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**Datasheet for the decision
of 8 July 2020**

Case Number: T 0354/17 - 3.3.03

Application Number: 12193785.8

Publication Number: 2596963

IPC: B60C1/00, C08C19/20, C08C19/25,
C08C19/44, C08F2/26, C08F36/06,
C08F2/38

Language of the proceedings: EN

Title of invention:
Functionalized polymer, rubber composition with such a polymer
and pneumatic tire

Patent Proprietor:
The Goodyear Tire & Rubber Company

Opponent:
Trinseo Deutschland GmbH

Relevant legal provisions:
EPC Art. 54, 56, 84

Keyword:
Novelty - (yes)
Inventive step - (yes)
Interpretation of the claims - explicit wording thereof - no
reason to construe differently



Beschwerdekammern

Boards of Appeal

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Case Number: T 0354/17 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 8 July 2020

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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 16 December
2016 rejecting the opposition filed against
European patent No. 2596963 pursuant to Article
101(2) EPC.**

Composition of the Board:

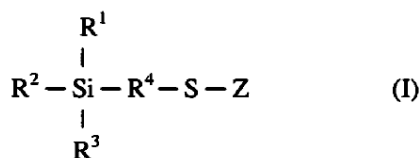
Chairman D. Semino
Members: M. C. Gordon
C. Brandt

Summary of Facts and Submissions

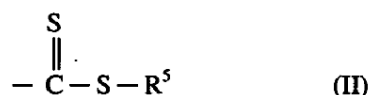
I. The appeal of the opponent lies against the decision of the opposition division posted on 16 December 2016 rejecting the opposition against European patent number 2 596 963.

II. The patent was granted with a set of 13 claims, whereby claim 1 read as follows:

1. A functionalized elastomer comprising the reaction product of a living anionic elastomeric polymer; and a polymerization terminator of formula I



where R¹, R² and R³ are independently selected from a C1 to C8 alkyl or a C1 to C8 alkoxy, with the proviso that at least two of R¹, R² and R³ are C1 to C8 alkoxy; R⁴ is selected from a C1 to C8 alkyl; Si is silicon; S is sulfur; and Z is R⁵ or of formula II



where R⁵ is an alkyl, an aryl, an alkylaryl or an arylalkyl.

Claims 2-10 were dependent on claim 1. Claims 11 and 12 were directed to rubber compositions comprising the elastomer of claims 1-10, whereby claim 12 required the presence of silica. Claim 13 was directed to a pneumatic tyre comprising the rubber composition of claim 11 or 12.

III. An opposition was filed invoking the grounds pursuant to Article 100(a) EPC (lack of novelty, lack of inventive step) and Article 100(b) EPC.

The following documents were relied upon by the opponent:

D1: US-A-2006/0089446

D2: Willcock, H. *et al*, Polymer Chem. 2010, 1, pp. 149-157

D3: WO-A-2007/047943

D4: US-B-7 301 042

D5: US-B-7 629 430

D6: US-A-3 957 718.

- IV. According to the decision, an objection of lack of sufficiency related to an inconsistency in the claims and amounted at most to a lack of clarity.

Claim 1 related to functionalized elastomers in which the indicated functional groups Z were present. Thus excluded from the claims were derivatives wherein said group had been cleaved to yield a thiol (-SH) group. This interpretation was independent of, and unaffected by, whatever occurred to the functional groups in further reaction steps, e.g. vulcanisation.

Novelty was acknowledged since none of the documents D1-D6 disclosed the living anionic elastomeric polymers with the defined modifier having the specified Z group.

The closest prior art was D3, the distinguishing feature being the nature of the terminal group Z. There was no evidence for a technical effect. Thus the objective problem had to be formulated as the provision of alternative end-group functionalized living anionic elastomers which could be used in the production of tyres and had improved polymer/filler interaction.

The solution, i.e. the nature of the terminal group, was not obvious. D3 contained no indication or suggestion of the claimed terminal group Z. D4 to D6 disclosed mercaptosilanes as coupling agents in elastomeric compositions. There was no indication in these documents to employ the said coupling agents as terminating agents in the production of living anionic elastomeric polymers in order to provide further functionalized elastomers for use in the production of tyres and with improved polymer/filler interaction.

Accordingly an inventive step was recognised and the opposition rejected.

- V. The opponent (appellant) lodged an appeal against the decision. Observations on the interpretation of the claims were made and on the basis of the conclusions reached objections of lack of novelty and lack of inventive step were pursued.
- VI. The patent proprietor (respondent) replied to the appeal. In particular the interpretation of the claims proposed by the appellant was disputed.
- VII. The Board issued a summons to attend oral proceedings. In its preliminary opinion the question of interpretation of the claims was central to the case, the conclusions to be reached on novelty and inventive step depending critically thereon.
- VIII. By letter of 9 June 2020 the appellant stated that it would neither attend nor be represented at the oral proceedings.

IX. Oral proceedings were held before the Board on 8 July 2020 in the sole presence of the respondent.

X. The arguments of the appellant can be summarised as follows:

(a) Interpretation of the claims

The wording "the reaction product of" was not to be interpreted, as had been done by the opposition division, as meaning only the direct reaction product. Such an interpretation had no basis either in the wording of the claim or in the description. The claims contained no limitation in terms of the starting materials, reaction conditions/work up and no structural details of the reaction product. Thus the claim did not exclude the products of further reaction steps including removal of the protective groups in order e.g. to yield thiol terminated products.

Trithiocarbonates (end group II) were reactive and could undergo thermal decomposition to yield thiol groups. This was shown by D2, page 150, scheme 2 and recognised as a possibility in paragraph 79 of the patent. This paragraph recognised that such groups could also be formed by nucleophilic attack, noting that nucleophiles would be present during the reaction of the polymer and the polymerisation terminator mentioned in the operative claims. Thus it was possible that the reaction might result in terminal thiol groups.

This view was supported by reference to examples 7 and 8 which exemplified claim 12 of the patent. The differences in the properties reported for examples

7 and 8 could only be explained by highly different interactions with the filler resulting from the presence of thiol groups. Such a different level of polymer/filler interaction was however not to be expected if merely the "direct" reaction product was involved.

(b) Novelty

In view of the broad interpretation to be given to the claims, with the consequence that the polymers could be terminated by thiol groups, the subject-matter claimed was anticipated by the disclosures of D1 and D3.

(c) Inventive step

The skilled person would still have arrived at these "direct" products without inventive effort, notwithstanding that the claims were not restricted thereto.

The opposition division had correctly observed that the subject-matter of the patent was not associated with any particular technical effect with respect to closest prior art D3, meaning that the objective problem had to be formulated as the provision of an alternative end-group functionalized elastomer.

From D3 (passage bridging pages 20/21) it was known that the free thiol group was associated with improved polymer-filler interaction compared with masked fillers.

Trithiocarbonates were known to be labile, and easily hydrolysable as shown by D4. Similarly the

reactivity of these functional groups was known from D2, D5 and D6 which confirmed that the use of trithiocarbonate protective groups for mercaptosilanes was known and that the corresponding compounds were commonly used as coupling agents in the field of elastomer compositions.

It would have been obvious to solve the identified objective problem by replacing the modifier of D3 by a different one such as that bearing a trithiocarbonate protective group.

Table 3 of the patent showed best results (lowest values) for the comparative example that was prepared according in general terms to the teaching of D3. Furthermore the results of the trithiocarbonate sample 3 were better than those of the thioether terminated sample 4.

As reported in paragraphs 79, 80 and 81 of the patent thioether groups were associated with higher Payne effect - lower polymer/filler interaction - compared to thiol. The reason for this had to be that the trithiocarbonate sample 3 formed at least some thiol groups as discussed in the patent at page 13, line 12. Thus the submission of the patentee that the definition of Z excluded mercapto groups was shown to be incorrect as was the argument that the group Z had to be retained in the product.

Regarding the embodiment where Z was R⁵, i.e. thioether, the difference with respect to D3 was that the terminator group was more stable and did not yield a free thiol group whereas the terminal

groups of D3 cleaved to provide a free -SH group. This was confirmed by the results of the patent in suit. Thus insofar as the patent pertained to thioether reaction products, the patent covered modifications giving rise to foreseeable disadvantages, meaning that an inventive step had to be denied.

XI. The arguments of the respondent can be summarised as follows.

(a) Interpretation of the claims

The claims were directed to the products as explicitly defined, not to derivatives thereof, e.g. resulting from cleavage of the terminal groups to yield thiol. Since claims 11 and 12 were dependent on claim 1 this applied also for said subject-matter, i.e. the group Z remained present in the compositions including the defined elastomer. The discussion in paragraph 79 of the patent according to which it was postulated that in some circumstances these groups might be eliminated to form mercapto groups was merely in the form of a theory as was indicated by the language employed. No evidence had been provided either in the patent, or by either party to the proceedings, to demonstrate whether this postulate was correct. Reference to D2 was not suitable to show that the suggested deprotection occurred since D2 did not relate to the same chemical entities as the patent and in any case different reaction conditions were indicated than those which would prevail in preparing the product of the operative claims.

Regarding the discussion in D3 (page 20, lines

20-30 and page 35, line 22) relating to treatment of the functionalized polymer in order to remove the terminal groups and thus deprotect the thiol function, the conditions indicated in D3 as necessary were not employed according to the patent and - it was reiterated - no evidence existed that the work up conditions exemplified would result in the said deprotection. Accordingly it was not correct to construe the claims in this fashion. Hence also for the claims directed to compositions containing the elastomer and other components such as silica it had not been shown that these corresponded to what was known from the prior art.

(b) Novelty

None of the cited documents disclosed living anionic polymers modified with the defined group Z according to claim 1.

Insofar as D1 related to silane coupling agents having the required terminal groups, these were employed not in the polymerisation as modifying terminal groups on the polymer, but subsequently as coupling agents.

Claim 11 relating to rubber compositions containing the elastomer, and claim 12 which required that the compositions contained silica were dependent on claim 1 and hence required that the elastomer contained the indicated terminal groups.

Accordingly novelty was to be acknowledged.

(c) Inventive step

D3 was the closest prior art and the problem was, as stated in the decision, the provision of alternative end-group functionalized elastomers having improved polymer/filler interaction.

D3 neither disclosed nor suggested a terminator group as defined in claim 1.

The other documents cited disclosed various mercaptosilanes for use as coupling agents in various rubber compositions. However none of these documents included a suggestion to employ these agents as end-group modifiers for anionic elastomeric polymers to provide polymers having improved polymer/filler interaction.

In any case it would not be obvious to modify the teaching of D3 by replacing the terminal group by that according to the operative claims since the defined group was the core of the invention of D3 and there was no recognition in the document that this could be substituted by other functional units, e.g. such as those known as coupling agents. Such an insight could be arrived at only on the basis of hindsight, i.e. with knowledge of the teachings of the patent in suit. Furthermore D4-D6 did not necessarily relate to the same type of elastomeric composition as defined in the patent and disclosed in D3.

XII. The appellant requested in writing that the decision under appeal be set aside and the patent be revoked.

XIII. The respondent requested that the appeal be dismissed and that the patent be maintained as granted, or, alternatively, that the decision under appeal be set

aside and the patent be maintained on the basis of one of the first to twelfth auxiliary requests filed with the response to the statement of grounds of appeal.

Reasons for the Decision

1. Main request - patent as granted

1.1 Interpretation of the claims

Claim 1 is in the format "product by process", employing the wording "the reaction product of".

The claim contains no details of the reaction conditions.

The position of the appellant is that the claim has to be construed not as limited to the direct reaction product, but (also) as directed to derivatives thereof, arising from further reaction (statement of grounds of appeal, section 2, "Interpretation of the claims").

The Board cannot agree with this interpretation. Article 84 EPC stipulates that the claims shall define the matter for which protection is sought. This matter is, according to claim 1, the reaction product of a living anionic elastomeric polymer and the defined terminator of formula (I). The claim does not include any features which would result in a broader interpretation of the claim beyond its explicit wording, e.g. as relating to some kind of derivative arising from further reaction of the resulting reaction product.

Accordingly there is no basis for the broad

interpretation urged by the appellant.

The appellant has also advanced technical arguments relating to the embodiment wherein the terminal group includes the moiety (II) - trithiocarbonate, namely that this would undergo elimination to yield a thiol terminal group. This argument is based on D2, with reference to the reaction scheme on page 152. Analogous arguments were advanced with respect to D3.

Independently of the foregoing conclusion that the claim is in any case not to be construed in the manner proposed by the appellant, this argument is not found convincing on technical grounds. The reaction scheme of D2 does not relate to polymers of the type claimed, but to unrelated RAFT (reversible addition-fragmentation chain transfer) materials. Furthermore the terminal groups reported in D2 are different to (I) and (II) as claimed. Thus it is questionable whether D2 is even relevant.

This alone is sufficient to allow the Board to discount that the mechanism postulated in D2 would be applicable to the claimed functionalized living anionic elastomers. Furthermore it is noted according to the discussion on page 152 of D2 that the indicated elimination requires temperatures substantially above the temperature range indicated in paragraph [0021], introducing a further element of doubt as to whether the proposed elimination would arise when preparing the polymers when following the teaching of the patent.

The analogous arguments advanced with respect to D3 are not convincing for the same reasons.

With respect to claim 11, directed to a composition

containing the functionalized elastomer and in particular claim 12 which requires silica as a filler, and the differing outcomes of examples 7 and 8 invoked by the appellant which were construed as indicating some form of further reaction (statement of grounds of appeal, page 8, first three paragraphs), it is noted that no evidence had been advanced to support the position that the proposed cleavage to thiol does in fact occur.

It is recognised that in paragraph 79 of the patent it is postulated that there is a "possibility" of cleavage of the trithiocarbonate group under certain conditions, including the presence of filler ("Trithiocarbonate can potentially cleave off to thiol group", page 13 lines 11 and 12). Further possible interactions are postulated in this paragraph. However, as noted by the respondent in the discussion of novelty, these statements are in the nature of a theory or supposition. No evidence - by either party - has been advanced, e.g. by reference to the cited documents, which would support the position that the proposed reactions actually occur and lead to a complete absence of Z groups as defined in claim 1.

Accordingly this argument also cannot serve to support the position of the appellant concerning interpretation of the claim.

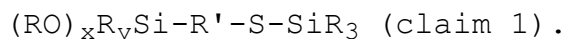
The available technical evidence therefore does not allow any conclusion other than that claim 1, and those claims dependent thereon in particular claims 11 and 12, are directed to what is literally defined, i.e. a living anionic elastomer bearing the stated functional groups and compositions containing said entity.

1.2 Novelty

D1 discloses modification of anionic living elastomers with mercaptosilanes (paragraphs 11, 17, 19, 23 and 25).

However in the light of the interpretation of the claims indicated above, such modifiers are not encompassed by claim 1.

D3 discloses the reaction product of living anionic elastomer with a silane-sulphide modifier:



This does not correspond to the definition of group (I), in particular the moiety Z, of claim 1. According to page 20, lines 20-25 the terminal (e.g. trimethyl silyl) group can be removed by exposure to compounds containing the -OH group resulting in formation of a thiol group. However as explained above, functionalized elastomers containing such groups are not encompassed by the claims.

Accordingly novelty has to be acknowledged.

1.3 Inventive step

1.3.1 Closest prior art

It is a matter of consensus that the closest prior art is represented by the teaching of D3 (decision, first paragraph in section "Art. 56 EPC"; statement of grounds of appeal, page 14, 5th paragraph; rejoinder, page 6, first paragraph in section relating to inventive step).

The distinguishing feature, as noted above is the nature of the terminal group Z.

1.3.2 Technical effect/objective problem

It is likewise a matter of consensus that no effect has been evidenced for this distinguishing feature with the consequence that the objective problem has to be formulated as the provision of alternative terminal group functionalized elastomers (decision, second paragraph in section "Art. 56 EPC"; statement of grounds of appeal, third paragraph in section "5. Inventive Step"; rejoinder, page 6, first paragraph in section relating to inventive step).

1.4 Obviousness

Mercaptosilanes having the structure broadly corresponding to that defined in claim 1 with Z being either of the alternatives defined, are known from D4-D6 as coupling agents to be added to elastomer compositions.

In some cases the same or similar functional groups to those required by claim 1 are disclosed:

D4: first paragraph of the description; section "Summary of the Invention"; hydrolysable blocked mercaptosilanes, column 9, lines 50-56 including as one alternative trithiocarbonate;

D5: first paragraph of the description; column 7, line 18 also discloses trithiocarbonates;

D6: column 7, line 52.

However there is no indication in any of these documents to employ these compounds not as coupling

agents (additives) for polymer compositions but instead as termination modifiers on elastomers, i.e. to incorporate these into the elastomer molecule as terminal groups.

More significantly, to the extent that D3 discloses terminal group modified elastomers the specific modifiers employed are presented as central to the invention of D3 as can be seen from the "Summary of the invention" on page 3 and the wording of claim 1. There is no recognition in D3 that compounds otherwise known as coupling agents, e.g. those of D4-D6 could be adapted or employed as termination agents/end group modifiers of living anionic elastomers. Indeed to do so would be to discard the central teaching of D3 and hence inherently represent a non-obvious modification on the basis thereof as closest prior art.

The argument of the appellant in the first paragraph of the section "Inventive step" in the statement of grounds of appeal relating to the use of trithiocarbonate as protective groups for mercaptosilanes (see foregoing section X.(c), 4th paragraph) is correct. However it has not been shown how this realisation would lead, in an obvious manner, to adapting these compounds to employ them as modifiers for elastomers. Furthermore the discussion on page 15, final three paragraphs of the statement of grounds of appeal (see foregoing section X.(c), 7th paragraph) relating to the trends in the effects shown in the patent for the different modifier groups amounts to nothing more than a possible explanation of the results obtained in the light of the information provided by the patent. However the *ex post* provision of an explanation of the observed results does not amount to demonstrating that the defined modification with

respect to D3 would be obvious, even in the context of the minimalist formulation of the problem.

Consequently, the Board can concur with the position of the respondent that such an insight can arise only with knowledge of the patent in suit leading to the conclusion that there are no grounds for reversing the findings of the opposition division with respect to inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed

The Registrar:

The Chairman:



B. ter Heijden

D. Semino

Decision electronically authenticated