

DRUG DELIVERY DEVICE

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," and U.S. Provisional Application No. 62/961,031, filed January 14, 2020, entitled, "Drug Delivery Device," each of which is incorporated by reference.

FIELD OF DISCLOSURE

[0002] The present disclosure relates to drug delivery devices, and, more particularly, devices 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] Many injector systems use coil and other spring structures to provide actuation energy for functions such as needle insertion and/or fluid delivery. The use of springs can offer benefits of simplicity and low cost, but it may have certain limitations. For example, there is a linear relationship between force and displacement in spring actuators. To provide sufficient energy for drug delivery at the end of plunger stroke, an excessive amount of energy may be input to the system as drug delivery commences. As another example, as higher viscosity drugs are delivered via autoinjectors, the requisite spring forces will likely increase. Springs with higher spring constants may transmit more force to the drug product and primary container. Various physical characteristics of a spring may affect the spring rate, and thus the spring force, such as wire diameter of the spring, mean diameter of the spring, the number of spring coils, and the spring material. Therefore, it may be desirable and/or advantageous to include device components that permit flexibility in spring design and/or that facilitate the use of springs with different physical characteristics with the remaining device components.

[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] According to a first aspect of the present invention, there is provided 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 during a delivery state. The device may further include a plunger moveable toward a distal end of the drug storage container to expel a drug from the drug storage container through the delivery member, the plunger including a body portion having an inner wall defining an axial chamber and an outer wall cooperating with the inner wall to define a body thickness less than 0.6 millimeters. The device may also include a plunger biasing member coupled with the plunger and configured to urge the plunger toward the distal end of the drug storage container.

[0007] The plunger body portion may have a hollow tubular shape. The plunger body portion may be made of metal or non-metal.

[0008] The plunger may be configured to selectively rotate from an initial rotational position to a second rotational position under a biasing force exerted by the plunger biasing member and to translate linearly toward the distal end of the drug storage container under the biasing force exerted by the plunger biasing member after rotating from the initial rotational position to the second rotational position.

[0009] The device may further include a plunger guide fixed relative to the housing, the plunger being disposed at least partially within the plunger guide. One of the plunger and the plunger guide may comprises a cam and the other one of the plunger and the plunger guide may comprises a cam follower.

[0010] The plunger may include the cam follower and the plunger guide includes the cam, and the cam follower may be formed by at least one flange extending radially outwardly from the plunger.

[0011] The plunger body thickness may be less than 0.6 millimeters, less than 0.4 millimeters, less than 0.3 millimeters, less than 0.2 millimeters, less than 0.1 millimeters, or less than 0.05 millimeters.

[0012] According to a second aspect of the present invention, there is provided a drug delivery device including a housing defining a longitudinal axis and having an opening; a guard moveably disposed adjacent to the opening; and 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. The device may further include a plunger moveable toward a distal end of the drug storage container to expel a drug from the drug storage container through the delivery member, the plunger including a body portion having an inner wall defining an axial chamber and an outer wall cooperating with the inner wall to define a body thickness. The device may also include a plunger biasing member disposed at least partially within the axial chamber, the plunger biasing member configured to urge the plunger toward the distal end of the drug storage container; and a releaser member configured to rotate relative to the housing and operably coupling the guard and the plunger at least during activation, wherein the plunger is configured to: selectively rotate from an initial rotational position to a second rotational position under a biasing force exerted by the plunger biasing member, and translate linearly toward the distal end of the drug storage container under the biasing force exerted by the plunger biasing member after rotating from the initial rotational position to the second rotational position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] 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.

[0014] Fig. 1A is a perspective view of an exemplary drug delivery device in accordance with various embodiments;

[0015] Fig. 1B is a perspective view of the drug delivery device in Fig. 1A, with a cap removed therefrom;

[0016] Fig. 1C is a perspective view of the drug delivery device in Fig. 1A, in a pre-injection configuration;

[0017] Fig. 1D is a perspective view of the drug delivery device in Fig. 1A, in an injection configuration;

[0018] Fig. 2 is cross-sectional view of the drug delivery device in Fig. 1;

[0019] Fig. 3A is an exploded assembly view of a portion, namely the drive mechanism, of the drug delivery device in Fig. 2;

[0020] Fig. 3B is an exploded assembly view of the drug delivery device in Fig. 2;

[0021] Fig. 4A is a perspective view of an exemplary drug storage container for use with a drug delivery device in accordance with various embodiments;

[0022] 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;

[0023] 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;

[0024] 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;

[0025] Fig. 4E is a perspective view of an exemplary housing for use with a drug delivery device in accordance with various embodiments;

[0026] 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;

[0027] 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;

[0028] Fig. 5B is a perspective view of an exemplary plunger guide in accordance with various embodiments;

[0029] Fig. 5C is a perspective, partial cross-sectional view of the plunger guide in Fig. 5B;

[0030] Fig. 6A is a perspective view of an exemplary guard member in accordance with various embodiments;

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 toward a distal end of the drug storage container to expel a drug from the drug storage container through the delivery member, the plunger including a body portion having an inner wall defining an axial chamber and an outer wall cooperating with the inner wall to define a body thickness less than 0.6 millimeters; and
 - a plunger biasing member coupled with the plunger and configured to urge the plunger toward the distal end of the drug storage container.
2. The drug delivery device of claim 1, wherein the body thickness is less than 0.4 millimeters.
3. The drug delivery device of claim 1, wherein the body thickness is less than 0.3 millimeters.
4. The drug delivery device of claim 1, wherein the body thickness is less than 0.2 millimeters.
5. The drug delivery device of claim 1, wherein the body thickness is less than 0.1 millimeters.
6. The drug delivery device of claim 1, wherein the body thickness is less than 0.05 millimeters.
7. A drug delivery device comprising:
 - a housing defining a longitudinal axis and having an opening;
 - a guard moveably disposed adjacent to the 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 toward a distal end of the drug storage container to expel a drug from the drug storage container through the delivery member, the plunger including a body portion having an inner wall defining an axial chamber and an outer wall cooperating with the inner wall to define a body thickness;
 - a plunger biasing member disposed at least partially within the axial chamber, the plunger biasing member configured to urge the plunger toward the distal end of the drug storage container; and
 - a releaser member configured to rotate relative to the housing and operably coupling the guard and the plunger at least during activation,wherein the plunger is configured to:
 - selectively rotate from an initial rotational position to a second rotational position under a biasing force exerted by the plunger biasing member, and
 - translate linearly toward the distal end of the drug storage container under the biasing force exerted by the plunger biasing member after rotating from the initial rotational position to the second rotational position.
8. The drug delivery device of claim 7, wherein the body portion has a hollow tubular shape.

9. The drug delivery device of claim any one of claims 7 or 8, wherein the body portion is made of metal.
10. The drug delivery device of claim any one of claims 7 or 8, wherein the body portion is made of a non-metal.
11. The drug delivery device of any one of claims 7 through 10, further comprising a plunger guide fixed relative to the housing, the plunger being disposed at least partially within the plunger guide.
12. The drug delivery device of claim 11, wherein one of the plunger and the plunger guide comprises a cam and the other one of the plunger and the plunger guide comprises a cam follower.
13. The drug delivery device of claim 12, wherein the plunger includes the cam follower and the plunger guide includes the cam, and wherein the cam follower is formed by at least one flange extending radially outwardly from the plunger.
14. The drug delivery device of any one of claims 7 through 13, wherein the body thickness is less than 0.6 millimeters.
15. The drug delivery device of any one of claims 7 through 13, wherein the body thickness is less than 0.4 millimeters.
16. The drug delivery device of any one of claims 7 through 13, wherein the body thickness is less than 0.3 millimeters.
17. The drug delivery device of any one of claims 7 through 13, wherein the body thickness is less than 0.2 millimeters.
18. The drug delivery device of any one of claims 7 through 13, wherein the body thickness is less than 0.1 millimeters.
19. The drug delivery device of any one of claims 7 through 13, wherein the body thickness is less than 0.05 millimeters.