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 control spring (19) arranged around the carrier (7) for translating the carrier (7) in a proximal direction (P) for insertion of the needle (4) through the chassis (2) into an injection site,

   wherein the control spring (19) is arranged to bias the case (12) against the chassis (2) in a distal direction (D) so as to extend the chassis (2) out of a proximal end (P) of the case (12), wherein an insertion depth of the needle (4) is defined by the carrier (7) abutting the chassis (2) in a predefined position, wherein the case (12) is arranged to release or allow release of the control spring (19) for needle insertion on translation of the case (12) in the proximal direction (P) relative to the chassis (2) against the bias into an advanced position.

2. Auto-injector (1) according to claim 1, characterized in that the carrier (7) is arranged to be translated in the distal direction (D) for retracting the needle (4) when the case (12) is moved in the distal direction (D) relative to the chassis (2) by a predefined distance.

3. Auto-injector (1) according to one of the claims 1 or 2, characterized in that a trigger button (13) is arranged distally or laterally in or on the case (12), wherein a needle insertion control mechanism (24) is arranged 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), wherein a plunger release mechanism (27) is arranged for releasing the plunger (9) for injection when the carrier (7) has at least

almost reached an injection depth during needle insertion, wherein a detent mechanism (18) is 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, wherein a syringe retraction control mechanism (25) is 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.

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

5. Auto-injector (1) according to one of the claims 3 or 4, 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 drug delivery when the carrier (7) has reached a predefined position during needle advancement.

6. Auto-injector (1) according to one of the claims 3 to 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 3 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 3 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) 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.

10. Auto-injector (1) according to one of the claims 3 to 9, 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.

11. Auto-injector (1) according to one of the claims 3 to 10, 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.

12. Auto-injector (1) according to one of the claims 3 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 claims 3 to 12, 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 one component of the auto-injector (1) indicating the end of the injection.

14. Auto-injector (1) according to claim 13, characterized in that the component of the auto-injector (1) comprises at least part of the chassis (2), the case (12), the trigger button (13), the carrier (7), the plunger (9) and/or the sleeve trigger (12).

15. Auto-injector (1) according to one of the claims 4 to 14, 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:

- 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 control spring (19) arranged around the carrier (7) for translating the carrier (7) in a proximal direction (P) for insertion of the needle (4) through the chassis (2) into an injection site,

characterized in that the control spring (19) is arranged to bias the case (12) against the chassis (2) in a distal direction (D) so as to extend the chassis (2) out of a proximal end (P) of the case (12), wherein an insertion depth of the needle (4) is defined by the carrier (7) abutting the chassis (2) in a predefined position, wherein the case (12) is arranged to release or allow release of the control spring (19) for needle insertion on translation of the case (12) in the proximal direction (P) relative to the chassis (2) against the bias into an advanced position.

2. Auto-injector (1) according to claim 1, characterized in that the carrier (7) is arranged to be translated in the distal direction (D) by the control spring (19) being released from the carrier (7) at its proximal end and switched to the chassis (2) or case (12) instead and by the distal end of the control spring (19) being switched from the case (12) to the carrier (7) for retracting the needle (4) when the case (12) is moved in the distal direction (D) relative to the chassis (2) by a predefined distance.

3. Auto-injector (1) according to one of the claims 1 or 2, characterized in that a trigger button (13) is arranged distally or laterally in or on the case (12), wherein a needle insertion control mechanism (24) is arranged 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), wherein a plunger release mechanism (27) is arranged for releasing the plunger (9) for injection when the carrier (7) has at least almost reached an injection depth during needle insertion, wherein a detent mechanism (18) is 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, wherein a syringe retraction control mechanism (25) is 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.

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

5. Auto-injector (1) according to one of the claims 3 or 4, 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 drug delivery when the carrier (7) has reached a predefined position during needle advancement.

6. Auto-injector (1) according to one of the claims 3 to 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 3 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 3 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) 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.

10. Auto-injector (1) according to one of the claims 3 to 9, 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.

11. Auto-injector (1) according to one of the claims 3 to 10, 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.

12. Auto-injector (1) according to one of the claims 3 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 claims 3 to 12, 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 one component of the auto-injector (1) indicating the end of the injection.

14. Auto-injector (1) according to claim 13, characterized in that the component of the auto-injector (1) comprises at least part of the chassis (2), the case (12), the trigger button (13), the carrier (7), the plunger (9) and/or the sleeve trigger (12).

15. Auto-injector (1) according to one of the claims 4 to 14, 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