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D E C I S I O N
of 26 June 2001

Case Number: T 0625/99 - 3.2.3

Application Number: 93924631.0

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Language of the proceedings: EN

Title of invention:
Method and apparatus for operating a circulating fluidized bed reactor system

Patentee:
Foster Wheeler Energia Oy

Opponent:
Alstom Energy Systems S.A.

Headword:
-

Relevant legal provisions:
EPC Art. 52, 54, 56

Keyword:
"Novelty and inventive step (yes)"

Decisions cited:
-

Catchword:
-



Case Number: T 0625/99 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 26 June 2001

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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 2 June 1999
revoking European patent No. 0 667 945 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: C. T. Wilson
Members: J. du Pouget de Nadaillac
J. P. B. Seitz

Summary of Facts and Submissions

I. With the present appeal, the appellant, proprietor of the European patent No. 0 667 945 contested the decision dated 2 June 1999 of the opposition division revoking the patent for lack of inventive step in view of the documents referenced D3 and D7 among the following documents of the prior art, which were cited in the opposition proceedings:

D1: US-A-5 014 652

D2: US-A-4 951 612

D3: US-A-5 060 599

D4: FR-A-2 323 101

D5: EP-B-0 457 983

D6: US-A-4 716 856

D7: US-A-4 594 967

II. Claims 1 and 11 of the patent as granted read as follows.

"1. A method of operating a circulating fluidized bed system, utilizing

- a combustion chamber (12), having a fluidized bed of solid particles therein;
- a particle separator (14) connected to a discharge opening (18) in the upper portion of the combustion chamber (12);

- a return duct (16) connected at an upper portion thereof to the particle separator (14) and at a lower portion to the combustion chamber (12); the method comprising the steps of:

- (a) establishing a fast fluidized bed of solid particles in the combustion chamber (12) so that a particle suspension comprising flue gases and solid particles entrained therein is caused to flow upwardly in the combustion chamber (12) and to be discharged through the discharge opening (18);
- (b) separating solid particles from the particle suspension in the particle separator (14);
- (c) directing separated solid particles into the return duct (16);

characterized by:

- (d) establishing a bed of solid particles in the return duct (16) having a heat exchanger chamber (36) in a lower portion thereof;
- (e) reintroducing solid particles directly from the heat exchanger chamber (36) having a wall section (22a) in common with the combustion chamber (12), into the combustion chamber through a solid particle inlet (42) disposed in the common wall section (22a);
- and
- (f) introducing additional solid particles directly from the combustion chamber (12) into the lower portion of the return duct

(16) through a passage (52) in the common wall section (22a)."

"11. A circulating fluidized bed reactor system comprising:

- a combustion chamber (12), having a fast fluidized bed of particles therein and an upper portion, a discharge opening (18) from said upper portion, and a lower portion;
- means for introducing fluidizing gas into said combustion chamber (12);
- a particle separator (14) connected to the discharge opening (18), for separating solid particles from a particle suspension discharged from the combustion chamber (12) through said discharge opening (18);
- a return duct (16) having upper and lower portions, and connected at its upper portion to said particle separator (14) and in its lower portion to said combustion chamber (12), for recycling separated solid particles from the particle separator (14) into said lower portion of said combustion chamber (12);

characterized by:

- a heat exchanger chamber (26) formed in the lower portion of said return duct (16) and having a bed of solid particles therein, for recovering heat from solid particles being recycled through the return duct,
- a wall section (22a) in common with said combustion chamber (12) and at least said heat exchanger chamber portion (36) of said return

- duct (16);
- a solid particle inlet (42) in the common wall section (22a), for introducing solid particles from the heat exchanger chamber (36) into the combustion chamber (12); and
- means for introducing solid particles directly from said combustion chamber (12) into said heat exchanger chamber (36)."

III. The appellant lodged the appeal on 14 June 1999 paying the appeal fee on the same date. On 29 September 1999 he submitted the Statement of Grounds of Appeal, together with three new sets of claims as auxiliary requests.

In a letter dated 7 April 2000, the respondent (opponent) contested the arguments of the appellant and the admissibility of the newly filed sets of claims.

In response to a preliminary opinion of the board of appeal, which was sent to the parties together with the summons to oral proceedings, the appellant filed on 22 May 2001 four new sets of claims as auxiliary requests, replacing the previous ones.

Oral proceedings took place on 26 June 2001. An amended column 7 of the patent description was filed by the appellant during these proceedings.

IV. The appellant argued as follows:

One advantage of the present invention is to have the heat exchanger chamber at the lower section of the return duct, so that it is possible to add heat transfer surfaces to the reactor system without having

to modify the combustion chamber, apart from the provision of the openings in the common wall between said chamber and the return duct. The other advantage, namely an easier control of the heat transfer under all load conditions, is achieved by the provision of the passages according to features (e) and (f) of claim 1 of the patent in suit. In particular during low load conditions, particles can be transferred from the combustion chamber into the heat exchanger chamber, so that the heat transfer capacity is maintained.

In D1, the described bed cooler is a heat exchanger chamber, which surrounds the lower part of the combustion chamber and is part of this chamber, as is clearly indicated in this document and moreover visible in the drawings. Thus, there is no common wall provided with the passages according to features (e) and (f) of claim 1. A similar situation is found in the reactor system according to D7. The heat exchanger shown in D3 is located in a pocket formed by the walls of the combustion chamber, see column 3, lines 50 to 58 of this prior art, and finally in D6, there is no disclosure or suggestion of feature (f) of claim 1.

V. The respondent challenged these arguments as follows:

In the present case, what is first important is to see how the return duct is defined: According to the preamble of claim 1, it is given as a passage which is connected at its upper part to the separator and at its lower part to the combustion chamber in order to recycle the particles separated in the separator into the lower part of the combustion chamber. Moreover, according to features (e) and (f) of claim 1, it has to have a common wall with the combustion chamber with

passages through this wall so that particles are introduced from the heat exchanger chamber into the combustion chamber and vice versa. The return duct is therefore essentially defined by its function.

In the arrangement shown in Figure 1 of D1, the particles separated in the separator fall through a duct into a heat exchanger chamber and then they are recycled, still by means of a duct, into the lower part of the combustion chamber. The expressions "common wall" and "lower section of the return duct" of claim 1 are to be relativised in the patent in suit, since according to its description - see column 11, lines 50 to 54, the bottom of the return duct is staged and the heat exchanger is disposed above the bottom of the return duct with a lower section provided between the heat exchanger and the discharge outlet of the particles. D1 discloses that particles coming from the combustion chamber are directly introduced into the heat exchanger chamber. Therefore, all the features of claim 1 are anticipated by the arrangement disclosed in D1. Since D7 discloses a similar fluidized boiler, the same arguments and conclusion apply, the only difference being an intermediate chamber between the heat exchanger chamber and the combustion chamber. Such an intermediate chamber was previously disclosed in the patent in suit.

The reactor system disclosed in D3 leads to the same conclusion. The pocket containing the heat exchanger at the lower section of the reactor is said to be part of the combustion chamber, but it can be as well considered to be part of the return duct having regard to the functional definition of claim 1. One cannot argue that this pocket requires a deformation of the

walls of the combustion chamber, since this is also the case with the present invention, in which the tubes forming the wall of the combustion chamber have to be deformed for realizing the passages according to features (e) and (f) of claim 1. Passages corresponding to these features are respectively shown at the bottom and at the top part of the pocket according to D3 and, between these passages, a common wall separates the heat exchanger chamber from the combustion chamber. In the introductory part of the description of the contested patent, it is indicated that, in a reactor system known from another prior art document, namely D6, the heat exchanger chamber is located in the bottom of the return duct. However, the arrangement shown in D6 is similar to that of D3, namely a heat exchanger located in a pocket realized by deformation of the wall tubes of the combustion chamber.

Thus, the pocket shown in D3 can in the same way be considered as being located in a lower portion of the return duct.

The subject-matter of claim 1 also does not imply an inventive step, having regard to D1 and D3. Both documents deal with the problem of the control of heat transfer in all load conditions and solve this problem by controlling the quantity of particles circulating through the heat exchanger chamber, as is the case with the present invention. The person skilled in the art, starting from the reactor according to Figure 1 of D1 and looking for a more compact device, will therefore consider the solution according to D3 and locate the heat exchanger chamber at the end of the duct (5) of D1.

VI. The appellant requested that the decision under appeal be set aside and that the patent be maintained either as amended during the present oral proceedings (description, column 7) or on the basis of one of the four auxiliary requests filed with the letter dated 22 May 2001.

The respondent requested the appeal to be dismissed.

Reasons for the Decision

1. The appeal is admissible.
2. The only amended part of the patent in suit concerns the part of the description of the patent in column 7, lines 7 to 9, which mentions the possibility of providing an intermediate chamber between the heat exchanger and combustion chambers. Since this part contradicts or at least casts doubt on the meaning of the term "directly" of feature (e) of claim 1, it was deleted. Such a deletion, which only aims at avoiding a lack of clarity, does not introduce new subject-matter, since a direct passage is clearly disclosed just before this part. This deletion is therefore admissible (Article 123 EPC).
3. The whole arguments of the respondent are based on a broad interpretation of one expression of feature (d) in claim 1, namely "in the lower portion of the return duct". Although the term "duct" as such is clear, having usually a structural meaning, and therefore is more restrictive than the function implied by such a term, the respondent and also the opposition division in the decision under appeal interpreted this term as

meaning a "passage" or "path", whatever the means for defining the passage are. Such an interpretation may be acceptable if there are reasons in the patent in suit for this, that is to say if according to Article 69 EPC a basis for a broad interpretation can be found in the description and drawings of the patent. However, in the present case, such reasons do not appear:

3.1 Figures 1 and 2 of the patent in suit and the description clearly disclose **a distinctive duct** which is limited by walls and connects the lower outlet of the separator to (the lower part of) the combustion chamber, see in particular the last lines of column 7 of the description. The walls of the duct are described in column 9, lines 1 to 14, and there is no suggestion that these walls could be omitted. One of these walls forms the common wall between the return duct and the combustion chamber and is provided with passages or inlets, one passage for introducing solid particles directly from the combustion chamber into the return duct being disposed above the bed of solid particles of the heat exchanger chamber and the other passage being located under this bed for the introduction of particles in the opposite direction.

3.2 The fact that in the patent in suit the bottom of the return duct is staged and that the heat exchanger chamber is disposed above this staged bottom does not prevent the heat exchanger chamber from still being disposed **in a lower portion of the return duct**, as required by claim 1, and, thus, provides no reason to understand the term "duct" only in the light of its function, that is to say to interpret it as broadly meaning "the passage of the particles". Moreover, such a broad interpretation, which could cover for example a

passage of the particles inside the combustion chamber and thus a modification of this chamber itself, is clearly inconsistent with one object of the present invention, namely to avoid the necessity of at least substantially altering the combustion chamber, see in this respect page 14 of the description as originally filed or the corresponding passage in column 7, line 52 to column 8, line 8 of the description of the patent in suit, as granted. It is true that a slight modification of the wall of the combustion chamber, which forms the "common wall", is needed for the provision of the passages of particles according to features (e) and (d) of claim 1, so that the above object may be relativised, but this has no influence on the solution itself as claimed, which clearly requires the location of the heat exchanger chamber in the lower portion of a return duct.

- 3.3 In the introductory part of the description of the patent in suit, reference is made to document D6, which according to this part of the description discloses the location of a heat exchanger chamber in the bottom of a return duct. However, this information relating to the content of D6 must be treated with caution since the true disclosure of this prior art indicates generally that the heat exchanger chamber is an integral part of the combustion chamber. According to Figure 2 of this document and the detailed part of the description - see column 8, lines 7 to 14 and lines 51 to 60, - the heat exchanger chamber is preferably formed from an inward deformation of the combustion chamber wall and one recycle leg, which corresponds to the return duct of the present invention, is said to open into this heat exchanger chamber; this is shown in the figure. There is no disclosure of the heat exchanger as being part of

the return duct and , as mentioned above, it is not the case. Therefore, although this part of the description of the patent in suit might mislead the reader into interpreting the above expression of feature (d) of claim 1 in a broad way, it cannot be used for this purpose, since it is clearly in error.

3.4 To sum up, in claim 1 of the patent in suit, the above mentioned expression of its feature (d) has not to be interpreted beyond the usual meaning of its wording and is to be understood as at least meaning the lower portion of a real duct limited by walls, the section of this duct being possibly variable. The same applies for claim 11.

4. Because of this interpretation, the novelty objections of the respondent concerning the subject-matter of claims 1 and 11 are not justified:

D1 and D7 clearly disclose a heat exchanger chamber, also called bed cooler, which is enclosed inside the walls of, and thus is part of the combustion chamber, surrounding or being beside the lower chamber or portion of the combustion chamber in which the fluidized bed of the combustion chamber is disposed. A vertical partition separates the heat exchanger chamber and this lower chamber. The heat exchanger chamber and the fluid bed have in common the upper portion or top chamber of the combustion chamber, so that particles, which are laden in the gas exhausting from the fluidized bed of the combustion chamber can directly drop down into the fluidized bed of the heat exchanger chamber. A first duct connects the bottom of the separator to the heat exchanger chamber and a second duct connects directly (D1) or indirectly (D7) the

bottom of the heat exchanger chamber to the fluidized bed of the combustion chamber, so that by means of this second duct particles coming from the heat exchanger can be introduced into the combustion chamber. The respondent and the opposition division have equated the first duct, the heat exchanger chamber and the second duct to the single return duct of the present invention, although the heat exchanger chamber, as seen above, is not inside a duct and is clearly part of the combustion chamber.

D3 discloses a heat exchanger with its fluidized bed, which is disposed in a pocket of the combustion chamber wall in a lower part of said chamber, just above the central fluidized bed of the combustion chamber. The upper and opened part of the pocket is so arranged that particles coming either from the just above disposed outlet of the separator discharge duct or from the side walls of the combustion chamber fall down directly into the pocket and thus into the fluidized bed of the heat exchanger. This pocket is separated from the central part of the combustion chamber by a wall, and a duct or opening in the bottom of the pocket permits the direct discharge of particles from the pocket into the central fluidized bed of the combustion chamber. In this document D3, the pocket is expressly given as being formed in the lower part of the combustion chamber and the return duct coming from the separator discharges the particles above this pocket, so that the exchanger chamber cannot be considered as being part of the return duct.

As already seen above in point 3.3, in the fluidized reactor according to D6, the heat exchanger chamber is not part of the return duct. Moreover, in this prior

art, there is no possibility for the particles to be introduced from the combustion chamber into the heat exchanger chamber, since this last chamber is at a higher pressure than the pressure in the combustion chamber (column 3, lines 59 to 66). Thus, additionally to feature (d), feature (f) of claim 1 of the patent in suit is also not known from this prior art.

The other documents, which were cited by the respondent, are less relevant and were not mentioned during the oral proceedings before the board of appeal.

Thus, the subject-matter of both independent claims 1 and 11 of the contested patent is new (Articles 52 and 54 EPC).

5. As seen above, none of the cited documents discloses or suggests a circulating fluidized bed reactor system having a heat exchanger chamber located in the lower part of the return duct of the separator. Both documents D1 and D3, which were combined by the respondent to support his arguments against the presence of an inventive step, teach a location inside the combustion chamber and, thus, cannot suggest the first feature (feature (d) in claim 1) of the characterising portion of both independent claims 1 and 11. Therefore, the subject-matter of both these claims involves an inventive step (Articles 52 and 56 EPC).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent as granted with the provision that the description, at column 7, lines 6 to 10, is amended to read: "The particles are reintroduced directly from the heat exchanger chamber into the combustion chamber."

The Registrar:

The Chairman:

A. Counillon

C. T. Wilson