CLAIMS

The invention claimed is:

1. A syringe device comprising:

a syringe body comprising a cylindrical housing and a chamber within the housing, the chamber having a longitudinal axis;

a piston comprising a stem, a longitudinal axis, a first end at a first end of the longitudinal axis and a second end opposing the first end, the first end being external to the chamber, the piston comprising a first opening at the first end and a second opening at the second end;

a fluid passageway extending through the first opening, longitudinally through the stem and through the second opening of the piston;

a third opening disposed along the longitudinal axis at a position between the first end and the second end of the piston other than at the first or second end of the piston and traversing the fluid passageway;

a valve, at least a portion of which is inserted within the third opening and orthogonally traversing the fluid passageway, the valve controlling selective fluid passage through the piston and being at least partially insertable within the cylindrical housing of the syringe body; and

a piston seal attached to the second end of the piston.

2. The device of claim 1 further comprising a hollow extension extending from the first end of the piston.

3. The device of claim 2 wherein the hollow extension is cylindrical.

4. The device of claim 2 wherein the hollow extension is configured to house a vial.

5. The device of claim 2 wherein the hollow extension is configured to reversibly receive a vial.

6. The device of claim 2 wherein the hollow extension comprises a base surface disposed distally relative to the first end of the piston, and wherein the hollow extension is configured to selectively retain a liquid.

7. The device of claim 2 further comprising a piercing structure disposed at least partially within the hollow extension.

8. The device of claim 7 wherein the piercing structure comprises a channel passing therethrough.

9. The device of claim 8 wherein the piercing structure has a tip, an external surface, and a base surface opposing the tip, and wherein the channel passes through the base surface and through the external surface at a position other than the tip.

10. The device of claim 8 wherein the channel is in fluid communication with the fluid passageway comprised by the piston.

11. The device of claim 8 wherein the piercing device is configured to puncture a septum associated with a vial and span the septum such that selective fluid communication is provided between the chamber and the vial through the fluid passageway and through the channel by way of the valve.

12. The device of claim 1, wherein the fluid passageway passes through the seal.

13. The device of claim 12 wherein the fluid passageway passes centrally through the seal.

14. The device of claim 1 wherein the stem comprises a first portion and a second portion, and wherein the valve is disposed at a junction between the first portion and the second portion.

15. The device of claim 1 wherein the valve is selected from the group consisting of a stopcock, a ball valve, a push-type valve, a slider valve, and a gate valve.

16. The device of claim 1 wherein the piston is longitudinally slideable relative to the chamber, wherein the valve is configured to be at least partially disposed within the chamber when the piston is slid into a forward-most position.

17. The device of claim 1 wherein the valve comprises an elastomeric material.

18. The device of claim 17 wherein the stem comprises a hard-plastic material.

19. A piercing structure comprising:

a head segment comprising a tip disposed at a first end of the structure, the head segment having a front surface and an opposing back surface, the front and back surfaces meeting each other at opposing cutting edges, the front surface being beveled and having a first solid bevel face and a second solid bevel face that meet each other along a centerline of the front surface;

a body portion comprising a base surface disposed at a second end opposing the first end; and

a fluid passageway passing radially centrally through the second end, radially centrally through the body portion and passing through a single opening in the front surface of the head segment at a location where the first and second solid bevel faces join without passing though the tip.

20. The piercing structure of claim 19 wherein the structure is configured to pierce a septum material having a thickness, and wherein the body portion has a length that is greater than the thickness.

21. The piercing structure of claim 20 wherein the body portion has a first segment having a first cross-sectional area, and a second segment having a second cross-sectional area greater than the first cross-sectional area, wherein the second segment extends between the base surface of the structure to the first segment.

22. The piercing structure of claim 21 wherein the second segment has a uniform circumference along an entirety of its length.

23. The piercing structure of claim 19 wherein the structure is arrowhead shaped.

24. A medication agent preparation system comprising:

a syringe comprising:

a syringe barrel having an internal chamber; and

a piston having a first end, a second end, and a fluid passageway passing longitudinally through the piston, at least a portion of the piston being inserted into the chamber, the portion comprising the first end;

a piercing structure associated with the second end of the piston, the piercing structure having a fluid channel and a tip;

a vial disposed proximate and movable relative to the tip of the piercing structure;

a first component of a medication agent disposed within the internal chamber;

a second component of the medication agent disposed within the vial; and

a valve associated with and orthogonally traversing the fluid passageway and disposed between the first end and the second end of the piston.

25. The system of claim 24 wherein the valve selectively isolates the first component from the second component.

26. The system of claim 24 further comprising a packaging material, wherein the vial is disposed at a position within the packaging material in a non-contacting relationship with the piercing structure upon initial packaging, and wherein the packaging material provides stabilization for the non-contacting relationship.

27. The system of claim 26 wherein the vial comprises a septum, and wherein the packaging material comprises a closed compartment which encloses the vial and the syringe and which allows manipulation of the vial position by an individual such that the septum may be punctured by the piercing structure without opening of the closed compartment.

28. The system of claim 26 wherein the packaging material comprises a closed compartment enclosing the syringe, the valve, and the vial, and wherein the packaging material allows manipulation of the valve through the packaging material for repositioning of the valve from a closed position to an open position.

29. The system of claim 26 wherein the packaging material provides an internal environment encompassing the syringe, the vial and the valve; wherein the piston is disposed at a first position relative to the chamber upon being initially packaged; wherein the packaging material allows manipulation of the vial position relative to the piercing device, manipulation of the valve, and manipulation of the piston position within the chamber without exposing any of the vial, the syringe or the valve to an environment external to the packaging.

30. The system of claim 29 wherein the internal environment is sterile.

31. The system of claim 29 wherein the manipulation of the vial, the valve and the piston provides mixing of the first and second component to form the medication agent.

32. A method of preparing a medication agent for administration to an individual, comprising:

providing a syringe device comprising a syringe barrel having a forward end that is capped and a piston disposed at an initial position relative to the syringe barrel, the piston having a first end within the syringe barrel, an opposing second end, and having a unitary fluid passageway passing longitudinally through the piston, through the first end and through the second end;

providing a first component of a medicant within the syringe barrel;

providing a second component of a medicant within a vial disposed within a vial housing associated with the second end of the piston;

providing a valve associated with the fluid passageway, the fluid passageway providing fluid communication between the vial and the syringe barrel, the valve being initially provided in a closed position blocking fluid passage through the passageway;

repositioning the valve to allow fluid passage between the vial and the syringe barrel;

after repositioning the valve, sliding the piston in a first direction to join the first component with the second component within the vial;

mixing the first and second components to produce the medication agent by repeated sliding of the piston in opposing directions; and

drawing the medication agent into the syringe barrel, the syringe device being administration-ready through the first end of the syringe without removal of the vial from the device.

33. The method of claim 32 further comprising:

providing a piercing structure within the vial housing; and

prior to the repositioning, utilizing the piercing structure to pierce a septum comprised by the vial, wherein the fluid passage between the vial and the syringe barrel comprises passage through the piercing structure.

34. The method of claim 32 further comprising closing the valve after drawing the medication agent into the syringe barrel.

35. The method of claim 32 wherein the valve is associated with the piston, wherein the valve is disposed external to the syringe barrel while the piston is in the initial position, and wherein the valve at least partially enters the barrel during the mixing.

36. The method of claim 32 wherein the piston comprises:

a seal disposed at a first end;

a second end opposing the first end; and

a stem portion between the first end and the second end, wherein the fluid passageway extends through the seal, through the stem and through the second end.

37. The method of claim 36 wherein the stem portion comprises a first segment, a second segment and a junction between the first and second segments, wherein the valve is disposed at the junction.

38. The method of claim 32 further comprising providing a piercing structure comprising:

a base portion;

a head portion having a tip, a beveled front surface and a back surface that joins the front surface at opposing cutting edges;

a stem portion extending between the base portion and the head portion, wherein the fluid passageway passes through the piercing structure radially centrally through the base and stem portions and through the head portion at a position on the front surface where two bevels meet and other than at the tip.

39. The method of claim 32 wherein at least one of the first and second components is in liquid form.

40. The method of claim 32 wherein the first component is a liquid and wherein joining the first and second components comprises flowing the first component into the vial.

41. The method of claim 32 wherein the second component is a liquid and wherein joining the first and second components comprises flowing the second component into the syringe barrel.

42. The method of claim 32 wherein the medication agent is administration-ready upon drawing into the syringe barrel, and wherein administering the agent to an individual comprises ejecting the agent from the syringe barrel while the valve is in the closed position.

43. The method of claim 42 further comprising attaching a needle to the syringe, and wherein the administering comprises ejecting the agent through the needle.

44. The method of claim 43 wherein the needle is attached after drawing the agent into the syringe barrel.

45. A method of preparing a medicant comprising:

providing a mixing device comprising:

a needleless syringe having a first end having an extension with a male fitting and a piston inserted within a second end; and

an adaptor connected to a first end of the syringe, the adaptor comprising a first port, a second port consisting of a female fitting associated with the first end of the syringe, a third

port associated with a vial, and a valve controlling fluid passage the ports; and

flowing a fluid into the adaptor through the first port and into the syringe through the second port.

46. The method of claim 45 wherein the vial contains a first component of a medicant, and further comprising mixing the fluid with the first component.

47. The method of claim 45 wherein the syringe contains a second component, and wherein the fluid is mixed with the second component prior to mixing with the first component.

48. A medicant preparation device comprising:

a syringe barrel having a first end with an extension comprising a male fitting, a second end, and a longitudinal axis therebetween;

a piston insertable within the syringe barrel through the second end, the piston being slideable within the barrel;

a vial containing a material;

an adapter component comprising:

a vial housing portion configured to reversibly receive the vial;

a port consisting of a female fitting configured to attach to the syringe at the male fitting at the first end of the syringe barrel;

a valve;

a first fluid passageway extending through the fitting to the valve; and

a second fluid passageway extending from the valve to the vial housing; and

flexible packaging configured to allow manipulation of the valve and sliding of the piston without opening of the package.

49. The device of claim 48 wherein the first and second passageways are orthogonal relative to each other.

50. The device of claim 48 wherein the adaptor component further comprises a third fluid passageway which extends from the valve, and wherein the valve is a three way valve.

51. The device of claim 48 wherein at least a portion of the packaging comprises a translucent material.

52. The device of claim 48 wherein the packaging comprises a removable portion, wherein prior to the removal of the removable portion at least one of the piston and valve are resistant to manipulation, and wherein removing the removable portion decreases the resistance to manipulation of at least one of the piston and the valve without exposing the syringe barrel, the piston or the adaptor component to an environment external to the packaging.

53. The device of claim 48 wherein a vial containing a first component of a medication agent is contained within the package.

54. The device of claim 53 wherein a second component is provided within the syringe barrel.

55. The device of claim 48 further comprising a piercing structure associated with the adaptor component.

56. The device of claim 48 wherein a vial having a septum is contained within the package, wherein the device further comprises a piercing structure, wherein the packaging allows manipulation of the vial position relative to the piercing structure, and wherein the piercing structure does not contact the septum prior to manipulation.

57. A device comprising:

a housing around a chamber;

a piston having a first end, a second end, and a fluid passageway from the first end to the second end, the piston being insertable into the chamber;

a valve associated with the fluid passageway such that flow through the fluid passageway is selectively regulated by the valve, the valve being disposed between the first and second ends of the piston at a position other than at the first or second end; and

a piercing structure proximate the second end of the piston, the piercing structure comprising:

a base portion having a first diameter; ~~and~~

a head segment comprising a tip, the head segment having a beveled front surface comprising first and second solid bevel faces, and a back surface that joins the front surface at cutting edges; and

a tube segment extending between the base portion and the head segment, the tube portion having a second diameter that is smaller than the first diameter and being more narrow than a widest position across the head segment, the piercing structure having an opening extending radially centrally through the base and a single opening extending through the front surface of the head segment at a point other than the tip at a position where the first and second solid bevel faces meet, the opening being in fluid communication with the fluid passageway.

58. The device of claim 57 wherein the piston is insertable into the chamber through a first end of the housing and wherein the housing is configured to receive a needle at an opposing second end.

59. The device of claim 57 wherein the piston comprises a seal disposed at the first end and wherein the passageway passes through the seal.

60. The device of claim 57 wherein the piston comprises a stem having a first part and a second part, and wherein the valve is disposed at a junction between the first and second parts.

61. The device of claim 57 wherein the piston has a piston length between the first and second ends, wherein the passageway has a minimum diameter along the piston length, and wherein a ratio of the piston length to the minimum diameter is greater than or equal to about 10:1.

62. The device of claim 57 further comprising a container integral with the piston, wherein the container is in selective fluid communication with the chamber through the fluid passageway.

63. The device of claim 57 further comprising:

a hollow extension integral with the second end of the piston; and

wherein the piercing structure is disposed within the hollow extension, wherein the hollow extension is configured to receive a vial comprising a septum, and wherein the septum is able to be pierced by the piercing structure upon at least partial insertion of the vial within the housing.

64. The device of claim 63 wherein the opening comprised by the piercing structure allows fluid communication between the fluid passageway and an internal region of the vial upon piercing the septum.

65. A device comprising:

a housing around a chamber;

a piston structure having a first opening at a first end which is insertable into the chamber, a second opening at a second end opposing the first end, and a third opening along the piston between the first and second ends, the second end having a container enclosing a compartment extending therefrom, the piston comprising a two part stem having first portion extending from the first end and a second portion extending from the container, the first and second portions meeting at a junction;

a fluid passageway through the piston from the first opening to the second opening; and

a valve structure associated with the third opening and orthogonally traversing the fluid passageway such that flow through the fluid passageway is selectively regulated by the valve, at least a portion of the valve structure being inserted within the opening, the valve structure being at least partially insertable within the chamber.

66. The device of claim 65 wherein the valve is disposed at the junction.

67. The device of claim 65 wherein the container and the second portion are commonly molded.

68. The device of claim 65 wherein the container and the second portion are independently molded and are subsequently affixed together.

69. The device of claim 68 wherein the container and second portion are affixed by welding.

70. A system for preparing a medicant comprising:

a needleless syringe having an opening through a male extension fitting at a first end and a piston insertable within a second end;

a container having a first medicant component disposed therein;

an adaptor attachable to the first end of the syringe by a port consisting of a female fitting which matingly receives the male fitting of the syringe, and comprising a housing configured to receive the container;

a valve integral with the adaptor, the valve being configured to control fluid passage through the opening at the first end of the syringe; and

a second medicant component disposed within the syringe.

71. The system of claim 70 wherein the valve is a three-way valve configured to controllably establish fluid communication between the container and the syringe.

72. The system of claim 70 wherein the adaptor comprises:

a first segment extending from the position of the valve to a first fitting attachable to the first end of the syringe;

a second segment extending from the position of the valve; and

a third segment extending from the position of the valve, the third segment comprising a housing configured the receive the container, wherein the third segment is orthogonal relative to the first segment.

73. The system of claim 70 wherein the adaptor is attachable to the first end of the syringe by a locking luer fitting.

74. The system of claim 70 wherein the housing comprises a piercing structure, the piercing structure comprising:

a head portion having a tip, a beveled front surface and a back surface that joins with the front surface at opposing cutting edges;

a base portion having a first diameter;

a stem portion extending between the base portion and the head portion having a second diameter that is smaller than the first diameter; and

a fluid passageway extending radially centrally through the base portion, through the stem portion and through the front surface of the head portion at a position where two bevel surfaces meet and at a position other than at the tip.

75. A syringe device comprising:

a syringe body comprising a cylindrical housing and a chamber within the housing;

a piston insertable within the chamber and having a longitudinal axis, the piston comprising a first stem portion and a second stem portion, the first stem portion and second stem portions together forming a rotatable valve that is controlled by rotation of the second stem portion relative to the first stem portion;

a fluid passageway extending along the longitudinal axis through the stem, such that the rotatable valve controls fluid passage though the piston; and

a piston seal attached to the first stem portion and being independent of the rotatable valve.

76. The syringe device of claim 75 wherein the rotatable valve comprises at least one o-ring.

CLAIMS

1. A syringe device comprising:

a syringe body comprising a cylindrical housing and a chamber within the housing, the chamber having a longitudinal axis;

a piston comprising a stem, a longitudinal axis, a first end at a first end of the longitudinal axis and a second end opposing the first end, the first end being external to the chamber, the piston comprising a first opening at the first end and a second opening at the second end;

a fluid passageway extending through the first opening, longitudinally through the stem and through the second opening of the piston;

a third opening disposed along the longitudinal axis at a position between the first end and the second end of the piston other than at the first or second end of the piston and traversing the fluid passageway;

a valve, at least a portion of which is inserted within the third opening and orthogonally traversing the fluid passageway, the valve controlling selective fluid passage through the piston and being at least partially insertable within the cylindrical housing of the syringe body;

a piercing structure associated with the first end of the piston, the piercing structure a base having a first diameter, a head portion having a maximum width, and a tube segment extending between the base and the head portion, the tube segment having a second diameter that is smaller than the first diameter and shorter than the maximum width of the head portion; and

a piston seal attached to the second end of the piston.

2. The device of claim 1 further comprising a hollow extension extending from the first end of the piston.

3. The device of claim 2 wherein the hollow extension is cylindrical.

4. The device of claim 2 wherein the hollow extension is configured to house a vial.

5. The device of claim 2 wherein the hollow extension is configured to reversibly receive a vial.

6. The device of claim 2 wherein the hollow extension comprises a base surface disposed distally relative to the first end of the piston, and wherein the hollow extension is configured to selectively retain a liquid.

7. The device of claim 2 wherein the piercing structure is disposed at least partially within the hollow extension.

8. The device of claim 7 wherein the piercing structure comprises a channel passing therethrough.

9. The device of claim 8 wherein the piercing structure has a tip, an external surface, and a base surface opposing the tip, and wherein the channel passes through the base surface and through the external surface at a position other than the tip.

10. The device of claim 8 wherein the channel is in fluid communication with the fluid passageway comprised by the piston.

11. The device of claim 8 wherein the piercing device is configured to puncture a septum associated with a vial and span the septum such that selective fluid communication is provided between the chamber and the vial through the fluid passageway and through the channel by way of the valve.

12. The device of claim 1, wherein the fluid passageway passes through the seal.

13. The device of claim 12 wherein the fluid passageway passes centrally through the seal.

14. The device of claim 1 wherein the stem comprises a first portion and a second portion, and wherein the valve is disposed at a junction between the first portion and the second portion.

15. The device of claim 1 wherein the valve is selected from the group consisting of a stopcock, a ball valve, a push-type valve, a slider valve, and a gate valve.

16. The device of claim 1 wherein the piston is longitudinally slideable relative to the chamber, wherein the valve is configured to be at least partially disposed within the chamber when the piston is slid into a forward-most position.

17. The device of claim 1 wherein the valve comprises an elastomeric material.

18. The device of claim 17 wherein the stem comprises a hard-plastic material.

19. A syringe device comprising:

a syringe body comprising a cylindrical housing and a chamber within the housing;

a piston insertable within the chamber and having a longitudinal axis, the piston comprising a first stem portion and a second stem portion, the first stem portion and second stem portions together forming a rotatable valve that is controlled by rotation of the second stem portion relative to the first stem portion;

a fluid passageway extending along the longitudinal axis through the stem, such that the rotatable valve controls fluid passage though the piston; and

a piston seal attached to the first stem portion and being independent of the rotatable valve.

20. The syringe device of claim 19 wherein the rotatable valve comprises at least one o-ring.