

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FLOTEK INDUSTRIES, INC., TURBECO, INC. and
TELEDRIFT COMPANY,
Petitioners,

v.

NATIONAL OILWELL DHT, L.P.,
Patent Owner.

Case IPR2015-01239
Patent 6,508,317 B2

Before JOSIAH C. COCKS, SUSAN L. C. MITCHELL, and
JAMES J. MAYBERRY, *Administrative Patent Judges*.

MAYBERRY, *Administrative Patent Judge*.

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

I. INTRODUCTION

Petitioners, Flotek Industries, Inc., Turbeco, Inc. (d/b/a Spidle Turbeco, d/b/a Galleon Turbeco and d/b/a Cavo Drilling Motors) and Teledrift Company (d/b/a Spidle Turbeco) (collectively, “Flotek”), filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–5, 7, and 8 of U.S. Patent No. 6,508,317 B2 (the “’317 patent”). Patent Owner, National Oilwell DHT, L.P. (“NOV”),¹ filed a Preliminary Response (Paper 10, “Prelim. Resp.”) to the Petition. We instituted trial on claims 1, 4, 7, and 8 but not on claims 2, 3, and 5. Paper 11, 40 (“Dec. on Inst.”).

After institution of trial, Patent Owner filed a Patent Owner Response (“PO Resp.”) to the Petition. Paper 18. Petitioner filed a Reply (“Reply”) to the Patent Owner Response. Paper 26. Petitioner relies on the Declaration testimony of Dr. Douglas E. Smith (“Dr. Smith”) in support of its Petition (Ex. 1002). Patent Owner relies on the Declaration testimony of Dr. John Edward Akin (Ex. 2004) (“Dr. Akin”) in support of its Patent Owner Response.

Oral hearing was conducted on August 2, 2016. The record contains a transcript of the hearing. Paper 38 (“Tr.”).

The Board has jurisdiction under 35 U.S.C. § 6. This final written decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. Petitioner has shown by a preponderance of the evidence that claims 1, 4, and 8 are unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 2,780,438 to Bielstein (Ex. 1008, “Bielstein”) and U.S. Patent No. 3,216,514

¹ At the time the Petition was filed, the patent owner of record was Andergauge Ltd. NOV subsequently recorded assignment documents evidencing that it is the current owner. *See* Ex. 3002.

to Nelson (Ex. 1009, “Nelson”). Petitioner has also shown by a preponderance of the evidence that claim 7 is unpatentable under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 4,080,115 to Sims (Ex. 1011, “Sims”).

A. Related Matters

The ’317 patent is the subject of litigation in *National Oilwell DHT, L.P. v. Flotek Industries, Inc.*, No. 2:14-CV-01056 (S.D. Tex.) and *National Oilwell DHT, L.P. v. Amega West Services, LLC*, No. 2:14-CV-01020 (E.D. Tex.). Pet. 1, Paper 7, 2.

B. The ’317 Patent

The ’317 patent, titled “Downhole Apparatus and Method of Use,” issued January 21, 2003. The claims of the ’317 patent are directed to a flow pulsing apparatus for a drill string and a flow pulsing drilling method. Ex. 1001, 6:24–8:25. Specifically, the claims are directed to a flow pulsing apparatus that employs a valve that varies the flow of drilling fluid through the housing by varying the area of a flow passage in the valve. *Id.*, Abstract.

Figures 2 and 3, reproduced below, depict an embodiment of the apparatus.

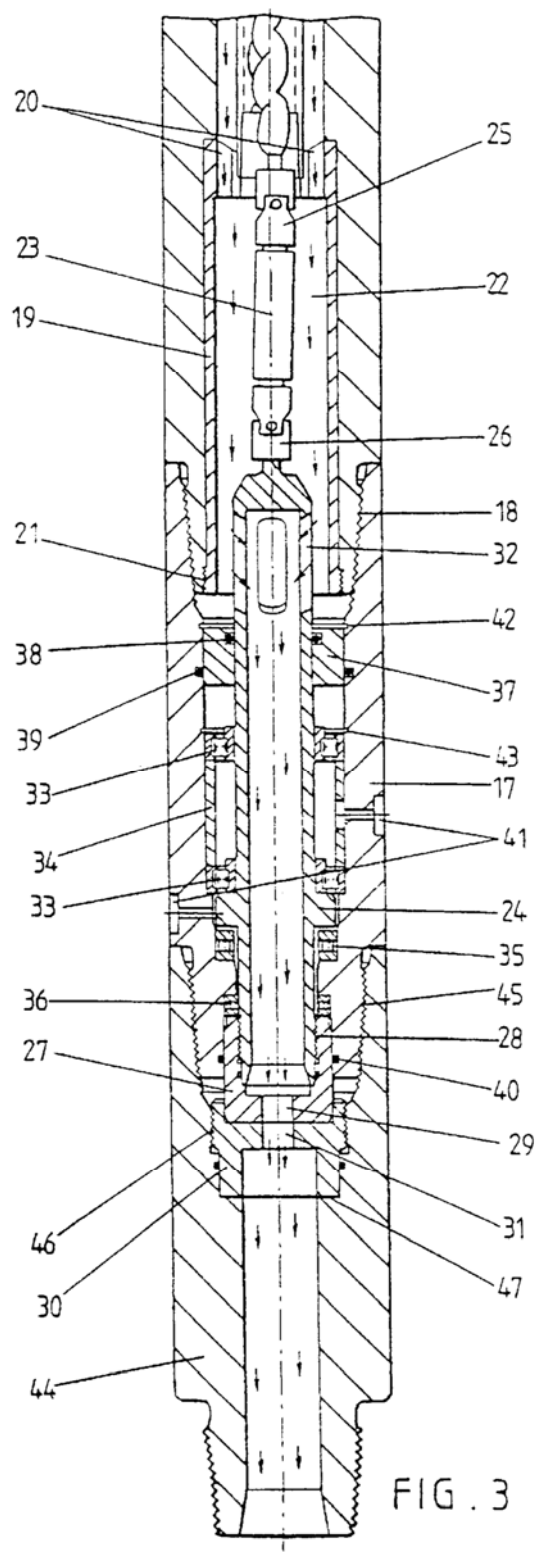
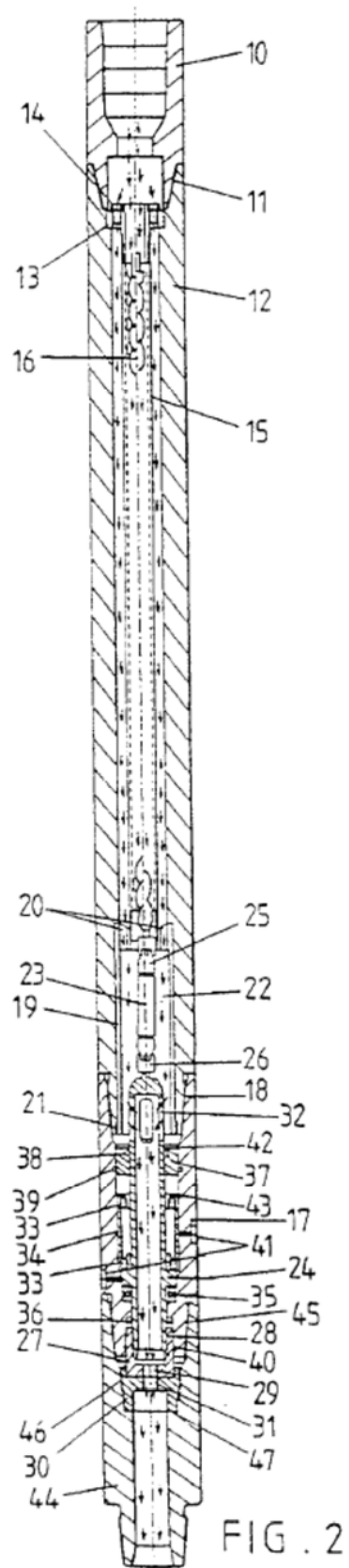


Figure 3 is an enlarged sectional view depicting the valve of the embodiment of a percussion sub illustrated in Figure 2 of the '317 patent. Ex. 1001, 3:38–39. Details of the invention are best understood by way of an explanation of how the valve and associated components work. Near the top of the apparatus is a positive displacement type motor, including stator 15 and rotor 16, which operates using the Moineau principle. Ex. 1001, 4:1–3. High velocity drilling fluid enters the top section of the apparatus, where flow is channeled to achieve a balanced flow rate, which allows the drilling fluid to rotate rotor 16 at a defined speed in relation to the drilling fluid flow rate. *Id.* at 4:6–12.

Rotor 16 connects to shaft 23, which is connected to tubular center shaft 24, such that rotor 16 turns center shaft 24. Ex. 1001, 4:18–25. Valve plate 27, which includes slot opening 29, is attached to the lower end of the center shaft 24 and is rotated by the shaft. *Id.* at 4:26–28. Slot opening 29 provides a fluid passageway for drilling fluid to flow onto fixed valve plate 30, which includes slot 31—slots 29, 31 define an open axial flow passageway through the valve. *Id.* at 4:29–32.

In operation, drilling fluid flows through radial slots 32 in center shaft 24 as the shaft rotates. Ex. 1001, 4:34–36. From shaft 24, fluid flows through slots 29 and 31 and, as the slots rotate into and out of alignment (through the rotation of plate 27), fluid flow is restricted periodically, causing a series of pressure pulses. *Id.* at 4:36–39. These pulses provide a percussive action to the drill bit, increasing the rate that the drill bit penetrates hard rock. *Id.* at 4:40–44. The pulses also vary the drilling fluid flow rate at the bit, which cleans cuttings away from the drill bit during drilling. *Id.* at 4:44–46.

Figure 4 of the '317 patent, is reproduced below.

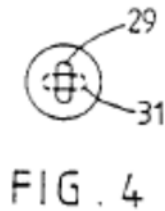


Figure 4 provides a plan view of plates 27 and 30. The plan view of the plates shows slots 29 and 31 in a 90 degree orientation from one another. In this orientation, the flow through the valve is at its minimum—flow is through the central overlapping area only. See Ex. 1001, Fig. 5. As plate 27 continues to rotate, slots 29 and 31 align to create a maximum flow area when slot 29 completely overlaps with slot 31. See *id.*

The embodiment of Figure 7 is similar to that of Figures 1–6, except it employs a larger positive displacement motor. See Ex. 1001, 5:25–27. The embodiment of Figures 8 and 9 is also similar to the embodiment of Figures 1–6. Figure 9 shows valve section 74 includes valve plates 80, 82, with valve plate 80 attached directly to rotor 76 of motor section 72, and valve plate 82 mounted on valve section 74 directly below valve plate 80. *Id.* at 5:43–55. Valve plates 80, 82 define flow ports 84, 86, which align during operation. As rotor 78 rotates, it transfers its side-to-side motion to valve plate 80, which provides a cyclic variation in the flow area defined by flow ports 84, 86. *Id.* at 5:56–61.

C. Illustrative Claims

Claims 1, 7, and 8 of the challenged claims of the '317 patent are independent and are reproduced below.

1. Flow pulsing apparatus for a drill string, the apparatus comprising:

a housing for location in a drill string above a drill bit, the housing defining a throughbore to permit passage of drilling fluid therethrough;

a valve located in the bore and including first and second valve members each defining a respective axial flow opening and which openings are aligned to collectively define an open axial drilling fluid flow port through the valve, the first member being rotatable about a longitudinal axis of the housing to vary the alignment of the openings between a first alignment in which the openings collectively define an open axial flow port of a first open area and a second alignment in which the openings collectively define an open axial flow port of a second open area greater than said first open area to, in use, provide a varying flow therethrough and variation of the drilling fluid pressure; and

drive means operatively associated with the valve for rotating the first member.

7. Downhole apparatus comprising:

a housing for location in a tubing string, the housing defining a throughbore to permit passage of fluid therethrough;

a device including a member which is transversely movable relative to an axis of the housing; and

a fluid actuated positive displacement motor having a rotor coupled to the member for communicating transverse movement of the rotor to the member.

8. A flow pulsing drilling method comprising the steps:

providing a valve in a drill string bore including first and second valve members each defining a respective axial flow opening and which openings collectively define an open axial flow port through the valve, the first member being rotatable about a longitudinal axis of the housing to vary the alignment of the openings, the openings being arranged such that in a complete rotation of the first member about said longitudinal axis the openings are always at least partially aligned and the axial flow port varies in area between a minimum first open area when the first member is positioned in a first alignment and a

maximum second open area when the first member is positioned in a second alignment; and

rotating the first member about said longitudinal axis to vary the alignment of the openings between said first alignment and said second alignment to provide variable flow therethrough and thus produce varying fluid pressure in the drilling fluid.

Ex. 1001, 6:24–33, 6:53–7:10, and 7:24–8:25.

D. The Prior Art

We instituted *inter partes* review on grounds of unpatentability for claims 1, 4, 7, and 8 of the '317 patent that rely on the following references:

Bielstein	US 2,780,438	Feb. 5, 1957	Ex. 1008
Nelson	US 3,216,514	Nov. 9, 1965	Ex. 1009
Sims	US 4,080,115	Mar. 21, 1978	Ex. 1011

E. Asserted Grounds of Unpatentability

We instituted *inter partes* review on the following grounds of unpatentability for the challenged claims of the '317 patent.²

References	Basis	Claims Challenged
Bielstein and Nelson	35 U.S.C. § 103(a)	1, 4, and 8
Sims	35 U.S.C. § 102(b)	7

² We did not institute trial on the asserted ground that claims 1–3 and 5 are unpatentable under 35 U.S.C. § 103(a) over Sims and Nelson. See Dec. on Inst. 39.

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *see also* *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142–46 (2016) (concluding that 37 C.F.R. § 42.100(b) “represents a reasonable exercise of the rulemaking authority that Congress delegated to the Patent Office”). Under the broadest reasonable construction standard, claim terms are generally given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Also, we are careful not to read a particular embodiment appearing in the written description into the claim if the claim language is broader than the embodiment. *See In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993) (“[L]imitations are not to be read into the claims from the specification.”) (citation omitted).

1. “drive means operatively associated with the valve for rotating the first [valve]member”

Independent claim 1 recites a “drive means operatively associated with the valve for rotating the first member.” Ex. 1001, 6:43–44; 7:9–10. Flotek appropriately recognizes that this claim limitation invokes the

requirements of 35 U.S.C. § 112, paragraph 6,³ and provides a construction consistent with our rules. *See* Pet. 4; 37 C.F.R. § 42.104(b)(3).

We construe means-plus-function limitations by determining what the claimed function is and identifying the structure disclosed in the specification that corresponds to the means for performing that function. *See Kemco Sales, Inc. v. Control Papers Co.*, 208 F.3d 1352, 1360 (Fed. Cir. 2000); *see also In re Donaldson Co.*, 16 F.3d 1189, 1193 (Fed. Cir. 1994) (“[P]aragraph six applies regardless of the context in which the interpretation of means-plus-function language arises, i.e., whether as part of a patentability determination in the PTO or as part of a validity or infringement determination in a court.”).

Flotek identifies the function for this claim element as “rotating the first [valve] member.” *See* Pet. 4. Flotek contends that the structures disclosed in the ’317 patent corresponding to this function are “turbines, rotary drill motors, positive displacement motors, or Moineau motors.” *Id.* NOV did not dispute Flotek’s construction of this term, including the identified structures, in its Preliminary Response and, as we determined that Flotek’s construction is reasonable, we adopted it in our Decision to Institute. *See* Dec. on Inst. 11. Neither party offers, expressly or implicitly, an alternative construction for this term and, based on the record developed during trial, we discern no reason to alter the meaning we previously determined, including identified structures. *See* PO Resp. 8 (“This response

³ Paragraph 6 of 35 U.S.C. § 112 was replaced with newly designated § 112(f) when § 4(c) of the America Invents Act (AIA), Pub.L. No. 112–29, took effect on September 16, 2012. Because the application resulting in the ’317 patent was filed before that date, we refer to the pre-AIA version of § 112.

addresses the patentability of the claims at issue under the claim constructions set forth by the Decision [instituting trial].”); *see generally* Reply (providing no alternative construction for the “drive means” term).

2. “axial flow opening”

Independent claim 1 recites “a valve located in the bore and including first and second valve *members each defining a respective axial flow opening* and which openings are aligned to collectively define an open axial drilling fluid flow port through the valve.” Ex. 1001, 6:29–33; 6:58–62 (emphasis added). Similarly, claim 8 recites “a valve in a drill string bore including first and second valve members each defining *a respective axial flow opening* and which openings collectively define an open axial flow port through the valve.” Ex. 1001, 8:8–11 (emphasis added).

In our Decision instituting trial, we determined that the ordinary and customary meaning of the term “axial flow opening” under a broadest reasonable interpretation is “an aperture or open width that permits flow in the axial direction.” Dec. on Inst. 13–14 (referencing Ex. 3001). Neither party offers, expressly or implicitly, an alternative construction for this term and, based on the record developed during trial, we discern no reason to alter the above construction.

B. Overview of the Prior Art

We instituted trial for grounds involving three prior art references—Bielstein, Nelson, and Sims.

1. Overview of Bielstein

Bielstein, titled “Device for Drilling Wells,” “is directed to apparatus in which vibrations are created for drilling a well.” Ex. 1008, 1:16–18.

Figures 1–3 of Bielstein, reproduced below, illustrate an embodiment of its invention.

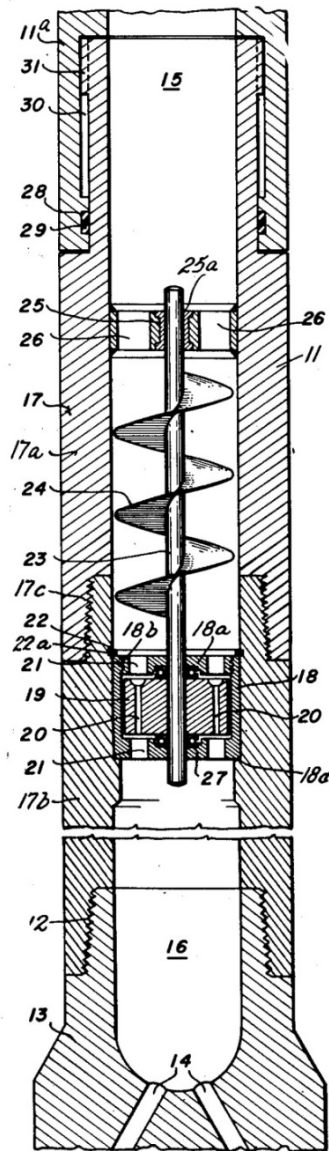


FIG. 1.

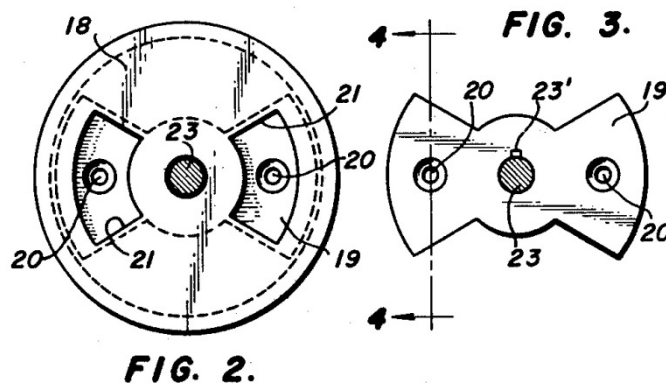


Figure 1 provides a sectional view of Bielstein's drilling device. Ex. 1008, 1:47. Bielstein's Figures 2 and 3 depict a plan view of valve 18 and a plan view of rotatable valve plate 19, respectively. *Id.* at 1:48–51.

Bielstein's drilling device includes drill string 11 that includes drill bit 13 and drill collar 17 attached to the drill string's lower end. Ex. 1008, 1:62–70. Mounted in drill collar 17 is valve 18, which includes rotatable valve plate 19. *Id.* at 1:70–72. Rotatable valve plate 19 is driven by helical vane 24, which is connected to rotatable valve plate 19 through shaft 23. *Id.* at 2:12–14.

During operation, drilling fluid is pumped into passageway 15 and through passageways 26 and against helical vane 24, which causes shaft 23 and valve plate 19 to rotate. Ex. 1008, 2:71–3:6. Rotatable valve plate 19 rotates from a fully open position, where passageways 21 are completely clear from the two main sections of plate 19, and fluid flow through the valve is at a maximum, to a fully closed position, where fluid flow is restricted, except for a small amount of flow through passageways 20. *Id.* at 3:18–21. Restricting the flow of drilling fluid causes a rapid buildup of hydraulic force on drilling collar 17 and creates a water hammer, which is transmitted through drilling collar 17 to drill bit 13 to provide a percussive force on the rock formation being drilled. *Id.* at 3:26–39.

2. Overview of Nelson

Nelson relates to an apparatus for rotary drilling wells. Ex. 1009, 1:8–10. More specifically, Nelson relates to an apparatus that periodically interrupts the flow of drilling fluid to a drill bit to vary the hydraulic pressure at the drill bit and within the borehole and to provide a percussive force on the drill bit. *Id.* at 1:64–2:23.

Nelson's Figures 1 and 2 are reproduced below.

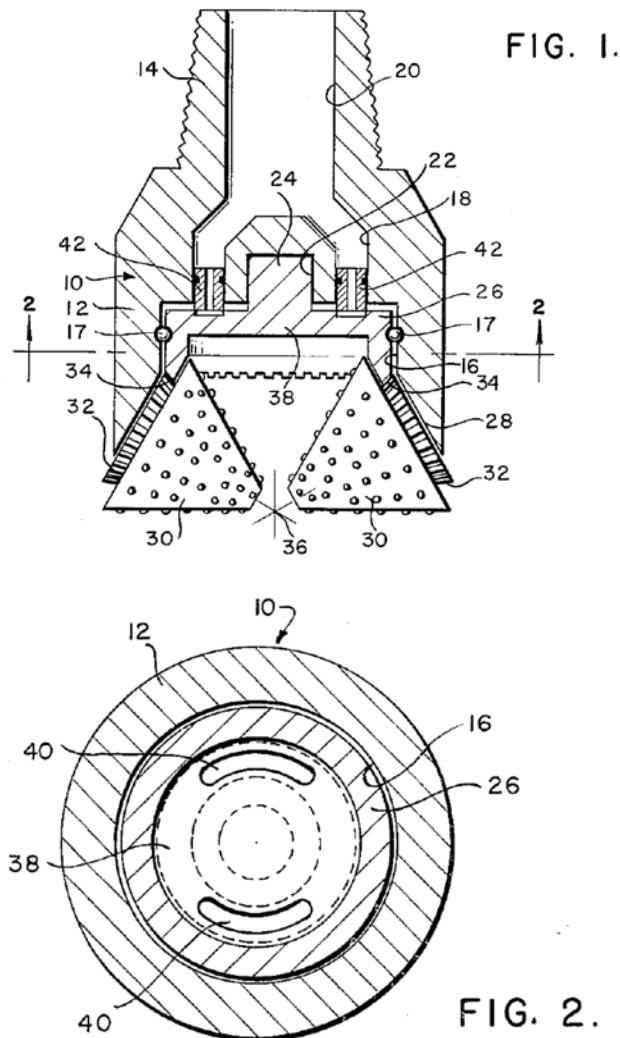


Figure 1 presents “a vertical, central, cross-sectional view illustrating a rotary drilling bit.” Ex. 1009, 2:28–29. Figure 2 presents “a cross-sectional view taken along the line 2—2 of Figure 1, looking in the direction indicated by the arrows [that is, away from and up hole of roller cones 30 of drill bit 10].” *Id.* at 2:31–33; Fig. 1.

Referring to Figures 1 and 2, drill bit 10 includes tubular housing 12, which is attached to the lower end of a drill string through threaded connection 14. Ex. 1009, 2:70–3:3. Housing 12 includes counterbore 16, passageways 18, and recess 22. *Id.* at 3:4–8. Valve member 26 includes lug 24, which extends into recess 22 and serves as a bearing for valve member 26, as does bearing 17 within counterbore 16. *Id.* at 3:10–13. Valve member 26 engages gear 32 of cones 30 so that, as cones 30 rotate, valve member 26 rotates about a vertical axis through lug 24. *Id.* at 3:23–29.

Valve member 26 includes arcuate openings 40, which move in and out of alignment with passageways 18 as valve member 26 rotates to “periodically partially or completely interrupt the flow of fluid through the bit.” Ex. 1009, 3:38–42. When flow is interrupted, “a sudden downward force or water hammer effect will be exerted on the bit, to increase the pressure of the cutters on the formation.” *Id.* at 3:65–67. Also, the hydrostatic pressure exerted by the drilling fluid at the drill face is reduced, such that the cuttings are readily removed from the drill face and entrained in the fluid. *Id.* at 3:67–73.

Nelson teaches that “it is not necessary to completely stop the flow of fluid to achieve the effect” described above. Ex. 1009, 4:73–75. Also, the fluid flow rate through the bit may “be regulated by the size of the passageway through which the fluid flows.” *Id.* at 5:1–2. Nelson further

teaches that “[t]he number and position of the openings 40 of the valve member may . . . be appropriately selected, so that by regulating the speed of rotation of the drilling string, the frequency of interruption of the flow of fluid through the bit may be controlled.” *Id.* at 4:7–11.

3. Overview of Sims

Sims provides “[a]n improved drive train for a progressive cavity device.” Ex. 1011, Abstract. The drive train includes “converting means,” which convert the reverse orbiting motion and rotational motion of a rotor about a single axis at a reduced speed. *Id.* at 3:52–57.

Sims’s Figure 1A is reproduced below.

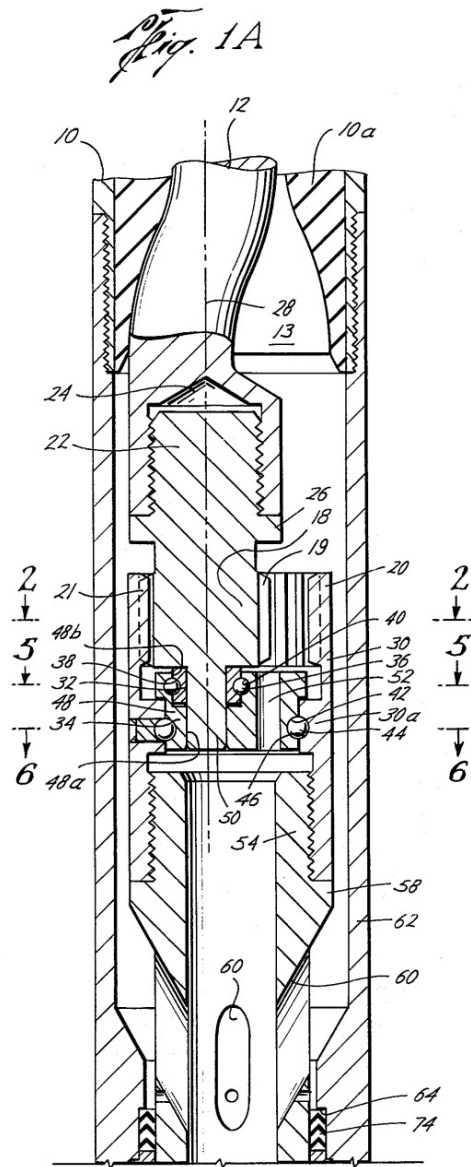


Figure 1A presents a sectional view of the drilling apparatus of the embodiment of Figure 1 of Sims. Ex. 1001, 3:14–18. In operation as the driving apparatus for a drilling device, drilling fluid flows between rotor 12 and lining 10a within housing 10 to produce a rotation, oscillation, and reverse orbit motion of rotor 12. *Id.* at 4:10–15. Pinion 18 is mounted on pinion shaft 22, which is attached to rotor 12. *Id.* at 3:64–67. Pinion 18 engages ring gear 20 to produce a slower rotational driving motion about a

single axis—that is, it converts the complex motion of rotor 12 into rotational motion where the rotation rate is slower than that of rotor 12. *See id.* at 4:15–29; 6:35–43. Pinion 18 engages ring gear 20 through extension 50. *Id.* at 4:51–55. Ring gear 20 includes openings 52, which allow drilling fluid to provide lubrication to the ring gear and pinion bearings as it passes through ring gear 20 and into tubular member 54. 4:57–58; 7:7–11.

Tubular member 54 transfers the rotational motion from ring gear 20 to drill bit 56. Ex. 1001, 4:59–62. Tubular member 54 includes ports 60, which provide fluid communication from the exterior of tubular member 54 to its interior, and ultimately to drill bit 56. *Id.* at 4:65–5:8. Fluid flows over rotor 12 and out outlet 13 and divides into two streams. *Id.* at 7:6–7. The smaller stream lubricates pinion bearings 32 and ring gear bearings 34, flowing through openings 52 to the interior of tubular member 54. *Id.* at 7:7–11. The larger stream flows through the annular space between ring gear sleeve 30 and drive train housing 62 and into tubular member 54, through ports 60, where it merges with the smaller first stream and continues to drill bit 56. *Id.* at 7:11–17.

4. Claims 1, 4, and 8 as unpatentable over Bielstein and Nelson

Flotek contends that claims 1, 4, and 8 would have been obvious to one of ordinary skill in the art based on the combined teachings of Bielstein and Nelson. Pet. 11.

Section 103(a) forbids issuance of a patent when “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been

obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.”

KSR Int’l Co. v. Teleflex Inc., 550 U.S. 398, 406 (2007).

The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when available, secondary considerations, such as commercial success, long felt but unsolved needs, and failure of others. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We analyze these factual determinations, below.

a. Level of Ordinary Skill in the Art

Flotek contends that the level of ordinary skill associated with the ’317 patent “is a person who has, through formal education or extensive practical experience, a Bachelor’s Degree in Mechanical Engineering or a similar degree, or 2–3 years of experience in designing, using or making downhole tools having various applications.” Pet. 3 (referencing the Declaration of Dr. Smith, Ex. 1002 ¶¶ 9–11). NOV does not dispute this definition of the level of ordinary skill associated with the ’317 patent. See PO Resp. (failing to discuss the level of ordinary skill in the art); Ex. 2004 (providing the Declaration of Dr. Akin, which fails to define the level of ordinary skill for the ’317 patent).⁴

Factual indicators of the level of ordinary skill in the art include “the various prior art approaches employed, the types of problems encountered in

⁴ Dr. Akin declares that “[b]ased on my work in the area of downhole tools, I have personal knowledge of the level of skill of those working in that field,” but fails to articulate what that level is. See Ex. 2004 ¶13.

the art, the rapidity with which innovations are made, the sophistication of the technology involved, and the educational background of those actively working in the field.” *Jacobson Bros. v. U.S.*, 512 F.2d 1065, 1071 (Ct. Cl. 1975); *see also Orthopedic Equip. Co. v. U.S.*, 702 F.2d 1005, 1011 (Fed. Cir. 1983) (quoting with approval *Jacobson Bros.*). We find that much of the prior art of record discloses similar equipment as that disclosed in the ’317 patent and addresses similar problems. *See* Exs. 1004–1010; *see also* Ex. 1001, 1:42–44 (indicating that an objective of the ’317 patent is to provide an improved flow pulsing method). We also find that the technology disclosed in the ’317 patent is not very sophisticated, as it discloses housings, drives, and rotating valves—well-known technology employed to provide pulsing fluid flow for a drill string. *See* Ex. 1001, 1:11–41.

In view of our factual findings and the lack of a dispute as to the level of ordinary skill, we adopt Flotek’s definition of the level of ordinary skill in the art.

b. Claim 1

Claim 1 recites “a housing for location in a drill string above a drill bit, the housing defining a throughbore to permit passage of drilling fluid therethrough.” Flotek contends that Bielstein discloses the recited housing, identifying drill string 11. Pet. 31–32; *see also* Ex. 1008, 1:62–68 (“[N]umeral 11 designates a drill string having attached to it at its lower end by mating threads 12 a conventional type of drill bit 13. . . . It will be noted that drill string 11 has a central passageway 15 and that the drill bit 13 is provided with a chamber 16 through which the drilling fluid flows.”). Claim

1 also requires a “drive means operatively associated with the valve for rotating the first member.” Flotek contends that Bielstein’s helical vane 24, which is connected to valve plate 19 through shaft 23, corresponds to structure identified in the ’317 patent for this means-plus-function element. Pet. 36; *see also* Pet. 3–5 (identifying the structure within the ’317 patent that performs the recited function); Ex. 1001, 1:27–42 (identifying “turbines of various forms” as rotating a valve to generate a pulsing fluid flow); Ex. 1002 ¶32 (same).

NOV does not contest Flotek’s application of Bielstein to these claim elements. *See* PO Resp. 9–27 (addressing the patentability of claims 1, 4, and 8 over Bielstein and Nelson, but not contesting that Bielstein discloses these elements). We are satisfied, based on our review of the trial record, that Flotek has demonstrated, by a preponderance of the evidence, that Bielstein discloses the “housing” limitation and the “drive means” limitation of claim 1, and we adopt Flotek’s reasoning and support as set forth above as our own findings.

Claim 1 further requires “a valve located in the bore and including first and second valve members each defining a respective axial flow opening and which openings are aligned to collectively define an open axial drilling fluid flow port through the valve.” Ex. 1001, 6:29–33. Claim 1 requires that the first valve member be capable of being rotated

about a longitudinal axis of the housing to vary the alignment of the openings between a first alignment in which the openings collectively define an open axial flow port of a first open area and a second alignment in which the openings collectively define an open axial flow port of a second open area greater than said

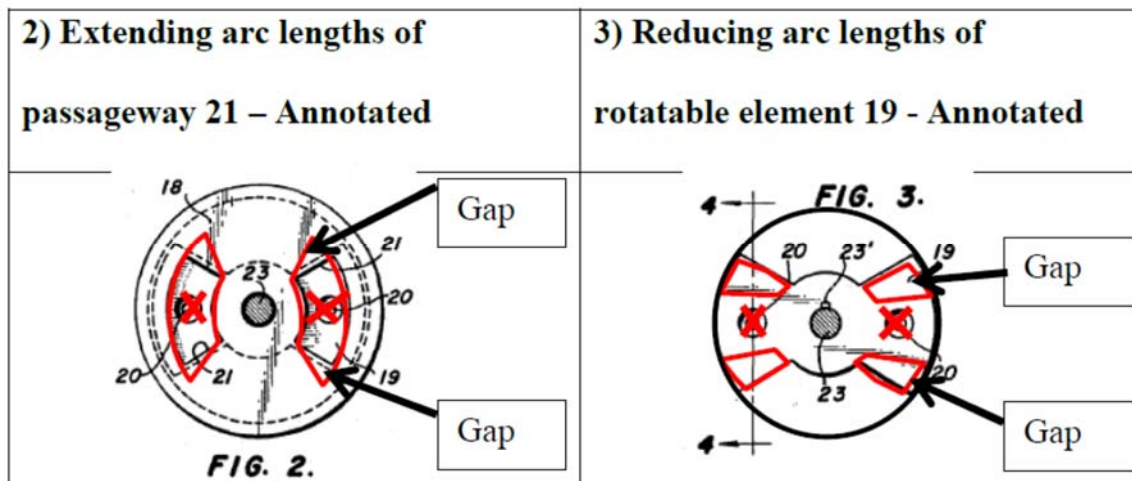
first open area to, in use, provide a varying flow therethrough and variation of the drilling fluid pressure.

Id. at 6:33–41.

Flotek explains that Bielstein’s rotatable valve plate 19 rotates about a longitudinal axis of housing 11. Pet. 33. As valve plate 19 rotates, the main sections of valve plate 19 vary the area of passageways 21 that are open to flow. *Id.* at 34.

Flotek proposes three modifications of Bielstein’s valve, based on the teachings of Nelson, to arrive at a valve that satisfies the requirements of claim 1.⁵ Pet. 17. In one modification, Bielstein’s rotating valve plate 19 and valve housing 18 are replaced by Nelson’s valve elements 42 and 26, with arcuate openings 40. *Id.* (“modification #1”). In a second modification, the geometry of openings 21 in valve housing 18 are altered by extending the arc length of each opening such that a small flow of fluid through the valve would be maintained without the need of passageways 20. *Id.* at 17–18 (“modification #2”). In a third modification, the arc length of the “butterfly wings” of rotatable valve plate 19 is reduced, creating the same effect as in modification #2. *Id.* at 18 (“modification #3”). The following image, taken from the Patent Owner Response, illustrates modifications #2 and #3.

⁵ Flotek interprets claim 1 to require the first and second valve members to always be at least partially aligned (thus always allowing some flow through the valve), an interpretation that leads to Flotek’s proposed modification of Bielstein in view of the teachings of Nelson. See Tr. 5–6. NOV disputes Flotek’s reading of claim 1. See Tr. 27–28. We need not address this dispute regarding the meaning of claim 1, as Flotek’s Petition asserts that claim 1 is unpatentable as obvious over Bielstein as modified by Nelson, not that Bielstein anticipates claim 1.



The image shows annotated versions of Bielstein’s Figure 2 depicting Flotek’s proposed modifications #2 and #3.⁶ PO Resp. 11–12.

As Flotek explains, under modification #2, passageways 21 are increased in width relative to the main sections of valve plate 19, such that when the main sections of valve plate 19 are aligned with passageways 21 (as depicted in Bielstein’s Figure 2), a small area is open for fluid to pass—replacing the function of openings 20 in valve plate 19. *See* Pet. 17–18; 34. In this “full closed” alignment, the flow area (“first open area”) allows a small amount of flow. *Id.* From this position, valve plate 19 rotates to increase the open area of the passageways. As it rotates, the flow area defined by the intersection of passageways 21 and the open width of valve plate 19 increases to a maximum area when the main sections of valve plate 19 rotate completely clear of passageways 21 and the open widths of the valve plate align with the complete area of the passageways—that is, the flow area is greater in this “full open” alignment as compared to the “full

⁶ As we find that modifications #2 and #3 to Bielstein arrive at a valve that satisfies the requirement of claim 1, we do not further analyze modification #1.

closed” alignment (or any alignment prior to the “full open” alignment). *Id.* at 34–35. Modification #3 results in the same operation, as both modifications effectively increase the size of openings 21 relative to the size of the “butterfly wings” of valve plate 19. NOV does not dispute that either modification #2 or modification #3 would yield the subject matter of the valve limitation of claim 1. *See* PO Resp. 9–27 (addressing the patentability of claims 1, 4, and 8 over Bielstein and Nelson, but not contesting that Bielstein, as modified, discloses the “valve” limitation). We are satisfied, based on our review of the trial record, that Flotek has demonstrated, by a preponderance of the evidence, that Bielstein discloses the “valve” limitation of claim 1, and we adopt Flotek’s reasoning and support as set forth above as our own findings.

i. Reasons to Combine Bielstein and Nelson

As part of the obviousness inquiry for claim 1, we consider “whether [an artisan of ordinary skill] would have been motivated to combine the prior art to achieve the claimed invention and whether there would have been a reasonable expectation of success in doing so.” *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1360 (Fed. Cir. 2006). Flotek contends that a person of ordinary skill in the art of the ’317 patent would have been motivated to modify Bielstein as proposed (that is, either modification #2 or modification #3) based on the teachings of Nelson. Pet. 14–18 (relying primarily on Dr. Smith’s Declaration, Ex. 1002). As Flotek explains, “[b]oth the Bielstein and the Nelson devices rely on the relative rotation of valve plates within a tubular housing to bring a set of openings or passageways into and out of alignment to create a variable pressure in the device to assist the drilling of the

formation.” *Id.* at 14; *see also* Ex. 1002 ¶ 53. That is, both references are directed to the same field of endeavor and solve similar problems.

As Flotek and Dr. Smith further explain, both Bielstein and Nelson teach that, to create the varying fluid pressure, the device does not necessarily have to completely stop flow. Pet. 15; Ex. 1002 ¶ 54. Bielstein teaches that a small amount of flow may be maintained through openings 20 in the main sections of valve plate 19. Pet. 16; Ex. 1002 ¶ 55. Flotek and Dr. Smith further explain that Nelson teaches that “[t]he rate of flow of fluid through the bit may, of course, be regulated by the size of the passageway through which the fluid flows.” Pet. 16; Ex. 1002 ¶ 54. That is, an alternative to including openings 20 would be to adjust the valve passageway size to allow for a small amount of flow. Pet. 16; Ex. 1002 ¶ 54. Nelson further teaches that “factors [such as rate of flow] as well as the speed and frequency of flow interruption may be varied to accommodate the apparatus to any operational conditions which may be encountered.” Ex. 1009, 4:75–5:6; *see also* Ex. 1002 ¶ 56 (“Accordingly, one of ordinary skill in the art would look to the valve geometry of Nelson to modify and improve the apparatus of Bielstein to make it more adaptable to differing operating conditions.”). Further, Dr. Smith testified in his deposition that one possible motivation to replace passageways 20 with a larger opening 21 relative to rotating valve element 19, is that passageways 20 may clog or that such a modified valve structure would be easier to manufacture. *See* Reply 7 (referencing Dr. Smith’s testimony).

Dr. Smith also declares that either modification #2 or modification #3 would “yield predictable results given the disclosures of Bielstein and

Nelson with respect to ensuring continual fluid flow and none would adversely impact the operating of the device.” Ex. 1002 ¶ 56.

NOV contends that a person of ordinary skill in the art would not have had reason to modify Bielstein based on the teachings of Nelson. NOV asserts three arguments to support this contention: 1) that modifications #2 and #3 would destroy Bielstein’s intended structure; 2) that modifications #2 and #3 would destroy Bielstein’s teachings of rapid rate of change in fluid volume; and 3) that numerous differences between Bielstein and Nelson belie any reason to combine the teachings of the references. *See* PO Resp. 9–27. We present each of these arguments in turn, along with Flotek’s reply.

First, NOV argues that modifications #2 and #3 would destroy Bielstein’s intended structure, as both modifications remove existing passageways 20. PO Resp. 12. NOV notes that passageways 20 provide a secondary flow path for a small amount of fluid to flow through Bielstein’s tool when the valve is closed. *Id.* NOV further notes that Bielstein fails to teach that clogging or manufacturability may be issues associated with passageways 20. *Id.* at 13. In reply, Flotek argues that nothing in Bielstein requires a secondary flow path. Reply 6. Flotek also argues, as to NOV’s criticism that Bielstein fails to expressly disclose that clogging of passageways 20 or manufacturability are issues, that the Supreme Court foreclosed such an argument in *KSR*. *Id.* at 7 (quoting *KSR Int’l Co.*, 520 U.S. at 419). Flotek contends that concerns such as clogging and manufacturability are part of the knowledge base of a person of ordinary skill. *Id.*

NOV's argument that Flotek's modifications #2 and #3 would destroy Bielstein's intended structure by removing passageways 20 does not persuade us that an artisan of ordinary skill would not have implemented the modifications. The proposed modifications retain the functionality of passageways 20—the functionality is performed by the larger relative size of openings 21 as compared to rotating valve plate 19, which allows some fluid to continually flow to the drill bit. These proposed modifications do not “destroy” the structure of Bielstein's valve—these modifications merely change how the valve would perform its functions. NOV fails to provide any persuasive evidence as to why an artisan of ordinary skill would not replace the functionality of passageways 20 with enlarged openings 21. *See, e.g.,* Ex. 2004 ¶ 35 (providing Dr. Akin's testimony that “I can find no support for [modifications #2 and #3]” but failing to indicate why such modifications would not have been made).

NOV also argues that Nelson fails to teach changing the geometry of openings. PO Resp. 13. NOV contends that, as Dr. Smith testified, Nelson does not describe port 18 in its valve structure. *Id.* NOV continues that Flotek's position relies on modifying openings 40 in rotating plate 38, not the housing. *Id.* at 15. NOV quotes Dr. Smith as saying “Nelson teaches that you could change 18 and 40 as passageways; and so I could suggest then what 18 would also have to look like, along with 40.” *Id.* In reply, Flotek points to Nelson's disclosure that flow may be regulated through the valve “by the size of the passageway through which the fluid flows” to support its position that Nelson does teach modifying valve opening geometry. Reply 7–8. That is, Nelson expressly teaches that the geometry of the passageways—their size—can be used to regulate the flow of fluid

through the valve. Flotek further states that, during prosecution of the parent application to the application that matured into the '317 patent, the patent examiner found that changing the shape of an opening is simply a matter of design choice. *Id.* at 8.

NOV further argues that if Nelson does teach changing the geometry of openings, then one of ordinary skill would simply change the size of openings 20 to solve any problem of clogging and, as such, there would be no reason to eliminate passageways 20. PO Resp. 15. NOV contends that “Flotek has provided no motivation for altering the shape of the blades of Bielstein’s rotating member or its valve housing, especially when such a change would require removing a key functional element (e.g., passageways 20) clearly featured in all embodiments provided by Bielstein.” *Id.* NOV also argues that Bielstein’s rotating element is sized such that it is larger than the openings in the valve housing and that this teaching would motivate a person having ordinary skill in the art to fully cover the valve housing openings when in a closed position, contrary to the proposed modifications #2 and #3. PO Resp. 15–17. Instead, an artisan of ordinary skill would vary the size of passageways 20 to vary flow as taught by Nelson. *Id.* at 17–18.

We agree with Flotek that Nelson’s teaching of changing the size of an opening in its rotating valve is sufficient to teach changing the geometry of any of the valve openings. We are similarly not persuaded by NOV argument that if Nelson does teach changing the geometry of openings, then one of ordinary skill would simply change the size of openings 20 to solve any problem of clogging and, as such, there would be no reason to eliminate passageways 20. Although changing the size of openings 20 may be one solution, it is not the only solution, and NOV directs us to no persuasive

evidence that an artisan of ordinary skill would change the size of openings 20 to the exclusion of other modifications. Indeed, Dr. Akin testifies that a person having ordinary skill in the art *could* change the geometry of passageways 20, but fails to explain why such a modification would be done to the exclusion of modifying openings 21 or even that modifying passageways 20 is preferable to modifying openings 21. See Ex. 2004 ¶ 36.

NOV's argument that Bielstein's rotating element is sized such that it is larger than the openings in the valve housing and that this teaching would motivate a person having ordinary skill in the art to fully cover the valve housing openings when in a closed position, contrary to the proposed modifications #2 and #3, is equally unavailing. NOV points to no disclosure in Bielstein that necessitates rotating element 19 be larger than opening 21. Similarly, NOV points to no other persuasive evidence to support a position that valve plate 19 must be larger than openings 21. See Ex. 2004 ¶ 37 (describing Bielstein's disclosed embodiment as completely covering openings 21 but failing to explain why a person having ordinary skill would understand that such a configuration must be maintained).

Second, NOV asserts that Bielstein teaches a tool designed to employ a water hammer effect to improve the penetration of a drill bit and that this water hammer effect results from a "rapid change in flow." PO Resp. 18 (referencing Ex. 1008, 3:28–36, 3:11–20). NOV stresses that Bielstein teaches that the change in flow "should be rapid." *Id.* at 18–19. NOV argues that Bielstein clearly intends "to provide rapid change in flow rates, and such a rapid change would assist Bielstein in achieving its goal of creating a water hammer effect to drill formations more readily." *Id.* at 19. NOV asserts that Dr. Smith admits that Flotek's proposed modifications

“would result in an extension of the period of time over which flow in the modified device would change from its maximum flow rate to its minimum flow rate” and that this extended time results in the change in flow no longer being rapid. *Id.* at 20; *see id.* at 21–22 (discussing Ex. 2002, a drawing created at Dr. Smith’s deposition reflecting his understanding of flow through Bielstein’s tool as modified and if unmodified). NOV argues that this evidence demonstrates that a person having ordinary skill in the art would have had no reason to make Flotek’s proposed modifications, other than hindsight reconstruction of the claimed invention. *Id.* at 23.

Flotek replies that Patent Owner’s argument misconstrues Bielstein’s teaching—Bielstein does not require that the rate of change of the fluid flow be rapid or even teach that it should be rapid. Reply 9–10. Instead, all Bielstein teaches is that the rate of change in fluid flow is rapid. *Id.* Flotek adds that Bielstein does not indicate what rate of change would fail to create a useful water hammer. *Id.* at 10; *see also* Ex. 2004 ¶ 44 (testifying that the proposed modification would make Bielstein’s device less productive, but not testifying that the change would render Bielstein ineffective as a water hammer). Flotek further replies that claim 1 does not require a water hammer effect, but merely requires varying fluid pressure through the drill string. *Id.* at 11.

Based on our review of the trial record, we are not persuaded that a person having ordinary skill in the art would not have made Flotek’s proposed modifications because such modifications allegedly would have destroyed the rapid rate of change in fluid flow achieved by Bielstein. NOV fails to explain adequately why, or to what extent, the water hammer effect is affected by the proposed modifications. Further, NOV does not contend

that the proposed modifications would render Bielstein ineffective as a water hammer. See Tr. 40:16–19 (“[W]hat Dr. Akin testified to was [the proposed modifications] would reduce the vibrational impact of the Bielstein reference. He did not say that it would completely preclude Bielstein from operating as a water hammer.”). Still further, as Flotek states, it is unclear from Dr. Smith’s testimony whether there is a reduced rate of change in the flow through Bielstein resulting from the modification. See 53:10–54:14.

Also, we give NOV’s Exhibit 2002 little weight in support of NOV’s position. Exhibit 2002 is a qualitative representation of how the flow characteristics through Bielstein’s valve might change under Flotek’s proposed modifications. See Ex. 2003, 55:6–59–7. This qualitative nature leads to speculation as to the effect of extending the period of maximum flow rate as depicted in the exhibit. It also fails to reflect how a person having ordinary skill in the art may adjust valve geometries and other operating parameters to optimize operations. See *KSR Int’l Co.*, 550 U.S. at 418 (“[The obviousness analysis] need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.”).

Third, NOV argues that “numerous differences exist between Bielstein and Nelson which would further deter the combination of such references by one of skill in the art.” PO Resp. 23. Specifically, NOV argues that Bielstein’s valve is located above the drill bit and Nelson’s valve is located at the drill bit. *Id.* at 24. NOV states that Nelson’s valve is driven by rotating cutting elements to cause reduced hydrostatic pressure where the cuttings are formed. *Id.* NOV argues that, in contrast, Bielstein’s valve is

located uphole from the bit to transmit the vibration energy downwardly to the bit, such that its teachings conflict with that of Nelson. *Id.* at 25. That is, Nelson’s teachings are directed to having the valve close to where cuttings are formed and Bielstein is directed to a valve remote from the bit. *Id.* at 26.

NOV continues that Nelson’s rotating element is cylindrical and Bielstein’s element is hourglass-shaped. PO Resp. 27. NOV further states that Nelson’s structure has teeth used to drive the rotation of the element and Bielstein’s element has smooth edges—demonstrating “striking differences” between the two valves. *Id.*

Flotek replies that “[t]he devices disclosed and claimed by [Bielstein] and those disclosed and claimed by Nelson are very similar.” Reply 1. Specifically, Flotek contends that both references employ a water hammer effect to improve drilling and the effect is created by a rotating valve. *Id.* at 2. Flotek further contends that both references disclose that it is not necessary for the rotating valve to stop all flow through the device to achieve its advantages. *Id.* Flotek also argues that NOV fails to demonstrate how the asserted differences between Bielstein and Nelson relate to whether an artisan of ordinary skill would have been motivated to make Flotek’s proposed modifications. *Id.* at 4.

We are not persuaded by NOV’s argument that differences between Bielstein and Nelson would discourage a person having ordinary skill in the art from modifying Bielstein with Nelson’s teachings. We agree with Flotek that Bielstein and Nelson are very similar to the extent that they employ a rotating valve to create a water hammer effect to improve drilling. We also agree with Flotek that NOV’s argument fails to explain adequately why its

asserted differences would have dissuaded an artisan of ordinary skill to modify the geometry of Bielstein's openings 21 or rotating element 19 based on Nelson's teachings. That is, NOV fails to explain persuasively why Nelson's valve being located at the drill bit and driven by the bit cones would somehow negate its teachings as to modifying valve opening geometries.

Based on the complete trial record, we determine that Flotek has demonstrated, by a preponderance of the evidence, that an artisan of ordinary skill would have had reason to modify Bielstein's valve to eliminate passageways 20 and either increase the size of openings 21 ("modification #2") or reduce the size of element 19 ("modification #3") so that at all times some flow would move through valve 18 to the drill bit. Nelson expressly teaches that "[t]he rate of flow through the [drill] bit may . . . be regulated by the size of the passageways through which fluid flows." Ex. 1009, 4:75–5:2. Nelson further teaches that rate of flow "may be varied to accommodate [Nelson's] apparatus to any operational conditions [that] may be encountered." *Id.* at 5:3–6. From these teachings, we credit Dr. Smith's testimony and find that an artisan of ordinary skill would have understood that certain operating conditions would serve as a driver for varying the flow characteristics through Bielstein's device. *See* Ex. 1002 ¶ 56 ("Accordingly, one of ordinary skill in the art would look to the valve geometry of Nelson to modify and improve the apparatus of Bielstein to make it more adaptable to differing operating conditions.").

Further, Bielstein discloses that its valve allows at least some flow of fluid to the drill bit at all times. *See, e.g.,* Ex. 1008, 3:21–26 (disclosing a minimum flow of "almost zero"); Figs. 1 and 2 (depicting passageways 20

that allow fluid flow through the valve when the valve is in the fully closed position). Similarly, Nelson discloses that “it is not necessary to completely stop the flow of fluid to achieve [Nelson’s] effect” of relieving the hydrostatic pressure. Ex. 1009, 4:73–75. We determine that a person having ordinary skill in the art would have had reason to modify Bielstein as proposed by Flotek to adapt Bielstein’s valve to certain operating conditions using the technique expressly taught by Nelson, such as to reduce the potential effects of clogging of passageways 20 as opined by Dr. Smith, and that such a modification would have been within the level of ordinary skill. See Ex. 1002 ¶¶ 53–56. As the Supreme Court made clear, “if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond that person’s skill.” *KSR Int’l Co.*, 550 U.S. at 401.

Further, we credit Dr. Smith’s testimony that Flotek’s proposed modifications would have yielded “predictable results given the disclosures of Bielstein and Nelson with respect to ensuring continual fluid flow and none would adversely impact the operating of the device.” Ex. 1002 ¶ 56; see *KSR Int’l Co.*, 550 U.S. at 417 (“If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability.”). As Dr. Smith declares, “Nelson indicates that valve geometry and positioning can be modified to meet any operating conditions and the needed speed and frequency of pressure pulsing.” Thus, we find that a person of ordinary skill in the art would have had a reasonable expectation of success in achieving the proposed modifications. Further, Flotek’s proposed modifications represent an alternative approach to solving the problem of providing a

constant flow of fluid to Bielstein’s drill bit. *Cf. KSR Int’l Co.*, 550 U.S. at 421 (“When there is a design need . . . to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.”).

ii. Secondary Considerations

NOV contends that secondary considerations militate against a conclusion that claim 1 is obvious. Specifically, NOV contends that its Agitator product embodies claims 1 and 8⁷ and 1) has experienced commercial success; 2) satisfied a long-felt yet unresolved need; 3) was copied by competitors; and 4) has been praised in the industry. PO Resp. 30–38. We present NOV’s contentions as to each of these four secondary considerations, along with Flotek’s reply, in turn.

As an initial matter, “[f]or objective evidence to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention.” *In re GPAC Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995). “[T]here is a presumption of nexus for objective considerations when the patentee shows that the asserted objective evidence is tied to a specific product and that product ‘is the invention disclosed and claimed in the patent.’” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1329 (Fed. Cir. 2016); *see also PPC Broadband, Inc. v. Corning Optical Commc’ns RF, LLC*, 815 F.3d 734, 747 (Fed. Cir. 2016) (“Because

⁷ Although this section of our Decision addresses the obviousness of claim 1, we analyze NOV’s secondary considerations for claims 1, 4, and 8 here, for convenience.

the evidence shows that the SignalTight connectors are ‘the invention disclosed and claimed in the patent,’ we presume that any commercial success of these products is due to the patented invention. This is true even when the product has additional, unclaimed features.”). “The presumption of nexus is rebuttable: a patent challenger may respond by presenting evidence that shows the proffered objective evidence was ‘due to extraneous factors other than the patented invention.’ Such extraneous factors include additional unclaimed features and external factors, such as improvements in marketing.” *WBIP, LLC*, 829 F.3d at 1329.

We find that NOV is entitled to this rebuttable presumption as to claims 1 and 8 but not as to claim 4. NOV relies on the testimony of Mr. Shwets, NOV’s Vice President – Drilling Technologies, to support its position that a nexus exists between the evidence and claims 1 and 8. *See* Ex. 2006. Mr. Shwets declares that the inventions of claims 1 and 8 were developed into the Agitator product—that is, that the Agitator product embodies claims 1 and 8. *See id.* ¶¶ 8, 9. NOV, however, does not contend that the Agitator product embodies claim 4, which depends from claim 1 and further requires the valve openings be non-circular. *See* Tr. 44–45; *see also* Ex. 2008, Fig. 1 (depicting the Agitator product having circular valve openings).

Commercial Success

NOV contends that the Agitator product generated in excess of \$100 million in revenues since 2009. PO Resp. 32. NOV further contends that there is a nexus between this revenue and the patented features of claims 1 and 8—specifically, the claimed valve configuration. *Id.* at 33. NOV argues that the Agitator’s performance results from using the oscillating and

stationary valves. *Id.* NOV further argues that evidence comparing the performance of drilling operations with and without the Agitator provides direct support that its commercial success is due to the patented features. *Id.* at 33–34. Finally, NOV points to evidence containing industry testimonials, which demonstrates that the Agitator’s success is due to the patented features. *Id.* at 34.

Flotek argues that there is no nexus between the Agitator revenue value provided by NOV and the patented features corresponding to claims 1 and 8. To support this position, Flotek cites to testimony from Mr. Shwets concerning coiled tubing applications of the Agitator, which would not include a drill string. Reply 20. Flotek further argues that NOV’s size, market power, and resources contribute to the Agitator’s revenue. *Id.* at 21. Flotek cites to Exhibit 2011, which indicates that the Agitator was employed in drilling in the Permian Basin after NOV purchased Grant Prideco. *Id.*; see also Ex. 2011, 2 (“The main reason for the tool’s introduction into the Permian Basin was the purchase of Grant Prideco by NOV ‘Once we became part of NOV we not only got this international footprint, we got access to all of their facilities,’ as well as the ability to stage tools.”).

We have considered Flotek’s arguments and find that they are insufficient to rebut the presumption of a nexus between the claimed inventions of claims 1 and 8 and any alleged commercial success. Flotek’s argument with respect to the coiled tubing application goes to the weight we assign NOV’s \$100 million revenue value, as it does not address the component of that revenue that is attributable to applications of the Agitator product that do employ a drill string. Flotek’s argument regarding Ex. 2011 illustrates one situation where NOV’s resources may have contributed to

revenue for the Agitator product, but this example alone is insufficient to rebut the presumption of nexus.

Flotek further argues that the \$100 million revenue value is but a small fraction of NOV's total revenue and that NOV fails to provide any information on market share of the Agitator in support of the alleged commercial success, although Mr. Shwets acknowledges that there are competing products in the market. Reply 20; *see also* Ex. 1020, 64:15–17 (indicating that there are competing friction reduction tools). Flotek further provides that some of the \$100 million in revenue is attributable to an application of the Agitator product that does not embody the claimed invention – an application that does not employ a drill string. *See* Reply 20; Ex. 1020, 54:3–16.

Even with the presumed nexus between claims 1 and 8 of the '317 patent and any alleged commercial success, NOV's proffered commercial success evidence is entitled to little weight. NOV offers a revenue value, but fails to put that value in perspective. "[T]he more probative evidence of commercial success relates to whether [] sales represent 'a substantial quantity in th[e] market.'" *In re Applied Materials, Inc.*, 692 F.3d 1289, 1300 (Fed. Cir. 2012). NOV provides no such market share data. Further, as Flotek notes, certain revenues are attributed to an application of the Agitator product that does not embody the claimed invention, thus discounting the total revenue value proffered by NOV.

Long-felt yet unresolved need

NOV also contends that the invention of claims 1 and 8 of the '317 patent satisfied a long-felt yet unresolved need. PO Resp. 34. To support this position, NOV points to the prior art references of record, which are

directed to improving drilling performance—that is, the prior art demonstrates that the industry has had the need for enhanced drilling capability since 1915. *Id.* at 34–35. NOV then points to the Agitator’s enhanced drilling performance compared to drilling operations that did not employ the Agitator. *Id.* at 36. NOV argues that this enhanced performance demonstrates the consistent failure of others to achieve the long-felt need of improved drilling performance. *Id.*

Flotek argues that, as evidenced by the prior art of record, the problem of using a water hammer effect to improve drilling performance has already been solved. Reply 22. Flotek further argues that any enhanced performance by the Agitator, compared to not using the Agitator, does not equate to a failure of others to solve a need. *See id.*

Although, evidence of a long felt but unresolved need tends to show non-obviousness because it is reasonable to infer that the need would have not persisted had the solution been obvious—“[a]bsent a showing of long-felt need or the failure of others, the mere passage of time without the claimed invention is not evidence of nonobviousness.” *See Iron Grip Barbell Co. v. USA Sports, Inc.*, 392 F.3d 1317, 1325 (Fed. Cir. 2004)). We agree with Flotek that all NOV has demonstrated is a passage of time from when tools that employ a water hammer effect were first introduced and the arrival of NOV’s Agitator product. NOV fails to explain adequately why the technology embodied in the prior art patents fails to satisfy the need for enhanced drilling performance by tools employing a water hammer effect. NOV has merely demonstrated that the Agitator’s drilling performance is superior to drilling without the Agitator. Because NOV’s evidence does not

show a long-felt need that had not been addressed, we give NOV's evidence very little weight.

Copying

NOV further contends that others have copied the Agitator product. PO Resp. 37. To support this position, NOV references two ongoing patent infringement litigations that allege that Flotek's Stimulator product and Amega West's AmegaVibe product infringe claims 1, 4, and 8 of the '317 patent. *Id.* In Reply, Flotek argues that: 1) neither infringement complaint alleges copying; 2) infringement has not been proved in either litigation; and 3) infringement of a patent claim does not equate to copying. Reply 23–24.

The fact that a competitor copied technology suggests it would not have been obvious. *See Windsurfing Int'l, Inc. v. AMF, Inc.*, 782 F.2d 995, 1000 (Fed. Cir. 1986) (“[C]opying the claimed invention, rather than one within the public domain, is indicative of non-obviousness.”). To support an assertion of copying, governing case law requires evidence that shows a specific product was replicated, “which may be demonstrated through internal company documents, direct evidence such as disassembling a patented prototype, photographing its features, and using the photograph as a blueprint to build a replica, or access to the patented product combined with substantial similarity to the patented product.” *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010). NOV has provided no such evidence. Accordingly, we find, based on the record, that the proffered evidence is insufficient to support an assertion of copying the inventions of claims 1, 4, and 8, thus we give it very little weight. Although the evidence, at best, may support an infringement claim, it does not support a claim of copying.

Industry praise

NOV contends that “[n]umerous members of the industry have given documented testimonials on behalf of NOV’s Agitator.” PO Resp. 38. Specifically, NOV points to praise from companies such as Sperry Drilling Services and Baker Hughes provided in Exhibit 2010 and praise in a news article provided as Exhibit 2011. *Id.*

In reply, Flotek argues that any praise lacks a nexus to the claimed invention. Reply 24. Flotek explains that NOV fails to attribute any of the purported advantages to claim limitations and that the performance characteristics discussed in this alleged praise are not associated with limitations of claims 1 or 8. *Id.* at 24–25.

We have considered Flotek’s position, and the underlying evidence, and determine that the evidence is sufficient to rebut the presumed nexus between the inventions of claims 1 and 8 and the proffered industry praise evidence. For example, statements attributed to Sperry Drilling Services assert that “[w]ith the Agitator™ system in hole, weight transfer was smooth and consequently toolfaces were rock steady” and “[i]t is very unlikely we would have been able to achieve the required doglegs without the Agitator™ system tool.” Ex. 2010, 1. Exhibit 2010, however, provides that the Agitator “dramatically reduce[s] friction through *gentle* axial oscillation” to “greatly improve[] weight transfer.” *Id.* (emphasis added). NOV fails to explain adequately what limitation of claims 1 and 8 results in *gentle* oscillation and the resulting improved weight transfer. In that respect, it is not apparent that this benefit is not attributed to an additional unclaimed feature. Similarly, Baker Hughes purportedly stated that the Agitator provided “[u]nparalleled tool face control and unprecedented ROP in sliding

mode”—another advantage associated with “gentle” oscillation. *See id.* Also, Exhibit 2010 attributes the placement of the Agitator high up the drill string to aiding moving pipe through curved sections, such as doglegs. *See id.*

Further, the record evidence indicates that placing the Agitator “directly above or very close to the motor” improves the toolface control and increases rate of penetration (“ROP”). *See* Ex. 2010, 1 (“In 90% of applications the Agitator™ system is run directly above, or very close to the motor in order to improve toolface control as well as to increase ROP.”). NOV fails to explain adequately how the placement of the Agitator in the drill string corresponds to any limitation of claims 1 and 8. Still further, the news article provided in Exhibit 2011 attributes the reduction in friction, and associated improved performance, to a shock tool, which is not claimed in claims 1 and 8. *See* Ex. 2011 (“When the wave goes into the shock tool it extends and releases the shock tool . . . , slinging the wave up and down the drill string[,] . . . [which] keeps (the drill string) moving so that no friction can form, letting it work more smoothly.”). Accordingly, we find that NOV’s proffered evidence of industry praise lacks a nexus to claims 1 and 8 and assign it very little weight.

iii. Conclusion—Claim1

We have weighed NOV’s evidence of secondary considerations and, on the trial record, we attribute little weight to the evidence. Weighing the underlying evidence in the trial record, including the reasons to combine the teachings of Bielstein and Nelson and NOV’s evidence of secondary considerations, we conclude that Flotek has demonstrated, by a

preponderance of the evidence, that claim 1 is unpatentable under 35 U.S.C. § 103(a) over Bielstein and Nelson.

c. Claim 4

Claim 4 depends from claim 1 and adds the limitation that “the valve openings are non-circular.” Ex. 1001, 6:50–51. Flotek contends that both Bielstein and Nelson teach non-circular openings. Pet. 37. For example, Flotek identifies that Bielstein’s openings 21 are arcuate, not circular. *Id.* Further, as we discussed above in connection with our analysis of claim 1 over Bielstein and Nelson, under Flotek’s proposed modifications, Bielstein’s openings 21 would retain their arcuate shape. We adopt Flotek’s reasoning and support as set forth above as our own findings.

NOV simply contends that there would have been no reason to modify Bielstein with the teachings of Nelson, an issue we addressed with regard to claim 1. *See* PO Resp. 9–27 (addressing the reason to combine Bielstein and Nelson, but not addressing whether Bielstein, as modified by Nelson, would disclose the subject matter of claim 4). As we determined above in connection with our analysis of claim 1, Flotek demonstrates, by a preponderance of the evidence, that an artisan of ordinary skill would have had reason to modify Bielstein with the teachings of Nelson.

Weighing the underlying evidence in the trial record, including the evidence of secondary considerations discussed above in connection with our analysis of claim 1 over Bielstein and Nelson, we conclude that Flotek has demonstrated, by a preponderance of the evidence, that claim 4 is unpatentable under 35 U.S.C. § 103(a) over Bielstein and Nelson.

d. Claim 8

Independent claim 8 is directed to a flow pulsing drilling method and includes the step of providing “a valve in a drill string bore including first and second valve members each defining a respective axial flow opening and which openings collectively define an open axial flow port through the valve.” *See* Ex. 1001, 8:6–11. Flotek contends that Bielstein discloses the quoted subject matter. Specifically, Flotek contends that Bielstein’s valve body 18 and rotatable valve plate 19, which is located in Bielstein’s drill string bore, satisfy this claim element. Pet. 20. As Flotek explains, the second valve member—valve body 18—includes two axial flow openings (passageways 21). *Id.* at 21. Further, the first valve member—valve plate 19—also includes two axial flow openings. *Id.* As indicated in Flotek’s annotated version of Bielstein’s Figure 3, the open space between the two ends of valve plate 19 form the axial flow openings. *See id.*⁸

The “providing” step of claim 8 further requires that “the first member be rotatable about a longitudinal axis of the housing^[9] to vary the alignment of the openings” in the first and second valve members. Ex. 1001, 8:11–13. The “providing” step also requires that “the axial flow port varies in area between a minimum first open area when the first member is positioned in a

⁸ The Petition also explains how Nelson discloses a valve with a first and second member as recited in claim 8. Pet. 22–23. As we base our Decision on Institution on Flotek’s modification to Bielstein’s valve body 18 and valve plate 19, we need not address this disclosure.

⁹ Claim 8 recites “the housing,” which appears to lack any antecedent basis. For the purposes of this decision, we interpret the term “the housing” to mean “a housing.”

first alignment and a maximum second open area when the first member is positioned in a second alignment.” *Id.* at 8:16–20.

Flotek explains that Bielstein’s valve plate 19 rotates about a longitudinal axis of housing 11. Pet. 23. As valve plate 19 rotates, the main sections of the plate expose area of passageways 21 that are open to flow. *Id.* Under one proposed modification of Bielstein, based on the teachings of Nelson, passageways 21 are increased in width relative to the main sections of valve plate 19 (and passageways 20 are eliminated), such that when the main sections of valve plate 19 are aligned with passageways 21 (as depicted in Bielstein’s Figure 2), a small area is open for fluid to pass—replacing the function of passageways 20 in valve plate 19. See Pet. 17–18, 23–24. In this “closed” position, the flow area is at a minimum. From this position, valve plate 19 rotates to increase the open area of the passageways—as it rotates, the flow area defined by the intersection of passageways 21 and the open width of valve plate 19 increases to a maximum area when the main sections of valve plate 19 rotate completely clear of passageways 21 and the open widths of the valve plate align with the complete area of the passageways. *Id.* at 23–24.

The “providing” step of claim 8 further requires that the openings are “arranged such that in a complete rotation of the first member about said longitudinal axis the openings are always at least partially aligned.” Ex. 1001, 8:13–16. Flotek explains that, as modified by the teachings of Nelson, Bielstein’s valve plate 19 and valve housing are always at least partially aligned. Pet. 23–24. As explained above, the modified configuration results in a small area of openings 21 remaining uncovered

and allowing some minimum flow when valve plate 19 moves to the “closed” position.

NOV does not contest Flotek’s contentions of how Bielstein, as modified, discloses the “providing” step of claim 8. *See* PO Resp. 9–27 (addressing the reason to combine Bielstein and Nelson, which we address with regard to claim 1 above, but not addressing whether Bielstein, as modified, would disclose the subject matter of claim 8). We find, based on the trial record, that Flotek has demonstrated, by a preponderance of the evidence, that Bielstein, as modified, discloses the “providing” step of claim 8, and we adopt Flotek’s reasoning and support as set forth above as our own findings.

Claim 8 further requires the step of “rotating the first member about said longitudinal axis to vary the alignment of the openings between said first alignment and said second alignment to provide variable flow therethrough and thus produce varying fluid pressure in the drilling fluid.” Ex. 1001, 8:21–25. As Flotek explains, in operation of Bielstein’s device, valve plate 19 rotates about a longitudinal axis to vary the alignment of passageways 21 and the open widths between the two main sections of valve plate 19, which produces a varied fluid pressure in the drilling fluid. Pet. 27–28. NOV does not provide additional arguments with respect to this claim element. *See* PO Resp. 9–27. We find, based on the trial record, that Flotek has demonstrated, by a preponderance of the evidence, that Bielstein, as modified by Nelson, discloses the “rotating” step of claim 8, and we adopt Flotek’s reasoning and support as set forth above as our own findings.

NOV argues that a person having ordinary skill in the art would have had no reason to modify Bielstein with the teachings of Nelson to arrive at

the subject matter of claim 8. *See* PO Resp. 9–27 (addressing the reason to combine Bielstein and Nelson and grouping claims 1, 4, and 8 together but not addressing whether Bielstein, as modified, would disclose the subject matter of claim 8). We addressed these arguments above, in connection with our analysis of claim 1, and were not persuaded that Flotek failed to demonstrate, by a preponderance of the evidence, that an artisan of ordinary skill would have had reason to modify Bielstein with the teachings of Nelson.

NOV also argues that secondary considerations militate against a conclusion that claim 8 is obvious. *See* PO Resp. 30–38. As discussed above in connection with our analysis of claim 1, we attribute little weight to this evidence. Weighing the underlying evidence in the trial record, including the evidence of secondary considerations, we conclude that Flotek has demonstrated, by a preponderance of the evidence, that claim 8 is unpatentable under 35 U.S.C. § 103(a) over Bielstein and Nelson.

5. Claim 7 as anticipated by Sims

In the Petition, Flotek contends that Sims anticipates claim 7 of the '317 patent, and we instituted trial on this ground. *See* Pet. 38–43; Dec. on Inst. 40. A “prior art reference—in order to anticipate under 35 U.S.C. § 102—must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements ‘arranged as in the claim.’” *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983)). Although NOV concedes that Sims anticipates claim 7, we separately analyze the trial record to determine if Flotek has

proved, by a preponderance of the evidence, that Sims anticipates claim 7. *See* 35 U.S.C. §§ 316(e), 318; *see also* PO Resp. (not addressing claim 7); Tr. 24 (“JUDGE COCKS: Counsel, before you go on, I’d like to clear up a matter here. Opposing counsel said that your response . . . conceded the unpatentability of Claim 7? Is that accurate? MR. McAUGHAN: That’s correct, Your Honor.”).

Claim 7 recites “a housing for location in a tubing string, the housing defining a throughbore to permit passage of fluid there-through.” Ex. 1001, 7:24–27. Flotek contends that drill strings 10 and 62 depicted in Sims’s Figures 1 and 1A satisfy this claim limitation. *Id.* at 39–40.

Claim 7 also recites “a device including a member which is transversely movable relative to an axis of the housing.” Ex. 1001, 8:1–2. Flotek contends that the recited member includes pinion 18, extension 50, and pinion shaft 22. Pet. 40–42. As Flotek explains, “pinion shaft 22, pinion 18 and extension 50 orbit about the longitudinal axis of [] housing 10.” *Id.* at 42. Flotek further explains that rotor 12 transfers its complex motion, which includes rotational motion and transverse motion, to pinion shaft 22, pinion 18, and extension 50, which is characteristic of Moineau-type motors such as that disclosed in Sims. *Id.*

Claim 7 further recites “a fluid actuated positive displacement motor having a rotor coupled to the member for communicating transverse movement of the rotor to the member.” Ex. 1001, 8:3–5. Flotek contends that Sims discloses a Moineau-type positive displacement motor with rotor 12 coupled to a member—pinion shaft 22, pinion 18, or extension 50. Pet. at 42–43.

As stated above, NOV does not contest Flotek's assertion that Sims anticipates claim 7. We find, based on the trial record, that Flotek has demonstrated, by a preponderance of the evidence, that Sims discloses each claim limitation of claim 7 as arranged in the claim, and we adopt Flotek's reasoning and support as set forth above as our own findings. Accordingly, we find that Flotek has demonstrated, by a preponderance of the evidence, that claim 7 unpatentable as anticipated by Sims.

III. CONCLUSION

For the foregoing reasons, we are persuaded that the information presented in the Petition establishes, by a preponderance of the evidence, that claims 1, 4, 7, and 8 of the '317 patent are unpatentable.

IV. ORDERS

After due consideration of the record before us, it is:

ORDERED that claims 1, 4, and 8 of the '317 patent are held to be *unpatentable* under 35 U.S.C. § 103(a) over Bielstein and Nelson;

FURTHER ORDERED that claim 7 of the '317 patent are held to be *unpatentable* under 35 U.S.C. § 102(b) as anticipated by Sims; 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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