INJECTION DEVICE WITH SYRINGE CARRIER ENGAGEMENT WITH CAP

FIELD OF THE INVENTION

The present invention relates to an injection device of the type that receives a syringe, extends it, discharges its contents and then retracts it automatically.

BACKGROUND OF THE INVENTION

Devices of this general description are shown in WO 95/35126 and EP-A-0 516 473 and tend to employ a drive spring and some form of release mechanism that releases the syringe from the influence of the drive spring once its contents are supposed to have been discharged, to allow it to be retracted by a return spring.

Often, such injection devices are required to work with glass pre-filled syringes that were originally designed for manual use. Such glass syringes have a flange at their base to allow a user to grip the syringe. The substantial force produced by the drive spring is applied to the piston of the syringe. This force is transferred to the housing and return spring, via syringe carrier. The syringe carrier is normally sheath which is designed to envelop the syringe and take up forces applied to the syringe to prevent damage to the frangible glass body of the syringe.

The syringe is manufactured with a boot which covers its needle. The aim of the boot is to protect the needle and maintain its sterility. The needle is joined to the glass body of the syringe by an integrity seal. With injection devices of the present invention, the syringe boot may be connected to the syringe body via a frangible connection, or, alternatively, the boot may be a tight rubber boot covering the needle. In either case, the boot is gripped by a cap of the injection device so that the boot becomes removed when the cap of the injection device is removed prior to use.

In current injection devices, the syringe carrier is nominally biased into the syringe by a

return spring. The bias is only overcome when a drive spring is released which forces the syringe carrier against the bias of the return spring to move the syringe into an extended position whilst its contents is ejected. However, before actuation of the drive spring, the syringe carrier is still free to move against the return spring when high loading forces are applied externally to the injection device, for example during impact of the injection device with a hard surface, such as when the device is dropped. In such situations, since the boot is held rigidly in the cap of the injection device, movement of the syringe carrier (and syringe) may disturb the integrity of the needle seal with the syringe or cause the frangible connection between the boot and the syringe to break. Of course, this exposes the needle and its contents to a non-sterile environment which is undesirable.

SUMMARY OF THE INVENTION

The injection devices of the present invention are designed to deal with the aforementioned problems.

An injection device according to the present invention comprises:

a housing adapted to receive a syringe having a reservoir portion and a discharge nozzle, so that the syringe is movable between a retracted position in which the discharge nozzle is contained within the housing and an extended position in which the discharge nozzle extends from the housing through an exit aperture;

a drive that acts upon the syringe to advance it from its retracted position to its extended position and discharge its contents through the discharge nozzle;

a removable cap adapted to be connected to the housing for closing the exit aperture; and

a syringe carrier for carrying the syringe as it is advanced,

wherein the removable cap is adapted to restrict movement of the syringe carrier in a direction towards the exit aperture when the removable cap is connected to the housing.

In this way, the syringe carrier, and, hence syringe is prevented from being moved when

an excessive impact force is applied to the syringe.

Preferably, the cap provides a first interface for restricting movement of the syringe carrier in a direction towards the exit aperture. The syringe carrier may provide a second interface for engaging the first interface. The first interface and second interface may each comprise a planar surface and the first interface may be located at an edge of on an annular component within the cap.

Preferably, the annular component is adapted to extend into the exit aperture when connected to the housing.

In a particular embodiment, the annular component is adapted to grip a removable shield on the discharge nozzle of the syringe.

In this way, the needle shield can be removed when the cap of the injection device is removed.

The syringe carrier may comprise a sheath for surrounding the reservoir portion of the syringe, wherein the sheath has a first internal diameter along its length, and an intermediate section with a second internal diameter which is smaller than the first internal diameter so that the intermediate section of the sheath is adapted to support the syringe between the reservoir portion and the discharge nozzle.

The second interface may be located on an annular protrusion at the first end of the syringe carrier which extends over the discharge nozzle. Preferably, the annular protrusion is a split annular protrusion. The injection device may further comprise: a sliding sleeve projecting from the exit aperture; and at least one locking arm which is engageable with the split annular protrusion, wherein the at least one locking arm disengages from the split annular protrusion on movement of the sliding sleeve into the injection device. In this way, engagement of the first and second interfaces when the cap is in place on the injection device prevents the locking arms of the device from being stressed during impact.

The annular protrusion may be split on diametrically opposing sides of the protrusion, and each split in the protrusion may comprise a locking surface for contacting with a corresponding locking arm. The injection device may further comprise means for biasing the syringe from its extended position to its retracted position.

The injection device may comprise a support for carrying the means for biasing the syringe.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Figures 1a and 1b show a side view of an injection device according to the present invention; and

Figure 2a shows an enlarged side view of part of the injection device shown in figure 1 without its external housing;

Figure 2b shows an enlarged side view of part of the injection device shown in figure 1 without certain internal components of the injection device being shown;

Figure 3 shows a perspective cut-through view of the cap of the injection device according to the embodiment of figure 1;

Figure 4 shows a perspective view of the syringe carrier and syringe according to the embodiment of figure 1; and

Figure 5 shows a perspective view of the cap of the injection device according to the embodiment of figure 1.

DETAILED DESCRIPTION OF THE INVENTION

Figures 1a and 1b show an injection device 110, having an injection device housing 112. The injection device 110 has a removable cap 190. With the cap 190 removed, as shown in Figure 2, the end of the housing 112 can be seen to have an exit aperture 128, through which the end of a sleeve 119 can emerge. The injection device 110 also has a trigger 180.

As shown in Figures 2a and 2b, the housing 112 contains a hypodermic syringe 114 of conventional type, including a syringe body 116 defining a reservoir and terminating at one end in a hypodermic needle (not shown) and at the other in a flange 120. The hypodermic needle is covered by a needle shield 118. The needle shield 118 is fixed inside the cap 190.

The syringe body 116 is of substantially constant diameter along the length of the reservoir, and is of significantly smaller diameter close to the end of the syringe which terminates in the hypodermic needle. A drive element 134 (syringe piston) acts through the bung of the syringe to discharge the contents of the syringe 114 through the needle 118. This drive element 134 constrains a drug (contained in the syringe) to be administered within the reservoir defined by syringe body 116. Whilst the syringe illustrated is of hypodermic type, this need not necessarily be so. Transcutaneous or ballistic dermal and subcutaneous syringes may also be used with the injection device of the present invention.

The housing 112 comprises a case nose 113 which is integrally formed with a sleeve 160. The sleeve 160 surrounds a syringe carrier 150 which is moveable within the sleeve 160 along its longitudinal axis.

As illustrated, the syringe 114 is housed within the syringe carrier 150. The syringe carrier 150 has a first end 151 and a reduced diameter section 151a. The section 151a of the syringe carrier supports the end of the syringe 114 nearest to the hypodermic needle. The syringe carrier 150 comprises a bearing surface 153 on which an end of a return spring 126 is located. The return spring 126, via the syringe carrier 150 biases the

syringe 114 from an extended position in which the needle 118 extends from the aperture 128 in the housing 112 to a retracted position in which the needle 118 is contained within the housing 112.

If the syringe were to fail or break, the syringe carrier 150, which substantially surrounds the syringe 114 along its length, would contain the broken pieces of syringe and reduce the likelihood of them from escaping from the injection device.

The housing 112 also includes a trigger 180, and a drive which here takes the form of a compression drive spring 130. Drive from the drive spring 130 is transmitted via a multi-component drive (118a) to the drive element 134 of the syringe 114 to advance the syringe from its retracted position to its extended position and discharge its contents through the needle 118. The drive accomplishes this task by acting directly on the syringe 114 and the drug in the syringe. Static friction between the drive element 134 and the syringe body 116 initially ensures that both the syringe 114 and bung advance together, until the return spring 126 bottoms out when the bearing surface 153 on the syringe carrier 150 comes up against an opposing bearing surface 161 on the sleeve 160.

The trigger 180 is provided on the housing 112 remote from the exit aperture 128. The trigger, when operated, serves to decouple a drive sleeve 131 on which the drive spring 130 acts from the housing 112, allowing it to move relative to the housing 112 under the influence of the drive spring 130. The operation of the device is then as follows.

The cap 190 can be removed by a user with a twist and pull action or simply by pulling the cap. The exact action required depends on the type of syringe 114 being used. In one embodiment, the syringe 114 will comprise a rigid needle shield 118 containing a rubber boot (not shown) in which the needle is contained. In this embodiment, the needle shield 118 simply needs to be removed by pulling the cap 190 along the longitudinal axis of the device 110. In an alternative embodiment, the syringe 114 comprises a plastic needle shield 118 which is held to the syringe 114 by a frangible connection. In order to break the frangible connection, the cap 190 must be first twisted and then pulled along the longitudinal axis of the device 110. A guiding element 191 on the end cap 113 serves to guide the removal of the cap 190 in the way that is required to

remove the needle shield 118.

Since the needle shield 118 is held inside the cap 190, removal of the cap 190, causes the needle shield to be removed, thereby exposing the needle of the syringe 114 within the injection device. At this time, the needle is still enclosed by the housing 112.

Initially, the syringe carrier 150 and syringe 114, are prevented from movement by a resilient latch member 162. By moving the sleeve 119 in a direction into the housing 112, the latch member 162 moves outwards disengaging from the syringe carrier 150. Once the latch member 162 has disengaged from the syringe carrier 150, the syringe 114 and syringe carrier 150 are free to move.

The trigger 180 can then be depressed by a user and the drive spring 130 is released. The drive spring 130 moves the drive sleeve 131, the piston 134 and, by virtue of static friction and hydrostatic forces acting through the drug to be administered, moves the syringe body 114 against the action of the return spring 126. The syringe body 114 moves the syringe carrier 150, which compresses the return spring 126. The hypodermic needle 118 emerges from the exit aperture 128 of the housing 112. This continues until the return spring 126 bottoms out or the syringe body 116 meets some other obstruction (not shown) that retards its motion. Because the static friction between the second drive element 134 and the syringe body 116 and the hydrostatic forces acting through the drug 124 to be administered are not sufficient to resist the full drive force developed by the drive spring 130, at this point the second drive element 134 begins to move within the syringe body 116 and the drug begins to be discharged.

The cap 190 of the injection device 110 of the present invention is depicted in Figure 3. The cap 190 includes an annular protrusion 191 which extends into the exit aperture 128 when it is attached to the injection device 110.

The annular protrusion 191 includes grip means 191a which grip the boot 118 of the syringe 114 so that the boot is removed when the cap 190 is removed from the injection device 114.

At an end of the annular protrusion 191, where it opposes the exit aperture 128, there is an edge of the annular protrusion 191 which provides a first planar interface 192 for interfacing with the first end 151 of the syringe carrier 150, on which resides a second planar interface 151b. The annular protrusion 191 and syringe carrier 150 are dimensioned so that the first and second planar interfaces 192, 151b are in juxtaposition with each other when the cap 190 is in place on the injection device 110. Thus, when the cap 190 is in place, movement of the syringe carrier 150 in a direction F out of the injection device 110 is prevented, for example, when the injection device 110 experiences an external impact force, when it hits a hard surface. Since forward movement is inhibited, damage to an integrity seal 196 and/or needle 197 of the syringe is prevented.

The syringe carrier 150 is shown with an intermediate section 151a of reduced diameter which acts to prevent forward movement of the syringe 114 in the syringe carrier 150 by gripping the syringe 114 between the discharge nozzle and the syringe body 116.

Figure 4 shows the first end of the syringe carrier 150, on which the second planar interface 151b is located. The syringe carrier 150 is in the form of a split annular sheath, with a split 193 in each diametrically opposing side of the sheath at the first end 151 of the syringe carrier 150. Each split 193 provides a restraining interface 194. When the sleeve 119 is in its extended (unactuated) position, the resilient latch members 161 are in juxtaposition with the restraining interfaces 194, thereby preventing forward movement of the syringe carrier 150. When the sleeve 119 is pushed into the injection device 110, the latch members splay away from the syringe carrier 150, permitting the syringe carrier 150 to travel forward on actuation of the trigger 180.

When the cap 190 is in place on the injection device 110, juxtaposition of the interfaces 192 and 151b prevents loading of (and hence damage to) the latch members 161 during high loading of the impact of the injection device 110 with, for example, external forces.

Figure 5 shows the cap 190 of the injection device as depicted in figure 3 without the boot 118 of the syringe 114 in place. The grip means 191a is seen to comprise rearward protrusions 198a which engage the boot 118 such that movement of the boot

118 in a direction out of the cap (i.e. opposite to direction F) is prevented. However, the grip means 191a is formed of resilient metallic material so that insertion of the boot 118 into the cap 190 is permitted, following which the protrusions engage the rubber material of the boot 118 to prevent its removal out of the cap 190.

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It will of course be understood that the present invention has been described above purely by way of example and modifications of detail can be made within the scope of the invention.

CLAIMS

1. An injection device comprising:

a housing adapted to receive a syringe having a reservoir portion and a discharge nozzle, so that the syringe is movable between a retracted position in which the discharge nozzle is contained within the housing and an extended position in which the discharge nozzle extends from the housing through an exit aperture;

a drive that acts upon the syringe to advance it from its retracted position to its extended position and discharge its contents through the discharge nozzle;

a removable cap adapted to be connected to the housing for closing the exit aperture; and

a syringe carrier for carrying the syringe as it is advanced,

wherein the removable cap is adapted to restrict movement of the syringe carrier in a direction towards the exit aperture when the removable cap is connected to the housing.

2. An injection device according to claim 1, wherein the cap provides a first interface for restricting movement of the syringe carrier in a direction towards the exit aperture.

3. An injection device according to claim 2, wherein the syringe carrier provides a second interface for engaging the first interface.

4. An injection device according to claim 3, wherein the first interface and second interface each comprise a planar surface.

5. An injection device according to any one of claims 2 to 4, wherein the first interface is located at an edge of on an annular component within the cap.

6. An injection device according to claim 5, wherein the annular component is adapted to extend into the exit aperture when connected to the housing.

7. An injection device according to claim 6, wherein the annular component is

adapted to grip a removable shield on the discharge nozzle of the syringe.

8. An injection device according to any preceding claim, wherein the syringe carrier comprises a sheath for surrounding the reservoir portion of the syringe, wherein the sheath has a first internal diameter along its length, and an intermediate section with a second internal diameter which is smaller than the first internal diameter so that the first end of the sheath is adapted to support the syringe between the reservoir portion and the discharge nozzle.

9. An injection device according to claim 8, wherein the second interface is located on an annular protrusion at the first end of the syringe carrier which extends over the discharge nozzle.

10. An injection device according to claim 9, wherein the annular protrusion is a split annular protrusion.

11. An injection device according to claim 10, further comprising:

a sliding sleeve projecting from the exit aperture; and

at least one locking arm which is engageable with the split annular protrusion, wherein the at least one locking arm disengages from the split annular protrusion on movement of the sliding sleeve into the injection device.

12. The injection device of claim 11, wherein the annular protrusion is split on diametrically opposing sides of the protrusion, and wherein each split in the protrusion comprises a locking surface for contacting with a corresponding locking arm.

13. An injection device according to any preceding claim further comprising means for biasing the syringe from its extended position to its retracted position.

14. An injection device according to claim 13, further comprising a support for carrying the means for biasing the syringe.

15. An injection device substantially as hereinbefore described with reference to and

as shown in the attached drawings.