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**Datasheet for the decision
of 25 July 2011**

Case Number: T 0321/09 - 3.2.03

Application Number: 04731172.5

Publication Number: 1716379

IPC: F28F 13/06

Language of the proceedings: EN

Title of invention:

Enhanced radiant heat exchanger apparatus

Applicant:

Pycos Engineering Ltd.

Headword:

-

Relevant legal provisions:

EPC Art. 56

Relevant legal provisions (EPC 1973):

-

Keyword:

"Inventive step (yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 0321/09 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 25 July 2011

Appellant: Pycos Engineering Ltd.
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 19 September 2008
refusing European patent application
No. 04731172.5 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: U. Krause
Members: C. Donnelly
K. Garnett

Summary of Facts and Submissions

- I. The appeal lies from the decision of the examining division, posted on 19 September 2008, refusing European application no. EP04731172.5.
- II. The applicant (hereinafter "the appellant") filed a notice of appeal against this decision on 18 November 2008 and paid the fee the same day. The grounds of appeal, dated 16 January 2009, were received on 19 January 2009.
- III. The following documents were mentioned in the contested decision:
- D1: GB-A-813565;
D2: DE-A-3702963
D4: FR-A-2760465;
D5: WO-A-9856872;
D6: US-A-5763724;
D7: US-A-4342642;
D8: FR-A-2688797;
D9: DE-A-3045731.
- IV. Essentially the examining division argued that the subject-matter of claims 1 and 2 lacked an inventive step in view of either D7 or D8 in combination with D2 or D9 (the publication numbers of which are not given in the decision, but are to be found in the IPER and communication of 20 May 2008 respectively).
- V. In a communication dated 10 May 2010, pursuant to Article 15(1) RPBA annexed to the summons to oral

proceedings, the Board informed the appellant of its provisional opinion.

VI. Oral proceedings before the Board were held on 25 July 2011. At the end of the discussions, the appellant made a sole request for the grant of a patent on the basis of claims 1 and 2 as filed during the oral proceedings.

VII. Claim 1 as filed during the oral proceedings of 25 July 2011 reads:

"A steam cracking furnace including a firebox (2), floor burners (3) and a radiant coil (5) comprising several radiant heat exchange devices (10) arranged in series within the firebox (2) and wherein the radiant heat exchange devices (10) each comprise a tube (11) to be heated by the burners (3) and inside the tube (11) at least one body (12) located inside of said tube (11) so that fluid (F) flowing in said tube flows around said body (12) which is adapted to receive radiative energy emitted by the enclosing tube (11) characterised in that said body (12) is a cylinder (16), equipped at the two ends with ogives of which one ogive is arranged at the end (15) facing an incoming fluid and the other ogive (15') is arranged at the opposite, downstream end and in that said tube (11) defines with said cylinder (16) an annular space (18) for the fluid (F) to flow there through and in which said cylinder (16) is centered inside of the tube (11) to realize an annulus (18) of a constant width to allow a uniform heat transfer to the fluid (F) and in that the centered position is effected by means of at least one spacer (13), preferably a plurality of spacers, each consisting of three elements

disposed at an angle of 120 degrees in order to avoid irregular disturbances of the fluid flow and in that said cylinder (16) is supported by a support (14), preferably in proximity of the downstream end (15')."

Claim 2 as filed during the oral proceedings of 25 July 2011 reads:

"A method of increasing the selectivity and reducing deposit of coke, creep and carbonization in a steam cracking furnace of an ethylene plant by increasing the heat transfer rate with a shorter contact time and a lower tube metal temperature, wherein the metal is heated to a temperature of 900°C to 1175°C and the temperature of the process gas is between 600°C and 900°C and a radiant coil (5) of the furnace comprises several radiant heat exchange devices (10) in series each comprising a tube (11) to be heated to the radiant coil temperature which tube is equipped inside with at least one body located inside of said tube (11) so that fluid (F) flowing in said tube flows around the said body (12) which is adapted to receive radiation energy from the heated tube (11) and to transfer it by convection to the process gas flowing in the tube characterized in that said body (12) is a cylinder (16), equipped at the two ends with ogives of which one ogive is arranged at the end (15) facing an incoming fluid and the other ogive (15') is arranged at the opposite, downstream end and that said tube (11) defines with said cylinder (16) an annular space (18) for the fluid (F) to flow there through and in which said cylinder (16) is centered inside of the tube (11) to realize an annulus (18) of a constant width to allow a uniform heat transfer to the

fluid (F) and the centered position is effected by means of at least one spacer (13), preferably a plurality of spacers, each consisting of three elements disposed at an angle of 120 degrees in order to avoid irregular disturbances of the fluid flow and in that said cylinder (16) is supported by a support (14), preferably in proximity of the downstream end (15')."

Reasons for the decision

1. The appeal is admissible.
2. Amendments - Article 123(2) EPC
 - 2.1 Amended claim 1 is based on originally filed claims 1 to 7 for the characteristics relating to the radiant heat exchange device and the original description, page 6, lines 1 to 5 for the features of the steam cracking furnace. The definition that "the body is a cylinder" is given at page 6, line 33.
 - 2.2 Claim 2 is based on the originally filed claim 11 and the original description, page 3, lines 23 to 26 for the definition of the temperature ranges and page 4, lines 12 to 27 for the part relating the objective of the claim.
 - 2.3 Thus, the requirements of Article 123(2) EPC are met.

3. Novelty/inventive step

3.1 D8 is considered to be the nearest prior art. Figures 1 to 3 of this document relating to a first embodiment disclose:

a steam cracking furnace including a firebox (10), burners (20) and a radiant coil comprising several radiant heat exchange devices arranged in series within the firebox (10) and wherein the radiant heat exchange devices each comprise a tube (14) to be heated by the burners (20) and inside the tube at least one body (22) located inside of said tube (14) so that fluid flowing in said tube flows around said body (22) which is adapted to receive radiative energy emitted by the enclosing tube (14)

wherein

said body (22) comprises a cylinder, closed at the two ends and said tube (14) defines with said body (22) an annular space for the fluid to flow there through and in that the position of the body is effected by means of a plurality of spacers (28) (see page 9, lines 25 to 29), and in that said body (22) is supported by a support (28).

3.2 The subject-matter of claim 1 differs therefrom in that it comprises:

(i) - floor burners; and

(ii) - the body is a cylinder;

(iii)- which cylinder is centered inside of the tube to realize an annulus of a constant width to allow a uniform heat transfer to the fluid; and

(iv) - is equipped at the two ends with ogives of which one ogive is arranged at the end facing an incoming fluid and the other ogive is arranged at the opposite, downstream end; and in that each spacer consists of:

(v) - three elements disposed at an angle of 120 degrees in order to avoid irregular disturbances of the fluid flow.

3.3 Feature (i) can be considered separately from the other distinguishing features and is generally known in the art (see for example D5 - burners 28). The other features interact technically to influence the flow of the fluid through the tube and around the body in order to minimise coking and pressure losses.

3.4 The Board agrees with the applicant that the body of the embodiment depicted in figures 1 to 3 of D8 is not a cylinder, but rather comprises a cylinder supporting the surface-area-extending wing elements 24. Therefore, even when such a body is centered inside of the tube, it cannot realize an annulus of a constant width, due to the outwardly extending wing elements 24. Furthermore, heat transfer in such an arrangement would not be uniform since it would tend to be concentrated at these wing elements, which are specifically intended to increase the heat transfer area.

3.5 The application explicitly advises against the use of extended surfaces (see page 2, lines 34 to 37) and

shows nothing other than a plain cylinder as the radiative heat absorbing body. Thus, within the context of the application, the skilled person would understand the definition that "the body is a cylinder" to mean that any extended surface additions are excluded. Consequently, in the arrangement of the invention the heat transfer would be evenly distributed around the whole outer periphery of the cylinder in contact with the fluid.

- 3.6 Hence, the invention adopts a different approach to that of the prior art. The elimination of extended surfaces in favour of a simple cylinder fitted with ogives solves the problem of coking by reducing stagnation of the feed gas at surface discontinuities and evening out heat transfer.
- 3.7 The cylindrical element 22 of D8 is only disclosed in combination with the wings 24 in all the embodiments and in claim 6. The geometries of the axial bodies covered by claim 1 of D8 are not specified. Further, although figure 4 of D8 shows a tapered cylindrical body with rounded ends which could be seen as corresponding to a type of ogive, no further details are given. Thus, D8 does not implicitly disclose a wingless cylindrical body equipped with ogives.
- 3.8 Figures 2a and 2b of D7 show devices wherein a tube is fitted with an insert 100;120 comprising a cylindrical body 111;121 supporting surface extending members 112;122 which divide the interior of the tube into three separate passages along the whole of its length. Thus, neither a cylinder nor an annulus in the sense of claim 1 is present.

- 3.9 D2 and D9 are not concerned with enhanced radiation heat exchangers and do not mention radiation heat transfer. Thus, these documents would not be consulted by the skilled person faced with the problem of reducing coking whilst maintaining heat transfer by radiation in cracking furnaces.
- 3.10 D1 shows a different type of insert body. D4 and D5 do not show an insert body. D6 does not show any details of the tube exchanger.
- 3.11 Thus, there is neither a disclosure nor a suggestion in the available prior art of the solution provided by the combination of at least the distinguishing features (ii), (iii) and (iv) defined above.
- 3.12 Hence, the subject-matter of claim 1 according to the sole request meets the requirements of Article 54 and 56 EPC.
- 3.13 The independent method claim 2 comprises the same distinguishing features and similar considerations apply.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the Examining Division with the order to grant a patent on the following basis:
 - (a) Amended claims 1 and 2;

 - (b) The amended description (8 pages);

 - (c) Figures 1,2a and 2b (sheets 1/2 and 2/2);

all as filed during the oral proceedings held on
25 July 2011.

Registrar:

Chairman:

M. Kiehl

U. Krause