BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS | BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE | CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [X] To Chairmen

D E C I S I O N
of 26 March 1999

Case Number: T 0687/97 - 3.3.3

Application Number: 87117915.6

Publication Number: 0271007

IPC: C08G 61/08

Language of the proceedings: EN

Title of invention:
Conversion of solid dicyclopentadiene to a liquid monomer for use in reaction injection molding

Patentee:
National Starch and Chemical Investment Holding Corporation

Opponent:
The B.F. Goodrich Company

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 114(1)

Keyword:
"Novelty (yes) - relevant features not made available - onus of proof not discharged"
"Inventive step (yes) - no hint to solution of technical problem"

Decisions cited:
-

Catchword:
-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0687/97 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 26 March 1999

Appellant: (Proprietor of the patent)
National Starch and Chemical Investment Holding Corporation
P.O. Box 7663
Wilmington
Delaware 19803-7663 (US)

Representative:
Hagemann, Heinrich, Dr.rer.nat., Dipl.-Chem.
Patentanwälte
Hagemann, Braun & Held
Postfach 86 03 29
81630 München (DE)

Respondent: (Opponent)
The B.F. Goodrich Company
3925 Embassy Parkway
Akron, Ohio 44313 (US)

Representative:
von Kreisler, Alek, Dipl.-Chem.
Patentanwälte
von Kreisler-Selting-Werner
Postfach 10 22 41
50462 Köln (DE)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office dated 19 February 1997, issued in writing on 1 April 1997 revoking European patent No. 0 271 007 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: C. Gérardin
Members: R. Young
A. Lindqvist

Summary of Facts and Submissions

I. The mention of the grant of European patent No. 0 271 007, with 18 claims, in respect of European patent application No. 87 117 915.6, filed on 3 December 1987 and claiming US priorities of 8 December 1986 and 26 February 1987 (US 939 608 and 19 465 respectively) was announced on 16 March 1994 (Bulletin 94/11). Claim 1 reads as follows:

"A mixture consisting of 40 to 95% by weight of dicyclopentadiene and 60 to 5% by weight of higher cyclopentadiene oligomers, which is liquid below 25°C."

Claims 2 to 5 are dependent claims, directed to elaborations of the mixture according to Claim 1.

Claim 6, an independent claim, is worded as follows:

"A method for preparing a metathesis-polymerizable mixture as claimed in claim 1, 2, 3, 4, or 5, which comprises subjecting dicyclopentadiene to a heat treatment at 125°C to 250°C in the absence of air under reflux conditions wherein pyrolysis products are prevented from escaping from the reaction and cyclopentadiene oligomers are formed, continuing the heating until a liquid mixture comprising 40 to 95% by weight of dicyclopentadiene and 60 to 5% by weight of higher cylopentadiene oligomers is formed and separating residual cyclopentadiene and low molecular weight pyrolysis products from the dicyclopentadiene and oligomer mixture to recover a product."

Claims 7 to 13 are dependent claims directed to elaborations of the method according to Claim 6.

Claim 14, an independent claim, reads as follows:

"Use of the liquid mixture containing dicyclopentadiene and higher cyclopentadiene oligomers as claimed in claim 1, 2, 3, 4, or 5 to produce by copolymerization a copolymer consisting of 40 to 95% by weight, based on total copolymer weight, of repeating units derived from dicyclopentadiene and 60 to 5% by weight of repeating units derived from higher cyclopentadiene oligomers."

Claim 15, an independent claim, reads as follows:

"A crosslinked copolymer consisting of 40 to 95% by weight, based on total copolymer weight, of repeating units derived from dicyclopentadiene and 60 to 5% by weight of repeating units derived from higher cyclopentadiene oligomers."

Claims 16 and 17 are dependent claims directed to elaborations of the copolymer according to Claim 15.

Claim 18, an independent claim, reads as follows:

"Process for producing a copolymer according to one of claims 15-17, characterized by copolymerizing a liquid mixture according to one of claims 1-5."

II. Notice of Opposition was filed on 16 December 1994 on the grounds of lack of novelty and lack of inventive step. The opposition was supported *inter alia* by the documents:

D1: B. Raistrick et al., "Liquid-Phase Reactions at High Pressures. Part V. The Polymerization of Cyclopentadiene and α-Dicyclopentadiene", Journal of the Chemical Society, 1939, pages 1761 to 1769;

D2: P. Wilson et al., "The Chemistry and Utilization of Cyclopentadiene", Chemical Reviews, 1944, pages 1 to 50;

D5: EP-A-0 084 375;

D6: EP-A-0 084 888;

D7: EP-A-0 181 640; and

D8: US-A-4 426 502.

A later filed document:

D13: Justus Liebigs Annalen der Chemie, Volume 447 (1926), pages 97 to 110

was, however, excluded from consideration pursuant to Article 114(2) EPC.

III. By a decision which was given at the end of oral proceedings held on 19 February 1997 and issued in writing on 1 April 1997, based on Claims 1 to 18 of a main request, corresponding to the patent as granted (Section I., above) and Claims 1 to 9 of an auxiliary request, corresponding to Claims 6 to 14, respectively, of the main request, the Opposition Division revoked the patent in suit.

According to the decision, Claim 1 of the main request lacked novelty in the light of the disclosures of the documents D1 and D2, since there seemed no reason to doubt that the mixtures of dicyclopentadiene (DCPD) and its higher oligomers disclosed therein were liquid below 25°C. As to the auxiliary request, the method according to Claim 1 differed from that of D6, the closest state of the art, in that, before removal of low boiling impurities, a heating step was included

which formed a proportion of higher oligomers. The technical problem arising was to provide a process for preparing a polymerisable composition with improved handling, which yielded DCPD polymers with a higher glass transition temperature (Tg). The known higher oligomers fell, however, within classes taught in D7 for use as comonomers in the polymerisation of norbornene-type cycloolefins, such as DCPD, to give an increase in Tg. The skilled person would moreover expect mixtures of DCPD and its higher oligomers to be liquid (D1). Thus, it was obvious for the skilled person to solve the technical problem in view of the teachings of D7 and D1. Hence, the subject-matter of the auxiliary request, although novel, did not involve an inventive step.

IV. On 30 May 1997, a Notice of Appeal against the above decision was filed, together with payment of the prescribed fee.

In the Statement of Grounds of Appeal, filed on 10 July 1997 and a further submission, filed on 24 February 1999, the Appellant (Patentee) argued in substance as follows:

(a) The late filed document D13 was highly relevant, and had been wrongly excluded from the proceedings, especially since an official communication, issued in preparation for the hearing, had foreshadowed its introduction.

(b) As to the main request, whilst some compositions obtained by heating DCPD under different pressures and including higher oligomers had been disclosed in D1 and D2, it was not directly and unambiguously derivable that they were liquid

below 25°C. This was confirmed by the disclosure of the excluded document D13, which was specifically referred to in both D1 and D2. Consequently, there was no lack of novelty.

(c) As to the auxiliary request, in respect of which novelty had been conceded, the skilled person, starting from D6, was given only one step in a multi-step method. D6 failed to disclose the following features of the method:

a) a metathesis-polymerizable **mixture** is produced, which

b) consists of 40 to 95 wt% of dicyclopentadiene and

c) 60 to 5 wt% of higher cyclopentadiene oligomers and

d) is liquid below 25°C, the process comprising

e) subjecting dicyclopentadiene to a heat treatment at 125 to 250°C

f) in the absence of air

g) under reflux conditions wherein pyrolysis products are prevented from escaping from the reaction and cyclopentadiene oligomers are formed, and

h) continuing the heating until a liquid mixture as defined above is formed.

The technical problem was that of providing an advantageous, economic process for preparing a metathesis-polymerisable mixture which was liquid at room temperature and, upon metathesis polymerisation, gave a polymer product having an increased Tg and heat distortion temperature (HDT). Although D7, which also only disclosed only one step of the method, taught that higher Tg products could be obtained by such polymerisation of norbornene-type monomers, it did not mention the problems of the physical state of such polymerisable mixtures nor explicitly disclose any higher DCPD oligomers or mixtures comprising them. It was thus not obvious how to combine D6 and D7 to arrive at the claimed method. Since, furthermore, the relevant combination of features was equally absent from the remaining documents cited, there was no lack of inventive step.

V. The Respondent (Opponent) argued, in a submission filed on 2 March 1998, substantially as follows:

(a) As regards the main request, the so-called missing feature in D1 and D2 (that the mixture was liquid below 25°C) was a physical property inherent in the disclosed compositions. Just because it was not measured did not mean it was non-existent. A known composition could not be made novel merely by reciting a physical property already inherent in it.

(b) As regards the auxiliary request, the method according to Claim 1 did not involve an inventive step, since the steps of subjecting DCPD to a heat treatment at 125°C to 250°C, were known from D1 and D2, and the step of effecting the heating in the absence of air was within the purview of the skilled person preparing monomer compositions for

metathesis polymerisation; the requirement for reflux conditions was neither new nor inventive, since similar conditions were produced in a closed vessel as disclosed in D1 and D2 as well as in the patent in suit itself; the step of continuing the thermal polymerisation until the required proportions in the mixture of DCPD and oligomers was achieved was a matter of routine, since it was well known that the extent of cyclopentadiene (CPD) polymerisation was time and temperature dependent (D1); finally, the step of separating CPD and low molecular weight pyrolysis products from the mixture was taught by D7.

(c) The use of a liquid mixture containing DCPD and higher CPD oligomers as claimed in Claim 14 of the auxiliary request was not patentable. In particular, with regard to D6, the "thermally polymerized DCPD resin", forming a component of the composition of Example 28, had been misinterpreted as not being a copolymerisable oligomer, in view of the Appellant's contention that this component was a preformed poly(DCPD) resin component not taking part in the polymerisation. However, the Appellant had admitted, in an Information Disclosure Statement (IDS) submitted in the prosecution, before the USPTO, of another case (Reissue Application Serial No. 07/758,501 of Klosiewicz '340) which was the counterpart of D6, that the identity of the component was a mixture of tri-, tetra- and higher polymers formed by the initial splitting of DCPD into CPD, and the subsequent Diels-Alder addition of CPD to DCPD and the resulting trimer. Thus, D6 disclosed the use of heat polymerised CPD resin as comonomers with DCPD.

The submission of 2 March 1998 was accompanied by a copy of an extract from the IDS.

VI. Oral proceedings were held on 26 March 1999. At the outset, the Board indicated its intention of introducing D13 into the proceedings. The parties repeated in substance the arguments already submitted in writing. Towards the end of the proceedings, the Appellant submitted a new main and sole request, corresponding to the Claims 1 to 14 only of the main request underlying the decision under appeal, i.e. the claims of the patent as granted, subject to the deletion of Claims 15 to 18.

VII. The Appellant requested that the decision under appeal be set aside, and the patent in suit maintained on the basis of Claims 1 to 14 of the patent in suit as granted.

The Respondent requested that the appeal be dismissed and the patent revoked in its entirety.

Reasons for the Decision

1. The appeal is admissible.

2. *Admissibility of late-filed document*

Document D13, which was first cited during the opposition proceedings by the Respondent (then the Opponent), in a submission filed on 22 March 1996, and was foreshadowed, in a communication of the Opposition Division, issued on 21 August 1996, as likely to be introduced into the proceedings (page 2), is highly relevant, because it is referred to in both D1 and D2 and is furthermore such as to throw light on the

crucial question of the physical state of the compositions disclosed in D1 and D2 (Section IV.(b), above). Consequently, the Board decided that it should be introduced into the proceedings under Article 114(1) EPC.

3. *Admissibility of amendments*

The amendment generating the main and sole request, made at the oral proceedings before the Board, involves the simple deletion of Claims 15 to 18 of the patent in suit as granted. No objection was raised under Article 123(2) or 123(3), or indeed under any other Article of the EPC, to this deletion. Nor does the Board see any reason of its own to raise an objection to such a deletion. On the contrary, the deletion results in a restriction of the subject-matter claimed in the patent in suit, and furthermore does not necessitate any consequential amendment of the description. Hence, there is no objection to the amendments in the main request, which are held to meet the requirements of Article 123(2) and 123(3) EPC.

4. *The patent in suit; the technical problem*

The patent in suit is concerned with preparing polymerisable mixtures based on dicyclopentadiene (DCPD), and to the use of such mixtures to prepare copolymers. Such copolymers are noteworthy for their unusually good balance of high impact strength and high modulus, and are consequently sought after for the moulding of shaped articles. However, a drawback for many applications is that they have relatively low heat distortion temperature (HDT) and glass transition temperature, Tg (page 2, lines 3 to 9 and 13 to 16). Furthermore, although such shaped articles can be prepared at low temperatures and pressures using a

metathesis catalyst system (W or Mo activated by an aluminium alkyl), DCPD melts at 32°C and is therefore a solid at room temperature. Accordingly, it must be heated during its formulation and transported through heat-jacketed lines to maintain a liquid state (page 2, lines 17 to 25).

4.1 The technical problem addressed by the patent in suit is thus to provide a polymerisable composition with improved handling, which yields DCPD polymers with a higher Tg and therefore HDT. The solution arises from the realisation that mixing pure DCPD with its higher oligomers, such as are formed by appropriate pyrolysis of DCPD under conditions preventing low molecular weight products from escaping, followed by removal of the low molecular weight fragments, can result in a melting point lowering effect and hence a mixture which is liquid at room temperature. Furthermore, polymerisation of such a mixture leads to a polymeric product having a higher HDT and Tg than pure polymerised DCPD (page 3, lines 17 to 21).

4.2 The claims of the main and sole request of the Appellant fall into three groups, each with a respective independent claim, as follows:

(a) Claims 1 to 5, directed to a mixture of 40 to 95% by weight of DCPD and 60 to 5% by weight of higher CPD oligomers, which is liquid below 25°C.

(b) Claims 6 to 13, directed to a method for preparing a metathesis-polymerisable mixture as claimed in claims 1 to 5, by such a pyrolysis technique involving heat treating DCPD at 125°C to 250°C in the absence of air under reflux conditions, and removing residual DCPD and low molecular weight pyrolysis products.

(c) Claim 14 to the use of the liquid mixture as claimed in claims 1 to 5 to produce, by copolymerisation, a copolymer.

5. *Novelty*

As regards (a), whilst it was common ground that mixtures of DCPD and its higher oligomers produced by pyrolysis of DCPD were known, for instance, from D1 and D2, according to which the product of heating purified DCPD, optionally under elevated pressure, is a mixture of unchanged DCPD and various higher oligomers of DCPD, especially the trimer, tetramer, and in some cases the pentamer, it was disputed whether such mixtures were liquid at below 25°C.

5.1 According to D1, which was generally agreed to be the closest state of the art in this respect, the product of heating purified α-DCPD in a closed tube over mercury at a temperature of 138°C at 5 000 atm. for 21 h was fractionated at 0.1 mm to remove dimer and trimer, the residue extracted with cold ether to remove tetramer, and the insoluble portion boiled with benzene to remove pentamer, the higher polymer remaining corresponding with a material (polycyclopentadiene) considered by Staudinger (loc. cit., 1926) to be a hexamer (page 1766). The melting points of the crude fractions were 5 to 10° in the case of crude dimer, trimer and pentamer, and up to 30° in the case of tetramer (page 1767, first paragraph). The yields from heating α-DCPD at a pressure 5 000 atm. were analysed as follows:

Dimer decomposed:	13.5%;
Trimer formed:	10%;
Tetramer formed	1%;
Pentamer/hexamer formed	-/-

(page 1767; Table IV, fourth horizontal row).

There is no explicit statement that the products formed are liquid below 25°C.

5.1.1 In this connection, the reference "loc. cit., 1926" in D1 corresponds to document D13 (citation at the top of page 1762 in D1). According to the latter, a sample which was heated for two weeks at 100° was afterwards liquid and on vacuum distillation yielded solid DCPD and a very little amount (about 2%) of tricyclopentadiene (page 104, last line to page 105, line 4). The higher the temperature and the duration of heating, the more the higher polymers are formed. Thus, the product of heating DCPD in a bomb at 150° to 160° for 14 h, in which the contents of the bomb after heating formed a solid mass ("eine feste Masse"), is as follows:

tricyclopentadiene...	about 40%
tetraclopentadiene...	about 10%
pentacyclopentadiene...	about 2%
polycyclopentadiene...	less than 1%
unreacted DCPD...	about 50%

(page 105, Table A. and first paragraph following).

5.1.2 Whilst a liquid product is disclosed, which contains only a relatively little amount of tricyclopentadiene (2%), this is less than half the minimum claimed, and it is evident that the relevant exemplified product containing a greater proportion of higher oligomers is a solid, i.e. not liquid below 25°C.

5.1.3 Thus, the significance of D13 (section 5.1.1, above) in assessing the disclosure of D1 (section 5.1, above) is that not all such products are liquids at below 25°C. On the contrary, the reference to a "residue", after fractionation in D1, implies, if anything, that the product of D1, like that of D13, contains solid fractions.

5.2 The argument of the Respondent at the oral proceedings, that the distribution of oligomers in compositions disclosed in the patent in suit, which were liquid below 25°C, were identical with those disclosed in D1, so that the latter would necessarily also be liquid at 25°C, was based on a comparison between such a mixture exemplified in the patent in suit, especially that of Example 8 in Table A, with the sample analysed in Table IV of D1. In this connection, according to Example 8 of the patent in suit, the product of heating DCPD in a closed tube at 170°C for one hour contained:

DCPD:	85.2%
co-dimer:	0.9%;
trimer:	8.8%;
tetramer:	0.6%; and
"light ends":	4.2%;

with a melting point of -22°C (page 6; Table A).

5.2.1 Whilst the proportions of unreacted DCPD, trimer and tetramer are at first sight rather similar in the two samples, closer examination shows that both the amount of trimer, at 8.8%, and of tetramer 0.6%, according to the patent in suit are lower than those according to D1, at 10% and 1%, respectively (section 5.1, above). Furthermore, the total of the components in the composition according to the patent in suit, as measured by gas-liquid chromatography, add up to 99.7%, whereas those according to D1, measured by fractional

distillation and extraction techniques, add up to only 97%. Thus, at least 2% of the components in D1 are unaccounted for. Finally, the conditions of formation of the two samples are very different (170°C for 1 h. according to the patent in suit, as opposed to 138°C for 21 h. in D1, the latter furthermore being performed at an overpressure of 5 000 atm.).

5.2.2 This is not altered by the argument of the Respondent, that only the starting amount of DCPD was unaccounted for in Table IV of D1, not the oligomers themselves, since this would merely imply a divergence in the "DCPD remaining" aspect of the distribution of components in the mixture, from that of the mixtures according to the patent in suit (submission of 2 March 1998, page 3, first complete para.).

5.2.3 The remaining samples exemplified in Table A of the patent in suit do not offer a more relevant comparison.

5.2.4 Consequently, there are differences in both the thermal history and the resulting distribution of oligomers in the samples under comparison, which means that they are not identical.

5.2.5 The view expressed by the Respondent at the oral proceedings, that they were sufficiently similar to be in the same physical state at the same temperature, so that there would have been no residue in the case of the sample referred to in D1, is not supported by the disclosure of the latter, which refers quite generally to the formation of an insoluble residue (page 1766, penultimate sentence, "the residue" and "the insoluble portion"). Nor was any other supporting evidence offered that there was no residue. Consequently, the view expressed amounts to an unsupported assertion.

5.2.6 The further argument of the Respondent, that the formation of oligomers did not evolve linearly with temperature and time, is irrelevant, since it merely means that different conditions of heating do not theoretically exclude the formation of identical compositions, not that they must necessarily result in identical compositions being formed.

5.2.7 Finally, the argument put forward by the Respondent at oral proceedings, that if all the fractions are liquid, their mixture must necessarily be liquid, is irrelevant, since it does not, in the Board's view, represent a hard and fast chemical principle which necessarily applies in all cases. It was in any case contradicted by the representative of the Appellant. Even if such a principle had been generally valid, however, not all the relevant fractions disclosed in D1 are in fact liquid below 25°C. On the contrary, the tetramer, which is present in the analysed mixture in an amount of 1%, is stated to have a melting point of 30°C (section 5.1, above).

5.2.8 Consequently, it cannot be directly and unambiguously derived from the disclosure of D1 that the samples under comparison are both in the same physical state at 25°C.

5.3 In other words, there is not only no statement in D1 that the mixtures are liquid at below 25°C, but neither is there any other reason for concluding that they must be. On the contrary, all the indications are that the product contains a solid residue and is therefore not liquid at the relevant temperature. It was, however, the onus of the Respondent at this stage to show that such a characteristic of the mixture was directly and unambiguously made available to the public by the disclosure of D1. This the Respondent has failed to do.

5.4 Hence, the view expressed in the decision under appeal, that "there seems no reason to doubt that the mixtures of D1 and D2 are liquid below 25°C" (Reasons, page 5) cannot be supported by the Board. On the contrary, it must be concluded that the disclosure of D1 does not make available an oligomer mixture which is liquid below 25°C. Consequently, the argument of inherency (section V.(a), above) must also fail.

5.5 The same conclusion applies *a fortiori* to the disclosure of D13, since it is made explicitly clear in this document that a solid mass is formed. Consequently, this disclosure also does not make available a mixture which is liquid below 25°C.

5.6 According to D2, higher polymers were obtained by Staudinger (reference to D13) by heating DCPD in sealed tubes. Results are given in tabular form (page 18). Closer examination of the latter shows, however, that these results correspond identically to those given in D13 (Table A., etc., page 105). Thus the information derivable from the disclosure according to D2 is no more than that made available by D13.

5.7 The general criticism of the Respondent, made at the oral proceedings, that the relevant value of 25°C below which the oligomer mixture had to be liquid was itself arbitrarily chosen, is not justified, since 25°C corresponds to a standard room temperature and it is stated in the introductory description of the patent in suit that a melting point even a few degrees higher than this (32°C) necessitates, in practice, the use of heat during formulation, and heat-jacketed lines to maintain a liquid state (page 2, lines 31 to 37). Consequently, the provision of a mixture as claimed in Claim 1 represents the solution of a relevant technical problem (section 4.1, above).

5.8 In summary, the subject-matter of Claim 1 is novel over the disclosures of D1, D2 and D13.

5.9 Lack of novelty was not alleged in respect of the disclosure of any other document. Consequently, the subject-matter of Claim 1, and, by the same token, that of Claims 2 to 5, is novel.

5.10 As regards claims groups (b) and (c), no allegation of lack of novelty was made in respect of any prior disclosure. Nor does the Board see any basis for an objection of its own in this respect. Consequently, the subject-matter of Claims 6 to 13 and 14 is novel.

5.11 In summary, the subject-matter claimed in the patent in suit is novel.

6. *Inventive step*

As regards claims group (a), the relevant closest state of the art for the assessment of inventive step was, by common consent of the parties at the oral proceedings, D7.

6.1 According to D7, a composition containing a norbornene-type cycloolefin primary monomer and a metathesis catalyst system for polymerising norbornene-type cycloolefins, is characterised in that it comprises at least 5% by weight of a norbornene-type cycloolefin comonomer which, in its polymeric state, would have a Tg that is higher than the Tg that the primary monomer would have after polymerisation as a homopolymer, **or** that has two or more reactive double bonds that will open during the polymerisation, so that the number of cross-links will be increased, **or** that contains four or more rings in the monomer structure, **or** that has a polar substituent in the five-position of the

norbornene structure (Claim 1, 13; emphasis by the Board). The primary monomer is preferably DCPD, which must be purified from the commercially available purity of 97%, for instance by removing low boiling volatiles distilled below 100°C at about 90 torr absolute pressure, to prevent impurities from inhibiting the polymerisation. It may be further treated with an absorbent such as silica gel (Claim 2; page 3, lines 14 to 32).

The norbornene-type cycloolefin comonomer may be present in an amount of 1 to 30, preferably 10 to 25% by weight (page 8, lines 7 to 10). A preferred comonomer is an adduct of cyclopentadiene and norbornene (Example 8) which, on copolymerisation, in solution, with DCPD in the presence of a metathesis catalyst results in copolymer having a correspondingly higher Tg (page 15, Example 8; and page 19, Example 18).

A disadvantage of such custom-synthesised comonomers is, however, that they are much more expensive than DCPD (patent in suit, page 2, lines 12 to 13).

6.1.1 The technical problem arising from D7 may thus be seen as the search for alternative comonomers suitable to be metathesis-copolymerised with DCPD which are relatively economical in cost, and which, on admixture with DCPD, yield a composition which is easy to handle and on copolymerisation forms a product of enhanced Tg.

6.1.2 The solution proposed according to Claim 1 of the patent in suit is to provide a mixture of 40 to 95% by weight of DCPD and 60 to 5% by weight of higher CPD oligomers, which is liquid below 25°C.

6.1.3 It is evident from the examples of the patent in suit, in particular the melting point data given in Table A on page 6, that the mixtures provided are liquid at the relevant temperature. Furthermore, such mixtures are polymerisable to a copolymer having a favourably high Tg (page 7, Table B).

6.1.4 Consequently, it is credible to the Board that the claimed measures provide an effective solution of the stated problem.

6.2 There is no mention in D7 of the use of DCPD oligomers as comonomers for DCPD. Nor is there any indication that the comonomers which are used may form a mixture with DCPD which is liquid at 25°C. On the contrary, the relevant exemplified monomers are polymerised in solution. Consequently, the disclosure is not concerned with the physical state of the comonomers used, or the avoidance of expensive comonomers. On the contrary, the exemplified comonomers are not only individually synthesised, but also isolated as single chemical substances prior to admixture with DCPD (Examples 1 to 8).

6.2.1 The argument of the Respondent, that the DCPD oligomers according to Claim 1 of the patent in suit fall within the general definition of a preferred "norbornene-type cycloolefin comonomer" according to D7, does not assist the skilled person to focus on the relevant specific oligomers except with the assistance of hindsight, since there is, for the reasons given above, no pointer in D7 either to the use of mixed oligomers or to the use of mixtures which are liquid at the relevant temperature.

6.2.2 In summary, D7 contains no hint to the solution of the technical problem.

6.3. The disclosures of D1, D2 and D13 are not concerned with providing mixtures capable of further copolymerisation to give shaped products having relevant properties (such as an enhanced Tg) as required by the terms of the technical problem, but rather with analysing the constitution of samples partially polymerised DCPD. Consequently, the skilled person faced with the technical problem would not regard these disclosures as relevant to his purpose.

6.3.1 Even if the attention of the skilled person were nevertheless, for some other reason, to fall on these disclosures, they do not, for the reasons already given (sections 5.3 to 5.6, above), make available a DCPD oligomer mixture which is liquid below 25°C. Consequently, there would be no reason for regarding them as suitable candidates for solving the problem.

6.3.2 The argument of the Respondent, that the skilled person would expect a mixture of oligomers to be liquid, on the basis of the disclosure, in D13, of a liquid product (section 5.1.2, above), is not convincing, because the latter contains a relatively small amount of tricyclopentadiene (2%), and there is no basis for extrapolating such information to apply to higher concentrations of oligomers. On the contrary, all the samples heated according to D13 to give higher oligomer concentrations were stated to form a solid mass (section 5.1.3, above).

In summary, none of D1, D2 and D13 offers any assistance either to the recognition of the relevant problem, or its solution.

6.4 According to D6, there is disclosed a method of making a thermoset homopolymer comprising: first, combining a plurality of reactant streams, one of which contains the activator of a metathesis-catalyst system, and a

second which contains the catalyst of this system, and at least one of which contains DCPD to form a reaction mixture and then, immediately injecting the reaction mixture into a mould where polymerisation occurs (Claim 1). The DCPD, which may be the endo- or exo- isomer, should be purified from the commercially available purity of 96-97%, for instance by removing low boiling volatiles distilled below 100°C at about 90 torr absolute pressure, to prevent impurities from inhibiting the polymerisation. It may be further treated with an absorbent such as silica gel (page 3, lines 36 to 44). Preferably, polymerisation is by a reaction injection moulding (RIM) process (page 4, line 49). An elastomer may be added to increase the impact strength of the resulting polymer (page 5, lines 36 to 37). According to typical examples (26 to 28), samples of polymerised DCPD were made by RIM, in which the catalyst/monomer and activator/monomer solution streams contained, in addition to DCPD, respectively 10% of "Kraton 1102" (a styrene-butadiene-styrene rubber) and, in one case (Example 28) a thermally polymerised dicyclopentadiene resin, as well as mineral fillers (page 9, line 36 to page 10, line 12; Table VIII).

6.4.1 This disclosure, whilst being similar to that of D7 in that the DCPD monomer is purified before use, is less relevant, since it is limited to the formation of a DCPD homopolymer. This excludes compositions forming the solution of the stated problem, since these necessarily contain different oligomers, which result in the formation of copolymers. Consequently, the essential thrust of the disclosure has no relevance to the solution of the technical problem.

6.4.2 Quite apart from this, there is no statement or suggestion in D6 that the monomer mixture is or should be liquid below 25°C. On the contrary, the examples use the monomers in solution form, as in D7. Thus, there is no hint to this crucial aspect of the solution of the technical problem.

6.4.3 The argument of the Respondent, that D6 on its proper interpretation, and contrary to the submission of the Appellant, disclosed the use of DCPD and higher oligomers as a polymerisable mixture, was based on a two page extract from a twelve page IDS made before the United States Patent and Trademark Office under 37 C.F.R. 1.97 and 1.98 (section V.(c), above). According to the latter, the "thermally polymerized dicyclopentadiene resin" component of the reaction mixture in Example 28 had comprised, "a mixture of tri-, tetra-, and higher polymers formed by the initial splitting of dicyclopentadiene in cyclopentadiene (Cp), and the subsequent Diels Alder addition of cyclopentadiene (Cp) to dicyclopentadiene (DCPD) and to the resulting cyclopentadiene trimer" (section V.(c), above). Whilst the extract admittedly mentions Examples 28 to 31 of "Kloseiwicz '340", allegedly corresponding to D6, it is incomplete, not only as to the text, but also in that there is no signature or other direct indication of the identity of the author. Since, furthermore, it represents a submission made under a different legal system, to an authority which is not the EPO, its legal status in the present case is moot. Even if its content were accepted at face value, however, there is no statement or suggestion that the mixture of "tri-, tetra-, and higher polymers" had been liquid below 25°C. Consequently, even if the

Respondent's interpretation is accepted in full, and even if the skilled person were to utilise the teaching of D6 on this basis, in spite of the lack of incentive to do so, the result would not correspond to the solution of the stated problem.

6.4.4 Thus, the disclosure of D6 does not provide the skilled person with any further assistance to the solution of the stated problem.

6.5 According to D5, a process for preparing a polymer by ring opening polymerisation of a norbornene-type monomer, or a mixture thereof is carried out in the presence of at least one organoammonium catalyst (Claim 1). The norbornene-type monomer may be chosen *inter alia* from dicyclopentadienes, dihydrodicyclopentadienes, trimers of cyclopentadiene, tetracyclododecenes and mixtures thereof (Claim 7).

Whilst the relevant monomer in one of the examples is DCPD (Example 5), there is no mention of using a mixture of DCPD with its trimers, much less with a composition of higher oligomers characterised by being liquid below 25°C.

Consequently, D5 contains no pointer to the solution of the technical problem.

6.6 Similar considerations apply to the disclosure of the remaining document, D8, which relates to the thermally initiated bulk polymerisation of cycloolefins using a norbornene type monomer, since the choice of monomers corresponds to that in D5 (D8, column 7, lines 47 to 52). Thus there is no hint to the solution of the technical problem in the disclosure of D8.

6.7 In other words, the solution of the technical problem does not arise in an obvious manner having regard to the cited state of the art.

6.8 Consequently, the subject-matter of Claim 1, and, by the same token, that of dependent Claims 2 to 5, involves an inventive step.

6.9 As regards groups (b) and (c), both these sets of claims require either the formation of a mixture as claimed in Claim 1, 2, 3, 4 or 5 (Claim 6) or the use of a mixture as so claimed (Claim 14) as an essential limitation. The subject-matter of Claims 1 to 5 has, however, been found to be novel and to involve an inventive step. Consequently, the subject-matter of Claims 6 to 13 and 14 is also novel and based on an inventive step.

7. In the light of the above, the appeal must succeed on the basis of the main and sole request of the Appellant.

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 on the basis of Claims 1 to 14 as granted and the description of the patent as granted.

The Registrar:

E. Görgmaier

The Chairman:

C. Gérardin