Claims

1. Auto-injector (1) for administering a dose of a liquid medicament (M), comprising:
- an elongate tubular case (12),
- a carrier subassembly comprising a tubular carrier (7) slidably arranged inside the case (12), the carrier (7) adapted to contain a syringe (3) with a hollow injection needle (4), a drive spring (8) and a plunger (9) for forwarding load of the drive spring (8) to a stopper (6) of the syringe (3), wherein the syringe (3) is lockable for joint axial translation with the carrier (7), wherein the drive spring (8) acts between the carrier (7) and the plunger (9),

wherein the plunger (9) in an initial state is locked to the carrier (7) by a ramped engagement to the carrier (7) and by being prevented from rotating out of this ramped engagement depending on a relative longitudinal position of the carrier (7) in the case (12), wherein the plunger (9) is arranged to be released for rotating out of the ramped engagement upon the needle (4) reaching at least nearly a predefined injection depth on translation of the carrier (7) in the proximal direction (P) for advancing the needle (4) beyond a proximal end of the auto-injector (1).

2. Auto-injector (1) according to claim 1, characterized in that the carrier (7) has a longitudinal aperture (7.9), wherein an outward protrusion (9.1) is arranged on the plunger (9) in a manner to engage a face (7.8) on the carrier (7) in the aperture (7.9), wherein at least one of the outward protrusion (9.1) or the face (7.8) on the carrier (7) is ramped so as to force the plunger (9) to rotate when translated, wherein an inward longitudinal rib (21.5) connected to the case (12) inwardly protrudes into the longitudinal aperture (7.9) in a manner to prevent disengagement of the outward protrusion (9.1) from the face (7.8) on the carrier (7) prior to translation of the carrier (7) for advancing the needle (4) and wherein the outward protrusion (9.1) comes clear of the inward longitudinal rib (21.5) on translation of the carrier (7) for advancing the needle (4) so as to rotate past a proximal end of the inward longitudinal rib (21.5) due to its ramped engagement to the carrier (7) under load of the drive spring (8).

3. Auto-injector (1) according to claim 2, characterized in that the inward longitudinal rib (21.5) is arranged on a second collar (21) arranged in the case (12) and initially locked to the case (12) for joint axial translation, the second collar (21) being part of a syringe retraction control mechanism (25), wherein the syringe retraction control mechanism (25) is arranged to disengage from the case (12) and engage to the carrier (7) when the case (12) is moved in the distal direction (D) after the carrier (7) has been translated for advancing the needle (4)wherein a control spring (19) is arranged in the case (12) around the carrier (7), the control spring (19) acting between the second collar (21) and a proximal first collar (20) so as to bias the case (12) or the carrier (7) in the distal direction (D).

4. Auto-injector (1) according to claim 3, characterized in:

- a tubular chassis (2) telescopable in the tubular case (12), wherein the carrier (7) is slidably arranged relative to the chassis (2),
- a trigger button (13) arranged distally or laterally in or on the case (12),
- a needle insertion control mechanism (24) comprising the first collar (21) for coupling a proximal end of the control spring (19) to either the carrier (7) for advancing it for needle insertion or to the chassis (2) for needle retraction depending on the relative axial position of the carrier (7) and the chassis (2),
- a detent mechanism (18) arranged for coupling the chassis (2) to the carrier (7) for joint axial translation relative to the case (12), wherein the detent mechanism (18) is arranged to decouple the chassis (2) from the carrier (7) upon actuation of the trigger button (13) thus allowing the carrier (7) to move relative to the chassis (2) so as to cause the needle insertion control mechanism (24) to switch the proximal end of the control spring (19) to the carrier (7) for needle insertion.

5. Auto-injector (1) according to claim 4, characterized in that the needle insertion control mechanism (24) comprises a first collar (20) biased by the control spring in a proximal direction (P), wherein at least one resilient beam (20.1) is proximally arranged on the first collar (20), wherein respective recesses are arranged in the carrier (7) and case (2), wherein a transversal extension of a head of the resilient beam (20.1) is wider than a gap between the carrier (7) and the chassis (2) causing the head of the resilient

beam (20.1) to abut a distal face on the recess in the chassis (2) while being prevented from deflecting in an inward direction (I) by the carrier (7) or to abut a distal face on the recess in the carrier (7) while being prevented from deflecting in an outward direction (O) by the chassis (2) thereby forwarding load from the control spring (19) to the carrier (7) for needle insertion, wherein the resilient beam (20.1) is arranged to be switched between the chassis (2) and the carrier (7) by ramped engagement of the head to the distal faces under load of the control spring (19) depending on the relative longitudinal position between the chassis (2) and the carrier (7).

6. Auto-injector (1) according to one of the claims 4 or 5, characterized in that the detent mechanism (18) is arranged to provide a resistive force which has to be overcome to advance the carrier (7) in the proximal direction (P) for needle insertion.

7. Auto-injector (1) according to one of the claims 4 to 6, characterized in that the detent mechanism (18) is arranged to provide a resistive force resisting translation of the carrier (7) in the distal direction (D) relative to the chassis (2) for keeping the carrier (7) in a defined position in a transitional state with both ends of the control spring (19) decoupled from the carrier (7).

8. Auto-injector (1) according to one of the claims 6 or 7, characterized in that the detent mechanism (18) comprises a resilient beam (2.1) on the chassis (2) and a rhomboid ramp member (7.1) on the carrier (7), the resilient beam (2.1) being essentially straight when relaxed and having a first beam head (2.2) arranged to interact in a ramped engagement with a proximal fourth ramp (7.2) or a distal fifth ramp (7.3) on the rhomboid ramp member (7.1) in such a manner that application of a translative force on the carrier (7) relative to the chassis (2) in the proximal direction (P) with the first beam head (2.2) engaged to the fourth ramp (7.2) deflects the resilient beam (2.1) in one transversal direction (O, I) when a predetermined value of the translative force, at least depending on the resilience of the resilient beam (2.1), is overcome so as to allow the first beam head (2.2) to travel along one transversal side of the rhomboid ramp member (7.1) on continued relative translation of the components (2, 7), wherein the resilient beam (2.1) is allowed to relax when the first beam head (2.2) has reached the fifth ramp

(7.3) thereby engaging it in a manner that application of a translative force on the carrier (7) in the distal direction (D) deflects the resilient beam (2.1) in the other transversal direction (I, O) when a predetermined value of the translative force, at least depending on the resilience of the resilient beam (2.1), is overcome so as to allow the first beam head (2.2) to travel along the other transversal side of the rhomboid ramp member (7.1) on continued translation of the carrier (7).

9. Auto-injector (1) according to one of the claims 4 to 8, characterized in that the case (12) is arranged to lock the detent mechanism (18) prior to being translated in the proximal direction (P) relative to the chassis (2) wherein the case (12) when translated into an advanced position in the proximal direction (P) is arranged to unlock the detent mechanism (18) rendering it operable.

10. Auto-injector (1) according to one of the preceding claims, characterized in that the distally arranged trigger button (13) is at least initially coupled to the carrier (7), wherein the case (12) is arranged to abut the trigger button (13) in the initial state preventing depression of the trigger button (13), wherein on translation of the case (12) into the advanced position relative to the chassis (2) the trigger button (13) remains coupled to the carrier (7) thus emerging from the case (12) so as to allow depression for starting an injection cycle.

11. Auto-injector (1) according to one of the claims 3 to 10, characterized in that the second collar (21) has a resilient proximal beam (21.1) with a second beam head (21.2) having an inward boss (21.3), wherein the second beam head (21.2) is arranged to be in a ramped engagement with a second case detent (12.2) in the case (12) in a manner ramping the second beam head (21.1) in the inward direction (I) under load of the control spring (19) in the distal direction (D), wherein the inward boss (21.3) is arranged to inwardly abut the carrier (7) for preventing inward deflection of the second beam head (21.1) and keep the second collar (21) locked to the case (12), wherein a third recess (7.7) is arranged in the carrier (7) for allowing the inward boss (21.3) to be inwardly deflected on translation of the case (12) in the distal direction (D) relative to the carrier (7) on removal of the auto-injector (1) from the injection site.

12. Auto-injector (1) according to one of the claims 4 to 11, characterized in that the trigger button (13) is arranged distally, wherein the case (12) is arranged as a wrap-over sleeve trigger having a closed distal end face (12.10) covering the trigger button (13), wherein in an initial state a clearance (33) is provided between the distal end face (12.10) of the sleeve trigger (12) and the trigger button (13) allowing for some travel of the sleeve trigger (12) against the bias of the control spring (19) in the proximal direction (P) in a first phase before abutting the trigger button (13).

13. Auto-injector (1) according to one of the preceding claims, characterized in that a releasable noise component (28) is provided, capable of, upon release, generating an audible and/or tactile feedback to a user, wherein the noise component (28) is arranged to be released when the plunger (9) reaches a position relative to the syringe (3) in which the stopper (4) is located in proximity of a proximal end of the syringe (3), and wherein the released noise component (28) impacts on a housing component (12, 13) indicating the end of the injection.

14. Auto-injector (1) according to one of the claims 4 to 13, characterized in that a visual use indicator is provided, comprising at least one indicator window (32) in the case (12), wherein a part of the chassis (2) is arranged to be located behind the indicator window (32) when the case (12) is in its distal position biased by the control spring (19), wherein a tab (20.4) on the first collar (20) is located outwardly from the part of the chassis (2) after the collar (20) has been translated in the proximal direction (P) during needle insertion, wherein the tab (20.4) and the part of the chassis (2) exhibit a visually distinctive feature.

Claims

1. Auto-injector (1) for administering a dose of a liquid medicament (M), comprising:

- an elongate tubular case (12),

- a carrier subassembly comprising a tubular carrier (7) slidably arranged inside the case (12), a drive spring (8) and a plunger (9), wherein the carrier (7) is adapted to contain a syringe (3) with a hollow injection needle (4), and wherein the plunger (9) is adapted for forwarding load of the drive spring (8) to a stopper (6) of the syringe (3), wherein the syringe (3) is lockable for joint axial translation with the carrier (7), wherein the drive spring (8) acts between the carrier (7) and the plunger (9),

wherein the plunger (9) in an initial state is locked to the carrier (7) by a ramped engagement to the carrier (7) and by being prevented from rotating out of this ramped engagement depending on a relative longitudinal position of the carrier (7) in the case (12), wherein the plunger (9) is arranged to be released for rotating out of the ramped engagement upon the needle (4) reaching at least nearly a predefined injection depth on translation of the carrier (7) in the proximal direction (P) for advancing the needle (4) beyond a proximal end of the auto-injector (1).

2. Auto-injector (1) according to claim 1, characterized in that the carrier (7) has a longitudinal aperture (7.9), wherein an outward protrusion (9.1) is arranged on the plunger (9) in a manner to engage a face (7.8) on the carrier (7) in the aperture (7.9), wherein at least one of the outward protrusion (9.1) or the face (7.8) on the carrier (7) is ramped so as to force the plunger (9) to rotate when translated, wherein an inward longitudinal rib (21.5) connected to the case (12) inwardly protrudes into the longitudinal aperture (7.9) in a manner to prevent disengagement of the outward protrusion (9.1) from the face (7.8) on the carrier (7) prior to translation of the carrier (7) for advancing the needle (4) and wherein the outward protrusion (9.1) comes clear of the inward longitudinal rib (21.5) on translation of the carrier (7) for advancing the needle (4) so as to rotate past a proximal end of the inward longitudinal rib (21.5) due to its ramped engagement to the carrier (7) under load of the drive spring (8).

3. Auto-injector (1) according to claim 2, characterized in that the inward longitudinal rib (21.5) is arranged on a second collar (21) arranged in the case (12) and initially locked to the case (12) for joint axial translation, the second collar (21) being part of a syringe retraction control mechanism (25), wherein the syringe retraction control mechanism (25) is arranged to disengage from the case (12) and engage to the carrier (7) when the case (12) is moved in the distal direction (D) after the carrier (7) has been translated for advancing the needle (4) wherein a control spring (19) is arranged in the case (12) around the carrier (7), the control spring (19) acting between the second collar (21) and a proximal first collar (20) so as to bias the case (12) or the carrier (7) in the distal direction (D).

4. Auto-injector (1) according to claim 3, characterized in:

- a tubular chassis (2) telescopable in the tubular case (12), wherein the carrier (7) is slidably arranged relative to the chassis (2),

- a trigger button (13) arranged distally or laterally in or on the case (12),

- a needle insertion control mechanism (24) comprising the first collar (21) for coupling a proximal end of the control spring (19) to either the carrier (7) for advancing it for needle insertion or to the chassis (2) for needle retraction depending on the relative axial position of the carrier (7) and the chassis (2),

- a detent mechanism (18) arranged for coupling the chassis (2) to the carrier (7) for joint axial translation relative to the case (12), wherein the detent mechanism (18) is arranged to decouple the chassis (2) from the carrier (7) upon ,actuation of the trigger button (13) thus allowing the carrier (7) to move relative to the chassis (2) so as to cause the needle insertion control mechanism (24) to switch the proximal end of the control spring (19) to the carrier (7) for needle insertion.

5. Auto-injector (1) according to claim 4, characterized in that the needle insertion control mechanism (24) comprises a first collar (20) biased by the control spring in a proximal direction (P), wherein at least one resilient beam (20.1) is proximally arranged on the first collar (20), wherein respective recesses are arranged in the carrier (7) and case (2), wherein a transversal extension of a head of the resilient beam (20.1) is wider than a gap between the carrier (7) and the chassis (2) causing the head of the resilient

beam (20.1) to abut a distal face on the recess in the chassis (2) while being prevented from deflecting in an inward direction (I) by the carrier (7) or to abut a distal face on the recess in the carrier (7) while being prevented from deflecting in an outward direction (O) by the chassis (2) thereby forwarding load from the control spring (19) to the carrier (7) for needle insertion, wherein the resilient beam (20.1) is arranged to be switched between the chassis (2) and the carrier (7) by ramped engagement of the head to the distal faces under load of the control spring (19) depending on the relative longitudinal position between the chassis (2) and the carrier (7).

6. Auto-injector (1) according to one of the claims 4 or 5, characterized in that the detent mechanism (18) is arranged to provide a resistive force which has to be overcome to advance the carrier (7) in the proximal direction (P) for needle insertion.

7. Auto-injector (1) according to one of the claims 4 to 6, characterized in that the detent mechanism (18) is arranged to provide a resistive force resisting translation of the carrier (7) in the distal direction (D) relative to the chassis (2) for keeping the carrier (7) in a defined position in a transitional state with both ends of the control spring (19) decoupled from the carrier (7).

8. Auto-injector (1) according to one of the claims 6 or 7, characterized in that the detent mechanism (18) comprises a resilient beam (2.1) on the chassis (2) and a rhomboid ramp member (7.1) on the carrier (7), the resilient beam (2.1) being essentially straight when relaxed and having a first beam head (2.2) arranged to interact in a ramped engagement with a proximal fourth ramp (7.2) or a distal fifth ramp (7.3) on the rhomboid ramp member (7.1) in such a manner that application of a translative force on the carrier (7) relative to the chassis (2) in the proximal direction (P) with the first beam head (2.2) engaged to the fourth ramp (7.2) deflects the resilient beam (2.1) in one transversal direction (O, I) when a predetermined value of the translative force, at least depending on the resilience of the resilient beam (2.1), is overcome so as to allow the first beam head (2.2) to travel along one transversal side of the rhomboid ramp member (7.1) on continued relative translation of the components (2, 7), wherein the resilient beam (2.1) is allowed to relax when the first beam head (2.2) has reached the fifth ramp

(7.3) thereby engaging it in a manner that application of a translative force on the carrier (7) in the distal direction (D) deflects the resilient beam (2.1) in the other transversal direction (I, O) when a predetermined value of the translative force, at least depending on the resilience of the resilient beam (2.1), is overcome so as to allow the first beam head (2.2) to travel along the other transversal side of the rhomboid ramp member (7.1) on continued translation of the carrier (7).

9. Auto-injector (1) according to one of the claims 4 to 8, characterized in that the case (12) is arranged to lock the detent mechanism (18) prior to being translated in the proximal direction (P) relative to the chassis (2) wherein the case (12) when translated into an advanced position in the proximal direction (P) is arranged to unlock the detent mechanism (18) rendering it operable.

10. Auto-injector (1) according to one of the preceding claims, characterized in that the distally arranged trigger button (13) is at least initially coupled to the carrier (7), wherein the case (12) is arranged to abut the trigger button (13) in the initial state preventing depression of the trigger button (13), wherein on translation of the case (12) into the advanced position relative to the chassis (2) the trigger button (13) remains coupled to the carrier (7) thus emerging from the case (12) so as to allow depression for starting an injection cycle.

11. Auto-injector (1) according to one of the claims 3 to 10, characterized in that the second collar (21) has a resilient proximal beam (21.1) with a second beam head (21.2) having an inward boss (21.3), wherein the second beam head (21.2) is arranged to be in a ramped engagement with a second case detent (12.2) in the case (12) in a manner ramping the second beam head (21.1) in the inward direction (I) under load of the control spring (19) in the distal direction (D), wherein the inward boss (21.3) is arranged to inwardly abut the carrier (7) for preventing inward deflection of the second beam head (21.1) and keep the second collar (21) locked to the case (12), wherein a third recess (7.7) is arranged in the carrier (7) for allowing the inward boss (21.3) to be inwardly deflected on translation of the case (12) in the distal direction (D) relative to the carrier (7) on removal of the auto-injector (1) from the injection site.

12. Auto-injector (1) according to one of the claims 4 to 11, characterized in that the trigger button (13) is arranged distally, wherein the case (12) is arranged as a wrap-over sleeve trigger having a dosed distal end face (12.10) covering the trigger button (13), wherein in an initial state a clearance (33) is provided between the distal end face (12.10) of the sleeve trigger (12) and the trigger button (13) allowing for some travel of the sleeve trigger (12) against the bias of the control spring (19) in the proximal direction(P) in a first phase before abutting the trigger button (13).

13. Auto-injector (1) according to one of the preceding claims, characterized in that a releasable noise component (28) is provided, capable of, upon release, generating an audible and/or tactile feedback to a user, wherein the noise component (28) is arranged to be released when the plunger (9) reaches a position relative to the syringe (3) in which the stopper (4) is located in proximity of a proximal end of the syringe (3), and wherein the released noise component (28) impacts on a housing component (12, 13) indicating the end of the injection.

14. Auto-injector (1) according to one of the claims 4 to 13, characterized in that a visual use indicator is provided, comprising at least one indicator window (32) in the case (12), wherein a part of the chassis (2) is arranged to be located behind the indicator window (32) when the case (12) is in its distal position biased by the control spring (19), wherein a tab (20.4) on the first collar (20) is located outwardly from the part of the chassis (2) after the collar (20) has been translated in the proximal direction (P) during needle insertion, wherein the tab (20.4) and the part of the chassis (2) exhibit a visually distinctive feature.