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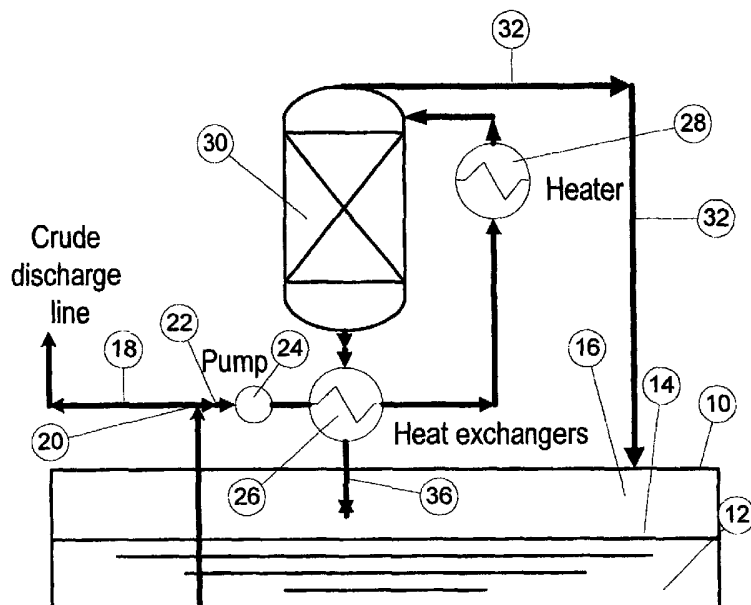
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(54) Title: METHOD AND APPARATUS FOR HANDLING OF COVERING GAS



(57) Abstract: A method for the handling of covering gas or inert gas in connection with a tank that conveys crude oil, during successive discharging and loading operations of the tank, is disclosed. The method is characterised by the fact that covering gas/inert gas is re-circulated in an approximate closed circulation by the following steps: that during discharging of the tank, covering gas is produced in a recognised manner known per se from the cargo to fill the gradually increasing void space in the tank, and that when the tank is filled again with crude oil, the gas from the tank is extracted again, and it is compressed and absorbed into the stabilized crude oil. An apparatus is mentioned for accomplishing the method.



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- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

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10 METHOD AND APPARATUS FOR HANDLING OF COVERING GAS

The invention presented here concerns a method and an apparatus for handling covering gas as stated in the introduction to the following patent claims 1 and 9.

15 The loading and carriage of, for example, crude oil by vessel, leads to large emissions of cargo components such as hydrocarbon gas (HC) from oil cargoes, also termed VOC.

Today some vessels are equipped with an inert gas generator that burns oil/diesel. The exhaust that is cleaned with seawater will mainly consist of nitrogen,
20 carbon dioxide and a small residue of oxygen.

Since there may be residues of flammable gases from the cargo in the tanks, the ingress of air could create an explosive mixtures which makes a safety hazard. As the cargo is delivered, the empty volume must be replenished with inert gas, to prevent oxygenated air from entering the tanks.

25 One problem with current methods is that the inert gas used for making the tank atmosphere safe leads to a higher level of vaporization of the cargo than necessary, plus the fact that inert gas is corrosive.

To procure another type of inert gas at various terminals will create a logistics problem since many sites will not have access to such gas. Further, there
30 will be a need for converting vessels and terminals with connections and hoses for supplying a protective atmosphere to the tanks.

With regard to dealing with covering gas that is displaced during loading of liquids, many methods have been suggested for collecting these gases when loading, so that emissions to the air are reduced. One standard method is to use a compressor for compressing gas that is displaced from cargo tanks and to absorb
5 the gas in the cargo.

The invention aims to present a new method of providing covering gas that eliminates all the disadvantages of plant in current use. The aim is thus to avoid emission from the cargo, avoid corrosion, avoid tie-up to platforms, terminals and similar, as well as to reduce energy consumption of compressor work by recovery
10 of the gas, etc.

A second aim of the invention is to present a method whereby, in a simple manner, one can continually control that only the amount of covering gas necessary at any given time is produced.

Further, the invention aims to produce a system in which covering gas can
15 be re-circulated on demand.

The method according to the invention is characterised by features appearing in the characterizing clause of the following Claim 1.

Additional features with the invention arrangement are described in the dependent method claim.

20 The invention, accordingly, may be expressed by the fact that the covering gas or inert gas that is used is extracted from the actual cargo. This principle is recognised known per se from the transportation of liquefied natural gas (LNG) as described in US patents 3.197.971 and 5.165.246. In these patents one allows a small part of the gas to vaporise so as to obtain overpressure for transporting the
25 liquefied gas out of the tank.

This invention uses a particular property of crude oil, namely the ability to absorb and emit hydrocarbon gas. After being stabilised in the processing plant, the oil will contain a small amount of dissolved gas. This gas can be released and used for covering gas. The oil, in itself, will remain unchanged and will be
30 delivered for refining. When oil is filled again in the tanks, the stabilised oil will be able to absorb
the covering gas in the tanks. In contrast to the foregoing US patents, the produced gas will not create a forward pressure for emptying the tank, but only serve as a covering gas with enough volume to prevent the ingress of air.

According to another aspect of the invention, which is stated under the following claim 9, an apparatus is defined that implies that the covering gas can now be re-circulated in a virtually closed circuit with hardly any emissions to air, and as follows:

5

1. During discharge of the tank, covering gas is produced, as stated in the foregoing, (i.e. from the actual cargo/crude oil) in order to fill the gradually increasing void space in the tank.
2. When the tank is filled once more with cargo, the tank gas is vented
10 again, then compressed and absorbed in the cargo/crude oil.

The crude oil will act as a buffer tank where the gas will be taken out on demand and fed back when the gas volume diminishes in the cargo tanks.

The particular asset of the apparatus according to the invention is
15 characterised by the features presented in claims 10 and 11.

With this invention, an explosive atmosphere is avoided by preventing the ingress of oxygen into the tank space. Accordingly, a gas mixture that has been extracted from the cargo is utilised as a sort of covering gas and not as a propellant gas. As and when the cargo is delivered, the void space must be
20 replenished so that oxygenated air shall not enter into the tanks. Extracting the gas continually from the actual cargo now solves this matter.

One advantage of this new covering gas is also that the corrosion is reduced, since inert gas is not used with carbon dioxide and salt, which combine to form a highly corrosive atmosphere.

25 One example of the proposed method is based on combining such a covering gas producing plant with a facility for recovering covering gas by absorption.

When the vessel comes to the discharging terminal, a generator will recover covering gas from the cargo. This gas is used for replenishing the void space in
30 the tank. After the vessel has delivered its cargo, the empty tanks will be protected by overpressure of gas that has been extracted from the cargo.

When the vessel comes to the loading buoy or production ship, the cargo will be filled up in the empty tanks. All covering gas will go to the absorption plant

that will extract the gas and supply it to the new cargo. The covering gas is taken out again when discharging is done, thus forming a re-circulating system.

According to the invention, a gas generator can be designed in two ways. One can use either heat or vacuum to release the gas. A combination of methods is also possible. To increase vaporisation, one can let the crude oil occupy a wide surface by atomising it into droplets or by letting it circulate (run) over large areas. This can be produced by conveying some of the cargo into a combination tower that is used for absorption during recovery and degassing during discharging.

Another possibility is to use a nozzle system where the cargo is atomised by being sprayed into the tank under pressure. The cargo will emit gas to be used as covering gas as and when the tanks are discharged.

The following account gives a description of a gas generator that is based on heat. To reduce energy consumption with the method according to the invention, the hot cargo can be directed through a heat exchanger that preheats the cargo into the generator. By continually monitoring tank pressure and the amount discharged, one can control the amount directed through the gas generator, and consequently, one can regulate the production of gas that is conveyed back to the tank as covering gas.

The gas atmosphere, thus, will circulate by virtue of the fact that it is released at the terminal and combines with the cargo during the loading.

The example mentioned is detailed in the following description referring to the accompanying drawing, which shows a typical design of a gas generator for covering gas according to the invention.

The figure shows a tank (10) that is partly filled with a fluid (12), as the volume above the fluid level (14) comprises a covering gas (16). A line (18) is used to supply load and remove discharge the tank (10) of crude oil. From a branching point (20) on the line (18) runs a line (22) via a pump (24) further through a heat exchanger (26), and a heat exchanger (28) to the upper part of the column (30). From the top of the column (30) runs a line (32) back to the top of the tank (10).

30

USE OF THE APPARATUS ACCORDING TO THE INVENTION.

DISCHARGING OF THE TANK 10

The figure depicts a tank (10) that is about to be discharged through the line (18). By means of the pump (24) a small part of the cargo is extracted in the line (22,

and passes through the heat exchanger 26 and the heat exchanger 28 whereupon a part of the extracted cargo vaporizes. Additional vaporization is obtained by means of spraying it into the top of the column 30 to attain further vaporization. In gas form the covering gas is then conducted to the tank top and the remaining
5 cargo is cooled and returned.

Normally, only a part of the extracted fluid will vaporize, and the rest of the liquid cargo will run back to the cargo through the line 36.

LOADING OF THE TANK 10

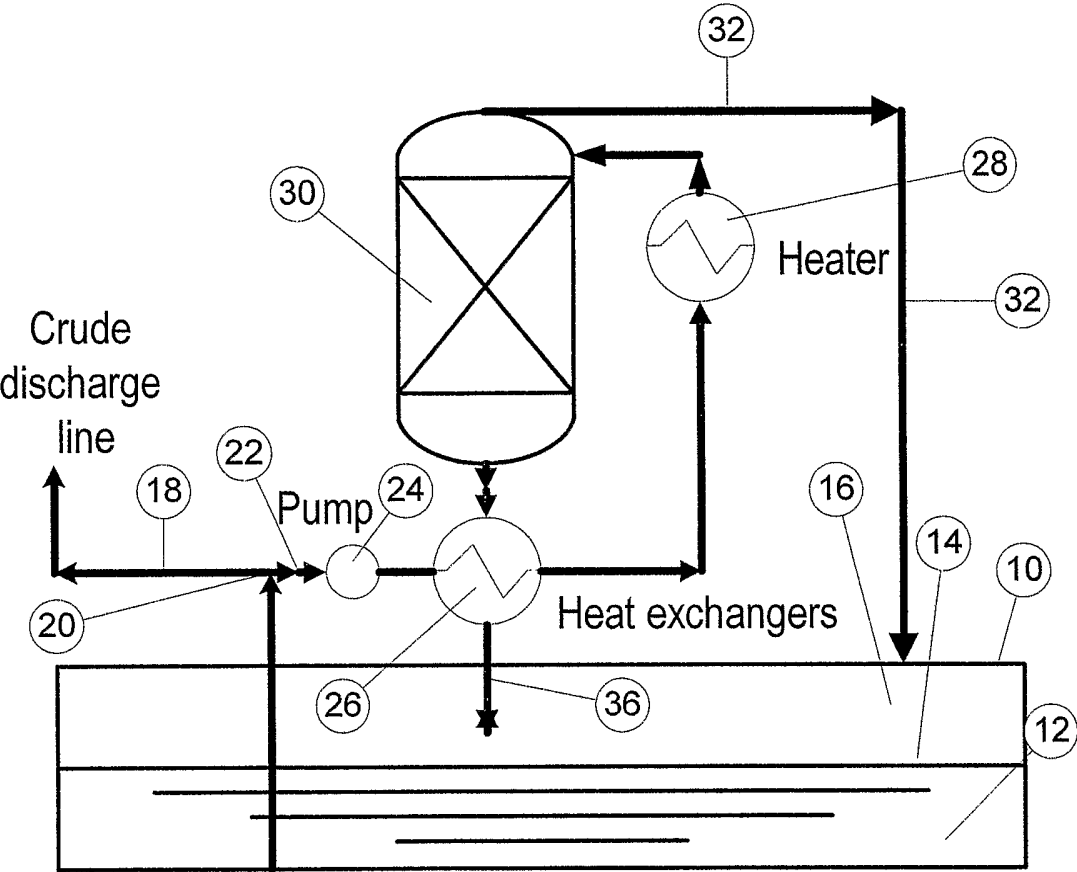
10 In this situation the tank 10 is filled with liquid. The filling of the cargo is done through the line 18. The gas is now recovered through a standard absorption plant where the absorption column could be the same as the degassing column during discharge.

During the filling of the tank, the column 30 is used to absorb covering gas
15 that is drawn off from the tank, since the covering gas is pressurized and absorbed in a cargo fluid that is led through the column 30.

P A T E N T C L A I M S .

1. Method for the handling of covering gas or inert gas in connection with a
5 tank that conveys crude oil, during successive discharging and loading operations
of the tank, characterised in that the covering gas/inert gas is re-circulated in
virtually closed circulation by the following steps:
that during discharging of the tank covering gas is produced in a recognised
manner known per se, from the cargo to fill the gradually increasing void space in
10 the tank, and
that when the tank is filled again with crude oil, the gas from the tank is
extracted again, and it is compressed and absorbed into the stabilized crude oil.
2. Method according to claim 1 characterised in that the covering gas is
15 produced from the cargo containing components that can be vaporized or
degassed.
3. Method according to claim 1-2, characterised in that the covering gas is
produced simultaneously with the tank being emptied of cargo, or when changes
20 in pressure occur in the tank, so that a slight overpressure in the tank is
maintained.
4. Method according to any of the foregoing claims, characterised in that a
part of the cargo is extracted and conducted through a plant, such as a gas
25 generator for producing gas, said gas being pressurized and fed back to the tank.
5. Method according to any of the foregoing claims, characterised in that
preheating the part boosts the vaporization of part of the cargo, subjecting it to
vacuum and/or atomisation.
30
6. Method according to claim 5, characterised in that preheating is
carried out by means of a part of the cargo being led through a heat exchanger
and/or over a heating element.

7. Method according to claim 5, characterised in that a vacuum is used in the gas generator.
8. Method according to claim 5, characterised in that a column is used for atomisation, where the unit of cargo is sprayed in at the top to form droplets.
9. Apparatus for the handling of covering gas or inert gas in connection with a tank conveying crude oil, during successive discharging and loading operations of the tank, characterised by
- 10 a circulation for re-circulating covering gas/inert gas, comprising:
means of vaporization/vaporization of a unit of cargo for the production of said covering gas, and means for filling a gradually increasing void space in the tank with covering gas, and
an means for venting gas from the tank, as well as a means of compressing
15 and absorption of the released tank gas.
10. Apparatus according to claim 9, characterised by a cargo tank (10), a loading and discharge line (18), a branch pipe (22) with pump (22) for the venting of a unit of cargo, means (24,28) for tempering the unit of cargo, a column (30) for
20 atomisation/vaporization of the cargo unit, in that a first stage line (32) connects the top of the column (30) to the cargo tank (10) and a second line (36) connects the base of the column (30) to the cargo tank (10).
11. Apparatus according to any one of claims 9-10, characterised in that
25 the column (30) in the circulation is used both for vaporization/vaporization of the cargo unit and for (later) absorbing pressurized covering gas, which is drawn off from the tank, in a cargo fluid that is directed through the column (30).



INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

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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)

IPC7: B65D, F17C

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

SE,DK,FI,NO classes as above

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

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3197972 A (R. Q. KING), 3 August 1965 (03.08.65), column 2, line 1 - line 31, cited in the application --	1-9
Y	PATENT ABSTRACTS OF JAPAN vol.005, no. 148 (C-072) 18 September 1981 (1981-09-18) & JP 56 081391 A (MITSUBISHI HEAVY IND LTD) 03 July 1981 (1981-07-03) abstract --	1-9
A	US 5165246 A (CIPOLLA ET AL), 24 November 1992 (24.11.92), column 6, line 41 - column 7, line 28, figure 3, cited in the application --	1-11

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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- "P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5678423 A (SIMON DAVIES ET AL), 21 October 1997 (21.10.97), abstract -- -----	1-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/10/02

International application No.

PCT/NO 02/00247

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