

**[0006]** The insertion and/or retraction movements of the trocar and/or cannula may be accomplished by incorporating an insertion mechanism disposed within the drug delivery device. Such an insertion mechanism, however, may increase the overall size, complexity, and/or cost of the drug delivery device.

**[0007]** The present disclosure sets forth insertion mechanisms and related methods embodying advantageous alternatives to existing insertion mechanisms and methods that may address one or more of the challenges or needs described herein, as well as provide other benefits and advantages.

## **SUMMARY**

**[0008]** In accordance with a first aspect, a wearable drug delivery device may include a housing, a drug storage container positioned at least partially within the housing, an insertion mechanism positioned at least partially within the housing. The insertion mechanism includes a delivery member connected or configured to be connected in fluid communication with the drug storage container, the delivery member being moveable between a first position wherein an insertion portion of the delivery member is positioned within the housing and a second position wherein the insertion portion of the delivery member is positioned exterior to the housing for insertion into a patient. Further, the insertion mechanism include a hub operably coupled with the delivery member, a power source configured to generate rotational motion, and a motion conversion mechanism

operatively coupled with the power source and the hub, the motion conversion mechanism being configured to convert the rotational motion of the power source into linear motion of the hub to move the delivery member between the first position and the second position. ~~The motion conversion mechanism includes a rotatable member, a slot, and a connector member slidably received in the slot and coupled to the rotatable member.~~ The operation of the power source causes at least a portion of the motion conversion mechanism to rotate about a rotational axis, the rotational axis being substantially stationary with respect to the housing during rotation of the at least a portion of the motion conversion mechanism.

**[0009]** ~~In accordance with a second aspect, There is disclosed~~ an insertion mechanism that may include a trocar or hollow delivery needle, a housing having a proximal end and a distal end. Further, the insertion mechanism may include a manifold and movable relative to the housing between a first manifold position adjacent to the proximal end of the housing and a second manifold position adjacent to

the distal end of the housing. A hub carrying the trocar or hollow delivery needle may be removably connected to the manifold, the hub being movable relative to the housing between a first hub position adjacent to the proximal end of the insertion mechanism housing and a second hub position adjacent to the distal end of the housing. Further, a power source may be configured to generate rotational motion, and a motion conversion mechanism may be operatively connecting the power source and the hub, and configured to convert the rotational motion of the power source into linear motion of the hub.

**[0010]** ~~In accordance with a third aspect,~~ There is disclosed a method that may include providing a wearable drug delivery device comprising a container, a drug disposed in the container, an insertion mechanism, and a fluid pathway connector defining a sterile fluid flow path between the container and the insertion mechanism, the insertion mechanism having an insertion mechanism housing, a hub, a trocar or hollow delivery needle secured to the hub, a manifold in fluid communication with the fluid pathway and carried by the hub, a power source configured to generate rotational motion, a motion conversion mechanism having a rotating member operatively connecting the power source and the hub, and configured to convert the rotational motion of the power source into linear motion of the hub. Next, the method may include disposing the wearable drug delivery device in contact with a patient's skin and activating the power source to linearly move the hub, trocar or hollow delivery needle, and manifold in a distal direction so that the trocar or hollow delivery needle penetrates the patient's skin. Following, the method includes retracting the trocar or hollow delivery needle from the patient by moving the hub in the proximal direction. The method may include expelling the drug from the container, through the fluid pathway connector for subcutaneous delivery to the patient.

**[0011]** In further accordance with any one or more of the foregoing first and second aspects and methods, the insertion mechanism for a drug delivery device and method may include any one or more of the following forms or method steps.

**[0012]** In one form, the insertion mechanism may include a cannula having a hollow interior and being axially aligned with the trocar or hollow delivery needle. The manifold may be configured to fluidly connect the hollow interior of the cannula and the fluid pathway connector.

What is Claimed:

1. A wearable drug delivery device comprising:

a housing;

a drug storage container positioned at least partially within the housing; and

an insertion mechanism positioned at least partially within the housing and including:

a delivery member connected or configured to be connected in fluid communication with the drug storage container, the delivery member being moveable between a first position wherein an insertion portion of the delivery member is positioned within the housing and a second position wherein the insertion portion of the delivery member is positioned exterior to the housing for insertion into a patient,

a hub operably coupled with the delivery member,

a power source configured to generate rotational motion, and

a motion conversion mechanism ~~operatively~~ coupled with the power source and the hub, the motion conversion mechanism being configured to convert the rotational motion of the power source into linear motion of the hub to move the delivery member between the first position and the second position,

~~wherein the motion conversion mechanism includes a rotatable member, a slot, and a connector member slidably received in the slot and coupled to the rotatable member.~~

wherein operation of the power source causes at least a portion of the motion conversion mechanism to rotate about a rotational axis, the rotational axis being substantially stationary with respect to the housing during rotation of the at least a portion of the motion conversion mechanism.

2. The wearable drug delivery device of claim 1, comprising at least one fluid conduit configured to fluidly connect the delivery member and the drug storage container, the at least one fluid conduit being coupled to the hub such that at least a portion of the fluid conduit and the hub translate jointly during insertion of the delivery member into the patient.

3. The wearable drug delivery device of claim 1, wherein at least a portion of the motion conversion mechanism includes a~~the~~ rotatable member ~~is~~ operably coupled to the hub and rotatable about ~~a~~the rotational axis by the power source.

4. The wearable drug delivery device of any one of claims 1 to 3, wherein the motion conversion mechanism includes a slot and a connector member slidably received in the slot, wherein rotation of the rotatable member causes the connector member to slide against a wall defining ~~a~~the slot.

5. The wearable drug delivery device of claim 1, wherein the connector member is a pin fixed to the rotatable member.

6. The wearable drug delivery device of claim 3, wherein the rotational axis is traverse to a longitudinal axis of the delivery member.

7. The wearable drug delivery device of claim 3, wherein the power source includes a torsional ~~al~~ spring.

8. The wearable drug delivery device of claim 7, wherein at least a portion of the torsion spring is exterior to the rotatable member.

9. The wearable drug delivery device of claim 3, wherein initial rotation of the rotatable member causes the delivery member to translate from the first position to the second position and subsequent rotation of the rotatable member causes the delivery member to translate from the second position to the first position.

10. The wearable drug delivery device of any one of claims 1-9, wherein the delivery member includes a hollow needle.

11. The wearable drug delivery device of claim 1, wherein the delivery member includes a solid trocar.

12. The wearable drug delivery device of claim 1, comprising an adhesive applied to an exterior wall of the housing for attaching the housing to skin of a patient.

13. The wearable drug delivery device of claim 12, comprising an opening formed in the exterior wall of the housing, wherein the insertion portion of the delivery member extends through the opening in the second position.