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D E C I S I O N
of 14 December 2005

Case Number: T 1019/01 - 3.3.05

Application Number: 96938352.0

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Title of invention:
Atomiser nozzle

Applicant:
Innovene Europe Limited

Opponent:
-

Headword:
Atomiser nozzle/INNOVENE EUROPE LIMITED

Relevant legal provisions:
EPC Art. 123(2), 56

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"Inventive step (yes) "

Decisions cited:
T 0158/97

Catchword:
-



Case Number: T 1019/01 - 3.3.05

D E C I S I O N
of the Technical Board of Appeal 3.3.05
of 14 December 2005

Appellant: Innovene Europe Limited
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 13 March 2001
refusing European application No. 96938352.0
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: M. Eberhard
Members: E. Wäckerlin
J. Willems

Summary of Facts and Submissions

- I. The appeal was lodged against the decision of the examining division refusing patent application No. 96 938 352.0 relating to a nozzle suitable for use for the injection of liquid into a fluidised bed, as well as two processes using such nozzle. The decision was based on the amended set of claims submitted during the oral proceedings before the examining division.
- II. The examining division held that the nozzle according to claim 20 did not involve an inventive step having regard to document D1 (US-A-4 434 049). It was admitted that *prima facie* there existed no incentive to modify the nozzle described in D1, but in the absence of a technical effect related to this modification the examining division regarded the latter as "technically non-functional" within the meaning of the decision T 0158/97 and, thus, irrelevant for inventive step considerations.

The process according to claim 1 was also found to lack an inventive step for the same reasons, because it merely defined the usual use of the nozzle of claim 20 for introducing liquid into a fluidised bed, and introduction of atomised liquid into a fluidised bed was taught by D1.

With regard to the process set out in claim 2 the examining division held that, starting from D2 (WO 94/28032) as the closest prior art, it was obvious to use a nozzle according to D1 in the process of D2. In addition, the provision of the mechanical device within the liquid inlet was merely an arbitrary

constructional difference to which no technical effect could be attributed.

III. With his statement of grounds of appeal dated 13 July 2001 the appellant submitted three sets of claims as the main request and two auxiliary requests.

IV. Independent claims 1, 2 and 20 of the main request, which correspond essentially to those filed on 31 January 2001, read as follows:

"1. A process for the introduction of liquid directly into a fluidised bed which comprises:

- (a) pressurising the liquid;
- (b) feeding the pressurised liquid to a liquid inlet of an atomising chamber of a nozzle;
- (c) preatomising the liquid using a mechanical device, which is not the liquid inlet opening per se, positioned within the liquid inlet;
- (d) feeding assisting atomising gas to a gas inlet of the atomising chamber;
- (e) atomising the preatomised liquid in the atomising chamber using the assisting atomising gas; and
- (f) discharging the atomised liquid as a spray into the fluidised bed through at least one outlet of the atomising chamber.

2. A continuous gas fluidised bed process for the polymerisation of olefin monomer selected from (a) ethylene, (b) propylene, (c) mixtures of ethylene and propylene and (d) one or more other alpha-olefins mixed with (a), (b) or (c), in a fluidised bed reactor by continuously recycling a gaseous stream comprising at least some of the ethylene and/or propylene through a

fluidised bed in said reactor in the presence of a polymerisation catalyst under reactive conditions, at least part of the said gaseous stream withdrawn from said reactor being cooled to a temperature at which liquid condenses out, separating at least part of the condensed liquid from the gaseous stream and introducing at least part of the separated liquid directly into the fluidised bed by:

- (a) pressurising the liquid;
- (b) feeding the pressurised liquid to a liquid inlet of an atomising chamber of a nozzle;
- (c) preatomising the liquid using a mechanical device, which is not the liquid inlet opening per se, positioned within the liquid inlet;
- (d) feeding assisting atomising gas to a gas inlet of the atomising chamber;
- (e) atomising the preatomised liquid in the atomising chamber using the assisting atomising gas; and
- (f) discharging the atomised liquid as a spray into the fluidised bed through at least one outlet of the atomising chamber.

20. A nozzle suitable for use for the injection of liquid into a fluidised bed said nozzle comprising:

- (a) an atomising chamber;
- (b) a liquid inlet to the atomising chamber;
- (c) a gas inlet to the atomising chamber; and
- (d) at least one atomising liquid outlet from the chamber,

characterised in that within the liquid inlet there is provided a mechanical device, which is not the liquid inlet opening per se, to preatomise the liquid."

- V. The appellant's arguments concerning the main request can be summarised as follows:

The invention relates to a nozzle which allows for improved control of injection of liquid into a fluidised bed in a continuous process for the gas-phase polymerisation of olefins. During scale-up of gas-liquid nozzles, it turned out to be necessary to increase the amount of atomising gas relative to the amount of liquid injected into the bed in order that efficient atomisation of the liquid could be maintained and also to maintain effective dispersion and penetration of liquid into the fluidised bed. Large scale nozzles required significantly increased amounts of atomising gas. It was found that by using a mechanical device within the liquid inlet of the nozzle to preatomise the liquid, the amount of gas required to atomise the liquid can be considerably reduced.

Document D1 discloses a nozzle which is suitable for the injection of an atomised high boiling oil stream into a FCC riser. The nozzle includes an oil inlet and a pipe wherein a gaseous material such as steam and/or CO₂ is used as a high velocity gaseous stream. The first section of the pipe comprises an impingement device, which is thus not located within the liquid inlet *per se*. Consequently the oil sees first the high velocity gaseous material stream before it impinges on the impingement device. In D1 the nature of the liquid medium (oil), the nature and the amount of the high velocity gaseous material (steam), "the sequence of (oil + high velocity gaseous material) before (impingement)" and the size of the elongated barrel represent a combination of features which is not only

different from what is disclosed in the present invention but furthermore which inherently leads to functional differences which make it useless for responding to the problem underlying the present invention.

In particular the objective of reducing the amount of atomising gas in order to be able to introduce a higher amount of liquid in the polymerization fluidised bed without provoking a bed collapse, which is achieved by the present invention, is not achieved by the nozzle of D1, nor even addressed as a problem. D1 teaches away from a direct impingement of a liquid onto a mechanical device as stated in column 5, lines 56-61 of D1. Thus, there is a prejudice to modify the nozzle device of D1 in order to arrive at the present invention.

Consequently the subject-matter of the claims fulfils the requirements of novelty and inventive step in respect of the teaching of D1.

- VI. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the claims according to the main request submitted with the grounds of appeal dated 13 July 2001 or, alternatively, on the basis of the first or second auxiliary requests also filed together with the grounds of appeal.

Reasons for the Decision

Main request

1. *Amendment of claims 1, 2 and 20*

1.1 During the oral proceedings held on 31 January 2001 before the examining division the appellant amended the claims by inserting the expression "which is not the liquid inlet opening per se" after "mechanical device" into feature (c) of claims 1 and 2, and into the characterising part of claim 20. The board considers that this amendment is in conformity with Article 123(2) EPC, since each of the figures 1, 2 and 3, and the corresponding explanations in the description as originally filed show that the "mechanical device" is, in fact, a distinct element arranged within the liquid inlet opening, but not the inlet as such (see figure 1 and page 17, lines 4-5, reference signs 9 and 8; figure 2 and page 17, lines 16-17, reference signs 9 and 10; figure 3 and page 17, lines 20-22, reference signs 9, 11).

2. *Novelty of the nozzle according to claim 20*

2.1 D1 discloses a process for effecting the catalytic conversion of hydrocarbons, in particular a process for fluid catalytic cracking of residual oil, which makes use of a special nozzle for the atomisation of the high boiling residual oil stream (see col. 1, lines 6-11; col. 2, lines 38-48; claim 2). The nozzle comprises the following elements:

- an atomising and mixing chamber (A) and a barrel member (B);

- a liquid inlet (58) to the atomising and mixing chamber (A);
 - a gas inlet (50) to the atomising and mixing chamber (A);
 - at least one atomised liquid outlet (62) at the tip of the nozzle;
- and
- an impingement device (52, 54) for preatomising the oil feed.

The impingement device is arranged in the atomising and mixing chamber (A) itself and not within the liquid inlet (50) (see D1, col. 10, lines 9-36 and figure 2; col. 4, lines 51-67, in particular lines 58-59; col. 9, lines 7-16 and lines 54-66; col. 10, lines 10-34). The claimed nozzle differs from that of D1 by the mechanical device (to preatomise the liquid) being located within the liquid inlet. Thus, the nozzle according to claim 20 is novel over D1.

- 2.2 D2 relates to a continuous gas phase fluidised bed process for the polymerisation of various olefin monomers. It discloses a nozzle comprising the features (a) to (d) set out in the preamble of claim 20. The nozzle does not include a mechanical device for preatomising the liquid (see D2, page 19, lines 1-6; page 19, line 34 to page 20, line 13; figure 2; claim 15). Thus, the nozzle according to claim 20 is also novel over D2.

3. *Inventive step of the nozzle according to claim 20*

- 3.1 The board considers that document D2 represents the closest prior art. D2 relates to the same technical

field as the present application, namely a continuous gas fluidised bed process for the polymerisation of olefin monomer selected from (a) ethylene, (b) propylene (c) mixtures of ethylene and propylene and (d) mixtures of a b or c with one or more other alpha-olefins, said process involving the use of a gas-induced atomiser nozzle which is specifically designed for carrying out the said process (see D2, page 5, line 32 to page 6, line 12; page 19, line 1 to page 20, line 13; claims 2 and 15). Document D1 is less relevant, because it relates to a completely different process, namely the fluid catalytic conversion (FCC) of high boiling residual oil feed material. Accordingly, the atomiser nozzle disclosed in D1 is especially designed for the FCC process (see D1, col. 3, lines 29-37; col. 9, line 17 to col. 10, line 48; Figure 2).

Even if the nozzle of D1 as such might be considered to be structurally closer to the claimed nozzle than the nozzle of D2, this alone does not justify taking D2 as the closest prior art, since the nozzle of D1 is used in a technical field which is very different from that of the present patent application (contrary to D2) and the technical problems arising in these different fields are also different. Therefore the choice of D1 as the closest prior art instead of D2 is based, in the board's view, on an *ex-post facto* analysis of the case.

- 3.2 Starting from D2 as closest prior art, the technical problem to be solved can be seen in providing a nozzle which allows to reduce the amount of atomising gas relative to the amount of liquid injected into the fluidised bed in the gas phase polymerisation of olefin monomers, while maintaining efficient atomisation of

the liquid and also effective dispersion and penetration of liquid into the fluidised bed (see application, page 5, lines 13-26).

- 3.3 In view of the experimental results given in the present application, it is credible that the technical problem has actually been solved by providing a mechanical device within the liquid inlet of the nozzle, to preatomise the liquid. It was found that the amount of gas required for a conventional nozzle without a mechanical device for preatomising the liquid, as disclosed in D2, is 7 % by weight at an injection rate of 30 m³/h. If the nozzle is equipped with a mechanical device in accordance with claim 20 of the present application, the amount of gas required drops to 2 % by weight, i.e. to less than one third (see page 18, table 1, first experiment).
- 3.4 D2 itself does not provide any hint towards the claimed solution of the problem. Therefore the question arises whether the skilled person would have combined D2 with D1 in order to solve the said problem.

D1 deals with the injection of a highly atomised heavy oil feed material in a FCC riser, whereby the technical problem is addressed to achieve intimate high temperature atomized and substantially instantaneous vaporized contact between a relatively high boiling oil feed material with suspended hot fluid catalyst particles (see col. 1, lines 6-11; col. 2, lines 38-44). According to Figure 2 of D1, the nozzle arrangement comprises an oil conduit inlet (48) with an orifice opening (50) which discharges the oil into an elongated pipe comprising a nozzle tip (C), a barrel member (B)

and an atomizing and mixing section (A). The atomizing and mixing section (A) comprises an impingement device in the form of a cylindrical member (54) with a surface (52) on which oil droplets are formed by impact. Further atomisation of the oil droplets is obtained by means of a gaseous material such as steam, CO₂ or a mixture thereof, which is charged to the atomizing and mixing section (A) at relatively high velocity (see col. 9, lines 54-66; col. 10, lines 9-37; col. 4, lines 51-68).

D1 addresses a different technical problem and contains no pointer to the solution according to present claim 20. The appellant has submitted that the nozzle disclosed in D1 is useless for solving the problem underlying the present application. In the nozzle of D1 the impingement device (54) is not located within the liquid inlet (50) *per se*, but within the atomising and mixing section (A) opposite said inlet (see col. 10, lines 17-18). Thus, the stream of oil feed material, preferably an emulsion of water and oil, comes into contact with the high velocity stream of gaseous material within the gap between the opening (50) and the cylindrical member (54) and impacts upon the surface (52) of said member under reduced oil surface tension conditions (see col. 3, lines 4-8 and col. 10, lines 10-23). The oil droplets thus formed are further atomised by the high velocity gaseous material stream and entrained along the barrel member (B) of the nozzle. This is different from the present nozzle, where the mechanical device for preatomising the liquid is arranged within the liquid inlet, so that the atomising gas has no contact with the liquid before pre-atomisation.

In the impugned decision the examining division stated that there is no *prima facie* incentive to change the location of the mechanical device, i.e. to position the mechanical device for the preatomisation within the liquid inlet. It was held, however, that this was not sufficient for the acknowledgment of an inventive step, because the constructional modification of the location of the mechanical device had to be regarded as a "technically non-functional" feature in the meaning of decision T 0158/97 (unpublished). It was pointed out that according to said decision technically non-functional modifications were irrelevant to inventive step, even if the skilled person would never have thought of such a modification (see T 0158/97, reasons 2.3).

In the board's view the technical circumstances underlying decision T 0158/97 are not comparable with the present case. There, it was found that the distinguishing feature, namely the presence of a third electrode in an apparatus for treating fluids, had at best no technical function and could even be technically disadvantageous (see T 0158/97, reasons 2.1 and 2.3). In contrast thereto the mechanical device of the claimed nozzle performs an essential function, i.e. the preatomisation of the liquid, and there can be no doubt that the location of said mechanical device within the liquid inlet has an impact on the whole atomisation process. For this reason the principle set out in point 2.3 of the reasons of decision T 0158/97 and referred to by the examining division is not applicable to the case of the present application.

In the absence of any evidence to the contrary the board holds that the statement by the appellant, according to which the nozzle of D1 cannot be used in the continuous fluidised bed process for the polymerisation of ethylene and/or propylene monomer, is plausible.

Even if the technical teachings of D1 and D2 were combined, this would still not lead to the nozzle according to claim 20. As a further step the design of the nozzle would have to be modified in order to arrange the impingement device **within the liquid inlet** instead of arranging it **opposite to the liquid inlet in the atomizing and mixing chamber** of the nozzle. Neither D1 nor D2 contain any pointer to such a modification, let alone a suggestion that the rearrangement of the impingement device might contribute to solve the problem stated above.

Therefore the board concludes that the claimed nozzle is not obvious having regard the disclosure of D1 and D2, taken alone or in combination.

3.5 For all these reasons the board holds that the nozzle according to claim 20 of the present application involves an inventive step within the meaning of Article 56 EPC.

4. *Novelty and inventive step of the processes according to independent claims 1 and 2, respectively*

Since the nozzle according to claim 20 is novel and inventive, the same applies to the independent claims 1 and 2, respectively, which involve the use of said

nozzle in processes for the introduction of liquid into a fluidised bed.

5. Claims 3 to 19 are dependent on claims 1 or 2; claim 21 is dependent on claim 20. Novelty and inventive step of these dependent claims follow from the dependencies.
6. In view of the above conclusions, there is no need to consider the appellant's auxiliary requests.

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 grant the patent on the basis of the following documents:
 - Claims 1 to 21 according to the main request filed with the grounds of appeal dated 13 July 2001.
 - Description and drawings of the PCT-application as published.

The Registrar

The Chairman

A. Wallrodt

M. Eberhard