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(54) **MULTI-STAGE GAS PRESSURE REDUCTION SYSTEM**

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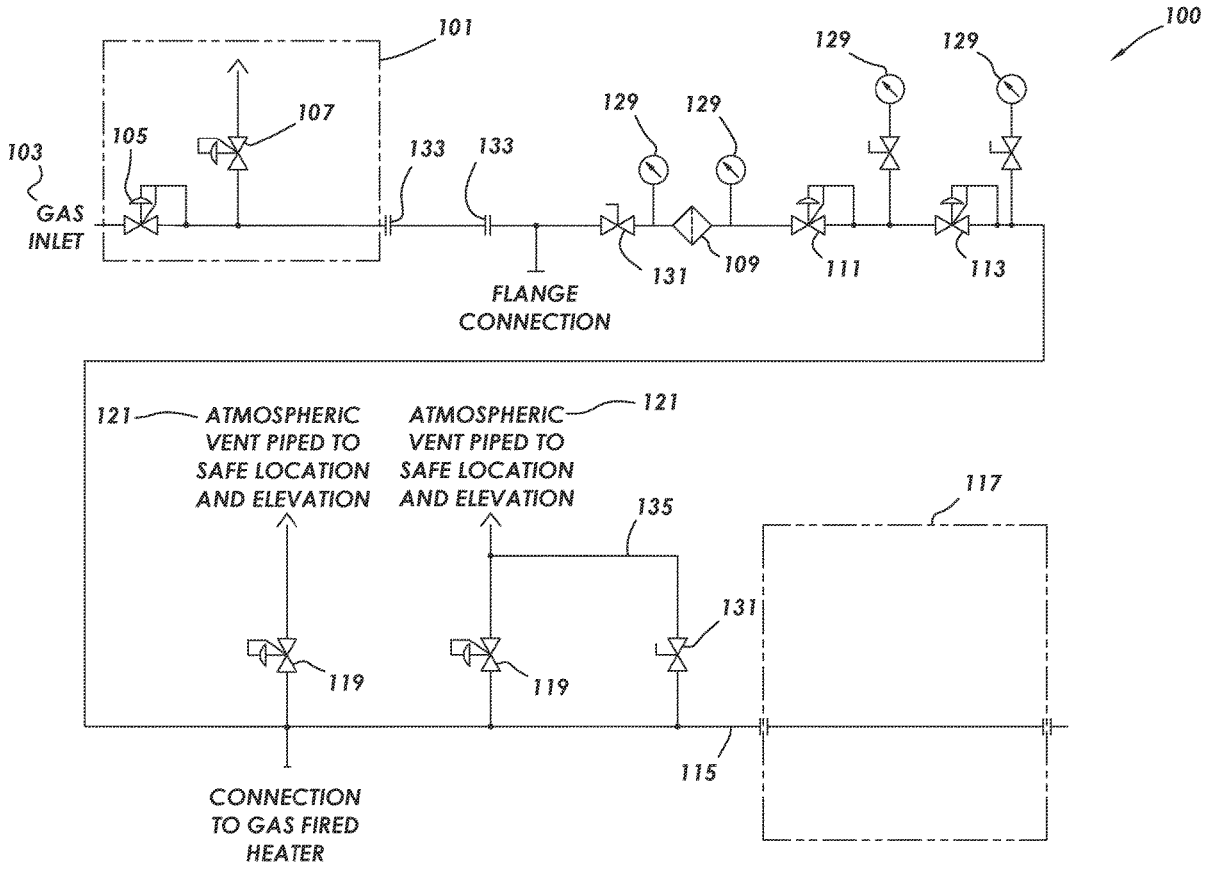
(57) **ABSTRACT**

A multi-stage gas pressure reduction system includes a first pressure regulator, the first pressure regulator positioned to receive gas at supply pressure from an inlet and to output gas at a first intermediate pressure. The multi-stage gas pressure regulation system includes a second pressure regulator, the second pressure regulator positioned to receive gas at the first intermediate pressure from the first pressure regulator and to output gas at a second intermediate pressure. The multi-stage gas pressure regulations system includes a third pressure regulator, the third pressure regulator positioned to receive gas at the second intermediate pressure from the second pressure regulator and to output gas at a third intermediate pressure to an outlet.



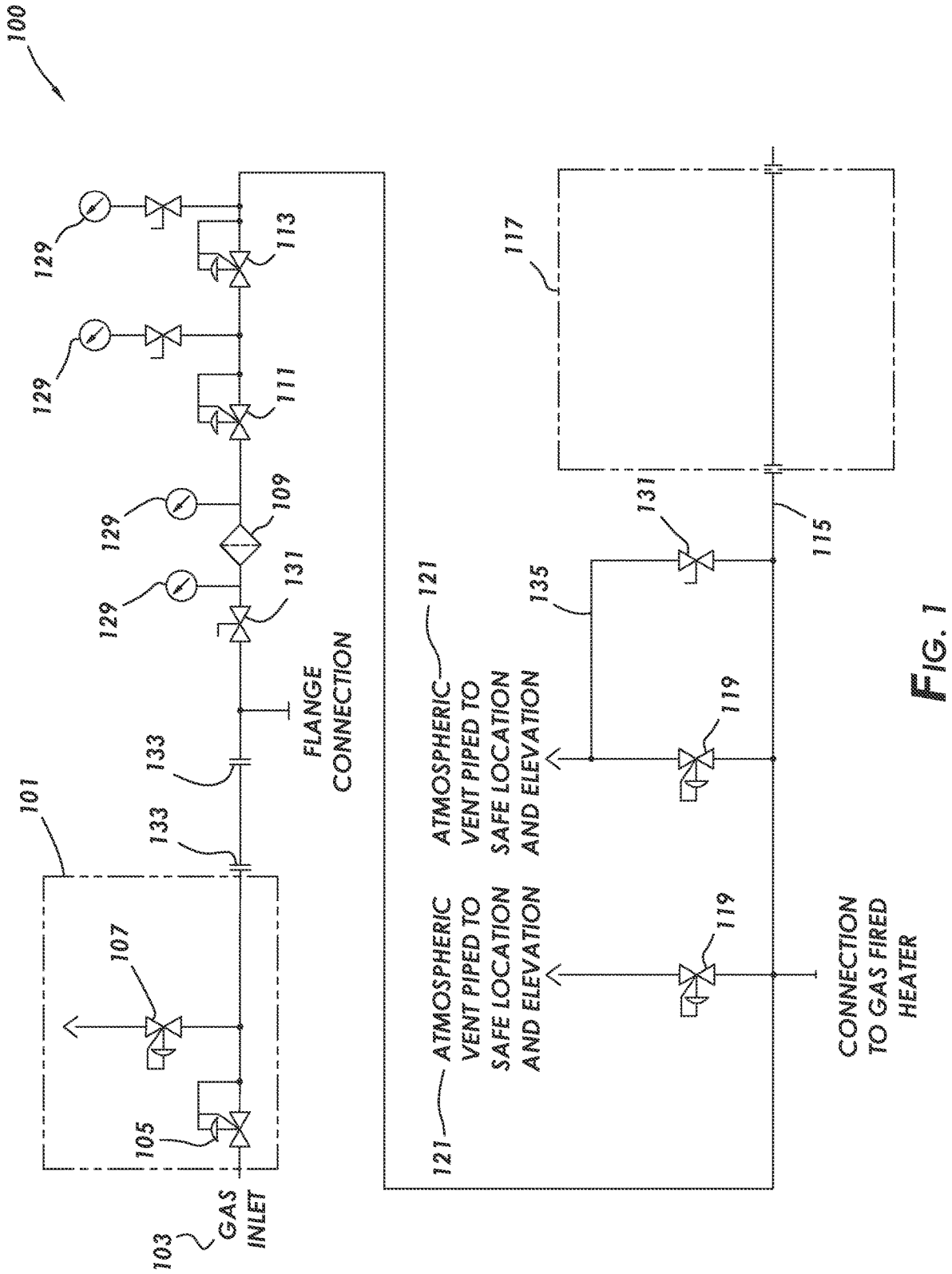

100
101
103
GAS INLET
105
107
129
129
129
129
109
111
113
131
131
133
133
FLANGE CONNECTION
117
115
121
ATMOSPHERIC VENT PIPED TO SAFE LOCATION AND ELEVATION
121
ATMOSPHERIC VENT PIPED TO SAFE LOCATION AND ELEVATION
135
119
119
CONNECTION TO GAS FIRED HEATER

FIG. 1

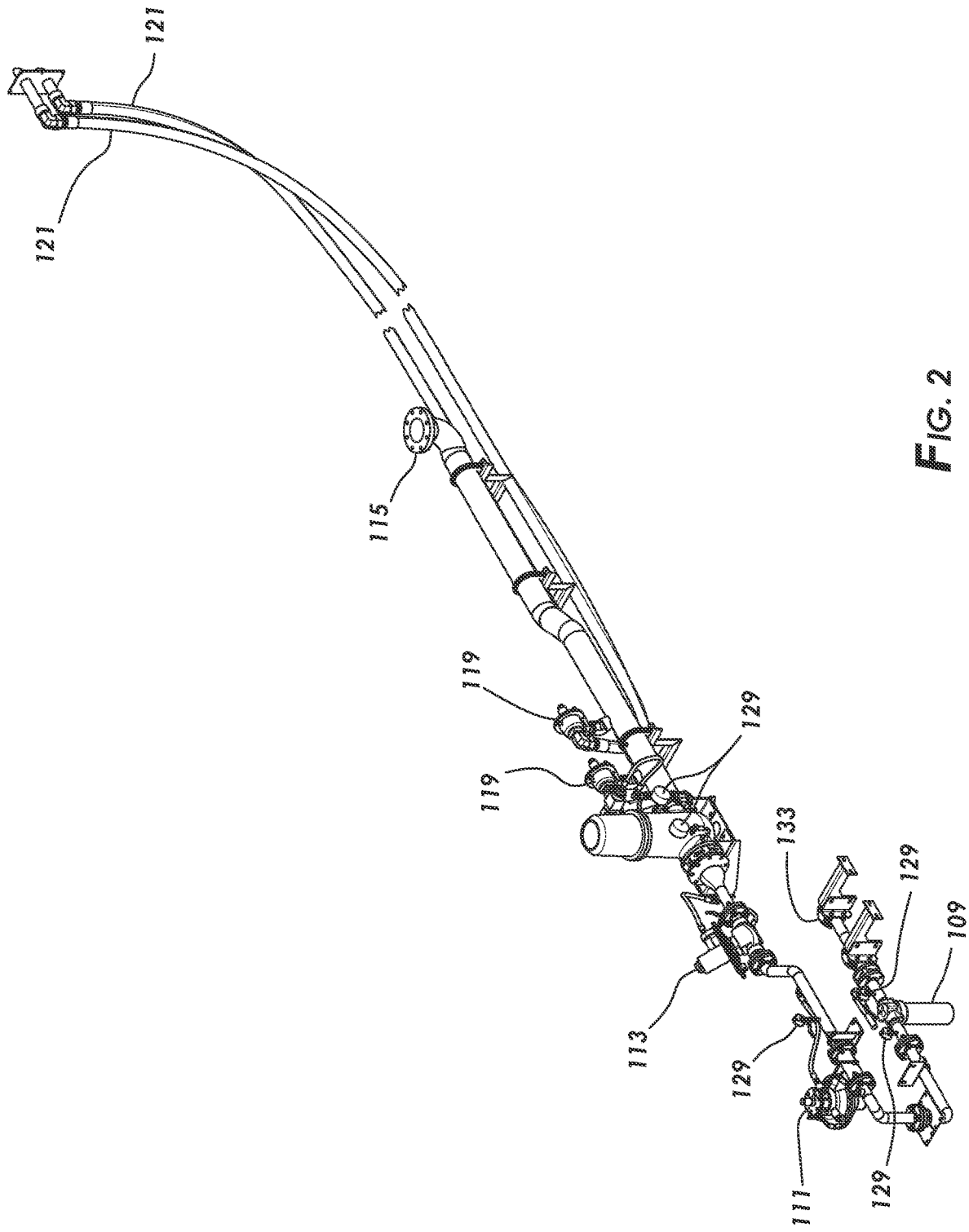


FIG. 2

MULTI-STAGE GAS PRESSURE REDUCTION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a nonprovisional application which claims priority from U.S. provisional application No. 63/310,044, filed Feb. 14, 2022, which is incorporated by reference herein in its entirety.

TECHNICAL FIELD/FIELD OF THE DISCLOSURE

[0002] The present disclosure relates to gas handling, and specifically to regulator systems.

BACKGROUND OF THE DISCLOSURE

[0003] In order to supply natural gas to gas powered devices, the pressure must be reduced from the high transit pressure to a lower pressure usable by the gas-powered device. Natural gas is typically compressed for transport by pipeline to hundreds if not thousands of PSI, while it is input to devices typically on the order of less than 10 PSI. Single stage regulators that have been used typically have difficulty maintaining specific outgoing pressures with precision in the face of supply pressure changes or changes in use. Also, single stage regulators lack redundancy in the case of a failure.

SUMMARY

[0004] The present disclosure provides for a multi-stage gas pressure reduction system. The multi-stage gas pressure reduction system includes a first pressure regulator, the first pressure regulator positioned to receive gas at supply pressure from an inlet and to output gas at a first intermediate pressure. The multi-stage gas pressure regulation system includes a second pressure regulator, the second pressure regulator positioned to receive gas at the first intermediate pressure from the first pressure regulator and to output gas at a second intermediate pressure. The multi-stage gas pressure regulations system includes a third pressure regulator, the third pressure regulator positioned to receive gas at the second intermediate pressure from the second pressure regulator and to output gas at a third intermediate pressure to an outlet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The present disclosure is best understood from the following detailed description when read with the accompanying figures. It is emphasized that, in accordance with the standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or reduced for clarity of discussion.

[0006] FIG. **1** is a schematic diagram of a multi-stage gas pressure reduction system consistent with at least one embodiment of the present disclosure.

[0007] FIG. **2** is a perspective view of a multi-stage gas pressure reduction system consistent with at least one embodiment of the present disclosure.

DETAILED DESCRIPTION

[0008] It is to be understood that the following disclosure provides many different embodiments, or examples, for implementing different features of various embodiments. Specific examples of components and arrangements are described below to simplify the present disclosure. These are, of course, merely examples and are not intended to be limiting. In addition, the present disclosure may repeat reference numerals and/or letters in the various examples. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed.

[0009] A schematic view of multi-stage gas pressure reduction system **100** consistent with at least one embodiment of the present disclosure is depicted in FIG. **1**. Gas may be supplied to gas system **101** at inlet **103**. Gas may, for example and without limitation, be supplied to inlet **103** at between 150-1500 PSIG or the gauge pressure of the gas relative to atmospheric air in pounds per square inch. Gas system **101** may include first pressure regulator **105**. In some embodiments, first pressure regulator **105** may reduce the pressure of the supplied gas from supply pressure to a first intermediate pressure. In some embodiments, for example and without limitation, the first intermediate pressure may be between 50-150 PSIG, between 100-130 PSIG, or may be 125 PSIG. In some embodiments, each pressure regulator described herein may be a diaphragm type regulator that adjusts the amount of gas flowing therethrough with the action of a diaphragm and spring. In some embodiments, gas system **101** may include first pressure relief valve **107**. First pressure relief valve **107** may be set to vent pressure in the case of a failure of first pressure regulator **105**. In some such embodiments, first pressure relief valve **107** may be set to 100-250 PSIG or another pressure above the pressure output of first pressure regulator **105** but below the anticipated pressure of gas supplied to multi-stage gas pressure reduction system **100**.

[0010] In some embodiments, multi-stage gas pressure reduction system **100** may include coalescing filter **109**. Coalescing filter **109**, also shown in FIG. **2**, may serve to separate water vapor and other contaminants from the gas supplied to multi-stage gas pressure reduction system **100**. Gas may then flow to second pressure regulator **111**. Second pressure regulator **111** may further reduce the pressure of the gas to a second intermediate pressure such as, for example and without limitation, between 20-120 PSIG, between 30-70 PSIG, or may be 40 PSIG. Gas may then flow to third pressure regulator **113**. Third pressure regulator **113** may further reduce the pressure of the gas to a third intermediate pressure, also referred to herein as inlet pressure such as, for example and without limitation, 2-10 PSIG, 3-5 PSIG, or 4 PSIG to be supplied to outlet **115**, which may be connected to a piece of gas-powered equipment **117** such as, for example and without limitation, a genset.

[0011] In some embodiments, one or more pressure relief valves **119** may be positioned between third pressure regulator **113** and outlet **115**. Pressure relief valves **119** may be set to vent pressure in the case of a failure of third pressure regulator **113** to protect any equipment coupled downstream of third pressure regulator **113** including, for example and without limitation, gas-powered equipment **117**. In some such embodiments, pressure relief valves **119** may be set to, for example and without limitation, 5-20 PSIG, 7-15 PSIG or another pressure above the pressure output of third

pressure regulator **113** but below the anticipated pressure of gas supplied to second pressure regulator **111**. In some embodiments, each of pressure relief valves **119** may be coupled to a corresponding atmospheric vent **121** positioned to vent relieved gases to a safe location and elevation.

[0012] In some embodiments, various gauges **129**, valves **131**, and flanges **133** may be included with multi-stage gas pressure reduction system **100**, which may be used to allow for testing, assembly, and maintenance of multi-stage gas pressure reduction system **100**. For example, in some embodiments, multi-stage gas pressure reduction system **100** may include manual bleed line **135** positioned to allow gas between third pressure regulator **113** and outlet **115** to be manually vented via atmospheric vent **121**. Manual bleed line **135** may, for example and without limitation, allow for the testing of regulator operation and to bleed the system for service and maintenance.

[0013] The foregoing outlines features of several embodiments so that a person of ordinary skill in the art may better understand the aspects of the present disclosure. Such features may be replaced by any one of numerous equivalent alternatives, only some of which are disclosed herein. One of ordinary skill in the art should appreciate that they may readily use the present disclosure as a basis for designing or modifying other processes and structures for carrying out the same purposes and/or achieving the same advantages of the embodiments introduced herein. One of ordinary skill in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the present disclosure and that they may make various changes, substitutions, and alterations herein without departing from the spirit and scope of the present disclosure.

1. A multi-stage gas pressure reduction system comprising:

a first pressure regulator, the first pressure regulator positioned to receive gas at supply pressure from an inlet and to output gas at a first intermediate pressure;

a second pressure regulator, the second pressure regulator positioned to receive gas at the first intermediate pressure from the first pressure regulator and to output gas at a second intermediate pressure; and

a third pressure regulator, the third pressure regulator positioned to receive gas at the second intermediate pressure from the second pressure regulator and to output gas at a third intermediate pressure to an outlet.

2. The multi-stage gas pressure reduction system of claim **1**, further comprising a pressure relief valve positioned between the first pressure regulator and the second pressure regulator.

3. The multi-stage gas pressure reduction system of claim **1**, further comprising a pressure relief valve positioned between the third pressure regulator and the outlet.

4. The multi-stage gas pressure reduction system of claim **3**, wherein the pressure relief valve is coupled to an atmospheric vent.

5. The multi-stage pressure reduction system of claim **4**, further comprising a manual bleed line coupled to the atmospheric vent positioned to allow manual bleeding of gas between the third pressure regulator and the outlet.

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