

We claim:

1. A device for mixing a plurality of fluids to formulate a mixture and for dispensing the mixture, the device comprising:
 - a plurality of cartridge assemblies each comprising a cartridge configured to contain one of the plurality of fluids;
 - a plurality of flow channels each having a central axis and each configured to communicate with a corresponding one of the cartridges;
 - a plurality of valve assemblies each positioned to communicate with one of the flow channels to adjust a mass flow rate of the fluid drawn from the corresponding cartridge;
 - a manifold assembly, comprising:
 - a manifold body having a mixing chamber and a plurality of inlets each configured to communicate with a corresponding one of the flow channels through which the fluid from the cartridge of the corresponding cartridge assembly is drawn into the mixing chamber during operation of the device;
 - a seal disposed within the manifold body adjacent to and having a size and a shape that substantially covers the inlets;
 - a spring disposed within the manifold body; and
 - a piston disposed within the manifold body between the seal and the spring, wherein the spring is moveable between an extended position in which the spring engages the piston to move the seal to a closed position that substantially and simultaneously closes the inlets from the flow channels and a compressed position that moves the seal away from the inlets to substantially and simultaneously open the inlets to the flow channels;
 - a dispensing pump assembly configured to communicate with the manifold assembly and configured to draw fluid from each of the cartridge assemblies; and
 - a nozzle configured to communicate with the dispensing pump assembly and to dispense the mixture;
 - wherein during operation the dispensing pump draws a volume of fluid from each cartridge through the corresponding flow channel and through the corresponding inlet into the mixing chamber to form the mixture, and
 - wherein during operation the mixture is drawn from the mixing chamber through the dispensing pump to the nozzle.
2. The device as in claim 1, wherein each cartridge assembly further comprises:

a closure device configured to substantially close the cartridge;
a conduit positioned within the cartridge;
a port positioned within the closure device and having an opened and a closed position and configured to communicate with the conduit and the corresponding flow channel in the opened position; and
a vent that is configured for entry of atmospheric air into the cartridge as fluid is removed when the dispensing pump is in a rebound state.

3. The device as in claim 1, further comprising a body encloses the cartridge assemblies, flow channels, valves, manifold assembly, and dispensing pump assembly.

4. The device as in claim 1, wherein a portion of the body is configured to open and close to provide access to the cartridge assemblies.

5. The device as in claim 1, wherein the cartridge assembly further comprises a bladder positioned in an interior of the cartridge and configured to hold the fluid.

6. The device as in claim 1, wherein the plurality of inlets is positioned in a base of the manifold body.

7. The device as in claim 1, wherein an outer surface of a side wall of the piston has at least one channel that extends substantially parallel to a central axis of the mixing chamber.

8. The device as in claim 1, wherein the adjustable valve is adjustable along a second axis that is not parallel to the central axis of the corresponding flow channel at a point along the flow channel at which the adjustable valve is adjacent and is configured to constrict a lumen of the flow channel to decrease the mass flow of fluid.

9. The device as in claim 8, wherein the adjustable valve comprises:
a control;
a threaded shaft that has a tip and that is mated to the control knob; and
a clamp into which the point along the flow channel is positioned;
wherein an axial rotation of the control in a first direction progressively moves the threaded shaft towards the clamp to a closed position that constricts the lumen of the flow channel; and

wherein an axial rotation of the control in a second direction progressively moves the threaded shaft away from the clamp to an opened position that rebounds the lumen of the flow channel.

10. The device as in claim 8, wherein the adjustable valve comprises:

a control;

a roller that is mated to the control;

a ramp that has an axis that is positioned at an angle relative to an axis of linear movement of the roller;

wherein the point along the flow channel is positioned between the roller and the clamp;

wherein a movement of the control in a first direction progressively moves the roller along the ramp to a closed position that constricts the lumen of the flow channel; and

wherein a movement of the control in a second direction progressively moves the roller along the ramp to an opened position that rebounds the lumen of the flow channel.

11. The device as in claim 1, wherein the adjustable valve is positioned within a lumen of the flow channel.

12. The device as in claim 11, wherein the adjustable valve comprises:

a control;

a needle having a tip and positioned within a valve body;

wherein the needle is mated to the control;

wherein an axial rotation of the control in a first direction axially advances the needle within the lumen of the flow channel;

wherein an axial rotation of the control in a second direction axially withdraws the needle within the lumen of the flow channel.

13. A device for mixing a plurality of fluids to form a mixture and for dispensing said mixture, comprising:

a plurality of cartridges each configured to contain one of the plurality of fluids;

a plurality of flow channels each having a central axis and each configured to communicate with a corresponding one of the cartridges;

a plurality of independently adjustable valves each positioned adjacent to one of the flow channels and adjustable along a second axis that is not parallel to the central axis to adjust a mass flow rate of the fluid drawn from the corresponding cartridge;

a manifold body having a plurality of inlets each configured to communicate with a corresponding one of the flow channels through which the fluid from the corresponding cartridge is drawn into a mixing chamber during operation;

a seal disposed within the manifold body adjacent to and sized to substantially cover the inlets;

a piston disposed within the manifold body between the seal and a spring, wherein the spring is moveable between an extended position in which the spring engages the piston to move the seal to a closed position that substantially and simultaneously closes the inlets from the flow channels and a compressed position that moves the seal away from the inlets to substantially and simultaneously open the inlets to the flow channels;

a dispensing pump configured for communication with the mixing chamber and configured to draw fluid from each of the cartridges; and

a nozzle configured for communication with the dispensing pump and configured to dispense the mixture,

wherein during operation the dispensing pump draws a volume of fluid from each cartridge through the corresponding flow channel and through the corresponding inlet into the mixing chamber to form the mixture, and

wherein during operation the mixture is drawn from the mixing chamber through the dispensing pump to the nozzle.

14. The device of claim 13, wherein each cartridge is removable.

15. The device of claim 13, further comprising at least two closure device each configured to substantially close a corresponding one of the cartridges.

16. The device of claim 13, further comprising:

a spike plate positioned downstream to the cartridges;

a second plate positioned downstream to the spike plate; and

a compressible layer positioned between the spike plate and second plate and into which flow channels are formed.

17. The device of claim 13, wherein an outer surface of a side wall of the piston has at least one channel that extends substantially parallel to a central axis of the mixing chamber.

18. The device of claim 13, wherein the closure device is positioned in an upstream portion of cartridges.

19. The device of claim 13, further comprising a spike plate positioned upstream to the cartridge and having at least two cannulated spikes configured to communicate with an interior of the cartridge and at least two uptake ports configured to communicate with the flow channels.

20. A device for mixing a plurality of fluids to form a mixture and for dispensing the mixture, comprising:

- a plurality of cartridge assemblies, each cartridge assembly comprising cartridge configured to contain one of the plurality of fluids;

- a plurality of flow channels each having a lumen having a diameter, a central axis, and each configured to communicate with a corresponding one of the cartridges, wherein the diameter of each flow channel is directly proportional to a mass flow rate of fluid drawn from the corresponding cartridge during operation of the device;

- a manifold assembly, comprising:

- a manifold body having a mixing chamber and a plurality of inlets each configured to communicate with a corresponding flow channel through which the fluid from the cartridge of the corresponding cartridge assembly is drawn into the mixing chamber during operation;

- a seal disposed within the manifold body adjacent to and sized to substantially and simultaneously close the inlets;

- a spring disposed within the manifold body; and

- a piston disposed within the manifold body between the seal and the spring, wherein the spring is moveable between an extended position in which the spring engages the piston to move the seal to a closed position that substantially and simultaneously closes the inlets from the flow channels and a compressed position that moves the seal away from the inlets to substantially and simultaneously open the inlets to the flow channels;

- a dispensing pump assembly configured for communication with the manifold assembly and configured to draw fluid from each of the cartridge assemblies; and

a nozzle configured for communication with the dispensing pump assembly and configured to dispense the mixture,

wherein during operation the dispensing pump draws the volume of fluid from each cartridge assembly through the corresponding inlet into the mixing chamber to form the mixture, and

wherein during operation the mixture is drawn from the mixing chamber through the dispensing pump to the nozzle.

21. The device of claim 20, wherein the diameter of each flow channel is different from the diameter of the other flow channels.

22. The device of claim 20, further comprising a plurality of independently adjustable valves each positioned to communicate with a corresponding one of the flow channels to adjust the mass flow rate of fluid drawn from the corresponding cartridge.

23. The device of claim 20, wherein an outer surface of a side wall of the piston has at least one channel that extends substantially parallel to a central axis of the mixing chamber.

We claim:

1. A device for mixing a plurality of fluids to formulate a mixture and for dispensing the mixture, the device comprising:

a plurality of cartridge assemblies each comprising a cartridge configured to contain one of the plurality of fluids;

a plurality of flow channels each having a central axis and each configured to communicate with a corresponding one of the cartridges;

a plurality of valve assemblies each positioned to communicate with one of the flow channels to adjust a mass flow rate of the fluid drawn from the corresponding cartridge;

a manifold assembly, comprising:

a manifold body having a mixing chamber and a plurality of inlets each configured to communicate with a corresponding one of the flow channels through which the fluid from the cartridge of the corresponding cartridge assembly is drawn into the mixing chamber during operation of the device;

a seal disposed within the manifold body adjacent to and having a size and a shape that substantially covers the inlets;

a spring disposed within the manifold body; and

a piston disposed within the manifold body between the seal and the spring, wherein the spring is moveable between an extended position in which the spring engages the piston to move the seal to a closed position that substantially and simultaneously closes the inlets from the flow channels and a compressed position that moves the seal away from the inlets to substantially and simultaneously open the inlets to the flow channels;

a dispensing pump assembly configured to communicate with the manifold assembly and configured to draw fluid from each of the cartridge assemblies; and

a nozzle configured to communicate with the dispensing pump assembly and to dispense the mixture;

wherein during operation the dispensing pump draws a volume of fluid from each cartridge through the corresponding flow channel and through the corresponding inlet into the mixing chamber to form the mixture, and

wherein during operation the mixture is drawn from the mixing chamber through the dispensing pump to the nozzle.

2. The device as in claim 1, wherein each cartridge assembly further comprises:

a closure device configured to substantially close the cartridge;
a conduit positioned within the cartridge;
a port positioned within the closure device and having an opened and a closed position and configured to communicate with the conduit and the corresponding flow channel in the opened position; and
a vent that is configured for entry of atmospheric air into the cartridge as fluid is removed when the dispensing pump is in a rebound state.

3. The device as in claim 1, further comprising a body encloses the cartridge assemblies, flow channels, valves, manifold assembly, and dispensing pump assembly.

4. The device as in claim 1, wherein a portion of the body is configured to open and close to provide access to the cartridge assemblies.

5. The device as in claim 1, wherein the cartridge assembly further comprises a bladder positioned in an interior of the cartridge and configured to hold the fluid.

6. The device as in claim 1, wherein the plurality of inlets is positioned in a base of the manifold body.

7. The device as in claim 1, wherein an outer surface of a side wall of the piston has at least one channel that extends substantially parallel to a central axis of the mixing chamber.

8. The device as in claim 1, wherein the adjustable valve is adjustable along a second axis that is not parallel to the central axis of the corresponding flow channel at a point along the flow channel at which the adjustable valve is adjacent and is configured to constrict a lumen of the flow channel to decrease the mass flow of fluid.

9. The device as in claim 8, wherein the adjustable valve comprises:
a control;
a threaded shaft that has a tip and that is mated to the control knob; and
a clamp into which the point along the flow channel is positioned;

wherein an axial rotation of the control in a first direction progressively moves the threaded shaft towards the clamp to a closed position that constricts the lumen of the flow channel; and

wherein an axial rotation of the control in a second direction progressively moves the threaded shaft away from the clamp to an opened position that rebounds the lumen of the flow channel.

10. The device as in claim 8, wherein the adjustable valve comprises:

a control;

a roller that is mated to the control;

a ramp that has an axis that is positioned at an angle relative to an axis of linear movement of the roller;

wherein the point along the flow channel is positioned between the roller and the clamp;

wherein a movement of the control in a first direction progressively moves the roller along the ramp to a closed position that constricts the lumen of the flow channel; and

wherein a movement of the control in a second direction progressively moves the roller along the ramp to an opened position that rebounds the lumen of the flow channel.

11. The device as in claim 1, wherein the adjustable valve is positioned within a lumen of the flow channel.

12. The device as in claim 11, wherein the adjustable valve comprises:

a control;

a needle having a tip and positioned within a valve body;

wherein the needle is mated to the control;

wherein an axial rotation of the control in a first direction axially advances the needle within the lumen of the flow channel;

wherein an axial rotation of the control in a second direction axially withdraws the needle within the lumen of the flow channel.

13. A device for mixing a plurality of fluids to form a mixture and for dispensing said mixture, comprising:

a plurality of cartridges each configured to contain one of the plurality of fluids;

a plurality of flow channels each having a central axis and each configured to communicate with a corresponding one of the cartridges; a plurality of independently adjustable valves each positioned adjacent to one of the flow channels and adjustable along a second axis that is not parallel to the central axis to adjust a mass flow rate of the fluid drawn from the corresponding cartridge;

a manifold body having a plurality of inlets each configured to communicate with a corresponding one of the flow channels through which the fluid from the corresponding cartridge is drawn into a mixing chamber during operation;

a seal disposed within the manifold body adjacent to and sized to substantially cover the inlets;

a piston disposed within the manifold body between the seal and a spring, wherein the spring is moveable between an extended position in which the spring engages the piston to move the seal to a closed position that substantially and simultaneously closes the inlets from the flow channels and a compressed position that moves the seal away from the inlets to substantially and simultaneously open the inlets to the flow channels;

a dispensing pump configured for communication with the mixing chamber and configured to draw fluid from each of the cartridges; and

a nozzle configured for communication with the dispensing pump and configured to dispense the mixture,

wherein during operation the dispensing pump draws a volume of fluid from each cartridge through the corresponding flow channel and through the corresponding inlet into the mixing chamber to form the mixture, and wherein during operation the mixture is drawn from the mixing chamber through the dispensing pump to the nozzle.

14. The device of claim 13, wherein each cartridge is removable.

15. The device of claim 13, further comprising at least two closure device each configured to substantially close a corresponding one of the cartridges.

16. The device of claim 13, further comprising: a spike plate positioned downstream to the cartridges; a second plate positioned downstream to the spike plate; and a compressible layer positioned between the spike plate and second plate and into which flow channels are formed.

17. The device of claim 13, wherein an outer surface of a side wall of the piston has at least one channel that extends substantially parallel to a central axis of the mixing chamber.

18. The device of claim 13, wherein the closure device is positioned in an upstream portion of cartridges.

19. The device of claim 13, further comprising a spike plate positioned upstream to the cartridge and having at least two cannulated spikes configured to communicate with an interior of the cartridge and at least two uptake ports configured to communicate with the flow channels.

20. A device for mixing a plurality of fluids to form a mixture and for dispensing the mixture, comprising:

- a plurality of cartridge assemblies, each cartridge assembly comprising cartridge configured to contain one of the plurality of fluids;

- a plurality of flow channels each having a lumen having a diameter, a central axis, and each configured to communicate with a corresponding one of the cartridges, wherein the diameter of each flow channel is directly proportional to a mass flow rate of fluid drawn from the corresponding cartridge during operation of the device;

- a manifold assembly, comprising:

- a manifold body having a mixing chamber and a plurality of inlets each configured to communicate with a corresponding flow channel through which the fluid from the cartridge of the corresponding cartridge assembly is drawn into the mixing chamber during operation;

- a seal disposed within the manifold body adjacent to and sized to substantially and simultaneously close the inlets;

- a spring disposed within the manifold body; and

- a piston disposed within the manifold body between the seal and the spring, wherein the spring is moveable between an extended position in which the spring engages the piston to move the seal to a closed position that substantially and simultaneously closes the inlets from the flow channels and a compressed position that moves the seal away from the inlets to substantially and simultaneously open the inlets to the flow channels;

- a dispensing pump assembly configured for communication with the manifold assembly and configured to draw fluid from each of the cartridge assemblies; and

- a nozzle configured for communication with the dispensing pump assembly and configured to dispense the mixture,

wherein during operation the dispensing pump draws the volume of fluid from each cartridge assembly through the corresponding inlet into the mixing chamber to form the mixture, and

wherein during operation the mixture is drawn from the mixing chamber through the dispensing pump to the nozzle.

21. The device of claim 20, wherein the diameter of each flow channel is different from the diameter of the other flow channels.

22. The device of claim 20, further comprising a plurality of independently adjustable valves each positioned to communicate with a corresponding one of the flow channels to adjust the mass flow rate of fluid drawn from the corresponding cartridge.

23. The device of claim 20, wherein an outer surface of a side wall of the piston has at least one channel that extends substantially parallel to a central axis of the mixing chamber.