INJECTION DEVICE

BACKGROUND 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.

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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 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. The boot may be formed from a rubber material. Naturally, it is necessary to maintain the sterility of the syringe contents up to the point of administration, which means that the boot must be removed with the syringe inside the injection device.

Typically, the action required to remove the boot from the syringe entails either pulling the boot away from the syringe or twisting the boot and pulling it away from the syringe. If a filled syringe has been around for quite a while before it is used, it is often difficult to remove the boot from the syringe; a substantial force is often required.

The injection device may be designed so that removal of a cap of the injection device also removes the boot from the syringe. In such cases, the boot must be connected to the cap in such a way that the force required to remove the boot from the syringe is less than the force required to disconnect the boot from the cap. In order to connect the boot to the

cap, an "insertion" force is exerted on the syringe. If this insertion force is too high, damage to the syringe and/or boot will occur, and the injection device will fail to operate correctly. The force required to remove a boot from a syringe is generally an order of magnitude greater than the maximum insertion force that can be exerted on the syringe via the boot without causing damage to the boot and/or syringe.

Therefore, there is a need for a means for connecting a cap of an injection device to a boot of a syringe in such a way that removal of the cap from the injection device causes removal of the boot from the syringe, and connection of the cap to the boot exerts a minimal force on the syringe and/or boot.

SUMMARY OF THE INVENTION

The methods and apparatus of the present invention are designed to address this need.

The present invention provides a cap for an injection device, the cap comprising:

a first part having a first end for receiving an injection device and a second end, the first part defining a first axis and having grip means for gripping the boot of a syringe, wherein the grip means is movable from a first position to a second position, the second position being further from the first axis than the first position; and

a second part having retention means arranged such that movement of the retention means from a third position to a fourth position prevents the grip means from moving from the first position to the second position.

The first part may include a pair of arms, each arm having a first end and a second end, wherein the grip means is formed at a first end of each arm, the first ends of the arms being closer to the first end of the cap than the second ends of the arms. The grip means may comprise a hooked end portion. Each arm may be formed from a segment of a cylinder. When the grip means is in the first position, the first ends of the arms may be closer to the first axis than when the grip means is in the second position. The arms may be arranged so that the axis of the cylinder from which each arm is formed is substantially parallel to the first axis when the grip means is in the first position.

The movement of the retention means from the third position to the fourth position may be in a direction substantially parallel to the first axis. The retention means may comprise a ring shaped portion. The internal diameter of the ring shaped portion may be less than the distance between the first ends of the arms when the grip means is in the second position. When the retention means is positioned in the fourth position. the ring shaped portion may surround the first ends of the arms. Once the retention means has been moved from the third position to the fourth position, the retention means may prevent the grip means from moving from the first position to the second position. The ring shaped portion may have one of a groove and a ridge formed on an inner surface thereof. The arms of the first part may have the other of the groove and the ridge formed on an external surface and proximal to the first end thereof, such that when the retention means is positioned in the fourth position, the ridge on one of the first and second parts of the cap is positioned within the groove on the other of the first and second parts of the cap.

In a first embodiment, the second part may comprise a pair of legs, wherein a first end of each of the pair of legs is connected to the ring shaped portion. Each of the pair of legs may have a foot at a second end thereof. The second end of the first part of the cap may be provided with one or more apertures therethrough. When the retention means is in the third position, each leg may extend through one of the apertures. When the retention means is in the fourth position, each of the feet may be positioned within one of the apertures. The retention means may be moved from the third position to the fourth position by applying a force to the foot of each leg, thus forcing the legs through the apertures, the ring shaped portion from the third position to the fourth position and the grip means from the first position to the second position.

In a second embodiment, the second part may comprise a cylindrical member having the retention means at a first end thereof, and a foot at a second end thereof. The cylindrical member may be provided with a pair of opposing apertures through which the arms of the first part may extend. The second end of the first part of the cap may be provided with a central aperture therethrough. When the retention means is in the third position, the foot of the second part may protrude through the central aperture, and when the

retention means is in the fourth position, the foot may be positioned within the first part of the cap or flush with the second end of the first part of the cap.

In either embodiment, the second part of the cap may further be provided with a movable protrusion which can communicate with a corresponding ridge proximal to the second end of the first part of the cap. The movable protrusion and the ridge function to maintain the second part in the third position until a force is applied to the foot or feet of the second part. The movable protrusion may be positioned proximal to the second end of the second part of the cap.

The cap may further comprise an external feature with which a user can grip the cap.

The present invention also provides an injection device comprising:

a housing containing a syringe having a discharge nozzle and a boot that covers its discharge nozzle, wherein the boot extends from a first end of the housing through an exit aperture; and

a cap as recited above.

When the first part of the cap includes a pair of arms, each arm having a first end and a second end, and when the grip means is formed at a first end of each arm, the first ends of the arms being closer to the first end of the cap than the second ends of the arms, then the diameter of the boot may be more than the distance between the grip means at the first end of each arm when the grip means is in the first position so that movement of the grip means from the second position to the first position causes the cap to be connected to the boot, and removal of the cap from the housing when the grip means is in the second position causes removal of the boot from the syringe.

The force required to remove the boot from the syringe may be less than the force required to disconnect the boot from the cap when the grip means is in the first position and the retention means is in the fourth position.

The force required to disconnect the boot from the cap when the grip means is in the first position and the retention means is in the fourth position may be an order of magnitude

greater than the force required to insert the boot into the cap when the grip means is in the first position and the retention means is in the third position.

The present invention also provides a method of attaching a cap to a boot of a syringe comprising:

providing a cap comprising:

a first part having a first end for receiving an injection device and a second end, the first part defining a first axis and having grip means for gripping the boot of a syringe, and

a second part having retention means, wherein

the grip means is arranged in a first position and the retention means is arranged in a third position;

inserting a boot of a syringe into the cap so that the grip means moves from the first position to a second position, the second position being further from the first axis than the first position,

inserting the boot of the syringe further into the cap so that the grip means moves from the second position to the first position, and the boot is gripped by the grip means; and

moving the retention means from the third position to a fourth position, thus preventing the grip means from moving from the first position to the second position, such that the boot cannot be removed from the cap.

When the first part includes a pair of arms, each arm having a first end and a second end, and the grip means is formed at a first end of each arm, the step of inserting the boot into the cap may comprise positioning the boot between the grip means at the first ends of each arm.

The first part and the grip means may be moulded as a single item.

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 plan view of an injection device including a cap according to a first embodiment of the present invention;

Figure 2 shows a perspective view of the injection device of figure 1;

Figure 3 shows a perspective view of a syringe for use in an injection device according to the present invention;

Figure 4 shows a perspective view of the syringe of figure 3 when connected to a cap according to a first or a second embodiment of the present invention;

Figure 5 shows a perspective view from a first direction of a cap according to a first embodiment of the present invention;

Figure 6 shows a perspective view from a second direction of a cap according to a first or a second embodiment of the present invention;

Figure 7 shows a perspective view of a second part of a cap according to a first embodiment of the present invention.

Figure 8 shows a perspective view from a first direction of a cap according to a second embodiment of the present invention;

Figure 9 shows a perspective view of a second part of a cap according to a second embodiment of the present invention;

Figures 10a and 10b show cut-away views of a cap according to a second embodiment of the present invention with the second part of the cap positioned in third and fourth positions respectively.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows an injection device 110 according to the present invention. The injection device has an injection device housing 112.

The housing 112 contains a hypodermic syringe 114 of conventional type as shown in figure 3. The syringe includes a syringe body 116 defining a reservoir and terminating at one end in a hypodermic needle. The syringe 114 has a hermetically sealed cover or "boot" 118 that covers the hypodermic needle and maintains the sterility of the syringe contents. The boot is generally formed of a soft rubber or plastics material. 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 injection device is further provided with a cap 130. The cap comprises a first part 132 and a second part 134.

According to a first embodiment of the invention, as shown in figures 1, 2 and 4 to 7, the first part 132 has a first end 136 for attachment to the housing 112 of the injection device 110. The first part 132 also includes grip means 139 for gripping the boot 118 of the syringe 114. The first part 132 includes a pair of arms 138, each having a first end and a second end. The grip means 139 are formed at the first end of each arm 138. Each arm 138 is formed from the segment of a cylinder. The arms 138 and grip means 139 are movable from a first position to a second position wherein the second position is further away than the first position from a first axis A-A defined by the first part 132 of the cap 130.

The second part 134 includes retention means for retaining the grip means 139 in the first position. The retention means comprises a ring-shaped portion 140. The internal diameter of the ring shaped portion 140 is less than the distance between the first ends of the arms 138 when the arms 138 are in the second position. The retention means is movable in a direction parallel to the axis A-A from a third position to a fourth position. When the retention means is in the third position, the ring shaped portion 140 surrounds

the second end of the arms 138. When the retention means is in the fourth position, as shown in figures 1 to 6, the ring shaped portion 140 is proximal to the grip means 139 and prevents the arms 138 from moving into the second position.

The second part 134 also includes a pair of legs 142. A first end of each leg 142 is connected to the ring shaped portion 140. Each leg has a foot 144 at a second end thereof.

The second end of the first part 132 of the cap 130 is provided with a pair of apertures 146. When the retention means is in the fourth position, as shown in figures 1 to 6, the feet 144 are positioned within the apertures 146. When the retention means is in the third position, the legs 142 extend through the apertures 146 and the ring shaped portion 140 is close to the second end of the first part 132 of the cap. In order to move the second part 134 from the third position to the fourth position, a force is applied to each foot 144. The legs move through the apertures 146 until the feet are positioned within the apertures 146. With this movement, the ring shaped portion 140 slides along the arms 138 until it is proximal to the first end of the arms 138, thus preventing the arms 138 from moving from the first position, away from the axis A-A, towards the second position.

During manufacture of the injection device 110, the syringe 114 and boot 118 are inserted into the housing as a single piece. In order to attach the cap 130 to the boot 118, the cap 130 is provided with the arms 138 in the first position and the ring shaped portion 140 in the third position, such that the legs 142 extend through the apertures 146. The cap 130 is then placed on the housing 110. As the cap 130 is pushed onto the housing, the boot 118 forces the arms 138 from the first position to the second position until the grip means reach the end of the boot 118 at which point the arms 138 spring from the second position to the first position. Consequently, the boot ends up positioned between the legs 138 of the first part 132. A force is then applied to the feet 144, which, in turn, pushes the ring shaped portion 140 down the outside of the arms 138, until the ring shaped portion is proximal to the first end of the arms 138, thus preventing the arms 138 from moving from the first position, away from the axis A-A, towards the second position .

According to a second embodiment of the invention, as shown in figures 1, 4, 6 and 8 to 10, the first part 132 has a first end 136 for attachment to the housing 112 of the injection device 110. The first part 132 also includes grip means 139 for gripping the boot 118 of the syringe 114. The first part 132 includes a pair of arms 138, each having a first end and a second end. The grip means 139 are formed at the first end of each arm 138. Each arm 138 is formed from the segment of a cylinder. The arms 138 and grip means 139 are movable from a first position to a second position wherein the second position is further away than the first position from a first axis A-A defined by the first part 132 of the cap 130.

The second part 134 includes retention means for retaining the grip means 139 in the first position. The retention means comprises a ring-shaped portion 140. The internal diameter of the ring shaped portion 140 is less than the distance between the first ends of the arms 138 when the arms 138 are in the second position. The retention means is movable in a direction parallel to the axis A-A from a third position, as shown in figure 10a, to a fourth position, as shown in figure 10b. When the retention means is in the third position, as shown in figure 10a, the ring shaped portion 140 surrounds a central portion of the arms 138. When the retention means is in the fourth position, as shown in figure 10b, the ring shaped portion 140 is proximal to the grip means 139 and prevents the arms 138 from moving into the second position.

The ring shaped portion 140 has a groove 150 formed on its inner surface. The arms 138 of the first part 132 have a corresponding ridge 152 formed on an external surface, proximal to the first end of the arms 138. When the retention means is positioned in the fourth position, as shown in figure 10b, the ridge 152 on the arms 138 is positioned within the groove 150 on the ring shaped portion 140.

The second part 134 comprises a cylindrical member with the retention means at a first end thereof, and a foot 144 at a second end thereof. The cylindrical member is provided with a pair of opposing apertures 160 through which the arms 138 of the first part extend.

The second end of the first part 132 of the cap 130 is provided with a central aperture 146. When the retention means is in the third position, as shown in figure 10a, the foot 144 of the second part 134 protrudes through the central aperture 146. When the retention means is in the fourth position, as shown in figure 10b, the foot 144 is positioned within the first part of the cap.

The second part 134 of the cap is further provided with a movable protrusion 154 which can communicate with a corresponding ridge 156 proximal to the second end of the first part 132 of the cap. The movable protrusion 154 and the ridge 156 function to maintain the second part 134 in the third position until a force is applied to the foot 144 of the second part 134.

In order to move the second part 134 from the third position to the fourth position, a force is applied to the foot 144. The movable protrusions 154 move towards the axis A-A and ride over the ridge 156. The apertures 160 move over the arms 138 until the groove 150 on the ring-shaped portion 140 engages the ridge 152 on the arms 138 and the foot 144 is positioned within the first part 132 of the cap. With this movement, the ring shaped portion 140 slides along the arms 138 until it is proximal to the first end of the arms 138, thus preventing the arms 138 from moving from the first position, away from the axis A-A, towards the second position.

During manufacture of the injection device 110, the syringe 114 and boot 118 are inserted into the housing as a single piece. In order to attach the cap 130 to the boot 118, the cap 130 is provided with the arms 138 in the first position and the ring shaped portion 140 in the third position, such that the foot 144 protrudes from the aperture 146. The cap 130 is then placed on the housing 110. As the cap 130 is pushed onto the housing, the boot 118 forces the arms 138 from the first position to the second position until the grip means reach the end of the boot 118 at which point the arms 138 spring from the second position to the first position. Consequently, the boot 118 ends up positioned between the legs 138 of the first part 132. A force is then applied to the foot 144, which, in turn, pushes the ring shaped portion 140 down the outside of the arms 138, until the groove 150 and ridge 152 engage and the ring shaped portion 140 is proximal to the first end of the arms 138, thus preventing the arms 138 from moving

from the first position, away from the axis A-A, towards the second position.

In both embodiments, when the injection device 110 is to be used, the user holds the housing 112 with one hand, and grips the cap 130 with the other hand using the grip surfaces 170. The user then pulls the cap 130 away from the housing 112. The grip means 139 grip the boot 118 and, in pulling the cap 130 away from the housing 110, the boot 118 is also removed from the syringe 114.

The force required to remove the boot 118 from the syringe 114 is significantly less than the force required to disconnect the boot 118 from the cap 130 when the grip means is gripping the boot 118.

The force required to disconnect the boot 118 from the cap 130 when the grip means is gripping the boot is significantly greater than the force required to insert the boot 118 into the cap 130 when the retention means is in the third position. For example, the force required to insert the boot between the arms 138 when the retention meansis in the first position is less than 1N, whereas the force required to remove the cap 130 from the boot 118 when the retention means is in the fourth position is of the order of 60N.

The exterior of the cap 130 is provided with a pair of grip surfaces 170. These grip surfaces 170 provide a surface through which the user can grip the cap 130.

The present invention provides a simple and effective way of solving the problems of the prior art devices. Since no modifications need to be made to the syringe or boot, a standard syringe can be used, and manufacturing costs can be reduced.

It will of course be understood that the present invention has been described by way of example, and that modifications of detail can be made within the scope of the invention as defined by the following claims.

CLAIMS

1. A cap for an injection device, the cap comprising:

a first part having a first end for receiving an injection device and a second end, the first part defining a first axis and having grip means for gripping the boot of a syringe, wherein the grip means is movable from a first position to a second position, the second position being further from the first axis than the first position; and

a second part having retention means arranged such that movement of the retention means from a third position to a fourth position prevents the grip means from moving from the first position to the second position.

2. A cap according to claim 1, wherein the first part includes a pair of arms, each arm having a first end and a second end, wherein the grip means is formed at a first end of each arm, and the first ends of the arms are closer to the first end of the cap than the second ends of the arms.

3. A cap according to claim 2, wherein the grip means comprises a hooked end portion.

4. A cap according to claim 2 or claim 3, wherein each arm is formed from a segment of a cylinder.

5. A cap according to claim 4, wherein the arms are arranged so that the axis of the cylinder from which each arm is formed is substantially parallel to the first axis when the grip means is in the first position.

6. A cap according to any of claims 2 to 5 wherein, when the grip means is in the first position, the first ends of the arms are closer to the first axis than when the grip means is in the second position.

7. A cap according to any preceding claim wherein the retention means comprises a ring shaped portion.

8. A cap according to any of claims 2 to 6 wherein the retention means comprises a ring shaped portion having an internal diameter which is less than the distance between the first ends of the arms when the grip means is in the second position.

9. A cap according to claim 8 wherein when the retention means is positioned in the fourth position, the ring shaped portion surrounds the first ends of the arms.

10. A cap according to claim 8 wherein when the retention means is positioned in the fourth position, the retention means prevent the grip means from moving from the first position to the second position.

11. A cap according to any of claims 7 to 10, wherein the ring shaped portion includes one of a groove and a ridge formed on an inner surface thereof.

12. A cap according to claim 11, wherein the arms of the first part have the other of the groove and the ridge formed on an external surface and proximal to the first end thereof.

13. A cap according to any of claims 7 to 12 wherein the second part further includes a pair of legs, wherein a first end of each of the pair of legs is connected to the ring shaped portion.

14. A cap according to claim 13 wherein each of the pair of legs has a foot at a second end thereof.

15. A cap according to claim 13 or 14 wherein the second end of the first part of the cap is provided with one or more apertures therethrough.

16. A cap according to claim 15, wherein when the retention means is in the third position, each leg extends through one of the apertures.

17. A cap according to claim 15 or claim 16 wherein when the retention means is in the fourth position, each of the feet is positioned within one of the apertures.

18. A cap according to any of claims 14 to 17, wherein the retention means can be moved from the third position to the fourth position by applying a force to the foot of each leg.

19. A cap according to any of claims 7 to 12 wherein the second part comprises a cylindrical member having the retention means at a first end thereof, and a foot at a second end thereof.

20. A cap according to claim 19 wherein the cylindrical member has a pair of opposing apertures therethrough, through which the arms of the first part extend.

21. A cap according to claim 19 or 20 wherein the second end of the first part of the cap is provided with a central aperture therethrough.

22. A cap according to claim 21 wherein when the retention means is in the third position, the foot of the second part protrudes through the central aperture, and when the retention means is in the fourth position, the foot is positioned within the first part of the cap or flush with the second end of the first part of the cap.

23. A cap according to any preceding claim wherein the second part of the cap is provided with a movable protrusion which can communicate with a corresponding ridge proximal to the second end of the first part of the cap.

24. An injection device comprising:

a housing containing a syringe having a discharge nozzle and a boot that covers the discharge nozzle, wherein the boot extends from a first end of the housing through an exit aperture; and

a cap according to any preceding claim.

25. An injection device according to claim 24, including a cap according to claim 2 wherein the diameter of the boot is more than the distance between the grip means at the first end of each arm when the grip means is in the first position.

26. A method of attaching a cap to a boot of a syringe comprising:

providing a cap comprising:

a first part having a first end for receiving an injection device and a second end. the first part defining a first axis and having grip means for gripping the boot of a syringe, and

a second part having retention means, wherein

the grip means is arranged in a first position and the retention means is arranged in a third position;

inserting a boot of a syringe into the cap so that the grip means moves from the first position to a second position, the second position being further from the first axis than the first position,

inserting the boot of the syringe further into the cap so that the grip means moves from the second position to the first position, and the boot is gripped by the grip means; and

moving the retention means from the third position to a fourth position, thus preventing the grip means from moving from the first position to the second position, such that the boot cannot be removed from the cap.

27. The method of claim 26, wherein the first part includes a pair of arms, each arm having a first end and a second end, and the grip means is formed at a first end of each arm, and the step of inserting the boot into the cap comprises positioning the boot between the grip means at the first ends of each arm.