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600 North Dairy Ashford
Houston, TX 77079-1175

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte MEGAN V. EVANS, NASIR ALI, JON M. MOCK, JAME YAO, and SRIRAM RAMANI

Appeal 2016-000867
Application 12/833,500
Technology Center 3700

Before JOHN C. KERINS, EDWARD A. BROWN, and SEAN P. O'HANLON, *Administrative Patent Judges*.

BROWN, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Megan V. Evans et al. (Appellants)[1] appeal under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 1, 3–7, and 10–14.[2] We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

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[1] The Appeal Brief identifies ConocoPhillips Co. as the real party in interest. Br. 2.

[2] Claims 2, 8, and 9 have been cancelled. Br. 22 (Claims App.).

CLAIMED SUBJECT MATTER

Claim 1, reproduced below, is representative of the claimed subject matter:

1. A process for liquefying a natural gas stream in a liquefied natural gas (LNG) facility, the process comprising:

a) providing a heavies/NGL recovery system that comprises a first distillation column and a second distillation column wherein the second distillation column is an natural gas liquids (NGL) column;

b) introducing a first portion of the natural gas stream from a liquefaction system into a first heat exchanger to produce a first cooled stream;

c) introducing a second portion of the natural gas stream into the first distillation column, wherein prior to entry into the first distillation column the stream is combined with the first cooled stream to form a combined stream;

d) using the first distillation column to separate the combined stream into a first predominately vapor stream and a first predominately liquid bottoms stream;

e) removing the first predominately vapor stream from the first distillation column and reintroducing the first predominately vapor stream into the liquefaction system;

f) removing the first predominately liquid bottoms stream from the first distillation column and introducing the first predominately liquid bottoms stream into the first heat exchanger to produce a first heated stream;

g) separating the first heated stream to form a portion of first heated stream and a remaining portion of the first heated stream, wherein the portion of the first heated stream is introduced into the bottom of the first distillation column;

h) introducing the remaining portion of the first heated stream into the second distillation column;

i) using the second distillation column to separate at least a portion of the remaining portion of the first heated stream into a second predominately liquid bottoms stream and a second predominately vapor stream;

> j) removing the second predominately vapor stream from the second distillation column and introducing the second predominately vapor stream into a second heat exchanger in indirect heat exchange with an external coolant to produce a second cooled stream;
>
> k) introducing the second cooled stream into a separation vessel to separate the second cooled stream into a third vapor fraction and a third liquid fraction;
>
> l) introducing at least a portion of the third vapor fraction into a fuel gas system fuel gas, wherein the at least a portion of the third vapor fraction is relatively concentrated in ethane and propane; and
>
> m) returning a portion of the third vapor fraction to a methane system component of the liquefaction system.

Br. 21–22 (Claims App.).

REJECTION

Claims 1, 3–7, and 10–14 are rejected under 35 U.S.C. § 103(a) as unpatentable over Roberts (US 6,662,589 B1, issued Dec. 16, 2003), Malsam (US 8,209,997 B2, issued July 3, 2012), Paradowski (US 2004/0244415 A1, published Dec. 9, 2004), Eaton (US 2008/0256976 A1, published Oct. 23, 2008), and Martin (US 4,102,659, issued July 25, 1978).

ANALYSIS

Claim 1 recites "e) removing the first predominately vapor stream from the first distillation column and *reintroducing the first predominately vapor stream into the liquefaction system*." Br. 21 (Claims App. (emphasis added)). The Examiner finds that Roberts discloses a process for liquefying a natural gas stream in a liquefied natural gas facility wherein a first distillation column (NGL absorber column 37) separates a combined stream into a first predominately vapor stream (first overhead vapor enriched in methane withdrawn from absorber column 37 via line 63) and a first predominately liquid bottoms stream. Final Act. 2–3 (citing Roberts, col. 5, l. 2, ll. 49–53, Fig.). The Examiner finds that the combination of Roberts, Malsam, and Paradowski fails to teach reintroducing the first predominately vapor stream into a liquefaction system. *Id.* at 6.

The Examiner finds that Eaton teaches reintroducing a first predominately vapor stream (overhead vapor stream 118) into a liquefaction system through a conduit 119 and a system (main methane economizer 74). *Id.* (citing Eaton ¶¶ 28, 32, 38, 44, Fig. 1). The Examiner concludes that it would have been obvious to modify the combination of Roberts, Malsam, and Paradowski by reintroducing the first predominately vapor stream (overhead vapor stream 118) into the liquefaction system through conduit 119 and system 74. *Id.* (citing Eaton ¶¶ 28, 32, 38, 44, Fig. 1).

Roberts discloses that the first overhead vapor withdrawn from absorber column 37 via line 63 is cooled and partially condensed in main heat exchanger 67, and then is separated into vapor and liquid streams in reflux drum 69. *See* Roberts, col. 5, ll. 50–56, Fig. The separated liquid stream, which contains primarily methane with a major portion of the ethane, propane, and C_5+ hydrocarbons in the overhead from absorber column 37, is withdrawn from reflux drum 69 via line 71 and supplied as a methane-rich reflux to absorber column 37. *See id.* at col. 5, ll. 55–63, Fig.

Regarding this reflux, Roberts describes:

> A methane-rich reflux liquid for the NGL absorber column is generated during the cooling of the methane-enriched absorber column overhead vapor that also contains most of the C_4–C_6 + components which are flashed at the introduction of the C_4–C_6 + absorber liquid into the column. *The introduction of these heavy hydrocarbons at the top of the absorber column increases the*

> *critical pressure of the upper column section vapor and liquid mixtures and allows the column to be operated at significantly higher pressure, e.g., above the critical pressure of methane (673 psia) such that the natural gas feed pressure need not be reduced.*

Roberts, col. 6, l. 58–col. 7, l. 1 (emphasis added).

Appellants contend that Roberts teaches away from reintroducing the first predominately vapor stream into the liquefaction system. Br. 6. The Examiner responds that the fact that Roberts does not disclose reintroducing first vapor stream 63 into the liquefaction system "does not mean that Roberts positively teaches away from *a portion of the first vapor stream (63) from entering the liquefaction system*." Ans. 15–16 (emphasis added). The Examiner states that "the first vapor stream (63) of Roberts is split into components and only one of the components (71) is used as the Reflux stream introduced back into the column (37, Figure 1)." *Id.* at 16.

Eaton discloses that an overhead (lights) stream in the conduit 118, which is produced in the heavies removal column 60, is combined with methane refrigerant and the combined stream is transferred via conduit 119 to methane economizer 74. Eaton ¶ 38, Fig. 1. The Examiner finds that Eaton teaches introducing first vapor stream 118 into liquefaction system 119, and concludes that it would have been obvious to modify Roberts so that "*a portion of the first vapor stream of Roberts* [is] to [] be introduced into the liquefaction system in light of the teachings of Eaton to allow efficient cooling and removal of weighty hydrocarbons from the vapor stream." Ans. 16 (emphasis added).

Appellants contend that modifying Roberts in view of Eaton to not use a reflux stream would render absorber column 37 inoperative or at least greatly adversely affect its efficiency. Br. 17. Appellants also contest the

Examiner's proposed modification to use only part of the methane-rich second overhead vapor withdrawn from reflux drum 69 via line 77 for introduction into the liquefaction system. *Id.*

Appellants' contentions are more persuasive. Roberts discloses that using the overhead vapor from absorber column 37 as a reflux liquid allows absorber column 37 to be operated at significantly higher pressures so that the natural gas feed pressure need not be reduced. *See* Roberts, col. 6, l. 58–col. 7, l. 1. This description implies that *not* using the overhead vapor from absorber column 37 as a reflux liquid would, at least, require other changes be made to Roberts's process. However, the Examiner's proposed modification of Roberts does not account for any such changes. In view of Roberts's description, we disagree with the Examiner that "the claim of inefficiency of . . . Roberts due to reintroducing first vapor stream to the liquefaction system, is an assumption by the Appellant without any evidence." Ans. 19.

Further, in Roberts, *all* first overhead vapor is disclosed to be withdrawn from absorber column 37 via line 63 and sent *only* to the main heat exchanger 67 and reflux drum 69. The Examiner does not identify any disclosure in Roberts that teaches or suggests instead sending only a portion of the first overhead vapor to main heat exchanger 67 and reflux drum 69.

"A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1327 (Fed. Cir. 2009) (citation omitted). A reference does not teach away "if it merely expresses a general preference for an alternative invention but does not 'criticize, discredit, or otherwise discourage' investigation into the invention claimed." *Id.* (citation omitted). But even if a reference is not found to teach away, its statements regarding preferences are relevant to a finding regarding whether a skilled artisan would be motivated to combine that reference with another reference. *See Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1051 n.15 (Fed. Cir. 2016) (en banc). Accordingly, even if Roberts "does not explicitly prohibit first vapor stream from being reintroduced into the liquefaction system" (Ans. 16), Roberts's disclosure regarding the purpose and advantage of using the overhead vapor from absorber column 37 as a reflux liquid in absorber column 37 is relevant to a finding regarding whether a skilled artisan would have found it obvious to have modified Roberts to introduce a part of the first vapor stream into the liquefaction system. *See Apple Inc.*, 839 F.3d at 1051 n.15.

Further, we agree with Appellants that the Examiner's rationale for modifying Roberts in view of Eaton to result in only a portion of Roberts's first vapor stream being introduced into the liquefaction system is inadequate. Br. 17; Ans. 16. The Examiner reasons that this modification would "allow efficient cooling and removal of weighty hydrocarbons from the vapor stream." Ans. 16. However, Roberts discloses that the reflux liquid for absorber column 37 contains C_4–C_6 + components, and that these heavy hydrocarbons increase the critical pressure of the upper column section vapor and liquid mixtures. Roberts, col. 6, l. 58–col. 7, l. 1. Accordingly, such heavy hydrocarbons are already removed in the process and are needed to produce the increase in critical pressure. Accordingly, the

Examiner's articulated reason to modify Roberts in view of Eaton is lacking in rational underpinnings.

Claim 1 also requires "k) introducing the second cooled stream into a separation vessel to separate the second cooled stream into a third vapor fraction and a third liquid fraction" and "l) introducing at least a portion of the third vapor fraction into a fuel gas system fuel gas, *wherein the at least a portion of the third vapor fraction is relatively concentrated in ethane and propane*." Br. 22 (Claims App. (emphasis added)).

The Examiner finds that Roberts discloses separating a second cooled stream in a separation vessel (product separator vessel 91) into a third vapor fraction (residual flash gas in line 95) and a third liquid fraction (LNG product in line 93), and introducing at least a portion of the third vapor fraction, which is relatively concentrated in ethane and propane, into a fuel gas system fuel gas. Final Act. 4 (citing Roberts, col. 5, l. 49– col. 6, l. 14, col. 6, ll. 58–65, Fig.). However, the Examiner acknowledges that Roberts does *not* explicitly teach that a portion of the third vapor fraction is relatively concentrated in ethane and propane. *Id.*

Roberts discloses that the flash gas is used as fuel. Roberts, col. 9, ll. 15–17. Appellants contend that Roberts's residual flash gas stream 95 is not relatively concentrated in ethane and propane. Br. 6 (citing Roberts col. 6, ll. 3–6, col. 9, ll. 16–18). Consistent with this position, Roberts does not describe that the flash gas in line 95 to have such composition.

The Examiner finds that Malsam teaches providing a third vapor fraction (line 43) to a sales gas containing "a lot of methane," "some ethane," and "some propane," and the third vapor containing methane,

ethane and propane. Final Act. 5 (citing Malsam, col. 6, ll. 15–20, Table 2, Fig. 1).

Malsam discloses that an overhead stream 42 from distillation column overhead separator 60 containing product sales gas (e.g., methane, ethane, and lighter components) is warmed in a heat exchanger 10, and the sales gas is sent through line 43 for further processing. *See* Malsam, col. 6, ll. 7–20, Fig. 1. As shown in Table 2 of Malsam, sales gas 43 contains, in mole fractions, 0.9453 methane, 0.0402 ethane, and 0.0001 propane.

The Examiner concludes that it would have been obvious to modify the liquefaction system of Roberts to provide a third vapor fraction containing methane, ethane, and propane to a sales gas "to remove all the useful vapor for its different uses." Final Act. 5. The Examiner appears to find that the combination of Roberts and Malsam does *not* teach that a portion of the third vapor fraction is relatively concentrated in ethane and propane. *Id.* Yet, the Examiner also appears to indicate that Malsam *does* provide this teaching, stating "Malsam teaches the portion of the third vapor containing methane, ethane and propane of some concentration (col. 8, Table 2), which meets the limitations of the claim." Ans. 17–18.

Appellants contend that Malsam's vapor line 43 is not a "third vapor fraction," as claimed. Br. 7. Appellants contend there is no basis to equate vapor line 43 with Appellants' overhead stream 642, which is obtained from the overhead of a second distillation column 654, which is fed from the bottoms of a first distillation column 652. *Id.* Further, Appellants contend that "claim 1 requires concentration in both ethane and propane in the third vapor stream," but Malsam's sales gas 43 "contains very little ethane" and "practically no propane." *Id.* at 7–8 (citing Malsam Table 2); *see also* Ans. 18.

The Examiner responds that Roberts's gas stream 95 contains methane and ethane. Ans. 16 (citing Roberts, col. 6, ll. 58–65). We note, however, that this passage pertains to using the overhead vapor from absorber column 37 as a reflux liquid and does not appear to establish any composition of the gas stream 95.

The Examiner also states that "Malsam teaches *some concentration* of ethane and propane in the third vapor stream." Ans. 16 (emphasis added). According to the Examiner, the limitation of "a portion of the third vapor fraction is relatively concentrated in ethane and propane"

> does not give any indication of how much ethane or propane exists in the third vapor fraction and *any fraction (as taught by Eaton) would read on this limitations of claim 1* and the limitation of ethane and propane of the instant application having more concentration than that of the prior art is not in the claims and not proven by the Appellant' [sic], hence the combination of Roberts/Eaton teach[es] the limitation of more ethane and propane than the prior art[.]

Ans. 16–17 (emphasis added).

Appellants' Specification does not describe the meaning of "relatively concentrated in ethane and propane," or describe any numerical values for the content of ethane or propane in the fraction of the vapor product that is routed via conduit G to fuel in the system shown in Figure 1a. *See* Spec. ¶ 46. Nonetheless, it is not apparent how the small ethane content listed in Table 2 of Malsam can be considered "relatively concentrated" with respect to the total sales gas. Furthermore, propane makes up a much smaller percentage of the sales gas than even ethane. It appears to be the Examiner's position that a "mere presence" is an amount greater than zero. However, the position that a "mere presence" of a gas constituent in the sales gas establishes a relative concentration of that constituent is premised on an overly broad construction of "relatively concentrated."

The Examiner also finds that Paradowski teaches separating a third vapor fraction into two separate vapor streams, that is, vapor streams 113, 115 and vapor streams 125, 127. Final Act. 5 (citing Paradowski, Fig. 1). The Examiner concludes that it would have been obvious to separate Malsam's third vapor fraction (sales gas stream 43) containing methane, ethane, and propane into two separate vapor streams; namely, a methane vapor stream and an ethane and propane vapor stream (i.e., vapor streams 113, 115 and vapor streams 125, 127 taught by Paradowski), in order to purify methane. Final Act. 5–6.

The Examiner finds that Eaton discloses returning a portion of a third vapor fraction (predominately methane vapors 141) to a methane system and separating other heavier elements from the predominantly methane vapors (LNG passed through conduit 142 separated from predominantly methane vapors 141) and that the portion of the vapor fraction is relatively concentrated in ethane and propane. *Id.* at 6. The Examiner concludes that it would have been obvious to modify the combination of Roberts, Malsam, and Paradowski to incorporate these teachings of Eaton. *Id.* at 6–7.

Eaton discloses that LNG exits the separator 75 via conduit 142, and predominately methane vapors exit separator 75 via conduit 141. *See* Eaton ¶¶ 48–49, Fig. 1. The predominately methane vapors are combined with predominately methane refrigerant from conduit 143, and the combined stream is conducted via conduit 144 to the methane economizer 65. *Id.* ¶ 49, Fig. 1.

Appellants contend that the third vapor stream in Eaton that enters separator 75 has been substantially deprived of heavies and, consequently, comprises predominately methane. Br. 12. We disagree with the Examiner's position that "the presence of *some ethane and propane* in the third vapor fraction even of depleted levels (Eaton, paragraph 43) read[s] on the broad limitations of [steps] K to M of claim 1." Ans. 17 (emphasis added). Accordingly, Eaton does not cure the deficiencies of the combination of Roberts, Malsam, and Paradowski.

For these reasons, the Examiner has not provided an adequate reason with rational underpinnings as to why one of ordinary skill in the art would have combined the teachings of the applied references in a way to result in the claimed process. Thus, we do not sustain the rejection of claim 1, or of dependent claims 3–7 and 10–14.

DECISION

We reverse the rejection of claims 1, 3–7, and 10–14.

REVERSED