

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte CRAIG S. GITTLEMAN, WILLIAM SCOT APPEL,
DAVID PHILLIP WINTER, and BRIAN KENNETH SWARD

Appeal 2007-4495
Application 10/706,320
Technology Center 1700

Decided: March 14, 2008

Before CHUNG K. PAK, PETER F. KRATZ, and CATHERINE Q. TIMM,
Administrative Patent Judges.

TIMM, *Administrative Patent Judge.*

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's
decision rejecting claims 1-71. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

I. BACKGROUND

The invention relates to a pressure swing absorption (PSA) method (independent claims 1 and 28) and system (independent claim 52) for purifying gas, and, more particularly to a PSA method and system for purifying hydrogen in a fuel cell system (Specification ¶ 0001). Claims 28 and 52 are illustrative of the subject matter on appeal:

28. A method for cycling a pressure swing adsorption (PSA) system, said PSA system receiving a feed gas and emitting a purified product gas and an exhaust gas, said PSA system including a plurality of adsorbent vessels, each vessel including an adsorbent for adsorbing impurities in the feed gas, each vessel including a feed end responsive to the feed gas and emitting the exhaust gas, and a product end that emits the product gas, said method comprising:

operating each vessel of the plurality of vessels in a production stage for a plurality of cycle periods, wherein operating the vessel in the production stage includes delivering the feed gas to the feed end of the vessel and drawing the product gas from the product end of the vessel;

operating each vessel of the plurality of vessels in at least one equalization down stage following the production stage for at least one cycle period, wherein operating the vessel in the equalization down stage includes coupling the product end of the vessel to the product end of another vessel that is at a lower pressure to lower the pressure in the vessel;

operating each vessel of the plurality of vessels in a blow-down stage directly following the at least one equalization down stage for at least one cycle period, wherein operating the vessel in the blow-down stage further reduces the pressure in the vessel to an exhaust pressure;

operating each vessel of the plurality of vessels in a purge stage following the blow-down stage, wherein operating

the vessel in the purge stage includes feeding reduced-pressure product gas into the product end of the vessel and emitting the exhaust gas through the feed end of the vessel;

operating each vessel of the plurality of vessels in at least one equalization up stage following the purge stage for at least one cycle period, wherein operating the vessel in the at least one equalization up stage includes increasing the pressure in the vessel;

operating each vessel of the plurality of vessels in a product pressurization stage directly following the at least one equalization up stage for at least one cycle period, wherein operating the vessel in the product pressurization stage includes pressurizing the vessel with the product gas to a product pressure; and

operating each vessel of the plurality of vessels in the production stage following the product pressurization stage.

52. A pressure swing adsorption (PSA) system for purifying a feed gas into a product gas, said system comprising:

a feed manifold responsive to the feed gas;

a product manifold outputting the product gas;

an exhaust manifold outputting an exhaust gas including impurities from the feed gas;

a plurality of vessels responsive to the feed gas from the feed manifold and outputting the product gas to the product manifold, said plurality of vessels including an adsorbent for adsorbing the impurities in the feed gas;

at least one feed valve coupled between the feed manifold and the plurality of vessels for controlling the feed gas applied to the vessels; and

at least one product valve coupled between the vessels and the product manifold for controlling the product gas drawn from the vessels to the product manifold, wherein the PSA system operates by a predetermined PSA cycle, said PSA cycle including operating each vessel of the plurality of vessels in a production stage for a plurality of cycle periods, wherein operating the vessel in the production stage includes delivering the feed gas to the feed end of the vessel and drawing the product gas from the product end of the vessel, operating each vessel of the plurality of vessels in a first equalization down stage following the production stage for at least one cycle period, wherein operating the vessel in the first equalization down stage includes coupling the product end of the vessel to the product end of an adjacent vessel that is at a lower pressure to lower the pressure in the vessel, operating each vessel of the plurality of vessels in a second equalization down stage following the first equalization down stage for at least one cycle period, wherein operating the vessel in the second equalization down stage includes coupling the product end of the vessel to the product end of another adjacent vessel that is at a purge pressure to further lower the pressure in the vessel, operating each vessel of the plurality of vessels in a blow-down stage directly following the second equalization down stage for at least one cycle period, wherein operating the vessel in the blow-down stage further reduces the pressure in the vessel to an exhaust pressure, operating each vessel of the plurality of vessels in a purge stage following the blow-down stage over a plurality of cycle periods, wherein operating the vessel in the purge stage includes feeding reduced –pressure product gas into the product end of the vessel and emitting the exhaust gas through the feed end of the vessel, operating each vessel of the plurality of vessels in a second equalization up stage following the purge stage for at least one cycle period, wherein operating the cycle in the second equalization up stage includes coupling the product end of the vessel to the product end of an adjacent vessel that is at a higher pressure to increase the pressure in the vessel, operating each vessel of the plurality of vessels in the first equalization up stage following a second equalization up stage for at least one cycle period, wherein operating the vessel

in the first equalization up stage includes coupling the product end of the vessel to the product end of another adjacent vessel that is at a higher pressure to further increase the pressure in the vessel, and operating each vessel of the plurality of vessels in a product pressurization stage directly following the first equalization up stage for at least one cycle period, wherein operating the vessel in a product pressurization stage includes pressurizing the vessel with product gas from the product manifold to a product pressure for the production stage.

Appellants request review of all of the rejections maintained by the Examiner, namely:

- A. The rejection of claims 6, 7, 13, 15, 16, 38, 40, 41, 58, 60, and 61 under 35 U.S.C. § 112, ¶ 2 as indefinite;
- B. The rejection of claims 6 and 7 under 35 U.S.C. § 112, ¶ 1 as lacking written descriptive support;
- C. The rejection of claims 1-8, 11, 14-17, 20-23, 26-33, 36, 39-42, 45-48, 51-62, 65-71 under 35 U.S.C. § 102(b) as anticipated by Fuderer et al. (US 3,986,849 issued Oct. 19, 1976);
- D. The rejection of claims 13, 18, 19, 24, 25, 38, 43, 44, 49, 50, 63, and 64 under 35 U.S.C. § 103(a) as unpatentable over Fuderer;
- E. The rejection of claims 9 and 34 under 35 U.S.C. § 103(a) as unpatentable over Fuderer in view of Lemcoff et al. (US 5,820,656 issued Oct. 13, 1998);
- F. The rejection of claims 10, 35, and 55 under 35 U.S.C. § 103(a) over Fuderer in view of Lemcoff et al. (US 5,807,423 issued Sep. 15, 1998); and

- G. The rejection of claims 12 and 37 under 35 U.S.C. § 103(a) over Fuberer in view of Towler (US 6,299,994 B1 issued Oct. 9, 2001) or Gittleman et al (US 2002/0110504 A1 published Aug. 15, 2002).

II. DISCUSSION

- A. *The rejection of claims 6, 7, 13, 15, 16, 38, 40, 41, 58, 60, and 61 under 35 U.S.C. § 112, ¶ 2*

According to the Examiner, “[c]laims 6 and 7 are indefinite because it is unclear how the blow down stage can directly follow the second equalization stage, while the third and fourth equalization stages take place between the second stage and blow down stage. With respect to claims 13, 15, 16, 38, 40, 41, 58, 60 and 61, the % hydrogen should be defined as mole %, volume %, or weight %.” (Ans. 3).

Appellants contend that claims 6 and 7 are definite “because one of ordinary skill in the art would recognize that the blow-down stage would directly follow the last equalization down stage.” (Br. 12). With respect to claims 13, 15, 16, 38, 40, 41, 58, 60 and 61, Appellants contend these claims are definite “because one of ordinary skill in the fuel cell art would know that the hydrogen in the reformat gas is a gas, and whether the percentage of hydrogen in the reformat gas was a mole percent, a volume percent or a weight percent.” (Br. 12-13).

As Appellants argue claims 6 and 7 as one group and claims 13, 15, 16, 38, 40, 58, 60, and 61 as another group, we select one claim from each group to decide the issues on appeal. We select claim 6 to represent the first group and claim 13 to represent the second.

The issue arising for each of claims 6 and 13 is: Does the claim, when read in light of the Specification, particularly point out and distinctly claim what Appellants regard as their invention?

For each claim, we answer this question in the negative.

35 U.S.C. § 112, ¶ 2 requires that the specification “conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.” The definiteness of the language employed in a claim must be analyzed not in a vacuum, but in light of the teachings of the particular application. *In re Moore*, 439 F.2d 1232, 1235 (CCPA 1971). A claim runs afoul of the requirements of § 112, ¶ 2 where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the applicant “regards as his invention” *See Allen Eng’g. Corp. v. Bartell Indus.*, 299 F.3d 1336, 1349 (Fed. Cir. 2002); *In re Cormany*, 476 F.2d 998, 1002 (CCPA 1973). A claim also runs afoul of § 112, ¶ 2 when it is inherently inconsistent with what is described in the specification. *In re Cohn*, 438 F.2d 989, 1000-01 (CCPA 1971).

35 U.S.C. § 112, ¶ 2 “puts the burden of precise claim drafting squarely on the applicant.” *In re Morris*, 127 F.3d 1048, 1056 (Fed. Cir. 1997); *see also Halliburton Energy Servs. v. M-L LLC*, 514 F.3d 1244, 1255 (Fed. Cir. 2008) (noting that “the patent drafter is in the best position to resolve the ambiguity in the patent claims, and it is highly desirable that patent examiners demand that applicants do so in appropriate circumstances so that the patent can be amended during prosecution rather than attempting to resolve the ambiguity in litigation.”). During patent prosecution an applicant has the opportunity to amend the claims in order to overcome

indefiniteness rejections. *Exxon Research and Eng'g. Co. v. U.S.*, 265 F.3d 1371, 1380 (Fed. Cir. 2001) (*citing In re Zletz*, 893 F.2d 319, 322 (Fed. Cir. 1989)).

1. *Claims 6 and 7*

Appellants submit that claims 6 and 7 are definite because one of ordinary skill in the art would recognize that the blow-down stage would directly follow the *last* equalization down stage (Br. 12). The question is: When interpreted, not in a vacuum, but in the light of the Specification, does claim 6 encompass what Appellants intend it to cover, i.e., a process including a third equalization down stage in which the blow-down stage directly follows the last equalization stage?

To answer this question, we first consider the teachings of the Specification. According to the Specification, the pressure swing absorption (PSA) system includes a series of vessels housing absorbent(s) that absorb unwanted fluids in the reformat gas (Specification ¶ 0024). The gas flowing through the vessels is controlled by valves (*id.*). “A PSA cycle controls the valves so that the vessels cycle through various stages of equalization, blow-down, purge, pressurization and production to purify the gas.” (*id.*).

Figure 2 is an illustration of a PSA cycle for the 9-bed (9 vessel) PSA system of Figure 1 according to one embodiment of the invention (Specification ¶ 0027). The cycle of Figure 2 includes two equalization down stages. The number in the top column is a particular cycle period (Specification ¶ 0045). The equalization down stages are labeled E1↓ and E2↓. The blow-down stages are labeled BD. As can be seen from Figure 2, in the two equalization stage process, the blow-down stage (BD) directly

follows, in the next cycle period, the second equalization down stage (E2↓) (*see also* Specification ¶¶ 0048-49). For instance, in bed-1, the second equalization down stage takes place in cycle period eight and the blow-down stage directly follows in cycle period nine.

Figure 3 shows another embodiment for a 9-bed PSA system, this one having three equalization stages (Specification ¶ 0028). In this embodiment, the sequence of operation, in successive cycle periods, is: second equalization down stage (E2↓), third equalization down stage (E3↓), blow-down stage (BD) (Figure 3).

Figure 4 shows a further embodiment for the 9-bed PSA system. This PSA cycle embodiment has four equalization stages. In this embodiment, the sequence of operation is: second equalization down stage (E2↓), third equalization down stage (E3↓), fourth equalization down stage (E4↓), blow-down stage (BD).

Figure 5 shows an embodiment for a two stage 5-bed cycle, and Figure 6 shows a three stage 12-bed cycle. In each case, the blow-down stage follows the last equalization down stage. In other words, in each embodiment, blow-down occurs in the next cycle period after the last equalization down stage.

The Specification is consistent with Appellants' statement in the Brief that the blow-down stage is to follow the *last* equalization down stage and, therefore, this seems to be what Appellants regard as their invention. According to the Specification, in every instance in which a third equalization down stage is present, it takes place in the cycle period directly following the second equalization stage, and the blow-down stage does not

take place until a cycle period occurring after the third equalization down stage (Specification ¶ 0056).

Claim 1 requires operating in a blow-down stage “directly following the second equalization down stage for at least one cycle period.”¹ In order to be consistent with the Specification and what Appellants regard as their invention, claim 1 must be read as limited to the embodiment in which the second equalization stage is the last equalization down stage conducted before blow-down.

Claim 6 further requires the process of claim 1 have a third equalization down stage, but according to the Specification where a third equalization down stage is included in the process, the blow-down stage does not “directly follow” the second equalization stage as required by claim 1; nor does the blow-down stage follow the last equalization down stage. Claim 6, therefore, is neither directed to the process Appellants regard as their invention, nor is it consistent with what is disclosed in the Specification.

We cannot say that claim 6 particularly points out and distinctly claims the subject matter which the applicant regards as the invention, i.e., a process in which the blow-down stage directly follows the *last* equalization down stage.

We sustain the rejection of claims 6 and 7 under 35 U.S.C. § 112, ¶ 2.

¹ We interpret “for at least one cycle period” in light of Specification paragraph 0054 which discloses that the relative times of the blow-down and purge stages can be changed as long as the total time of the blow-down plus purge is seven cycle periods. Therefore, the blow-down stage must take place in the cycle period “directly following” the second equalization down stage, and it may also extend into further cycle periods.

2. Claims 13, 15, 16, 38, 40, 41, 58, 60, and 61

Claim 13, the claim we select to represent the issues on appeal for the second group of claims, requires the reformat feed gas contain less than 59% hydrogen. As pointed out by the Examiner, the basis of the percentage calculation is not included in the claim and there are several possibilities (mole %, volume %, and weight %) (Answer 3). Appellants contend that “one of ordinary skill in the fuel cell art would know that the hydrogen in the reformat gas is a gas, and whether the percentage of hydrogen in the reformat gas was a mole percent, a volume percent or a weight percent” (Br. 12), but Appellants offer no evidence in support of this statement, nor cite any portion of the Specification disclosing the basis; much less point out by way of argument which of the alternatives would have been apparent to those of ordinary skill. In the absence of such evidence, it is reasonable to conclude that those of ordinary skill in the art, not knowing the basis of the percentage calculation, would not be reasonably apprised of the scope of the claim. This is a case in which Appellants are in the best position to resolve the ambiguity in the claims, and therefore, the burden properly falls on them. *Halliburton*, 514 F.3d at 1255.

We sustain the rejection of claims 13, 15, 16, 38, 40, 41, 58, 60, and 61 as indefinite under 35 U.S.C. § 112, ¶ 2.

B. The rejection of claims 6 and 7 under 35 U.S.C. § 112, ¶ 1 as lacking written descriptive support

Turning to the rejection of claims 6 and 7 as lacking written descriptive support under 35 U.S.C. § 112, ¶ 1, we agree with the Examiner there is no written descriptive support for the claims. As we stated above,

the written description is limited to processes in which the blow-down stage occurs in the next cycle period after the last equalization step. There is no written descriptive support for a process including three or more equalization down stages in which the blow-down stage “directly follows” the second equalization down stage.

We sustain the rejection of claims 6 and 7 under 35 U.S.C. § 112, ¶ 1.

C. The rejection of claims 1-8, 11, 14-17, 20-23, 26-33, 36, 39-42, 45-48, 51-62, 65-71 under 35 U.S.C. § 102(b) as anticipated by Fuderer

In regard to the rejection of claims 1-8, 11, 14-17, 20-23, 26-33, 36, 39-42, 45-48, 51-62, and 65-71, which the Examiner rejects as anticipated by Fuderer, Appellants present arguments for a number of claim groupings. We address each group as follows.

1. Independent claims 1, 28, and 52

Appellants argue the independent claims 1, 28, and 52 as a group. We select claim 52 to represent the issues for this grouping of claims.

Appellants contend that, in their claimed invention, the blow-down stage immediately follows an equalization down stage whereas, in Fuderer, the blow-down stage follows a cocurrent depressurization providing purge gas stage (PP stage) (Br. 7). Appellants further contend that their claimed purge stage includes feeding reduced-pressure product gas into the product end of the vessel and emitting the exhaust gas through the feed end of the vessel, an operation Appellants allege is not performed by Fuderer (Br. 7). Appellants also contend that, during the PP stage and purge stages of Fuderer, the vessels are not coupled as claimed. Namely, Appellants contend that:

[Appellants'] claims clearly recite that the blow-down stage immediately follows an equalization down stage, where the equalization down stage is performed by coupling a product end of the vessel to the product end of an adjacent vessel. The PP stage of Fuderer that precedes the blow-down stage does not include vessel coupling in this manner. Therefore, Appellant respectfully submits that Fuderer cannot anticipate the independent claims because this element is not found in Fuderer.

(Br. 8).

Appellants further contend that:

Further, [Appellants'] claimed purge stage includes feeding reduced-pressure product gas into the product end of the vessel and emitting the exhaust gas through the feed end of the vessel. It does not appear that Fuderer PSA system specifically performs this operation during the purge stage.

(Br. 8).

The Examiner finds that Fuderer describes “a pressure swing absorption system, comprising at least nine adsorption tanks, each having a feed end connected to a feed manifold and an exhaust manifold, a product end connected to a product manifold and several interconnecting manifolds, valves for controlling flow between each tank and each manifold” (Answer 3-4). The Examiner further finds that “the system is additionally inherently capable of performing all of the steps regardless of the disclosed operation because it contains all of the structural components needed to do so.” (Ans. 7.) The Examiner also finds that the PP stage of Fuderer meets the requirements of the claimed equalization down stage, the vessel product end being coupled as claimed and the PP stage functioning the same as the

claimed equalization down stage (Ans. 7). The Examiner also finds that operation in the purge stage takes place as claimed (Ans. 8).

The dispositive issue is: Does Fuderer describe an apparatus having the structure required by claim 52?

We answer this question in the affirmative.

Claim 52 is directed to a pressure swing absorption “system,” i.e., an apparatus. This apparatus comprises various apparatus structures including a feed manifold, a product manifold, an exhaust manifold, a plurality of vessels, at least one feed valve, and at least one product valve. The claim further recites various functions for the apparatus structures and how the apparatus operates to perform the pressure swing absorption.

“A machine is a concrete thing, consisting of parts, or of certain devices and combination of devices.” *See Burr v. Duryee*, 68 U.S. (1 Wall.) 531, 570 (1863) (defining "machine"). Therefore, the patentability of an apparatus claim depends on the claimed structure, not on the use or purpose of that structure, *Catalina Mktg. Int'l v. Coolsavings.com*, 289 F.3d 801, 809, (Fed. Cir. 2002), or the function or result of that structure. *In re Danly*, 263 F.2d 844, 848 CCPA 1959); *In re Gardiner*, 171 F.2d 313, 315-16 (CCPA 1948). If the prior art structure possesses all the claimed characteristics including the capability of performing the claimed function, then there is a prima facie case of unpatentability. *In re Ludtke*, 441 F.2d 660, 663-64 (CCPA 1971).

As found by the Examiner, Fuderer describes apparatus including the manifolds, vessels, and valves required by claim 52 (Ans. 3-4). See, for instance, Figures 1, 5, 8, 11, and 14 of Fuderer. Moreover, given that the PSA operation is dependent on the opening and closing of the valves, and

Fuderer includes the necessary valves, we agree with the Examiner that the apparatus of Fuderer would be capable of operating as required by claim 52.

With regard to Appellants' contention that Fuderer does not couple the product ends of adjacent vessels as claimed, we note that Fuderer describes valves and conduits that allow the claimed coupling. Appellants have not shown that there is a structural difference between the claimed apparatus and the apparatus of Fuderer.

2. Dependent claim 7

Claim 7, as we discuss above in reference to the rejection under 35 U.S.C. ¶ 112, ¶ 2, fails to particularly point out and distinctly claim what Appellants regard as their invention. Speculative assumptions would be required to determine the scope of the claim and to evaluate the 35 U.S.C. § 102 rejection. In such a situation, it is not appropriate to sustain a prior art rejection. *See In re Steele*, 305 F.2d 859, 862 (CCPA 1962) (reversed because § 103 rejection was based on considerable speculation as to meaning of terms of claims and assumptions as to their scope).

We, therefore, do not sustain the rejection of claim 7 under 35 U.S.C. § 102(b).

3. Dependent claims 22, 23, 47, 48, 67, and 68

With respect to claims 22, 23, 47, 48, 67, and 68, Appellants contend that Fuderer cannot anticipate because "the Fuderer PSA system operates at a pressure of 7 atmospheres or less, and it is believed that Fuderer operates at a much higher pressure, over 10 atmospheres (1 psia = 0.068046 atmospheres), to get higher gas purities." (Br. 9).

The Examiner finds that with respect to claims 58-62 and 65-70, “no structural limitations are recited that would distinguish the claimed device over the system of the prior art.” (Ans. 5).

We select claim 67 to represent the issues on appeal with respect to this group of claims. Claim 67 is an apparatus claim dependent on claims 56 and 52. The issue arising is: Does Fuderer describe an apparatus including each and every structural feature required by claim 67?

We answer this question in the affirmative.

Claim 67 further limits claim 52 to a PSA system that purifies a reformat feed gas into a hydrogen product gas and operates at pressure below 7 atmospheres (*see* claim 56 as well as claim 67). It is reasonable to conclude that the apparatus of Fuderer would be capable of operating at the claimed pressures. Whether Fuderer describes operating at such pressures is irrelevant: the claim is directed to an apparatus and, therefore, must be distinguished from the prior art structurally.

We sustain the rejection of claims 22, 23, 47, 48, 67, and 68 under 35 U.S.C. § 102 as anticipated by Fuderer.

4. Dependent claims 2-6, 8, 11, 14-17, 20, 26, 27, 29-33, 36, 39-42, 45, 46, 51-62, 65-67, and 69-71

According to Appellants, dependent claims 2-6, 8, 11, 14-17, 20, 26, 27, 29-33, 36, 39-42, 45, 46, 51-62, 65-67 and 69-71 are not anticipated by Fuderer because

the independent claims 1, 28 and 52 recite a blow-down stage immediately following an equalization down stage, where the equalization down stage is performed by coupling a product end of the vessel to the product end of an adjacent vessel and feeding reduced-pressure product gas into the product end of the vessel and emitting the

exhaust gas to the feed end of the vessel which Fuderer does not teach, as discussed above.

(Br. 9).

Appellants' contention is the same or substantially the same as that advanced for the first grouping of claims. We select claim 53 as representative and sustain the rejection of claim 53, with which claims 2-6, 8, 11, 14-17, 20, 26, 27, 29-33, 36-39, 45, 46, 51, 52, and 54-62, 65-67, and 69-71 fall, for the reasons discussed above with regard to the rejection of the claim 52.

D. The rejection of claims 13, 18, 19, 24, 25, 38, 43, 44, 49, 50, 63, and 64 under 35 U.S.C. § 103(a) as unpatentable over Fuderer

1. Dependent claims 19, 44, and 64

With regard to claims 19, 44 and 64, Appellants contend that "Fuderer alone cannot make these claims obvious." (Br. 10). This is because, according to Appellants,

it does not appear that Fuderer teaches first and second adsorbents in the vessels, where a first adsorbent is selected from the group consisting Zeolite 5A, Zeolite LiX, and combinations thereof, and the second adsorbent is selected from the group consisting of activated carbon, activated alumina, Zeolite 13X, Zeolite 4A and combinations thereof, where the first and second adsorbents are positioned in the vessels so that the feed gas first passes over the second adsorbent before contacting the first adsorbent.

(id).

The Examiner finds that Fuderer discloses all of the limitations except that zeolite is a zeolite 5A (Ans. 5, 8). The Examiner, however, determines that "one having ordinary skill in the art would know to select a type of zeolite that is most effective for adsorbing target contaminants based on cost, availability, the level of contamination, and the desired purity level of

the product gas, and to use the system to purify feed gas having any acceptable or conventional level of hydrogen.” (Ans. 5, 8).

We select claim 64 as representative. Claim 64 further requires that the vessels of claim 52 include a first absorbent selected from zeolite 5A, zeolite LiX, and combinations thereof, and a second absorbent in the feed end of the vessels, the second absorbent selected from a group of absorbents including, among others, activated carbon.

The issue arising is: Have Appellants identified reversible error in the Examiner’s obviousness rejection of representative claim 64 based on the asserted lack of a teaching in Fuderer of the claimed combination of absorbents?

We answer this question in the negative.

Fuderer provides evidence that vessels packed with an activated carbon in the first section and a calcium zeolite A in the second section were conventional in the art of PSA purification of hydrogen (Fuderer, col. 1, ll. 22-25; col. 9, ll. 17-23) as were vessels packed with activated carbon alone (Fuderer, col. 2, ll. 39-42) or calcium zeolite A alone (Fuderer, col. 10, ll. 1-2).

Appellants’ Specification provides evidence that zeolites such as 13X and 5A were known in prior art absorption systems for purifying hydrogen (Specification ¶ 0015).

“[A] prior art reference must be ‘considered together with the knowledge of one of ordinary skill in the pertinent art.’” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). In an obviousness analysis, the proper focus is on evidence of what was known before the time of invention, and the analysis must not unduly constrain the breath of knowledge available to

one of ordinary skill in the art. *In re Translogic Tech.*, 504 F.3d 1249, 1260 (Fed. Cir. 2007). An improvement in the art is obvious if “it is likely the product not of innovation but of ordinary skill and common sense.” *KSR Int’l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1742 (2007).

In the present case, Fuderer and Appellants’ own Specification provides evidence that those of ordinary skill in the art had routinely selected various absorbents including activated carbon and zeolites such as 5A and 13X for use in absorption vessels in various combinations including packing the feed end with one absorbent and the product end with another. “The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR*, 127 S. Ct. at 1739 (2007). The evidence supports a finding that combinations of known absorbents would provide the predictable result of absorbing impurities from hydrogen gas; Appellants provide no evidence that the claimed combinations yield unpredictable or unexpected results.

We sustain the rejection of claims 19, 44, and 64 under 35 U.S.C. § 103(a) as unpatentable over Fuderer.

2. *Dependent claims 13, 18, 24, 38, 43, 49, 50, and 63*

With regard to claims 13, 18, 24, 38, 43, 49, 50 and 63, Appellants contend that “Fuderer alone cannot make these claims obvious” because “Fuderer does not teach a blow-down step immediately following an equalization down stage, where the equalization down stage is performed by coupling a product end of the vessel to the product end of an adjacent vessel and feeding reduced pressure product gas into the product end of the vessel and emitting the exhaust gas to the feed end of the vessel, as discussed above concerning the independent claims 1, 28 and 52.” (Br. 10).

We select dependent claim 63 as the representative claim for this claim grouping. Appellants' argument raises the same issue we addressed above in reference to the claim grouping of claims 1, 28, 52: Does Fuderer describe an apparatus having the structure required by claim 52?

As the reasoning is the same for claim 63 as it was for claim 52, we sustain the rejection for the reasons we discussed above addressing the rejection of representative claim 52.

We sustain the rejection of claims 13, 18, 24, 38, 43, 49, 50, and 63 under 35 U.S.C. § 103(a) as unpatentable over Fuderer.

E. The rejections under 35 U.S.C. § 103(a) as unpatentable over Fuderer in view of other secondary references

The Examiner added further references to reject claims 9, 10, 12, 34, 35, 37, and 55. Specifically, the Examiner added Lemcoff '656 to reject claims 9 and 34; Lemcoff '423 to reject claims 10, 35, and 55; and Towler or Gittleman to reject claims 12 and 37.

For each of these rejections, Appellant contends that the added reference fails to teach or suggest the sequence of PSA steps as discussed above, and therefore cannot be combined with Fuderer to make Appellant's claimed invention obvious (Br. 10-11).

1. The rejection of claims 10, 35, and 55 over Fuderer in view of Lemcoff '423

Turning first to the rejection of claims 10, 35, and 55 over Fuderer in view of Lemcoff '423, and selecting claim 55 as representative, we determine the issue to be: Have Appellants shown that the Examiner reversibly erred in finding a reason to combine the teachings of the references?

We answer this question in the negative.

Claim 55 further limits the apparatus of claim 52 to one containing at least one rotary feed valve and at least one rotary product valve. The Examiner relies upon Lemcoff '423 as demonstrating that it was known in the art to use such valves in PSA systems. The fact that Lemcoff '656 does not teach or suggest the claimed PSA steps, is not relevant under the facts of this appeal. In fact, the Examiner acknowledges that Lemcoff '423 does not disclose the claimed PSA steps (Ans. 8-9), rather, the Examiner relies upon the Lemcoff '423 for its teachings of rotary valves, and provides a reasonable rationale supporting the use of those valves in the apparatus of Fuderer, a PSA apparatus (Ans. 5-6). Appellants have failed to show a reversible error in the reasoning of the Examiner.

We sustain the rejection of claims 10, 35, and 55 over Fuderer in view of Lemcoff '423

2. The rejection of claims 9 and 34 over Fuderer in view of Lemcoff '656

We next turn to the rejection of claims 9 and 34 over Fuderer in view of Lemcoff '656. We select claim 34 to represent the issues on appeal. This claim is directed to the process of 28 with the additional limitation of coupling the vessels with a rotary feed valve and a rotary product valve.

The fact that claim 34 is dependent on claim 28, necessitates we consider Appellants' initial contentions directed at the claim group including claim 28, i.e., the group of claims 1, 28, and 52. For that claim group, Appellants contend that, in their claimed invention, the blow-down stage immediately follows an equalization down stage whereas, in Fuderer, the blow-down stage follows a cocurrent depressurization providing purge gas

(PP) stage (Br. 7). Appellants further contend that their claimed purge stage includes feeding reduced-pressure product gas into the product end of the vessel and emitting the exhaust gas through the feed end of the vessel, an operation Appellants allege is not performed by Fuderer (Br. 7).

The Examiner contends that the PP stage of Fuderer meets the requirements of the claimed equalization down stage, the vessel product end being coupled as claimed and the PP stage functioning the same as the claimed equalization down stage (Ans. 7). The Examiner also finds that operation in the purge stage takes place as claimed (Ans. 8). The Examiner further points out that claim 28 does not require some of the limitations argued by Appellants (Ans. 7-8).

The issues arising are: (1) Is the cocurrent depressurization providing purge gas (PP) stage of Fuderer, despite the difference in name, a equalization down stage within the scope of claim 28; and (2) Are the vessels of Fuderer coupled as claimed during the equalization down stage and purge stage?

We answer these questions in the affirmative.

To answer the first question, we must consider the scope of the claim phrase “equalization down stage.” During examination, “claims . . . are to be given their broadest reasonable interpretation consistent with the specification, and . . . claim language should be read in light of the specification as it would be interpreted by one of ordinary skill in the art.” *In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004).

In our review of the Specification, we find no specific definition of “equalization down stage” that would exclude the PP stage of Fuderer, in fact, the Specification describes the equalization down stage preceding the

blow-down stage as being connected to the purge stage vessel in the same way as Fuderer's PP stage. See, for instance, paragraph 0048 of the Specification which states that:

During a second equalization down (E2 down) stage, the product end 16 of the particular vessel 12 is connected to the product end 16 of another adjacent vessel 12 through the corresponding equalization valve VQ that is at a purge pressure having just completed a purge stage during the previous cycle period, described below.

(Specification ¶ 0048). In the embodiment discussed in this portion of the Specification, the second equalization down stage, is the last equalization down stage before the blow-down stage.

As Appellants point out, column 8, lines 51-55 of Fuderer discuss the cocurrent depressurization providing purge gas (PP) stage, stating “[p]urge gas is entering the bed 4 discharge end through purge valve 34 and is being supplied thereto through the purge gas manifold by cocurrent depressurization gas released from the discharge end of the bed 6 through valve 36.” This disclosure relates to the first time unit (cycle period) of the cycle. Figure 2 of Fuderer indicates that vessel 4 is in purge mode (P) and vessel 6 is in cocurrent depressurization providing purge gas mode (PP) during the first time unit. Reading column 8, lines 51-55 in reference to the illustration of the apparatus in Figure 1, it becomes clear that the product end (discharge end) of vessel 6, the vessel in PP stage, is coupled to the product end of vessel 4, which being in purge (P) stage is at a lower pressure.

Not only does the Specification not define “equalization down stage” in a way that would exclude the PP stage of Fuderer, it further provides

evidence that the PP stage, in fact, operating in the same way as Appellants last equalization down stage directly preceding the blow-down stage.

Appellants note that Fuderer “clearly distinguishes the pressure equalization down stages as being different from the PP stage.” (Br. 8). However, there are differences between Appellants’ own equalization stages. For instance, in Appellants’ two equalization stage embodiment, the vessel undergoing a first equalization is not coupled to the purge stage vessel, it is coupled to the first equalization up stage vessel adjacent to it. Therefore, the fact that Fuderer chose to assign a different name (PP stage) to the stage preceding the blow-down stage is of little relevance.

As explained above, the coupling of the PP stage of Fuderer is the same as that required by the equalization stage of claim 28.

We also find that, in the purge stage, the vessels of Fuderer are coupled as required by claim 28. Figure 3 indicates that valve 44, the valve at the feed end of the purging vessel 4, is open to the exhaust manifold so that exhaust gas would be emitted through the feed end of vessel 4 as claimed. The Examiner’s explanation with regard to the appendices to the Answer also provide evidence that Fuderer describes the claimed coupling.

We determine that the cocurrent depressurization providing purge gas (PP) stage of Fuderer, despite the difference in name, is an equalization down stage within the scope of claim 28; and (2) the vessels of Fuderer are coupled as claimed during the equalization down stage and purge stage.

Because Appellants contend that Lemcoff ‘656 cannot be combined with Fuderer because Lemcoff ‘656 does not teach or suggest the sequence of PSA steps, the next question that arises is: Have Appellants shown that

the Examiner reversibly erred in finding a reason to combine the teachings of the references?

We answer this question in the negative.

The Examiner acknowledges that Lemcoff '656 does not disclose the claimed PSA steps (Ans. 5-6), rather, the Examiner relies upon the secondary reference for additionally claimed features, and provides a reasonable rationale supporting the use of those additional features in the apparatus of Fuderer (Ans. 5-6). Appellants have failed to show a reversible error in the reasoning of the Examiner.

We sustain the rejection of claims 9 and 34 under 35 U.S.C. § 103(a) over Fuderer in view of Lemcoff '656.

3. The rejection of claims 12 and 37 over Fuderer in view of Towler or Gittleman

Turning last to the rejection of claims 12 and 37 over Fuderer in view of Towler or Gittleman, we select claim 37 to represent the issues on appeal for this rejection.

Appellants contend that Tower and Gittleman do not teach or suggest PSA systems and, therefore, fail to provide the teaching missing from Fuderer to make their claimed invention obvious (Br. 11). The issue is: Have Appellants shown that the Examiner reversibly erred in rejecting claim 37 over Fuderer in view of Towler or Gittleman.

On this record, we answer this question in the negative. The Examiner did not rely upon either Towler or Gittleman for a teaching of a PSA system, the Examiner relied upon Fuderer. Appellants have not shown that the Examiner reversibly erred.

Accordingly, we sustain the rejection of claims 12 and 37 under 35 U.S.C. §103(a) over Fuderer in view of Towler or Gittleman.

III. CONCLUSION

In summary, we sustain the rejection of claims 6 and 7 under 35 U.S.C. § 112, ¶¶ 1 and 2; we sustain the rejection of claims 13, 15, 16, 38, 40, 41, 58, 60, and 61 under 35 U.S.C. § 112, ¶ 2; we sustain the rejection of claims 1-6, 8, 11, 14-17, 20-23, 26-33, 36, 39-42, 45-48, 51-62, and 65-71 under 35 U.S.C. § 102(b) over Fuderer; we sustain the rejection of claims 13, 18, 19, 24, 25, 38, 43, 44, 49, 50, 63, 64 under 35 U.S.C. § 103(a) over Fuderer; we sustain the rejection of claims 9 and 34 under 35 U.S.C. § 103(a) over Fuderer and Lemcoff '656; we sustain the rejection of claims 10, 35, and 55 under 35 U.S.C. § 103(a) over Fuderer and Lemcoff '423; we sustain the rejection of claims 12 and 37 under 35 U.S.C. § 103(a) over Fuderer and Towler or Gittleman. We do not sustain the rejection of claim 7 under 35 U.S.C. § 102(b) over Fuderer.

IV. DECISION

The decision of the Examiner is affirmed.

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V. TIME PERIOD FOR RESPONSE

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

AFFIRMED

tf/lb

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