Claims

1. A method for delivering ultra-high purity helium gas to a usage site, said method comprising:

providing at least one primary vessel containing cryogenic ultra-high purity helium fluid, said ultra-high purity helium fluid comprising ultra-high purity helium liquid and gas; said primary vessel comprising one or more wall members configured to form an internal vessel compartment to hold said ultra-high purity helium liquid and gas; said internal vessel compartment having one or more vacuum insulation layers and one or more thermal shield layers aligned adjacent to each other at the periphery of said internal vessel compartment adjacent to said one or more wall members; said primary vessel having at least one inlet opening at or near a top portion of the primary vessel through which ultra-high purity helium gas can be fed into the internal vessel compartment; and said primary vessel having at least one outlet opening above a bottom portion of the primary vessel through which said ultra-high purity helium liquid can be dispensed from the internal vessel compartment;

providing at least one secondary vessel containing cryogenic ultra-high purity helium fluid, said ultra-high purity helium fluid comprising ultra-high purity helium liquid and gas; said secondary vessel comprising one or more wall members configured to form an internal vessel compartment to hold said ultra-high purity helium liquid and gas; said internal vessel compartment having one or more vacuum insulation layers and one or more thermal shield layers aligned adjacent to each other at the periphery of said internal vessel compartment adjacent to said one or more wall members; said secondary vessel having at least one outlet opening at or near a top portion of the secondary vessel through which ultra-high purity helium gas can be dispensed to the internal vessel compartment of said primary vessel; said secondary vessel being in ultra-high purity helium gas flow communication with said primary vessel; and said secondary vessel having at least one outlet opening above a bottom portion of the secondary vessel through

which said ultra-high purity helium liquid can be dispensed from the internal vessel compartment;

optionally delivering ultra-high purity helium gas from said primary vessel and/or said secondary vessel through at least one economizer apparatus to said usage site, said at least one economizer apparatus comprising a backpressure valve for control of flow of ultra-high purity helium gas therethrough to said usage site;

admitting to said primary vessel from said secondary vessel ultra-high purity helium fluid, said ultra-high purity helium fluid comprising ultra-high purity helium gas, said ultra-high purity helium gas being admitted to a pressure in said primary vessel sufficient to discharge ultra-high purity helium liquid from said primary vessel;

conveying said ultra-high purity helium liquid from said primary vessel to at least one vaporization apparatus; said vaporization apparatus having at least one inlet opening through which ultra-high purity helium liquid can be fed into the vaporization apparatus; and said vaporization apparatus having at least one outlet opening through which ultra-high purity helium gas can be dispensed from the vaporization apparatus;

effecting a phase change of said ultra-high purity helium liquid in said vaporization apparatus to form ultra-high purity helium gas; and

delivering said ultra-high purity helium gas from said vaporization apparatus to said usage site.

2. The method of claim 1 further comprising controlling delivery rate of said ultra-high purity helium gas to said usage site utilizing (i) said ultra-high purity helium gas fed into the internal vessel compartment of said primary vessel from secondary vessel, (ii) said one or more thermal shield layers, and/or (iii) at least one economizer apparatus.

3. The method of claim 1 wherein (i) said ultra-high purity helium gas fed into the internal vessel compartment of said primary vessel from secondary vessel

controls delivery rate of said ultra-high purity helium liquid from said at least one primary vessel to said at least one vaporization apparatus and ultra-high purity helium gas from said at least one vaporization apparatus to said usage site and ultra-high purity helium gas from said at least one primary vessel and said at least one secondary vessel through said at least one economizer apparatus to said usage site; (ii) said one or more thermal shield layers control net evaporation rate of said ultra-high purity helium liquid in said at least one primary vessel and said at least one secondary vessel, said net evaporation rate controls delivery rate of said ultra-high purity helium liquid from said at least one primary vessel to said at least one vaporization apparatus and ultra-high purity helium gas from said at least one vaporization apparatus to said usage site, and controls delivery rate of said ultra-high purity helium gas from said at least one primary vessel and said at least one secondary vessel through said at least one economizer apparatus to said usage site; and (iii) said at least one economizer apparatus controls delivery rate of said ultra-high purity helium gas from said at least one primary vessel and said at least one secondary vessel to said usage site while maintaining ultra-high purity helium liquid in said at least one primary vessel and said at least one secondary vessel.

4. The method of claim 1 wherein said one or more thermal shield layers have an internal compartment to hold a thermal shield fluid, said thermal shield fluid comprising a liquid or a gas.

5. The method of claim 1 wherein said one or more thermal shield layers comprise liquid nitrogen (LN_2) thermal shield layers and helium gas thermal shield layers.

6. The method of claim 1 which comprises at least one of (i) delivering ultra-high purity helium gas from vapor space and/or a thermal shield layer of said primary vessel and/or said secondary vessel through at least one economizer apparatus to said usage site, and (ii) admitting to said primary vessel from vapor space and/or a thermal shield layer of said secondary vessel ultra-high purity

helium gas, said ultra-high purity helium gas being admitted to a pressure in said primary vessel sufficient to discharge ultra-high purity helium liquid from said primary vessel.

7. The method of claim 1 wherein said thermal shield layers decrease heat leaks into said at least one primary vessel and said at least one secondary vessel, thereby decreasing net evaporation rate of said ultra-high purity helium liquid in said at least one primary vessel and said at least one secondary vessel.

8. The method of claim 1 wherein said thermal shield layers decrease heat leaks into said at least one primary vessel and said at least one secondary vessel, thereby decreasing net evaporation rate of said ultra-high purity helium liquid in said at least one primary vessel and said at least one secondary vessel, and thereby decreasing the amount of ultra-high purity helium gas needed to be withdrawn from said at least one primary vessel and said at least one secondary vessel in order to maintain maximum allowable working pressure of said at least one primary vessel and said at least one secondary vessel.

9. The method of claim 1 further comprising controlling said at least one economizer apparatus to draw ultra-high purity helium gas from said at least one primary vessel and/or said at least one secondary vessel for delivery to said usage site while maintaining ultra-high purity helium liquid in said at least one primary vessel and/or said at least one secondary vessel.

10. The method of claim 1 wherein said at least one primary vessel and said at least one secondary vessel comprise ISO containers.

11. The method of claim 1 wherein said ultra-high purity helium gas is used at said usage site at a use rate of at least about 10 Nm^3/hr.

12. The method of claim 1 wherein said usage site is a semiconductor manufacturing site.

13. The method of claim 1 wherein (i) said ultra-high purity helium gas is used as a carrier gas for introducing a precursor into a deposition chamber, (ii) said ultra-high purity helium gas is used for dry etching in LCD processes, (iii) said ultra-high purity helium gas is used in backside cooling to control the rate and uniformity of etching processes of silicon layers, or (iv) said ultra-high purity helium gas is used to check for leaks and line purges.

14. The method of claim 1 further comprising withdrawing ultra-high purity helium liquid from said primary vessel at a temperature not greater than the temperature at which the concentration of at least one impurity in said ultra-high purity helium liquid being withdrawn equals a predetermined limit, wherein the at least one impurity is selected from water, carbon dioxide, oxygen, argon and nitrogen.

15. The method of claim 1 further comprising passing said ultra-high purity helium gas through a low temperature pressure protection (LTPP) unit and a filtration apparatus, prior to delivering said ultra-high purity helium gas to said usage site.

16. A system for delivering ultra-high purity helium gas to a usage site, said system comprising:

at least one primary vessel containing cryogenic ultra-high purity helium fluid, said ultra-high purity helium fluid comprising ultra-high purity helium liquid and gas; said primary vessel comprising one or more wall members configured to form an internal vessel compartment to hold said ultra-high purity helium liquid and gas; said internal vessel compartment having one or more vacuum insulation layers and one or more thermal shield layers aligned adjacent to each other at the periphery of said internal vessel compartment adjacent to said

one or more wall members; said primary vessel having at least one inlet opening at or near a top portion of the primary vessel through which ultra-high purity helium gas can be fed into the internal vessel compartment; and said primary vessel having at least one outlet opening above a bottom portion of the primary vessel through which said ultra-high purity helium liquid can be dispensed from the internal vessel compartment;

at least one secondary vessel containing cryogenic ultra-high purity helium fluid, said ultra-high purity helium fluid comprising ultra-high purity helium liquid and gas; said secondary vessel comprising one or more wall members configured to form an internal vessel compartment to hold said ultra-high purity helium liquid and gas; said internal vessel compartment having one or more vacuum insulation layers and one or more thermal shield layers aligned adjacent to each other at the periphery of said internal vessel compartment adjacent to said one or more wall members; said secondary vessel having at least one outlet opening at or near a top portion of the secondary vessel through which ultra-high purity helium gas can be dispensed to the internal vessel compartment of said primary vessel; said secondary vessel being in ultra-high purity helium gas flow communication with said primary vessel; and said secondary vessel having at least one outlet opening above a bottom portion of the secondary vessel through which said ultra-high purity helium liquid can be dispensed from the internal vessel compartment;

an ultra-high purity helium gas feed line extending exteriorly from at least one outlet opening at or near the top portion of the secondary vessel to the at least one inlet opening at or near the top portion of the primary vessel through which ultra-high purity helium gas can be dispensed to the internal vessel compartment of said primary vessel, the ultra-high purity helium gas feed line containing at least one ultra-high purity helium gas flow control valve therein for control of flow of the ultra-high purity helium gas therethrough, and at least one economizer apparatus; said at least one economizer apparatus comprising a backpressure valve for control of flow of ultra-high purity helium gas therethrough to said usage site;

at least one vaporization apparatus; said vaporization apparatus having at least one inlet opening through which ultra-high purity helium liquid can be fed into the vaporization apparatus; and said vaporization apparatus having at least one outlet opening through which ultra-high purity helium gas can be dispensed from the vaporization apparatus;

an ultra-high purity helium liquid discharge line extending exteriorly from at least one outlet opening above the bottom portion of the primary vessel to the at least one inlet opening of the vaporization apparatus through which ultra-high purity helium liquid can be dispensed to the vaporization apparatus, the ultra-high purity helium liquid feed line containing at least one ultra-high purity helium liquid flow control valve therein for control of flow of the ultra-high purity helium liquid therethrough; and

an ultra-high purity helium gas discharge line extending exteriorly from at least one outlet opening of the vaporization apparatus to said usage site, the ultra-high purity helium gas discharge line containing at least one ultra-high purity helium gas flow control valve therein for control of flow of the ultra-high purity helium gas therethrough.

17. The system of claim 16 wherein said ultra-high purity helium gas discharge line contains a low temperature pressure protection (LTPP) unit and a filtration apparatus.

18. A method for controlling delivery of ultra-high purity helium gas to a usage site, said method comprising:

providing at least one primary vessel containing cryogenic ultra-high purity helium fluid, said ultra-high purity helium fluid comprising ultra-high purity helium liquid and gas; said primary vessel comprising one or more wall members configured to form an internal vessel compartment to hold said ultra-high purity helium liquid and gas; said internal vessel compartment having one or more vacuum insulation layers and one or more thermal shield layers aligned adjacent to each other at the periphery of said internal vessel compartment

adjacent to said one or more wall members; said primary vessel having at least one inlet opening at or near a top portion of the primary vessel through which ultra-high purity helium gas can be fed into the internal vessel compartment; and said primary vessel having at least one outlet opening above a bottom portion of the primary vessel through which said ultra-high purity helium liquid can be dispensed from the internal vessel compartment;

providing at least one secondary vessel containing cryogenic ultra-high purity helium fluid, said ultra-high purity helium fluid comprising ultra-high purity helium liquid and gas; said secondary vessel comprising one or more wall members configured to form an internal vessel compartment to hold said ultra-high purity helium liquid and gas; said internal vessel compartment having one or more vacuum insulation layers and one or more thermal shield layers aligned adjacent to each other at the periphery of said internal vessel compartment adjacent to said one or more wall members; said secondary vessel having at least one outlet opening at or near a top portion of the secondary vessel through which ultra-high purity helium gas can be dispensed to the internal vessel compartment of said primary vessel; said secondary vessel being in ultra-high purity helium gas flow communication with said primary vessel; and said secondary vessel having at least one outlet opening above a bottom portion of the secondary vessel through which said ultra-high purity helium liquid can be dispensed from the internal vessel compartment;

optionally delivering ultra-high purity helium gas from said primary vessel and/or said secondary vessel through at least one economizer apparatus to said usage site, said at least one economizer apparatus comprising a backpressure valve for control of flow of ultra-high purity helium gas therethrough to said usage site;

admitting to said primary vessel from said secondary vessel ultra-high purity helium fluid, said ultra-high purity helium fluid comprising ultra-high purity helium gas, said ultra-high purity helium gas being admitted to a pressure in said primary vessel sufficient to discharge ultra-high purity helium liquid from said primary vessel;

conveying said ultra-high purity helium liquid from said primary vessel to at least one vaporization apparatus; said vaporization apparatus having at least one inlet opening through which ultra-high purity helium liquid can be fed into the vaporization apparatus; and said vaporization apparatus having at least one outlet opening through which ultra-high purity helium gas can be dispensed from the vaporization apparatus;

effecting a phase change of said ultra-high purity helium liquid in said vaporization apparatus to form ultra-high purity helium gas;

delivering said ultra-high purity helium gas from said vaporization apparatus to said usage site; and

utilizing said ultra-high purity helium gas fed into the internal vessel compartment of said primary vessel from secondary vessel, said one or more thermal shield layers, and/or at least one economizer apparatus to control delivery of said ultra-high purity helium gas to said usage site.

19. The method of claim 18 wherein (i) said ultra-high purity helium gas fed into the internal vessel compartment of said primary vessel from secondary vessel controls delivery rate of said ultra-high purity helium liquid from said at least one primary vessel to said at least one vaporization apparatus and ultra-high purity helium gas from said at least one vaporization apparatus to said usage site and ultra-high purity helium gas from said at least one primary vessel and said at least one secondary vessel through said at least one economizer apparatus to said usage site; (ii) said one or more thermal shield layers control net evaporation rate of said ultra-high purity helium liquid in said at least one primary vessel and said at least one secondary vessel, said net evaporation rate controls delivery rate of said ultra-high purity helium liquid from said at least one primary vessel to said at least one vaporization apparatus and ultra-high purity helium gas from said at least one vaporization apparatus to said usage site, and controls delivery rate of said ultra-high purity helium gas from said at least one primary vessel and said at least one secondary vessel through said at least one economizer apparatus to said usage site; and (iii) said at least one economizer apparatus controls delivery rate of said

ultra-high purity helium gas from said at least one primary vessel and said at least one secondary vessel to said usage site while maintaining ultra-high purity helium liquid in said at least one primary vessel and said at least one secondary vessel.

20. The method of claim 18 which comprises at least one of (i) delivering ultra-high purity helium gas from vapor space and/or a thermal shield layer of said primary vessel and/or said secondary vessel through at least one economizer apparatus to said usage site, and (ii) admitting to said primary vessel from vapor space and/or a thermal shield layer of said secondary vessel ultra-high purity helium gas, said ultra-high purity helium gas being admitted to a pressure in said primary vessel sufficient to discharge ultra-high purity helium liquid from said primary vessel.

What Is Claimed Is:

Claim 1

A method for delivering ultra high purity helium gas from a vaporizing device to a site of use, comprising:

a step of supplying ultra high purity helium liquid to at least one primary container, wherein the ultra high purity helium fluid contains ultra high purity helium liquid and gas, the primary container has one or a plurality of wall members configured so as to form an internal container compartment in order to maintain the ultra high purity helium liquid and gas, the internal container compartment has one or a plurality of vacuum thermal insulation layers and one or a plurality of heat shielding layers, the vacuum insulating layer and the heat shielding layer are arranged to be mutually adjacent on the circumferential edge part of the internal container compartment that is adjacent to a plurality of wall members, the primary container has at least one entry opening on the upper part or close to the upper part of the primary container, and ultra high purity helium gas can be supplied to the internal container compartment through the entry opening, the primary container has at least one exit opening higher than the bottom part of the primary container, and ultra high purity helium liquid can be distributed from the internal container compartment through the exit opening;

a step of supplying ultra high purity helium liquid to at least one secondary container, wherein the ultra high purity helium fluid contains ultra high purity helium liquid and gas, the primary container has one or a plurality of wall members configured so as to form an internal container compartment in order to maintain the ultra high purity helium liquid and gas, the internal container compartment has one or a plurality of vacuum thermal insulation layers and one or a plurality of heat shielding layers, the vacuum insulating layer and the heat shielding layer are arranged to be mutually adjacent on the circumferential edge part of the internal container compartment that is adjacent to a plurality of wall members, the secondary container has at least one exit opening on the upper part or close to the upper part of the secondary container, the ultra high purity helium gas can be distributed through the exit opening to the internal container compartments of the primary container, the secondary container connects the first container and the flow of ultra high purity helium gas, and

the secondary container has at least one exit opening higher than the bottom part of the secondary container, and ultra high purity helium liquid can be distributed from the internal container compartment through the exit opening;

an optional step of delivering the ultra high purity helium gas from the primary container and/or the secondary container through at least one economizer device to the site of use, and at least one of the economizer devices has a back pressure valve for controlling the flow rate of the ultra high purity helium gas to the site of use;

a step of injecting the ultra high purity helium fluid from the secondary container to the primary container, wherein the ultra high purity helium fluid includes only ultra high purity helium gas, and the ultra high purity helium gas is injected into the primary container with sufficient pressure to discharge the ultra high purity helium liquid from the primary container;

a step of delivering the extra high purity helium liquid from the primary container to at least one vaporizing device, wherein the vaporizing device has at least one entry opening and the ultra high purity helium liquid can be supplied through the entry opening to the vaporizing device, and the vaporizing device has at least one exit opening, and ultra high purity helium gas can be distributed from the vaporizing device through the exit opening; and

a step of generating ultra high purity helium gas by performing a phase transition of the ultra high purity helium liquid in the vaporizing device.

Claim 2

The method according to claim 1, further comprising a step of controlling the deliver speed of the ultra high purity helium gas to the site of use using (i) the ultra high purity helium gas supplied from the secondary container into the internal container compartment of the primary container, (ii) one or a plurality of heat shielding layers, and/or (iii) at least one economizer device.

Claim 3

The method according to claim 1, wherein (i) the ultra high purity helium gas supplied from the secondary container into the internal container compartment of the primary container controls the deliver speed of the ultra high purity helium liquid from at least one primary container to at least one vaporizing device, the deliver speed of the ultra high purity helium gas from at least one vaporizing device to the site of use, and the deliver speed of the ultra high purity helium gas from at least one of the primary containers and at least one of the secondary containers through at least one economizer device to the site of use; (ii) the one or plurality of heat shielding layers controls the net evaporation rate of the ultra high purity helium liquid in at least one primary container and at least one secondary container, the net evaporation rate controls the deliver speed of the ultra high purity helium liquid from at least one of the primary containers to at least one of the vaporizing devices, and the deliver speed of the ultra high purity helium gas from at least one vaporizing device to the site of use, and the deliver speed of the ultra high purity helium gas from at least one primary container and at least one secondary container through at least one economizer device to the site of use; and (iii) the at least one economizer device controls the deliver rate of ultra high purity helium gas from at least one primary container and at least one secondary container to the site of use, while maintaining the ultra high purity helium liquid in at least one of the primary containers and at least one of the secondary containers.

Claim 4

The method according to claim 1, wherein the one or plurality of heat shielding layers has an internal compartment for holding a heat shielding fluid, and the heat shielding fluid includes a liquid and a gas.

Claim 5

The method according to claim 1, wherein the one or plurality of heat shielding layers has a liquid nitrogen (LN_2) heat shielding layer and a helium gas heat shielding layer.

Claim 6

The method according to claim 1, further comprising at least one of (i) a step of delivering ultra high purity helium gas from the vapor space and/or heat shielding layer of the primary container and/or the secondary container, through at least one economizer device to the site of use, and (ii) a step of injecting ultra high purity helium gas from the vapor space and/or heat shielding layer of the secondary container to the primary container, wherein the ultra high purity helium gas is injected into the primary container with sufficient pressure to discharge the ultra high purity helium liquid from the primary container.

Claim 7

The method according to claim 1, wherein the heat shield layer can reduce the heat leak into at least one of the primary containers and at least one of the secondary containers, and in doing so, the net evaporation rate of the ultra pure helium liquid in at least one of the primary containers and at least one of the secondary containers can be reduced.

Claim 8

The method according to claim 1, wherein the heat shielding layer reduces the heat leak into at least one of the primary containers and into at least one of the secondary containers thereby reducing the net evaporation rate of the ultra pure helium liquid in at least one of the primary containers and in at least one of the secondary containers, and thus the amount of ultra pure helium gas that has to be withdrawn from at least one of the primary containers and from at least one of the secondary containers can maintain the maximum allowable working pressure of at least one of the primary containers and of at least one of the secondary containers.

Claim 9

The method according to claim 1, further comprising a step of controlling at least one of the economizer devices in order to withdraw the ultra high purity helium liquid from at least one of the primary containers and/or at least one of the secondary containers, and deliver to the site of use, while maintaining the ultra high purity helium liquid in at least one of the primary containers and/or at least one of the secondary containers.

Claim 10

The method according to claim 1, wherein the at least one primary container and the at least one secondary container have an ISO container.

Claim 11

The method according to claim 1, wherein the ultra high purity helium gas is used at a rate of use of at least approximately 10 Nm^3/hour.

Claim 12

The method according to claim 1, wherein the site of use is a semiconductor manufacturing facility.

Claim 13

The method according to claim 1, wherein (i) the ultra high purity helium gas is used as a carrier gas for introducing a precursor into a deposition compartment; (ii) the ultra high purity helium gas is used for dry etching in an LCD process; (iii) the ultra high purity helium gas is used by back cooling in order to control the uniformity and the rate of an etching process of a silicon layer; or (iv) the ultra high purity helium gas is used for inspecting leaks and line purges.

Claim 14

The method according to claim 1, further comprising a step of withdrawing the ultra high purity helium liquid from the primary container at a temperature below the temperature where the concentration of at least one impurity in the ultra high purity helium liquid that is withdrawn is at a predetermined limit value, and the at least one impurity is selected from water, carbon dioxide, oxygen, argon, and nitrogen.

Claim 15

The method according to claim 1, further comprising a step of passing the ultra high purity helium gas to a low temperature pressure protecting (LTPP) unit and a filter device, prior to delivering the ultra high purity helium gas to the site of use.

Claim 16

A system for delivering ultra high purity helium gas to a site of use, comprising:

at least one primary container containing a cryogenic ultra high purity helium fluid, wherein the ultra high purity helium fluid contains ultra high purity helium liquid and gas, the primary container has one or a plurality of wall members configured so as to form an internal container compartment in order to maintain the ultra high purity helium liquid and gas, the internal container compartment has one or a plurality of vacuum thermal insulation layers and one or a plurality of heat shielding layers, the vacuum insulating layer and the heat shielding layer are arranged to be mutually adjacent on the circumferential edge part of the internal container compartment that is adjacent to a plurality of wall members, the primary container has at least one entry opening on the upper part or close to the upper part of the primary container, and the ultra high purity helium gas can be supplied to the internal container compartment through the entry opening, the primary container has at least one exit opening higher than the bottom part of the primary container, and the ultra high purity helium liquid can be distributed from the internal container compartment through the exit opening;

at least one secondary container that contains a cryogenic ultra high purity helium liquid, wherein the ultra high purity helium fluid contains ultra high purity helium liquid and gas, the primary container has one or a plurality of wall members configured so as to form an internal container compartment in order to maintain the ultra high purity helium liquid and gas, the internal container compartment has one or a plurality of vacuum thermal insulation layers and one or a plurality of heat shielding layers, the vacuum insulating layer and the heat shielding layer are arranged to be mutually adjacent on the circumferential edge part of the internal container compartment that is adjacent to a plurality of wall members, the secondary container has at least one exit opening on the upper part or close to the upper part of the secondary container, the ultra high purity helium gas can be distributed through the exit opening to the internal container compartments of the primary container, the secondary container connects the first container and the flow of ultra high purity helium gas, and

the secondary container has at least one exit opening higher than the bottom part of the secondary container, and the ultra high purity helium liquid can be distributed from the internal container compartment through the exit opening;

an ultra high purity helium gas supply line extending outside from at least one exit opening at or near the top part of the secondary container to at least one entrance opening at or near the top part of the primary container, which can distribute ultra pure helium gas to the internal container compartment in the primary container by passing through the entry opening; the ultra pure helium gas supply line has at least one ultra pure helium gas flow control valve included inside in order to control the flow rate of the ultra pure helium gas that passes therethrough; at least one economizer device is included in the system; and a back pressure valve is included in at least one of the economizer devices in order to control the flow rate of the ultra pure helium gas that passes through to the site of use;

at least one vaporizing device having at least one entrance opening through which ultra high purity helium liquid can be supplied into the vaporizing device, and the vaporizing device has at least one exit opening through which ultra high purity helium gas can be dispensed from the vaporizing device;

an ultra high purity helium liquid discharge line extending inside from at least one exit opening of the bottom part of the primary container to at least one entrance opening of the vaporizing device through which ultra high purity helium liquid can be dispensed to the vaporizing device, the ultra high purity helium liquid supply line having at least one ultra high purity helium liquid flow control valve for controlling the flow of the ultra high purity helium gas, the ultra high purity helium gas discharge line has at least one internal ultra high purity helium gas flow rate control valve that controls the flow rate of the ultra high purity helium gas.

Claim 17

The system according to claim 16, wherein the ultra high purity helium gas discharge line contains a low temperature protecting (LTPP) unit and a filter device.

Claim 18

A method for controlling the delivery of ultra high purity helium gas to a site of use, comprising:

a step of supplying cryogenic ultra high purity helium liquid to at least one primary container, wherein the ultra high purity helium fluid contains ultra high purity helium liquid and gas, the primary container has one or a plurality of wall members configured so as to form an internal container compartment in order to maintain the ultra high purity helium liquid and gas, the internal container compartment has one or a plurality of vacuum thermal insulation layers and one or a plurality of heat shielding layers, the vacuum insulating layer and the heat shielding layer are arranged to be mutually adjacent on the circumferential edge part of the internal container compartment that is adjacent to a plurality of wall members, the primary container has at least one entry opening on the upper part or close to the upper part of the primary container, and ultra high purity helium gas can be supplied to the internal container compartment through the entry opening, the primary container has at least one exit opening higher than the bottom part of the primary container, and ultra high purity helium liquid can be distributed from the internal container compartment through the exit opening;

a step of supplying ultra high purity helium liquid to at least one secondary container, wherein the ultra high purity helium fluid contains ultra high purity helium liquid and gas, the primary container has one or a plurality of wall members configured so as to form an internal container compartment in order to maintain the ultra high purity helium liquid and gas, the internal container compartment has one or a plurality of vacuum thermal insulation layers and one or a plurality of heat shielding layers, the vacuum insulating layer and the heat shielding layer are arranged to be mutually adjacent on the circumferential edge part of the internal container compartment that is adjacent to a plurality of wall members, the secondary container has at least one exit opening on the upper part or close to the upper part of the secondary container, the ultra high purity helium gas can be distributed through the exit opening to the internal container compartments of the primary container, the secondary container connects the first container and the flow of ultra high purity helium gas, and

the secondary container has at least one exit opening higher than the bottom part of the secondary container, and ultra high purity helium liquid can be distributed from the internal container compartment through the exit opening;

an optional step of delivering the ultra high purity helium gas from the primary container and/or the secondary container through at least one economizer device to the site of use, and at least one of the economizer devices has a back pressure valve for controlling the flow rate of the ultra high purity helium gas to the site of use;

a step of injecting the ultra high purity helium fluid from the secondary container to the primary container, wherein the ultra high purity helium fluid includes only ultra high purity helium gas, and the ultra high purity helium gas is injected into the primary container with sufficient pressure to discharge the ultra high purity helium liquid from the primary container; and

at least one vaporizing device having at least one entrance opening, and the vaporizing device has at least one exit opening through which ultra high purity helium gas can be dispensed from the vaporizing device;

a step of generating ultra high purity helium gas by performing a phase transition of the ultra high purity helium liquid in the vaporizing device.

a step of distributing ultra high purity helium gas from the vaporizing device to the site of use; and

a step of controlling the deliver speed of the ultra high purity helium gas to the site of use using the ultra high purity helium gas supplied from the secondary container into the internal container compartment of the primary container, one or a plurality of heat shielding layers, and/or at least one economizer device.

Claim 19

The method according to claim 18, wherein (i) the ultra high purity helium gas supplied from the secondary container into the internal container compartment of the primary container controls the deliver speed of the ultra high purity helium liquid from at least one primary container to at least one vaporizing device, the deliver speed of the ultra high purity helium gas from at least one vaporizing device to the site of use, and the deliver speed of the ultra high purity helium gas from at least one of the primary containers and at least one of the secondary containers through at least one economizer device to the site of use; (ii) the one or plurality of heat shielding layers controls the net evaporation rate of the ultra high purity helium liquid in at least one primary container and at least one secondary container, the net evaporation rate controls the deliver speed of the ultra high purity helium liquid from at least one of the primary containers to at least one of the vaporizing devices, and the deliver speed of the ultra high purity helium gas from at least one vaporizing device to the site of use, and the deliver speed of the ultra high purity helium gas from at least one primary container and at least one secondary container through at least one economizer device to the site of use; and (iii) the at least one economizer device controls the deliver rate of ultra high purity helium gas from at least one primary container and at least one secondary container to the site of use, while maintaining the ultra high purity helium liquid in at least one of the primary containers and at least one of the secondary containers.

Claim 20

The method according to claim 1, further comprising at least one of (i) a step of delivering ultra high purity helium gas from the vapor space and/or heat shielding layer of the primary container and/or the secondary container, through at least one economizer device to the site of use, and (ii) a step of injecting ultra high purity helium gas from the vapor space and/or heat shielding layer of the secondary container to the primary container, wherein the ultra high purity helium gas is injected into the primary container with sufficient pressure to discharge the ultra high purity helium liquid from the primary container.