CLAIMS

1. An automatic drug injection device comprising

- an outer body (1; 100) extending along a longitudinal axis (X),
- a syringe group (6; 106) placed in said outer body (1; 100) and fixed thereto, said syringe group comprising a syringe (7; 107) containing the drug to be injected, a needle (7a; 107a) and plunger means (8; 108) axially slidable and pivotable relative to said outer body (1; 100),
- means for arming (4; 104, 204) said device from a stored position to a first armed position for injecting a first dose and at least a second armed position for injecting a second dose, said arming means being arranged at one end of the outer body (1; 100),
- first elastic means (10; 110) arranged between said arming means (4; 104, 204) and said plunger means (8; 108), said first elastic means being in compressed condition when the device is in its stored position and decompressing to push forward said plunger means (8; 108) and delivery successively said first and said at least second dose,
- a sliding sheath (30; 130) arranged at the other end of said outer body (1; 100) and constrained to slide axially thereinto, as a result of a pressure exerted on its free end, in contrast with second elastic means (35; 135) arranged between said sliding sheath (30; 130) and said outer body (1; 100), between a sliding lock-out position, in which said sliding sheath (30; 130) projects from said outer body (1; 100) covering the needle (7a; 107a) of the syringe, and a device trigger position, in which said sliding sheath (30; 130) is retracted in said outer body (1; 100) leaving the needle (7a; 107a) of the syringe exposed, said second elastic means (35; 135) being suitable to bring said sliding sheath (30; 130) back to said lock-out position when said pressure action ceases,
- cam drive means (28; 128) operatively connected to said sliding sheath (30; 130) and axially pivotable in said outer body (1; 100),
- trigger cam means (26, 27; 126, 127) pivotable integrally with said cam drive means and connected operatively with said plunger means (8; 108) to angularly displace said plunger means (8; 108) to said trigger positions of the first dose

and the at least second dose,

- stepped guide means (44; 144) integral to said outer body (1; 100) and operatively connected with said plunger means (8; 108) to control the extent of the axial sliding of said plunger means (8; 108) and therefore limit the volume of drug delivered for each dose, said trigger cam means (26, 27; 126, 127) and said drive cam means (28; 128) being formed on a same support (23; 123) pivotally arranged between said outer body (1; 100) and said plunger means (8; 108).

2. The device according to any one of the previous claims, wherein said trigger cam means (26, 27; 126, 127) are formed on the outer surface of said support (23; 123) and comprise at least an axial slot (27; 127) extending from an end edge of said support (23; 123) and defining an axial first trigger cam track (27a; 127a) for pushing said plunger means (8; 108), and at least a corresponding axial second trigger cam track (26c; 126c) for pushing said plunger means (8; 108) angularly spaced with respect to said first trigger cam track (27a; 127a).

3. The device according to any one of the previous claims, wherein said plunger means (8; 108) comprise at least a radial peg (15; 115) outwardly extending perpendicularly to said axis (X) to interact with said trigger cam means (26, 27; 126, 127) and said stepped guide means (44; 144).

4. The device according to claim 3, wherein said plunger means (8; 108)comprise at least a pair of radial pegs (15; 115) extending at diametrically opposed parts.

5. The device according to any one of the previous claims, wherein said sliding sheath (30; 130) interacts with said drive cam means (28; 128) through free ends (32; 132) of axial legs (31; 131) extending from said sliding sheath (30; 130).

6. The device according to claim 5, wherein said drive cam means (28; 128) are formed on the outer surface of said support (23; 123) and comprise, for each of said axial legs (31; 131), at least a first drive cam track (28a; 128a) extending from the other end of said support (23; 123) and inclined with respect to said axis (X), and at least a second drive cam track (28b; 128b) extending from the same end of said support (23; 123) and incident with said first drive cam track (28a; 128a), the free ends (32; 132) of said axial legs (31; 131) slidingly engaging with said first drive cam track (28a; 128a)

and successively said second drive cam track (28b; 128b) when a pressure action is exerted on the free end (3; 103) of the sliding sheath (30; 130), whereby said support (23; 123) is rotated in a direction opposite to the inclination of said first drive cam track (28a; 128a), and respectively when said pressure action ceases.

7. The device according to any one of the previous claims, wherein said device arming means comprise a dose selection knob (4; 104, 204) pivotally connected to said outer body (1; 100) in a way to be allowed to rotate in only one direction and temporarily connected to said support (23; 123) to angularly displace it to an extent able to unlock the device for the delivery of a dose.

8. The device according to claim 7, wherein said dose selection knob (4) comprises at least two feet (21) diametrically opposed engaged with respective slide seats (22) of said support (23) having a leading edge (22a) against which said feet (21) abut to cause said support (23) to rotate.

9. The device according to claims 7 or 8, wherein said dose selection knob (4) is equipped with ratchet legs (18) slidably engaged with ramp surfaces (19) formed on said outer body (1), said ramp surfaces (19) defining ramp steps (19a) against which said legs (189 abut when said dose selection knob (49 reaches the armed position for delivery of a dose.

10. The device according to claim 9, wherein temporary stop means (46, 47) are provided between the dose selection knob (4) and the outer body (1) for mutually engaging when the free ends of the ratchet legs (18) fall off the step (19a) of the ramp surface (19) of the outer body (1).

11. The device according to anyone of the claims 1 to 6, wherein said device arming means comprise a dose selection knob (104) and a ratchet (204) arranged within said dose selection knob (104) and snap connected thereto, said ratchet (204) being pivotally connected to said outer body (100) so that it can be rotated in only one direction and temporarily connected to said support (123) to impart it an angular displacement for unlocking the device for a dose delivery.

12. The device according to claim 11, wherein said ratchet (204) comprises at least two feet (121) diametrically opposed engaged with respective slide seats (122) of said support (123) having a leading edge (122a) against which turnig legs (121a) of said

feet (121) abut to cause said support (123) to rotate.

13. The device according to claim 12, wherein a design clearance (Y) exists between the trigger cam track (127a) and the respective radial peg (115) and a design clearance (Z) of lower extent exists between the turning legs (121a) of the feet (121) and the respective leading edges (122a) of the grooves (122), whereby the rotation of the dose selection knob (104) to arm the device for the first dose does not cause the plunger means (108) to rotate.

14. The device according to any one of claims 11 to 13, wherein said ratchet (204) is equipped with flexible legs (118) configured to slide under flexion, as a result of the rotation of the dose selection knob (104), on respective ribs (119) of said outer body (100), and to jump abutting against them with their ends, whereby the reverse rotation of the dose selection knob (1049 is prevented when the dose selection knob (104) reaches the armed position for delivery of a dose.

15. The device according to claim 14, wherein reversible stop means (120, 120a) are provided between the ratchet (204) and the outer body (100), for abutting against each other when the free ends of flexible arms (118) abuts against rims (119) of said outer body (100).

16. The device according to any one of the previous claims, wherein said drive cam means (28; 128) comprise projecting cantilever legs (29; 129) capable of deflecting to allow said sliding sheath (30; 130) to slide with respect to said support (23; 123) when the pressure action on said front end (3; 103) ceases and to prevent it to occur before said dose selection knob (4; 104, 204) is positioned in a dose selection armed position.

17. The device according to claim 16, wherein each of said cantilever legs (29; 129) is arranged in a respective second drive cam track (28b; 128b) and its free end constitutes the lock-out edge (29a; 129a) against which the end (32; 132) of the axial leg (31; 131) abuts when the device is in the lock-out condition.

18. The device according to claim 17, wherein a stop edge (28c; 128c) is placed sideways of said axial lock-out edge (29a; 129a) to serve as abutment for said ends (32; 132) to prevent the dose selection knob (4; 104, 204) from rotating beyond the positions of first dose and second dose delivery.

19. The device according to any one of the previous claims, wherein a bayonet

connection is provided between said arming means (4; 104, 204) and said plunger means (8; 108) to make them axially integral in said stored position and to release them in said dose delivery operating conditions.

20. The device according to claim 19, wherein said bayonet connection comprises at least a retention clip (13) of the dose selection knob (4) and a corresponding substantially L-shaped slot (12) formed by a circumferential retention slot branch (12a) and an axial release slot branch (12b) on said plunger means (8), in the device stored position said retention clip (13) being engaged in said retention slot branch (12a) to oppose the thrust of said first elastic means (10), following to an angular displacement of said dose selection knob (4) said retention clip (13) sliding along said retention slot branch (12a) when passing from said stored position to said first dose delivery position until it axially lines up with said release slot branch (12b), whereby said plunger means (8)can move axially relative to said dose selection knob (4).

21. The device according to claim 19, wherein said bayonet connection comprises a pair of retention feet (112) inwardly projecting from said ratchet (204) at diametrically opposed parts and corresponding actuation slots (113) extending from said plunger rod (108) and hanging on the retention feet (112).

22. The device according to claim 2, wherein said stepped guide means (44) comprising location surfaces (44a, 44b) for said plunger means (8) lying on planes perpendicular to said axis (X), said plunger means (8) being angularly displaced as a result of the pushing action exerted by said axial cam tracks (27a, 26c) along said location surfaces (44a, 44b) and then axially displaced once the end of said location surfaces is reached.

23. The device according to claim 22, wherein said guide means (44) comprise at least a stepped guide profile comprising two location surfaces (44a, 44b) and a stop ledge (44c) connected by two axial profile portions (44d, 44e).

24. The device according to any one of claims 22 or 23, wherein said stepped guide means (44) are formed on the inner face of said outer body (1).

25. The device according to any one of the previous claims, wherein said outer body (100) comprises a chassi (100a) axially engaged within an outer sleeve (100b) and integral thereto, said sliding sheath (130) being axially slidable in said chassis

(100a), said support (123) being axially arranged in said outer sleeve (100b), the axial legs (131) of said sliding sheath (130) being slidably engaged in axial slots (147) of said chassis (100a), said outer sleeve (100b) being connected pivotally in only one direction to said ratchet (204).

26. The device according to claim 25, wherein said stepped guide means (144) are formed on the inner face of the chassis (100a) and comprise a location surface (144a and a stop ledge (144c) connected by an axial profile portion (144d, 144e).

27. The device according to any one of the previous claims, wherein said sliding sheath (30; 130) comprises flexible tines (41; 141) along its outer surface for abutting against a protrusion of said outer body (1; 100) to provide resistance to the relative axial sliding and inwardly deflect under moderate force exerted thereon through said protrusion, the elastic release of said flexible tines to the not deflected condition exerting a thrust compliant with the pressure action causing the sliding sheath (30; 130) to slide toward the inside of said outer body (1; 100).

28. The device according to any one of the previous claims, wherein said first elastic means comprise a spring (10; 110) placed inside said plunger means (8; 108) around a support rod (11; 111) extending between said arming means (4; 104, 204) and said plunger means (8; 108).

29. The device according to any one of the previous claims, wherein said outer body (1;100) is formed with at least one transparent inspection window (38; 138) for controlling the drug delivery condition, a corresponding axial opening (37; 137) axially aligned to said window (38; 138) being formed on said sliding sheath (30; 130).

30. The device according to any one of the previous claims, wherein said needle (7a; 107a) is covered by a needle shield (7b; 107b) and a needle shield remover (45; 145) is removably secured to the outer body (1; 100) and is provided with an inner tubular grip (45b; 145b) fit for engaging with the needle shield (7b; 107b), whereby, by pulling the needle shield remover (45; 145) before the first dose is administered, the user can remove the needle shield (7b; 107b) and free the needle (7a; 107a) for the injection.

The device according to claim 30, wherein said needle shield remover (145) comprises an insert (146) having hooks digging into the needle shield (107b).

CLAIMS

1. An automatic drug injection device comprising:

an outer body extending along a longitudinal axis;

a syringe group placed in said outer body and fixed thereto, said syringe group comprising a syringe containing a drug to be injected, a needle and plunger means axially slidable and pivotable relative to said outer body;

means for arming said device from a stored position to a first armed position for injecting a first dose and at least a second armed position for injecting a second dose, said arming means being arranged at one end of the outer body;

first elastic means arranged between said arming means and said plunger means, said first elastic means being in compressed condition when the device is in its stored position and decompressing to push forward said plunger means and delivery successively said first dose and said at least second dose;

a sliding sheath arranged at the other end of said outer body and constrained to slide axially thereinto, as a result of a pressure exerted on its free end, in contrast with second elastic means arranged between said sliding sheath and said outer body, between a sliding lock-out position, in which said sliding sheath projects from said outer body covering the needle of the syringe, and a device trigger position, in which said sliding sheath is retracted in said outer body leaving the needle of the syringe exposed, said second elastic means being suitable to bring said sliding sheath back to said lock-out position when said pressure action ceases;

cam drive means operatively connected to said sliding sheath and axially pivotable in said outer body;

trigger cam means pivotable integrally with said cam drive means and connected operatively with said plunger means to angularly displace said plunger means to said device trigger positions of the first dose and the at least second dose, and

stepped guide means integral to said outer body and operatively connected with said plunger means to control an extent of the axial sliding of said plunger means and therefore limit a volume of drug delivered for each dose, said trigger cam means and said cam drive means being formed on a same support pivotally arranged between said outer body and said plunger means.

2. The device according to claim 1, wherein said trigger cam means are formed on the outer surface of said support and comprise at least an axial slot extending from an end edge of said support and defining an axial first trigger cam track for pushing said plunger means, and

at least a corresponding axial second trigger cam track for pushing said plunger means angularly spaced with respect to said first trigger cam track.

3. The device according to claim 2, wherein said stepped guide means comprises location surfaces for said plunger means lying on planes perpendicular to said axis, said plunger means being angularly displaced as a result of pushing action exerted by said trigger cam tracks along said location surfaces and then axially displaced once the end of said location surfaces is reached.

4. The device according to claim 3, wherein said stepped guide means comprise at least a stepped guide profile comprising two location surfaces and a stop ledge connected by two axial profile portions.

5. The device according to claim 3, wherein said stepped guide means are formed on an inner face of said outer body.

6. The device according to claim 1, wherein said plunger means comprise at least a radial peg outwardly extending perpendicularly to said axis to interact with said trigger cam means and said stepped guide means.

7. The device according to claim 6, wherein said plunger means comprise at least a pair of radial pegs extending at diametrically opposed parts.

8. The device according to claim 1, wherein said sliding sheath interacts with said cam drive means through free ends of axial legs extending from said sliding sheath.

9. The device according to claim 8, wherein said cam drive means are formed on the outer surface of said support and comprise, for each of said axial legs, at least a first drive cam track extending from the other end of said support and inclined with respect to said axis, and at least a second drive cam track extending from the same end of said support and incident with said first drive cam track, the free ends of said axial legs slidingly engaging with said first drive cam track and successively said second drive cam track when a pressure action is exerted on the free end of the sliding sheath, whereby said support is rotated in a direction opposite to an inclination of said first drive cam track, and respectively when said pressure action ceases.

10. The device according to claim 1, wherein said device arming means comprise a dose

selection knob pivotally connected to said outer body in a way to be allowed to rotate in only one direction and temporarily connected to said support to angularly displace it to an extent able to unlock the device for the delivery of a dose.

11. The device according to claim 10, wherein said dose selection knob comprises at least two feet diametrically opposed engaged with respective slide seats of said support having a leading edge against which said feet abut to cause said support to rotate.

12. The device according to claim 10, wherein said dose selection knob is equipped with ratchet legs slidably engaged with ramp surfaces formed on said outer body, said ramp surfaces defining ramp steps against which said legs abut when said dose selection knob reaches the armed position for delivery of a dose.

13. The device according to claim 12, wherein temporary stop means are provided between the dose selection knob and the outer body for mutually engaging when free ends of the ratchet legs fall off the step of the ramp surface of the outer body.

14. The device according to claim 1, wherein said device arming means comprise a dose selection knob and a ratchet arranged within said dose selection knob and snap connected thereto, said ratchet being pivotally connected to said outer body so that it can be rotated in only one direction and temporarily connected to said support to impart it an angular displacement for unlocking the device for a dose delivery.

15. The device according to claim 14, wherein said ratchet comprises at least two feet diametrically opposed engaged with respective slide seats of said support having a leading edge against which turning legs of said feet abut to cause said support to rotate.

16. The device according to claim 15, wherein a design clearance exists between the trigger cam track and a radial peg and a design clearance of lower extent exists between the turning legs of the feet and respective leading edges of grooves of said support, whereby the rotation of the dose selection knob to arm the device for the first dose does not cause the plunger means to rotate.

17. The device according to claim 14, wherein said ratchet is equipped with flexible legs configured to slide under flexion, as a result of the rotation of the dose selection knob, on respective ribs of said outer body, and to jump abutting against them with their ends,

whereby the reverse rotation of the dose selection knob is prevented when the dose selection knob reaches the armed position for delivery of a dose.

18. The device according to claim 17, wherein reversible stop means are provided between the ratchet and the outer body, for abutting against each other when free ends of flexible arms abuts against rims of said outer body.

19. The device according to claim 14, wherein a bayonet connection is provided between said arming means and said plunger means to make them axially integral in said stored position and to release them in said dose delivery operating conditions.

20. The device according to claim 19, wherein said bayonet connection comprises at least a retention clip of the dose selection knob and a corresponding substantially L-shaped slot formed by a circumferential retention slot branch and an axial release slot branch on said plunger means, in the device stored position said retention clip being engaged in said retention slot branch to oppose a thrust of said first elastic means, following to an angular displacement of said dose selection knob said retention clip sliding along said retention slot branch when passing from said stored position to said first dose delivery position until it axially lines up with said release slot branch, whereby said plunger means can move axially relative to said dose selection knob.

21. The device according to claim 19, wherein said bayonet connection comprises a pair of retention feet inwardly projecting from said ratchet at diametrically opposed parts and corresponding actuation slots extending from said plunger rod and hanging on the retention feet.

22. The device according to claim 14 wherein said outer body comprises a chassis axially engaged within an outer sleeve and integral thereto, said sliding sheath being axially slidable in said chassis, said support being axially arranged in said outer sleeve, axial legs of said sliding sheath being slidably engaged in axial slots of said chassis, said outer sleeve being connected pivotally in only one direction to said ratchet.

23. The device according to claim 22, wherein said stepped guide means are formed on an inner face of the chassis and comprise a location surface and a stop ledge connected by an axial profile portion.

24. The device according to claim 1, wherein said cam drive means comprise projecting

cantilever legs capable of deflecting to allow said sliding sheath to slide with respect to said support when the pressure action on said front end ceases and to prevent sliding of said sliding sheath with respect to said support from occurring before said dose selection knob is positioned in a dose selection armed position.

25. The device according to claim 24, wherein each of said cantilever legs is arranged in a respective second drive cam track and a free end of the cantilever legs constitutes a lock-out edge against which free ends of axial legs abut when the device is in the lock-out condition.

26. The device according to claim 25, wherein a stop edge is placed sideways of said lock-out edge to serve as abutment for said ends to prevent the dose selection knob from rotating beyond the positions of first dose and second dose delivery.

27. The device according to claim 1, wherein said sliding sheath comprises flexible tines along its outer surface for abutting against a protrusion of said outer body to provide resistance to the relative axial sliding and inwardly deflect under moderate force exerted thereon through said protrusion, the elastic release of said flexible tines to the not deflected condition exerting a thrust compliant with the pressure action causing the sliding sheath to slide toward the inside of said outer body.

28. The device according to claim 1, wherein said first elastic means comprise a spring placed inside said plunger means around a support rod extending between said arming means and said plunger means.

29. The device according to claim 1, wherein said outer body is formed with at least one transparent inspection window for controlling the drug delivery condition, a corresponding axial opening axially aligned to said window being formed on said sliding sheath.

30. The device according to claim 1, wherein said needle is covered by a needle shield and a needle shield remover is removably secured to the outer body and is provided with an inner tubular grip fit for engaging with the needle shield, whereby, by pulling the needle shield remover before the first dose is administered, the user can remove the needle shield and free the needle for an injection.

31. The device according to claim 30, wherein said needle shield remover comprises an insert having hooks digging into the needle shield.