

LIQUID SOURCE VAPORIZATION SYSTEM

TECHNICAL FIELD

5 [0001] The present application relates to the technical field of semiconductor manufacturing, and specifically relates to a liquid source vaporization system.

BACKGROUND

10 [0002] In manufacturing processes of integrated circuits, to enable a silicon wafer to meet certain process characteristics, such as forming different insulation layers, dielectric layers and the like on the surface of the silicon wafer, the silicon wafer needs to be placed in a process chamber with certain temperature, pressure and process gas atmosphere. In some advanced process procedures, some special process medium, which are usually stored in a liquid form, are introduced, while in the process, these liquid process medium are delivered
15 into the process chamber after being converted into a gaseous form.

[0003] In the related art, the liquid process medium are generally converted into a gaseous state in two different ways in a delivering process with high control precision of the liquid flow rate and stability, i.e., a vapor pressure difference control method and a liquid phase direct control method.

20 [0004] The vapor pressure difference control method, also called a baking method, is a method of converting a liquid process medium into a gaseous state by means of a pressure difference between a vapor pressure of a liquid material and a pressure in a process chamber, and a gas mass flowmeter. However, since the vapor pressure difference control method involves heating the liquid in the container to a saturated vapor pressure for vaporization,
25 and the pressure is reduced after vaporization, the transmission requirement can be met only when the process chamber is in a vacuum environment, and the amount of the vaporized gas is relatively small, which cannot meet the requirement when a high flow rate of process gas is required. In addition, since the gas mass flowmeter is disposed on an outlet pipeline, the gas to be measured has a higher temperature, while since the gas mass flowmeter has limited
30 temperature resistance, the measurement requirement cannot be met when the baking temperature is too high, resulting in a limited applicable liquid range. In addition, due to large volume and mass, the baking device/container for baking the liquid medium is

generally placed at the bottom of apparatus, producing a long distance from the baking device to a process chamber, and requiring temperature management on all pipelines and devices en route. As a result, the vaporized gas may be liquefied again when meeting cold spots.

[0005] The liquid phase direct control method, also called a direct vaporization method, is a method of converting a liquid process medium into a gaseous state by means of a liquid mass flowmeter and a vaporizer. This method mainly relies on a vaporizer, where a carrier gas is introduced into the vaporizer to atomize and spray the liquid process medium into a vaporization chamber. The vaporization chamber is heated externally as a whole, so that the atomized process medium is vaporized through heat radiation emitted from the vaporization chamber, and liquid spray which is not completely vaporized is completely vaporized through heat conduction generated by contacting an inner wall of the vaporization chamber before being output.

[0006] Although the above methods can solve many problems of the vapor pressure difference control method, there are still new problems. For example, since a carrier gas is needed to atomize the liquid process medium, there is residual liquid process medium in the pipelines after each use, which may affect a subsequent use. Therefore, how to clean the residual process medium in the pipelines is an urgent problem to be solved in the art.

SUMMARY

[0007] To solve at least one of the technical problems in the related art, the present application provides a liquid source vaporization system, which can solve the problem of a residual liquid process medium in a pipeline after each use in the related art.

[0008] To achieve the purpose of the present application, there is provided a liquid source vaporization system applied to a semiconductor process apparatus, including:

a vaporization device configured to vaporize a liquid process medium into a gaseous process medium;

a liquid source pipeline configured to supply a liquid process medium to the vaporization device;

a purging pipeline configured to supply a purging gas to the vaporization device;

a first control unit configured to selectively control the purging pipeline or the liquid source pipeline to be communicated with the vaporization device;

an output pipeline configured to deliver the vaporized gaseous process medium into a process chamber of the semiconductor process apparatus;

a tail gas treatment pipeline configured to deliver pollutants blown out of the vaporization device by the purging gas to a tail gas treatment device; and

a second control unit configured to selectively control the tail gas treatment pipeline or the output pipeline to be communicated with the vaporization device.

5 [0009] In some embodiments, the liquid source vaporization system has a working state and a first cleaning state;

in the working state, the first control unit controls the liquid source pipeline to be communicated with the vaporization device, and the second control unit controls the output pipeline to be communicated with the vaporization device; and

10 in the first cleaning state, the first control unit controls the purging pipeline to be communicated with the vaporization device, and the second control unit controls the tail gas treatment pipeline to be communicated with the vaporization device.

[0010] In some embodiments, the vaporization device includes:

15 a vaporizer having a vaporization chamber configured to vaporize the liquid process medium;

a liquid inlet pipeline, wherein an outlet end of the liquid inlet pipeline is communicated with the vaporization chamber, and an inlet end of the liquid inlet pipeline is communicated with an outlet end of the liquid source pipeline and an outlet end of the purging pipeline, respectively; and

20 a gas outlet pipeline, wherein an inlet end of the gas outlet pipeline is communicated with the vaporization chamber, and an outlet end of the gas outlet pipeline is communicated with an inlet end of the output pipeline and an inlet end of the tail gas treatment pipeline, respectively.

[0011] In some embodiments, the liquid source vaporization system has a working state and
25 a first cleaning state;

in the working state, the first control unit controls the liquid source pipeline to be communicated with the liquid inlet pipeline, and the second control unit controls the output pipeline to be communicated with the gas outlet pipeline; and

30 in the first cleaning state, the first control unit controls the purging pipeline to be communicated with the liquid inlet pipeline, and the second control unit controls the tail gas treatment pipeline to be communicated with the gas outlet pipeline.

[0012] In some embodiments, the first control unit includes:

a first control valve disposed on the liquid source pipeline and configured to control on/off of the liquid source pipeline;

a second control valve disposed on the purging pipeline and configured to control on/off of the purging pipeline; and

the second control unit includes:

5 a third control valve disposed on the output pipeline and configured to control on/off of the output pipeline; and

a fourth control valve disposed on the tail gas treatment pipeline and configured to control on/off of the tail gas treatment pipeline.

[0013] In some embodiments, the vaporization device further includes:

10 a carrier gas pipeline, wherein an inlet end of the carrier gas pipeline is configured to be communicated with a carrier gas source, and an outlet end of the carrier gas pipeline is communicated with the vaporization chamber; and

a carrier gas control valve disposed on the carrier gas pipeline and configured to control on/off of the carrier gas pipeline.

15 [0014] In some embodiments, the carrier gas control valve is open in the working state; and the carrier gas control valve is closed in the first cleaning state.

[0015] In some embodiments, the liquid source vaporization system further has a second cleaning state; and

20 in the second cleaning state, the first control unit controls the purging pipeline to be communicated with the liquid inlet pipeline, the second control unit controls the gas outlet pipeline to be communicated with the tail gas treatment pipeline, and the carrier gas control valve is open.

[0016] In some embodiments, the liquid source vaporization system further includes:

25 a first flowmeter disposed on the liquid inlet pipeline and configured to control a flow rate of the liquid process medium;

a first bypass pipeline, wherein an inlet end of the first bypass pipeline is communicated with the liquid inlet pipeline and located between the first flowmeter and the vaporizer, and an outlet end of the first bypass pipeline is communicated with the tail gas treatment pipeline; and

30 a bypass control unit configured to selectively control the first flowmeter to be communicated with the vaporization chamber or the first bypass pipeline.

[0017] In some embodiments, the liquid source vaporization system has a working state and a third cleaning state;

in the working state, the first control unit controls the liquid source pipeline to be communicated with the liquid inlet pipeline, the bypass control unit controls the first

flowmeter to be communicated with the vaporization chamber, and the second control unit controls the output pipeline to be communicated with the gas outlet pipeline; and

in the third cleaning state, the first control unit controls the purging pipeline to be communicated with the liquid inlet pipeline, and the bypass control unit controls the first flowmeter to be communicated with the first bypass pipeline.

[0018] In some embodiments, the bypass control unit includes a first bypass valve and a second bypass valve, the first bypass valve is disposed on the first bypass pipeline and configured to control on/off of the first bypass pipeline; and the second bypass valve is disposed on the liquid inlet pipeline and located between the inlet end of the first bypass pipeline and the vaporizer, and configured to control on/off of the liquid inlet pipeline.

[0019] In some embodiments, the liquid source vaporization system further includes:

a first flowmeter disposed on the liquid inlet pipeline and configured to control a flow rate of the liquid process medium;

a second bypass pipeline, wherein an inlet end of the second bypass pipeline is communicated with a purging gas source, and an outlet end of the second bypass pipeline is communicated with the liquid inlet pipeline and located between the first flowmeter and the vaporization chamber; and

a fifth control valve disposed on the second bypass pipeline and configured to control on/off of the second bypass pipeline.

[0020] In some embodiments, in the working state, the carrier gas control valve is open, and the fifth control valve is closed;

the liquid source vaporization system further has a fourth cleaning state; and

in the fourth cleaning state, the first control unit controls the liquid source pipeline and the purging pipeline to be disconnected from the liquid inlet pipeline, the carrier gas control valve and the fifth control valve are open, and the second control unit controls the tail gas treatment pipeline to be communicated with the gas outlet pipeline.

[0021] In some embodiments, the liquid source vaporization system further includes:

a residual liquid collector configured to recycle the residual liquid process medium;

a residual liquid recycle pipeline, wherein an outlet end of the residual liquid recycle pipeline is communicated with the residual liquid collector, and an inlet end of the residual liquid recycle pipeline is communicated with the liquid inlet pipeline;

a sixth control valve disposed on the residual liquid recycle pipeline and configured to control on/off of the residual liquid recycle pipeline; and

the vaporization device further includes:

a seventh control valve disposed on the liquid inlet pipeline and located between the inlet end of the residual liquid recycle pipeline and the vaporizer, and configured to control on/off between the vaporizer and the liquid inlet pipeline.

[0022] In some embodiments, the liquid source vaporization system further includes:

5 an exhaust pipeline, wherein the residual liquid collector has a vent communicated with the tail gas treatment pipeline through the exhaust pipeline; and

an eighth control valve disposed on the exhaust pipeline and configured to control on/off of the exhaust pipeline.

[0023] In some embodiments, in the working state, the seventh control valve is open, and
10 the sixth control valve is closed; and

the liquid source vaporization system further has a first residual liquid recycling state in which the first control unit controls the purging pipeline to be communicated with the liquid inlet pipeline, the seventh control valve is closed, and the sixth control valve and the eighth control valve are open.

15 [0024] In some embodiments, the liquid source vaporization system further includes:

a ninth control valve disposed on the residual liquid recycle pipeline and located between the sixth control valve and the outlet end of the residual liquid recycle pipeline;

a purging branch, wherein an inlet end of the purging branch is communicated with a purging gas source, and an outlet end of the purging branch is communicated with the
20 residual liquid recycle pipeline and located between the ninth control valve and the sixth control valve; and

a tenth control valve disposed on the purging branch and configured to control on/off of the purging branch.

[0025] In some embodiments, in the working state, the sixth control valve and the tenth
25 control valve are closed, and the seventh control valve is open; and

the liquid source vaporization system further has a second residual liquid recycling state in which the first control unit controls the liquid source pipeline and the purging pipeline to be disconnected from the liquid inlet pipeline, the sixth control valve is closed, and the tenth control valve, the ninth control valve, and the eighth control valve are open.

30 [0026] In some embodiments, the liquid source vaporization system further includes:

a residual gas discharge pipeline, wherein an inlet end of the residual gas discharge pipeline is communicated with the residual liquid recycle pipeline and located between the sixth control valve and the ninth control valve, and an outlet end of the residual gas discharge pipeline is communicated with the tail gas treatment pipeline; and

a residual gas control valve disposed on the residual gas discharge pipeline and configured to control on/off of the residual gas discharge pipeline.

[0027] In some embodiments, the liquid source vaporization system further has a pipeline residual gas discharging state; and

5 in the pipeline residual gas discharging state, the first control unit controls the purging pipeline to be communicated with the liquid inlet pipeline, the tenth control valve, the ninth control valve, and the seventh control valve are closed, and the sixth control valve and the residual gas control valve are open.

[0028] In some embodiments, the vaporization device further includes:

10 a carrier gas pipeline, wherein an inlet end of the carrier gas pipeline is configured to be communicated with a carrier gas source, and an outlet end of the carrier gas pipeline is communicated with the vaporization chamber;

a carrier gas control valve disposed on the carrier gas pipeline and configured to control on/off of the carrier gas pipeline;

15 a first flowmeter disposed on the liquid inlet pipeline and configured to calculate a flow rate of the liquid process medium;

a second bypass pipeline, wherein an inlet end of the second bypass pipeline is communicated with the purging gas source, and an outlet end of the second bypass pipeline is communicated with the liquid inlet pipeline and located between the first flowmeter and
20 the vaporization chamber; and

a fifth control valve disposed on the second bypass pipeline and configured to control on/off of the second bypass pipeline.

[0029] In some embodiments, in the working state, the carrier gas control valve is open, and the fifth control valve is closed; or

25 in the first cleaning state, the seventh control valve is open, and the carrier gas control valve, the fifth control valve, the sixth control valve, and the tenth control valve are closed; or

the liquid source vaporization system further has a second cleaning state; and

30 in the second cleaning state, the first control unit controls the purging pipeline to be communicated with the liquid inlet pipeline, and the fifth control valve, the sixth control valve, and the tenth control valve are closed, and the seventh control valve is open; or

the liquid source vaporization system further has a fourth cleaning state; and

in the fourth cleaning state, the first control unit controls the liquid source pipeline and the purging pipeline to be disconnected from the liquid inlet pipeline, the tenth control

valve and the sixth control valve are closed, the carrier gas control valve and the fifth control valve are open, and the second control unit controls the tail gas treatment pipeline to be communicated with the gas outlet pipeline; or

the liquid source vaporization system further has a first residual liquid recycling state; and

in the first residual liquid recycling state, the fifth control valve and the tenth control valve are closed; or

in the second residual liquid recycling state, the fifth control valve and the residual gas control valve are closed; or

the liquid source vaporization system further has a pipeline residual gas discharging state; and

in the pipeline residual gas discharging state, the first control unit controls the purging pipeline to be communicated with the liquid inlet pipeline, and the fifth control valve, the tenth control valve, the ninth control valve, and the seventh control valve are closed, and the sixth control valve and the residual gas control valve are open.

[0030] The present application has the following beneficial effects:

by providing the purging pipeline, the first control unit, the tail gas treatment pipeline and the second control unit, the liquid source vaporization system of the present application can not only vaporize a liquid process medium through the vaporization device, but also control the purging pipeline and the tail gas treatment pipeline to be communicated with the vaporization device by the first and second control units, to introduce a purging gas into the vaporization device for internal cleaning of the vaporization device, and blow out the residual process medium in the corresponding pipeline by the purging gas flowing through, thereby reducing the residual process medium in the pipelines and avoiding affecting a subsequent use. In addition, due to the tail gas treatment pipeline, pollutants blown out of the vaporization device by the purging gas can be delivered to a tail gas treatment device for treatment through the tail gas treatment pipeline, thereby avoiding the pollution of the pollutants to the environment.

BRIEF DESCRIPTION OF DRAWINGS

[0031] FIG. 1 is a schematic structural diagram of a liquid source vaporization system according to a first embodiment of the present application;

[0032] FIG. 2 is a schematic diagram of the liquid source vaporization system according to

the first embodiment of the present application in a working state;

[0033] FIG. 3 is a schematic diagram of the liquid source vaporization system according to the first embodiment of the present application in a first cleaning state;

[0034] FIG. 4 is a schematic diagram of the liquid source vaporization system according to the first embodiment of the present application in a second cleaning state;

[0035] FIG. 5 is a schematic diagram of a liquid source vaporization system according to a second embodiment of the present application in a third cleaning state;

[0036] FIG. 6 is a schematic diagram of a liquid source vaporization system according to a third embodiment of the present application in a fourth cleaning state;

[0037] FIG. 7 is a schematic diagram of a liquid source vaporization system according to a fourth embodiment of the present application in a first residual liquid recycling state;

[0038] FIG. 8 is a schematic diagram of a liquid source vaporization system according to a fifth embodiment of the present application in a second residual liquid recycling state;

[0039] FIG. 9 is a schematic diagram of a liquid source vaporization system according to a sixth embodiment of the present application in a pipeline residual gas discharging state;

[0040] FIG. 10 is a schematic diagram of a liquid source vaporization system according to a seventh embodiment of the present application in a working state;

[0041] FIG. 11 is a schematic diagram of the liquid source vaporization system according to the seventh embodiment of the present application in a first cleaning state;

[0042] FIG. 12 is a schematic diagram of the liquid source vaporization system according to the seventh embodiment of the present application in a second cleaning state;

[0043] FIG. 13 is a schematic diagram of the liquid source vaporization system according to the seventh embodiment of the present application in a third cleaning state;

[0044] FIG. 14 is a schematic diagram of the liquid source vaporization system according to the seventh embodiment of the present application in a first residual liquid recycling state;

[0045] FIG. 15 is a schematic diagram of the liquid source vaporization system according to the seventh embodiment of the present application in a second residual liquid recycling state;

[0046] FIG. 16 is a schematic diagram of the liquid source vaporization system according to the seventh embodiment of the present application in a pipeline residual gas discharging state; and

[0047] FIG. 17 is a schematic diagram of a liquid source vaporization system according to an eighth embodiment of the present application in a pipeline residual gas discharging state.

[0048] List of reference signs:

10, liquid source pipeline; 20, vaporization device; 21, vaporizer; 22, liquid inlet pipeline; 23, gas outlet pipeline; 24, carrier gas pipeline; 25, carrier gas control valve; 26, seventh control valve; 30, output pipeline; 40, purging pipeline; 50, first control unit; 51, first control valve; 52, second control valve; 60, tail gas treatment unit; 61, tail gas treatment device; 62, tail gas treatment pipeline; 70, second control unit; 71, third control valve; 72, fourth control valve; 80, first flowmeter; 90, first bypass pipeline; 100, bypass control unit; 101, first bypass valve; 102, second bypass valve; 110, second bypass pipeline; 120, fifth control valve; 130, residual liquid recycle device; 131, residual liquid collector; 132, residual liquid recycle pipeline; 133, sixth control valve; 134, exhaust pipeline; 135, eighth control valve; 136, ninth control valve; 137, residual gas discharge pipeline; 138, residual gas control valve; 140, purging branch; and 150, tenth control valve.

DETAIL DESCRIPTION OF EMBODIMENTS

[0049] To better understand the technical solution of the present application for those skilled in the art, the liquid source vaporization system of the present application will be described in detail below in conjunction with the accompanying drawings.

[0050] In a first embodiment shown in FIG. 1, a liquid source vaporization system applied to a semiconductor process apparatus is disclosed. The liquid source vaporization system includes: a liquid source pipeline 10, a vaporization device 20, an output pipeline 30, a purging pipeline 40, a first control unit 50, a tail gas treatment unit 60, and a second control unit 70.

[0051] The liquid source pipeline 10, the vaporization device 20 and the output pipeline 30 are communicated sequentially. In other words, an inlet end of the liquid source pipeline 10 is communicated with a liquid source, and an outlet end of the liquid source pipeline 10 is communicated with the vaporization device 20, so that the liquid source pipeline 10 can supply a liquid process medium to the vaporization device 20. After entering the vaporization device 20, the liquid process medium is vaporized into a gaseous process medium by the vaporization device 20, and then delivered through the output pipeline 30 into a process chamber of a semiconductor process apparatus for a corresponding semiconductor process.

[0052] In this embodiment, an inlet end of the purging pipeline 40 is communicated with a purging gas source, an outlet end of the purging pipeline 40 is communicated with the vaporization device 20, and the purging pipeline 40 is configured to supply a purging gas to the vaporization device 20. The first control unit 50 is configured to selectively control the

purging pipeline 40 to be communicated with the vaporization device 20, or control the liquid source pipeline 10 to be communicated with the vaporization device 20. It will be readily appreciated that when the purging pipeline 40 is communicated with the vaporization device 20, the purging gas from the purging gas source can be delivered to the vaporization device 20 through the purging pipeline 40; and when the liquid source pipeline 10 is communicated with the vaporization device 20, the liquid process medium from the liquid source can be delivered to the vaporization device 20 through the liquid source pipeline 10. The first control unit 50 is configured to enable a switch between supplying the purging gas to the vaporization device 20 and supplying the liquid process medium to the vaporization device 20.

[0053] The tail gas treatment unit 60 includes a tail gas treatment pipeline 62. An inlet end of the tail gas treatment pipeline 62 is communicated with the vaporization device 20, an outlet end of the tail gas treatment pipeline 62 is configured to be communicated with a tail gas treatment device 61, and the tail gas treatment pipeline 62 is configured to deliver pollutants blown out of the vaporization device 20 by the purging gas to the tail gas treatment device 61 for treatment. The second control unit 70 is configured to selectively control the tail gas treatment pipeline 62 to be communicated with the vaporization device 20, or control the output pipeline 30 to be communicated with the vaporization device 20. It will be readily appreciated that when the tail gas treatment pipeline 62 is communicated with the vaporization device 20, pollutants blown out of the vaporization device 20 by the purging gas can be delivered to the tail gas treatment device 61 through the tail gas treatment pipeline 62; and when the output pipeline 30 is communicated with the vaporization device 20, the gaseous process medium vaporized by the vaporization device 20 can be delivered to the process chamber through the output pipeline 30. The second control unit 70 is configured to enable a switch between supplying the pollutants to the tail gas treatment device 61 and supplying the gaseous process medium to the process chamber.

[0054] By providing the purging pipeline 40, the first control unit 50, the tail gas treatment pipeline 62 and the second control unit 70, the liquid source vaporization system provided in the embodiments of the present application can not only vaporize a liquid process medium through the vaporization device 20, but also control the purging pipeline 40 and the tail gas treatment pipeline 62 to be communicated with the vaporization device 20 by the first control unit 50 and the second control unit 70, to introduce a purging gas into the vaporization device 20 for internal cleaning of the vaporization device 20, and blow out the residual process medium in the corresponding pipeline by the purging gas flowing through, thereby reducing

the residual process medium in the pipelines and avoiding affecting a subsequent use. In addition, due to the tail gas treatment pipeline 62, pollutants blown out of the vaporization device 20 by the purging gas can be delivered to a tail gas treatment device 61 for treatment through the tail gas treatment pipeline 62, thereby avoiding the pollution of the pollutants to the environment.

[0055] As shown in FIGs. 2 to 3, the liquid source vaporization system has a working state and a first cleaning state in use. The liquid source vaporization system is switched between the working state and the first cleaning state by the first control unit 50 and the second control unit 70.

[0056] As shown in FIG. 2, in the working state, the first control unit 50 controls the liquid source pipeline 10 to be communicated with the vaporization device 20, and the second control unit 70 controls the output pipeline 30 to be communicated with the vaporization device 20. After entering the vaporization device 20 through the liquid source pipeline 10, the liquid process medium is vaporized by the vaporization device 20, and then delivered into the process chamber of the semiconductor process apparatus through the output pipeline 30 for a corresponding semiconductor process.

[0057] As shown in FIG. 3, in the first cleaning state, the first control unit 50 controls the purging pipeline 40 to be communicated with the vaporization device 20, and the second control unit 70 controls the tail gas treatment pipeline 62 to be communicated with the vaporization device 20. The purging gas passes through the purging pipeline 40, the vaporization device 20, the tail gas treatment pipeline 62 and the tail gas treatment device 61 sequentially to purge air, moisture, particles and the like therein, while pollutants blown out of the vaporization device 20 by the purging gas can be delivered to the tail gas treatment device 61 for treatment through the tail gas treatment pipeline 62, thereby avoiding the pollution of the pollutants to the environment.

[0058] It should be noted that in the first cleaning state, in addition to cleaning the vaporization device 20 after the liquid process medium is vaporized by the liquid source vaporization system, the cleaning may also be performed before the liquid process medium is vaporized by the liquid source vaporization system, to purge air, moisture, particles, and the like in the pipelines or the vaporization device 20, and prepare for the process.

[0059] Further, in this embodiment, the vaporization device 20 includes a vaporizer 21, a liquid inlet pipeline 22, a gas outlet pipeline 23, a carrier gas pipeline 24, and a carrier gas control valve 25. The vaporizer 21 has a vaporization chamber configured to vaporize the liquid process medium. An outlet end of the liquid inlet pipeline 22 is communicated with

the vaporization chamber, and an inlet end of the liquid inlet pipeline 22 is communicated with an outlet end of the liquid source pipeline 10 and an outlet end of the purging pipeline 40, respectively. An inlet end of the gas outlet pipeline 23 is communicated with the vaporization chamber, and an outlet end of the gas outlet pipeline 23 is communicated with an inlet end of the output pipeline 30 and an inlet end of the tail gas treatment pipeline 62, respectively. An inlet end of the carrier gas pipeline 24 is configured to be communicated with a carrier gas source, and an outlet end of the carrier gas pipeline 24 is communicated with the vaporization chamber. The carrier gas control valve 25 is disposed the carrier gas pipeline 24, and configured to control on/off of the carrier gas pipeline 24.

[0060] The tail gas treatment unit 60 further includes a vacuum pump. An inlet end of the tail gas treatment pipeline 62 is communicated with an outlet end of the gas outlet pipeline 23, an outlet end of the tail gas treatment pipeline 62 is communicated with the tail gas treatment device 61, and the vacuum pump is disposed on the tail gas treatment pipeline 62.

[0061] The first control unit 50 includes a first control valve 51 and a second control valve 52. The first control valve 51 is disposed on the liquid source pipeline 10 and configured to control on/off of the liquid source pipeline 10. The second control valve 52 is disposed on the purging pipeline 40 and configured to control on/off of the purging pipeline 40.

[0062] The second control unit 70 includes a third control valve 71 and a fourth control valve 72. The third control valve 71 is disposed on the output pipeline 30 and configured to control on/off of the output pipeline 30. The fourth control valve 72 is disposed on the tail gas treatment pipeline 62 and configured to control on/off of the tail gas treatment pipeline 62. The vacuum pump is located between the fourth control valve 72 and the tail gas treatment device 61, and configured to provide power for a gas in the tail gas treatment pipeline 62 flowing into the tail gas treatment device 61.

[0063] The liquid source vaporization system has a working state, a first cleaning state, and a second cleaning state.

[0064] As shown in FIG. 2, in the working state, the first control valve 51 is open, the second control valve 52 is closed, the third control valve 71 is open, the fourth control valve 72 is closed, and the carrier gas control valve 25 is open. The liquid source pipeline 10, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23 and the output pipeline 30 are communicated sequentially. The liquid process medium enters the vaporizer 21 through the liquid source pipeline 10 and the liquid inlet pipeline 22 sequentially, where the liquid process medium is vaporized into a gaseous process medium by the vaporizer 21, and then enters the process chamber of the semiconductor process apparatus through the gas

outlet pipeline 23 and the output pipeline 30 sequentially for a corresponding semiconductor process.

[0065] As shown in FIG. 3, in the first cleaning state, the second control valve 52 is open, the first control valve 51 is closed, the fourth control valve 72 is open, the third control valve 71 is closed, and the carrier gas control valve 25 is closed. The purging gas passes through the purging pipeline 40, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23 and the tail gas treatment pipeline 62 sequentially, to purge residual liquid, air, moisture, particles and the like in the pipelines and the vaporizer 21, while pollutants blown out of the vaporization device 20 by the purging gas enters the tail gas treatment device 61 through the tail gas treatment pipeline 62 for treatment, thereby avoiding the pollution of the pollutants to the environment.

[0066] As shown in FIG. 4, in the second cleaning state, the second control valve 52 is open, the first control valve 51 is closed, the fourth control valve 72 is open, the third control valve 71 is closed, and the carrier gas control valve 25 is open. A main purpose of the second cleaning state is to discharge residual liquid and gas in the pipelines and the vaporizer 21 completely when the process is ended. The purging gas passes through the purging pipeline 40, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23 and the tail gas treatment pipeline 62 sequentially, while the liquid inside is vaporized into gas by the vaporizer 21 under the action of a carrier gas since the carrier gas control valve 25 is open, and then blown out together with the purging gas, so that the residual liquid and gas in the pipelines and the vaporizer 21 can be purged completely. Meanwhile, pollutants blown out of the vaporization device 20 by the purging gas enters the tail gas treatment device 61 through the tail gas treatment pipeline 62 for treatment, thereby avoiding the pollution of the pollutants to the environment.

[0067] It should be noted that, in the first embodiment, the liquid source vaporization system further includes a first flowmeter 80 disposed on the liquid inlet pipeline 22 and configured to control a flow rate of the liquid process medium.

[0068] It should be further noted that, in the first embodiment, the first control unit 50 includes a first control valve 51 and a second control valve 52, but this is not limiting. For example, in some other embodiments not shown in the drawings, the first control unit 50 may be a three-way valve, with a first end communicated with the liquid inlet pipeline 22, a second end communicated with the liquid source pipeline 10, and a third end communicated with the purging pipeline 40, so that the three-way valve can selectively communicate the purging pipeline 40 and the liquid inlet pipeline 22, or communicate the liquid source

pipeline 10 and the liquid inlet pipeline 22. In other words, without violating the working principle of the present application, any structure that enable the switching between communicating the purging pipeline 40 and the liquid inlet pipeline 22 and communicating the liquid source pipeline 10 and the liquid inlet pipeline 22 is within the protection scope of the present application. Similarly, in the first embodiment, the second control unit 70 may also be a three-way valve, which is not repeated here.

[0069] In a second embodiment of the present application as shown in FIG. 5, there is further provided a liquid source vaporization system, which is substantially the same as the first embodiment, except that in this embodiment, the liquid source vaporization system further includes: a first bypass pipeline 90 and a bypass control unit 100. An inlet end of the first bypass pipeline 90 is communicated with the liquid inlet pipeline 22 and located between the first flowmeter 80 and the vaporizer 21, and an outlet end of the first bypass pipeline 90 is communicated with the tail gas treatment pipeline 62. Specifically, the outlet end of the first bypass pipeline 90 is communicated to the tail gas treatment pipeline 62, and located between the fourth control valve 72 and the vacuum pump. The bypass control unit 100 is configured to selectively control the first flowmeter 80 to be communicated with the vaporization chamber or the first bypass pipeline 90.

[0070] The bypass control unit 100 includes a first bypass valve 101 and a second bypass valve 102. The first bypass valve 101 is disposed on the first bypass pipeline 90 and configured to control on/off of the first bypass pipeline 90. The second bypass valve 102 is disposed on the liquid inlet pipeline 22 and located between the inlet end of the first bypass pipeline 90 and the vaporizer 21, and configured to control on/off of the liquid inlet pipeline 22.

[0071] The liquid source vaporization system has a working state and a third cleaning state.

[0072] In the working state, the first control unit 50 controls the liquid source pipeline 10 to be communicated with the liquid inlet pipeline 22, the bypass control unit 100 controls the first flowmeter 80 to be communicated with the vaporization chamber, and the second control unit 70 controls the output pipeline 30 to be communicated with the gas outlet pipeline 23. Specifically, the first control valve 51 is open, and the second control valve 52 is closed; while the third control valve 71 is open, the fourth control valve 72 is closed, the second bypass valve 102 is open, the first bypass valve 101 is closed, and the carrier gas control valve 25 is open. In the working state, the liquid source pipeline 10, the first flowmeter 80, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23, and the output pipeline 30 are communicated sequentially. The liquid process medium enters the

vaporizer 21 through the liquid source pipeline 10, the first flowmeter 80, and the liquid inlet pipeline 22 sequentially, where the liquid process medium is vaporized into a gaseous process medium by the vaporizer 21, and then enters the process chamber of the semiconductor process apparatus through the gas outlet pipeline 23 and the output pipeline 30 sequentially for a corresponding semiconductor process.

[0073] As shown in FIG. 5, in the third cleaning state, the first control unit 50 controls the purging pipeline 40 to be communicated with the liquid inlet pipeline 22, and the bypass control unit 100 controls the first flowmeter 80 to be communicated with the first bypass pipeline 90. Specifically, the second control valve 52 is open, and the first control valve 51 is closed; while the first bypass valve 101 is open, the second bypass valve 102 is closed, and the carrier gas control valve 25 is closed. In this manner, the purging pipeline 40, the first flowmeter 80, the liquid inlet pipeline 22, the first bypass pipeline 90, the tail gas treatment pipeline 62, the vacuum pump, and the tail gas treatment device 61 are communicated sequentially. Since the liquid process medium commonly used may be spontaneously combustible, corrosive, toxic, or have other hazardous properties, when the first flowmeter 80 needs maintenance and replacement, sufficient purging should be performed to prevent residuals in devices and pipelines to ensure personnel safety. When the liquid source vaporization system is in the third cleaning state, the purging gas sequentially passes through the purging pipeline 40, the first flowmeter 80, the liquid inlet pipeline 22, the first bypass pipeline 90, the tail gas treatment pipeline 62, the vacuum pump, and the tail gas treatment device 61, to blow pollutants and residual liquid in the purging gas to the tail gas treatment device 61, thereby ensuring the safety of operators during maintenance and replacement of the first flowmeter 80.

[0074] It should be noted that, in the second embodiment, the bypass control unit 100 includes the first bypass valve 101 and the second bypass valve 102, but this is not limiting. For example, in some other embodiments not shown in the drawings, the first control unit 50 may be a three-way valve, with a first end communicated with the liquid inlet pipeline 22, a second end communicated with the first bypass pipeline 90, and a third end communicated with the vaporizer 21, so that the three-way valve can communicate the liquid inlet pipeline 22 and the first bypass pipeline 90, or communicate the liquid inlet pipeline 22 and the vaporizer 21. In other words, without violating the working principle of the present application, any structure that enable the switching between the vaporizer 21 and the first bypass pipeline 90 is within the protection scope of the present application.

[0075] In a third embodiment of the present application as shown in FIG. 6, there is further

provided a liquid source vaporization system, which is substantially the same as the first embodiment, except that in this embodiment, the liquid source vaporization system further includes: a second bypass pipeline 110 and a fifth control valve 120. An inlet end of the second bypass pipeline 110 is communicated with a purging gas source, and an outlet end of the second bypass pipeline 110 is communicated with the liquid inlet pipeline 22 and located between the first flowmeter 80 and the vaporization chamber. The fifth control valve 120 is disposed on the second bypass pipeline 110 and configured to control on/off of the second bypass pipeline 110.

[0076] The liquid source vaporization system has a working state and a fourth cleaning state.

[0077] In the working state, the first control valve 51 is open, the second control valve 52 is closed, and the fifth control valve 120 is closed, while the third control valve 71 is open, the fourth control valve 72 is closed, and the carrier gas control valve 25 is open. The liquid source pipeline 10, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23, and the output pipeline 30 are communicated sequentially. The liquid process medium enters the vaporizer 21 through the liquid source pipeline 10 and the liquid inlet pipeline 22 sequentially, where the liquid process medium is vaporized into a gaseous process medium by the vaporizer 21, and then enters the process chamber of the semiconductor process apparatus through the gas outlet pipeline 23 and the output pipeline 30 sequentially for a corresponding semiconductor process.

[0078] As shown in FIG. 6, in the fourth cleaning state, the fifth control valve 120 is open, the first control valve 51 is closed, and the second control valve 52 is closed, while the carrier gas control valve 25 is open, the fourth control valve 72 is open, and the third control valve 71 is closed.

[0079] The fourth cleaning state is used mainly for a situation where the first flowmeter 80 fails and does not allow passage of liquid. When the liquid source vaporization system is in the fourth cleaning state, the purging gas source, the second bypass pipeline 110, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23, the tail gas treatment pipeline 62, the vacuum pump, and the tail gas treatment device 61 are communicated sequentially. The purging gas bypasses the first flowmeter 80 through the second bypass pipeline 110, and then enters the vaporizer 21 through the liquid inlet pipeline 22, while the vaporizer 21 vaporizes the residual liquid therein with the aid of the carrier gas, and then completely purges residual liquid, air, moisture, particles and the like in the pipelines and the vaporizer 21 under the action of the purging gas, to discharge the vaporized gas and pollutants into the tail gas treatment device 61 for treatment through the gas outlet pipeline 23 and the tail gas

treatment pipeline 62, thereby avoiding the pollution of the pollutants to the environment. By providing the second bypass pipeline 110, when the first flowmeter 80 fails and does not allow passage of liquid, the residual liquid in a pipeline at a rear end of the first flowmeter 80 can be thoroughly eliminated first to ensure the overall safety.

5 [0080] In the related art, if the vaporizer 21 has a heating problem, and cannot continue to vaporize the liquid process medium, it will be difficult to discharge the residual liquid process medium in the pipelines. To solve this problem, in a fourth embodiment of the present application as shown in FIG. 7, there is further provided a liquid source vaporization system, which is substantially the same as the first embodiment, except that in this
10 embodiment, the liquid source vaporization system further includes: a residual liquid recycle device 130 communicated with the liquid inlet pipeline 22 and configured to recycle the residual process medium.

[0081] In the liquid source vaporization system according to the fourth embodiment of the present application, the residual liquid recycle device 130 is added on the basis of the first
15 embodiment, which can recycle the residual liquid in the pipelines, and thus reduce the loss of the liquid process medium and the material cost.

[0082] Specifically, in the fourth embodiment, as shown in FIG. 7, the residual liquid recycle device 130 includes: a residual liquid collector 131, a residual liquid recycle pipeline 132, and a sixth control valve 133. The residual liquid collector 131 is configured to recycle
20 the residual liquid process medium. An outlet end of the residual liquid recycle pipeline 132 is communicated with the residual liquid collector 131, and an inlet end of the residual liquid recycle pipeline 132 is communicated with the liquid inlet pipeline 22. The sixth control valve 133 is disposed on the residual liquid recycle pipeline 132 and configured to control on/off of the residual liquid recycle pipeline 132.

25 [0083] To recycle the residual liquid in cooperation with the residual liquid recycle device 130, the vaporization device 20 further includes: a seventh control valve 26 disposed on the liquid inlet pipeline 22 and located between the inlet end of the residual liquid recycle pipeline 132 and the vaporizer 21, and configured to control on/off between the vaporization chamber of the vaporizer 21 and the liquid inlet pipeline 22.

30 [0084] Further, the residual liquid recycle device 130 further includes an exhaust pipeline 134 and an eighth control valve 135. The residual liquid collector 131 has a vent communicated with the tail gas treatment pipeline 62 through the exhaust pipeline 134. The eighth control valve 135 is disposed on the exhaust pipeline 134 and configured to control on/off of the exhaust pipeline 134. The exhaust pipeline 134 can discharge excess gas and

pressure in a container of the residual liquid collector 131 into the tail gas treatment pipeline 62, thereby facilitating the collection of residual liquid.

[0085] In this embodiment, the liquid source vaporization system has a working state and a first residual liquid recycling state.

5 [0086] In the working state, the first control valve 51 is open, and the second control valve 52 is closed; while the third control valve 71 is open, the fourth control valve 72 is closed, the seventh control valve 26 is open, the sixth control valve 133 is closed, and the carrier gas control valve 25 is open. In the working state, the liquid source pipeline 10, the first flowmeter 80, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23, and
10 the output pipeline 30 are communicated sequentially. The liquid process medium enters the vaporizer 21 through the liquid source pipeline 10, the first flowmeter 80, and the liquid inlet pipeline 22 sequentially, where the liquid process medium is vaporized into a gaseous process medium by the vaporizer 21, and then enters the process chamber of the semiconductor process apparatus through the gas outlet pipeline 23 and the output pipeline
15 30 sequentially for a corresponding semiconductor process.

[0087] As shown in FIG. 7, in the first residual liquid recycling state, the second control valve 52 is open, the first control valve 51 is closed, the sixth control valve 133 is open, the seventh control valve 26 is closed, the eighth control valve 135 is open, and the carrier gas control valve 25 is closed.

20 [0088] A main purpose of the first residual liquid recycling state is to enable the residual liquid in the pipelines to enter the residual liquid collector 131 along with the purging gas for recycle when the vaporizer 21 fails and cannot perform vaporization. When the liquid source vaporization system is in the first residual liquid recycling state, the purging gas source, the purging pipeline 40, the liquid inlet pipeline 22, the residual liquid recycle
25 pipeline 132, and the residual liquid collector 131 are communicated sequentially, and an exhaust port of the residual liquid collector 131, the exhaust pipeline 134, the tail gas treatment pipeline 62, and the tail gas treatment device 61 are communicated sequentially. The purging gas sequentially passes through the purging pipeline 40, the liquid inlet pipeline 22 and the residual liquid recycle pipeline 132 to enter the residual liquid collector 131, and
30 then passes through the exhaust port of the residual liquid collector 131, the exhaust pipeline 134, and the tail gas treatment pipeline 62 to enter the tail gas treatment device 61. In this process, the residual liquid in the pipelines enters the residual liquid collector 131 along with the purging gas for recycle, while the gaseous process medium or other waste gas in the pipelines may enter the tail gas treatment device 61 along with the purging gas for treatment,

so that the environmental pollution can be avoided while ensuring the collection of residual liquid.

[0089] In the liquid source vaporization system according to the fourth embodiment of the present application, by providing the residual liquid collector 131, the residual liquid recycle pipeline 132, and the sixth control valve 133, and providing the seventh control valve 26 on the liquid inlet pipeline 22 between the inlet end of the residual liquid recycle pipeline 132 and the vaporizer 21, the sixth control valve 133 and the seventh control valve 26 can selectively control the liquid inlet pipeline 22 to be communicated with the residual liquid recycle pipeline 132, or control the liquid inlet pipeline 22 to be communicated with the vaporizer 21, so that the residual liquid in the pipelines can be recycled when the liquid inlet pipeline 22 is communicated with the residual liquid recycle pipeline 132, and thus reduce the loss of the liquid process medium and the material cost. In addition, the exhaust pipeline 134 can discharge excess gas and pressure in a container of the residual liquid collector 131 into the tail gas treatment pipeline 62, and enable the gaseous process medium or other waste gas in the pipelines to enter the tail gas treatment device 61 along with the purging gas for treatment, so that the environmental pollution can be avoided while facilitating the collection of residual liquid, which is a typical application of one device with multiple purposes.

[0090] In a fifth embodiment of the present application as shown in FIG. 8, there is further provided a liquid source vaporization system, which is substantially the same as the fourth embodiment, except that in this embodiment, the liquid source vaporization system further includes: a ninth control valve 136 disposed on the residual liquid recycle pipeline 132 and located between the sixth control valve 133 and the outlet end of the residual liquid recycle pipeline 132.

[0091] The liquid source vaporization system further includes: a purging branch 140 and a tenth control valve 150. An inlet end of the purging branch 140 is communicated with a purging gas source, and an outlet end of the purging branch 140 is communicated with the residual liquid recycle pipeline 132 and located between the ninth control valve 136 and the sixth control valve 133. The tenth control valve 150 is disposed on the purging branch 140 and configured to control on/off of the purging branch 140.

[0092] In this embodiment, the liquid source vaporization system has a working state and a second residual liquid recycling state.

[0093] In the working state, the first control valve 51 is open, the second control valve 52 is closed, and the tenth control valve 150 is closed; while the third control valve 71 is open, the fourth control valve 72 is closed, the seventh control valve 26 is open, the sixth control

valve 133 is closed, and the carrier gas control valve 25 is open. In the working state, the liquid source pipeline 10, the first flowmeter 80, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23, and the output pipeline 30 are communicated sequentially. The liquid process medium enters the vaporizer 21 through the liquid source pipeline 10, the first
5 flowmeter 80, and the liquid inlet pipeline 22 sequentially, where the liquid process medium is vaporized into a gaseous process medium by the vaporizer 21, and then enters the process chamber of the semiconductor process apparatus through the gas outlet pipeline 23 and the output pipeline 30 sequentially for a corresponding semiconductor process.

[0094] As shown in FIG. 8, in the second residual liquid recycling state, the tenth control
10 valve 150 is open, the first control valve 51 is closed, the second control valve 52 is closed, the ninth control valve 136 is open, the sixth control valve 133 is closed, the seventh control valve 26 is closed, the eighth control valve 135 is open, and the carrier gas control valve 25 is closed.

[0095] A main purpose of the second residual liquid recycling state is to purge the pipelines
15 after the residual liquid is collected, so as to discharge impurities such as air, moisture and the like in the pipelines and the residual liquid collector 131. When the liquid source vaporization system is in the second residual liquid recycling state, the purging gas source, the purging branch 140, the residual liquid recycle pipeline 132, and the residual liquid collector 131 are communicated sequentially, and an exhaust port of the residual liquid
20 collector 131, the exhaust pipeline 134, the tail gas treatment pipeline 62, and the tail gas treatment device 61 are communicated sequentially. The purging gas sequentially passes through the purging branch 140 and the residual liquid recycle pipeline 132 to enter the residual liquid collector 131, and then passes through the exhaust port of the residual liquid collector 131, the exhaust pipeline 134, and the tail gas treatment pipeline 62 to enter the tail
25 gas treatment device 61. In this process, impurities such as air, moisture and the like in the pipelines and the residual liquid collector 131 are discharged from the residual liquid collector 131 along with the purging gas, and enter the tail gas treatment device 61 along with the purging gas for treatment, so that the collected residual liquid is ensured to be in a relatively stable state without reacting with the gas impurities. Meanwhile, the environmental
30 pollution caused by the discharged waste gas can be avoided.

[0096] In a sixth embodiment of the present application as shown in FIG. 9, there is further provided a liquid source vaporization system, which is substantially the same as the fifth embodiment, except that in this embodiment, the residual liquid recycle device 130 further includes: a residual gas discharge pipeline 137 and a residual gas control valve 138. An inlet

end of the residual gas discharge pipeline 137 is communicated with the residual liquid recycle pipeline 132 and located between the sixth control valve 133 and the ninth control valve 136, and an outlet end of the residual gas discharge pipeline 137 is communicated with the tail gas treatment pipeline 62 and located between the fourth control valve 72 and the vacuum pump. The residual gas control valve 138 is disposed on the residual gas discharge pipeline 137 and configured to control on/off of the residual gas discharge pipeline 137.

[0097] In this embodiment, the liquid source vaporization system has a working state and pipeline residual gas discharging state.

[0098] In the working state, the first control valve 51 is open, the second control valve 52 is closed, and the tenth control valve 150 is closed; while the third control valve 71 is open, the fourth control valve 72 is closed, the seventh control valve 26 is open, the sixth control valve 133 is closed, and the carrier gas control valve 25 is open. In the working state, the liquid source pipeline 10, the first flowmeter 80, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23, and the output pipeline 30 are communicated sequentially. The liquid process medium enters the vaporizer 21 through the liquid source pipeline 10, the first flowmeter 80, and the liquid inlet pipeline 22 sequentially, where the liquid process medium is vaporized into a gaseous process medium by the vaporizer 21, and then enters the process chamber of the semiconductor process apparatus through the gas outlet pipeline 23 and the output pipeline 30 sequentially for a corresponding semiconductor process.

[0099] As shown in FIG. 9, in the pipeline residual gas discharging state, the second control valve 52 is open, the first control valve 51 is closed, the tenth control valve 150 is closed, the sixth control valve 133 is open, the residual gas control valve 138 is open, the seventh control valve 26 is closed, the ninth control valve 136 is closed, and the carrier gas control valve 25 is closed.

[0100] A main purpose of the pipeline residual gas discharging state is to purge the pipelines by a purging gas when the residual liquid collection is completed and the residual liquid collector 131 needs to be removed, to discharge the residual gaseous process medium, air, moisture and other impurities in the pipelines.

[0101] When the liquid source vaporization system is in the pipeline residual gas discharging state, the purging gas source, the purging pipeline 40, the liquid inlet pipeline 22, the residual liquid recycle pipeline 132, the residual gas discharge pipeline 137, the tail gas treatment pipeline 62 and the tail gas treatment device 61 are communicated sequentially. The purging gas sequentially passes through the purging pipeline 40, the liquid inlet pipeline 22, the residual liquid recycle pipeline 132, the residual gas discharge pipeline 137 and the

tail gas treatment pipeline 62 to enter the tail gas treatment device 61, during which the purging gas carries the gaseous process medium, air, moisture and other impurities in the pipelines to the tail gas treatment device 61 for treatment, so that the gaseous process medium, air, moisture and other impurities in the pipelines are removed while ensuring safe removal of the residual liquid collector 131. Meanwhile, the environmental pollution caused by the discharged waste gas can be avoided.

[0102] In a seventh embodiment of the present application as shown in FIGs. 10 to 16, there is further provided a liquid source vaporization system, which is substantially the same as the sixth embodiment, except that in this embodiment, the liquid source vaporization system further includes: a second bypass pipeline 110 and a fifth control valve 120. An inlet end of the second bypass pipeline 110 is communicated with a purging gas source, and an outlet end of the second bypass pipeline 110 is communicated with the liquid inlet pipeline 22 and located between the first flowmeter 80 and the vaporization chamber. The fifth control valve 120 is disposed on the second bypass pipeline 110 and configured to control on/off of the second bypass pipeline 110.

[0103] In this embodiment, the liquid source vaporization system has a working state, a first cleaning state, a second cleaning state, a fourth cleaning state, a first residual liquid recycling state, a second residual liquid recycling state, and a pipeline residual gas discharging state.

[0104] As shown in FIG. 10, in the working state, the first control valve 51 is open, the second control valve 52 is closed, the fifth control valve 120 is closed, the tenth control valve 150 is closed, the seventh control valve 26 is open, the sixth control valve 133 is closed, the carrier gas control valve 25 is open, the third control valve 71 is open, and the fourth control valve 72 is closed.

[0105] In the working state, the liquid source pipeline 10, the first flowmeter 80, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23, and the output pipeline 30 are communicated sequentially. The liquid process medium enters the vaporizer 21 through the liquid source pipeline 10, the first flowmeter 80, and the liquid inlet pipeline 22 sequentially, where the liquid process medium is vaporized into a gaseous process medium by the vaporizer 21, and then enters the process chamber of the semiconductor process apparatus through the gas outlet pipeline 23 and the output pipeline 30 sequentially for a corresponding semiconductor process.

[0106] As shown in FIG. 11, in the first cleaning state, the second control valve 52 is open, the first control valve 51 is closed, the fifth control valve 120 is closed, the tenth control valve 150 is closed, the seventh control valve 26 is open, the sixth control valve 133 is closed,

the carrier gas control valve 25 is closed, the fourth control valve 72 is open, and the third control valve 71 is closed.

[0107] The purging gas passes through the purging pipeline 40, the liquid inlet pipeline 22, the vaporizer 21, and the gas outlet pipeline 23 sequentially, to purge residual liquid, air, moisture, particles and the like in the pipelines and the vaporizer 21, while pollutants blown out of the vaporization device 20 by the purging gas enters the tail gas treatment device 61 through the tail gas treatment pipeline 62 for treatment, thereby avoiding the pollution of the pollutants to the environment.

[0108] As shown in FIG. 12, in the second cleaning state, the second control valve 52 is open, the first control valve 51 is closed, the fifth control valve 120 is closed, the tenth control valve 150 is closed, the seventh control valve 26 is open, the sixth control valve 133 is closed, the carrier gas control valve 25 is open, the fourth control valve 72 is open, and the third control valve 71 is closed.

[0109] A main purpose of the second cleaning state is to discharge residual liquid and gas in the pipelines and the vaporizer 21 when the process is ended. The purging gas passes through the purging pipeline 40, the liquid inlet pipeline 22, the vaporizer 21, and the gas outlet pipeline 23 sequentially, while the liquid inside is vaporized into gas by the vaporizer 21 under the action of a carrier gas since the carrier gas control valve 25 is open, and then blown out together with the purging gas, so that the residual liquid and gas in the pipelines and the vaporizer 21 can be purged completely. Meanwhile, pollutants blown out of the vaporization device 20 by the purging gas enters the tail gas treatment device 61 through the tail gas treatment pipeline 62 for treatment, thereby avoiding the pollution of the pollutants to the environment.

[0110] As shown in FIG. 13, in the fourth cleaning state, the fifth control valve 120 is open, the first control valve 51 is closed, the second control valve 52 is closed, the tenth control valve 150 is closed, the seventh control valve 26 is open, the sixth control valve 133 is closed, the carrier gas control valve 25 is open, the fourth control valve 72 is open, and the third control valve 71 is closed.

[0111] The fourth cleaning state is used mainly for a situation where the first flowmeter 80 fails and does not allow passage of liquid. When the liquid source vaporization system is in the fourth cleaning state, the purging gas source, the second bypass pipeline 110, the liquid inlet pipeline 22, the vaporizer 21, the gas outlet pipeline 23, the tail gas treatment pipeline 62, the vacuum pump, and the tail gas treatment device 61 are communicated sequentially. The purging gas bypasses the first flowmeter 80 through the second bypass pipeline 110, and

then enters the vaporizer 21 through the liquid inlet pipeline 22, while the vaporizer 21 vaporizes the residual liquid therein with the aid of the carrier gas, and then completely purges residual liquid, air, moisture, particles and the like in the pipelines and the vaporizer 21 under the action of the purging gas, to discharge the vaporized gas and pollutants into the tail gas treatment device 61 for treatment through the gas outlet pipeline 23 and the tail gas treatment pipeline 62, thereby avoiding the pollution of the pollutants to the environment. By providing the second bypass pipeline 110, when the first flowmeter 80 fails and does not allow passage of liquid, the residual liquid in a pipeline at a rear end of the first flowmeter 80 can be thoroughly eliminated first to ensure the overall safety.

[0112] As shown in FIG. 14, in the first residual liquid recycling state, the second control valve 52 is open, the first control valve 51 is closed, the fifth control valve 120 is closed, the tenth control valve 150 is closed, the sixth control valve 133 is open, the ninth control valve 136 is open, the seventh control valve 26 is closed, the residual gas control valve 138 is closed, the eighth control valve 135 is open, the carrier gas control valve 25 is closed, the third control valve 71 is closed, and the fourth control valve 72 is closed.

[0113] A main purpose of the first residual liquid recycling state is to enable the residual liquid in the pipelines to enter the residual liquid collector 131 along with the purging gas for recycle when the vaporizer 21 fails and cannot perform vaporization. When the liquid source vaporization system is in the first residual liquid recycling state, the purging gas source, the purging pipeline 40, the liquid inlet pipeline 22, the residual liquid recycle pipeline 132, and the residual liquid collector 131 are communicated sequentially, and an exhaust port of the residual liquid collector 131, the exhaust pipeline 134, the tail gas treatment pipeline 62, and the tail gas treatment device 61 are communicated sequentially. The purging gas sequentially passes through the purging pipeline 40, the liquid inlet pipeline 22 and the residual liquid recycle pipeline 132 to enter the residual liquid collector 131, and then passes through the exhaust port of the residual liquid collector 131, the exhaust pipeline 134, and the tail gas treatment pipeline 62 to enter the tail gas treatment device 61. In the process, the residual liquid in the pipelines enters the residual liquid collector 131 along with the purging gas for recycle, while the gaseous process medium or other waste gas in the pipelines may enter the tail gas treatment device 61 along with the purging gas for treatment, so that the environmental pollution can be avoided while ensuring the collection of residual liquid.

[0114] In the liquid source vaporization system according to the seventh embodiment of the present application, by providing the residual liquid collector 131, the residual liquid recycle

pipeline 132, and the sixth control valve 133, and providing the seventh control valve 26 on the liquid inlet pipeline 22 between the inlet end of the residual liquid recycle pipeline 132 and the vaporizer 21, the sixth control valve 133 and the seventh control valve 26 can selectively control the liquid inlet pipeline 22 to be communicated with the residual liquid recycle pipeline 132, or control the liquid inlet pipeline 22 to be communicated with the vaporizer 21, so that the residual liquid in the pipelines can be recycled when the liquid inlet pipeline 22 is communicated with the residual liquid recycle pipeline 132, and thus reduce the loss of the liquid process medium and the material cost. In addition, the exhaust pipeline 134 can discharge excess gas and pressure in a container of the residual liquid collector 131 into the tail gas treatment pipeline 62, and enable the gaseous process medium or other waste gas in the pipelines to enter the tail gas treatment device 61 along with the purging gas for treatment, so that the environmental pollution can be avoided while facilitating the collection of residual liquid, which is a typical application of one device with multiple purposes.

[0115] As shown in FIG. 15, in the second residual liquid recycling state, the tenth control valve 150 is open, the first control valve 51 is closed, the second control valve 52 is closed, the fifth control valve 120 is closed, the ninth control valve 136 is open, the sixth control valve 133 is closed, the seventh control valve 26 is closed, the residual gas control valve 138 is closed, the eighth control valve 135 is open, the carrier gas control valve 25 is closed, the third control valve 71 is closed, and the fourth control valve 72 is closed.

[0116] A main purpose of the second residual liquid recycling state is to purge the pipelines after the residual liquid is collected, so as to discharge impurities such as air, moisture and the like in the pipelines and the residual liquid collector 131. When the liquid source vaporization system is in the second residual liquid recycling state, the purging gas source, the purging branch 140, the residual liquid recycle pipeline 132, and the residual liquid collector 131 are communicated sequentially, and an exhaust port of the residual liquid collector 131, the exhaust pipeline 134, the tail gas treatment pipeline 62, and the tail gas treatment device 61 are communicated sequentially. The purging gas sequentially passes through the purging branch 140 and the residual liquid recycle pipeline 132 to enter the residual liquid collector 131, and then passes through the exhaust port of the residual liquid collector 131, the exhaust pipeline 134, and the tail gas treatment pipeline 62 to enter the tail gas treatment device 61. In this process, impurities such as air, moisture and the like in the pipelines and the residual liquid collector 131 are discharged from the residual liquid collector 131 along with the purging gas, and enter the tail gas treatment device 61 along with the purging gas for treatment, so that the collected residual liquid is ensured to be in a

relatively stable state without reacting with the gas impurities. Meanwhile, the environmental pollution caused by the discharged waste gas can be avoided.

[0117] As shown in FIG. 16, in the pipeline residual gas discharging state, the second control valve 52 is open, the first control valve 51 is closed, the fifth control valve 120 is closed, the tenth control valve 150 is closed, the sixth control valve 133 is open, the residual gas control valve 138 is open, the seventh control valve 26 is closed, the ninth control valve 136 is closed, the eighth control valve 135 is closed, the carrier gas control valve 25 is closed, the third control valve 71 is closed, and the fourth control valve 72 is closed.

[0118] A main purpose of the pipeline residual gas discharging state is to purge the pipelines by a purging gas when the residual liquid collection is completed and the residual liquid collector 131 needs to be removed, to discharge the residual gaseous process medium, air, moisture and other impurities in the pipelines.

[0119] When the liquid source vaporization system is in the pipeline residual gas discharging state, the purging gas source, the purging pipeline 40, the liquid inlet pipeline 22, the residual liquid recycle pipeline 132, the residual gas discharge pipeline 137, the tail gas treatment pipeline 62 and the tail gas treatment device 61 are communicated sequentially. The purging gas sequentially passes through the purging pipeline 40, the liquid inlet pipeline 22, the residual liquid recycle pipeline 132, the residual gas discharge pipeline 137 and the tail gas treatment pipeline 62 to enter the tail gas treatment device 61, during which the purging gas carries the gaseous process medium, air, moisture and other impurities in the pipelines to the tail gas treatment device 61 for treatment, so that the gaseous process medium, air, moisture and other impurities in the pipelines are removed while ensuring safe removal of the residual liquid collector 131. Meanwhile, the environmental pollution caused by the discharged waste gas can be avoided.

[0120] It should be noted that, in this embodiment, the pipeline residual gas discharging state may also implement the function of the third cleaning state in the second embodiment. In other words, when the first flowmeter 80 needs maintenance and replacement, to ensure personnel safety, the liquid source vaporization system of this embodiment may be adjusted to the pipeline residual gas discharging state to blow pollutants and residual liquid in the purging gas to a tail gas treatment system for treatment, thereby ensuring the safety of operators during maintenance and replacement of the first flowmeter 80, which is a typical application of one device with multiple purposes.

[0121] In the related art, both the atomizer in the vaporizer 21 and the flowmeter have small-aperture structures, and when the liquid source is viscous, jamming can easily occur.

Therefore, the vaporizer 21 and the flowmeter need to be replaced and maintained.

[0122] To solve the above-described problems, the liquid source vaporization system of this embodiment further has a first flushing state, which is substantially the same as the first residual liquid recycling state, except that in the first flushing state, the first control valve 51 is open, and the second control valve 52 is closed. Moreover, instead of a process medium, the liquid introduced from the liquid source is an organic solvent, such as n-octane and the like, with which the pipelines and the devices are flushed. Then, the residual liquid and organic solvent in the pipelines after the flushing sequentially passes through the purging pipeline 40, the liquid inlet pipeline 22 and the residual liquid recycle pipeline 132 to enter the residual liquid collector 131 to be collected, thereby completing the flushing of pipelines. Then, the system may enter the first residual liquid recycling state to recycle the residual liquid in the pipelines by the purging gas, thereby completing cleaning of the pipelines.

[0123] In addition, the liquid source vaporization system of this embodiment further has a second flushing state, which is substantially the same as the second cleaning state, except that in the second flushing state, the first control valve 51 is open, and the second control valve 52 is closed. Moreover, instead of a process medium, the liquid introduced from the liquid source is also an organic solvent, such as n-octane and the like, The organic solvent passes through the purging pipeline 40, the liquid inlet pipeline 22, the vaporizer 21, and the gas outlet pipeline 23 sequentially, while the liquid organic solvent inside is vaporized into gas by the vaporizer 21 under the action of a carrier gas since the carrier gas control valve 25 is open, and the residual process medium in the vaporizer 21 is dissolved and blown out together, so that the residual process medium in the pipelines and the vaporizer 21 is completely flushed, and enters the tail gas treatment device 61 through the tail gas treatment pipeline 62 for treatment, thereby avoiding the pollution of the pollutants to the environment. Then, the system may enter the second cleaning state to recycle the residual liquid in the pipelines by the purging gas, thereby completing cleaning of the pipelines.

[0124] The first flushing state differs from the second flushing state in that the first flushing state includes flushing the pipelines upstream of the vaporizer 21, while the second flushing state can flush an interior of the vaporizer 21.

[0125] In an eighth embodiment of the present application as shown in FIG. 17, there is further provided a liquid source vaporization system, which is substantially the same as the seventh embodiment, except that in this embodiment, the exhaust pipeline 134 is directly connected to the tail gas treatment device 61 without passing through the vacuum pump. A main purpose of this structure is to adjust the liquid source vaporization system directly to

the second residual liquid recycling state after installation, and since it is the first purging of the residual liquid collector 131, and no special gas or liquid is present in the pipelines, the residual liquid can be directly purged into the tail gas treatment system without passing through the vacuum pump.

5 [0126] It should be noted that, in the above embodiment, to avoid fluctuations in an original temperature after the carrier gas enters the vaporizer 21, the vaporization device 20 further includes a heat exchanger disposed on the carrier gas pipeline 24 and configured to heat the carrier gas, so that the temperature of the carrier gas can be increased to a desired temperature within a short time, thereby improving the vaporization effect.

10 [0127] In the above embodiment, the first flowmeter 80 is a mass flowmeter that can precisely control a flow rate of the liquid. In addition, to precisely control a flow rate of the carrier gas, the carrier gas pipeline 24 is provided with a gas flowmeter, which is a mass flowmeter that can precisely control a flow rate of the gas. However, this is not restrictive and any device capable of accurately measuring a flow rate of a liquid or gas falls within the
15 scope of the present application without departing from the inventive concept of the present application.

[0128] It should be noted that, to monitor a state of the liquid or gas in the pipelines, a pressure detection device may be provided on the pipelines to confirm the overall transmission performance and safety. Take the seventh embodiment as an example:

20 [0129] A first pressure detection device may be provided on the liquid inlet pipeline 22. The first pressure detection device is located between an inlet end of the residual liquid recycle pipeline 132 and the first flowmeter 80, and configured to detect a pressure of the fluid entering the vaporizer 21, thereby confirming a stable supply pressure of the liquid source.

25 [0130] A second pressure detection device may be further provided on the gas outlet pipeline 23 to detect a gas outlet pressure at a rear end of the vaporizer 21. If the gas outlet pressure is too low, the carrier gas pressure and the carrier gas amount may be appropriately increased to raise the gas outlet pressure, so that the forward transmission of the fluid is ensured while the tightness of the pipelines is confirmed.

30 [0131] A third pressure detection device may be further provided on the residual gas discharge pipeline 137. The third pressure detection device is located between an inlet end of the tail gas treatment pipeline 62 and the residual gas control valve 138 and configured to confirm the tightness of the pipelines.

[0132] A fourth pressure detection device may be further provided at an entrance of the

vacuum pump to confirm whether the vacuum pump is in normal operation and the pipelines are in a vacuum state.

[0133] It should be further noted that, in the above embodiment, the gas in the pipelines is pumped by a vacuum pump with a negative pressure and discharged to the tail gas treatment device, but this is not limiting, and a gas pump, a fan, or other devices may also be used, and any device capable of generating a gas flow and discharging the gas flow to the tail gas treatment device falls within the protection scope of the present application.

[0134] It will be appreciated that the above implementations are merely exemplary implementations for the purpose of illustrating the principle of the present application, and the present application is not limited thereto. Various modifications and improvements can be made by a person having ordinary skill in the art without departing from the spirit and essence of the present application. Accordingly, all of the modifications and improvements also fall within the protection scope of the present application.

What is claimed is:

1. A liquid source vaporization system applied to a semiconductor process apparatus, comprising:

5 a vaporization device (20) configured to vaporize a liquid process medium into a gaseous process medium;

a liquid source pipeline (10) configured to supply the liquid process medium to the vaporization device (20);

10 a purging pipeline (40) configured to supply a purging gas to the vaporization device (20);

a first control unit (50) configured to selectively control the purging pipeline (40) or the liquid source pipeline (10) to be communicated with the vaporization device (20);

an output pipeline (30) configured to deliver the vaporized gaseous process medium into a process chamber of the semiconductor process apparatus;

15 a tail gas treatment pipeline (62) configured to deliver pollutants blown out of the vaporization device (20) by the purging gas to a tail gas treatment device (61); and

a second control unit (70) configured to selectively control the tail gas treatment pipeline (62) or the output pipeline (30) to be communicated with the vaporization device (20).

20 2. The liquid source vaporization system according to claim 1, wherein the liquid source vaporization system has a working state and a first cleaning state; in the working state, the first control unit (50) controls the liquid source pipeline (10) to be communicated with the vaporization device (20), and the second control unit (70) controls the output pipeline (30) to be communicated with the vaporization device (20); and

25 in the first cleaning state, the first control unit (50) controls the purging pipeline (40) to be communicated with the vaporization device (20), and the second control unit (70) controls the tail gas treatment pipeline (62) to be communicated with the vaporization device (20).

3. The liquid source vaporization system according to claim 1, wherein the vaporization device (20) comprises:

a vaporizer (21) having a vaporization chamber configured to vaporize the liquid

process medium;

a liquid inlet pipeline (22), wherein an outlet end of the liquid inlet pipeline (22) is communicated with the vaporization chamber, and an inlet end of the liquid inlet pipeline (22) is communicated with an outlet end of the liquid source pipeline (10) and an outlet end of the purging pipeline (40), respectively; and

a gas outlet pipeline (23), wherein an inlet end of the gas outlet pipeline (23) is communicated with the vaporization chamber, and an outlet end of the gas outlet pipeline (23) is communicated with an inlet end of the output pipeline (30) and an inlet end of the tail gas treatment pipeline (62), respectively.

4. The liquid source vaporization system according to claim 3, wherein the liquid source vaporization system has a working state and a first cleaning state; in the working state, the first control unit (50) controls the liquid source pipeline (10) to be communicated with the liquid inlet pipeline (22), and the second control unit (70) controls the output pipeline (30) to be communicated with the gas outlet pipeline (23); and

in the first cleaning state, the first control unit (50) controls the purging pipeline (40) to be communicated with the liquid inlet pipeline (22), and the second control unit (70) controls the tail gas treatment pipeline (62) to be communicated with the gas outlet pipeline (23).

5. The liquid source vaporization system according to claim 3, wherein the first control unit (50) comprises:

a first control valve (51) disposed on the liquid source pipeline (10) and configured to control on/off of the liquid source pipeline (10);

a second control valve (52) disposed on the purging pipeline (40) and configured to control on/off of the purging pipeline (40); and

the second control unit (70) comprises:

a third control valve (71) disposed on the output pipeline (30) and configured to control on/off of the output pipeline (30); and

a fourth control valve (72) disposed on the tail gas treatment pipeline (62) and configured to control on/off of the tail gas treatment pipeline (62).

6. The liquid source vaporization system according to claim 4, wherein the

vaporization device (20) further comprises:

a carrier gas pipeline (24), wherein an inlet end of the carrier gas pipeline (24) is configured to be communicated with a carrier gas source, and an outlet end of the carrier gas pipeline (24) is communicated with the vaporization chamber; and

5 a carrier gas control valve (25) disposed on the carrier gas pipeline (24) and configured to control on/off of the carrier gas pipeline (24).

7. The liquid source vaporization system according to claim 6, wherein
the carrier gas control valve (25) is open in the working state; and
10 the carrier gas control valve (25) is closed in the first cleaning state.

8. The liquid source vaporization system according to claim 6, wherein
the liquid source vaporization system further has a second cleaning state; and
in the second cleaning state, the first control unit (50) controls the purging pipeline
15 (40) to be communicated with the liquid inlet pipeline (22), the second control unit (70) controls the gas outlet pipeline (23) to be communicated with the tail gas treatment pipeline (62), and the carrier gas control valve (25) is open.

9. The liquid source vaporization system according to claim 3, wherein the liquid
20 source vaporization system further comprises:

a first flowmeter (80) disposed on the liquid inlet pipeline (22) and configured to control a flow rate of the liquid process medium;

a first bypass pipeline (90), wherein an inlet end of the first bypass pipeline (90) is communicated with the liquid inlet pipeline (22) and located between the first
25 flowmeter (80) and the vaporizer (21), and an outlet end of the first bypass pipeline (90) is communicated with the tail gas treatment pipeline (62); and

a bypass control unit (100) configured to selectively control the first flowmeter (80) to be communicated with the vaporization chamber or the first bypass pipeline (90).

30 10. The liquid source vaporization system according to claim 9, wherein
the liquid source vaporization system has a working state and a third cleaning state;
in the working state, the first control unit (50) controls the liquid source pipeline (10) to be communicated with the liquid inlet pipeline (22), the bypass control unit (100) controls the first flowmeter (80) to be communicated with the vaporization chamber, and

the second control unit (70) controls the output pipeline (30) to be communicated with the gas outlet pipeline (23); and

in the third cleaning state, the first control unit (50) controls the purging pipeline (40) to be communicated with the liquid inlet pipeline (22), and the bypass control unit (100) controls the first flowmeter (80) to be communicated with the first bypass pipeline (90).

11. The liquid source vaporization system according to claim 9, wherein the bypass control unit (100) comprises a first bypass valve (101) and a second bypass valve (102), the first bypass valve (101) is disposed on the first bypass pipeline (90) and configured to control on/off of the first bypass pipeline (90); and the second bypass valve (102) is disposed on the liquid inlet pipeline (22) and located between the inlet end of the first bypass pipeline (90) and the vaporizer (21), and configured to control on/off of the liquid inlet pipeline (22).

12. The liquid source vaporization system according to claim 6, wherein the liquid source vaporization system further comprises:

a first flowmeter (80) disposed on the liquid inlet pipeline (22) and configured to control a flow rate of the liquid process medium;

a second bypass pipeline (110), wherein an inlet end of the second bypass pipeline (110) is communicated with a purging gas source, and an outlet end of the second bypass pipeline (110) is communicated with the liquid inlet pipeline (22) and located between the first flowmeter (80) and the vaporization chamber; and

a fifth control valve (120) disposed on the second bypass pipeline (110) and configured to control on/off of the second bypass pipeline (110).

13. The liquid source vaporization system according to claim 12, wherein in the working state, the carrier gas control valve (25) is open, and the fifth control valve (120) is closed;

the liquid source vaporization system further has a fourth cleaning state; and in the fourth cleaning state, the first control unit (50) controls the liquid source pipeline (10) and the purging pipeline (40) to be disconnected from the liquid inlet pipeline (22), the carrier gas control valve (25) and the fifth control valve (120) are open, and the second control unit (70) controls the tail gas treatment pipeline (62) to be

communicated with the gas outlet pipeline (23).

14. The liquid source vaporization system according to claim 4, wherein the liquid source vaporization system further comprises:

5 a residual liquid collector (131) configured to recycle the residual liquid process medium;

a residual liquid recycle pipeline (132), wherein an outlet end of the residual liquid recycle pipeline (132) is communicated with the residual liquid collector (131), and an inlet end of the residual liquid recycle pipeline (132) is communicated with the liquid inlet pipeline (22);

10 a sixth control valve (133) disposed on the residual liquid recycle pipeline (132) and configured to control on/off of the residual liquid recycle pipeline (132); and

the vaporization device (20) further comprises:

a seventh control valve (26) disposed on the liquid inlet pipeline (22) and located between the inlet end of the residual liquid recycle pipeline (132) and the vaporizer (21), and configured to control on/off between the vaporizer (21) and the liquid inlet pipeline (22).

15 15. The liquid source vaporization system according to claim 14, wherein the liquid source vaporization system further comprises:

20 an exhaust pipeline (134), wherein the residual liquid collector (131) has a vent communicated with the tail gas treatment pipeline (62) through the exhaust pipeline (134); and

an eighth control valve (135) disposed on the exhaust pipeline (134) and configured to control on/off of the exhaust pipeline (134).

16. The liquid source vaporization system according to claim 15, wherein in the working state, the seventh control valve (26) is open, and the sixth control valve (133) is closed; and

30 the liquid source vaporization system further has a first residual liquid recycling state in which the first control unit (50) controls the purging pipeline (40) to be communicated with the liquid inlet pipeline (22), the seventh control valve (26) is closed, and the sixth control valve (133) and the eighth control valve (135) are open.

17. The liquid source vaporization system according to claim 15, wherein the liquid source vaporization system further comprises:

a ninth control valve (136) disposed on the residual liquid recycle pipeline (132) and located between the sixth control valve (133) and the outlet end of the residual liquid recycle pipeline (132);

a purging branch (140), wherein an inlet end of the purging branch (140) is communicated with a purging gas source, and an outlet end of the purging branch (140) is communicated with the residual liquid recycle pipeline (132) and located between the ninth control valve (136) and the sixth control valve (133); and

a tenth control valve (150) disposed on the purging branch (140) and configured to control on/off of the purging branch (140).

18. The liquid source vaporization system according to claim 17, wherein in the working state, the sixth control valve (133) and the tenth control valve (150) are closed, and the seventh control valve (26) is open; and

the liquid source vaporization system further has a second residual liquid recycling state in which the first control unit (50) controls the liquid source pipeline (10) and the purging pipeline (40) to be disconnected from the liquid inlet pipeline (22), the sixth control valve (133) is closed, and the tenth control valve (150), the ninth control valve (136), and the eighth control valve (135) are open.

19. The liquid source vaporization system according to claim 18, wherein the liquid source vaporization system further comprises:

a residual gas discharge pipeline (137), wherein an inlet end of the residual gas discharge pipeline (137) is communicated with the residual liquid recycle pipeline (132) and located between the sixth control valve (133) and the ninth control valve (136), and an outlet end of the residual gas discharge pipeline (137) is communicated with the tail gas treatment pipeline (62); and

a residual gas control valve (138) disposed on the residual gas discharge pipeline (137) and configured to control on/off of the residual gas discharge pipeline (137).

20. The liquid source vaporization system according to claim 19, wherein the liquid source vaporization system further has a pipeline residual gas discharging state; and

in the pipeline residual gas discharging state, the first control unit (50) controls the purging pipeline (40) to be communicated with the liquid inlet pipeline (22), and the tenth control valve (150), the ninth control valve (136), and the seventh control valve (26) are closed, and the sixth control valve (133) and the residual gas control valve (138) are open.

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21. The liquid source vaporization system according to claim 19, wherein the vaporization device (20) further comprises:

a carrier gas pipeline (24), wherein an inlet end of the carrier gas pipeline (24) is configured to be communicated with a carrier gas source, and an outlet end of the carrier gas pipeline (24) is communicated with the vaporization chamber;

10

a carrier gas control valve (25) disposed on the carrier gas pipeline (24) and configured to control on/off of the carrier gas pipeline (24);

a first flowmeter (80) disposed on the liquid inlet pipeline (22) and configured to calculate a flow rate of the liquid process medium;

15

a second bypass pipeline (110), wherein an inlet end of the second bypass pipeline (110) is communicated with the purging gas source, and an outlet end of the second bypass pipeline (110) is communicated with the liquid inlet pipeline (22) and located between the first flowmeter (80) and the vaporization chamber; and

a fifth control valve (120) disposed on the second bypass pipeline (110) and configured to control on/off of the second bypass pipeline (110).

20

22. The liquid source vaporization system according to claim 21, wherein

in the working state, the carrier gas control valve (25) is open, and the fifth control valve (120) is closed; or

25

in the first cleaning state, the seventh control valve (26) is open, and the carrier gas control valve (25), the fifth control valve (120), the sixth control valve (133), and the tenth control valve (150) are closed; or

the liquid source vaporization system further has a second cleaning state; and

in the second cleaning state, the first control unit (50) controls the purging pipeline (40) to be communicated with the liquid inlet pipeline (22), the fifth control valve (120), the sixth control valve (133), and the tenth control valve (150) are closed, and the seventh control valve (26) is open; or

30

the liquid source vaporization system further has a fourth cleaning state; and

in the fourth cleaning state, the first control unit (50) controls the liquid source

pipeline (10) and the purging pipeline (40) to be disconnected from the liquid inlet pipeline (22), the tenth control valve (150) and the sixth control valve (133) are closed, the carrier gas control valve (25) and the fifth control valve (120) are open, and the second control unit (70) controls the tail gas treatment pipeline (62) to be communicated with
5 the gas outlet pipeline (23); or

the liquid source vaporization system further has a first residual liquid recycling state; and

in the first residual liquid recycling state, the fifth control valve (120) and the tenth control valve (150) are closed; or
10 in the second residual liquid recycling state, the fifth control valve (120) and the residual gas control valve (138) are closed; or

the liquid source vaporization system further has a pipeline residual gas discharging state; and

in the pipeline residual gas discharging state, the first control unit (50) controls the
15 purging pipeline (40) to be communicated with the liquid inlet pipeline (22), the fifth control valve (120), the tenth control valve (150), the ninth control valve (136), and the seventh control valve (26) are closed, and the sixth control valve (133) and the residual gas control valve (138) are open.