



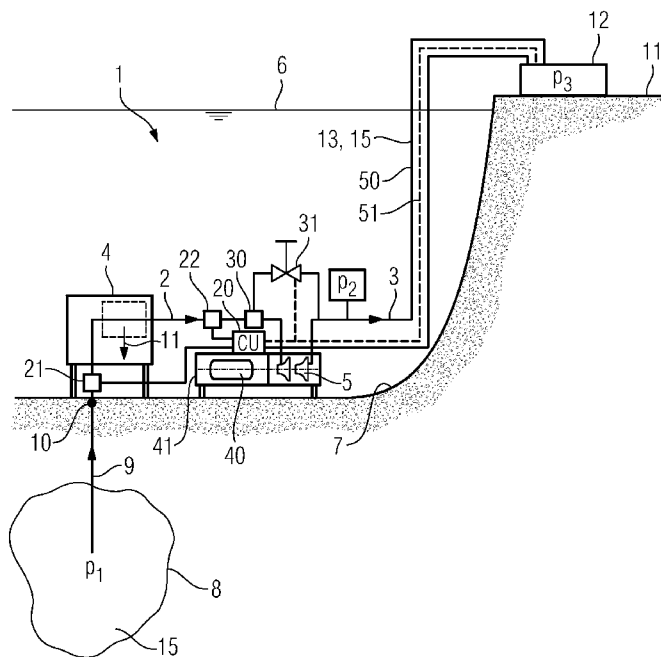
- (51) **International Patent Classification:**
F04D 29/70 (2006.01) F04D 27/02 (2006.01)
- (21) **International Application Number:**
PCT/EP2009/051919
- (22) **International Filing Date:**
18 February 2009 (18.02.2009)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
08003399.6 25 February 2008 (25.02.2008) EP
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- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) **Title:** COMPRESSOR UNIT



(57) **Abstract:** The invention relates to a Compressor unit (1) with a compressor (5), with a suction line (2) and with a discharge line (3), with a control unit (20), which controls the compressor (5) and/or adjacent modules. Further the invention relates to a method to operate a compressor unit (1) of the incipiently mentioned type. To avoid any damage caused by non-gaseous fluid amount the invention proposes that in the suction line (2) at least one detection device (21, 22) is provided to identify non-gaseous fluid amounts in the fluid to be compressed on their way to enter the compressor (5), which detection device (21, 22) is connected to the control unit (20) in a signal transmitting manner.

WO 2009/106465 A1

Description

Compressor unit

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The invention relates to a compressor unit with a compressor, with a suction line and with a discharge line, with a control unit, which controls the compressor's operation and/or the operation of adjacent modules. Further the invention relates
10 to a method to operate a compressor unit, which compressor unit is of the incipiently mentioned type.

Recent developments in particular in the field of natural gas exploitation are aiming to compress natural gas below sea-
15 level directly at the well-head. These developments are economically very interesting because offshore platforms involve extremely high costs for operating personal. Underwater compression of natural gas might in future make
20 mend offshore platforms superfluous.

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However, the new development goes along with enormous technical problems connected with difficult operating conditions and bad accessibility of the compression units. Major challenges are low temperatures near the freezing
25 point, high pressure of the surrounding chemically aggressive seawater, non-purified and chemically aggressive fluid to compress, wherein the natural gas varies in the suction-pressure and carries next to foreign particles also non-gaseous fluids respectively liquids in significant
30 amounts. Over the life-time of the well, the pressure of the natural gas to be exploited decreases significantly. According to environmental protection no media exchange between the compressor unit and the surrounding is admitted.

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The focus of the invention is laid on the problem of the occurrence of high amounts of non-gaseous fluid entering the compressor. It is already known to install between the well-head and the compressor unit a separator, to get rid of

non-gas fluid before entering the compressor. To avoid excessive pressure loss in the separation unit and to keep the installation effort in reasonable limits, the separator cannot be built to cope with every possible amount of non-gas
5 fluid, which might occur. On the other hand the compressor unit might be destroyed by only one incident, during which the separator was not able to cope with the amount of non-gaseous fluid.

10 It is therefore one object of the invention to make the compressor unit save against high amounts of non-gaseous fluids in the suction line on the way to enter the compressor and to avoid any damage.

15 The object is achieved by a compressor unit according to the incipiently mentioned type, wherein in the suction line at least one detection device is provide to identify non-gaseous amounts in the fluid to be compressed on the way to enter the compressor, which detection device is connected to the
20 control unit in a signal transmitting manner.

The installation of the detection device gives the control-unit the opportunity to react depending on the condition of the fluid in the suction line.

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The detection device can be any device, which is capable to identify non-gaseous amounts in the suction line. The detection can be done for instance by an optical sensor or also by an acoustic especially ultra sonic sensor. Preferably
30 the detection is specialized on the detection of liquids but cannot also be built to identify solid objects.

One advantageous possibility of the control unit to react upon the detection of non-gaseous amounts is to reduce the
35 speed of operation of the compressor, when an amount of non-gas detected exceeds a certain limit. This certain limit should be below an amount, which would be capable to destroy the compressor of the compressor unit.

Another possibility, which can be provided alternatively or in addition to the speed reduction feature is the provision of a dissolving unit, which dissolves non-gaseous, especially liquid amounts on their way entering the compressor. The dissolvation is preferably initiated by the control unit, when an amount of non-gas detected exceeds a certain limit. To avoid damage, the certain limit should be below any critical amount, which might be destructible for any module involved. The dissolving unit can in particular comprise a valve and a jet respectively nozzle installed in a dissolvation chamber, wherein the valve opens the way for compressed process fluid from a higher pressure level down to the suction pressure in the dissolvation chamber, which is located in the suction line. As soon as the detection device identifies amounts of non-gaseous fluid, which are to be dissolved, the control unit opens the valve and a jet stream in the dissolvation chamber dissolves the undesirable amount of non-gas into smaller amounts, which are not harmful to the modules downstream.

One embodiment of the invention provides an electric motor driving the compressor, which is enclosed together with a compressor in a gas-tight housing.

Another embodiment of the invention provides a separator in the suction line between the well-head and the compressor, wherein a detection device can be installed upstream or downstream the separator or on both sides.

The above mentioned attributes and other features and advantages of the invention and the manner of attaining them will become more apparent and the invention itself will be better understood by reference to the following description of the currently best mode of carrying out the invention taken in conjunction with an accompanying drawing, wherein

Figure 1: shows a schematic depiction of the compressor unit installed sub sea over a well-head of natural gas and comprising a suction line, a discharge line and a separator.

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Figure 1 shows a compressor unit 1 comprising a suction line 2, a discharge line 3, a separator 4 and a compressor 5 located between the suction line 2 and the discharge line 3. The compressor unit 1 installed under sea level 6 on the sea ground 7. Below the sea ground 7 is a well of natural gas 8 with a delivery line 9 leading to a well-head 10. Above sea level 6 on a ground 11 a facility 12 is installed, which is further processing the fluid 13, which is natural gas 15, delivered by the compressor 5.

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The natural gas 15 is stored in the well 8 at a pressure p_1 , compressed by the compressor 5 up to a pressure p_2 and reaches the facility 12 at a pressure p_3 . Between well-head 10 and the compressor 5 the separator 4 is installed to purify the natural gas 15 from foreign particles and undesirable liquids. However, it cannot be excluded that the amount of liquids respectively of non-gas amounts 17 might exceed the capacity of the separator 4 and that critical amounts are leaving the separator 4 on their way to the compressor 5, which might be destructible.

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The compressor 5 is equipped with a control unit 20, which is connected with detection devices 21, 22, provided in the suction line 2. The detection devices 21, 22 detect amounts of non-gas on their way entering the compressor 5. One detection device 21 is installed directly at the well-head 10 and the other detection device 22 is installed between the separator 4 and the compressor 5. It is also possible to use only one detection device 21, 22 in either one of the positions. However, the use of two detection devices 21, 22 gives more possibilities to react if amounts of non-gas or liquids occur. In this particular example the control unit 20 lowers the speed of the compressor 5 as soon as the first

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detection device 21 detects an amount of non-gas exceeding a certain limit.

5 Between the separator 4 and the compressor 5 behind the second detection device 22 a dissolution chamber 30 is provided, which is built to dissolve amounts of liquids on their way entering the compressor. The dissolution is done by a jet respectively nozzle emitting a stream of natural gas from the higher pressure level p2 tapped of the discharge
10 line 3. In the line connecting the extraction from the discharge line 3, a valve 31 is provided, which is controlled by the control unit 20. If the second detection device 22 detects a critical amount of non-gas respectively of liquid the control unit 20 initiates the opening of the valve 31 and
15 the stream exiting the nozzle from the higher pressure level p2 in the dissolution chamber dissolves the critical amount into harmless small amounts of non-gas entering the compressor 5.

20 The compressor 5 is driven by an electric motor 40, which is enclosed with the compressor 5 in a gas-tight housing 41, wherein the motor-rotor and the compressor rotor are connected to one shaft supported by not depicted magnetic bearings. A power supply line 50 and a signal line 51 connect
25 the onshore facility 12 with the control unit 21 respectively the compression unit 1.

Patent claims

1. Compressor unit (1) with the compressor (5), which a suction line (2) and with a discharge line (3), with a control unit (21), which controls the compressor (5) and/or adjacent modules, characterized in that in the suction line 2 at least one detection device (21, 22) is provided to identify non-gaseous fluid amounts in the fluid to be compressed on their way to enter the compressor (5), which detection device (21, 22) is connected to the control unit (20) in a signal transmitting manner.
2. Compressor unit (1) according to claim 1, characterized in that the control unit (20) controls the compressor's (5) operation speed and is build in such a way that the speed of operation is reduced, when an amount of non-gas detected exceeds a certain limit.
3. Compressor unit (1) according to one of the preceding claims 1, 2, characterized in that the compressor unit (1) comprises a dissolving unit (30), which dissolves non-gas amounts on their way entering the compressor (5) and wherein the dissolvation is initiated, when an amount of non-gaseous fluid detected exceeds a certain limit.
4. Compressor unit (1) according to one of the preceding claims 1 - 3, characterized in, that the compressor unit (1) comprises an electric motor (40), which is enclosed together with the compressor (5) in a gas-tight housing (41).

5. Compressor unit (1), according to one of the preceding claims 1 - 4,

characterized in, that

the compressor unit (1) comprises a separator (4) in the suction line (2), which is separating non-gaseous fluid amounts from the fluid before the fluid enters the compressor (5).

6. Compressor unit (1) according to one of the preceding claims 1 - 5,

characterized in, that

a detection device (21, 22) is provided upstream and/or downstream the separator (4).

7. Method to operate a compressor unit (1), which compressor unit comprises a compressor (5), a suction line (2), a discharge line (3) and a control unit (20), which controls the compressor's operation (5) and/or the operation of adjacent modules, characterized in that at least one

detection device (21, 22) is provided to detect non-gaseous fluid amounts in the fluid to be compressed and that the detection device is connect in a signal transmitting manner to the control unit (20) and that the control unit (20) changes the operation of the compressor or of adjacent

modules as a reaction to the detection of non-gaseous fluid amounts in the fluid.

8. Method according to claim 7,

characterized in, that

the control unit (20) lowers the speed of operation of the compressor (5), when an amount of non-gaseous fluid in the suction line is detected, which exceeds a certain limit.

9. Method according to claim 7 or 8,
characterized in, that
a dissolution unit (30) is provided and that the control
unit (20) initiates a dissolution of amounts of non-gas on
5 their way entering the compressor, when the detection
device (21, 22) detected an amount of non-gas exceeding a
certain limit.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/051919

A. CLASSIFICATION OF SUBJECT MATTER
INV. F04D29/70 F04D27/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04D D04D B01D E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

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X	WO 01/50024 A (SHELL INT RESEARCH [NL]; SHELL CANADA LTD [CA]; POORTE RAIMO EDWIN GRE) 12 July 2001 (2001-07-12) page 5, line 13 - line 23; figure 1 page 6, line 4 - line 10 page 6, line 29 - line 32	1, 2, 4-8
A	US 5 393 202 A (LEVALLOIS EMILE [FR]) 28 February 1995 (1995-02-28) column 3 - column 6; claim 1; figure 1	1, 7
A	US 3 568 771 A (VINCENT RENIC P ET AL) 9 March 1971 (1971-03-09) claims 1-3; figure 1	1, 7
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Further documents are listed in the continuation of Box C.

See patent family annex.

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Date of the actual completion of the international search

31 March 2009

Date of mailing of the international search report

09/04/2009

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/051919

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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