Claims

1. Auto-injector (1) for administering a dose of a liquid medicament (M), comprising:
   - a tubular chassis (2) arranged to contain a syringe (3) with a hollow needle (4) and a stopper (6) for sealing the syringe (3) and displacing the medicament (M), the chassis (2) having a distal end (D) and a proximal end (P) with an orifice intended to be applied against an injection site, wherein the syringe (3) is slidably arranged with respect to the chassis (2),
   - a drive spring (8) capable of operating the syringe (3) to supply the dose of medicament (M),
   - a control spring (19) capable of
     - pushing the needle (4) from a covered position inside the chassis (2) into an advanced position through the orifice and past the proximal end (P) for needle insertion, and
     - advance the chassis (2) over the needle (4) after at least partially delivering the medicament (M),
   - activating means arranged to lock the drive spring (8) and the control spring (19) in a pressurized state prior to manual operation and capable of, upon manual operation, releasing the control spring (19) and/or the drive spring (8) for injection, wherein a carrier subassembly, comprising a tubular carrier (7) is slidably arranged in the chassis, the carrier (7) containing the syringe (3), the drive spring (8) and a plunger (9) for forwarding load of the drive spring (8) to the stopper (6), wherein the syringe (3) is locked for joint axial translation with the carrier (7), wherein the control spring (19) is connectable to the carrier (7) by first interlock means (20, 23, 24) for needle insertion, wherein the activating means comprise second interlock means (11, 13, 15) arranged for releasing the drive spring (8) when the carrier has at least almost reached an injection depth and wherein the first interlock means (20, 23, 24) are arranged for decoupling the control spring (8) from the carrier (7) and coupling it to the chassis (2) for advancing it over the needle (4) into a needle safe position.

2. Auto-injector (1) according to claim 1, characterized in that the activating means comprise 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), wherein the trigger sleeve (12) is arranged to release the control spring (19) upon translation in proximal direction (P) relative to the chassis (2).

3. Auto-injector (1) according to claim 2, characterized in that third interlock means (16, 17, 18) are 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) thus releasing the control spring (19) for needle insertion.

4. Auto-injector (1) according to one of the claims 2 to 3, characterized in that the control spring (19) is arranged around the carrier (7), wherein the first interlock means (20, 23, 24) comprise a proximal collar (20) arranged around the carrier (7) proximally from the control spring (19), wherein the control spring (19) acts between the trigger sleeve (12) and the proximal collar (20), wherein the proximal collar (20) exhibits at least one pin (22) engageable in a respective first recess (23) in the carrier (7) for coupling the proximal collar (20) to the carrier (7), wherein the trigger sleeve (12) exhibits a third boss (24) for outwardly supporting the proximal collar (20) so as to prevent decoupling of the pin (22) from the first recess (23), wherein the carrier (7) is arranged to extend out of the proximal end of the trigger sleeve (12) under load of the control spring (19) when the auto-injector (1) is being removed from the injection site thereby removing the third boss (24) from behind the proximal collar (20) thus causing the pin (20) to decouple from the first recess (23) due to ramped engagement and to be coupled to the chassis (2) for advancing it over the needle (4).

5. Auto-injector (1) according to claim 4, characterized in that fourth interlock means (25, 26, 27) are arranged for restricting extension of the chassis (2) from the proximal end of the trigger sleeve (12) to an initial pre-injection position, wherein the fourth interlock means (25, 26, 27) are arranged to disengage upon translation of the carrier subassembly during needle insertion.

6. Auto-injector (1) according to one of the preceding claims, characterized in that the second interlock means (11, 13, 15) comprise a thrust collar (11) distally arranged on the plunger (9), the thrust collar (11) having a wider diameter than the plunger (9), wherein the drive spring (8) acts between the thrust collar (11) and the carrier (7), wherein at least one first resilient clip (15) is arranged in the carrier (7), the first resilient clip (15) proximally engageable behind the thrust collar (11) for preventing translation of the plunger (9), wherein a first boss (13) in the trigger sleeve (12) is arranged for outwardly supporting the first resilient clip (15) and preventing it from flexing outwards, wherein the first boss (13) is arranged to be removed from behind the first resilient clip (15) on translation of the carrier subassembly at least almost into a maximum proximal position during needle insertion, thereby allowing the first resilient clip (15) to be flexed outwards by the thrust collar (11) due to ramped engagement under load of the drive spring (8) thus releasing the plunger (9) for injection.

7. Auto-injector (1) according to one of the claims 3 to 6, characterized in that the third interlock means (16, 17, 18) comprise at least one second resilient clip (16) on the chassis (2) arranged to be engaged in a respective aperture (17) in the carrier (7), wherein a respective second boss (18) is arranged in the trigger sleeve (12) for outwardly supporting the second resilient clip (16) and preventing it from flexing outwards, wherein the second boss (18) is arranged to be removed from behind the second resilient clip (16) on translation of the chassis (2) and the carrier subassembly in distal direction (D) relative to the trigger sleeve (12) during manual operation into a position just before the carrier (7) abuts against the trigger sleeve (12) thereby allowing the second resilient clip (16) to flex outwards due to ramped engagement with the carrier (7) under load of the control spring (19) thus releasing the carrier subassembly from the chassis (2).

8. Auto-injector (1) according to one of the claims 5 to 7, characterized in that the fourth interlock means (25, 26, 27) comprise at least one third resilient clip (25) on the chassis (2) arranged to abut against a shoulder (26) in the trigger sleeve (12) in proximal direction (P), wherein a fourth boss (27) is arranged on the carrier (7) for

inwardly supporting the third resilient clip (25) and preventing it from flexing inwards, wherein the fourth boss (27) is arranged to be removed from behind the third resilient clip (25) on translation of the carrier subassembly in proximal direction (P) relative to the chassis (2) during needle insertion thereby allowing the third resilient clip (25) to flex inwards due to ramped engagement with the fourth boss (27) under load of the control spring (19) thus allowing the chassis (2) to travel beyond the initial pre-injection position into a needle safe position.

9. Auto-injector (1) according to one of the preceding claims, characterized in that a flange (32) is arranged on the carrier (7) for abutting against the distal end of the control spring (19) so as to prevent the carrier subassembly from advancing substantially beyond its maximum proximal position when the chassis (2) has been advanced over the needle (4).

10. Auto-injector (1) according to one of the preceding claims, characterized in that a snap feature is provided between the chassis (2) and the carrier (7) for locking them together when the chassis (2) is in the needle safe position.

11. Auto-injector (1) according to one of the claims 3 to 10, characterized in that a detent mechanism is provided for opposing translation of the chassis (2) in distal direction at a point before the release of the third interlock means (16, 17, 18).

12. Auto-injector (1) according to one of the preceding claims, characterized in that the injection depth is defined by the carrier (7) contacting the chassis (2).

13. Method for operating an auto-injector (1), the auto-injector (1) comprising a tubular chassis (2) and a carrier subassembly comprising a tubular carrier (7) slidably arranged in the chassis (2), the carrier (7) containing a syringe (3), 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), wherein a control spring (19) is arranged around the carrier (7) inside a wrap-over trigger sleeve (12) arranged over the distal end (D) of the auto-injector (1) and extending at least almost over the whole length of the auto-injector (1), wherein

first interlock means (20, 23, 24) are arranged to connect a proximal end of the control spring (19) to the carrier (7) or to the chassis (2) depending on a relative axial position of the carrier (7) and the trigger sleeve (12), wherein a distal end of the control spring (19) is connected to the trigger sleeve (12), wherein second interlock means (11, 13, 15) are arranged to prevent or allow release of the drive spring (8) depending on a relative axial position of the trigger sleeve (12) and the carrier (7), the method comprising the steps of:

- coupling the control spring (19) to the carrier (7) by the first interlock means (20, 23, 24) and preventing release of the drive spring (8) by the second interlock means (11, 13, 15) 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,
- advancing the carrier subassembly for insertion of a hollow injection needle (4) on the syringe (3) into an injection site upon full translation of the trigger sleeve (12),
- 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, thereby connecting the control spring (19) to the chassis (2) by the first interlock means (20, 23, 24),
- advancing the chassis (2) in proximal direction (P) relative to the carrier subassembly into a needle safe position under load of the control spring (19).

14. Method according to claim 11, characterized in that third interlock means (16, 17, 18) are arranged for coupling the chassis (2) to the carrier (7) for joint axial translation relative to the trigger sleeve (12) depending on a relative axial position of the trigger sleeve (12) and the chassis (2), wherein the third interlock means (16, 17, 18) are released thereby decoupling the chassis (2) from the carrier (7) upon translation of the trigger sleeve (12) in proximal direction (P) thus releasing the control spring (19) for needle insertion.

15. Method according to one of the claims 11 or 12, characterized in that fourth interlock means (25, 26, 27) are arranged for restricting extension of the chassis (2) from the proximal end of the trigger sleeve (12) to an initial pre-injection position depending on a relative axial position of the carrier (7) and the chassis (2), wherein the fourth interlock means (25, 26, 27) are disengaged upon translation of the carrier subassembly during needle insertion.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Auto-injector for administering a dose of a liquid medicament, comprising:
- a tubular chassis arranged to contain a syringe with a hollow needle and a stopper for sealing the syringe and displacing the medicament, the chassis having a distal end and a proximal end with an orifice intended to be applied against an injection site, wherein the syringe is slidably arranged with respect to the chassis,
- a drive spring capable of operating the syringe to supply the dose of medicament,
- a control spring capable of
pushing the needle from a covered position inside the chassis into an advanced position through the orifice and past the proximal end for needle insertion, and
advance the chassis over the needle after at least partially delivering the medicament,
- activating means arranged to lock the drive spring and the control spring in a pressurized state prior to manual operation and capable of, upon manual operation, releasing the control spring and/or the drive spring for injection,
wherein a carrier subassembly, comprising a tubular carrier is slidably arranged in the chassis, the carrier containing the syringe, the drive spring and a plunger for forwarding load of the drive spring to the stopper, wherein the syringe is locked for joint axial translation with the carrier, wherein the control spring is connectable to the carrier by first interlock means for needle insertion, wherein the activating means comprise second interlock means arranged for releasing the drive spring when the carrier has at least almost reached an injection depth, the control spring being a single spring, wherein the first interlock means are arranged for decoupling the control spring from the carrier and coupling it to the chassis for advancing it over the needle into a needle safe position.

2. Auto-injector according to claim 1, characterized in that the activating means comprise a wrap-over trigger sleeve arranged over the distal end of the

auto-injector, the trigger sleeve extending at least almost over the whole length of the auto-injector, wherein the trigger sleeve is arranged to release the control spring upon translation in proximal direction relative to the chassis.

3. Auto-injector according to claim 2, characterized in that third interlock means are 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 thus releasing the control spring for needle insertion.

4. Auto-injector according to one of the claims 2 to 3, characterized in that the control spring is arranged around the carrier, wherein the first interlock means comprise a proximal collar arranged around the carrier proximally from the control spring, wherein the control spring acts between the trigger sleeve and the proximal collar, wherein the proximal collar exhibits at least one pin engageable in a respective first recess in the carrier for coupling the proximal collar to the carrier, wherein the trigger sleeve exhibits a third boss for outwardly supporting the proximal collar so as to prevent decoupling of the pin from the first recess, wherein the carrier is arranged to extend out of the proximal end of the trigger sleeve under load of the control spring when the auto-injector is being removed from the injection site thereby removing the third boss from behind the proximal collar thus causing the pin to decouple from the first recess due to ramped engagement and to be coupled to the chassis for advancing it over the needle.

5. Auto-injector according to claim 4, characterized in that fourth interlock means are arranged for restricting extension of the chassis from the proximal end of the trigger sleeve to an initial pre-injection position, wherein the fourth interlock means are arranged to disengage upon translation of the carrier subassembly during needle insertion.

6. Auto-injector according to one of the preceding claims, characterized in that the second interlock means comprise a thrust collar distally arranged on the

plunger, the thrust collar having a wider diameter than the plunger, wherein the drive spring acts between the thrust collar and the carrier, wherein at least one first resilient clip is arranged in the carrier, the first resilient clip proximally engageable behind the thrust collar for preventing translation of the plunger, wherein a first boss in the trigger sleeve is arranged for outwardly supporting the first resilient clip and preventing it from flexing outwards, wherein the first boss is arranged to be removed from behind the first resilient clip on translation of the carrier subassembly at least almost into a maximum proximal position during needle insertion, thereby allowing the first resilient clip to be flexed outwards by the thrust collar due to ramped engagement under load of the drive spring thus releasing the plunger for injection.

7. Auto-injector according to one of the claims 3 to 6, characterized in that the third interlock means comprise at least one second resilient clip on the chassis arranged to be engaged in a respective aperture in the carrier, wherein a respective second boss is arranged in the trigger sleeve for outwardly supporting the second resilient clip and preventing it from flexing outwards, wherein the second boss is arranged to be removed from behind the second resilient clip on translation of the chassis and the carrier subassembly in distal direction relative to the trigger sleeve during manual operation into a position just before the carrier abuts against the trigger sleeve thereby allowing the second resilient clip to flex outwards due to ramped engagement with the carrier under load of the control spring thus releasing the carrier subassembly from the chassis.

8. Auto-injector according to one of the claims 5 to 7, characterized in that the fourth interlock means comprise at least one third resilient clip on the chassis arranged to abut against a shoulder in the trigger sleeve in proximal direction, wherein a fourth boss is arranged on the carrier for inwardly supporting the third resilient clip and preventing it from flexing inwards, wherein the fourth boss is arranged to be removed from behind the third resilient clip on translation of the carrier subassembly in proximal direction relative to the chassis during needle insertion thereby allowing the third resilient clip to flex inwards due to ramped

engagement with the fourth boss under load of the control spring thus allowing the chassis to travel beyond the initial pre-injection position into a needle safe position.

9. Auto-injector according to one of the preceding claims, characterized in that a flange is arranged on the carrier for abutting against the distal end of the control spring so as to prevent the carrier subassembly from advancing substantially beyond its maximum proximal position when the chassis has been advanced over the needle.

10. Auto-injector according to one of the preceding claims, characterized in that a snap feature is provided between the chassis and the carrier for locking them together when the chassis is in the needle safe position.

11. Auto-injector according to one of the claims 3 to 10, characterized in that a detent mechanism is provided for opposing translation of the chassis in distal direction at a point before the release of the third interlock means.

12. Auto-injector according to one of the preceding claims, characterized in that the injection depth is defined by the carrier contacting the chassis.

13. Method for operating an auto-injector, the auto-injector comprising a tubular chassis and a carrier subassembly comprising a tubular carrier slidably arranged in the chassis, the carrier containing a syringe, 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, wherein a control spring is arranged around the carrier inside a wrap-over trigger sleeve arranged over the distal end of the auto-injector and extending at least almost over the whole length of the auto-injector, the control spring being a single spring, wherein first interlock means are arranged to connect a proximal end of the control spring to the carrier or to the chassis depending on a relative axial position of the carrier and the trigger sleeve, wherein a distal end of the control spring is connected to

wherein second interlock means are arranged to prevent or allow release of the drive spring depending on a relative axial position of the trigger sleeve and the carrier, the method comprising the steps of:

- coupling the control spring to the carrier by the first interlock means and preventing release of the drive spring by the second interlock means in an initial state,
- translating the trigger sleeve in proximal direction relative to the chassis against the force of the control spring when the proximal end of the auto-injector is being pushed against an injection site,
- advancing the carrier subassembly for insertion of a hollow injection needle on the syringe into an injection site upon full translation of the trigger sleeve,
- releasing the drive spring by the second interlock means when the needle at least almost reaches an injection depth during needle insertion, thereby allowing the drive spring to advance the plunger and the stopper for at least partially delivering the medicament,
- translating the trigger sleeve in distal direction under load of the control spring relative to the carrier subassembly on removal of the auto-injector from the injection site, thereby connecting the control spring to the chassis by the first interlock means,
- advancing the chassis in proximal direction relative to the carrier subassembly into a needle safe position under load of the control spring.

14. Method according to claim 13, characterized in that third interlock means are arranged for coupling the chassis to the carrier for joint axial translation relative to the trigger sleeve depending on a relative axial position of the trigger sleeve and the chassis, wherein the third interlock means are released thereby decoupling the chassis from the carrier upon translation of the trigger sleeve in proximal direction thus releasing the control spring for needle insertion.

15. Method according to one of the claims 13 or 14, characterized in that fourth interlock means are arranged for restricting extension of the chassis from the proximal end of the trigger sleeve to an initial pre-injection position depending

on a relative axial position of the carrier and the chassis, wherein the fourth interlock means are disengaged upon translation of the carrier subassembly during needle insertion.