Claims

1. A fluid filtration system comprising:
a) at least one fluid storage vessel;
b) at least one filter containing compartment;
c) at least one fluid transfer line connecting the storage vessel to an entrance end of a filter containing compartment, which fluid transfer line is capable of directing a fluid from the storage vessel into the entrance end of the filter containing compartment;
d) at least one expansion chamber with at least two openings, wherein a first opening is connected at an exit end of the filter containing compartment and wherein a second opening is connected to a gas flow controller; wherein the expansion chamber contains no separation means between the first and second opening; and wherein at least one level sensor is mounted on or in the expansion chamber;
e) at least one gas flow controller for alternately providing the expansion chamber with positive and negative pressure;
f) at least one fluid harvest port connected to the filter containing compartment for removing filtered fluid from the filter containing compartment.

2. A fluid filtration system according to claim 1, wherein the expansion chamber is connected to the gas flow controller with a gas line.

3. A fluid filtration system according to any one of claims 1-2, wherein the gas line comprises a filter between the expansion chamber and the gas flow controller, preferably wherein the filter is a sterile filter, and optionally wherein the gas line comprises a sterile filter with heater.

4. A fluid filtration system according to any one of claims 1-3, wherein the fluid storage vessel is a bioreactor.

5. A fluid filtration system according to any one of claims 1-4, wherein the filter containing compartment contains a hollow fiber filter.

6. A fluid filtration system according to any one of claims 1-5, wherein at least two level sensors are mounted on or in the expansion chamber, and preferably wherein the level sensor is or level sensors are mounted on the surface of the expansion chamber.

7. A fluid filtration system according to any one of claims 1-6, wherein said level sensors are capable of measuring a minimal and a maximal fluid level in the expansion chamber, and functionally coupled to the gas flow controller.

8. A fluid filtration system according to any one of claims 1-7, capable of alternately aspirating the fluid of the system from the storage vessel, through the filter containing compartment into the expansion chamber, and expelling the fluid from said expansion chamber through the filter containing compartment back into the storage vessel, wherein fluid aspiration is performed by applying negative pressure into the expansion chamber and fluid expulsion is performed by applying positive pressure into the expansion chamber.

9. A fluid filtration system according to any one of claims 1-8, wherein said negative pressure is obtained by creating a vacuum in the expansion chamber and positive pressure is obtained by injecting gas, for instance compressed air, into the expansion chamber.

10. A fluid filtration system according to any one of claims 1-9, wherein the filter in the filter containing compartment comprises a plurality of bundled hollow fibers whose axes extend longitudinally from the entrance end to the exit end of the filter containing compartment.

11. A fluid filtration system according to any one of claims 1-10, wherein the filter containing compartment and the expansion chamber are disposable, preferably wherein the filter containing compartment, the expansion chamber, the fluid storage vessel and the fluid transfer line are disposable.

12. A process for filtering a fluid comprising:
a) providing a fluid filtration system comprising at least one fluid storage vessel;

at least one filter containing compartment; a fluid transfer line connecting the storage vessel to an entrance end of the filter containing compartment, which transfer line is capable of directing a fluid from the storage vessel into the entrance end of the filter containing compartment;
at least one expansion chamber connected on one side to an exit end of the filter containing compartment allowing for liquid from said compartment to enter the chamber and on the other side to a gas flow controller, which alternately provides negative and positive pressure into the expansion chamber thereby aspirating fluid from the exit end of the filter containing compartment and expelling fluid back into the exit end of the filter containing compartment, forming a direct gas-liquid interface without separation means into the expansion chamber; and at least one permeate port connected to the filter containing compartment for removing filtered fluid from the filter containing compartment;
b) drawing fluid out of the storage vessel through the filter into the expansion chamber by applying negative pressure into the expansion chamber;
c) expelling the fluid from the expansion chamber through the filter back into the storage vessel by applying positive pressure into the expansion chamber;
d) repeating steps b and c generating an alternative tangential flow of fluid through the filter; and
e) removing the filtered fluid from the filtration system.

13. A process for filtering a fluid according to claim 12, wherein the fluid storage vessel is a bioreactor.

14. A process for filtering a fluid according to any one of claims 12-13, wherein the filter containing compartment and/or the expansion chamber are disposable, preferably wherein the filter containing compartment, the expansion chamber, the fluid storage vessel and the fluid transfer line are disposable.

15. A process for filtering a fluid according to any one of claims 12-14, wherein the positive and negative pressure are regulated by level sensors which measure the fluid level in the expansion chamber.

16. A process for filtering a fluid according to claim 15, wherein the level sensors are mounted on the expansion chamber.

17. A process for filtering a fluid according to any one of claims 12-16, wherein the filter containing compartment contains a hollow fiber filter.

18. A process for filtering a fluid according to any one of claims 12-17, wherein said negative pressure is obtained by creating a vacuum in the expansion chamber and positive pressure is obtained by injecting gas, for instance compressed air, into the expansion chamber.

Claims

1. A fluid filtration system comprising:
a) at least one fluid storage vessel;
b) at least one filter containing compartment;
c) at least one fluid transfer line connecting the storage vessel to an entrance end of a filter containing compartment, which fluid transfer line is capable of directing a fluid from the storage vessel into the entrance end of the filter containing compartment;
d) at least one expansion chamber with at least two openings, wherein a first opening is connected at an exit end of the filter containing compartment and wherein a second opening is connected to a gas flow controller; wherein the expansion chamber contains no separation means between the first and second opening; and wherein at least one level sensor is mounted on or in the expansion chamber;
e) at least one gas flow controller for alternately providing the expansion chamber with positive and negative pressure;
f) at least one fluid harvest port connected to the filter containing compartment for removing filtered fluid from the filter containing compartment.

2. A fluid filtration system according to claim 1, wherein the expansion chamber is connected to the gas flow controller with a gas line.

3. A fluid filtration system according to any one of claims 1-2, wherein the gas line comprises a filter between the expansion chamber and the gas flow controller, preferably wherein the filter is a sterile filter, and optionally wherein the gas line comprises a sterile filter with heater.

4. A fluid filtration system according to any one of claims 1-3, wherein the fluid storage vessel is a bioreactor.

5. A fluid filtration system according to any one of claims 1-4, wherein the filter containing compartment contains a hollow fiber filter.

6. A fluid filtration system according to any one of claims 1-5, wherein at least two level sensors are mounted on or in the expansion chamber, and preferably wherein the level sensor is or level sensors are mounted on the surface of the expansion chamber.

7. A fluid filtration system according to any one of claims 1-6, wherein said level sensors are capable of measuring a minimal and a maximal fluid level in the expansion chamber, and functionally coupled to the gas flow controller.

8. A fluid filtration system according to any one of claims 1-7, capable of alternately aspirating the fluid of the system from the storage vessel, through the filter containing compartment into the expansion chamber, and expelling the fluid from said expansion chamber through the filter containing compartment back into the storage vessel, wherein fluid aspiration is performed by applying negative pressure into the expansion chamber and fluid expulsion is performed by applying positive pressure into the expansion chamber.

9. A fluid filtration system according to any one of claims 1-8, wherein said negative pressure is obtained by creating a vacuum in the expansion chamber and positive pressure is obtained by injecting gas, for instance compressed air, into the expansion chamber.

10. A fluid filtration system according to any one of claims 1-9, wherein the filter in the filter containing compartment comprises a plurality of bundled hollow fibers whose axes extend longitudinally from the entrance end to the exit end of the filter containing compartment.

11. A fluid filtration system according to any one of claims 1-10, wherein the filter containing compartment and the expansion chamber are disposable, preferably wherein the filter containing compartment, the expansion chamber, the fluid storage vessel and the fluid transfer line are disposable.

12. A process for filtering a fluid comprising:

a) providing a fluid filtration system comprising at least one fluid storage vessel;

at least one filter containing compartment; a fluid transfer line connecting the storage vessel to an entrance end of the filter containing compartment, which transfer line is capable of directing a fluid from the storage vessel into the entrance end of the filter containing compartment;
at least one expansion chamber connected on one side to an exit end of the filter containing compartment allowing for liquid from said compartment to enter the chamber and on the other side to a gas flow controller, which alternately provides negative and positive pressure into the expansion chamber thereby aspirating fluid from the exit end of the filter containing compartment and expelling fluid back into the exit end of the filter containing compartment, forming a direct gas-liquid interface without separation means into the expansion chamber; and
at least one permeate port connected to the filter containing compartment for removing filtered fluid from the filter containing compartment;
b) drawing fluid out of the storage vessel through the filter into the expansion chamber by applying negative pressure into the expansion chamber;
c) expelling the fluid from the expansion chamber through the filter back into the storage vessel by applying positive pressure into the expansion chamber;
d) repeating steps b and c generating an alternative tangential flow of fluid through the filter; and
e) removing the filtered fluid from the filtration system.

13. A process for filtering a fluid according to claim 12, wherein the fluid storage vessel is a bioreactor.

14. A process for filtering a fluid according to any one of claims 12-13, wherein the filter containing compartment and/or the expansion chamber are disposable, preferably wherein the filter containing compartment, the expansion chamber, the fluid storage vessel and the fluid transfer line are disposable.

15. A process for filtering a fluid according to any one of claims 12-14, wherein the positive and negative pressure are regulated by level sensors which measure the fluid level in the expansion chamber.

16. A process for filtering a fluid according to claim 15, wherein the level sensors are mounted on the expansion chamber.

17. A process for filtering a fluid according to any one of claims 12-16, wherein the filter containing compartment contains a hollow fiber filter.

18. A process for filtering a fluid according to any one of claims 12-17, wherein said negative pressure is obtained by creating a vacuum in the expansion chamber and positive pressure is obtained by injecting gas, for instance compressed air, into the expansion chamber.