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**D E C I S I O N**  
**of 20 July 2000**

**Case Number:** T 0908/97 - 3.3.3

**Application Number:** 89115230.8

**Publication Number:** 0363608

**IPC:** C08L 69/00

**Language of the proceedings:** EN

**Title of invention:**

Polymer mixture comprising an aromatic polycarbonate, a styrene-containing copolymer and/or graft polymer and a phosphate based flame-retardant; articles formed therefrom

**Patentee:**

GENERAL ELECTRIC COMPANY

**Opponents:**

- 01: Bayer AG, Leverkusen Konzernverwaltung RP Patente Konzern  
02: DSM N.V. Patent Department  
03: Asahi Kasei Kogyo Kabushiki Kaisha

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive step - problem and solution - ex post facto analysis"

**Decisions cited:**

G 0010/91, G 0001/95, T 0301/87

**Catchword:**

-



Case Number: T 0908/97 - 3.3.3

**D E C I S I O N**  
**of the Technical Board of Appeal 3.3.3**  
**of 20 July 2000**

**Other party:**  
(Opponent 1)

Bayer AG, Leverkusen  
Konzernverwaltung RP  
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**Appellant 2:**  
(Opponent 2)

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**Appellant 3:**  
(Opponent 3)

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**Representative:**

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**Respondent:**  
(Proprietor of the patent)

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**Representative:**

Eggert, Hans-Gunther, Dr.  
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**Decision under appeal:**

Decision of the Opposition Division of the  
European Patent Office posted 31 July 1997  
rejecting the opposition filed against European  
patent No. 0 363 608 pursuant to Article 102(2)  
EPC.

**Composition of the Board:**

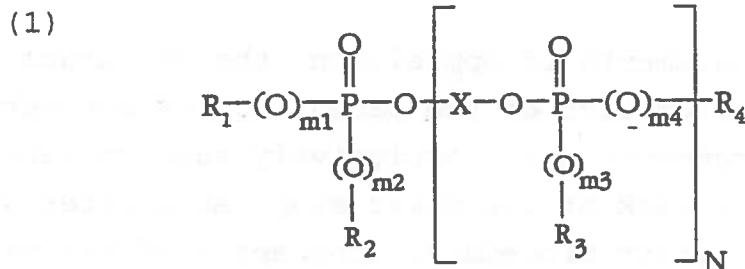
**Chairman:** C. Gérardin  
**Members:** A. Däweritz  
A. Lindqvist

### Summary of Facts and Submissions

I. The grant of European patent No. 0 363 608 in respect of European patent application No. 89 115 230.8 filed on 18 August 1989 and claiming priority of 22 September 1988 of an earlier application in the Netherlands (8802346), was announced on 26 January 1994 (Bulletin 94/04) on the basis of 12 claims.

Claim 1 as granted read as follows:

"A polymer mixture which comprises (A) an aromatic polycarbonate, (B) a copolymer and/or graft copolymer containing styrene and/or alpha-methyl-styrene and/or a styrene substituted with one or more halogen atoms or with organic groups in its aromatic nucleus and (C) as flame-retardant an oligomeric phosphate or a blend of oligomeric phosphates with the following formula 1:



wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, and R<sub>4</sub>, each represent an aryl which may be substituted with halogen atoms or alkylgroups chosen independently of each other and wherein X is an arylene group, M<sub>1</sub>, M<sub>2</sub>, M<sub>3</sub>, and M<sub>4</sub>, each independently of each other are 0 or 1 and wherein, N has an average value of 1.2 to 1.7."

Claims 2 to 11 concern preferred embodiments of the polymer mixture according to Claim 1. Claim 12 relates to articles formed therefrom.

II. Notices of Opposition were filed

- (i) on 21 October 1994 by Bayer AG (Opponent 1) on the ground of lack of patentability as mentioned in Article 100, in particular Article 100(a) and (b) EPC, because the polymer mixture as claimed did not satisfy the requirements of Article 56 EPC;
- (ii) on 24 October 1994 by DSM N.V. (Opponent 2) on the grounds of Article 100 EPC, because the subject-matter claimed was not patentable within the terms of Articles 52 and 56 (Article 100(a)) EPC; and
- (iii) on 26 October 1994 by Asahi Kasei Kogyo Kabushiki Kaisha (Opponent 3) on the ground of lack of inventive step (Articles 52(1) and 56 EPC).

In their statements of opposition, the Opponents requested revocation of the patent in its entirety based on arguments which exclusively substantiated the objection of lack of inventive step. At a later stage of the opposition procedure, Opponent 3 additionally raised an objection of insufficiency of disclosure pursuant to Article 100(b) EPC (letter dated 4 October 1995).

The objections were supported essentially by the following documents (the version used for the present decision is mentioned in brackets):

D1: JP-A-59 024 736 (English translation referred to as (1c) in the decision under appeal)

D2: JP-A-59 202 240 (English translation; identified as (2b) in the decision under appeal)

D3: JP-A-59 045 351 (English translation; named (3a) in the decision under appeal) and

D6: EP-A-0 103 230.

After expiry of the opposition period pursuant to Article 99(1) EPC, several experimental reports as well as

D11: Ind. Eng. Chem. Prod. Res. Dev. (1982) 21, 332 to 336

were additionally submitted.

III. By decision announced orally on 8 April 1997 and issued in writing on 31 July 1997, the Opposition Division held that the grounds of opposition did not prejudice the maintenance of the patent as granted and rejected the oppositions.

(i) The Opposition Division did not admit D11 nor the late filed test reports into the proceedings under Article 114(2) EPC, because they were *prima facie* not relevant.

(ii) Novelty which had not been disputed by the Opponents was acknowledged.

- (iii) Starting from D6, which was regarded as representing the closest prior art, it was not considered obvious to improve the flame-retardancy of the known polymer mixture and to reduce its melt viscosity by modifying it in accordance with Claim 1 of the patent in suit. Consequently, an inventive step was acknowledged.

IV. On 21 and 26 August 1997 and on 8 September 1997, respectively, Notices of Appeal were lodged by Appellants (Opponents) 3, 1 and 2, all requesting that the decision be set aside and the patent be revoked because of lack of inventive step. The appeal fees were paid in due time. On 3 May 2000, Appellant 1 withdrew its appeal.

In the Statements of Grounds of Appeal filed on 9, 5 and 8 December 1997, respectively, as well as in later submissions, the Appellants essentially maintained their previous objections. To that end they relied mainly on D6, D1, D2 and D3 and on additionally filed declarations and experimental reports. Their arguments can be summarised as follows:

- (i) It would have been obvious to use polyphosphates having an N-value of 1.2 to 1.7 as flame-retardants in polycarbonate/styrenic resin compositions mainly in view of D6 and D3 or D6 and D2.

Based on D2 as a starting point, it would have been equally obvious to use such polyphosphates together with resin mixtures as known e.g. from D6.

- (ii) A variation of the N-value (below or inside the range of 1.2 to 1.7 or up to 2.9) did not have a significant influence on flame-retardancy, nor did it allow to deduce reliable information about melt viscosity. Moreover, there was an insufficient disclosure of the nature of the N-value.

The experiments in Respondent's test report submitted on 20 December 1999 differed in more than one feature contrary to the normal requirements for comparative tests.

- V. In its counterstatements, the Respondent (Proprietor) supported the findings of the decision under appeal substantially as follows:

- (i) D6 required the polyphosphates to have a degree of polycondensation higher than 3 and to be branched, contrary to the oligophosphates used in the claimed polymer mixture. To demonstrate this difference, an experimental report was submitted (received on 20 December 1999) wherein the preparation of "MPO" polyphosphate was carried out in accordance with Example 1 k) of D6 on the basis of the more detailed information provided in

D6a: EP-A-0 103 227,

which concerned the preparation of these compounds.

Moreover, Examples 2 to 5 of D6 showed UL-94 classifications of V-0 which could, however, only be achieved in the additional presence of relatively high amounts of a brominated flame-retardant.

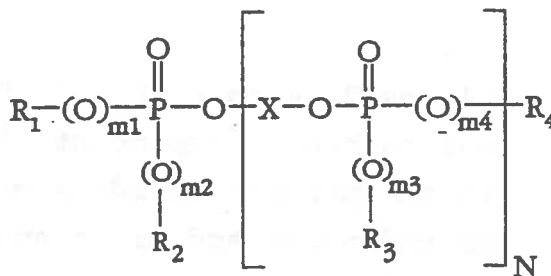
D3 described binary compositions wherein the flame-retardant had N-values of between 1 and 5. It was silent with respect to melt viscosity of the compositions. A modification of the composition of D6 in accordance with D3 could only be considered with hindsight.

The experimental data provided by the Appellants did not represent the cited prior art.

- (ii) Three auxiliary requests were filed on 29 March 1999, including Auxiliary Request II, Claim 1 of which reads as follows:

- "1. A polymer mixture which comprises
- (A) 5-95 % by weight, calculated with respect to the sum of the quantities of (A) and (B), of an aromatic polycarbonate;
  - (B) 95-5 % by weight, calculated with respect to the sum of the quantities of (A) and (B), of a copolymer and/or graft copolymer containing styrene and/or  $\alpha$ -methylstyrene and/or a styrene substituted with one or more halogen atoms or with organic groups in its aromatic nucleus;
  - (C) as flame-retardant 1-25 parts by weight, calculated per 100 parts by weight of (A) + (B), of an oligomeric phosphate or a blend of oligomeric phosphates with the following formula 1 :





wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub>, each represent an aryl which may be substituted with halogen atoms or alkyl groups chosen independently of each other and wherein X is an arylene group, m<sub>1</sub>, m<sub>2</sub>, m<sub>3</sub> and m<sub>4</sub>, each independently of each other, are 0 or 1 and wherein N has an average value of 1.2 to 1.7; and

(D) one or more of the following flame retardants:

- a salt having flame-retarding properties for aromatic polycarbonates and/or
- a halogen-containing low-molecular weight compound and/or high-molecular weight polymer and/or
- a perfluoroalkane polymer and/or
- a metal compound active as a synergist,

namely in an amount of up to 20 parts by weight, calculated per 100 parts by weight of (A) + (B)."

Claims 2, 4 to 6, 8 and 10 to 12 as granted are maintained as dependent Claims 2 to 9, subject to an appropriate adjustment of their appendancies and minor amendments of editorial nature.

- (iii) Auxiliary request IV was received on 20 December 1999, a modified Auxiliary request III and further Auxiliary request V on 13 July 2000. Claim 1 of Auxiliary request V differs from Claim 1 of Auxiliary request II in that  $m_1$ ,  $m_2$ ,  $m_3$  and  $m_4$  are all equal to 1,  $R_1$ ,  $R_2$ ,  $R_3$  and  $R_4$  all represent a phenyl group; and X represents a phenylene group. Claims 4 to 6, 8 and 10 to 12 as granted are maintained as dependent Claims 2 to 8, subject to an appropriate adjustment of their appendancies and minor amendments of editorial nature.
- (iv) The Respondent did not consent to consider any points raised by the Appellants other than the question of inventive step.

VI. Oral proceedings were held on 20 July 2000.

- (i) The Appellants essentially emphasised their previous submissions.

1. The following documents were submitted in the course of the oral proceedings by the Appellants to support their arguments:

- (a) Table comparing weight average N and number average N;
- (b) Comparison of the compositions according to the patent in suit and D6;

- (c) Preparation of oligophosphates of D6;
- (d) Preparation of oligophosphates of D2 (Example 2);
- (e) Table showing Patentees's TFCT Tests; and
- (f) Graph of Gosens Data.

2. D6 anticipated the claimed subject-matter. The large overlap between the patent in suit and D6 should at least be taken into account with respect to inventive step. Since the claims of the patent in suit were open to further components and since the polyphosphates (C) were mixtures, as could be derived from the decimal N-values, Claim 1 encompassed the prior art mixtures. Moreover, the oligophosphates were prepared in the same way from the same starting compounds as in the prior art, hence they were identical, or at least mere alternatives to the previously known polyphosphates. No surprising effects had been demonstrated by the Respondent. The definition of the N-values was insufficient (weight or number averages?; monophosphate excluded or included?). Consequently, the N-value was meaningless.

- (ii) The Respondent first maintained its arguments presented in writing, then pointed out that the discussion about the meaning of N started only at a late stage of the opposition proceedings and should therefore be disregarded. Only its own test report submitted on 20 December 1999 compared mixtures according to the invention

(using an oligophosphate FR-1) with those according to the prior art relied upon by the Appellants (i.e. the test using FR-2) and extended even further towards the invention (i.e. the test using FR-3). The results of these tests had not been refuted by the Appellants.

The Appellants had not provided any convincing argument why the skilled person **would**, as opposed to **could**, have modified the composition of D6 in the way required in the patent in suit. The prior art did not give any information which could have allowed to predict the resulting properties when modifying the known compositions.

- VII. The Appellants requested that the decision under appeal be set aside and that the patent be revoked. The Respondent requested that the decision be set aside and that the patent be maintained on the basis of the claims filed as "Auxiliary Request II" on 29 March 1999 (main request), alternatively on the basis of the claims filed as "Auxiliary Request V" on 13 July 2000 (auxiliary request).

## Reasons for the Decision

1. The appeal is admissible.
2. *Procedural Matter*
  - 2.1 Legal and Factual Framework for the Examination of the Opposition
    - 2.1.1 The numerous late filed documents and test reports referred to by the parties in their written submissions made it necessary to discuss their relevance first. Following that preliminary discussion it was decided to admit only D11 and the Respondent's Comparative Test Report of 17 December 1999.
    - 2.1.2 During the opposition period according to Article 99 EPC, Opponents 1 to 3 raised and substantiated their objections only with respect to Articles 52(1) and 56 EPC, i.e. inventive step.

In the decision under appeal, the Opposition Division established *expressis verbis* that novelty had not been disputed by the Opponents in the opposition procedure (cf. point III.ii) above). Further, as specified in point 13 of the Facts and Submissions of the first instance's decision, Opponent 3 had made clear that the reference to Article 83 EPC in its letter of 4 October 1995 should not be interpreted as a new ground for opposition pursuant to Article 100 (b) EPC. Consequently, inventive step was the only issue considered and decided by the Opposition Division.

- 2.1.3 From G 10/91 (OJ EPO 1993, 420; point 18 of the reasons) it is clear that the purpose of the appeal procedure *inter partes* is mainly to give the losing party the possibility to challenge the decision of the

Opposition Division on its merits. It is not in accordance with this principle to consider grounds for opposition on which the decision of the Opposition Division was not based. Since the appeal procedure is by its very nature less investigative than an administrative procedure, such as an opposition procedure before the Opposition Division, the Enlarged Board considered that fresh grounds for opposition may in principle not be introduced at the appeal stage without the consent of the patentee (cf. also G 1/95, OJ EPO 1996, 615).

- 2.1.4 In the present case, the Respondent has *expressis verbis* and repeatedly refused to give its consent to the consideration of any fresh grounds for opposition (Counterstatement of Appeal, section IV; letter of 13 July 2000, section I).
- 2.1.5 For these reasons, inventive step is the only issue to be considered in this appeal.
- 2.2 Further issues raised during the proceedings
  - 2.2.1 The Appellants put much emphasis on the calculation and the meaning of index N in formula 1 since the given range of values was related to a parameter which allowed several interpretations. This was particularly objectionable, because N was an essential feature for the determination of the scope of Claim 1 and, consequently, for the assessment of inventive step. In document (a), the Appellants calculated the number and weight averages of the N-value distribution of the oligomeric phosphate based on Table 2 of Respondent's test report received on 20 December 1999. These calculations were intended to demonstrate that the

oligomeric phosphate FR-1 fulfilled the requirements for N as defined in Claim 1 only if one considered the weight average or if one disregarded the content of monophosphate (N = 0) in the calculation of the number average.

In the course of the appeal proceedings, various arguments, declarations and amended declarations as well as test reports were submitted in writing by the Appellants, in particular by Appellant 3, which were intended not only to illustrate that ambiguity, but also to support the objection that the patent lacked enabling disclosure, so that an "appropriate evaluation of the validity of the contested patent" was impossible (see Appellant 3's submission received on 9 June 2000, Items I and II). Additionally the Appellant raised questions as to the definition and calculation of the average N-value.

- 2.2.2 The Respondent took the opposite view concerning these objections and argued that the points raised by the Appellants related to the interpretation of the extent of the protection (Article 69 EPC) or to the clarity of the claims (Article 84 EPC) rather than to the question of inventive step (Articles 52(1) and 56 EPC; see the letter received on 6 July 2000, items I and II).
- 2.2.3 The Board concurs with the Respondent's argument that the discussion about the meaning and calculation of "N" appears to concern the question of clarity, i.e. an issue which is not a ground for opposition as defined in Article 100 EPC, or the question of sufficiency of disclosure (Article 100(b) EPC), i.e. an issue not to be considered in the appeal, rather than the actual question of inventive step.

This finding is supported by the fact that none of the experimental data submitted by the Appellants is a true repetition of the prior art and that Appellant 3's statements in (i) the "Further Submission from Opponent 3" received on 18 March 1999 and (ii) "Opponent III's Counterstatement" received on 9 June 2000 clearly relate to clarity:

- (i) alleged inconsistencies between the wording of Claim 1 as granted ("an oligomeric phosphate or") and the amendments resulting in the deletion of integers from the original definition of N (pages 1 to 5);
- (ii) alleged "lack of enabling disclosure in regard to the definition of the average N-value" (see in particular "Item II"), reference to "a number of inconsistencies or self-contradictions with respect to the definition of the average N-value" (page 2, first paragraph) and request for a "Clear definition of the average N-value is absolutely necessary to determine the scope of the alleged invention of the contested patent" (page 1, item II. 1).

Therefore, none of these objections can be taken into account in these proceedings (see points 2.1 to 2.1.5, *supra*).

### 3. *Wording of the Claims*

In G 10/91 (*loc. cit.*), the Enlarged Board specified that, in case of amendments of the claims or other parts of a patent in the course of opposition or appeal proceedings, the *amendments* were to be fully examined as to their compatibility with the requirements of the EPC (e.g. Article 123(2) and (3) EPC; cf. point 19 of the reasons). In T 301/87 (OJ EPO 1990, 335; in



particular points 3.6 to 3.8), the Board emphasised that if an amendment to the patent has been made in opposition proceedings this fact did not immediately and automatically throw open the possibility to raise all objections (e.g. clarity) which may arise under the EPC.

### 3.1 Main request

No objection in connection with the amendments has been raised by the Appellants pursuant to Articles 84 or 123 EPC with respect to the wording of the main request. The Board does not see any reason for such an objection either.

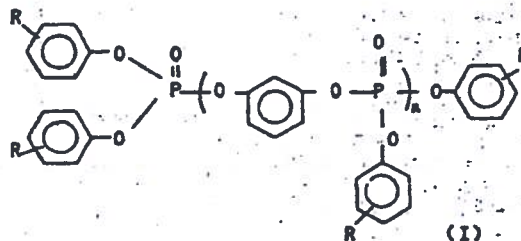
The amendments in Claim 1 are based on Claims 3, 7 and 9 as granted and on page 5, lines 17 to 19 of the patent specification (corresponding to Claims 5, 9 and 11 as well as page 10, lines 26 to 30 of the application as originally filed). As stated above, dependent Claims 2 to 9 correspond to Claims 2, 4 to 6, 8, and 10 to 12 as granted, subject to an appropriate adjustment of their appendancies and minor amendments of editorial nature.

### 3.2 Auxiliary request

The same is true for the claims of the auxiliary request. In comparison to Claim 1 of the main request, Claim 1 has been further amended by incorporation of the features of Claim 2 as granted. Dependent Claims 2 to 8 correspond to Claims 4 to 6, 8, and 10 to 12 as granted, subject to the same proviso as above.

4. State of the Art

4.1 D1 relates to flame-retardant polystyrene resin compositions comprising polystyrene resins and polyphosphate compounds of the following general formula (I)



wherein R is hydrogen or methyl and n is 1 to 5 (Claim 1). These phosphates provide a high fire retardancy and a more effective inhibition of dripping when burning compared to previously used phosphate compounds (page 4, lines 18 to 23). In the examples, a number of polyphosphates, esterified with phenol and/or cresol and having n-values in the range of 1.0 to 3.1 (no explanation of the method of determination of these n-values is given in D1), were used as sole flame-retardants or in combination with a brominated organic compound.

As explained in the document (page 3, line 14 to page 4, line 17), it had been common hitherto to improve flame-retardancy by adding organic halogenated phosphate esters or other organic halogen compounds to the resins which, however, lowered the impact strengths and the softening points and allowed extrusion or moulding of the resin composition only in limited temperature ranges. This required an accurate control of the processing temperature in order to avoid the decomposition of the flame-retardant and discolouration, loss of flame-retardancy and dripping of the polymer composition. In order to overcome the dipping problem the amounts of the additive had to be

increased which however impaired the mechanical properties. It had therefore been difficult to predict which sort of chemical structure could result in an additive showing strong flame-retardancy without adversely affecting other properties of the resin composition.

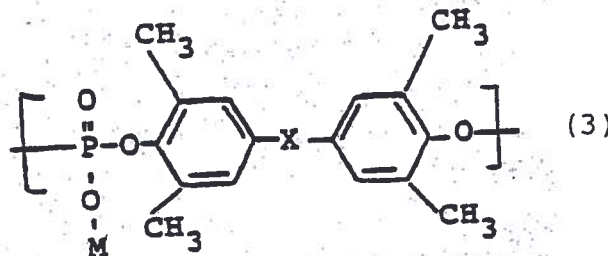
- 4.2 D2, to which reference is made on page 2, lines 45 to 49 of the patent in suit, relates to flame-retardant thermoplastic resin compositions containing mixtures of "n-mers" of polyphosphate esters which are obtained by reacting phosphorus oxychloride with diphenols and monophenols. In these esters,  $n$  (being the number of phosphorus atoms in the molecule) is an integer of 1 to 15, the content of the component with  $n = 1$  is 40 % by weight or less (claim 1), and the acid value is 15 or less. Two individual  $n$ -values, 4 and 5, are mentioned in the description (page 7, lines 20 and 22; page 8, lines 2 and 5).

The thermoplastic resins include polyphenylene ethers, polyesters, polyamides, polycarbonates and polyolefinic resins. The polyphenylene ether resins could be used alone or in admixture with a number of other polymers of different types including styrene polymers, polycarbonates, polysulfones, polyamides, polyolefins or rubbers (page 6, last two paragraphs and page 7, line 1). Further details as regards polycarbonate or examples including polycarbonate are not disclosed.

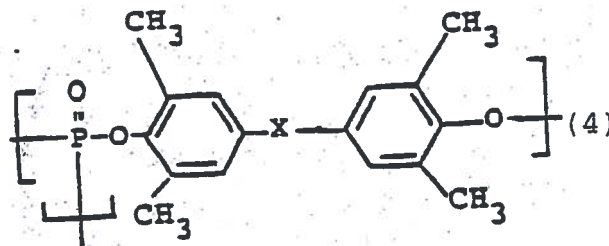
- 4.3 D3 discloses fire-retardant polyamide compositions or, alternatively, fire-retardant polycarbonate compositions which contain a polyphosphate compound, the structural formula of which differs from formula (I) in D1 (see point 4.1) only in that each terminal phenyl is substituted by groups R1 and R2, each of which independently representing a hydrogen atom or a lower alkyl group. Again,  $n$  represents 1 to 5. These

resorcinol polyphosphates are said to impart fire-retardancy to polyamides or aromatic polycarbonates without sacrificing their mechanical properties, appearance and heat-resistance (page 3, lines 21 to 26). For polycarbonate compositions, reference is additionally made to improved weathering resistance, colour stability as well as resistance to oxidation and anti-ultraviolet radiation (page 5, lines 13 to 16). In Examples 5 to 9, polycarbonate compositions containing either polyphosphates with n-values of 1.0 to 2.9 alone or in combination with further flame-retardants are mentioned. The document is silent about the method used to determine the n-values.

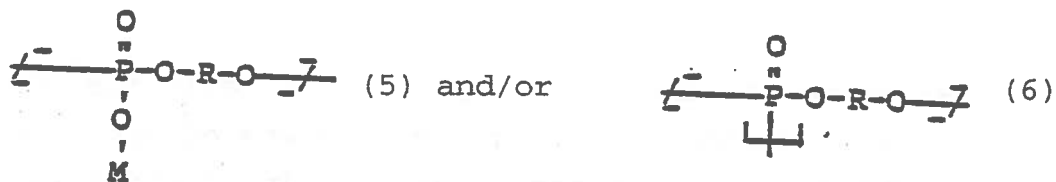
4.4 D6 discloses flame-retardant polymer mixtures comprising (a) a polycarbonate made up of specific starting compounds, (b) a styrene polymer and/or a graft polymer and (c) a branched polyphosphate consisting of at least 1 mol % of repeating units



and/or

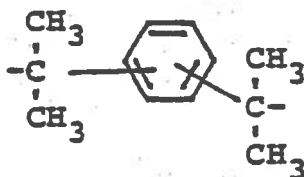


as well as up to 99 mol % of repeating units

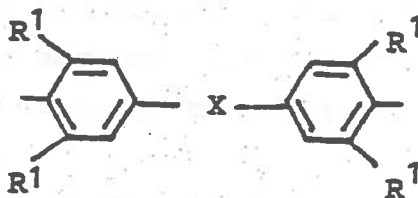


Optionally, the compositions comprised further components (d) organic chlorinated and/or brominated compounds and (e) polytetrafluoroethylene (PTFE).

In these formulae, X is a C<sub>1</sub>- to C<sub>5</sub>-alkylene or alkylidene group, a C<sub>5</sub>- to C<sub>6</sub>-cycloalkylene or cycloalkylidene group, a single bond, -S- or

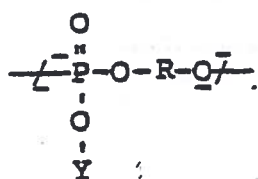


and M has the meaning of H, alkali or alkaline earth metal, Y or R-OH; wherein Y is an alkyl, cycloalkyl, aryl or alkylaryl group and R is an o-, m- or p-phenylene or a group

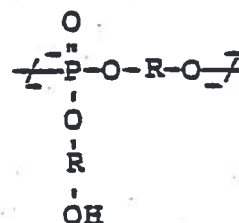


with R<sup>1</sup> being H, halogen, or C<sub>1</sub>- to C<sub>3</sub>-alkyl. In any case, units (5) and (6) are different from units (3) and (4) (Claim 1).

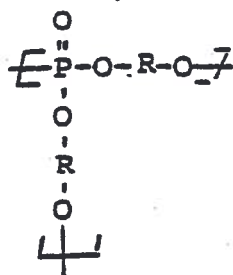
Starting at line 17 on page 12, the definition of the flame retardant (c) is given by means of specific recurring units in the polymer chain. Besides several optional units, which can be disregarded for the purpose of determining the actual structure of the polyphosphates (c), the latter contains the following linear recurrent units (7) and/or (8), branched units (10), and terminal units (11), (12) and (13) as mandatory moieties:



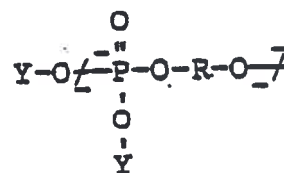
(7),



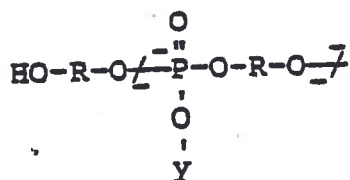
(8),



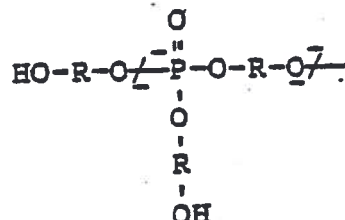
(10),



(11),



(12) and



(13)

The relative amounts of these different moieties in the polyphosphate can be influenced by adjusting the molar ratios of aromatic diol and phosphate during the polyphosphate synthesis (page 15, lines 24 to 28).

Thus, units (7) and (11) generally prevail with respect to units (8) and (13) when diol/phosphates are used in ratios of 0.66/1 to 1.49/1, whereas at molar ratios of 1.51 to 2.3/1 the units (8) and (13) predominate (page 16, lines 1 to 24), i.e. in the first case, there

are practically no phenolic hydroxyls derived from aromatic diols left in the polyphosphate, whereas, in the second case, a maximum number of phenolic groups derived from aromatic diols is present in the polyphosphate.

On page 17, third paragraph, reference is made to average degrees of polycondensation of, in general, 3 to 30; 4 to 25, in particular 7 to 20, being preferred.

Example 1 k) describes 2,2-bis(3,5-dimethyl-4-hydroxyphenyl)propane polyphosphate ("MPO") prepared from tetramethyl-bisphenol-A and triphenyl phosphate in a molar ratio of 0.91/1. Its relative viscosity is 1.07 (measured in methylene chloride at 5 g/l).

This product is used in Examples 2 to 5 in a combination of (a) polycarbonate and (b) high impact polystyrene or ABS and (e) PTFE (page 32, Table). In each of these examples, MPO (c) is used in combination with (d) decabromodiphenyl ether, another flame-retardant, in weight percentages of 15 and 10, 10 and 10, 5 and 8, as well as 10 and 10, based on the total weight of the compositions.

The property spectrum of the compositions includes high fire resistance, low dropping tendency while burning and high processing stability, which can be recognised from the fact that the melt exhibits a low tendency to discolourations or to the release of gases which are reflected in the mouldings as discolourations and streaks. Further advantages mentioned are good melt flowability and high strengths of the mouldings on joint lines. They also exhibit good strength, high surface quality of the mouldings and a low electrostatic charging ability. The thermal stability is especially stressed, even in the case of high

quantities of polyphosphate (page 27, lines 4 to 17). In the examples, flame-resistance (UL-94; 1/8 and 1/16" test rods), notched impact strength  $a_k$ , impact strength  $a_n$ , joint line strength  $a_{nF}$  and Vicat B of the samples have been measured (page 32, Table).

4.5 D11 relates to the use of poly(1,4-phenylenephenyl phosphate) (PPO) and poly(1,4-phenylenephenyl phosphonate) (PPP) as flame-retardants for polyesters. On page 334, right column, second and third paragraphs, referred to by Appellant 2 during the oral proceedings, the influence of the molecular weight of PPP is discussed with respect to flammability performance and blending with polyester. There are no discernible differences between low and high molecular weight PPP; lower molecular weight should lead to more uniform blending due to lower melt viscosities.

5. *Problem and Solution*

5.1 The patent in suit concerns a polymer mixture comprising (A) an aromatic polycarbonate, (B) a styrene-containing copolymer and/or graft copolymer and (C) a phosphate based flame-retardant and articles made therefrom.

5.2 Such a product is known from D6 which the Board, like the parties and the Opposition Division, regards as representing the closest state of the art.

5.2.1 In its letter received on 11 July 2000 and in its submissions during the oral proceedings, Appellant 2 argued and Appellant 3 supported the view that there was such an overlap between the disclosure of D6 and the claimed subject-matter that novelty was even questionable.



The polymer mixture as claimed comprised (A) all aromatic polycarbonates and (B) a broad range of styrenic polymers, so that these two components could not serve to distinguish the claimed subject-matter from the composition known from D6. The definitions of X and R<sub>1</sub> to R<sub>4</sub> in formula (1) included all the definitions of the corresponding groups in D6 as well.

As stated in the decision under appeal (point 6.2.3), an average degree of polycondensation of about 3 corresponded to a linear flame-retardant and a diol/phosphate molar ratio of 0.66/1 to 0.96/1 resulted almost exclusively in structural units (7) and (11). Like the Opposition Division, the Appellant concluded that a molar diol/ phosphate ratio of 0.66/1 (= 2/3) inevitably led to a linear oligomer of the general schematic structure: phosphate-diol-phosphate-diol-phosphate. This argument also applied to Example 1 k), describing a polyphosphate "MPO" prepared from starting compounds in a molar ratio of 0.91/1 (page 30, line 18; cf. document (c)).

The Appellants conceded that D6 also referred to branched polyphosphates, but only in connection with a molar diol/phosphate ratio of 2.03/1 to 2.5/1 (page 16, lines 13 to 16).

Moreover, the decimal N-value of 1.2 to 1.7 made it clear that the phosphate component did not relate to a pure compound but to a mixture (cf. document (b)), which is the normal result of transesterifications occurring in the preparation of such compounds. Exhibit 2-1 of Appellant 3 submitted on 9 April 1999 demonstrated that mixtures of polyphosphates as in D6 always comprised oligophosphates within the definition of component (C).

Finally, the wording of Claim 1 required only the presence of oligophosphates having an average polycondensation degree within a range of 2.2 to 2.7, but it did not exclude the presence of further polyphosphates having higher N-values, i.e. as an optional component (D).

5.2.2 All these arguments were rebutted by the Respondent on the basis of its test report submitted on 20 December 1999. D6 clearly required both a branched structure and the use of tetramethyl bisphenol A as a diol starting compound. In order to verify the structure of "MPO" according to Example 1 k), an outside research institute was commissioned to prepare the flame-retardant ("FR-2") in accordance with D6 and its parallel case, D6a, which gave more details about the preparation and properties of these compounds (cf. "Anlage 2" to the Counterstatement of Appeal: page 1, last paragraph). Moreover, a further polyphosphate (FR-3) with an even lower diol/phosphate molar ratio of 0.57 (i.e. less than the lower limit of 0.66/1 as in D6) was prepared which, according to the Appellants' arguments (documents (c) and (d)), should in any case have a linear short-chain structure. Both polyphosphates showed relative viscosities in accordance with D6 ( $\eta_{rel} = 1.065$  and  $1.012$ , respectively, measured in  $\text{CH}_2\text{Cl}_2$ , 5.0 g/l, 25°C; D6, page 17, lines 19 to 22: 1.01 to 1.20; D6a: page 20, lines 12 to 14 and the footnote concerning  $\eta_{rel}$  on page 25). In both cases, the N-value could not be measured by means of HPLC, which according to the Respondent showed that these products were apparently branched (cf. the experimental report, pages 2 and 3).

5.2.3 The Board cannot share the Appellants' interpretation of D6, because the general teaching of this citation unambiguously requires the polyphosphate flame-retardant to be branched, which means a minimum of 4

phosphate units. The branched structure is further confirmed by the detailed description of the various structural units present in the polyphosphate, amongst which branching unit (10) is mandatory (D6: pages 12 to 14; cf. point 4.4, *supra*).

The passage on page 16, lines 1 to 16, relied upon by the Appellants has to be read in its context, which means that the subsequent two paragraphs (page 16, lines 17 to 24) have to be taken into account. They explain the influence of the molar ratio on the types of aromatic terminal and pending side groups, which can either be -Y groups (i.e. unsubstituted, see page 4, lines 1/2) or -R-OH groups. This passage on page 16 does not deal at all with linear or branched structures of the polyphosphate chain, in contrast to the last 2 lines on that page. It is however true that D6 is somewhat inconsistent in this respect when it refers to an average P-value of 3 (page 17, line 15).

The evidence provided by the Respondent on 20 December 1999 (i.e. more than 6 months before the oral proceedings), the results of which have not been refuted by the Appellants, casts at least strong doubts on the Appellants' arguments. MPO (FR-2) apparently does not have a structure allowing the N-value to be determined by HPLC. Moreover, this is also true for FR-3 which according to the model calculation on the second page of document (c) should have a N-value of less than 2, because the molar diol/phosphate ratio is 0.57/1, compared to 0.66/1 in that calculation.

These experimental data clearly show that the reaction of the aromatic diols with phosphoric acid esters does not take place in accordance with the explanations presented by Appellant 2 in the oral proceedings on the basis of document (c), but is obviously more complex. The reactivities of the different molecules in the

reaction mixture towards the other reactants present are apparently not such that the formation of a single species of the type A-B-A-B-A would inevitably occur when a A/B ratio of 3/2 is used.

On the contrary, the fact that the authors of D6 considered "MPO" to be a preferred branched flame-retardant within the terms of Claim 1, as demonstrated by its use in Examples 2 to 7 and 10 to 13, even further supports the Respondent's position.

It follows that it cannot be deduced from these facts and the evidence on file that the polyphosphates of D6 would have been, beyond all reasonable doubt, linear and similar, let alone identical, to the compounds having an N-value of between 1.2 and 1.7 as required in Claim 1.

5.3 In line with the introductory statements in the patent specification (page 2, lines 9 to 17, 29 to 39) and in view of the melt viscosity data reported for different shear rates (see page 9, Table D), the technical problem underlying the patent in suit may thus be seen as the provision of a composition having improved flame-resistance as well as a level of plasticization easier to control.

5.4 Main request

According to the main request, this problem is solved by a composition as defined in Claim 1, which comprises (A) 5 to 95 % by weight of an aromatic polycarbonate, (B) 5 to 95 % by weight of a styrenic polymer and - as flame-retardants - both (C) 1 to 25 parts by weight of a particular oligophosphate flame-retardant having an average polycondensation degree of 1.2 to 1.7 and (D) up to 20 parts by weight of one or more of specific additional flame retardants, the amounts of which are

calculated per 100 parts by weight of (A) + (B). From the very wording of Claim 1, contrary to the Appellants' arguments, it is clear that this solution does not encompass polyphosphates having higher N-values than 1.7.

As can be seen from page 6, lines 54/55, page 7, Example XVI and Comparative Example XVII, as well as from the test report submitted by the Respondent on 20 December 1999, the two aspects of the above defined technical problem are effectively solved by the composition as defined in Claim 1 of the patent in suit.

The Board is satisfied that in the test report composition A according to the claimed subject-matter (including oligophosphate FR-1) shows significantly improved flame-retardancy measured in accordance with the UL-94 standards in comparison to composition B which includes FR-2. The same is true for composition C including FR-1 when compared with composition D based on FR-3. The melt viscosities measured at various shear rates and Vicat 120B values of compositions A and C are also remarkably different from those of compositions B and D.

In accordance with established jurisprudence, the burden of proof when contesting these experimental data in the Respondent's test report received on 20 December 1999 was on the Appellants. In the absence of any evidence for their arguments, their objections concerning the differences between the monomeric compositions of, on the one hand, FR-1 and, on the other hand, FR-2 and FR-3 in the said test report, which were raised for the first time in the oral proceedings, cannot outweigh the evidence provided by the Respondent.

6. *Obviousness*

It remains to be decided whether the solution was obvious to a person skilled in the art having regard to the state of the art relied upon by the Appellants.

6.1 As set out under point 6.1 of the decision under appeal, D6 was regarded by the Appellants (then Opponents 2 and 3) and the Respondent to represent the closest state of the art cited in these proceedings. The Board concurs with this finding.

6.1.1 The blend of D6 is based on the same polymer components rendered flame-resistant by phosphate compounds. Even though the compositions of D6 show V-0 rating, it is only achieved when the polyphosphate MPO is used in combination with an additional brominated flame-retardant in weight percentages of 15 and 10, 10 and 10 or 5 and 8, respectively, based on the total weight of the compositions (see the table on page 32). Hence, these examples cannot be compared with examples based on compositions free of the additional brominated compound and cannot form the basis for a convincing argument of lack of inventive step. The additional 0.2 parts by weight of Teflon in both the examples of D6 and Examples V and XVI of the patent in suit can be disregarded in this context.

6.1.2 The document aims at compositions having a broad range of applications (page 27, lines 4 to 17) and reference is made to various properties such as high fire-resistance, low dropping tendency while burning and high processing stability which can be seen from the fact that its melt exhibits a low tendency to discolouration or to the release of gases which are reflected in the mouldings as discolourations and streaks. Good flowability in the melt, high strengths of the mouldings at the joint lines, good strength,

high surface quality of the mouldings and low electrostatic charging ability are also mentioned, as well as thermal stability, even at high quantities of polyphosphates.

From the remark about thermal stability observed even at high quantities of polyphosphates, it is evident that not each of these properties is found to the same degree within the whole range of possible compositions in D6. It is clear as well that the composition of the phosphate compound has a significant impact on the various properties of the final composition (page 15, line 24 to page 16, line 1) and that the polyphosphates are different from the oligophosphates used in the patent in suit (see point 5.2.3).

Finally, no hints can be found in the citation which of the above properties can be controlled in a specific way upon variation of one of the constituents of the final blend, let alone, upon replacement of component (c) by a different phosphorus compound.

6.1.3 It is evident from these considerations that D6 by itself does not suggest to select the specific oligophosphates having an N-value of 1.2 to 1.7 in order to solve the above two aspects of the technical problem.

6.2 D1 does not suggest to select these specific oligophosphates for polycarbonate/styrenic polymer blends either.

6.2.1 First, the document deals with polystyrene resins only.

- 6.2.2 Secondly, according to the second paragraph on page 2 "it is quite difficult to predict what sort of chemical structure will result in an additive showing strong fireproofing action without adversely affecting other properties of a resin composition."
- 6.2.3 Thirdly, the examples recite average values for the time from ignition to flame extinction of 5 specimens of each composition. These average values can neither be translated into V-0, V-1 or V-2 values of the UL-94 standards, which require that, if only one specimen from a set of five specimens does not comply with the requirements, another set of five specimens is to be tested, nor do they give any hints as to the deviation of the individual measurements from the average value.
- 6.2.4 Fourthly, in these examples compounds within and outside the N-range of 1.2 to 1.7 were used, and there is no indication that the former might be more effective than the latter, thus no incentive to consider a particular polycondensation degree. Therefore, a selection of certain compounds from the examples could only be based on the knowledge of the patent in suit, i.e. on *ex post facto* analysis.
- 6.3 The phosphate compounds of D2 comprise 1 to 15 phosphorus atoms. There is no suggestion to use those compounds having an N-value of 1.2 to 1.7 in order to obtain a V-0 rating. The examples are silent in this respect as well (cf. page 15, Table 4, polystyrene: V-1). Although the document teaches that these compounds may be used in different thermoplastic resins, it does not refer to combinations of polycarbonate and styrenic resins, but only to blends of polyphenylene ethers with other resins (page 5, last paragraph and Examples of execution 1 to 3). Hence, the argument in point 6.2.2 applies here as well.



6.4 D3 concerns polyamide or polycarbonate compositions comprising polyphosphates having N-values of 1 to 5. Combinations of thermoplastic resins are not envisaged at all. The above findings as to D1 apply to this document as well (in particular, points 6.2.2 to 6.2.4).

6.5 D11 does not provide any incentive to select an oligophosphate in accordance with the definition of Claim 1 of the patent in suit either. It does not even mention particular degrees of polycondensation.

6.6 It follows that the claimed subject-matter does not derive in an obvious manner from D6, nor any combination thereof with any one of documents D1, D2, D3 or D11.

6.7 During the oral proceedings, the Appellants suggested that D2 could likewise be used as a starting point and that it would have been obvious to replace the thermoplastic resin in this document by a combination of polycarbonate and styrenic resins as known from D6.

In view of the above findings, this could only be based on *ex post facto* analysis (see point 6.2.4). There was no incentive to select compounds of specific N-values nor to blend these compounds with the specific combination of thermoplastic resins in order to solve the above technical problem. This finding would also apply to any other combination of D2 with the above citations.

6.8 It follows that the polymer mixture in accordance with Claim 1 would not be obvious to a person skilled in the art having regard to the documents relied upon by the Appellants, whether considered in isolation or in combination and, therefore, involves an inventive step.

7. Claims 2 to 8, which relate to preferred embodiments of the mixture of Claim 1, as well as Claim 9, which includes all limitations and features of Claim 1, are supported by the patentability of the main claim and thus also allowable.
  
8. Since the main request of the Respondent has been successful, there is no need to further consider its auxiliary request.

## 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 claims according to the main request ("Auxiliary Request II" filed on 29 March 1999), after any consequential amendment of the description.

The Registrar:



E. Görgmaier

The Chairman:



C. Gérardin