What is claimed is:

1. A polishing apparatus comprising:

a rotatable polishing table for supporting a polishing pad;

a rotatable top ring having a pressure chamber for pressing a substrate against the polishing pad;

a pressure regulator configured to regulate a pressure of a gas in the pressure chamber;

a gas delivery line which couples the pressure regulator to the pressure chamber;

a buffer tank provided between the pressure chamber and the pressure regulator, the buffer tank being a hermetic container having a hermetic space formed therein, a volume of the hermetic space being equal to or larger than a volume of the pressure chamber, the buffer tank being located outside the rotatable top ring; and

a branch line which couples the buffer tank to the gas delivery line, the branch line being in communication with the hermetic space of the buffer tank.

2. The polishing apparatus according to claim 1, wherein the pressure regulator includes a pressure-regulating valve, a pressure gauge configured to measure the pressure of the gas at a downstream side of the pressure-regulating valve, and a valve controller configured to control an operation of the pressure-regulating valve so as to minimize a difference between a target value of the pressure in the pressure chamber and a pressure value measured by the pressure gauge.

3. The polishing apparatus according to claim 1, further comprising:

a flow meter configured to measure a flow rate of a gas flowing in the gas delivery line,

the buffer tank is located between the pressure regulator and the flow meter.

4. The polishing apparatus according to claim 3, wherein the buffer tank has a structure that does not allow its interior volume to vary regardless of a pressure in the buffer tank.

5. The polishing apparatus according to claim 3, wherein the buffer tank is configured to change its volume according to a pressure in the buffer tank.

6. The polishing apparatus according to claim 5, wherein at least a portion of the buffer tank is formed by a structural member that is deformable according to the pressure in the buffer tank.

7. The polishing apparatus according to claim 6, further comprising:

a limiting cover located outside the buffer tank to limit deformation of the buffer tank.

8. The polishing apparatus according to claim 6, wherein the structural member that is deformable according to the pressure in the buffer tank is a diaphragm.

9. The polishing apparatus according to claim 6, wherein the structural member that is deformable according to the pressure in the buffer tank is a bellows tube.

10. The polishing apparatus according to claim 5, wherein the buffer tank includes:

a cylinder;

a piston disposed in the cylinder;

a rolling diaphragm that seals a gap between the cylinder and the piston; and

a spring that supports the piston,

the rolling diaphragm has a bent portion surrounding the piston, and the bent portion has an inverted U-shaped cross section.

11. The polishing apparatus according to claim 3, wherein a height of the top

ring relative to the polishing pad when the top ring is pressing the substrate against the polishing pad is constant.

12. The polishing apparatus according to claim 1,

wherein the buffer tank is configured to change its volume according to a pressure in the buffer tank.

13. The polishing apparatus according to claim 12, wherein at least a portion of the buffer tank is formed by a structural member that is deformable according to the pressure in the buffer tank.

14. The polishing apparatus according to claim 13, further comprising:

a limiting cover located outside the buffer tank to limit deformation of the buffer tank.

15. The polishing apparatus according to claim 13, wherein the structural member that is deformable according to the pressure in the buffer tank is a diaphragm.

16. The polishing apparatus according to claim 13, wherein the structural member that is deformable according to the pressure in the buffer tank is a bellows tube.

17. The polishing apparatus according to claim 12, wherein the buffer tank includes:

a cylinder;

a piston disposed in the cylinder;

a rolling diaphragm that seals a gap between the cylinder and the piston; and

a spring that supports the piston,

the rolling diaphragm has a bent portion surrounding the piston, and the bent portion has an inverted U-shaped cross section.

18. The polishing apparatus according to claim 12, wherein a height of the top ring relative to the polishing pad when the top ring is pressing the substrate against the polishing pad is constant.

19. A polishing apparatus comprising:

a rotatable polishing table for supporting a polishing pad;

a rotatable top ring having a pressure chamber for pressing a substrate against the polishing pad; and

a pressure regulator configured to regulate a pressure of a gas in the pressure chamber,

the pressure regulator includes a pressure-regulating valve, a pressure gauge configured to measure the pressure of the gas at a downstream side of the pressure-regulating valve, and a valve controller configured to control an operation of the pressure-regulating valve so as to minimize a difference between a target value of the pressure in the pressure chamber and a pressure value measured by the pressure gauge,

the valve controller has an amplification factor of not more than 0 dB when an oscillation frequency of the measured pressure value is within a predetermined frequency range, the amplification factor representing a ratio of the measured pressure value to the target value and being expressed using decibel as unit, and

a frequency corresponding to a rotational speed of the polishing table is within the predetermined frequency range.

20. The polishing apparatus according to claim 19, wherein:

the valve controller includes a first valve controller and a second first valve controller;

the pressure regulator has a switching unit configured to switch between the first valve controller and the second valve controller;

the first valve controller has the amplification factor of not more than 0 dB when the oscillation frequency of the measured pressure value is within the predetermined frequency range; and

the second valve controller has the amplification factor of more than 0 dB when the oscillation frequency of the measured pressure value is within the predetermined frequency range.

21. The polishing apparatus according to claim 19, wherein the pressure regulator includes a band elimination filter that lowers the amplification factor of the valve controller to 0 dB or less when the oscillation frequency of the measured pressure value is within the predetermined frequency range.

22. The polishing apparatus according to claim 19, wherein the polishing table and the top ring are configured to rotate at a same rotational speed.

23. The polishing apparatus according to claim 19, further comprising:

an amplification factor measuring device configured to measure the amplification factor of the valve controller,

the amplification factor measuring device is configured to

input a test target value into the pressure regulator while causing the test target value to oscillate at a frequency that is within the predetermined frequency range,

obtain an output value of the pressure gauge while inputting the oscillating test target value into the pressure regulator, and

calculate the amplification factor of the valve controller from the output

value and the test target value.

24. The polishing apparatus according to claim 23, further comprising:

a tuning device configured to adjust an operation of the valve controller to allow the valve controller to have the amplification factor of not more than 0 dB when the calculated amplification factor is more than 0 dB.