Description

Drive assembly, piston rod, drug delivery device, and use of a spring

The present disclosure relates to a piston rod, a drive assembly, a drug delivery device, and to the use of a spring.

EP 1923083 A1 discloses drive mechanisms for use in drug delivery devices.

It is an object of the present disclosure to provide for a novel piston rod, drive assembly, drug delivery device, and/or use of a spring.

SUMMARY

In a first aspect, there is provided a drive assembly for a drug delivery device comprising:

- a housing having a proximal end and a distal end;
- a piston rod being axially displaceable and rotatable with respect to the housing between a first angular position and a second angular position,
- a drive member being axially displaceable; and
- a rotational bias member being operable to transfer a resilient bias to the piston rod;

the drive assembly being configured such that, for setting a dose:

- the drive member is proximally axially displaceable with respect to the housing and the piston rod from a rest position to a dose set position;
- when setting the dose, the piston rod is rotated in a first rotational direction and, subsequent to the rotation in the first rotational direction, is rotated in a second rotational direction with respect to the housing and the drive member;
- the drive member interacts with the piston rod to convert proximal axial movement of the drive member with respect to the housing into rotational movement of the piston rod in the first rotational direction towards the second angular position against the resilient bias; and
- the rotational bias member interacts with the piston rod such that the piston rod is rotated in the second rotational direction towards the first angular position with respect to the drive member and the housing by means of the resilient bias.

In a second aspect, there is provided a piston rod for a drug delivery device, the piston rod having a proximal end, a distal end and a main longitudinal axis extending between the proximal end and the distal end, wherein the piston rod comprises at least one first ratchet pocket with a proximal side wall and a distal side wall which axially delimit the first ratchet pocket such that the first ratchet pocket tapers in a first angular direction with respect to the axis.

In a third aspect, there is provided the use of a spring in a drug delivery device, the drug delivery device comprising

- a housing having a proximal end and a distal end,
- a cartridge, a piston being retained within the cartridge,
- a piston rod for distally displacing the piston with respect to the cartridge for dispensing a dose, and
- a drive member for rotating the piston rod in a first rotational direction with respect to the housing when setting the dose,

wherein the spring is used

- for storing energy for driving a rotation of the piston rod in a second rotational direction with respect to the housing by interacting with the piston rod for biasing the piston rod in the second rotational direction during setting of the dose and
- for storing energy for driving an axial displacement for reducing pressure of the piston rod on the piston by interacting with the piston rod for biasing the piston rod in an axial direction after dispensing of the dose.

According to at least one aspect, a piston rod is provided for. The piston rod may be flexible or not. It may be a simple rod, a lead screw, a rack and pinion system, a worm gear system, or the like. The piston rod may have a circular or a non-circular cross-section. It may be made of any suitable material known by a person skilled in the art and may be of unitary or multi-part construction. The piston rod may have a proximal end, a distal end, and a main longitudinal axis extending between the proximal end and the distal end.

According to at least one aspect, the piston rod has one or more rows of axially spaced ribs and/or indentations. The ribs or indentations preferably form one or more rows of ratchet pockets. The row(s) of ratchet pockets may extend in an axial or substantially axial direction. A row of ratchet pockets which extends in an axial or substantially axial direction is subsequently denoted as an axial row of ratchet pockets.

According to at least one aspect, each ratchet pocket tapers in a radial direction towards the longitudinal axis of the piston rod. Expediently, in this case, the ratchet pockets are configured for interacting with a radially displaceable pawl element.

According to at least one aspect, the piston rod comprises at least one first ratchet pocket with a proximal sidewall and a distal sidewall. The proximal sidewall and the distal sidewall may delimit the first ratchet pocket axially and, preferably, such that the first ratchet pocket tapers in a first angular direction with respect to the longitudinal axis.

Claims

1. A drive assembly for a drug delivery device comprising:
- a housing (10A, 10B, 10C) having a proximal end (100P) and a distal end (100D);
- a piston rod (20) being axially displaceable and rotatable with respect to the housing (10A, 10B, 10C) between a first angular position and a second angular position,
- a drive member (30) being axially displaceable; and
- a rotational bias member (50) being operable to transfer a resilient bias to the piston rod (20);
the drive assembly being configured such that, for setting a dose:
- the drive member (30) is proximally axially displaceable with respect to the housing (10A, 10B, 10C) and the piston rod (20) from a rest position to a dose set position;
- when setting the dose, the piston rod (20) is rotated in a first rotational direction and, subsequent to the rotation in the first rotational direction, is rotated in a second rotational direction with respect to the housing (10A, 10B, 10C) and the drive member (30);
- the drive member (30) interacts with the piston rod (20) to convert proximal axial movement of the drive member (30) with respect to the housing (10A, 10B, 10C) into rotational movement of the piston rod (20) in the first rotational direction towards the second angular position against the resilient bias; and
- the rotational bias member (50) interacts with the piston rod (20) such that the piston rod (20) is rotated in the second rotational direction towards the first angular position with respect to the drive member (30) and the housing (10A, 10B, 10C) by means of the resilient bias.

2. The drive assembly of claim 1, wherein, for dispensing the set dose,
- the drive member (30) is distally displaceable with respect to the housing (10A, 10B, 10C) from the dose set position towards the rest position; and
- the drive member (30) interacts with the piston rod (20) to displace the piston rod (20) distally with respect to the housing (10A, 10B, 10C).

3. The drive assembly of claim 2, wherein the piston rod ~~(20)~~ is only axially displaced during dispensing of the dose.

4. The drive assembly of one of the preceding claims, wherein the piston rod ~~(20)~~ has a row of ratchet pockets ~~(220)~~ and the rotational bias member ~~(50)~~ is configured for interacting with the row of ratchet pockets ~~(220)~~ for blocking a proximal axial movement of the piston rod ~~(20)~~ with respect to the housing ~~(10A, 10B, 10C)~~.

5. The drive assembly of one of the preceding claims, wherein the rotational bias member ~~(50)~~ is rotatable with respect to the housing ~~(10A, 10B, 10C)~~.

6. The drive assembly of claim 5, wherein, when setting the dose, the rotational bias member ~~(50)~~ follows the piston rod ~~(20)~~ in the first rotational direction when the piston rod ~~(20)~~ rotates in the first rotational direction and the piston rod ~~(20)~~ follows the rotational bias member ~~(50)~~ in the second rotational direction when the rotational bias member ~~(50)~~ rotates in the second rotational direction.

7. The drive assembly of claim 6, wherein, when dispensing the set dose, the piston rod ~~(20)~~ interacts with the rotational bias member ~~(50)~~ to transform a distal axial movement of the piston rod ~~(20)~~ into a rotational movement of the rotational bias member ~~(50)~~ in the first rotational direction with respect to the piston rod and the housing ~~(10A, 10B, 10C)~~ against the resilient bias.

8. The drive assembly of claims 4 and 7, wherein, when dispensing the set dose, the rotational bias member ~~(50)~~ is rotated in the first rotational direction by means of interaction with the piston rod ~~(50)~~ for disengaging with one of the ratchet pockets ~~(220)~~ and, subsequent to the rotation in the first rotational direction, the rotational bias member ~~(50)~~ is rotated in the second rotational direction with respect to the housing ~~(10A, 10B, 10C)~~ and the piston rod ~~(20)~~ by means of the resilient bias for engaging another one of the ratchet pockets ~~(220)~~.

9. The drive assembly of one of claims 5 to 8, further comprising a spring ~~(80)~~ for generating the resilient bias, wherein the drive assembly is operable to elastically deform the spring ~~(80)~~ for increasing the resilient bias when the rotational bias

member (50) is rotated in the first rotational direction with respect to the housing (10A, 10B, 10C).

The drive assembly of claim 9, wherein
- the rotational bias member (50) has a first part (50A) which is axially locked with respect to the housing and a second part (50B) which is axially displaceable with respect to the housing, and
- the rotational bias member (50) is operable to elastically deform the spring (80) by means of axially displacing the second part (50B) with respect to the first part (50A).

11. The drive assembly of claim 10, wherein the second part (50B) is rotationally coupled to the first part (50A) and the drive assembly is configured for converting axial movement of the second part (50B) with respect to the first part (50A) into rotational movement of the first part (50A) with respect to the housing (10A, 10B, 10C).

12. The drive assembly of one of the preceding claims, wherein the drive member (30) limits the angular range of the rotational motion of the piston rod (20) in the second rotational direction.

13. A piston rod (20) for a drug delivery device, the piston rod (20) having a proximal end (200P), a distal end (200D) and a main longitudinal axis extending between the proximal end (200P) and the distal end (200D), wherein the piston rod (20) comprises at least one first ratchet pocket (210) with a proximal side wall (2120) and a distal side wall (2110) which axially delimit the first ratchet pocket (210) such that the first ratchet pocket (210) tapers in a first angular direction with respect to the axis.

14. The piston rod (20) of claim 13, wherein the piston rod (20) comprises a first axially extending protrusion (230), the first axially extending protrusion (230) defining a channel (240) in cooperation with the first ratchet pocket (210), with the first ratchet pocket (210) forming a bulge of the channel (240).

15. The piston rod ~~(20)~~ of one of claims 13 or 14, wherein the piston rod ~~(20)~~ comprises at least one second ratchet pocket ~~(220)~~ angularly offset from the first ratchet pocket ~~(210)~~, the second ratchet pocket ~~(220)~~ having a proximal side wall ~~(2220)~~ and a distal side wall ~~(2210)~~ which axially delimit the second ratchet pocket ~~(220)~~ such that the second ratchet ~~(220)~~ pocket tapers in a second angular direction with respect to the axis, the second angular direction being opposite to the first angular direction.

16. The piston rod ~~(20)~~ of claim 15, wherein the piston rod ~~(20)~~ comprises a second axially extending protrusion ~~(260)~~, the second axially extending protrusion ~~(260)~~ defining a channel ~~(270)~~ in cooperation with the second ratchet pocket ~~(220)~~, with the second ratchet pocket ~~(220)~~ forming a bulge of the channel ~~(270)~~.

17. The piston rod ~~(20)~~ of one of claims 15 or 16, comprising two first ratchet pockets ~~(210)~~, wherein the second ratchet pocket ~~(220)~~ is axially arranged between the two first ratchet pockets ~~(210)~~.

18. The piston rod ~~(20)~~ of one of claims 13 to 17, wherein, as seen in plan view onto the piston rod ~~(20)~~ and the first ratchet pocket ~~(210)~~, the distal side wall ~~(2110)~~ of the first ratchet pocket ~~(210)~~ is substantially perpendicular to the axis and the proximal side wall ~~(2120)~~ of the first ratchet pocket ~~(210)~~ is inclined with respect to the axis.

19. Use of a spring ~~(80)~~ in a drug delivery device, the drug delivery device comprising
- a housing ~~(10A, 10B, 10C)~~ having a proximal end ~~(100P)~~ and a distal end ~~(100D)~~,
- a cartridge ~~(75)~~, a piston ~~(77)~~ being retained within the cartridge ~~(75)~~,
- a piston rod ~~(20)~~ for distally displacing the piston ~~(77)~~ with respect to the cartridge ~~(75)~~ for dispensing a dose, and
- a drive member ~~(30)~~ for rotating the piston rod ~~(20)~~ in a first rotational direction with respect to the housing ~~(10A, 10B, 10C)~~ when setting the dose,
wherein the spring ~~(80)~~ is used
- for storing energy for driving a rotation of the piston rod ~~(20)~~ in a second rotational direction with respect to the housing ~~(10A, 10B, 10C)~~ by interacting with the piston rod ~~(20)~~ for biasing the piston rod ~~(20)~~ in the second rotational direction

during setting of the dose and

- for storing energy for driving an axial displacement for reducing pressure of the piston rod ~~(20)~~ on the piston ~~(77)~~ by interacting with the piston rod ~~(20)~~ for biasing the piston rod ~~(20)~~ in an axial direction after dispensing of the dose.

20. The use of claim 19 in a drug delivery device additionally comprising a rotatable stop member ~~(50)~~ for blocking proximal axial movement of the piston rod ~~(20)~~, wherein the spring ~~(80)~~ is additionally used for interacting with the stop member ~~(50)~~ for resiliently biasing the stop member ~~(50)~~ in the second rotational direction.