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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte AHMAD MORADI-ARAGHI,
MIN CHENG, RILEY B. NEEDHAM, JAMES H. HEDGES,
RAMESH S. SARATHI, FAYE L. SCULLY, TERRY M. CHRISTIAN,
HUILI GUAN, CORY BERKLAND, and JENN-TAI LIANG

Appeal 2019-002396
Application 15/145,842
Technology Center 1700

Before GEORGE C. BEST, CHRISTOPHER C. KENNEDY, and
JANE E. INGLESE, *Administrative Patent Judges*.

BEST, *Administrative Patent Judge*.

DECISION ON APPEAL

Pursuant to 35 U.S.C. § 134(a), Appellant¹ appeals from the
Examiner's decision to reject claims 1–3 of Application 15/145,842. Final
Act. (May 31, 2018). We have jurisdiction under 35 U.S.C. § 6(b).

For the reasons set forth below, we *affirm*.

¹ We use the word “Appellant” to refer to “applicant” as defined in 37
C.F.R. § 1.42. Appellant identifies ConocoPhillips Co. and the University of
Kansas as the real parties in interest. Appeal Br. 1.

BACKGROUND

The '842 Application describes methods for stable cross-linking of swellable polymers. Spec. ¶ 4. These cross-linked swellable polymers are said to be particularly useful in enhanced oil recovery applications. *Id.*

During the primary stage of production from an oil well, hydrocarbons are driven from the well by a number of natural mechanisms, including natural water pushing into the well, expansion of natural gas of the top of the reservoir, expansion of gas initially dissolved in the hydrocarbon, and gravity drainage. *Id.* ¶ 5. After the natural reservoir drive diminishes, secondary and tertiary recovery methods are applied to further increase recovery of hydrocarbon from the well. *Id.* ¶ 6. One method that may be used to enhance recovery is injection of water into the reservoir. *Id.* ¶¶ 7–8. Water injection enhances recovery in two ways: (1) the water provides pressure support of the reservoir and (2) the water sweeps or displaces oil from the reservoir and pushes it toward oil production wells. *Id.* ¶ 8.

Oil recovery using water injection is limited by so-called “thief zones,” which cause the water to preferentially travel through more porous regions of the reservoir, bypassing less porous zones and leaving oil behind. *Id.* ¶ 9. Oil recovery may be improved by using a swellable polymer to block the thief zones, causing a more effective sweep of the reservoir. *Id.*

Claim 1 is representative of the '842 Application's claims and is reproduced below from the Claims Appendix of the Appeal Brief.

1. A method of increasing the recovery of hydrocarbon fluids in the subterranean formation, comprising:
 - a) injecting into the subterranean formation of a mixture comprising water and a composition comprising:
 - i) expandable microparticles comprising acrylamide-based polymers crosslinked with labile

crosslinkers and stable crosslinkers, wherein said acrylamide-based polymers are capable of undergoing transamidation reactions;

ii) an unreacted tertiary crosslinker comprising polyethylenimine (“PEI”), wherein said tertiary crosslinker is capable of further covalently crosslinking said microparticles by transamidation after degradation of said labile crosslinkers to form a stable gel;

b) aging said mixture at 190° F until it gels, and;

c) producing hydrocarbon from said subterranean formation.

Appeal Br. 16 (indentation supplied).

REJECTIONS

On appeal, the Examiner maintains the following rejections:

1. Claims 1–3 are rejected under 35 U.S.C. § 103 as unpatentable over Moradi-Araghi ’114² as evidenced by Review.³ Final Act. 5–6; Answer 3–4.
2. Claims 1–3 are rejected under 35 U.S.C. § 103 as unpatentable over the combination of Moradi-Araghi ’114 and Review. Final Act. 7–8; Answer 4–5.
3. Claims 1–3 are rejected under 35 U.S.C. § 103 as unpatentable over Moradi-Araghi ’214⁴ as evidenced by and Review. Final Act. 8; Answer 5.

² US 2010/0314114 A1, published December 16, 2010.

³ A. Moradi-Araghi et al., *A review of thermally stable gels for fluid diversion in petroleum production*, 26 J. Pet. Sci. & Eng’g 1–10 (2000) (hereinafter “Review”).

⁴ US 8,669,214 B2, issued March 11, 2014.

4. Claims 1–3 are rejected under 35 U.S.C. § 103 as unpatentable over the combination of Moradi-Araghi '214 and Review. Final Act. 8–9; Answer 5–6.

DISCUSSION

Rejection 1. Appellant argues for reversal of this rejection with respect to the claims as a group. *See* Appeal Br. 8–15. We, therefore, select claim 1 is representative of the group of rejected claims. 37 C.F.R. § 41.37(c)(1)(iv).

In rejecting claims 1–3, the Examiner found, in relevant part, that Moradi-Araghi '114 describes shutting in the PEI/acrylate particle composition at a temperature of 150°F. Final Act. 6 (citing Moradi-Araghi '114 ¶ 47). The Examiner also found that Moradi-Araghi '114 discusses comparative examples that are shut in at temperatures of up to 190°F. *Id.* (citing Moradi-Araghi '114 ¶ 45). The Examiner further found that a person of ordinary skill in the art would have had a reasonable expectation of success in using the composition exemplified in '114 at 190°F because “if the temperature was not useful in the instant invention of Moradi[-Araghi '114] it would not make sense to test comparative compositions at said temperature.” *Id.* (emphasis omitted). The Examiner further cites Review as evidence that a transamidation reaction can occur between acrylic acid residues and polyethylenimine at temperatures of up to 156°C (312.8°F). *Id.*

Appellant argues that the rejection of claims 1–3 should be reversed for any of five reasons: (1) no reasonable expectation of success, (2) a lack of motivation to combine the prior art relied upon in the rejections, (3) Review teaches away from using the claimed invention, (4) the

prohibitive cost supposedly associated with the combination of prior art, and (5) the totality of the prior art should support a finding of nonobviousness. Appeal Br. 8–15. We address these arguments in turn.

First, Appellant argues that for an obviousness rejection to be proper, the Examiner must establish that a person having ordinary skill in the art would have had a reasonable expectation of success that the proposed combination of references could be successfully created. Appeal Br. 8–9 (citing *In re Vaeck*, 947 F.2d 488, 493 (Fed. Cir. 1991)).

Appellant’s argument is correct as an expression of law. Appellant, however, does not attempt to identify any error in the Examiner’s finding, Final Act. 6, that a person having ordinary skill in the art would have had such a reasonable expectation.

We, therefore, cannot reverse the rejection of claim 1 on this basis.

Second, Appellant argues that “[t]here is no motivation to combine Moradi[-Araghi ’114] and [Review].” Appeal Br. 9–10.

This argument is not persuasive of reversible error in the rejection of claim 1. In particular, the argument is not relevant to this rejection. As explained in the Final Action, this rejection is based upon Moradi-Araghi ’114 alone. Final Act. 6. Review is cited as evidence that the transamidation reaction between PEI and the acrylamide polymer will occur at temperatures up to 156°C (312.8°F). *Id.* Because Rejection 1 is not based on a combination of references, the Examiner need not establish a reason to combine Moradi-Araghi ’114 and Review.

We, therefore, cannot reverse this rejection on this basis.

Third, Appellant argues that Review teaches away from using polyacrylamide and polyethylenimine in high-temperature reservoirs. Appeal Br. 10–12. In particular, Appellant points to the following passages teaching

away from the Examiner's proposed modification of Moradi-Araghi '114:
(1) "Other recent studies describe the use of a modified polyacrylamide with polyethyleneimine. While the resulting gels are stable, their use is **prohibitive** due to a requirement of a large polymer content (3- to 7 -fold), as well as the high price of chemicals needed," *id.* at 11 (quoting Review Abstract), and (2) "However, the rate of gelation for this process becomes **too fast to be suitable for temperatures** above 93°C," *id.* (quoting Review 6).

We have reviewed and considered the entirety of Review. Considered in context, the passages cited by Appellant would not have discouraged a person of ordinary skill in the art from believing that there was a reasonable expectation of success in getting the Examiner's proposed modified version of Moradi-Araghi '114 to succeed. In the body of the article, the Abstract's statement that the use of the polyethyleneimine-modified polyacrylamide gels is cost prohibitive is explained in greater detail: "The gels produced by the system require a large polymer concentration (5–10%). This requirement, coupled with the high price of the polymer prohibits the use of this gelling system *in most treatments*." Review Abstract 6 (emphasis added). Thus, Review's full teaching regarding the economic viability of the Examiner's proposed modification of Moradi-Araghi '114 is that it is only economically viable in a limited number of situations. While this is less desirable than a system that would be broadly applicable, it is not a teaching that the systems described and suggested in Moradi-Araghi '114 have no economic utility. Similarly, the passage quoted by Appellant regarding the rate of gelation becoming too fast to be suitable at temperatures above 93°C is not a persuasive teaching away, 93°C is 199.4°F. Thus, Review states that

the rate of gelation for the polyethyleneimine-in modified polyacrylamide gel system is suitable at the claimed temperature of 190°F.

In view of the foregoing, we cannot reverse the rejection of claims 1–3 on this basis.

Fourth, Appellant argues that “[w]hile cost by itself is not reason enough to show teaching away or lack of motivation, it should be considered as another factor showing that [Review] teaches away from the use of its polyacrylamide/PEI system, and that there is no motivation to combine [Review] and Moradi[-Araghi ’114].” Appeal Br. 12 (citing *Anderson Corp. v. Pella Corp.*, 300 F. App’x 893, 898–99 (Fed. Cir. 2008)).

Appellant’s argument, however, focuses on the cost incurred due to the formation of new cracks during the injection process. Review, however, teaches that these new cracks are the result of the injection of cold water needed to bring the reservoir temperature below 90°C. Review 6. The claimed invention, however, is limited to temperatures of 190°F, which is 87.8°C. Thus, the added expense of cold water injection with concomitant crack formation is not necessary.

In view of the foregoing, Appellant’s argument regarding prohibitive cost is not persuasive of reversible error.

Fifth, Appellant argues that the totality of the prior art must be considered in reaching a conclusion regarding obviousness. Appeal Br. 13–15. In particular, Appellant argues that the “use of the microparticle system as a gel to block thief zones at higher temperatures was contrary to [the] accepted wisdom” in the field. *Id.* at 13.

As a matter of law, Appellant correctly notes that skepticism in the field is objective evidence of nonobviousness. Appeal Br. 13–14. If established, objective evidence of nonobviousness must be considered as

part of the totality of the evidence in reaching a conclusion regarding obviousness *vel non*. *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992) (“[P]atentability is determined on the totality of the record, by a preponderance of evidence with due consideration to persuasiveness of argument.”).

In this case, however, we agree with the Examiner that Appellant has not demonstrated the existence of skepticism in the art. As the Examiner explains:

[Review] does not teach gelling too quickly at the claimed temperatures (190[°]F). [Review] teaches gelling too quickly at temperatures above 93[°]C (199.4[°]F). Arguments therein (and further regarding the detrimental changes) are thusly not persuasive. Arguments drawn to Moradi[-Araghi '114] and its teaching of using much lower temperatures are not found persuasive because Moradi[-Araghi '114] does not limit the temperatures of his reference. . . . The only disclosure of temperature is found in the examples, wherein 150[°]F is used in an inventive example and 190[°]F is used in a comparative example. Moradi[-Araghi '114] offers no guidance as to what temperatures would/would not work.

Answer 15.

Because Appellant has not established the existence of skepticism in the art, we cannot reverse the rejection of claims 1–3 on this basis.

In view of the foregoing, we are not persuaded that Appellant has established the existence of reversible error in the Examiner’s rejection of claims 1–3 as obvious over Moradi-Araghi '114 as evidenced by Review.

Rejection 2. The Examiner also rejected claims 1–3 as unpatentable over the combination of Moradi-Araghi '114 and Review. Final Act. 7–8; Answer 4–5.

In rejecting claims 1–3, the Examiner found that Moradi-Araghi '114 discloses every element of the subject matter of the claims except that Moradi-Araghi '114 ages the PEI/polyacrylamide gel at 150°F but does not disclose aging at 190°F. Final Act. 7. The Examiner also found that Review discloses that PEI cross-links covalent bonds with copolymers of acrylamide via covalent bonds and that the resultant gel is stable at temperatures up to 156° C (312.8°F). *Id.* The Examiner further found that Review describes temperatures of 194°F as suitable for cross-linking acrylamide polymers with PEI for use in oil recovery applications. *Id.* The Examiner found:

It would have been obvious to one of ordinary skill in the [art] before the effective filing date of the invention to include in Moradi[-Araghi '114] the use of shut-in temperatures of up to 194F, as taught by [Review], since such is recognized to be a suitable reaction temperature for the reaction taught therein. Such amounts to the simple substitution of a known element (temperature) for another to obtain predictable (gelling) results and/or combining prior art elements (known temperatures for a reaction) according to known methods (the reaction between the components of Moradi[-Araghi '114] is known in the prior art) to yield predictable (gelling) results. See MPEP 2143A,B.

Id. at 7–8 (italics omitted).

Appellant argues for reversal of this rejection with respect to the claims as a group. *See* Appeal Br. 8–15. We, therefore, select claim 1 is representative of the group of rejected claims. 37 C.F.R. § 41.37(c)(1)(iv).

Appellant's arguments for reversal of this rejection are combined with its arguments for reversal of Rejection 1. Because, however, the substance of Rejection 2 differs from that of Rejection 1, our analysis differs in some respects. We present our analysis of Appellant's five arguments for reversal of rejection 2 below.

First, Appellant argues that the Examiner has not established that a person of ordinary skill in the art at the time of the invention would have had a reasonable expectation of success in creating the asserted combination of Moradi-Araghi '114 and Review. Appeal Br. 8–9.

As discussed above, Appellant correctly expresses the law requiring that an obviousness rejection is only proper if a person of ordinary skill in the art would have had a reasonable expectation of success in making the combination relied upon in the rejection. Appellant, however, does not identify any error in the Examiner's findings that Review teaches that the desired transamidation reaction proceeds satisfactorily at temperatures of up to 194°F.

Appellant, therefore, has not demonstrated reversible error on this basis.

Second, Appellant argues that the Examiner erred in finding a motivation to combine Moradi-Araghi '114 with Review. Appeal Br. 9–10. In particular, Appellant argues that Moradi-Araghi '114 teaches forming ionic bonds between the polyacrylamide microparticle and an external cationic crosslinker like PEI. *Id.* at 9 (citing Moradi-Araghi '114 ¶ 12). Appellant further argues that Review teaches a different system in which the polyacrylamide forms covalent bonds when it is crosslinked with PEI. *Id.* According to Appellant, “[i]f combined with the temperatures recited in [Review], the particle system in Moradi[-Araghi '114] would not be **expected** to form a suitable gel for diverting water. Instead, the ionic bonds would be expected to weaken and allow water to pass through the thief zones.” *Id.* at 10.

This argument is not persuasive. As the Examiner explains, a person of ordinary skill in the art would have been motivated to form the covalently

cross-linked polyacrylamide/PEI gel based upon Review's description of the gel as being stable at temperatures up to 156°C. Moreover, Review teaches that the gelation rate of a mixture of PEI and polyacrylamide is acceptable at temperatures below 199.4°F.

In view of the foregoing, we cannot reverse the rejection of claims 1–3 as unpatentable over the combination of Moradi-Araghi '114 and Review on this basis.

Third, Appellant argues that Review teaches away from the Examiner's proposed combination of art. Appeal Br. 10–12.

For the reasons discussed in our discussion of Rejection 1, we do not find this argument to be persuasive of the existence of reversible error in this rejection.

Fourth, Appellant argues that Review's discussion of the allegedly prohibitive costs associated with the formation of a covalently bonded PEI/polyacrylamide gel would have discouraged a person of ordinary skill in the art from making the combination proposed in the Rejection. Appeal Br. 12–13.

For the reasons set forth in our discussion of Rejection 1, we do not find this argument to be persuasive of the existence of reversible error in this rejection.

Fifth, Appellant argues that the totality of the prior art supports a finding of nonobviousness. Appeal Br. 13–15.

For the reasons set forth in our discussion of Rejection 1, we do not find this argument to be persuasive of the existence of reversible error in this rejection.

In view of the foregoing, we affirm the rejection of claims 1–3 as unpatentable over the combination of Moradi-Araghi '114 and Review.

Rejections 3 and 4. In the Final Action, the Examiner states that Rejection 3 is cumulative of rejection 1 and that rejection 4 is cumulative of rejection 2. Final Act. 8–9.

For the reasons set forth above, we have affirmed the Rejections 1 and 2. We, therefore, also affirm the cumulative Rejections 3 and 4.

CONCLUSION

In summary:

Claims Rejected	Basis	Affirmed	Reversed
1–3	§ 103 Moradi-Araghi '114 as evidenced by Review	1–3	
1–3	§ 103 Moradi-Araghi '114 and Review	1–3	
1–3	§ 103 Moradi-Araghi '214 as evidenced by Review	1–3	
1–3	§ 103 Moradi-Araghi '214 and Review	1–3	
Overall Outcome		1–3	

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED