



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.06.2011 Bulletin 2011/24

(51) Int Cl.:
F25J 3/04^(2006.01)

(21) Application number: **09178498.3**

(22) Date of filing: **09.12.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
 Designated Extension States:
AL BA RS

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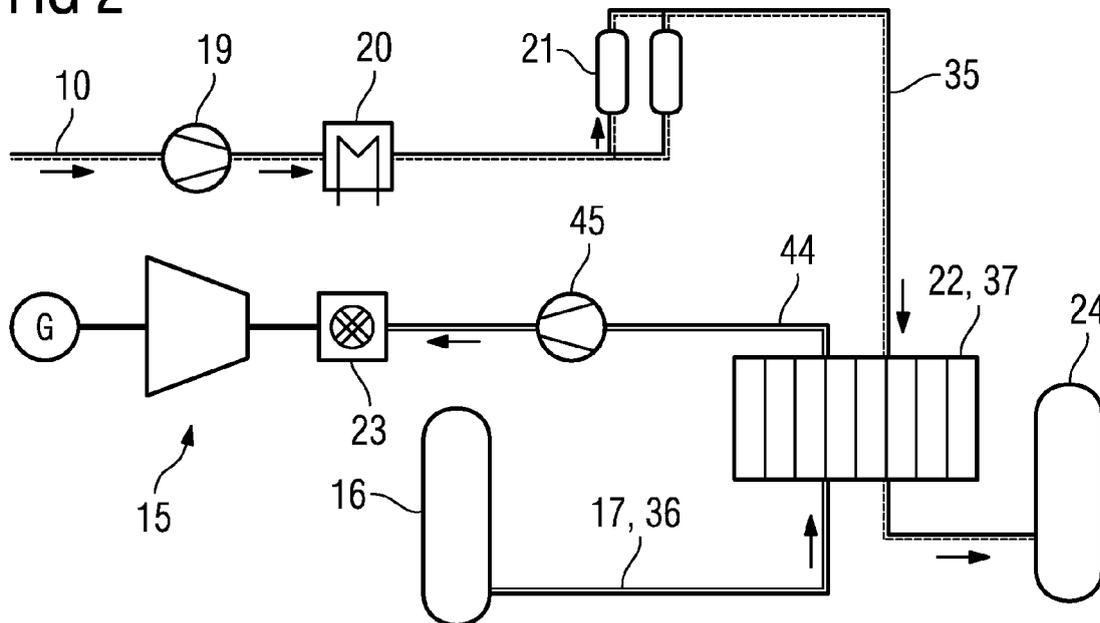
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(54) **Liquid natural gas cooled air separation unit for integrated gasification combined cycle power plants**

(57) Disclosed is a gas island for an integrated gasification combined cycle power plant, comprising an air separation unit (24), an air duct (35) emptying into the

air separation unit (24) and an LNG duct (36), wherein a heat exchanger system (37) on a primary side is arranged in the air duct (35) and on a secondary side in the LNG duct (36).

FIG 2



Description

[0001] Liquid natural gas cooled air separation unit for integrated gasification combined cycle power plants

5 FIELD OF INVENTION

[0002] The invention relates to a gas island for an integrated gasification combined cycle power plant and a method for speeding-up a start-up process for cryogenic separation of an air feed in an air separation unit.

10 BACKGROUND OF THE INVENTION

[0003] Integrated gasification combined cycle (IGCC) technology is popular in areas where natural gas supply is limited, coal is abundant and emission controls are strict. This is the case, for example, in coastal China.

[0004] Gas turbines used in IGCC power plants typically require a secondary fuel for start-up, which is often natural gas. When oxygen, nitrogen and synthetic gas (syngas) are ready, the changeover to syngas combustion is made.

[0005] Where natural gas is not available liquid natural gas (LNG) is delivered to IGCC-power plants and stored in liquid (cryogenic) form on site. Besides its use for starting up air-integrated IGCC plants it also is used as secondary fuel in case there is a problem in the gas island.

[0006] In order to be burnt in the gas turbine, LNG has to be vaporized again. The LNG is typically warmed and vaporized using large ambient air vaporizers. The liquefaction of natural gas is energy-intensive and this "cold energy" (the energy invested to liquefy natural gas) is wasted when the LNG is vaporised using ambient air.

[0007] At the same time, as one of the first stages of the IGCC start-up process, the air separation unit (ASU), that supplies pure oxygen and nitrogen to the gasifier, must be cooled to cryogenic temperatures during start-up and kept cool during short outages (when the secondary fuel is likely to be in use). The ASU is usually cooled through refrigeration, i.e. compression, cooling, expansion. To cool, product gases are used (which during start-up are not so cold). This cooling is very energy intensive and the cooling process for start up from warm can take 36-72 hours. Sometimes the cool-down period is shortened by use of stored liquid nitrogen (LIN), which is pumped through the ASU heat exchanger to cool the process fluids. The LIN may have been produced onsite, or it may have been delivered.

30 SUMMARY OF THE INVENTION

[0008] An object of the invention is to provide a gas island for an integrated gasification combined cycle power plant for accelerated start-up processes. Another object of the invention is to provide a method for speeding-up a start-up process for cryogenic separation of an air feed for an air separation unit for integrated gasification combined cycle power plants.

[0009] This object is achieved by the claims. The dependent claims describe advantageous developments and modifications of the invention.

[0010] An inventive gas island for an integrated gasification combined cycle power plant comprises an air separation unit, an air duct emptying into the air separation unit and an LNG duct, wherein a heat exchanger system is arranged on a primary side in the air duct and on a secondary side in the LNG duct.

[0011] Thereby both, the energy invested to liquefy natural gas is recovered and the start-up process for the air separation unit is accelerated.

[0012] According to one aspect of the invention the heat exchanger system is a single heat exchanger. This measure is very cost-efficient.

[0013] According to another aspect of the invention the heat exchanger system comprises at least a first and a second heat exchanger, wherein a primary side of the first heat exchanger is arranged in the air duct, a secondary side of the second heat exchanger is arranged in the LNG duct and the secondary side of the first heat exchanger and the primary side of the second heat exchanger are interconnected. This solution minimizes the impact of a leak in the heat exchanger where the LNG flows through.

[0014] It is advantageous when the secondary side of the first heat exchanger and the primary side of the second heat exchanger are arranged in a closed circuit. This allows operation of the heat exchanger system even when the heat transfer medium, for example nitrogen from the ASU, is not available yet.

[0015] Advantageously a pump is arranged in the circuit.

[0016] It is even more advantageous when instead of a simple pump a compressor and an expander forming a compander are arranged in the circuit to increase the refrigeration efficiency.

[0017] According to an aspect of the invention a multi-port-valve is arranged in a waste duct interconnecting a distillation column system of the air separation unit and the secondary side of the first heat exchanger, and where for a switching status of the multi-port-valve a circuit is interposed, in which the primary side of the second heat exchanger is arranged,

thereby interconnecting the secondary side of the first heat exchanger and the primary side of the second heat exchanger. This embodiment makes use of a cooled waste stream as a refrigerant. As an alternative a gaseous nitrogen (GAN) product stream could be used.

5 [0018] According to another aspect of the invention the air duct bifurcates into a branch duct and a main duct, wherein the heat exchanger system and a valve are arranged in the branch duct. This solution minimizes the interference with the ASU and is very advantageous in case the standard ASU design shall not be altered.

[0019] According to one aspect of the invention a pump is arranged in the LNG duct in the direction of flow of LNG upstream of the heat exchanger system. This solution requires only a simple pump and improves heat exchange efficiency.

10 [0020] According to another aspect of the invention a compressor is arranged in the LNG duct in the direction of flow of LNG downstream of the heat exchanger system. Since the hazard created by hydrocarbons in an ASU or in the inerting nitrogen stream is significant, this low pressure heat exchanger solution increases heat exchanger safety in case of a leak. A failure in the wall separating the two media LNG on the one side and air (or nitrogen) on the other side will lead to a leak of air (or nitrogen) to the natural gas, having no more serious effect than diluting the fuel. Furthermore, this solution has no special requirements for the heat exchanger or evaporation cooler due to LNG pressure.

15 [0021] Advantageously at least one heat exchanger of the heat exchanger system is an evaporation cooler.

[0022] Advantageously the gas island is part of an integrated gasification combined cycle power plant where the LNG duct is connected to a combustion chamber of a gas turbine and an oxygen duct connects the air separation unit to a gasifier. An inventive method to speed-up a start-up process for cryogenic separation of an air feed for an air separation unit for integrated gasification combined cycle power plants comprises cooling the ASU using LNG evaporation.

20 [0023] Advantageously the method comprises:

- compressing air with an air compressor connected to a column of an air separation unit via an air duct,
- cooling air in an expansion stage arranged in the air duct,
- cycling the cooled air via the air duct to the column,
- 25 - ramping up the air separation unit to part load,
- supplying LNG to a heat exchanger system arranged in the air duct,
- supplying heated LNG as gas to a combustion chamber of a gas turbine in the combined cycle power plant,
- firing the gas turbine and beginning operation on natural gas,
- supplying compressed air from a compressor of the gas turbine to the air separation unit,
- 30 - ramping up the air separation unit,
- producing gaseous nitrogen (GAN) and gaseous oxygen (GOX) streams with the air separation unit.

[0024] In accordance with an aspect of the invention LNG is no longer supplied to ASU for enhanced cooling, as soon as a gasifier starts up and sufficient syngas is available and the gas turbine is changed over to syngas operation.

35 [0025] With this invention energy consumption is reduced by significantly shortening the cool-down time whilst avoiding storage or delivery of other cryogenics. The cold energy of the LNG is no longer wasted.

BRIEF DESCRIPTION OF THE DRAWINGS

40 [0026] The invention will now be further described with reference to the accompanying drawings in which:

Figure 1 is a schematic flow diagram of an integrated combined cycle power plant comprising a gas island and a power island,

45 Figure 2 represents a basic concept of the inventive gas island with a liquid gas cooled air separation unit,

Figure 3 represents a simple inclined LNG/Air heat exchanger,

Figure 4 represents an embodiment with nitrogen refrigerant for enhanced safety,

50 Figure 5 shows a refrigeration cycle with a compander,

Figure 6 shows an embodiment with reduced impact on the ASU design, where a slipstream flow of air is cooled,

55 Figure 7 shows a waste cycle used for additional cooling,

Figure 8 represents one aspect of the invention where LNG is used as a main air compressor aftercooler in a part-integrated air stream.

[0027] In the drawings like references identify like or equivalent parts.

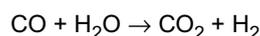
DETAILED DESCRIPTION OF THE INVENTION

5 [0028] Figure 1 is a schematic flow diagram of an integrated gasification combined cycle power plant 1 consisting of a gas island 2 and a power island 3. Integrated gasification combined cycle (IGCC) is a technology that turns coal into gas - synthetic gas (syngas). For power generation an a combined cycle power plant (CCPP) impurities are removed from the coal gas before it is combusted.

10 [0029] In the gas island 2 carbonaceous materials 4, such as coal, petroleum, biofuel, or biomass is prepared in a fuel preparation 5 and conducted to a gasifier 6 where it is converted in a gasification process into a gas mixture called synthesis gas or syngas 7 by reacting the raw material at high temperatures with a controlled amount of oxygen 8 and/or steam. The resulting gas mixture comprises carbon monoxide and hydrogen.

15 [0030] The oxygen 8 is provided by an air separation unit 9, where air 10 is separated into its primary elements typically nitrogen, oxygen and argon. There are various technologies that are used for the separation process; the most common is via cryogenic distillation consisting of the following three stages compression, purification and distillation. During the compression stage atmospheric air is pre-filtered, compressed and then subsequently cooled to remove large size particles and moisture. In the purification stage the process air is passed through a molecular sieve, which removes any remaining water vapour, carbon dioxide and hydrocarbons in alternating absorption units. In the distillation stage process air is passed through a heat exchanger and cooled. The process air enters into a distillation column where it is separated
20 into pure nitrogen, pure oxygen and residual gas. The nitrogen 11 can either be used for flushing of the fuel system or for mixing with the synthesis gas. The oxygen 8 is delivered to the gasifier 6.

25 [0031] A means of mitigating the contribution of fossil fuel emissions to global warming is carbon capture and storage (CCS) based on capturing carbon dioxide (CO₂) and storing it away from atmosphere. For this purpose, after the gasification process the obtained raw gas containing large amounts of carbon monoxide undergoes the water-gas shift reaction in a shift reactor 12, a chemical reaction in which carbon monoxide reacts with water vapor to form carbon dioxide and hydrogen:



30 [0032] After sulphur removal 13 and removal of carbon dioxide 14 the syngas contains mainly hydrocarbon, which after further conditioning steps is sent to the gas turbine 15 of the power island 3 to be burnt.

35 [0033] For start-up as well as for other cases where syngas or a natural gas pipeline are not available an LNG tank 16 is arranged on the gas island 2 for storing liquid (cryogenic) natural gas (LNG) 17 on site. In case of need, the gas turbine 15 of the power island 3 is supplied with LNG 17. For this purpose LNG 17 has to be vaporized again. The LNG 17 is typically warmed and vaporized using large ambient air vaporizers 18.

[0034] Figure 2 shows the basic concept of the inventive gas island with a liquid gas cooled air separation unit for integrated gasification combined cycle power plants.

40 [0035] Air 10 is compressed in main air compressor 19, cooled in heat exchanger 20 and cleaned and dried in molecular sieve 21, then supplied via air duct 35 to a heat exchanger system 37 which could be a single heat exchanger 22. During start-ups and outages, LNG 17, until then stored in LNG tank 16, is supplied to the main heat exchanger 22 via LNG duct 36 to be evaporated against the compressed air 10. The recovered natural gas 44 is then supplied via compressor 45 to the combustion chamber 23 of the gas turbine 15 and the cooled and compressed air 10 is transferred to the high pressure (HP) column of a distillation column system 24 of the ASU 9 for distillation.

45 [0036] ASUs 9 are often built with an expander cycle (not shown), to provide the necessary refrigeration. It is anticipated that this process will still be needed, as the LNG will only offer cooling during start-up.

[0037] The IGCC start-up procedure is as follows:

1. ASU 9 begins compression with its main air compressor 19 (MAC). It cycles air to a distillation column system 24 (including an expansion stage) and begins to cool. A partially air-integrated ASU 9 will ramp up to 50% load with its MAC 19. LNG is supplied to the ASU heat exchanger 22 or MAC aftercooler 20. The cooling process is enhanced.
2. The LNG boils and is supplied as gas to CCPP combustion chamber 23.
3. The gas turbine 15 fires and begins operation on natural gas. Oxygen and Nitrogen products are not yet required.
4. The gas turbine compressor supplies compressed air to the ASU 9.
5. The ASU 9 ramps up.
- 55 6. As the ASU 9 cools, it begins to produce gaseous nitrogen (GAN) and gaseous oxygen (GOX) streams.
7. When GAN and GOX streams reach desired purity, the gasifier starts up. Syngas is initially supplied to the flare (if necessary).
8. When sufficient syngas is available, gas turbine changes over to syngas operation. No more natural gas is required.

9. LNG is no longer supplied to ASU 9 for enhanced cooling. Some NG may be flared.

10. ASU 9 continues to cool via normal design.

5 **[0038]** With reference to Figure 3, a simple inclined LNG/Air heat exchanger 22 is shown. There is a danger of mixing natural gas into the process air 10 of the ASU 9. The hazard created by hydrocarbons in an ASU 9, or in the inerting nitrogen stream (see alternative embodiment in Figure 7) is significant. Some advantage may be taken from the pressure difference. If the LNG 17 is to be evaporated at ambient pressure before compression for combustion, then the pressure difference is optimal for a safe heat-exchanger as shown in Figure 3. A failure in the wall 25 separating the two media will lead to a leak of air 10 (or nitrogen, see Figures 4 and 7) to the natural gas 25, having no more serious effect than diluting the fuel. A significant leak would be detected if heating value / Wobbe index measurements are made before combustion or air flow in the ASU 9 is measured.

10 **[0039]** If the LNG 17 is to be pumped while still liquid and evaporated at pressure, there is a greater risk of natural gas leaking into the air or the refrigerant. Pumped LNG will require a (e.g.) 30 bar ambient vaporiser, requiring much thicker walls and thus a significant capital increase.

15 **[0040]** This is a key reason to avoid the integration in the main heat exchanger 22 (Figure 2) but instead to use a separate heat exchanger 26 as shown in Figure 4.

20 **[0041]** Figure 4 suggests a setup that uses gaseous nitrogen (GAN) as the refrigerant, thereby minimising the impact of a leak. However as pure nitrogen will not be available at the start of cool-down, this option is only possible with a closed loop cooling system. A pump 27 circulates the GAN. In this embodiment the compressor 45 of Figure 2 arranged downstream of the heat exchanger system 37 can be replaced by a pump 46 arranged upstream of the heat exchanger system 37.

25 **[0042]** Figure 5 represents another refrigeration cycle using nitrogen as the refrigerant. But instead of a simple positive displacement machine 16 to circulate the GAN as in Figure 4, a complete refrigeration cycle could be installed with a compander 28. Also by raising the pressure of the nitrogen the (higher boiling point) LNG should provide sufficient refrigeration to liquefy.

30 **[0043]** Where ASU suppliers are unwilling to alter their standard design, or the engineering required removes the cost benefit, the process could be removed from the ASU. Figure 6 shows an embodiment where a second heat exchanger 26 is installed that cools an air stream 29 at the ASU boundary, thereby minimising interference with the ASU 9. The LNG cools part of the feed air stream 10, which in turn cools the distillation column system 24.

35 **[0044]** In an alternative arrangement shown in Figure 7 a waste stream 30 of the ASU 9 is used as refrigerant for the compressed air stream 10. A further possibility would be to use the GAN product stream as refrigerant (cf. Figure 5, where nitrogen is used as refrigerant in a closed loop in contrast to Figure 7 with an open loop).

40 **[0045]** By cooling a waste cycle, a cooled waste stream could be diverted to a heat exchanger 26 and used as the refrigerant. For this purpose a multi-port-valve 31 arranged in a waste duct 38 interposes a circuit 32 in which the primary side of the second heat exchanger 26 is arranged, thereby interconnecting the secondary side of the first heat exchanger 22 and the primary side of the second heat exchanger 26. During normal operation the circuit 32 is bypassed.

45 **[0046]** Figure 8 shows an ASU design where an additional refrigeration unit 33 is installed downstream of the main air compressor (MAC) 19. This allows more water to be condensed out 40 and thus reduces the size of the adsorbers 21. Where the additional cooling is only available at start-up, the adsorber size must remain the same. However, the existence of this design might further reduce necessary re-engineering.

50 **[0047]** Figure 8 further shows a part-integrated embodiment where part of the air from the compressor 34 of the gas turbine 15 is used to feed the ASU 9. This part stream can either be added to the air stream 10 of the MAC 19 before (dashed line) or after (solid line) the additional refrigeration unit 33.

55 **[0048]** With this invention a start-up time saving of 20-30 hours could be possible. This results in much less use of secondary fuel and less power demand from the ASU 9. Since this invention removes the need for an LNG vaporiser there may be a further availability benefit or a reduction in maintenance activities achieved as ambient vaporisers tend to ice up and can become ineffective if not regularly thawed.

[0049] Another benefit is the enhanced molecular-sieve operation during start-up since it is possible that the reduced air temperature will increase the effectiveness of the molecular sieve.

Claims

1. A gas island (2) for an integrated gasification combined cycle power plant (1), comprising:

- an air separation unit (9),
- an air duct (35) emptying into the air separation unit (9) and
- a liquid natural gas duct (36),

characterized in that a heat exchanger system (37) is arranged on a primary side in the air duct (35) and on a secondary side in the liquid natural gas duct (36).

2. The gas island (2) as claimed in claim 1, wherein the heat exchanger system (37) is a single heat exchanger (22,33).
3. The gas island (2) as claimed in claim 1, wherein the heat exchanger system (37) comprises at least a first (22) and a second heat exchanger (26), wherein a primary side of the first heat exchanger (22) is arranged in the air duct (35), a secondary side of the second heat exchanger (26) is arranged in the liquid natural gas duct (36) and the secondary side of the first heat exchanger (22) and the primary side of the second heat exchanger (26) are interconnected.
4. The gas island (2) as claimed in claim 3, wherein the secondary side of the first heat exchanger (22) and the primary side of the second heat exchanger (26) are arranged in a closed circuit.
5. The gas island (2) as claimed in claims 3 or 4, wherein a pump (27) is arranged in the circuit.
6. The gas island (2) as claimed in claims 3 or 4, wherein a compander (28) is arranged in the circuit.
7. The gas island (2) as claimed in claim 3, wherein a multi-port-valve (31) is arranged in a waste duct (38) interconnecting a distillation column system (24) of the air separation unit (9) and the secondary side of the first heat exchanger (22), and where for a switching status of the multi-port-valve (31) a circuit (32) is interposed in which the primary side of the second heat exchanger (26) is arranged, thereby interconnecting the secondary side of the first heat exchanger (22) and the primary side of the second heat exchanger (26).
8. The gas island (2) as claimed in any of the preceding claims, wherein the air duct (35) bifurcates into a branch duct (41) and a main duct (42), wherein the heat exchanger system (37) and a valve (43) are arranged in the branch duct (41).
9. The gas island (2) as claimed in any of the preceding claims, wherein a pump (46) is arranged in the liquid natural gas duct (36) in the direction of flow of liquid natural gas upstream of the heat exchanger system (37).
10. The gas island (2) as claimed in any of claims 1 to 8, wherein a compressor (45) is arranged in the liquid natural gas duct (36) in the direction of flow of liquid natural gas downstream of the heat exchanger system (37).
11. The gas island (2) as claimed in any of the preceding claims, wherein at least one heat exchanger (26) of the heat exchanger system (37) is an evaporation cooler.
12. An integrated gasification combined cycle power plant (1) with a gas island (2) as claimed in any of the preceding claims, wherein the liquid natural gas duct (36) is connected to a combustion chamber (23) of a gas turbine (15) and an oxygen duct (8) connects the air separation unit (9) to a gasifier (6).
13. A method for speeding-up a start-up process for cryogenic separation of an air feed for an air separation unit (9) for integrated gasification combined cycle power plants (1), comprising: cooling air to be fed to the air separation unit (9) using liquid natural gas expansion.
14. The method as claimed in claim 13, comprising:
 - compressing air with an air compressor connected to a column of an air separation unit via an air duct,
 - cooling air in an expansion stage arranged in the air duct,
 - cycling the cooled air via the air duct to the column,
 - ramping up the air separation unit to part load,
 - supplying liquid natural gas to a heat exchanger system arranged in the air duct,
 - supplying heated liquid natural gas as gas to a combustion chamber of a gas turbine in the combined cycle power plant,
 - firing the gas turbine and beginning operation on natural gas,
 - supplying compressed air from a compressor of the gas turbine to the air separation unit,
 - ramping up the air separation unit,
 - producing gaseous nitrogen (GAN) and gaseous oxygen (GOX) streams with the air separation unit.

EP 2 333 470 A1

15. The method as claimed in claims 13 or 14, wherein LIQUID NATURAL GAS is no longer supplied to the ASU (9) for enhanced cooling, as soon as a gasifier (6) starts up and sufficient syngas is available and the gas turbine (15) is changed over to syngas operation.

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FIG 1

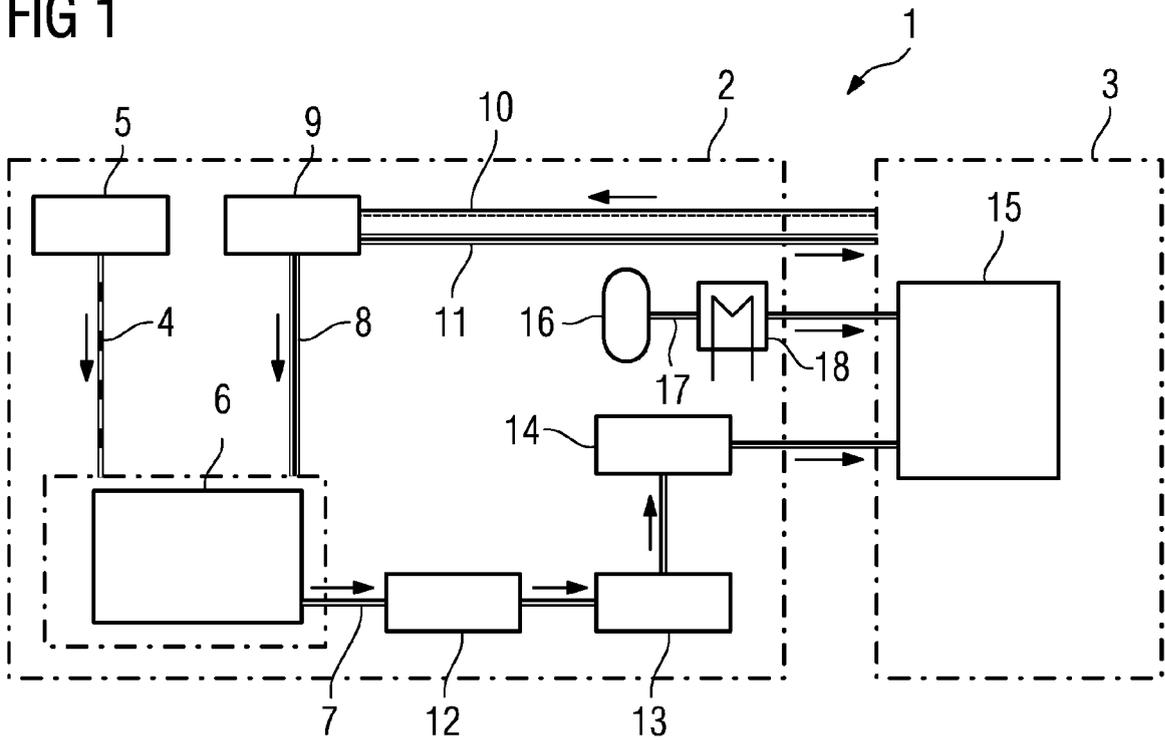


FIG 2

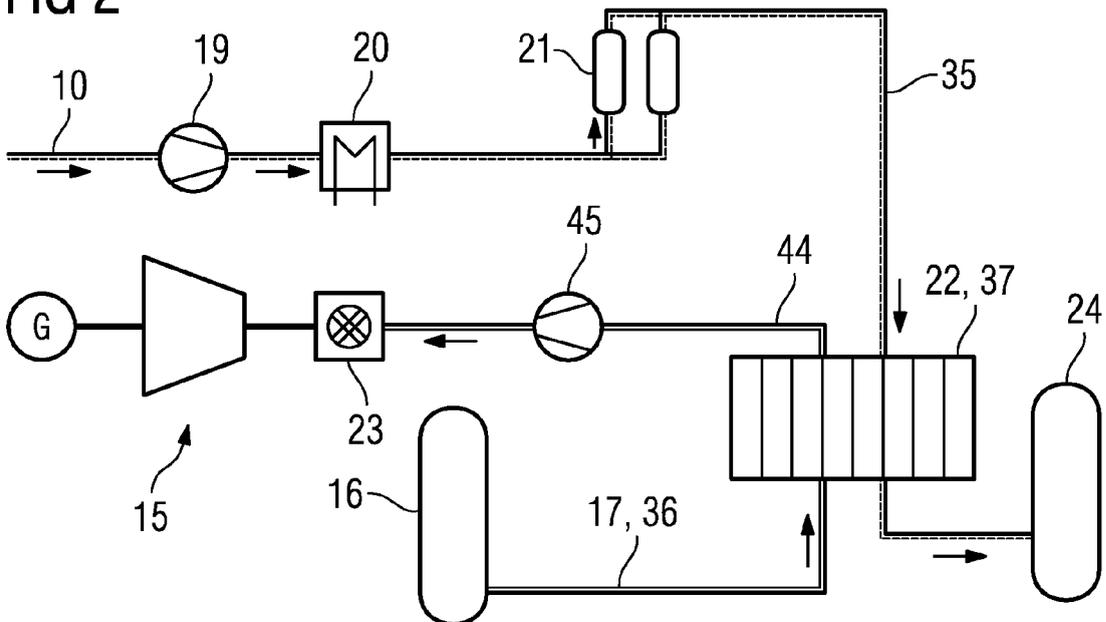


FIG 3

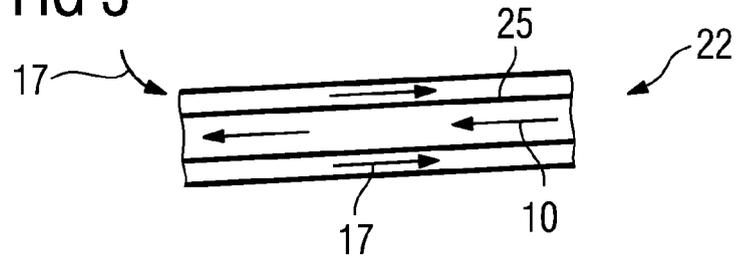


FIG 4

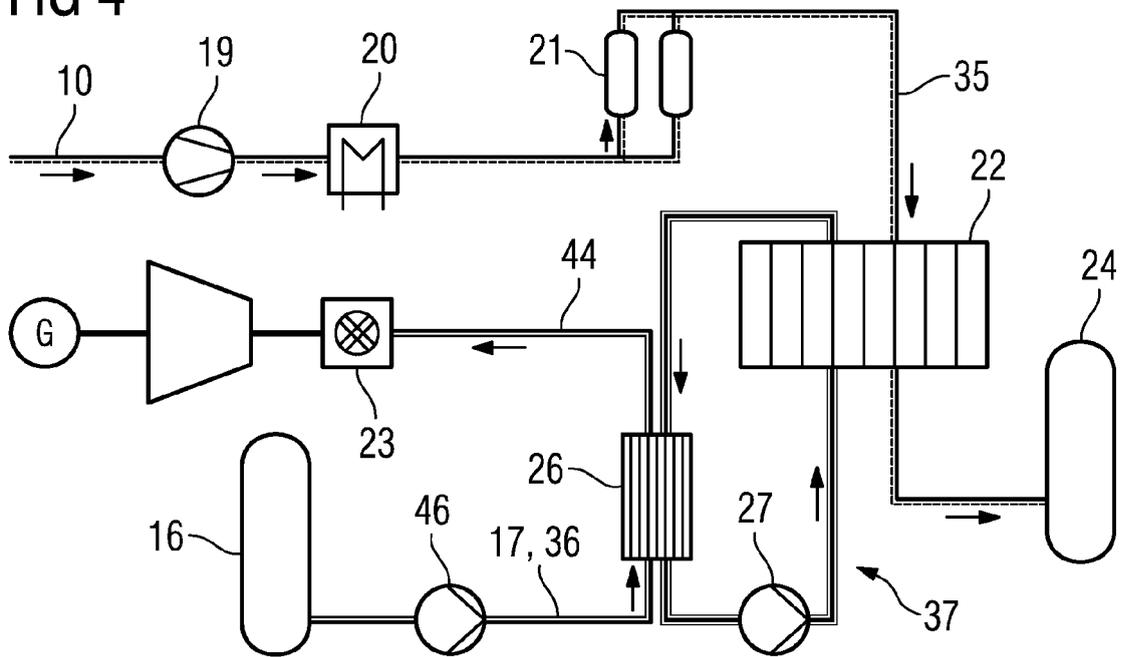


FIG 5

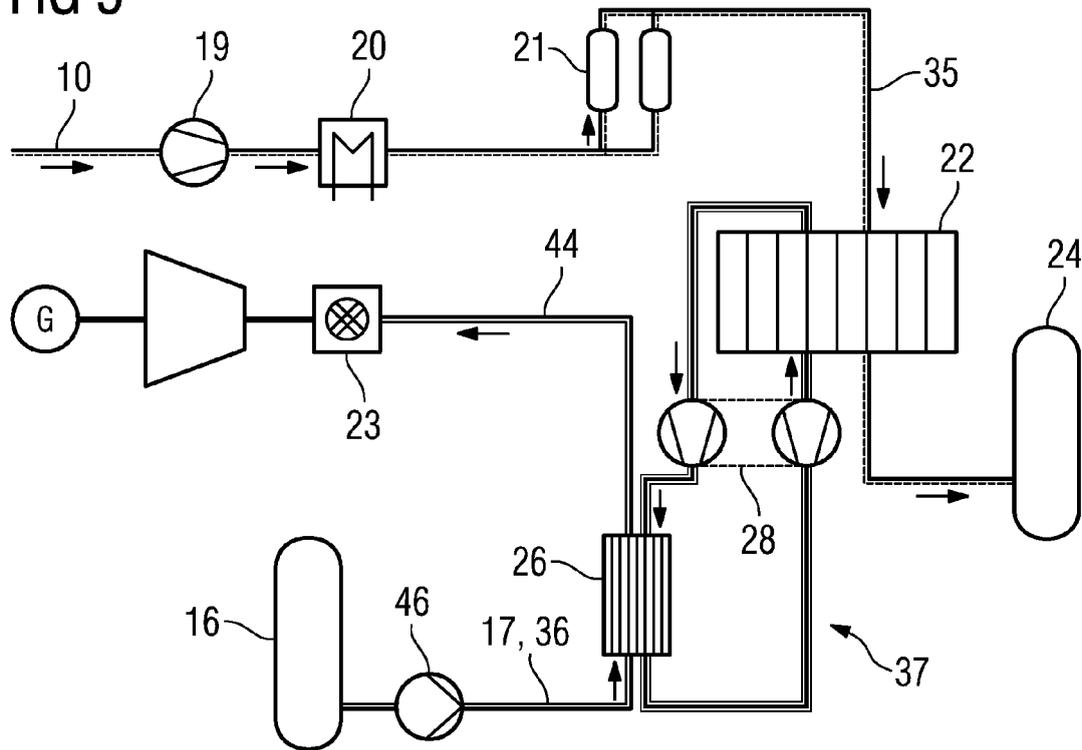


FIG 6

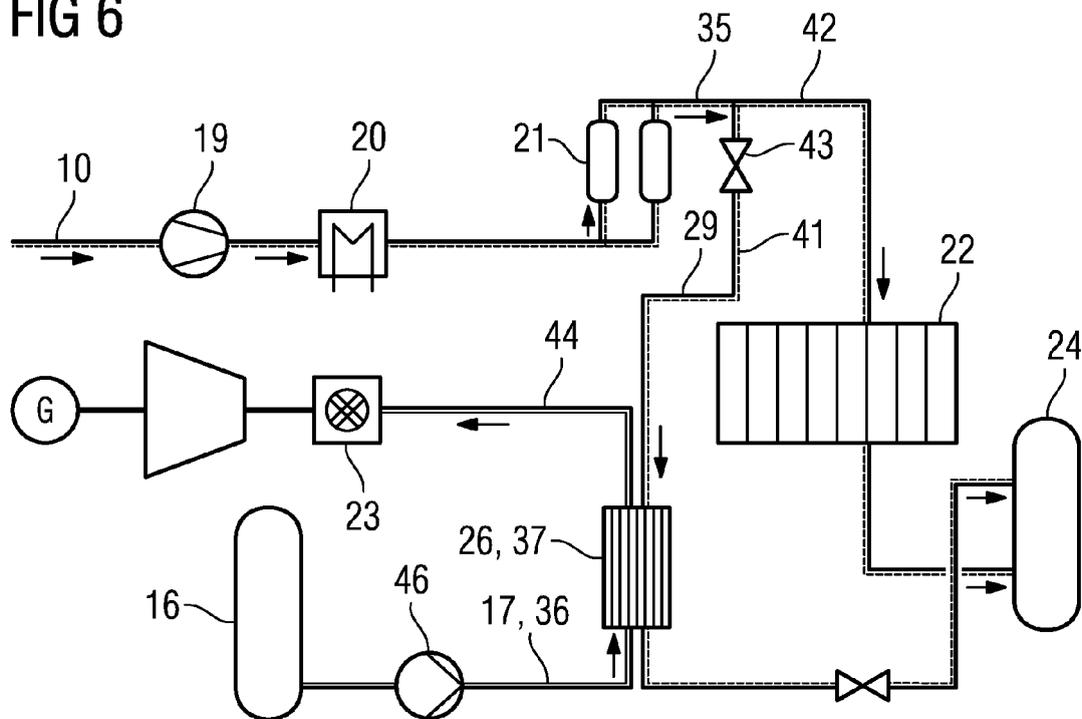


FIG 7

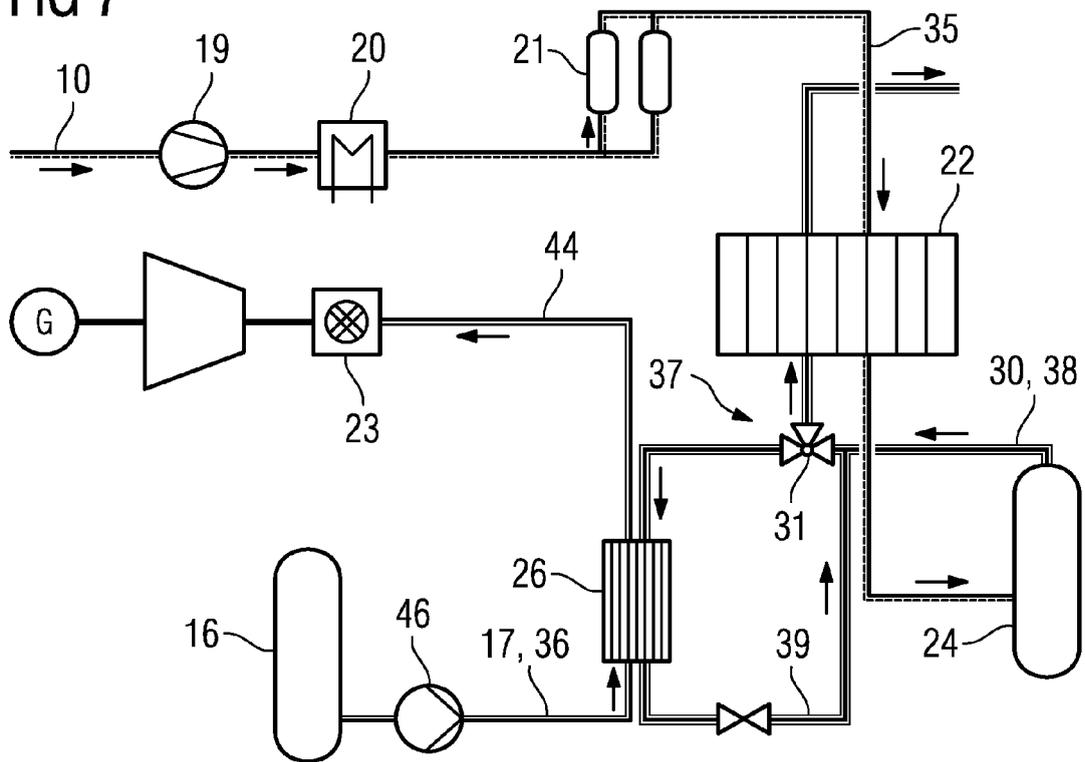
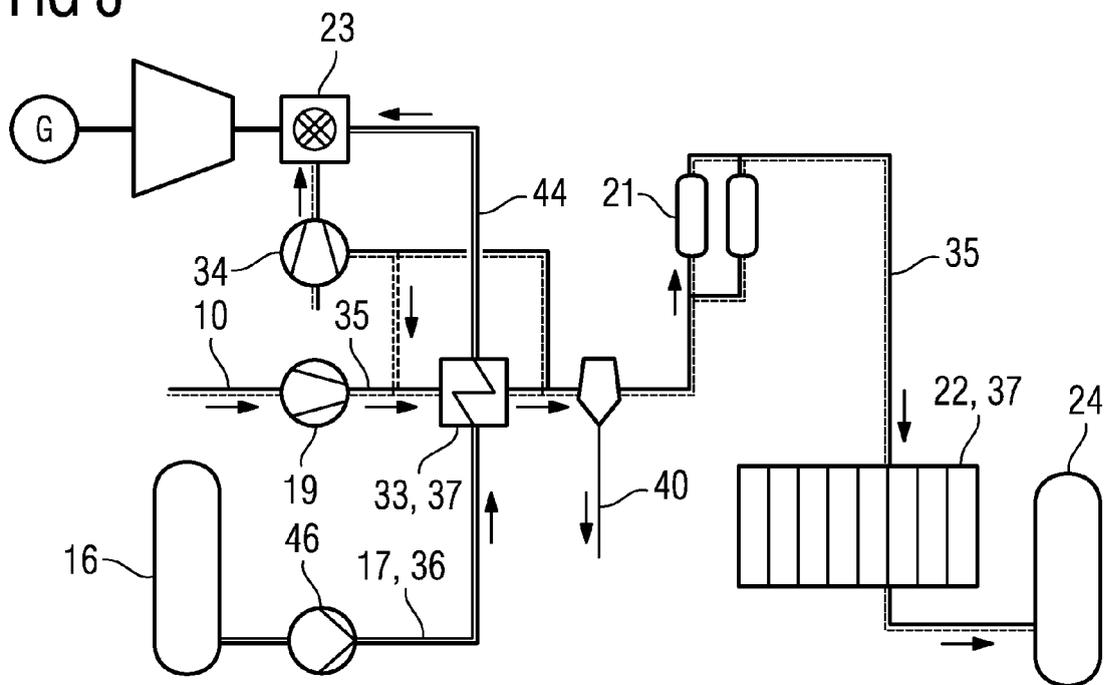


FIG 8





EUROPEAN SEARCH REPORT

Application Number
EP 09 17 8498

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	JP 2002 267355 A (TOSHIBA CORP) 18 September 2002 (2002-09-18) * abstract; figures 1,2,4,5,6 *	1,2,8, 11,12	INV. F25J3/04
Y	* paragraphs [0001], [0006] *	2,8-10	

X	US 3 728 093 A (COFIELD W) 17 April 1973 (1973-04-17) * column 2, line 54 - line 56 *	1,11,12	
Y	* column 3, line 58 - line 62 * * column 4, line 39 - line 53 * * column 5, line 42 - line 53 * * column 5, line 69 - line 74; figure *	2,8-10	

Y	YAMANOUCI N ET AL: "USING LNG COLD FOR AIR SEPARATION IN THIS CASE, USING THE CRYOGENIC ENERGY OF LNG HAS SAVED ELECTRIC POWER AMOUNTING TO ABOUT 0.5 KWH PER CUBIC METER OF PRODUCT" CHEMICAL ENGINEERING PROGRESS, AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, NEW YORK, NY, US, vol. 75, no. 7, 1 January 1979 (1979-01-01), pages 78-82, XP001203259 ISSN: 0360-7275 * figures 1,2 *	9,10	
			TECHNICAL FIELDS SEARCHED (IPC)
			F25J
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 23 July 2010	Examiner 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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EPO FORM 1503 03.02. (P04C01)



Application Number

EP 09 17 8498

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:
see additional sheet(s)
- 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

EP 09 17 8498

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, 2, 8-12

A gas island for an IGCC-power plant comprising inter alia a heat exchanger system which consists of a single heat exchanger and which is arranged on a primary side of a feed air duct of an ASU and on a secondary side in a liquid natural gas duct.

2. claims: 1, 3-12

A gas island for an IGCC-power plant comprising inter alia a heat exchanger system whci comprises at least a first and second heat exchanger wherein a primary side of the frist heat exchanger is arranged in the feed air duct of an ASU, a secondary side of the second heat exchanger is arranged in a liquid natural gas duct and the secondary side of the frist heat exchanger and the primary side of the second heat exchanger are interconnected.

3. claims: 13-15

A method for speeding-up a start-up process of an ASU for an IGCC-power plant comprising cooling the air feed by liquid natural gas

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

EP 09 17 8498

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.

23-07-2010

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82