INJECTION DEVICE

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

Known injection devices 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 sealed hypodermic syringes which typically have a hermetically sealed cover or "boot" that covers the hypodermic needle and maintains the sterility of the syringe contents. Naturally, it is necessary to maintain the sterility of the syringe contents up to the point of administration, which means that for devices that are designed to be disposable, the boot must be removed with the syringe inside the injection device.

Generally, the action required to remove the boot from the syringe entails either pulling the boot away from the syringe or twisting the boot and, either at the same time or subsequently, pulling the boot away from the syringe.

Co-pending United Kingdom patent application no. 0412051.5, the contents of which is incorporated herein by reference, describes a cap for an injection device that connects to the boot of the syringe so that removal of the housing closure member from the housing causes removal of the boot from the syringe.

In certain types of syringe, for example a Bünder ReadyJect™ type syringe, the boot must be twisted to break a frangible joint before it can be pulled off. Since the syringe is contained in the housing and not held directly by a user, it must be supported rigidly in the housing so that rotation of the boot does not cause rotation of the syringe which would result in the boot not being removed. This is particularly the case when significant rotational force is required to remove the boot and/or break the frangible joint.

The cylindrical shape of a syringe does not lend itself to being supported against rotation, especially since the syringes which are used with injection devices of the type described herein are often made of glass which can fracture.

SUMMARY OF THE INVENTION

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

In view of the foregoing and in accordance with the present invention, there is provided an injection device comprising:

a housing comprising a syringe having a discharge nozzle which 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;

a syringe cap for enclosing the discharge nozzle and removable from the syringe by rotation relative to the syringe; and

a syringe carrier adapted to restrain rotation of the syringe relative to the housing as the cap is removed.

Thus, the syringe cap can be removed easily by rotating it with the syringe held firmly in the housing.

In one embodiment of the present invention, the syringe carrier comprises a grip adapted to restrain rotation of the syringe relative to the housing.

Preferably, the grip comprises at least one deformable rib. Thus, a firm connection is formed between the syringe and the syringe carrier on insertion of the syringe into the syringe carrier.

Preferably, the syringe carrier comprises a ring through which the discharge nozzle of the syringe extends, the ring including the grip on its inner circumference.

In one embodiment of the present invention, the syringe comprises a syringe body and at least one spline protruding radially from the syringe body extending at least in part along the length of the body of the syringe.

The grip may comprise at least one rib engageable with the at least one spline on the syringe body. This way, the rib and spline may interlock with each other in a tooth-like way to form improved resistance to rotation.

At least one spline may be located adjacent the discharge nozzle.

A housing cap may be releasably attached over an aperture of the housing through which the discharge nozzle extends in use, wherein the housing cap is in communication with the syringe cap.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Figure 1 shows a cross-sectional view of an injection device according to the present invention; and

Figure 2 shows an enlarged part of the injection device shown in figure 1.

Figure 3 shows a perspective view of a syringe carrier for use in the present invention from a first direction;

Figure 4 shows a perspective view of the syringe carrier of figure 3 from a second direction;

Figure 5 shows an enlarged cross-sectional view of the end of the syringe carrier of figures 3 and 4;

Figure 6 shows a cross-sectional view of a syringe for use in the present invention; and

Figure 7 shows a perspective view of the injection device of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Figures 1 and 2 show an injection device 110, having an injection device housing 112. The end of the housing 112 has an exit aperture 128, through which the end of a sleeve 119 can emerge.

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 118 and at the other in a flange 120. 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 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 124 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.

As illustrated, the syringe is housed within a syringe carrier 150. The syringe carrier is best seen in figures 3 and 4. The syringe carrier 150 has a proximal end 151 through which the

needle 118 of the syringe protrudes. The needle 118 is attached to the syringe body 116 of the syringe by a needle sub-assembly 172 which has a reduced diameter. At the proximal end 151 of the syringe carrier 150, there is a section of reduced diameter 173 which supports the end of the syringe 114 on its body 116. The syringe carrier 150 also includes a pair of flexible projections 152. The pair of flexible projections 152 communicate with a corresponding pair of locking apertures on a return spring support 160 so that the syringe carrier 150 cannot move relative to the return spring support 160. The syringe carrier 150 also comprises a bearing surface 153 close to its second end, against which a corresponding bearing surface of the return spring support 160 is biased by a return spring 126. The return spring 126, via the return spring support 160 and 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.

The syringe carrier 150 comprises a sheath 154 into which the syringe 114 can be inserted from a distal end 170. The syringe 114 is provided with a boot (not shown). If the syringe were to fail or break, the sheath 154, which 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 110.

The housing is further provided with a resilient latch member 161 that is biased into a position in which it engages a locking surface 163 on the return spring support 160. Before engaging the locking surface 163, the latch member 161 also extends through a latch opening 165 in the sleeve 119. The latch member 161 includes a ramped surface 167 against which an edge of the latch opening 165 acts in the manner of a cam acting on a cam follower.

The housing also includes an actuator, 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 to the piston 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 drug 124 and the syringe 114. Static friction between the drive element 134 and the syringe body 116 initially ensures that they

advance together, until the return spring 126 bottoms out or the syringe body 116 meets some other obstruction (not shown) that retards its motion.

The multi-component drive between the drive spring 130 and the syringe 114 consists of three principal components. A drive sleeve 131 takes drive from the drive spring 130 and transmits it to a first drive element 132. This in turn transmits drive to the drive element 134 already mentioned.

The drive element 132 includes a hollow stem 140, the inner cavity of which forms a collection chamber 142 in communication with a vent 144 that extends from the collection chamber through the end of the stem 140. The second drive element 134 includes a blind bore 146 that is open at one end to receive the stem 140 and closed at the other. As can be seen, the bore 146 and the stem 140 define a fluid reservoir 148, within which a damping fluid is contained.

A trigger (not shown) is provided on the housing 112 remote from the exit aperture 128. The trigger, when operated, serves to decouple the drive sleeve 131 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.

Initially, the return spring carrier 152, and consequently the syringe carrier 150 and syringe 114, are prevented from movement by the resilient latch member 161. By moving the sleeve 119 in a direction into the housing 112, the edge of the latch opening 165 is brought into contact with the ramped surface 167 of the latch member 161, causing the latch member 161 to move outwards and thus to disengage from the return spring support 160. Once the latch member 161 has disengaged from the locking surface 163, the syringe is free to move.

The actuator is then depressed and the drive spring 130 is released. The drive spring 130 moves the drive sleeve 131, the drive sleeve 131 moves the first drive element 132 and the first drive element 132 moves the second drive element 134. The second drive element 134 moves and, by virtue of static friction and hydrostatic forces acting through the drug 124 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 in turn moves the return spring support 160 and 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 124 begins to be discharged. Dynamic friction between the second drive element 134 and the syringe body 116 and hydrostatic and hydrodynamic forces now acting through the drug 124 to be administered are, however, sufficient to retain the return spring 126 in its compressed state, so the hypodermic needle 118 remains extended.

Before the second drive element 134 reaches the end of its travel within the syringe body 116, so before the contents of the syringe have fully discharged, flexible latch arms linking the first and second drive elements 132, 134 reach a constriction within the housing 112 formed by arms 155 at the end of the syringe carrier which is nearest to the flange 120 of the syringe 114. The constriction moves the flexible latch arms to a position so that they no longer couple the first drive element 132 to the second drive element 134. Once this happens, the first drive element 132 acts no longer on the second drive element 134, allowing the first drive element 132 to move relative to the second drive element 134.

Because the damping fluid is contained within a reservoir 148 defined between the end of the first drive element 132 and the blind bore 146 in the second drive element 134, the volume of the reservoir 146 will tend to decrease as the first drive element 132 moves relative to the second drive element 134 when the former is acted upon by the drive spring 130. As the reservoir 148 collapses, damping fluid is forced through the vent 144 into the collection chamber 142. Thus, once the flexible latch arms have been released, some of the force exerted by the drive spring 130 does work on the damping fluid, causing it to flow though the constriction formed by the vent 144; the remainder acts hydrostatically through the fluid and through friction between the first and second drive elements 132, 134, thence via the second drive element 134. Consequently, the second drive element 134 continues to move within the syringe body 116 and the drug 124 continues to be discharged. Losses

associated with the flow of the damping fluid do not attenuate the force acting on the body of the syringe to a great extent. Thus, the return spring 126 remains compressed and the hypodermic needle remains extended.

After a time, the second drive element 134 completes its travel within the syringe body 116 and can go no further. At this point, the contents of the syringe 114 are completely discharged and the force exerted by the drive spring 130 acts to retain the second drive element 134 in its terminal position and to continue to cause the damping fluid to flow though the vent 144, allowing the first drive element 132 to continue its movement.

Before the reservoir 148 of fluid is exhausted, flexible latch arms linking the drive sleeve 131 with the first drive element 132 reach another constriction within the housing 112. The constriction moves the flexible latch arms so that they no longer couple the drive sleeve 131 to the first drive element 132. Once this happens, the drive sleeve 131 acts no longer on the first drive element 132, allowing them to move relative each other. At this point, the forces developed by the drive spring 130 are no longer being transmitted to the syringe 114. The only force acting on the syringe will be the return force from the return spring 126 which acts on the end of the syringe 114 nearest to the needle 118 via the return spring support 160 and the syringe carrier 150. Consequently, the syringe is returned to its retracted position and the injection cycle is complete.

Figure 5 shows an enlarged cross-sectional view of the proximal end 151 of the syringe carrier 150 and figure 6 shows, in isolation, the syringe 116 with syringe cap 180 over the discharge needle 118. The section 173 of reduced cross sectional area in the syringe carrier 150 can be seen in greater detail in figure 5. Also provided at the proximal end 151 is a ring 185 through which the syringe cap 180 and needle sub-assembly 172 protrude when the syringe 114 is inserted into the syringe carrier 150. On the inner circumference of the ring 185, there is provided a plurality of deformable ribs 190 which deform resiliently to provide a grip on the needle-sub-assembly 172 when the syringe 114 is inserted into the syringe carrier 150. The grip provided by the deformable ribs 190 prevents rotation of the syringe 114 within the syringe carrier 150.

On the outer surface of the needle sub-assembly 195 of the syringe 114, there is a plurality

splines 195 which protrude radially from the syringe body and extend along their length, at least in part, along the length of the needle sub-assembly 195 of the syringe 114.

In one embodiment of the invention, the splines 195 and ribs 190 may be arranged to engage each other as interlocking teeth, thereby providing improved grip and resistance to rotation.

Figure 7 shows the injection device with a housing cap 199 into which the syringe cap 180 is inserted on manufacture of the injection device 110. The syringe cap 180 is held rigidly in the housing cap 199 so that, on rotation of the housing cap 199, the syringe cap 180 is also rotated (whilst the syringe 114 is gripped against the rotation in the syringe carrier 150), thereby breaking a frangible connection of the syringe cap 180 to the needle sub-assembly 172.

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 comprising a syringe having a discharge nozzle which 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;

a syringe cap for enclosing the discharge nozzle and removable from the syringe by rotation relative to the syringe; and

a syringe carrier adapted to restrain rotation of the syringe relative to the housing as the cap is removed.

2. The injection device of claim 1, wherein the syringe carrier comprises a grip adapted to restrain rotation of the syringe relative to the housing.

3. The injection device of claim 2, wherein the grip comprises at least one deformable rib.

4. The injection device of claim 2 or claim 3, wherein the syringe carrier comprises a ring through which the discharge nozzle of the syringe extends, the ring including the grip on its inner circumference.

5. The injection device of claim 1, wherein the syringe comprises a syringe body and at least one spline protruding radially from the syringe body extending at least in part along the length of the body of the syringe.

6. The injection device of claim 2, wherein the syringe comprises a syringe body and at least one spline protruding radially from the syringe body extending at least in part along the length of the body of the syringe.

7. The injection device of claim 6, wherein the grip comprises at least one rib engageable with the at least one spline on the syringe body.

8. The injection device of any one of claims 5 to 8, wherein the at least one spline is

located adjacent the discharge nozzle.

10. The injection device of any one of the preceding claims, further comprising a housing cap releasably attached over an aperture of the housing through which the discharge nozzle extends in use, wherein the housing cap is in communication with the syringe cap.

11. The injection device of any one of the preceding claims, substantially as hereinbefore described with reference to the accompanying drawings.