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D E C I S I O N
of 8 May 1995

Case Number: T 0283/92 - 3.3.3

Application Number: 8763129.2

Publication Number: 0258168

IPC: C08K 3/36

Language of the proceedings: EN

Title of invention:
Rubber vulcanization agents and methods for their preparation

Applicant:
THE GOODYEAR TIRE & RUBBER COMPANY

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0283/92 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 8 May 1995

Appellant: THE GOODYEAR TIRE & RUBBER COMPANY
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Akron, Ohio 44316-0001 (US)

Representative: Leitz, Paul
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Decision under appeal: **Decision of the Examining Division of the European Patent Office dated 7 November 1991 refusing European patent application No. 87 630 129.2 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: C. Gérardin
Members: H. H. Fessel
M. W. Schar

Summary of Facts and Submissions

I. The European patent application No. 87 630 129.2, filed on 28 July 1987 was refused by a decision of the Examining Division 2.1.02.013 of the European Patent Office dated 7 November 1991.

That decision was based on a set of 8 claims filed on 20 July 1990, of which Claim 1 reads as follows:

"A process for making a vulcanizing agent characterized by (1) preparing a mixture of water, sulfur and an olefin wherein the weight ratio of sulfur to olefin ranges from 1 to 50 parts by weight of sulfur per part by weight of olefin and wherein the weight ratio of olefin plus sulfur to water ranges from 1:2.5 to 1:60; (2) heating the mixture to 120-200°C with agitation to form the vulcanizing agent; (3) cooling and isolating the granular vulcanizing agent."

Claim 5 is a further independent claim which is directed to a process for preparing a rubbery vulcanizate by (A) mixing a rubbery material with a sulphur-olefin adduct obtained by a process as defined in Claim 1 and (B) vulcanizing the resulting mixture. Claims 2 to 4 and 6 to 8 concern preferred embodiments of the process according to Claims 1 and 5 respectively.

II. The reason for the decision was that the subject-matter as claimed in Claim 1 did not involve any inventive step vis-à-vis the teaching given in the following prior art documents:

(1) US-A-2 989 513 and

(2) DE-A-1 806 987.

More specifically, it was stated that the use of vulcanizing agents from sulphur and olefin which had been prepared in the claimed weight ratios at a temperature above 120°C, optionally in the presence of an inert diluent and catalysts, was known from (1) and (2).

The Examining Division held the objective technical problem, which was to provide the copolymer directly in particulate form, i.e. without the need for grinding or removal of an organic diluent, to be effectively solved with the means given in Claim 1. It argued that in view of the different polymerisation techniques, such as bulk, solution or emulsion polymerisation, a person skilled in the polymerisation art would not hesitate to use emulsion polymerisation in order to solve the above problem. The range of water specified in Claim 1 encompassed virtually any amount a skilled worker would consider feasible in practice for an "inert diluent" and thus could not amount to evidence for an inventive step. Accordingly the subject-matter of Claim 1 did not meet the requirements of Article 56 EPC whereas it appeared that the subject-matter of Claims 2 to 6 would in principle be patentable.

III. On 27 December 1991 a Notice of Appeal was lodged against that decision together with payment of the prescribed fee. The Statement of Grounds of Appeal was received on 12 March 1992.

i) By letter received on 29 August 1994 the Appellants specified that as main request the appeal procedure should be followed on the basis of Claims 1 to 4 filed on 20 July 1990. In substance, the Appellants argued that the documents relied upon in the decision under appeal did not render obvious the process as claimed.

Document (1) concerned the preparation, with or without solvent, of a fluid sulphur olefin product and not one in granular form whereas the method disclosed in (2) was a neat reaction or used inert organic diluents to get solid products which had to be chopped subsequently. In contrast to the solvents in these citations, which were only optional features, water played a major role in the claimed process, since it had to be present in sufficient quantities to ensure the formation of beads and to act as a heat sink.

ii) Together with the Statement of Grounds of Appeal the Appellants filed a set of 6 claims to be considered as an auxiliary request, wherein the two independent process claims had been limited to the use of a specific mixture of dicyclopentadiene and styrene as an olefin, which the Examining Division had considered to be a feature involving an inventive step.

IV. The Appellants requested that the decision under appeal be set aside and that a patent be granted on the basis of Claims 1 to 4 enclosed with the letter dated 20 July 1990 as main request or, alternatively, on the basis of Claims 1 to 6 received on 12 March 1992 as an auxiliary request.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. The subject-matter of present Claim 1 corresponds to the subject-matter of Claim 2 as filed originally and meets therefore the requirements of Article 123(2) EPC.

3. The feature distinguishing the subject-matter of Claim 1 from the teachings given by (1) and (2) is the use of water as the inert diluent. Novelty is thus not disputed.

4. The application in suit concerns a process for preparing a vulcanising agent for natural and synthetic rubbers. As acknowledged in the introductory section of the application in suit (page 2, lines 39 to 42), such a process is described in US-A-2 989 513 identified above as document (1), which the Board regards as the closest state of the art. More specifically, this citation relates to the preparation of interpolymers of sulphur and one or more olefinic hydrocarbons as well as rubber vulcanisates prepared therewith; such vulcanisable compositions comprise a major proportion of a rubber and from about 1 to about 12% by weight based on the weight of said rubber of the curing agent. The interpolymers which are most useful are those having ratios of 1:2 to about 1:5 olefinic equivalents to sulphur atoms (col. 3, lines 1 to 5). They may be produced by polymerisation in an inert diluent such as benzene, toluene, chlorobenzene, carbon disulphate, and the like, or the reaction can be conducted in the absence of a diluent (col. 3, lines 45 to 49) and at a temperature of preferably 145 to 160°C (line 53). All the interpolymers exemplified, namely the polymers of styrene and sulphur in mole:atom ratios of 1:2.8; 1:4 and 1:4.5 as well as polymers of styrene and sulphur containing 10 to 20% by weight of dipentene or alpha-methyl styrene (Example I) and sulphur-ethylene and sulphur-isobutylene polymers in the atom:mole ratio of 4:1 (Example IX), are fluid products. These products are said to provide rubber vulcanizates with excellent aging properties (column 1, lines 40 to 42).

In the absence in the application in suit of any comparative test with fluid product, the technical problem can only be seen in the definition of a further process for preparing vulcanizing agents.

This problem is said to be solved with the means given in Claim 1, i.e. by heating the mixture of water, sulphur and an olefin in the ratios given therein to a temperature of 120-200°C with agitation.

In view of Examples 10 and 11 in the application in suit, which show high states of cure and thereby good aging properties, the Board is satisfied that the above problem is effectively solved.

5. It remains to be decided whether the claimed subject-matter is obvious having regard to the teaching of the documents relied upon in the decision under appeal which also appear to the Board to be the most relevant ones.

5.1 According to the teaching of document (1), the preparation of sulphur-olefin hydrocarbon polymers can be carried out in an inert diluent or in the absence thereof. Another embodiment, in particular the use of water in specific amounts as required in the application in suit, is not envisaged in this citation.
The argument in the decision under appeal (Reasons for the decision, point 3.3) that water was an obvious alternative to inert diluents, and that therefore an emulsion polymerization process would be the evident solution to the above defined problem, cannot be accepted. First, the diluent is only an optional feature in document (1), which means that in the absence thereof there cannot be any incentive to use water. Secondly, as pointed out by the Appellants, such an approach overlooks the fact that in the claimed process the role of water cannot be equated with the function of a

diluent in the prior art. On the one hand, the presence of water aims at the formation of beads upon cooling of the reaction mixture, whereas the organic diluents by definition would tend to dissolve the adducts; on the other hand, water acts as a heat sink for the exothermic reaction, which is not necessary in the known process.

These differences are evidence that the use of water involves more than the mere substitution of one reaction medium for another.

5.2 Document (2), which refers to document (1), can be regarded as a further development of the process disclosed in the latter, in that the vulcanizing agent is prepared from sulphur and a conjugated dene in the presence of 10% by weight of an amine (Claim 1). Like in the process according to document (1), the polymerization reaction can be carried out with or without organic solvent (page 2, paragraph 2, in fine), which means that the above considerations about the non-equivalence between organic diluent and water apply equally here.

A further point to be considered is the requirement that in this state of the art the curing agent be fluid in order to be effective (page 4, paragraph 2, lines 1 to 7). Such prerequisite is the opposite of the physical state aimed at in the application in suit, where the adducts are obtained as beads. This renders the subject-matter of Claim 1 non obvious.

5.3 The conclusion of non-obviousness is supported by the fact that more than 25 years elapsed between the date of publication of document (1), i.e. 1961, and the priority date of the application in suit, i.e. 1986. Such a lapse

of time is considerable in a field as active and explored as the vulcanization of rubbers and speaks for inventiveness of the solution proposed by the Appellants.

5.4 For these various reasons, the Board concludes that the subject-matter as defined in Claim 1 involves an inventive step.

6. The subject-matter of Claim 1 being allowable, the same applies to the subject-matter of Claims 2 to 4, which are directed to preferred embodiments of the process according to Claim 1 and whose inventiveness is supported by that of main process claim.

Auxiliary request.

7. Since the Board has come to the conclusion that the main request can be granted, there is no need to examine the 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 Examining Division with the order to grant a patent on the basis of Claims 1 to 4 filed on 20 July 1990 and the following description:
-pages 1 to 4 and 6 to 16 as originally filed;
-pages 5 and 17 as filed on 20 July 1990.

The Registrar

E. Görgmaier

The Chairman

C. Gérardin