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(71) Applicant (for all designated States except US): ABB GAS TECHNOLOGY AS [NO/NO]; Sandslihaugen 1, Postboks 64 Sandsli, N-5861 Bergen (NO).

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(72) Inventor; and

(75) Inventor/Applicant (for US only): UTKILEN, Kristian [NO/NO]; Leitet 15, N-5018 Bergen (NO).

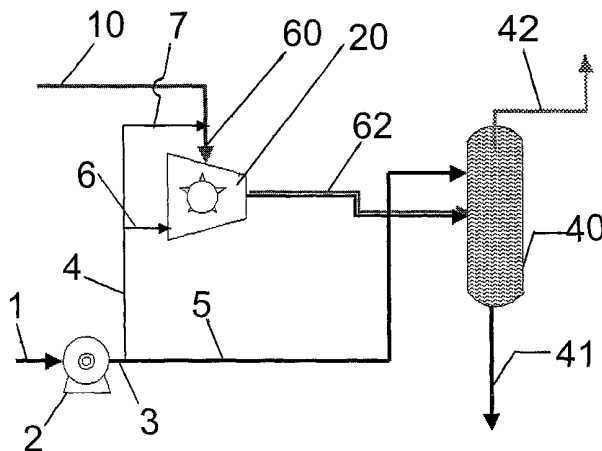
(74) Agent: A/S BERGEN PATENTKONTOR; C. Sundtsgt. 36, N-5004 Bergen (NO).

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(54) Title: METHOD AND DEVICE FOR PROCESSING GASES, AND USE THEREOF



(57) Abstract: A method and device is described for treatment of hydrocarbon gases which shall be absorbed in an absorption medium, in which the hydrocarbon gases are compressed to increase the efficiency of the absorption. The invention is characterised in that the compression is carried out by means of a liquid ring compressor, where the liquid, which forms the liquid ring, is the same material as the absorption medium, with the liquid ring preferably being liquidhydrocarbon. A device and application are also described.

WO 02/062452 A1

## METHOD AND DEVICE FOR PROCESSING GASES, AND USE THEREOF.

The present invention relates to a method for treatment of hydrocarbon gases which are to be absorbed, and where these gases are pressurised to increase the efficiency of the absorption.

Hydrocarbon gases are often called VOC gases, where VOC means volatile organic compounds. The source for such hydrocarbon gases is crude oil which contains a mixture of compounds, from the volatile hydrocarbons to the heavier volatile hydrocarbons (depending on the length of the carbon chain). In most of the processes in which crude oil is treated or stored, the highly volatile compounds will evaporate and form a gas phase. It is common to feed such evaporated hydrocarbons through a circuit in which the gases are compressed and are absorbed in a hydrocarbon liquid which is then returned to the crude oil.

The method according to the invention is in particular associated with processes of absorption in which the absorption, i.e. a condensation, takes place in an absorption column, but the invention shall not be limited to this.

The absorption medium is often the medium which the gas originally comes from, whereupon the gas is then regenerated/recycled.

Compressors are used for the above mentioned pressure increase in the gas which shall be absorbed, and a liquid ring compressor is normally used for this purpose.

A liquid ring compressor is a mechanical pump, which uses a liquid as a piston to compress the gas. Such liquid ring compressors come in several models, for example such as shown in the figures 1A and 1B.

5           The liquid ring compressor in figure 1B, comprises a closed housing or cover 10 with inlet 12 and outlet 14, and which limits a chamber 16, in which a movable part is fitted, a balanced rotor 18. The rotor comprises a number of vanes 20 evenly distributed around the rotor  
10 circumference, with a rotor chamber 19 being formed between each vane. The rotor 18 is the only movable part, and all the functions of a mechanical piston are provided by a liquid piston 22 which creates a ring form when the rotor rotates. The rotor, which is driven by a diesel motor,  
15 electro-motor or the like, transfers power to the liquid and keep this in motion. The liquid will follow the inner side of the rotor housing 10 and form a ring with approximately constant thickness. As a consequence of the rotor 18 being positioned off-centre in relation to the  
20 compressor housing, the liquid will fill and empty each rotor chamber one time for each rotation. Therefore, one achieves a piston effect and gas that is conducted into the housing through the inlet 26 is compressed and conducted out through the outlet 28 as gas with higher pressure.

25           A double-acting compressor is shown in figure 1B. The compressor housing 30 has an oval shape such that where the housing is smallest, diametrically opposite compressor chambers are formed. The two opposite compression chambers balance side-forces on the rotor.

30           When such a liquid ring compressor is used for gas absorption, water is normally used to supply the compressor housing and forms the liquid ring in the housing. However, there are several disadvantages with this. One of these concerns bringing another (foreign) medium or material into  
35 the system. Furthermore, much of the liquid in the liquid ring follows the pressurised gas to the absorption column itself, and the water must be separated in its own separator.

One part of the liquid is cooled and is re-circulated afresh through the liquid ring compressor. Another part will be conducted out of the system together with condensate, which is separated out in the separator.

5 From British patent GB 1,408,124, it is known to use di-ketene as the liquid in a liquid ring compressor for compression of ketene to avoid some of the problems. Ketene is an active material which has a tendency to polymerise or be converted to a resin-like material. By using di-ketene  
10 in the liquid ring itself, one avoids this problem, but one gets at the same time an unintended side effect. The gas is compressed and is led together with the di-ketene to a liquid separator. Some of the gas is absorbed in the di-ketene and is taken along to the re-circulation of the di-  
15 ketene. The absorbed ketene will over time be converted to di-ketene, and the process will therefore always produce an excess of di-ketene, which must be drained off from the process.

Thus, according to the British patent a liquid is used  
20 which implies that the gas undergoes a chemical change. A liquid separator is used to obtain this liquid from the compressed gas. The object of the patent is therefore to compress ketene without inherent tendencies to polymerise.

It is an object of the invention to provide a new  
25 method and device which in its entirety will overcome the above-mentioned disadvantages.

The method according to the invention is characterised in that the liquid ring used in the liquid ring compressor comprises the absorption medium.

30 The specially preferred embodiments of the method are described in the dependent claims 2-5.

The device is characterised in that the liquid ring comprises the absorption medium.

The specially preferred embodiments of the device are  
35 described in the dependent claims 7-9.

The applications according to the invention are evident from the dependent claims 9-11.

It is important that during compression the gas does not react chemically with the liquid ring material, i.e. that the gas only undergoes a compression and condensation in the liquid ring material.

5 The present invention distinguishes itself from the British patent in that the main object is to absorb hydrocarbon gas in a liquid consisting of (heavier) hydrocarbons. As this liquid is used as a liquid ring, the compression can be carried out without the use of a liquid  
10 separator.

It is desirable that the absorption starts in the compressor. Improved efficiency is achieved through associated pipes and installation of an absorption column. None of the components in the gas or liquid will change  
15 chemical composition according to the present invention. The present method for compression will be considerably simpler than corresponding methods with other liquids or compressor types. In other words, the main object is completely different to GB 1,408,124.

20 According to the invention, the device and method are applied in the processing of combustible VOC gases. Tanks that contain variable amounts of combustible liquids emit VOC gases, which are collected and are conducted into the system. The absorption medium can be the same liquid which  
25 the gas comes from, or a corresponding liquid.

The former case relates to occasions when the absorption liquid is conducted back to the same tank, which continuously emits the VOC gases. The latter case relates to occasions when the absorption liquid is not fed back to  
30 such a VOC emitting tank, but is handled separately in another installation.

By using the absorption medium itself as a liquid ring, one achieves a number of advantages. The liquid in the liquid ring compressor is a part of the absorption  
35 medium which is to be mixed with the gas from the absorption column. It is therefore not necessary to separate the liquid from the gas after compression. This leads to a considerable simplification in the process and

saving in equipment. One also achieves that the gas will start an absorption in the liquid already in the compressor and the pipe system leading to the absorption column. In addition, one avoids a foreign medium being introduced into the system. The object of this process is to absorb as much as possible of the gas in the absorption medium. A good infusion of the gas already in the liquid ring compressor is an advantage as a further infusion of the absorption medium will take place in the absorption column.

10 The separation of the gas and liquid after compression is unnecessary. Nor will a chemical reaction or conversion occur after the compression.

The invented method and device can be used in most absorption processes. The savings and advantages are many:

15

One can use a robust compressor type, i.e. a liquid ring compressor which is not sensitive to what is sucked in, i.e. that the compressor accepts gas, liquid and to some extent small solid particles.

20

It is unnecessary to install a separator to separate gas and liquid downstream from the compressor, something which is necessary with conventional screw and liquid ring compressors.

25

One does not need to think about getting the correct conditions at the compressor outlet to achieve separation. This means that one can chose absorption pressure without thinking of the necessary temperature.

30

One avoids compressor breakdowns as a consequence of the lubricating oil becoming deteriorated by water and/or condensate.

35

One avoids the continuous feeding of utilities such as the supply of water and lubricating oil.

One avoids cooling medium and cooler in the cases where the absorbent can carry away heat from the compressor.

5 A large part of the instrumentation and control of the cooling and separation circuit can be omitted.

Thus, there are several features which render the invented solution superior compared to existing technology.

10 In the previous absorption, where one uses a liquid ring compressor, one normally uses a medium which absorbs the gas to the least possible extent as the liquid ring, as one shall separate the gas from the liquid in the next part-step. With the present invention one makes the direct  
15 opposite. One uses an absorption medium as the liquid ring itself, and one achieves a desired absorption in the compressor. In a conventional liquid ring process a separator is installed to separate the liquid medium from the gas. In the present process, an absorption column is  
20 installed instead, to achieve good absorption.

In the following, a short sketch is given of how the method and device according to the invention can be adapted to an actual situation in which a liquid ring compressor and an absorption column are connected in a closed circuit  
25 which concerns processing of a combustible gas which is evaporated from a source, such as a storage tank or the like. It is pointed out that the example must be regarded as non-limiting, as the invention in its widest sense is as described in the subsequent patent claims.

30 Reference is made to figure 2 which, in a simplified way, outlines such a circuit. A liquid ring compressor 20 and an absorption column 40 of the types which are described earlier are inserted in the circuit.

35 Exhaust gases, such as combustible hydrocarbons (VOC gases), are conducted into the system by way of the pipe 10 and directly in through pipe 60 to the liquid ring compressor 20, which includes a liquid ring of the same

material as the absorption medium in the absorption column 40.

The absorption medium is conducted through pipe 1 and pump 2 to pipe 3, whereupon it is split into two streams, 4 and 5. Pipe 4 supplies the absorption medium to the liquid ring compressor. The stream is split in two where pipe 6 supplies liquid continuously to the liquid ring, and pipe 7 sprays absorption medium into the gas for cooling and start of the absorption process.

The pressured gas, which brings with it liquid from the liquid ring, is diverted from the liquid ring compressor 20 through pipe 62 and further into the absorption column 40, where the pressurised gas rises up through a layer of absorption medium supplied through pipe 5. The VOC depleted gas is led further out from the top of the column 40 through pipe 42 and to air 44. The absorption medium enriched with gas is led out through pipe 41.

Thus, an improved system for absorption of gases is provided with the present invention.



P A T E N T   C L A I M S

1. Method for treatment of hydrocarbon gases which shall be absorbed in an absorption medium, in which the hydrocarbon gases are compressed to increase the efficiency of the absorption, characterised in that the compression is carried out by means of a liquid ring compressor, in which the liquid which forms the liquid ring is the same material as the absorption medium.
2. Method according to claim 1, characterised in that the liquid ring is a liquid hydrocarbon.
3. Method according to claims 1-2, characterised in that a liquid ring material is applied whereby the gas does not undergo any chemical reaction during the compression.
4. Method according to claims 1-3, characterised in that the volume of liquid ring is supplied, preferably continuously, by new absorption liquid to replace the liquid ring material which is carried away by the compressed gas.
5. Method according to one of the preceding claims, characterised in that the absorption of the gas in the liquid starts already in the compressor and the pipe system leading to the absorption column.
6. Device for treatment of hydrocarbon gases which shall be absorbed in an absorption agent, characterised by a liquid ring compressor in which the gases are pressurised, where the liquid ring of the compressor comprises the same material as the absorption medium.
7. Device according to claim 6, characterised in that the liquid ring is a liquid hydrocarbon.

8. Device according to claims 6-7, characterised in that the liquid ring compressor is connected to an absorption column for absorption of the compressed hydrocarbon gas.

5 9. Application of device and method according to the claims 1-7, for processing of combustible VOC gases which are evaporated from tanks containing continuously varying amounts of combustible liquids, from where the VOC gases evaporate, which VOC gases are collected and are led into  
10 the system according to the invention through a pipe.

10. Application according to claim 9 where the gas has previously been a part of the absorption medium.

15 11. Application according to claim 9 where the gas has previously not been a part of the absorption medium.

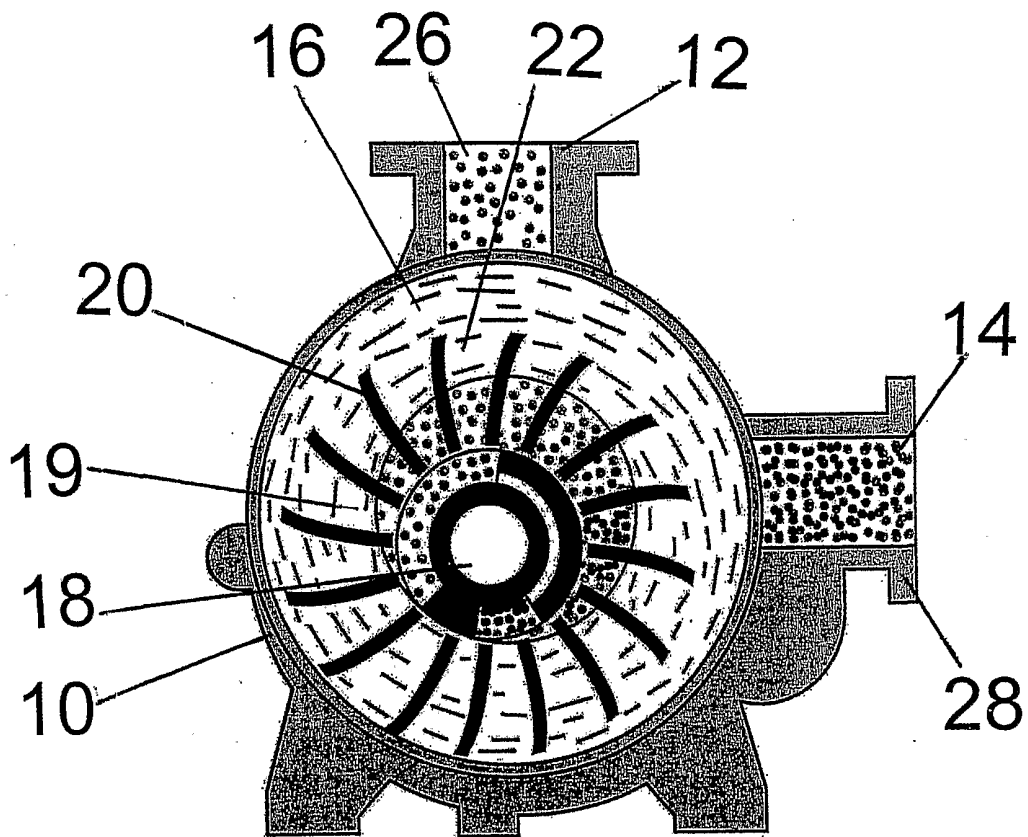


FIG 1A

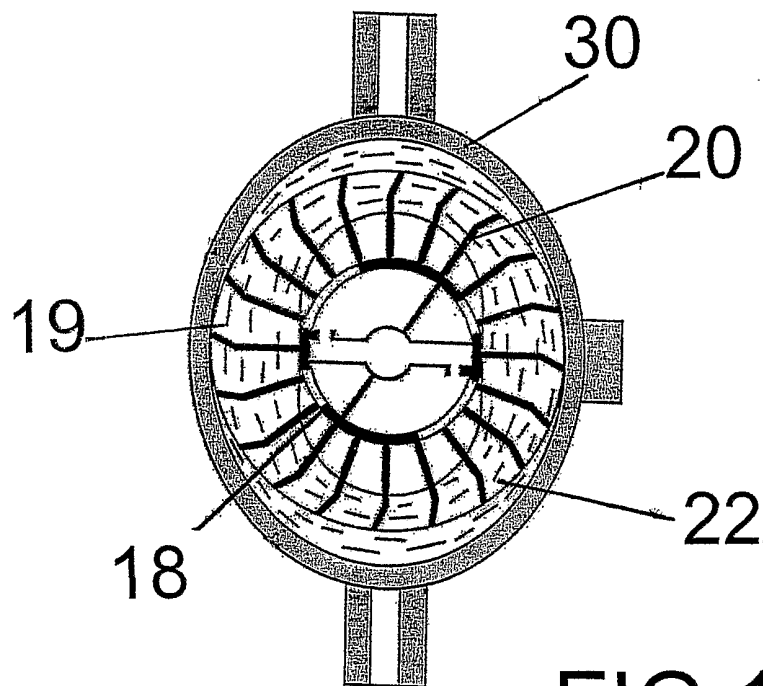


FIG 1B

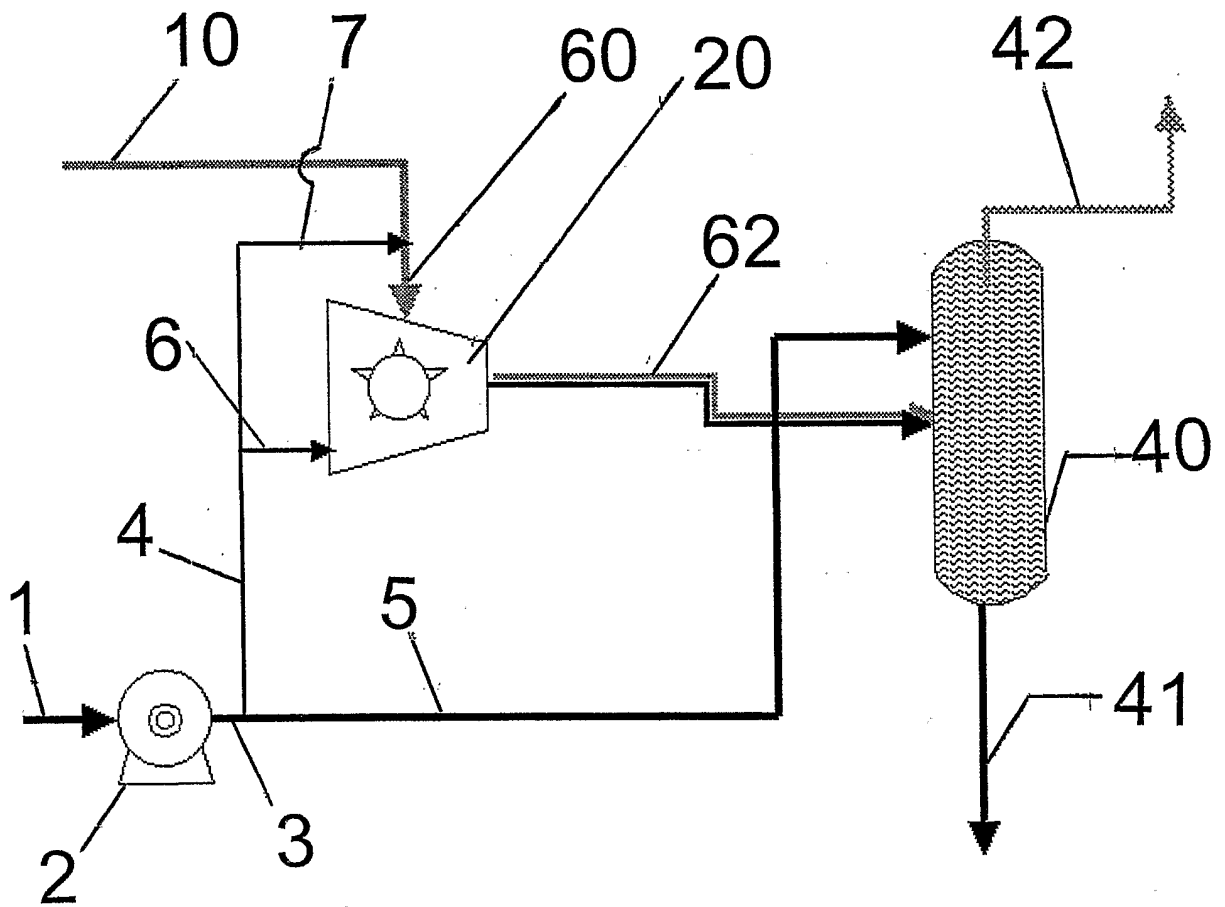


FIG 2

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 02/00027

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B01D 53/14, B01D 53/18, C10G 5/04

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: B01D, C10G

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)

WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5315832 A (RICHARD B. HOPEWELL), 31 May 1994 (31.05.94), column 3, line 13 - line 65, figures 1, 2, abstract --	1-11
A	US 5476986 A (ANKER J. JACOBSEN), 19 December 1995 (19.12.95), figure 1, claims 1,3, abstract --	1-11
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A	US 4001332 A (GÜNTER MAU ET AL), 4 January 1977 (04.01.77), column 4, line 35 - line 55, figure 1, claim 1 --	1-11

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

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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

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Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Authorized officer

Ulf Nyström/ELY  
Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/01/02

International application No.

PCT/NO 02/00027

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