(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) **Weltorganisation für geistiges Eigentum**
Internationales Büro

(43) **Internationales Veröffentlichungsdatum**
1. Juli 2010 (01.07.2010)

PCT

(10) **Internationale Veröffentlichungsnummer**
WO 2010/072305 A1

(51) **Internationale Patentklassifikation**:
B01D 53/047 (2006.01) ***F25J 3/02*** (2006.01)
C01B 31/20 (2006.01) ***F25J 3/06*** (2006.01)

(21) **Internationales Aktenzeichen**: PCT/EP2009/008447

(22) **Internationales Anmeldedatum**:
26. November 2009 (26.11.2009)

(25) **Einreichungssprache**: Deutsch

(26) **Veröffentlichungssprache**: Deutsch

(30) **Angaben zur Priorität**:
10 2008 062 497.7
16. Dezember 2008 (16.12.2008) DE

(71) **Anmelder** *(für alle Bestimmungsstaaten mit Ausnahme von US)*: **LINDA-KCA-DRESDEN GMBH** [DE/DE]; Bodenbacher Str. 80, 01277 Dresden (DE).

(72) **Erfinder; und**

(75) **Erfinder/Anmelder** *(nur für US)*: **LEITGEB, Paul** [DE/DE]; Wurzelseppstr. 23, 82049 Pullach (DE). **LEITMAYR, Werner Sebastian** [DE/DE]; Brunnenstr. 11a, 86633 Neuburg/Donau (DE). **STOFFREGEN, Torsten** [DE/DE]; Franz-Bänsch-Str. 9a, 01217 Dresden (DE). **RITTER, Roland** [DE/DE]; Louise-Seidler-Str. 18, 01217 Dresden (DE).

(74) **Anwalt**: **KASSECKERT, Rainer**; c/o Linde AG, Legal Services Intellectual Property, Dr.-Carl-von-Linde-Strasse 6-14, 82049 Pullach (DE).

(81) **Bestimmungsstaaten** *(soweit nicht anders angegeben, für jede verfügbare nationale Schutzrechtsart)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, 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, PE, 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) **Bestimmungsstaaten** *(soweit nicht anders angegeben, für jede verfügbare regionale Schutzrechtsart)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches (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,

[Fortsetzung auf der nächsten Seite]

(54) **Title**: METHOD AND DEVICE FOR TREATING A GAS FLOW COMPRISING CARBON DIOXIDE FROM A LARGE COMBUSTION PLANT

(54) **Bezeichnung** : VERFAHREN UND VORRICHTUNG ZUR BEHANDLUNG EINES KOHLENDIOXIDHALTIGEN GASSTROMS AUS EINER GROSSFEUERUNGSANLAGE

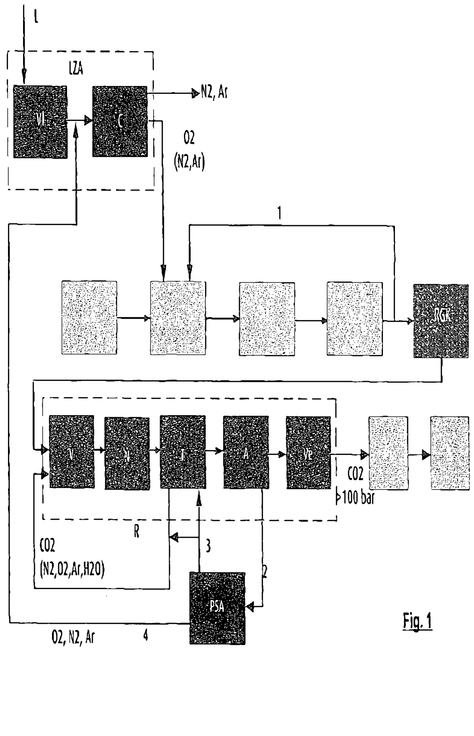

Fig. 1

(57) **Abstract**: The invention relates to a method and to a device for treating a gas flow comprising carbon dioxide from a large combustion plant, particularly a power plant. The gas flow is separated in a carbon dioxide scrubbing stage R into a partial gas flow having increased carbon dioxide content and a partial gas flow having reduced carbon dioxide content. The partial gas flow having increased carbon dioxide content is fed into a further processing and/or storage unit **S**. In particular, by compressing the carbon dioxide in the bedrock, the emission of climate-damaging gases can be reduced. In order to increase the proportion of compressible CO_2, the invention proposes that the partial gas flow having reduced carbon dioxide content is fed into a pressure swing adsorption stage PSA, wherein a fraction rich in carbon dioxide and a fraction having low carbon dioxide content are generated. The fraction rich in carbon dioxide is fed back into the carbon dioxide scrubbing stage R, or fed directly into the further processing and/or storage unit S.

(57) **Zusammenfassung**: Die Erfindung betrifft ein Verfahren und eine Vorrichtung zur Behandlung eines kohlendioxidhaltigen Gasstroms aus einer Großfeuerungsanlage, insbesondere eines Kraftwerks. Der Gasstrom wird in einer Kohlendioxidreinigungsstufe R in einen Teilgasstrom mit erhöhtem Kohlendioxidgehalt

[Fortsetzung auf der nächsten Seite]

WO 2010/072305 A1

SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Veröffentlicht:

— *mit internationalem Recherchenbericht (Artikel 21 Absatz 3)*

und einen Teilgasstrom mit vermindertem Kohlendioxidgehalt aufgetrennt. Der Teilgasstrom mit erhöhtem Kohlendioxidgehalt wird einer Weiterverwertung und/oder Speicherung S zugeführt. Insbesondere kann durch Verpressung des Kohlendioxids im Untergrund die Emission klimaschädlicher Gase vermindert werden. Zur Erhöhung des verpressbaren CO2- Anteils wird vorgeschlagen, dass der Teilgasstrom mit vermindertem Kohlendioxidgehalt einer Druckwechseladsorptionsstufe PSA zugeführt wird, in der eine kohlendioxidreiche und eine kohlendioxidarme Fraktion erzeugt werden. Die kohlendioxidreiche Fraktion wird zur Kohlendioxidreinigungsstufe R zurückgeführt oder direkt der Weiterverwertung und/oder Speicherung S zugeführt.

Description

Process and apparatus for the treatment of a carbon dioxide-containing gas stream from a large-scale combustion plant

The invention relates to a process for the treatment of a carbon dioxide-containing gas stream from a large-scale combustion plant, in particular of a power station, where the gas stream is separated in a carbon dioxide purification stage into a gas substream having an increased carbon dioxide content and a gas substream having a reduced carbon dioxide content and the gas substream having an increased carbon dioxide content is passed to further use and/or storage, and also an apparatus for carrying out the process.

Carbon dioxide-containing gas streams are obtained in all large-scale combustion plants which are operated using fossil fuels such as coal, petroleum or natural gas. These include power stations in particular, but also industrial furnaces, steam boilers and similar large-scale thermal plants for power and/or heat generation. Owing to the adverse effect of carbon dioxide gas on the climate, there is a search for solutions which enable emissions of carbon dioxide-containing offgases into the atmosphere to be reduced.

New power station concepts in which the fossil fuel, e.g. coal, is burnt using an oxygen-rich combustion gas, in particular technical-grade oxygen or oxygen-enriched air, (oxygen combustion gas process) have recently been proposed. The oxygen content of this combustion gas is, for example, from 95 to 99.9% by volume. The offgas formed which is also referred to as flue gas, contains mainly carbon dioxide (CO_2) in a proportion of about 70-85% by volume. The aim of these new concepts is to compress the carbon dioxide which is formed in the combustion of the fossil fuels and is present in a high concentration in the flue gas in suitable underground formations, in particular in certain rock strata or strata conducting salt water and thus to limit carbon dioxide emission into the atmosphere. The climate-damaging effect of greenhouse gases such as carbon dioxide are to be reduced as a result. Such power stations are referred to in technical speech as "oxyfuel" power stations.

In the concepts known hitherto, dust removal, removal of nitrogen oxides and desulphurization of the flue gas are carried out in successive steps. Subsequent to this flue gas purification, the carbon dioxide-rich offgas which has been treated in this way is compressed and fed to a carbon dioxide purification stage. A gas substream having a reduced carbon dioxide content and another gas substream having an increased carbon dioxide content are typically produced there by means of a cryogenic separation process. The gas substream having an increased carbon dioxide content represents the desired carbon dioxide product stream which is obtained with a carbon dioxide content of, for example, more than 95% by volume and is intended for further utilization, in particular for transport to storage reservoirs. The gas substream having a reduced carbon dioxide content is obtained as secondary stream (known as vent gas) at from 15 to 30 bar, preferably 18-25 bar, and contains predominantly the constituents not intended for compressed storage, in particular inert gases such as nitrogen (N_2) and argon (Ar) and also oxygen (O_2). However, proportions of carbon dioxide are also still present in this gas substream in a concentration of about 25-35% by volume. This vent gas is at present released into the atmosphere. This reduces the degree of possible utilization and compressed storage of the carbon dioxide. This degree of CO_2 utilization is also referred to as CO_2 recovery ratio. The recovery ratio r is defined as the ratio of purified CO_2 obtained to the CO_2 formed in the combustion process, multiplied by the factor 100:

$$r = \frac{CO_2 \text{ (recovered and purified)}}{CO_2 \text{ (formed)}} \times 100$$

The introduction of the oxyfuel technology has the objective of achieving very high CO_2 recovery ratios, i.e. to produce as much CO_2 as possible in the required quality for compressed storage and at the same time reduce the amount of environmentally damaging CO_2 (greenhouse gas) as emission into the atmosphere. Efforts at present assume that the CO_2 recovery ratio should be at least 90%.

This recovery ratio can be influenced by the CO_2 content of the flue gas, by the type of process and by the energy consumption.

Apart from CO_2 in a concentration of about 75-90% by volume (preferably from 75 to 85% by volume), the following further components are found in the raw gas: nitrogen, oxygen, argon and traces of carbon monoxide, sulphur oxide and nitrogen oxide. Since the CO_2 product should have a CO_2 content of > 95% by volume, the inert constituents have to be reduced. This leads to part of the CO_2 also being lost together with the inerts which are separated off in the cryogenic purification. This means that the desire for CO_2-free power stations has hitherto not been able to be fulfilled, but at best low-CO_2 power stations have been able to be realised.

In the paper presented at "Purification of Oxyfuel-Derived CO_2; IEAGHG International Oxy-Combustion

Network, Yokohama, Japan, 5/6 March 2008; Vince White (Air Products PLC, UK)", it was proposed that the oxygen be recovered from the vent gas by means of a membrane unit and recirculated to the oxyfuel power station and mixed into the combustion gas. The remaining gas with the remaining amounts of CO_2 is released into the atmosphere.

It is an object of the present invention to configure a process of the type mentioned at the outset and also an apparatus for carrying out the process so as to increase the CO_2 recovery ratio.

This object is achieved in terms of a process by the gas substream having a reduced carbon dioxide content being fed to a pressure swing adsorption stage in which a fraction which is rich in carbon dioxide and a fraction which is low in carbon dioxide are produced.

The fraction which is rich in carbon dioxide can be recirculated to the carbon dioxide purification stage or be passed directly to further use and/or storage.

The carbon dioxide purification stage which is used for producing a usable or storable, in particular compressible, CO_2 product and is configured, for example, as a cryogenic carbon dioxide liquefication plant is thus extended by a pressure swing adsorption stage (pressure swing adsorption plant or PSA). In the pressure swing adsorption stage, the vent gas which is normally released into the atmosphere is worked up to form a fraction which is rich in carbon dioxide and a fraction which is low in carbon dioxide (in particular containing about 500 ppmv of CO_2). The fraction which is rich in carbon dioxide has a CO_2 content of, in particular, more than 85% by volume and is recirculated to the carbon dioxide purification plant as additional feed gas. This makes it possible to achieve a significant increase in the recovery ratio compared to conventional processes which operate without a pressure swing adsorption stage. It is in this way possible to achieve CO_2 recovery ratios of as much as 99% in large-scale combustion plants which are operated as oxyfuel plants.

The carbon dioxide purification stage typically comprises compression of the gas stream so that a precompressed gas substream having a reduced carbon dioxide content (vent gas) is obtained under a pressure of preferably 15-30 bar, particularly preferably 18-25 bar, is obtained and can be fed to the pressure swing adsorption stage. This makes it possible to employ a pressure swing adsorption stage without further compression.

An air fractionation plant is usually used for providing the combustion gas having an increased oxygen content which is required for oxyfuel plants. In this case, the gas stream is formed by a carbon dioxide-containing offgas stream from a large-scale combustion plant in which fossil fuels are burnt using a combustion gas which is produced in an air fractionation plant and has an oxygen content higher than that of air. In a particularly preferred embodiment of the invention, the fraction which is low in carbon dioxide from the pressure swing adsorption stage is in this case recirculated to the air fractionation plant. In this way, the fraction which is low in carbon dioxide and consists essentially of nitrogen, oxygen and argon can be reused in the overall power station process. This fraction contains oxygen (in particular about 12-25% by volume) and is preferably already compressed so that this gas mixture can be integrated into the process of the air fractionation plant. In particular, this fraction can be introduced into a previously compressed feed gas stream to the air fractionation plant. This reduces the proportion of recirculated oxygen in the compression of air for the air fractionation plant and enables compression energy to be saved.

The carbon dioxide purification stage advantageously comprises a drying stage, in particular an adsorptive drying stage, for drying the gas stream. In this case, preference is given to at least part of the fraction which is rich in carbon dioxide and/or that which is low in carbon dioxide from the pressure swing adsorption stage being used as regeneration gas for the drying stage. Here, the required pressure can be provided by the pressure swing adsorption stage.

Any temperature fluctuations resulting from use of the gas fraction as regeneration gas (e.g. during heating and cooling of the adsorbers) can be evened out by recirculating part of the gas stream flowing out from the drying stage to a raw gas cooling stage (in particular flue gas condensation) preceding the carbon dioxide purification stage or feeding it back into the gas stream upstream of the gas stream compression and thus contributing to mixing of the CO_2 raw gas stream and making it uniform.

Particularly when the fraction which is low in carbon dioxide is used as regeneration gas for the drying stage before it is introduced into the air fractionation plant, any temperature fluctuations resulting from the use as regeneration gas are preferably evened out by feeding part of the gas stream flowing out from the drying stage into a direct cooling stage of the air fractionation plant.

The carbon dioxide purification stage advantageously encompasses a multistage gas stream compression. In this case, the fraction which is rich in carbon dioxide from the pressure swing adsorption stage is preferably fed into the gas stream upstream of the first stage of the gas stream compression. At an increased delivery pressure from the pressure swing adsorption stage, this fraction can also be fed at a pressure of more than 2 bar, in particular from 2 to 4 bar, into the gas stream downstream of the first stage of the gas stream compression. In the case of introduction downstream of the first compressor stage, the compression energy for CO_2 recirculation can be reduced.

The invention further provides an apparatus for the treatment of a carbon dioxide-containing gas stream from a large-scale combustion plant, in particular a power station, having a carbon dioxide purification facility supplied with the gas stream, a discharge line for a gas substream having an increased carbon dioxide content and a discharge line for a gas substream having a reduced carbon dioxide content, wherein the discharge line for the gas substream having an increased carbon dioxide content is connected to a utilization facility and/or a storage reservoir.

In terms of the apparatus, the stated object is achieved by the discharge line for the gas substream having a reduced carbon dioxide content being connected to a pressure swing adsorption plant which has a discharge line for a fraction which is rich in carbon dioxide and a discharge line for a fraction which is low in carbon dioxide, wherein the discharge line for the fraction which is rich in carbon dioxide is connected to the carbon dioxide purification facility.
In oxyfuel plants, the large-scale combustion plant is usually connected to an air fractionation plant for

producing a combustion gas having an oxygen content which is higher than that of air. In this case, it is proposed that the discharge line of the pressure swing adsorption plant for the fraction which is low in carbon dioxide be connected to the air fractionation plant.

In addition, the carbon dioxide purification facility preferably comprises a gas stream compression facility.

Furthermore, the discharge line of the pressure swing adsorption plant for the fraction which is low in carbon dioxide is advantageously connected to a discharge line of a compressor of the air fractionation plant.

The carbon dioxide purification facility typically comprises a drying facility, in particular a drying facility having an adsorber, for drying the gas stream. In this case, it is proposed that the drying facility be connected directly via a line to the pressure swing adsorption plant. The drying facility can also be connected directly via a line to a gas stream feed line of a compressor of the carbon dioxide purification facility located upstream of the drying facility. Another variant provides for the drying facility to be connected directly via a line to a raw gas cooling facility located upstream of the carbon dioxide purification facility.

According to a further development of the inventive concept, the carbon dioxide purification facility comprises a plurality of compressors or compressor stages and the discharge line of the pressure swing adsorption plant for the fraction which is rich in carbon dioxide is connected to a gas stream feed line to the first compressor or compressor stage or to a gas stream transfer line from the first compressor or from the first compressor stage to the second compressor or to the second compressor stage.

The invention provides the possibility of significantly increasing the CO_2 recovery ratio in large-scale combustion plants, in particular power stations, which operate, for example, according to the oxyfuel technology. As a result, a larger proportion of carbon dioxide can be compressed in rock strata or underground strata which conduct salt water, so that less carbon dioxide is emitted into the atmosphere. A significant contribution to reducing the greenhouse effect can be achieved in this way. At the same time, there is the possibility of likewise integrating a previously compressed gas stream having an oxygen content of about 12-25% by volume into the overall process in order to reduce the compressor energy in the air fractionation plant by an amount corresponding to the amount of oxygen in the gas stream.

The invention is suitable for all conceivable large-scale combustion plants in which carbon dioxide-containing gas streams are obtained. These include, for example, power stations operated using fossil fuels, industrial furnaces, steam boilers and similar large-scale thermal plants for power and/or heat generation. The invention can be used particularly advantageously in large-scale combustion plants which are supplied with technical-grade oxygen or oxygen-enriched air as combustion gas and in which off gas streams having high carbon dioxide concentrations are accordingly obtained. The invention is particularly suitable for low-CO_2 coal-fired power stations which are operated using oxygen as combustion gas ("oxyfuel" power stations) and in which the carbon dioxide present in high concentration in the offgas is separated off and compressed underground ("CO_2 capture technology").

The invention and further embodiments of the invention are illustrated below with the aid of the examples presented schematically in the figures.

In the figures:

Figure 1 shows a block flow diagram of integration of a pressure swing adsorption plant into an oxyfuel power station with dryer regeneration by means of the CO_2-rich fraction

Figure 2 shows a block flow diagram of integration of a pressure swing adsorption plant into an oxyfuel power station with dryer regeneration by means of the low-CO_2 fraction

Figure 3 shows a block flow diagram of integration of a pressure swing adsorption plant into an oxyfuel power station with direct supply of the CO_2-rich fraction to the storage

The present example relates to a coal-fired power station which is operated using a combustion gas having an oxygen content of about 95% by volume and in which an offgas stream enriched with carbon dioxide is treated for compression underground. In Figure 1, a combustion chamber K of the coal-fired power station is supplied with coal from a coal drying facility KT. In the combustion chamber K, the coal is burnt by means of a combustion gas which has an oxygen content of about 95% by volume and also contains proportions of nitrogen, oxygen and argon (about 5% by volume). The combustion gas is generated from the ambient air L in an air fractionation plant LZA which comprises an air compressor VI and a precooling stage, an adsorber station and a coldbox C. The offgas (flue gas) from the combustion chamber K is conveyed via a filter F and purified in a downstream flue gas desulphurization plant REA. Part of the gas stream which has been purified in this way is recirculated via a CO_2 return line 1 to the combustion chamber K. The remaining gas stream goes into a flue gas cooling stage RGK. The cooled gas stream is fed to a carbon dioxide purification stage R which comprises a precompression V, a DeNOx N and drying T and also a separation A and final compression Ve. In the separation A, a gas substream having an increased carbon dioxide content and a gas substream having a reduced carbon dioxide content are obtained. The gas substream having an increased carbon dioxide content is the desired CO_2 product stream which is finally fed at a pressure of above 100 bar into a pipeline P and transported to a storage S. As storage S, it is possible to use, for example, an underground stratum which conducts salt water or an underground rock stratum. The gas substream having a reduced carbon dioxide content (vent gas) which is obtained as secondary stream is fed at a pressure of about 15 bar via line 2 to the pressure swing adsorption plant PSA. In the pressure swing adsorption plant PSA, a fraction which is rich in carbon dioxide and a fraction which is low in carbon dioxide are produced. The fraction 3 which is rich in carbon dioxide is recirculated at a pressure of more than 2 bara to the carbon dioxide purification stage R, as a result of which the proportion of CO_2 in the CO_2 product stream to the pipeline P and thus the CO_2 recovery ratio are ultimately increased. The fraction 3 which is rich in carbon dioxide can firstly also be used as regeneration gas for the drying stage T, which comprises an adsorber station, present in the carbon dioxide purification stage R. For this purpose, a substream of the fraction 3 which is rich in carbon dioxide is fed directly to the adsorber station of the drying stage T. Another substream having a CO_2 content of about 90% by volume and containing proportions of N_2, O_2 and Ar is recirculated at atmospheric pressure to the precompression V. The fraction 4 which is low in carbon dioxide obtained in the pressure swing adsorption plant PSA, which has a CO_2 content of about 500 ppm and contains proportions of O_2, N_2 and Ar, is recirculated at a pressure of more than 6.5 bara to the air fractionation plant LZA and, after the air compression LV, fed into the feed gas stream to the air fractionation plant.

The variant depicted in Figure 2 differs from that shown in Figure 1 in that the fraction 4 which is low in carbon dioxide from the pressure swing adsorption plant PSA is used for regenerating the adsorbers of the drying stage T before being recirculated to the air fractionation plant LZA, while the CO_2-rich fraction 3 is recirculated directly to the precompression V.

Finally, Figure 3 shows a variant in which the fraction 3 which is rich in carbon dioxide from the pressure swing adsorption plant is, after a pressure increase stage D, fed directly to the final compressor Ve for supply to the storage S. The fraction 4 which is low in carbon dioxide is used for regenerating the adsorbers of the drying stage T. This variant is particularly suitable when a purity of the CO_2-rich fraction which corresponds to the requirements for the CO_2 product is achieved, e.g. by use of a vacuum pressure swing adsorption plant (VPSA). In this case, the CO_2-rich fraction can be brought directly by a pressure increase stage to the inlet-side pressure level of the final compression Ve, so that recirculation via the CO_2 purification steps V, N, T and

A can be omitted. In this way, the load on these purification steps can be decreased.

Claims

1. Process for the treatment of a carbon dioxide-containing gas stream from a large-scale combustion plant, in particular of a power station, where the gas stream is separated in a carbon dioxide purification stage into a gas substream having an increased carbon dioxide content and a gas substream having a reduced carbon dioxide content and the gas substream having an increased carbon dioxide content is passed to further use and/or storage, characterized in that the gas substream having a reduced carbon dioxide content is fed to a pressure swing adsorption stage (PSA) in which a fraction (3) which is rich in carbon dioxide and a fraction (4) which is low in carbon dioxide are produced.

2. Process according to Claim 1, characterized in that the fraction (3) which is rich in carbon dioxide is recirculated to the carbon dioxide purification stage (R).

3. Process according to Claim 1 or 2, characterized in that the fraction (3) which is rich in carbon dioxide is passed to further use and/or storage.

4. Process according to any of Claims 1 to 3, where the gas stream is formed by a carbon dioxide-containing offgas stream from a large-scale combustion plant in which fossil fuels are burnt by means of a combustion gas produced in an air fractionation plant (LZA) which has an oxygen content higher than that of air, characterized in that the fraction (4) which is low in carbon dioxide from the pressure swing adsorption plant (PSA) is recirculated to the air fractionation plant (LZA).

5. Process according to any of Claims 1 to 4, characterized in that the carbon dioxide purification stage (R) comprises a gas stream compression (V) so that a precompressed gas substream having a reduced carbon dioxide content is fed to the pressure swing adsorption stage (PSA).

6. Process according to any of Claims 1 to 5, characterized in that the fraction (4) which is low in carbon dioxide from the pressure swing adsorption stage (PSA) is introduced into a previously compressed feed gas stream to the air fractionation plant (LZA).

7. Process according to any of Claims 1 to 6, characterized in that the carbon dioxide purification stage (R) comprises a drying stage (T), in particular an adsorptive drying stage (T), for drying the gas stream and at least part of the fraction (3) which is rich in carbon dioxide and/or the fraction (4) which is low in carbon dioxide from the pressure swing adsorption stage (PSA) is used as regeneration gas for the drying stage (T).

8. Process according to Claim 7, characterized in that part of the gas stream flowing out from the drying stage is fed back into the gas stream upstream of the gas stream compression (V).

9. Process according to Claim 7, characterized in that part of the gas stream flowing out from the drying stage is recirculated to a raw gas cooling stage (RGK) upstream of the carbon dioxide purification stage (R).

10. Process according to Claim 7, characterized in that part of the gas stream flowing out from the drying stage is recirculated to a direct cooling stage of the air fractionation plant (LZA).

11. Process according to any of Claims 1 to 10, characterized in that the carbon dioxide purification stage (R) comprises a multistage gas stream compression (V) and the fraction (3) which is rich in carbon dioxide from the pressure swing adsorption stage (PSA) is fed into the gas stream upstream of the first stage of the gas stream compression (V).

12. Process according to any of Claims 1 to 10, characterized in that the carbon dioxide purification stage (R) comprises a multistage gas stream compression (V) and the fraction (3) which is rich in carbon dioxide from the pressure swing adsorption stage (PSA) is fed at a pressure of more than 2 bar into the gas stream downstream of the first stage of the gas stream compression (V).

13. Apparatus for the treatment of a carbon dioxide-containing gas stream from a large-scale combustion plant, in particular a power station, having a carbon dioxide purification facility supplied with the gas stream, a discharge line for a gas substream having an increased carbon dioxide content and a discharge line for a gas substream having a reduced carbon dioxide content, wherein the discharge line for the gas substream having an increased carbon dioxide content is connected to a utilization facility and/or a storage reservoir, characterized in that the discharge line (2) for the gas substream having a reduced carbon dioxide content is connected to a pressure swing adsorption plant (PSA) which has a discharge line (3) for a fraction which is rich in carbon dioxide and a discharge line for a fraction which is low in carbon dioxide.

14. Apparatus according to Claim 13, characterized in that the discharge line (3) for the fraction which is rich in carbon dioxide is connected to the carbon dioxide purification facility (R).

15. Apparatus according to Claim 13 or 14, characterized in that the discharge line (3) for the fraction which is rich in carbon dioxide is connected to the utilization facility and/or storage reservoir.

16. Apparatus according to any of Claims 13 to 15, where the large-scale combustion plant is connected to an air fractionation plant (LZA) for producing a combustion gas having an oxygen content which is higher than that of air, characterized in that the discharge line of the pressure swing adsorption plant (PSA) for the fraction which is low in carbon dioxide is connected to the air fractionation plant (LZA).

17. Apparatus according to any of Claims 13 to 16, characterized in that the carbon dioxide purification facility (R) comprises a gas stream compression facility (V).

18. Apparatus according to any of Claims 13 to 17, characterized in that the discharge line of the pressure swing adsorption plant (PSA) for the fraction which is low in carbon dioxide is connected to a discharge line of a compressor (LV) of the air fractionation plant (LZA).

19. Apparatus according to any of Claims 13 to 18, characterized in that the carbon dioxide purification facility (R) comprises a drying facility (T), in particular a drying facility (T) comprising adsorbers, for drying the gas stream and the drying facility (T)

is connected directly via a line to the pressure swing adsorption plant (PSA).

20. Apparatus according to Claim 19, characterized in that the drying facility (T) is connected directly via a line to a gas stream feed line of a compressor (V) of the carbon dioxide purification facility (R) upstream of the drying facility (T).

21. Apparatus according to Claim 19, characterized in that the drying facility (T) is connected directly via a line to a raw gas cooling facility (RGK) upstream of the carbon dioxide purification facility (R).

22. Apparatus according to any of Claims 13 to 21, characterized in that the carbon dioxide purification facility (R) comprises a plurality of compressors (V) and the discharge line (3) of the pressure swing adsorption plant (PSA) for the fraction which is rich in carbon dioxide is connected to a gas stream feed line to the first compressor or to a gas stream transfer line from the first compressor to the second compressor.

P08C138 = IC0160
15.12.2008 - Thomas Lehner

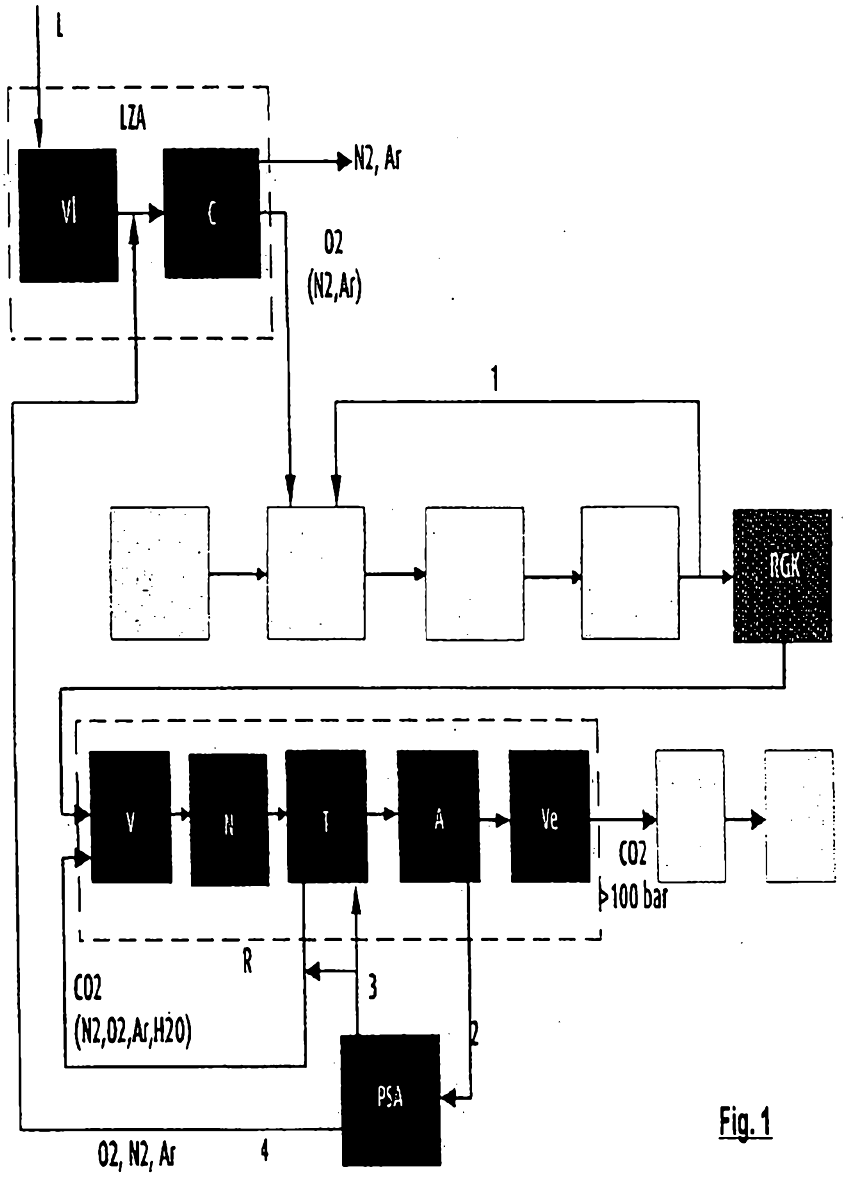

Fig. 1

P08C138 = IC0160
15.12.2008 - Thomas Lehner

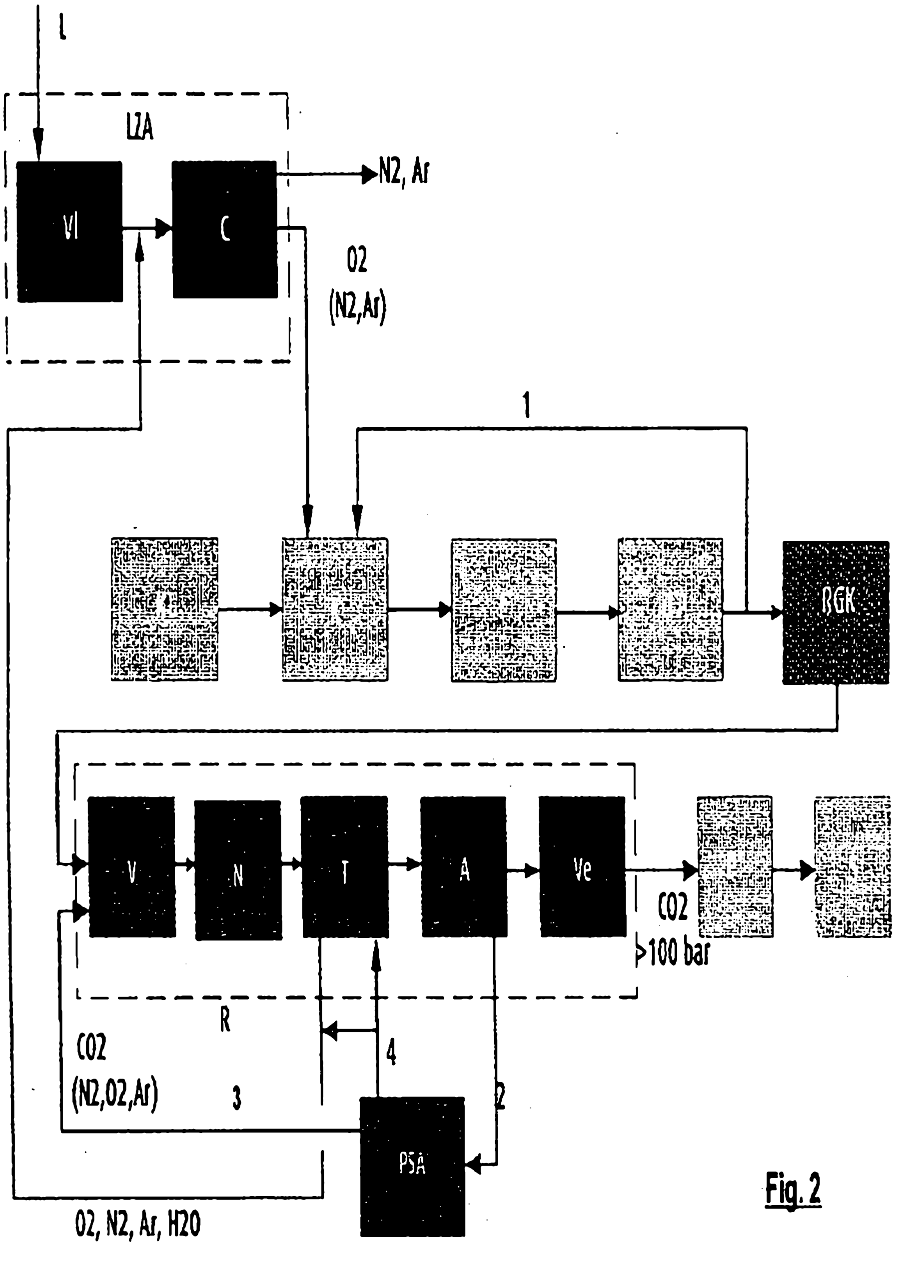

Fig. 2

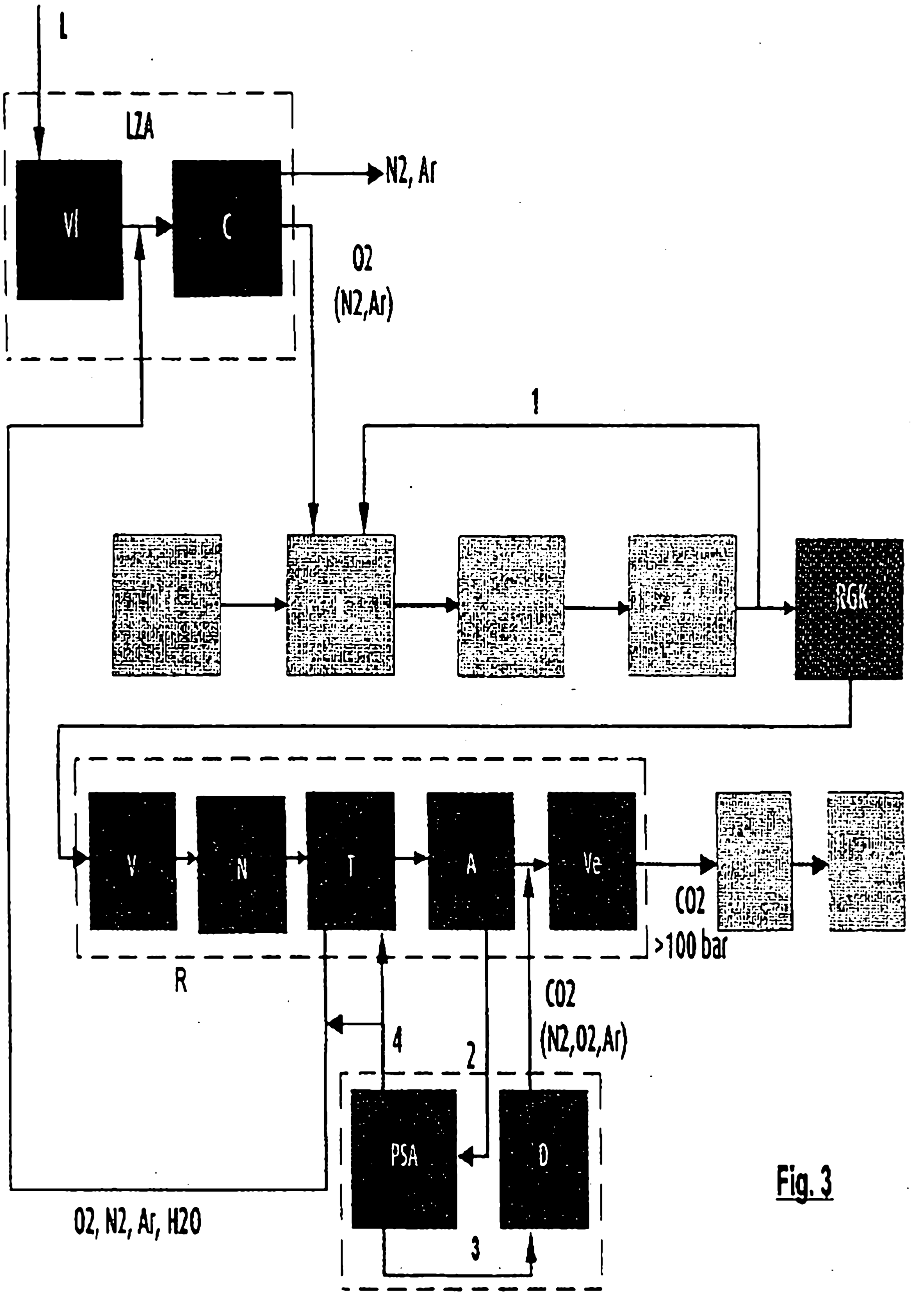
L
LZA
Vl
C
N2, Ar
O2
(N2,Ar)
1
RGK
V
N
T
A
Ve
CO2
>100 bar
R
CO2
(N2,O2,Ar)
4
2
PSA
D
3
O2, N2, Ar, H2O

Fig. 3