Releasable Coupling and Injection Device

Background Technology

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

Because of the stack-up of tolerances of the various components of the device, a certain margin of safety must be built into the activation of the release mechanism, to ensure that it is effective. The consequence of underestimating the safety margin is that the release mechanism may fail to operate even once the syringe contents have been discharged, which is unsatisfactory in a device that is supposed to retract automatically, particularly for self-administered drugs. On the other hand, overestimating the safety margin may mean that some of the syringe contents are discharged after the syringe has retracted, which results firstly in a short dose and secondly in what may be termed a "wet" injection. Wet injections are undesirable for the squeamish, particularly in connection with self-administered drugs.

UK patent applications nos. 0210123, 0229384 and 0325596 describe a series of injection devices designed to deal with this problem. Each makes use of a neat trick that delays the release of the syringe for a certain period of time after the release mechanism has been activated, in an attempt to ensure that the syringe has been completely discharged. The devices illustrated in UK patent application no. 0325596 make use of a two-part drive incorporating a fluid-damped delay mechanism that is particularly effective in ensuring complete discharge of the syringe contents. In each case, the device relies upon two unlatching mechanisms. The first unlatching mechanism initiates the fluid damping mechanism and the second releases the syringe from the actuator, allowing it to be withdrawn. The unlatching mechanisms are activated by components of the injection device having been advanced to nominal unlatching positions relative to the device casework. Unlatching mechanisms, including the mechanisms described in the present application, that are activated by components of the injection device having been advanced to nominal unlatching positions relative to the syringe are described in our concurrently filed application no. [not yet known].

Figure 1 shows just such an injection device 110 in which a housing 112 contains a hypodermic syringe 114. The syringe 114 is of conventional type, including a syringe body 116 terminating at one end in a hypodermic needle 118 and at the other in a flange 120. The conventional plunger that would normally be used to discharge the contents of the syringe 114 manually have been removed and replaced with a drive element 134 as will be described below, terminating in a bung 122. This drive element 134 constrains a drug 124 to be administered within the 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. Generally, the syringe must include a discharge nozzle, which in a hypodermic syringe is the needle 118.

As illustrated, the housing includes a return spring 126 that biases the syringe 114 from an extended position in which the needle 118 extends from an aperture 128 in the housing 112 to a retracted position in which the discharge nozzle 118 is contained within the housing 112. The return spring 126 acts on the syringe 114 via a sleeve 127.

At the other end of the housing is a compression drive spring 130. Drive from the drive spring 130 is transmitted via a multi-component drive to the syringe 114 to advance it 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. Hydrostatic forces acting through the drug and, to a lesser extent, static friction between the bung 122 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 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 flexible latch arms 133 on a first drive element 132. This in turn transmits drive via flexible latch arms 135 to a second drive element, the drive element 134 already mentioned.

The first 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 at the middle of the housing 112 and, 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 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, in each case by acting through the flexible latch arms 133, 135. 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 116 against the action of the return spring 126. The return spring 126 compresses and 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 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 forces 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, the flexible latch arms 135 linking the first and second drive elements 132, 134 reach a constriction 137. The constriction 137 is formed by a component 162 that is attached to the syringe flange 120, so it will be understood that when the syringe 114 advances from its retracted position to its extended position, the component 162 advances with it. The constriction 137 moves the flexible latch arms 135 inwards from the position shown to a position at which they no longer couple the first drive element 136 to the second drive element 134, aided by the bevelled surfaces on the constriction 137. Once this happens, the first drive element 136 acts no longer on the second drive element 134, allowing the first drive element 132 to move relative to the second drive element 134.

One drawback associated with this arrangement is that the latch arms 135 are flexed by a constriction 137 through which the drive elements must pass, and which can therefore, at best, flex the latch arms 135 so that their outer extremities coincide with the outer surface of the second drive element 134. As the first and second drive elements 132, to move relative to each other, the latch arms 135 must flex further, so that their outer extremities coincide with the inner surface of the second drive element 134. This requirement introduces manufacturing difficulties and may also affect the reliability of the unlatching mechanism itself.

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 148 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 135 have been released, the force exerted by the drive spring 130 does work on the damping fluid, causing it to flow through the constriction formed by the vent 144, and also acts hydrostatically through the fluid and through friction between the first and second drive element 132, 134, to drive the second drive element 134. 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 118 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 through the vent 144, allowing the first drive element 132 to continue its movement.

Before the reservoir 148 of fluid is exhausted, the flexible latch arms 133 linking the drive sleeve 131 with the first drive element 132 reach another constriction 139, also provided by the component 162 that is attached to the syringe flange 120. The constriction 139 moves the flexible latch arms 133 inwards from the position shown to a position at which they no longer couple the drive sleeve 131 to the first drive element 132, aided by the bevelled surfaces on the constriction 139. Once this happens, the drive sleeve 131 acts no longer on the first drive element 132, allowing them to move relative to each other.

The latch arms 133 must be capable of supporting high shock load at the start of stroke, but must also be capable of releasing with relatively low unlatching forces. Tests have shown that this dual requirement is very difficult to achieve with flexible latch arms 133: if the latch arms are made stiff enough to carry the shock load, they may easily became too stiff to unlatch with acceptably small forces.

Once the drive sleeve 131 is acting no longer on the first drive element 132, of course, the syringe 114 is released, because the force developed by the drive spring 130 is no longer being transmitted to the syringe 114, and the only force acting on the syringe will be the return force from the return spring 126. Thus, the syringe 114 now returns to its retracted position and the injection cycle is complete.

All this takes place only once the cap 111 has been removed from the end of the housing 112 and the boot 123 from the syringe.

Summary of the Invention

As discussed above, there are two shortcomings in the design illustrated in figure 1. The first is that to enable the first and second drive elements to move relative to each other, the latch arms must flex further than they are flexed by the constriction through which they are caused to pass. This requirement introduces manufacturing difficulties and may also affect the reliability of the unlatching mechanism itself. It is an objective of the present invention to provide an improved drive coupling and unlatching mechanism that does not suffer from this shortcoming.

Accordingly, the present invention provides a releasable drive coupling comprising:

a first drive element having a first projecting flexible arm; and

a second drive element capable of sliding relative to the first drive element and having:

a drive surface adapted to receive the first flexible arm, to allow axial loads to be transmitted from one drive element to the other; and

a second projecting flexible arm so positioned relative to the drive surface that inward flexing of the second flexible arm causes it to act upon the first flexible arm and flex the latter to a point at which it is no longer received by the drive surface, at which point the first and second drive elements are free to slide relative to one another and the drive coupling is thus disengaged.

It will immediately be seen that, owing to the use of the first flexible arms to flex the second flexible arms, there is no longer any need for the second flexible arms to flex further as the drive elements move relative to each other.

Preferably, the first flexible arms operate in compression to transmit axial loads from one drive element to the other. This deals with one problem of using flexible arms under tension, which can be difficult to delatch, needing a relatively high delatching force. An arm in compression provides a good ratio of carrying load to delatching load and is a stable configuration.

For convenience, the coupling may be arranged as follows::

the first drive element is an inner drive element;

the first flexible arm projects outwardly from the inner drive element;

the second drive element is an outer drive element capable of sliding over the inner drive element;

the second flexible arm projects outwardly from the outer drive element; and

inward flexing of the outer flexible arm causes it to flex the inner flexible arm inwardly.

Preferably, the outer drive element has a bore in which the inner drive element is received. The inner drive element may have a plurality of outwardly projecting, inner flexible arms and the outer drive element a corresponding plurality of drive surfaces and a corresponding plurality of outwardly projecting, outer flexible arms. For reasons of symmetry, such outwardly projecting, inner and outer flexible arms may be substantially equidistantly spaced around the circumference of the inner drive element.

A simple extension of the present invention provides an automatically releasable drive coupling comprising:

a releasable drive coupling according to the invention;

an actuator acting upon one of the drive components; and

a decoupling component so arranged that, as the outer drive element is advanced by the actuator, it flexes the outer flexible arm inwardly, automatically disengaging the drive coupling.

The decoupling component may comprise a channel through which the inner and outer drive elements pass when acted upon by the actuator, the channel being so arranged that, as the outer drive element passes through it, it flexes the outer flexible arm inwardly, automatically disengaging the drive coupling.

In its application to an injection device, the present invention provides:

a housing adapted to receive a syringe having a discharge nozzle, the housing including means for biasing the syringe from an extended position in which the

discharge nozzle extends from the housing to a retracted position in which the discharge nozzle is contained within the housing;

an automatically releasable drive coupling according to the invention in which:

the inner drive element is acted upon by the actuator and the outer drive element acts upon the syringe to advance it from its retracted position to its extended position and discharge its contents through the discharge nozzle; and

the decoupling component automatically disengages the drive coupling when the drive elements have been advanced to a nominal decoupling position.

The second drawback associated with the arrangement of figure 1 is that the dual requirement of stiffness and flexibility in the latch arms coupling the actuator to the first drive element is difficult to meet. It is a further objective of the present invention to obviate that requirement. Accordingly, a second aspect of the present invention provides an injection device comprising:

a housing adapted to receive a syringe having a discharge nozzle, the housing including means for biasing the syringe from an extended position in which the discharge nozzle extends from the housing to a retracted position in which the discharge nozzle is contained within the housing;

an actuator;

first and second drive elements, of which the first is acted upon by the actuator and in turn acts upon the second, and the second acts upon the syringe to advance it from its retracted position to its extended position and discharge its contents through the discharge nozzle, the first drive element being capable of movement relative to the second when the first is acted upon by the actuator and the second is restrained by the syringe;

of the actuator and the first drive element, one comprises a flexible arm that engages with a second drive surface on the other, allowing the actuator to act upon the first drive element and preventing the former from moving relative to the latter; and

the second drive element comprises a stop that prevents the flexible arm disengaging from the drive surface until the first drive element has been advanced to a nominal release position relative to the second, whereupon the flexible arm disengages from the second drive surface, allowing the actuator to move relative to

the first drive element and thus releasing the syringe from the action of the actuator, whereupon the biasing means restores the syringe to its retracted position.

By the same token, there is also provided an injection device comprising:

a housing adapted to receive a syringe having a discharge nozzle, the housing including means for biasing the syringe from an extended position in which the discharge nozzle extends from the housing to a retracted position in which the discharge nozzle is contained within the housing;

an actuator;

a drive, acted upon by the actuator and acting upon the syringe to discharge its contents through the discharge nozzle; and

of the actuator and the drive, one comprises a flexible arm that engages with a drive surface on the other, allowing the actuator to act upon the drive and preventing the former from moving relative to the latter;

in which the flexible arm is prevented from disengaging from the drive surface until the drive has been advanced to a nominal release position, whereupon the flexible arm disengages from the drive surface, allowing the actuator to move relative to the drive and thus releasing the syringe from the action of the actuator, whereupon the biasing means restores the syringe to its retracted position.

The use of a stop to restrain the flexible arm and prevent its disengagement from the drive surface means that it need not be made as stiff as was the case with figure 1. Hence a more flexible material can be used and the shortcomings associated with the arrangement of figure 1 are avoided.

Preferably, the action of the actuator on the first drive element tends to disengage the flexible arm from the drive surface, but is prevented from doing so by the stop until the said nominal release position has been reached.

In a convenient implementation of this aspect of the invention, the second flexible arm includes a detent and the stop is in register with the detent when the said nominal release position is reached, thus allowing the flexible arms to flex. Preferably, the

second flexible arm is biased toward a position at which it engages the second drive surface and the action of the actuator causes it to move against its bias, thus disengaging it from the drive surface.

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 is an illustration of a comparative injection device as discussed above; and

Figure 2 is an embodiment of the present invention.

Detailed Description

Figure 2 shows an injection device 210 in which a housing 212 contains a hypodermic syringe 214. The syringe 214 is again of conventional type, including a syringe body 216 terminating at one end in a hypodermic needle 218 and at the other in a flange 220, and a rubber bung 222 that constraints a drug 224 to be administered within the syringe body 216. The conventional plunger that would normally be connected to the bung 222 and used to discharge the contents of the syringe 214 manually, has been removed and replaced with a multi-component drive element as will be described below. Whilst the syringe illustrated is again of hypodermic type, this need not necessarily be so. As illustrated, the housing includes a return spring 226 that biases the syringe 214 from an extended position in which the needle 218 extends from aperture 228 in the housing 212, to a retracted position in which the hypodermic needle 218 is contained within the housing 212. The return spring 226 acts on the syringe 214 via a sleeve 227.

At the other end of the housing is a compression drive spring 230. Drive from the drive spring 230 this transmitted via the multi-component drive to the syringe 214 to advance it from its retracted position to its extended position and discharge its contents through the needle 218. The drive accomplishes this task by acting directly on the drug 224 and the syringe 214. Hydrostatic forces acting through the drug and, to a lesser extent, static friction between the bung 222 and the syringe body 216

initially ensures that they advance together, until the return spring 226 bottoms out or the syringe body 216 meets some other obstruction that retards its motion.

The multi component drive between the drive spring 230 and the syringe 214 again consists of three principal components. The drive sleeve 231 takes drive from the drive spring 230 and transmits it to flexible latch arms 233 on a first drive element 232. These elements are shown in detail "A". The first drive element 232 in turn transmits drive via flexible latch arms 235 to a second drive element 234. These elements are shown in detail "B". As before, the first drive element 232 includes a hollow stem 240, the inner cavity of which forms a collection chamber 242. The second drive element 234 includes a blind for 246 that is open at one end to receive the stem 240 and closed at the other. As can be seen, the bore 246 and the stem 240 define a fluid reservoir 248, within which a damping fluid is contained.

A trigger (not shown) is provided at the middle of the housing 212 and, one operated, serves to decouple the drive sleeve 231 from the housing 212 allowing it to move relative to the housing 212 under the influence of the drive spring 230. The operation of the device is then as follows.

Initially, the drive spring 230 moves the drive sleeve 231, the drive sleeve 231 moves the first drive element 232 and the first drive element 232 moves the second drive element 234, in each case by acting through the flexible matching arms 233, 235. The second drive element 234 moves and, by virtue of static friction and hydrostatic forces acting through the drug 224 to be administered, moves the syringe body 216 against the action of the return spring 226. The return spring 226 compresses and the hypodermic needle 218 emerges from the exit aperture 228 of the housing 212. This continues until the return spring 226 bottoms out or the syringe body 216 meets some other obstruction that retards its motion. Because the static friction between the bung 222 and the syringe body 216 and the hydrostatic forces acting through the drug 224 to be administered are not sufficient to resist the full drive force developed by the drive spring 230, at this point the second drive element 234 begins to move within the syringe body 216 and the drug 224 begins to be discharged. Dynamic friction between

the bung 222 and the syringe body 216 and hydrostatic forces acting through the drug 224 to be administered are, however, sufficient to retain the return spring 226 in its compressed state, so the hypodermic needle 218 remains extended.

Before the second drive element 234 reaches the end of its travel within the syringe body 216, so before the contents of the syringe have fully discharged, the flexible latch arms 235 linking the first and second drive elements 232, 234 reach a constriction 237. The constriction 237 is formed by a component 262 that is initially free to move relative to all other components, but that is constrained between the syringe flange 220 and additional flexible arms 247 on the second drive element 234. These additional flexible arms 247 overlie the flexible arms 235 on the first drive element 232, by means of which drive is transmitted to the second drive element 234. Figure 4 illustrates the injection device 210 at the position where the additional flexible arms 247 are just making contact with the constriction 237 in the component 262.

The constriction 237 moves the additional flexible arms 247 inwards, aided by the bevelled surfaces on both, and the additional flexible arms 247 in turn move the flexible arms 235, by means of which drive is transmitted from the first drive element 232 to the second drive element 234, inwards from the position shown to a position at which they no longer couple the first and second drive elements together. Once this happens, the first drive element 232 acts no longer on the second drive element 234, allowing the first drive element 232 to move relative to the second drive element 234.

Because the damping fluid is contained within a reservoir 248 defined between the end of the first drive element 232 and the blind bore 246 in the second drive element 234, the volume of the reservoir 248 will tend to decrease as the first drive element 232 moves relative to the second drive element 234 when the former is acted upon by the drive spring 230. As the reservoir 248 collapses, damping fluid is forced into the collection chamber 242. Thus, once the flexible latch arms 235 have been released, the force exerted by the drive spring 230 does work on the damping fluid, causing it to flow into the collection chamber 242, and also acts hydrostatically through the fluid

and through friction between the first and second drive elements 232, 234, thence via the second drive element 234. 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 226 remains compressed and the hypodermic needle remains extended.

After a time, the second drive element 234 completes its travel within the syringe body 216 and can go no further. At this point, the contents of the syringe 214 are completely discharged and the force exerted by the drive spring 230 acts to retain the second drive element 234 in its terminal position and to continue to cause the damping fluid to flow into the collection chamber 142, allowing the first drive element 232 to continue its movement.

A flange 270 on the rear of the second drive element 234 normally retains the flexible arms 233 in engagement with the drive sleeve 231. However, before the reservoir 248 of fluid is exhausted, the flexible latch arms 233 linking the drive sleeve 231 with the first drive element 232 move sufficiently far forward relative to the second drive element 234 that the flange 270 is brought to register with a rebate 272 in the flexible arms 233, whereupon it ceases to be effective in retaining the flexible arms 233 in engagement with the drive sleeve 231. Now, the drive sleeve 231 moves the flexible latch arms 233 inwards from the position shown to a position at which they no longer couple the drive sleeve 231 to the first drive element 232, aided by the bevelled latching surfaces 274 on the flexible arms 233. Once this happens, the drive sleeve 231 acts no longer on the first drive element 232, allowing them to move relative to each other. At this point, of course, the syringe 214 is released, because the forces developed by the drive spring 230 are no longer being transmitted to the syringe 214, and the only force acting on the syringe will be the return force from the return spring 226. Thus, the syringe 214 now returns to its retracted position and the injection cycle is complete.

Claims

1. A releasable drive coupling comprising:

a first drive element having a first projecting flexible arm; and

a second drive element capable of sliding relative to the first drive element and having:

a drive surface adapted to receive the first flexible arm, to allow axial loads to be transmitted from one drive element to the other; and

a second projecting flexible arm so positioned relative to the drive surface that inward flexing of the second flexible arm causes it to act upon the first flexible arm and flex the latter to a point at which it is no longer received by the drive surface, at which point the first and second drive elements are free to slide relative to one another and the drive coupling is thus disengaged.

2. A coupling according to claim 1 in which the first flexible arms operate in compression to transmit axial loads from one drive element to the other.

3. A coupling according to claim 1 or claim 2 in which:

the first drive element is an inner drive element;

the first flexible arm projects outwardly from the inner drive element;

the second drive element is an outer drive element capable of sliding over the inner drive element;

the second flexible arm projects outwardly from the outer drive element; and

inward flexing of the outer flexible arm causes it to flex the inner flexible arm inwardly.

4. A coupling according to claim 3 in which the outer drive element has a bore in which the inner drive element is received.

5. A coupling according to claim 3 or claim 3 in which:

the inner drive element has a plurality of outwardly projecting, inner flexible arms; and

the outer drive element has a corresponding plurality of drive surfaces and a corresponding plurality of outwardly projecting, outer flexible arms.

6. A coupling according to claim 5 in which the outwardly projecting, inner flexible arms are substantially equidistantly spaced around the circumference of the inner drive element.

7. A coupling according to claim 6 comprising exactly two, diametrically opposite inner flexible arms.

8. A coupling according to claim 5 or claim 6 in which the outwardly projecting, outer flexible arms are substantially equidistantly spaced around the circumference of the outer drive element.

9. A coupling according to claim 7 comprising exactly two, diametrically opposite outer flexible arms.

10. An automatically releasable drive coupling comprising:

a releasable drive coupling according to any preceding claim;

an actuator acting upon one of the drive components; and

a decoupling component so arranged that, as the second drive element is advanced by the actuator, it flexes the second flexible arm inwardly, automatically disengaging the drive coupling.

11. A coupling according to claim 10 in which the decoupling component comprising a channel through which the first and second drive elements pass when acted upon by the actuator, the channel being so arranged that, as the second drive element passes through it, it flexes the second flexible arm inwardly, automatically disengaging the drive coupling.

12. An injection device comprising:

a housing adapted to receive a syringe having a discharge nozzle, the housing

including means for biasing the syringe from an extended position in which the discharge nozzle extends from the housing to a retracted position in which the discharge nozzle is contained within the housing;

an automatically releasable drive coupling according to claim 10 or claim 11 in which:

the first drive element is acted upon by the actuator and the second drive element acts upon the syringe to advance it from its retracted position to its extended position and discharge its contents through the discharge nozzle; and

the decoupling component automatically disengages the drive coupling when the drive elements have been advanced to a nominal decoupling position.

13. An injection device according to claim 12, further comprising:

a release mechanism, activated when the first drive element has been advanced to a nominal release position that is more advanced than the said nominal decoupling position, and adapted to release the syringe from the action of the actuator, whereupon the biasing means restores the syringe to its retracted position.

14. An injection device according to claim 13 in which the nominal release position is defined by the actuator interacting with the first drive element once the nominal decoupling position has been reached, at which position the first drive element is restrained by the syringe against further movement.

15. An injection device according to claim 13 or claim 14 in which the release mechanism is adapted to decouple the first drive element from the actuator once the said nominal release position has been reached, thus releasing the syringe from the action of the actuator.

16. An injection device according any one of claims 13-15, further comprising a second coupling, between the actuator and the first drive element, that prevents the actuator from moving relative to the first drive element until the nominal release

position has been reached.

17. An injection device according to claim 16 in which the second coupling comprises cooperating features of the actuator and the first drive element allowing the former to act upon the latter.

18. An injection device comprising:

a housing adapted to receive a syringe having a discharge nozzle, the housing including means for biasing the syringe from an extended position in which the discharge nozzle extends from the housing to a retracted position in which the discharge nozzle is contained within the housing;

an actuator;

first and second drive elements, of which the first is acted upon by the actuator and in turn acts upon the second, and the second acts upon the syringe to discharge its contents through the discharge nozzle, the first drive element being capable of movement relative to the second when the first is acted upon by the actuator and the second is restrained by the syringe;

of the actuator and the first drive element, one comprises a flexible arm that engages with a drive surface on the other, allowing the actuator to act upon the first drive element and preventing the former from moving relative to the latter; and

the second drive element comprises a stop that prevents the flexible arm disengaging from the drive surface until the first drive element has been advanced to a nominal release position relative to the second, whereupon the flexible arm disengages from the drive surface, allowing the actuator to move relative to the first drive element and thus releasing the syringe from the action of the actuator, whereupon the biasing means restores the syringe to its retracted position.

19. An injection device according to claim 18 in which the second drive element advances the syringe from its retracted position to its extended position.

20. An injection device comprising:

a housing adapted to receive a syringe having a discharge nozzle, the housing including means for biasing the syringe from an extended position in which the discharge nozzle extends from the housing to a retracted position in which the discharge nozzle is contained within the housing;

an actuator;

a drive, acted upon by the actuator and acting upon the syringe to discharge its contents through the discharge nozzle; and

of the actuator and the drive, one comprises a flexible arm that engages with a drive surface on the other, allowing the actuator to act upon the drive and preventing the former from moving relative to the latter;

in which the flexible arm is prevented from disengaging from the drive surface until the drive has been advanced to a nominal release position, whereupon the flexible arm disengages from the drive surface, allowing the actuator to move relative to the drive and thus releasing the syringe from the action of the actuator, whereupon the biasing means restores the syringe to its retracted position.

21. An injection device according to claim 18-20, in which the action of the actuator tends to disengage the flexible arm from the drive surface, but is prevented from doing so until the said nominal release position has been reached.

22. An injection device according to claim any one of claims 18 or claim 19 in which the flexible arm includes a detent and the stop is in register with the detent when the said nominal release position is reached, thus allowing the flexible arms to flex.

23. An injection device according to claim 21 or claim 22 in which the flexible arm is biased toward a position at which it engages the second drive surface and the action of the actuator causes it to move against its bias, thus disengaging it from the drive surface.

24. An injection device according to any one of claims 18-23 in which the said one of the actuator and the first drive element is the first drive element.

25. An injection device according to any one of claims 21-24 in which the said one of the actuator and the first drive element comprises a plurality of such flexible arms.

26. An injection device according to any one of claims 18-25 in which:

the releasable coupling comprises cooperating features of the first and second drive elements that allow the first to act upon the second.

27. An injection device according to claim 26 in which the cooperating features include flexible arms on one of the drive elements that engage with a drive surface on the other.

28. An injection device according to claim 26 or claim 27 in which the coupling comprises a decoupling mechanism, activated when the drive elements have been advanced to the said nominal decoupling position and adapted to decouple the inner drive element from the outer, thus allowing the first drive element to move relative to the second.

29. An injection device according to claim 26, in which:

the releasable coupling comprises flexible arms on one of the drive elements that engage with a drive surface on the other; and

the decoupling component causes the flexible arms to move when the said nominal decoupling position is reached, by acting on an intermediate component, thus disengaging the flexible arms from the drive surface to allow the first drive element to move relative to the second.

30. An injection device according to claim 29 in which the intermediate component is a flexible component of the drive element upon which the said drive surface is to be found.

31. An injection device according to any one of claims 27, 29 and 30 in which the flexible arms are biased toward a position at which they engage the drive surface and the decoupling component causes them to move against their bias, thus disengaging them from the drive surface.