Claims

1. Auto-injector (1) for administering a dose of a liquid medicament (M), comprising:
- a tubular chassis (2) telescopable in a tubular case (12),
- a carrier subassembly comprising a tubular carrier (7) slidably arranged relative to the chassis (2) 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),
- a trigger button (13) arranged distally or laterally in or on the case (12),
- a control spring (19) arranged around the carrier (7),
- a needle extension control mechanism (24) for coupling a proximal end of the control spring (19) to either the carrier (7) for advancing it for needle extension or to the chassis (2) for needle retraction depending on the relative axial position of the carrier (7) and the chassis (2),
- a plunger release mechanism (27) arranged for releasing the plunger (9) for expelling the medicament when the carrier (7) has at least almost reached an extended proximal position,
- 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 extension control mechanism (24) to switch the proximal end of the control spring (19) to the carrier (7) for needle extension,
- a syringe retraction control mechanism (25) arranged for coupling a distal end of the control spring (19) to either the carrier (7) for needle retraction or to the case (12) otherwise.

2. Auto-injector (1) according to claim 1, characterized in that the needle extension 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 extension, 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).

3. Auto-injector (1) according to one of the claims 1 or 2, characterized in that the plunger release mechanism (27) comprises at least one resilient arm (15) on the carrier (7) arranged to be in a ramped engagement to the plunger (9) so as to disengage them under load of the drive spring (8), wherein a peg (14) protrudes from a distal end face of the trigger button (13) in the proximal direction (P) in a manner to support the resilient arm (15) preventing disengagement of the carrier (7) from the plunger (9) and thus release of the drive spring (8) when the carrier (7) is in a distal position, wherein the trigger button (13) is arranged to remain in position relative to the case (12) when the carrier (7) is translated for advancing the needle (4) so as to pull the resilient arm (15) away from the peg (14) thus allowing deflection of the resilient arm (15) due to the ramped engagement under load of the drive spring (8) for disengaging the plunger (9) from the carrier (7) and releasing the drive spring (8) for movement of the plunger when the carrier (7) has reached a predefined position relative to the case(12).

4. Auto-injector (1) according to one of the preceding claims, 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 extension.

5. Auto-injector (1) according to one of the preceding claims, 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).

6. Auto-injector (1) according to one of the claims 4 or 5, 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).

7. Auto-injector (1) according to one of the preceding claims, 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) when the chassis (2) is being pressed against an injection site, 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.

8. 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 when the chassis (2) is being pressed against the injection site 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.

9. Auto-injector (1) according to one of the preceding claims, characterized in that the syringe retraction control mechanism (25) comprises a second collar (21) bearing against the distal end of the control spring (19) and having 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.

10. Auto-injector (1) according to one of the preceding claims, 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).

11. Auto-injector (1) according to one of the preceding claims, characterized in that a releasable feedback component (28) is provided, capable of, upon release, generating an audible and/or tactile feedback to a user, wherein the feedback 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 feedback component (28) impacts on a housing component (12, 13) indicating the end of the injection.

12. Auto-injector (1) according to one of the claims 2 to 11, 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 extension, wherein the tab (20.4) and the part of the chassis (2) exhibit a visually distinctive feature.

13. Method of operating an auto-injector (1), preferably according to any of the preceding claims, the auto-injector (1) comprising:
- a tubular chassis (2) telescopable in a tubular case (12),
- a carrier subassembly comprising a tubular carrier (7) slidably arranged relative to the chassis (2) 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),
- a trigger button (13) arranged distally or laterally in or on the case (12),
- a control spring (19) arranged around the carrier (7),

- a needle extension control mechanism (24) for coupling a proximal end of the control spring (19) to either the carrier (7) or to the chassis (2),
- a plunger release mechanism (27) arranged for locking the drive spring (8),
- a detent mechanism (18) arranged for coupling the chassis (2) to the carrier (7),
- a syringe retraction control mechanism (25) arranged for coupling a distal end of the control spring (19) to either the carrier (7) or to the case (12),

the method comprising the steps of:

- coupling the proximal end of the control spring (19) to the carrier (7) by the needle extension control mechanism (24), preventing release of the drive spring (8) by the plunger release mechanism (27), preventing decoupling of the chassis (2) from the carrier (7) by the detent mechanism (18) and coupling the distal end of the control spring (19) to the case (12) by the syringe retraction control mechanism (25) in an initial state,
- translating the case (12) in the proximal direction (P) relative to the chassis (2) against the force of the control spring (19)
- unlocking the detent mechanism (18) when the case (12) is translated into an advanced position thereby allowing translation of the carrier (7) relative to the chassis (2)
- translating the carrier (7) in the proximal direction (P) thereby switching the needle extension control mechanism (24) so as to decouple the proximal end of the control spring (19) from the chassis (2) and couple it to the carrier (7), thereby releasing the control spring (19) for advancing the carrier (7) for needle extension,
- releasing the drive spring (8) by the plunger release mechanism (27) when the needle (4) at least almost reaches an extended proximal position thereby allowing the drive spring (8) to advance the plunger (9) and the stopper (6) for at least partially expelling the medicament (M),
- translating the case (12) in the distal direction (D) under load of the control spring (19) relative to the carrier (7)
- decoupling the proximal end of the control spring (19) from the carrier (7) and coupling it to the chassis (2) by the needle extension control mechanism (24) and decoupling the distal end of the control spring (19) from the case (12) and

coupling it to the carrier (7) by the syringe retraction control mechanism (25) when the case (12) reaches a defined position relative to the carrier (7) during translation in the distal direction (D),

- retracting the carrier subassembly into the chassis (2) into a needle safe position under load of the control spring (19).

14. Method according to claim 9, characterized in that a resistive force is provided by the detent mechanism (18) which has to be overcome to advance the carrier (7) in the proximal direction (P) for needle extension.

15. Method according to one of the claims 9 or 10, characterized in that a resistive force is provided by the detent mechanism (18) 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 after decoupling the proximal end of the control spring (19) from the carrier (7) and coupling it to the chassis (2) by the needle extension control mechanism (24) and before decoupling the distal end of the control spring (19) from the case (12) and coupling it to the carrier (7) by the syringe retraction control mechanism (25).

CLAIMS

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

- a tubular chassis (2) telescopable in a tubular case (12),

- a carrier subassembly comprising a tubular carrier (7) slidably arranged relative to the chassis (2) 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),

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

- a control spring (19) arranged around the carrier (7),

- a plunger release mechanism (27) arranged for releasing the plunger (9) for expelling the medicament when the carrier (7) has at least almost reached an extended proximal position, **characterized in that** the auto-injector (1) further comprises:

- a needle extension control mechanism (24) for coupling a proximal end of the control spring (19) to either the carrier (7) for advancing it for needle extension 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 extension control mechanism (24) to switch the proximal end of the control spring (19) to the carrier (7) for needle extension,

- a syringe retraction control mechanism (25) arranged for coupling a distal end of the control spring (19) to either the carrier (7) for needle retraction or to the case (12) otherwise.

2. Auto-injector (1) according to claim 1, **characterized in that** the needle extension 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 extension, 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).

3. Auto-injector (1) according to one of the claims 1 or 2, **characterized in that** the plunger release mechanism (27) comprises at least one resilient arm (15) on the carrier (7) arranged to be in a ramped engagement to the plunger (9) so as to disengage them under load of the drive spring (8), wherein a peg (14) protrudes from a distal end face of the trigger button (13) in the proximal direction (P) in a manner to support the resilient arm (15) preventing disengagement of the carrier (7) from the plunger (9) and thus release of the drive spring (8) when the carrier (7) is in a distal position, wherein the trigger button (13) is arranged to remain in position relative to the case (12) when the carrier (7) is translated for advancing the needle (4) so as to pull the resilient arm (15) away from the peg (14) thus allowing deflection of the resilient arm (15) due to the ramped engagement under load of the drive spring (8) for disengaging the plunger (9) from the carrier (7) and releasing the drive spring (8) for movement of the plunger when the carrier (7) has reached a predefined position relative to the case(12).

4. Auto-injector (1) according to one of the preceding claims, **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 extension.

5. Auto-injector (1) according to one of the preceding claims, **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).

6. Auto-injector (1) according to one of the claims 4 or 5, **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).

7. Auto-injector (1) according to one of the preceding claims, **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) when the chassis (2) is being pressed against an injection site, 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.

8. 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 when the chassis (2) is being pressed against the injection site 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.

9. Auto-injector (1) according to one of the preceding claims, **characterized in that** the syringe retraction control mechanism (25) comprises a second collar (21) bearing against the distal end of the control spring (19) and having 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.

10. Auto-injector (1) according to one of the preceding claims, **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).

11. Auto-injector (1) according to one of the preceding claims, **characterized in that** a releasable feedback component (28) is provided, capable of, upon release, generating an audible and/or tactile feedback to a user, wherein the feedback 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 feedback component (28) impacts on a housing component (12, 13) indicating the end of the injection.

12. Auto-injector (1) according to one of the claims 2 to 11, **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 extension, wherein the tab (20.4) and the part of the chassis (2) exhibit a visually distinctive feature.

13. Method of operating an auto-injector (1), according to any of the preceding claims, the auto-injector (1) comprising:

- a tubular chassis (2) telescopable in a tubular case (12),

- a carrier subassembly comprising a tubular carrier (7) slidably arranged relative to the chassis (2) 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),

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

- a control spring (19) arranged around the carrier (7),

- a needle extension control mechanism (24) for coupling a proximal end of the control spring (19) to either the carrier (7) or to the chassis (2),

- a plunger release mechanism (27) arranged for locking the drive spring (8),

- a detent mechanism (18) arranged for coupling the chassis (2) to the carrier (7),

- a syringe retraction control mechanism (25) arranged for coupling a distal end of the control spring (19) to either the carrier (7) or to the case (12),

the method comprising the steps of:

- coupling the proximal end of the control spring (19) to the carrier (7) by the needle extension control mechanism (24), preventing release of the drive spring (8) by the plunger release mechanism (27), preventing decoupling of the chassis (2) from the carrier (7) by the detent mechanism (18) and coupling the distal end of the control spring (19) to the case (12) by the syringe retraction control mechanism (25) in an initial state,

- translating the case (12) in the proximal direction (P) relative to the chassis (2) against the force of the control spring (19)

- unlocking the detent mechanism (18) when the case (12) is translated into an advanced position thereby allowing translation of the carrier (7) relative to the chassis (2)

- translating the carrier (7) in the proximal direction (P) thereby switching the needle extension control mechanism (24) so as to decouple the proximal end of the control spring (19) from the chassis (2) and couple it to the carrier (7), thereby releasing the control spring (19) for advancing the carrier (7) for needle extension,

- releasing the drive spring (8) by the plunger release mechanism (27) when the needle (4) at least almost reaches an extended proximal position thereby allowing the drive spring (8) to advance the plunger (9) and the stopper (6) for at least partially expelling the medicament (M),

- translating the case (12) in the distal direction (D) under load of the control spring (19) relative to the carrier (7)

- decoupling the proximal end of the control spring (19) from the carrier (7) and coupling it to the chassis (2) by the needle extension control mechanism (24) and decoupling the distal end of the control spring (19) from the case (12) and coupling it to the carrier (7) by the syringe retraction control mechanism (25) when the case (12) reaches a defined position relative to the carrier (7) during translation in the distal direction (D),

- retracting the carrier subassembly into the chassis (2) into a needle safe position under load of the control spring (19).

14. Method according to claim 13, **characterized in that** a resistive force is provided by the detent mechanism (18) which has to be overcome to advance the carrier (7) in the proximal direction (P) for needle extension.

15. Method according to one of the claims 13 or 14, **characterized in that** a resistive force is provided by the detent mechanism (18) 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 after decoupling the proximal end of the control spring (19) from the carrier (7) and coupling it to the chassis (2) by the needle extension control mechanism (24) and before decoupling the distal end of the control spring (19) from the case (12) and coupling it to the carrier (7) by the syringe retraction control mechanism (25).