CLAIMS

Claim 1: A gas pressure regulator for regulating a pressure of a gas system, the gas pressure regulator comprising:

a first chamber;

a first diaphragm separating the first chamber into a first compartment and a second compartment;

a second chamber;

a second diaphragm separating the second chamber into a third compartment and a fourth compartment, the fourth compartment being connected to, and in communication with, the first compartment of the first chamber;

a movement of the first diaphragm causes a corresponding movement of the second diaphragm that changes a first volume of the fourth compartment and a second volume of the third compartment;

a vertically extending adaptor connecting the first compartment of the first chamber to the fourth compartment of the second chamber,

the adaptor including

a lower threaded vertical portion with a first outer diameter,

a lip extending in a horizontal direction,

an upper threaded vertical portion with a second outer diameter, and

at least one opening in the upper threaded vertical portion,

wherein the first outer diameter matches an inner diameter of a vertically extending portion of the first compartment, the second outer diameter matches an inner diameter of the second chamber, and an opening area of the at least one opening is greater than an opening area of a smallest opening between the first compartment and the fourth compartment.

Claim 2: The gas pressure regulator of Claim 1, further comprising:

a vent breather valve located in the first compartment that exhausts air from the first compartment into the surrounding atmosphere, or draws air into the first compartment from the surrounding atmosphere, wherein the vent breather valve exhausts or draws in air from the first compartment at a maximum vent breather valve exhaust rate when an air pressure in the first compartment reaches a predetermined threshold.

Claim 3: The gas pressure regulator of Claim 1, wherein:

the at least one opening exchanges air between the first compartment and the fourth compartment at a rate greater than a maximum vent breather valve exhaust rate.

Claim 4: The gas pressure regulator of Claim 1, wherein:

the opening area of the at least one opening is between 0.25 square inches and 0.6 square inches, the opening area preferably being 0.38 square inches.

Claim 5: The gas pressure regulator of Claim 1, wherein:

an inner diameter of the second diaphragm is securely pinched between a top surface of the first compartment and the adaptor lip; and

an outer diameter of the second diaphragm is securely pinched by at least one fastener between an upper surface of the second chamber and a bottom surface of the second chamber.

Claim 6: The gas pressure regulator of Claim 1, wherein:

a distance measured along a surface of the second diaphragm between the inner diameter and the outer diameter of the second diaphragm is greater than a distance between an outer diameter of the second chamber and an outer diameter of the spring tower of the first compartment.

Claim 7: A gas pressure regulator for regulating a pressure of a gas system, the gas pressure regulator comprising:

a first chamber;

a first diaphragm separating the first chamber into a first compartment and a second compartment;

a second chamber;

a second diaphragm separating the second chamber into a third compartment and a fourth compartment, the fourth compartment being connected to, and in communication with, the first compartment of the first chamber;

a movement of the first diaphragm causes a corresponding movement of the second diaphragm that changes a first volume of the fourth compartment and a second volume of the third compartment;

at least one spring connected to an upper surface of the second diaphragm, and to an upper surface of the second chamber; and

at least one spring connected to a lower surface of the second diaphragm, and to a lower surface of the second chamber; and

a lower horizontal vent plate of the second chamber limits the displacement of the second diaphragm.

Claim 8: The gas pressure regulator of Claim 7, wherein:

a speed of movement of the second diaphragm is regulated at least by a rigidity of the second diaphragm and by a rigidity of the at least one spring, and a rate of exchange of air with the atmosphere through openings in the lower horizontal vent plate.

Claim 9: The gas pressure regulator of Claim 1, further comprising:

a safety cap with a threaded radial portion matching the inner diameter of the second compartment, and a horizontally extending lip pressing down on a sealing element, the safety cap seals the second chamber to the atmosphere, and the safety cap can withstand pressures of up to 25 psi.

Claim 10: The gas pressure regulator of Claim 1, the second chamber comprising:

an upper shell with a first radial inner section, a second horizontal section, and a third radial outer section; and

a lower annular horizontal plate,

wherein the first radial inner section is connected to the upper threaded vertical portion of the adaptor, and an inner diameter of the lower annular horizontal plate is greater than an outer diameter of the spring tower of the first compartment.

Claim 11: The gas pressure regulator of Claim 10, wherein:

the lower annular horizontal plate includes air openings in communication with the atmosphere.

Claim 12: The system as claimed in claim 11, wherein:

the air openings have a minimum cumulative opening area of 0.25 square inches, and a preferred cumulative opening area of 0.38 square inches.

Claim 13: The system as claimed in claim 12, wherein:

the air openings are circular openings and are evenly distributed over the lower annular horizontal plate.

Claim 14: The gas pressure regulator of Claim 1, wherein the movement of the second diaphragm increases a first volume of the fourth compartment and decreases a second volume of the third compartment.

Claim 15: The gas pressure regulator of Claim 1, wherein the movement of the second diaphragm decreases a first volume of the fourth compartment and increases a second volume of the third compartment.

Claim 16: A method for regulating a pressure of a gas system with a gas pressure regulator comprising:

mounting a regulator with a first chamber, a first diaphragm, a vent breather valve and a safety cap on a pressurized system, the first diaphragm separating the first chamber into a first compartment and a second compartment, the vent breather valve being located in the first compartment and the safety cap sealing the first compartment;

removing the safety cap while the pressurized system is operating;

connecting a second chamber to the first chamber via an adaptor, the second chamber including a second diaphragm separating the second chamber into a third compartment and a fourth compartment, the fourth compartment being connected to, and in communication with, the first compartment;

replacing the safety cap above the second chamber; and

operating the pressurized system,

wherein during operation of the pressurized system, a movement of the first diaphragm causes a corresponding movement of the second diaphragm that changes a volume of the fourth compartment.