WHAT IS CLAIMED IS:

1. An ejector device for ejecting fluid onto a surface, the device comprising:

a housing;

a reservoir having a volume (V_t) and containing or configured to receive a volume of fluid (V_f) disposed within said housing;

a fluid loading plate in fluid communication said reservoir; and

an ejector mechanism in fluid communication with said fluid loading plate;

wherein said fluid loading plate includes a fluid reservoir interface for attaching to the reservoir, an ejector mechanism interface for attaching the fluid loading plate to the ejector mechanism, and one or more fluid channels for channeling fluid from the fluid reservoir interface to the ejector mechanism interface, the fluid loading plate being configured so as to be placed in a parallel arrangement with the ejector mechanism so as to provide fluid to a rear surface of the ejector mechanism, said ejector mechanism being configured to eject a stream of droplets of said fluid through one or more openings.

2. The ejector device of claim 1, wherein said ejector device is capable of ejecting said stream of droplets when said ejector device is tilted.

3. The ejector device of claim 1, wherein said ejector device is capable of ejecting said stream of droplets when said ejector device is tilted up to 180 degrees upside-down.

4. The ejector device of claim 1, wherein said reservoir further comprises a fluid V_f in said volume V_t.

5. The ejector device according to claim 1, wherein said fluid is for ophthalmic, topical, oral, nasal, or pulmonary use.

6. The ejector device according to claim 4, wherein said reservoir further comprises a gas of volume V_{gas} in said volume V_t.

7. The ejector device of claim 1, wherein said reservoir is composed of a flexible material.

8. The ejector device of claim 1, wherein said reservoir is collapsible.

9. The ejector device of claim 8, wherein said collapsible reservoir is collapsed by volume V_c when filled with a volume of fluid V_f

10. The ejector device of claim 8, wherein said collapsible reservoir is under negative internal pressure.

RECTIFIED SHEET (RULE 91) ISA/EP

11. The ejector device of claim 9, wherein said collapsed reservoir expands in volume V_{exp} when exposed to a positive pressure differential, where the pressure inside the reservoir is greater than ambient pressure.

12. The ejector device of claim 11, wherein said volume V_r is chosen to be greater than the volume V_{exp} for a defined positive pressure differential.

13. The ejector device of claim 1, wherein said reservoir does not leak through said openings when is the reservoir is exposed to a positive pressure differential where the pressure inside the reservoir is greater than ambient pressure.

14. The ejector device of claim 13, wherein said pressure differential is less than or equal to 40 kPa.

15. The ejector device of claim 1, wherein the ejector mechanism is configured to eject a stream of droplets having an average ejected droplet diameter greater than 15 microns, with the stream of droplets having low entrained airflow so that the pressure of the stream of droplets onto the surface will be substantially imperceptible when sprayed against a human or animal body surface.

16. The ejector device of claim 1, wherein the ejector mechanism interface of the fluid load plate and the rear surface of the ejector mechanism are in parallel arrangement so as to form a capillary separation and generate fluid flow between the fluid load plate and the ejector mechanism at the rear surface of the ejector mechanism.

17. The ejector device of claim 16, wherein the fluid load plate and the ejector mechanism are separated by a distance of about 0.2 mm to about 0.5 mm so as to form capillary separation.

18. The ejector device of claim 1, wherein the ejector mechanism comprises an ejector plate coupled to a generator plate and a piezoelectric actuator; the generator plate including a plurality of openings formed through its thickness, the piezoelectric actuator being operable to oscillate the ejector plate, and thereby the generator plate, at a frequency and generate a directed stream of droplets.

19. The ejector device of claim 8, wherein the fluid load plate comprises a puncture plate fluid delivery system and a capillary plate that delivers the fluid from the collapsible reservoir to the ejector mechanism.

RECTIFIED SHEET (RULE 91) ISA/EP

20. The ejector device of claim 19, wherein the puncture plate fluid delivery system and capillary plate are integrally formed to define a puncture/capillary plate fluid delivery system.

21. The ejector device of claim 20, wherein the puncture/capillary plate fluid delivery system includes a fluid retention area and at least one hollow puncture needle for transferring fluid from the retention area to the ejector interface.

22. The ejector device of claim 21, wherein the puncture/capillary plate fluid delivery system includes first and second mating portions, the flexible reservoir being attached to and in fluid communication with the second mating portion, the second mating portion including a puncturable seal to define the retention area.

23. The ejector device of claim 22, wherein the first mating portion forms a receptacle for the second mating portion, and includes the at least one hollow puncture needle for puncturing the flexible reservoir.

24. The ejector device of claim 23, wherein the first mating portion and the at least one puncture needle may be integrally formed.

25. The ejector device of claim 22, wherein the puncturable seal that is included in the second mating portion comprises a self-sealing silicone.

26. The ejector device of claim 1, further comprising auto-closing system for reducing crystallization, evaporation, and contamination risk, the auto-closing system including a user-activated slide-plate for covering at least part of the ejector mechanism.

27. The ejector device of claim 26, wherein the ejector mechanism defines at least one ejector opening, and the slide-plate is configured to sealingly engage a gasket or seal formed around the at least one ejector opening, and is slidable between an open position in which the at least one ejector opening is exposed, and a close position in which the at least one ejector opening is covered by the slide-plate.

28. The ejector device of claim 27, wherein the slide-plate is biased toward its closed position by means of a spring.

29. The ejector device of claim 27, wherein the slide plate includes an opening configured to coincide with the at least one ejector opening in the ejector mechanism when the slide-plate is in its open position.

30. The ejector device of claim 29, wherein the auto-closing system includes means to ensure that the slide plate presses with sufficient pressure against the gasket or seal when in the closed position.

31. The ejector device of claim 1, wherein the ejector mechanism comprises an ejector plate coupled to a generator plate and a piezoelectric actuator, said generator plate including a plurality of openings formed through its thickness, and said piezoelectric actuator being operable to oscillate the ejector plate, and thereby the generator plate, at a resonant frequency of said ejector plate coupled to said generator plate to generate a directed stream of droplets.

32. The ejector device of claim 31, wherein the piezoelectric actuator is made of lead free piezoelectric material.

33. The ejector of claim 32, wherein the piezoelectric material is selected from the group consisting of a $BiFeO_3$-based material, a bismuth sodium titanate (BNT) material, bismuth potassium titanate (BKT) material, a dual-mode magnetostrictive/piezoelectric bilayered composite, tungsten-bronze material, a sodium niobate material, a barium titanate material, and a polyvinylidene fluoride material.

34. The device of claim 30, having an average ejected droplet diameter greater than 15 microns, the stream of droplets having low entrained airflow so that the pressure of the stream of droplets onto the surface will be substantially imperceptible when sprayed against a human or animal body target.

35. The device of claim 31, wherein said ejector plate has a central open region aligned with the plurality of openings of the generator plate, and the piezoelectric actuator is coupled to a peripheral region of the ejector plate so as not to obstruct the plurality of openings of the generator plate.

36. The device of claim 35, wherein said generator plate has a reduced size relative to said ejector plate, and the size of said generator plate is determined, at least in part, by the area occupied by said central open region and the arrangement of said plurality of openings.

37. The device of claim 36, wherein said ejector plate is circular and the actuator has an annular configuration, the ejector plate and the piezoelectric actuator having the same outer diameter.

38. The device of claim of claim 37, wherein said ejector plate is circular and the actuator has an annular configuration, the ejector plate has a larger outer diameter than d the piezoelectric actuator.

39. A device for delivering a fluid to a target, the device comprising:

a housing;

a reservoir disposed within the housing for receiving a volume of fluid or pre-filled with a volume of fluid; and

an centro-symmetric ejector mechanism in fluid communication with the reservoir and configured to eject a stream of droplets, said centro-symmetric ejector mechanism comprising an ejector plate coupled to a generator plate and a piezoelectric actuator, said generator plate including a plurality of openings formed through its thickness, and said piezoelectric actuator being operable to oscillate the ejector plate, and thereby the generator plate, at a resonant frequency of said ejector plate coupled to said generator plate to generate a directed stream of droplets.

40. The device of claim 39, wherein said piezoelectric actuator comprises a lead free piezoelectric material.

41. The device of claim 39, wherein said ejector plate further comprises a symmetric low order mounting structure.

42. The device of claim 41 wherein said piezoelectric actuator comprises a lead free piezoelectric material.

43. The device of claim 42, wherein said lead free piezoelectric material is selected from the group consisting of a $BiFeO_3$-based material, a bismuth sodium titanate (BNT) material, bismuth potassium titanate (BKT) material, a dual-mode magnetostrictive/piezoelectric bilayered composite, tungsten-bronze material, a sodium niobate material, a barium titanate material, a polyvinylidene fluoride material.

44. The device of claim 39, wherein said generator plate is a high modulus polymeric generator plate.

45. The device of claim 39, wherein the average ejected droplet diameter is greater than 15 microns, the stream of droplets having low entrained airflow so that the pressure of the stream of droplets onto the surface will be substantially imperceptible when sprayed against a human or animal body target.

46. The device of claim 39, wherein said ejector plate has a central open region aligned with the plurality of openings of the generator plate, and the piezoelectric actuator is coupled to a peripheral region of the ejector plate so as not to obstruct the plurality of openings of the generator plate.

47. The device of claim 46, wherein said generator plate has a reduced size relative to said ejector plate, and the size of said generator plate is determined, at least in part, by the area occupied by said central open region and the arrangement of said plurality of openings.

48. The device of claim 47, wherein said ejector plate is circular and the actuator has an annular configuration, the ejector plate and the piezoelectric actuator having the same outer diameter.

49. The device of claim of claim 47, wherein said ejector plate is circular and the actuator has an annular configuration, the ejector plate has a larger outer diameter than d the piezoelectric actuator.

50. An ejector mechanism configured to eject a stream of droplets, the ejector mechanism comprising:

an ejector plate coupled to a generator plate and a piezoelectric actuator;

the generator plate including a plurality of openings formed through its thickness; and

the piezoelectric actuator being operable to oscillate the ejector plate, and thereby the generator plate, at a frequency and generate a directed stream of droplets.

51. The ejector mechanism of claim 50, wherein said generator plate is a high modulus polymeric generator plate.

52. The device of claim 50, wherein said ejector plate further comprises a symmetric low order mounting structure.

53. The ejector mechanism of claim 50, wherein said piezoelectric actuator comprises a lead free piezoelectric material.

54. The ejector mechanism of claim 53, wherein said lead free piezoelectric material is selected from the group consisting of a $BiFeO_3$-based material, a bismuth sodium titanate (BNT) material, bismuth potassium titanate (BKT) material, a dual-mode magnetostrictive/piezoelectric bilayered composite, tungsten-bronze material, a sodium niobate material, a barium titanate material, and a polyvinylidene fluoride material.

55. The ejector mechanism of claim 50, wherein one or more of said plurality of openings defines an entrance cavity and a capillary channel.

56. The ejector mechanism of claim 50, wherein said generator plate is a high modulus polymer generator plate.

57. The ejector mechanism of claim 56, wherein the generator plate is formed from a material selected from the group consisting of: ultrahigh molecular weight polyethylene (UHMWPE), polyimide, polyether ether ketone (PEEK), polyvinylidene fluoride (PVDF), and polyetherimide.

58. The ejector mechanism of claim 50, wherein said ejector plate has a central open region aligned with the generator plate, and the piezoelectric actuator is coupled to a peripheral region of the ejector plate so as not to obstruct the plurality of openings of the generator plate.

59. The ejector mechanism of claim 58, wherein said generator plate has a reduced size relative to said ejector plate and the size of said generator plate is determined, at least in part, by the area occupied by said central open region and the arrangement of said plurality of openings.

60. The ejector mechanism of claim 58, wherein said ejector plate is circular and the actuator has an annular configuration, said ejector plate and said piezoelectric actuator having the same outer diameter.

61. The ejector mechanism of claim 58, wherein said ejector plate is circular and the actuator has an annular configuration, said ejector plate has a larger diameter than the piezoelectric actuator.

62. A reservoir for holding fluid for ejection by an ejector device, wherein the reservoir is collapsible.

63. The reservoir of claim 62, wherein said fluid is for ophthalmic, topical, oral, nasal, or pulmonary use.

64. The reservoir of claim 62, wherein said reservoir has a volume V_t and is provided with a fluid to a volume V_f, which is less than V_t.

65. The reservoir of claim 64, wherein said collapsible reservoir is collapsed by volume V_r when filled with the volume of fluid V_f.

66. The reservoir of claim 65, wherein said collapsible reservoir is under negative internal pressure.

67. The reservoir of claim 65, wherein said collapsed reservoir expands in volume V_{exp} when exposed to a positive pressure differential, where the pressure inside the reservoir is greater than ambient pressure .

68. The reservoir of claim 65, wherein said volume V_r is chosen to be greater than the volume V_{exp} for a defined positive pressure differential.

69. An ejector assembly, comprising:

a droplet ejector mechanism for ejecting fluid droplets,

a fluid loading plate for channeling fluid from a reservoir to the droplet ejector mechanism, comprising a fluid reservoir interface for attaching to the reservoir, an ejector mechanism interface for attaching the fluid loading plate to the ejector mechanism, and one or more fluid channels for channeling fluid from the fluid reservoir interface to the ejector mechanism interface, the fluid loading plate being configured so as to be placed in a parallel arrangement with the ejector mechanism so as to provide fluid to a rear surface of the ejector mechanism.

70. The fluid loading plate of claim 69, wherein the ejector mechanism interface of the fluid loading plate and the rear surface of the droplet ejector mechanism are in parallel arrangement so as to form a capillary separation and generate fluid flow between the fluid loading plate and the droplet ejector mechanism to define a fluid loading area at the rear surface of the droplet ejector mechanism.

71. The fluid loading plate of claim 70, wherein the fluid loading plate and the droplet ejector mechanism are separated by a distance of about 0.2 mm to about 0.5 mm so as to form capillary separation.

72. The fluid loading plate of claim 70, comprising a puncture plate fluid delivery system and a capillary plate that delivers the fluid from a reservoir to the ejector mechanim.

73. The fluid loading plate of claim 72, wherein the puncture plate fluid delivery system and capillary plate are integrally formed to define a puncture/capillary plate fluid delivery system.

74. The fluid loading plate of claim 73, wherein the puncture/capillary plate fluid delivery system includes a fluid retention area and at least one hollow puncture needle for transferring fluid from the retention area to the droplet ejector rear surface.

75. The fluid loading plate of claim 74, wherein the puncture/capillary plate fluid delivery system includes first and second mating portions, a flexible reservoir being attached

to and in fluid communication with the second mating portion, the second mating portion including a puncturable seal to define the fluid retention area.

76. The fluid loading plate of claim 75, wherein the first mating portion forms a receptacle for the second mating portion, and includes the at least one hollow puncture needle for puncturing the flexible reservoir.

77. The fluid loading plate of claim 76, wherein the first mating portion and the at least one puncture needle may be integrally formed.

78. The fluid loading plate of claim 76, wherein the puncturable seal that is included in the second mating portion comprises a self-sealing silicone.

WHAT IS CLAIMED IS:

1. An ejector device for ejecting fluid onto a surface, the device comprising:

a housing;

a reservoir having a volume (V_t) and containing or configured to receive a volume of fluid (V_f) disposed within said housing;

a fluid loading plate in fluid communication said reservoir; and

an ejector mechanism in fluid communication with said fluid loading plate;

wherein said fluid loading plate includes a fluid reservoir interface for attaching to the reservoir, an ejector mechanism interface for attaching the fluid loading plate to the ejector mechanism, and one or more fluid channels for channeling fluid from the fluid reservoir interface to the ejector mechanism interface,

the fluid loading plate being configured so as to be placed in a parallel arrangement with the ejector mechanism so as to form a capillary separation and generate capillary fluid flow between the fluid loading plate and the ejector mechanism at the rear surface of the ejector mechanism, said ejector mechanism being configured to eject a stream of droplets of said fluid through one or more openings.

2. The ejector device of claim 1, wherein said ejector device is capable of ejecting said stream of droplets when said ejector device is tilted.

3. The ejector device of claim 1, wherein said ejector device is capable of ejecting said stream of droplets when said ejector device is tilted up to 180 degrees upside-down.

4. The ejector device of claim 1, wherein said reservoir further comprises a fluid V_f in said volume V_t.

5. The ejector device according to claim 1, wherein said fluid is for ophthalmic, topical, oral, nasal, or pulmonary use.

6. The ejector device according to claim 4, wherein said reservoir further comprises a gas of volume V_{gas} in said volume V_t.

7. The ejector device of claim 1, wherein the ejector mechanism is configured to eject a stream of droplets having an average ejected droplet diameter greater than 15 microns, with the stream of droplets having low entrained airflow so that the pressure of the stream of droplets onto the surface will be substantially imperceptible when sprayed against a human or animal body surface.

8. The ejector device of claim 1, wherein the fluid load plate and the ejector mechanism are separated by a distance of about 0.2 mm to about 0.5 mm so as to form capillary separation.

9. The ejector device of claim 1, wherein the ejector mechanism comprises an ejector plate coupled to a generator plate and a piezoelectric actuator; the generator plate including a plurality of openings formed through its thickness, the piezoelectric actuator being operable to oscillate the ejector plate, and thereby the generator plate, at a frequency and generate a directed stream of droplets.

10. The ejector device of claim 1, wherein the ejector mechanism comprises an ejector plate coupled to a generator plate and a piezoelectric actuator, said generator plate including a plurality of openings formed through its thickness, and said piezoelectric actuator being operable to oscillate the ejector plate, and thereby the generator plate, at a resonant frequency of said ejector plate coupled to said generator plate to generate a directed stream of droplets.

11. The device of claim 10, wherein said ejector plate has a central open region aligned with the plurality of openings of the generator plate, and the piezoelectric actuator is coupled to a peripheral region of the ejector plate so as not to obstruct the plurality of openings of the generator plate.

12. The device of claim 11, wherein said generator plate has a reduced size relative to said ejector plate, and the size of said generator plate is determined, at least in part, by the area occupied by said central open region and the arrangement of said plurality of openings.

13. The device of claim 12, wherein said ejector plate is circular and the actuator has an annular configuration, the ejector plate and the piezoelectric actuator having the same outer diameter.

14. The device of claim of claim 13, wherein said ejector plate is circular and the actuator has an annular configuration, the ejector plate has a larger outer diameter than d the piezoelectric actuator.

15. An ejector assembly, comprising:

a droplet ejector mechanism for ejecting fluid droplets,

a fluid loading plate for channeling fluid from a reservoir to the droplet ejector mechanism, comprising a fluid reservoir interface for attaching to the reservoir, an ejector mechanism interface for attaching the fluid loading plate to the ejector mechanism, and one or more fluid channels for channeling fluid from the fluid reservoir interface to the ejector mechanism interface, the fluid loading plate being configured so as to be placed in a parallel arrangement with the ejector mechanism so as to form a capillary separation and generate capillary fluid flow between the fluid loading plate and the ejector mechanism at the rear surface of the ejector mechanism.

16. The ejector assembly of claim 15, wherein the fluid loading plate and the droplet ejector mechanism are separated by a distance of about 0.2 mm to about 0.5 mm so as to form capillary separation.