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H. NIELSEN
TWO-COMPARTMENT HYPODERMIC SYRINGE FOR SEPARATE
STORING OF MORE COMPONENTS
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Fig. 1

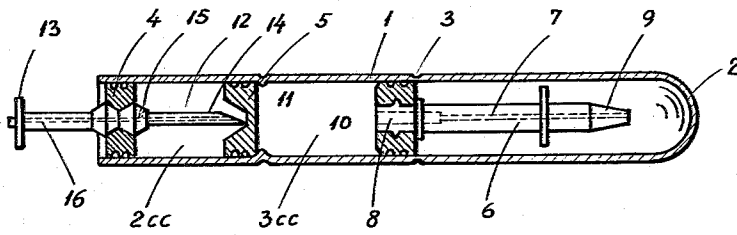


Fig. 2.

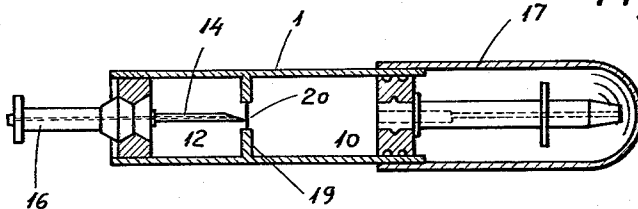


Fig. 3.

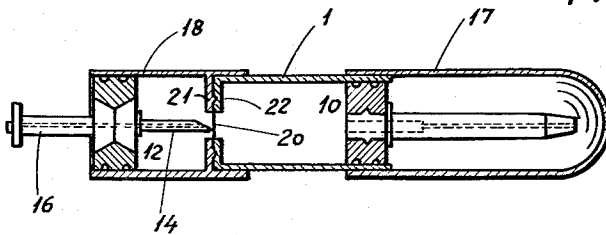
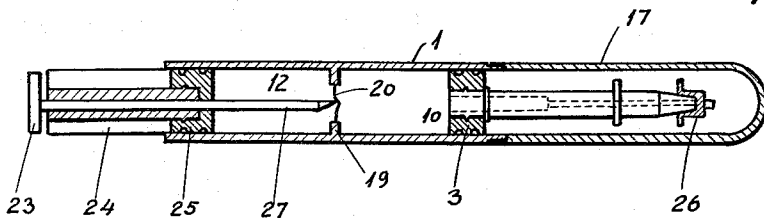


Fig. 4.



Inventor:
HELMUTH NIELSEN
By Sol Shappirio
Attorney

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TWO-COMPARTMENT HYPODERMIC SYRINGE FOR SEPARATE STORING OF MORE COMPONENTS

Helmuth Nielsen, Herlev, Denmark, assignor to Lovens Kemiske Fabrik ved A. Kongsted, a Danish firm
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 16 Claims. (Cl. 128—220)

This invention relates to hypodermic syringes of the kind which are provided with compartments for the storing of the injection preparation. Such hypodermic syringes, also known as hypodermic ampoules are, in fact, well-known. In comparison with the ordinary ampoules they offer considerable advantages; for instance, it is not necessary first to suck the injection liquid from an ampoule into the barrel of the hypodermic syringe prior to the injection, which transfer is complicated and time-wasting and involves the danger of contamination or infection of the contents. This disadvantage may be considerably reduced by the use of a hypodermic ampoule which has been charged with the injection liquid under sterile conditions at the factory where the injection liquid was manufactured, and which may be discarded when the contents have been injected.

In certain well-known hypodermic ampoules the injection liquid is poured into a cylindrical container and sealed with a partially perforated stopple which forms a leak-tight piston inside the cylindrical container, and which is provided with a connecting hub for the mounting of a hypodermic needle. The cylindrical container may be extended beyond the piston, e.g. by means of a sealed cap which encases the connecting hub and which must be removed prior to the mounting of the hypodermic needle.

In other well-known hypodermic syringes the piston in the cylindrical container consists of a body provided with a central bore in which a tubular needle, pointed at both ends, is slidingly mounted, the bore at the end facing the injection liquid being sealed by a partition which can be pierced by the tubular needle being pushed in axial direction, and when the piston with the tubular needle in the above-mentioned position subsequently is pulled into the container, the injection liquid is forced out through the tubular needle. Such hypodermic ampoules, too, may be provided with a cap protecting the tubular needle and keeping it sterile until the hypodermic ampoule is to be employed, but they have the defect that the cap must be removed before it is possible to get the tubular needle into position for the piercing of the sealing partition of the piston.

Many injection preparations, however, are instable when ready-made in the form of injectable solutions and are consequently treated in more, preferably two containers, the contents of which must be mixed shortly before use. This, for instance, is the case with a number of preparations which will only keep dry, e.g. crystalline or freeze-dried state and which immediately before use must be dissolved or suspended in a solvent or a suspension agent, possibly one which provides the preparation with a pH value by which it will only keep for a limited length of time. In case of such pharmaceuticals being marketed in ampoules, the medical profession is faced with the necessity of preparing their own injection preparation by mixing the two components of the injection preparation. For this purpose the drug is commonly sold in separate ampoules each containing one of the sterile components in question of the finished preparation, of which components at least one must be liquid; the ampoules are generally closed by means of a membrane which can be pierced by means of the hypodermic needle

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inserted in the hypodermic syringe. In order to make it sufficiently strong without so much force being required for the piercing that the hypodermic needle is damaged, the partition is in some cases given the shape of a stopple in which a special marked spot is sufficiently thin or soft to permit piercing, whereas the other part of the stopple is of a thicker or a more resistant material. The medicament is used in the following way: First the hypodermic needle is inserted into the one ampoule, the contents of which are liquid, and of which a measured quantity is sucked into the syringe. The hypodermic needle is then pulled out and inserted into the other ampoule into which the contents of the syringe are ejected, whereupon the hypodermic needle, if necessary, is pulled out again to permit shaking of the ampoule so that an adequate mixing, dissolution or suspension can take place. Finally, the hypodermic needle is inserted into the latter ampoule again, and the desired quantity of the mixture is sucked into the syringe in order to be injected into the patient.

This method is even more complicated and offers an even greater risk of contamination or infection of the preparation than the method aforesaid which employs only one ampoule.

Consequently, a great number of ampoules have been suggested, each having two compartments separated by a partition when stored, and the contents of which can be mixed either by removal of the partition so that the mixing can take place in the combined compartments; or by a hypodermic needle mounted on a hypodermic syringe being inserted into the ampoule through its cover and sucking up the contents of one of the compartments of the ampoule, whereupon the needle is inserted into the other compartment of the ampoule, which serves as a mixing compartment, and sucks up liquid there. Finally, the ready-made preparation must, as in cases where separate ampoules are employed for each of the components, be sucked out of the mixing compartment and into the syringe from which it is injected into the patient.

The two-compartment ampoules in which the contents are mixed after the removal of the partition have the defect that it is difficult to make the removable partition leak-tight, and consequently the preparation will often prove to have been more or less damaged during the storing and must therefore be discarded. The two-compartment ampoules, however, which in connection with the mixing of the components necessitate the sucking into the syringe from one of the compartments do not offer any substantial advantages over the use of individual ampoules for each of the components. Consequently, this invention relates to a hypodermic syringe with individual compartments for the storing of the components of the injection preparation, the mixing taking place through one operation, and the injection through another subsequent operation with the same, as a syringe constructed apparatus without another hypodermic syringe being employed at any time. The syringe constructed as a hypodermic ampoule can be discarded when the medicament contained in its ampoule compartment has been used.

In connection with the description of the invention given below, the drawing shows the following:

FIGURE 1 is a longitudinal cross-section through one form of the invention. FIGURES 2 to 4 are longitudinal cross sections through modified forms of the invention.

The hypodermic syringe of the present invention is characterized in that the syringe has two cylindrical compartments separated by a partition which can be pierced, each of the said cylindrical compartments being provided with a piston movable towards the partition, one of said pistons carrying a needle the free end of which points against the partition, whereas the other piston is provided with a hypodermic needle, the canal of which is connected with the other cylindrical compartment through the piston

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or with a connecting tube adapted to connect an injection needle to the cylindrical compartment in question and to secure it to the syringe in injection position. By this it is possible to transfer the solid drug contained in the first barrel compartment to the other barrel compartment only by forcing the piston of the former towards the partition between the two compartments which is then pierced by the needle, establishing contact between the two compartments, whereupon the liquid, while the piston is forced further towards the pierced partition, is pressed into the other ampoule compartment without the hypodermic needle having been used or even touched. When mixed, the ready preparation is injected into the patient just by pressing down the other piston. In this way the handling of the hypodermic syringe is simple and quick, and the danger of infection which may arise if a hypodermic needle is inserted into one or the other of the ampoule compartments, has been eliminated.

The needle intended for piercing the partition is preferably only very slightly shorter than the distance between the piston and the partition in the cylindrical compartment in which it is housed.

In one embodiment of the invention the needle intended to pierce the partition is tubular and provided with an aperture which will permit transfer of the liquid component through the needle from one compartment to the other after the needle has pierced the partition. This embodiment is particularly suitable if the partition consists of, e.g. a rubber membrane or a membrane of a similar elastic material which when pierced fits close to the piercing agent and prevents any substantial leaking out of the liquid through the perforation.

In another embodiment of the invention the needle intended for piercing the partition is movable in the axial direction of the cylindrical compartment and is provided with an extension preferably having a sectional area larger than that of the needle, the extension being mounted in a tight-fitting central bore in the piston and the operating rod connected with the piston, and provided with an operating plate extending beyond the operating rod. This embodiment is particularly suitable if the partition is of a non-elastic material, e.g. aluminium foil, which after piercing by the needle will permit the liquid to move without hindrance along the needle. In this embodiment a pressure on the operating plate will push the needle towards the partition, and through it, whereupon the operating plate will be forced against the operating rod which will then push the piston towards the partition and force the liquid into the adjacent compartment.

If the sectional area of the needle is smaller than that of the extension, it is furthermore possible to mount the piston in the liquid-containing compartment of the ampoule close to the surface of the liquid, i.e. without any substantial air space between piston and liquid, as the needle, having a smaller sectional area than the bore, can be inserted in the operating rod without a pressure above the atmosphere in the liquid-containing compartment, the thickened extension of the needle acting as an adequate seal when inserted.

According to a particularly appropriate embodiment of the invention, a case for the protection of the hypodermic needle or device for the mounting of a hypodermic needle is attached to the inner wall of the latter cylindrical compartment or supported by the said wall or connected with the edge of the piston end of the said wall. In this way it is possible to secure that the hypodermic needle or the device for the mounting of such a needle, being sterile when leaving the factory, will remain sterile. It is a special advantage that the said protecting case remains untouched in its position during the transfer of the injection component from the first compartment to the other as well as during the process of mixing. Only when the mixing is completed and the injection is to be made into the patient, it will be necessary to remove the protecting case.

According to the present invention the walls of both

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cylindrical compartments may furthermore be mutually connected or integrally moulded with the wall of the protecting case so that they form a tube in which the piston, carrying the hypodermic needle or the device for the mounting of such a needle, is inserted to such a depth that the said hypodermic needle or device is completely encased in the space formed by the tube. At a suitable distance from the said piston the stationary partition is mounted in the same barrel, and at a suitable distance from the partition the other piston is mounted. Consequently, the hypodermic syringe with ampoule compartments and protecting case will form a whole, inside which sterile conditions prevail.

Beyond the point of the hypodermic needle the tube may be sealed by a wall moulded integrally with the wall of the tube or by a cover which can be sterilized. In this way the hypodermic needle or the device for the mounting of such a needle is protected from damage and infection.

The drawings show in sections the various embodiments of the hypodermic syringe according to the present invention. In a tube 1, one end of which is sealed by means of a barrel plate 2, two pistons 3 and 4 tightly fitting against the barrel wall, and a partition 5, also tightly fitting against the barrel wall and fixed on it, are mounted. The piston 3 has in the construction shown a connecting piece 6 with a through-canal 7, the piston end of which has an enlarged section 8. The free end 9 of the connecting piece 6 is cone-shaped, thus making it suitable for the mounting of a hypodermic needle holder not shown in the illustration, and, if desired, is provided with a flange or handle for the impression of the piston during the injection. The piston 3 is mounted at a distance from the partition 5 which will allow for a suitable ampoule compartment 10 which may contain one of the injection components, if desired a powder component. The partition 5 is provided with a central part which can be pierced by means of a tubular needle. Between the partition 5 and the piston 4 is an ampoule compartment 12 which in essentials may be filled with a liquid injection component, e.g. a solvent for the solid powdered drug in ampoule compartment 10. The piston 4 is firmly and closely connected with a holder 13 which is provided with a pointed tubular needle 14, the point of the needle facing and being close to that part of the partition 5 which can be pierced 11; besides, the holder is provided with a suitable operating rod 16.

The syringe is used and operates as follows: Immediately or shortly before use the piston 4 is pressed to the right towards that part of the partition 5 which can be pierced 11. The point of the tubular needle 14 will consequently pierce the partition, and a connection between the ampoule compartments 10 and 12 is established. By pressing the piston 4 further to the right, as shown in the figure, the contents of the ampoule compartment 12 is ejected into the ampoule compartment 10. The two components can now be mixed by shaking.

If the syringe is used, e.g. in hospitals, the said operation may be carried out by an assistant before the syringes prepared in this way are handed to the physician or the person who is going to perform the injection.

When the injection is going to take place, the part of the tube 1 which extends beyond the piston 3 is removed, which part forms a case protecting the through-canal 7. In order to facilitate the removal the tube may be provided with a groove making it possible to break or cut off the protecting case. A hypodermic needle is then mounted on the cone 9, and the injection is performed by pressing the piston 3 back into the ampoule compartment 10. In this way the tubular needle 14 will fit into the enlarged section 8. After the injection the hypodermic needle is removed and sterilized, whereas the syringe is discarded.

The tube 1, the pistons, the partition, the connecting piece and the piston rod may be made of many different

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materials. The tube may be made of glass in which case a glass file will be the adequate means for cutting off the part of the tube extending beyond the piston 3 before the syringe is used. The pistons may be made of caoutchouc or a suitable plastic, e.g. a polyvinyl material, and this also applies to the partition 5. The connecting piece 6 may be of e.g. polyethylene, and the piston rod of Plexiglas etc. The tube 1 may also be of some plastic material. The choice of material, however, should be made with due regard to the possibilities of sterilization.

When filling the ampoule compartment 12 with a liquid injection component it must be taken into account that the piston 4 must be capable of being pressed so much forward that the tubular needle will pierce the partition 11 without any liquid leaking out. In most cases it is therefore necessary, when filling, to allow for a suitable air space. When the piston 4 is pressed towards the partition, an excess pressure will arise in the ampoule compartment 10 which excess pressure will be transmitted to the compartment between the piston 3 and the partition. Therefore, it is necessary during this operation to keep the syringe in a vertical position with the piston 3, pointing upwards to prevent any liquid leaking out through the canal 7. By cutting off the foremost part of the tube 1, the excess pressure arising from the movement of the piston 4 is neutralized, and will also cause air to escape through the canal 7. The essential advantage of using the syringe according to the present invention is that no outside air is sucked in through the canals of the hypodermic needle or the connecting piece at any time. Conversely, the filling of an ordinary hypodermic syringe with the liquid from an ampoule will cause suction of a considerable quantity of outside air the moment the hypodermic needle is removed from the ampoule after the contents of the latter have been sucked into the hypodermic syringe, as a vacuum prevails during the suction operation, which vacuum is neutralized when the hypodermic needle is removed from the cover membrane of the ampoule.

In the embodiment of the present invention shown in FIG. 2, the tube 1 ends close in front of the ampoule compartment 10, and the foremost closed part of the tube 1 has been replaced by a cap 17 which preferably may be of a plastic which can easily be cut. The cap 17 fits closely to the foremost part of the tube 1 and may be connected with the latter by welding or by means of an adhesive. The material of the cap 17 must be strong enough to stand sterilization by heating. Furthermore, the tube 1 which preferably may also be of a plastic, is provided with a partition 19 integrally cast with the wall of the tube, the central part of the partition consisting of a thin membrane 20, which can be easily pierced by the tubular needle 14.

Also in the embodiment of the present invention shown in FIG. 3 the foremost part of the tube 1 is shaped as a separate cap 17. In this embodiment, however, the tube 1 is limited to form the part which surrounds the ampoule compartment 10, as the ampoule compartment 12 forms a separate, hindmost part 18 of the tube. The tube 1 has at its backward-facing opening an inward-turning flange 22, and the part 18 in its foremost section a similar flange 21. The tube 1 and the part 18 are assembled in such a way that the two flanges abut on each other with an intermediary membrane 20 of e.g. caoutchouc, the flanges and the membrane forming together a closely fitting partition of which the central part of the membrane is free and can be pierced by the tubular needle 14.

In the embodiment shown in FIG. 4 the partition 20 consists of a thin non-elastic membrane soldered to the wall of the barrel and provided with a hollow in which the point of the needle 27 rests. The extension of the needle which has a larger sectional area than the needle proper is mounted in a tight-fitting central bore through the piston 25 and the operating rod 24 and extends be-

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yond the operating rod in an operating plate 23. The operating plate is mounted at such a distance from the top of the operating rod that a pressure on the former will push the needle so much forward that the partition 20 is pierced after which a continued pressure will push the operating rod and the piston 25 against the partition and force the liquid contents into the adjacent container. The device for the mounting of a hypodermic needle is in the present embodiment provided with a protecting cap 26.

I claim:

1. Hypodermic syringe comprising two cylindrical compartments placed in aligned coaxial relation to each other and separated by an immovable pierceable partition, and a piston inserted in each of said cylindrical compartments so as to be tightly movable towards the immovable partition along the cylindrical wall thereof, the piston inserted in one of the cylinders carrying a piercing needle extending into the space enclosed by the walls of the cylinder, the piston and the immovable partition and pointing towards the latter, and the one inserted in the other of said cylinders carrying a hypodermic needle the rear end of which is directed against the immovable partition and, the point of which is directed away from the immovable partition and the interior cavity of which is in connection with the space confined by the wall of the cylinder, the piston and the immovable partition.

2. Syringe as claimed in claim 1, in which the extension of the piercing needle into the space enclosed has substantially the same length as the length of the cylinder between the piston and the immovable partition.

3. Syringe as claimed in claim 1, in which the piercing needle pointing towards the partition and extending through one of the compartments is tubular and its interior cavity adjacent to the piston is connected to the interior space defined by the walls of the cylinder, the piston and the immovable partition.

4. Hypodermic syringe comprising two cylindrical compartments placed in aligned coaxial relation to each other and separated by an immovable pierceable partition and a piston inserted in each of said cylindrical compartments so as to be tightly movable along the cylindrical wall thereof, the piston inserted in one of the cylinders carrying a piercing needle extending into the space enclosed by the walls of the cylinder, the piston and the immovable partition and pointing towards the latter, and the one inserted into the other of said cylinders carrying a connecting pipe adapted for connecting a hypodermic needle with said compartment and securing said needle to the syringe.

5. Syringe as claimed in claim 4, in which the extension of the piercing needle into the space enclosed has substantially the same length as the length of the cylinder between the piston and the immovable partition.

6. Syringe as claimed in claim 4, in which the piercing needle pointing towards the partition and extending through one of the compartments is tubular and its interior cavity adjacent to the piston is connected to the interior space defined by the walls of the cylinder, the piston and the immovable partition.

7. Hypodermic syringe comprising two cylindrical compartments placed in aligned coaxial relation to each other and separated by an immovable pierceable partition and a piston inserted in each of said cylinders so as to be tightly movable along the cylindrical wall thereof, the piston inserted into one of said cylinders having an axial bore in which a solid piercing needle is tightly fitted so as to permit longitudinal shifting thereof, the part of the needle extending into the space between the piston and the immovable partition pointing against the latter and the other end being provided with an operating plate, and the piston inserted into the other cylinder carrying a hypodermic needle the rearward end of which is directed against the immovable partition and the point of which is directed away from the piston and the interior cavity of which is

in connection with the space confined by the walls of the cylinder, the piston and the partition,

8. Hypodermic syringe according to claim 7, in which the extension of the piercing needle into the space enclosed has substantially the same length as the length of the cylinder between the piston and the immovable partition.

9. Hypodermic syringe as claimed in claim 7, in which the piercing needle pointing towards the partition and extending through one of the compartments is tubular and its interior cavity adjacent to the piston is connected to the interior space defined by the walls of the cylinder, the piston and the immovable partition.

10. Hypodermic syringe comprising two cylindrical compartments placed in aligned coaxial relation to each other and separated by an immovable pierceable partition, and a piston inserted into each of the cylinders so as to be tightly movable along the cylindrical wall thereof, the piston inserted into one of said cylinders having an axial bore in which a solid piercing needle is tightly fitted so as to permit longitudinal shifting thereof, the part of the needle extending into the space between the piston and the immovable partition pointing against the latter and the other end being provided with an operating plate, and the piston inserted into the other cylinder carrying a connecting tube adapted to connect the cavity of an injection needle with the interior of the compartment confined by the walls of the cylinder, the piston and the immovable partition and to fix the said injection needle in injection position to the syringe.

11. Hypodermic syringe as claimed in claim 10, in which the extension of the piercing needle into the space enclosed has substantially the same length as the length of the cylinder between the piston and the immovable partition.

12. Hypodermic syringes as claimed in claim 10, in which the piercing needle pointing towards the partition and extending through one of the compartments is tubular and its interior cavity adjacent to the piston is connected to the interior space defined by the walls of the cylinder, the piston and the immovable partition.

13. Syringe comprising a cylindrical tubular body the interior cavity of which is divided into two parts by a fluid-tight immovable pierceable partition, a piston being inserted into each part so as to be tightly movable along the cylindrical wall thereof, the piston inserted into one of said cylinders having an axial bore in which a solid piercing needle is tightly fitted so as to permit longitudinal shifting thereof, the part of the needle extending into the space between the piston and the immovable partition pointing against the latter and the other end being provided with an operating plate, and the piston inserted into the other cylinder carrying a hypodermic needle the

rear end of which is directed against the immovable partition and the point of which is directed away from the piston and the interior cavity of which is in connection with the space confined by the walls of the cylinder, the piston and the partition, the length of the tubular body being so chosen that the hypodermic needle is protected in its entire length by the part of the wall of the body extending beyond the piston carrying said hypodermic needle when the piston is inserted to a distance from the partition, leaving adequate space for mixing the contents of the two compartments.

14. Hypodermic syringe as claimed in claim 13, in which the part of the tubular body extending beyond the piston carrying the hypodermic needle is closed at its free end.

15. Hypodermic syringe as claimed in claim 13, in which the part of the tubular body extending beyond the piston carrying the hypodermic needle is provided with a lid of a material capable of being sterilized.

16. Syringe comprising a cylindrical tubular body the interior cavity of which is divided into two parts by a fluid-tight immovable pierceable partition, a piston being inserted into each part so as to be tightly movable along the cylindrical wall thereof, the piston inserted into one of said cylinders having an axial bore in which a solid piercing needle is tightly fitted so as to permit longitudinal shifting thereof, the part of the needle extending into the space between the piston and the immovable partition pointing against the latter and the other end being provided with an operating plate, and the piston inserted into the other cylinder carrying a connecting tube adapted to connect the cavity of an injection needle with the interior of the compartment confined by the walls of the cylinder, the piston and the immovable partition and to fix the said injection needle in injection position to the syringe, the length of the tubular body being so chosen that the connecting tube is protected in its entire length by the part of the wall of the body extending beyond the piston carrying said connecting tube when the piston is inserted to a distance from the immovable partition leaving adequate space for the mixing of the contents of the two compartments.

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