

DRUG DELIVERY DEVICE AND METHODS OF DELIVERING A DRUG

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] The present application claims the priority of U.S. Provisional Application No. 62/908,504, filed September 30, 2019, entitled, "Drug Delivery Device," U.S. Provisional Application No. 62/960,996, filed January 14, 2020, entitled, "Drug Delivery Device and Methods of Delivering a Drug," and U.S. Provisional Application No. 62/962,042, filed January 16, 2020, entitled, "Drug Delivery Device and Methods of Delivering a Drug," each of which is incorporated by reference.

FIELD OF DISCLOSURE

[0002] The present disclosure relates to drug delivery devices and methods of delivering a drug, and, more particularly, devices and methods for automatically injecting a drug into a patient.

BACKGROUND

[0003] A general aversion to exposed needles, as well as health and safety issues, have led to the development of drug delivery devices which conceal a needle or other insertion member prior to use and which automate various aspects of an injection process. Such devices offer a variety of benefits as compared with traditional forms of drug delivery including, for example, delivery via a conventional syringe.

[0004] A drug delivery device may incorporate various mechanisms to implement various automated features. Such features may include automatically covering a needle in a pre-delivery and/or post-delivery state, automatically inserting a needle and/or a cannula into a user, automatically activating a drive mechanism, automatically indicating to the user that drug delivery is complete, among other features. Typically a drug delivery device will incorporate a separate or independently operable mechanism to realize each of its automated features. As a consequence, with each added feature, the mechanical complexity of the device tends to increase. This, in turn, can increase the size of the device, which can make it cumbersome for the user to handle, as well as increase manufacturing costs and timeframes. As the demand grows for drug delivery devices with greater ease of use and safety, finding a way to incorporate more automated features without adding undue complexity to the drug delivery device presents various design and manufacturing challenges.

[0005] The present disclosure sets forth drug delivery devices embodying advantageous alternatives to existing drug delivery devices, and that may address one or more of the challenges or needs mentioned herein.

SUMMARY

[0006] One aspect of the present disclosure provides a drug delivery device including a housing defining a longitudinal axis and having an opening and a drug storage container including a delivery member having an insertion end configured to extend at least partially through the opening. The device may further include a plunger moveable in a distal direction with respect to the drug storage container to expel a drug from the drug storage container through the delivery member and a plunger biasing member configured to urge the plunger in the distal direction. The device may also include a guard positioned adjacent to the opening of the housing that is operably coupled with the plunger biasing member such that a relative movement between the guard and the housing along the longitudinal axis permits release of the plunger biasing member. The device may further include a lock component configured to resist the relative movement between the guard and the housing until the lock component is released. At least a portion of the lock component is rotatable with respect to the housing about the longitudinal axis, the at least a portion of the lock component has a first position where the at least a portion of the lock component resists the relative movement between the guard and the housing and a second position where the at least a portion of the lock component does not resist or offers less resistance to the relative movement between the guard and the housing. In at least some embodiments, release of

the lock component may allow for utilization of inertial forces from the user force to drive the housing and the drug storage container toward the injection site.

[0007] The lock component may include a lock ring rotatable with respect to the housing about the longitudinal axis. The lock ring may have a first position where the lock ring resists the relative movement between the guard and the housing and a second position where the lock ring does not resist the relative movement between the guard and the housing. The lock ring may

additionally or alternatively include a lock arm having a base and a deflectable end, where deflection of the deflectable end permits the lock ring to rotate between the first position and the second position. The lock arm may also include a lock ridge.

[0008] The guard may include an inertial rib configured to engage the lock ring and to resist rotational movement of the lock ring relative to the housing. The guard may further include an inertial rib configured to engage the deflectable end of the lock arm and resist movement of the lock ring from the first position to the second position. The guard may include a camming rib configured to engage a camming surface of the lock ring and urge the lock ring towards the second position.

[0009] The lock ring may include a camming surface configured to engage the guard and urge the lock ring towards a third position. The lock ring may also include a stop ridge configured to selectively engage the guard and limit or resist relative movement between the guard and the lock ring along the longitudinal axis, when the lock ring is in the third position.

[0010] The guard may include a proximally-facing camming surface and the housing may include a distally-facing camming surface. The lock ring may include a distally-facing camming surface and a proximally-facing camming surface configured to engage respectively the proximally-facing camming surface of the guard and the distally-facing camming surface of the housing when the lock ring is in the first position to resist proximal movement of the guard. One or more of the proximally-facing camming surface of the guard and the distally-facing camming surface of the housing may urge the lock ring to rotate from the first position toward the second position during proximal movement of the guard. The distally-facing camming surface of the lock ring may be configured to disengage from the proximally-facing camming surface of the guard when the lock ring rotates into the second position.

[0011] The lock ring may include a radially outwardly extending protrusion and the radially outwardly extending protrusion may include the distally-facing camming surface. The guard may include a radially inwardly extending protrusion and the radially inwardly extending protrusion may include the first proximally-facing camming surface.

[0012] Any two or combination of the following are parallel to each other: the proximally-facing camming surface of the guard, the distally-facing camming surface of the housing, the distally-facing camming surface of the lock ring, and the proximally-facing camming surface of the lock ring.

[0013] Another aspect of the present disclosure provides a drug delivery device including a housing defining a longitudinal axis and having an opening and a drug storage container including a delivery member having an insertion end configured to extend at least partially through the opening. The device may further include a plunger moveable in a distal direction with respect to the drug storage container to expel a drug from the drug storage container through the delivery member and a plunger biasing member configured to urge the plunger in the distal direction. The device may also include a guard positioned adjacent to the opening such that the housing has a first position with respect to the guard where the plunger biasing member is locked and a second position with respect to the guard where the plunger biasing member is unlocked. The device may further include a lock component configured to maintain the housing in the first position until the lock component is released. At least a portion of the lock component is rotatable with respect to the housing about the longitudinal axis, the at least a portion of the lock component has a first position where the at least a portion of the lock component resists the relative movement between the guard and the housing and a second position where the at least a portion of the lock component does not resist or offers less resistance to the relative movement between the guard and the housing. In at least some embodiments, release of the lock component may allow for utilization of inertial forces from the user force to drive the housing and the drug storage container toward the injection site.

[0014] Another aspect of the present disclosure provides a method of using a drug delivery, including providing a drug delivery device including a housing, a drug storage container having a delivery member and coupled with the housing such as to substantially prevent relative movement therebetween, a plunger movable with respect to the drug

storage container to expel a drug from the drug storage container through the delivery member, a plunger biasing member configured to urge the plunger in the distal direction, a guard coupled with the housing, and a lock component configured to resist relative movement between the guard and the housing. Another step may include placing the drug delivery device such that the guard

surrounds an injection site. Yet another step may include applying a force to the housing toward the injection site sufficient to overcome resistance of the lock component and permit relative movement between the housing and the guard, thereby driving the housing and the drug storage container toward the injection site. In at least some embodiments, overcoming resistance of the lock component may allow for utilization of inertial forces from the user force to drive the housing and the drug storage container towards the injection site. At least a portion of the lock component is rotatable with respect to the housing, the at least a portion of the lock component has a first position where the at least a portion of the lock component resists the relative movement between the housing and the guard and a second position where the at least a portion of the lock component does not resist or offers less resistance to the relative movement between the housing and the guard.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] It is believed that the disclosure will be more fully understood from the following description taken in conjunction with the accompanying drawings. Some of the drawings may have been simplified by the omission of selected elements for the purpose of more clearly showing other elements. Such omissions of elements in some drawings are not necessarily indicative of the presence or absence of particular elements in any of the exemplary embodiments, except as may be explicitly delineated in the corresponding written description. Also, none of the drawings is necessarily to scale.

[0016] Fig. 1A is a perspective view of an exemplary drug delivery device in accordance with various embodiments;

[0017] Fig. 1B is a perspective view of the drug delivery device in Fig. 1A, with a cap removed therefrom;

[0018] Fig. 1C is a perspective view of the drug delivery device in Fig. 1A, in a pre-injection configuration;

[0019] Fig. 1D is a perspective view of the drug delivery device in Fig. 1A, in an injection configuration;

[0020] Fig. 2 is cross-sectional view of the drug delivery device in Fig. 1;

[0021] Fig. 3A is an exploded assembly view of a portion, namely the drive mechanism, of the drug delivery device in Fig. 2;

[0022] Fig. 3B is an exploded assembly view of the drug delivery device in Fig. 2;

[0023] Fig. 4A is a perspective view of an exemplary drug storage container for use with a drug delivery device in accordance with various embodiments;

[0024] Fig. 4B is a perspective view of an exemplary container holder for use with a drug delivery device in accordance with various embodiments, where the container holder is in an open position;

[0025] Fig. 4C is a perspective view of the container holder in Fig. 4B coupled with the drug storage container in Fig. 4A, where the container holder is in a closed position;

[0026] Fig. 4D is a perspective view of an exemplary container holder for use with a drug delivery device in accordance with various embodiments, where the container holder is in a closed position;

[0027] Fig. 4E is a perspective view of an exemplary housing for use with a drug delivery device in accordance with various embodiments;

[0028] Fig. 4F is a partial cross-sectional view of the container holder and the drug storage container, taken around line 4F-4F in Fig. 4C;

[0029] Fig. 5A is a partial cross-sectional view of the container holder, the drug storage container, taken around line 5A-5A in Fig. 4C, as well as a partial cross-sectional view of a distal portion of an exemplary plunger guide coupled with the container holder and the drug storage container;

[0030] Fig. 5B is a perspective view of an exemplary plunger guide in accordance with various embodiments;

[0031] Fig. 5C is a perspective, partial cross-sectional view of the plunger guide in Fig. 5B;

[0032] Fig. 6A is a perspective view of an exemplary guard member in accordance with various embodiments;

[0033] Fig. 6B is a perspective view of an exemplary guard extension in accordance with various embodiments;

[0034] Fig. 6C is a perspective, partial cross-sectional, view of the guard extension, the releaser, and the plunger guide, wherein the components are in a pre-injection position;

- [0035] Fig. 7A is a perspective view of an exemplary releaser member in accordance with various embodiments;
- [0036] Fig. 7B is another perspective view of the releaser member in Fig. 7A;

What is claimed is:

1. A drug delivery device comprising:
 - a housing defining a longitudinal axis and having an opening;
 - a drug storage container including a delivery member having an insertion end configured to extend at least partially through the opening during a delivery state;
 - a plunger moveable in a distal direction with respect to the drug storage container to expel a drug from the drug storage container through the delivery member;
 - a plunger biasing member configured to urge the plunger in the distal direction;
 - a guard positioned adjacent to the opening, the guard operably coupled with the plunger biasing member such that a relative movement between the guard and the housing along the longitudinal axis permits release of the plunger biasing member;
 - and
 - a lock component configured to resist the relative movement between the guard and the housing until the lock component is released,wherein at least a portion of the lock component is rotatable with respect to the housing about the longitudinal axis, the at least a portion of the lock component having a first position where the at least a portion of the lock component resists the relative movement between the guard and the housing and a second position where the at least a portion of the lock component does not resist or offers less resistance to the relative movement between the guard and the housing.
2. The drug delivery device of claim 1, wherein at least the portion of the lock component includes a lock ring.
3. The drug delivery device of claim 2, wherein the lock ring includes a lock arm having a base and a deflectable end, wherein deflection of the deflectable end permits the lock ring to rotate between the first position and the second position.
4. The drug delivery device of claim 3, wherein the deflectable end includes a lock ridge.
5. The drug delivery device of any of claims 2 through 4, wherein the guard includes an inertial rib configured to engage the lock ring and resist rotational movement of the lock ring relative to the housing.
6. The drug delivery device of claim 5, wherein the inertial rib is configured to engage the deflectable end of the lock arm and resist movement of the lock ring from the first position to the second position.
7. The drug delivery device of claim 6, wherein the guard further includes a camming rib configured to engage a first camming surface of the lock ring and urge the lock ring towards the second position.
8. The drug delivery device of claim 7, wherein the lock ring further includes:
 - a second camming surface configured to engage the guard and urge the lock ring towards a third position; and
 - a stop ridge configured to selectively engage the guard and limit or resist relative movement between the guard and the lock ring along the longitudinal axis when the lock ring is in the third position.
9. The drug delivery device of claim 2, wherein:
 - the guard includes a first proximally-facing camming surface,

the housing includes a first distally-facing camming surface, and

the lock ring includes a second distally-facing camming surface and a second proximally-facing camming surface configured to engage respectively the first proximally-facing camming surface of the guard and the first distally-facing camming surface of the housing when the lock ring is in the first position to resist proximal movement of the guard.

10. The drug delivery device of claim 9, wherein one or more of the first proximally-facing camming surface of the guard and the first distally-facing camming surface of the housing urges the lock ring to rotate from the first position toward the second position during proximal movement of the guard.

11. The drug delivery device of claim 10, wherein the second distally-facing camming surface of the lock ring is configured to disengage from the first proximally-facing camming surface of the guard when the lock ring rotates into the second position.

12. The drug delivery device of any of claims 9 through 11, wherein any two or combination of the following are parallel to each other: the first proximally-facing camming surface of the guard, the first distally-facing camming surface of the housing, the second distally-facing camming surface of the lock ring, and the second proximally-facing camming surface of the lock ring.

13. The drug delivery device of any of claims 9 through 12, wherein the lock ring includes a radially outwardly extending protrusion and the radially outwardly extending protrusion includes the second distally-facing camming surface.

14. The drug delivery device of any of claims 9 through 13, wherein the guard includes a radially inwardly extending protrusion and the radially inwardly extending protrusion includes the first proximally-facing camming surface.

15. A drug delivery device comprising:

a housing defining a longitudinal axis and having an opening;

a drug storage container including a delivery member having an insertion end configured to extend at least partially through the opening during a delivery state;

a plunger moveable in a distal direction with respect to the drug storage container to expel a drug from the drug storage container through the delivery member;

a plunger biasing member configured to urge the plunger in the distal direction;

a guard positioned adjacent to the opening such that the housing has a first position with respect to the guard where the plunger biasing member is locked and a second position with respect to the guard where the plunger biasing member is unlocked; and

a lock component configured to maintain the housing in the first position until the lock component is released,

wherein at least a portion of the lock component is rotatable with respect to the housing about the longitudinal axis, the at least a portion of the lock component having a first position where the at least a portion of the lock component resists the relative movement between the guard and the housing and a second position where the at least a portion of the lock component does not resist or offers less resistance to the relative movement between the guard and the housing.

16. The drug delivery device of claim 15, wherein at least the portion of the lock component includes a lock ring.

17. The drug delivery device of claim 16, wherein the lock ring includes a lock arm having a base and a deflectable end, wherein deflection of the deflectable end permits the lock ring to rotate between the first position and the second position.

18. The drug delivery device of claim 17, wherein the deflectable end includes a lock ridge.

19. The drug delivery device of any of claims 16 through 18, wherein the guard includes an inertial rib configured to engage the lock ring and resist rotational movement of the lock ring relative to the housing.

20. The drug delivery device of claim 19, wherein the inertial rib is configured to engage the deflectable end of the lock arm and resist movement of the lock ring from the first position to the second position.

21. The drug delivery device of claim 20, wherein the guard further includes a camming rib configured to engage a first camming surface of the lock ring and urge the lock ring towards the second position.

22. The drug delivery device of claim 21, wherein the lock ring further includes:
a second camming surface configured to engage the guard and urge the lock ring towards a third position; and
a stop ridge configured to selectively engage the guard and limit or resist relative movement between the guard and the lock ring along the longitudinal axis when the lock ring is in the third position.

23. The drug delivery device of claim 16, wherein:
the guard includes a first proximally-facing camming surface,
the housing includes a first distally-facing camming surface, and
the lock ring includes a second distally-facing camming surface and a second proximally-facing camming surface configured to engage respectively the first proximally-facing camming surface of the guard and the first distally-facing camming surface of the housing when the lock ring is in the first position to resist proximal movement of the guard.

24. The drug delivery device of claim 23, wherein one or more of the first proximally-facing camming surface of the guard and the first distally-facing camming surface of the housing urges the lock ring to rotate from the first position toward the second position during proximal movement of the guard.

25. The drug delivery device of claim 24, wherein the second distally-facing camming surface of the lock ring is configured to disengage from the first proximally-facing camming surface of the guard when the lock ring rotates into the second position.

26. The drug delivery device of any of claims 23 through 25, wherein any two or combination of the following are parallel to each other: the first proximally-facing camming surface of the guard, the first distally-facing camming surface of the housing, the second distally-facing camming surface of the lock ring, and the second proximally-facing camming surface of the lock ring.

27. The drug delivery device of any of claims 23 through 26, wherein the lock ring includes a radially outwardly extending protrusion and the radially outwardly extending protrusion includes the second distally-facing camming surface.

28. The drug delivery device of any of claims 23 through 27, wherein the guard includes a radially inwardly extending protrusion and the radially inwardly extending protrusion includes the first proximally-facing camming surface.

29. A method of using a drug delivery device, comprising:

providing a drug delivery device including a housing, a drug storage container having a delivery member and coupled with the housing such as to substantially prevent relative movement therebetween, a plunger movable with respect to the drug storage container to expel a drug from the drug storage container through the delivery member, a plunger biasing member configured to urge the plunger in the distal direction, a guard coupled with the housing, and a lock component configured to resist relative movement between the guard and the housing;

placing the drug delivery device such that the guard surrounds an injection site; and

applying a force to the housing toward the injection site sufficient to overcome the lock component and permit relative movement between the housing and the guard, thereby driving the housing and the drug storage container toward the injection site,

wherein at least a portion of the lock component is rotatable with respect to the housing, the at least a portion of the lock component having a first position where the at least a portion of the lock component resists the relative movement between the housing and the guard and a second position where the at least a portion of the lock component does not resist or offers less resistance to the relative movement between the housing and the guard.