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Bezeichnung der Erfindung: Thermoplastic composition having improved impact modifier and process for production
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : C08L 9/00

ENTSCHEIDUNG / DECISION

vom / of / du 7 January 1991

Anmelder / Applicant / Demandeur : General Electric Company

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence : Polyphenylethylene/GE

EPÜ / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : "Inventive step (confirmed)"

Leitsatz / Headnote / Sommaire

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Case Number : T 147/87 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 7 January 1991

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Decision under appeal : Decision of Examining Division 014 of the European Patent Office dated 22 December 1986 refusing European patent application No. 82 900 069.4 pursuant to Article 97(1) EPC

Composition of the Board :

Chairman : F. Antony
Members : R. Lunzer
R. Schulte

Summary of Facts and Submissions

I. European patent application No. 82 900 069.4 was filed under the provisions of the PCT on 23 November 1981, claiming priority based on application No. 210 643 filed in the United States on 26 November 1980, and it was published as WO 82/01885 on 10 June 1982.

II. By a decision dated 22 December 1986, the Examining Division refused the application on the ground that the invention claimed in Claim 1, as amended in the course of correspondence with the Applicant, was lacking in any inventive step contrary to Article 56 EPC.

III. Claim 1 of the application at the time when finally rejected in the decision under appeal was in the following form:

"A thermoplastic composition, comprising an admixture of polyphenylene ether and butadiene-modified alkenyl aromatic resin wherein the butadiene-modified polyalkenyl aromatic resin comprises polybutadiene in the form of a membrane, characterised in that the membrane (A) forms a continuous network in said resin or (B) is in the form of discrete segments of such a membrane network."

IV. In reaching its adverse decision, the Examining Division relied on the following prior art documents:

(1) GB-A-1 422 208
(2) Polymer Engineering Science, 17 (1977), 498 to 505.

V. The decision under appeal accepted as a fact that polyphenylene ethers (hereinafter PPE) are well known

thermoplastic materials, whose lack of processability could be improved by blending with rubber modified high impact polystyrene. This was acknowledged in (1), page 1, lines 57 to 93. The invention of (1) resided in ensuring that the rubber part of the polybutadiene modified polystyrene took the form of a membrane, so that the polystyrene formed a continuous phase, while the polybutadiene was in the form of a plurality of disconnected membranes. The decision then referred to (2), which deals with the different microstructures which can be obtained in polybutadiene modified polystyrenes according to their composition and treatment. It drew particular attention to the last paragraph of the article bridging pages 504 and 505, which, in describing Fig. 13A and 13B, indicated that a network of polybutadiene might be obtained. It stated:

"When the concentration of the block polymer in the solution is higher, the lamellar domains of polybutadiene have numerous interconnections, and the morphology of the material after polymerisation is as shown in figures 13B. The morphology of this system may be described as a "foam" structure, where the polybutadiene domains comprise the cell walls and the polystyrene phase is enmeshed within these domains. Fracture behaviour of these systems and its comparison to that of HIPS and blends of block polymers and polystyrene should be an interesting area for further research." (emphasis added).

Reading these two disclosures together, the decision under appeal held that a skilled worker, seeking to improve the properties of the products described in (1), would have been led by (2) to expect that superior properties might well be obtainable by applying the teaching of networks in (2) to the compositions of PPE and polybutadiene modified polystyrene disclosed in D1, and accordingly concluded that the alleged invention lacked any inventive step.

VI. An appeal against this decision was lodged on 19 February 1987, the appeal fee was paid the day before, and the Grounds of Appeal were filed on 3 April 1987. The Appellant requests that the decision under appeal should be set aside, and that a patent should be granted on the basis of the Claim 1 as put forward in its latest communication dated 20 December 1990, together with dependent Claims 2 to 6. Claim 1 takes the following form:

"A thermoplastic composition consisting essentially of an admixture of polyphenylene ether and butadiene-modified alkenyl aromatic resin, wherein the butadiene-modified polyalkenyl aromatic resin comprises 3 to 15% by weight polybutadiene and is in the form of a membrane, characterized in that said membrane (A) forms a continuous network in said resin, or (B) is in the form of discrete segments of such a membrane network."

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. **Allowability of Amendments**

2.1 As compared with the claim as originally filed, the claim in the present proposed amendment adds three features:

(a) it makes it clear that the polybutadiene membrane takes the form of a continuous network;

(b) that as an alternative, this network can be broken up into discrete segments;

(c) the polybutadiene-modified polyalkenyl aromatic resin comprises 3 to 15% by weight polybutadiene; and

(d) the claimed composition does not only comprise, but consists essentially of polyphenylene ether and butadiene-modified polyalkenyl aromatic resin, to the essential exclusion of other polymeric constituents.

2.2 At page 3 of the description as filed, in the Introduction to the Invention it is stated that:

"For these compositions, the butadiene-modified resin is a network polymer combining polyalkenyl aromatic and polybutadiene membrane. On being subjected to high shear, the continuous membrane phase is shredded into discrete segments which impart an increased impact strength to the composition."

This statement is hardly a model of clarity, and the reference to a "network polymer" (a term commonly used to mean "a cross-linked polymer") rather than to a "polymer which is present in the form of a continuous phase or network", has already caused some confusion. Nevertheless, the Board is satisfied that, read with the eyes of a skilled person, this disclosure in the application as filed provides a sufficient basis for items (a) and (b) identified above. At page 6, lines 5 to 8 of the application as filed there is a specific disclosure of the feature identified as (c) above. As to (d), as no polymeric constituents other than those referred to above are disclosed in the original documents, while on the other hand certain optional non-polymeric constituents are mentioned on page 7, last paragraph, it is again clear to the skilled reader that the originally used term "comprising" in the given context is to be interpreted as meaning "consisting essentially of".

2.3 Accordingly, the Board is satisfied that each of the proposed amendments are such as were disclosed in the application as filed, and thus that the inclusion of these features in the present Claim 1 does not offend against the provisions of Article 123(2) EPC.

3. **Closest prior art**

3.1 In the Board's view, the closest prior art is (1). This relates to a thermoplastic composition comprising a matrix of PPE in polystyrene, in which there is uniformly dispersed a discontinuous phase comprising particles of styrene homopolymer englobulated in a polybutadiene rubber membrane. The size of these particles is limited to 0.1 to 0.7 microns, and the wall thickness of the membrane to not more than 1/4 of the average particle diameter, and the rubber content is limited to 1 to 10% by weight of the rubber modified polystyrene.

3.2 In Table 1 on page 6 there are two comparative Examples which demonstrate that if the above stated limits on either particle size or rubber content are exceeded, then, in both cases, there is a loss of desired transparency, and in the case where the particle size is large, there is also a serious loss of impact strength.

3.3 It is important to observe that the whole tenor of this document is that its advantages are obtainable if, but only if, the polybutadiene membrane is in the specified form.

4. **Problem and solution**

4.1 The problem with which the patent application in suit is actually concerned, as also the objective problem as seen by the Board based on a comparison of the results attainable with the alleged invention when compared with the closest prior art, (1), is the attainment of a

thermoplastic composition which combines ease of handling and good mouldability with mechanical properties, notably impact strength, elongation, and tensile strength, which are significantly better than those attainable in accordance with (1).

4.2 In Example II of the application, an Izod notch impact strength of 0.201 kg.m/cm is reported as having been achieved in a composition containing only 3% of butadiene rubber. In Example III, more details of the mechanical properties attainable in accordance with the alleged invention are given. In the Table below are set out the results included in the two Examples in the application in suit, as well as the corresponding figures given in (1) in the Table on page 6 (appropriately converted).

	Rubber Content	Impact strength	Elongation	Tensile strength
Example II	3%	0.201		
Example III	2%	0.158	52%	78.59 N/mm^2
(1) Table on page 6	6%	0.155	48%	70.34 N/mm^2

4.3 From the above it is apparent that markedly superior impact strength is shown in Example II when using only half the quantity of rubber used in (1), while even with 2% of rubber as in Example III, each of the figures given is marginally better than those shown in (1). Taking these figures into account, the Board is satisfied that a credible improvement has been attained over the properties attainable in accordance with the teaching of (1).

5. Novelty

5.1 Having reviewed the cited documents, the Board is satisfied that none of them discloses a thermoplastic composition having all the features defined in Claim 1. Therefore, the subject-matter of Claim 1 is novel within the meaning of Article 54 EPC. Novelty being uncontested, no further elaborations are needed.

6. Inventiveness

6.1 The issue of inventiveness turns on whether it would have been obvious to the skilled person, if confronted with the above stated problem, and taking the disclosure of (1) as his starting point, to have arrived at the present alleged invention.

6.2 As indicated in paragraph 3.3 above, this prior document contains a strong indication that the polybutadiene membrane must be in the form there specified. Of course, the skilled worker will readily make changes to the teachings of a prior document if he has any incentive to do so. Thus, in the present circumstances, if there were to be some basis for expecting that better properties might be attainable by changing the structure of the polybutadiene membrane, it might reasonably be assumed that the skilled reader would do so. However, having regard to the clear teaching of this prior document that the membrane has to take the form there specified, it would need a significant pointer in another direction to lead the skilled worker to follow that part of its teaching directed to using the compositions there described, while at the same time abandoning the kernel of its teaching, which is directed to achieving a specified morphology.

6.3 In the decision under appeal, the Examining Division held that it was able to find such a pointer in (2). This is a research paper which discusses a considerable variety of microstructures which can be obtained in polybutadiene modified polystyrenes. Although it makes no mention of the possible inclusion of PPE, as it is undisputed that PPE is well known as a commonly available polymer which is miscible with polystyrene, the Board is prepared to presume that the teachings of this document in relation to polybutadiene modified polystyrene would readily be extended by a skilled reader to the combination of PPE with polybutadiene modified polystyrene.

6.4 Turning to the detail of the contents of (2), it is worthy to note that in Figs. 4A and 4B, 5A and 5B, electron photomicrographs are shown, in 4A and 5A for triblock polymers, and in 4B and 5B for these same triblock polymers blended with styrene homopolymer. The reader of the article, paying attention to morphology, could not fail to observe that although the polybutadiene in Fig. 4B is described as being the dispersed phase in the form of short cylinders, in fact there is a considerable degree of network-like continuity in this phase as seen in the photomicrograph. This structure is very different from that shown in Fig. 5B, which resembles that shown in Fig. 1 of (1), and which is rejected in that document as being the less desired (see page 2, lines 74 to 83). Furthermore, such a reader could hardly fail to notice that in Table 1 at page 503 of (2), the product which is illustrated in Fig. 5B is shown to have a notch impact strength of 246 J/m, which is to be contrasted with a mere 48 J/m for the corresponding test carried out on a sample in accordance with the structure shown in Fig. 4B.

6.5 Thus, in the main part of the paper, the best results are apparently achieved with the microstructure which is expressly rejected as undesired in (1), while the much better performance of the test piece in accordance with Fig. 5B, over the corresponding test piece in accordance with Fig. 4B, could reasonably suggest that serious loss of impact strength is to be expected from the presence of a relatively continuous butadiene phase.

6.6 In the decision under appeal, the main part of (2) was ignored. Instead, the Examining Division relied on the suggestion for possible future research, i.e. the paragraph which has already been quoted in V. above. The Board accepts that the structure there described and illustrated, particularly in Fig. 13B, is very like that which is the subject of the present patent application. However, the language in which investigation into this area is recommended is cautious in the extreme. The Board interprets the final sentence (quoted in V. above) as being a statement by the authors meaning - "We think that this might be an interesting area for further investigation, but we have not the slightest idea as to whether anything of value at all is to be found there."

6.7 It is certainly not a suggestion that better performance, in any respect whatsoever, is anticipated by the authors. Thus, the Board does not regard this document as being a pointer in the relevant direction which is sufficiently strong to induce any worker, using (1) as his starting point, to abandon the essence of its teaching in the expectation of attaining useful results.

6.8 That would in itself be enough to dispose of (2) as being a pointer towards the present invention. However, for completeness it is added that the Board would expect the skilled reader of this article to observe the curious fact

that although the authors found time to produce samples which were subject to electron microscopy, (Figs. 13A and 13B), which is a relatively complicated and time consuming task, they failed, so it would seem, to carry out a simple Izod impact test, which can be performed in a few minutes. This is not the place to speculate why the authors so confined their investigation. The Board goes no further than commenting that the absence of any data on the impact strength of samples which had been made could raise doubts in the mind of the skilled reader as to the usefulness of products having the microstructures illustrated.

6.9 Accordingly, the Board is not satisfied that even a combination of (1) with (2) would give any pointer to the skilled reader in the direction of the invention, and, therefore, considers that an objection of lack of inventive step against Claim 1 as proposed to be amended cannot be entertained.

7. The subject-matter of Claim 1 of the application in suit thus involves an inventive step as required by Article 56 EPC, and the claim is therefore patentable. The same applies to Claims 2 to 6 which relate to compositions falling within the scope of Claim 1.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the Examining Division with the order that a patent be granted on the basis of Claims 1 to 6, referred to in paragraph VI above, subject to appropriate adaptation of the description.

The Registrar: The Chairman:

E. Görgmaier F. Antony