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 relative to the chassis (2) and partially arranged in the chassis (2), the carrier (7) containing 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 locked for joint axial translation with the carrier (7),
   - a wrap-over trigger sleeve (12) arranged over the distal end (D) of the auto-injector (1), the trigger sleeve (12) extending at least almost over the whole length of the auto-injector (1),
   - a control spring (19) arranged around the carrier (7),
   - first interlock means (20, 22, 23, 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 trigger sleeve (12),
   - second interlock means (11, 13, 15) arranged for releasing the drive spring (8) for injection when the carrier (7) has at least almost reached an injection depth during needle insertion,
   - third interlock means (16, 17, 18) arranged for coupling the chassis (2) to the carrier (7) for joint axial translation relative to the trigger sleeve (12), wherein the third interlock means (16, 17, 18) are arranged to decouple the chassis (2) from the carrier (7) upon translation of the trigger sleeve (12) in proximal direction (P) relative to the chassis (2) thus releasing the control spring (19) for needle insertion,
   - fourth interlock means (21, 25, 26, 28) arranged for coupling a distal end of the control spring (19) to either the carrier (7) for needle retraction or to the trigger sleeve (12) otherwise.

2. Auto-injector (1) according to claim 1, characterized in that the first interlock means (20, 22, 23, 24) comprises a proximal collar (20) for transmitting load of the proximal end of the control spring (19), the proximal collar (20) arranged to be engaged on a thread (22) on the carrier (7) in an initial state, the proximal collar (20) having a pin (23) arranged to be splined to a first longitudinal groove (24) in the trigger sleeve (12) in the initial state so as to prevent rotation of the proximal collar (20) and couple it to the carrier (7), wherein the first longitudinal groove (24) is arranged to release the pin (23) upon translation of the chassis (2) and carrier (7) in proximal direction (P) under load of the control spring (19) when the auto-injector (1) is removed from the injection site thereby allowing rotation and translation of the proximal collar (20) relative to the carrier (7) under load of the control spring (19) and subsequent abutting of the proximal collar (20) against the chassis (2).

3. Auto-injector (1) according to one of the claims 1 or 2, characterized in that the second interlock means (11, 13, 15) comprises two resilient arms (11) arranged distally on the plunger (9), the resilient arms (11) exhibiting a thrust face for the drive spring (8), wherein a first boss (13) protrudes from a distal trigger end face (14) of the trigger sleeve (12) in proximal direction (P), wherein the first boss (13) is arrangeable between the two resilient arms (11) thus preventing them from flexing towards each other, wherein protrusions (15) are arranged in the carrier (7) for respectively catching one of the resilient arms (11) in a manner to prevent translation of the plunger (9) in proximal direction (P), wherein the boss (13) is arranged to be removed from between the resilient arms (11) thus allowing them to flex inwards due to their ramped engagement to the protrusions (15) under load of the drive spring (8) and to release the plunger (9) when the carrier (7) has at least almost reached the injection depth during needle insertion.

4. Auto-injector (1) according to one of the preceding claims, characterized in that the third interlock means (16, 17, 18) comprises at least one resilient clip (16) on the chassis (2) engageable in a respective aperture (17) in the carrier (7), wherein at least one second boss (18) is arranged in the trigger sleeve (12) for outwardly supporting the resilient clip (16) so as to prevent the resilient clip (16) from flexing

outwards and disengaging the carrier (7) from the chassis (2), wherein the second boss (18) is arranged to be removed from behind the resilient clip (16) on translation of the trigger sleeve (12) in proximal direction (P) relative to the chassis (2) thereby allowing the resilient clip (16) to flex outwards due to its ramped engagement with the carrier (7) under load of the control spring (19).

5. Auto-injector (1) according to one of the preceding claims, characterized in that the fourth interlock means (21, 25, 26, 28) comprise a distal collar (21) for transmitting load of the distal end of the control spring (19), the distal collar (21) and the trigger sleeve (12) having a bayonet fitting restricting translation of the distal collar (21) relative to the trigger sleeve (12) in distal direction (D) in at least one locked angular position of the distal collar (21) and allowing translation of the distal collar (21) relative to the trigger sleeve (12) in distal direction (D) in at least one unlocked angular position of the distal collar (21), wherein the respective angular position is determined by a splined engagement of the distal collar (21) with the carrier (7), wherein the distal collar (21) is arranged to be rotated into the unlocked angular position upon translation of the chassis (2) and carrier (7) in proximal direction (P) under load of the control spring (19) when the auto-injector (1) is removed from the injection site thereby allowing translation of the distal collar (21) relative to the trigger sleeve (21) under load of the control spring (19) in distal direction (D) and subsequent abutting of the distal collar (21) against an external shoulder (33) on the carrier (7) for retraction.

6. Auto-injector (1) according to claim 5, characterized in that the bayonet fitting comprises at least one circumferentially arranged third boss (25) on the inner surface of the trigger sleeve (12) and a corresponding number of circumferentially arranged fourth bosses (26) on the outer surface of the distal collar (21), wherein in the locked angular position corresponding pairs of third bosses (25) and fourth bosses (26) are essentially aligned in a manner to abut against each other thus preventing translation of the distal collar (21) in distal direction (D), wherein in the unlocked angular position corresponding pairs of third bosses (25) and fourth

bosses (26) become misaligned in a manner to allow translation of the distal collar (21) in distal direction (D).

7. Auto-injector (1) according to one of the claims 5 or 6, characterized in that the splined engagement comprises at least one longitudinal spline (27) on the carrier engaged with a respective second longitudinal groove (28) on the inner surface of the distal collar (21), wherein the spline (27) is essentially parallel for maintaining the distal collar (21) in the locked angular position but ends with a lead screw thread (32) near its distal end for rotating the distal collar (21) into the unlocked angular position.

8. Auto-injector (1) according to one of the preceding claims, characterized in that a detent mechanism is provided for opposing translation of the chassis (2) relative to the trigger sleeve (12) for triggering needle insertion.

9. Method for operating an auto-injector (1), the auto-injector (1) comprising:
   - a tubular chassis (2),
   - a carrier subassembly comprising a tubular carrier (7) slidably arranged relative to the chassis (2) and partially arranged in the chassis (2), the carrier (7) containing 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 locked for joint axial translation with the carrier (7),
   - a wrap-over trigger sleeve (12) arranged over the distal end (D) of the auto-injector (1), the trigger sleeve (12) extending at least almost over the whole length of the auto-injector (1),
   - a control spring (19) arranged around the carrier (7),
   - first interlock means (20, 22, 23, 24) for coupling a proximal end of the control spring (19) to either the carrier (7) or to the chassis (2),
   - second interlock means (11, 13, 15) arranged for locking the drive spring (8),
   - third interlock means (16, 17, 18) arranged for coupling the chassis (2) to the carrier (7),

- fourth interlock means (21, 25, 26, 28) arranged for coupling a distal end of the control spring (19) to either the carrier (7) or to the trigger sleeve (12),

the method comprising the steps of:

- coupling the proximal end of the control spring (19) to the carrier (7) by the first interlock means (20, 23, 24), preventing release of the drive spring (8) by the second interlock means (11, 13, 15), preventing decoupling of the chassis (2) from the carrier (7) by the third interlock means (16, 17, 18) and coupling the distal end of the control spring (19) to the trigger sleeve (12) in an initial state,
- translating the trigger sleeve (12) in proximal direction (P) relative to the chassis (2) against the force of the control spring (19) when the proximal end (P) of the auto-injector (1) is being pushed against an injection site,
- disengaging the third interlock means (16, 17, 18) when the trigger sleeve (12) is at least almost fully translated thereby releasing the control spring (19) for advancing the carrier subassembly for needle insertion,
- releasing the drive spring (8) by the second interlock means (11, 13, 15) when the needle (4) at least almost reaches an injection depth during needle insertion, thereby allowing the drive spring (8) to advance the plunger (9) and the stopper (6) for at least partially delivering the medicament (M),
- translating the trigger sleeve (12) in distal direction (D) under load of the control spring (19) relative to the carrier subassembly on removal of the auto-injector (1) from the injection site,
- decoupling the proximal end of the control spring (19) from the carrier (7) and coupling it to the chassis (2) by the first interlock means (20, 23, 24) and decoupling the distal end of the control spring (19) from the trigger sleeve (12) and coupling it to the carrier (7) by the fourth interlock means (21, 25, 26, 28) when the trigger sleeve (12) reaches a defined position relative to the carrier (7),
- retracting the carrier subassembly into the chassis (2) into a needle safe position under load of the control spring (19).

10. Method according to claim 9, characterized in that the first interlock means (20, 22, 23, 24) comprises a proximal collar (20) for transmitting load of the proximal end of the control spring (19), wherein the proximal collar (20) is engaged

on a thread (22) on the carrier (7) in the initial state, wherein a pin (23) on the proximal collar (20) is splined to a first longitudinal groove (24) in the trigger sleeve (12) in the initial state so as to prevent rotation of the proximal collar (20) and couple it to the carrier (7), wherein upon translation of the chassis (2) and carrier (7) in proximal direction (P) during removal of the auto-injector (1) from the injection site the pin (23) travels beyond a proximal end of the first longitudinal groove (24), thereby the control spring (19) to rotate and translate the proximal collar (20) relative to the carrier (7) into a position where proximal collar (20) abuts against the chassis (2).

11. Method according to one of the claims 9 or 10, characterized in that the second interlock means (11, 13, 15) comprises two resilient arms (11) arranged distally on the plunger (9), the resilient arms (11) exhibiting a thrust face for the drive spring (8), wherein a first boss (13) protrudes from a distal trigger end face (14) of the trigger sleeve (12) in proximal direction (P), wherein the first boss (13) is arranged between the two resilient arms (11) in the initial state thus preventing them from flexing towards each other, wherein protrusions (15) are arranged in the carrier (7) for respectively catching one of the resilient arms (11) in a manner to prevent translation of the plunger (9) in proximal direction (P), wherein the boss (13) is removed from between the resilient arms (11) when the carrier (7) has at least almost reached the injection depth during needle insertion thus allowing the resilient arms (11) to flex inwards due to their ramped engagement to the protrusions (15) under load of the drive spring (8) and to release the plunger (9).

12. Method according to one of the claims 9 to 11, characterized in that the third interlock means (16, 17, 18) comprises at least one resilient clip (16) on the chassis (2) engaged in a respective aperture (17) in the carrier (7) in the initial state, wherein at least one second boss (18) is arranged in the trigger sleeve (12) for outwardly supporting the resilient clip (16) so as to prevent the resilient clip (16) from flexing outwards and disengaging the carrier (7) from the chassis (2) in the initial state, wherein the second boss (18) is removed from behind the resilient clip (16) on translation of the trigger sleeve (12) in proximal direction (P) relative to the

chassis (2), wherein the resilient clip (16) is subsequently flexed outwards due to its ramped engagement with the carrier (7) under load of the control spring (19).

13. Method according to one of the claims 9 to 12, characterized in that the fourth interlock means (21, 25, 26, 28) comprise a distal collar (21) for transmitting load of the distal end of the control spring (19), the distal collar (21) and the trigger sleeve (12) having a bayonet fitting restricting translation of the distal collar (21) relative to the trigger sleeve (12) in distal direction (D) in at least one locked angular position of the distal collar (21) and allowing translation of the distal collar (21) relative to the trigger sleeve (12) in distal direction (D) in at least one unlocked angular position of the distal collar (21), wherein the respective angular position is determined by a splined engagement of the distal collar (21) with the carrier (7), wherein the distal collar (21) is in the locked angular position in the initial state, wherein the distal collar (21) is rotated into the unlocked angular position by the splined engagement upon translation of the chassis (2) and carrier (7) in proximal direction (P) when the auto-injector (1) is removed from the injection site wherein the distal collar (21) is subsequently translated in distal direction (D) relative to the trigger sleeve (21) under load of the control spring (19) into a position where it abuts against an external shoulder (33) on the carrier (7) which is then translated in distal direction (D) for retraction.

14. Method according to claim 13, characterized in that the bayonet fitting comprises at least one circumferentially arranged third boss (25) on the inner surface of the trigger sleeve (12) and a corresponding number of circumferentially arranged fourth bosses (26) on the outer surface of the distal collar (21), wherein in the initial state the bayonet fitting is set in the locked angular position by essentially aligning corresponding pairs of third bosses (25) and fourth bosses (26) in a manner to abut against each other thus preventing translation of the distal collar (21) in distal direction (D), wherein upon translation of the chassis (2) and carrier (7) in proximal direction (P) when the auto-injector (1) is removed from the injection site the distal collar (21) is rotated by the splined engagement into the unlocked angular position.

thereby misaligning corresponding pairs of third bosses (25) and fourth bosses (26) in a manner to allow translation of the distal collar (21) in distal direction (D).

15. Method according to one of the claims 13 or 14, characterized in that the splined engagement comprises at least one longitudinal spline (27) on the carrier engaged with a respective second longitudinal groove (28) on the inner surface of the distal collar (21), wherein the second longitudinal groove (28) is guided on an essentially parallel part of the spline (27) in the initial state for maintaining the distal collar (21) in the locked angular position wherein the second longitudinal groove (28) is moved along the spline (27) upon translation of the chassis (2) and carrier (7) in proximal direction (P) when the auto-injector (1) is removed from the injection site and enters a lead screw thread (32) near a distal end of the spline (27) for rotating the distal collar (21) into the unlocked angular position.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Auto-injector for administering a dose of a liquid medicament, comprising:
-a tubular chassis,
-a carrier subassembly comprising a tubular carrier slidably arranged relative to the chassis and partially arranged in the chassis , the carrier containing a syringe with a hollow injection needle, a drive spring and a plunger for forwarding load of the drive spring to a stopper of the syringe, wherein the syringe is locked for joint axial translation with the carrier,
-a wrap-over trigger sleeve arranged over the distal end of the auto- injector, the trigger sleeve extending over the whole length, or subtantually the whole lengh, of the auto-injector,
-a control spring arranged around the carrier,
-first interlock means for coupling a proximal end of the control spring to either the carrier for advancing it for needle insertion or to the chassis for needle retraction depending on the relative axial position of the carrier and the trigger sleeve,
-second interlock means arranged for releasing the drive spring for injection when the carrier has at least substantially reached an injection depth during needle insertion,
-third interlock means arranged for coupling the chassis to the carrier for joint axial translation relative to the trigger sleeve, wherein the third interlock means are arranged to decouple the chassis from the carrier upon translation of the trigger sleeve in proximal direction relative to the chassis thus releasing the control spring for needle insertion,
- fourth interlock means arranged for coupling a distal end of the control spring to either the carrier for needle retraction or to the trigger sleeve otherwise.

2. Auto-injector according to claim 1, characterized in that the first interlock means comprises a proximal collar for transmitting load of the proximal end of the control spring, the proximal collar arranged to be engaged on a thread on the carrier in an initial state, the proximal collar having a pin arranged to be splined to a first longitudinal groove in the trigger sleeve in the initial state so as to prevent rotation of the proximal collar and couple it to the carrier, wherein the first longitudinal groove is arranged to release the pin upon translation of the chassis and carrier in proximal direction under load of the control spring when the auto-injector is removed from the injection site thereby allowing rotation and translation of the proximal collar relative to the carrier under load of the control spring and subsequent abutting of the proximal collar against the chassis.

3. Auto-injector according to one of the claims 1 or 2, characterized in that the second interlock means comprises two resilient arms arranged distally on the plunger, the resilient arms exhibiting a thrust face for the drive spring, wherein a first boss protrudes from a distal trigger end face of the trigger sleeve in proximal direction, wherein the first boss is arrangeable between the two resilient arms thus preventing them from flexing towards each other, wherein protrusions are arranged in the carrier for respectively catching one of the resilient arms in a manner to prevent translation of the plunger in proximal direction, wherein the boss is arranged to be removed from between the resilient arms thus allowing them to flex inwards due to their ramped engagement to the protrusions under load of the drive spring and to release the plunger when the carrier has reached, or substantially reached, the injection depth during needle insertion.

4. Auto-injector according to one of the preceding claims, characterized in that the third interlock means comprises at least one resilient clip on the chassis engageable in a respective aperture in the carrier, wherein at least one second boss is arranged in the trigger sleeve for outwardly supporting the resilient clip so as to prevent the resilient clip from flexing outwards and disengaging the carrier from the chassis, wherein the second boss is arranged to be removed from behind the resilient clip on translation of the trigger sleeve in proximal direction relative to the chassis thereby allowing the resilient clip to flex outwards due to its ramped engagement with the carrier under load of the control spring.

5. Auto-injector according to one of the preceding claims, characterized in that the fourth interlock means comprise a distal collar for transmitting load of the distal end of the control spring, the distal collar and the trigger sleeve having a bayonet fitting restricting translation of the distal collar relative to the trigger sleeve in distal direction in at least one locked angular position of the distal collar and allowing translation of the distal collar relative to the trigger sleeve in distal direction in at least one unlocked angular position of the distal collar, wherein the respective angular position is determined by a splined engagement of the distal collar with the carrier, wherein the distal collar is arranged to be rotated into the unlocked angular position upon translation of the chassis and carrier in proximal direction under load of the control spring when the auto-injector is removed from the injection site thereby allowing translation of the distal collar relative to the trigger sleeve under load of the control spring in distal direction and subsequent abutting of the distal collar against an external shoulder on the carrier for retraction.

6. Auto-injector according to claim 5, characterized in that the bayonet fitting comprises at least one circumferentially arranged third boss on the inner surface of the trigger sleeve and a corresponding number of circumferentially arranged fourth bosses on the outer surface

of the distal collar, wherein in the locked angular position corresponding pairs of third bosses and fourth bosses are essentially aligned in a manner to abut against each other thus preventing translation of the distal collar in distal direction, wherein in the unlocked angular position corresponding pairs of third bosses and fourth bosses become misaligned in a manner to allow translation of the distal collar in distal direction.

7. Auto-injector according to one of the claims 5 or 6, characterized in that the splined engagement comprises at least one longitudinal spline on the carrier engaged with a respective second longitudinal groove on the inner surface of the distal collar, wherein the spline is substantially parallel for maintaining the distal collar in the locked angular position but ends with a lead screw thread near its distal end for rotating the distal collar into the unlocked angular position.

8. Auto-injector according to one of the preceding claims, characterized in that a detent mechanism is provided for opposing translation of the chassis relative to the trigger sleeve for triggering needle insertion.