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BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte WINDSONG FANG and THOMAS J. WHEELER

Appeal 2019-004186
Application 13/525,488
Technology Center 3600

Before PHILLIP J. KAUFFMAN, TARA L. HUTCHINGS, and ALYSSA A. FINAMORE, *Administrative Patent Judges*.

KAUFFMAN, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 1–20. Final Act. 2–12. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm in part.

[1] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as ConocoPhillips Company. Appeal Br. 3.

CLAIMED SUBJECT MATTER

The claims are directed to the production of heavy oil or bitumen[2] from a reservoir (formation). Spec. ¶ 34; Abstract. In order to extract heavy oil and bitumen, it is necessary to lower their high viscosities. Spec. ¶¶ 4, 5. The Specification describes a "steam-assisted production process" as a viscosity reducing process that "utilize[s] steam to heat the formation to reduce the viscosity thereof, thus increasing the production rate and amount." Spec. ¶ 24. One particular type of steam-assisted production process is steam assisted gravity drainage ("SAGD"). Spec. ¶¶ 7, 8. As the name implies, this process utilizes steam to reduce the viscosity of the heavy crude oil or bitumen so that it may gravity drain into the lower wellbore. Spec. ¶ 8.

Claims 1 and 7 are reproduced below.[3]

> 1. A method for improving production of heavy oil in a steam-assisted production process that has at least one production well in a hydrocarbon formation, comprising:
>
> a) providing a horizontal target well for injecting recycled carbon dioxide, wherein the target well is located at least 30 meters horizontally away from at least one production well and into a top of a pay zone in a bitumen or heavy oil reservoir wherein said pay zone is a bitumen or heavy oil pay zone;
>
> b) preparing the target well for injecting the recycled carbon dioxide;
>
> *c) injecting the recycled carbon dioxide into said target well and said pay zone at an initial pressure that is at least 1% higher than an initial reservoir pressure, wherein said carbon dioxide adequately penetrates the bitumen or heavy oil, said carbon dioxide being significantly dissolved into the bitumen or heavy oil;*

[2] Colloquially known as "tar." Spec. ¶ 4.

[3] Italics added for emphasis.

d) injecting the recycled carbon dioxide at an increased pressure relative to reservoir pressure when a thermal front approaches the production well;

e) the dissolved carbon dioxide making the bitumen or heavy oil more readily drainable to the producer as the thermal front approaches;

f) wherein some of the injected carbon dioxide remains in the gas phase, said remaining gaseous carbon dioxide moving to the top of the pay zone to provide an insulating benefit and reducing heat loss to the over burden; and

g) recovering said heavy oil or bitumen from said at least one production well.

7. A method for enhanced oil recovery, comprising:

a) *providing at least one horizontal producer well near a bottom of a pay zone containing bitumen or heavy oil in a hydrocarbon reservoir;*

b) providing at least one horizontal steam injection well in said pay zone above said producer well;

c) providing at least one horizontal target well for injecting recycled carbon dioxide, wherein the target well is located at a horizontal distance away from said production well and said steam injection well and into a top of said pay zone;

d) injecting recycled carbon dioxide into said target well at pressure that is at least 1% higher than the pressure of said hydrocarbon reservoir, wherein said carbon dioxide adequately penetrates the bitumen or heavy oil and said carbon dioxide is significantly dissolved into the bitumen or heavy oil;

e) injecting steam into said steam injection well, the dissolved carbon dioxide making the bitumen or heavy oil more readily drainable to the producer as the thermal front approaches;

f) wherein some of the injected carbon dioxide remains in the gas phase, said remaining gaseous carbon dioxide moving to the top of the pay zone to provide an insulating benefit and reduce heat loss to the over burden; and

g) collecting the bitumen or heavy oil produced in said producer well.

REJECTIONS[4]

I. Claims 1–6 are rejected under 35 U.S.C. § 103(a) as unpatentable over Horner, Rao, and Bandyopadhyay.[5] Final Act. 3–7.

II. Claims 7–20 are rejected under 35 U.S.C. § 103(a) as unpatentable over Horner and Bandyopadhyay. Final Act. 7–12.

ANALYSIS

Claims 1–6[6]

The Examiner concludes that the subject matter of independent claims 1–6 would have been obvious from the combined teachings of Horner, Rao, and Bandyopadhyay. Final Act. 3–7.

The method recited in independent claim 1 includes the steps of: (1) "injecting . . . recycled carbon dioxide into said target well and said pay zone at an initial pressure that is at least 1% higher than an initial reservoir pressure" (limitation (c)), and (2) "injecting the recycled carbon dioxide at an increased pressure relative to reservoir pressure when a thermal front approaches the production well" (limitation (d)). For the reasons that follow, the combined teachings of Horner, Rao, and Bandyopadhyay would not have resulted in both of these steps.

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[4] In the Final Office Action, the Examiner also rejected claims 1–6 under 35 U.S.C. § 112, first paragraph, for lack of written description. Final Act. 2. The Examiner withdrew this rejection in the Answer. Ans. 3.

[5] Horner (US 7,172,030 B2, issued Feb. 6, 2007); Rao (US 2006/0289157 A1, published Dec. 28, 2006); Bandyopadhyay (US 3,674,092, issued July 4, 1972).

[6] Claims 2–6 depend from independent claim 1.

Horner teaches a method for recovering hydrocarbons from a formation that includes natural gas overlying, and in pressure communication with, bitumen. Horner 6:6–10; 9:55–10:2; 10:59–11:12; Fig. 7. The method produces natural gas by injecting Waste Gas that includes carbon dioxide into the formation while either maintaining or increasing the pressure within the formation; and the method produces bitumen using SAGD. Horner 6:3–10; 11:53–12:8; Figs. 6, 7.

The Examiner correctly finds that Horner teaches "injecting Waste Gas into the natural gas reservoir though the injection well(s) at a pressure and rate that causes the pressure in the natural gas reservoir to be maintained or increased notwithstanding the production of natural gas from the reservoir." Horner 11:63–67 (cited at Ans. 11); *see also* Horner 16:23–42 (claims 18, 20). However, we agree with Appellant that Horner does not teach the separate step of "injecting the recycled carbon dioxide at an increased pressure relative to reservoir pressure when a thermal front approaches the production well." *See* Reply Br. 3. Instead, as Appellant points out, the cited passage is consistent with injecting Waste Gas at a constant pressure sufficiently greater than the initial pressure of the natural gas in the formation to increase the pressure acting on the bitumen. *See* Appeal Br. 12. Horner makes no disclosure regarding the approach of a thermal front. Nor are we persuaded by the Examiner's reasoning that Horner meets the limitation at issue because reservoir pressure may drop as a thermal front approaches causing the injected Waste Gas to be at an increased pressure relative to reservoir pressure. *See* Ans. 10–11. Again, Horner says nothing about thermal fronts, and further, the Examiner's reasoning lacks evidentiary support.

The Examiner relies on another passage in Horner. Final Act. 4 (citing Horner 10:5). This passage describes the transfer of heat from steam injected into the reservoir during the SAGD process. The passage does not describe a separate step of injecting recycled carbon dioxide at an increased pressure relative to reservoir pressure when a thermal front approaches the production well.

The Examiner does not rely upon Rao or Bandyopadhyay to remedy the deficiency of Horner. *See* Final Act. 4–6.

Consequently, we do not sustain the rejection of claims 1–6 under 35 U.S.C. § 103(a) as unpatentable over Horner, Rao, and Bandyopadhyay.

Claims 7, 11–15, and 18–20

The Examiner concludes that the subject matter of claims 7, 11–15, and 18–20 would have been obvious from the combined teachings of Horner and Bandyopadhyay. Because Appellant does not present separate arguments for the patentability of claims 7, 11–15, and 18–20, we select claim 7 as representative. 37 C.F.R. § 41.37(c)(1)(iv).

Claim 7 recites steps of "providing at least one horizontal producer well near a bottom of a pay zone containing bitumen or heavy oil in a hydrocarbon reservoir" (limitation (a)); and "providing at least one horizontal target well for injecting recycled carbon dioxide, wherein the target well is located . . . into a top of said pay zone" (limitation (b)). Appellant argues that these steps require injection directly into oil, and further contends that Horner fails to teach or suggest these steps. Appeal Br. 8–10.

The Examiner correctly interprets the phrase "into a top of said pay zone" as sufficiently broad to encompass injection into natural gas overlying bitumen within a reservoir. Ans. 5. The Examiner defines a "pay zone" as a "reservoir or portion of a reservoir that contains economically producible hydrocarbons." *Id.* (quoting *Schlumberger Oilfield Glossary*, https://www.glossary.oilfield.slb.com/en//Terms/p/pay.aspx); *see also* Rao ¶ 9 (defining a "pay zone" as "rock in which oil and gas are found in exploitable quantities"). Horner describes "production" of both natural gas and bitumen from a reservoir in which the natural gas overlies the bitumen. Horner 9:55–10:2; 10:59–11:12. Therefore, giving the phrase "pay zone" its broadest reasonable interpretation, the reservoir described by Horner defines a pay zone containing both bitumen and natural gas. Ans. 6. Because Figure 7 of Horner depicts the target well as extending into an upper portion of the reservoir, that is, into the carbon dioxide overlying the bitumen, the Examiner correctly finds that Horner describes injection "into a top of said pay zone."

Appellant contends that Rao fails to teach certain limitations and that the Examiner's proposal to combine the teachings of Horner and Rao is improper. Appeal Br. 10–12. These contentions are unpersuasive because the Examiner does not rely on Rao.

Appellant contends that Horner fails to teach or suggest a separate step of injecting recycled carbon dioxide at an increased pressure relative to reservoir pressure when a thermal front approaches the production well. Appeal Br. 12–13. Representative claim 7 mentions the thermal front only once, in connection with the timing with which carbon dioxide dissolves into

the heavy oil or bitumen.[7] Claim 7 does not recite injecting at an increased pressure when the thermal front approaches. Therefore, Appellant's contention is not commensurate with the scope of claim 7.

Appellant has not shown error in the Examiner's conclusion that the subject matter of representative claim 7 would have been obvious from the combined teachings of Horner and Bandyopadhyay. Consequently, we sustain the rejection of claims 7, 11–15, and 18–20 under 35 U.S.C. § 103(a) as unpatentable over Horner and Bandyopadhyay.

[7] Appellant cites Mahmoud as teaching that "the amount of CO_2 that will dissolve at the interface is insignificant." Appeal Br. 9 n.1 (citing Mahmoud, *Range of Operability of Gas-Assisted Gravity Drainage Process*, SPE 113474 (presented at the 2008 SPE/DOE Improved Oil Recovery Symposium, Tulsa, OK, Apr. 19–23, 2008). This assertion is not persuasive. As the Examiner correctly finds, Horner teaches that carbon dioxide injected into natural gas overlying bitumen will "be dissolved in bitumen, thereby reducing the viscosity." Ans. 7 (quoting Horner 11:44–52). Against this teaching, Mahmoud says that the slower recovery rate in a water-alternating-gas ("WAG") recovery process as opposed to a GAGD process "can be attributed to the time period of CO2 gas injection where CO2 gas has just travelled to the top without making any contribution to production." Mahmoud 10. Mahmoud teaches that "WAG could be performed with both miscible and immiscible models." *Id.* Nevertheless, because alternating water and carbon dioxide injections in a WAG recovery process produce hydrocarbons by displacing the hydrocarbons from the reservoir (Rao ¶ 5), it is not clear that the authors of Mahmoud are referring to the dissolution of injected carbon dioxide into the hydrocarbon in this sentence. Therefore, the teachings of Horner persuade us that, where the carbon dioxide is injected prior to the steam in Horner's process (*see* Horner 12:31–34), "[the] carbon dioxide [will make] the bitumen or heavy oil more readily drainable to the producer as the thermal front approaches," as recited in claim 7. Ans. 7.

Claims 8–10, 16, and 17

Claim 8 recites the "method of claim 7, wherein said [horizontal distance said target well is away from said production well and said steam injection well] is at least 30 meters away from said at least one producer well." Claims 9 and 10 recite similar limitations. Claim 16 recites the "method of claim 12, wherein there are a plurality of oil production wells and wherein said [horizontal distance said target well is away from said steam injection well and said production wells] is at least 25 meters away from said plurality of oil production wells." Claim 17 recites the "method of claim 12, wherein said [horizontal distance said target well is away from said steam injection well and said production well] is 30–50 meters away from said oil production well and said steam injection."

The Examiner concludes that the subject matter of claims 8–10, 16, and 17 would have been obvious from the combined teachings of Horner and Bandyopadhyay. The Examiner concludes that it would have been obvious to optimize the position of the target well relative to the positions of the production and steam injection wells in such a way as to satisfy the limitations of claims 8–10, 16, and 17. Final Act. 10–12 (citing *In re Aller*, 220 F.2d 454, 456 (CCPA 1955)).

The Examiner has not adequately explained why optimization of the distance between the target well, on the one hand, and the production and steam injection wells, on the other, in Horner's process would have resulted in the distances, or distance ranges, recited in claims 8–10, 16, and 17. As Appellant correctly points out, the Examiner's findings and analysis are not persuasive because the Specification and Horner teach recovery processes based on different principles. Appeal Br. 13. Horner teaches using Waste

Gas injection not only to provide carbon dioxide to reduce the viscosity of the bitumen, but also to provide a horizontal sweep of the natural gas from the pay zone. Appeal Br. 13–14; Horner, Fig. 7. The Specification does not appear to describe using the injected carbon dioxide to perform any similar sweep of the bitumen or heavy oil reservoir. *See, e.g.*, Spec. ¶ 20. Therefore, we do not sustain the rejection of claims 8–10, 16, and 17 under 35 U.S.C. § 103(a) as unpatentable over Horner and Bandyopadhyay.

CONCLUSION

In summary:

Claims Rejected	35 U.S.C. §	Reference/Basis	Affirmed	Reversed
1–6	103(a)	Horner, Rao, Bandyopadhyay		1–6
7, 11–15, 18–20	103(a)	Horner, Bandyopadhyay	7, 11–15, 18–20	
8–10, 16, 17	103(a)	Horner, Bandyopadhyay		8–10, 16, 17
Overall Outcome			7, 11–15, 18–20	1–6, 8–10, 16, 17

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C. F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv) (2011).

AFFIRMED IN PART