N7623 (25)

PATENT SPECIFICATION (11) 1 449 986

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(21) Application No. 33430/74 (22) Filed 29 July 1974

(31) Convention Application No. 384682 (32) Filed 1 Aug. 1973 in (19)

(33) United States of America (US)

(44) Complete Specification published 15 Sept. 1976

(51) INT CL² A61M 5/24 5/20

(52) Index at acceptance

A5R 33C1A 33C4

(54) HYPODERMIC SYRINGE

(71) We, N. V. PHILIPS' GLOEILAMPENFABRIEKEN, a limited liability Company, organized and established under the laws of the Kingdom of the Netherlands, of Emmasingel 29, Eindhoven, Holland, do hereby 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:—

This invention relates to a hypodermic syringe of the type wherein a spring-loaded operating mechanism drives an ampoule and attached cannula to cause the cannula to project from the syringe and to cause medicament to be expelled from the ampoule via the cannula.

According to one aspect of the invention there is provided a hypodermic syringe comprising a cartridge holder, a cartridge slidably mounted within the holder and including an ampoule having an attached cannula, the ampoule comprising a cylindrical sleeve slidably carrying a piston, said sleeve being open at one end and having means at the other end for rigidly mounting the cannula thereon, fluid medicament in the sleeve between the piston and the cannula, a spring-loaded operating mechanism associated with the cartridge for sliding the cartridge in the holder so that the free end of the cannula extends from the holder and also for delivering, via the cannula, the fluid carried in the ampoule, a sheath of resilient material surrounding the cannula and formed as a cylinder having a closed end slightly spaced from the free end of the cannula, and means for restricting movement of the closed end of the sheath relative to the holder whereby, on said sliding of the cartridge, the free end of the cannula pierces the sheath.

According to a further aspect of the invention there is provided a hypodermic syringe comprising a cartridge holder having a cylindrical body one end of which is open and the other end of which is provided with a centrally positioned aperture, a cartridge slidably mounted in the holder and including an ampoule with a cannula rigidly fixed at one end thereof by a hub, said cannula being directed toward the said other end of the holder, the ampoule comprising a cylindrical sleeve slidably carrying a piston, said sleeve being open at one end and having a necked portion at the other end to receive the hub, fluid medicament in the sleeve between the piston and the cannula, a spring-loaded operating mechanism for slidably moving the cartridge in the holder so that the free end of the cannula projects through the aperture, the mechanism also serving to expel, via the cannula, the fluid carried in the ampoule, a sheath surrounding the cannula, said sheath comprising a cylinder of resilient material having a closed end and an open end, the length of the sheath being such that the closed end thereof is slightly spaced from the free end of the cannula with the open end engaging the cannula hub, the outer diameter of the sheath being greater than that of the aperture in the cartridge holder whereby when the operating mechanism moves the cartridge the free end of the cannula pierces the sheath.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, of which:—

Figure 1 shows a hypodermic syringe according to the invention,

Figure 2 shows the same syringe after the operating mechanism has been "fired" but before the medicament is expelled, and

Fig. 3 is a view similar to Fig. 2, illustrating a slight retraction of the cannula from the fully extended position of Fig. 2 which retraction occurs during the terminal portion of the injection.

In the following description of the "forward" and "rear" ends of the syringe and any of its components are to be understood as referring to the uppermost and lowermost ends, respectively, as viewed in the Figures.

The syringe comprises an outer cylindrical sleeve 100 having an inturned shoulder 110 at its forward end and an an-

nular groove 113 in the inner wall adjacent its rear end. A cartridge assembly 106 is assembled in the shouldered end of the outer sleeve 100. The cartridge assembly 106 includes a cartridge 135 and a cartridge holder sleeve 104 fitted within the sleeve 100. Sleeve 104 has a decreased diameter end portion 153 forming a shoulder 154 which fits against seat 112 provided by outer sleeve shoulder 110. The extreme forward end portion 156 of the holder sleeve 104 is tapered and has a small circular aperture 158.

The cartridge 135 includes an ampoule cylinder 136 containing liquid medicament 146, a piston 148, and a cannula 150. The ampoule cylinder 136 has a necked portion 80 and terminates in an enlarged annular flange with a diameter less than that of the cylinder 136. The cannula 150 is secured to a cannula hub 81 which in turn is affixed to the enlarged flange on the necked portion 80. Cannula hub 81 comprises a reduced diameter portion 84, which is secured to cannula 150, and an intermediate body portion 86 connected to an enlarged body portion 88. The enlarged body portion 88 fits over and is secured to the annular flange of the necked portion 80 of the ampoule cylinder 136. Within the neck of the ampoule cylinder 136 between the rear end of the cannula 150 and the medicament, there may be interposed a fluid pressure rupturable diaphragm of the type described in Patent No. 1,203,098.

The cartridge assembly 106 is assembled in the outer sleeve 100 with the cannula 150 spaced from the apertured end of the holder 104. The overall length of the ampoule cylinder 136 and cannula 150 is such that the latter is contained within the holder sleeve 104, as illustrated in Fig. 1.

The outer sleeve 100 is of such length that it accommodates the cartridge assembly 106 in one (forward) end and receives a spring-loaded operating mechanism 200 in the other (rear) end to complete the device. The mechanism 200 comprises an inner sleeve 101 having an out-turned flange 103 at its forward end which abuts the rear end of the cartridge holder sleeve 104 when the mechanism is inserted in the outer sleeve 100. The rear end of the inner sleeve 101 is centrally apertured to form a hole 120. The rear outer face 122 of the inner sleeve 101 is planar and is perpendicular to the longitudinal axis of the sleeve for a purpose to be brought out later.

A plunger 162 fits within the forward end of inner sleeve 101. This plunger has a cylindrical body portion 163 and a circular head portion 164 of a diameter larger than the body portion 163 and generally slightly less than that of the piston 148 in the ampoule cylinder 136. The head 164 has an opening which is sized to align and correspond to a through hole 166 in the plunger body 163. The plunger head 164 is provided with a plurality of circumferentially spaced, radially extending tabs 168. These tabs 168 have an outer diameter greater than that of the plunger head 164 so that the tabs will engage the rear end of the ampoule cylinder 136. Londitudinal slots 172 are formed in the plunger head 164 immediately behind the tabs 168. These slots are sized so that they will accommodate the tabs 168 when the latter are later broken off or bent into the slots in operation of the device. These slots extend throughout the length of the head behind the tabs.

Referring to Figs. 1 and 2, a locking detent 176 is fitted through the hole 166 in the plunger 162 and has a central body portion 178 with outwardly extending lugs 180 on the forward end engaging an annular shoulder 182 of the plunger head 164. The rear end of the locking detent 176 is provided with four equally spaced, longitudinally extending springy detent arms 184 terminating in frusto-conical detent heads 186. This locking detent 176 maintains the plunger 162 and inner gun sleeve 101 in assembled position with a coil spring 138 compressed therebetween as follows. The coil spring 138 is positioned over the plunger body 163 and abuts the plunger head 164 at its forward end and abuts the inner surface of the rear end wall of the inner sleeve 101 at the other. Upon compressing the coil spring 138 sufficiently, the detent heads 186 are cammed inwardly by engaging the periphery of the end wall opening 120 and pass therethrough whereupon the bases of the detent heads 186 come to rest on the rear planar face 122 of the inner sleeve 101 to retain the plunger and inner sleeve in assembled condition shown in Figure 1 with the coil spring 138 compressed therebetween. When desired, the rear planar surface 122 of the inner sleeve 101 may be overlaid with a metal washer 127, in which case it is advantageous to provide a guide and holding flange 128 to surround the opening 120. The flange 128 is provided with a lip portion to retain the washer in place.

As illustrated in Figs. 1 and 2, the inner sleeve 101 has a plurality of longitudinally extending raised ribs 129 running from the flange 103 approximately one-half the length of the said sleeve. An outer sleeve 192 fits over inner sleeve 101 and is of a diameter to frictionally engage ribs 129. The outer sleeve 192 has a rear end 194 with a central aperture 196 from which extends a frusto-conical cam surface 198 sized and shaped to cooperate with frusto-conical detent heads 186 to cam said heads radially inwardly. The outer sleeve 192 is provided

with a circumferential locking rib 199 which fits in groove 113 in the outer sleeve 100 to retain the mechanism 200 in position in said outer sleeve. It should be noted that the length of outer sleeve 192 is slightly less than that of the inner sleeve 101 so as to make certain that there will be spaced etween the forward end of the outer sleeve 192 and the flange 103 of the inner sleeve 101 so that the two sleeves may be moved relative to each other to cam frusto-conical detent heads 186 inwardly in operating the device.

In order to make certain that the frusto-conical detent heads 186 are not accidentally cammed inwardly, a safety assembly is provided. This safety assembly comprises a cap 142 having a cylindrical sleeve 143 sized to fit over the rear end portion of outer sleeve 192. A pin 144 extends inwardly from the center of the cap 142 through aperture 196 in outer sleeve 192 into the opening formed by the inner portions of the detent heads 186 to prevent inward movement of said detent heads. The cap 142 is provided internally with a plurality of spacer abutments 145 to assure proper positioning of the cap on the outer sleeve 192.

As shown in Fig. 1, a sheath 250 of resilient material is positioned over the cannula 150 such that the open end of the sheath fits over and around cannula hub portion 84 and abuts the shoulder 82 formed by hub portions 84 and 86. The length of the sheath is such that its closed end is slightly beyond or spaced from the forward end of cannula 150. In order to make certain that the forward end of the sheathed cannula is maintained in proper alignment with aperture 158, a plurality of ribs 157 is formed on the inner surface of tapered holder portion 156 surrounding said aperture. Thus, the closed end of the sheath 250 is held in necessary alignment by bearing against the converging section of the ribs 157.

To use the syringe, which is designed for the self-administration of a medicament, the safety assembly is first removed by pulling off cap 142. The forward end of the syringe is then placed against a part of the body, e.g. the thigh, of the person using the syringe and the outer sleeve 100 is moved firmly in the forward direction. This causes the space between the forward end of the outer sleeve 192 and the flange 103 to close and, hence, the rear end face 122 of inner sleeve 101 approaches rear end 194 of outer sleeve 192. The tips of detent heads 186 enter the aperture 196 and the detent heads engage cam surface 198, which engagement moves the heads inwardly towards each other until a point is reached when the bases of the detent heads move clear of metal washer 127. Cartridge 135 is now moved rapidly forward under the action of compressed spring 138. The closed end of sheath 250 cannot move forward relative to sleeve 104 and so the forward end of cannula 150 pierces sheath 250. Figure 2 shows the situation reached when the cartridge has been moved forward to its maximum extent but no medicament has been expelled from ampoule cylinder 106. As can be seen, cannula sheath 250 has been compressed during the forward motion and acts as a shock absorber to gradually absorb some of the energy provided by the power spring 138 as it drives the cartridge 135 forward. It should be noted that at no time, even when the cannula is fully extended, is the sheath compressed to such an extent that it would act as a solid and thereby provide no shock absorbance.

When the cannula 150 is fully extended as shown in Fig. 2, the cannula sheath 250 will be compressed the greatest amount hence the largest reactionary force will exist in the compressed sheath in such position. As illustrated in Fig. 2, the cartridge 135 has completed its travel under the force of spring 138 to start the injection cycle. When cartridge 135 has moved as far as it can, as shown in Figure 2, spring 138 causes tabs 168 to fracture or to bend so that they no longer engage the rear end of ampoule cylinder 136. Piston 148 is now moved by spring 138 to expel the medicament 146 from the ampoule cylinder. The resilience of sheath 250 is such that, in its maximum compressed condition as shown in Figure 2, the restoring force it exerts on ampoule cylinder 136 is slightly greater than the force exerted by spring 138 when the piston 148 reaches a position just short of full piston travel. This causes the cartridge 135 to retract slightly; the situation now being as shown in Figure 3.

Thus sheath 250 not only serves the purpose of protecting cannula 150 from contamination prior to use of the syringe, it also acts as a shock absorber to prevent fracture of ampoule cylinder 136 (which is generally of glass) and further provides slight withdrawal of the cannula at the end of injecting the medicament.

WHAT WE CLAIM IS:—

1. A hypodermic syringe comprising a cartridge holder, a cartridge slidably mounted within the holder and including an ampoule having an attached cannula, the ampoule comprising a cylindrical sleeve slidably carrying a piston, said sleeve being open at one end and having means at the other end for rigidly mounting the cannula thereon, fluid medicament in the sleeve

with a circumferential locking rib 199 which fits in groove 113 in the outer sleeve 100 to retain the mechanism 200 in position in said outer sleeve. It should be noted that the length of outer sleeve 192 is slightly less than that of the inner sleeve 101 so as to make certain that there will be spaced between the forward end of the outer sleeve 192 and the flange 103 of the inner sleeve 101 so that the two sleeves may be moved relative to each other to cam frusto-conical detent heads 186 inwardly in operating the device.

In order to make certain that the frusto-conical detent heads 186 are not accidentally cammed inwardly, a safety assembly is provided. This safety assembly comprises a cap 142 having a cylindrical sleeve 143 sized to fit over the rear end portion of outer sleeve 192. A pin 144 extends inwardly from the center of the cap 142 through aperture 196 in outer sleeve 192 into the opening formed by the inner portions of the detent heads 186 to prevent inward movement of said detent heads. The cap 142 is provided internally with a plurality of spacer abutments 145 to assure proper positioning of the cap on the outer sleeve 192.

As shown in Fig. 1, a sheath 250 of resilient material is positioned over the cannula 150 such that the open end of the sheath fits over and around cannula hub portion 84 and abuts the shoulder 82 formed by hub portions 84 and 86. The length of the sheath is such that its closed end is slightly beyond or spaced from the forward end of cannula 150. In order to make certain that the forward end of the sheathed cannula is maintained in proper alignment with aperture 158, a plurality of ribs 157 is formed on the inner surface of tapered holder portion 156 surrounding said aperture. Thus, the closed end of the sheath 250 is held in necessary alignment by bearing against the converging section of the ribs 157.

To use the syringe, which is designed for the self-administration of a medicament, the safety assembly is first removed by pulling off cap 142. The forward end of the syringe is then placed against a part of the body, e.g. the thigh, of the person using the syringe and the outer sleeve 100 is moved firmly in the forward direction. This causes the space between the forward end of the outer sleeve 192 and the flange 103 to close and, hence, the rear end face 122 of inner sleeve 101 approaches rear end 194 of outer sleeve 192. The tips of detent heads 186 enter the aperture 196 and the detent heads engage cam surface 198, which engagement moves the heads inwardly towards each other until a point is reached when the bases of the detent heads move clear of metal washer 127. Cartridge 135 is now moved rapidly forward under the action of compressed spring 138. The closed end of sheath 250 cannot move forward relative to sleeve 104 and so the forward end of cannula 150 pierces sheath 250. Figure 2 shows the situation reached when the cartridge has been moved forward to its maximum extent but no medicament has been expelled from ampoule cylinder 106. As can be seen, cannula sheath 250 has been compressed during the forward motion and acts as a shock absorber to gradually absorb some of the energy provided by the power spring 138 as it drives the cartridge 135 forward. It should be noted that at no time, even when the cannula is fully extended, is the sheath compressed to such an extent that it would act as a solid and thereby provide no shock absorbance.

When the cannula 150 is fully extended as shown in Fig. 2, the cannula sheath 250 will be compressed the greatest amount hence the largest reactionary force will exist in the compressed sheath in such position. As illustrated in Fig. 2, the cartridge 135 has completed its travel under the force of spring 138 to start the injection cycle. When cartridge 135 has moved as far as it can, as shown in Figure 2, spring 138 causes tabs 168 to fracture or to bend so that they no longer engage the rear end of ampoule cylinder 136. Piston 148 is now moved by spring 138 to expel the medicament 146 from the ampoule cylinder. The resilience of sheath 250 is such that, in its maximum compressed condition as shown in Figure 2, the restoring force it exerts on ampoule cylinder 136 is slightly greater than the force exerted by spring 138 when the piston 148 reaches a position just short of full piston travel. This causes the cartridge 135 to retract slightly; the situation now being as shown in Figure 3.

Thus sheath 250 not only serves the purpose of protecting cannula 150 from contamination prior to use of the syringe, it also acts as a shock absorber to prevent fracture of ampoule cylinder 136 (which is generally of glass) and further provides slight withdrawal of the cannula at the end of injecting the medicament.

WHAT WE CLAIM IS:—

1. A hypodermic syringe comprising a cartridge holder, a cartridge slidably mounted within the holder and including an ampoule having an attached cannula, the ampoule comprising a cylindrical sleeve slidably carrying a piston, said sleeve being open at one end and having means at the other end for rigidly mounting the cannula thereon, fluid medicament in the sleeve

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between the piston and the cannula, a spring-loaded operating mechanism associated with the cartridge for sliding the cartridge in the holder so that the free end of the cannula extends from the holder and also for delivering, via the cannula, the fluid carried in the ampoule, a sheath of resilient material surrounding the cannula and formed as a cylinder having a closed end slightly spaced from the free end of the cannula, and means for restricting movement of the closed end of the sheath relative to the holder whereby, on said sliding of the cartridge, the free end of the cannula pierces the sheath.

2. A hypodermic syringe comprising a cartridge holder having a cylindrical body one end of which is open and the other end of which is provided with a centrally positioned aperture, a cartridge slidably mounted in the holder and including an ampoule with a cannula rigidly fixed at one end thereof by a hub, said cannula being directed toward the said other end of the holder, the ampoule comprising a cylindrical sleeve slidably carrying a piston, said sleeve being open at one end and having a necked portion at the other end to receive the hub, fluid medicament in the sleeve between the piston and the cannula, a spring-loaded operating mechanism for slidably moving the cartridge in the holder so that the free end of the cannula projects through the aperture, the mechanism also serving to expel, via the cannula, the fluid carried in the ampoule, a sheath surrounding the cannula, said sheath comprising a cylinder of resilient material having a closed end and an open end, the length of the sheath being such that the closed end thereof is slightly spaced from the free end of the cannula with the open end engaging the cannula hub, the outer diameter of the sheath being greater than that of the aperture in the cartridge holder whereby when the operating mechanism moves the cartridge the free end of the cannula pierces the sheath.

3. A hypodermic syringe as claimed in Claim 2 wherein the sheath is so sized that, upon movement of the cartridge, the sheath is compressed between the cannula hub and the apertures end of the cartridge holder and acts as a shock absorber.

4. A hypodermic syringe as claimed in Claim 3 wherein the size of the sheath is such that it is never fully compressed on movement of the cartridge.

5. A hypodermic syringe as claimed in Claim 4 wherein means are provided in the apertured end of the cartridge holder for positioning the closed end of the resilient sheath with respect to the cartridge holder.

6. A hypodermic syringe as claimed in Claim 2 wherein the resilient sheath is so arranged that, when it is compressed by maximum movement of the cartridge under action of the operating mechanism, the reactionary energy stored in the compressed sheath is sufficient to overcome the energy remaining in the operating mechanism and to retract the cannula a small distance.

7. A hypodermic syringe as claimed in Claim 3 wherein the cylindrical sleeve is made of glass.

8. A hypodermic syringe substantially as herein described with reference to the drawings.

C. A. CLARK,
Chartered Patent Agent,
Century House,
Shaftesbury Avenue,
London, W.C.2.
Agent for the Applicants.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1976.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.