CLAIMS

1. A gas supply and dispensing system, comprising:

an array of at least two gas storage and dispensing vessels arranged for sequential on-stream dispensing involving crossover from a first one or more on-stream vessels to a first one or more standby vessels in the array, said system used to dispense gas at a preset gas flow rate;

a manifold comprising piping and at least two valves in fluid communication with the array of vessels;

a controller; and

one or more sensors in communication with the controller, wherein said one or more sensors sense one or more predefined endpoints of the first one or more on-stream vessels thereby causing the controller to initiate auto-crossing from the first one or more on-stream vessels to the first one or more standby vessels in the array having gas therein, for subsequent dispensing of gas from said first one or more standby vessels;

wherein the controller after sensing the one or more predefined endpoints initiates flow of gas from said first one or more standby vessels, said first one or more standby vessels thereby becoming the second one or more on-stream vessels dispensing gas concurrently with said first one or more on-stream vessels for a period prior to terminating the flow of gas from the first one or more on-stream vessels.

2.The gas supply and dispensing system of claim 1 wherein the period provides enough time for the first one or more on-stream vessels and the second one or more on-stream vessels to reach equilibrium.

3. The gas supply and dispensing system of claim 1 or 2, wherein during said period prior to terminating the flow of the gas from the first one or more on-stream vessels, the controller increases the flow of the gas from the second one or more on-stream vessels to a flow rate that is greater than the preset gas flow rate.

4. The gas supply and dispensing system of claim 1 or 2, wherein during said period prior to terminating the flow of the gas from the first one or more on-stream vessels, the controller increases the flow of the gas from the second one or more on-stream vessels to a flow rate that is greater than the preset gas flow rate, and then after sensing that the

~~flow rate is above the preset flow rate, decreases the flow rate from the second one or more on-stream vessels to the preset gas flow rate.~~

~~5. The gas supply and dispensing system of claim 1 or 2, wherein during said period prior to terminating the flow of the gas from the first one or more on-stream vessels, the controller increases the flow of the gas from the second one or more on-stream vessels to a flow rate that is greater than the preset gas flow rate, then after sensing that the flow rate is above the preset flow rate, decreases the flow rate from the second one or more on-stream vessels to the preset gas flow rate, and terminates the flow from the first one or more on-stream vessels.~~

~~6. The gas supply and dispensing system of any of claims 1-5, wherein the controller further comprises a timer that is activated when the predefined endpoint is sensed, to define the period during which the second one or more on-stream vessels and the first one or more on-stream vessels are dispensing said gas, and triggers the system to terminate the flow of gas from the first one or more on-stream vessels at the end of the period.~~

~~7. The gas supply and dispensing system of any of claims 3-6, wherein the controller further comprises a timer that is activated to define the period during which the flow rate from the second one or more on-stream vessels is greater than the preset gas flow rate and triggers the system to decrease the flow rate of gas from the second one or more on-stream vessels at the end of a defined amount of time measured by the timer.~~

~~8. The gas supply and dispensing system of any of claims 1-7wherein the one or more sensors are selected from pressure transducers, timers, weight scales, mass flow controllers, and temperature sensors.~~

~~9. The gas supply and dispensing system of any of claims 1-8, wherein the one or more predefined endpoints comprise a predefined endpoint weight of the one or more on-stream vessels.~~

~~10. The gas supply and dispensing system of any of claims 1-9, wherein the one or more predefined endpoints comprise a predefined endpoint pressure of gas dispensed from~~

~~the one or more on-stream vessels.~~

~~11. The gas supply and dispensing system of any of claims 1-10, wherein the one or more predefined endpoints comprise a predefined endpoint flow rate of gas dispensed from the one or more on-stream vessels.~~

~~12. The gas supply and dispensing system of any of claims 1-11, wherein the one or more predefined endpoints comprise a predefined endpoint cumulative volume of gas dispensed from the one or more on-stream vessels.~~

~~13. The gas supply and dispensing system of any of claims 1-12, wherein the one or more predefined endpoints comprise a predefined endpoints rate of change of a characteristic of gas dispensed from the one or more on-stream vessels.~~

~~14. The gas supply and dispensing system of any of claims 1-13, wherein the one or more predefined endpoints comprise a predefined endpoint dispensing time of gas dispensing from the one or more on-stream vessels.~~

~~15. The gas supply and dispensing system of any of claims 1-14, wherein the manifold comprises one or more pressure transducers to measure the gas pressure of the one or more on-stream vessels.~~

~~16. The gas supply and dispensing system of any of claims 1-15, wherein the manifold comprises a process gas supply line and one or more pressure transducers located in said process gas supply line to measure the pressure of the gas flowing in said process gas supply line.~~

~~17. The gas supply and dispensing system of any of claims 1-16, wherein said manifold comprises one or more control valves having a proportional integrating derivative (PID) control loop to control the flow of the gas.~~

~~18. The gas supply and dispensing system of claim 17, wherein said one or more control valves having a proportional integrating derivative (PID) control loop is operatively coupled with a pressure transducer.~~

19. The gas supply and dispensing system of any of claims 1-18, wherein the gas storage and dispensing vessels are disposed in a gas cabinet.

20. The gas supply and dispensing system of any of claims 1-19, wherein said valves comprise process isolation valves

wherein the system substantially reduces pressure variation of gas dispensed by the system, in relation to a gas supply and dispensing system wherein the crossover from said first one or more on-stream vessels to said second one or more stand-by vessels.

21. A method of substantially reducing pressure variation of gas dispensed from a gas supply and dispensing system comprising:

an array of at least two gas storage and dispensing vessels arranged for sequential on-stream dispensing involving crossover from a first one or more on-stream vessels to a first one or more standby vessels in the array, said system used to dispense gas at a preset gas flow rate comprising the steps of:

supplying the process gas from said first one or more on-stream vessels;

depleting the process gas from said first one more on-stream vessels;

sensing one or more predefined endpoints for said one or more first on-stream vessels;

opening one or more valves to begin supplying the process gas from said first one or more standby vessels, said first one or more standby vessels thereby becoming the second one or more on-stream vessels dispensing the process gas concurrently with said first one or more on-stream vessels;

increasing the flow of the process gas from the second one or more on-stream vessels above a preset flow rate;

detecting the increased flow rate from the second one or more on-stream vessels;

retuning the gas flow from the second one or more on-stream vessels to the preset flow rate; and

closing one or more valves to isolate the first one or more on-stream vessels from the system.

22.The method of claim 21 further comprising the step of starting a cross-over timer upon said opening step, wherein said cross-over timer measures a preset period of time

~~until said step of closing said one or more valves to isolate the first one or more on-line vessels from the system.~~

~~23. The method of claims 21 or 22 wherein said system further comprises one or more sensors selected from a weight sensor, pressure transducer, flowrate sensor, volumetric (cumulative) flowmeter, cycle timer, temperature sensor, or combinations thereof for performing said sensing step.~~

~~24. The method of any of claims 21 to 23 further comprising the step of checking the presence and status of the first one or more standby vessels prior to said opening step.~~

~~25. The method of any of claims 21 to 24, wherein said sensing step senses a decreased flowrate of the process gas measured by a pressure sensor, or a decreased rate of change of one or more characteristics of the process gas.~~

~~26. The method of any of claims 21 to 25 further comprising the step of allowing the second one or more on-stream vessels dispensing gas concurrently with said first one or more on-stream vessels to equilibrate prior to said increasing step.~~

~~27. The method of claim 26 wherein said allowing step is measured by an equalization timer that is initiated at the opening step.~~

~~28. The method of any of claims 21 to 27, wherein the system will sound an alarm if an error is detected in any of the steps.~~

~~29. The method of any of the claims 21 to 28 wherein after said closing step, the method further comprises the step of replacing said first one or more on-stream vessels with one or more fresh vessels.~~

~~30. The method of any of the claim 29 wherein said system further comprises a manifold in fluid communication with the first one or more on-stream vessels, and prior to the step of removing said first one or more on-stream vessels, said method further comprises the steps of venting and purging the manifold.~~

~~31. The method of any of the claims 21-30 wherein the one or more predefined endpoints are selected from an endpoint weight of the first one or more on-stream vessels, an endpoint pressure of gas dispensed from the first one or more on-stream vessels, an endpoint flow rate of gas dispensed from the first one or more on-stream vessels, an endpoint cumulative volume of gas dispensed from the first one or more on-stream vessels, an endpoint rate of change of a characteristic of gas dispensed from the first one or more on-stream vessels, and an endpoint dispensing time of gas dispensing from the first one or more on-stream vessels.~~

~~32. The method of any of claim 21 to 31, wherein the step of increasing the flow of the process gas from the second one or more on-stream vessels above a preset flow rate is performed by using a proportional integrating derivative (PID) control loop operatively coupled with a pressure transducer in fluid communication with the second one or more on-line vessels.~~

~~33. The method of any of claims 29 to 32 wherein, repeating the method steps in claims 21 to 32 wherein the second one or more on-stream vessels are the first one or more on-stream vessels and the fresh one or more vessels are the first one or more standby vessels.~~

CLAIMS

1. A gas supply and dispensing system, comprising:

an array of at least two gas storage and dispensing vessels arranged for sequential on-stream dispensing involving crossover from a first one or more on-stream vessels to a first one or more standby vessels in the array, said system used to dispense gas at a preset gas flow rate;

a manifold comprising piping and at least two valves in fluid communication with the array of vessels;

a controller; and

one or more sensors in communication with the controller, wherein said one or more sensors sense one or more predefined endpoints of the first one or more on-stream vessels thereby causing the controller to initiate auto-crossing from the first one or more on-stream vessels to the first one or more standby vessels in the array having gas therein, for subsequent dispensing of gas from said first one or more standby vessels;

wherein the controller after sensing the one or more predefined endpoints initiates flow of gas from said first one or more standby vessels, said first one or more standby vessels thereby becoming the second one or more on-stream vessels dispensing gas concurrently with said first one or more on-stream vessels for a period prior to terminating the flow of gas from the first one or more on-stream vessels.

2.The gas supply and dispensing system of claim 1 wherein the period provides enough time for the first one or more on-stream vessels and the second one or more on-stream vessels to reach equilibrium.

3. The gas supply and dispensing system of claim 1, wherein during said period prior to terminating the flow of the gas from the first one or more on-stream vessels, the controller increases the flow of the gas from the second one or more on-stream vessels to a flow rate that is greater than the preset gas flow rate.

4. The gas supply and dispensing system of claim 1, wherein during said period prior to terminating the flow of the gas from the first one or more on-stream vessels, the controller increases the flow of the gas from the second one or more on-stream vessels to a flow rate that is greater than the preset gas flow rate, and then after sensing that the flow rate is above the

preset flow rate, decreases the flow rate from the second one or more on-stream vessels to the preset gas flow rate.

5. The gas supply and dispensing system of claim 1, wherein during said period prior to terminating the flow of the gas from the first one or more on-stream vessels, the controller increases the flow of the gas from the second one or more on-stream vessels to a flow rate that is greater than the preset gas flow rate, then after sensing that the flow rate is above the preset flow rate, decreases the flow rate from the second one or more on-stream vessels to the preset gas flow rate, and terminates the flow from the first one or more on-stream vessels.

6. The gas supply and dispensing system of claim 1, wherein the controller further comprises a timer that is activated when the predefined endpoint is sensed, to define the period during which the second one or more on-stream vessels and the first one or more on-stream vessels are dispensing said gas, and triggers the system to terminate the flow of gas from the first one or more on-stream vessels at the end of the period.

7. The gas supply and dispensing system of claim 3, wherein the controller further comprises a timer that is activated to define the period during which the flow rate from the second one or more on-stream vessels is greater than the preset gas flow rate and triggers the system to decrease the flow rate of gas from the second one or more on-stream vessels at the end of a defined amount of time measured by the timer.

8. The gas supply and dispensing system of claim 1, wherein the one or more sensors are selected from pressure transducers, timers, weight scales, mass flow controllers, and temperature sensors.

9. The gas supply and dispensing system of claim 1, wherein the one or more predefined endpoints comprise a predefined endpoint weight of the one or more on-stream vessels.

10. The gas supply and dispensing system of claim 1, wherein the one or more predefined endpoints comprise a predefined endpoint pressure of gas dispensed from the one or more on-stream vessels.

11. The gas supply and dispensing system of claim 1, wherein the one or more predefined

endpoints comprise a predefined endpoint flow rate of gas dispensed from the one or more on-stream vessels.

12. The gas supply and dispensing system of claim 1, wherein the one or more predefined endpoints comprise a predefined endpoint cumulative volume of gas dispensed from the one or more on-stream vessels.

13. The gas supply and dispensing system of claim 1, wherein the one or more predefined endpoints comprise a predefined endpoints rate of change of a characteristic of gas dispensed from the one or more on-stream vessels.

14. The gas supply and dispensing system of claim 1, wherein the one or more predefined endpoints comprise a predefined endpoint dispensing time of gas dispensing from the one or more on-stream vessels.

15. The gas supply and dispensing system of claim 1, wherein the manifold comprises one or more pressure transducers to measure the gas pressure of the one or more on-stream vessels.

16. The gas supply and dispensing system of claim 1, wherein the manifold comprises a process gas supply line and one or more pressure transducers located in said process gas supply line to measure the pressure of the gas flowing in said process gas supply line.

17. The gas supply and dispensing system of claim 1, wherein said manifold comprises one or more control valves having a proportional integrating derivative (PID) control loop to control the flow of the gas.

18. The gas supply and dispensing system of claim 17, wherein said one or more control valves having a proportional integrating derivative (PID) control loop is operatively coupled with a pressure transducer.

19. The gas supply and dispensing system of claim 1, wherein the gas storage and dispensing vessels are disposed in a gas cabinet.

20. The gas supply and dispensing system of claim 1, wherein said valves comprise process

isolation valves

wherein the system substantially reduces pressure variation of gas dispensed by the system, in relation to a gas supply and dispensing system wherein the crossover from said first one or more on-stream vessels to said second one or more stand-by vessels.

21. A method of substantially reducing pressure variation of gas dispensed from a gas supply and dispensing system comprising:

an array of at least two gas storage and dispensing vessels arranged for sequential on-stream dispensing involving crossover from a first one or more on-stream vessels to a first one or more standby vessels in the array, said system used to dispense gas at a preset gas flow rate comprising the steps of:

supplying the process gas from said first one or more on-stream vessels;

depleting the process gas from said first one more on-stream vessels;

sensing one or more predefined endpoints for said one or more first on-stream vessels;

opening one or more valves to begin supplying the process gas from said first one or more standby vessels, said first one or more standby vessels thereby becoming the second one or more on-stream vessels dispensing the process gas concurrently with said first one or more on-stream vessels;

increasing the flow of the process gas from the second one or more on-stream vessels above a preset flow rate;

detecting the increased flow rate from the second one or more on-stream vessels;

retuning the gas flow from the second one or more on-stream vessels to the preset flow rate; and

closing one or more valves to isolate the first one or more on-stream vessels from the system.

22.The method of claim 21 further comprising the step of starting a cross-over timer upon said opening step, wherein said cross-over timer measures a preset period of time until said step of closing said one or more valves to isolate the first one or more on-line vessels from the system.

23. The method of claim 21, wherein said system further comprises one or more sensors selected from a weight sensor, pressure transducer, flowrate sensor, volumetric flowmeter, volumetric cumulative flowmeter, cycle timer, temperature sensor, and combinations thereof for performing said sensing step.

24. The method of claim 21, further comprising the step of checking the presence and status of the first one or more standby vessels prior to said opening step.

25. The method of claim 21, wherein said sensing step senses a decreased flowrate of the process gas measured by a pressure sensor, or a decreased rate of change of one or more characteristics of the process gas.

26. The method of claim 21, further comprising the step of allowing the second one or more on-stream vessels dispensing gas concurrently with said first one or more on-stream vessels to equilibrate prior to said increasing step.

27. The method of claim 26 wherein said allowing step is measured by an equalization timer that is initiated at the opening step.

28. The method of claim 21, wherein the system will sound an alarm if an error is detected in any of the steps.

29. The method of claim 21, wherein after said closing step, the method further comprises the step of replacing said first one or more on-stream vessels with one or more fresh vessels.

30. The method of claim 29, wherein said system further comprises a manifold in fluid communication with the first one or more on-stream vessels, and prior to the step of removing said first one or more on-stream vessels, said method further comprises the steps of venting and purging the manifold.

31. The method of claim 21, wherein the one or more predefined endpoints are selected from an endpoint weight of the first one or more on-stream vessels, an endpoint pressure of gas dispensed from the first one or more on-stream vessels, an endpoint flow rate of gas dispensed from the first one or more on-stream vessels, an endpoint cumulative volume of gas dispensed from the first one or more on-stream vessels, an endpoint rate of change of a characteristic of gas dispensed from the first one or more on-stream vessels, and an endpoint dispensing time of gas dispensing from the first one or more on-stream vessels.

32. The method of claim 21, wherein the step of increasing the flow of the process gas from the second one or more on-stream vessels above a preset flow rate is performed by using a proportional integrating derivative (PID) control loop operatively coupled with a pressure transducer in fluid communication with the second one or more on-line vessels.

33. The method of claim 29 wherein, repeating the method steps in claim 20, wherein the second one or more on-stream vessels are the first one or more on-stream vessels and the fresh one or more vessels are the first one or more standby vessels.