INJECTION DEVICE

FIELD OF THE INVENTION

The present invention relates to an injection device of the type that receives a syringe, extends it through an exit aperture, 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 and a needle through which the contents of the syringe can be ejected. Prior to use, the needle is generally covered with a needle shield which may be of plastic or rubber material. The needle shield itself may be contained in a rigid housing which is gripped in a cap on the injection device. Thus, when the cap of the injection device is removed by a user, the needle shield is also removed allowing the device to be operated to extend and expose the needle. The needle shield acts to protect the needle from mechanical damage and maintain its sterility.

In practice, the syringe may not be held rigidly in place within the injection device due, for example, to manufacturing tolerances in the syringe and injection device. In particular, the syringe may be able to move rearwardly in the injection device, i.e. away from the exit aperture. Since the needle shield is gripped in the device cap which is held rigidly in place on a front end of the injection device, if the device is dropped or

subjected to adverse external loading, the syringe may move rearwardly so that the needle shield becomes detached from the syringe needle. This is undesirable because the needle is exposed to an environment which may not be sterile. The needle may also become damaged without the protection of the needle shield.

SUMMARY OF THE INVENTION

The injection device of the present invention is designed to deal with the aforementioned problems.

In accordance with a first aspect of the invention, the present invention provides an injection device comprising:

a housing adapted to receive a syringe having a discharge nozzle at a first end of the syringe, the syringe being 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; and

a syringe carrier for carrying the syringe as it is advanced, the syringe carrier having a first end through which the discharge nozzle extends and a second end opposite the first end,

wherein the syringe carrier is adapted to restrict movement of the syringe relative to the syringe carrier in a direction from the first end of the syringe carrier to the second end of the syringe carrier.

In this way, the syringe and its discharge nozzle can be protected against damage caused by rearward movement within the injection device.

The syringe may comprise a flange at a second end of the syringe opposite the first end of the syringe.

The syringe carrier may comprise, at its second end, means for restricting movement of

the syringe relative to the syringe carrier in a direction from the first end of the syringe carrier to the second end of the syringe carrier.

The means for restricting movement may comprise at least one lug on the syringe carrier for preventing movement of the syringe relative to the syringe carrier. The lug may be deformable.

In this way, the syringe can be easily inserted into the syringe carrier during manufacture whilst subsequently being rigidly held at its flange to prevent rearward movement.

Each lug is adapted to be in juxtaposition to the flange on the syringe.

Alternatively, the means for restricting movement comprises at least one damping element.

In this way, movement of the syringe in the syringe carrier is damped and restricted such that the shock of an impact force is not transmitted along the syringe causing damage to the syringe.

The damping element is arranged to bias the syringe in a direction from the second end to the first end of the syringe carrier. Thus, if the impact force is from an end of the injection device, the rearward movement of the syringe can be absorbed by the damping element.

The damping element may comprise resilient biasing means formed from resilient material. In particular, the resilient biasing means could be in the form of an arc of resilient material,

wherein each end of the arc is attached to the syringe carrier and an outer convex surface of the arc is in juxtaposition with the flange of the syringe.

In this way, the biasing means can be integrally moulded with the syringe carrier for eas of manufacture.

Preferably, the syringe carrier includes a delatch mechanism for releasing the drive from acting on the syringe after the contents of the syringe has been discharged and wherein each end of the arc is attached to the delatch mechanism.

The delatch mechanism may be in the form of an annular portion which is adapted to couple with the drive element in order to disconnect the drive element from the drive.

The discharge nozzle comprises a hypodermic needle and the syringe comprises a removable needle shield on the needle. In this embodiment, the syringe carrier is adapted to prevent rearward movement of the syringe so that the needle shield does not become removed from the syringe when an impact force is applied to the injection device. This prevents the discharge nozzle of the syringe becoming exposed to an non-sterile environment if, for example, the device is dropped onto a hard surface. In addition, the integrity seal of the discharge nozzle connecting to the syringe can be disturbed if rearward movement of the syringe occurs. The present invention overcomes this problem.

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;

Figures 3a and 3b show a perspective view of the syringe carrier in a first embodiment of

the invention; and

Figures 4a and 4b show a perspective view of one embodiment of the syringe carrier in a second embodiment of the invention.

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.

One embodiment of the present invention is depicted in Figures 3a and 3b. The syringe carrier is shown with two arms 172 extending from a second end 158 of the syringe

carrier 150, opposite its first end 151. As shown in figure 3b, the syringe 114 has a flange 120 on its rear end attached to the syringe body 116. An underside 175 of the flange 120 is in juxtaposition with one or more supporting lugs 170 located on the arms 172, wherein each supporting lug provides a supporting interface for the underside 175 of the flange 120 to prevent forward movement of the syringe during device operation.

Each arm 172 also includes restraining lugs 172 which are dimensioned and shaped with a restraining surface 173 to prevent movement in a rearwards direction R (i.e. movement in a direction from the first end 151 to the second end 158 of the syringe carrier 150) of the syringe 114 relative to the syringe carrier 150. Each restraining surface 173 prevents rearward movement by interfacing with an upper surface 176 of the flange. Following insertion of the syringe 114 into the syringe carrier 150 during manufacture, there may be a nominal separation between the restraining surface 173 and the upper surface 176 of the flange 120. This nominal separation allows some movement of the syringe 114 in a rearwards direction R to buffer the impact of the discharge nozzle as it becomes fully extended during use, thereby reducing pain to a user of the device.

During manufacture of the device 110, the syringe 114 is inserted into the syringe carrier 150 by first inserting its discharge nozzle through the opening at the second end 158 of the syringe carrier 150. The underside 175 of the flange 120 is nominally prevented from passing over the lugs 171. The lugs 171 are sloped on their top surface which means that, as the underside 175 of the flange 120 is pushed over the lugs 171, the arms 172 move apart so that, eventually, the lugs 171 no longer hinder movement of the syringe 114 into the syringe carrier 150 and the restraining surface 173 of the lugs hinders rearward movement of the syringe 114 in the syringe carrier 150.

An alternative embodiment of the invention is shown in Figures 4a and 4b. In this embodiment, the syringe carrier 150 includes arms 172 and supporting lugs 170 as described above. The syringe carrier also includes a release mechanism 250 that acts to release the drive sleeve 131 from the piston 134 when the drive sleeve 131 moves over the release mechanism 250 when the syringe 114 reaches its extended position. In this way, the force of the drive spring 130 on the syringe 114 is released when it reaches its extended position so that the syringe 114 can then be retracted.

The release mechanism 250 is attached to the arms 172 of the syringe carrier 150 by protrusions 260 which engage with openings (not shown) on the arms 172.

The release mechanism 260 includes two damping elements 270 which are each in the form of an arc of material connected at each end of the arc to the release mechanism 250 at pivot points P. The damping elements 270 are on opposing sides of the release mechanism 250. The damping elements 270 can each resiliently pivot about points P as a result of the resilience of the material and the lever arm formed at the points P. The damping elements 270 can resiliently pivot in a direction R towards the body of the release mechanism 250, providing bias in the opposite direction. In this way, when the release mechanism 250 is rigidly connected via protrusions 260 to the arms 172, following insertion of the syringe 114 during manufacture, a convex section C of each arc is in juxtaposition with the upper surface 176 of the flange 120. Thus, movement of the syringe 114 within the syringe carrier 150 in direction R is damped.

In this way, sudden movement of the syringe 114 caused by an impact force is absorbed by the damping elements 270. Since the damping elements 270 absorb such syringe movement gradually, there is reduced likelihood that the flange 120 can fracture. Moreover, the needle shield 118 remains in place on the discharge nozzle, whilst the integrity seal of the discharge nozzle connecting to the syringe does not get disturbed because sudden rearward movement of the syringe 114 is damped.

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 discharge nozzle at a first end of the syringe, the syringe being 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; and

a syringe carrier for carrying the syringe as it is advanced, the syringe carrier having a first end through which the discharge nozzle extends and a second end opposite the first end,

wherein the syringe carrier is adapted to restrict movement of the syringe relative to the syringe carrier in a direction from the first end of the syringe carrier to the second end of the syringe carrier.

2. The injection device of claim 1, wherein the syringe comprises a flange at a second end of the syringe opposite the first end of the syringe.

3. The injection device of claim 2, wherein the syringe carrier comprises, at its second end, means for restricting movement of the syringe relative to the syringe carrier in a direction from the first end of the syringe carrier to the second end of the syringe carrier.

4. The injection device of claim 3, wherein the means for restricting movement comprises at least one lug on the syringe carrier for preventing movement of the syringe relative to the syringe carrier beyond a nominal distance.

5. The injection device of claim 4, wherein each lug is adapted to be in juxtaposition to the flange on the syringe, thereby preventing all movement of the syringe relative to the syringe carrier.

6. The injection device of claim 4, wherein a underside of each lug is positioned at a

nominal distance above the flange.

7. The injection device of claim 3, wherein the means for restricting movement comprises at least one damping element.

8. The injection device of claim 3, wherein the damping element is arranged to bias the syringe in a direction from the second end to the first end of the syringe carrier.

9. The injection device of claim 8, wherein the damping element comprises biasing means formed from resilient material.

10. The injection device of claim 9, wherein the biasing means is in the form of an arc of resilient material,

wherein each end of the arc is attached to the syringe carrier and an outer convex surface of the arc is in juxtaposition with the flange of the syringe.

11. The injection device of any one of claims 7 to 10, wherein the syringe carrier includes a delatch mechanism for releasing the drive from acting on the syringe after the contents of the syringe has been discharged and wherein the damping element is located on the delatch mechanism.

12. The injection device of claim 11, wherein the delatch mechanism is in the form of an annular portion which is adapted to couple with the drive element in order to disconnect the drive element from the drive.

13. The injection device of any one of the preceding claims, wherein the discharge nozzle comprises a hypodermic needle and the syringe comprises a removable needle shield on the needle.

14. An injection device substantially as hereinbefore described with reference to and as shown in the attached drawings.