Claims

1. Auto-injector (1) for administering a dose of a liquid medicament (M), comprising:
   - a tubular chassis (2),
   - a carrier subassembly comprising a tubular carrier (7) slidably arranged partially inside the chassis (2), 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),
   - a needle insertion control mechanism (24) 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 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).

2. Auto-injector (1) according to claim 1, characterized in that the resilient beam (20.1) is shaped as an arrowhead (20.1) having an outward sixth ramp (20.2) and an inward ninth ramp (20.3).

3. Auto-injector (1) according to one of the claims 1 or 2, characterized in that the distal face on the recess in the chassis (2) is shaped as a distal seventh ramp (2.4) and/or that the distal face on the recess in the carrier (2) is shaped as a distal tenth ramp (7.6).

4. Auto-injector (1) according to one of the preceding claims, characterized in that the gap between the carrier (7) and the chassis (2) is wider than a shaft of the resilient beam (20.1) between the first collar (20) and the head, wherein an aperture (2.5) is arranged proximally from the recess in the chassis (2) allowing the head of the resilient beam (20.1) to disengage from the carrier (7) and to deflect into the aperture (2.5) when the carrier (7) has been sufficiently translated relative to the chassis (2) in the proximal direction (P) thus switching the proximal end of the control spring (19) to the chassis (2) for allowing needle retraction.

5. Auto-injector (1) according to one of the preceding claims, characterized in that the resilient beam (20.1) is connected to the first collar (20) by a living hinge.

6. Auto-injector (1) according to one of the preceding claims, characterized in that the resilient beam (20.1) is initially coupled to the chassis (2), wherein the auto-injector (1) is arranged to be actuated by translating the carrier (7) in the proximal direction (P) until the resilient beam (20.1) switches to the carrier (7) translating it further under load of the control spring (19).

7. Auto-injector (1) according to claim 6, characterized in that an elongate tubular case (12) is arranged, wherein the chassis (2) and the carrier (7) are telescoped within the case (12), wherein the case (12) is biased in the distal direction (D) and arranged to translate in the proximal direction (P) against the bias when the chassis (2) is pressed against an injection site, wherein a first rib (12.3) on the case (12) is arranged to prevent the head of the resilient beam (20.1) from entering the aperture (2.5) when the chassis (2) is pressed against the injection site, wherein on removal from the injection site and subsequent translation of the case (12) in the distal

direction (D) the first rib (12.3) is moved so as to allow the head of the resilient beam (20.1) to disengage from the carrier (7) and deflect into the aperture (2.5).

8. Auto-injector (1) according to one of the preceding claims, characterized in:

- a trigger button (13) arranged distally or laterally in or on the case (12),
- a plunger release mechanism (27) arranged for releasing the plunger (9) for injection when the carrier (7) has at least almost reached an injection depth during needle insertion,
- 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, and
- 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.

9. Auto-injector (1) according to claim 8, 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.

10. Auto-injector (1) according to one of the claims 8 or 9, 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).

11. Auto-injector (1) according to one of the claims 8 to 10, 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.

12. Auto-injector (1) according to one of the claims 8 to 11, 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.

13. Auto-injector (1) according to one of the claims 8 to 12, 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.

14. Auto-injector (1) according to one of the claims 8 to 13, 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).

15. 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.

CLAIMS

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

- a tubular chassis (2),

- a carrier subassembly comprising a tubular carrier (7) slidably arranged partially inside the chassis (2), 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), characterized in that the auto-injector (1) further comprises:

- a needle insertion control mechanism (24) 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 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 chassis (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).

2. Auto-injector (1) according to claim 1, characterized in that the resilient beam (20.1) is shaped as an arrowhead (20.1) having an outward sixth ramp (20.2) and an inward ninth ramp (20.3).

3. Auto-injector (1) according to one of the claims 1 or 2, characterized in that the distal face on the recess in the chassis (2) is shaped as a distal seventh ramp (2.4) and/or that the distal face on the recess in the carrier (2) is shaped as a distal tenth ramp (7.6).

4. Auto-injector (1) according to one of the preceding claims, characterized in that the gap between the carrier (7) and the chassis (2) is wider than a shaft of the resilient beam (20.1) between the first collar (20) and the head, wherein an aperture (2.5) is arranged proximally from the recess in the chassis (2) allowing the head of the resilient beam (20.1) to disengage from the carrier (7) and to deflect into the aperture (2.5) when the carrier (7) has been sufficiently translated relative to the chassis (2) in the proximal direction (P) thus switching the proximal end of the control spring (19) to the chassis (2) for allowing needle retraction.

5. Auto-injector (1) according to one of the preceding claims, characterized in that the resilient beam (20.1) is connected to the first collar (20) by a living hinge.

6. Auto-injector (1) according to one of the preceding claims, characterized in that the resilient beam (20.1) is initially coupled to the chassis (2), wherein the auto-injector (1) is arranged to be actuated by translating the carrier (7) in the proximal direction (P) until the resilient beam (20.1) switches to the carrier (7) translating it further under load of the control spring (19).

7. Auto-injector (1) according to claim 6, characterized in that an elongate tubular case (12) is arranged, wherein the chassis (2) and the carrier (7) are telescoped within

the case (12), wherein the case (12) is biased in the distal direction (D) and arranged to translate in the proximal direction (P) against the bias when the chassis (2) is pressed against an injection site, wherein a first rib (12.3) on the case (12) is arranged to prevent the head of the resilient beam (20.1) from entering the aperture (2.5) when the chassis (2) is pressed against the injection site, wherein on removal from the injection site and subsequent translation of the case (12) in the distal direction (D) the first rib (12.3) is moved so as to allow the head of the resilient beam (20.1) to disengage from the carrier (7) and deflect into the aperture (2.5).

8. Auto-injector (1) according to one of the preceding claims, characterized in:

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

- a plunger release mechanism (27) arranged for releasing the plunger (9) for injection when the carrier (7) has at least almost reached an injection depth during needle insertion,

- 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, and

- 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.

9. Auto-injector (1) according to claim 8, 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.

10. Auto-injector (1) according to one of the claims 8 or 9, 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).

11. Auto-injector (1) according to one of the claims 8 to 10, 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.

12. Auto-injector (1) according to one of the claims 8 to 11, 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.

13 Auto-injector (1) according to one of the claims 8 to 12, 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.

14. Auto-injector (1) according to one of the claims 8 to 13, 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).

15. 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.