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DECISION
of 16 October 2003

Case Number:	T 0007/01 - 3.3.3
Application Number:	92870154.9
Publication Number:	0536104
IPC:	C08F 10/00
Language of the proceedings:	EN

Title of invention:
Homogeneous - heterogeneous catalyst system for polyolefins

Applicant:
FINA TECHNOLOGY, INC.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 84

Keyword:
"Novelty (main request - no; auxiliary request - yes)"
"Inventive step (auxiliary request: problem and solution - no)"
"Claims - clarity (no)"
"Claims - scope of protection"
"Claims - support by description"

Decisions cited:
-

Catchword:
-

Case Number: T 0007/01 - 3.3.3

DECISION
of the Technical Board of Appeal 3.3.3
of 16 October 2003

Appellant:

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Decision under appeal:

Decision of the Examining Division of the European Patent Office posted 12 May 2000 refusing European application No. 92870154.9 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: R. Young
Members: A. Däweritz
J. Van Moer

Summary of Facts and Submissions

I. European patent application No. 92 870 154.9, filed on 23 September 1992, claiming the priority of 30 September 1991 of an earlier application in the United States of America (768783) and published under No. 0 536 104 on 7 April 1993, was refused by a decision of the Examining Division, issued in writing on 12 May 2000.

The decision was based on a set of claims submitted by letter dated 9 August 1999. Its independent Claims 1 and 14 read as follows:

"1. Use of a catalyst system for the polymerization of olefins comprising a combination of at least one homogeneous catalyst which is a metallocene catalyst comprising

a) a neutral metallocene of the general formula

$$R"_b(CpR_4)\ (CpR'_4)M'R^*_{v-2}$$

where R" is a bridge imparting stereo-rigidity to the structure to the metallocene by connecting the two cyclopentadienyl rings, b is 0 or 1, Cp is a cyclopentadienyl ring, R and R' are substituents on the cyclopentadienyl rings and can be a hydride or a hydrocarbyl from 1-9 carbon atoms, each R and R' being the same or different, each (CpR_4) and (CpR'_4) being the same or different, M' is a Group IIIB, IVB, VB or VIB metal, R^* is a hydride, a halogen or a hydrocarbyl from 1-20 carbon atoms, v is the valence of M', and

b) an ionizing agent which will ionize a neutral metallocene compound to form a cationic metallocene catalyst

in combination with at least one heterogeneous catalyst which is a conventional Ziegler-Natta transition metal compound catalyst comprising

a) a transition metal of the general formula MR^{+}_{x}, where M is a Group IIIB, IVB, VB or VIB metal, R^{+} is a halogen or a hydrocarboxyl and x is the valence of the metal and

b) an aluminum alkyl of the general formula $AlR^{\#}_{3}$ where $R^{\#}$ is an alkyl of from 1-8 carbon atoms and $R^{\#}$ may be the same or different, and

c) an electron donor organosilicon compound."

"14. Process for polymerizing propylene using the catalyst system of any one of claims 1 to 13."

The remaining dependent Claims 2 to 13 related to elaborations of the use according to Claim 1.

II. In particular, the decision held that these claims met the requirements of Articles 123(2) EPC.

(a) Moreover, novelty was acknowledged over each of documents

D1: EP-A-0 436 238 and

D2: EP-A-0 436 399.

In view of the submission of the Applicant in a letter dated 1 September 1995 that an aluminium alkyl alone could not ionise the metallocene catalyst, as illustrated by

D3: EP-A-0 427 697,

filed therewith, the difference from D1 was seen in the fact that the catalyst system used according to Claims 1 or 14 contained an ionising agent by which a cationic metallocene catalyst was formed from the neutral metallocene compound.

From D2, the claims differed in that the above catalyst system contained an external electron donor for the Ziegler-Natta catalyst.

(b) The technical problem to be overcome with regard to D1, which represented the closest state of the art, was seen in the provision of a way to polymerise olefins, in particular propylene, to polyolefins, in particular polypropylene, having a broader molecular weight distribution (MWD).

According to comparative experiments filed by letter dated 15 October 1998, this problem was solved by the presence of methylaluminoxane (MAO) as an ionising agent. Since this solution of the technical problem had already been known from D2, the subject-matter of claims 1 to 13 did not involve an inventive step in view of the combined teachings of the two cited documents.

The limitation of Claim 14 to the polymerisation of propylene did not render the claim inventive either, because propylene had been referred to in D2 as a suitable monomer.

Moreover, since the application did not provide any information whatsoever about the stereospecificity of the polypropylene obtained according to Claim 14, this feature was not important for the claimed subject-matter and could not, therefore, be taken into account for the assessment of inventive step.

Consequently, the subject-matter of Claims 1 to 14 did not involve an inventive step.

III. On 14 July 2000, a Notice of Appeal against the above decision was lodged by the Appellant (Applicant). The prescribed fee was paid on the same date.

In the Statement of Grounds of Appeal, received on 14 September 2000, the reasons for the decision were contested.

The arguments submitted by the Appellant may be summarised as follows:

Whilst it had been shown by the Appellant that only one variable instead of at least four needed to be changed to solve the technical problem, document D2 did not teach that an increase in MAO would result in polyolefins of broader MWD, but would rather have led the person of ordinary skill to change the Zr/Ti ratio, use an aluminium alkyl compound and change the solubility of the organoaluminium oxy-compound in addition to changing the amount of MAO to affect MWD. Moreover, the examples of D2 related to polyethylene and did not involve the use of an electron donor.

Nor was a person skilled in the art led by a combination of D1 and D2 to use an external electron donor together with a combination of a homogeneous (metallocene) and a heterogeneous (conventional Ziegler-Natta) catalyst in the polymerisation of propylene, since the skilled person could not expect that a polymer with an MWD as broad as or broader than the MWD obtained with the heterogeneous catalyst alone could be produced.

Furthermore, the application provided information about the stereospecificity of the polypropylene obtained, because the melting points of the polymers of Examples 1 to 5 were shown. The melting point was, however, known to be related to the crystallinity of the xylene insoluble fraction of the polymer and, hence, to the stereospecificity of the polymer. Therefore, the melting points disclosed (160 to 163°C) were an indication for a crystalline polymer, ie stereospecific polypropylene.

In summary, there was no suggestion nor motivation to modify the teachings of the cited documents.

IV. The wording concerning an auxiliary request for oral proceedings at the end of the Statement of Grounds of Appeal, which referred to "... unless one of applicant's requests can be granted", on the one hand, and the missing identification of the above latest set of claims (section I, above) as the main or an auxiliary request, on the other, gave rise to the question of whether any previously filed claims were still maintained, and if so, which sequence of such requests would have been intended.

Therefore, the Appellant was invited in an annex to a summons, dated 18 July 2003, to oral proceedings (it will be referred to in this decision as the "Annex") clearly and unambiguously to identify its request(s) to be considered in the appeal proceedings. Furthermore, a number of objections and questions were raised in the annex, in particular with respect to the requirements of Article 84 EPC, including those quoted below:

"5. The meaning of the definitions of the two catalyst systems in Claim 1, which, at first glance, appears to be clear, is, however, compromised by other parts of the application documents (see below) and gives rise to an objection under Article 84 EPC of lack of clarity and of support by the description.

5.1 Thus, according to page 5, lines 12 to 19, "the components may be combined in any order", ie the metallocene compound, the ionizing compound, the aluminium alkyl, the transition metal compound and the electron donor. Hence, it is doubtful whether each of the two components (b) and component (c) can in fact be assigned to one of either the homogeneous or the heterogeneous catalysts.

5.2 Moreover, in EP-A-0 427 697 (filed by the Appellant with the letter dated 1 September 1995), reference is made to Ziegler-Natta catalysts comprising metallocene and MAO compounds (page 2, lines 38/39). The examples of the application in suit do not provide clarification in this respect, since in none of them the chemical nature of the conventional Ziegler-Natta catalyst is provided.

5.3 The above doubts concerning component (b) are further intensified by the fact that, in claim 7 and on page 8, examples of the ionizing agent are listed, which include *expressis verbis* aluminium alkyl and triethyl aluminium. At least the latter of these compounds complies, however, with the definition of component (b) of the conventional Ziegler-Natta catalyst. It follows therefrom that both components (b) cannot be considered as separate constituents contrary to the wording of Claim 1.

5.4 In particular, with regard to this finding, it is unclear why the first experiment in the experimental report filed with the letter of 15 October 1998 was identified as being comparative. Furthermore, it is, moreover, silent about the chemical composition and amounts of the Ziegler-Natta catalyst components used.

5.5 Moreover, in the Statement of Grounds of Appeal, reference is repeatedly made to an alleged difference of the claimed subject-matter from the teaching in D2, EP-A-0 436 399, ie the use of MAO ... in order to ... broaden the molecular weight distribution. However, both independent claims are completely silent in this respect. They are also completely silent about the proportions of the individual components necessary to achieve this goal aimed at (cf. page 8, lines 12 to 15)."

"5.7 Consequently, Claim 1 does not define the matter for which protection is sought in a clear manner which is fully supported by the description (Article 84 EPC)."

"7.1 As already stated (item 5.2, above), the components (b) in the two catalysts cannot be considered as separate different constituents. In view of this finding, D1, …, appears to disclose a catalytic system for the polymerisation of an α-olefin to provide stereoregular polymers, eg polypropylene (in all examples except for Examples 5 and 6) having a wide molecular weight distribution (…). Therefore, the document is deemed highly relevant for the patentability of presently claimed subject-matter."

"8. … It should be noted that arguments in support of a claim can only be convincing if they are based on mandatory features of that claim."

Additionally, the "Annex" contained some preliminary, provisional remarks concerning the necessity, in relation to the alleged stereospecificity of the products in the application in suit, of providing clear support for the assertion that the melting points were a clear and unambiguous indication for a crystalline polymer.

V. In reply to the summons and the above "Annex", two new requests were submitted by letter dated 10 September 2003, consisting of two sets of 16 claims and 15 claims, respectively (Main and Auxiliary request), together with a version of the description adapted to the new sets of claims, additional arguments in support of the two requests, and a further document

D4: A. Pavan et al., in Makromol. Chem., 178 (1977), pages 1099 to 1109.

(a) New Claims 1 and 16 according to the Main request submitted with the letter dated 10 September 2003 read as follows:

"1. Use of a catalyst system for the polymerization of propylene having a bimodal molecular weight distribution, comprising combination of at least one homogeneous catalyst system which is a metallocene catalyst comprising:

a) a neutral metallocene of the general formula

$R''_b(CpR_4)\ (CPR'_4)M'R_{v-2}$ [*sic*]

where R" is a bridge imparting stereo-rigidity to the structure to th[e] metallocene by connecting the two cyclopentadienyl rings, b is 0 or 1, Cp is a cyclopentadienyl ring, R and R' are substituents on the cyclopentadienyl rings and can be a hydride or a hydrocarbyl from 1-9 carbon atoms, each R and R' being the same or different, each (CpR_4) and (CpR'_4) being the same or different, M' is a Group IIIB, IVB, VB [or] VIB metal, R^* is a hydride, a halogen or a hydrocarbyl from 1-20 car[bon] atoms, v is the valence of M', and

b) an ionizing agent which will ionize a neutral metallocene compound to form a cationic metallocene catalyst

in combination with at least one heterogeneous catalyst system which is a conventional Ziegler-Natta transition metal compound catalyst comprising

a) a transition metal of the general formula MR^+_x, where M is a Group IIIB, IVB, VB or VIB metal, R^+ is a halogen or a hydrocarboxyl and x is the valence of the metal and

b) an aluminum alkyl of the general formula $AlR^\#_3$ where $R^\#$ is an alkyl of from 1-8 carbon atoms and $R^\#$ may be the same or different, and

c) an electron donor organosilicon compound."

"16. Process for polymerizing propylene having a bimodal controlled molecular weight distribution using the catalyst system of any one of claims 1 to 15".

The remaining Claims 2 to 15 of the Main request were dependent use claims.

Claim 1 of the Auxiliary request differed from the wording of Claim 1, as quoted above, in that a feature disclosed on page 9, lines 3 to 5 was added at the end of the above Claim 1:

"wherein the ratio of the heterogeneous to homogeneous catalysts is varied in order to control the polydispersity of the polypropylene produced."

This was also made the feature of Claim 14 of the Main request which claim, consequently, was omitted from the Auxiliary request, and which resulted in the renumbering and adaptation of the last two claims in the Auxiliary request.

(b) Emphasis was put on the argument that D1 did not disclose the use of an activating agent for the metallocene catalyst component. Hence, it did not teach to use a metallocene catalyst system but only a metallocene catalyst component together with the other components of its catalyst system in order to arrive at polypropylene having a broad molecular weight distribution and a high stereoregularity.

In D2, a catalyst system comprising a titanium catalyst component containing Ti, Mg and Cl as its essential components, a transition metal compound containing a ligand having cyclopentadienyl skeleton, and organoaluminium oxy-compound such as aluminoxane and, optionally, an organoaluminium such as a trialkylaluminium, was used for preparing polymers having a broad molecular weight distribution, essentially from ethylene. No external electron donor was used which was useful in the activation step.

(c) The passage on page 5, lines 12 to 19, of the application in suit was to be interpreted that the components of the two catalyst <u>systems</u> could be combined in any order, in the sense that each catalyst system was prepared separately and then combined in the reaction zone in any order.

The conventional Ziegler-Natta component had been described in the paragraph bridging pages 5 and 6 of the application.

(d) The measured melting temperatures in the examples of the application as originally filed and in the data submitted with the letter dated 9 August 1999 were a clear indication for the level of stereospecificity of the polypropylene product, since there was a known relationship between this temperature and the isotactic index (cf. D4). Hence, the skilled person would have known from the measured melting temperatures, mentioned above, that the isotactic index would be over 90%.

The same information would be derived from the xylene solubility of the polymers obtained in the examples submitted with the letter dated 9 August 1999.

(e) Hence, the catalyst systems disclosed in the application could be used to produce polypropylene having a broad bimodal MWD and a fairly high level of stereospecificity, eg by varying respective amounts of its components and by varying the amount of hydrogen.

VI. By letter dated 10 October 2003, the Board was informed by the Appellant that it would not attend the oral proceedings.

VII. The oral proceedings were held on 16 October 2003 as scheduled, in the absence of the Appellant.

VIII. According to the written submissions in the letter dated 10 September 2003, the Appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the set of claims according to the Main request or, in the alternative, of that according to the Auxiliary request.

Reasons for the Decision

1. The appeal is admissible.

2. *Procedural matter*

Since the absent Appellant had duly been summoned, the proceedings were continued in accordance with Rule 71(2) EPC.

3. *Main request*

3.1 Article 123(2) EPC

3.1.1 The features of Claim 1 of the Main request find their basis in the following claims and passages of the application as originally filed:

Claims 1 to 3, 11 and 16; page 4, lines 16 to 18; page 5, lines 6, 9, 11 and 14; page 6, lines 15 to 19.

3.1.2 Consequently, the Board is satisfied that the requirements of Article 123(2) EPC are met by Claim 1.

3.2 Interpretation of Claim 1

3.2.1 The components of the catalyst systems

(a) As addressed in the Annex, item 5.1 (section IV, above), the components may be combined in any order, which has given rise to the question of whether individual components can be assigned to one of the two catalysts.

(b) The Appellant disputed this observation and relied on the argument that, after the (separate) preparation of each catalyst system, the components of the two catalyst <u>systems</u> could be combined in any order and that "the conventional Ziegler-Natta component is described in the disclosure in the paragraph bridging pages 5 and 6" (section V(b), above).

(c) However, the meaning of the term "component" as used on page 5, lines 12 to 19 does not clearly and unambiguously support this argument. In this passage, reference is made to the manufacture of the "multi-catalyst system … by mixing the components of at least one homogeneous catalyst system and at least one heterogeneous system. The components may be combined in any order." This statement is further compounded by the reference to the description of the Ziegler-Natta component in the paragraph bridging pages 5 and 6, since this paragraph relates only to the metal compound MR^{+}_{x} as one of "the conventional heterogeneous Ziegler-Natta transition metal compound catalyst components".

(d) Thus, the emphasis in the general description is on the mixing of catalyst components, but not on catalyst systems.

(e) This emphasis is also reflected in the majority of the examples. Thus, in each of Examples 1, 2 and 5, the individual components were combined in the following sequence:

The metallocene had been mixed with triethylaluminium ("TEAl"), before this mixture was added to a first steel bomb already containing the conventional Ziegler-Natta catalyst and the

"CMDS" (the electron donor; a compound nowhere explained in the application documents, but presumably identical to the alkoxysilane used in the examples of D1). "MAO" (methylaluminoxane) which had been placed into a second bomb was only fed, together with propylene, to the reactor already containing a major part of this monomer, after the contents of the first bomb had been charged thereto.

This means, however, that MAO, as "the ionizing agent", was added only as the last component to the reactor, but not in the preparation of the "homogeneous catalysts system" before the combination of the two catalyst systems, as suggested in the "Arguments submitted in preparation to Oral Proceedings" (which will be referred to as "Arguments …", herein below; annexed to the letter dated 10 September 2003).

(f) Hence, the above argument of the Appellant is not convincing and does not remove the obscurities referred to under item 5.1 of the "Annex". In particular, it cannot be regarded as establishing a distinction over the disclosure of D1 (cf. sections V(b) and (c), above), which concerns a method for polymerising an α-olefin in the presence of a catalytic system comprising a transition metal catalytic component comprising a Ti compound free of hydrocarbyl ligands, a Ti, Zr or Hf compound having, as a ligand, at least one cyclopentadiene, or polycyclic condensed-ring compound of cyclopentadiene, or alkyl derivatives thereof, and an organic Al compound (D1: Claim 1).

3.2.2 The ionising agent

(a) These obscurities are further intensified by the fact that Examples 1, 2 and 5 of the application in suit are apparently in agreement not only with page 5, lines 12 to 15 ("… combined in any order"), but also with page 8, lines 4 to 8 of the description as originally filed. In the latter passage, "aluminium alkyl" had been referred to as one of the suitable ionising agents for the metallocene compound (as addressed in item 5.3 of the "Annex"; section IV, above).

(b) This definition, which had also been the content of a dependent claim as originally filed, was characterised by the then applicant in the letter dated 1 September 1995 as having been "in error", because "An aluminium alkyl alone <u>is not an effective ionizing agent</u> for activating a metallocene compound as a catalyst". In support of this statement, reference was made to Example 1 of D3 which had demonstrated that the use of aluminium alkyl alone did not produce an active catalyst, and no polymer had been obtained in that example ("i.e., '0' polymer yield"). Therefore, this "ambiguous language" had been removed from the claim concerned and replaced by "… ionizing agent is chosen from the group consisting of an alumoxane and a combination of other Lewis acids with an aluminium alkyl." (page 2, 2nd paragraph).

(c) In Example 1 of D3, a solution of TEAl in toluene had been charged into a reactor under nitrogen pressure and, after heating to 70°C, mixed by stirring with propylene also fed to the reactor. Then a solution in toluene of iPr(Cp-I-Flu)$ZrMe_2$ was put in a steel bomb and propylene was pumped through this bomb into the reactor, whilst the temperature remained at 70°C and the contents of the reactor were agitated for 30 min. "At the end of the polymerization, the reactor was cooled and the unreacted propylene was vented from the reactor. There was no reaction product.".

(d) It is evident that, in this example, the marginal conditions are quite different from those in both the application in suit and D1. Apart from the monomer and the inert solvent, which were also present in the reactor, the "catalytic system" in this example of D3 consisted of a binary mixture of aluminium alkyl and metallocene, whilst, in D1 and in the application in suit, Ziegler-Natta catalysts (inclusive of, in their examples, an electron donor) are also present.

Therefore, the showing in that example of D3 does not amount to a statement that is a generality, valid also for the more complex systems in the application in suit and D1. In particular, D1 gives the indication that a metallocene even in the absence of "an activating agent for the metallocene catalyst component" (bottom of the first page of the "Arguments …") has a significant effect on the polymerisation of polypropylene and its product (as shown in the examples and comparative examples of D1; eg Example 1 and Comparative Example 1).

(e) Consequently, the Board cannot accept that it has been validly shown by the Appellant that an aluminium alkyl within the set of circumstances as defined by Claim 1 and as further explained in the description as filed would not act as an ionising agent for the metallocene and the listing on page 8, in fact, had been "in error".

(f) On the contrary, page 8, lines 4 to 9, as originally filed (section 3.2.2 (a), above) read as follows:

"The ionizing agent is an alumoxane, an aluminum alkyl, other Lewis acid or a combination thereof which will ionize a neutral metallocene compound to form a cationic metallocene catalyst. Examples of such ionizing agents are methyl alumoxane (MAO), triethyl aluminum (TEAl) and tris(pentafluorophenyl)boron. Other ionizing agents …" (emphasis by the Board). Thus, aluminium alkyl, in general, and TEAl, in particular, were indeed clearly presented as suitable ionizing agents for the homogeneous catalyst.

Nor does the attempt by the Appellant to amend the second sentence of the above passage of description to refer to TEAl only in combination with tris(pentafluorophenyl)boron - even if allowable under Article 123(2) EPC - alter the validity of what is said in the first sentence concerning the ionizing agent in general.

(g) It follows that it has not been convincingly established that the original definition of this component had been erroneous, but, since "aluminium alkyl" as such still complies with the definition of the ionising agent, and component (b) of the heterogeneous catalyst as defined in Claim 1 is within the ambit of this definition, the observations in item 5.3 of the "Annex" are still valid, ie both components (b) in Claim 1 cannot be considered as separate constituents which could serve to distinguish the claimed subject-matter from the disclosure of D1.

3.2.3 MAO as ionising agent

On the one hand and as shown above, MAO is only one example of a suitable ionising agent. On the other, this compound is not referred to anywhere in Claim 1. Hence, as pointed out in the Annex (item 8; section IV, above), the arguments presented at the various stages of these proceedings which rely on the presence of MAO cannot be convincing, since they are not based on a mandatory feature of Claim 1.

3.2.4 MWD and its Bimodality

(a) The use of MAO has been repeatedly referred to in the Statement of Grounds of Appeal as being of particular importance in order to broaden the MWD of the product in comparison to the prior art or to provide an alternative method to provide polypropylene having a broad MWD. As pointed out above, these arguments cannot be convincing, because they rely on the presence of MAO which is not mentioned in Claim 1.

(b) The present Claim 1 is directed to the use of the homogeneous-heterogeneous catalyst system for the polymerisation of propylene having a bimodal MWD (it is assumed that this latter feature should refer to polypropylene rather than to propylene).

(c) According to the description, an MWD "*as broad (as) or broader than* the MWD of the heterogeneous catalyst alone" can be achieved by using this multi-catalyst system (page 8, lines 12 to 15; emphasis added; section III, above). However, the claims are completely silent about the proportions of the individual components and reaction conditions necessary to achieve the goal of broadening the MWD, *let alone to reach the bimodality of the molecular weight distribution as required by the functional feature of Claim 1.* Rather, the present wording includes a catalyst system which may contain only vanishingly small amounts of any one of the two homogeneous and heterogeneous, respectively, catalysts or catalyst systems to obtain a polymer with an MWD as broad as that attainable with the heterogeneous catalyst alone. It does not, however, define the ratios of the two catalyst systems and further conditions necessary to achieve bimodality of the MWD.

(d) Bimodality of the MWD is mentioned only in general terms as an "object of this invention " (page 4, lines 16 to 18), and in connection with Figures 4 to 6 without providing any particulars, such as the catalyst systems used or the reaction conditions. Finally, none of the examples in the application in suit refers to this feature required in the claims.

(e) In view of the statement on page 8, lines 12 to 15, referred to in section 3.2.4 (c), above, it appears therefore that, besides the deficiencies discussed in the previous sections 3.2 to 3.2.3, Claim 1 either does not specify all the essential features necessary to define the claimed invention, ie to produce a polypropylene fulfilling the mandatory functional feature of having a bimodal MWD, or such a bimodal MWD is automatically provided by the remaining features defined in the claim.

(f) Consequently, this functional feature can be considered only as a *desideratum* or as a redundant feature. It cannot, therefore, validly serve to distinguish the claimed subject-matter from the disclosure of the prior art, in particular D1.

3.2.5 It follows from these considerations and findings, that Claim 1 does not define the matter for which protection is sought in a clear manner which is fully supported by the description (Article 84 EPC).

Nor can the arguments provided by the Appellant and the amendments carried out in the application invalidate the relevance of the prior art cited, in particular D1, since the claim has to be interpreted in the light of the description as to the meaning and meaningfulness of the individual components of its catalyst system as pointed out in the above sections 3.2.1 to 3.2.4(f).

3.3 The relevant state of the art

3.3.1 As already indicated above (section 3.2.1(f), *supra*), D1 relates to a method for polymerising an α-olefin comprising the step of polymerising the α-olefin in the presence of a catalytic system which comprises (a) a transition metal catalytic component comprising a Ti compound free of hydrocarbyl ligands, (b) a Ti, Zr or Hf compound having, as a ligand, at least one cyclopentadiene, or polycyclic condensed-ring compound of cyclopentadiene, or alkyl derivatives thereof, and (c) an organic Al compound (Claim 1). Specifically, titanium tri- and tetrahalides, such as the respective chlorides, are mentioned as preferred examples for component (a) (column 2, lines 30 to 41). Preferred organic ligands in component (b) are selected from cyclopentadienyl, indenyl or fluorenyl groups co-ordinated to the metal, most preferably titanium (column 4, lines 1 to 21). Preferred organoaluminium compounds are trialkylaluminium, such as trimethyl-, triethyl-, tripropyl- and tributylaluminium or alkylaluminium compounds containing one or two chlorine or bromine atoms (column 7, lines 6 to 12).

3.3.2 The polymerisation is preferably carried out in the presence of an agent for improving stereoregularity, a specific example thereof being an alkoxysilane, eg cyclohexylmethyldimethoxysilane (column 7, line 14 *et seq*. and the examples). The catalytic system of D1 is effective for producing polyolefins having a wide molecular weight distribution (column 2, lines 4 to 10).

3.3.3 Thus, in Example 7 (specifically addressed in the first communication of the Examining Division dated 12 November 1993, item 3.1), the MWD of the polypropylene product was significantly broader than that of polypropylene prepared in the absence of dicyclopentadienyl titanium dichloride (Comparative Example 5). The product of the example had an extraction residue content of 99.5% after eluation with boiling heptane (a known eluant for the determination of the stereoregularity of polypropylene; cf. D4: Table 1, Footnote a; cf. section V(d), above).

3.3.4 Document D1 also addresses the possibility to modify the molecular weight and the MWD of the product by varying the concentration of hydrogen in the course of the polymerisation (column 8, line 42 to column 9, line 5).

3.4 Novelty

3.4.1 In the decision under appeal, novelty was acknowledged on the basis of the finding that the claims of the application in suit were different from D1 in that the catalyst system contained an ionising agent which reacted with a neutral metallocene compound to form a cationic metallocene catalyst, whilst the aluminium alkyl in D1 did not fulfil this requirement as demonstrated by D3 (section II (a), above).

3.4.2 However, although the wording of Claim 1 *prima facie* appears to refer to five distinct components of the multi-catalyst system, the novelty assessment in the decision cannot be maintained when attempting to understand the meanings of the definitions in the claim, in particular that of the ionising agent, in the light of the description. The distinction between Claim 1 of the application in suit and D1, made by the Examining Division, is not supported by clear and unambiguous facts as pointed out above in sections 3.2.1(f), 3.2.2(e), 3.2.2(g), 3.2.3 and 3.2.4(f), *supra*. Rather, the aluminium alkyl component of the heterogeneous catalyst and the ionising agent of the homogeneous catalyst are not to be construed as distinct components. Therefore, the catalyst system of D1 would fall within the ambit of Claim 1.

Nor has the Appellant provided convincing arguments or experimental evidence (to which it had been invited; Minutes of oral proceedings held on 18 November 1998, items 10 and 11) which would refute the above findings of the Board.

3.4.3 Consequently, the Board has come to the conclusion that, in view of the necessary interpretations of the meanings of the definitions in the claim, the subject-matter of Claim 1 lacks novelty vis-à-vis D1.

3.5 Thus, the Main request fails either for the reason of lack of clarity (section 3.2.5, above) or for lack of novelty (section 3.4.3, above).

4. *Auxiliary request*

4.1 Article 123(2) EPC

4.1.1 Claim 1 of the Auxiliary request differs from Claim 1 of the Main request only by the additional feature of varying "the ratio of the heterogeneous to homogeneous catalysts" in order to control the polydispersity of the polypropylene produced (section V(a), above).

4.1.2 This additional feature at the end of Claim 1 of the Auxiliary request has its basis on page 9, lines 3 to 5.

4.1.3 Consequently, this claim also complies with Article 123(2) EPC.

4.2 Interpretation of Claim 1

The wording of Claim 1 according to this request contains *expressis verbis* all the features of Claim 1 according to the Main request. This means, however, that all the above findings with regard to the main request (sections 3.2.1 to 3.2.5, above) also apply to the same features in this claim, which, therefore, does not comply with Article 84 EPC.

4.3 Novelty

It also follows from the above considerations that a possible difference of Claim 1 from the disclosure of D1 can only reside in the additional feature of varying the ratios of the two catalyst systems. In fact, D1 does not disclose this feature.

Consequently, novelty is acknowledged with regard to D1.

4.4 Technical problem and solution

4.4.1 In the contested decision, the technical problem was seen in the use of a catalyst system which leads to polypropylene having a broadened molecular weight distribution (section II(b), above). According to the Appellant, a further aspect of the technical problem was to be seen in the provision of polypropylene having a high stereoregularity (letter of 9 August 1999).

4.4.2 Irrespective of the question of whether the feature of stereoregularity finds a clear basis in the original application documents or not, it must be noted that Claim 1 does not contain any such functional feature. Moreover, D1 refers to the improvement of stereoregularity by means of an electron donor such as an alkoxy silane (column 7, lines 14 to 16; cf. the application in suit: page 6, last paragraph). This means, however, that this effect has already been achieved by means of a process feature relied upon by the Appellant for achieving this effect, which is the same as in D1 (letter dated 9 August 1999). Therefore, it cannot support of an inventive step as asserted by the Appellant.

4.4.3 In view of the identical wording in this respect in both Claims 1 under consideration, the findings in regard of the question of breadth of MWD and the required functional feature of bimodality of the MWD cannot be different from those set out in sections 3.2.4 to 3.2.4(f), and in particular in sections 3.2.4(c) and 3.2.4(d),above.

Since (i), with the multi-catalyst system, the MWD of the product may be as broad as the MWD obtainable with the heterogeneous catalyst alone (page 8, last paragraph), (ii) the claim does not define the ratios of the two catalysts necessary to achieve the desired product and (iii) no experimental evidence has been made available, which would demonstrate that the desired product was indeed obtained at any chosen ratio as mentioned under (ii), it has not been shown that the relevant technical problem was indeed solved in the full range of the claim. Hence, the technical problem can only be defined in a less ambitious way, ie as the definition of an alternative method for preparing polypropylene having an MWD at least as broad as attainable with a conventional Ziegler-Natta catalyst.

4.5 Inventive step

It remains to be decided whether the solution found was obvious to a person skilled in the art having regard to the state of the art cited in the decision under appeal.

4.5.1 As regards the question of whether the only distinguishing feature, the variation of the ratio of the two catalyst systems, is a modification of the process of D1, which is made obvious by D2 (section V(b), above), the answer has apparently been given in the Statement of Grounds of Appeal, where it is said: "The person of ordinary skill in the art would not be directed by D2 to use MAO to broaden MWD. Instead, the person of ordinary skill in the art would be directed to change the Zr/Ti ratio …", ie the ratio between the metallocene and the Ziegler-Natta catalyst as used eg in Example 3 of D2.

4.5.2 Consequently, Claim 1 according to the Auxiliary request is not based on an inventive step.

4.6 Thus, the Auxiliary request fails, on the one hand, for the reason of lack of clarity (section 4.2 in conjunction with section 3.2.5, above) and on the other, after having interpreted the features of Claim 1 on the basis of the description, for lack of inventive step.

5. Consequently, neither of the requests of the Appellant can prevail.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

R. J. Young.

E. Görgmaier R. Young