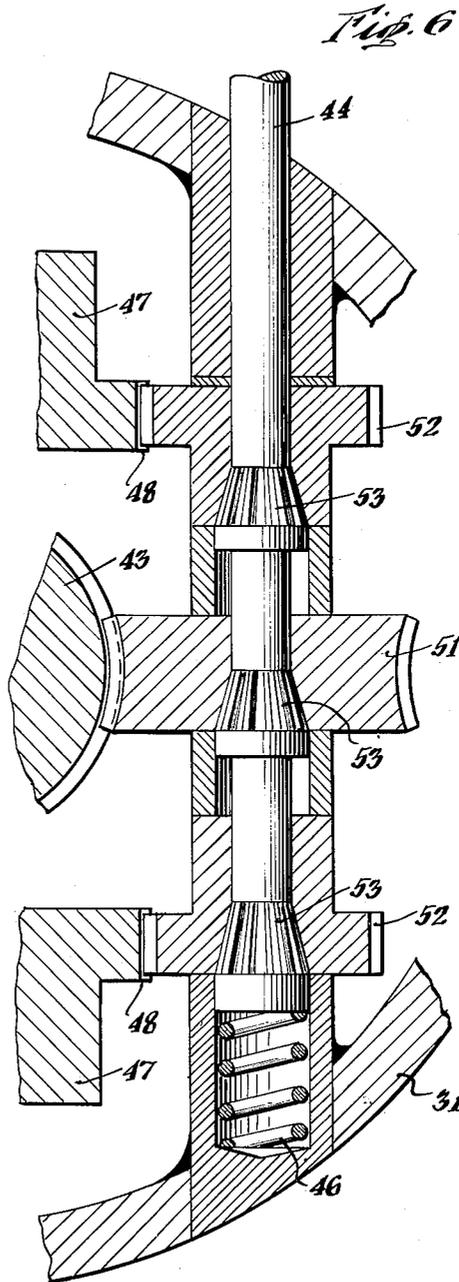
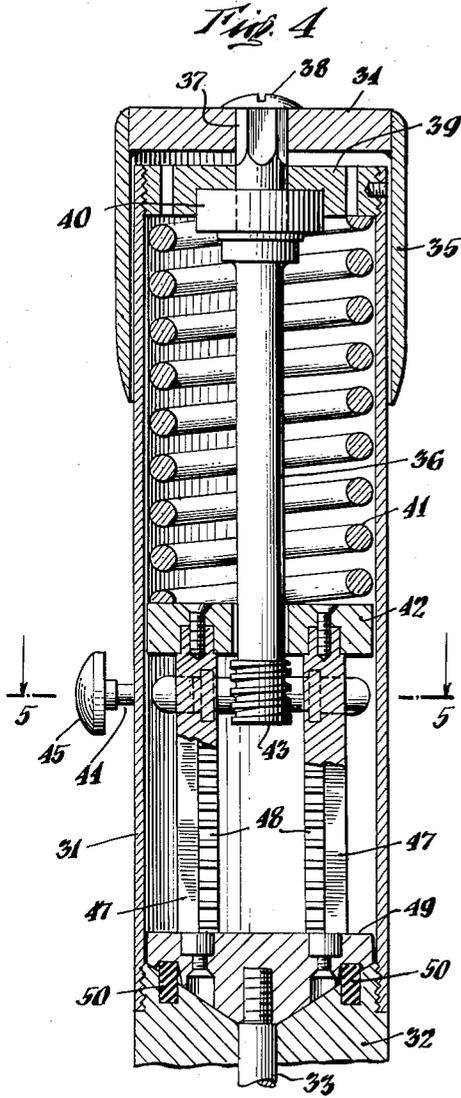
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INJECTION DEVICE

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Application January 17, 1951, Serial No. 206,482

8 Claims. (Cl. 128—173)

This invention relates to a structurally and functionally improved injection device, by means of which medicaments may be hypodermically injected without employing a piercing needle to conduct the liquid into the tissues.

This application is a continuation in part of my prior case on "Injection Device" filed in the United States Patent Office on March 2, 1948, and identified under Serial Number 12,597, now abandoned.

It is an object of the invention to furnish a unit of this type which may readily be operated and controlled to perform the desired functions.

A further object is that of designing a unit of this type which will embody relatively few parts, each individually simple and rugged in construction, such parts being capable of ready manufacture and assembly, and when so assembled operating over long periods of time with freedom from all difficulties.

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

Fig. 1 is a sectional side view of an injection device;

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 fragmentary sectional view taken along the lines 3—3 and in the direction of the arrows as also indicated in Fig. 1;

Fig. 4 is a fragmentary sectional side view of an alternative form of mechanism;

Fig. 5 is a transverse sectional view taken along the lines 5—5 and in the direction of the arrows as indicated in Fig. 4; and

Fig. 6 is a fragmentary enlarged sectional view showing details of the mechanism.

In Figs. 1 to 3 the reference numeral 5 indicates the body of the unit which is conveniently formed of metal and the lower end of which provides a medicament-receiving chamber. While the latter may take one of numerous different forms, it is preferred that it be of the type which receives an ampule rather than one which directly receives the liquid medicament. Also, while the ampule containing the medicament may take numerous different forms, it will conveniently embrace the structure hereinafter described. Therefore, it is to be distinctly understood with regards to the medicament receiving and discharging portions of the unit that the following description taken in connection with the drawings is to be regarded as illustrative rather than in a limiting sense, except where otherwise indicated in the claims.

Thus, access to the lower portion of the body 5 may be obtained through a cap 6 preferably having screw-threaded engagement with such body. This cap is formed with a discharge orifice which may be defined by a cannula 7 having its inner end sharpened or pointed so that a piercing structure is provided. The medicament-receiving chamber of the unit is of a size such that it is capable of receiving the body of an ampule 8. This ampule may be constructed of any desired material and conveniently has its outer end closed by a pierceable stopper 9 while its

inner end is closed by a second stopper 10. The latter may be shifted within the bore of the ampule and thus function as a piston to expel the liquid therefrom. It will be appreciated the bore defined by at least the outer end of the cannula 7, or by any other orifice which is furnished adjacent the discharge end of the unit, should be sufficiently fine that a jet or stream of minute cross-sectional area will be discharged therefrom.

Also as illustrated the cap 6, in its application to the body 5, may cause the pointed inner end of the cannula 7 to pierce the stopper 9. With such piercing the medicament contained within ampule 8 will flow into the bore of the cannula. Under continued tightening of the cap therefore, not alone will the medicament be rendered accessible for use, but also the bore of the cannula or other orifice-defining element will be filled with medicament. This will serve to vent any air from that bore. Therefore, in the subsequent use of the device no fear need be felt that a patient will be injected with any amounts of air.

Now with a view to providing a mechanism for causing an expulsion of the liquid from the chamber, under such velocity that the desired results are achieved, it will be observed that a bore or passage 11 extends to that chamber. Within that passage a plunger 12 is capable of reciprocation. When projected to its fullest extent the outer end of the plunger will reach a position adjacent the lower end of the medicament-receiving chamber. The inner or upper end of the plunger may be suitably secured to a projectable unit 13 which may take the form of a cup. Bearing against the upper edge of this member is one end of a compression spring 14. The opposite end of this spring may react against a bearing plate 15. With this spring compressed in the manner shown in Fig. 1 it is apparent that if member 13 may shift outwardly or towards the cap 6, plunger 12 will be projected with considerable velocity to cooperate with the structure of the ampule or to otherwise expel the medicament within the chamber.

A cap 16 is rotatably mounted at the upper end of body 5. It may be retained in position by a ring 17 conveniently coupled to it by threads 18. This ring 17 extends beyond a flange or abutment 19 conveniently forming a part of the body 5. Therefore, outward movement of the cap 16 is prevented. Inward movement of the same is obviously prevented incident to the engagement of the cap with the outer edge of body 5. A shaft 20 is secured to the inner face of cap 16 and extends within the bore of the body. This shaft supports adjacent its lower end a worm 21. Such worm engages with a worm wheel 22. Accordingly, when cap 16 is rotated it is apparent that wheel 22 will be turned.

The latter encircles an actuating shaft 23. The ends of this shaft extend through and beyond the casing or body 5. One of these ends may mount a button or head portion 24. Secured against rotation with respect to the shaft 23 are gears 25. The latter have their teeth in engagement with the teeth of racks 26 secured to the inner face of cup member 13. A spring 27 normally maintains the teeth of the gears 25 and the racks 26 in engagement by maintaining the parts in aligned positions; it being observed that a shifting of the shaft 23 beyond a predetermined position at which such alignment is established, is prevented. As will also be noted the cup member 13 is formed with slots 28 to permit of the passage of shaft 23. Therefore the cup may not rotate but will rather be confined to movements in a plane parallel to the axis of the unit.

A bearing 29 of suitable anti-friction material may be secured to shaft 23 so as to be incapable of rotating with respect to the same. This may be desirably achieved by a drive or force fit. A key 30 conveniently extends into grooves or keyways in the bearing 29 and worm wheel

22 to prevent rotation of these elements with respect to each other. By this construction it is obvious, however, that shaft 23 may be axially shifted to compress spring 27, without such shifting causing a disengagement of worm wheel 22 from worm 21. As will also be understood when the shaft is thus shifted it will carry with it the gears 25, the teeth of which will accordingly clear the teeth of racks 26.

In order to potentialize the device for operation the user will grasp the body in one hand and the cap 16 in the other. Thereupon he will effect relative rotation of these parts. As will be apparent under such rotation the ring 17 will move as a unit with the cap and rotatably bear against the flange 19. This operation of the parts will serve to cause a functioning of the force-compounding mechanism due to the fact that shaft 20 will turn with the cap, thus turning worm 21 and driving worm wheel 22. Therefore, shaft 23 will be rotated. Accordingly gears 25 in mesh with the teeth of racks 26 will cause the latter to be retracted. This will result in corresponding movement on the part of member 13 to compress or tension the spring 14. When this spring has been sufficiently compressed, the device is ready for use.

Conveniently prior to this operation the loading cap 6 is dismounted and any previously discharged ampule is removed. The cap, together with its associated parts, may have been sterilized if desired. In any event there is introduced into the medicament chamber an ampule conveniently embracing a tubular body and stoppers as heretofore described. Thereupon the loading cap is again mounted on the body of the device. In such mounting the inner end of cannula 7 will penetrate the adjacent ampule stopper. Accordingly communication will be established between the bore of the cannula or its equivalent and the body of the medicament. It is apparent that during this operation air within the cannula bore will be displaced by the medicament so that no difficulties will be experienced in that connection.

The discharge or orifice end of the apparatus is now placed adjacent or in contact with the skin which overlies the tissues to be injected. Thereupon, by bringing pressure to bear against the button or head portion 24 shaft 23 is axially displaced. As afore brought out this will serve to shift the teeth of the gears 25 to positions at which they clear the racks. However, the worm wheel 22 will remain in engagement with worm 21. As such clearing is effected, spring 14 will be released to force member 13 outwardly, carrying with its plunger 12. The end of this plunger will cooperate with (for example) the piston stopper 10. The bore of the cannula or other orifice being filled with medicament and being in communication with the body of the latter, it is apparent that this liquid will be expelled under great velocity and pressure in the form of a fine stream from the orifice to produce the desired results.

A premature discharge of the device may obviously not occur. This will be because of the characteristics of a worm and worm wheel. They being in effect irreversible it is apparent that spring 14 may be compressed to any desired extent without its thrust resulting in a rotation of the worm wheel. Only when shaft 23 is axially shifted as the result of actuation by the operator will the spring drive the plunger in the manner afore described.

In the form of construction shown in Figs. 4 and 5 the numeral 31 indicates the main casing of the device which may embrace a tube. To the outer or discharge end of this tube a body 32 is coupled conveniently by threads. This body is provided with a bore within which a plunger 33 corresponding to plunger 12 reciprocates. In common with the earlier structure a medicament chamber may form a part of body 32 and conveniently accommodate an ampule maintained in proper position by a loading cap as previously described. Either that cap, the ampule, or any other suitable part may define the minute discharge orifice as also previously described.

Also, in common with the earlier described mechanism, a cap is rotatably mounted adjacent the opposite end of the main casing or tube 31. This cap conveniently includes a disk 34 and a downwardly extending sleeve portion 35 overlapping the upper end of tube 31. The disk and sleeve are secured to each other by soldering or in any other desired manner. A shaft 36 is provided with a non-circular end portion 37 extending through a correspondingly surfaced aperture in disk 34; the parts being secured by, for example, a screw 38. The end of tube 31 adjacent the cap is closed by a plug 39 which has screw threaded engagement with the adjacent tube end. This plug is conveniently furnished with openings to receive the ends of a spanner wrench for tightening. An anti-frictional bearing 40 of the thrust type rotatably supports shaft 36 and seats against plug 39. One end of a compression spring 41 bears against the inner face of the plug and has its opposite end bearing against a disk 42. Shaft 36 extends rotatably through plug 39 and disk 42 to a point beyond the latter.

At that point this shaft mounts or terminates in a worm 43. To opposite sides of the worm transversely extending shafts 44 are provided. These shafts are slidably and rotatably supported by suitable bearing portions extending inwardly from sleeve 31. The outer ends of these shafts extend beyond the sleeve and are connected by a common trigger button or actuator 45. The latter is normally extended in projected position by means of springs 46 bearing against the opposite shaft ends. Members 47 are disposed beyond diametrically opposite points on the face of worm 43 and conveniently at points midway between the shafts 44. These members present rack portions 48 in their opposite edges. The upper or outer ends of members 47 are secured to disk 42 and extend from that face of the latter which is opposite to the one against which spring 41 bears. The lower or outer ends of members 47 are secured to a piston 49. The latter carries the plunger 33. Conveniently a bumper 50 may extend inwardly from body 32. This will serve to arrest and cushion the movement of piston 49.

Mounted upon each of the shafts 44 is a worm wheel 51 which latter meshes with worm 43. The worm wheels of the different shafts 44 are, as shown, preferably disposed in the same plane. Also carried by each of these shafts are a pair of pinions 52. The teeth of these pinions mesh one with each of the adjacent racks 48 of the two members 47. As shown, especially in Fig. 6, the connection between the worm wheel 51, pinions 52 and the shafts 44 is preferably effected by a multi-clutch structure. This may take one of numerous different forms. Preferably it will include tapered spline portions 53, normally forced into bearing engagement with similarly surfaced recesses forming parts of the pinions and worm wheel, by means of springs 46. It will, of course, be appreciated that an arrangement similar to that shown in Fig. 6 could be employed in connection with the structure shown in Figs. 1, 2 and 3. Also by duplicating the actuating shaft 23 of the earlier figures in a manner similar to that described in connection with present Figs. 4 and 5, a balanced structure could be achieved.

The apparatus as shown in the last three figures would be operated by rotating cap assembly 34—35. This would serve to effect rotation of shaft 36. Accordingly worm 43 would be turned. With the pinions and worm wheels secured against rotation with respect to shafts 44 the rotation of worm 43 would cause these shafts to turn. Therefore the pinions would retract members 47 due to their engagement with the racks 48. This would, in turn, cause a retraction of piston 49 and rod 33. When the latter had cleared the medicament chamber an ampule could be inserted in that chamber as heretofore described or else the chamber could be otherwise loaded. Under these circumstances rod 33 would be re-

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tracted to the desired extent and the spring 41 or other power structure would be similarly compressed.

Therefore, if the apparatus is brought to a position at which it overlies the area to be injected an operator would merely have to maintain the unit against lateral displacement while simultaneously pressing the trigger button or actuator 45. With such pressure shafts 44 would be projected against the action of springs 46. Therefore the clutch assemblies between the pinions, worm wheel and shafts 44 would be rendered inoperative. At that moment disk 42, members 47 and piston 49 would be released for projection by the power source. Accordingly plunger 33 would be projected through the medicament chamber to expel liquid at the necessary pressures and velocities.

It is apparent that by the structures shown in Figs. 4 and 5, a balanced arrangement of the parts is achieved. Also an assembly is provided in which the several parts may readily be manufactured and grouped together. Incident to the balanced gearing arrangement furnished there would be no danger of the forces acting to distort or deflect any parts of the mechanism and especially shaft 36. Moreover, the pressures acting on piston 49 will also be properly balanced.

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. An injection device including a body, an operating member rotatable with respect to said body, a shaft secured to said member, a worm attached to said shaft, a second and axially displaceable shaft mounted by said body, a worm wheel connected to said displaceable shaft and in driving engagement with said worm, a gear mounted by said displaceable shaft, a rack driven by said gear, a projectible member mounted for sliding movement within said body and connected to move with said rack, a spring compressible by said projectible member and means connected to said member and extendable into a medicament-receiving chamber forming a part of said body for expelling liquid therefrom.

2. An injection device including a body, an operating member rotatable with respect to said body, a shaft secured to said member, a worm attached to said shaft, a second and axially displaceable shaft mounted by said body, a worm wheel connected to said displaceable shaft and in driving engagement with said worm, a gear mounted by said displaceable shaft, a rack driven by said gear, a projectible member mounted for sliding movement within said body and connected to move with said rack, a spring compressible by said projectible member and means for normally maintaining said displaceable shaft in a position at which the gear and rack are in driving engagement.

3. An injection device including a body, an operating member rotatable with respect to said body, a shaft secured to said member, a worm attached to said shaft, a second and axially displaceable shaft mounted by said body, a worm wheel connected to said displaceable shaft and in driving engagement with said worm, a gear mounted by said displaceable shaft, a rack driven by said gear, a projectible member mounted for sliding movement within said body and connected to move with said rack, a spring compressible by said projectible member and means for normally maintaining said displaceable shaft in a position at which the gear and rack are in driving engagement; said displaceable shaft extending beyond said body and means secured to said shaft whereby said shaft may be displaced to free said gear from driving engagement with said rack.

4. An injection device including a body, an operating member rotatable with respect to said body, a shaft secured to said member, a worm attached to said shaft, a

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second and axially displaceable shaft mounted by said body, a worm wheel connected to said displaceable shaft and in driving engagement with said worm, a gear mounted by said displaceable shaft, a rack driven by said gear, a projectible member mounted for sliding movement within said body and connected to move with said rack, a spring compressible by said projectible member and means for normally maintaining said displaceable shaft in a position at which the gear and rack are in driving engagement, said displaceable shaft extending beyond said body, means secured to said shaft whereby said shaft may be displaced to free said gear from driving engagement with said rack and means cooperating with said projectible member to prevent projection of the latter.

5. An injection device including in combination a hollow body, a cap rotatably mounted by said body, a compressible power source disposed within said body, means connected to said source to be projected thereby through a medicament chamber associated with said body, a rack connected to said projectible means, a pinion having its teeth in mesh with the teeth of said rack, a shaft mounting said pinion, manually operable force-multiplying means connected to said cap and shaft to retract said rack and means whereby said rack may be manually disconnected from said force-multiplying means.

6. An injection device including in combination a hollow body, a compressible force-producing means within said body, a cap rotatably mounted by said body, a worm secured for rotation with said cap, a worm wheel meshing with said worm, a shaft supporting said wheel, a pinion also supported by said shaft, a piston against which said force-producing means acts, a retracting rack secured to said piston and having its teeth in engagement with said pinion and means for releasing the coupling existing between said cap and rack.

7. An injection device including in combination a hollow body, a compressible force-producing means within said body, a cap rotatably mounted by said body, a worm secured for rotation with said cap, a worm wheel meshing with said worm, a shaft supporting said wheel, a pinion also supported by said shaft, a piston against which said force-producing means acts, a retracting rack secured to said piston and having its teeth in engagement with said pinion, clutch assemblies forming parts of said shaft, pinion and worm wheel and said shaft being mounted for axial movement to render said assemblies inoperative.

8. An injection device including in combination a sleeve, a cap rotatably supported at one end of said sleeve, a piston slidable within said sleeve and projectible to expel medicament from a chamber associated therewith, a pair of retracting members having their inner ends connected to said piston, racks extending from the edges of each of said members, a worm mounted for rotation with said cap, shafts extending one to each side of said members and worm, worm wheels meshing with said worm and mounted one by each of said shafts, pairs of pinions also mounted by each of said shafts and one to each side of said worm wheels to mesh with said racks, clutch means for connecting said worm wheels and pinions with the shafts upon which they are mounted and means for projecting said shafts to render said clutch means inoperative.

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