UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JOHN W. VAN ZEE,
WOO-KUM LEE, and MAHESH MURTHY

Appeal 2007-4328
Application 10/385,413
Technology Center 1700

Decided: February 28, 2008

Before CHARLES F. WARREN, CATHERINE Q. TIMM, and
LINDA M. GAUDETTE, *Administrative Patent Judges*.

WARREN, *Administrative Patent Judge*.

DECISION ON APPEAL

Applicants appeal to the Board from the decision of the Primary Examiner finally rejecting claims 4, 8 through 11, 24 through 31, 41, and 42 in the Office Action mailed July 28, 2006. 35 U.S.C. §§ 6 and 134(a) (2002); 37 C.F.R. § 41.31(a) (2005).

We reverse the decision of the Primary Examiner.

Claims 41 and 42 illustrate Appellants' invention of an electrochemical fuel cell system and a method of operating an

electrochemical fuel cell system, and are representative of the claims on appeal:

41. An electrochemical fuel cell system adapted for maintaining the efficient production of electrical power of a fuel cell, said system comprising:

a fuel cell having a normal operating temperature for producing electricity;

a fuel supply containing a hydrogen rich fuel for delivery to said fuel cell;

a fuel supply conduit connecting said fuel supply and said fuel cell for delivering a fuel stream of said hydrogen rich fuel to said fuel cell:

a heating mechanism in communication with said fuel supply conduit operative to generate heat in said fuel supply conduit for increasing the temperature of said fuel stream entering said fuel cell to raise said normal operating temperature of said fuel cell to an elevated operating temperature; and

an impurity sensor carried by said fuel supply conduit for sensing impurities in said fuel stream prior to said impurities entering said fuel cell;

said impurity sensor operatively associated with said heating mechanism for activating said heating mechanism in response to detecting impurities in said fuel stream prior to said impurities entering said fuel cell;

whereby, said normal operating temperature of said fuel cell is raised to said elevated operating temperature before said impurities enter said fuel cell so that binding of said impurities within said fuel cell is resisted.

42. A method of improving the efficiency of an electrochemical fuel cell system of the type having a fuel supply for delivering a hydrogen rich fuel stream through a fuel supply conduit to a fuel cell stack, said method comprising the steps of:

providing an impurity sensor carried by said fuel supply conduit communicating with said fuel stream passing therein for detecting impurities in said fuel stream;

detecting the presence of impurities in said fuel stream passing through said fuel supply conduit;

monitoring said impurities in said fuel stream to determine an impurity level prior to said impurities entering said fuel cell;

detecting a rise in said impurity level above a predetermined impurity level prior to said impurities entering said fuel cell;

providing a heating mechanism disposed between said impurity sensor and said fuel cell communicating with said fuel supply conduit and said impurity sensor, wherein said heating mechanism is operative to generate heat in said fuel supply conduit for increasing the temperature of said fuel stream entering said fuel cell so that a normal operating temperature of said fuel cell is raised to an elevated operating temperature by heating of said fuel stream; and

activating said heating mechanism in response to detecting said rise in said impurity level to raise the temperature of said fuel cell stack to said elevated operating temperature before said impurities enter said fuel cell;

whereby, raising said normal operating temperature of said fuel cell to said elevated operating temperature before said impurities enter said fuel cell resists binding of said impurities within said fuel cell to maintain efficient electricity production.

The Examiner relies upon the evidence in these references (Ans. 2-3):

Kawatsu	US 5,925,476	Jul. 20, 1999
Nitta	US 6,106,963	Aug. 22, 2000
Rock	US 6,358,638 B1	Mar. 19, 2002
Nonobe	US 2002/0094467 A1	Jul. 18, 2002

Appellants request review of the grounds of rejection advanced on appeal (Br. 2-3):

Claims 41, 4, and 10 under 35 U.S.C. § 102(b) as anticipated by Nitta (Ans. 4);

Claims 8 and 9 under 35 U.S.C. § 103(a) as unpatentable over Nitta in view of Rock (Ans. 4);

Claims 8 and 9 under 35 U.S.C. § 103(a) as unpatentable over Nitta in view of Nonobe (Ans. 5);

Claim 11 under 35 U.S.C. § 103(a) as unpatentable over Nitta in view of Kawatsu (Ans. 6);

Claims 42, 24, 25, and 27 through 31 under 35 U.S.C. § 103(a) as unpatentable over Kawatsu in view of Nitta (Ans. 6); and

Claim 26 under 35 U.S.C. § 103(a) as unpatentable over Kawatsu in view of Nitta as applied to claim 42, further in view of Rock (Ans. 8).

Appellants argue the claims in the first ground of rejection as a group and further argue claim 41 separately; the claims in the second and third grounds of rejection as a group; and the claims in the fifth ground of rejection as a group and further argue claim 42 separately. Br., e.g., 10, 11, 13, 15, and 18. Thus, we decide this appeal based on claims 41, 8, 11, 42, and 26 as representative of the grounds of rejection and Appellants' groupings of claims. 37 C.F.R. § 41.37(c)(1)(vii)(2006).

The dispositive issues in this appeal are whether the Examiner has properly interpreted the language of representative independent claims 41 and 42 and properly determined the teachings of Nitta and Kawatsu, and thus, properly carried the burden of establishing a prima facie case in each of the grounds of rejection.

The Examiner relies on Nitta in each of the grounds of rejection based on the same facts found therein on the basis of an interpretation of claim language that focuses on the basic apparatus components "a fuel supply conduit," "a heating mechanism," and "an impurity sensor" of the fuel cell system specified in claim 41 and similarly of the method of operating a fuel cell in claim 42, without giving weight to the claim language expressing functional, operational, and interaction limitations of the components. The Examiner takes the position that the language used to define these components constitutes a "manner of operation" for an "intended use" and thus, does not further structurally define the components. Ans. 3 and 9-10.

Appellants contend the claim language specifies the manner the components "are mechanically interconnected and associated" and "how they function together," and thus, are not statements of "intended use." Br. 8-9.

The terms of claims 41 and 42 must be given their broadest reasonable interpretation in their ordinary usage in context as they would be understood by one of ordinary skill in the art, in light of the written description in the Specification, including the drawings, without reading into the claim any disclosed limitation or particular embodiment. *See*, *e.g.*, *In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004); *In re Hyatt*, 211 F.3d 1367, 1372 (Fed. Cir. 2000); *In re Morris*, 127 F.3d 1048, 1054-55 (Fed. Cir. 1997); *In re Zletz*, 893 F.2d 319, 321-22 (Fed. Cir. 1989).

In interpreting the claim language, it must be determined whether functional and operational language in the preamble and in the body of the claim confers a structural limitation, *see*, *e.g.*, *In re Echerd*, 471 F.2d 632, 634-35 (CCPA 1973); *In re Ludtke*, 441 F.2d 660, 663-64 (CCPA 1971); *In re Swinehart*, 439 F.2d 210, 212-13 (CCPA 1971) (there is nothing intrinsically wrong in defining something by what it does rather than by what it is), or conveys a method of intended use concept. *See, e.g., In re Yanish*, 477 F.2d 958, 959 (CCPA 1973); *In re Casey*, 370 F.2d 576, 579-80 (CCPA 1967); *In re Otto*, 312 F.2d 937, 939-40 (CCPA 1963). As in all matters of claim interpretation, this determination requires consideration of the language in the preamble and in the body of the claim in light of the disclosure in the Specification, including the drawings, without reading any disclosed embodiment into the claims as a limitation. *See, e.g., In re Stencel*,

828 F.2d 751, 754-55 (Fed. Cir. 1987), and cases cited therein ("Whether a [statement] . . . of intended purpose constitutes a limitation to the claims is, as has long been established, a matter to be determined on the facts of each case in view of the claimed invention as a whole."). Thus, such terms as "operative" and "operatively associated" must be interpreted on this basis. *See, e.g., Innova/Pure Water, Inc. v. Safari Water Filtration Systems, Inc.*, 381 F.3d 1111, 1118-19 (Fed. Cir. 2004) (the term "operatively connected . . . is a general term frequently used in patent drafting to reflect a functional relationship between claimed components . . . [and generally] means the claimed components must be connected in a way to perform a designated function").

On this record, we agree with Appellants that the plain language of the preamble and body of claims 41 and 42 with respect to "a fuel supply conduit," "a heating mechanism," and "an impurity sensor" set forth functional limitations which specify the structural relationship between these components and the manner in which the components must be capable of functioning. We determine the language of claim 41 specifies, with reference to Specification Figs. 1 and 2, any fuel supply conduit 22 that connects in any respect any fuel supply of hydrogen rich fuel to fuel cell 28 for delivery of the fuel stream to the cell. The hydrogen rich fuel supply can be formed, among other things, in reformer 14, and fuel supply conduit 22 connects the fuel supply exiting reformer 14 with fuel cell 28. The "heating mechanism" is any manner of heating mechanism in "communication" with fuel supply conduit 22, such that the heating mechanism is connected to the conduit internally, such as heating coil 30, or externally, such as gas injector

18. The heating mechanism must be "operative," that is, has the capability, to generate heat in the conduit to increase the temperature of the fuel stream therein to the extent that the operating temperature of the fuel cell is elevated to any extent above the normal operating temperature of the cell in response thereto. Fuel supply conduit 22 must also "carry," that is, contain or have attached, any impurity sensor 16 capable of sensing an impurity in the fuel stream flowing through the conduit. Impurity sensor 16 and heating mechanism 18 or 30 must be "operatively associated," that is, connected, such as through control unit 20, so that the heating mechanism is activated in response to detection of impurities in the fuel stream in conduit 22 before the impurities enter the fuel cell. *See* Spec., e.g., 5-7 and 10-12.

Claim 42 contains similar language with respect to the structural and functional relationship between the apparatus components of the claimed method, but further specifies that the "heating mechanism" must be disposed between impurity sensor 16 and fuel cell 28 in communication with both fuel supply conduit 22 and the impurity sensor, and otherwise must have the same capability in the manner also stated in claim 41. *See* Spec., e.g., 5-7 and 10-12.

Turning now to the grounds of rejection of claims 41 and 42, the Examiner finds, with respect to claim 41, that "Nitta teaches a fuel cell system with a fuel supply, conduit, heating mechanism (reformer), impurity sensor (CO sensor) and control unit." Ans. 4, citing Nitta col. 9, l. 15 to col. 10, l. 45 and Fig. 1. "The temperature of the reformer is increased in response to the CO sensor detecting impurities," and thus "increases the temperature of the fuel supplied to the fuel cell, thereby increasing the

temperature of the fuel cell." Ans. 4. The Examiner further finds Nitta discloses "a fuel supply conduit connecting the fuel supply to the fuel cell and a heating mechanism (CO reducing unit) that raises the fuel's temperature in the fuel supply conduit to an elevated temperature in response to a higher amount of impurities . . . before it enters the fuel cell." Ans. 10-11. The Examiner finds the cooling unit of the CO reducing unit keeps "the heating mechanism at a controlled higher temperature to remove impurities," wherein "[t]he heat-producing reaction in the CO reducing unit is an exothermic reaction and the cooling unit controls the appropriate temperature range for normal operation or at an increased temperature for eliminating the impurities." Ans. 11, citing Nitta col. 10, ll. 14-21. The Examiner further finds the "heating mechanism" is "in communication" with the fuel supply conduit and is "in operational communication" with the impurity sensor and "the heating mechanism is activated and inherently raises the temperature of the fuel" when impurities are detected. Ans. 12, , citing Nitta col. 9, ll. 17-62, col. 10, ll. 16-44, and Fig. 1.

With respect to claim 42, the Examiner finds Kawatsu would have disclosed raising and lowering the temperature of the fuel cell in response to, among other things, detection of poisoning of the cell's catalyst using, among other things, feedback from a senor for carbon monoxide to a control unit. Ans. 7, citing Kawatsu col. 6, ll. 25-68, col. 9, ll. 10-25, col. 14, ll. 1-67, col. 15, ll. 25-31, and Figs. 1, 6, 7, and 11. The Examiner determines "Kawatsu is silent to the use of a heater to heat the supply of fuel for the fuel cell," and finds that Nitta's system detects the level of carbon monoxide and corrects the level before the fuel reaches the cell. Ans. 7-8,

citing Nitta col. 9, l. 15 to col. 10, l. 45. In this respect, the Examiner takes the position that "[w]hile the heater of Nitta is located before the sensor and not between the impurity sensor and the fuel cell, it would be obvious to one of ordinary skill in the art . . . to have rearranged the heating mechanism to heat the fuel supply, since it is held that rearranging parts of an invention involves only routine skill in the art." Ans. 8. The Examiner concludes it would have been obvious to this person "to modify the fuel cell system of Kawatsu with the heater system of Nitta to lower the amount of CO that reaches the fuel cell." Ans. 8.

Appellants contend, with respect to claim 41, that Nitta "teaches heating the fuel as part of a filtering process to filter out impurities in the fuel stream before the fuel stream is delivered to the fuel cell," but not "that heating the fuel as part of the filtering process results in the fuel stream still being heated by the time it enters the fuel cell" such that it "affects the normal operating temperature of the fuel cell." Br. 10-11. Appellants contend there is no teaching in Nitta "of heating the fuel cell from a normal operating temperature to an elevated operating temperature" and, in this respect, that Nitta provides "a cooling unit for the CO reducing unit (part of the reformer) to maintain acceptable operating temperature for the unit." Br. 10-11. Appellants contend "there is no disclosure in Nitta of a heating mechanism that generates heat in fuel supply line 63" as "[t]he fuel is first treated by the reformer/CO reducing unit 26 and then delivered to fuel supply line 63." Br. 10-11. Appellants point out that Nitta does not teach the claim limitation requiring the impurity sensor in the conduit to be operatively associated with the heating mechanism such that the hearing

mechanism is activated in response to impurities detected in the fuel stream prior to entry of impurities into the fuel cell. Br. 12. Thus, Appellants argue that Nitta teaches various claimed structural elements but not in the claimed arrangement and with the claimed functional cooperation. Br. 12.

Appellants contend, with respect to claim 42, that Kawatsu teaches adjusting temperature and pressure in the fuel cell when the control mechanism determines the catalyst has been poisoned by impurities in the fuel stream, and adjusts the temperature of the fuel cell primarily with a water cooling pump and not the use of a heater to heat the fuel supply for the cell. Br. 13. Appellants contend Nitta does not teach heating the fuel cell by heating the fuel stream. Br. 14. Appellants contend Kawatsu and Nitta do not teach a heating mechanism which meet the claim limitation of a heating mechanism disposed in the fuel supply conduit between the impurity sensor and the fuel cell that is operative to heat the fuel stream in the conduit in response to the impurity sensor sensing an impurity, such that the heated fuel stream elevates the temperature of the fuel cell above normal operating temperature. Br. 15-16.

We find Nitta would have disclosed to one of ordinary skill in this art, with respect to Fig. 1, a fuel cell system having fuel reformer 26 which consists of heater-vaporizer 27, reforming unit 28, and CO reducing unit 29. Nitta col. 7, ll. 59-62. Methanol and water vaporized in heater-vaporizer 27 are subjected to an endothermic steam-reforming reaction in reforming unit 28, which reaction is supported with heat from the vaporized methanol and water, heat from burner 30, and/or an exothermic oxidizing reforming reaction, to form a hydrogen rich reformed gas as a fuel supply for fuel cells

40. Nitta col. 7, l. 63 to col. 9, l. 34. The amount of carbon monoxide in the reformed gas is reduced in CO reducing unit 29 to supply fuel of sufficiently low carbon monoxide content, with an exothermic selective oxidation reaction with oxygen provided through blower 38 which is connected to control unit 50. Nitta col. 9, l. 35 to col. 10, l. 13. CO reducing unit 29 is equipped with a cooling system to maintain the temperature of the unit within a range suitable for the reaction. Nitta col. 10, ll. 14-21. CO reducing unit 29 is also equipped with an unillustrated carbon monoxide sensor connected to control unit 50, and the control unit regulates the operating temperature in the unit to control the carbon monoxide concentration of the fuel at an acceptable level. Nitta col. 10, ll. 22-35. The fuel from CO reducing unit 29 is conducted to fuel cells 40 through fuel supply line 63. Nitta col. 10, ll. 35-39. Nitta teaches that when the carbon monoxide in the reformed gas in reforming unit 28 is acceptable, reformer 26 need not contain CO reducing unit 29. Nitta col. 10, ll. 39-43.

We find Kawatsu would have disclosed to one of ordinary skill in this art, with respect to Fig. 1, a fuel cell system in which hydrogen rich fuel is formed from methanol and water in reformer 16 and conducted to fuel cells 10 through fuel supply conduit 17, and which further contains, among other things, back-pressure regulating valve 19 that regulates the opening of the gaseous fuel discharge conduit 18. Kawatsu col. 8, l. 60 to col. 9, l. 6. Among the sensors used to detect fuel cell operating conditions are carbon monoxide sensor 30 which is disposed in the middle of fuel supply conduit 17 for measuring carbon monoxide in the gaseous fuel; temperature sensor 34 in stack of fuel cells 10; and pressure sensor 36 for measuring the

pressure of the gaseous fuel, which sensors are connected to control unit 38. Kawatsu col. 9, ll. 11-23 and col. 12, l. 41 to col. 13, l. 46. Control unit 38 adjusts back-pressure regulating valve 19 to vary the flow of the gaseous fuel in fuel cells 10 to control the output from the cells. Kawatsu col. 13, l. 47 to col. 14, l. 3. Fuel cell stack 10 has a cooling water system with cooling water pump 24 and circulation path 22. Col. 9, ll. 6-10. Upon receipt of sensor output which indicates the anode catalyst is poisoned with carbon monoxide, control unit 38 raises the fuel cell temperature by adjusting the rate of cooling water pump 24 and further adjusts the fuel gas pressure, until sensor output readings indicate the anode catalyst is no longer poisoned. Kawatsu col. 14, l. 4 to col. 15, l. 31.

Kawatsu further discloses a similar system to the embodiment illustrated in Fig. 1 in the embodiment illustrated in Fig. 15, wherein reformer 16 includes reformer unit 16a to decompose methanol and in a further reaction form carbon dioxide and hydrogen; shift reaction unit 16b to react remaining carbon monoxide with water; and partial oxidation unit 16c to selectively oxidize remaining carbon monoxide, all the units connected to control unit 38. Kawatsu col. 22, ll. 25-41. In this embodiment, carbon monoxide sensor 530, disposed in the middle of fuel supply conduit 17, has the additional function of measuring the amount of methanol in the fuel, and if control unit 38 determines the amount is excessive, the unit raises the temperature of reformer unit 16a to enhance the reactivity of methanol. Kawatsu col. 20, l. 62 to col. 24, l. 38.

On this record, we agree with Appellants that Nitta does not prima facie anticipate the claimed system encompassed by claim 41 as we

interpreted this claim above. As Appellants contend, Nitta would have taught processing the fuel supply in reformer 26 and releasing the fuel supply to fuel supply line 63 which carries the fuel to fuel cells 40. As Appellants further contend, Nitta does not teach a carbon monoxide sensor to ascertain the carbon monoxide concentration in fuel supply line 63 and a heating mechanism operatively associated with the sensor to heat the fuel supply in fuel supply line 63 to the extent necessary to elevate the operating temperature of fuel cell 40 above normal operating temperature.

Indeed, Nitta discloses control unit 50 operatively associates the carbon monoxide sensor and the cooling system of CO reducing unit 29 to adjust the oxygen provided thereto through blower 38 to maintain the exothermic selective oxidation of carbon monoxide therein at a level accounting for the concentration of carbon monoxide present in the fuel received from reforming unit 28 as reported by the sensor, and adjusts the temperature of CO reducing unit 29 accordingly with the cooling system to maintain a suitable temperature range for unit operation. There is no teaching in Nitta that the carbon monoxide sensor reports the carbon monoxide concentration of the fuel supply released from CO reducing unit 29 to fuel supply line 63 and on this basis, adjusts the temperature of the unit such that the released fuel supply contains sufficient heat to elevate the temperature of the fuel cells above normal operating temperature. Indeed, the fuel supply formation and delivery side of Nitta's fuel cell system contains a heating mechanism that provides heat to a subsequent unit only with respect to heater-vaporizer unit 27 which supplies heat for the endothermic steam reforming reaction in reforming unit 28, because any

heat supplied to the fuel supply entering fuel supply line 63 is dependent on the process parameters of CO reducing unit 29.

Accordingly, on this record, we determine the Examiner has not established that prima facie, as a matter of fact, Nitta describes to one skilled in this art a fuel cell system that meets each and every limitation of the claimed fuel cell system encompassed by claim 41, arranged as required therein, either expressly or inherently. *See, e.g.*, *In re Schreiber*, 128 F.3d 1473, 1477 (Fed. Cir. 1997), and cases cited therein ("To anticipate a claim, a prior art reference must disclose every limitation of the claimed invention, either explicitly or inherently.").

Therefore, in the absence of a prima facie case of anticipation, we reverse the rejection of claims 41, 4, and 10 under 35 U.S.C. § 102(b).

On this record, we also agree with Appellants that the combination of Kawatsu and Nitta does not render prima facie obvious the claimed method of operating a fuel cell system encompassed by claim 42 as we interpreted this claim above. Like Nitta, Kawatsu does not disclose heating the fuel cells 10 with heat supplied through fuel supply conduit 17. Kawatsu controls the temperature of the fuel cell stack with the cooling water system thereof via control unit 38 responding to anode catalyst poisoning determined in part from input from carbon monoxide sensor 30 disposed in fuel supply conduit 17. Kawatsu discloses reformer 16 can have the same three units for forming the fuel supply as does Nitta. We do not find evidence in Kawatsu and Nitta, separately or combined, which supports the Examiner's contention that one of ordinary skill would have rearranged the carbon monoxide sensor and the other elements of Nitta's CO reducing unit

29 of fuel reformer 26 and fuel supply line 63 to arrive at a system having a heating mechanism disposed between a carbon monoxide sensor and a fuel cell in a fuel supply conduit, as specified in claim 42, and on this basis would have modified Kawatsu's system by inserting a heating mechanism between monoxide sensor 30 and fuel cell 10 in fuel supply conduit 17 as claimed.

Indeed, the Examiner has not explained why rearrangement to the extent of rearranging the components of two separate units of Nitta's system required to reach the claimed apparatus components of the claimed method encompassed by claim 42, involves only routine skill in the art. *See, e.g., KSR Int'l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1741 (2007)("it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does"); *In re Kahn*, 441 F.3d 977, 985-88 (Fed. Cir. 2006)("[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness."); *In re Rouffet*, 149 F.3d 1350, 1358, 47 USPQ2d 1453, 1458 (Fed. Cir. 1998)("hindsight" is inferred when the specific understanding or principal within the knowledge of one of ordinary skill in the art leading to the modification of the prior art in order to arrive at appellant's claimed invention has not been explained); *In re Fritch*, 972 F.2d 1260, 1266 ("The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification."); *In re Dow Chem. Co.*,

837 F.2d 469, 473 (Fed. Cir. 1988) ("The consistent criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that [the claimed process] should be carried out and would have a reasonable likelihood of success viewed in light of the prior art. Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure." (citations omitted)). In view of the similarity in the teachings of the references, even if one of ordinary skill in this art did combined Kawatsu and Nitta, the result would not have been the cooperative arrangement of apparatus components encompassed by claim 42. *See, e.g., Uniroyal, Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 1050-54 (Fed. Cir. 1988).

Accordingly, in the absence of a prima facie case of obviousness, we reverse the rejection of claim 42 under 35 U.S.C. § 103(a).

We now turn to the grounds of rejection of dependent claim 8 over the combined teachings of Nitta and Rock and of dependent claim 26 over the combined teachings of Kawatsu, Nitta, and Rock. Claim 8 further limits claim 41 by specifying "a hot gas injector included in said heating mechanism connected to said fuel supply conduit for introducing a stream of heated gas into said fuel supply conduit to rapidly raise the temperature of the fuel cell." Claim 26 further limits claim 42 by specifying "the step of heating said fuel cell stack by activating a hot gas injector for rapidly infusing heated gas into said fuel supply conduit."

We find Rock, with reference to the figure, would have disclosed to one of ordinary skill in this art a fuel cell system containing, among other things, fuel processor 4, which is, e.g., a steam reformer or autothermal

reactor. The resulting reformate 6 advances through line 12 to "one or more CO clean-up devices 10 which typically includes a water gas shift reactor and a preferential oxidation reactor, both of which are well known in the art." "[T]he reformate feed stream 12 is fed to the fuel cell stack 8" through line 12. "[A] small amount of air . . . is fed into the feed stream 12 via a metering device 14 at the entrance to the stack 8" after the air is heated "incident to the heat of compression that is produced in the compressor 16." Rock col. 3, l. 41, to col. 4, l. 2. The membrane electrode assembly (MEA) is heated when "sufficient O_2 (i.e. as air) is provided to the H_2-rich feed stream for the anode side of stack 8" and "[t]hermal start-up of the stack 8 can further be effected by hearing the coolant (e.g. with a combustor) that normally circulates through the stack 8 to cool it." Rock col. 4, ll. 7-42.

We agree with Appellants (Br. 17-18) that the Examiner (Ans. 4-5, 8-9, and 13-15) has not established a prima facie case of obviousness in either of the grounds of rejection. The Examiner has not established that the temperature of the air incidentally heated by the compressor and injected by the metering device 14 will alone inherently raise the temperature of fuel cell 8. Even if such heating inherently occurred, modification of the system taught by Nitta and by the combined teachings of Kawatsu and Nitta using Rock's heating mechanism would not result in the claimed invention since, as we determined above with respect to claims 41 and 42, there would be no carbon monoxide sensor operatively associated with or in communication with that hearing mechanism taught by the applied references as required by claims 8 and 26, respectively.

Accordingly, in the absence of a prima facie case of obviousness of claims 8, 9, and 26 over the applied references including Rock, we reverse these grounds of rejection under 35 U.S.C. § 103(a).

Dependent claim 8 is further rejected over the combined teachings of Nitta and Nonobe. We find Nonobe would have disclosed to one of ordinary skill in this art, with reference to Fig. 1, that hydrogen off-gas discharged from fuel cell 100 is returned to hydrogen gas main-stream passage 401 through circulation passage 403 for reuse of the off-gas in fuel cell 100. Nonobe ¶¶ 0042-0044. We agree with Appellants (Br. 18-19) that the Examiner (Ans. 5-6 and 15) has not established a prima facie case of obviousness. There is no evidence in Nonobe that the heat in the hydrogen off-gas that is returned to main-stream passage 401 has sufficient heat to meet the hot gas injector and other limitations of claim 8 as we interpreted this claim above. Even if such heating inherently occurred, the modification of Nitta's system by recirculation of the hydrogen off-gas does not provide the other claim limitations not met by Nitta as we determined above.

Accordingly, in the absence of a prima facie case of obviousness of claims 8 and 9 over the combined teachings of Nitta and Nonobe, we reverse these grounds of rejection under 35 U.S.C. § 103(a).

Finally, we agree with Appellants (Br. 19) that even if the fuel cell system of Nitta was modified with a voltage sensor as specified in claim 11 in view of the teachings of Kawatsu as proposed by the Examiner (Ans. 6 and 15-16), the modification of Nitta's system would not provide the other claim limitations as we determined above. Accordingly, in the absence of a

prima facie case of obviousness of claim 11 over the applied references, we reverse this ground of rejection under 35 U.S.C. § 103(a).

The Primary Examiner's decision is reversed.

REVERSED

PL Initial
sld

MCNAIR LAW FIRM, P.A.
P.O. BOX 10827
GREENVILLE, SC 29603-0827