the high-purity oxygen production apparatus can be maintained by means of nitrogen supplied from the ASU.

[Means for Solving the Problems]

[0008]

A high-purity oxygen production system according to the present invention comprises: an air separation apparatus including a main heat exchanger, a medium-pressure column and a low-pressure column; and a high-purity oxygen production apparatus including a nitrogen compressor, a nitrogen heat exchanger and at least one (high-purity) oxygen rectification column,

wherein an oxygen-containing stream serving as a starting material for high-purity oxygen is supplied from the low-pressure column to the high-purity oxygen production apparatus, and liquid nitrogen obtained from the medium-pressure column is supplied to the high-purity oxygen production apparatus in order to replenish cold heat required for operation of the high-purity oxygen production apparatus;

wherein the air separation apparatus (A1) comprises:

a main heat exchanger (1) for subjecting starting material air to heat exchange;

a medium-pressure column (2) to which the starting material air that has passed through the main heat exchanger (1) is introduced, the medium-pressure column (2) having a medium-pressure column bottom (21) in which a first rectification liquid is collected, a medium-pressure column rectification portion (22) for rectifying the starting material air, and a medium-pressure column top (23) arranged above the medium-pressure column rectification portion (22); and

a low-pressure column (4) arranged above the medium-pressure column (2), the low-pressure column (4) having a low-pressure column bottom (41) inside or below which is arranged a nitrogen condenser (3) for condensing a gas drawn from the medium-pressure column top (23) and conducted by a circulation line (L6) and in which a second rectification liquid (oxygen-containing stream) is

collected, a low-pressure column rectification portion (42) for rectifying the first rectification liquid (oxygen-rich liquid) drawn from the medium-pressure column bottom (21), and a low-pressure column top (43) to which is introduced at least a portion of a condensed stream condensed in the nitrogen condenser (3).

By virtue of this configuration, it is possible to supply liquid nitrogen in order to supply the cold required by the high-purity oxygen production apparatus, without the use of a costly conventional liquefaction apparatus. Furthermore, the pressure of the liquid nitrogen obtained from the medium-pressure column is close to an operating pressure of the high-purity oxygen production apparatus, so it is possible to supply liquid nitrogen without generating a large pressure loss, which is efficient.

[0009]
The air separation apparatus (A1) comprises:
a main heat exchanger (1) for subjecting starting material air (Feed air) to heat exchange;
a medium-pressure column (2) to which the starting material air that has passed through the main heat exchanger (1) is introduced, the medium-pressure column

[Document Name] Patent Claims

[Claim 1]

High-purity oxygen production system comprising: an air separation apparatus including a main heat exchanger, a medium-pressure column and a low-pressure column; and a high-purity oxygen production apparatus including a nitrogen compressor, a nitrogen heat exchanger and at least one oxygen rectification column,

wherein an oxygen-containing stream serving as a starting material for high-purity oxygen is supplied from the low-pressure column to the high-purity oxygen production apparatus, and liquid nitrogen obtained from the medium-pressure column is supplied to the high-purity oxygen production apparatus in order to replenish cold heat required for operation of the high-purity oxygen production apparatus;

wherein the air separation apparatus (A1) comprises:

a main heat exchanger (1) for subjecting starting material air to heat exchange;

a medium-pressure column (2) to which the starting material air that has passed through the main heat exchanger (1) is introduced, the medium-pressure column (2) having a medium-pressure column bottom (21) in which a first rectification liquid is collected, a medium-pressure column rectification portion (22) for rectifying the starting material air, and a medium-pressure column top (23) arranged above the medium-pressure column rectification portion (22); and

a low-pressure column (4) arranged above the medium-pressure column (2), the low-pressure column (4) having a low-pressure column bottom (41) inside or below which is arranged a nitrogen condenser (3) for condensing a gas drawn from the medium-pressure column top (23) and conducted by a circulation line (L6) and in which a second rectification liquid (oxygen-containing stream) is collected, a low-pressure column rectification portion (42) for rectifying the first rectification liquid (oxygen-rich liquid) drawn from the medium-pressure column bottom (21), and a low-pressure column top (43)

to which is introduced at least a portion of a condensed stream condensed in the nitrogen condenser (3).

[Claim 2]

High-purity oxygen production system according to Claim 1 wherein the high-purity oxygen production apparatus (A2) comprises:

a first oxygen rectification column (7) having: a first oxygen rectification column rectification portion (72) to which the second rectification liquid drawn from the low-pressure column bottom (41) is introduced at an intermediate portion thereof or therebelow, a first oxygen rectification column bottom (71) arranged below the first oxygen rectification column rectification portion (72), and a first oxygen rectification column top (73) arranged above the first rectification column rectification portion (72);

a first oxygen evaporator (8) arranged inside or below the first oxygen rectification column bottom (71), the first oxygen evaporator (8) causing evaporation of a rectification liquid falling from the first oxygen rectification column rectification portion (72) and the second rectification liquid (oxygen-containing stream) which has been introduced;

a first oxygen condenser (9) arranged inside or above the first oxygen rectification column top (73), wherein a first oxygen rectification gas drawn from an upper portion of the first oxygen rectification column rectification portion (72) is cooled and liquefied by first liquid nitrogen condensed in the first oxygen evaporator (8), and is returned to the first oxygen rectification column rectification portion (72);

a second oxygen rectification column (10) having a second oxygen rectification column bottom (101), a second oxygen rectification column rectification portion (102) arranged above the second oxygen rectification column bottom (101), and a second oxygen rectification column top (103) arranged above the second oxygen rectification column rectification portion (102);

a second oxygen evaporator (11) arranged inside or below the second oxygen rectification column bottom (101), the second oxygen evaporator (11) causing evaporation of a rectification liquid falling from the second oxygen rectification column rectification portion (102);
a second oxygen condenser (12) arranged inside or above the second oxygen rectification column top (103), wherein the second oxygen condenser (12) cools and liquefies a second oxygen rectification gas drawn from an upper portion of the second oxygen rectification column rectification portion (102) by means of second liquid nitrogen sent to the second oxygen condenser (12), and returns the cooled and liquefied gas to the second oxygen rectification column rectification portion (102);
a nitrogen heat exchanger (13) to which is introduced a nitrogen-rich gas drawn from a space (1031) above the second oxygen condenser (12) in the second oxygen rectification column top (103);
a nitrogen compressor (14) for compressing the nitrogen-rich gas drawn from the nitrogen heat exchanger (13);
a line (L12) for recirculating a compressed nitrogen-rich gas compressed in the nitrogen compressor (14) to the nitrogen heat exchanger (13), and introducing the nitrogen-rich gas to a space (711) below the first oxygen evaporator (8) in the first oxygen rectification column bottom (71); and
a branch line (L121) which branches from the line (L12) and introduces the nitrogen-rich gas to a space (1011) below the second oxygen evaporator (11) in the second oxygen rectification column bottom (101).

[Claim 3]
High-purity oxygen production system according to Claims 1 or 2, wherein the high-purity oxygen production apparatus (A2) comprises:
a high-purity oxygen tank (15) for storing high-purity oxygen extracted in a liquid;

a pressurizer (16) for evaporating a portion of high-purity liquid oxygen and pressurizing the high-purity liquid oxygen; and
a liquid nitrogen buffer (17) for storing liquid nitrogen.

[Claim 4]
High-purity oxygen production system according to any one of Claims 1 to 3, wherein the high-purity oxygen production apparatus (A2) comprises:
a line (L62) for supplying liquid nitrogen from the medium-pressure column (2) of the air separation apparatus (A1) to a liquid nitrogen buffer (17);
a liquid nitrogen flowmeter (300) which is provided on the line (L62) and measures a flow rate of liquid nitrogen; and
a control valve (301) for controlling an amount measured by the liquid nitrogen flowmeter (300) to a predetermined amount or a predetermined range.

[Claim 5]
High-purity oxygen production system according to Claims 3 or 4, wherein a high-purity oxygen liquid pressurized in a high-purity oxygen tank (15) is introduced (via a line L142) to the main heat exchanger (1) in the air separation apparatus (A1) and evaporated, and extracted as high-purity oxygen gas.

[Claim 6]
High-purity oxygen production system according to any one of Claims 1 to 5, wherein a nitrogen expansion line (L50) is provided in a nitrogen cycle of the high-purity oxygen production apparatus (A2) in such a way as to supply cold heat to the high-purity oxygen production apparatus (A2).