

HEATING PIPING DEVICE FOR INTRODUCING HEATED

FLUID INTO A PIPING SYSTEM

FIELD

[0001] The disclosure relates to a heating piping device, and more particularly
5 to a heating piping device for introducing heated fluid into a piping system.

BACKGROUND

[0002] In the optoelectronic or semiconductor industry, the manufacturing
process is often accompanied by the emission of waste gas, which is transported to a
scrubber through a discharge piping system and a dry pump. However, the waste gas
10 flowing through the piping system condenses due to the long piping length of the piping
system, which results in problems such as temperature unevenness or temperature
reduction, and results in deposition of the waste gas in the piping system. Condensation
and deposition of the waste gas will cause reduction of the pipe diameter of the piping
system over time or even blockage, thereby causing safety concerns.

15 [0003] To ameliorate the deposition of waste gas in the piping system, a gas
heating device is used to introduce heated gas into the piping system to mix with the
waste gas and maintain the piping system at a certain temperature so as to discharge
the waste gas smoothly. The gas heating device includes a housing, a spiral tube

disposed within the housing for a gas to flow therethrough, and a heating tube disposed within the housing to heat the spiral tube so as to heat the gas in the spiral tube.

[0004] As the gas flow rate and the temperature of the gas heating device is constant and cannot be adjusted according to the different process requirements, high temperature and high flow rate under long term use will cause problems of energy and flow waste.

SUMMARY

[0005] Therefore, an object of the disclosure is to provide a heating piping device for introducing heated fluid into a piping system that can alleviate at least one of the drawbacks of the prior art.

[0006] According to the disclosure, the heating piping device connectable with a gas reservoir unit for heating a fluid provided from the gas reservoir unit and introducing the heated fluid into a piping system includes at least one heating unit and a control module. The heating unit is connectable with the piping system and receives the fluid provided from the gas reservoir unit. The heating unit includes a mounting cylinder which defines a heating space therein, a spiral channel which is formed in the heating space, and a heater member which is disposed in the heating space for heating the fluid in the spiral channel into the heated fluid. The spiral channel has a first end in fluid

communication with the gas reservoir unit for receiving the fluid flowing from the gas reservoir unit, and a second end for permitting the heated fluid to flow outwardly therefrom and to be introduced into the piping system. The heating unit further includes a flow control valve which is disposed at the first end of the spiral channel and which is
5 connectable with the gas reservoir unit, and a check valve which is disposed at the second end of the spiral channel to only permit the heated fluid to flow outwardly of the spiral channel from the second end. The control module is electronically connected with the flow control valve and the heater member. The control module transmits a flow signal to the flow control valve to control the amount of the fluid flowing into the spiral channel,
10 and transmits a temperature signal to the heater member to control the temperature of the heater member.

[0007] The control module electronically connected with the flow control valve and the heater member transmits the flow signal to the flow control valve to control the amount of the fluid flowing into the spiral channel, and transmits the temperature signal
15 to regulate the temperature of the heater member. The temperature of the heater member and the amount of the fluid into the heating unit can be adjusted to meet different manufacturing requirements. Thus, unnecessary energy and flow consumption is avoided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Other features and advantages of the disclosure will become apparent in the following detailed description of the embodiments with reference to the accompanying drawings. It is noted that various features may not be drawn to scale.

5 [0009] FIG. 1 is a schematic view illustrating an embodiment of a heating piping device according to the disclosure mounted on a piping system.

[0010] FIG. 2 is a block electrical diagram of the embodiment.

[0011] FIG. 3 is a schematic view similar to FIG. 1, illustrating the embodiment mounted on the piping system in another form.

10 [0012] FIG. 4 is a schematic view similar to FIG. 1, illustrating another embodiment of the heating piping device.

[0013] FIG. 5 is a fragmentary, exploded perspective view illustrating a flow increasing piping assembly of the embodiment and a piping system.

15 [0014] FIG. 6 is a perspective view illustrating a flow increasing pipe of the flow increasing piping assembly.

[0015] FIG. 7 is a cross-sectional view of the flow increasing pipe.

[0016] FIG. 8 is a longitudinal section view of the flow increasing pipe.

[0017] FIG. 9 is a schematic view similar to FIG. 1, illustrating two heating units

of the embodiment mounted on a piping system.

[0018] FIG. 10 is a schematic sectional view illustrating the heating unit of the embodiment in a modified form.

DETAILED DESCRIPTION

5 [0019] Before the disclosure is described in greater detail, it should be noted that where considered appropriate, reference numerals or terminal portions of reference numerals have been repeated among the figures to indicate corresponding or analogous elements, which may optionally have similar characteristics.

[0020] It should be noted herein that for clarity of description, spatially relative
10 terms such as “top,” “bottom,” “upper,” “lower,” “on,” “above,” “over,” “downwardly,” “upwardly” and the like may be used throughout the disclosure while making reference to the features as illustrated in the drawings. The features may be oriented differently (e.g., rotated 90 degrees or at other orientations) and the spatially relative terms used herein may be interpreted accordingly.

15 [0021] Referring to FIGS. 1 and 2, an embodiment of a heating piping device is adapted for heating a fluid 8 provided from a gas reservoir unit 1 and introducing heated fluid into a piping system 9. The piping system 9 may be for transporting a waste gas 7 generated from a reaction chamber 4 in semiconductor manufacturing processes to a

gas scrubber unit 5. The piping system 9 includes a pump 6, an extraction pipe 90 which is connected between the pump 6 and the reaction chamber 4, an upstream piping segment 91 which extends from the pump 6, and a downstream piping segment 92 which is connected between the upstream piping segment 91 and the gas scrubber unit 5. The waste gas 7 generated from the reaction chamber 4 is extracted through the extraction pipe 90 by the pump 6, and is transported to the gas scrubber unit 5 through the upstream piping segment 91 and the downstream piping segment 92. The heating piping device may be also used in optoelectronic or petrochemical apparatus. The heating piping device of the embodiment includes a heating unit 2 and a control module 3.

[0022] The gas reservoir unit 1 is for providing the fluid 8, and includes a reservoir 11 for storing the fluid 8, and a transporting tube 12 which is connected with the reservoir 11 for transporting the fluid 8.

[0023] The heating unit 2 has two opposite terminal ends which are connected with the piping system 9 and the gas reservoir unit 1, and includes a flow control valve 20 which is disposed adjacent to the transporting tube 12, a mounting cylinder 21 which defines a heating space 210 therein, a heater member 22 which is disposed in the heating space 210, a helical pipe 23 which is disposed in the heating space 210 and which spirally surrounds the heater member 22 to be heated by the heater member 22, and a

connecting tube 24 which has two opposite ends that are respectively connected with one end (a second end 232 in FIG. 1) of the helical pipe 23 and the downstream piping segment 92 of the piping system 9. The helical pipe 23 has the other end (a first end 231 in FIG. 1) connected with the transporting tube 12.

5 [0024] The flow control valve 20 is for controlling the flow of the fluid 8 introduced in the helical pipe 23 from the transporting tube 12. In one embodiment, the flow control valve 20 is a solenoid regulator valve, and may be of other types so as to control the flow of the fluid 8 in an electrically controlled manner. The fluid 8 may be gas or liquid.

10 [0025] The mounting cylinder 21 has an outer cylinder wall 211 which surrounds the spiral channel 230, and an inner cylinder wall 212 which is interposed between the outer cylinder wall 211 and the spiral channel 230. The outer cylinder wall 211 is made from a thermal insulation material, for example, a zirconium dioxide material, Teflon or other thermal insulation materials. The inner cylinder wall 212 is made from a high
15 thermally conductive ceramic material or a high thermally conductive metal material, such as an Aluminum Nitride (AlN) ceramic material.

 [0026] The helical pipe 23 defines a spiral channel 230 therein. The spiral channel 230 has a first end 231 in fluid communication with the transporting tube 12, and

a second end 232 opposite to the first end 231 axially and connected with the connecting tube 24.

[0027] In one embodiment, the heater member 22 is a lamp heater, such as a halogen lamp or a quartz halogen lamp, which uses the light emitted therefrom as a heat energy. It is noted that the heater member 22 may be also a high-frequency electromagnetic induction (HFEMI) heater or a conventional thermistor heater which can heat the helical pipe 23.

[0028] The fluid 8 from the transporting tube 12 flows in the spiral channel 230 through the first end 231, and is heated in the spiral channel 230 by the heater member 22 into a heated fluid 81. The heated fluid 81 then flows in the downstream piping segment 92 through the second end 232 and is mixed with the waste gas 7. The fluid and gas mixture is discharged into the gas scrubber unit 5.

[0029] The heating unit 2 further includes a check valve 25 which is disposed at the second end 232 of the spiral channel 230 to only permit the heated fluid 81 to flow outwardly of the spiral channel 230 from the second end 232, and a temperature sensor 26 which is mounted on the connecting tube 24 to measure the temperature of the heated fluid 81 in the connecting tube 24.

[0030] The connecting tube 24 is bent and has an inclined segment which

extends and is inclined relative to the downstream piping segment 92 of the piping system 9 by an acute inclined angle (θ) that is more than 0 degree and less than 90 degrees.

[0031] The control module 3 includes a circuit board (not shown) and a control chip 31 which is mounted on the circuit board and electronically connected with the flow control valve 20, the heater member 22 and the temperature sensor 26. The control module 3, through the control chip 31, transmits a flow signal (S1) to the flow control valve 20 to control the amount of the fluid 8 flowing into the spiral channel 230, and transmits a temperature signal (S2) to the heater member 22 to control the temperature of the heater member 22. The temperature sensor 26 transmits a sensor signal (S3) to the control module 3 such that the control module 3 transmits the temperature signal (S2) according to the received sensor signal (S3) to determine whether the temperature of the heater member 22 is adjusted.

[0032] It is noted that, in this embodiment, the heating piping device is adapted to be connected at the downstream piping segment 92 between the pump 6 and the gas scrubber unit 5 to introduce the heated fluid 81 into the piping system 9 and mix with the waste gas so as to facilitate discharging of the waste gas to the gas scrubber unit 5. Alternatively, as shown in FIG. 3, the heating piping device is mountable at an upstream

side of the reaction chamber 4 so as to introduce the heated fluid 81 a manufacturing reaction chamber to aid reaction.

[0033] In operation of the embodiment, the fluid 8 flows from the transporting tube 12 to the heating unit 2, and the control module 3 transmits the flow signal (S1) to the flow control valve 20 to control the flow control valve 20 and adjust the amount of the fluid 8 flow. The fluid 8 flows into the spiral channel 230 from the first end 231 and is heated into the heated fluid 81, and the heated fluid 81 then flows into the piping system 9 from the second end 232 and is mixed with the waste gas 7 to be discharged together with the waste gas 7. With the connecting tube 24 connected with and inclined relative to the piping system 9, the stream of the heated fluid 81 is inclined relative to the piping system 9 to generate a vortex effect, which renders mixing of the heated fluid 81 with the waste gas 7 at the upstream piping segment 91 more evenly. During the operation, the control module 3 is controlled to determine the adjustment of the temperature of the heater member 22 in response to the transmitted sensor signal (S3). The amount of the fluid 8 into the heating unit 2 is also controlled by the control module 3 to meet different manufacturing requirements. Thus, unnecessary energy and flow consumption is avoided.

[0034] With reference to FIGS. 4 and 5, in another embodiment, the heating unit

2 further includes a flow increasing piping assembly 27 which is connected with an end of the connecting tube 24 and mountable between the upstream piping segment 91 and the downstream piping segment 92 of the piping system 9.

[0035] The flow increasing assembly 27 has a flow increasing pipe 271, an outer pipe 272 which is sleeved around the flow increasing pipe 271, and a tubular spacer 274 which is interposed between the flow increasing pipe 271 and the outer pipe 272 and which has a communication hole 273. The flow increasing pipe 271 has a tubular wall which extends axially to have two opposite piping ends that are respectively connectable with the upstream piping segment 91 and the downstream piping segment 92 for flow of the gas 7 therethrough. Specifically, the opposite piping ends of the flow increasing pipe 271 respectively have a first port 275 and a second port 276 in fluid communication with the upstream piping segment 91 and the downstream piping segment 92. The outer pipe 272 surrounds and is spaced apart from the flow increasing pipe 271 to cooperatively define a surrounding passage 270 therebetween. The outer pipe 272 has a penetrating hole 277 which extends radially therethrough and which is in spatial communication with the surrounding passage 270. The end of the connecting tube 24 is connected with the penetrating hole 277 for flowing the heated fluid 81 into the surrounding passage 270.

[0036] With reference to FIGS. 6 to 8, the flow increasing pipe 271 has a

plurality of through holes 278 which extend radially through the tubular wall to be in fluid communication with the surrounding passage 270 through the communication hole 273 (see FIG. 5) and which are arranged peripherally and axially to receive the heated fluid 81. Each of the through holes 278 extends from an outer wall surface of the tubular wall to an inner wall surface of the tubular wall, and is inclined from the upstream piping segment 91 toward the downstream piping segment 92. The through holes 278 are also formed adjacent to one of the first port 275 and the second port 276.

[0037] With reference to FIGS. 4 and 5, in operation of the embodiment, the fluid 8 is introduced into the heating unit 2 through the transporting tube 12, flows through the spiral channel 230 and is heated into the heated fluid 81. The heated fluid 81 flows toward the through holes 278 through the penetrating hole 277 and along the surrounding passage 270. With the inclined through holes 278, an increased pressure is generated when the heated fluid 81 ejects through the through holes 278 to increase the flow rate and facilitate mixing of the heated fluid 81 with the gas 7.

[0038] It is noted that, in the previous embodiments, the helical pipe 23 has two opposite ends (i.e., the first and second ends 231, 232) which are respectively disposed at two opposite ends of the mounting cylinder 21. Alternatively, the first and second ends 231, 232 of the spiral channel 230 may be formed at the same end of the mounting

cylinder 21 to meet the different piping systems 9 and requirements, as shown in FIG.

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[0039] With reference to FIG. 9, the heating piping device of the disclosure includes a plurality of the heating units 2 mountable on the longer piping system 9 to
5 keep the piping system 9 with a predetermined temperature and enhance the thermal insulation in the piping system 9.

[0040] Furthermore, the flow control valve 20 can be controlled and shut down through the control module 3 in a state when it is not required to introduce the fluid 8 into the piping system 9.

10 [0041] With reference to FIG. 10 which illustrates the heating unit 2 in a modified form, the mounting cylinder 21 has a double-layer vacuum-insulation structure. Specifically, the mounting cylinder 21 has an outer cylinder wall 211 which surrounds the spiral channel 230, and an inner cylinder wall 212 which is interposed between the outer
cylinder wall 211 and the spiral channel 230 and which defines the heating space 210.
15 The outer cylinder wall 211 and the inner cylinder wall 212 have closed lower ends. The mounting cylinder 21 further has an upper cover 213 which is disposed on and closes an upper end of the outer cylinder wall 211, an inner cover 214 which is connected with the upper cover 213 and which is disposed on and closes an upper end of the inner cylinder

wall 212, a first thermally insulating member 215 which is securely attached to the lower end of the outer cylinder wall 211, and a second thermally insulating member 216 which is attached to a lower side of the first thermally insulating member 215. With the upper cover 213, the inner cover 214, the first thermally insulating member 215 and the second thermally insulating member 216, the heating space 210 is substantially formed in a vacuum insulation state.

[0042] The heating unit 2 further includes a sleeve tube 28 which is received in the heating space 210 through the upper cover 213 and the inner cover 214. The sleeve tube 28 is made from a quartz (Silicon dioxide) material. The heater member 22 is removably mounted within the sleeve tube 28.

[0043] The first end 231 and the second end 232 of the helical pipe 23 are mounted at the same end of the mounting cylinder 21 and extend through the upper cover 213 and the inner cover 214.

[0044] With the double-layer vacuum-insulation structure of the outer cylinder wall 211 and the inner cylinder wall 212, and with the upper cover 213, the inner cover 214, the first thermally insulating member 215 and the second thermally insulating member 216, passing of the heat in the heating space 210 through the mounting cylinder 21 is avoided for energy saving. Additionally, the mounting cylinder 21 has a great heat

insulation, which prevents damage to the operator.

[0045] The heater member 22 is removably mounted within the sleeve tube 28 so as to conveniently replace the heater member 22 without the need to renew the whole heating unit 2, thereby increasing convenience and reducing maintenance costs.

5 [0046] As illustrated, the mounting cylinder 21 has the outer cylinder wall 211 made from a thermal insulation material, such as a zirconium dioxide material or Teflon, so as to have a great thermal insulation, and the inner cylinder wall 212 made from a high thermally conductive ceramic material or a high thermally conductive metal material so as to have the heating space 210 be heated evenly by the heating unit 2 and avoid
10 heat consumption. Moreover, the control module 3 is electronically connected with the flow control valve 20, and, through the control chip 31, transmits the flow signal (S1) to the flow control valve 20 to control the amount of the fluid 8 flowing into the spiral channel 230. The control module 3 also, through the control chip 31, transmits the temperature signal (S2) to the heater member 22 to regulate the temperature of the heater member
15 22. Thus, overflow of the fluid and energy consumption is prevented. Furthermore, with the flow increasing pipe 271 having the inclined through holes 278, the heated fluid 81 flows from the outer pipe 272 to the surrounding passage 270 and ejects through the through holes 278 to generate a vortex effect so as to produce an increased pressure to

the heated fluid 81 and the gas 7 to expedite the flow toward the downstream piping segment 92. Additionally, in the embodiments, the heating piping device of the disclosure is mounted between the pump 6 and the gas scrubber unit 5 to facilitate discharge the waste gas to the gas scrubber unit 5. Alternatively, the heating piping device is also mountable at an upstream side of the reaction chamber 4 to introduce the heated fluid 81 in the manufacturing reaction chamber to aid reaction.

[0047] In the description above, for the purposes of explanation, numerous specific details have been set forth in order to provide a thorough understanding of the embodiments. It will be apparent, however, to one skilled in the art, that one or more other embodiments may be practiced without some of these specific details. It should also be appreciated that reference throughout this specification to “one embodiment,” “an embodiment,” an embodiment with an indication of an ordinal number and so forth means that a particular feature, structure, or characteristic may be included in the practice of the disclosure. It should be further appreciated that in the description, various features are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of various inventive aspects; such does not mean that every one of these features needs to be practiced with the presence of all the other features. In other words, in any

described embodiment, when implementation of one or more features or specific details does not affect implementation of another one or more features or specific details, said one or more features may be singled out and practiced alone without said another one or more features or specific details. It should be further noted that one or more features
5 or specific details from one embodiment may be practiced together with one or more features or specific details from another embodiment, where appropriate, in the practice of the disclosure.

[0048] While the disclosure has been described in connection with what are considered the exemplary embodiments, it is understood that this disclosure is not limited
10 to the disclosed embodiments but is intended to cover various arrangements included within the spirit and scope of the broadest interpretation so as to encompass all such modifications and equivalent arrangements.

CLAIMS:

1. A heating piping device connectable with a gas reservoir unit for heating a fluid provided from the gas reservoir unit and introducing the heated fluid into a piping system, comprising:

5 at least one heating unit connectable with the piping system and receiving the fluid provided from the gas reservoir unit, said heating unit including a mounting cylinder which defines a heating space therein, a spiral channel which is formed in said heating space, and a heater member which is disposed in said heating space for heating the fluid in said spiral channel into the heated fluid, said spiral channel having a first end in fluid
10 communication with the gas reservoir unit for receiving the fluid flowing from the gas reservoir unit, and a second end for permitting the heated fluid to flow outwardly therefrom and to be introduced into the piping system, said heating unit further including a flow control valve which is disposed at said first end of said spiral channel and which is connectable with the gas reservoir unit, and a check valve which is disposed at said
15 second end of said spiral channel to only permit the heated fluid to flow outwardly of said spiral channel from said second end; and

a control module electronically connected with said flow control valve and said heater member, said control module transmits a flow signal to said flow control valve to

control the amount of the fluid flowing into said spiral channel, and transmits a temperature signal to said heater member to control the temperature of said heater member.

2. The heating piping device of claim 1, the piping system including an upstream piping segment for receiving a gas, and a downstream piping segment for discharging the gas, wherein said heating unit further includes a flow increasing piping assembly which has a flow increasing pipe, said flow increasing pipe having a tubular wall which extends axially to have two opposite piping ends that are respectively connectable with the upstream piping segment and the downstream piping segment for flow of the gas therethrough, and a plurality of through holes which extend radially through said tubular wall, which are arranged peripherally and axially and which are in fluid communication with said second end of said spiral channel to receive the heated fluid from said spiral channel.

3. The heating piping device of claim 2, wherein each of said through holes of said flow increasing pipe extends from an outer wall surface of said tubular wall to an inner wall surface of said tubular wall and is inclined from the upstream piping segment toward the downstream piping segment so as to produce an increased pressure when the heated fluid ejects through said through holes.

4. The heating piping device of claim 3, wherein said flow increasing piping assembly further has an outer pipe which surrounds and is spaced apart from said flow increasing pipe to cooperatively define a surrounding passage therebetween, said surrounding passage being in fluid communication with said through holes, said outer
5 pipe having a penetrating hole which extends radially therethrough and which is in spatial communication with said surrounding passage for receiving the heated fluid from said spiral channel.

5. The heating piping device of claim 1, wherein said heating unit includes a helical pipe which defines said spiral channel therein, said helical pipe having two opposite ends
10 which are respectively disposed at two opposite ends of said mounting cylinder.

6. The heating piping device of claim 1, wherein said heating unit further includes a connecting tube which extends from said second end of said spiral channel, and a temperature sensor which is mounted on said connecting tube to measure the temperature of the heated fluid in said connecting tube, and which transmits a sensor
15 signal to said control module such that said control module transmits the temperature signal according to the received sensor signal.

7. The heating piping device of claim 1, wherein said heating unit further includes a connecting tube having two ends which are respectively connected with said mounting

cylinder and the piping system, said connecting tube being inclined relative to the piping system by an acute inclined angle.

8. The heating piping device of claim 1, wherein said mounting cylinder has an outer cylinder wall which surrounds said spiral channel, said outer cylinder wall being made
5 from a zirconium dioxide material.

9. The heating piping device of claim 1, wherein said mounting cylinder has an outer cylinder wall which surrounds said spiral channel, and an inner cylinder wall which is interposed between said outer cylinder wall and said spiral channel, said inner cylinder wall being made from a high thermally conductive ceramic material or a high thermally
10 conductive metal material.

10. The heating piping device of claim 9, wherein said inner cylinder wall is made from an Aluminum Nitride ceramic material.

11. The heating piping device of claim 1, wherein said heating unit has two opposite terminal ends which are respectively connectable with the gas reservoir unit and the
15 piping system.

12. The heating piping device of claim 1, wherein said mounting cylinder has an outer cylinder wall which surrounds said spiral channel, an inner cylinder wall which is interposed between said outer cylinder wall and said spiral channel, an upper cover (213)

which is disposed on and closes an upper end of said outer cylinder wall, an inner cover which is disposed on and closes an upper end of said inner cylinder wall, a first thermally insulating member which is securely attached to a lower end of said outer cylinder wall, and a second thermally insulating member which is attached to said first thermally insulating member.

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13. The heating piping device of claim 1, wherein said heating unit further includes a sleeve tube which is received in said heating space, said heater member being removably mounted within said sleeve tube.