

PATENT SPECIFICATION

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(54) DISPOSABLE INJECTION SYRINGE

(71) We, N.V. PHILIPS' GLOEILAMPENFABRIEKEN, a limited liability Company, organised and established under the laws of the Kingdom of the Netherlands, of Emmasingel 29, Eindhoven, the Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The invention relates to a disposable injection syringe and in particular to an injection syringe having a cylindrical liquid container with needle connection means at one end of the container, and a piston in the container for movement by a plunger rod so as to eject material to be injected.

In the design of such syringes, reduction of the amount of liquid remaining in the syringe after injection is desirable. The development of new medicines involves steadily increasing costs for research in an industry which is heavily research-based, particularly because of the requirements imposed on new medicines by national authorities and advances in medical science, so that the costs of medicines are rising continually. Further, in a continuing effort to minimize the quantity of material being administered to patients, there is a trend to administer relatively smaller quantities of injection liquid than previously, and therefore injection syringes are desirable with smaller capacities. Also, a large quantity of unusable injection liquid can be a disadvantage because this may needlessly pollute the environment when a used syringe is destroyed.

Injection syringes, both disposable and re-usable, have been used for many years for injection of medicines into patients. These syringes have had the disadvantage that not all the liquid contained within the syringe can be administered. In part this

occurs because a quantity of injection liquid remains in the needle; however, at least part of the disadvantage arises because the piston cannot be moved entirely to the end of the liquid-containing portion of the syringe, that is, to the beginning of the needle. Thus there is a quantity of injection liquid left between the piston and the beginning of the needle.

This problem is particularly noticeable in disposable syringes which are pre-filled with medicine by the manufacturer. To allow long storage times of such pre-filled syringes without excessive degradation of the medicine, in most cases it is necessary to protect the injection liquid from deterioration which would result from extended contact with the material from which the needle or needle connection means are made; these syringes usually being made from a metal or a synthetic resin. Therefore a sealing member is often provided at the needle end of the liquid container, the sealing member being manufactured from a chemically-inert material such as a rubber material of a pharmaceutical quality. The piston is made from materials which are similarly selected. As a result, during storage the injection liquid contacts only the materials from which the liquid container, the piston and the sealing member are made.

Disposable syringes of the previously-known types have a constriction or an inwardly-extending flange which is formed by a portion of the liquid container itself at the needle connection end. This flange, necessary to enable the attachment of the needle hub, serves as a stop, limiting the motion of the piston, and defines a central space with the constriction, so that a region of non-injectable liquid is formed. Known injection syringes of the types described above, depending on their capacity, generally contain a volume between 0.1 and 0.3 ml of unusable injection liquid. Reduction of this unusable quantity to a minimum is

desirable, particularly where expensive medicines are involved or injection syringes of small capacity are to be used.

An object of the invention is to minimize the quantity of unusable medication which is wasted whenever an injection is to be made.

Accordingly, the invention provides a disposable injection syringe comprising a cylindrical liquid container having a needle hub for connecting an injection needle at one end, a piston movable in the container in a direction to expel liquid from the syringe via said needle hub, a rupturable sealing member closing said one end of the container, and a chamber in the needle hub into which the sealing member can expand and be ruptured, and into which the piston is movable; the sealing member being sufficiently flexible that it can be displaced by the piston, on movement thereof in said direction, so as to allow the piston to move past the ruptured sealing member substantially all the way to the end of the chamber.

Because of the construction of the syringe according to the invention, and the flexibility of the sealing member, it is possible to move the piston even beyond the end of the actual liquid container, thus dispensing almost all of the remaining liquid beyond the sealing member. By use of this construction, the volume of remaining liquid can be reduced to less than 0.05 ml, a saving of 50-80% compared with previously known syringes. This construction is especially advantageous when a sealing member of the type used in the "Cartrix" system, having a thin elastic diaphragm which can be ruptured by pressure, such as the syringe described in U.K. Patent 1,203,098 or 1,210,676.

Embodiments of the invention will now be described in detail, by way of example, with reference to the accompanying drawings, of which:-

Figure 1 is a side view, partially in section, of a complete injection syringe according to the invention,

Figure 2 is a cross-sectional view of a liquid container having a thickened outer portion at each end,

Figure 3 is a cross-sectional view of another form of a liquid container having a thickened portion at the needle connection end only,

Figure 4 is a side view, partially in section, of the holder end of a syringe having a liquid container according to Figure 3,

Figure 5 is a cross-sectional view of still another form of a liquid container having notches at each end for connection of the needle and a finger grip,

Figure 6 is a sectional view of a finger grip suitable for use with the container of Figure 5,

Figure 7 is a cross-sectional view of the

needle connection portion of a syringe having a tearable diaphragm as a sealing member, using the container of Figures 2 or 3, and

Figure 8 is a cross-sectional view of another embodiment of a syringe according to the invention having a Luer cone for a needle connection means.

Figure 1 shows a complete injection syringe according to the invention. A cylindrical liquid container 11, having a maximum inside diameter of 6 mm, communicates with an injection needle 12 covered, prior to use, by a protection cap 13. A needle connection means 14, for example a formed metal sleeve crimped at one end around the exterior of the needle, is fitted snugly over a needle connection end 122 of the container 11. Fitted liquid-tight in the container 11 is a piston 15 attached to a plunger rod 16, the rod passing through a finger-grip 17 attached at the end of the container 11 remote from the needle connection means 14.

Figure 2 shows in cross-section a first form of a liquid container usable in the syringe shown in Figure 1. The needle connection end 21 of the container has a thickened portion 22 protruding outward in comparison with the main portion of the container, so that a needle or needle connection means can be fastened thereabout. At the opposite end 23 a similar thickened portion 24 provides an external circumferential ridge for attachment of a finger-grip. It will of course be clear that neither the thickened portion 22 nor the portion 24 need be cylindrical in their exterior surfaces, although this is a preferred feature leading to simplicity in manufacture. The important feature is that the entire length of the inner surface be circular cylindrical; that is, of constant diameter.

Figure 3 shows similarly in cross-section another form of a liquid container usable with the syringe of Figure 1. This differs from the Figure 2 embodiment in that the finger-grip connection end 31 does not have a thickened portion. Such a container is readily used with a holding means such as that described in U.K. Patent Application No. 18428/75 (Serial No. 1,479,536). Such a finger-grip holding means is shown in Figure 4, in which a tensioning ring or collet 40 is pressed tightly inward by a tensioning sleeve 41, the ring 40 being held against an end portion 42 of a liquid container 142. The plunger rod can be attached to the piston by means known per se, e.g. a screw thread connection or a snap connection.

Figure 5 shows in cross-section still another form of a cylindrical liquid container of the syringe according to the invention, having the outside diameter substantially constant throughout its length. To

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attach the needle, a notch 51 is formed in the outer surface of the container at the needle attachment end, and a notch 52 is formed in the outer surface at the finger-grip connection end. A finger grip 60 suitable for use with either the container of Figure 2 or 5 is shown in Figure 6, the grip having an inward circumferential ridge 62 adapted for engaging in the notch 52 of the Figure 5 container. For use with the container of Figure 2, the projection 24 shown in Figure 2 fits in the internal circumferential depression 64 between the ridge 62 and an end stop 66 projecting inwardly.

Figure 7 shows the preferred form of a needle connection end and needle connection used with the invention. A liquid container 71 similar to that shown in Figure 2 or Figure 3 has a thickened end portion 222. A sealing member 72 is held against an end face of the portion 222, the center of the sealing member having an elastic diaphragm 73 so proportioned that it can expand into a chamber 78 in a needle hub 75 and be ruptured by pressure from the interior of the container. Surrounding the diaphragm 73 is a tubular portion 223 extending a short distance inside the container 71 to locate member 72 during assembly. At the other end of the connection means 14 is a needle 74 held firmly in a portion 77 of needle hub 75 by crimping or shrinking. At an upper end 76 of the hub provision is made for the mounting of a needle protection cap such as the cap 13.

Because of the flexibility of the sealing member 72, movement of a piston 15 through the container 71 first causes diaphragm 73 to expand into chamber 78 and be ruptured by the applied piston pressure and then, on further movement of the piston beyond the end of container 71, the piston deflects the tubular portion 223 and the diaphragm 73 into the chamber 78 so as to permit the piston end to pass beyond sealing member 72 and, hence, to expel a maximum proportion of injectable liquid which was contained in the chamber 78.

Still another form of a connection means is shown in Figure 8, the container 81, sealing member 82 and diaphragm 83 being otherwise similar to those shown in Figure 7 and having related reference numerals. The end of the needle hub remote from the liquid container 81 has a Luer cone 85, of the well-known type to which a needle can be connected immediately prior to use of the syringe. Before attaching the needle, the syringe is activated by causing the elastic diaphragm 83 to tear against a sharp tip 85 provided on a cap 87 which is used to seal the Luer cone before use.

By way of example, a syringe constructed according to the preferred embodiment of Figure 1 and having an inside diameter of

the liquid container of approximately 4.7 mm, was found to have an unusable remaining liquid volume less than 0.05 mm. Such a syringe, when constructed with a total capacity of 0.5 mm, may find particular application for administering medicine to control thrombosis. The syringe according to the invention, having an unusable volume of less than 10% of the original volume, offers very considerable advantage over an unusable volume of 20 to 60% in the prior known syringe types.

It will be clear to those skilled in the art that many other modifications of the embodiments shown and described are possible. For example, the entire liquid container may be placed in a holder suitable for that purpose, such as that shown in U.K. Patent No. 1,467,767. Whether of the design shown therein, or of the designs shown in the various Figures of the accompanying drawing, the various parts of the syringe may be manufactured from any material which is suitable for the intended purpose and medicament. Preferably, however, the liquid container consists of glass. The piston and the sealing member preferably consist of a pharmaceutical grade of rubber.

WHAT WE CLAIM IS:-

1. A disposable injection syringe comprising a cylindrical liquid container having a needle hub for connecting an injection needle at one end, a piston movable in the container in a direction to expel liquid from the syringe via said needle hub, a rupturable sealing member closing said one end of the container, and a chamber in the needle hub into which the sealing member can expand and be ruptured, and into which the piston is movable; the sealing member being sufficiently flexible that it can be displaced by the piston, on movement thereof in said direction, so as to allow the piston to move past the ruptured sealing member substantially all the way to the end of the chamber.
2. A syringe as claimed in Claim 1, wherein said sealing member is a thin elastic diaphragm which is rupturable by pressure.
3. A syringe as claimed in Claim 1, including a pin arranged to rupture the sealing member on displacement of the latter by the piston.
4. A syringe as claimed in any previous Claim wherein the container has a maximum inside diameter of 6 mm.
5. A syringe as claimed in any previous Claim, provided with finger-grip means attached to the other end of the container.
6. A syringe as claimed in any previous Claim wherein the container is made of glass.
7. A syringe as claimed in any previous Claim wherein the sealing member is made of a rubber material.
8. A syringe as claimed in Claim 8



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attach the needle, a notch 51 is formed in the outer surface of the container at the needle attachment end, and a notch 52 is formed in the outer surface at the finger-grip connection end. A finger grip 60 suitable for use with either the container of Figure 2 or 5 is shown in Figure 6, the grip having an inward circumferential ridge 62 adapted for engaging in the notch 52 of the Figure 5 container. For use with the container of Figure 2, the projection 24 shown in Figure 2 fits in the internal circumferential depression 64 between the ridge 62 and an end stop 66 projecting inwardly.

Figure 7 shows the preferred form of a needle connection end and needle connection used with the invention. A liquid container 71 similar to that shown in Figure 2 or Figure 3 has a thickened end portion 222. A sealing member 72 is held against an end face of the portion 222, the center of the sealing member having an elastic diaphragm 73 so proportioned that it can expand into a chamber 78 in a needle hub 75 and be ruptured by pressure from the interior of the container. Surrounding the diaphragm 73 is a tubular portion 223 extending a short distance inside the container 71 to locate member 72 during assembly. At the other end of the connection means 14 is a needle 74 held firmly in a portion 77 of needle hub 75 by crimping or shrinking. At an upper end 76 of the hub provision is made for the mounting of a needle protection cap such as the cap 13.

Because of the flexibility of the sealing member 72, movement of a piston 15 through the container 71 first causes diaphragm 73 to expand into chamber 78 and be ruptured by the applied piston pressure and then, on further movement of the piston beyond the end of container 71, the piston deflects the tubular portion 223 and the diaphragm 73 into the chamber 78 so as to permit the piston end to pass beyond sealing member 72 and, hence, to expel a maximum proportion of injectable liquid which was contained in the chamber 78.

Still another form of a connection means is shown in Figure 8, the container 81, sealing member 82 and diaphragm 83 being otherwise similar to those shown in Figure 7 and having related reference numerals. The end of the needle hub remote from the liquid container 81 has a Luer cone 85, of the well-known type to which a needle can be connected immediately prior to use of the syringe. Before attaching the needle, the syringe is activated by causing the elastic diaphragm 83 to tear against a sharp tip 85 provided on a cap 87 which is used to seal the Luer cone before use.

By way of example, a syringe constructed according to the preferred embodiment of Figure 1 and having an inside diameter of

the liquid container of approximately 4.7 mm, was found to have an unusable remaining liquid volume less than 0.05 mm. Such a syringe, when constructed with a total capacity of 0.5 mm, may find particular application for administering medicine to control thrombosis. The syringe according to the invention, having an unusable volume of less than 10% of the original volume, offers very considerable advantage over an unusable volume of 20 to 60% in the prior known syringe types.

It will be clear to those skilled in the art that many other modifications of the embodiments shown and described are possible. For example, the entire liquid container may be placed in a holder suitable for that purpose, such as that shown in U.K. Patent No. 1,467,767. Whether of the design shown therein, or of the designs shown in the various Figures of the accompanying drawing, the various parts of the syringe may be manufactured from any material which is suitable for the intended purpose and medicament. Preferably, however, the liquid container consists of glass. The piston and the sealing member preferably consist of a pharmaceutical grade of rubber.

WHAT WE CLAIM IS:-

1. A disposable injection syringe comprising a cylindrical liquid container having a needle hub for connecting an injection needle at one end, a piston movable in the container in a direction to expel liquid from the syringe via said needle hub, a rupturable sealing member closing said one end of the container, and a chamber in the needle hub into which the sealing member can expand and be ruptured, and into which the piston is movable; the sealing member being sufficiently flexible that it can be displaced by the piston, on movement thereof in said direction, so as to allow the piston to move past the ruptured sealing member substantially all the way to the end of the chamber.

2. A syringe as claimed in Claim 1, wherein said sealing member is a thin elastic diaphragm which is rupturable by pressure.

3. A syringe as claimed in Claim 1, including a pin arranged to rupture the sealing member on displacement of the latter by the piston.

4. A syringe as claimed in any previous Claim wherein the container has a maximum inside diameter of 6 mm.

5. A syringe as claimed in any previous Claim, provided with finger-grip means attached to the other end of the container.

6. A syringe as claimed in any previous Claim wherein the container is made of glass.

7. A syringe as claimed in any previous Claim wherein the sealing member is made of a rubber material.

8. A syringe as claimed in Claim 8

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wherein the piston is also made of a rubber material.

5 9. A disposable injection syringe substantially as hereinbefore described with reference to the accompanying drawings.

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