United States Patent [19]

Lee

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[54] PISTON VALVE SYRINGE GUN

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[73] Assignee: Cooper, McDougall & Robertson Limited, Hertfordshire, England

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[52] U.S. Cl. 222/309, 222/387

[51] Int. Cl. G01f 11/06

[58] Field of Search 222/387, 309; 137/525, 533

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Assistant Examiner—John P. Shannon
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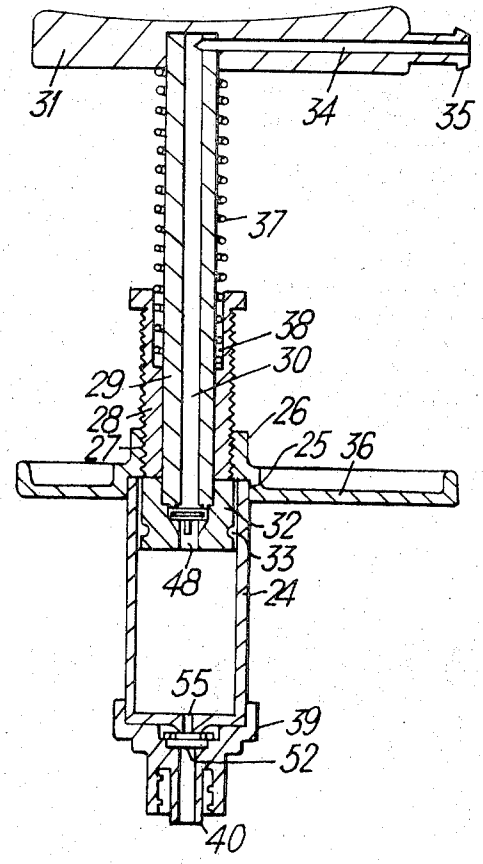
[57] ABSTRACT

A syringe gun suitable for dispensing liquid or semi-liquid comprises, in combination, a barrel, a piston rod, a piston attached to the piston rod and located within the barrel for discharging the contents of the barrel therefrom, an inlet valve enabling the passage of liquid or semi-liquid into the barrel, and a discharge valve enabling the passage of liquid or semi-liquid out of the barrel. At least one of said valves is the combination of a chamber, an inlet orifice to the chamber, a plate within the chamber of substantially greater cross-sectional area than that of the inlet orifice, the plate having an inlet side and an outlet side, a passage for liquid or semi-liquid from the inlet side of the plate to the outlet side of the plate, and an outlet orifice for enabling the passage of liquid or semi-liquid from the chamber. In this valve arrangement the plate seals the inlet orifice under pressure upon the outlet side of the plate and, in the alternative, permits the passage of liquid or semi-liquid through the inlet orifice, by the flexing or moving of the plate away from the inlet orifice and through said passage to the outlet orifice by flexing of the resilient plate or the moving of a floating plate from the inlet orifice, and through said passage to the outlet orifice.

13 Claims, 8 Drawing Figures



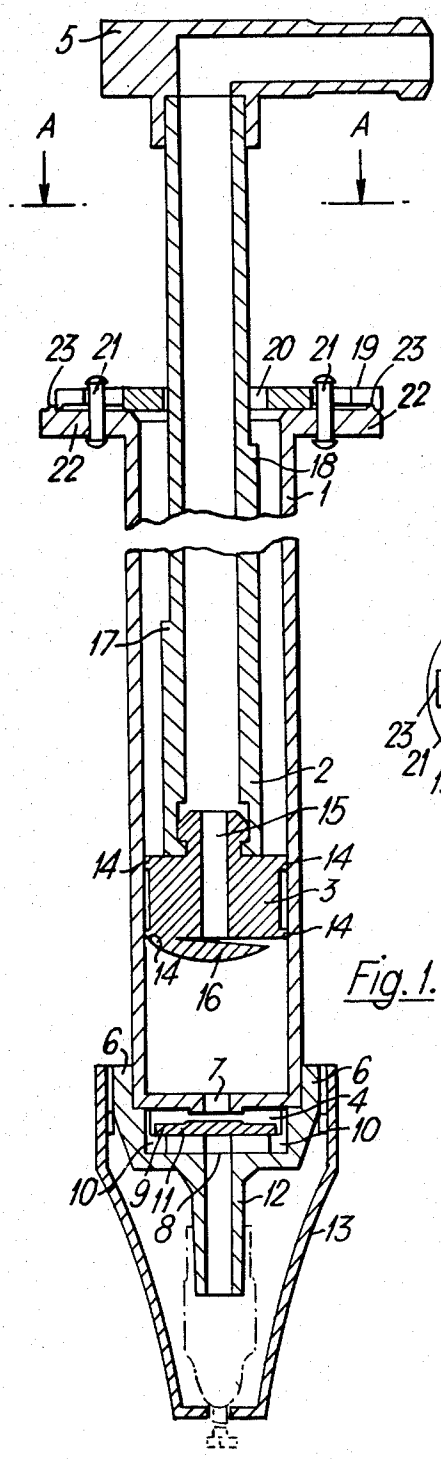

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Fig. 1.

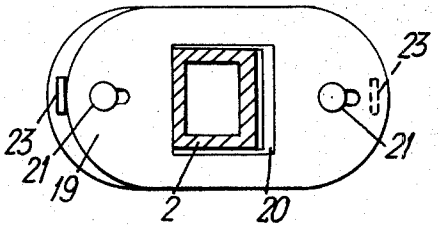
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Fig. 2.

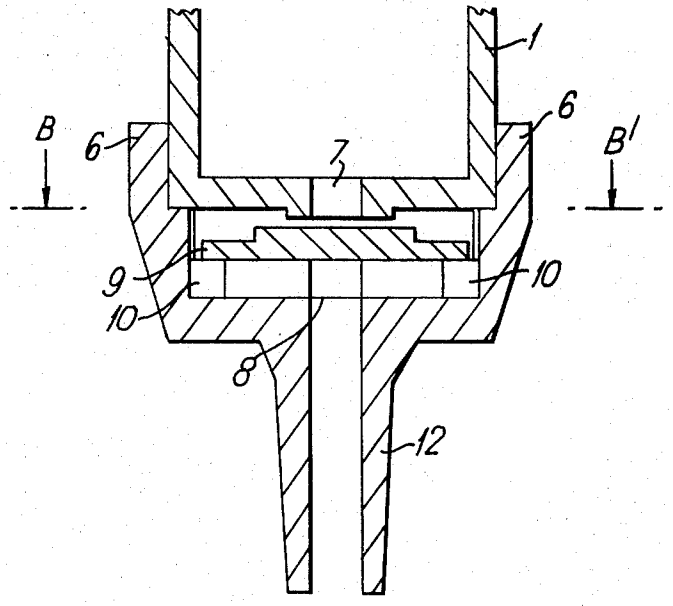

Fig. 3.

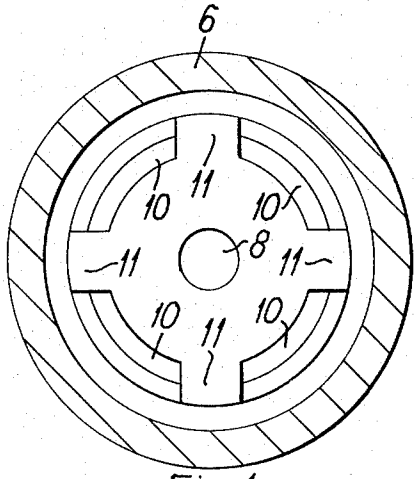

Fig. 4.

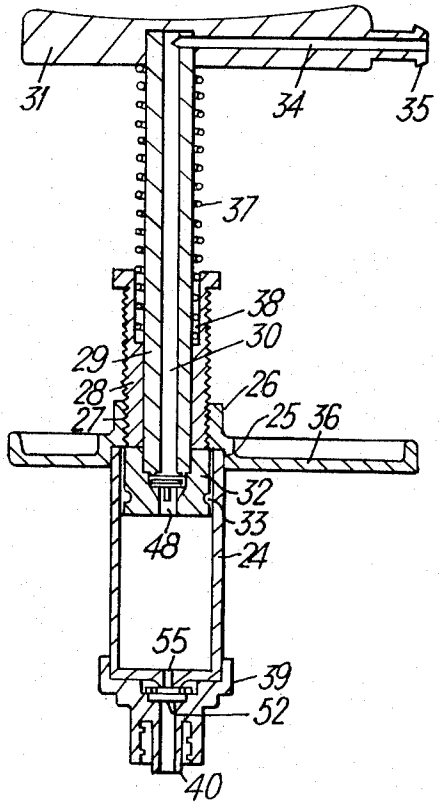
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Fig. 5.

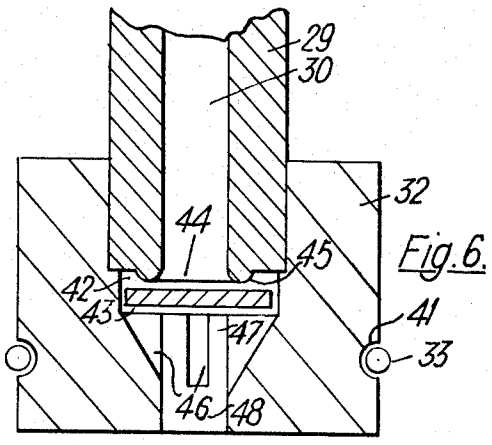
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Fig. 6.

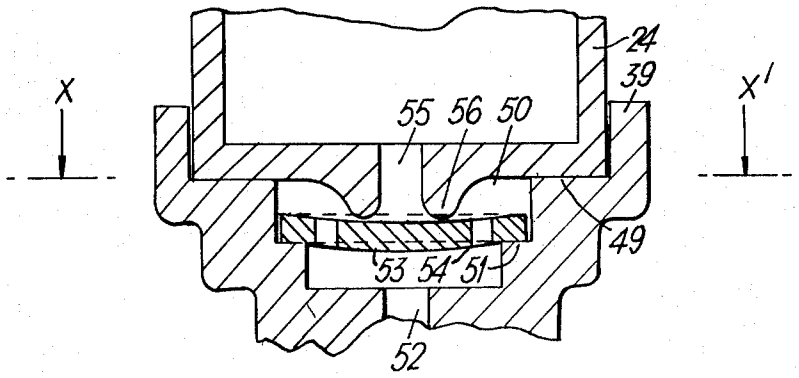

Fig. 7.

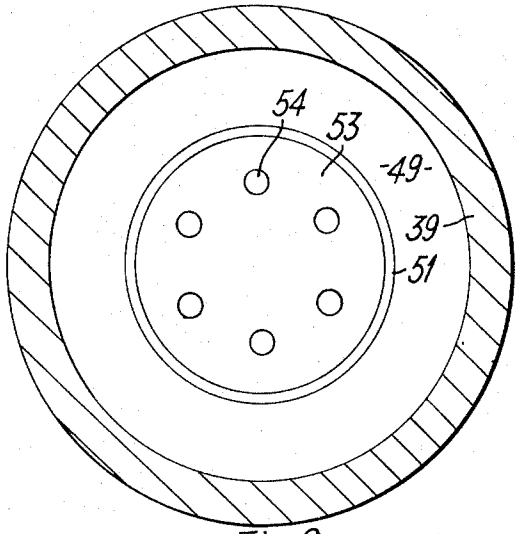

Fig. 8.

PISTON VALVE SYRINGE GUN

BACKGROUND OF THE INVENTION

This invention relates to improvements in syringe guns.

In particular the present invention relates to improvements in multiple-dose syringe guns capable of dispensing a large number of desirably predetermined doses of a liquid. This invention is especially useful in the veterinary field where it is often necessary to dose a large number of animals, for example sheep or cattle, with a drug, vaccine or the like.

When dosing a large number of animals a substantial quantity of liquid is required, and this may be carried in a container attached to the operator's back or arm. The liquid is usually fed via a tube to the syringe gun. Such a syringe gun must normally be capable of accurately dispensing a predetermined amount of liquid on a large number of successive occasions without leakage. Desirably it must also be light and easy to operate, to minimise the manual effort required by the operator; and of simple and cheap construction, so that it can be readily constructed but be sufficiently inexpensive to be disposable after the necessary dosing operations have been completed. It is also advantageous if the syringe gun can be adjusted to deliver different predetermined dosages.

Heretofore many syringe guns have employed ball valves which are not only of complicated and therefore expensive construction but can be inaccurate when dispensing liquids such as vaccines which generally contain minute solid particles. These particles often tend to lodge between the ball and its housing, and prevent or interfere with closure, resulting in difficulties such as leakage and inaccurate dosing.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a valve for use in a syringe gun of simple construction which minimizes these difficulties.

For the purposes of the present invention the term liquid includes freely-flowing substances of a semi-liquid nature and also pastes of a comparatively low viscosity.

Accordingly in one aspect the present invention provides a syringe gun suitable for dispensing liquid comprising a barrel, a piston with attached piston-rod within the barrel for discharging the contents of the barrel therefrom, an inlet valve and a discharge valve, at least one one of the valves comprising a chamber having inlet and outlet orifices, a plate within the chamber of substantially greater cross-sectional area than the inlet orifice of the chamber, the plate sealing the inlet orifice under pressure upon the outlet orifice side of the plate and being capable of moving or flexing away from the inlet orifice when the pressure on the inlet orifice side of the plate exceeds that on the outlet orifice side to permit liquid to pass from the inlet orifice, through the chamber and out via the outlet orifice.

In one form, at least one of the valves of the syringe gun hereinbefore described comprises a chamber having inlet and outlet orifices, a plate within the chamber of substantially greater cross-sectional area than the inlet orifice of the chamber and normally held by a support against the inlet orifice so as to seal it, the plate being resilient such that when the pressure on the inlet orifice side of the plate exceeds that on the outlet orifice side the plate flexes away from the inlet orifice and liquid may pass from the inlet orifice, through the chamber and out via the outlet orifice but when the excess pressure is removed the plate returns to the closed position and is held there by the support.

The chamber and the support of the valve are most conveniently constructed of a thermoplastic material, such as polystyrene. The chamber of the valve is preferably of circular cross-section with the inlet and outlet orifices centrally located at the two opposite ends, and the orifices are themselves preferably circular holes; the unit is then more readily constructed. The plate is preferably of circular cross-section and maybe of any resilient material but natural or synthetic rubber is preferred, primarily because of cost and availability considerations.

In one embodiment the resilient plate is constructed with a raised central portion on the inlet orifice side of greater, though not substantially greater, cross-sectional area than the inlet orifice. This construction is particularly advantageous in that there is less tendency for liquid passing through the valve under pressure to be retarded. The raised central portion of the resilient plate is flexed away from the inlet orifice of the chamber under the conditions hereinbefore described such that the liquid may flow readily and quickly through the valve in the manner hereinbefore described. Alternatively, the inlet orifice may have a raised lip to form a valve seat and this may be used in conjunction with a resilient plate of flat shape without a raised contral portion. The same easy flow of liquid through the valve is obtained with this arrangement.

The support may be in the form of stepped castellations situated on the base of the valve chamber and of such a size that they hold the peripheral parts of the resilient plate in position. Liquid from the valve chamber passes through the spaces between the castellations to the outlet orifice.

Thus in general the valve is normally closed when there is no excess pressure on the inlet orifice side of the resilient plate by virtue of the support. When pressure is applied, at least a portion of the plate closing the inlet orifice flexes and liquid flows through the inlet orifice, btween the inner wall of the chamber and the plate through the castellated recesses, and finally flowing through the outlet orifice. When the pressure deforming the resilient plate is removed, the plate resumes its original shape and any "back-flow" of liquid or air is effectively prevented. If the liquid is one which contains minute particles, such as a vaccine, then any particles lodged in the valve do not prevent closure as the resilient plate deforms to allow for them and still provides efficient closure.

In another embodiment the resilient plate within the valve chamber is flat and is recessed at one or more points around the periphery to permit the passage of liquid from the valve chamber into the outlet orifice of the valve. In a preferred configuration the plate has a plurality of such recesses and these latter are symmetrically disposed. The plate is preferably used in conjunction with a valve chamber wherein the inlet orifice has a raised lip which forms a valve seat. Alternatively, when no such raised lip is present, the resilient plate is advantageously constructed with a raised central portion of greater, though not substantially greater, cross-sectional area than the inlet orifice. The support holding the plate against the inlet orifice is optionally castel-

lated, the castellations, when present, being of the form as hereinbefore described. It will be understood that if such castellations are not present the width of the support must be such that the peripheral recesses in the resilient plate are not totally occluded thereby and liquid may flow freely from the valve chamber through the recesses into the outlet orifice of the valve.

In yet another embodiment the resilient plate is flat and is pierced by one or more holes or slots to permit the passage of liquid from the valve chamber into the outlet orifice of the valve, the holes being located such that they are neither in communication with the inlet orifice of the valve chamber nor totally occluded by the support holding the plate against the inlet orifice. In a preferred configuration the plate has a plurality of holes which are symmetrically disposed within the plate, and for ease of manufacture the holes are preferably of circular cross-section. The plate is preferably used in conjunction with a valve chamber wherein the inlet orifice has a raised lip which forms a valve seat, when the holes are preferably located within the plate peripheral to the area in contact with said raised lip. Alternatively, when no such raised lip is present, the resilient plate is advantageously constructed with a raised central portion of greater, though not substantially greater, cross-sectional area than the inlet orifice with the holes located peripheral to the raised central portion. The support holding the plate against the inlet orifice is optionally castellated, the castellations, when present, being of the form as hereinbefore described.

The valve in the syringe gun according to the invention is particularly suitable as a discharge valve in that the problems of leakage and desirability of accurate dosing necessitate efficient closure at the discharge point in the gun. In such circumstances, it may be conveniently integral with the barrel of the syringe. The pressure differential required to move liquid through the valve maybe created by the discharge stroke of the piston in the syringe barrel.

The valve the subject of the present invention may also be used as the inlet valve for a syringe gun, when it is most conveniently integral with, for example, the piston. The combined piston and valve is connected to the piston-rod and is advantageously constructed such that there are one or more rings, such as, for example, rubber O-rings, on the circumference of the piston which provide a tight fit with the inside of the barrel of the syringe. When the combined piston and valve is drawn up the barrel away from the base thereof the pressure on the outlet orifice side of the resilient plate is reduced; the excess pressure on the inlet orifice side of the plate causes the plate to flex away from the inlet orifice of the valve to permit liquid to pass from a container through the inlet orifice into the valve chamber, through the outlet orifice and into the barrel of the syringe. It will be appreciated that where the outlet valve of the syringe gun is also of the type provided by the present invention, the decrease in pressure in the barrel of the syringe consequent upon withdrawal of the piston increases the effectiveness of the seal between the inlet orifice and the resilient plate in the said outlet valve. Conversely, the increase in pressure in the barrel of the syringe consequent upon advancing the piston towards the base of the barrel, to expel the liquid contents therefrom through the outlet valve thereof as hereinbefore described, will increase the effectiveness of the seal in the inlet valve between the resilient plate and the inlet orifice.

In another form, at least one of the valves of the syringe gun hereinbefore described comprises a chamber having inlet and outlet orifices, a plate within the chamber of cross-sectional area less than that of the interior of the chamber but substantially greater than that of the inlet orifice of the chamber, the plate sealing the inlet orifice when the pressure upon the outlet orifice side of the plate exceeds that upon the inlet orifice side thereof and being capable of moving away from the inlet orifice to abut a support when the pressure upon the inlet orifice side of the plate exceeds that upon the outlet orifice side thereof to permit liquid to pass from the inlet orifice, through the chamber and out via the outlet orifice. As hereinbefore described the chamber of the valve is preferably of circular cross-section with the inlet and outlet orifices centrally located at the two opposite ends, and the orifices are themselves preferably circular holes. The support may be in the form of castellations situated on the base of the valve chamber. The inlet orifice of the chamber may have a raised lip to form a valve seat, and the plate within the chamber may have a raised central portion on the inlet orifice side of greater, though not substantially greater, cross-sectional area than the inlet orifice. The plate is preferably of circular cross-section and may, as hereinbefore described, be recessed at one or more points around its periphery or pierced by one or more holes or solts. In the form described above, the valve is particularly suitable as the inlet valve of the syringe gun, and is preferably integral with the piston thereof. The combined piston and valve is advantageously constructed such that there are one or more rings, such as, for example, rubber O-rings, on the circumference of the piston which provide a tight fit with the inside of the barrel of the syringe.

The inlet valve for the gun may, alternatively, be of a different construction. It has been found that particularly efficient operation can be achieved by having, connected to the piston-rod, a combined piston and valve formed from a plug of resilient material, preferably natural or synthetic rubber, having a central bore and at the outlet end a flap of resilient material which is normally positioned so as to seal the bore but, when under liquid pressure from a reservoir, is moved from the outlet of the bore so as to allow liquid to pass through into the syringe barrel. The liquid pressure may be created by the operation to fill the syringe barrel with liquid from a reservoir in a container.

Such a combination of piston and inlet valve is particularly advantageous since the plug of resilient material is of very simple construction. There is no need for integers requiring screw-thread connections or attachments, nor for a housing for the valve, nor for a valve spring, nor for keepers which allow liquid through the valve but retain any valve spring in position. Moreover, there is no need for washers nor other seating components for attaching the valve to the piston. The plug can simply be fitted directly on to the end of the piston-rod, thereby forming itself the piston head. There is therefore need for only one moulding operation, and simple friction fitment is sufficient to attach it to the piston-rod.

Preferably the flap is integral with the plug and is formed by making a lateral slit in a partially bored plug, such that the slit and the bore meet. In this way two

perfectly mating surfaces are produced which envelope any minute particles which might lodge in the valve.

The combined piston and valve is advantageously constructed in such a way that there are one or more rings on its circumference to provide a tight fit with the barrel of the syringe.

In another apsect the present invention provides the combinations of piston and inlet valve described herein.

A most convenient method of dispersing a predetermined volume of liquid from a syringe gun, dose determination, is to limit the stroke of the piston to a particular length. In a further aspect the present invention provides a dose selector which comprises means for limiting the backward stroke of a piston in a syringe gun, the means being in the form of two mutually abutting surfaces, one on the external surface of the syringe piston-rod and the other in or on the barrel of the syringe. The abutment surfaces can be made simply by having them integral with the piston-rod and barrel, so that they may be obtained when the main units are formed, for example, during their moulding.

The abutment surface on the syringe piston-rod may take the form of a projection or step which abuts a projection on the inside of the barrel or a plate across the end of the barrel through which the piston-rod passes. As another possibility the projection on the piston-rod may pass through a slot in the wall of the barrel, the length of the slot determining the dose selected.

If desired a variable dose selection can be obtained by having two or more abutment surfaces on the piston-rod which abut one or more movable surfaces on or in the barrel. This can conveniently be achieved by having a square piston-rod with graduated steps on its faces, preferably two steps, each on opposite faces. A sliding plate abuts each of the steps as it is moved to different positions, thereby causing the backward stroke of the piston to be limited to a series of different lengths.

An alternative form of dose selector suitable for use in syringe guns having at least one of the inlet and outlet valves of the type provided by the present invention comprises means for limiting the backward stroke of the piston, the means being in the form of two mutually abutting surfaces, the one either on the rear face of the piston or on the external surface of the syringe piston rod and the other in or on a sleeve held in a fixed but variable disposition relative to the syringe barrel.

In a preferred embodiment the rear face of the piston abuts the face of a sleeve located within the barrel of the syringe, the rear end of the syringe barrel being firmly attached to a base member with the sleeve held within a bore in said base member.

In one configuration the bore in the base member is screw-threaded internally and the sleeve is screw-threaded externally such that rotation of the sleeve within the bore moves the former relative to the base member and to the firmly held syringe barrel to limit the backward stroke of the piston. In a second configuration the opposing faces of the bore and sleeve are smooth and the base member is in the form of a split collar, having a longitudinal slit in a part of the wall of the bore therein and extending the whole length thereof, and is provided with means for clamping in apposition the two surfaces thus formed. The base member has a recess with the aforementioned bore centrally located therein, the internal dimensions of the bore and recess being such that when the opposing surfaces of the base member are clamped together by the means provided therefor, the sleeve and rear end of the syringe barrel are firmly held within the bore and recess respectively, the position of the sleeve relative to the base member and syringe barrel determining the limit of the backward stroke of the piston within the barrel. The dose dispensed from the syringe is adjusted by changing the position of the sleeve relative to the base member and syringe barrel whilst the clamping means applied to the base member is temporarily released. As another possibility the base member has a smooth bore and a longitudinal slit in a part of the wall of the bore extending from the rear face of the base member throughout part but not all of the length thereof, the base member being provided with means for clamping in apposition the two surfaces formed by the aforementioned slit. The rear end of the syringe barrel is firmly attached to the base member concentrically with the bore therein, the internal dimensions of the bore being such that when the opposing surfaces of the slit in the base member are clamped together by the means provided therefor, the sleeve is firmly held with respect to the base member and syringe barrel.

In each of the above-described configurations the base member is advantageously constructed with lateral projections which serve as finger grips for holding the syringe gun.

In an alternative embodiment a projection on the external surface of the piston rod abuts a projection on the inner surface of a sleeve surrounding the barrel of the syringe. In one configuration the sleeve has a longitudinal slit in a part of the wall thereof and extending from one end thereof, said sleeve being provided with means for clamping in apposition the two surfaces formed by the slit. The internal dimensions of the sleeve are such that when the opposing surfaces of the slit are clamped together by the means provided therefor, the barrel of the syringe is firmly held within the sleeve. The dose dispensed from the syringe is adjusted by changing the position of the sleeve relative to the syringe barrel whilst the clamping means applied to the sleeve is temporarily released. The sleeve is advantageously constructed with lateral projections which serve as finger grips for holding the syringe gun.

The syringe barrel, piston rod, dose selector plate, base member and sleeve hereinbefore described may be constructed of any suitable materials such as thermoplastic materials or light metal, and the piston rod is advantageously spring-loaded for return to the predispense position. The syringe barrel or the sleeve may be graduated to indicate the volume of liquid to be dispensed.

In still further aspects the present invention provides a syringe gun having any combination of inlet and discharge valves as hereinbefore described and a dose selector also as hereinbefore described.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, though only by way of illustration, with reference to the accompanying drawings in which:

FIG. 1 is a longitudinal cross-section of a syringe according to the invention incorporating inlet and discharge valves as hereinbefore defined and a dose selector also as defined;

FIG. 2 is a section on the line A—A of FIG. 1 showing in greater detail the dose selector;

FIG. 3 is an enlargement of the discharge valve of FIG. 1; and

FIG. 4 is a section on the line B—B¹ of the valve shown in FIG. 3 with the resilient plate removed.

FIG. 5 is a lateral view of a median longitudinal section of a second syringe provided by the present invention incorporating inlet and discharge valves as hereinbefore defined and a dose selector also as defined;

FIG. 6 is an enlargement of the combined inlet valve and piston of FIG. 5;

FIG. 7 is an enlargement of the discharge valve of FIG. 5; and

FIG. 8 is a plan view of a section on the line XX¹ of the valve shown in FIG. 7 with the syringe barrel removed.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIGS. 1 to 4, the syringe consists of a barrel 1, piston-rod 2 having combined piston head and inlet valve 3 and thumb pad 5. Barrel 1 has discharge valve 4 at its outlet end.

Valve 4 consists of a housing 6, inlet and outlet orifices 7 and 8 respectively and a resilient plate 9 which rests on stepped castellations 10 having spaces 11 therebetween and is held against inlet orifice 7 (shown in the drawing for the sake of clarity as spaced apart from the inlet orifice). The housing 6 is integral with a needle mount 12 and the discharge valve 4 is enclosed by a needle lock nut 13.

Combined piston and inlet valve 3 has rings 14 on its outer surface and a central bore 15 with a flap 16 at its discharge end.

The piston-rod 2 is provided with steps 17 and 18 and passes through plate 19 having a rectangular hole 20. Dose selector plate 19 is attached by rivets 21 to a pair of shoulders 22 having protuberences 23. These shoulders act as finger grips for holding the syringe during operation.

The syringe is loaded in the following manner; pressure is applied to thumb pad 5 so that the piston is as far into the barrel as possible. Dose selector plate 19 is moved to a position in which it is ready to abut either step 17 or 18. Piston 2 is now withdrawn until step 17 (say) abuts plate 19. As the piston 2 is being withdrawn liquid within the piston-rod (fed from a container not shown in the drawings) flows through the central bore 15 of combined piston and valve 3, the withdrawal causing flap 16 to open, into the barrel 1 where it is retained ready to be dispensed.

When it is desired to inject, pressure is applied to the thumb pad 5 and the liquid is forced against the portion of the resilient plate 9 closing inlet orifice 7, this portion of the plate buckles slightly and liquid flows over the plate, down into the valve chamber, and out of outlet orifice 8. It will be understood that the pressure of the liquid will cause flap 16 to be pressed firmly over bore 15 thus preventing the liquid flowing back into the piston-rod. When all the liquid has been dispensed the plate 9 resumes its original shape and closes inlet orifice 7.

With reference to FIGS. 5 to 8, the syringe gun comprises a barrel 24, the rear end of which is firmly located within a recess 25 in a base member 26 having an internally screw-threaded bore 27 concentric with and of lesser diameter than the recess 25 and the interior of the barrel 24. Rotatably disposed within the bore 27 is an externally screw-threaded sleeve 28 within which is slidably located a piston-rod 29 having an axial bore 30. Firmly attached to the rear end of the piston-rod 29 is a thumb pad 31 and to the other end is firmly attached a combined inlet valve and piston 32 having a rubber O-ring 33 on its circumference to provide a tight fit with the inside of the barrel 24. The thumb pad 31 has a bore 34 continuous with the bore 30 of the piston-rod 29 and opening to the exterior via a nipple 35; the base member 26 has lateral projections 36 serving as finger grips for holding the syringe gun. A spring 37 slidably surrounds the piston-rod 29 and extends between the thumb pad 31 and the rear end of the sleeve 28 where it is slidably located within a recess 38. The discharge end of the barrel 24 is firmly located within a discharge valve housing 39 having a needle mount 40 integral therewith.

The combined inlet valve and piston 32 has a circumferential groove 41, wherein is firmly located the rubber O-ring 33, and a central chamber 42 of circular cross-section within which is centrally disposed a rubber valve disc 43, also of circular cross-section and of lesser diameter than the chamber 42. The bore 30 of the piston-rod 29 communicates with the chamber 42 via an inlet orifice 44 of circular cross-section and of substantially smaller diameter than the valve disc 43 and having a raised lip 45 integral with the piston rod 29 and forming a seat for the valve disc 43. The base of the chamber 42 comprises flat-topped castellations 46 integral with the body of the piston 32 with interposed recesses 47 converging to an outlet orifice 48 of circular cross-section and leading to the interior of the barrel 24; the distance between the tops of the castellations 46 and the raised lip 45 is greater than the thickness of the valve disc 43.

The discharge valve housing 39 is firmly located upon the discharge end of the barrel 24 with a step 49 abutting the end wall thereof. A chamber 50 within the housing 39 is of circular cross-section and has a step 51 and an outlet orifice 52, the latter being of circular cross-section and opening to the exterior via the needle mount 40. Supported by the step 51 and centrally located within the chamber 50 is a resilient rubber plate 53, of circular cross-section and of lesser diameter than the chamber 50 and being pierced by a plurality of circular holes 54 disposed equidistantly from the centre of the plate 53 and located within the unsupported portion thereof. The interior of the barrel 24 communicates with the chamber 50 via an inlet orifice 55 of circular cross-section and of substantially smaller diameter than the plate 53 and having a raised lip 56 integral with the end wall of the barrel 24. The respective heights of the step 51 and the lip 56 are such that the plate 53 is normally held against the lip 56 and is flexed thereby to effect a seal of inlet orifice 55 at their point of contact, the diameter of the lip 56 being such that said point of contact lies within the ring of holes 54 in the plate 53.

When the syringe gun is in use the unit dose dispensed therefrom is determined by the length of the backward stroke of the piston 32 within the barrel 24, this being set by the point along the barrel at which the rear face of the piston 32 abuts the end of the sleeve 28. Rotation of sleeve 28 within the bore 27 of base member 26 changes the position of the sleeve 28 relative to the base member 27 and to the firmly held barrel 24; the end of sleeve 28 is in this manner brought to lie at

a different point along the barrel 24 to provide for a piston stroke of a different length and hence the dispensation of a different unit dose.

The syringe gun is loaded in the following manner. With the gun prepared in the manner hereinbefore described to dispense a desired unit dose, pressure is applied to thumb pad 31 so that the piston 32 is as far into the barrel 24 as possible; the piston 32 is then withdrawn until the rear face thereof abuts the end of sleeve 28. During this withdrawal the pressure within barrel 24 on the outlet orifice side of valve disc 43 is reduced below that on the inlet orifice side thereof and the valve disc 43 is held on the floor of the chamber 42 against the castellations 46. Liquid within the bore 30 of piston-rod 29 (fed through bore 34 in thumb pad 31 from a reservoir, not shown, attached to nipple 35) flows through inlet orifice 44, between valve disc 43 and lip 45 into chamber 42, around the sides of disc 43, through recesses 47 between castellations 46 and out via outlet orifice 48 into barrel 24 where the liquid is retained. At the same time the decrease in pressure in barrel 24 increases the effectiveness of the seal between the plate 53 and lip 56 in discharge valve housing 39 and any back flow of air or liquid through inlet orifice 55 is prevented.

When it is desired to discharge the contents of the barrel 24, pressure is applied to thumb pad 31 and the piston 32 is driven down the barrel 24 as far as possible. As a result of the movement of the piston 32 the pressure in barrel 24 on the inlet orifice side of plate 53 is increased above that on the outlet orifice side thereof to a level where at least a portion of plate 53 is flexed away from lip 56; liquid then flows under pressure from the barrel 24 through the inlet orifice 55, between lip 56 and plate 53 into the chamber 50, then through holes 54 to leave via outlet orifice 52. Likewise the pressure on the outlet orifice side of disc 43 is raised above that on the inlet orifice side thereof and the disc 43 is held against lip 45 to seal inlet orifice 44 and prevent any escape of liquid back into the bore 30 of the piston-rod 29. When the piston 32 reaches the end of its discharge stroke the pressure flexing the plate 53 away from the lip 56 is removed; plate 53 then resumes its original shape and any back flow of liquid or air through inlet orifice 55 is prevented. The syringe gun is then ready for another operational cycle.

We claim:

1. In a syringe gun suitable for dispensing liquid or semi-liquid, the combination of a barrel, a piston rod, a piston attached to said piston rod and located within said barrel for discharging the contents of said barrel therefrom, an inlet valve for enabling passage of liquid or semi-liquid into said barrel, and a discharge valve for enabling passage of liquid or semi-liquid out of said barrel, wherein at least one of said valves is the combination of a chamber, said chamber having an inlet wall and said inlet wall defining an inlet orifice to said chamber, a resilient plate within said chamber of substantially greater cross-sectional area than said inlet orifice, said plate having an inlet side and an outlet side, a passage for liquid or semi-liquid from said inlet side of said plate to said outlet side of said plate, said inlet wall and said plate each having a central area for enabling the sealing of said inlet orifice and each having a peripheral area, a support within said chamber abutting said outlet side of said plate, whereby the peripheral area of said inlet side of said plate is spaced apart from the peripheral area of said inlet wall, and an outlet wall to said chamber, said outlet wall defining an outlet orifice for enabling passage of liquid or semi-liquid from said chamber, at least one said central area projecting beyond its own peripheral area towards said other central area, whereby the central area of said inlet side of said resilient plate will be held against the central area of said inlet wall by said support to seal said inlet orifice and will flex away from said central area of said inlet wall under pressure upon said inlet side of said plate to permit the passage of liquid or semi-liquid through said inlet orifice and through said passage to said outlet orifice.

2. The combination defined in claim 1, wherein the cross-sectional area of said plate is the same as or is less than the internal cross-sectional area of said chamber, and wherein said plate is so shaped as to define at least one perforation in said peripheral area forming said passage whereby liquid or semi-liquid may pass from said inlet side of said plate to said outlet side of said plate.

3. The combination defined in claim 2, wherein said plate defines a plurality of perforations in said peripheral area of said plate, said perforations being symmetrically disposed within said plate, whereby liquid or semi-liquid may pass from said inlet side of said plate to said outlet side of said plate.

4. The combination defined in claim 1, wherein said inlet valve is the combination of a chamber, said chamber having an inlet wall and said inlet wall defining an inlet orifice to said chamber, a floating plate within said chamber of substantially greater cross-sectional area than said inlet orifice but smaller than the internal cross-sectional area of said chamber, said plate having an inlet side and an outlet side, a support within said chamber, a passage for liquid or semi-liquid from said inlet side of said plate to said outlet side of said plate, and an outlet wall to said chamber, said outlet wall defining an outlet orifice for enabling passage of liquid or semi-liquid from said chamber, whereby said plate will seal said inlet orifice under pressure upon said outlet side of said plate and will move from said inlet orifice under pressure upon said inlet side of said plate to abut said support to permit passage of liquid or semi-liquid through said inlet orifice, and through said passage to said outlet orifice, and wherein said discharge valve is the combination of a chamber, said chamber having an inlet wall and said inlet wall defining an inlet orifice to said chamber, a resilient plate within said chamber of substantially greater cross-sectional area than said outlet orifice, said plate having an inlet side and an outlet side, a passage for liquid or semi-liquid from said inlet side of said plate to said outlet side of said plate, said inlet wall and said plate each having a central area for enabling the sealing of said inlet orifice and each having a peripheral area, a support within said chamber abutting said outlet side of said plate, whereby the peripheral area of said inlet side of said plate is spaced apart from the peripheral area of said inlet wall, and an outlet wall to said chamber, said outlet wall defining an outlet orifice for enabling passage of liquid or semi-liquid from said chamber, at least one said central area projecting beyond its own peripheral area towards said other central area, whereby the central area of said inlet side of said plate will be held against the central area of said inlet wall by said support to seal said inlet orifice and will flex away from said central area of said

inlet wall under pressure upon said inlet side of said plate to permit the passage of liquid or semi-liquid through said inlet orifice and through said passsage to said outlet orifice.

5. The combination defined in claim 4, wherein said central area of said inlet wall is raised as a lip, whereby said central area of said inlet side of said resilient plate may seat against said lip to seal said inlet orifice.

6. The combination defined in claim 4, wherein the central area of said plate projects beyond its own peripheral area towards the central area of said inlet wall.

7. The combination as defined in claim 1, there being means for limiting the backward stroke of said piston to allow the entry of a predetermined quantity of liquid or semi-liquid into said barrel through said inlet valve.

8. The combination as defined in claim 1, wherein said inlet valve is integral with said piston.

9. The combination defined in claim 1, wherein said passage comprises castellations defining interposed recesses in said support whereby when said plate abuts said support liquid or semi-liquid may pass from said inlet side of said plate to said outlet side of said plate by way of said recesses between said castellations.

10. In a syringe gun suitable for dispensing liquid or semi-liquid, the combination of a barrel, a piston rod, a piston attached to said piston rod and located within said barrel for discharging the contents of said barrel therefrom, an inlet valve for enabling passage of liquid or semi-liquid into said barrel, and a discharge valve for enabling passage of liquid or semi-liquid out of said barrel, there being at least one ring of resilient material on the circumference of said piston whreby an air- and liquid-tight fit is provided between said piston and said barrel, wherein said inlet valve is integral with said piston and is the combination of a chamber, said chamber having an inlet wall and said inlet wall defining an inlet orifice to said chamber, a floating plate within said chamber of substantially greater cross-sectional area than said inlet orifice but smaller than the internal cross-sectional area of said chamber, said plate having an inlet side and an outlet side, a support within said chamber, a passage for liquid or semi-liquid from said inlet side of said plate to said outlet side of said plate, and an outlet wall to said chamber, said outlet wall defining an outlet orifice for enabling passage of liquid or semi-liquid from said chamber, whereby said plate will seal said inlet orifice under pressure upon said outlet side of said plate and will move from said inlet orifice under pressure upon said inlet side of said plate to abut said support to permit passage of liquid or semi-liquid through said inlet orifice, and through said passage to said outlet orifice.

11. In a syringe gun suitable for dispensing liquid or semi-liquid, the combination of a barrel, said barrel having a front end and a rear end, a piston rod, a piston attached to said piston rod and located within said barrel for discharging the contents of said barrel therefrom upon a forward stroke of said piston and said piston rod, said piston having a front face and a rear face, an inlet valve integral with said piston for enabling passage of liquid or semi-liquid into said barrel, a discharge valve for enabling passage of liquid or semi-liquid out of said barrel, and means for limiting the backward stroke of said piston to allow the entry of a predetermined quantity of liquid or semi-liquid into said barrel through said inlet valve, said means for limiting the backward stroke of said piston being the combination of two mutually abutting surfaces, the one surface being on said rear face of said piston and the other surface being on a sleeve held in a fixed but variable disposition relative to said barrel; wherein said inlet valve is the combination of a chamber, said chamber having an inlet wall and said inlet wall defining an inlet orifice to said chamber, a floating plate within said chamber of substantially greater cross-sectional area than said inlet orifice but smaller than the internal cross-sectional area of said chamber, said plate having an inlet side and an outlet side, a support within said chamber, a passage for liquid or semi-liquid from said inlet side of said plate to said outlet side of said plate, and an outlet wall to said chamber, said outlet wall defining an outlet orifice for enabling passage of liquid or semi-liquid from said chamber, whereby said plate will seal said inlet orifice under pressure upon said outlet side of said plate and will move from said inlet orifice under pressure upon said inlet side of said plate to abut said support to permit the passage of liquid or semi-liquid through said inlet orifice and through said passage and through said outlet orifice into said barrel; and wherein said discharge valve is the combination of a chamber, said chamber having an inlet wall and said inlet wall defining an inlet orifice to said chamber, a resilient plate within said chamber of substantially greater cross-sectional area than said inlet orifice, said plate having an inlet side and an outlet side, said inlet wall and said plate each having a central area for enabling the sealing of said inlet orifice and each having a peripheral area, a support within said chamber abutting said outlet side of said plate, whereby the peripheral area of said inlet side of said plate is spaced apart from the peripheral area of said inlet wall, a passage for liquid or semi-liquid from said inlet side of said plate to said outlet side of said plate, and an outlet wall to said chamber, said outlet wall defining an outlet orifice for enabling passage of liquid or semi-liquid from said chamber, at least one said central area projecting beyond its own peripheral area towards said other central area, whereby the central area of said inlet side of said plate is held against the central area of said inlet wall by said support to seal said inlet orifice and under pressure upon said inlet side of said plate will flex away from said central area of said inlet wall to permit the passage of liquid or semi-liquid through said inlet orifice through said passage and through said outlet orifice.

12. The combination defined in claim 11, wherein a base member has said rear end of said barrel firmly attached thereto, said base member defining a bore therein, and wherein said sleeve is located within said barrel and is held within said bore in said base member.

13. The combination defined in claim 12, wherein said bore in said base member is screw-threaded internally and wherein said sleeve is screw-threaded externally, whereby rotation of said sleeve within said bore will move said sleeve relative to said base member and to said barrel.

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