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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/633,307	02/27/2015	Wesley R. QUALLS	072427-612138 (42253US02)	6150

27148 7590 06/16/2020

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ART UNIT	PAPER NUMBER
3793	

NOTIFICATION DATE	DELIVERY MODE
06/16/2020	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte WESLEY R. QUALLS, MATTHEW C. GENTRY, PAULA A. LEGER, and ROBERT L. BOULANGER

Appeal 2019-006610
Application 14/633,307
Technology Center 3700

Before EDWARD A. BROWN, WILLIAM A. CAPP, and BRANDON J. WARNER, *Administrative Patent Judges*.

BROWN, *Administrative Patent Judge*.

DECISION ON APPEAL

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 8–20.[2] We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

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[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. 2.

[2] Claims 1–7 and 21–27 are withdrawn. Appeal Br. (Claims App.).

CLAIMED SUBJECT MATTER

Claims 8 and 14 are independent claims. Claim 8, reproduced below, illustrates the claimed subject matter:

> 8. A cryogenic gas processing system comprising:
>
> a chiller;
>
> a low temperature separator (LTS) including an inlet fluidically connected to the chiller, a first outlet and a second outlet;
>
> a flash drum including an inlet fluidically connected to the LTS and a plurality of conduits; and
>
> a heat exchanger fluidically connected to the second outlet of the LTS and the plurality of conduits of the flash drum, the heat exchanger comprising:
>
> a first side bar formed from a nickel-iron alloy;
>
> a second side bar formed from a nickel-iron alloy, wherein the nickel content of the nickel-iron alloy is between about 32% and 42%, the second side bar being spaced from the first side bar;
>
> a fin element formed from a nickel-iron alloy extending between the first side bar and the second side bar forming a first layer of the heat exchanger, the fin element including an inner passage and being formed from a nickel-iron alloy;
>
> a first nickel-iron alloy bond joining the fin element and the first side bar; and
>
> a second nickel-iron alloy bond joining the fin element and the second side bar.

Appeal Br. 10 (Claims App.).

REJECTIONS

Claims 8–13 are rejected under 35 U.S.C. § 103 as unpatentable over Johnson (US 5,402,645, issued Apr. 4, 1995), Schauls (US 3,983,191, issued Sept. 28, 1976), Tonkovich (US 2004/0228781 A1, published Nov. 18, 2004), and Mathias (US 2004/0055329 A1, published Mar. 25, 2004).

Claims 14–20 are rejected under 35 U.S.C. § 103 as unpatentable over Schauls, Tonkovich, and Mathias.

Claims 8–13 are rejected under 35 U.S.C. § 103 as unpatentable over Johnson, Schauls, Tonkovich, and Hoberg (US 8,889,066 B2, issued Nov. 18, 2014).

Claims 14–20 are rejected under 35 U.S.C. § 103 as unpatentable over Schauls, Tonkovich, and Hoberg.

ANALYSIS

Claims 8–13 over Johnson, Schauls, Tonkovich, and Mathias

Appellant argues the rejection of claims 8–13 as a group. Appeal Br. 4–7. We select claim 8 as representative of the group to decide the appeal as to the rejection. Claims 9–13 stand or fall with claim 8. *See* 37 C.F.R. § 41.37(c)(1)(iv).

As to claim 8, the Examiner finds that Johnson discloses a heat exchanger 30, but concedes that Johnson does not disclose that heat exchanger 30 comprises a first side bar, a second side bar, and a fin element, as claimed. Final Act. 10. The Examiner relies on Schauls as disclosing a plate-fin heat exchanger comprising plates 12 connected through side bars (metallic sealing means 14) and a corrugated fin between side bars forming a first layer and an inner passage. *Id.* at 10–11. The Examiner concludes that it would have been obvious to one of ordinary skill in the art to utilize a plate-fin heat exchanger, as disclosed by Schauls, in Johnson to provide a high heat transfer surface area in a compact design, and further that using Schauls's plate-fin heat exchanger in Johnson would be a simple substitution of one known element for another to obtain predictable results. *Id.* at 11.

The Examiner concedes that Johnson and Schauls do not disclose that their heat exchangers are formed from nickel-iron alloy or nickel-iron alloy bonds, as claimed. Final Act. 11. The Examiner finds that Tonkovich discloses a plate-fin heat exchanger including components made of nickel-iron alloy and which can be diffusion bonded to each other. *Id.* (citing Tonkovich ¶¶ 31, 35, 37, 46). The Examiner concludes that it would have been obvious to use diffusion bonded nickel-iron alloy components in a heat exchanger, as disclosed by Tonkovich, in the heat exchanger of Johnson/Schauls. *Id.* The Examiner reasons that this simple substitution of one known heat exchanger material for another would have been obvious to one of ordinary skill in the art to obtain predictable results, such as increased resistance to extreme temperatures and higher corrosion resistance. *Id.* at 11–12.

The Examiner concedes that Johnson, Schauls, and Tonkovich do not explicitly disclose that the nickel content of the nickel-iron alloy is between about 32% and 42%, as claimed. Final Act. 12. The Examiner finds, however, that this limitation is disclosed by Mathias as a well-known alloy composition for heat exchangers. *Id.* (citing Mathias ¶ 73). The Examiner concludes that it would have been obvious to one of ordinary skill in the art to utilize a nickel-iron alloy, as disclosed by Mathias, in the modified heat exchanger of Johnson to provide high ductility and low thermal expansion at cryogenic low temperatures. *Id.* The Examiner reasons that this modification is a simple substitution of one known heat exchanger material for another to obtain predictable results, such as increased resistance to thermal expansion at extreme temperatures. *Id.*

Appellant contends that one of ordinary skill would not have been motivated to modify Schauls' heat exchanger with a nickel-iron alloy, as claimed. Appeal Br. 5. Appellant acknowledges that Schauls teaches a plate-fin heat exchanger. *Id.* However, Appellant notes that Schauls discloses that "'[p]lates 12 are preferably constructed of aluminum for reasons of its high thermal conductivity.'" *Id.* (boldface omitted). According to Appellant, "'[t]he Examiner acknowledges Schauls teaches away from the use of a nickel-iron alloy by indicating aluminum fins are preferable.'" Reply Br. 2. Appellant asserts that one of ordinary skill would not have modified the heat exchanger of Schauls with a nickel-iron alloy, as claimed, which has a lower thermal conductivity than aluminum. Appeal Br. 5. Appellant also disagrees that the proposed modification is a simple substitution, as the material substitution would directly impact the heat exchanger's performance characteristics. *Id.*

Appellant's contentions are unpersuasive. "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." *In re Urbanski*, 809 F.3d 1237, 1244 (Fed. Cir. 2016) (citation omitted). "A reference does not teach away, however, if it merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into the invention claimed." *See Galderma Labs v. Tolmar, Inc.*, 737 F.3d 731, 738 (Fed. Cir. 2013). Further, "[there is no requirement that the] prior art must teach that a particular combination is preferred, or 'optimal,' for the combination to be obvious." *See In re Fulton*, 391 F.3d 1195, 1202 (Fed. Cir. 2004)).

Here, Schauls discloses that aluminum is preferred for forming plates of the heat exchanger because aluminum has high thermal conductivity. This disclosure merely expresses a general preference for using aluminum, but does not explicitly criticize, discredit, or otherwise discourage the use of a nickel-iron alloy to form the plates. We are not persuaded that this disclosure teaches away from the Examiner's proposed modification.

Appellant acknowledges that the structure illustrated in Figure 1 of Tonkovich includes a heat exchanger 170, fins, and a fin plate. Appeal Br. 5–6. Appellant contends, however, that this structure is not reasonably the same as a plate-fin heat exchanger. *Id.* at 6. Appellant also contends that Tonkovich does not disclose a nickel-iron alloy, *such as Invar*, which has a lower coefficient of heat transfer, as claimed. *Id.* (citing Tonkovich ¶ 37). Appellant contends that Inconel, described in paragraph 37 of Tonkovich as a suitable material for making heat exchanger 170, is a nickel-*chromium* alloy, not "a nickel-iron alloy (Invar)," as claimed. *Id.* at 6–7 (boldface omitted).

The Examiner responds that "Appellant does not provide a specific definition for nickel-iron alloy and therefore the broadest reasonable interpretation of nickel-iron alloy is an alloy that contains nickel and iron." Ans. 6.[3] The Examiner finds that Inconel is an alloy including nickel and iron, and thus, a nickel-iron alloy under the Examiner's interpretation of this term. *Id.* (citing https://en.wikipedia.org/wiki/Inconel).

[3] The Examiner's Answer includes multiple consecutive pages each numbered "page 1." We refer to the first page of the Examiner's Answer that is numbered "page 1" (the third page, including cover) as page 3, and the subsequent pages, which are also numbered as "page 1," as page 4, etc.

Claim 8 recites "a first side bar formed from a nickel-iron alloy," "a fin element formed from a nickel-iron alloy," "a first nickel-iron alloy bond," "a second nickel-iron bond," and "a second side bar formed from a nickel-iron alloy, wherein the nickel content of the nickel-iron alloy is between about 32% and 42%." Appeal Br. 10 (Claims App.). Hence, claim 8 specifies the nickel content of the nickel-iron alloy forming the second side bar, but does not specify any particular nickel or iron content of the first side bar, fin element, first nickel-iron bond, or second nickel-iron bond.

We agree with Appellant that the Examiner has not established that Tonkovich discloses a nickel-iron alloy having a nickel content of between about 32% and 42%. Appellant notes that the Wikipedia article cited by the Examiner describes that Inconel "'is a family of austenitic nickel-chromium-based superalloys'" and "'Inconel alloys vary widely in their compositions, but all are predominately nickel, with chromium as the second element.'" Reply Br. 3–4 (boldface omitted). Appellant points out that the compositions of Inconel detailed in the Wikipedia article have a nickel content greater than the claimed range. Although the article shows that Inconel contains nickel and iron, the Examiner has not established that Tonkovich discloses a second side bar formed form a nickel-iron alloy having the claimed composition.

However, the rejection relies on Mathias as teaching a nickel-iron alloy having a nickel content between about 32% and 42% used for heat exchangers. Final Act. 12 (citing Mathias ¶ 73). Mathias discloses:

> Aluminum is typically used as a material of construction in conventional cryogenic heat exchangers. Aluminum minimizes heat transfer resistance between fluid streams due to

> the fact that it is a high thermal conductive material. *However, since it is a high thermal conductive material aluminum tends to decrease the effectiveness of the heat exchangers due to axial conduction.* This limits the ability to shorten the length of these heat exchangers and thereby reduce the overall pressure drop. *An advantage of the present invention is that it is not necessary to use high thermal conductive materials such as aluminum in constructing the heat exchanger used with the inventive process.*

Mathias ¶ 6 (emphasis added). Mathias also discloses:

> *A useful material is the iron-nickel alloy INVAR which contains in excess of about 36% nickel.* These materials provide thermal conductivities that are sufficient to provide the necessary requirements for overall heat transfer coefficients. *An advantage of using these materials is that inefficiencies due to axial conduction are significantly reduced as compared to using high thermal conductive materials such as aluminum.* This permits the use of relatively short microchannels in the heat exchangers. *Thus, although the microchannels may be constructed of a high thermal conductive material such as aluminum, an advantage of the inventive process is that it is not necessary to use such materials.*

Mathias ¶ 73 (emphasis added). Mathias discloses that Invar has a low coefficient of thermal expansion and "does not experience significant thermal expansion in the extremely low temperature environment (i.e., less than about -163° C.) or in a room temperature environment." *Id.* ¶ 74. The medium heat conductivity reduces longitudinal heat conduction, and the nickel content enhances corrosion resistance. *Id.*

Appellant does not address the Examiner's reliance on Mathias in the Appeal Brief. Accordingly, Appellant does not apprise us of error in the Examiner's findings for Mathias, or in the Examiner's reasoning that it would have been obvious to modify the heat exchanger of Johnson/Schauls by substituting one known heat exchanger material (i.e., Invar disclosed by

Mathias) for another (i.e., aluminum disclosed by Schauls) to obtain predictable results, such as increased resistance to thermal expansion at extreme low temperatures. Indeed, Mathias discloses that Invar can be used instead of "high thermal conductivity materials such as aluminum" in heat exchangers used in cryogenic applications. Mathias ¶ 73.

In the Appeal Brief, Appellant does not present any specific argument addressing the Examiner's reliance on Mathias. In the Reply Brief, however, Appellant argues that "[d]espite the Examiner's Answer to the contrary, Tonkovich is not drawn to a plate-fin heat exchanger, nor is Mathias or Hoberg and taken alone, or in combination, provide no teachings of a plate-fin heat exchanger with a nickel-iron alloy, as recited in independent claim 8." Reply Br. 2 (boldface omitted). First, apart from specific exceptions, arguments not raised in the Appeal Brief, but raised for the first time in the Reply Brief, "will not be considered by the Board for purposes of the present appeal, unless good cause is shown." 37 C.F.R. § 41.41(b)(2). Here, Appellant does not show good cause why this new argument addressing Mathias could not have been made earlier.

Second, even if considered, Appellant's new argument does not apprise us of error in the Examiner's findings for Mathias, or in the Examiner's reasoning supporting the modification of the plate-fin heat exchanger of Johnson/Schauls in view of Mathias's teachings. Even if, as Appellant asserts, Matthias taken alone, or in combination, does not explicitly teach "a plate-fin heat exchanger with a nickel-iron alloy," as recited in claim 8, "there is no requirement that the prior art of record explicitly teach a combination," and motivation to modify a reference may be "implicit in the knowledge of one of ordinary skill in the art." *KSR Int'l*

Co. v. Teleflex Inc., 550 U.S. 398, 418–19 (2007) ("the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim"); *see also In re Kahn*, 441 F.3d 977, 987–88 (Fed. Cir. 2006) (teaching, motivation, or suggestion may be implicit from the prior art as a whole, rather than expressly stated in the references).

For the above reasons, we sustain the rejection of claim 8 as unpatentable over Johnson, Schauls, Tonkovich, and Mathias. Claims 9–13 fall with claim 8.

Claims 14–20 over Schauls, Tonkovich, and Mathias

Appellant merely states that claim 14 recites substantially similar subject matter as discussed for claim 8.[4] Appeal Br. 7. As Appellant does not apprise us of any error in the Examiner's rejection of claim 8, we sustain the rejection of claim 14, and claims 15–20 depending therefrom, as unpatentable over Schauls, Tonkovich, and Mathias for substantially the same reasons as discussed above for claim 8.

Claims 8–13 over Johnson, Schauls, Tonkovich, and Hoberg

The Examiner also rejects 8–13 as unpatentable over Johnson, Schauls, Tonkovich, and Hoberg. Final Act. 2. However, this rejection is duplicative to that discussed above and is not reached here, as an alternate rejection of each of these claims has been affirmed.

[4] Claim 14 specifies the nickel content of the nickel-iron alloy forming the first side bar, but not the nickel or iron content of the second side bar, fin element, first nickel-iron bond, or second nickel-iron bond. Appeal Br. 11 (Claims App.).

Claims 14–20 over Schauls, Tonkovich, and Hoberg

The Examiner also rejects 14–20 as unpatentable over Schauls, Tonkovich, and Hoberg. Final Act. 6. However, this rejection is also duplicative to that discussed above and is not reached here, as an alternate rejection of each of these claims has been affirmed.

DECISION SUMMARY

Claim(s) Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
8–13	103	Johnson, Schauls, Tonkovich, Mathias	8–13	
14–20	103	Schauls, Tonkovich, Mathias	14–20	
8–13	103[5]	Johnson, Schauls, Tonkovich, Hoberg		
14–20	103[6]	Schauls, Tonkovich, Hoberg		
Overall Outcome			8–20	

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

AFFIRMED

[5] The rejection of claims 8–13 as unpatentable over Johnson, Schauls, Tonkovich, and Hoberg is not reached here.
[6] The rejection of claims 14–20 as unpatentable over Schauls, Tonkovich, and Hoberg is not reached here.