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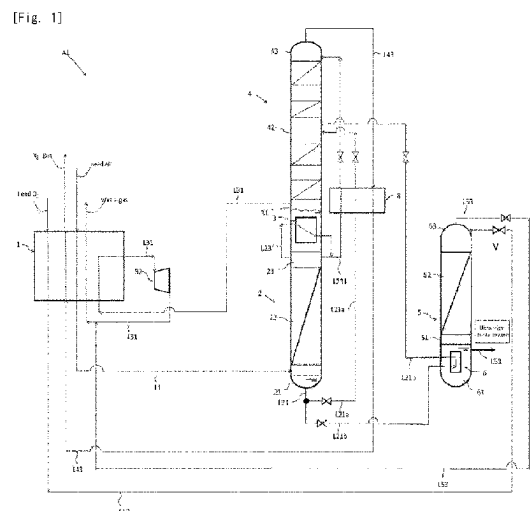
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- (74)

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(54)

ULTRA-HIGH-PURITY OXYGEN PRODUCTION METHOD AND ULTRA-HIGH-PURITY OXYGEN PRODUCTION APPARATUS

(57) An ultra-high-purity oxygen production method comprises a step in which feed oxygen comprising low-boiling-point components as impurities is introduced from a warm end of a main heat exchanger (1) and cooled, then introduced into an oxygen rectification column (5), and product ultra-high-purity oxygen from which the low-boiling-point components have been removed is drawn as a gas or a liquid from a lower portion of the oxygen rectification column.



(52) Cooperative Patent Classification (CPC): (Cont.)
F25J 2200/72; F25J 2205/86; F25J 2210/50;
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F25J 2245/02; F25J 2245/50; F25J 2250/10;
F25J 2250/20; F25J 2270/14



PARTIAL EUROPEAN SEARCH REPORT

Application Number

under Rule 62a and/or 63 of the European Patent Convention.
This report shall be considered, for the purposes of
subsequent proceedings, as the European search report

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	WO 2023/274574 A1 (LINDE GMBH [DE]) 5 January 2023 (2023-01-05)	1	INV. F25J3/04
Y	* figure 2 *	2-9, 11-14	F25J3/08
Y	----- CN 216 048 690 U (TAIFENG XINJIAO AIR SEPARATION PLANT LTD COMPANY) 15 March 2022 (2022-03-15) * figure 1 *	2,3,5,8, 11-13	
Y	----- US 6 196 021 B1 (WISSOLIK ROBERT [US]) 6 March 2001 (2001-03-06) * figure 2 *	3,4,9	
Y	----- EP 0 762 066 A2 (AIR PROD & CHEM [US]) 12 March 1997 (1997-03-12) * figure 5 *	6-9, 11-14	
Y	----- CN 115 406 182 A (ZHEJIANG ZHIHAI CHEMICAL EQUIPMENT ENG CO LTD) 29 November 2022 (2022-11-29) * figure *	6-9, 11-14	
	----- - / - -		TECHNICAL FIELDS SEARCHED (IPC) F25J

INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC so that only a partial search (R.62a, 63) has been carried out.

Claims searched completely :

Claims searched incompletely :

Claims not searched :

Reason for the limitation of the search:

see sheet C

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Place of search	Date of completion of the search	Examiner
Munich	24 January 2025	Göritz, Dirk
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document		

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PARTIAL EUROPEAN SEARCH REPORT

Application Number

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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (IPC)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	EP 3 739 714 A1 (LINDE GMBH [DE]) 18 November 2020 (2020-11-18) * paragraphs [0020], [0034], [0067] * -----	1	
A	CN 113 061 905 A (CHINA NAT OFFSHORE OIL CORP; CNOOC OIL & PETROCHEMICALS CO LTD ET AL.) 2 July 2021 (2021-07-02) * figure * -----	1	
			TECHNICAL FIELDS SEARCHED (IPC)

INCOMPLETE SEARCH
SHEET C

Application Number

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Claim(s) completely searchable:

1-9, 11-14

Claim(s) not searched:

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Reason for the limitation of the search:

Claims 6 and 10 have been drafted as separate independent claims. Under Article 84 in combination with Rule 43(2) EPC an application may contain more than one independent claim in a particular category only if the subject matter claimed falls within one or more of the exceptional situations set out in paragraphs (a), (b) or (c) of Rule 43(2) EPC. This is not the case in the present application however, because it is evident that the subject-matter of said claims does neither involve a plurality of inter-related products, nor different uses of a product or apparatus. Furthermore, said claims appear to relate merely to various ways of describing the ASU of the same ultra-high purity oxygen production apparatus and are therefore no "alternative" solutions in the sense of different or even mutually exclusive possibilities.

The search has been restricted to the subject-matter indicated by the applicant in his letter of 30-07-2024 filed in reply to the invitation pursuant to Rule 62a(1) EPC.



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-5

Ultra-high-purity oxygen production method utilizing an air separation unit comprising a main heat exchanger, a nitrogen rectification column, a nitrogen condenser, an oxygen rectification column, and an oxygen vaporizer, wherein the method comprises:

a step in which feed oxygen comprising low-boiling-point components as impurities is introduced from a warm end of the main heat exchanger, cooled and at least partially liquefied, then introduced into the oxygen rectification column, and ultra-high-purity oxygen from which the low-boiling-point components have been removed is drawn as a gas or a liquid from a lower portion of the oxygen rectification column or from the oxygen vaporizer;

and a step in which one or more of:

a portion of feed air cooled in the main heat exchanger, a portion of the feed oxygen cooled in the main heat exchanger, and a liquid or gas drawn from a medium-pressure rectification column constituting the nitrogen rectification column is utilized as a heating medium in the oxygen vaporizer, liquefied oxygen supplied from a bottom portion of the oxygen rectification column is vaporized, and a vapour stream thereof is supplied to the bottom portion of the oxygen rectification column.

2. claims: 6-9, 11-14

Ultra-high-purity oxygen production apparatus comprising: a main heat exchanger into which feed air and feed oxygen are introduced;

a first rectification column having a bottom portion into which the feed air, that has undergone heat exchange in the main heat exchanger, is introduced;

at least one nitrogen condenser for condensing a nitrogen-rich gas drawn from a column top of the first rectification column;

a second rectification column having a column top into which is introduced a nitrogen-rich gas condensed in the nitrogen condenser and/or a nitrogen-rich liquid drawn from the column top of the first rectification column, after said nitrogen-rich liquid has been cooled in a sub-cooler;

an oxygen rectification column having a column top or a purification portion into which the feed oxygen that has undergone heat exchange in the main heat exchanger is introduced;

an oxygen vaporizer which is arranged below a bottom portion of the oxygen rectification column or within the oxygen rectification column and vaporizes liquefied oxygen while using, as a heating medium, one or more of:

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

a portion of feed air cooled in the main heat exchanger, a portion of the feed oxygen cooled in the main heat exchanger, and a liquid or gas drawn from a medium-pressure rectification column constituting the nitrogen rectification column;

and a sub-cooler for performing heat exchange of:
an oxygen-enriched liquid drawn from the bottom portion of the first rectification column, a purified gas condensed in the nitrogen condenser and/or a purified gas drawn from the column top of the first rectification column, and a nitrogen-rich gas drawn from the column top of the second rectification column.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24 - 01 - 2025

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