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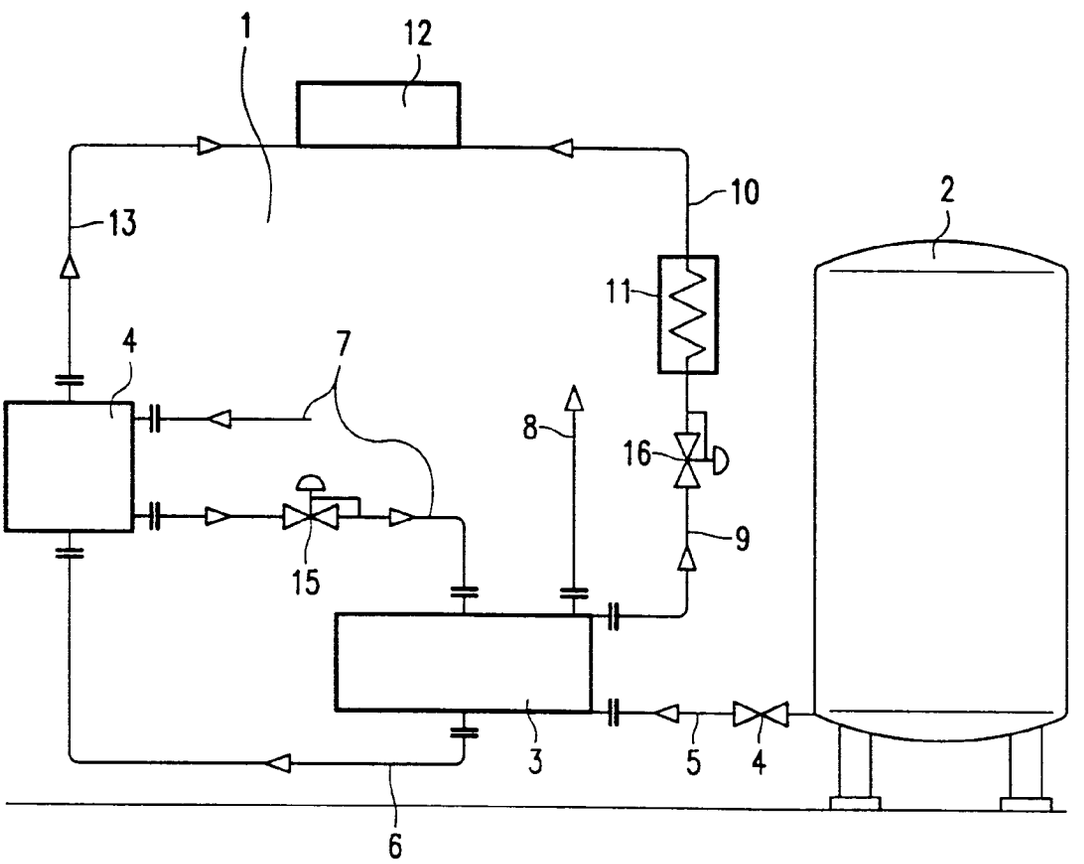
(54) A method and installation for the removal of nitrogen from natural gas

(57) The invention relates to a method for the removal of nitrogen from natural gas by means of cryo-condensation. According to the invention liquid oxygen is used as the cooling means.

Usually the natural gas has a nitrogen content of about 14% by volume.

The invention further relates to an installation for the removal of nitrogen from natural gas.



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Description

The present invention relates to a method and installation for the removal of nitrogen from natural gas.

Nitrogen is not wanted in natural gas because nitrogen does not contribute to a higher flame temperature, on the contrary, nitrogen is ballast; therefore nitrogen needs to be removed from natural gas.

Moreover, at high flame temperatures nitrogen is known to bind to oxygen, forming toxic NO_x compounds.

These reasons also make it clear that for the combustion process nitrogen is a most undesirable gas.

It is generally known that oxyfuel is a much applied process, in which during the combustion process pure oxygen is used instead of air with the aim to improve the efficiency of ovens. It goes without saying that here also the nitrogen present in the air (about 79% by volume) is merely ballast which, apart from the disadvantages just mentioned, leads to heat loss because nitrogen is blown into the atmosphere as warmed up gas.

The object of the invention is the removal of nitrogen from natural gas and the use of pure oxygen, resulting in increased efficiency.

To this end the nitrogen present in the natural gas has to be removed before the natural gas enters the combustion process.

To this end the present invention provides a method and installation.

The method for the removal of nitrogen from natural gas by means of cryocondensation according to the invention is characterized in that liquid oxygen is used as the cooling means.

According to the prior art cryocondensation of hydrocarbons is carried out using cold nitrogen as cooling means.

According to the present invention the disadvantages mentioned above are effectively removed.

It has been shown that the method according to the invention is particularly suitable for the removal of nitrogen from natural gas having a nitrogen content of about 14% by volume.

Basically the general idea of the invention is that the liquid oxygen is boiled off in a cryocondensation unit, causing the hydrocarbons to condense. After heating, the condensed hydrocarbons, together with the gaseous oxygen that has developed, can be used in the combustion process.

According to a favourable embodiment of the present invention, the liquid oxygen is fed to a heat exchanger where the nitrogen-rich natural gas is condensed and the residual gaseous nitrogen is discharged while after being warmed up, the nitrogen-free condensed hydrocarbons as well as the gaseous oxygen, are led to a burner.

The natural gas to be treated is preferably precooled in a heat exchanger to about -80°C before cooling with liquid oxygen to about -165°C.

In comparison to the prior art, the method according to the invention provides the following advantages:

1) The toxic NO_x compounds are reduced to a minimum.
2) A highly calorific natural gas is obtained from a natural gas of low calorific value such as, for instance, natural gas from the North Sea.
3) A natural gas is obtained having a greater combustion efficiency, which natural gas is particularly suitable for use in melting furnaces in the glass industry, ceramic industry, steel industry and non-ferro industry.

Further, the present invention relates to an installation for the removal of nitrogen from natural gas, characterized in that the installation (1) is provided with a storage tank (2) for liquid oxygen, which tank (2) is connected by means of a pipe (5) with the heat exchanger (3) for the condensation of the natural gas which, via pipe (7) and heat exchanger (3) is linked to the heat exchanger (4), from which the nitrogen-free condensed natural gas via a pipe (6), after being heated in the heat exchanger (4), arrives via pipe (13) in the burner (12), while liquid oxygen from heat exchanger (3) enters via pipe (9) the heat exchanger (11) to be fed in the gaseous phase via pipe (10) to burner (12) and gaseous nitrogen is removed from the heat exchanger (3) via pipe (8).

The invention will now be further elucidated with reference to the drawing which illustrates a preferred embodiment of the installation in accordance with the invention.

In the drawing the installation according to the invention is indicated by reference number (1). The installation (1) according to the invention is provided with a storage tank (2) for liquid oxygen.

The installation is further provided with heat exchangers (3,4, and 11).

Natural gas, for instance from Groningen, having a nitrogen content of 14% by volume is fed via the mains to the heat exchanger (4) in which the natural gas is cooled to -80°C. Via valve (15) the thus cooled natural gas is led to the heat exchanger (3) in order to be further cooled with the aid of liquid oxygen to -160°C to -165°C, which liquid oxygen is led from the storage tank (2) into the heat exchanger via pipe (5) and tap (14). Via pipe (6) the hydrocarbons condensed in the heat exchanger (3) are fed into the heat exchanger (4), where the liquid hydrocarbons become gaseous and in that form are transported via pipe (13) to, for instance, the burner (12) of a melting furnace.

Further, oxygen coming from the heat exchanger (3) in liquid form is led via pipe (9) and tap (16) to the burner (12) in the heat exchanger (11). In the heat exchanger (11) cold gaseous oxygen is further heated to ambient temperature. Via pipe (10) the gaseous oxygen is united with the hydrocarbons in burner (12) of the melting furnace.

It goes without saying that other embodiments of

the method and installation according to the invention are possible without departing from the underlying principle. Naturally any such variants are comprised in the present invention.

Claims

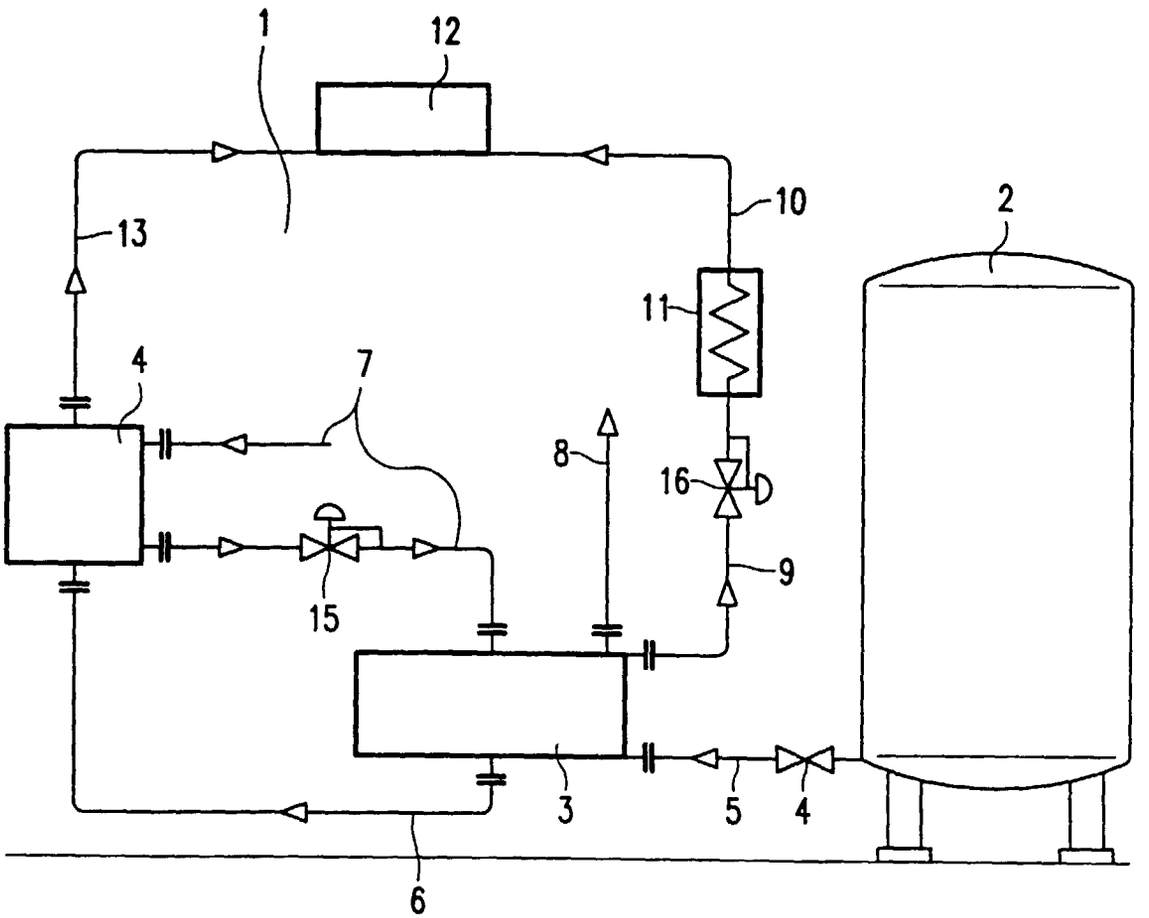
1. A method for the removal of nitrogen from natural gas by means of cryocondensation, **characterized** in that liquid oxygen is used as the cooling means.

2. A method in accordance with claim 1, **characterized** in that the natural gas has a nitrogen content of about 14% by volume.

3. A method in accordance with claim 1 or 2, **characterized** in that the liquid oxygen is fed to a heat exchanger where the nitrogen-rich natural gas is condensed and the residual gaseous nitrogen is discharged while after being warmed up, the nitrogen-free condensed hydrocarbons as well as the gaseous oxygen, are led to a burner.

4. A method in accordance with claims 1-3, **characterized** in that the natural gas is first precooled in a heat exchanger to about -80°C before cooling with liquid oxygen to about -165°C.

5. An installation for the removal of nitrogen from natural gas, **characterized** in that the installation 1 is provided with a storage tank 2 for liquid oxygen, which tank 2 is connected by means of a pipe 5 with the heat exchanger 3 for the condensation of the natural gas which, via pipe 7 and heat exchanger 3 is linked to the heat exchanger 4, from which the nitrogen-free condensed natural gas via a pipe 6, after being heated in the heat exchanger 4, arrives via pipe 13 in the burner 12, while liquid oxygen from heat exchanger 3 enters via pipe 9 the heat exchanger 11 to be fed in the gaseous phase via pipe 10 to burner 12 and gaseous nitrogen is removed from the heat exchanger 3 via pipe 8.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EUROPEAN SEARCH REPORT

Application Number
EP 96 20 3555

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US 5 390 499 A (RHOADES GEORGE D ET AL) 21 February 1995 ---		F25J3/06
A	US 5 036 671 A (NELSON WARREN L ET AL) 6 August 1991 -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F25J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 March 1997	Meertens, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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