



(11) **EP 1 700 071 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
13.06.2012 Bulletin 2012/24

(51) Int Cl.:
F17C 9/02 ^(2006.01) **F25J 3/02** ^(2006.01)
F17C 9/04 ^(2006.01)

(21) Application number: **04798684.9**

(86) International application number:
PCT/GB2004/004988

(22) Date of filing: **25.11.2004**

(87) International publication number:
WO 2005/059459 (30.06.2005 Gazette 2005/26)

(54) **PROCESS FOR THE CONDITIONING OF LIQUEFIED NATURAL GAS**

VERFAHREN ZUR KONDITIONIERUNG VON FLÜSSIGERDVGAS

PROCEDE PERMETTANT DE CONDITIONNER LE GAZ NATUREL LIQUEFIE

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LU MC NL PL PT RO SE SI SK TR**

(30) Priority: **18.12.2003 GB 0329343**

(43) Date of publication of application:
13.09.2006 Bulletin 2006/37

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(56) References cited:
GB-A- 1 261 457 US-A- 3 837 821
US-B1- 6 564 579 US-B1- 6 604 380

- **HUANG S ET AL: "SELECT THE OPTIMUM
EXTRACTION METHOD FOR LNG
REGASIFICATION VARYING ENERGY
COMPOSITIONS OF LNG IMPORTS MAY
REQUIRE TERMINAL OPERATORS TO REMOVE
C2+ COMPOUNDS BEFORE INJECTING
REGASIFIED LNG INTO PIPELINES"
HYDROCARBON PROCESSING, GULF
PUBLISHING CO. HOUSTON, US, vol. 83, July
2004 (2004-07), pages 57-62, XP009038899 ISSN:
0018-8190**

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Description

[0001] This invention relates to a process for conditioning liquefied natural gas.

[0002] Liquefied natural gas (LNG) needs to be vaporized before being fed into a pipeline for distribution. In a typical vaporization process, the LNG is fed into a tank. This inevitably results in some gas vapour loss; typically this off-gas is compressed and then passed to a boil-off condenser where it is condensed, for example by passing a quantity of LNG from the tank into the boil-off condenser where the boil off gas, at increased pressure, is combined with the LNG stream to produce an all-liquid stream which may be passed back into the tank or combined with an outflow stream from the tank. LNG is then passed from the tank to a pump which discharges the LNG, at a suitable pressure, to a pipeline, via one or more heat exchangers which vaporize the LNG.

[0003] However, in many cases, the LNG does not meet required product or pipeline specifications because of the presence of excess quantities of hydrocarbons containing two or more carbon atoms, and various additional processing steps are required.

[0004] GB 1,185,053 discloses a high pressure process for obtaining a fluid rich in methane from LNG. The high pressures used lead to high engineering and operating costs. Fig. 1 shows a column which is fed by a pump which subjects the feed stream to the column to a pressure of 25 bars absolute, which means that the column must be engineered to operate at a pressure of close to 25 bars absolute.

[0005] US 6,604,380 is also a high pressure process, with a pump raising the pressure of the LNG to 100-500 psig, preferably the process range of 300-350 psi (1 psi = 0.0689 bar). The scheme is complex, initially splitting the feed stream into at least two parts, with at least one part being used as a reflux stream to a packed column.

[0006] US 2003/0158458A1 discloses a scheme for separating methane-rich and ethane-rich components from an LNG stream, which includes a separator and a column. Fig. 1 shows the feed stream being passed direct to the column 28, which is operated using a reflux pumped from the separator 24. In effect, the separator acts to recycle the gas stream from the column, and therefore only part of the LNG feed is subject to that separation.

[0007] US 6,564,579 describes a process for the removal of natural gas liquids, typically hydrocarbons containing two or more carbon atoms, from LNG, in order to provide a product with a reduced heating value which meets pipeline or other commercial specifications. This process, which is of a type which may be referred to as conditioning, includes the following steps: vaporizing at least a major portion of a stream of the liquefied natural gas to produce an at least partially vaporized natural gas stream; fractionating the at least partially vaporized natural gas stream to produce a gas stream and a natural gas liquids stream; compressing the gas stream to in-

crease the pressure of the gas stream by about 50 to about 150 psi to produce a compressed gas stream and cooling the compressed gas stream by heat exchange with the stream of liquefied natural gas to produce a liquid compressed gas stream; pumping the liquid compressed gas stream to produce a high-pressure liquid stream at a pressure from about 800 to about 1200 psig; vaporizing the high-pressure liquid stream to produce a conditioned natural gas suitable for delivery to a pipeline or for commercial use; and recovering the natural gas liquids.

[0008] The process of US 6,564,579 provides a number of advantages. However, the process has itself a number of significant disadvantages. In particular, a preferred embodiment of the process as shown in figure 5 of US 6,564,579 requires the use of a high-pressure distillation vessel (38 in figure 5); thus, according to column 7 lines 15-30: "The overhead gas from the separation vessel 86 is passed via a line 94 to compression in a compressor 50 wherein the pressure is increased by approximately 50 to 150 psi. The pressure in line 54 after compression in compressor 50 is typically from about 100 to about 300 psig. This enables the return of the gas from tank 86 via line 54 to heat exchanger 34 for liquefaction. The liquids recovered from separator 86 are passed via a line 88 to a pump 90 from which they are passed via a line 92 to distillation vessel 38. Distillation vessel 38 functions as described previously to separate NGLs, which are recovered through a line 46, and to produce an overhead gas stream, which comprises primarily methane. This gaseous stream is recovered through a line 48 and is passed to combination with the gas stream in line 54. The combined streams are then liquefied in heat exchanger 34." Because the pressure in line 48 must be the same as the pressure in line 53, column 38 must be operated with a gaseous outlet pressure of 100 to about 300 psig. This means that the liquid stream from 86 must be pumped (via pump 90) to column 38.

[0009] US 3837821, which discloses the features of the preamble of claim 1, discloses a method of production under high pressure of a gas rich in methane, to which is added a volatile gaseous fraction in which the natural gas is brought to an intermediate pressure and a volatile gaseous fraction is added to the natural gas at the said intermediate pressure, wherein the volatile gaseous fraction is added to the natural gas in the liquid state, after which the mixture obtained is brought to the pressure of the distribution system reheated and vaporized.

[0010] We have now found a simplified process for the conditioning of LNG which can be operated more efficiently and cheaply than the processes of the prior art.

[0011] Accordingly the present invention provides a process for the conditioning of liquefied natural gas, which comprises applying the following steps to a feed stream of liquefied natural gas:

- i. vaporizing at least a major portion of the feed stream of liquefied natural gas to produce an at least partially vaporized natural gas stream;

- ii. separating the at least partially vaporized natural gas stream to produce a first stream which is rich in methane and a second stream which is rich in hydrocarbons having two or more carbon atoms;
- iii. if required, compressing the first stream from step (ii) to increase the pressure and produce a compressed gas stream;
- iv. cooling the first stream from step (ii) or the compressed gas stream from step (iii) by heat exchange with at least part of the feed stream of liquefied natural gas to produce a liquid compressed gas stream;
- v. passing the second stream from step (ii) without pumping to a distillation vessel to produce a natural gas liquids stream and a further stream rich in methane, the operating pressure of the distillation vessel being such that the further stream rich in methane exits the distillation vessel at a pressure in the range of from 2 to 6 barg;
- vi. cooling the further stream rich in methane from step (v) by heat exchange with at least part of the feed stream of liquefied natural gas and subsequently pumping to produce a liquid compressed gas stream;
- vii. optionally combining the liquid compressed gas streams from steps (iv) and (vi);
- viii. vaporizing the liquid compressed gas streams from steps (iv), (vi) and/or (vii) to produce a conditioned natural gas; and
- ix. recovering the natural gas liquids

characterised in that at least the major portion of the feed stream of liquefied natural gas is vaporized in step (i) by heat exchanger of at least part of the feed stream of liquefied natural gas with the first stream from step (ii) or the compressed gas stream from step (iii) and with the further stream rich in methane from step (v).

[0012] The process according to the invention produces a conditioned natural gas which is suitable for delivery to a pipeline, or for other commercial use, together with natural gas liquids. In general, the natural gas liquids comprise hydrocarbons having 2 or more carbon atoms. If desired, the initial natural gas liquids product obtained by the process of the invention can be further processed, for example by the removal of ethane in a deethaniser column.

[0013] Preferably in excess of 90% or 95% of the feed stream to the process, preferably all of the feed stream, is fed to step (i) of the process. If desired, a small quantity of the feed stream may be used to perform certain functions within the process, for example to cool a compressor. It is however an advantage of the process according to the invention that none of the feed stream is required to act as a reflux in columns used in the process, unlike the process of US 6,604,380, in which part of the incoming cold LNG bypasses the vapourising heat exchanger and is used as reflux in the column 22 and possibly the separator 20.

[0014] Preferably the separation of step (ii) is carried

out using a separator which contains a minimum of internal structure. No reflux streams are necessary, and therefore no packing materials or gas-liquid separation trays are required, although if desired the separator may contain one or more knit-mesh structures to assist in removing entrained liquids.

[0015] The output from step (ii) comprises two separate streams, a gas stream and a liquids stream. The gas stream is compressed if necessary in optional step (iii) (whether this is necessary will depend upon the operating pressure of the fractionation step (ii)) and sent to a heat exchanger where, in step (iv), it is cooled against the LNG feed stream. The liquids stream is separated into a natural gas liquids stream and a gas stream in the distillation vessel of step (v), which vessel contains gas-liquid separation packing or trays to provide vapour-liquid contact. Said vessel does not require the presence of a reflux stream; specifically, it does not require the presence of a cold LNG reflux stream obtained from the feed stream to the process.

[0016] The gas stream resulting from step (v) is sent to a heat exchanger where it is cooled against the LNG feed stream (step (vi)). It is an important feature of the process of the invention that the gas streams from steps (ii)/(iii) and (v) are at different pressures from each other and are therefore cooled in separate streams. The heat exchange on these two streams may be carried out using different heat exchangers, or it may be carried out using a multi-stream heat exchanger. Preferably the heat exchanger(s) used is a plate-fin exchanger; these are very compact, and tighter temperature approaches are possible.

[0017] Following the heat exchange of steps (iv) and (vi), the gas stream originating from step (v) may be compressed to equalise its pressure with that of the higher-pressure stream originating from step (ii)/(iii), and the two streams may be combined prior to pumping to further increase the pressure, followed by vaporization to produce the desired conditioned natural gas.

[0018] The process of the present invention provides a number of advantages relative to the process described in Figure 5 of US 6,564,579. Because there is no requirement to merge two separate gas streams prior to heat exchange, the distillation vessel used in step (iv) operates at a relatively low pressure, the exit stream rich in methane being at a pressure in the range of from 2 to 6 barg, preferably from 3 to 5 barg (in contrast to the column of Figure 5 of US 6,564,579 which operates at a relatively high pressure, the exit stream being at 100 to 300 psig, equivalent to 6.9 to 20.7 barg). The liquid stream from step (ii) may therefore be let down into the distillation vessel: no pump is required to transfer the natural gas liquids stream from step (ii) to the distillation vessel, and the process is thereby simplified. The compressor used to compress the gas stream exiting from the distillation vessel in step (ii) can be used at a lower pressure differential. Importantly, the distillation vessel may be reboiled using seawater rather than steam which is required for

the reboiling of higher pressure vessels, although steam may be used if desired. And finally, keeping the gas streams from steps (ii)/(iii) and (v) separate rather than combining them prior to heat exchange may improve the heat recovery efficiency, especially if a plate-fin heat exchanger(s) is used.

[0019] The process of the invention may be integrated with existing LNG handling facilities. The process may also form part of an integrated energy recovery system as described in US 6,564,579.

[0020] The invention is further illustrated in the accompanying drawing, in which the figure illustrates a flow scheme which represents the process according to the invention.

[0021] A tank 1 contains LNG forming the feed to the process. Tank 1 is typically a cryogenic tank. An in-tank pump 2 pumps the LNG from tank 1 via a pump 3 which increases the pressure typically to around 9 to 13 barg. From the pump 3 the LNG is passed to a multi-channel heat exchanger 4, preferably of the plate-fin type. A line 5 carries the LNG to a separation vessel 6 having two outlet lines and a minimum of internal structure. Outlet line 7 carries a gas stream from the separation vessel 6 to a compressor 8 where the pressure is increased typically by from 2 to 5 bar, for example around 3 bar. A line 9 feeds the resulting compressed gas stream back to one channel 30 of the multi-channel heat exchanger 4. Outlet line 10 carries a liquid stream from the separation vessel to a distillation vessel 11 containing gas-liquid separation packing or trays to provide vapour-liquid contact, which separates the input stream into a liquid stream comprising natural gas liquids which are removed via line 12, and a gas stream which is removed via line 13 and fed back to the multi-channel heat exchanger 4 using a separate channel 31 from that used by line 9. The pressure drop across distillation vessel 11 is such that pressure of the gas stream removed via line 13 is in the range of from 2 to 6 barg.

[0022] The distillation vessel 11 is provided with a reboiler 20 comprising a heat exchanger 21 and a line 22 forming a closed loop back to the distillation vessel 11.

[0023] The stream exiting channel 30 is carried by line 14 typically at a pressure of from 12 to 16 barg to mixing point 15. The stream exiting channel 31 is carried to a pump 16 where its pressure is equalised to that of the stream exiting channel 30 before being carried to mixing point 15 where it is combined with the stream exiting channel 30. The combined streams are then passed to pump 17 and subsequently vaporised in heat exchanger 18 before being discharged into a pipeline.

[0024] The whole process is carried out at normal cryogenic temperatures, for example, the feed stream of LNG is typically at a temperature of around -170 to -150°C, the temperature at each point in the process depending upon the pressure.

[0025] The exact temperatures and pressures used will naturally depend upon the exact set-up details of the process. Various modifications of the flow scheme shown

in the figure are likewise possible. For example, pump 3 may be omitted if the LNG feed stream is at a sufficiently high initial pressure. An additional pump may be added to line 5 if it is desired to run the system at a higher pressure. Multi-channel heat exchanger 4 may be replaced by two separate heat exchangers, with a corresponding rearrangement of the LNG feed stream.

10 Claims

1. A process for the conditioning of liquefied natural gas, which comprises applying the following steps to a feed stream of liquefied natural gas:

- i. vaporizing at least a major portion of the feed stream of liquefied natural gas to produce an at least partially vaporized natural gas stream;
- ii. separating the at least partially vaporized natural gas stream to produce a first stream which is rich in methane and a second stream which is rich in hydrocarbons having two or more carbon atoms;
- iii. if required, compressing the first stream from step (ii) to increase the pressure and produce a compressed gas stream;
- iv. cooling the first stream from step (ii) or the compressed gas stream from step (iii) by heat exchange with at least part of the feed stream of liquefied natural gas to produce a liquid compressed gas stream;
- v. passing the second stream from step (ii) without pumping to a distillation vessel (11) to produce a natural gas liquids stream and a further stream rich in methane, the operating pressure of the distillation vessel (11) being such that the further stream rich in methane exits the distillation vessel (11) at a pressure in the range of from 2 to 6 barg;
- vi. cooling the further stream rich in methane from step (v) by heat exchange with at least part of the feed stream of liquefied natural gas and subsequently pumping to produce a liquid compressed gas stream;
- vii. optionally combining the liquid compressed gas streams from steps (iv) and (vi);
- viii. vaporizing the liquid compressed gas streams from steps (iv), (vi) and/or (vii) to
- ix. produce a conditioned natural gas; and
- x. recovering the natural gas liquids

characterised in that at least the major portion of the feed stream of liquefied natural gas is vaporized in step (i) by heat exchange of at least part of the feed stream of liquefied natural gas with the first stream from step (ii) or the compressed gas stream from step (iii) and with the further stream rich in methane from step (v).

2. A process as claimed in claim 1, in which in step (v) the further stream rich in methane exits the distillation vessel (11) at a pressure in the range of from 3 to 5 barg. 5
3. A process as claimed in either claim 1 or claim 2, in which the separation of step (ii) is carried out using a separator (6) with no reflux streams and containing no packing materials or gas-liquid separation trays. 10
4. A process as claimed in any one of claims 1 to 3, in which the distillation column (11) used in step (v) contains gas-liquid separation packing or trays and is operated without the presence of a reflux stream. 15
5. A process as claimed in any one of claims 1 to 4, in which in excess of 90% of the feed stream to the process is processed in step (i), none of said feed stream being used to act as a reflux in any column used in the process. 20
6. A process as claimed in any one of claims 1 to 5, in which the further stream rich in methane atom step (v) is cooled by heat exchange with at least part of the feed stream of liquefied natural gas and is subsequently pumped to equalise its pressure with that of the liquid compressed gas stream produced in step (iv), and the two streams are combined. 25
7. A process as claimed in claim 6, in which said combined stream is pumped to increase the pressure and subsequently vaporized. 30
8. A process as claimed in any one of claims 1 to 7, in which the distillation vessel (11) in step (ii) is provided with a reboiler (20) which uses seawater as coolant. 35
9. A process as claimed in any one of claims 1 to 8, in which the input pressure of the at least partially vaporized natural gas stream into step (ii) is in the range of from 9 to 13 barg. 40
10. A process as claimed in claim 9, in which the pressure of the compressed gas stream produced in step (iii) is increased by from 2 to 5 bar. 45
11. A process as claimed in claims 9 or 10, in which the liquid compressed gas stream from step (iv) is at a pressure of 12 to 16 barg. 50
12. A process according to any one of claims 1 to 11, in which the temperature of the feed stream of liquefied naturel gas is in the range of from -170 to -150°C.
13. A process as claimed in any one of claims 1 to 12, in which the heat exchanger(s) (4) used in steps (ii)/(iii) and (v) is/are a plate-fin exchanger(s). 55

Patentansprüche

1. Verfahren zur Konditionierung von verflüssigtem Erdgas, welches das Anwenden der folgenden Schritte auf einen Speisestrom von verflüssigtem Erdgas umfasst:
 - i. Verdampfen zumindest eines Hauptteils des Speisestroms von verflüssigtem Erdgas unter Erzeugung eines zumindest teilweise verdampften Erdgasstroms;
 - ii. Trennen des zumindest teilweise verdampften Erdgasstroms unter Erzeugung eines ersten Stroms, der reich an Methan ist, und eines zweiten Stroms, der reich an Kohlenwasserstoffen mit zwei oder mehr Kohlenstoffatomen ist;
 - iii. wenn erforderlich, Komprimieren des ersten Stroms aus Schritt (ii), um den Druck zu erhöhen und einen komprimierten Gasstrom zu erzeugen;
 - iv. Kühlen des ersten Stroms aus Schritt (ii) oder des komprimierten Gasstroms aus Schritt (iii) durch Wärmeaustausch mit zumindest einem Teil des Speisestroms von verflüssigtem Erdgas unter Erzeugung eines flüssigen komprimierten Gasstroms;
 - v. Leiten des zweiten Stroms aus Schritt (ii) ohne Pumpen zu einem Destillationsgefäß (11) unter Erzeugung eines Erdgasflüssigstroms und eines weiteren Stroms, der reich an Methan ist, wobei der Betriebsdruck des Destillationsgefäßes (11) derart ist, dass der weitere Strom, der reich an Methan ist, das Destillationsgefäß (11) bei einem Druck in dem Bereich von 2 bis 6 barg verlässt;
 - vi. Kühlen des weiteren Stroms, der reich an Methan ist, aus Schritt (v) durch Wärmeaustausch mit zumindest einem Teil des Speisestroms von verflüssigtem Erdgas und anschließend Pumpen unter Erzeugung eines flüssigen komprimierten Gasstroms;
 - vii. gegebenenfalls Vereinigen der flüssigen komprimierten Gasströme aus den Schritten (iv) und (vi);
 - viii. Verdampfen der flüssigen komprimierten Gasströme aus den Schritten (iv), (vi) und/oder (vii) unter
 - ix. Erzeugung eines konditionierten Erdgases und
 - x. Gewinnen der Erdgasflüssigkeiten,

dadurch gekennzeichnet, dass zumindest der Hauptteil des Speisestroms von verflüssigtem Erdgas in Schritt (i) durch Wärmeaustausch zumindest eines Teils des Speisestroms von verflüssigtem Erdgas mit dem ersten Strom aus Schritt (ii) oder dem komprimierten Gasstrom aus Schritt (iii) und mit dem weiteren Strom, der reich an Methan ist, aus Schritt

(v) verdampft wird.

2. Verfahren nach Anspruch 1, wobei in Schritt (v) der weitere Strom, der reich an Methan ist, das Destillationsgefäß (11) bei einem Druck in dem Bereich von 3 bis 5 barg verlässt. 5
3. Verfahren nach entweder Anspruch 1 oder Anspruch 2, wobei die Trennung von Schritt (ii) durchgeführt wird, indem ein Separator (6) ohne Rücklaufströme verwendet wird und keine Packmaterialien oder Gas-Flüssigkeits-Trennböden enthalten sind. 10
4. Verfahren nach einem der Ansprüche 1 bis 3, wobei die in Schritt (v) verwendete Destillationssäule (11) Gas-Flüssigkeits-Packung oder -Böden enthält und ohne die Gegenwart eines Rücklaufstroms betrieben wird. 15
5. Verfahren nach einem der Ansprüche 1 bis 4, wobei mehr als 90 % des Speisestroms des Verfahrens in Schritt (i) verarbeitet werden, wobei nichts von dem Speisestrom als ein Rücklauf in einer in dem Verfahren verwendeten Säule verwendet wird. 20
6. Verfahren nach einem der Ansprüche 1 bis 5, wobei der weitere Strom, der reich an Methan ist, aus Schritt (v) durch Wärmeaustausch mit zumindest einem Teil des Speisestroms von verflüssigtem Erdgas abgekühlt und anschließend gepumpt wird, um seinen Druck mit dem des in Schritt (iv) erzeugten flüssigen komprimierten Gasstroms abzugleichen, und die beiden Ströme vereinigt werden. 25
7. Verfahren nach Anspruch 6, wobei der vereinigte Strom gepumpt wird, um den Druck zu erhöhen, und anschließend verdampft wird. 30
8. Verfahren nach einem der Ansprüche 1 bis 7, wobei das Destillationsgefäß (11) in Schritt (ii) mit einem Rückverdampfer (20) versehen ist, der Meerwasser als Kühlmittel verwendet. 35
9. Verfahren nach einem der Ansprüche 1 bis 8, wobei der Eingangsdruck des zumindest teilweise verdampften Erdgasstroms in Schritt (ii) im Bereich von 9 bis 13 barg liegt. 40
10. Verfahren nach Anspruch 9, wobei der Druck des in Schritt (iii) erzeugten komprimierten Gasstroms von 2 auf 5 bar erhöht wird. 45
11. Verfahren nach den Ansprüchen 9 oder 10, wobei der flüssige komprimierte Gasstrom aus Schritt (iv) einen Druck von 12 bis 16 barg hat. 50
12. Verfahren nach einem der Ansprüche 1 bis 11, wobei die Temperatur des Speisestroms von verflüssigtem

Erdgas im Bereich von -170 bis 150 °C liegt.

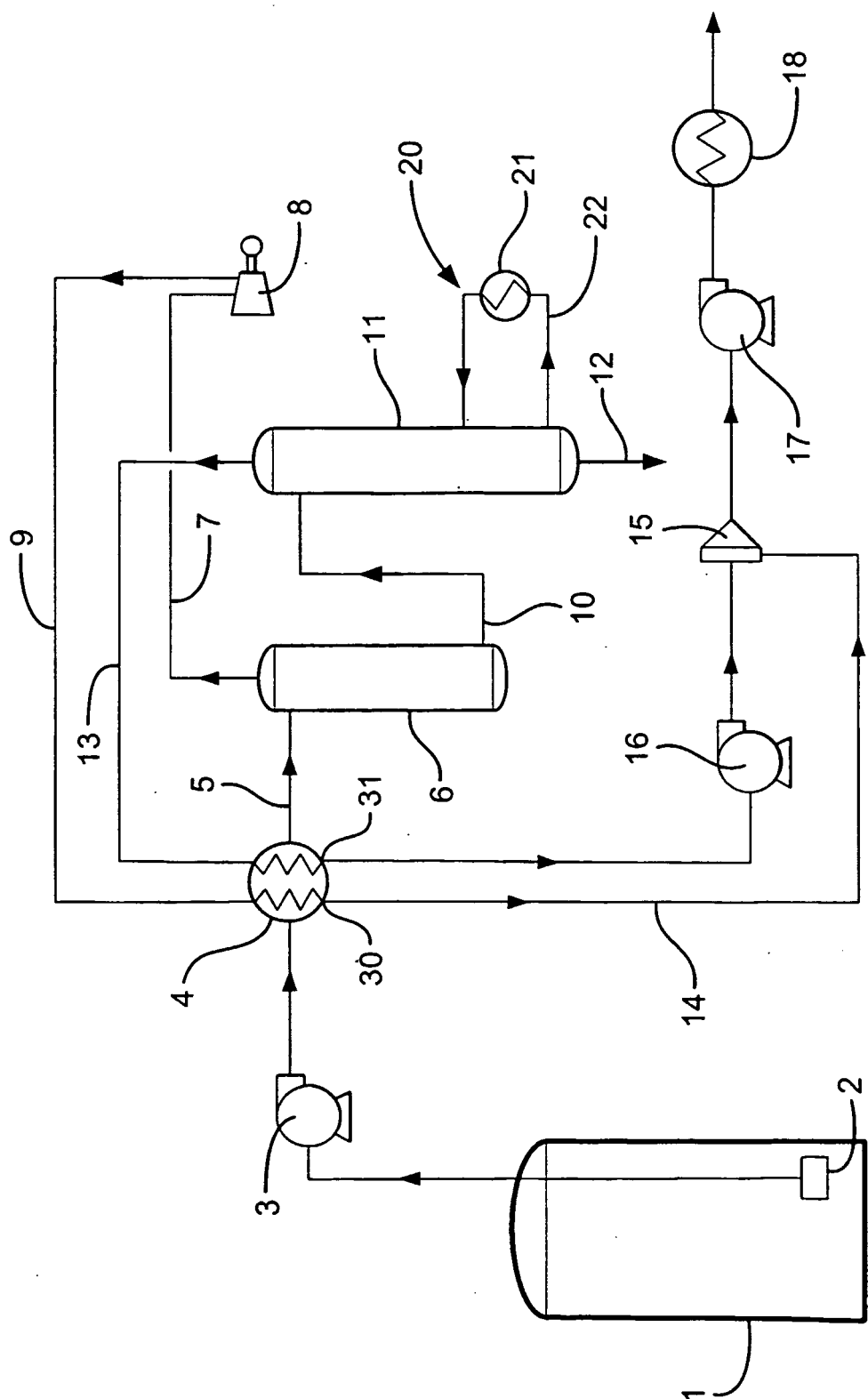
13. Verfahren nach einem der Ansprüche 1 bis 12, wobei der/die in den Schritten (ii)/(iii) und (v) verwendete (n) Wärmetauscher (4) (ein) Wirbelzellentauscher ist/sind.

Revendications

1. Procédé pour le conditionnement de gaz naturel liquéfié, qui comprend l'application des étapes suivantes à un courant de charge de gaz naturel liquéfié :

- i. vaporisation d'au moins une partie majeure du courant de charge de gaz naturel liquéfié pour produire un courant de gaz naturel au moins partiellement vaporisé ;
- ii. séparation du courant de gaz naturel au moins partiellement vaporisé pour produire un premier courant qui est riche en méthane et un deuxième courant qui est riche en hydrocarbures ayant deux ou plus de deux atomes de carbone ;
- iii. si nécessaire compression du premier courant obtenu dans l'étape (ii) pour augmenter la pression et produire un courant de gaz comprimé ;
- iv. refroidir le premier courant obtenu dans l'étape (ii) ou le courant de gaz comprimé obtenu dans l'étape (iii) par échange de chaleur avec au moins une partie du courant de charge de gaz naturel liquéfié pour produire un courant de gaz comprimé liquide ;
- v. passage du deuxième courant obtenu dans l'étape (ii) sans pompage vers un récipient de distillation (11) pour produire un courant liquide de gaz naturel et un autre courant riche en méthane, la pression opérationnelle du récipient de distillation (11) étant telle que l'autre courant riche en méthane sorte du récipient de distillation (11) sous une pression située dans la plage allant de 2 à 6 bar au manomètre ;
- vi. refroidissement de l'autre courant riche en méthane obtenu dans l'étape (v) par échange de chaleur avec au moins une partie du courant de charge du gaz naturel liquéfié et ensuite pompage pour produire un courant de gaz comprimé liquide ;
- vii. éventuellement combinaison des courants de gaz comprimé liquide obtenus dans les étapes (iv) et (vi) ;
- viii. vaporisation des courants de gaz comprimé liquide obtenus dans les étapes (iv), (vi) et/ou (vii) pour
- ix. produire un gaz naturel conditionné ; et
- x. récupération des liquides du gaz naturel,

- caractérisé en ce qu'**au moins la majeure partie du courant de charge de gaz naturel liquéfié est vaporisée dans l'étape (i) par échange de chaleur d'au moins une partie du courant de charge de gaz naturel liquéfié avec le premier courant obtenu dans l'étape (ii) ou le courant de gaz comprimé obtenu dans l'étape (iii) et avec l'autre courant riche en méthane obtenu dans l'étape (v).
2. Procédé selon la revendication 1, dans lequel, dans l'étape (v), l'autre courant riche en méthane sort du récipient de distillation (11) sous une pression située dans la plage allant de 3 à 5 bar au manomètre.
 3. Procédé selon l'une ou l'autre de la revendication 1 et de la revendication 2, dans lequel la séparation de l'étape (ii) est effectuée au moyen d'un séparateur (6) sans courant de reflux et ne contenant pas de matériaux de garnissage ou de plateaux de séparation gaz-liquide.
 4. Procédé selon l'une quelconque des revendications 1 à 3, dans lequel la colonne de distillation (11) utilisée dans l'étape (v) contient des plateaux ou un garnissage de séparation gaz-liquide et fonctionne en l'absence d'un courant de reflux.
 5. Procédé selon l'une quelconque des revendications 1 à 4, dans lequel plus de 90 % du courant de charge pour le procédé sont traités dans l'étape (i), aucune partie dudit courant de charge n'étant utilisée pour servir de reflux dans une quelconque colonne utilisée dans le procédé.
 6. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel l'autre courant riche en méthane obtenu dans l'étape (v) est refroidi par échange de chaleur avec au moins une partie du courant de charge de gaz naturel liquéfié et est ensuite pompé pour que sa pression soit égalisée avec celle du courant de gaz comprimé liquide produit dans l'étape (iv), et les deux courants sont combinés.
 7. Procédé selon la revendication 6, dans lequel ledit courant combiné est pompé pour que la pression soit augmentée et ensuite vaporisé.
 8. Procédé selon l'une quelconque des revendications 1 à 7, dans lequel le récipient de distillation (11) dans l'étape (ii) est doté d'un rebouilleur (20) qui utilise de l'eau de mer en tant que caloporteur.
 9. Procédé selon l'une quelconque des revendications 1 à 8, dans lequel la pression d'entrée du courant de gaz naturel au moins partiellement vaporisé dans l'étape (ii) est située dans la plage allant de 9 à 13 bar au manomètre.
 10. Procédé selon la revendication 9, dans lequel la pression du courant de gaz comprimé produit dans l'étape (iii) est augmentée de 2 à 5 bar.
 11. Procédé selon la revendication 9 ou 10, dans lequel le courant de gaz comprimé liquide obtenu dans l'étape (iv) est sous une pression de 12 à 16 bars au manomètre.
 12. Procédé selon l'une quelconque des revendications 1 à 11, dans lequel la température du courant de charge de gaz naturel liquéfié est située dans la plage allant de -170 à -150°C.
 13. Procédé selon l'une quelconque des revendications 1 à 12, dans lequel le ou les échangeurs de chaleur (4) utilisés dans les étapes (ii)/(iii) et (iv) sont des échangeurs à plaques-ailettes.



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- GB 1185053 A [0004]
- US 6604380 B [0005] [0013]
- US 20030158458 A1 [0006]
- US 6564579 B [0007] [0008] [0018] [0019]
- US 3837821 A [0009]