Sept. 29, 1953 G. N. HEIN, JR 2,653,605

INJECTION DEVICE AND AMPOULE

Filed March 22, 1951 3 Sheets-Sheet 1

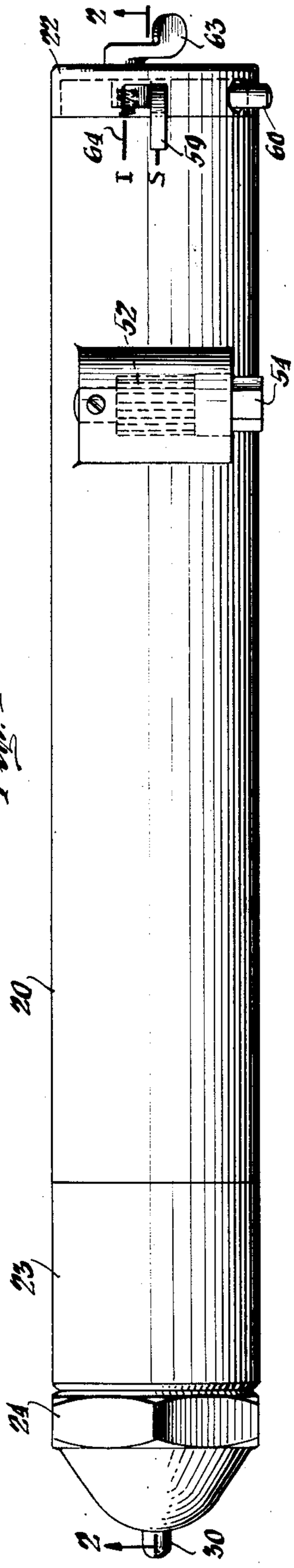

Fig. 1

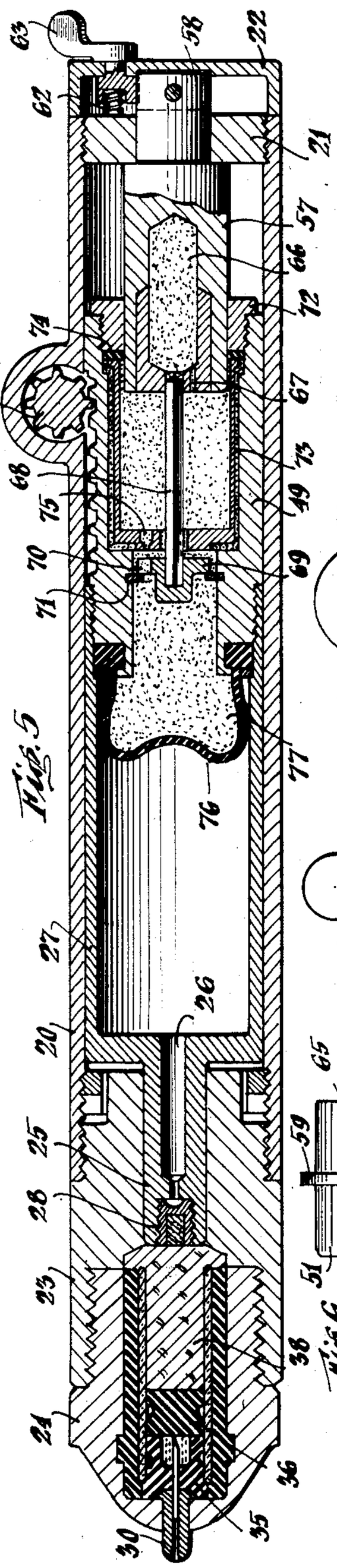

Fig. 5

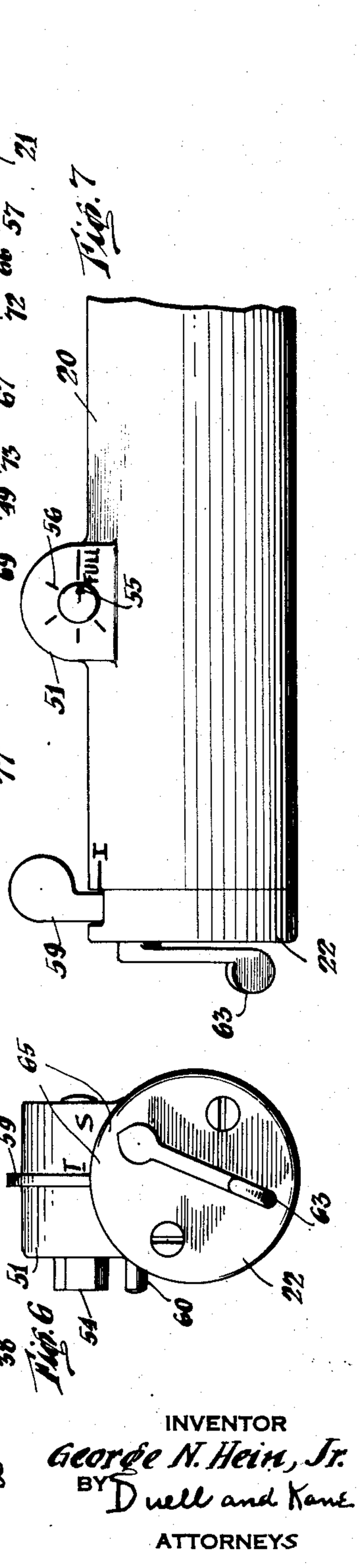

Fig. 7

Fig. 6

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INJECTION DEVICE AND AMPOULE

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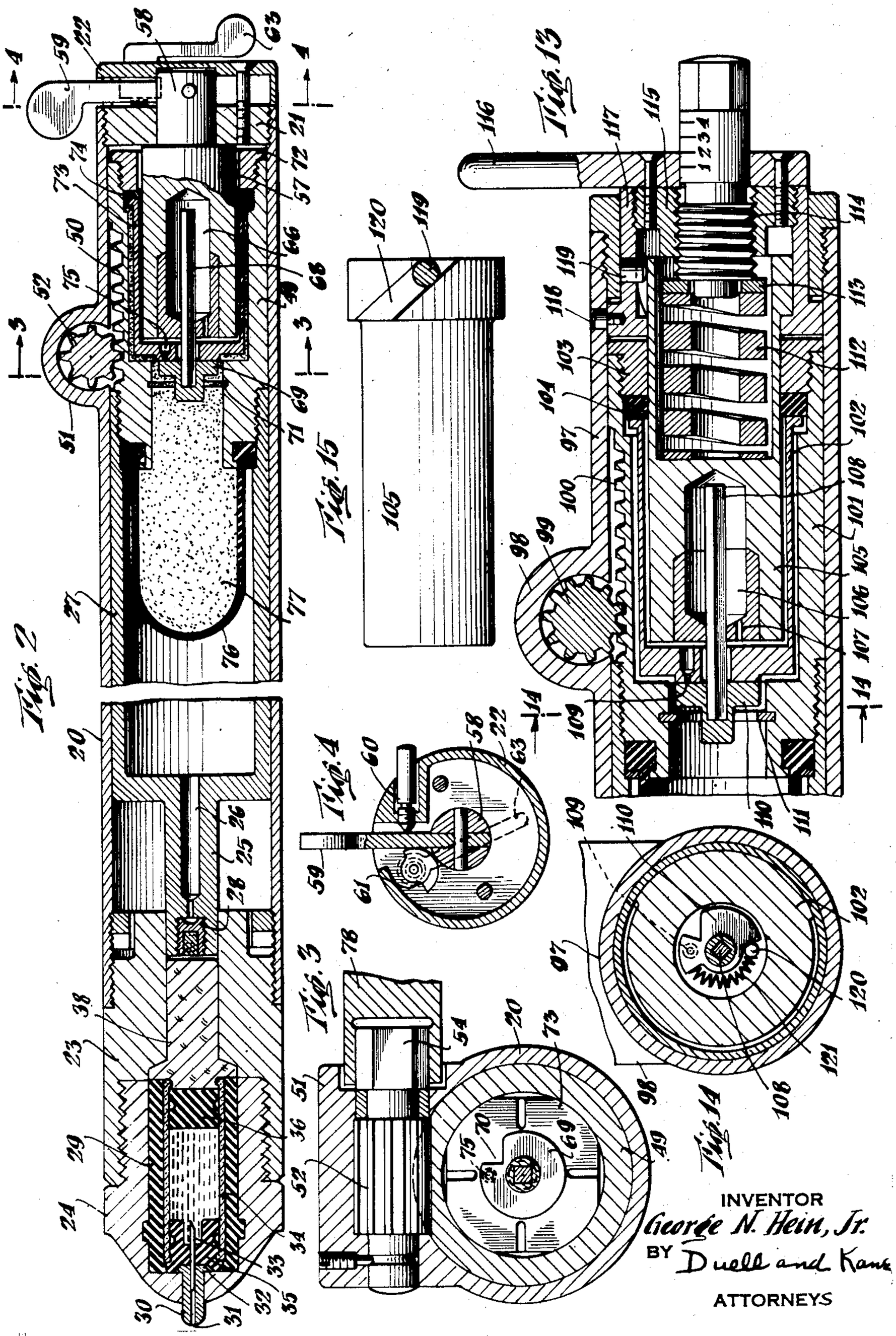

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INJECTION DEVICE AND AMPOULE

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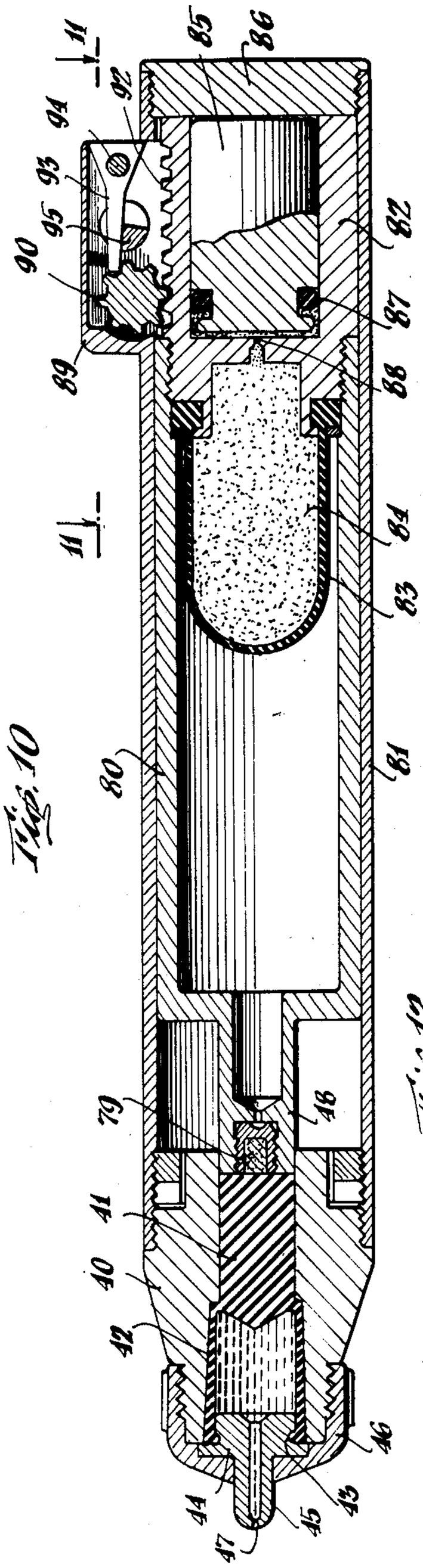

Fig. 10

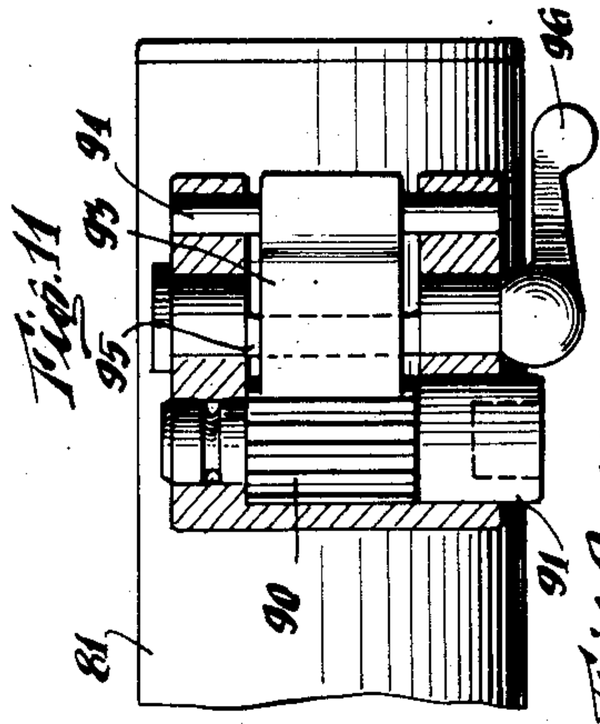

Fig. 11

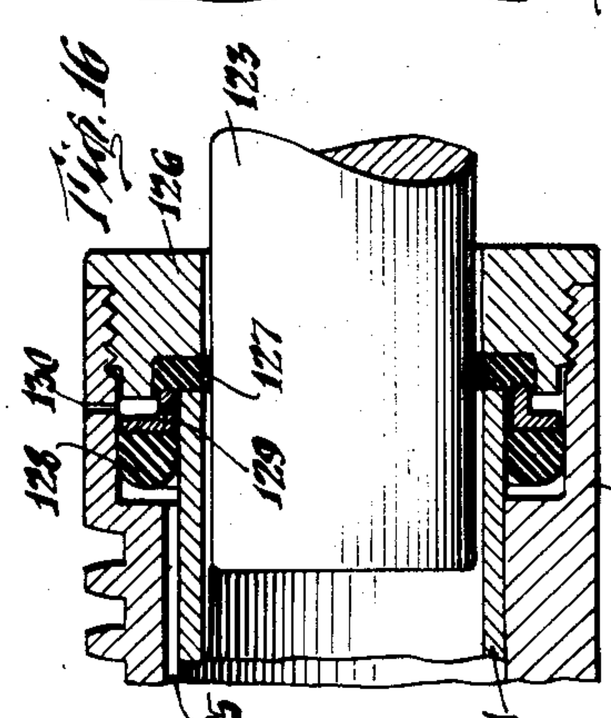

Fig. 16

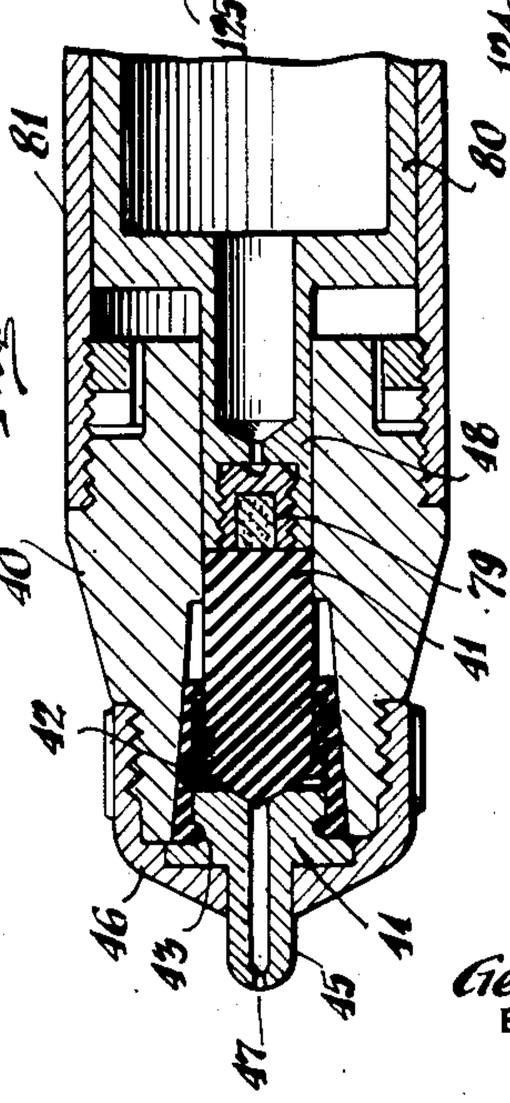

Fig. 12

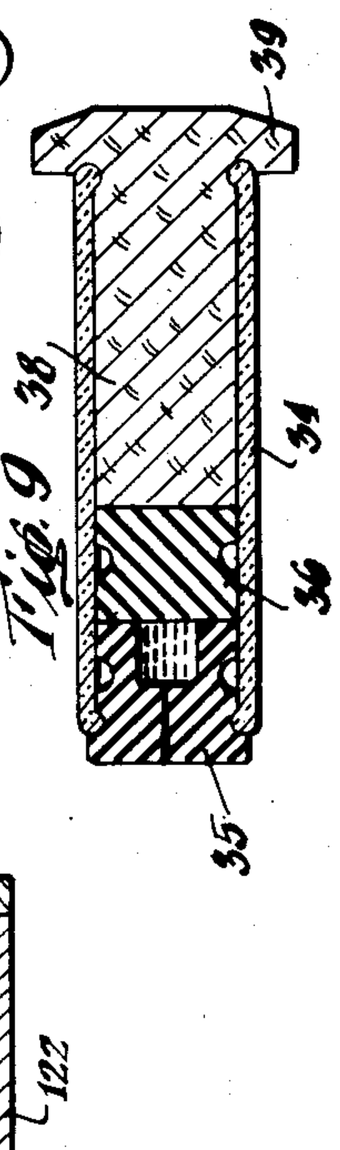

Fig. 9

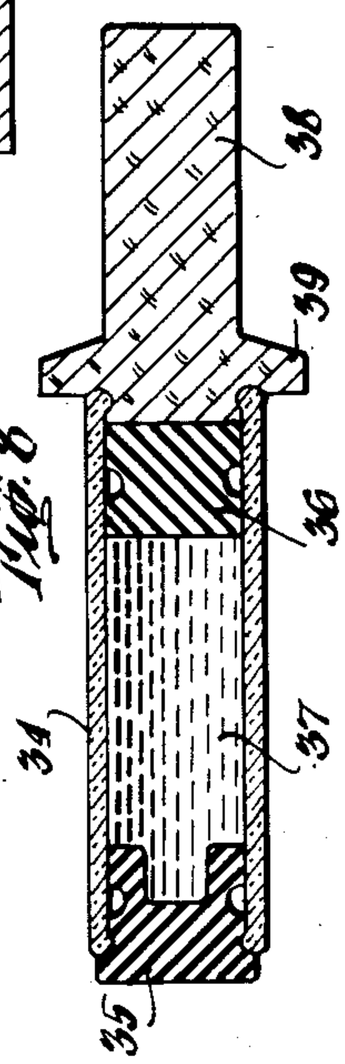

Fig. 8

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INJECTION DEVICE AND AMPOULE

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Application March 22, 1951, Serial No. 217,005

26 Claims. (Cl. 128—173)

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This invention relates to a structurally and functionally improved hypodermic injection device and an ampule usable in connection with that type of device.

It is an object of the invention to furnish an apparatus having improved functional and structural characteristics and by means of which hypodermic injections of medicament may be accomplished without the use of a skin and tissue perforating needle; the medicament being discharged at velocities and in a sufficiently fine stream such that penetration of the epidermis by the solution will be achieved.

A further object is that of providing an ampule for use with an apparatus of this type in which the ampule may conveniently be discarded after a single injection; such unit being capable of production at nominal cost and even if formed of glass or other shatterable material embodying an assembly such that the liability of its being accidentally broken will be minimized when the ampule is used with an injection apparatus constructed in accordance with the present teachings.

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 side elevation of the apparatus;

Fig. 2 is a longitudinal sectional view thereof;

Figs. 3 and 4 are transverse sectional views taken respectively along the lines 3—3 and 4—4 and in the direction of the arrows as indicated in Fig. 2;

Fig. 5 is a view similar to Fig. 2 but showing the positions which the parts assume at the end of the injection stroke;

Fig. 6 is an end view of the apparatus;

Fig. 7 is a fragmentary side elevation of the rear portion of the same;

Fig. 8 is a sectional side view of a preferred form of ampule prior to its discharge;

Fig. 9 shows that ampule after it has been discharged;

Fig. 10 is a view similar to Fig. 2 but showing an alternative form of structure;

Fig. 11 is a sectional view taken along the line 11—11 and in the direction of the arrows as indicated in Fig. 10;

Fig. 12 is a fragmentary view of the end of the apparatus as shown in Fig. 10 but illustrating the parts when they have assumed a different position;

Fig. 13 is a fragmentary sectional view on somewhat enlarged scale and showing a further form of structure;

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Fig. 14 is a transverse sectional view taken along the line 14—14 and in the direction of the arrows as indicated in Fig. 13;

Fig. 15 is a side elevation of one of the units of the assembly as shown in Fig. 13; and

Fig. 16 is a fragmentary sectional view of an alternative structure.

Referring primarily to Figs. 1 to 7 inclusive, the numeral 20 indicates the exterior casing of the device which may be in the form of a tube. Secured to the rear end of the latter by, for example, threads, is a plate 21. In turn attached to this is a cap 22 which may be co-extensive with the casing 20. To the forward end of tube or casing 20 an extension 23 is conveniently secured by screw threads. This extension mounts a loading cap or nose piece 24. Such mounting as shown may be effected by any suitable form of quick-detachable coupling such as screw threads. The nose piece and extension define between them a medicament chamber as hereinafter described.

A plunger assembly has a portion projectible to cause expulsion of medicament from within that chamber. That portion may be in the form of a stem or plunger 25 slidable within a bore of extension 23. Stem 25 is preferably formed with a bore 26 providing access to the interior of the main body 27 of the assembly. The outer end of bore 26 may normally be sealed by a plug 28 or in any other desired manner. The interior of body 27 is filled with a gas under pressure or otherwise provides a pressure accumulator structure. In most respects, gas is preferred. While the pressures may be of any desired values, I have found that with the parts properly proportioned, satisfactory results are achieved if the pressure within body 27 is around 1500 pounds to the square inch. Compressed air may, of course, be employed and as such should be considered as falling within the broad definition of gas. In most respects, however, I prefer to employ an inert gas such as nitrogen.

The assembly furnished adjacent the forward or outer end of the apparatus defines a medicament chamber or provides a mounting for an ampule or suitable container within which the medicament is disposed. As illustrated especially in Figs. 2 and 5 an ampule constructed of glass or similar material is to be employed as part of the operative assembly. Therefore, the extension 23 and nose piece 24 are formed with bores such that they may receive an ampule assembly as hereinafter described. The rear portion of the bore formed in extension 23 is such that it may receive the stem 25. At its outer end this bore enlarges to a diameter preferably equal to the bore formed

in nose piece **24**. That bore receives a liner or sleeve **29** of displaceable rubber or similar material. The outer end of the bore within nose piece **24** is reduced and continued in the form of an opening through which a tip **30** may extend having a discharge orifice **31** of minute cross sectional area (for example an orifice of from .004'' to .012''). Tip **30** terminates in an enlarged base portion **32**. A piercing cannula **33** may be mounted by the tip and base to extend inwardly. The bore defined by sleeve **29** should be just sufficient to receive the ampule.

A preferred form of ampule constructed of glass or similar material has been shown in its initial or unfired stage in Fig. 8. In that view the numeral **34** indicates the glass tube provided adjacent its forward or outer end with a pierceable stopper **35**. Adjacent its rear end a second stopper **36** may be mounted. In certain instances, this stopper may be dispensed with. However, as a general matter of procedure, it is preferred that it be employed. Both stoppers **35** and **36** are formed of rubber or similar material and stopper **36** is of the piston type. A body of fluid medicament **37** is interposed between stoppers **35** and **36**. An actuator forms a part of the ampule assembly and includes a rod portion **38** extending conveniently into the bore of tube **34** to abut against stopper **36**. If no such stopper is employed then rod portion **38** may function as an expulsion piston. At a point spaced from the forward end of actuator **38**, an outwardly extending flange portion **39** is provided. Again it is preferred to employ such a portion. However, as will be apparent, this part might be dispensed with, if desired. In any event, the entire actuator is formed of a moldable material which, under pressure, will flow to conform to the surfaces of a chamber within which it is confined. A convenient form of material is paraffin. As will be apparent, if the parts of the assembly include generally the configuration disclosed in Fig. 8, then these parts will remain in assembled condition for any desired period of time and will maintain the solution against contamination by air.

Such an ampule assembly is disposed within the bore of sleeve **29** by inserting tube **34** into that sleeve. Prior to this operation nose piece **24** is, of course, dismounted from extension **23**. After nose piece **24** is applied to extension **23** it will be apparent that the body or post portion **38** of the actuator will be disposed within the bore of extension **23** if stem **25** is retracted as shown in Fig. 2. With the assembly of the parts, cannula **33** will pierce stopper **35** to establish communication between the orifice **31** and the interior of the ampule. Flange portion **39** will overlie the rear edges of tube **34** and also the end edges of sleeve **29**. The actuator being of flowable or moldable material it follows that if stem **25** is projected pressure will be exerted against stopper **36** (if the latter be employed) and against the end edge of sleeve **29**. That sleeve being constructed of rubber or other displaceable material, it follows that the end pressure against it will result in a constriction of its bore so that the surfaces of the latter move into supporting relationship with the outer faces of tube **34** to prevent the latter from bursting incident to the pressures which are generated internally of the same. Such pressures follow as a consequence of the simultaneous projection of rod or post portion **38** into the bore of tube **34** with consequent expulsion of the liquid body

37 through cannula **33** and orifice **31**. If these pressures are sufficiently high and the orifice defines a proper jet of liquid then ejection of the medicament will occur at a velocity and in a sufficiently fine stream such that it will penetrate the epidermis without the aid of a needle.

The fully discharged position of the ampule assembly has been shown in Fig. 9 and also in connection with the apparatus in Fig. 5. Referring to the former figure, it will be observed that the post portion **38** of the ampule under the urging of stem **25** or its equivalent powering portion has moved into the bore of tube **34** to thus shift stopper **36** or the forward end of the post portion **38** to a point immediately adjacent stopper **35**. With the parts thus disposed substantially all medicament **37** within the ampule has been expelled. Flange **39** remains in existence although it may have been slightly reformed to overlap the adjacent end edges of tube **34** as sleeve **29** compresses. As will be understood flange **39** need not necessarily be preformed in that if stem **25** or its equivalent moves with sufficient force and proper space if available, the body of the actuator will be remolded during the expulsion stroke to cause part of that body to extend and bear in compressing engagement with the rear edge of sleeve **29**.

While in many respects it is preferred to employ an ampule of this general type to define a medicament chamber, different structures might be employed. One such structure has been shown in Figs. 10 and 12. In those views the numeral **40** indicates an extension or nose piece attached to the main casing of the device and which defines a bore suitable for the reception of the medicament-containing unit. That unit may be formed of rubber or other suitable flexible material and conveniently include a rear stem **41** and a forward cup portion **42**. The latter is flared in a forward direction and may define adjacent its rim a flange **43** to extend into a groove formed in the peripheral edge of a base **44** integral with the nozzle tip **45**. A loading cap **46** is secured to extension or nose piece **40** by, for example, screw threads. The end of nozzle **45** defines an orifice **47** which is of the desired minute cross sectional area.

If a power assembly including a stem **48** projectible into the bore of extension or nose piece **40** is employed in the structures of Figs. 10 and 12, then that stem will bear against the actuator portion or post **41** and shift the latter as stem **48** is projected. Under these circumstances cup **42** will involute upon post portion **41** and the latter will move through the cup and function as a piston against the body of medicament within the same. This movement of the parts will continue until the forward end of post **41** abuts the base **44** of nozzle **45**. Therefore substantially all medicament will be discharged through the orifice **47** of the nozzle. As will be apparent other forms additional to those heretofore described in Figs. 8, 9, 10 and 12 may be employed to furnish a medicament containing chamber. Under ordinary circumstances, however, it is preferred to utilize a structure such as has been shown in Figs. 8 and 9.

Now considering the structure of the operating mechanism as especially shown in Figs. 1 to 6 inclusive, it will be seen that the body **27** of the plunger assembly has attached to its rear end by means of threads or in any other desirable manner a tubular portion **49**. As shown especially in Fig. 3 an area of the exterior face of this por-

tion is flattened and formed with a series of teeth 50 providing a rack. Casing 20 is conveniently extended as at 51 to furnish a housing for a pinion 52 the teeth of which mesh with the rack teeth 50. Also this extended portion provides a bearing for the ends of a shaft which is integral with or affixed against movement with respect to pinion 52. One end of this shaft may project beyond portion 51 as indicated at 54 to provide a surface suitable for the mounting of a wrench or crank (not shown) by means of which the shaft and pinion are turned. As in Fig. 7 the opposite end of the pinion shaft may provide a surface bearing an indicia mark 55. This registers with a series of marks 56 formed on the side face of casing portion 51. It is apparent that this structure will function as a "tell-tale" in order to indicate the position of the interior mechanism as hereinafter described.

A piston 57 is provided with a rearward extension 58. The latter passes through an opening in plate 21 and into the space defined by cap 22. A trigger in the form of an arm 59 is attached to this extension and projects through a slot formed in the peripheral wall of cap 22. As shown especially in Fig. 4 the arc of movement of the trigger arm 59 is limited by adjacent walls. With one of these an adjustable stop in the form of a screw threaded pin 60 may be associated. The end of this pin will contact the side face of lever 59 when the latter is moved to one extreme position. Normally pin 60 will be immovable. However as it is adjusted within limits it will serve to provide a stop governing the speed and flow of fluid in a manner such that the velocity and/or force of projection will be varied. To prevent an accidental rotation of piston 57 incident to a swinging of trigger arm 59 a "safety" structure may also be provided. Conveniently as shown, especially in Fig. 4, this may include a rotatable cam 61 supported upon the cap 22 and which, as shown in Fig. 5, may be provided with a friction spring 62 to prevent its being rotated without deliberate effort. The cam is mounted upon a shaft which extends beyond the end of cap 22 and at that point mounts a crank 63 It is apparent that when the parts are in the position shown in Fig. 4, the trigger lever 59 is held against swinging movements. When cam 61 is rotated to have its surfaces clear the side face of arm 59, then the latter may be swung to rotate piston 57. As shown especially in Fig. 1, indicating marks 64 may be provided upon the face of casing 20 adjacent lever 59 to register the positions to which the latter should be shifted in order to provide for "safety" or "injection." Similarly the face of cap 22 may be provided with indicating marks 65 registering the corresponding positions on the part of lever 63. The indicia at 55 and 56 may furnish corresponding marks.

Piston 57 is hollow and provides a chamber 66. This chamber has an outlet wall formed with an off-center opening 67 of relatively small area. It is also formed with a central opening which is non-circular in section and within which a rod 68 reciprocates. This rod has secured to its other or forward end a valve head 69 formed with notches or interruptions 70. Outward movement of this head is limited by a stop conveniently in the form of a snap ring 71. The rear end of member 49 is closed by a plug 72. The latter has sliding movement over the surface of piston 57. A cup shaped member 73 has its rim adjacent plug 72. A suitable packing 74 is interposed between these elements. At this time it is

to be noted that the diameter of cup 73 is substantially less than the diameter of the recess forming a part of member 49 and which receives this cup. Therefore spaces intervene the adjacent member and cup surfaces. The base of the cup is formed with a central opening through which rod 68 may pass. It is also formed with an off-center opening 75.

As afore brought out, the interior of the hollow body 27 of the plunger assembly furnishes an accumulator structure. Extending into this is a member generally referred to as an extensible diaphragm. In the embodiment illustrated in Figs. 1 to 7, this extensible diaphragm is in the form of a rubber sack 76 which may, of course, be formed of other materials than rubber or artificial rubber. The face of the diaphragm or its peripheral edges are secured to the forward edge of member 49 by being clamped, for example, between that tube and the rear edge of member 27. As will be apparent in lieu of the sack illustrated any desired extensible structure such as a metallic bellows or corresponding unit might be mounted at this point. In any event, the diaphragm serves to isolate the gas under pressure from materials to the rear of the same. Such material in the present exemplification may be a relatively thick fluid in the form of a body of grease 77.

Considering primarily the operation of the expelling or injecting mechanism as shown in Figs. 1 to 7 inclusive and disregarding for the moment the ejection of the medicament it will be understool that with an apparatus constructed as described the safety lever 63 as well as the trigger 59 are initially swung to their safe positions indicated by the indica 64 and 65. Thereupon a suitable wrench (a portion of which has been indicated by the numeral 78 in Fig. 3) is applied to the non-circular end 54 of a shaft mounting pinion 52. This wrench or crank preferably embodies a structure such that it has lost motion when turned in an improper direction. That direction would be clockwise as viewed in Figs. 2 and 5. The socket portions of the wrench turn with the handle or arm of the latter as it is swung in a counter-clockwise direction according to those views. So swung it will rotate pinion 52. The teeth of the latter engage with the teeth of rack 50. Therefore that rack together with member 49 of which it forms a part will be retracted or, in other words, moved to the right as viewed in Figs. 2 and 5. As the member 49 is shifted from the position shown in Fig. 5 to that illustrated in Fig. 2, material 77 within the hollow portion 66 of piston 57 will displace through an opening or openings 67 into the interior of cup 73. This will occur because rod 68 is being projected into chamber 66. In this connection it will be understood that with the initiation of movement such as the foregoing, valve 69 will have moved to the position shown in Fig. 5 where it engages the stop or ring 71. Such shifting will occur because material 77 has displaced from cup 73 and will pass through the central opening and opening 75 in the base of the cup to act against the inner face of valve 69. Therefore as the parts are shifted to retracted or "cocked" position the body of material 77 will increasingly move into the interior of the expandible or diaphragm member 76 to extend and fill the latter despite the pressure existing within the interior of unit 27.

Incident to the pressure acting upon diaphragm 76 it is apparent that when the parts

reach their fully retracted position as in Fig. 2 the body of material 77 (which is now mainly within the diaphragm) will cause the face of valve 69 to move into sealing contact with the adjacent face of the base of cup 73. Therefore no fluid or grease may flow through opening 75. However if the safety lever or equivalent element 63 is swung to the position indicated by the letter "I" 65, then trigger 59 may shift from a position in line with the "S" of indicia 64 toward a position in line with "I" of that indicia.

As trigger 59 is swung it is apparent it will rotate stem 58 as well as piston 57. Due to the conforming and non-circular faces of rod 66 and the opening in the base of piston 57 through which that rod extends such rotation will also be transmitted to the rod as well as the valve mounted by the same. As valve body 69 rotates with respect to the base of cup 73 the notch 70 of the valve will align with the opening 75. Therefore fluid in the form of grease or other material may flow through opening 75 of cup 73. Consequently, during cocking valve 69 will be instantly moved outwardly by the flowable material to the position indicated in Fig. 5. This will be true because the material will bear against the under face of that valve to thus shift the latter into engagement with the stop 71. However, during the injection, or working stroke of the parts, valve 69 would merely turn to uncover orifice 75. Accordingly, grease will, under these circumstances, be free to flow into the piston chamber and the valve would be held adjacent to its seat by the rearward flow of the grease and the viscosity of the latter between the valve seat and head. During injection, the pressure below valve 69 would never exceed that existing beyond that valve or, in other words, within the diaphragm 76. Therefore material 77 under the pressure exerted by the gas within hollow body 27 will be forced by the inner face of the diaphragm to flow into the space intervening the base of cup 73 and the end of piston 57 as well as into the chamber 66 of the latter. This action of the parts will continue until the body 27 has been fully projected. The extent of such projection as well as the fully cocked and discharge positions will, of course, be evidenced by the "tell-tale" provided by the indicia 55—56. As will be understood prior to the release or shifting of trigger 59 the crank has been detached from portion 54 and during the projection of the parts stem 25 has moved in unison with body 27. During the operation of the parts seal or packing 74 is constantly under pressure. Therefore leakages at this point are negligible.

Now considering solely the expulsion of medicament regardless of the power means employed to assure this result it will be understood that when the parts were in "cocked" position, an ampule of the type shown in Fig. 8 might have been disposed with its post portion 38 extending into the bore of extension 23. Thereupon, with nose piece 24 applied to the extension the forward end of the ampule would be in communication with the bore 31 of tip 30. Under these circumstances flange 39 would overlie the rear edge of ampule 34 and bear against compressible sleeve 29. Therefore as projection of stem 25 occurred post 38 would have its material flow so as to eject the medicament 37 from within the bore of tube 34 by subjecting that body of medicament to high pressure. Simultaneously the exterior face of the ampule would be subjected to substantially equal pressures incident to the compression of sleeve 29. Therefore the danger of the ampule

shattering would be nullified or rendered extremely remote. When the base of member 27 reached its point adjacent the rear face of extension 23 substantially all medicament will be discharged as shown in Fig. 5. Therefore by now removing nosepiece 24 the spent ampule can be removed and discarded. In such removal it might, in most instances, be desirable to apply wrench 78 to the shaft mounting pinion 52 for the purpose of rotating the latter to a minute extent such as would cause a slight retraction of the parts with consequent relief of bearing pressures.

Obviously a similar result would be achieved if the medicament chamber embraced a structure such as has been shown in Figs. 10 and 12. To employ such a chamber a nosepiece of the type shown at 40 in these figures would be substituted for the extension and nose piece or loading cap shown in the earlier figures. In any event as illustrated in Figs. 10 and 12, the projection of the stem 48 would cause post 41 to be projected. This would cause the base of the cup and its side walls 42 to be inverted on post 41; this operation continuing until substantially a complete discharge of the medicament body within the cup had been effected.

In Figs. 10, 11 and 12 a somewhat simplified form of projecting mechanism has been shown in comparison with that illustrated in the earlier figures. The stem 48 in these views may be closed by a plug 79 with which sealing material may be associated after body 80 has had its interior charged with suitable gas under pressure. This structure may be identical with the detailed design at this point in the earlier figures. Likewise body 80 is enclosed within a tubular casing 81 within which it slides and the rear end of this body is attached by threads or in any other desired manner to the forward end of a hollow member 82. The latter also supports an extensible or diaphragm member 83 which is filled with grease 84 or other suitable material. Member 82 presents a bore within which a piston 85 rides. The latter may be secured to or disposed adjacent the end cap or plate 86. A seal 87 is conveniently carried in a groove forming a part of piston 85 and bears in contact with the inner bore face of member 82. The face of that member is provided with an orifice 88 for the passage of the material 84. Preferably no metering pin extends through this orifice although such a structure might be employed if desired. In any event it is apparent that a valve assembly is not present at this point. Therefore with the interior of body 80 being under proper pressure (for example around 1500 pounds per square inch) it follows that seal 87 is constantly under pressure. Therefore leakages at this point are avoided.

Tubular casing 81 may be provided with an extended portion 89 which houses a pinion 90 and rotatably supports the ends of a shaft 91 affixed to or integral with that pinion. The teeth of the latter, in addition to meshing with the teeth of a rack 92, provide an annular ratchet. A spring pressed pawl 93 cooperates with this ratchet and is pivotally supported as at 94. A cam 95 is rotatably supported to extend adjacent the arm of pawl 93. A suitable actuating portion 96 is connected with cam 95.

The same procedure as heretofore described in connection with the operation of the apparatus of Figs. 1 to 7 inclusive occurs also in connection with this structure. More particularly a crank or other suitable actuating member is coupled to shaft 91 and pinion 90 is rotated to retract member 82. With cam 95 in the position

shown in Fig. 10, pawl 93 will prevent any accidental projection of the parts. As retraction occurs piston 85 will express the grease or other material through orifice 88 into diaphragm or extendable member 33. The parts will now occupy positions such as have been shown in Fig. 10. If, therefore, a medicament chamber (such as a cup or ampule—see Figs. 8 and 10 respectively) is disposed in operative association with the outer end of the apparatus and the parts of that outer end are assembled in the manner shown, the device will be ready for functioning. Such functioning will involve the placing of the apparatus in proper position with respect to the area to be injected. Thereafter it will include an operation of the actuator 96 in order to rock cam 95 and release pawl 93 from the teeth of ratchet pinion 90. Under these circumstances, the latter is free to rotate. Therefore member 80, its stem 48 and the unit 82 will move forward as a single assembly. This will cause a discharge of the medicament under desired pressures and velocities. It is found with an apparatus of this type that greater release noise is present than in connection with the structure of the earlier figures. Where such an effect is not objectionable this simplified assembly may therefore be used.

In Figs. 13, 14 and 15 an assembly has been shown which, in many respects is similar to that illustrated in Figs. 1 to 7 inclusive. However a pressure regulating structure is embodied in the assembly of the later figures. In these the numeral 97 indicates the casing or exterior tube of the device conveniently provided with an extended portion 98 within which a pinion 99 rotates. The teeth of the latter mesh with the teeth of a rack 100 forming a part of a member 101 corresponding to member 49 and similarly to the former having a hollow body attached to its outer end and also mounting the base of a diaphragm or extensible unit. Within the bore of member 101 a cup-shaped unit 102 is disposed. This unit is spaced from the inner face of member 101 and an end plug 103 may maintain a seal 104 in position and so that wiping contact over the outer surface of piston 105 follows. This seal, of course, also prevents leakage. Piston 105 is formed with a chamber 106 from which an off-center opening 107 extends. This opening is in addition to a central opening having a non-circular configuration and with which the correspondingly faced edge portions of a rod 108 cooperate.

The base of the cup-shaped unit 102 is also formed with an off-center opening 109 and a circular opening through which rod 108 extends. A valve 110 is carried by the outer end of the rod and has its movements axially of member 101 limited by a stop conveniently in the form of a snap ring 111. The rear end of piston 105 may be counterbored and receive a spring 112 which bears against its base; the opposite end of the spring bearing against a washer 113 engaged by a screw 114. Screw 114 has threaded bearing in a plug 115 to which is attached a lever or trigger 116. Secured to this plug by, for example, screw threads is a collar 117. The latter carries a pin 118 riding within an arcuate slot formed in casing 97. Also it carries a pin 119 which rides within a helically extending groove 120 forming a part of piston 105. As shown especially in Fig. 14 a stop pin 120 may have one end of a spring 121 bearing against it, the opposite end of this spring bearing against

valve 110. This structure will serve to take up back lash or play between post or rod 108 and the orifice or opening which is centrally disposed within the base of piston 105.

Considering the operation of the assembly as shown especially in Fig. 13 it is apparent that if the parts are "cocked" the operator may—upon desiring to fire the device—simply rock trigger or lever 116 with respect to casing 97. The amount of movement between the parts will, of course, be limited by pin 118 moving between the ends of the slot or groove within which it rides. In any event, a turning or rocking of lever 116 will cause a rotation of plug 115 and sleeve 117 and a rotation of piston 105. Consequently valve 110 will also be oscillated. This will result in an uncovering of the passage 109 by the valve in the manner previously described. Therefore grease under pressure will be free to pass through passage 109 and act against the outer face of piston 105.

If the pressure so exerted is sufficiently great then spring 112 will be compressed and the piston will move rearwardly. Incident to such rearward movement the helical groove 120 in cooperation with pin 119 will cause a limited rotation of the piston. This, in turn, will result in a partial closing of the valve 110. Consequently the action of the parts will be slowed down due to the drop of pressure. As soon as this occurs spring 112 will thrust piston 105 forwardly to again open valve 110 to a greater extent. Thus during the entire working stroke the parts will automatically adjust to cause a pre-determined speed of operation. It is apparent that this speed may be adjusted by adjusting the position of pin 114 to thus vary the tension on spring 112.

Finally, if in any or all of the foregoing constructions, difficulties are experienced incident to an escape of grease 77—84 or other fluid, then a structure such as is suggested in Fig. 16 may be employed. As will be seen in that view the numeral 122 indicates the body of the member upon which the ratchet teeth are formed and 123 the body of the piston slidable within the bore of cup-shaped member 124. Any desired number of channels 125 may exist between the body of member 122 and the outer face of cup 124. A plug or ring 126 conveniently closes the rear end of body 122 and a gasket of suitable resilient material indicated at 127 may be interposed between the inner face of this ring and the rear edge of cup 124. An enlarged space is conveniently furnished adjacent the rear end of body 122 and a suitable seal 128 is disposed within this space. Interposed between seals 127 and 128 is a ring 129 the forward space of which has an area in excess of the rear face of the same. This excess area may be fractionally larger or up to several times as large according to the needs of any given installation. In any event assuming that grease, for example under 1500 pounds pressure, is flowing within channel 125 it will act against seal 128 and the larger face of ring 129 in order to shift the latter rearwardly against seal 127. If, for example, the rear face of ring 129 is half the area of its forward face then (aside from friction and other losses) seal 127 is forced into contact with the face of piston 123 at a pressure of 3,000 pounds to the square inch. If a construction such as this is employed, any suitable number of vent holes 130 may be provided through the body of member 122. These will prevent undue pressure

from building up within the sealing area; thereby equalizing differential pressure.

In the several forms of actuating apparatus illustrated it is apparent that a piston unit is, in each instance, preferably employed adjacent the rear of the casing. It is this unit upon which the hollow member reciprocates. Even if an interposed cup-shaped element is provided the grease or other fluid acts against the outer or forward face of the piston in order to exert the necessary thrust. In each instance a metered or controlled flow of the fluid being displaced is effected. This control either occurs as a consequence of the size of the opening or openings through which the fluid flows rearwardly or the metering structure afforded incident to the valve support. In the latter connection it will be understood that any desired result might be achieved by contouring the surfaces of the parts as taught in my prior application for United States Letters Patent on "Injection Device" filed in the U. S. Patent Office on December 19, 1950 and identified under Serial Number 201,588. Finally as previously outlined it is preferred to employ an ampule involving a moldable or flowable post or flange portion in connection with an apparatus embodying the structure as taught in the present application. As shown the structure of the ampule tube or post may be modified so that the two interlock to prevent accidental separation of these elements. However it will be understood that an ampule discharging assembly of a different structure might, in many instances, be used to advantage.

Thus, among others, the several objects of the invention as specifically aforenoted 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 device including in combination a hollow body, a member reciprocal within said body, a medicament-expelling part connected to said member to be movable therewith, said member being hollow and containing gas under pressure, a unit fixed with respect to said body and distensible into said member to increase the pressure of gas within the same, means providing a chamber in communication with the interior of said unit to receive flowable material and means for retracting said member to cause said material to flow from said chamber to said unit.

2. An injection device including in combination a hollow body, a member reciprocal within said body, a medicament-expelling part connected to said member to be movable therewith, said member being hollow and containing gas under pressure, a unit fixed with respect to said body and distensible into said member to increase the pressure of gas within the same, means providing a chamber in communication with the interior of said unit to receive flowable material, means for retracting said member to cause said material to flow from said chamber to said unit and valve means disposed between said chamber and unit for controlling such flow.

3. An injection device including in combination a hollow body, a member reciprocal within said body, a medicament-expelling part connected to said member to be movable therewith, said member being hollow and containing gas under pressure, a unit fixed with respect to said body and distensible into said member to increase the pressure of gas within the same, means providing a chamber in communication with the interior of said unit to receive flowable material, means for retracting said member to cause said material to flow from said chamber to said unit, valve means disposed between said chamber and unit for controlling such flow and means disposed adjacent one end of said body and extending beyond the face of the latter for controlling the action of said valve means.

4. An ampule including a tubular body, thrust-transmitting means projectible through the bore of said body for expelling liquid from within the same and means forming a part of said thrust-transmitting means to move adjacent the outer surface of said body to cause the same to be supported against bursting.

5. An ampule including a tubular body, thrust-transmitting means projectible through the bore of said body for expelling liquid from within the same, means forming a part of said thrust-transmitting means to move adjacent the outer surface of said body to cause the same to be supported against bursting and said thrust-transmitting means being mounted adjacent one of the ends of said ampule.

6. As an article of manufacture a moldable body for disposal adjacent the end of an ampule from which medicament is to be expelled, said body comprising a part to act against an ampule for effecting such expulsion, a part to cause pressure to be exerted against the exterior of said ampule for supporting the same and a part to be acted upon by pressure means to shift said body and cause divided flow thereof between the first named parts of said body.

7. An ampule including a tubular body, a piston mounted adjacent one end of said body, thrust transmitting means projectible against said piston and through the bore of said body for expelling liquid from within the same and means forming a part of said thrust-transmitting means to move adjacent the outer surface of said body to cause the same to be supported against bursting.

8. As an article of manufacture an ampule including in combination a tubular body within the bore of which medicament is to be disposed, said body presenting a discharge end and a post of flowable material disposed adjacent the opposite end of said body.

9. As an article of manufacture an ampule including in combination a tubular body within the bore of which medicament is to be disposed, said body presenting a discharge end, a post of flowable material disposed adjacent the opposite end of said body and means for retaining said post in association with said body.

10. An injection apparatus comprising in combination a body, means adjacent one end of said body to provide a mounting for a medicament chamber, means movable within said body and projectible towards said chamber said means comprising a hollow unit containing gas under pressure, a piston disposed adjacent the opposite end of said body, a cylinder member slidable over the surfaces of said piston and furnished with an opening towards said hollow unit, a diaphragm mounted by said cylinder and extending into said unit and means for reciprocating said cylinder over said piston.

11. A hypodermic injection device including in combination a body, means associated with said body to provide a mounting for a medicament-containing chamber, a plunger projectible to-

wards said mounting to expel medicament from a chamber associated therewith, an accumulator to contain fluid under pressure, means provided with a fluid passage and connected to said plunger to move as the latter is retracted and to increase the pressure within said accumulator, means against which the fluid under pressure reacts to cause a projection of said plunger and a valve shiftable to control the flow of fluid through said passage.

12. A hypodermic injection device including in combination a body, means associated with said body to provide a mounting for a medicament-containing chamber, a plunger projectible towards said mounting to expel medicament from a chamber associated therewith, an accumulator to contain fluid under pressure, means provided with a fluid passage and connected to said plunger to move as the latter is retracted and to increase the pressure within said accumulator, means against which the fluid under pressure reacts to cause a projection of said plunger, a valve rotatably mounted adjacent one end of said passage and normally sealing the same, said valve being formed with an opening and means for rotating said valve to align said opening with said passage whereby fluid may flow through the latter.

13. A hypodermic injection device including in combination a body, means associated with said body to provide a mounting for a medicament-containing chamber, a plunger projectible towards said mounting to expel medicament from a chamber associated therewith, an accumulator to contain fluid under pressure, means provided with a fluid passage and connected to said plunger to move as the latter is retracted and to increase the pressure within said accumulator, means against which the fluid under pressure reacts to cause a projection of said plunger, a valve shiftable to control the flow of fluid through said passage and a valve actuator extending adjacent the outer face of said body and rotatable with respect to the latter, said actuator being connected to said valve to move the latter.

14. A hypodermic injection device including in combination a body, means associated with said body to provide a mounting for a medicament-containing chamber, a plunger projectible towards said mounting to expel medicament from a chamber associated therewith, an accumulator to contain fluid under pressure, means provided with a fluid passage and connected to said plunger to move as the latter is retracted and to increase the pressure within said accumulator, a piston carried by said body and extending into said last named means to provide a reaction point such that said plunger will project under the pressure of said fluid and a valve shiftable to control the flow of fluid through said passage.

15. A hypodermic injection device including in combination a body, means associated with said body to provide a mounting for a medicament-containing chamber, a plunger projectible towards said mounting to expel medicament from a chamber associated therewith, an accumulator to contain fluid under pressure, means provided with a fluid passage and connected to said plunger to move as the latter is retracted and to increase the pressure within said accumulator, means against which the fluid under pressure reacts to cause a projection of said plunger, a valve shiftable to control the flow of fluid through said passage, a rack connected to said plunger to move with the latter and a pinion rotatably carried by

said body and having its teeth cooperating with the teeth of said rack for causing a retraction of said plunger.

16. A hypodermic injection device including in combination a body, means associated with said body to provide a mounting for a medicament-containing chamber, a plunger projectible towards said mounting to expel medicament from a chamber associated therewith, said plunger containing gas under pressure, a piston carried by said body, a member ensleeved over said piston and formed with a passage for the flow of liquid, a diaphragm carried by said member and separating the interior of the latter from the gas within said plunger and a valve controlling the flow of liquid through said passage.

17. A hypodermic injection device including in combination a body, means associated with said body to provide a mounting for a medicament-containing chamber, a plunger projectible towards said mounting to expel medicament from a chamber associated therewith, said plunger containing gas under pressure, a piston carried by said body, a member ensleeved over said piston and formed with a passage for the flow of liquid, a diaphragm carried by said member and separating the interior of the latter from the gas within said plunger, a valve disposed adjacent said passage for controlling the flow of liquid therethrough, means for connecting said valve with said piston and means for rotating said piston with respect to said body for similarly moving said valve and controlling the flow of liquid through said passage.

18. A hypodermic injection device including in combination a body, means associated with said body to provide a mounting for a medicament-containing chamber, a plunger projectible towards said mounting to expel medicament from a chamber associated therewith, said plunger containing a gas under pressure, a piston carried by said body, a member ensleeved over said piston and movable with said plunger, a diaphragm carried by said member and extending into said plunger, a rack forming a part of said member, a pinion having its teeth cooperable with the teeth of said rack for retracting the latter and said plunger and releasable means engaging said pinion to free the latter for rotation and said rack for projection.

19. A hypodermic injection device including in combination a body, means associated with said body to provide a medicament chamber, an ampule disposable within said chamber, displaceable material intervening the outer face of said ampule and the inner face of said chamber, an actuator associated with said ampule to move with respect to the same to eject medicament therefrom and cause a displacement of said material such that said ampule is supported and power means for causing a shifting of said actuator.

20. A hypodermic injection device including in combination a body, means associated with said body to provide a mounting for a medicament-containing chamber, a plunger projectible towards said mounting to expel medicament from a chamber associated therewith, said plunger being hollow and containing gas under pressure, a member carried by said plunger to move with the same, a diaphragm supported by said member and extending into the plunger, a piston carried by said body, a spring urging said piston to a projected position, a cup ensleeved over said piston and carried by said member, said cup

being formed with an opening, a valve for controlling the flow of fluid through said opening and means for shifting said valve.

21. An ampule including in combination a tubular body to receive fluid medicament, means adjacent one end of said body for preventing an escape of fluid therefrom, means adjacent the opposite end of said body and movable through the bore of the same for expelling fluid from such body and means forming a part of said last-named means to shift exteriorally of said ampule and cause its body to be supported against bursting.

22. An ampule including a tubular body to receive fluid medicament, means adjacent one end of said body for preventing an escape of fluid therefrom, a piston adjacent the opposite end of said body and movable through the bore of the same for expelling fluid from said ampule and a mass of flowable material arranged beyond the outer face of said piston and shiftable exteriorally of said ampule to cause the body of the latter to be supported against bursting.

23. An ampule including in combination a tubular body to receive fluid medicament, a pierceable stopper adjacent one end of said body for preventing an escape of fluid therefrom, a piston adjacent the opposite end of said body and movable through the bore of the same for expelling fluid from said ampule and a mass of displaceable material disposed beyond the exterior face of said piston to shift exteriorally of said ampule and cause its body to be supported against bursting.

24. An injection device including in combination a hollow body, a member reciprocal within said body, a medicament-expelling part connected to said member to be movable therewith, a pressure accumulator associated with said member, a distendable unit acting against said accumulator to increase the pressure of the same, means providing a chamber in communication

with the interior of said unit to receive flowable material and means for retracting said member with respect to said body.

25. A hypodermic injector including in combination a hollow body, a piston assembly projectible therein to expel medicament from a chamber forming a part of said body, said assembly including a pair of spaces connected by a passage, one of said spaces being charged with gas under pressure, an expansible unit mounted by the said assembly and extending into said one space, the interior of said unit and the other of said spaces receiving fluid displaceable from one to the other through said passage, means mounted by said body and acting against the fluid in the other space to displace the same into said unit to expand the latter against the gas within said one space and means interposed within said passage for controlling the flow of fluid therethrough.

26. A hypodermic injector including in combination a hollow body, a piston assembly projectible therein to expel medicament from a chamber forming a part of said body, said assembly including a pair of spaces connected by a passage, one of said spaces being charged with gas under pressure, an expansible unit mounted by the said assembly and extending into said one space, the interior of said unit and the other of said spaces receiving fluid displaceable from one to the other through said passage, means mounted by said body and acting against the fluid in the other space to displace the same into said unit to expand the latter against the gas within said one space, valve means interposed in said passage for governing the flow of fluid therethrough and means for shifting the position of said valve means.

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No references cited.