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97-1159

Paper No. 28

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today
(1) was not written for publication in a law journal and
(2) is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte The UNIVERSITY OF AKRON

Appeal No. 97-1159
Control No. 90/003,437¹

HEARD: MAY 6, 1997

Before KIMLIN, WARREN, and OWENS, Administrative Patent Judges.
OWENS, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal from the examiner's final rejection of claims 1-6 and 18-21. Claims 7-17, which are the only other claims in the patent under reexamination, have been indicated allowable by the examiner. Claim 1 is illustrative and reads as follows:

¹ Reexamination proceeding for U. S. Patent No. 3,985,830, issued October 12, 1976, to The University of Akron, and based on application 05/488,676 filed July 15, 1974. Reexamination request filed May 17, 1994.

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1. A polymer product comprising:

a nucleus having more than one molecule of m-divinylbenzene; and,

at least three polymeric arms linked to said nucleus, wherein said polymeric arms are selected from the group consisting of homopolymers and copolymers of conjugated diene monomers and block copolymers of conjugated diene and monovinyl aromatic monomers wherein said conjugated diene block is linked to said nucleus.

THE REFERENCES

Milkovich (Canada `645) 716,645 Aug. 24, 1965
(Canadian patent)

Hawley's Condensed Chemical Dictionary, 12th ed., 438 (Van Nostrand Reinhold, New York, 1993) (Hawley).

Worsfold et al., "Préparation et caractérisation de polymères-modèle à structure en étoile, par copolymérisation séquencée anionique", 47 *Canadian Journal of Chemistry* 3379-85 (1969)² (Worsfold).

Zilliox et al., "Synthesis of star-shaped macromolecules by anionic copolymerization", *I.U.P.A.C. Preprints of the International Symposium on Macromolecular Chemistry*, Brussels-Louvain, June 12-16, 1967 (IUPAC preprint).

THE REJECTIONS

Claims 1-6 and 18-21 stand rejected under 35 U.S.C. § 103 as being unpatentable over Canada `645 alone or in view of Hawley. These claims also stand rejected under 35 U.S.C. § 103 as being unpatentable over Worsfold in view of the IUPAC preprint.

²Citations herein are to the English translation of this reference which is of record (request for reexamination, Attachment 8).

OPINION

_____ We have carefully considered all of the arguments advanced by appellant and the examiner and agree with the examiner that appellant's claimed invention would have been obvious to one of ordinary skill in the art at the time of appellant's invention over the applied references. Accordingly, the aforementioned rejections will be affirmed.

At the outset, we note that appellant states that claims 1-3, 5, 6 and 18-20 stand or fall as one group, as do claims 4 and 21 (brief, page 4). We, therefore, limit our discussion to one claim within each group, namely, claims 1 and 4. 37 CFR § 1.192(c)(7)(1995).

Appellant's invention as recited in claim 1 is a polymer comprised of a nucleus having more than one repeating unit of m-divinylbenzene (m-DVB), and at least three arms linked to the nucleus, wherein the arms are selected from 1) homopolymers and copolymers of conjugated diene monomers, and 2) block copolymers of conjugated diene and monovinyl aromatic monomers wherein the conjugated diene block is linked to the nucleus.

Appellant's claim 1 does not state that the polymer is a star polymer. However, the polymer is described as a star polymer throughout appellant's specification. As correctly stated by the examiner (answer, page 14), because the expired

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patent under reexamination can no longer be amended, the claims should be given a narrow construction which tends to render them valid. *Ex parte Bowles*, 23 USPQ2d 1015, 1017 (Bd. Pat. App. & Int. 1991); *Ex parte Pabst-Motoren*, 1 USPQ2d 1655, 1656 (Bd. Pat. App. & Int. 1986). Accordingly, we construe appellant's claim 1 as being directed toward a star polymer.

Appellant's claim 4, which depends from claim 1, states that the ratio of the m-DVB molecules to polymeric arms is at least 2.4 to 1.

*Rejection Under 35 U.S.C. § 103 Over Canada `645
Alone or in View of Hawley*

Canada `645 discloses polymers wherein a dialkenyl arene, which can be divinylbenzene (DVB), couples block copolymers of a monoalkenyl arene, such as styrene, and a conjugated diene, such that the conjugated diene moiety is linked to the DVB (page 2, line 25 - page 3, line 3; page 10, lines 8-13). The reference states that the polymers can be star shaped and can have a molecular weight which is 3 to 10 times the average molecular weight of the A-B block polymer, and the reference discloses a star-shaped configuration (page 9, lines 17-19; page 10).

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Appellant's polymer and the Canada `645 polymer can be similar and apparently can be identical, as indicated by the following comparison of characteristics of these polymers and of the processes for making them:

1) The arms of both appellant's polymer (col. 3, lines 46-58)³ and the Canada `645 polymer (page 3, lines 17-31; page 7, line 5; page 7, line 30 - page 8, line 11) can be formed by reacting an organolithium initiator with a polymerizable monovinyl aromatic compound such as styrene (compound A) to form a first polymer block having a terminal lithium ion, and adding to the first polymer block a conjugated diene monomer, such as isoprene or butadiene (compound B), to form a two-block polymer structure A-B-Li.

2) The molecular weights of appellant's A and B blocks are, respectively, about 5,000 to 100,000 or higher, and 5,000 to 200,000 or higher (col. 4, lines 10-16). The preferred molecular weights of the Canada `645 A and B blocks are, respectively, about 2,000 to 100,000, and 5,000 to 200,000 (page 3, lines 9-12).

3) Both the Canada `645 and appellant's A-B-Li block polymers are joined by a linking compound which, in both

³ Citations herein regarding appellant's polymer and the process for making it are to the patent under reexamination, U.S. Patent No. 3,985,830.

appellant's process (col. 4, lines 25-55) and the Canada `645 process (page 4, lines 1-6), can be DVB.

4) Appellant's claim 1 requires that the polymer contain more than one repeating unit of m-DVB. The Canada `645 polymer contains at least one, preferably 1 to 25, repeating units of DVB (page 4, lines 3-6).

5) Appellant's claim 4 recites that the ratio of the repeating units of m-DVB to the polymeric arms is at least 2.4:1. In the Canada `645 polymer, the ratio of the equivalents of dialkenyl arene (e.g., DVB) to the equivalents of lithium ion-terminated chains (i.e., A-B-Li polymers), is between 0.5:1 and 20:1 (page 8, lines 19-23). Since there are 2 equivalents of DVB per mole, the molar DVB:Li range disclosed in Canada `645 is 0.25:1 to 10:1. In Example I of Canada `645, the molar DVB:Li ratios for columns 1 and 2 of Table I (page 15) are, respectively, 9.8:1 and 4.4:1 (see examiner's answer, page 5), and in Example II B (Table III, page 15), the molar DVB:Li ratio is 5:1.

6) Appellant's polymer has at least three arms and a star-shaped configuration (col. 2, lines 43-46). The Canada `645 polymer has at least two arms (page 4, line 4), and the reaction which forms it "appears to occur in such a way as to produce branched or star-shaped polymers" (page 9, lines 17-19).

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7) The solvent for appellant's polymerization is "a solvent free from protons such as cyclohexane, benzene or toluene alone or with a polar solvent including cyclic or linear ethers, tertiary amines or phosphines" (col. 3, lines 65-68). Solvents for making the Canada `645 polymer include, among others, isopentane, pentanes, cyclohexane, benzene and toluene (page 7, lines 11-13).

8) Appellant's polymerization temperature is about 20°C to 50°C, preferably 25°C (col. 3, line 68 - col. 4, line 2). The Canada `645 polymerization temperature preferably is between about 20°C and 65°C (page 7, lines 14-15).

Canada `645 does not state whether the DVB used therein contains m-DVB. However, appellant does not challenge the examiner's argument that either the DVB in Canada `645 is commercial DVB which contains a mixture of isomers including m-DVB, or that it would have been obvious to one of ordinary skill in the art to select m-DVB without undue experimentation (answer, page 6).⁴

⁴ Hawley is relied upon by the examiner (answer, pages 6-7) for a teaching that commercial DVB is comprised of a mixture of isomers which includes the m-DVB isomer recited in appellant's claim 1. Hawley was published in 1993, which is after the July 15, 1974 filing date of the patent under reexamination, and therefore is not prior art. Appellant, however, does not object to the examiner's limited use of this reference (reply brief, page 1).

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Appellant argues that Examples II A and II B of Canada `645, wherein the ratios of the equivalents of DVB to the equivalents of Li are, respectively, 2:1 and 10:1, are not supportive of star formation because the molecular weight of the product polymer in both examples is twice that of the arms (brief, pages 13-14). We are not persuaded by this argument for two reasons.

First, the molecular weight more than doubles in each of these examples. In Example II A, the ratio of the molecular weight of the polymer product to that of the arms is 2.11 (i.e., 400/190), whereas this ratio for Example II B is 2.21 (i.e., 265/120). Appellant has not explained why an increase in molecular weight by more than a factor of two indicates that no star-shaped polymer is formed. We note that the requester argues that the fact that these ratios are greater than 2, which would be the ratio for a two-arm polymer, indicates that some star-shaped polymer is formed (reply by requester, paper no. 13, page 49).

Second, as pointed out by the examiner (answer, page 11), in the article, *Star Polymers: Experiment, Theory and Simulation*, XCIV *Advances in Chemical Physics* 67-163 (1996), in which one of the authors is Fetters, who is one of the inventors of the invention in the patent under reexamination, it is stated that in Canada `645, "the primary product formed was linear triblock, not

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the claimed star" (page 73), and "the star polymers claimed in Ref. 28 [i.e., Canada `645] were, in reality, coupled linear triblocks having little star-shaped polymer" (reply brief, Attachment 3). These statements indicate that the Canada `645 product contains some star-shaped polymer.

We note that these statements are consistent with the following: 1) the statement by the Canada `645 inventor, Dr. Milkovich, in his November 2, 1977 letter to Dr. Fetters, one of the inventors of the `830 patent under reexamination, that Canada `645 shows that star branched block copolymers were produced (request for reexamination, Exhibit 49), 2) the December 2, 1977 letter from Dr. Milkovich to Dr. Fetters wherein Dr. Milkovich states that Example II B of the Canada `645 patent produces star-shaped polymers, *Id.*, 3) the article by Dr. Milkovich, *Synthesis of Controlled Polymer Structures, in Anionic Polymerization Kinetics, Mechanisms, and Synthesis*, 41-57 (American Chemical Society, Washington, D. C., 1981), wherein he presents a GPC analysis which shows that star-shaped polymer is produced in Example II B of Canada `645 (request for reexamination, Exhibit 34), and 4) addenda 3 and 4 of the declaration of Dr. Carl L. Willis (request for reexamination), wherein Dr. Willis repeats Example II B of Canada `645 and shows that star-shaped polymer is produced.

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For the above reasons we find, in view of the evidence relied upon by the examiner, that there is a *prima facie* case of anticipation of appellant's invention as recited in claims 1 and 4 over Example II B of Canada `645. Since anticipation is the epitome of obviousness, *In re Skoner*, 517 F.2d 947, 950, 186 USPQ 80, 83 (CCPA 1975), we conclude that appellant's claimed invention would have been *prima facie* obvious to one of ordinary skill in the art over Canada `645, alone or in view of Hawley.

Appellant has provided no evidence or convincing argument as to why star-shaped polymer is not obtained in Example II B of Canada `645. We therefore conclude, based on the preponderance of the evidence and argument in the record, that appellant's invention as recited in claims 1-6 and 18-21 would have been obvious to one of ordinary skill in the art Canada `645, alone or in view of Hawley. Accordingly, the rejection of claims 1-6 and 18-21 under 35 U.S.C. § 103 over these references is affirmed.

*Rejection Under 35 U.S.C. § 103 Over Worsfold
in View of the IUPAC Preprint*

Worsfold discloses star-shaped polymers having 6.9 to 15.5 polystyrene arms and an m-DVB nucleus, wherein the ratio of the number of m-DVB repeating units to the number of lithium ion-carrying polystyrene arms is 0.55 to 21, and discloses how to make these polymers (second page; third page, Table 1).

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Worsfold's polymers differ from the polymer recited in appellant's claims 1 and 4 in that the arms of Worsfold's polymers are polystyrene rather than either 1) homopolymers or copolymers of conjugated diene monomers, or 2) block copolymers of monovinyl aromatic monomers (e.g., styrene) and conjugated diene monomers wherein the conjugated diene block is linked to the nucleus. To remedy this deficiency, the examiner relies upon the IUPAC preprint. This reference discloses preparing star-shaped polymers having a DVB nucleus and polystyrene arms, and states that "[m]ost of our results have been obtained on polystyrene star-polymers the bifunctional comonomers being DVB. But we have been able to synthesize also star-shaped polyisoprene samples, using the same comonomer . . ." (page 3).

The examiner argues (answer, page 9) that in view of the IUPAC preprint, polyisoprene and polystyrene would have been considered by one of ordinary skill in the art to be obvious variants for preparing star-shaped polymers according to the Worsfold disclosure.

Appellant argues that polystyrene and DVB are alike in that they have similar structures and reactivities, whereas polydienes are unlike DVB in structure and reactivity (brief, page 17). Appellant provides evidence that polyisoprenyl lithium has a much

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slower reactivity with styrene than does polystyryl lithium (reply brief, pages 5-6). We do not find appellant's argument to be convincing because appellant has not explained, and it is not apparent to us, why the structural characteristics and differences in reactivity pointed out by appellant would have led one of ordinary skill in the art to believe that reacting a lithium-carrying polydiene with DVB would not produce any star-shaped polymer.

Appellant argues that the IUPAC preprint does not provide an enabling disclosure. *Id.* Appellant has not explained, and it is not apparent to us, why one of ordinary skill in the art, given the techniques disclosed in Worsfold and the IUPAC preprint, would not have been able to synthesize star polymers which have either polystyrene arms or polyisoprene arms. Appellant argues that experimental support for the statement in the IUPAC preprint that star-shaped polyisoprene samples were synthesized, which Dr. Rempp (one of the authors of the IUPAC preprint) said in a deposition is in a graduate student's thesis, does not appear in the thesis (brief, pages 17-18). We are not persuaded by this argument because appellant has not explained why the lack of supporting data in this thesis means that one of ordinary skill in the art, given Worsfold and the IUPAC preprint, could not make a product containing star-shaped polyisoprene.

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Appellant points out that the statement in the IUPAC preprint regarding preparation of star-shaped polyisoprene polymers does not appear in a paper presented by Dr. Rempp at a conference during June 12-16, 1967, and was not mentioned when the paper was presented at the conference, but does not explain why this means that one of ordinary skill in the art, given Worsfold and the IUPAC preprint, would not have been able to make polyisoprene star polymers.

Appellant acknowledges that a paper which was presented at this conference by all of the authors of the IUPAC preprint and which later appeared in *Journal of Polymer Science, Part C, No. 22*, pp. 145-156 (1968) (request for reexamination, Attachment 5; reply by requester, Paper No. 13, page 49), states that star-shaped polymers were made (brief, page 19). Appellant argues that the fact that the molecular weight of the polyisoprene product was twice that of the arms indicates that no polyisoprene stars with three or more arms were made. *Id.* We are not persuaded by this argument because appellant has not established that the fact that the molecular weight doubled means that no star polymer was present. We note that Dr. Rempp, one of the authors of the paper, stated that the molecular weight was only

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double because the yield of star polymer was low, and that GPC data showed that star polymer was produced (request for reconsideration, declaration of Rempp, item 5).

For the above reasons, we conclude, based on the preponderance of the evidence and argument in the record, that appellant's claimed invention would have been obvious to one of ordinary skill in the art at the time of appellant's invention over Worsfold in view of the IUPAC preprint. We therefore affirm the rejection of claims 1-6 and 18-21 over these references.

DECISION

The rejections under 35 U.S.C. § 103 of claims 1-6 and 18-21 as being unpatentable over Canada '645 alone or in view of Hawley, and over Worsfold in view of the IUPAC preprint, are affirmed.

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