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**Datasheet for the decision
of 7 June 2006**

Case Number: T 0046/05 - 3.3.03

Application Number: 95201699.6

Publication Number: 0678535

IPC: C08G 2/18

Language of the proceedings: EN

Title of invention:

Process for producing polyoxymethylene copolymer

Patentee:

ASAHI KASEI CHEMICALS CORPORATION

Opponent:

Ticona GmbH

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56, 114(1), 123(2)

Keyword:

"Amendments - added subject matter (yes) main request,
1st-4th auxiliary requests"

"Novelty - fifth auxiliary request - (yes)"

"Inventive step - fifth auxiliary request - (yes)"

Decisions cited:

G 0010/91, G 0001/93, T 0686/91, T 0989/93, T 0701/97

Catchword:

-



Case Number: T 0046/05 - 3.3.03

D E C I S I O N
of the Technical Board of Appeal 3.3.03
of 7 June 2006

Appellant:
(Opponent)

Ticon GmbH
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Representative:

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Respondent:
(Patent Proprietor)

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Representative:

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Decision under appeal:

Decision of the Opposition Division of the
European Patent Office dated 21 September 2004
and posted 4 November 2004 rejecting the
opposition filed against European Patent
No. 0678535 pursuant to Article 102(2) EPC.

Composition of the Board:

Chairman: C. Idez
Members: M. Gordon
E. Dufrasne

Summary of Facts and Submissions

- I. Mention of the grant of European Patent No. 0 678 535 in the name of Asahi Kasei Kogyo Kabushiki Kaisha, later Asahi Kasei Chemicals Corporation, in respect of European patent application No. 95 201 699.6, a divisional application of European patent application No. 91 902 766.4, filed on 17 January 1991 and claiming priority of a Japanese patent application No. JP 26 641 490 dated 5 October 1990, was announced on 23 June 1999 (Bulletin 1999/25) on the basis of 4 claims.

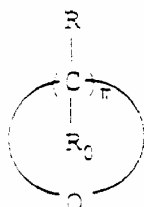
Claim 1 read as follows:

"1. A process for producing a polyoxymethylene copolymer which comprises copolymerizing a mixture of a cyclic oligomer of formaldehyde or a cyclic acetal as the principal monomer and a comonomer selected from cyclic ethers and cyclic formals, in the presence of a perfluoroalkylsulfonic acid or a perfluoroalkylsulfonic acid derivative as the polymerization catalyst in an amount of 5×10^{-6} to 2×10^{-5} % by mole relative to the principal monomer to obtain a copolymer which contains at least 0.07% by mole of polyoxyalkylene units in proportion to polyoxymethylene units, wherein the content of water and formic acid in the monomer mixture are, respectively, not more than 40 ppm by weight".

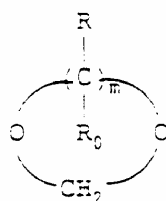
Claim 2 restricted the content of comonomer in the polymerization mixture to 0.3 to 3.5 % by mole of the principal monomer.

Claim 3 read as follows:

"3. A process according to any one of claim 1 or 2, in which the comonomer is selected from cyclic ethers represented by the formula



and cyclic formals represented by the formula



in which formulae m is 2 to 6 and R and R₀ may be the same or different and R groups bound to different carbon atoms and R₀ groups bound to different carbon atoms may be the same or different from each other, and are selected from hydrogen, alkyl groups and aryl groups."

Claim 4 specified a further step of deactivating the catalyst.

- II. A notice of opposition against the grant of the patent was filed on 22 March 2000 by Ticona GmbH, invoking the grounds pursuant to Article 100(a) EPC, in particular that the subject matter claimed in the patent lacked novelty (Article 54 EPC) and was not founded on an inventive step (Article 56 EPC).

Eight documents were cited in the notice of opposition, *inter alia*:

- E1: PL 90 091 (cited in the form of an English translation);
- E2: US 3 580 928
- E3: US 4 312 977
- E4: US 4 431 794.

A further document, designated E9 was submitted by the proprietor in its response to the notice of opposition, dated 31 October 2000.

(nb during the proceedings before the opposition division, the prefixes "E" or "D" were variously, and inconsistently employed to designate the documents, the relevant index numbers however remained constant. In this decision the prefix "E" will be employed).

In a subsequent submission of 23 March 2001, after said response of the proprietor to the notice of opposition, six further documents, designated E10-E15 were cited, *inter alia*:

- E10: K. Weissermel *et al* "Polymerization of Trioxane",
Angewandte Chemie, International Edition, 1967 (6),
No. 6, pp 526-533;
- E11: US 3 607 882;
- E12: US 4 332 644.

In its last submission prior to the oral proceedings before the opposition division (a letter dated 19 July 2004) the opponent invoked for the first time the grounds of opposition pursuant to Article 100(c) EPC. Further two additional documents, E16 and E17 were cited.

In a decision announced orally on 21 September 2004 and issued in writing on 4 November 2004 the opposition division rejected the opposition.

With regard to the documents E10-E15 and E16 and E17 the decision stated:

"The Patentee objected to the Opponent's filing of additional documents in general outside the nine month opposition period and to the admission of D16 and D17 in particular. In the event these documents were not discussed in detail and were not formally admitted to the procedure".

Although the ground pursuant to Article 100(c) EPC had been invoked subsequent to filing of the notice of opposition, the Opposition Division considered it to be potentially sufficiently serious to warrant admission pursuant to Article 114(1) EPC. With regard to this ground, the decision held that the wording "selected from cyclic ethers and cyclic formals" did not constitute a broadening of the subject matter of the application since the application as originally filed taught, albeit in a discussion of the background art, that these were the comonomers conventionally employed in the art.

Regarding novelty, it was held that none of the documents cited disclosed all the features of the claims. In particular E1 was silent on the level of formic acid. The statement in E1 that the trioxane was recrystallised and freshly distilled could not be interpreted as disclosing that the trioxane would exhibit the necessary level of formic acid, since from E2 it was unclear that such purification would automatically lead to a decrease in the formic acid content. The argument of the opponent that the inventor

of E1 would have used monomer purification techniques known from E2 or E3 and that these purification techniques would inherently lead to a reduction in formic acid level were dismissed.

Regarding inventive step, it was held that E1 represented the closest prior art, the subject matter claimed being distinguished therefrom by the specified maximum content of formic acid in the monomers. The technical problem was formulated as being to provide polymers with improved heat stability, heat aging resistance and hot water resistance. The use of pure monomers and the impact of impurities such as water and formic acid on the copolymers, in particular the activity as chain transfer agents, was known from a number of documents. The data in the patent was held to show that both the initiator employed and the impurity content of the monomers influenced the properties of the copolymers obtained. E1 taught that the process was tolerant of impurities other than water. However E1 contained no teaching to employ monomer feeds of low formic acid content in order to obtain polymers with lower formate end group contents and improved distribution of comonomer units leading to polymers having improved thermal stability.

Accordingly the opposition was rejected.

- III. An appeal against this decision was filed by the opponent on 7 January 2005, the appropriate fee being paid on the same day.
- IV. The statement of grounds of appeal were filed on 11 March 2005. The objections in respect of extension beyond the content of the application as filed

(Art 123(2) EPC) and lack of inventive step (Article 56 EPC) were maintained.

- (a) With regard to the documents E10-E15 and E16 and E17, it was submitted that the position taken in the decision (cited above) was not clear and appeared only to exclude E16 and E17.

With regard to E10 to E15 it was submitted that these documents had been filed as a reaction to the proprietor's response to the opposition. The proprietor had had ample opportunity to take position on these and had in fact done so. There was no formal request to deem these documents inadmissible.

- (b) With regard to Article 123(2) EPC it was argued that the wording in claim 1 "...selected from cyclic ethers and cyclic formals..." was derived from a discussion of the background art and should not be read as part of the disclosure of the invention. This wording constituted a generalisation intermediate between the most general and most specific disclosures of the invention in the application as filed.
- (c) Concerning inventive step, it was held that E1 was the closest prior art, the claimed subject matter being distinguished therefrom by the specified content of formic acid. The subjective problem was, as formulated in paragraph [0008] of the patent the production of polyoxymethylene copolymers having both good stability, and good mechanical properties. Previously known catalysts could have a degradation effect on the polymer, adversely affecting the molecular weight and stability. E1 taught to overcome these deficiencies by using the catalyst defined in the claims of the patent.

However the claimed subject matter was associated with no unexpected technical advantage, hence the objective problem was to provide an alternative process.

It was generally known in the art that formic acid had a deleterious effect on the polymerization and the art taught to purify trioxane to remove or at least reduce the amount of formic acid. Further it was a common desideratum to produce polymers with as high a molecular weight as possible. It was known from E10 that water and carboxylic acids will reduce the molecular weight of the polymer. Hence the skilled person would seek to keep as low as possible the concentration of materials capable of acting as chain transfer agents, such as water or formic acid, and so employ highly purified monomers. The statement in E1 that the process was tolerant of impurities did not preclude the use of highly pure monomers.

It was further submitted, with reference to documents disclosing methods for purifying trioxane (E2, E3, E11, E12), that it would be a matter of obviousness to keep the starting monomers as free of impurities as possible.

It was disputed that there was any link between the features of impurity level and type and amount of catalyst and that these merely represented a collocation of known features that would have been routinely adopted by the skilled person.

It was also disputed that the claimed catalyst or the features of the subsidiary claims could support an inventive step.

V. In its response dated 21 September 2005 the respondent (proprietor) submitted first and second auxiliary requests for the case that the objection pursuant to Article 123(2) EPC should be held to be well founded. Claim 1 of the first auxiliary request corresponded to a combination of claims 1 and 3 as granted, in that the comonomer was defined as specified in granted claim 3. Claim 3 of this request corresponded to granted claim 4. Claim 1 of the second auxiliary request restricted the comonomer to certain specifically named compounds, stated to be derived from pages 5 and 6 of the application as filed. In this request also claim 4 as granted became claim 3.

- (a) It was requested that the documents filed outside the opposition period not be formally admitted to the procedure. If these documents were to be admitted, remittal to the opposition division was requested.
- (b) It was requested to reverse the decision admitting the ground of opposition pursuant to Article 100(c)/123(2) EPC.

Regarding the substance of this objection it was submitted that the fact that the wording in question was present in a discussion of the background art did not detract from the fact that it formed part of the information content of the application as filed and would be read by the skilled person as an indication of the field of the invention.

- (c) Regarding inventive step the position of the appellant was disputed. In particular it was argued that since the process of E1 was disclosed as being tolerant of impurities, there was no incentive to seek extremely pure materials.

It was further submitted that the combination of the catalyst and the impurity level were linked. The low level of catalyst reduced the effect of hydride shift while the vulnerability of the catalyst to loss of activity had been minimised by controlling the impurity level of the trioxane. Thus these two features worked together to provide a process with unexpected advantages.

VI. The Board issued on 10 February 2006 a summons to attend oral proceedings. In the accompanying communication, it was provisionally held that the ground of opposition pursuant to Article 100(c) EPC had been admitted by the opposition division and hence formed part of the appeal proceedings. It was further provisionally held that the objections pursuant to Article 123(2) EPC in respect of the main request were well founded. No conclusion could be reached in respect of the first auxiliary request due to certain discrepancies between the wording thereof and that of the claims as originally filed. Auxiliary request 2 was provisionally held to meet the requirements of Article 123(2) EPC.

Regarding novelty it was provisionally held that the amount of catalyst disclosed in examples II and III of E1, when related to the principal monomer as required by claim 1 of the patent as granted, fell outside (above) the claimed range. Thus the claimed subject matter was provisionally held to be distinguished from the disclosure of E1 by the content of formic acid and by the catalyst concentration.

VII. In a letter dated 30 March 2006 the respondent filed new main and first auxiliary requests which, it was

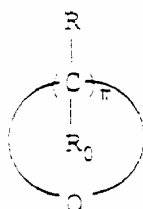
stated, had been amended to address the objections pursuant to Article 123(2) EPC.

Claim 1 of the main request read as follows:

"1. A process for producing a polyoxymethylene copolymer which comprises copolymerizing a mixture of a cyclic oligomer of formaldehyde or a cyclic acetal as the principal monomer with a cyclic ether or cyclic formal as comonomer, in the presence of a perfluoroalkylsulfonic acid or a perfluoroalkylsulfonic acid derivative as the polymerization catalyst characterised in that the perfluoroalkylsulfonic acid or perfluoroalkylsulfonic acid derivative is present in an amount of 5×10^{-6} to 2×10^{-5} % by mole relative to the principal monomer to obtain a copolymer which contains at least 0.07% by mole of polyoxyalkylene units in proportion to polyoxymethylene units, and the content of water and formic acid in the monomer mixture are, respectively, not more than 40ppm by weight."

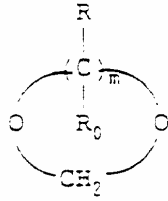
Claim 1 of the first auxiliary request differed from claim 1 of the main request in that the phrase "with a cyclic ether or cyclic formal as comonomer" was replaced by the wording:

"and a comonomer which is a cyclic ether represented by the formula



wherein R and R₀ may be the same or different and are each selected from hydrogen, an alkyl group and an aryl group, R bound to different carbon atoms and R₀ bound to different carbon atoms may respectively be the same or

different and are selected from hydrogen, an alkyl group and an aryl group, and m is 2 to 6; or a cyclic formal represented by the formula



wherein R and R₀ may be the same or different and are each selected from hydrogen, an alkyl group and an aryl group, R bound to different carbon atoms and R₀ bound to different carbon atoms may respectively be the same or different and are selected from hydrogen, an alkyl group and an aryl group, and m is 2 to 6;".

The subsidiary claims remained as previously noted. It was submitted that the objections pursuant to Article 123(2) EPC had been overcome by recasting claim 1 of the main request into the two part form. The amendments to the auxiliary request were directed to eliminating the discrepancies highlighted by the board in the communication.

- VIII. With a letter dated 3 May 2006 the appellant argued with respect to the late filed documents that the statement in the decision "these documents" referred only to E16 and E17 but that E10-E15 had been admitted into the procedure. As emerged from paragraph 2.6.5 of the decision E10, E11 and E12 had been taken into account by the opposition division. The appellant further maintained the objections pursuant to Article 123(2) EPC with respect to the main request. It was disputed that the reformulation of the claim overcame this objection.

A further, new, objection pursuant to Article 123(2) EPC was raised in respect of all the requests regarding the feature that the content of polyoxyalkylene units in proportion to polyoxymethylene units be at least 0.07 % by mole.

It was submitted that the only disclosure in the application as filed was of the range of 0.07 to 0.5% by mole of inserted oxyalkylene units relative to 100 moles of oxymethylene units. There was no basis for an open ended definition of this feature. Further page 3, line 54 of the A-document stated that copolymers containing more than 0.5% of oxyalkylene units had "markedly poor" mechanical properties.

Regarding inventive step, in the light of the comments by the board relating to E1 it was submitted that E1 no longer constituted the closest prior art since it differed both in respect of the amount of catalyst and the formic acid content. It was furthermore considered not to be a good springboard to the invention because of the teaching - deemed to be "isolated and incorrect" - that "generally products of a lower degree of purity... may be used".

The appellant submitted that instead E4 was the closest prior art document. The sole example of this document disclosed all the features of claim 1 with the exception that it did not explicitly (emphasis of the appellant) state that the concentrations of water and formic acid were less than 40ppm. The problems to be solved by the patent were formulated as being insufficient molecular weight and inadequate thermal stability due to the formation of unstable terminal structures. These problems were considered to be connected since higher molecular weight polymers would have proportionally fewer terminals and hence higher

thermal stability. E2 taught to solve this problem by reducing the impurity content to about 40ppm.

IX. In a letter dated 10 May 2006 the respondent objected to the introduction of a further objection pursuant to Article 123(2) EPC, and requested that if this be admitted to the procedure, the respondent be accorded the right to formulate further auxiliary requests, either in advance of, or at, the oral proceedings.

X. Oral proceedings were held on 7 June 2006.

(a) The respondent confirmed that the second auxiliary request as filed in the response to the statement of grounds of appeal was maintained.

In the course of the oral proceedings a further four requests were filed (third to sixth auxiliary requests).

Claim 1 of the third auxiliary request was modified compared to claim 1 of the main request by restricting the proportion of polyoxyalkylene units in proportion to polyoxymethylene units to the range of 0.07% to 1.02% by mole. The wording of claims 2-4 corresponded to that of the equally numbered claims of the main request.

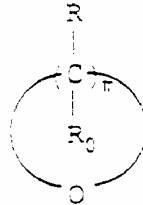
Claim 1 of the fourth auxiliary request, restricted this range to 0.07% to 0.5% by mole. The wording of claims 2-4 of this request corresponded to that of the equally numbered claims of the main request.

The fifth auxiliary request combined the features of the first and fourth auxiliary requests.

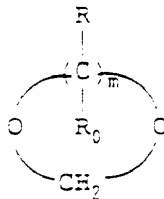
Claim 1 thereof thus read as follows:

"1. A process for producing a polyoxymethylene copolymer which comprises copolymerizing a mixture

of a cyclic oligomer of formaldehyde or a cyclic acetal as the principal monomer and a comonomer which is a cyclic ether represented by the formula



wherein R and R₀ may be the same or different and are each selected from hydrogen, an alkyl group and an aryl group, R bound to different carbon atoms and R₀ bound to different carbon atoms may respectively be the same or different and are selected from hydrogen, an alkyl group and an aryl group, and m is 2 to 6; or a cyclic formal represented by the formula



wherein R and R₀ may be the same or different and are each selected from hydrogen, an alkyl group and an aryl group, R bound to different carbon atoms and R₀ bound to different carbon atoms may respectively be the same or different and are selected from hydrogen, an alkyl group and an aryl group, and m is 2 to 6; in the presence of a perfluoroalkylsulfonic acid or a perfluoroalkylsulfonic acid derivative as the polymerization catalyst in an amount of 5x10⁻⁶ to 2x10⁻⁵ % by mole relative to the principal monomer to obtain a copolymer which contains 0.07% - 0.5% by mole of polyoxyalkylene units in proportion to polyoxymethylene units, and wherein the content of

water and formic acid in the monomer mixture are, respectively, not more than 40 ppm by weight." The wording of claim 2 of this request corresponded to that of granted claim 2 while the wording of claim 3 corresponded to that of granted claim 4.

Claim 1 of the sixth auxiliary request differed from claim 1 of the fifth auxiliary request by restricting the principal monomer to trioxane. The subclaims 2 and 3 were as noted for the fifth auxiliary request.

- (b) Regarding the late filed documents E10-E15, the appellant submitted these should be admitted and considered. These had been filed in response to the answer of the proprietor to the opposition and were relevant, being directed to the arguments relating to inventive step, in particular to demonstrate common general knowledge. The filing of these did not represent an abuse. The decision showed that E10, E11 and E12 had been considered, which indicated that all of E10-E15 had been admitted.

The respondent submitted that the fact that the documents had been considered did not mean that a decision was taken to admit these. Further the fact that the respondent had presented arguments to take account of these documents was irrelevant to the question of whether they should be admitted. It was submitted that the opposition division did not rely on these documents in its reasoning, despite the mention of certain of these in the decision.

After deliberation, the board informed the parties that E10 to E15 were in the procedure.

(c) Regarding the admissibility of the ground pursuant to Article 100(c) EPC,

(i) the respondent submitted that this had not been invoked during the nine month opposition period. As the opposition division had decided on the substantive aspects of this issue in the proprietor's (respondent's) favour, it had had no opportunity to appeal against the admission of this ground. The Board was still in a position to rule this objection inadmissible due to having been filed late. The second objection, raised in the letter dated 3 May 2006 was in any case too late, and having not been admitted was not yet part of the procedure. It was submitted that if the ground was introduced then the case should be remitted to the opposition division.

(ii) The appellant submitted that the most recently filed objection pursuant to Article 123(2) EPC constituted a new argument but not a new ground. This change in the case could be admitted at the board's discretion (Article 10b(1) RPBA). The objection was not complex and could be dealt with swiftly.

(iii) After deliberation the board informed the parties that the ground of Article 123(2) EPC was already in the proceedings and that the new argument under this ground was admitted.

(d) Regarding the substance of the objection pursuant to Article 123(2) EPC

(i) The appellant submitted that the terms "polyoxymethylene" and "polyoxyalkylene" were synonymous with "oxymethylene" and "oxyalkylene" respectively.

There was no express basis for the open ended definition of at least 0.07% by mole. Page 3 line 49 of the A publication disclosed a closed range.

(ii) The respondent submitted that the cited passage gave support for an open ended range. The lower limit was associated with heat resistance - below this threshold heat resistance was poor. The upper value represented the upper limit at which good mechanical properties were obtained. Both properties were optimised within the range. The patent was based on a divisional application for which, in contrast to the parent application, mechanical properties were irrelevant. Only heat resistance was important. This could be seen from page 20 of the documents for grant ("Druckexemplar") from which the phrase "and tensile strength was excellent" had been deleted. The irrelevance of the upper limit of 0.5 for the divisional application was further supported by examples 32 and 33 of the granted patent which had been comparative examples in the application as originally filed and the parent application. With regard to a statement in paragraph [0008] of the patent that the amount of inserted

oxyalkylene units be restricted to a certain range, the respondent submitted that this was prefaced by "The present inventors have found", which meant that the statement should not be interpreted as relating restrictively to the subject matter of the invention.

- (iii) Following deliberation the board informed the parties of the conclusion that the main and first and second auxiliary requests did not meet the requirements of Article 123(2) EPC. The respondent submitted the above mentioned third and fourth auxiliary requests. The appellant argued that hereby a substantial limitation of the claims had been made which had never been considered either by the examination or opposition division and could possibly be relied upon by the respondent in respect of its submissions on inventive step. Hence it was submitted, with reference to Article 10b(3) RPBA that these amendments should not be admitted. The respondent submitted that the amended requests should be admitted, being a reaction to a late filed objection by the appellant. It further submitted that the amendment was made solely in order to address the objection raised pursuant to Article 123(2) EPC, and it was not intended to rely on this feature in the discussion of inventive step.

Following further deliberation the board informed the parties that the third and

fourth auxiliary requests were admitted to the procedure.

- (iv) Regarding the substantive issues in respect of the third auxiliary request, the appellant objected to the upper limit of 1.02% by mole of oxyalkylene units, arguing that the only basis for this was a comparative example in the application as originally filed. It was further submitted that it was inadmissible to extract this feature from the comparative example in isolation of the other features thereof. The respondent submitted that although the example in question had been indicated to be a comparative example in the divisional application as originally filed, the text (description and examples) of the divisional application being identical to that of the parent application, the invention to which the divisional application related was different from that of the parent (see section X.d.ii above). As a consequence, the labelling of certain examples had changed during prosecution. The example in question had been a comparative one as regards the mechanical properties, but not in respect of the heat resistance properties. There was no reason to assume that the compositions of examples 32 and 33 were not valid for the invention of the divisional application as a whole. In any case it was submitted that the labelling of an example did not affect the disclosure thereof.

- (v) Regarding the fourth auxiliary request the appellant raised no objections to the range of the content of oxyalkylene units. However it was submitted, as set out in the written proceedings, that the definition of the comonomer contravened Article 123(2) EPC since the only basis for this was in a discussion of the prior art. The respondent submitted that the opposition division had accepted this wording. With regard to the decision G 1/93 (OJ EPO 1994, 541) it was argued that this amendment merely limited the protection conferred but did not constitute a change in the technical teaching. It was also submitted that this amendment gave the respondent (proprietor) no unwarranted advantage. This did not constitute an intermediate generalisation but employed the wording of the application as filed, albeit in a discussion of the background art.
- (vi) Following announcement by the board that the third and fourth auxiliary requests did not meet the requirements of Art. 123(2) EPC the respondent submitted the above mentioned fifth and sixth auxiliary requests.
- (vii) Regarding the fifth auxiliary request the appellant raised no objections pursuant to Article 123(2) EPC.
- (e) Objections pursuant to novelty (Article 54 EPC) were not raised.
- (f) Regarding inventive step the appellant considered E4 to represent the closest prior art. The subject matter of claim 1 of the fifth auxiliary request

differed from the example of E4 due to the specified content of water and formic acid in the monomers. The properties of the polymer obtained - Melt Index (190°C, 2.16 Kg) of 4 g/minute and a thermal stability in nitrogen (2 hours, 220°C) of 99.8% demonstrated very good thermal stability but low molecular weight. The technical problem according to the patent was to improve heat stability and mechanical properties. It was obvious to solve this by increasing the molecular weight, which increase could be achieved in an obvious manner by reducing the content of formic acid and water in the monomers. E2 taught a process for purifying trioxane to yield impurity levels of less than 40 ppm, which monomers yielded high molecular weight polymers due to the reduction in chain transfer reactions. A similar teaching was derivable from E11 and E12. The review article E10 showed why reducing water and formic acid led to improved thermal stability since proton donors acted as chain transfer agents, leading to a reduction in molecular weight. Regarding the teaching in E1 that the process was tolerant of impurities it was submitted this was an isolated teaching and could not play any role in the light of the teachings of E4, E2 and E11. The respondent submitted that the conclusions reached by the opposition division remained valid even though the identity of the closest prior art had changed. E1 and E4 were more or less equivalent. There was no teaching in E4 to reduce the water and formic acid content. The patent claimed a specific catalyst in a specific low amount in combination with a low amount of defined

impurities. The key teaching in E1 was that the process was tolerant of impurities other than water. There was no teaching relating to formic acid. The objective problem was, as before, to improve heat and hot water stability. E4 provided no teaching to reduce the amount of water but taught to employ water as a regulator in an amount of 100-3000 ppm.

Regarding the teachings relating to purification of trioxane, it was not disclosed that such highly pure trioxanes would be useful with the catalysts defined in the claim. The improvements promised by E2 related to different catalysts and were not needed by the process of E1 or E4. Although E1 taught distillation and recrystallisation as adequate purification techniques the teaching of E2, in the context of a different catalyst system, was that these process would not yield sufficiently pure monomer. Hence E2 taught a purification which was not necessary when employing the catalyst of E1, E4 and the patent.

- XI. The appellant (opponent) requested that the decision under appeal be set aside and that the European patent No. 678 535 be revoked.

The respondent (proprietor) requested that the decision under appeal be set aside and that the patent be maintained on the basis of the main request or, in the alternative, of one of the first to sixth auxiliary requests in that order.

Reasons for the Decision

1. The appeal is admissible.

2. *Documents filed outside the opposition period*

From the discussion of inventive step in the decision under appeal (paragraph 2.6.5), it is apparent that the documents E10, E11 and E12 were taken into account since these are referred to in the reasoning. From page 3 of the minutes of the oral proceedings before the opposition division it is further apparent that document E15 was discussed.

Accordingly, it must be concluded, that since the opposition division considered these documents sufficiently relevant to discuss them both at the oral proceedings and in the decision that the first group of late filed documents (E10-E15) was *de facto* admitted to the procedure.

This conclusion means that the statement in paragraph 2.3 of the decision under appeal reproduced in section II above, relating to certain documents not being admitted to the procedure can only be understood as applying to the explicitly mentioned documents E16 and E17. Thus these documents were not admitted by the opposition division. No request has been made to admit these to the present appeal proceedings.

Accordingly the documents E10-E15 are in the present procedure, while documents E16 and E17 are excluded.

3. *Admissibility of the Ground of Opposition pursuant to Article 100(c) EPC*

According to the decision under appeal (paragraph 2.4) the opposition division deemed the objection raised under this ground to be "potentially sufficiently

serious" to warrant that the opposition division should examine this of its own motion pursuant to Article 114(1) EPC.

Accordingly this ground was admitted to the proceedings by the opposition division and hence forms part of the present appeal proceedings.

Consequently it remains to be decided whether the further objection pursuant to this ground filed with the letter of 3 May 2006 is to be admitted to the proceedings.

As held in paragraph 1.2 of the reasons of decision T 701/97 (23 August 2001, not published in the OJ EPO) there is no justification for [the board] excluding or disregarding relevant arguments concerning the ground of opposition under Article 100(c) EPC for the sole reason that they differ from the lines of argument relied upon - under the same ground - before the first instance. In the examination of objections under Article 100(c) EPC the contents of the application as filed and of the granted patent are to be considered as the relevant facts, and all attempts to demonstrate divergences between them are to be considered as arguments based on these facts. Accordingly, the legal and factual framework (Opinion G 10/91, OJ EPO 1993, 420, paragraph 6 of the reasons) is not changed since no new facts or evidence and no new grounds need to be relied upon. Accordingly the board has to consider all arguments that are relevant regardless of when they were introduced into the proceedings.

Accordingly, the ground of Article 100(c) EPC is already in the proceedings. The new arguments based on this ground rely on the same facts and evidence as those underlying the argument already considered and

hence the board has the duty to take this new argument into consideration.

The third, fourth and fifth auxiliary requests were filed as a reaction to these new arguments and were therefore admitted to the proceedings.

4. *Main request*

4.1 *Article 123(2) EPC*

4.1.1 Claim 1 of the main request specifies a process for preparing a copolymer, one of the features of the obtained copolymer being that it contains at least 0.07% by mole of polyoxyalkylene units in proportion to polyoxymethylene units.

4.1.2 According to page 4, line 12 of the application as originally filed, the proportion of oxyalkylene units to oxymethylene units is within a closed range from 0.07-0.5% by mole.

As a result of the amendment, made in the course of the examination proceedings (cf letter of 20 August 1997 from the then applicant) this closed range has been removed and one limit thereof used as the lower limit for an open-ended definition of the feature in question.

4.1.3 In that respect at the oral proceedings before the board the respondent has argued that the two limits of the range were independent of each other and related to different technical aspects, namely excellent long term resistance to heat and resistance to hot water on the one hand and excellent stability and mechanical properties on the other.

The board however observes that in the section of the application as originally filed, starting at page 3 line 19 entitled "Disclosure of the invention" it was stated that a copolymer having highly excellent stability and mechanical property **and** excellent long

term resistance to heat and resistance to hot water can be obtained "...by restricting to a certain **range** the amount of inserted oxyalkylene units in polyoxymethylene copolymer..." (emphasis by the board). In the immediately preceding section, starting at page 3 line 11, it is stated that the invention relates to polyoxymethylene copolymer having both excellent stability and mechanical property and excellent long term resistance to heat and resistance to hot water. In the introduction of the application as originally filed (section headed "Background Art") the problems of obtaining polyoxymethylenes combining these two characteristics are discussed.

4.1.4 It is hence evident that the application as originally filed consistently discloses the invention as relating to a process for preparing a polyoxymethylene copolymer having at the same time good mechanical properties and good resistance to heat and hot water. In that respect it is further disclosed in the application as originally filed at page 6 line 17 to page 7 line 1 that this combination of properties is only attained when the content of polyoxyalkylene units is within the defined range of 0.07 to 0.5 % by mole. Specifically it is taught that at a content below 0.07 % by mole, stability and long term resistance to heat and resistance to hot water become poor. Above the limit of 0.5 % by mole the mechanical property becomes markedly poor.

4.1.5 There is therefore no disclosure in the application as originally filed which would support the position of the respondent put forward at the oral proceedings that this (divisional) application was concerned solely with one of these aspects, the other being immaterial.

On the contrary, this argument of the respondent imputes to the granted patent a technical teaching which was not derivable from the application as filed. The consequence is that there is no disclosure in the application as originally filed that the content of polyoxyalkylene units was subject only to a constraint as regards the minimum level, the maximum level being unrestricted.

4.1.6 It is therefore concluded that claim 1 of the main request does not meet the requirement of Article 123(2) EPC.

4.2 The main request must be refused.

5. *First auxiliary request, second auxiliary request*

Since the respective claims 1 of the first and second auxiliary requests suffer from the same defect in respect of Article 123(2) EPC as claim 1 of the main request with regard to the definition of only a minimum value for the content of the polyoxyalkylene units in the copolymer, for the reasons explained in paragraph 4, the first and second auxiliary requests are also inadmissible.

6. *Third auxiliary request*

6.1 *Article 123(2) EPC*

According to the third auxiliary request the content of polyoxyalkylene units in proportion to polyoxymethylene units in the copolymer is in the range of 0.07-1.02% by mole.

6.1.1 The lower limit is derived from page 4 line 12 of the application as originally filed.

6.1.2 The upper limit of this range is disclosed in comparative example 20 of the application as originally

filed, which, in the granted patent is inventive example 33.

Since this example is designated in the application as originally filed a comparative example it is apparent that *prima facie* said example does not represent the invention to which the application relates.

6.1.3 The respondent has argued that it is not the label that is attached to an example that is critical but rather the technical teaching thereof. In order to examine whether, despite the designation of this example as "comparative" it nevertheless should properly be interpreted as being an example illustrating the invention of the application as filed, it is necessary to consider the technical features of this example. The content of polyoxyalkylene units in said example is, as noted 1.02 % by mole relative to the polyoxymethylene units. As discussed with respect to the main request (paragraph 4 above) the teaching of the description of the application as filed is that the problem defined in the application as originally filed is solved only when the content of polyoxyalkylene groups is in the range of 0.07 to 0.5% by mole. Since the content of polyoxyalkylene units in the copolymer of comparative example 20 is 1.02% by mole, and so outside this range, it is evident that this example does not represent the invention to which the application as originally filed pertains.

6.1.4 Accordingly it is concluded that the definition in claim 1 of a range, the upper limit of which, taken from a comparative example, is outside the range indicated in the description as being necessary for solving the technical problem defined in the application as originally filed extends the scope of

the claim beyond the content of the application as originally filed contrary to Article 123(2) EPC

6.2 The third auxiliary request must be refused.

7. *Fourth auxiliary request*

7.1 *Article 123(2) EPC*

Claim 1 of the fourth auxiliary request specifies that the content of polyoxyalkylene units in proportion to polyoxymethylene units be in the range 0.07-0.5 % by mole. This corresponds to the disclosure in the application as originally filed, cited above. The appellant raised no objection to this feature pursuant to Article 123(2) EPC, nor has the board any objections of its own.

7.1.1 The claim further specifies that the comonomer be a cyclic ether or cyclic formal.

This wording is found verbatim at page 1, lines 20 to 21 of the application as originally filed. This disclosure however is in a section entitled "Background Art" and is stated to relate to polyoxymethylenes synthesised by prior art techniques. Therefore this statement does not pertain to the invention of the application as originally filed.

Those disclosures relating to the comonomer which are identified as pertaining to the invention of the application as filed fall into two sections. Firstly there is the wording originally present in claim 1, namely "a comonomer copolymerizable therewith".

Secondly at page 4, starting at line 20 and continuing to page 5 line 13 of the application as originally filed, specific cyclic ethers and cyclic formals, defined by structural formulae and corresponding to granted claim 3 cited above are disclosed. The specification of "cyclic ethers or cyclic formals" is

intermediate between these two disclosures, but is supported by neither.

- 7.1.2 The respondent made reference to Decision G 1/93, in particular the statement in paragraph 2 of the order that a feature which, without providing a technical contribution to the subject-matter, merely limited the protection conferred by the patent was not to be considered as objectionable under Article 123(2). It is apparent from the correspondence during the examination phase (letter dated 20 August 1997) that the motivation for making this amendment was to address a substantive objection pursuant to Article 84 EPC that the original definition of the comonomers ("a comonomer polymerizable therewith") constituted an inadmissible attempt to define the subject matter claimed in terms of the result to be achieved. According to the submissions of the then applicant, this objection was addressed by replacing this wording by including the suitable comonomers "in accordance with the general statements on page 5 of the original application". Accordingly it is evident that since this amendment defines the suitable monomers to be used it inevitably makes a technical contribution to the subject matter of the patent in suit.
- 7.1.3 It is therefore concluded that the feature that the comonomer be a cyclic ether or cyclic formal is not disclosed in the application as originally filed and hence that claim 1 of the fourth auxiliary request does not meet the requirements of Article 123(2) EPC.
- 7.2 The fourth auxiliary request must be refused.

8. *Fifth auxiliary request*

8.1 *Article 123(2), (3) EPC*

No objections were raised against the admissibility of claim 1 of the fifth auxiliary request pursuant to Article 123(2) EPC. Since both the ratio and the definition of the comonomers have been amended to correspond to the disclosures of the application as originally filed, the board is satisfied that this request meets the requirements of Article 123(2) EPC. Further the introduction of the upper limit of the range for the permitted content of polyoxyalkylene units and the specification of the permissible comonomers does not result in an extension of the protection conferred compared to the granted patent with the consequence that the requirements of Article 123(3) EPC are also met.

8.2 *Novelty*

No novelty objections were raised against the subject matter of the fifth auxiliary request. Nor has the board any objections of its own.

8.3 *Inventive Step*

8.3.1 *Closest state of the art, technical problem*

The patent in suit relates to a process for producing a polyoxymethylene copolymer. Such processes are known from E1 and E4. While E1 was considered in the decision under appeal to represent the closest state of the art, E4 has been held by the appellant to be the closest state of the art. Therefore it is necessary in a first step to establish which document represents the closest state of the art.

- (a) E1 relates according to claim 1 thereof to a process for preparing copolymers of trioxane with cyclic comonomers employing as initiator a compound derived

from perfluoroalkane-sulphonic or perfluoroarylene-sulphonic acids. According to claim 2 of E1 the quantity of initiator is preferably from 5×10^{-5} to 5×10^{-3} mol% relative to the sum of the monomers employed.

With regard to copolymerization, E1 teaches that the comonomer units provide internal stabilization of the chain. E1 further teaches that known processes have various disadvantages such as requiring high levels of catalysts, the residues of which result in degradation of the copolymer. It was found that these disadvantages could be overcome by conducting the polymerization in the presence of perfluoroalkane- or perfluoroarylene-sulphonic acids and their derivatives, which initiators were effective at significantly lower levels than the known initiators. This process employing low concentrations of said initiators allowed polymers with high molecular weight to be obtained, which were not available with known methods. As "low concentration of initiator" is disclosed 1-5ppm. It is further taught that generally monomers and comonomers of a lower degree of purity than in the known process may be used. It is however preferable to reduce the water content of the monomers so that it does not exceed 100ppm, preferably not exceed 10ppm. It is taught that water in the system has an unfavourable effect on the molecular weight and thermal stability of the polyacetal. This requirement is also taught to apply to other (unspecified) substrates employed. According to example II of E1 a copolymerization of trioxane (freshly distilled), dioxalane and poly (ethylene oxide) is carried out employing trifluoromethanesulphonic acid ethyl ester as the initiator. It can be calculated from example II of E1 that the amount of catalyst relative

to the trioxane (principal monomer) is 4.5×10^{-4} mol%. According to example I of E1, the trioxane is purified by recrystallisation.

- (b) E4 relates according to claim 1 to a continuous process for the preparation of an oxymethylene polymer by mass polymerization. According to claim 3 the process also applies to the preparation of copolymers. According to the description, the problem which E4 set out to solve was to provide a process which was simple to carry out and to control. Various comonomers are proposed including cyclic ethers and cyclic formals. It is proposed to employ a regulator to control the molecular weight. Such regulator is water, employed in amounts of from 10 to 10000 ppm, preferably 100 to 3000 ppm. As initiators *inter alia* fluoroalkyl sulphonic acids are proposed, preferably in amounts of 0.05 to 10ppm. According to the sole example of E4, liquid trioxane, butane diol formal and methylal are combined and polymerized with trifluoromethanesulphonic acid. It can be calculated that the amount of the catalyst, based on trioxane is 1.7×10^{-5} mol%. The resulting product is reported to have a melt index (190°C, 2.16kg) of 4g/Minute and a thermal stability in nitrogen (2 hours, 220°C) of 99.8%.
- (c) The identity of the closest state of the art is governed by consideration of whether it relates to the same technical problem as addressed by the patent in question, not by the number of technical features it has in common with the claimed subject matter (T 686/91, 30 June 1994, not published in the OJ EPO, section 4 of the reasons). In T 989/93 (16 April 1997, not published in the OJ EPO, paragraph 12 of the reasons) it was similarly held that the closest prior art should relate

to the same or a similar technical problem as that underlying the patent in suit.

- (i) As can be understood from the introduction of the patent in suit prior art polyoxymethylenes, divided into homopolymers and copolymers, were known to have only one of two desirable properties, either excellent mechanical property or excellent stability. Specifically polyoxymethylene homopolymers were known to be excellent in mechanical properties, but poor in stability while polyoxymethylene copolymers obtained by copolymerization of formaldehyde or trioxane with cyclic ethers or formals were known to have excellent stability but poor mechanical properties. Further the long term resistance to heat or resistance to hot water, even of the copolymers, was unsatisfactory. Therefore according to paragraph [0008] the patent in suit addresses the problem of providing a process for producing a polyoxymethylene copolymer having simultaneously excellent stability and mechanical properties and excellent long term resistance to heat and resistance to hot water.
- (ii) From the foregoing analyses of E1 and E4 and the discussion of the technical problem underlying the patent in suit, it is apparent that only E1 is concerned with the same technical problem, namely the issue of stability of the resulting polymers, particularly with regard to the presence of catalyst residues. E1 also gives

consideration to the potential effect of impurities in the monomers on the properties of molecular weight and thermal stability of the resulting polymers. E4, on the other hand is primarily focussed on the process and (a measurement of thermal stability of the polymer in the example notwithstanding) does not provide any consideration of the thermal stability of the resulting polymers or the factors affecting this.

It is therefore concluded, with reference to the above cited case law, that since E1 is concerned, like the patent in suit, with the issues of thermal stability of the resulting polymers, this disclosure represents the closest prior art.

- (d) Thus starting from E1 the technical problem may be seen as the provision of a polymerization process providing polymers with excellent mechanical stability and mechanical properties and excellent long term resistance to heat and resistance to hot water.

8.3.2 *The patent in suit, the solution.*

Compared to the closest prior art E1, the patent in suit proposes, according to claim 1 of the fifth auxiliary request to solve the technical problem underlying the patent in suit (see 8.3.1 (d)) by a process having the following features:

- the catalyst content is restricted to the range of 5×10^{-6} to 2×10^{-5} % by mole of the principal monomer;
- the content of formic acid in the monomer mixture is not more than 40 ppm.

It will now be examined whether this problem has in fact been solved by the defined features.

(a) The examples and comparative examples demonstrate different combinations of the relevant reaction parameters and report the properties of the polymers so obtained. A summary of certain examples is presented in the following table. All of these examples employ as the principal monomer trioxane and as the comonomer 1,3 dioxolane in an amount of 0.8 mol% based on the principal monomer. The catalyst is trifluoromethanesulphonic acid.

Example	Catalyst conc. (mol%)	Water in monomer (ppm)	Formic acid in monomer (ppm)	Heat stability (min)	Heat aging resistance (% , 2000hrs)	Hot water resistance (% , 2000hrs)
1	5.10^{-6}	2	3	101	90	86
2	5.10^{-6}	5	10	98	92	85
4	1.10^{-5}	18	19	91	90	84
7	2.10^{-5}	32	22	85	90	85
Comp. 11	1.10^{-6}	2	3	--*	--	--
Comp. 12	2.10^{-5}	52	8	--	--	--
Comp. 13	2.10^{-5}	2	55	--	--	--
Comp. 16	5.10^{-5}	2	3	52	55	36

*: no polymer formed (comparative examples 11, 13) or yield less than 50% (comparative example 12).

Note:

The heat stability was measured by retaining the polymer in an injection moulding machine at a cylinder temperature of 230°C, and then forming into test pieces. The time at which a silver streak developed on the surface of the test piece was determined.

Resistance to heat aging was determined by placing defined test pieces in an oven at 240°C and then examining for retention of tensile strength.

Resistance to hot water was determined by immersing defined test pieces in flowing hot water at 120°C and then examining for retention of tensile strength.

(b) The evidence of the examples demonstrates that unless all three of the parameters - concentration of catalyst and the contents of water and formic acid - are

maintained in the range defined in the claim, then either no polymer is obtained or a polymer with poor stability properties results.

Based on this evidence, the board is satisfied that the technical problem set out in the patent in suit is effectively solved by the claimed measures.

8.3.3 *Obviousness of the claimed solution*

It remains to be decided whether the claimed subject matter was obvious to the person skilled in the art having regard to the relevant prior art.

- (a) According to E1 the polymerization process is tolerant of impurities other than water. Thus E1 provides no suggestion or incentive to seek to reduce the formic acid content of the monomers employed. On the contrary it is explicitly stated in E1 that an advantage of the process is that starting materials of a lower degree of purity than in the known processes may be used. It is also the case that the content of catalyst employed in the examples of E1 is above the upper limit specified in the operative claims. Hence E1 would also provide no teaching to employ such a content of catalyst.

Accordingly the disclosure of E1 on its own does not render obvious the subject matter claimed according to claim 1.

- (b) A number of documents disclose methods of purifying trioxane, in particular E2, E11 and E12.

- (i) E2 discloses purifying trioxane by treating with liquid sodium to react with the impurities. It is disclosed that this allows the impurity level to be reduced to below about 40ppm. Water and formic acid are explicitly mentioned as impurities. It is further stated that as little as 100ppm of the impurities can cause sufficient chain

transfer reaction to lead to significantly lower molecular weight than would have been obtained in the absence of such impurities. It is further stated that distillation and recrystallisation (the purification methods employed in the examples E1) do not allow sufficient reduction of the content of impurities. In the polymerization example of E2 hexafluoroarsenate is employed as the catalyst.

- (ii) E11 also relates to a process for purifying trioxane to less than 40ppm of impurities. This is achieved by contacting with an alkali metal ketyl. The role of impurities, water and formic acid being specifically mentioned, in chain transfer reactions and hence reduction in molecular weight is discussed. Polymerization is carried out. The catalyst employed is however not specified.
- (iii) E12 relates to a process for purifying trioxane involving continuous distillation, comprising extracting with benzene the distillate obtained by heating an aqueous solution of formaldehyde, feeding the trioxane containing benzene solution into a distillation column, distilling out the benzene and withdrawing the trioxane from the column bottom, whereby the trioxane concentration is maintained in a specified range. It is taught that this process yields trioxane having less than 10ppm of chain transfer agents, water and formic acid being specifically mentioned. In the examples

polymerization is effected using boron trifluoride dibutyl etherate.

- (iv) Since the polymerization examples of the documents E2, E11 and E12 employ different catalyst systems to that of E1 and the patent in suit, none of these documents provides a teaching concerning the interrelationship between the level of the required catalyst, the contents of water and formic acid in the monomers and the thermal stability properties of the resulting polymers evidenced by the patent in suit.
- (v) Since E1 explicitly states that one of the advantages of the process thereof is that starting materials of lower purity can be employed than for other processes, there would in any case be no incentive for the skilled person to employ highly pure monomers in the process according to E1. The stated advantage of the process of E1 is confirmed by the teachings of those citations relating to highly purified trioxane, in particular E2. One of the teachings of E2 is that distillation or recrystallisation of trioxane would not result in a sufficiently pure starting material. The examples of E1 however employ a trioxane purified by distillation or recrystallisation and demonstrate that a material purified in this manner is indeed sufficiently pure to undergo polymerization and obtain polymers of high molecular weight.

Accordingly consideration of the art relating to highly purified trioxane would present no reason for the skilled person employing the process of E1 to seek to employ highly pure materials. In any case doing so would neglect one of the explicitly stated benefits of that process and thus be inconsistent with the teachings of E1.

- (c) E4 discloses a process in which, according to the example, an amount of catalyst within the range specified by claim 1 of the fifth auxiliary request is employed. E4 does not impose any restriction on the content of formic acid. Further, E4 teaches to employ a molecular weight regulator in an amount of 10 to 10000 ppm, preferably 100 to 3000 ppm, one suitable regulator being water. Hence the teaching of E4 is, in contrast to E1 that water can not only be tolerated but can even be beneficial and may be present in an amount extending above the maximum limit permitted by claim 1 of the fifth auxiliary request. Accordingly since E1 and E4 contain contrary teachings regarding the aspect identified as critical in E1, namely water content, the skilled person would not have considered combining these teachings. Hence it would not have been obvious for the skilled person to consider E4 when seeking to modify the process of E1.
- (d) Consideration of the theoretical aspects in conjunction with the teaching of E1 also does not lead to the features of the claimed process. E10 is a review article relating to polymerization of trioxane. On page 532 it is discussed that chain transfer reactions lead to reduction in molecular weight. Proton donating agents are mentioned as a class of chain transfer agents. While this teaching may suggest to reduce the

content of chain transfer agents in order to prevent reduction of molecular weight, this discussion is not in the context of the catalysts defined in claim 1 of the fifth auxiliary request. While water is specifically mentioned, carboxylic acids are only referred to as a class, i.e. formic acid is not explicitly disclosed. Further the amounts of the chain transfer agents as defined in claim 1 of the fifth auxiliary request are not disclosed. Accordingly this teaching is only of a general nature and does not render obvious to solve the objective technical problem by the combination of features defined in claim 1.

8.3.4 It is therefore concluded that the claimed solution to the objective technical problem is not obvious in the light of the prior art cited by the appellant.

8.4 The subject matter of the claims of the fifth auxiliary request is therefore founded on an inventive step.

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 the fifth auxiliary request, with any necessary consequential amendments of the description.

The Registrar

The Chairman

E. Görgmaier

C. Idez