or more additional inlets may be provided to input additional fluids into the pump/mixer for mixing.

[0013] In one particular embodiment, a pump/mixer device includes a main inlet located at the top or upper region of the pump/mixer, the main inlet configured to be secured to or integrated into a bottom of a vessel or container. An outer chamber is disposed in the pump/mixer and is fluidically connected to the main inlet. A plurality of lower chambers are disposed in the pump/mixer beneath the outer chamber and fluidically connected to the outer chamber by respective check valves interposed between the outer chamber and the plurality of lower chambers. A central chamber is disposed in the pump/mixer, wherein the central chamber is fluidically connected to the plurality of lower chambers with respective check valves interposed between the central chamber and the plurality of lower chambers. The pump/mixer has at least one outlet fluidically connected to the central chamber via respective outlet check valve(s). The pump/mixer has one or more additional inlets fluidically coupled to the central chamber via respective inlet check valve(s). A moveable diaphragm is disposed in each of the plurality of lower chambers, the moveable diaphragms interfacing with a respective actuating element driven by a wobble or nutating plate operatively coupled to a motor or drive unit, wherein actuation causes each of the moveable diaphragms to move in opposing directions (e.g., up and down). This movement pumps fluid through the pump/mixer.

[0014] In another embodiment, a method of operating the pump/mixer includes driving the motor or drive unit to actuate the wobble or nutating plate; inputting a first fluid from the vessel or container into the main inlet pump/mixer; inputting second or additional fluid(s) into the pump/mixer via the one or more additional inlets; mixing the first fluid and the second or additional fluid(s) in the central chamber of the pump/mixer; and outputting the mixed fluid via the at least one outlet.

[0015] In another embodiment, a pump device includes an inlet located at the top or upper region of the pump, the inlet configured to be secured to or integrated into a bottom of a vessel or container. An outer chamber is disposed in the pump and fluidically connected to the inlet. A plurality of lower chambers are disposed in the pump beneath the outer chamber and are fluidically connected to the outer chamber by respective check valves interposed between the outer chamber and the plurality of lower chambers. A central chamber is disposed in the pump, the central chamber is fluidically connected to the plurality of lower chambers with respective check valves interposed between the central chamber and the plurality of lower chambers. The pump device includes a plurality of outlets fluidically

connected to the central chamber via respective outlet check valve(s). A moveable diaphragm is disposed in each of the plurality of lower chambers, the moveable diaphragms interfacing with a respective actuating element driven by a wobble or nutating plate operatively coupled to a motor or drive unit, wherein actuation causes each of the moveable diaphragms to move in opposing directions (e.g., up and down).

[0016] In another embodiment, a method of operating the pump device includes driving the motor or drive unit to actuate the wobble or nutating plate; inputting a fluid from the vessel or container into the pump; and outputting the fluid from the pump via the plurality of outlets.

Brief Description of the Drawings

[0017] FIG. 1 illustrates a pump according to one embodiment. The pump includes a plurality of outlets. One or more of the outlets may be substituted with inlets (and inlet check valves) to create a pump/mixer as explained herein.

[0018] FIG. 2 illustrates an exploded view of a pump of the type illustrated in FIG. 1.

[0019] FIG. 3 illustrates a cross-sectional view of the pump embodiment of FIG. 1. The direction of fluid flow from the inlet to the outlet is illustrated by arrow A.

[0020] FIG. 4 is a cross-section illustrating the central housing of the pump of FIG. 1.

[0021] FIG. 5 is another cross-section taken along the central housing of the pump of FIG. 1.

[0022] FIG. 6A illustrates a top-down view of a pump/mixer device according to one embodiment.

[0023] FIG. 6B illustrates a top-down cross-section of the pump/mixer device of FIG. 6A that shows the how the wobble or nutating plate interfaces with the actuating ring and actuating elements to drive the pump/mixer. While the pump/mixer is shown in FIGS. 6A and 6B, the pumping operation is the same with the pump of FIG. 1.

[0024] FIG. 7 illustrates a pump/mixer according to one embodiment. The pump/mixer includes a plurality of inlets (5) and a single outlet.

[0025] FIG. 8 illustrates an exploded view of the pump/mixer of FIG. 7.

[0026] FIG. 9 illustrates a cross-sectional view of the pump/mixer of FIG. 7. The direction of fluid flow from the inlets (top and side) to the outlet is illustrated by arrows.

[0027] FIG. 10 is a cross-section showing the central housing of the pump/mixer of FIG. 7.

What is claimed is:

1. A pump/mixer device comprising:

a main inlet located at a top or upper region of the pump/mixer, the main inlet configured to be secured to or integrated into a bottom of a vessel or container;

an outer chamber disposed in the pump/mixer and fluidically connected to the main inlet;

a plurality of lower chambers disposed in the pump/mixer beneath the outer chamber and fluidically connected to the outer chamber by respective check valves interposed between the outer chamber and the plurality of lower chambers;

a central chamber disposed in the pump/mixer, the central chamber fluidically connected to the plurality of lower chambers with respective check valves interposed between the central chamber and the plurality of lower chambers;

at least one outlet fluidically connected to the central chamber;

one or more additional inlets fluidically coupled to the central chamber via respective inlet check valve(s); and

a moveable diaphragm disposed in each of the plurality of lower chambers, the moveable diaphragms interfacing with a respective actuating element driven by a wobble or nutating plate operatively coupled to a motor or drive unit, wherein actuation causes each of the moveable diaphragms to move in opposing directions.

2. The pump/mixer device of claim 1, wherein the pump/mixer comprises a plurality of outlets.

3. The pump/mixer device of claim 1, wherein the pump/mixer comprises a plurality of inlets.

4. The pump/mixer device of any of claims 1-3, wherein the wobble or nutating plate is coupled to the motor or drive unit by an eccentric drive shaft.

5. The pump/mixer device of claim 1, wherein the number of moveable diaphragms comprises an odd number of diaphragms.

6. The pump/mixer device of claim 1, wherein the number of moveable diaphragms comprises an even number of diaphragms.

7. The pump/mixer device of claim 1, wherein the one or more additional inlets are removable from the pump/mixer device.

8. The pump/mixer device of claim 1, wherein the one or more outlets are removable from the pump/mixer device.

9. The pump/mixer device of claim 1, wherein the one or more additional inlets are fluidically connected to a flow passage comprising a jet structure formed therein adjacent to respective inlet check valves.

10. The pump/mixer device of claim 1, further comprising a vortex breaker that extends or projects from the inlet and includes a plurality of fins formed about the periphery thereof.

11. The pump/mixer device of claim 1, wherein the pump/mixer device is removable from the vessel or container.

12. The pump/mixer device of claim 1, comprising an upper housing containing the main inlet, a central housing containing the plurality of lower chambers and the central chamber, and a bottom housing or plate containing the moveable diaphragms and secured to the central housing.

13. A method of operating the pump/mixer device any of claims 1-12 comprising:

driving the motor or drive unit to actuate the wobble or nutating plate;

inputting a first fluid from the vessel or container into the main inlet pump/mixer;

inputting second or additional fluid(s) into the pump/mixer via the one or more additional inlets;

mixing the first fluid and the second or additional fluid(s) in the central chamber of the pump/mixer; and

outputting the mixed fluid via the at least one outlet.

14. The method of claim 13, wherein the second or additional fluid(s) are inputted into the pump/mixer by one or more additional pumps.

15. The method of claim 13, wherein the one or more additional inlets contain or are coupled to respective valves, and one or more of the respective valves are actuated to initiate and/or stop flow of the second or additional fluid(s) into the pump/mixer.

16. The method of claim 13, wherein the second or additional fluid(s) comprises a buffer fluid or concentrated fluid.

17. A pump device comprising:

an inlet located at a top or upper region of the pump, the inlet configured to be secured to or integrated into a bottom of a vessel or container;

an outer chamber disposed in the pump and fluidically connected to the inlet;

a plurality of lower chambers disposed in the pump beneath the outer chamber and fluidically connected to the outer chamber by respective check valves interposed between the outer chamber and the plurality of lower chambers;

a central chamber disposed in the pump, the central chamber fluidically connected to the plurality of lower chambers with respective check valves interposed between the central chamber and the plurality of lower chambers;

a plurality of outlets fluidically connected to the central chamber; and

a moveable diaphragm disposed in each of the plurality of lower chambers, the moveable diaphragms interfacing with a respective actuating element driven by a wobble or nutating plate operatively coupled to a motor or drive unit, wherein actuation causes each of the moveable diaphragms to move in opposing directions.

18. The pump device of claim 17, wherein the wobble or nutating plate is coupled to the motor or drive unit by an eccentric drive shaft.

19. The pump device of claim 17, wherein the number of moveable diaphragms comprises an odd number of diaphragms.

20. The pump device of claim 17, wherein the number of moveable diaphragms comprises an even number of diaphragms.

21. The pump device of claim 17, wherein the plurality of outlets are removable from the pump device.

22. The pump device of claim 17, further comprising a vortex breaker that extends or projects from the inlet and includes a plurality of fins formed about the periphery thereof.

23. The pump device of claim 17, wherein the pump device is removable from the vessel or container.

24. The pump device of claim 17, comprising an upper housing containing the inlet, a central housing containing the plurality of lower chambers and the central chamber, and a bottom housing or plate containing the moveable diaphragms and secured to the central housing.

25. A method of operating the device any of claims 17-24 comprising:
driving the motor or drive unit to actuate the wobble or nutating plate;
inputting a fluid from the vessel or container into the pump; and
outputting the fluid from the pump via the plurality of outlets.