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**Datasheet for the decision
of 8 October 2019**

Case Number: T 0821/16 - 3.3.02

Application Number: 05720741.7

Publication Number: 1736231

IPC: B01D53/14, B01D53/62,
B01D53/78, B01D53/96, C01B31/20

Language of the proceedings: EN

Title of invention:
APPARATUS AND METHOD FOR RECOVERING CO2

Patent Proprietor:
MITSUBISHI HEAVY INDUSTRIES, LTD.
The Kansai Electric Power Co., Inc.

Opponent:
ALSTOM Technology Ltd

Headword:

Relevant legal provisions:
EPC Art. 52(1), 54, 56, 84, 123(2)
EPC R. 80
RPBA Art. 12(4)

Keyword:

Late-filed allegation of fact - admitted (no)

Main request - admitted (yes), novelty (no)

Auxiliary request - admitted (yes), added matter (no), clarity (yes), novelty (yes), inventive step (yes)

Decisions cited:

G 0003/14

Catchword:



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Case Number: T 0821/16 - 3.3.02

D E C I S I O N
of Technical Board of Appeal 3.3.02
of 8 October 2019

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(Patent Proprietors)

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Decision under appeal:

**Decision of the Opposition Division of the
European Patent Office posted on 29 January 2016
revoking European patent No. 1736231 pursuant to
Article 101(3) (b) EPC**

Composition of the Board:

Chairman M. O. Müller
Members: M. Maremonti
 M. Blasi

Summary of Facts and Submissions

- I. The appeal by the patent proprietors (hereinafter "appellants") lies from the decision of the opposition division to revoke European patent No. 1 736 231.
- II. The granted patent contains twelve claims, the independent claim 1 of which reads as follows:

*"1. A CO₂ recovery system including an absorption tower (13) that contacts CO₂-containing gas with a CO₂-absorbing solution to remove CO₂ and a regeneration tower (15) that regenerates a rich solution having absorbed CO₂, and reusing a lean solution, obtained by removing CO₂ from the rich solution in the regeneration tower, in the absorption tower, comprising:
a regeneration heater (18) that extracts the lean solution recovered near a bottom portion of the regeneration tower (15) to the outside, and heat-exchanges the lean solution with saturated steam; and
a steam-condensate heat exchanger (21) that heats the rich solution to be supplied to the regeneration tower (15) or heats a semi-lean solution obtained by removing part of CO₂ from the rich solution, with residual heat of steam condensate fed from the regeneration heater, the semi-lean solution having been extracted from a middle portion of the regeneration tower."*

Claims 2 to 10 define particular embodiments of the system of claim 1 while claims 11 and 12 define a CO₂ recovery method.

- III. The following documents were among those cited during the opposition proceedings:

D1: WO 2004/005818 A2

D2: US 3,563,696

D3: US 4,973,340

The opposition division came to *inter alia* the following conclusions on the then pending requests (main request and auxiliary requests 1 to 8):

- The subject-matter of claim 1 of the main request was not novel over D1.
- Auxiliary requests 1 to 8 were admitted to the proceedings and complied with Rule 80 EPC.
- The subject-matter of claim 1 of auxiliary request 1 was also not novel over D1.
- The subject-matter of claim 1 of auxiliary request 2 infringed Article 123(2) EPC.
- Auxiliary requests 3 to 7 were not clear under Article 84 EPC.
- The subject-matter of claim 1 of auxiliary request 8 was novel but it did not involve an inventive step in view of D1 being taken as the closest prior art.

IV. In their statement of grounds of appeal, the appellants contested the reasoning of the opposition division and filed *inter alia* sets of claims of a main request and auxiliary request 1.

With their letter dated 17 January 2017, they filed *inter alia* claims of a new main request and the following item of evidence (document number given by the board):

D9: Declaration of Hideki Fujisawa dated
16 January 2017

V. In its reply to the statement of grounds of appeal and in subsequent letters, the opponent (hereinafter "respondent") contested the admittance of the claim requests as well as the patentability of the claimed subject-matter. It also filed the following item of evidence (document number given by the board):

D12: Certified translation into English by Katrin Franke dated 14 April 2018 of some paragraphs of the international application filed in Japanese language and published as WO 2005/097299 into English dated 14 April 2018.

VI. On 1 July 2019, the board issued a communication in preparation for the oral proceedings to be scheduled according to the requests of the parties. In this communication, the board expressed *inter alia* the preliminary opinion that the main request and auxiliary request 1 as filed by the appellants should be admitted into the proceedings. It also expressed the preliminary view that the terms "*line*" and "*pipe*" were considered to be synonyms and that the objections raised by the respondent under Article 100(c) EPC regarding the replacement of the terms "*supplies*" and "*provided*" by "*conveys*" and "*interposed*" should not be admitted into the proceedings.

VII. In reply to the board's communication, the respondent stated in a letter dated 22 July 2019 that it would not attend the oral proceedings. No comments were filed with regard to the preliminary opinion of the board expressed in its communication.

VIII. Oral proceedings before the board were held on 8 October 2019 in the respondent's absence.

IX. Final requests

The appellants requested that the decision under appeal be set aside and the patent be maintained on the basis of the claim sets filed during the appeal proceedings as a main request and auxiliary requests 1, 1a, 2, 3, 2a and 3a, to be dealt with in this specified order, the main request and auxiliary request 3 having been filed by letter dated 17 January 2017, auxiliary requests 1 and 2 having been filed with the statement of grounds of appeal, auxiliary requests 2a and 3a having been filed by letter dated 11 July 2017 and auxiliary request 1a having been filed by letter dated 6 September 2019.

The respondent requested in writing that the appeal be dismissed and that neither the main request nor auxiliary requests 1, 2, 2a, 3 and 3a be admitted into the proceedings.

X. The arguments of the appellants, where relevant to the present decision, may be summarised as follows:

Main request - admittance:

- The amendments to the main request merely concerned the reintroduction of an accidentally omitted text passage in dependent claim 9, so as to align claim 9 with the wording of claim 9 as granted. In fact, the claims of the main request were identical to the claims as granted.
- This reintroduction did not give rise to any new issues and there was no unforeseen change in the claimed subject matter. The respondent should be able to rely on the earlier assessment of patentability of claim 9, as it was certainly done

when drafting the notice of opposition. Therefore, the admittance of the main request did not lead to an unfair treatment of the respondent.

- Moreover, the introduced subject-matter was neither complex nor likely to cause any delays in the procedure.
- The main request should thus be admitted into the proceedings pursuant to Article 13(1) RPBA.

Ground for opposition under Article 100(c) EPC:

- The application leading to the contested patent was originally filed in Japanese as PCT/JP2005/004473. Declaration D9 confirmed that paragraphs [0032] and [0033] of the English translation of the application text including the term "*line*" represented a full and true translation of the corresponding paragraphs [0032] and [0033] of the original Japanese language PCT application text.
- The original text of the application as filed thus provided sufficient basis for the term "*line*" as included in the claims of the main request.

Main request - novelty:

- The subject-matter of claim 1 differed from the disclosure of D1 in that the system comprised a steam-condensate heat exchanger that heated the rich solution to be supplied to the regeneration tower with residual heat of steam condensate fed from the regeneration heater.
- This feature might only be interpreted in the sense that liquid steam condensate was directly used in a heat exchanger to heat the rich solution fed to the

regeneration tower. This was evident for example from the inspection of figure 10 of the contested patent, according to which it was the liquid steam coming from the flash drum (54), which was fed to the heat exchanger (21) in order to heat up the rich solution (14).

- Also pages 14 to 16 of the application as filed confirmed that the rich solution fed to the regenerator was heat-exchanged with the heat of the steam condensate (page 16, lines 23 to 27).
- Figure 2 of D1 showed instead that steam vapour, and not liquid, was sent to the regenerator (230). The liquid steam was merely discharged. Moreover, the vapour steam was not used in the regenerator (230) for heat exchange but rather for removing CO₂ from the rich solution portion fed to said regenerator (230), see page 7, lines 5-6 and the paragraph bridging pages 8 and 9 of D1.
- This was even more evident from figure 13 of the contested patent which depicted a system corresponding to the embodiment of figure 2 of D1. Here, it was shown that the solution (20-1) fed to the regenerator (31), equivalent to the regenerator (230) of D1, was actually cooled down from 113.8 °C to 103.4 °C. Therefore, the heat of the steam fed to the regenerator (31) at 119 °C was only used to desorb CO₂ from the solution (20-1) and not to heat the semi-lean solution (28) extracted from the regenerator (31), which was cooled instead.
- It was acknowledged that this embodiment of figure 13 of the contested patent was identified as being according to the invention in the application as filed. This was, however, because the appellants

had not been aware of the disclosure of D1 when drafting the application for the contested patent. As soon as D1 was cited by the examining division against the novelty of the claimed subject-matter, this embodiment was identified as a comparative example, see paragraph [0061] of the contested patent.

- The fact that in figure 2 of D1 the residual heat of steam condensate was not used to heat the rich solution to be supplied to the regeneration tower also resulted from the passage on page 10, lines 3 to 6 of D1 itself. Here, the authors of D1 did mention this possibility as an envisageable, but not implemented, alternative.
- Therefore, it had to be concluded that the subject-matter of claim 1 was novel over D1.

Auxiliary request 1 - admittance:

- Auxiliary request 1 was based on auxiliary request 5 as filed before the opposition division. The respondent therefore had plenty of opportunity and time to consider the subject-matter of this request.
- Moreover, auxiliary request 1 represented a *bona fide* attempt to overcome the clarity issues identified by the opposition division. The filing of auxiliary request 1 was done at the earliest possible stage.
- Therefore, auxiliary request 1 should be admitted into the proceedings.

Auxiliary request 1 - compliance with Rule 80 EPC:

- The deletion of the second alternative of claim 1 as granted provided a clearer distinction from the cited prior art and especially D2, which was cited by the respondent against the second alternative of claim 1. The amendment was therefore occasioned by a ground for opposition.
- The omission of dependent claims was also justifiable in view of Rule 80 EPC. These claims were omitted in response to the clarity issues that led to the rejection of *inter alia* auxiliary request 5 by the opposition division. Additionally, the deletion of the dependent claims was an appropriate way of avoiding the problem of added subject-matter that could be caused by novel combinations of features created by back-references of the dependent claims to the amended independent claims.
- It had to be concluded that auxiliary request 1 complied with Rule 80 EPC.

Auxiliary request 1 - Article 123(2) EPC:

- As regards the introduction of the term "*line*", the same arguments applied as for the main request.
- Moreover, the amendment in claim 1 did not lead to any inadmissible intermediate generalisation. In fact, the skilled person studying the original text of the application as filed (figure 1 and paragraphs [0032] to [0038]) readily understood that there was no functional relationship between the isolated feature, i.e. the feature specifying the downstream position of the steam-condensate

heat exchanger with respect to the lean-solution heat exchanger, and the remaining features identified by the respondent, namely the filling layers (25a), (25b) of the absorption tower (13) and the filling layers (26a) and (26b) of the regeneration tower (15). The heat exchange took place outside said absorption and regeneration towers. For the claimed invention it did not matter how CO₂ absorption and desorption were accomplished in detail, i.e. by means of which internal structure of the absorption and regeneration towers. The application as filed merely cited the allegedly "missing features" without describing any functional relationship between these and the remaining features of the invention. The whole teaching concerning heat exchange did not mention any of these "missing features".

- The same considerations applied to claim 2. The claimed arrangement of heat exchangers in different supply lines was not functionally related to the internal structure of the absorption and regeneration towers. In other words, the claimed invention might be worked using any kind of absorption and regeneration tower, provided that their function as specified in claim 2 was fulfilled.

Auxiliary request 1 - clarity:

- It was by no means unreasonable to describe an apparatus by means of its mode of operation. The intended meaning was readily understood by the person skilled in the art. The respondent did not explain why the method features mentioned in the claims should give rise to ambiguity.

- The separation of the regeneration tower into an upper and a lower portion was already included in the granted claims, so that it was not open to clarity objections.
- The claims of auxiliary request 1 were thus clear.

Auxiliary request 1 - novelty and inventive step:

- The steam-condensate heat exchanger that heats the rich solution to be supplied to the regeneration tower at a position downstream of the lean-solution heat exchanger effectively distinguished the subject-matter of claim 1 from the disclosure of D1. The subject-matter of claim 1 was thus novel over D1.
- The distinguishing feature resulted in a CO₂ recovery system which provided a more effective use of heat and steam.
- Even if the skilled person was minded to split the Solvent Cross Exchanger of D1 into two separate heat exchangers, they would not have arrived at the claimed subject-matter. In fact, given the function of said Solvent Cross Exchanger, the split would have led to two heat exchangers disposed in parallel and not in sequential connection.
- Even assuming that the skilled person would have considered a sequential arrangement, there was still nothing to prompt the skilled person to place the steam-condensate heat exchanger downstream of the lean-solution heat exchanger, in order to heat the rich solution to be supplied to the regeneration tower more efficiently.

- Also documents D2 and D3 did not point to the claimed solution. D2 (figure 1) taught the use of two reboilers arranged in sequence with respect to the flow of steam. There was thus no motivation to provide two heat exchangers in series with respect to the scrubbing solution. Moreover, the teaching of D2 was not compatible with figure 2 of D1. In fact the steam exiting the downstream reboiler of D2 transferred heat to a semi-lean solution extracted from the regeneration tower, whereas in D1 the steam, after flashing, was mixed to a rich solution in the regenerator (230). Moreover, in D2 there was no heat exchange between the lean-solution supply line and the rich-solution supply line and also no heat exchange between the semi-lean-solution supply line and the rich-solution supply line. The absence of any heat exchange at these crossing points was contrary to the teaching of using a Solvent Cross Exchanger as shown in figure 2 of D1.
- Document D3 showed in figure 1 two reboilers arranged sequentially with respect to the flow of a lean solution circulated at the bottom of the regeneration tower. In view of this teaching, the person skilled in the art would, at best, have been motivated to replace the reboiler (228) of figure 2 of D1 by two sequential reboilers. However, such a modification would not lead the skilled person to the present invention.
- With regard to claim 2, the three mentioned heat exchangers had to be separate so as to allow the specified heat transfers on the different supply lines. This requirement was not fulfilled by the Solvent Cross Exchanger of D1. Also, the assertion

of the respondent that lean and semi-lean regenerators of D1 might be assimilated to the upper and lower portions of the regeneration tower specified in claim 2 was not correct. Actually, according to claim 2, said portions were part of the same device, namely the regeneration tower.

- The subject-matter of the claims of auxiliary request 1 thus involved an inventive step.

XI. The respondent counter-argued in writing as follows:

Main request - admittance:

- Along with their submission of 17 January 2017, the appellants filed a new main request which replaced the main request filed with the statement of grounds of appeal.
- This contravened Article 12(2) RPBA. The new main request was filed late and contravened procedural economy. The main request should thus not be admitted into the proceedings.

Ground for opposition under Article 100(c) EPC:

- Page 15, lines 1 to 11 and claim 7 of the application as filed only provided a basis for a solution supply "pipe" that "supplies" the solution. No basis might be found for replacing "pipe" and "supplies" by "line" and "conveys". In particular, translation D12 confirmed that the term "line" did not have a proper basis in the original application filed in the Japanese language as PCT/JP2005/004473.
- Additionally, paragraph [0033] of the application as filed only disclosed that a lean-solution heat

exchanger was "*provided*" and not "*interposed*" in the rich-solution supply pipe.

- It had to be concluded that Article 123(2) EPC was not complied with.

Main request - novelty:

- Figure 2 of document D1 disclosed a system comprising all of the features of the first alternative defined in claim 1. In particular, the Solvent Cross Exchanger shown in this figure corresponded to the steam-condensate heat exchanger as defined in claim 1.
- The wording used in claim 1 indicated that only the residual heat had to be used for heating and not the steam condensate itself. In other words, claim 1 did not require the heating to be conducted by direct heat exchange with the steam condensate. Intermediate heat transfer steps were not excluded.
- Moreover, the steam condensate referred to in claim 1 did not have to be a liquid but it might also be pressurised saturated steam, as indicated in paragraph [0034] of the contested patent.
- Figure 3 and paragraphs [0033] to [0035] of the contested patent indeed described an embodiment identical to figure 2 of D1, in which the steam-condensate heat exchanger included a first flash drum. This embodiment was according to the invention in the application as filed and only later amended to become a comparative embodiment. It demonstrated that it did not matter if the heat was transferred directly to the rich solution to be supplied to the regeneration tower or if the heat

was transferred indirectly to the rich solution with several steps in between. It also did not matter that the heat was transferred to the rich solution directly from the steam condensate.

- Therefore, the subject-matter of claim 1 lacked novelty over D1.

Auxiliary request 1 - admittance:

- Auxiliary request 1 did not converge with auxiliary request 2 since the two requests were directed to completely different ideas. Moreover, auxiliary request 1 was not identical to auxiliary request 5 filed before the opposition division. Under Article 12(4) RPBA, it might have been presented during the first instance proceedings.
- Therefore, auxiliary request 1 should not be admitted into the proceedings.

Auxiliary request 1 - compliance with Rule 80 EPC:

- The deletion of the second alternative of claim 1 as granted as well as the deletion of all dependent claims were not occasioned by a ground for opposition.
- Therefore, auxiliary request 1 did not comply with Rule 80 EPC.

Auxiliary request 1 - Article 123(2) EPC:

- Auxiliary request 1 contained added subject-matter due to the replacement of the terms "pipe", "supplies" and "provided" with "line", "conveys" and "interposed", respectively.

- Moreover, there was no literal basis in the application as filed for the source of the residual heat of the lean solution, which according to claim 1 came from the lean-solution supply line.
- Additionally, the position of the steam-condensate heat exchanger (21) downstream of the lean-solution heat exchanger (23) was only disclosed in figure 1 in combination with other features, such as the filling layers (25a), (25b) of absorption tower (13) and filling layers (26a) and (26b) of regeneration tower (15). Accordingly, the isolation of this feature extended beyond the content of the application as filed.
- The same objection applied to claim 2.
- Therefore, auxiliary request 1 did not meet the requirements of Article 123(2) EPC.

Auxiliary request 1 - clarity:

- The position of the steam-condensate heat exchanger (21) downstream of the lean-solution heat exchanger (23) was not an apparatus feature but merely a method feature, therefore rendering claim 1 unclear.
- The same objection applied to claim 2. In addition, it was unclear what an upper-portion regeneration tower and a lower-portion regeneration tower were. It was also unclear at which position of the regeneration tower the first and second rich-solution supply lines (20-1, 20-2) were connected.
- Hence, the claims of auxiliary request 1 lacked clarity.

Auxiliary request 1 - novelty and inventive step:

- The system shown in figure 2 of D1 represented the closest prior art. Here, the lean-solution heat exchanger and the steam-condensate heat exchanger were both formed by the Solvent Cross Exchanger.
- The subject-matter of claim 1 merely differed from the closest prior art in that the lean-solution heat exchanger and the steam-condensate heat exchanger were arranged sequentially.
- Nevertheless, it was a common design to split a heat exchanger into two different heat exchangers when circumstances made it desirable. Heat exchangers connected in series were known for example from D2 (figure 1, reference signs 32 and 36) and from D3 (figure, reference signs 4 and 18).
- The subject-matter of claim 1 thus lacked an inventive step.
- Claim 2 did not specify any arrangement of the upper and lower portion of the regeneration tower. Accordingly, the second regenerator (230) of D1 may also be an upper-portion regeneration tower wherein the first regenerator (220) may also be a lower-portion regeneration tower. Therefore, claim 2 differed from the closest prior art in the same feature as claim 1 and the same objection applied.
- Hence, the subject-matter of auxiliary request 1 lacked an inventive step.

Reasons for the Decision

The respondent was duly summoned but did not attend the oral proceedings. The board decided to continue the proceedings in the respondent's absence pursuant to Rule 115(2) EPC and to treat the respondent as relying on its written case in accordance with Article 15(3) RPBA.

Main request - Admittance into the proceedings

1. The respondent objected to the admittance of the main request into the proceedings because it contravened Article 12(2) RPBA and procedural economy.
- 1.1 The appellants filed the set of claims of the main request after their statement of grounds of appeal, namely with the letter dated 17 January 2017. The board notes that the claim set of the main request merely differs from the one of the main request pending before the opposition division and filed with the statement of grounds of appeal in an amendment carried out in dependent claim 9. In fact, the wording of claim 9 was changed from:

"9. The CO₂ recovery system according to claim 1, the regeneration tower (15) including an upper-portion regeneration tower (15-U) and a lower-portion regeneration tower (15-L)"

to (amendment highlighted by the board):

*"9. The CO₂ recovery system according to claim 1, the regeneration tower (15) including an upper-portion regeneration tower (15-U), **a middle-portion***

regeneration tower (15-M) and a lower-portion regeneration tower (15-L)".

This amendment brought claim 9 into line with claim 9 as granted. In fact, the claims of the present main request are identical to the claims as granted.

1.2 On one hand, the amendment in claim 9 merely concerns a dependent claim and it does not change the appellants' case compared to their case before the opposition division and as presented at the start of the appeal proceedings. The board does not see any infringement of Article 12(2) RPBA. On the other hand, it is not understood, why such an amendment should contravene procedural economy as alleged by the respondent. It rather straightforwardly overcomes the objections raised by the respondent against claim 9 in its reply to the statement of grounds of appeal (page 2) under Articles 83, 84, 123(2) and (3) EPC and Rule 80 EPC.

1.3 It is further noted that these latter objections of the respondent were late-filed since they could have been raised already before the opposition division against the then pending main request. The change made in claim 9 is nothing but a reaction to these late-filed objections.

1.4 The board therefore decided to admit the main request into the proceedings pursuant to Article 13(1) RPBA.

Main request - ground for opposition under Article 100(c) EPC - admittance of new allegations of fact

2. The respondent objected to the auxiliary requests filed by the appellants under Article 123(2) EPC by arguing *inter alia* that the application as filed only provided

a basis for a solution supply "*pipe*", that "*supplies*" the solution and for a lean-solution heat exchanger that is "*provided*" in the rich-solution supply pipe. The claims of the auxiliary requests respectively cited the terms "*line*", "*conveys*" and "*interposed*" instead, for which there was no basis in the application as filed. D12 was filed to corroborate this argumentation.

- 2.1 The board notes that the terms objected to are also present in the claims of the main request in the identical context (see e.g. all claims 2 to 9). Thus the objections are in fact directed to the main request.
- 2.2 As mentioned under 1.1 above, the claims of the main request are identical to the claims as granted. It follows that the above objections of the respondent raised under Article 123(2) EPC have to be regarded as a recurrence to the ground for opposition under Article 100(c) EPC. This ground had, however, not been invoked by the respondent in its notice of opposition.
- 2.3 The objection concerning the replacement of the term "*pipe*" with "*line*" had, however, been discussed before the opposition division (impugned decision, page 9, point 13.3). It thus has to be concluded that the ground for opposition under Article 100(c) EPC had been introduced into the proceedings.
- 2.4 However, the objections concerning the introduction of the terms "*conveys*" and "*interposed*" had not been discussed before the opposition division. These objections raised in appeal for the first time therefore amount to new allegations of fact. The board sees no reasons why the respondent could not have brought forward these new allegations of fact already before the opposition division.

This board's view was communicated to the parties in the preliminary opinion issued in preparation for the oral proceedings (VI, *supra*). In its reply to this communication (VII, *supra*), the respondent did not contest the board's finding.

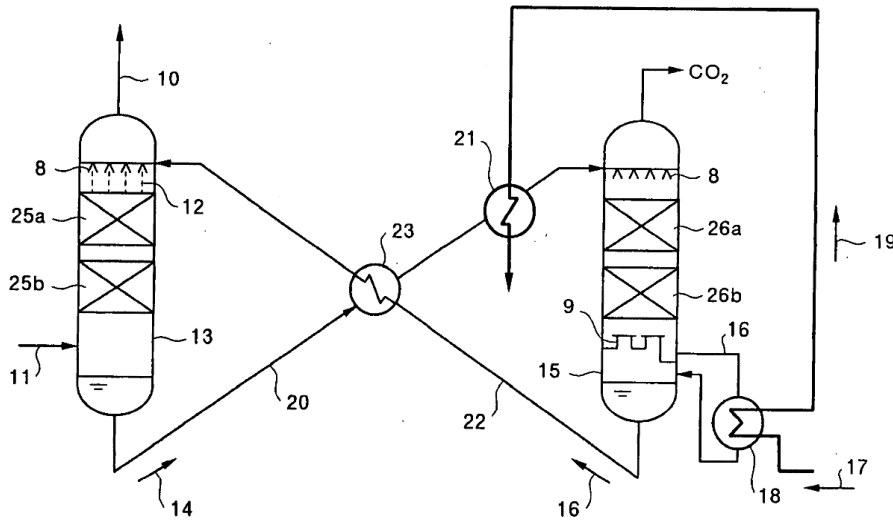
2.5 The board therefore decided not to admit these new allegations of fact related to the introduction of the terms "*conveys*" and "*interposed*" into the appeal proceedings (Article 12(4) RPBA).

2.6 As regards the replacement of the term "*pipe*" with "*line*", the respondent did not explain why such an amendment led to an extension of the claimed subject-matter. In fact, the board is of the opinion that the terms in question are synonyms and thus equivalent in scope.

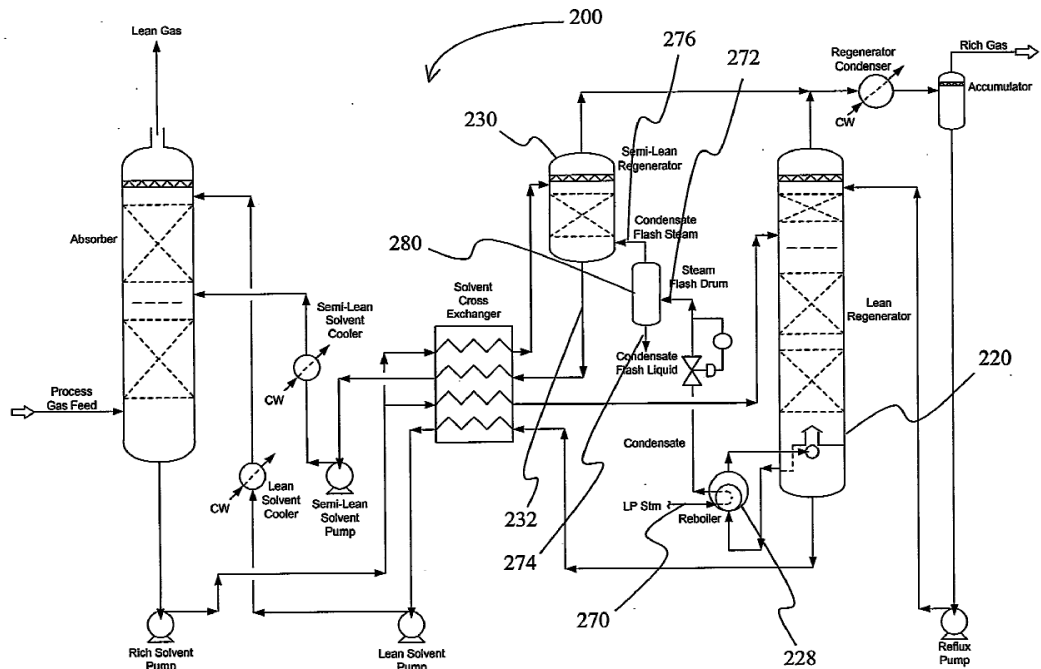
2.7 The board thus concludes that the ground for opposition under Article 100(c) EPC does not prejudice the maintenance of the contested patent as granted.

Main request - claim 1 - novelty - Articles 100(a) and 54 EPC

3. Claim 1 of the main request (II, *supra*) covers a first alternative, according to which the steam-condensate heat exchanger (21) heats the rich solution (14) to be supplied to the regeneration tower (15) with residual heat of steam condensate fed from the regeneration heater (18). An example of such first alternative is shown in figure 1 of the opposed patent, reproduced for convenience here below:



3.1 The respondent objected to the novelty of said first alternative in view of the disclosure of D1, specifically the system shown in figure 2 of D1, which is reproduced for convenience here below:



3.2 The board observes that D1, with reference to this figure, discloses a CO₂ recovery system including an absorption tower ("Absorber") that contacts CO₂-

containing gas with a CO₂-absorbing solution to remove CO₂ and a regeneration tower (220) that regenerates a rich solution having absorbed CO₂, and reusing a lean solution, obtained by removing CO₂ from the rich solution in the regeneration tower, in the absorption tower, comprising a regeneration heater (228) that extracts the lean solution recovered near a bottom portion of the regeneration tower (220) to the outside, and heat-exchanges the lean solution with saturated steam; and a heat exchanger ("Solvent Cross Exchanger") that heats the rich solution to be supplied to the regeneration tower (220).

3.3 The appellants (X, *supra*) submitted that in said Solvent Cross Exchanger of D1 the rich solution to be supplied to the regeneration tower was not heated "*with residual heat of steam condensate fed from the regeneration heater*" as required by claim 1 at issue and that this feature distinguished the claimed subject-matter from D1.

3.4 The board disagrees. The feature of claim 1 "*heat exchanger (21) that heats the rich solution to be supplied to the regeneration tower (15) ... with residual heat of steam condensate **fed from** the regeneration heater*" (emphasis added by the board) actually requires that in said heat exchanger (21), the rich solution is at least heated in part by heat *originating* from the steam condensate that, in turn, *originates* from the regeneration heater. Contrary to the view of the appellants, the used wording cannot be interpreted so narrowly to only imply that the rich solution is necessarily heated by steam condensate coming from the regeneration heater and **fed to** the heat exchanger (21). In other words, the adopted wording is not restricted to a heat exchanger, in which *direct*

heating of the rich solution by the steam condensate coming from the regeneration heater takes place.

The fact that several embodiments described in the contested patent show such *direct heating* (e.g. figure 1 reported above) has no bearing on the above conclusion, since the scope of a claim is determined on the basis of the claim wording alone, i.e. without referring to the description.

3.5 The adopted wording is also not restricted to steam in liquid form, as also argued by the appellants (X, *supra*) with reference to figure 10 of the contested patent. Said figure 10 does in fact show a flash drum (54) placed on the steam line coming from the regeneration heater and separating steam in liquid and vapour form, whereby only the liquid is fed to the heat exchanger (21). However, on the one hand, no flash drum is mentioned in claim 1 at issue. On the other hand, the contested patent describes a number of other embodiments (figures 1, 4, 7), in which the steam is fed as it is, i.e. without flash separation, to the heat exchanger (21). In such embodiments, the steam is also referred to as "steam condensate" (paragraphs [0026], [0037] and [0045]).

3.6 With reference to figure 2 of D1, the rich solution fed to the regeneration tower (220) is heated within the Solvent Cross Exchanger at least partially by the semi-lean solution (232) extracted from the semi-lean regenerator (230). The residual heating capacity of this semi-lean solution (232) is determined by the heat exchange taking place within said semi-lean regenerator (230). The latter is fed at the top by a rich solution also heated within the Solvent Cross Exchanger and at the bottom by "Condensate Flash Steam" (276) which is

fed, via the flash drum (280), from the regeneration heater (228) ("reboiler" in figure 2 of D1). For the reasons set out under 3.5 above, said "Condensate Flash Steam" (276) does represent a "steam condensate" within the meaning of claim 1 at issue.

The residual heat of this steam condensate (276) is then transferred within the semi-lean regenerator (230) to the rich solution fed in at the top. This heat is in part used to desorb CO₂ from the rich solution and in part remains in the semi-lean solution (232) obtained after desorption, thus determining its temperature and its capacity to heat up the rich solution fed to regeneration tower (220) within the Solvent Cross Exchanger. It follows that the rich solution fed to regeneration tower (220) is heated within the Solvent Cross Exchanger *"with residual heat of steam condensate fed from the regeneration heater"*, as required by claim 1 at issue.

- 3.7 The argument (X, *supra*) that, according to D1 (page 7, lines 5 to 6 and page 8, line 29 to page 9, line 2), steam condensate (276) was used for another purpose, namely to reduce the CO₂ partial pressure above the solvent in semi-lean regenerator (230), has no bearing on the above conclusion that residual heat of said steam condensate (276) remains in the semi-lean solution (232).
- 3.8 The appellants (X, *supra*) referred to example 4 of the contested patent showing, with reference to figure 13, a system corresponding to the one of figure 2 of D1. This figure is reproduced for convenience here below:

desorbing CO₂ and determining the final temperature of the semi-lean solution (28). In other words, in the absence of the steam condensate injection at the bottom of the semi-lean regenerator (31), the temperature of the semi-lean solution (28) would be lower than the indicated 103.4 °C. Therefore, even if rich solution (20-1) is cooled down in the regenerator (31) by forming the semi-lean solution (28), the latter still contains residual heat of the injected steam condensate.

This view is supported by the text of example 4 itself (paragraph [0061] of the contested patent), stating that in the regenerator (31) (figure 13) (corresponding to the semi-lean regenerator (230) of D1) "*the rich solution 14 was heat-exchanged **with the steam from the steam condensate***". Moreover, according to this example, "*using the **residual heat** of the semi-lean solution 28 **after the heat exchange**, the other part of the rich solution 14 divided was heat-exchanged in the semi-lean-solution **heat exchanger 29** [corresponding to the Solvent Cross Exchanger of D1], to increase the temperature of **the rich solution 14 to be supplied to the regeneration tower 15**" (text in square brackets and emphasis added by the board).*

- 3.9 The board further notes that said example 4 of the contested patent was disclosed in the application as filed as an example according to the invention. Claim 1 as filed was identical to claim 1 of the main request. It thus has to be concluded that the authors of the contested patent also regarded the system described in example 4 (and shown in figure 13, corresponding to figure 2 of D1) as an embodiment of the invention, according to which therefore, residual heat of steam condensate fed from the regeneration heater was used in

the heat exchanger (29) to heat the rich solution to be supplied to the regeneration tower. The fact that this example 4 was identified as comparative at the granting stage has no bearing on the above conclusion.

3.10 The appellants also referred (X, *supra*) to the statement reported on page 10, lines 5-6 of D1. Here, D1 states that "*it is contemplated that various devices other than a cross heat exchanger are also appropriate. For example, the rich solvent stream may be heated utilizing residual heat from the steam reboiler*". However, this statement is very vague and not followed by any concrete teaching which clarifies without ambiguity which alternative system configuration the authors of D1 actually intended. Hence, this statement cannot change the conclusion set out above and drawn from figure 2 of D1.

3.11 For the reasons mentioned above, the board is convinced that the Solvent Cross Exchanger shown in figure 2 of D1 does represent a "*steam-condensate heat exchanger*" in the sense of claim 1 at issue and therefore that the CO₂ recovery system shown in figure 2 of D1 comprises all of the features of claim 1 of the main request, which thus lacks novelty over D1.

The ground for opposition under Article 100(a) and Article 54 EPC thus prejudices the maintenance of the patent as granted. The main request of the appellants is thus not allowable.

Auxiliary request 1 - admittance

4. The set of claims of auxiliary request 1 was filed with the statement of grounds of appeal. It only contains independent claims 1 and 2, reciting as follows

(amendments compared to claim 1 as granted (II, *supra*) highlighted by the board):

"1. A CO₂ recovery system including an absorption tower (13) that contacts CO₂-containing gas with a CO₂-absorbing solution to remove CO₂ and a regeneration tower (15) that regenerates a rich solution having absorbed CO₂, and reusing a lean solution, obtained by removing CO₂ from the rich solution in the regeneration tower, in the absorption tower, comprising:

a regeneration heater (18) that extracts the lean solution recovered near a bottom portion of the regeneration tower (15) to the outside, and heat-exchanges the lean solution with saturated steam; and a steam-condensate heat exchanger (21) that heats the rich solution to be supplied to the regeneration tower (15) ~~or heats a semi-lean solution obtained by removing part of CO₂ from the rich solution, with residual heat of steam condensate fed from the regeneration heater, the semi-lean solution having been extracted from a middle portion of the regeneration tower~~

the CO₂ recovery system further comprising:

a rich-solution supply line (20) that conveys the rich solution from the absorption tower (13) to the regeneration tower (15);

a lean solution [sic] supply line (22) that extracts the lean solution from the regeneration tower (15) and conveys extracted lean solution to the absorption tower (13); and

a lean-solution heat exchanger (23) that is interposed in the rich-solution supply line (20) and the lean-solution supply line (22), and heats the rich solution in the rich-solution supply line (20) with residual heat of the lean solution in the lean-solution supply line (22),

wherein the steam-condensate heat exchanger (21) heats the rich solution to be supplied to the regeneration tower (15) at a position downstream of the lean-solution heat exchanger (23)."

"2. A CO₂ recovery system including an absorption tower (13) that contacts CO₂-containing gas with a CO₂-absorbing solution to remove CO₂ and a regeneration tower (15) that regenerates a rich solution having absorbed CO₂, and reusing a lean solution, obtained by removing CO₂ from the rich solution in the regeneration tower, in the absorption tower, comprising:

a regeneration heater (18) that extracts the lean solution recovered near a bottom portion of the regeneration tower (15) to the outside, and heat-exchanges the lean solution with saturated steam; and a steam-condensate heat exchanger (21) that heats the rich solution to be supplied to the regeneration tower (15) ~~or heats a semi lean solution obtained by removing part of CO₂ from the rich solution, with residual heat of steam condensate fed from the regeneration heater, the semi lean solution having been extracted from a middle portion of the regeneration tower,~~ **the regeneration tower (15) including an upper-portion regeneration tower (15-U) and a lower-portion regeneration tower (15-L), and the CO₂ recovery system further comprising:**

a rich-solution supply line (20) that conveys the rich solution from the absorption tower (13) to the regeneration tower (15);

a branching node (24) provided in the rich-solution supply line (20) and that branches the rich-solution supply line (20) into a first rich-solution supply line (20-1) and a second rich-solution supply line (20-2), wherein the steam-condensate heat exchanger (21) is

provided in the first rich-solution supply line (20-1) and heats the rich solution in the first rich-solution supply line (20-1) with residual heat of the steam condensate;

a semi-lean-solution supply line (30) that extracts semi-lean solution from the upper-portion regeneration tower (15-U) and conveys extracted semi-lean solution to a middle stage portion of the absorption tower (13);

a semi-lean-solution heat exchanger (29) that is provided in the second rich-solution supply line (20-2) and the semi-lean-solution supply line (30), and heats the rich solution in the second rich-solution supply line (20-2) with residual heat of the semi-lean solution (28) in the semi-lean solution [sic] supply line (30), and

a lean-solution supply line (22) that extracts the lean solution from the regeneration tower (15) and conveys extracted lean solution to the absorption tower (13);

and a lean-solution heat exchanger (23) that is interposed in the first rich-solution supply line (20-1) and the lean-solution supply line (22), and heats the rich solution in the first rich-solution supply line (20-1) with residual heat of the lean solution in the lean-solution supply line (22),

wherein the steam-condensate heat exchanger (21) heats the rich solution to be supplied to the regeneration tower (15) at a position downstream of the lean-solution heat exchanger (23), wherein

one end of the first rich-solution supply line (20-1) being connected to the lower-portion regeneration tower (15-L), and one end of the second rich-solution supply line (20-2) being connected to the upper-portion regeneration tower (15-U)."

The respondent (XI, *supra*) objected to the admittance of auxiliary request 1 into the appeal proceedings.

- 4.1 However, the board notes that claim 1 of auxiliary request 1 is identical to embodiment (a) of claim 1 of auxiliary request 5 filed before and admitted by the opposition division (annex to the minutes of the oral proceedings before the opposition division). Claim 2 is identical to claim 2 of said auxiliary request 5 with the only exception that it has been formulated as an independent claim. The remaining claims of said auxiliary request 5 have been deleted in auxiliary request 1 so as to overcome the clarity objection raised by the opposition division in the impugned decision (page 11, point 15.2).
- 4.2 Therefore, the subject-matter of claims 1 and 2 of auxiliary request 1 is identical to subject-matter already admitted by the opposition division. The deletion of the dependent claims represents a direct reaction to objections raised in the appealed decision. As a consequence, the board sees no reasons not to admit auxiliary request 1 into the proceedings.
- 4.3 The board thus decided to admit auxiliary request 1 into the proceedings pursuant to Article 12(4) RPBA.

Auxiliary request 1 - compliance with Rule 80 EPC

5. The respondent (XI, *supra*) objected to auxiliary request 1 under Rule 80 EPC, particularly in view of the deletion of an embodiment of claim 1 as granted and of all dependent claims (4, *supra*).

The board notes, however, that the deletion of one independent embodiment can always be seen as an amendment made to overcome a ground for opposition.

Moreover, this embodiment was objected to by the respondent in its notice of opposition for lack of inventive step (notice of opposition, section III, pages 10 to 14). Also the deletion of the dependent claims can always be seen as an amendment made to overcome a ground for opposition, e.g. under Article 100(b) or (c) EPC.

The board thus concludes that auxiliary request 1 complies with Rule 80 EPC.

Auxiliary request 1 - compliance with Article 123(2) EPC

6. The respondent (XI, *supra*) objected to auxiliary request 1 under Article 123(2) EPC.
 - 6.1 As regards the objections based on the replacement of the terms "*pipe*", "*supplies*" and "*provided*" by "*line*", "*conveys*" and "*interposed*", reference is made to points 2 to 2.7, above. The same conclusions apply.
 - 6.2 The respondent also argued (XI, *supra*) that the claimed subject-matter represented intermediate generalisations of embodiments of the application as filed, without any basis therein.
 - 6.3 The board disagrees. The subject-matter of claim 1 is based on the text from page 14, line 23 to page 16, line 27 of the application as filed, referring to figure 1. The subject-matter of claim 2 is based on the text from page 21, line 20 to page 23, line 1 of the application as filed, referring to figure 4.

The respondent argued that figures 1 and 4 also showed other features, e.g. the filling layers (25a), (25b) of the absorption tower (13) and the filling layers (26a) and (26b) of the regeneration tower (15), which were not included in claims 1 and 2 at issue. However, from

the above cited text of the application as filed, it is immediately evident that there is no interaction whatsoever between the heat exchange performed in heat exchangers (23), (21) and (29), representing the core of the teaching of the described embodiments, and the internal structure of the absorption and regeneration towers, briefly mentioned on page 15, lines 15 to 19 of the application as filed and having no influence on the heat exchange process. The non-inclusion of the features concerning the internal structure of absorption and regeneration towers therefore does not lead to any unallowable intermediate generalisation of the embodiments referred to above.

As regards the source of the residual heat of the lean solution, which according to claim 1 comes from the lean-solution supply line, this feature, also objected to by the respondent (XI, *supra*), is directly and unambiguously disclosed on page 15, lines 8 to 14 of the application as filed.

- 6.4 The board thus concludes that the subject-matter of claims 1 and 2 of auxiliary request 1 is directly and unambiguously disclosed in the application as filed and therefore, meets the requirements of Article 123(2) EPC.

Auxiliary request 1 - clarity under Article 84 EPC

7. The respondent also objected to the clarity of the claims of auxiliary request 1.
- 7.1 Contrary to the opinion of the respondent (XI, *supra*), the board notes that the inclusion of method features in apparatus claims does not necessarily lead to a lack of clarity *per se*. No arguments were submitted by the respondent as to why such an inclusion would render the

claims unclear. In the present case, the board considers that the method features mentioned in claims 1 and 2 rather support the understanding of the apparatus structure, so that no lack of clarity results from their inclusion.

- 7.2 As regards the split of the regeneration tower into an upper and a lower portion also objected to by the respondent (XI, *supra*), this feature was already included in the claims as granted (e.g. in claim 2) and as such is not open to clarity objections (see decision G 3/14, OJ EPO 2015, A102, order).
- 7.3 In its preliminary opinion (VI, *supra*, point 10.3 of the communication), the board had expressed some concerns about the formulation of claim 2 as an independent claim, since claim 2 *de facto* contains all features of claim 1. However, after reconsideration the board agrees with the appellants in that claim 2 should be formulated as an independent claim. The reason is that this claim is directed to a separate embodiment compared to claim 1. In fact, these two embodiments are also presented separately in the contested patent, see the "first embodiment" described in paragraphs [0022] to [0028] and figure 1, and the "second and third embodiment" described in paragraphs [0036] to [0038] and figure 4. The formulation of claim 2 as an independent claim renders its subject-matter clearer.
- 7.4 The board therefore concludes that the claims of auxiliary request 1 meet the requirement of Article 84 EPC with regard to clarity.

Auxiliary request 1 - novelty and inventive step - Articles 54 and 56 EPC

8. It is common ground that the subject-matter of claim 1 of auxiliary request 1 (4, *supra*) differs from the CO₂ recovery system disclosed in D1 with reference to figure 2 in that the rich solution to be supplied to the regeneration tower is sequentially heated first in a lean-solution heat exchanger with residual heat of the lean solution and second in a steam-condensate heat exchanger with residual heat of steam condensate fed from the regeneration heater.

The subject-matter of claim 1 is thus novel. The same applies to claim 2, which, as set out above, contains all of the features of claim 1 (Article 54 EPC).

8.1 The closest prior art

Both parties indicated the disclosure of D1 and specifically the CO₂ recovery system shown in figure 2, as the closest prior art. In view of the issues addressed and the CO₂ recovery system disclosed (3.2, *supra*), the board sees no reasons to take a different stance.

8.2 The technical problem

- 8.2.1 The appellants put forward (X, *supra*) that the aforementioned distinguishing feature resulted in a CO₂ recovery system which provided a more effective use of heat and steam.

- 8.2.2 In the assessment of inventive step however, the board, for the sake of argument only and in favour of the respondent, assumed that no technical effect is associated with the distinguishing feature mentioned

above, so that the objective technical problem resided in the provision of an alternative CO₂ recovery system.

8.3 Obviousness of the claimed solution

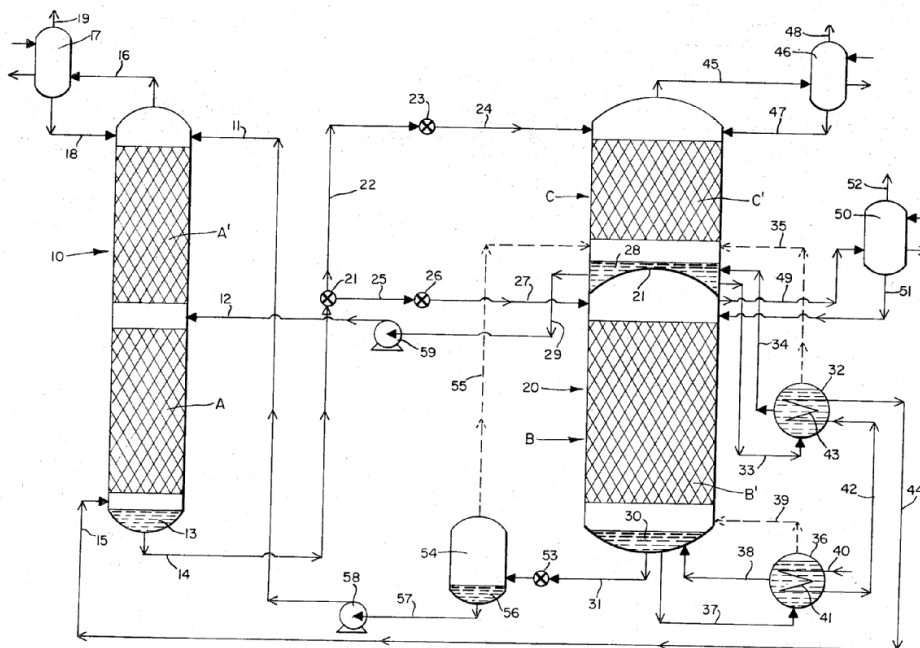
8.3.1 The respondent argued (XI, *supra*) that it was a common design to split a heat exchanger, like the Solvent Cross Exchanger of figure 2 of D1, into two different heat exchangers connected in series, when circumstances made it desirable. Such a sequential arrangement pertained to the common general knowledge of the skilled person and was shown for example in D2 and D3.

8.3.2 The board acknowledges that heat exchangers connected in series were generally known to the skilled person. However, the question is not whether sequential heat exchangers were known to the skilled person or not, but rather whether the skilled person, aiming at providing a solution to the above mentioned technical problem, would have modified the CO₂ recovery system of the closest prior art so to arrive at the claimed subject-matter.

8.3.3 By examining figure 2 of D1 (3.1, *supra*), the skilled person would have recognised that splitting the Solvent Cross Exchanger of D1 into two separate heat exchangers would have led to two heat exchangers disposed in parallel, each dedicated to heating one of the two portions in which the rich solution extracted from the absorber is divided (figure 2, branching node upstream of the Solvent Cross Exchanger). No indication is contained in D1 that would point to the additional subsequent heating of the portion of the rich solution fed to the regeneration tower. The skilled person would thus not have arrived at the claimed subject-matter when taking the disclosure of document D1 alone into account.

8.3.4 Also documents D2 and D3 do not point to the claimed solution.

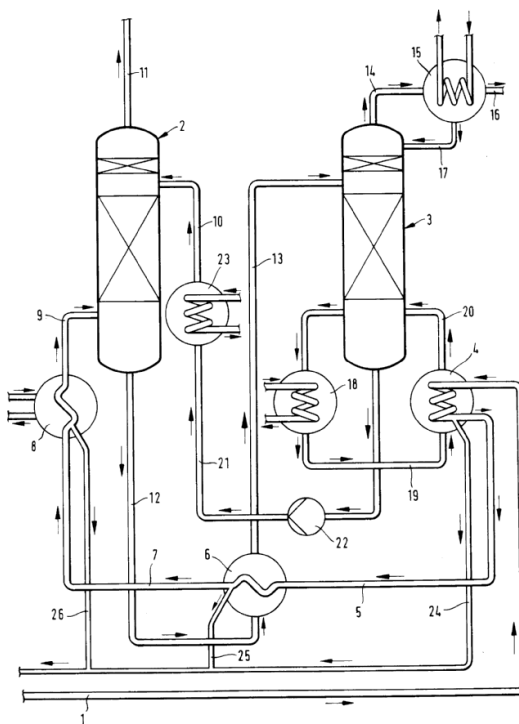
Document D2 discloses (figure 1) a CO₂ and H₂S separation system including an absorption tower (10) and a regeneration tower (20). Figure 1 of D2, referred to by the respondent, is reproduced for convenience here below:



The two heat exchangers connected in series referred to by the respondent are the two reboilers (32) and (36) arranged in sequence with respect to the flow of steam. The rich solution supplied via lines (24) and (27) to the regeneration tower (20) is not heated. The combination of documents D1 and D2 would therefore not have led to the claimed subject-matter. Moreover, the teaching of D2 is not compatible with the system of figure 2 of D1. In fact, the steam exiting the downstream reboiler (32) of D2 is fed via lines (44) and (15) to the absorption tower (10) and is not used,

as in D1, to support regeneration in the semi-lean regenerator (230).

Document D3 discloses (figure) an H₂S removal system including an absorption tower (2) and a regeneration tower (3). The figure of D3, referred to by the respondent, is reproduced for convenience here below:



The two heat exchangers connected in series referred to by the respondent are the two reboilers (4) and (18) arranged sequentially with respect to the flow of a lean solution circulated at the bottom of the regeneration tower in lines (19) and (20). The rich solution supplied via line (13) to the regeneration tower (3) is heated in the single heat exchanger (6) by residual heat of the incoming gas. The combination of

documents D1 and D3 would therefore also not have led to the claimed subject-matter.

- 8.3.5 The board is therefore convinced that the skilled person, aiming at providing a solution to the posed technical problem, would not have been prompted by either D2 or D3 to modify the CO₂ recovery system of the closest prior art to arrive at the claimed subject-matter.

The board concludes that the subject-matter of claim 1 involves an inventive step (Article 56 EPC).

8.4 Claim 2

Even assuming, as argued by the respondent (XI, *supra*), that the subject-matter of claim 2 would differ from the closest prior art only in the single distinguishing feature identified for claim 1 (8, *supra*), the subject-matter of claim 2 would still involve an inventive step for the reasons set out above with respect to claim 1 (Article 56 EPC).

Conclusion

9. The board concludes that the claims of auxiliary request 1 comply with the requirements of the EPC and are thus allowable.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the opposition division with the order to maintain the patent in amended form with claims 1 and 2 of auxiliary request 1 filed with the statement of grounds of appeal, and a description to be adapted thereto.

The Registrar:

The Chairman:



N. Maslin

M. O. Müller

Decision electronically authenticated