

Gas Heating Control System and Gas Heating Control Method

The present application claims the priority of the Chinese patent application filed on April 13, 2023 before the CNIPA, China National Intellectual Property Administration with the application number of 202310391599.5, which is incorporated herein in its entirety by reference.

Technical Field

The present application relates to the technical field of vacuum pumps, and more particularly relates to a gas heating control system and a gas heating control method.

Background Art

After a vacuum pump is used, it is necessary to maintain and sweep the vacuum pump so as to ensure the interior of the vacuum pump to be clean. During a sweeping process of the vacuum pump, a nitrogen gas needs to be introduced into the vacuum pump to clean remaining gases or impurities inside the pump. Generally, the gas introduced into the vacuum pump is likely to condense on an inner wall of the vacuum pump or a rotor. In order to ensure a cleaning effect, during the process of introducing the nitrogen gas into the vacuum pump for purging, the nitrogen gas configured for purging needs to be heated to avoid condensation of the gas, thereby smoothly cleaning the remaining gases and impurities. However, in the prior art, the nitrogen gas is generally heated to a uniform preset temperature, and this mode is poor in adaptability, which cannot ensure that a good purging effect can be obtained under different working conditions.

Summary of the Invention

The present application provides a gas heating control system and a gas heating control method.

The present application provides a gas heating control system, including: a signal collection module configured to collect internal environmental information of a pump body to be purged; a gas path module including a gas passage and a heater and a valve body which are provided on the gas passage, wherein the gas passage is configured to communicate a gas source with the pump body to be purged, and the heater is provided upstream of the valve body along a gas flow direction inside the gas passage; and a control module connected to the signal collection module, the heater and the valve body, and configured to acquire the internal environmental information, determine a target temperature of gas according to the internal environmental information, control the heater to heat a gas flowing through the gas passage to the target temperature of gas, and control the valve body to be opened when a temperature of the gas flowing through the gas passage reaches the target temperature of gas.

The present application further provides a gas heating control method applied to a control module in a gas heating control system, wherein the gas heating control system further includes a signal collection module and a gas path module, the signal collection module is configured to collect internal environmental information of a pump body to be purged, the gas path module includes a gas passage and a heater and a valve body which are provided on the gas passage, the gas passage is configured to communicate a gas source with the pump body to be purged, the heater is provided upstream of the valve body along a gas flow direction inside the gas passage, the control module is connected to the signal collection module, the heater and the valve body, and the gas heating control method includes: acquiring the internal environmental information; determining a target temperature of gas according to the internal environmental information; controlling the heater to heat a gas flowing through the gas passage to the target temperature of gas; and controlling the valve body to be opened.

Beneficial effects

The present application has the following beneficial effects: in the present application, the target temperature of gas is determined according to the internal environmental information of the pump body to be purged, and then a purge gas is heated to the target temperature of gas and then introduced into the pump body to be purged for purging, so that the temperature of the purge gas is more adaptive to the actual situation of the pump body to be purged, thereby enhancing the effect of preventing the condensation of the gas and improving the purging effect.

Brief Description of the Drawings

FIG. 1 is a structural block diagram of a gas heating control system provided in an example of the present application.

FIG. 2 is a structural schematic diagram of a gas path module provided in an example of the present application.

FIG. 3 is a structural schematic diagram of a valve body switching circuit provided in an example of the present application.

FIG. 4 is a structural schematic diagram of a signal collection circuit provided in an example of the present application.

FIG. 5 is a structural schematic diagram of a temperature collection circuit provided in an example of the present application.

FIG. 6 is a flowchart of a gas heating control method provided in an example of the present application.

Description of reference numerals:

gas heating control system-10; signal collection module-11; gas path module-13; control

module-15; gas passage-131; heater-135; valve body-137; main pipe section-1311; branch pipe section-1312; electromagnetic valve-1371; pressure sensor-111; temperature sensor-112; gas flow sensor-113; gas flow control unit-132; flow sensor-134; first one-way valve-1361; and second one-way valve-1362.

Detailed Description of the Invention

With reference to FIG. 1, an example of the present application provides a gas heating control system 10. The gas heating control system 10 is configured to control a heating process of a purge gas (namely, a gas introduced into a pump body and configured to clean residual gases or impurities inside the pump body, for example, a nitrogen gas) inside the pump body.

The gas heating control system 10 may include a signal collection module 11, a gas path module 13, and a control module 15.

The signal collection module 11 is configured to collect internal environmental information of the pump body to be purged. It should be noted that the internal environmental information of the pump body to be purged includes, but is not limited to, a type of a gas introduced into the pump body to be purged, a gas pressure inside the pump body to be purged, an environmental temperature inside the pump body to be purged, or a gas flow inside the pump body to be purged, and the like.

With reference to FIG. 2, the gas path module 13 may include a gas passage 131, a heater 135, and a valve body 137. The gas passage 131 is configured to communicate a gas source with the pump body to be purged. The heater 135 is provided on the gas passage 131 and configured to heat a gas flowing through the gas passage 131. The valve body 137 is provided on the gas passage 131, and the valve body 137 is provided downstream of the heater 135 along a gas flow direction inside the gas passage 131.

In an example shown in FIG. 2, the gas passage 131 may include a main pipe section 1311 and a plurality of branch pipe sections 1312. The plurality of branch pipe sections 1312 are provided in parallel and all communicated with the main pipe section 1311. The main pipe section 1311 is configured to be communicated with the gas source. Ends of the plurality of branch pipe sections 1312 facing away from the main pipe section 1311 are all configured to be communicated with the pump body to be purged. The heater 135 may be provided on the main pipe section 1311. The valve body 137 may include a plurality of electromagnetic valves 1371. Each of the electromagnetic valves 1371 is provided on one of the branch pipe sections 1312 and configured to control the on/off of the branch pipe section 1312 on which the electromagnetic valve 1371 is positioned. By providing the heater 135 on the main pipe section 1311, it is convenient to heat the purge gas uniformly, while the gas passage 131 includes a plurality of branch pipe sections 1312,

and each of the branch pipe sections 1311 is provided with one electromagnetic valve 1371, which is helpful in achieving fine ventilation control.

The control module 15 is connected to the signal collection module 11, the heater 135 and the valve body 137, and configured to acquire the internal environmental information of the pump body to be purged from the signal collection module 11, determine a target temperature of gas according to the internal environmental information, control the heater 135 to heat a gas flowing through the gas passage 131 to the target temperature of gas, and control the valve body 137 to be opened when a temperature of the gas flowing through the gas passage 131 reaches the target temperature of gas.

Illustratively, the control module 15 may determine the target temperature of gas of the purge gas according to the pressure inside the pump body to be purged, the environmental temperature inside the pump body to be purged, and the type of the gas introduced into the pump body to be purged which are collected by the signal collection module 11.

Illustratively, the control module 15 may be respectively connected to the electromagnetic valve 1371 provided on each of the branch pipe sections 1312 to control the opening and closing of the electromagnetic valve 1371. Further, the control module 15 may be connected to each of the electromagnetic valves 1371 through the valve body switching circuit. The valve body switching circuit may be as shown in FIG. 3, in which N2-CTL1-Y represents a signal for controlling the opening and closing of the valve body which is sent by the control module 15, and N2-OUT1 is a control signal which is output via the valve body switching circuit and configured to control the opening and closing of the electromagnetic valve 1371 connected to the valve body switching circuit.

It should be understood that the gas path module 13 may further include a temperature sensor (not shown in the drawings) connected to the control module 15. The temperature sensor is provided on the gas passage 131 and positioned between the heater 135 and the valve body 137. The temperature sensor is configured to detect the temperature of the gas flowing through the gas passage and feed the detected temperature back to the control module 15. Thus, it is helpful for the control module 15 to know the heating condition of the purge gas in time and control the valve body 137 to be opened in time when the temperature of the purge gas reaches the target temperature of gas.

It should be understood that in other examples, the temperature sensor provided on the gas passage 131 may be triggered only when detecting that the temperature of the gas flowing through the gas passage reaches the target temperature of gas to feed a result back to the control module 15. Thus, it is helpful in saving the computing power of the control module 15.

In the example of the present application, the target temperature of gas is determined according to

the internal environmental information of the pump body to be purged, and then a purge gas is heated to the target temperature of gas and then introduced into the pump body to be purged for purging, so that the temperature of the purge gas is more adaptive to the actual situation of the pump body to be purged, thereby enhancing the effect of preventing the condensation of the gas and improving the purging effect.

In an example, the signal collection module 11 may include at least one of a gas type sensor, a pressure sensor, and a temperature sensor.

With continued reference to FIG. 1, illustratively, the signal collection module 11 may include the pressure sensor 111 and the temperature sensor 112. The pressure sensor 111 is configured to detect a gas pressure inside the pump body to be purged. The temperature sensor 112 is configured to detect an environmental temperature inside the pump body to be purged. The pressure sensor 111 and the temperature sensor 112 may be both mounted inside the pump body to be purged.

Further, the gas heating control system 10 may further include a signal regulation module 12. The signal regulation module 12 is connected between the pressure sensor 111 and the temperature sensor 112 and the control module 15 and configured to convert signals collected by the pressure sensor 111 and the temperature sensor 112 into signals recognizable by the control module 15.

It should be understood that in other examples, model selection may also be performed for the pressure sensor 111, the temperature sensor 112, and the control module 15, so that under the condition that the pressure sensor 111 and the temperature sensor 112 which are included in the signal collection module 11 are directly connected to the control module 15, the control module 15 may recognize and process the signals collected by the pressure sensor 111 and the temperature sensor 112.

In an example, the signal collection module 11 may further include a gas flow sensor 113. The gas flow sensor 113 is configured to detect a gas flow inside the pump body to be purged, and may be mounted inside the pump body to be purged. The gas path module 13 further includes a gas flow control unit 132 provided on the gas passage 131. The gas flow control unit 132 may be positioned upstream of the heater 135 along a gas flow direction inside the gas passage 131. The control module 15 is connected to the gas flow sensor 113 and the gas flow control unit 132. The control module 15 is further configured to collect a gas flow from the gas flow sensor 113, determine a purge gas amount according to the gas flow, and control the operation of the gas flow control unit 132 based on the purge gas amount. Such an arrangement is helpful in saving the purge gas, thereby reducing costs.

Further, with continued reference to FIG. 2, the gas path module 13 may further include a flow sensor 134 provided on the gas passage 131 and positioned between the gas flow control unit 132 and the heater 135. The flow sensor 134 may be connected to the control module 15. The control

module 15 may also be configured to control the operation of the gas flow control unit 132 based on a detection result of the flow sensor 134, thereby being helpful in performing finer control of the purge gas. As shown in FIG. 2, the gas path module 13 may further include a first one-way valve 1361 and a second one-way valve 1362 which are provided on the main pipe section 1311 of the gas passage 131. The second one-way valve 1362 is positioned between the flow sensor 134 and the heater 135. The flow sensor 134 and the gas flow control unit 132 are positioned between the first one-way valve 1361 and the second one-way valve 1362. The gas flow control unit 132 and the flow sensor 134 are provided between the first one-way valve 1361 and the second one-way valve 1362, thereby being helpful in enhancing the accuracy of gas flow control.

Further, in an example in which the gas heating control system 10 further includes a signal regulation module 12, the signal regulation module 12 may also be connected between the gas flow sensor 113 and the control module 15 and configured to convert signals collected by the gas flow sensor into signals recognizable by the control module 15.

Similarly, model selection may also be performed for the gas flow sensor 113 and the control module 15, so that under the condition that the gas flow sensor 113 included in the signal collection module 11 is directly connected to the control module 15, the control module 15 may recognize and process the signals collected by the gas flow sensor 113.

It should be understood that the signal regulation module 12 may include a plurality of signal regulation units. The number of the signal regulation units may correspond to the total number of the pressure sensor 111, the temperature sensor 112, and the gas flow sensor 113. The pressure sensor 111, the temperature sensor 112, and the gas flow sensor 113 may be respectively connected to one signal regulation unit. Each of the signal regulation units is configured to convert signals collected by the pressure sensor 111, the temperature sensor 112 or the gas flow sensor 113 connected to the signal regulation unit into signals recognizable and processable by the control module 15.

Further, a signal collection circuit may also be provided between the pressure sensor 111 and the signal regulation unit connected to the pressure sensor 111, or between the gas flow sensor 113 and the signal regulation unit connected to the gas flow sensor 113. The signal collection circuit is configured to adjust signals collected by the pressure sensor 111 or signals collected by the gas flow sensor 113 to a predetermined range, for example, 4-20 mA, thereby enabling the signals to have relatively high anti-interference capability. Illustratively, a circuit structure of the signal collection circuit may be as shown in FIG. 4. It should be understood that reference may also be made to the prior art for a specific structure of the signal collection circuit, which will not be described in detail in the present application.

Further, a temperature collection circuit may be provided between the temperature sensor 112 and

the signal regulation unit connected to the temperature sensor 112. Illustratively, a circuit connection diagram of the temperature sensor 112 and the temperature collection circuit may be as shown in FIG. 5, in which TEMP-IN8+ represents an output signal of the temperature sensor 112; and terminals with the same reference numerals represent that there is a connection relationship between the two, for example, two terminals both marked with TEMP-IN8+ are connected, two terminals both marked with T8+ are connected, and two terminals both marked with T8- are connected; and TEMP-ADC8 is an output signal of the temperature collection circuit. It should be understood that reference may also be made to the prior art for a specific structure of the temperature collection circuit, which will not be described in detail in the present application.

It should be noted that the temperature sensor presented in the present application may all be the temperature sensor adopting PT100 as a sensitive element. Since a platinum resistor has the features of high precision, reliable performance, good stability, and the like, and the linearity of a relationship curve between a resistance relative change rate of the platinum resistor and a temperature is better, the temperature sensor adopting PT100 as the sensitive element can better measure the temperature.

Based on the same inventive concept, with reference to FIG. 6, an example of the present application further provides a gas heating control method applied to the control module 15 in the gas heating control system 10 in the above examples. The gas heating control method may include the following steps:

step S11, acquiring the internal environmental information;

step S12, determining a target temperature of gas according to the internal environmental information;

step S13, controlling the heater to heat a gas flowing through the gas passage to the target temperature of gas; and

step S14, controlling the valve body to be opened.

In an example, step S12 may include: determining the target temperature of gas according to the internal environmental information and a preset correspondence table, the preset correspondence table recording corresponding relationships between different internal environmental information and a required temperature for a purge gas.

Claims

1. A gas heating control system, comprising:
 - a signal collection module configured to collect internal environmental information of a pump body to be purged;
 - a gas path module comprising a gas passage and a heater and a valve body which are provided on the gas passage, wherein the gas passage is configured to communicate a gas source with the pump body to be purged, and the heater is provided upstream of the valve body along a gas flow direction inside the gas passage; and
 - a control module connected to the signal collection module, the heater and the valve body, and configured to acquire the internal environmental information, determine a target temperature of gas according to the internal environmental information, control the heater to heat a gas flowing through the gas passage to the target temperature of gas, and control the valve body to be opened when a temperature of the gas flowing through the gas passage reaches the target temperature of gas.
2. The gas heating control system of claim 1, wherein the signal collection module comprises at least one of a gas type sensor, a pressure sensor, and a temperature sensor.
3. The gas heating control system of claim 2, wherein the signal collection module comprises the pressure sensor and the temperature sensor, and the gas heating control system further comprises a signal regulation module, the signal regulation module is connected between the pressure sensor and the temperature sensor and the control module.
4. The gas heating control system of claim 2, wherein the signal collection module further comprises a gas flow sensor configured to detect a gas flow inside the pump body to be purged, the gas path module further comprises a gas flow control unit provided on the gas passage, the gas flow control unit is positioned upstream of the heater along the gas flow direction inside the gas passage, the control module is connected to the gas flow sensor and the gas flow control unit, and the control module is further configured to determine a purge gas amount according to the gas flow and control operation of the gas flow control unit based on the purge gas amount.
5. The gas heating control system of claim 4, further comprising a signal regulation module connected between the gas flow sensor and the control module.
6. The gas heating control system of claim 1, wherein the gas passage comprises a main pipe section and a plurality of branch pipe sections, the plurality of branch pipe sections are provided in parallel and all communicated with the main pipe section, the main pipe section is configured to be communicated with the gas source, ends of the plurality of branch pipe sections facing away from the main pipe section are all configured to be communicated with the pump body to be purged, the heater is provided on the main pipe section, the valve body comprises a plurality of

electromagnetic valves, and each of the electromagnetic valves is provided on one of the branch pipe sections.

7. The gas heating control system of any one of claims 1 to 6, wherein the gas path module comprises a temperature sensor connected to the control module, the temperature sensor is provided on the gas passage and positioned between the heater and the valve body, and the temperature sensor is configured to detect the temperature of the gas flowing through the gas passage and feed the detected temperature back to the control module.

8. A gas heating control method applied to a control module in a gas heating control system, wherein the gas heating control system further comprises a signal collection module and a gas path module, the signal collection module is configured to collect internal environmental information of a pump body to be purged, the gas path module comprises a gas passage and a heater and a valve body which are provided on the gas passage, the gas passage is configured to communicate a gas source with the pump body to be purged, the heater is provided upstream of the valve body along a gas flow direction inside the gas passage, the control module is connected to the signal collection module, the heater and the valve body, and the gas heating control method comprises:

acquiring the internal environmental information;

determining a target temperature of gas according to the internal environmental information;

controlling the heater to heat a gas flowing through the gas passage to the target temperature of gas; and

controlling the valve body to be opened.

9. The gas heating control method of claim 8, wherein the internal environmental information comprises at least one of a type of a gas introduced into the pump body to be purged, a pressure inside the pump body to be purged, and an inner temperature of the pump body to be purged.

10. The gas heating control method of claim 8, wherein the determining a target temperature of gas according to the internal environmental information, comprises:

determining the target temperature of gas according to the internal environmental information and a preset correspondence table, the preset correspondence table recording corresponding relationships between different internal environmental information and a required temperature for a purge gas.