

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ATLAS COPCO AIRPOWER N.V.,
Petitioner,

v.

KAESER KOMPRESSOREN SE,
Patent Owner.

Case IPR2015-01421
Patent 8,349,054 B2

Before ERICA A. FRANKLIN, CHRISTOPHER L. CRUMBLEY, and
JO-ANNE M. KOKOSKI, *Administrative Patent Judges*.

FRANKLIN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Atlas Copco Airpower N.V. (“Petitioner”) filed a Petition to institute an *inter partes* review of claims 1–20 of U.S. Patent No. 8,349,054 B2 (Ex. 1001, “the ’054 patent”). Paper 1 (“Pet.”). Kaeser Kompressoren SE (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 7 (“Prelim. Resp.”).

On December 28, 2015, we instituted an *inter partes* review of claims 1, 2, 4, 5, and 7–20 of the ’054 patent. Paper 8 (“Dec. Inst.”). In a Request for Rehearing, Petitioner sought reconsideration of our decision not to institute an *inter partes* review of dependent claim 6. Paper 10. We denied the rehearing request after determining that Petitioner did not identify in the request matters that Petitioner believed the Board misapprehended or overlooked. Paper 11. Thereafter, Patent Owner filed a Patent Owner Response to the Petition. Paper 16 (“PO Resp.”). Petitioner filed a Reply to Patent Owner’s Response. Paper 17 (“Pet. Reply”).

On August 4, 2016, the parties presented arguments at an oral hearing. The hearing transcript has been entered in the record. Paper 21 (“Tr.”).

The Board has jurisdiction under 35 U.S.C. § 6. In this Final Written Decision, issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73, we determine that Petitioner has shown by a preponderance of the evidence that claims 1, 2, 4, 5, 7–12, and 14–20 of the ’054 patent are unpatentable. We determine also that Petitioner has not shown by a preponderance of the evidence that claim 13 is unpatentable.

A. *Related Proceedings*

Petitioner and Patent Owner do not identify any related matters that would affect, or be affected by, a decision in this proceeding. Pet. 1; Paper

4, 2–3. Both parties provide notice that Petitioner’s earlier petition for *inter partes* review of the ’054 patent in *Atlas Copco Airpower N.V. v. Kaeser Kompressoren SE*, Case IPR2014-00776 (PTAB Nov. 17, 2014) (“IPR ’776”) was denied. *Id.* Additionally, Patent Owner provides notice of an appeal to the European Patent Office of a decision relating to Patent Owner’s counterpart European Patent EP 2332631 B1. Paper 4, 3.

B. The ’054 Patent

The ’054 patent is directed to “an adsorption drying apparatus [and] an adsorption drying method . . . for drying compressed gases.” Ex. 1001, 1:6–8. The apparatus comprises a rotatable, drum-like chamber having a plurality of parallel adsorption conduits, wherein the adsorption chamber can be moved through a drying sector, wherein compressed gas is dried, and a regeneration sector, in which adsorption material is regenerated. *Id.* at 1:31–36, 3:38–40. Disposed at a first end of the adsorption chamber is a first feeding line and a first discharging line, wherein the first feeding line “is configured such that the gas stream to be dried may be fed to the regeneration sector as a full flow.” *Id.* at 3:29–30, 3:40–42. A second discharging line is in communication with a second feeding line “and thus forms a connecting line.” *Id.* at 3:42–44.

The ’054 patent also discloses that a “pressure increasing device is provided within the connecting line downstream of the condenser, so as to increase the pressure of the gas flowing from the second discharging line to the second feeding line.” *Id.* at 3:44–48. The pressure-increasing device “prevents the formation of an undesired leakage stream in a simple manner.” *Id.* at 4:30–32. The ’054 patent states:

In the proposed adsorption drying apparatus, the pressure increasing device generates a positive differential pressure between the drying and regeneration sectors in order to prevent air from passing from the regeneration sector into the drying sector. The purpose of the pressure-increasing device hence is to compensate for the pressure loss of the gas from the regeneration inlet chamber to the drying outlet chamber via the regeneration sector, the condenser, the drying sector as well as the corresponding connecting lines to the chamber and, in addition, to build up the positive differential pressure mentioned above.

Id. at 4:38–48. “The pressure-increasing device may be a mechanical compressor, in particular a compressor and/or a fan and/or a pump and/or a side-channel compressor and/or a turbo compressor, e.g., a radial compressor.” *Id.* at 5:46–49.

C. Illustrative Claims

Independent claims 1 and 15 of the '054 patent are illustrative of the claims at issue:

1. An adsorption drying apparatus, particularly for drying a compressed gas, comprising
 - an adsorption chamber (11) having a plurality of adsorption conduits (101) containing an adsorption material (123),
 - a first feeding line (106) and a first discharging line (109) disposed at a first end (111) of the adsorption chamber (11), and a second feeding line (108) and a second discharging line (107) disposed at a second end (112) of the adsorption chamber (11), wherein the adsorption chamber (11) is rotatable with respect to the feeding and discharging lines (106, 107, 108, 109),
 - the adsorption conduits being fluidically connectable in temporal alternation with the first feeding line (106) and

the second discharging line (109)¹ or the first discharging line (107)² and the second feeding line (108), so that a drying sector (102) and a regeneration sector (103) are defined, wherein the gas is dried in the drying sector (102), and the adsorption material (123) is regenerated in the regeneration sector (103),

the first feeding line (106) being configured such that the gas to be dried is feedable to the regeneration sector (103) as a full flow,

the second discharging line (107) being in communication with the second feeding line (108) and thus forming a connecting line in which a condenser is provided,

a pressure increasing device (18) provided within the connecting line to increase pressure of the gas flowing from the second discharging line (107) to the second feeding line (108),

a cooling stream optionally branched off at the first (111) or second end (112) of the adsorption chamber (11), so as to cool the adsorption chamber (11) within a cooling sector (119), and

the regeneration sector (103) and the drying sector (102) being connected in cascade for a serial through-flow, such that a gas stream fed to the drying sector (102) essentially completely corresponds to a gas stream discharged from the regeneration sector (103), optionally including the a gas stream discharged from the cooling

¹ This occurrence of “(109)” appears to be a typographical error that should read “(107).” *See Novo Indus., L.P. v. Micro Molds Corp.*, 350 F.3d 1348, 1357 (Fed. Cir. 2003) (an error may be corrected “if (1) the correction is not subject to reasonable debate based on consideration of the claim language and the specification and (2) the prosecution history does not suggest a different interpretation of the claims.”).

² This occurrence of “(107)” appears to be a typographical error that should read “(109).” In view of the claim language and specification, that correction is not subject to reasonable debate, and the prosecution history does not suggest a different reading.

sector.

Ex. 1001, 13:48–14:21.

15. An adsorption drying method for drying a compressed gas, the method comprising the following steps a) to e):
- a) providing an adsorption chamber (11) having a plurality of adsorption conduits (101);
 - b) conducting the gas to be dried in according to a full flow principle from a first end (111) of the adsorption chamber (11) to a second end (112) of the adsorption chamber (11) through a regeneration sector (103);
 - c) increasing a pressure of the gas after conducting it through the regeneration sector;
 - d) conducting the gas from the second end (112) to the first end (111) of the adsorption chamber (11) through a drying sector (102); and
 - e) rotating the adsorption chamber (11).

Id. at 15:35–16:8.

D. The Cited References

Petitioner relies on the following prior art:

Dunne	US 2005/0150378 A1; published July 14, 2005	Ex. 1002
White	US 6,527,836 B1; issued Mar. 4, 2003	Ex. 1003
The Handbook	COMPRESSED AIR AND GAS HANDBOOK (John P. Rollins ed., 5th ed. 1989)	Ex. 1004
Vertriest	US 2003/0163929 A1; published Sept. 4, 2003	Ex. 1005

Petitioner relies also upon the declaration of Kent S. Knaebel, Ph.D. (Ex. 1009). Patent Owner did not submit declarant testimony.

E. The Instituted Grounds of Unpatentability

We instituted an *inter partes* review as to claims 1, 2, 4, 5, and 7–20 of the '054 patent on the following grounds of unpatentability:

A. Claims 1, 2, 4, 5, and 14–18 are unpatentable under 35 U.S.C. § 102(b) as anticipated by Dunne;

B. Claim 4 under 35 U.S.C. § 103(a) are unpatentable as having been obvious over Dunne;

C. Claims 12, 13, 19, and 20 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over Dunne and White; and

D. Claims 7–11 under 35 U.S.C. § 103(a) are unpatentable as having been obvious over Dunne and the Handbook.

II. PATENTABILITY ANALYSIS

A. Claim Construction

In an *inter partes* review, the Board interprets claim terms in an unexpired patent according to the broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142–46 (2016) (affirming applicability of broadest reasonable construction standard to *inter partes* review proceedings). Under that standard, and absent any special definitions, we give claim terms their ordinary and customary meaning, as would be understood by one of ordinary skill in the art at the time of the invention. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definitions for claim terms must be set forth with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

At various points in their respective arguments, Petitioner and Patent Owner assert broadest reasonable interpretations of certain claim terms. *See, e.g.*, Pet. 22, 29, 34, 47, 53; PO Resp. 10 and 51. We determine that express construction of only the following claim terms is necessary. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (only terms which are in controversy need to be construed, and only to the extent necessary to resolve the controversy).

“a pressure increasing device provided within the connecting line”

Petitioner asserts that the broadest reasonable construction of “a pressure increasing device” is “a device that increases pressure.” Pet. 29. Petitioner does not propose a specific construction for the phrase “within the connecting line.” Patent Owner asserts that “a pressure increasing device provided within the connecting line” means that “the pressure increasing device is in communication with both the regeneration outlet and the drying inlet.” PO Resp. 10. Patent Owner does not propose a specific construction for the term “pressure increasing device.”

The Specification explains that the pressure increasing device is provided to “increase the pressure of the gas flowing from the second discharging line to the second feeding line.” Ex. 1001, 3:46–48. The Specification also explains that the pressure increasing device “may be a mechanical compressor, in particular a compressor and/or a fan and/or a pump and/or a side-channel compressor and/or a turbo compressor, e.g., a radial compressor.” Ex. 1001, 5:46–49. Independent claim 1 describes the connecting line by reciting, in part, “the second discharging line being in communication with the second feeding line and thus forming a connecting line.” Based upon our consideration of those descriptions and the

Specification as a whole, we construe the phrase “a pressure increasing device provided within the connecting line” broadly to mean a device, such as a mechanical compressor, in particular a compressor, fan, pump, side-channel compressor, and/or a turbo compressor, e.g., a radial compressor, provided within the line formed between the second discharging line and the second feeding line, wherein the device increases pressure of gas flowing from the second discharging line to the second feeding line.

“controller [for controlling a speed of the pressure-increasing device] is controlled via a signal from an input compressor”

Claim 12 depends from claim 1 and recites, in part, “a controller for controlling a speed of the pressure-increasing device.” Claim 13 depends from claim 12 and recites, in part, “wherein the controller is controlled via a signal from an input compressor.”

As discussed below in this Decision, Patent Owner asserts that the claim phrase “‘controlling a speed of the pressure increasing device’ refers to a control of speed during the operation of the pressure increasing device, not merely simple turning off of the pressure increasing device.” PO Resp. 51. Patent Owner asserts also that “controlled via a signal from an input compressor” is different from responding to a signal from an input compressor. *Id.*

In the Reply, Petitioner proposes a construction for the phrase “controlling the speed.” Pet. Reply 22. According to Petitioner, the broadest reasonable interpretation of that phrase encompasses “turning off.” *Id.* Also, Petitioner relies on there being “no substantive difference between ‘responding’ to a signal and being ‘controlled via a signal’” but does not further propose a construction for that claim term. *Id.*

Petitioner and Patent Owner fail to demonstrate how their respective interpretations represent the broadest reasonable construction in light of the '054 Specification. Based upon our review of the Specification, we determine that “controlling a speed of the pressure-increasing device” is distinct from controlling the powered state of the device by turning off the motor powering the device. Indeed, we do not see, and Petitioner has not identified, any description in the Specification suggesting that “controlling the speed” encompasses disabling the motor of the device. Nor do we find that a person of ordinary skill in the art would understand that powering off a device so that it has no speed amounts to controlling the speed of the device. Rather, the Specification refers to the speed of the pressure increasing device, or a drive unit for increasing the pressure, in terms of operating at a constant speed, adjusting the speed, operating at a variable speed, and regulating the speed. *See, e.g.*, Ex. 1001, 9:45–53, 12:42–54. Therefore, based upon our consideration of those descriptions and the Specification as a whole, we determine that the broadest reasonable construction of the claim phrase “controlling a speed” requires the ability to maintain or adjust, i.e., increase and decrease, the speed of the device during the powered operation of the device, as distinguished from simply disabling the device so as to result in the speed dropping to zero.

Further, we find that the Specification describes the controller for controlling a speed of the pressure-increasing device “is preferably configured so as to evaluate at least one parameter of the pressure-increasing device . . . , and to *correspondingly control the speed* of the pressure-increasing device.” *Id.* at 8:36–51 (emphasis added). Thus, we determine that in light of the Specification, the broadest reasonable construction of the

claim phrase “wherein the controller is controlled via a signal from an input compressor” requires the controller to maintain or adjust the speed of the pressure-increasing device in a manner corresponding to a signal from an input compressor.

B. Level of Ordinary Skill in the Art

The level of skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *Al-Site Corp. v. VSI Int’l Inc.*, 174 F.3d 1308, 1324 (Fed. Cir. 1999) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966) and *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991)).

Petitioner provides the following description of a person of ordinary skill in the art, supported by the testimony of its declarant, Dr. Knaebel:

A person of ordinary skill in the art to which the ’054 patent is directed would have had an understanding of mechanical or chemical engineering principles in general and, in particular, would have had an understanding of the structure, theory and design of devices and systems that use adsorption drying technology to dry compressed gas using a rotor. This person would have had at least a bachelor’s (or equivalent) degree in mechanical or chemical engineering, as well as at least two additional years of either laboratory or industry experience dealing specifically with technology of adsorption drying of compressed gas, and the equipment typically used for adsorption drying of compressed gas. (Knaebel Decl. ¶ 26.)

Pet. 45.

Patent Owner does not provide a statement describing a person of ordinary skill in the art. Nor does Patent Owner provide the testimony of a declarant purported to be such a person. Based upon our review of the record as a whole, we find that Petitioner’s statement regarding the

qualifications of a person of ordinary skill in the art is sound and supported by the evidence. Accordingly, we adopt Petitioner's description. Moreover, we recognize Dr. Knaebel as a person of ordinary skill in the art.

C. Anticipation by Dunne

Petitioner contends that Dunne anticipates claims 1, 2, 4, 5 and 14–18. Pet. 23. Patent Owner disagrees. PO Resp. 15–40.

1. Dunne

Dunne discloses a gas purification method and apparatus to remove impurities from a gas feed stream after compression of the gas feed stream. Ex. 1002 ¶ 1. “[A] heated compressed gas is sent through a regeneration sector of a rotary adsorber to remove impurities from the regeneration sector . . . [and] to produce a stream of compressed gas containing these impurities.” *Id.* ¶ 9. The contaminated stream of compressed gas is cooled in a condenser, where a portion of contaminants is condensed from the stream and removed. *Id.* The resulting cooled stream of compressed gas is passed to an adsorption sector of the rotary adsorber, “wherein a further quantity of contaminants is removed from said compressed gas to produce a purified compressed gas product” that is then brought to a desired temperature. *Id.* “[A] minor portion of cooled compressed purified gas is removed from the purified compressed gas product to be sent to a cooling sector of said rotary adsorber to cool said cooling sector.” *Id.*

Dunne explains that adding a cooling step using an adsorbent wheel to its process “allows for less of the enthalpy of the system to leave in the product stream. Therefore the cooled stream will now be drier since it will be at equilibrium with the adsorbent bed at a lower temperature.” *Id.* ¶ 25. According to Dunne, for this process to operate effectively to remove

impurities from a high pressure flow of gas, “the stream going to the adsorption zone needs to be compressed prior to contacting the adsorbent wheel, so that the pressure of the inlet to the cooling zone is greater than the pressure of the inlet to the regeneration zone.” *Id.* ¶ 26. Further, Dunne explains that “[w]hether this compression is done prior to or after the condenser on the regeneration or cooling effluent may be a matter for the specifics of the process streams.” *Id.* ¶ 27.

2. Analysis

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros., Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987). “Anticipation requires the presence in a single prior art disclosure of all elements of a claimed invention arranged as in the claim.” *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983) (citation omitted).

a. Independent Claim 1

Petitioner contends that Dunne discloses an adsorption drying apparatus for drying a compressed gas that meets every element of independent claim 1. Pet. 23–32 (citing Ex. 1009 ¶¶ 50–52, 62, 65–79, 81, 86). Patent Owner contends only that Petitioner failed to establish that Dunne discloses “a pressure increasing device provided within the claimed location, i.e., the connecting line.” PO Resp. 16. With respect to the remaining, undisputed limitations of claim 1, we agree with Petitioner that Dunne discloses these limitations, and adopt Petitioner’s contentions.

According to Petitioner and Dr. Knaebel, Dunne inherently discloses a pressure increasing device provided within the connecting line to increase

pressure of the gas flowing from the second discharging line to the second feeding line, as required by claim 1. Pet. 29. In support of that assertion, Petitioner and Dr. Knaebel rely, in part, upon the following statement in Dunne:

“[f]or this process to effectively operate to remove impurities from a high pressure flow of gas, ***the stream going to the adsorption zone needs to be compressed prior to contacting the adsorbent wheel***, so that the pressure of the inlet to the cooling zone is greater than the pressure of the inlet to the regeneration zone.”

Id. (quoting Ex. 1002 ¶ 26). According to Petitioner and Dr. Knaebel, a person of ordinary skill in the art would have understood Dunne’s disclosure that the stream going to the adsorption zone “needs to be compressed” inherently discloses that (a) the pressure of that stream needs to be increased, and (b) doing so requires a pressure-increasing device. *Id.* (citing Ex. 1009 ¶¶ 50–52,³ 76, 86).

Petitioner also asserts that Dunne’s required compression, i.e., pressure increase, necessarily occurs “within the connecting line,” as required by claim 1. Pet. 30. For this contention, Petitioner relies, in part, on Dunne’s Figures 1 and 2, reproduced below:

³ According to Dr. Knaebel, “[b]y increasing the pressure in the line ‘prior to contacting the adsorbent wheel’ . . . the pressure of the gas at the outlet of the adsorption (drying) sector is elevated, and so is the pressure of the gas flowing over into the adjacent ‘inlet to the cooling zone.’” Ex. 1009 ¶ 51.

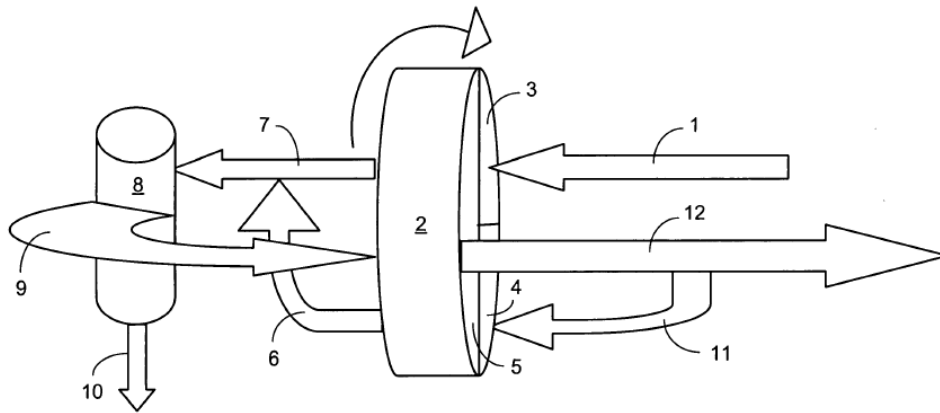


FIG. 1

Dunne's Figure 1 shows a "simplified depiction of the process" of its invention. Ex. 1002 ¶ 15.

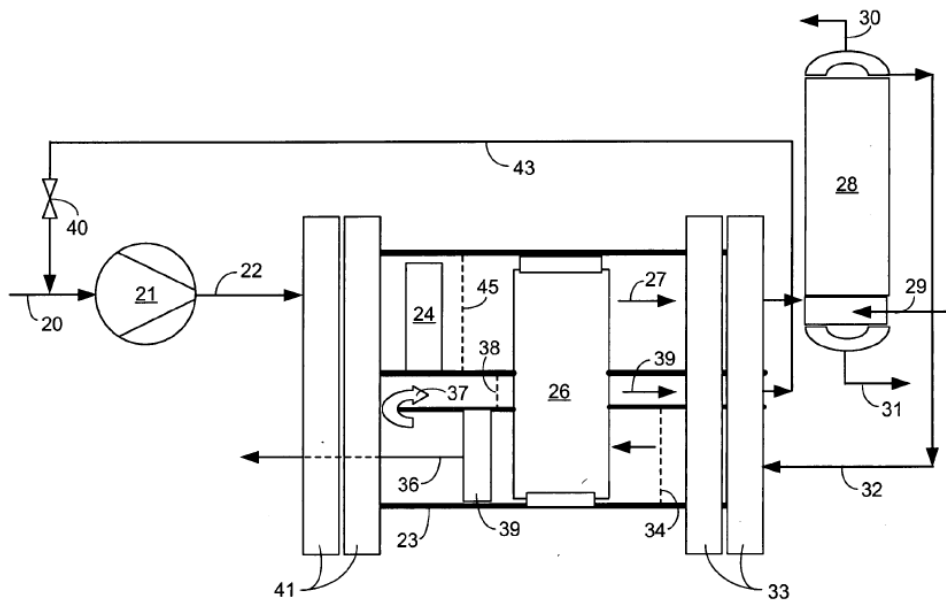


FIG. 2

Dunne's Figure 2 shows a schematic of a high pressure desiccant wheel air dryer system. *Id.* ¶ 44. Petitioner asserts that line 7 in Figure 1 and line 27 in Figure 2 each refer to a "second discharging line," and line 9 in Figure 1

and line 32 in Figure 2 each refer to a “second feeding line.” Pet. 25. Further, Petitioner asserts that Figure 1 shows line 7 in communication with line 9, thus forming a “connecting line” in which condenser 8 is provided. *Id.* at 28. Similarly, Petitioner asserts that Figure 2 shows that line 27 is in communication with line 32, thus forming a “connecting line” in which condenser 28 is provided. *Id.* at 28–30. Patent Owner does not contend otherwise.

According to Petitioner and Dr. Knaebel, Dunne’s disclosure that “the stream going to the adsorption zone needs to be compressed prior to contacting the adsorbent wheel” must refer to “either streams 7 and 9 in Figure 1 or either streams 27 and 32 in Figure 2” because *only* those streams go to the adsorption zone. *Id.* at 30 (citing Ex. 1009 ¶ 77). Petitioner asserts further that Dunne describes an embodiment wherein a condenser may be placed prior to compression so that compression occurs in a stream after it passes through the condenser and before it goes to the adsorption zone, which must mean, for that embodiment, “compression occurs to stream 9 in Figure 1 or stream 32 in Figure 2.” *Id.* at 31 (citing Ex. 1009 ¶ 78).

According to Petitioner and Dr. Knaebel, because streams 7 and 9 in Figure 1, and streams 27 and 32 in Figure 2, make up the “connecting line” recited by claim 1, Dunne discloses two embodiments wherein the pressure increase required by Dunne takes place within the connecting line to increase pressure of the gas flowing from the second discharging line to the second feeding line. *Id.* at 30 (citing Ex. 1009 ¶ 77).

Based upon our review of Dunne and the supporting testimony of Dr. Knaebel, whose opinion, in this regard, we afford persuasive weight, we agree with Petitioner that Dunne discloses each element of claim 1,

including inherently disclosing two alternative embodiments wherein a pressure increasing device is provided within the connecting line to increase pressure of the gas flowing from the second discharging line to the second feeding line. In particular, we are persuaded that a person of ordinary skill in the art would understand that Dunne teaches that the compression required by paragraph 26 may optionally be provided in either stream 7 or 9, shown in Dunne's Figure 1. Each of those streams may be seen as "going to the adsorption zone" and providing an opportunity for compression "prior to contacting the adsorbent wheel," as required by Dunne. Ex. 1002 ¶ 26. Further, compression in any of those streams is consistent with the teaching in paragraph 27 of Dunne that compression may occur "prior to or after the condenser on the regeneration or cooling effluent," i.e., Figure 1 shows that compression occurs in stream 7 prior to reaching the condenser and in stream 9 after the condenser, wherein each of those streams may be considered a regeneration effluent as they flow from the regeneration sector.

Further, Petitioner has shown persuasively, and Patent Owner has not argued otherwise, that streams 7 and 9 depicted in Dunne's Figure 1 make up a "connecting line in which a condenser 8 is provided" as required by claim 1. Pet. 28–30. Thus, we determine that Dunne's inherent disclosure of providing a pressure increasing device in either of streams 7 or 9, results in two embodiments of the invention which necessarily meet all of the limitations in claim 1, including providing a pressure increasing device within the connecting line to increase the gas flowing from the second discharging line to the second feeding line.

We have considered Patent Owner's assertion that Dunne does not disclose a pressure increasing device provided within the connecting line.

PO Resp. 16. Patent Owner supports that contention by asserting that Dunne's paragraph 26 does not apply to Figures 1 and 2, but rather to "the general concept of additional compression of a stream" which is disclosed "only in the context of [Figures] 4–6." *Id.* at 18–19. We disagree with Patent Owner, as that contention contradicts Dunne's disclosure and is unsupported by persuasive evidence. Dunne's description of the invention beginning at paragraph 23 expressly refers to Figures 1 and 2 when describing an example of using a wheel system to remove water from a stream of air. Ex. 1002 ¶ 23. Although a portion of paragraph 23 apparently addresses a feature not shown in Figure 2, i.e., the cooling effluent stream being combined with the regeneration effluent stream prior to cooling and condensation, such feature is depicted in Figure 1, as acknowledged by Patent Owner. *See, e.g., id.*, stream 6, *see also* PO Resp. 17 ("a path of the cooling effluent stream is shown in the general process schematic of Fig. 1"). Thereafter, paragraphs 24–27 each begin by referring to "this process." We find that a skilled artisan would understand the usage of the phrase "this process" in paragraphs 24–27 refers to the general process described in each of the preceding paragraphs, beginning with paragraph 23, and at least the simplified depiction of the process in Figure 1. *See* Ex. 1002 ¶ 15.

Patent Owner suggests that, even if Dunne's paragraph 26 refers to Figures 1 and 2, there is no reasonable explanation why neither figure shows a pressure increasing device allegedly inherently disclosed in paragraph 26. PO Resp. 19. As Petitioner has correctly asserted, no such explanation is required as "disclosing the embodiment in textual form is enough." Pet. Reply 15–16 (quoting *Seachange Int'l, Inc. v. C-Cor Inc.*, 413 F.3d 1361, 1380 (Fed. Cir. 2005)). Moreover, as a simplified depiction, it is

understandable that Figure 1 does not show the location and means for compressing the gas stream described in paragraph 26. We note that, other than dismissing the applicability of paragraph 26, Patent Owner does not assert that a skilled artisan would not understand that a pressure increasing device would be needed to accomplish the required compression described by Dunne.

Further, Patent Owner asserts that even if Dunne discloses a pressure increasing device, Dunne does so “only in relation to a pressure increasing device positioned within a cooling stream, not a pressure increasing device positioned within a line connecting the regeneration outlet and drying inlet, as recited in claim 1.” PO Resp. 19. In support of that contention, Patent Owner argues that “Petitioner’s interpretation of ¶ [0026] is not the only possible reading of *Dunne*.” *Id.* at 26–29. According to Patent Owner, paragraph 26 is “ambiguous on its face” and that “such ambiguities in *Dunne* must be resolved against Petitioner and in favor of Patent Owner.” *Id.* at 25. In that regard, Patent Owner contends that paragraph 26 “– taking into consideration the overall context of *Dunne* – obviously relates to a necessary condition in order to carry out the cooling step described in the preceding paragraph.” *Id.* at 28.

In that preceding paragraph, Dunne explains, “[t]he addition of a cooling step, in the present invention using an adsorbent wheel allows for less of the enthalpy of the system to leave in the product stream. Therefore the cooled stream will now be drier since it will be at equilibrium with the adsorbent bed at a lower temperature.” Ex. 1002 ¶ 25. Dunne explains also that configuring its adsorbent wheel to perform this cooling step “only requires dividing the wheel into the three zones – regeneration, cooling and

adsorption.” *Id.* Paragraph 23 of Dunne explains that the “dried product stream is split, with some of it going back into the cooling zone of the wheel.” *Id.* ¶ 23, *see also id.* at Fig. 1 (stream 12). Then, the cooling effluent stream (stream 6) is combined with the regeneration effluent stream prior to cooling and condensation (stream 7). *Id.* at Fig. 1.

According to Patent Owner, “in order to return the cooling effluent stream to the adsorption zone, which is the primary objective of *Dunne*, the pressure of the cooling effluent stream must be increased to a level sufficient to allow it to be combined with a stream upstream of the adsorption zone.” PO Resp. 28. Patent Owner asserts that “[t]he combined stream is then led to the adsorption zone, such that the cooling stream is retained in the system.” *Id.* Thus, Patent Owner asserts that Dunne’s disclosure in paragraph 26 of a “‘stream going to the adsorption zone’ can just as easily refer to the cooling stream which is reintroduced to the adsorption zone.” *Id.* at 29. Therefore, according to Patent Owner, even if Dunne’s paragraph 26 inherently discloses a pressure increasing device, “at least one logical interpretation” is that the device “would be positioned within the cooling stream, not within the line connecting the regeneration outlet with the adsorption inlet.” *Id.* at 35.

We note that Patent Owner has not provided any declaration or deposition testimony rebutting or calling into question the opinion of Dr. Knaebel. As discussed above, we have afforded persuasive weight to Dr. Knaebel’s testimony that a person of skill in the art would understand Dunne as disclosing embodiments wherein a pressure increasing device is positioned in stream 7 or 9 in relation to Figure 1, and that either position necessarily meets the claim limitation of providing a pressure increasing

device within the connecting line to increase pressure of the gas flowing from the second discharging line to the second feeding line. Thus, the preponderance of the evidence supports Petitioner's position that Dunne discloses two embodiments that anticipate claim 1.

Moreover, even if we found persuasive Patent Owner's argument that a person of skill in the art may have interpreted Dunne as disclosing an embodiment wherein a pressure increasing device is located in stream 6, that determination does not negate the disclosure of the two anticipatory embodiments inherently disclosed by Dunne, i.e., wherein the pressure increasing device is located in either stream 7 or 9. At best, Patent Owner's argument establishes only that Dunne additionally discloses a third alternative embodiment of its adsorption drying apparatus that does not anticipate claim 1. In other words, even in view of a disclosure of a third non-anticipatory embodiment, the preponderance of the evidence establishes that Dunne inherently discloses two other embodiments that a person of skill in the art would at once envisage upon reading the reference, wherein both of those embodiments necessarily meet the limitations of claim 1, including providing a pressure increasing device in the connecting line. *See In re Petering*, 301 F.2d. 676, 681 (CCPA 1962) (recognizing an inherent disclosure of as one that a person of ordinary skill in the art would at once envisage upon reading the reference).

b. Dependent Claims 2, 4, 5, and 14

Petitioner contends that Dunne discloses every element of dependent claims 2, 4, 5, and 14. Pet. 33–39. Patent Owner asserts that those claims are not anticipated by Dunne for the same reasons discussed regarding

independent claim 1. PO Resp. 40. Thus, we are not persuaded by Patent Owner's argument for the same reasons discussed regarding claim 1.

Further, we agree with and adopt Petitioner's showing that Dunne discloses each element of dependent claims 2, 4, 5 and 14 (Pet. 33–39). In particular, with respect to the limitation in claim 4 requiring the pressure increasing device to be a “mechanical compressor,”⁴ Petitioner asserts that Dunne inherently discloses the use of a compressor by requiring the stream going to the adsorption zone “be compressed.” Pet. 34 (citing Ex. 1002 ¶ 26); Ex. 1009 ¶ 89. Patent Owner asserts that Petitioner fails to address how Dunne discloses a “mechanical” compressor, as opposed to “a compressor in general.” PO Resp. 41.

Claim 4 expressly provides that the mechanical compressor may be “optionally selected from a compressor, a fan, a pump, a side-channel compressor[], a turbo compressor, and a radial compressor.” Because that grouping includes the recitation of a “compressor,” we are satisfied by Petitioner's showing that Dunne's inherent disclosure of a “compressor” meets the limitation of a “mechanical compressor” recited by claim 4.

Based on the record as a whole, we determine that the Petitioner has established by a preponderance of the evidence that claims 2, 4, 5, and 14 are anticipated by Dunne.

⁴ We agree with Petitioner and Patent Owner that the recitation in claim 4 of a “mechanical condenser” is a typographical error that should read “mechanical compressor.” Pet. 34; PO Resp. 42. The parties do not dispute such a correction, and we find it not subject to reasonable debate based on the specification and claim language. Nor does the prosecution history suggest a different reading.

c. Independent Claim 15 and Dependent Claims 16–18

Petitioner contends that Dunne discloses every element of independent claim 15 and dependent claims 16–18. Pet. 39–44. In particular, regarding claim 15, Petitioner asserts that Dunne inherently discloses the required step of “increasing a pressure of the gas after conducting it through the regeneration sector” based upon Dunne’s disclosures at paragraphs 26 and 27, for reasons similar to those discussed regarding claim 1’s recitation of a “pressure-increasing device.” *Id.* at 40–42.

Patent Owner asserts that Dunne does not anticipate claim 15, or its dependent claims 16–18. In particular, Patent Owner asserts that Dunne does not inherently disclose “increasing a pressure of the gas after conducting it through the regeneration sector” for essentially the same reasons discussed with respect to claim 1. PO Resp. 15–16.

Based on the record as a whole, and for similar reasons discussed regarding the challenge to claim 1, we determine that the Petitioner has established by a preponderance of the evidence that claims 15–18 are also anticipated by Dunne (Pet. 39–44).

D. Obviousness of Claim 4 over Dunne

Petitioner contends that the subject matter of claim 4 is rendered obvious by Dunne. Pet. 46. Patent Owner disagrees. PO Resp. 41–45.

Claim 4 depends from claim 1. As discussed with respect to the anticipation ground, claim 4 further requires “the pressure-increasing device” to be “a mechanical compressor.” As an alternative to its anticipation challenge of claim 4, Petitioner asserts that it would have been obvious to a person of ordinary skill in the art to implement the compression

disclosed by Dunne by using a compressor. Pet. 46 (citing Ex. 1009 ¶ 89). Patent Owner disagrees for the reasons discussed regarding the anticipation ground for claim 4. PO Resp. 45.

Moreover, even if we did not determine that Dunne anticipates claim 4, Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claim 4 would have been obvious over Dunne. In particular, Dunne requires “the stream going to the adsorption zone to be compressed.” Ex. 1002 ¶ 26. As Dr. Knaebel explained, a person of ordinary skill in the art would understand that a compressor is a device that compresses gas. Ex. 1009 ¶ 89. Thus, we are persuaded by Dr. Knaebel’s credible and unrebutted testimony that a person of ordinary skill in the art would have found it obvious to use a compressor to implement the compression described by Dunne. *Id.* (citing Ex. 1002 ¶ 26).

E. Obviousness of Claims 12, 13, 19, and 20 over Dunne and White

Petitioner contends that the subject matter of claims 12, 13, 19, and 20 are rendered obvious by the combination of Dunne and White. Pet. 46–52. Patent Owner disagrees. PO Resp. 45–57.

1. White

White discloses “[a] rotating drum adsorber process and system includ[ing] a rotating drum of adsorbent medium in a shell including partitions which define an adsorption sector, a regeneration sector[,] and a cooling sector.” Ex. 1003, Abstract. In a preferred embodiment, a portion of moist gas feed stream 30 is directed through compressor after-cooler 34 into adsorption (drying) sector 38, while another portion of moist feed inlet stream 30 is diverted as regeneration stream 44 through regeneration sector 40. *Id.* at 26:41–50. Upon exiting regeneration sector 40, regeneration

exhaust stream 46 is cooled, and condensed water is separated and collected. *Id.* at 26:55–58. Regeneration exhaust stream 44 is then combined with moist gas feed inlet stream 30 and directed to adsorption sector 38. *Id.* at 26:58–61.

To ensure that any leakage will pass only in the direction from adsorption sector 38 into regeneration sector 40, thereby avoiding contamination of the adsorption sector, the regeneration sector is kept at a lower pressure than the adsorption sector. *Id.* at 26:61–66. A device, such as blower 48, is used to increase the pressure of lower pressure cooled regeneration exhaust stream 46 before combining it with higher pressure moist gas feed inlet stream 30. *Id.* at 26:66–27:6.

2. Analysis

A conclusion that claimed subject matter is obvious must be supported by evidence, as shown by some objective teaching in the prior art or by knowledge generally available to one of ordinary skill in the art that would have led that individual to combine the relevant teachings of the references to arrive at the claimed invention. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988).

Claim 12 depends from claim 1, and requires an adsorption drying apparatus “further comprising a controller for controlling a speed of the pressure-increasing device [], optionally via frequency conversion.” Claim 13 depends from claim 12 and additionally recites “wherein the controller is controlled via a signal from an input compressor, optionally via a speed of the input compressor and/or via a pressure within the input compressor and/or the adsorption drying apparatus.” Claim 19 depends from claim 15 and further requires that a drive unit for increasing the pressure in step c) is

operated at a variable speed, wherein the speed is determined by evaluating at least one of the seven recited parameters, e.g., the “speed of the input compressor” and “inlet temperature into the pressure-increasing device.” Claim 20 also depends from claim 15 and further requires that “the rotation in step 3) is started only when a predefined temperature threshold of the gas and/or a component of an adsorption drying apparatus used is exceeded.”

Petitioner asserts that a person of ordinary skill in the art would have found it obvious to use the blower disclosed by White for the compression required by Dunne because: (a) a blower is “merely a type of compressor used in a relatively low-pressure application,” (b) White used “its blower for the very purpose that it would be used in the *Dunne* apparatus, namely to increase the pressure of gas in a line flowing from a regeneration zone to a drying zone in an adsorption system,” and (c) White suggests that its blower may be used advantageously in other applications. Pet. 49. Petitioner asserts that when White’s blower is used with Dunne’s apparatus shown in Figures 1 and 2, the combination satisfies all of the requirements of claims 12, 13, 19, and 20. *Id.* at 50–51 (citing Ex. 1009 ¶¶ 123–124, 126, 154–157). Specifically, Petitioner asserts that White discloses that the speed of its blower is controlled by a controller, “based on any of a number of detected variables, including based on a signal from the input compressor and based on the inlet temperature of the air around (and flowing into) the blower.” *Id.* at 50 (citing Ex. 1003, 36:27–52, 41:55–42:5, 39:4–16; Ex. 1009 ¶¶ 123–124, 126, 154–157).

At the outset, Patent Owner argues that White does not cure the alleged deficiencies of Dunne with respect to independent claims 1 and 15, i.e., failing to disclose a pressure-increasing device provided within the

connecting line. PO Resp. 45–47. According to Patent Owner, due to at least their dependency on claim 1 or 15, the subject matter of the challenged claims would not have been obvious over the combination of Dunne and White. *Id.* We are not persuaded by this argument as we have determined, based on the record as a whole, that Petitioner has established by a preponderance of the evidence that Dunne discloses each element of claims 1 and 15.

Patent Owner also argues that Petitioner’s proposed modification of Dunne is improper because the inventions of Dunne and White are “fundamentally different from each other.” PO Resp. 47–48. Specifically, Patent Owner asserts that White discloses a partial-flow configuration while Dunne discloses a full flow configuration. *Id.* Patent Owner, however, has not explained persuasively, and we do not see, why a person of ordinary skill in the art would have considered White’s isolated teachings relating to the use of a blower or the use of a predefined temperature threshold to start a drum rotation to only be applicable to a partial-flow configuration. As Petitioner and Dr. Knaebel have discussed, White explains that certain aspects of its disclosure, e.g., the blower, “may be advantageously used in other applications.” Ex. 1003, 39:43–52.

a. Claims 12 and 13

Patent Owner asserts further that White does not teach or suggest a controller for controlling a speed of the pressure-increasing device, “wherein the controller is controlled via a signal from an input compressor,” as required by claim 13. PO. Resp. 51. According to Patent Owner, although White’s speed controller controls speed, it does not do so via a signal from an input compressor. *Id.* Rather, Patent Owner asserts White discloses that

its speed controller only responds to a signal from the input compressor by turning off the blower motor. *Id.* In support of that contention, Patent Owner refers to a statement in Dr. Knaebel’s declaration describing White as disclosing that its “speed controller responds to a signal from an input compressor” and that response is to turn off the blower. *Id.* (citing Ex. 1009 ¶ 127; Ex. 1003, 41:55–42:5). According to Patent Owner, the claim phrase “‘controlling a speed of the pressure increasing device’ refers to a control of the speed during the operation of the pressure increasing device, not merely to a simple turning off of the pressure increasing device.” *Id.*

Petitioner replies by asserting that “Patent Owner identifies no substantive difference between ‘responding’ to a signal and being ‘controlled via a signal.’” Pet. Reply 22. Petitioner also asserts that the broadest reasonable interpretation of the phrase “controlling the speed” encompasses “turning off.” *Id.*

After considering the arguments and the evidence, we agree with Patent Owner that Petitioner has not established by a preponderance of the evidence that claim 13 is unpatentable under 35 U.S.C. § 103(a) as having been obvious over Dunne and White. In particular, we agree with Patent Owner that Petitioner and Dr. Knaebel have not shown persuasively that White’s speed controller is *controlled* via a signal from an input compressor. As Patent Owner observed, Dr. Knaebel accurately characterizes White’s controller as responding in a specific manner to a signal from an input from the compressor, i.e., that signal may prompt the controller to turn off the blower motor. Ex. 1009 ¶ 127 (citing Ex. 1003, 41:55–42:5). As discussed above, we have determined that the claim phrase “controlling a speed”

requires the ability to maintain or adjust, i.e., increase and decrease, the speed of the device during the powered operation of the device.

In turn, we have determined that the claim phrase “wherein the controller is controlled via a signal from an input compressor” requires the controller’s control of the speed of the pressure-increasing device, i.e., by maintaining or adjusting that speed during operation of the device by a signal from an input compressor. Because Petitioner and Dr. Knaebel have not demonstrated that White teaches or suggests that a signal from the input compressor causes the controller to correspondingly maintain or adjust the speed of the pressure-increasing device, we do not find persuasive the assertion that combining White’s blower and controller with Dunne’s drying apparatus renders obvious the subject matter of claim 13.

On the other hand, claim 12 requires a controller for controlling a speed of the pressure-increasing device, without further requiring the controller to be controlled via a signal from an input compressor.⁵ White discloses that its controller is a speed adjustment device. Ex. 1003, 10:1–2. Therefore, based upon our review of the record, we conclude that Petitioner has established by a preponderance of the evidence that claim 12 is unpatentable under 35 U.S.C. § 103(a) as having been obvious over Dunne and White. *See* Pet. 50.

b. Claim 19

According to Petitioner and Dr. Knaebel, White teaches two of the alternative parameters for operating a pressure increasing device at a

⁵ At the hearing, counsel for Patent Owner clarified its position acknowledging that White discloses a speed controller with respect to claim 12. Tr. 44–45.

variable speed recited by claim 19, i.e., by the “speed of the input compressor” or by the “inlet temperature into the pressure-increasing device.” Pet. Reply 23 (citing Ex. 1009 ¶¶ 155–156).

We agree with Patent Owner that White does not disclose operating the pressure increasing device at a variable speed wherein the speed is determined by evaluating the speed of the input compressor. PO Resp. 54. As discussed above, regarding the challenge to claim 13, Petitioner has not established persuasively that White teaches or suggests that the speed of its blower is controlled by a signal from the input compressor. See Pet. 50–51; Ex. 1009 ¶¶ 155–156.

However, we find that the preponderance of the evidence supports Petitioner’s position that White discloses operating the pressure increasing device at a variable speed wherein the speed is determined by evaluating inlet temperature into the pressure-increasing device. Patent Owner asserts that White’s teaching that “the invention may include means for monitoring the temperature of the air in the chamber, such as, by way of example, a temperature sensor, for automatically fine tuning the required blower speed” does not support Dr. Knaebel’s opinion that White’s speed controller for its blower satisfies claim 19 by “respond[ing] to an inlet temperature into the blower.” PO Resp. at 54–55 (quoting Ex. 1003, 10:34–38 and Ex. 1009 ¶ 157). According to Patent Owner, the “air in [] the chamber” monitored in White is different from the air that is about to enter the blower, i.e., the exhaust stream which has passed through the cooling device and separator, and is pressurized therein. *Id.* at 55 (citing Ex. 1003, Fig. 1). Patent Owner asserts also that White discourages control based upon individual temperature values by stating that a “feature of the present invention is the

use of a temperature differential, instead of a single temperature, [. . .]
[b]ecause the temperature differential is not affected by varied operating
conditions.” *Id.* (quoting Ex. 1003, 5:62–6:7).

Petitioner replies that the temperature of the “air in the chamber” is
the same as or at least includes the “inlet temperature into the blower”
because White explains that the blower is located in the chamber where the
temperature of the air is monitored. Pet. Reply 23 (citing Ex. 1003, 10:27).

Although Patent Owner raises a potential issue with Petitioner’s
position, Patent Owner has not provided evidence from the cited references
or from a declarant to rebut Petitioner’s evidence on this point, i.e.,
Dr. Knaebel’s testimony that the temperature monitored in the chamber, as
disclosed by White, provides the inlet temperature into the pressure-
increasing device. Ex. 1009 ¶ 157. Thus, based on the record as a whole,
we determine that Petitioner has established by a preponderance of the
evidence that claim 19 is unpatentable under 35 U.S.C. § 103(a) as having
been obvious over Dunne and White.

c. Claim 20

Regarding claim 20, Petitioner asserts that White discloses controlling
the motor that turns the adsorbent drum using a microprocessor. Pet. 51
(citing Ex. 1003, 32:49–33:3). Petitioner asserts also that White discloses
“controlling the rotational speed of the drum based on temperature of the air
in the regeneration sector, for example, and disabling the drum motor if the
input compressor stops delivering compressed air.” *Id.* (citing Ex. 1003,
42:42–59, 43:20–39, 41:55–57). Additionally, Petitioner asserts that White
discloses a system for controlling the operation of a rotary drum adsorber
having a power supply for distributing power to the drum motor in response

to a temperature condition in the adsorber system reaching a predetermined state. *Id.* (citing Ex. 1003, 22:15–32; Ex. 1009 ¶ 160). According to Petitioner and Dr. Knaebel, a person of ordinary skill in the art would have appreciated the efficiency benefit and energy savings of utilizing a controller that starts the adsorbent wheel turning only after a certain temperature threshold is reached, as disclosed by White, therefore rendering the combination of that feature with Dunne’s method obvious. Pet. 52; Ex. 1009 ¶ 161.

Patent Owner asserts that White’s disclosures regarding controlling the *rotational speed* of the drum and disabling the drum motor based on temperature are not relevant to claim 20, which is directed to *starting* the rotation of the drum based on a predefined temperature threshold being exceeded. PO Resp. 55–56. We disagree with Patent Owner. As Dr. Knaebel has persuasively explained, White describes that its adsorber system may include a power supply connection for “distributing power to the rotary drum motor in response to at least one operating condition reaching a predetermined state.” Ex. 1009 ¶ 160 (quoting Ex. 1003, 22:15–32). White describes one such operation condition as “a temperature condition in the adsorber system.” Ex. 1003, 22:22–23. Based upon those teachings, we find credible Dr. Knaebel’s testimony that a skilled artisan would understand from White that when a “temperature condition in the adsorber system” reaches a “predetermined state,” that temperature has exceeded “a predefined temperature threshold,” as required by claim 20. Ex. 1009 ¶ 160. Once that condition occurs, White explains that a power supply connection distributes power to the rotary drum motor to rotate the drum. Ex. 1003, 22:26–28.

Moreover, Dr. Knaebel provides persuasive testimony that a skilled artisan would have appreciated from White's method of delivering power to the rotary drum motor after a temperature condition is met that starting the rotation of the drum at that time would provide efficiency and energy savings benefits. Ex. 1009 ¶ 161. Therefore, based on our consideration of the record as a whole, we conclude that Petitioner has established by a preponderance of the evidence that claim 20 is unpatentable under 35 U.S.C. § 103(a) as having been obvious over Dunne and White.

Accordingly, we determine that Petitioner has established by a preponderance of the evidence that claims 12, 19, and 20 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over Dunne and White. Petitioner has not established by a preponderance of the evidence, however, that claim 13 is unpatentable over that combination.

*F. Obviousness of Claims 7–11 over
Dunne and the Handbook*

Petitioner contends that the subject matter of claims 7–11 are rendered obvious by the combination of Dunne and the Handbook. Pet. 52–58. Patent Owner disagrees. PO Resp. 57–60.

1. The Handbook

The Handbook includes a section on compressor performance explaining that “[d]epending on application, compressors are manufactured as positive-displacement, dynamic, or thermal type.” Ex. 1004, 564. “[D]ynamic types include radial-flow (centrifugal), axial-flow and mixed-flow machines.” *Id.* The Handbook provides definitions of terms applicable to dynamic-type compressors, including the term “diffuser.” *Id.* at 639. “*Diffuser*” is defined as “a stationary passage surrounding an impeller in which velocity pressure imparted to the flowing medium by the impeller is

converted into static pressure.” *Id.* at 640. “*Impeller*” is defined as “the part of the rotating element that imparts energy to the flowing medium by means of centrifugal force.” *Id.* The Handbook describes a centrifugal compressor, in its simplest form, as “a single-stage, single-flow unit with the impeller overhung on a motor.” *Id.* at 645. The Handbook explains that such a single-flow unit includes a diffuser and describes a diffuser diameter for a “normal parallel-wall vaneless diffuser.” *Id.* at 645, 663.

2. Analysis

“The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007). “If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability.” *Id.* at 417.

Patent Owner argues that the Handbook does not cure the alleged deficiency of Dunne with respect to independent claim 1, i.e., failing to disclose a pressure-increasing device provided within the connecting line to increase pressure of the gas flowing from the second discharge line to the second feeding line. PO Resp. 58. According to Patent Owner, due to at least their dependency on claim 1, the subject matter of claims 7–11 would not have been obvious over Dunne and the Handbook. *Id.* at 58–59. We are not persuaded by that argument as we have determined that Petitioner has established by a preponderance of the evidence that Dunne discloses each element of claim 1. Having addressed that contention, we now turn to the further limitations of the challenged claims.

a. Claim 7

Claim 7 depends from independent claim 1 and further recites

“wherein the pressure-increasing device (18) is a radial compressor having a ring diffuser (121).” Ex. 1001, 14:57–58. Petitioner asserts that “[a] person of ordinary skill in the art would have understood that many types of compressors exist that could achieve the ‘compression’ described by *Dunne*.” Pet. 52–53 (citing Ex. 1009 ¶ 98). Petitioner asserts that the Handbook discloses a variety of standard compressors, including radial-flow (centrifugal) compressors, i.e., radial compressors. *Id.* at 53; Ex. 1004, 564. According to Petitioner and Dr. Knaebel, one of the known and obvious options to a person of ordinary skill in the art seeking to accomplish Dunne’s required compression would have been a radial compressor. *Id.* at 53 (citing Ex. 1009 ¶ 99).

Further, Petitioner asserts that a “diffuser” is a well-known component of a centrifugal compressor. Pet. 53 (citing Ex. 1009 ¶ 99; Ex. 1004, 645). Petitioner asserts also that diffusers having a ring shape were well known and “normal.” *Id.* at 54 (citing Ex. 1009 ¶ 101; Ex. 1004, 663). According to Petitioner and Dr. Knaebel,

[o]ne of the obvious options for a person of ordinary skill in the art seeking to implement the apparatus described in connection with Figure 2 of *Dunne* and the “compress[ion]” described in paragraph 26 of *Dunne* would have been to use a standard centrifugal (aka radial) compressor with a “normal” ring-shaped diffuser.

Id. (citing Ex. 1009 ¶ 102).

Patent Owner argues that “such a specific configuration of a compressor is only one possible configuration of a large number of configurations identified in the *Handbook*. As such, one skilled in the art would not necessarily have arrived at the claimed invention by reference to the *Handbook*.” PO Resp. 59.

Based on record as a whole, Petitioner has provided a rational basis for asserting that a person of skill in the art would have selected a radial compressor having a ring diffuser to accomplish the compression required by Dunne. While we agree with Patent Owner that the Handbook describes a variety of compressor types, Petitioner has established persuasively that a skilled artisan would have found it obvious to select a radial compressor to serve the compression requirement set forth in Dunne. Specifically, Dr. Knaebel provides credible, unrebutted testimony that a person of ordinary skill in the art would have known that a radial compressor would be a suitable compressor type to provide the function described by Dunne and would have selected it from among the listed options in the Handbook. Ex. 1009 ¶¶ 98–99. Similarly, Dr. Knaebel persuasively explains that a skilled artisan would have understood that a radial compressor, in its simplest form, is a single-stage, single-flow unit, wherein that unit includes a diffuser. Ex. 1009 ¶¶ 98–99; Ex. 1004, 645. In other words, Petitioner and Dr. Knaebel have shown that arriving at the limitation recited in claim 7 would require no more than combining a familiar element according to a known method to produce a predictable result. *KSR*, 550 U.S. at 416.

Accordingly, we determine that Petitioner has established by a preponderance of the evidence that claim 7 is unpatentable under 35 U.S.C. § 103(a) as having been obvious over Dunne and the Handbook.

b. Claims 8–11

Petitioner asserts that the combination of Dunne and the Handbook teaches or suggests the limitations of claims 8–11. Pet. 55. Specifically, Petitioner relies on the combination of Dunne and the Handbook to suggest the limitation “guided at least in a line section of the connecting line” recited

in claim 8, in the event that we interpret that limitation as meaning “guided through the wall of a structure that forms part of the connecting line” and/or that “outside of the pressure space,” recited in claims 9–11, is interpreted as “at atmospheric pressure.” *Id.* at 55–58.

In particular, Petitioner asserts that the Handbook describes “shafts that run from a compressor impeller within a pressurized housing, through the housing, and out to a drive unit outside of the pressurized housing.” *Id.* at 57 (citing Ex. 1004, 687–693). Petitioner explains that in all of the Handbook examples with that configuration, “the shafts are supported by bearings or bushings formed or mounted in the wall of a housing, and seals are used to ensure that the pressure within the housing does not escape through the passageway used by the shaft to pass through the housing.” *Id.*; Ex. 1009 ¶¶ 106, 111, 116, 121. According to Petitioner, using such a drive shaft/seal configuration in the wall of pressure vessel 23 or passageway 32 with respect to Dunne’s Figure 2 would have amounted to arranging known elements performing their known functions with expected results. Pet. 57 (citing *KSR*, 550 U.S. at 417).

Petitioner asserts a skilled artisan would have further found it obvious to position the compressor impeller within a pressurized housing as disclosed in the Handbook to achieve Dunne’s instruction that compression must take place as gas travels from the regeneration sector to the adsorption sector in Dunne. *Id.* at 58 (citing Ex. 1009 ¶¶ 106, 111, 116, 121). Patent Owner does not raise separate arguments regarding claim 8, or its dependent claims 9–11. See PO Resp. 57–60 (raising separate argument for claim 7 only).

Based on the record as a whole, we are persuaded by Dr. Knaebel’s

testimony, Ex. 1009 ¶¶ 106, 111, 116, 121, that each of the limitations of claims 8–11 would have been obvious to a person of ordinary skill in the art seeking to achieve Dunne’s required compression, based upon the teachings of the Handbook.

Accordingly, we determine that Petitioner has established by a preponderance of the evidence that claims 8–11 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over Dunne and the Handbook.

III. CONCLUSION

For the foregoing reasons, we conclude that Petitioner has established by a preponderance of the evidence that claims 1, 2, 4, 5, 7–12, and 14–20 of the ’054 patent are unpatentable. Petitioner, however, has not established by a preponderance of the evidence that claim 13 is unpatentable.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1, 2, 4, 5, 7–12, and 14–20 of the ’054 patent are deemed to be *unpatentable*;

ORDERED that claim 13 has not been shown to be unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Patent 8,349,054 B2

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