TITLE OF THE INVENTION

[0001] Fluid Delivery Device Needle Retraction Mechanisms, Cartridges and Expandable Hydraulic Fluid Seals

CROSS-REFERENCE TO RELATED APPLICATIONS

[0002] This application claims the benefit of U.S. Provisional Patent Application No. 61/353,004 filed June 9, 2010 entitled "Fluid Delivery Device Cartridges, Needle Retraction Mechanisms and Expandable Hydraulic Fluid Seals", incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

[0003] The present invention generally relates to a fluid delivery device and more particularly to fluid delivery device needle retraction mechanisms, cartridges and expandable hydraulic fluid seals for use with an ambulatory device for delivering a medicament to a patient.

[0004] Many attempts have been made to provide continuous or near continuous dosing of drugs and other fluids, such as insulin, using pump systems. Although some systems for continuous delivery work quite well, individuals using these systems, particularly in continuous dose mode, need to monitor the devices closely to ensure continuity and accuracy of dosing under variable environmental conditions such as temperature and air pressure. In addition, there are few options for individuals who require the ability to vary the dose of medication quickly and accurately, and most of the available options are cumbersome, difficult to operate, intrusive, and/or expensive.

[0005] Accordingly, it would be desirable to provide a simple, intuitive, inexpensive ambulatory device able to provide fluid dosing under patient control, as well as safety and consistency in the metered or continuous dose over a wide range of environmental conditions.

BRIEF SUMMARY OF THE INVENTION

[0005a] According to a first aspect of the present invention, there is provided a fluid delivery device comprising: a housing having a first hydraulic chamber and a second hydraulic chamber; a flow restrictor fluidly coupling the first hydraulic chamber and the second hydraulic chamber; a cartridge having a container forming a fluid reservoir sealed at a proximal end with a piston, the

cartridge being insertable into the housing to couple the piston with the second hydraulic chamber, the fluid reservoir being substantially filled with a liquid and the second hydraulic chamber being filled with a hydraulic fluid prior to inserting the cartridge within the housing, the cartridge including a septum configured to be pierced by a delivery needle; and an actuator coupled to the housing and configured to deliver a force to the piston through the first and second hydraulic chambers.

[0005b] According to a second aspect of the present invention, there is provided a fluid delivery device comprising: a housing having a first hydraulic chamber and a second hydraulic chamber; a flow restrictor fluidly coupling the first hydraulic chamber and a second hydraulic chamber; a cartridge forming a fluid reservoir between a slideable piston and a septum configured to receive a delivery needle, the cartridge including a stopper configured to seal a distal end of the cartridge after the fluid reservoir is substantially filled with a liquid, the piston being coupled with the second hydraulic chamber; and an actuator coupled to the housing and configured to deliver a force to the piston through the first and second hydraulic chambers.

[0005c] According to a third aspect of the present invention, there is provided a fluid delivery device comprising: a housing having a first hydraulic chamber and a second hydraulic chamber; a flow restrictor fluidly coupling the first hydraulic chamber and a second hydraulic chamber; a fluid reservoir having a piston; a seal sealing an end of the second hydraulic chamber and configured to couple with the piston, the seal being expandable between a compressed position and an expanded position; and an actuator coupled to the first hydraulic chamber and configured to expand the seal, move the piston and deliver a force to the fluid reservoir through the first and second hydraulic chambers.

[0006] In one embodiment there is a fluid delivery device that comprises (a) a housing configured to be coupled to a skin surface in an engaged position, (b) a fluid reservoir coupled to the housing, (c) an actuator coupled to the housing and configured to deliver a force to the fluid reservoir, the actuator having a first position and a second position, and (c) a needle assembly having a needle the needle having a delivery end configured to extend from the housing and into the skin surface in a delivery configuration, the needle assembly being configured to

CLAIMS

I/we claim:

1. A fluid delivery device comprising:

a housing configured to be coupled to a skin surface in an engaged position;

a fluid reservoir coupled to the housing;

an actuator coupled to the housing and configured to deliver a force to the fluid reservoir, the actuator having a first position and a second position; and

a needle assembly having a needle, the needle having a delivery end configured to extend from the housing and into the skin surface in a delivery configuration, the needle assembly being configured to automatically withdraw the delivery end of the needle into the housing upon the actuator moving from the first position to the second position.

2. The fluid delivery device of claim 1 further comprising:

a locking member configured to keep the delivery end of the needle within the housing in a locked position.

3. The fluid delivery device of claim 2 further comprising:

a needle release configured to position the locking member into the locked position upon the actuator moving from the first position into the second position.

4. The fluid delivery device of claim 3, wherein the needle release is spring biased toward the locking member in the first position.

5. The fluid delivery device of claim 4, wherein the needle release includes at least one projection configured to engage with the locking member.

6. The fluid delivery device of claim 5, wherein the at least one projection is ramped.

7. The fluid delivery device of claim 2 further comprising:

an actuation button coupled to the needle and having a sleeve surrounding at least a portion of the needle, wherein the locking member is spring biased toward the sleeve, the sleeve having at least one abutment surface configured to engage with the locking member to prevent at least one of engaging and disengaging the needle.

8. The fluid delivery device of claim 7, wherein the at least one abutment surface includes a first abutment surface and a second abutment surface, the locking member engageable with the first abutment surface to releaseably retain the needle in the engaged position, the locking member engageable with the second abutment surface to unreleaseably retain the needle in the locked position.

9. The fluid delivery device of claim 8, wherein the first abutment surface is axially spaced along the needle from the second abutment surface and the actuation button is configured to be spring biased away from the skin surface in the delivery configuration.

10. The fluid delivery device of claim 3, wherein the needle release is spring biased, the needle release being retained in the first position by a lock release coupled to the actuator, the lock release configured to release the needle release and allow the needle release to move in a direction of the spring bias in the second position.

11. The fluid delivery device of claim 10, wherein the lock release includes a shaft extending from the actuator.

12. The fluid delivery device of claim 2, wherein the locking member comprises a helical torsion spring.

13. The fluid delivery device of claim 2, wherein the locking member is configured to releaseably retain the needle in the engaged position.

14. The fluid delivery device of claim 1 further comprising:

a first hydraulic chamber;

a second hydraulic chamber; and

a flow restrictor fluidly coupling the first hydraulic chamber and a second hydraulic chamber,

wherein the actuator is configured to deliver the force to the fluid reservoir through the first and second hydraulic chambers.

15. The fluid delivery device of claim 1, wherein the actuator reaches an end of travel in the second position.

16. The fluid delivery device of claim 1, wherein fluid is delivered through the needle in the first position and the fluid ceases to be delivered from the needle in the second position.

17. The fluid delivery device of claim 1, wherein the housing includes a bottom surface, the bottom surface including an adhesive configured to releaseably couple the housing to the skin surface in the engaged position.

18. A fluid delivery device comprising:

a housing having a bottom surface, the bottom surface including an adhesive configured to releaseably couple the housing to a skin surface in an engaged position;

a needle assembly having a needle, the needle having a delivery end configured to extend from the housing and into the skin surface in a delivery configuration, the needle assembly being configured to automatically withdraw the delivery end of the needle into the housing upon decoupling the bottom surface of the housing from the skin surface.

19. The fluid delivery device of claim 18 further comprising;

a locking member configured to keep the delivery end of the needle within the housing in a locked position.

20. The fluid delivery device of claim 19 further comprising:

a needle release configured to position the locking member into the locked position upon decoupling the housing from the skin surface.

21. The fluid delivery device of claim 20, wherein the needle release includes at least one projection configured to engage with the locking member.

22. The fluid delivery device of claim 21, wherein the at least one projection is ramped.

23. The fluid delivery device of claim 20, wherein the needle release is spring biased toward the skin surface in the engaged position.

24. The fluid delivery device of claim 20 further comprising:

a lock release configured to compress a spring biasing the needle release in the engaged position, the spring configured to move the needle release upon decoupling the housing from the skin surface.

25. The fluid delivery device of claim 20, wherein the needle release is contained within the housing in the engaged position and extends from the housing in the locked position.

26. The fluid delivery device of claim 19 further comprising:

an actuation button coupled to the needle and having a sleeve surrounding at least a portion of the needle, wherein the locking member is spring biased toward the sleeve, the sleeve having at least one abutment surface configured to engaging with the locking member to prevent at least one of engaging and disengaging the needle.

27. The fluid delivery device of claim 26, wherein the at least one abutment surface includes a first abutment surface and a second abutment surface, the locking member engageable with the first abutment surface to releaseably retain the needle in the engaged position, the locking member engageable with the second abutment surface to unreleaseably retain the needle in the locked position.

28. The fluid delivery device of claim 27, wherein the first abutment surface is axially spaced along the needle from the second abutment surface and the actuation button is configured to be spring biased away from the skin surface in the delivery configuration.

29. The fluid delivery device of claim 19, wherein the locking member comprises a helical torsion spring.

30. The fluid delivery device of claim 19, wherein the locking member is configured to releaseably retain the needle in the engaged position.

31. The fluid delivery device of claim 18 further comprising:

a fluid reservoir coupled to the housing; and

an actuator coupled to the housing and configured to deliver a force to the fluid reservoir.

32. The fluid delivery device of claim 31 further comprising:

a first hydraulic chamber;

a second hydraulic chamber; and

a flow restrictor fluidly coupling the first hydraulic chamber and a second hydraulic chamber,

wherein the actuator is configured to deliver a force to the fluid reservoir through the first and second hydraulic chambers.

33. The fluid delivery device of claim 31, wherein the actuator includes a first position and a second position, and

wherein the needle assembly is configured to automatically withdraw the delivery end of the needle into the housing upon the actuator moving from the first position to the second position.

34. A fluid delivery device comprising:

a housing having a first hydraulic chamber and a second hydraulic chamber;

a flow restrictor fluidly coupling the first hydraulic chamber and the second hydraulic chamber;

a cartridge having a container forming a fluid reservoir sealed at a proximal end with a piston, the cartridge being insertable into the housing and configured to couple the piston with the second hydraulic chamber, the fluid reservoir being substantially filled with a liquid prior to inserting the cartridge within the housing, the cartridge including a septum configured to be pierced by a delivery needle; and

an actuator coupled to the housing and configured to deliver a force to the piston through the first and second hydraulic chambers.

35. The fluid delivery device of claim 34, further comprising a cartridge seal coupled between the proximal end of the cartridge and the housing when the cartridge is inserted into the housing.

36. The fluid delivery device of claim 35, wherein the cartridge seal is compressible.

37. The fluid delivery device of claim 35 further comprising:

a hydraulic cap extending through the cartridge seal and coupling the piston and the second hydraulic chamber.

38. The fluid delivery device of claim 37, wherein the hydraulic cap is substantially rigid.

39. The fluid delivery device of claim 35, wherein the proximal end of the cartridge includes an overflow channel in fluid communication with the second hydraulic chamber when the cartridge is inserted into the housing.

40. The fluid delivery device of claim 39, wherein the overflow channel is formed between an outer peripheral edge of the proximal end of the cartridge and an inner peripheral edge of the proximal end of the cartridge, the outer peripheral edge extending axially further from the cartridge than the inner peripheral edge.

41. The fluid delivery device of claim 35, wherein the cartridge seal covers the second hydraulic reservoir prior to inserting the cartridge into the housing and the second hydraulic

reservoir includes a piercing member configured to pierce the cartridge seal upon insertion of the cartridge into the housing.

42. The fluid delivery device of claim 41, wherein the piercing member includes a needle.

43. The fluid delivery device of claim 34, wherein the septum is slideably coupled with the container.

44. The fluid delivery device of claim 43, wherein the septum is configured to slide distally with respect to the container upon inserting the cartridge into the housing.

45. The cartridge of claim 43, wherein the septum includes a space for receiving an end of the delivery needle and a fluid passageway fluidly coupling the space and the fluid reservoir, the fluid passageway having a cross sectional area that is less than a cross sectional area of the space.

46. The cartridge of claim 43, wherein the septum seals a distal end of the container.

47. The cartridge of claim 43, wherein the septum is displaced with respect to the container when the septum is displaced upon inserting the cartridge into the housing.

47. The fluid delivery device of claim 34, wherein the cartridge includes a volume and a pressure, the volume being reduceable to enable insertion of the cartridge into the housing prior to engagement with the delivery needle and without changing the pressure.

48. The fluid delivery device of claim 34, wherein the second hydraulic chamber is configured to expel hydraulic fluid upon insertion of the cartridge into the housing.

49. The fluid delivery device of claim 34, wherein the cartridge further comprises a relief valve, the piston configured to expel air and/or fluid through the relief valve upon insertion of the cartridge into the housing.

50. The fluid delivery device of claim 34, wherein the cartridge further comprises a relief piston configured to slide distally upon insertion of the cartridge into the housing.

51. The fluid delivery device of claim 34, wherein the cartridge further comprises a septum configured to be pierced by the delivery needle.

52. The fluid delivery device of claim 34 further comprising:

a cap coupling the piston and the second hydraulic reservoir when the cartridge is inserted into the housing, the cap having a side wall and at least one of a top surface or a bottom surface that extends axially outwardly from the side wall, at least one of the top surface or the bottom surface being configured to invert upon inserting the cartridge into the housing.

53. A cartridge for use with a fluid delivery device comprising:

a container forming a fluid reservoir having a volume, a pressure and a septum configured to be pierced by a delivery needle, the volume being reduceable to enable insertion of the cartridge into the fluid delivery device prior to engagement with the delivery needle and without changing the pressure of the fluid reservoir.

54. The cartridge of claim 53, wherein the septum is slideably coupled with the container.

55. The cartridge of claim 53, wherein the septum is configured to slide distally with respect to the container upon inserting the cartridge with the fluid delivery device.

56. The cartridge of claim 53, wherein the septum includes a space for receiving an end of the delivery needle and a fluid passageway fluidly coupling the space and the fluid reservoir.

57. The cartridge of claim 53, wherein the septum seals a distal end of the container and a piston seals a proximal end of the container.

58. The cartridge of claim 53, wherein the septum is displaced with respect to the container when a piston within the container is displaced upon inserting the cartridge into the fluid delivery device.

59. The cartridge of claim 53 further comprising:

a piston slideable within the container.

60. The cartridge of claim 53, wherein the container is substantially rigid.

61. The cartridge of claim 53 further comprising:

a relief valve and a piston, the piston configured to expel air and/or fluid through the relief valve upon insertion of the cartridge into the fluid delivery device.

62. The cartridge of claim 53 further comprising:

a relief piston configured to slide distally upon insertion of the cartridge into the fluid delivery device.

63. A fluid delivery device comprising:

a housing having a first hydraulic chamber and a second hydraulic chamber;

a flow restrictor fluidly coupling the first hydraulic chamber and a second hydraulic chamber;

a cartridge forming a fluid reservoir between a slideable piston and a stopper, the stopper configured to seal a distal end of the cartridge after the fluid reservoir is substantially filled with a liquid, the piston being coupled with the second hydraulic chamber; and

an actuator coupled to the housing and configured to deliver a force to the piston through the first and second hydraulic chambers.

64. The fluid delivery device of claim 63, wherein the cartridge includes a septum configured to receive a delivery needle.

65. A fluid delivery device comprising:

a housing having a first hydraulic chamber and a second hydraulic chamber;

a flow restrictor fluidly coupling the first hydraulic chamber and a second hydraulic chamber;

a fluid reservoir;

a seal sealing the second hydraulic chamber and configured to couple with the fluid reservoir, the seal being expandable between a compressed position and an expanded position; and

an actuator coupled to the first hydraulic chamber and configured to expand the seal and deliver a force to the fluid reservoir through the first and second hydraulic chambers.

66. The fluid delivery device of claim 65, wherein the cross sectional area of a distal end of the seal is smaller than the cross sectional area of a proximal end of the seal in the expanded position.

67. The fluid delivery device of claim 66, wherein the seal includes at least two telescoping members.

68. The fluid delivery device of claim 66, wherein the seal includes at least two cylindrical members having different diameters.

69. The fluid delivery device of claim 66, wherein the seal is generally conically shaped in the expanded position.

70. The fluid delivery device of claim 65 further comprising a cartridge having a container, a slideable piston and the fluid reservoir.

CLAIMS

1. A fluid delivery device comprising: a housing having a first hydraulic chamber and a second hydraulic chamber; a flow restrictor fluidly coupling the first hydraulic chamber and the second hydraulic chamber; a cartridge having a container forming a fluid reservoir sealed at a proximal end with a piston, the cartridge being insertable into the housing to couple the piston with the second hydraulic chamber, the fluid reservoir being substantially filled with a liquid and the second hydraulic chamber being filled with a hydraulic fluid prior to inserting the cartridge within the housing, the cartridge including a septum configured to be pierced by a delivery needle; and an actuator coupled to the housing and configured to deliver a force to the piston through the first and second hydraulic chambers.

2. The fluid delivery device of claim 1, further comprising a cartridge seal coupled between the proximal end of the cartridge and the housing when the cartridge is inserted into the housing.

3. The fluid delivery device of claim 2, wherein the cartridge seal is compressible.

4. The fluid delivery device of claim 2 further comprising: a hydraulic cap covering an end of the second hydraulic chamber, the hydraulic cap extending through the cartridge seal and coupling the piston and the second hydraulic chamber.

5. The fluid delivery device of claim 4, wherein the hydraulic cap is substantially rigid.

6. The fluid delivery device of claim 2, wherein the proximal end of the cartridge includes an overflow channel in fluid communication with the second hydraulic chamber when the cartridge is inserted into the housing.

7. The fluid delivery device of claim 6, wherein the overflow channel is formed between an outer peripheral edge of the proximal end of the cartridge and an inner peripheral edge of the proximal end of the cartridge, the outer peripheral edge extending axially further from the cartridge than the inner peripheral edge.

8. The fluid delivery device of claim 2, wherein the cartridge seal covers an end of the second hydraulic reservoir prior to inserting the cartridge into the housing and the cartridge seal is pierced upon insertion of the cartridge into the housing.

9. The fluid delivery device of claim 8, wherein the second hydraulic reservoir includes a piercing member configured to pierce the cartridge seal upon insertion of the cartridge into the housing.

10. The fluid delivery device of claim 9, wherein the piercing member includes a needle.

11. The fluid delivery device of claim 1, wherein the septum is slideably coupled with the container.

12. The fluid delivery device of claim 11, wherein the septum is configured to slide distally with respect to the container upon inserting the cartridge into the housing.

13. The cartridge of claim 11, wherein the septum includes a space for receiving an end of the delivery needle and a fluid passageway fluidly coupling the space and the fluid reservoir, the fluid passageway having a cross sectional area that is less than a cross sectional area of the space.

14. The cartridge of claim 11, wherein the septum seals a distal end of the container.

15. The cartridge of claim 11, wherein the septum is displaced with respect to the container when the septum is displaced upon inserting the cartridge into the housing.

16. The fluid delivery device of claim 1, wherein the second hydraulic chamber is configured to expel hydraulic fluid upon insertion of the cartridge into the housing.

17. The fluid delivery device of claim 1, wherein the cartridge further comprises a relief valve, the piston configured to expel air and/or fluid through the relief valve upon insertion of the cartridge into the housing.

18. The fluid delivery device of claim 1, wherein the cartridge further comprises a relief piston configured to slide distally upon insertion of the cartridge into the housing.

19. The fluid delivery device of claim 1 further comprising: a cap coupling the piston and the second hydraulic reservoir when the cartridge is inserted into the housing, the cap having a side wall and at least one of a top surface or a bottom surface that extends axially outwardly from the side wall, at least one of the top surface or the bottom surface being configured to invert upon inserting the cartridge into the housing.

20. The fluid delivery device of claim 1, wherein the cartridge includes a volume and a pressure, the volume being reduceable to enable insertion of the cartridge into the housing prior to engagement with the delivery needle and without changing the pressure.

21. The fluid delivery device of claim 1, wherein the cartridge includes an pre-insertion pressure prior to inserting the cartridge into the housing and an assembled pressure after the cartridge has been inserted into the housing and prior to engagement with the delivery needle, the pre-insertion pressure being generally equal to the assembled pressure.

22. The fluid delivery device of claim 1, wherein there is substantially no air between the second hydraulic chamber and the septum after the cartridge has been inserted into the housing.

23. A fluid delivery device comprising: a housing having a first hydraulic chamber and a second hydraulic chamber; a flow restrictor fluidly coupling the first hydraulic chamber and a second hydraulic chamber; a cartridge forming a fluid reservoir between a slideable piston and a septum configured to receive a delivery needle, the cartridge including a stopper configured to seal a distal end of the cartridge after the fluid reservoir is substantially filled with a liquid, the piston being coupled with the second hydraulic chamber; and an actuator coupled to the housing and configured to deliver a force to the piston through the first and second hydraulic chambers.

24. The fluid delivery device of claim 23, wherein the delivery needle is configured to pierce the septum in a direction generally perpendicular to a direction the stopper is inserted in the distal end of the cartridge.

25. A fluid delivery device comprising: a housing having a first hydraulic chamber and a second hydraulic chamber; a flow restrictor fluidly coupling the first hydraulic chamber and a second hydraulic chamber; a fluid reservoir having a piston; a seal sealing an end of the second hydraulic chamber and configured to couple with the piston, the seal being expandable between a compressed position and an expanded position; and an actuator coupled to the first hydraulic chamber and configured to expand the seal, move the piston and deliver a force to the fluid reservoir through the first and second hydraulic chambers.

26. The fluid delivery device of claim 25, wherein the cross sectional area of a distal end of the seal is smaller than the cross sectional area of a proximal end of the seal in the expanded position.

27. The fluid delivery device of claim 26, wherein the seal includes at least two telescoping members.

28. The fluid delivery device of claim 26, wherein the seal includes at least two cylindrical members having different diameters.

29. The fluid delivery device of claim 26, wherein the seal is generally conically shaped in the expanded position.

30. The fluid delivery device of claim 25, wherein the fluid reservoir is a prefilled cylindrical cartridge that is insertable into the housing.