NOTE: This disposition is nonprecedential.

United States Court of Appeals for the Federal Circuit

KICHUL SEONG,
Appellant

v.

BEDRA INC., BERKENHOFF GMBH, POWERWAY GROUP CO. LTD.,
Appellees

2020-1870

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2018-01415.

Decided: April 13, 2021

KICHUL SEONG, Pyeongtaek, South Korea, pro se.

REGINALD J. HILL, Jenner & Block LLP, Chicago, IL, for appellees. Also represented by BENJAMIN J. BRADFORD.

Before NEWMAN, LOURIE, and DYK, *Circuit Judges*.

LOURIE, *Circuit Judge*.

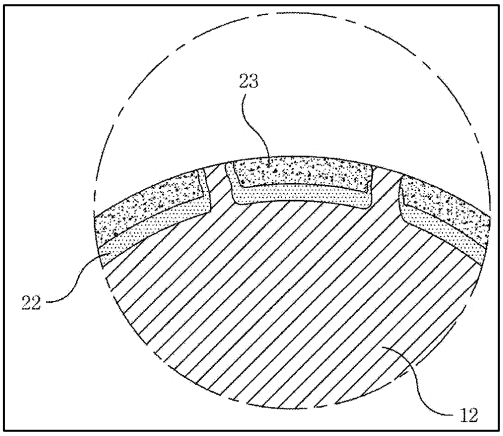
Ki-Chul Seong appeals from the final written decision of the Patent Trial and Appeal Board (the "Board") holding that claims 1–13 and 15 of U.S. Patent 8,822,872 (the "'872 patent") are unpatentable because they would have been obvious over Tomalin and Nishioka patents and denying Seong's Contingent Motion to Amend. *See Bedra Inc. v. Seong*, No. IPR2018-01415, 2020 WL 355007 (P.T.A.B. Jan. 21, 2020) ("*Decision*"). Seong only appeals from the Board's decision regarding claims 2–5, 10–12 and 16. Because the Board did not commit legal error, and substantial evidence supports the Board's factual findings, we *affirm*.

BACKGROUND

Seong owns the '872 patent, which is directed to "an electrode wire for electro-discharge machining ['EDM'] and [methods] for manufacturing [electrode wires]." '872 patent Abstract. EDM technology employs an electrode wire and a high-frequency voltage to perform a cutting process. *See id.* at col. 1 ll. 18–47; *see also* Fig. 1. The '872 patent explains that pure copper wire has been used for EDM, but with three disadvantages: low tensile strength, inferior machining accuracy, and slow machining speed. *See id.* at col. 1 ll. 54–64. The inventors purport to address those disadvantages by providing a wire with various materials, cracks, and grains.

The '872 patent claims a wire that includes three components. A "core" including "a first metal;" "a first alloy layer;" and "a second alloy layer formed at an outer portion of the first alloy layer." *Id.* at col. 16 ll. 20–49; col. 17 l. 9–col. 18 l. 6. Cracks are formed in the second alloy layer by "twisting the wire with a plurality of rollers." *Id.* at col. 16 ll. 20–44. The "core wire material is erupted onto a surface of the electrode wire . . . so that a plurality of grains are formed on the surface of the electrode wire." *Id.* at col. 16 l. 20–col. 18 l. 16. Regarding claims 2–5, 10–12, and 16, the core material and first alloy material are erupted together. *See id.* Figure 10 illustrates a cross section of a

wire including a core wire 12, a first alloy layer 22, and a second alloy layer 23:



'872 patent Fig. 10.

Particularly relevant to this appeal is the claim term "grain." For context, the '872 patent description states that an "object of the present invention is to make grain fragments . . . by pushing the softer core wire material onto a surface of an electrode wire along [pre-formed] cracks when performing elongation and drawing processes." *Id.* at col. 4 ll. 15–27. "[T]he grain including the core wire material, the first alloy material, and the second alloy material is distributed on the surface of the electrode wire." *Id.* at col. 15 ll. 45–49. The written description notes that "grain including the core wire material is arranged in a direction substantially perpendicular to a longitudinal direction of the electrode wire" and "grain including at least the second alloy material is surrounded by the core wire material." *Id.* at col. 4 l. 66–col. 5 l. 5.

The '872 patent includes independent claims 1 and 9. At issue in this appeal are claims 2–5, which depend from claim 1, and claims 10–12 and 16, which depend from claim 9.

1. An electrode wire for electro-discharge machining, the electrode wire comprising:

a core wire including a first metal, the core wire having a smooth surface;

a first alloy layer formed at a boundary region between the core wire and a second metal plated on an outer surface of the core wire due to mutual diffusion between the core wire and the second metal; and

a second alloy layer formed at an outer portion of the first alloy layer due to diffusion of the first metal to the second metal, the second alloy layer having a plurality of cracks therein, the plurality of cracks being formed by twisting the wire with a plurality of rollers,

wherein a core wire material is erupted onto a surface of the electrode wire for electro-discharge machining, which includes at least the core wire, the first alloy layer, and the second alloy layer, along the cracks appearing on the second alloy layer, so that a plurality of grains are formed on the surface of the electrode wire, a length of a grain in the circumferential direction being more than twice a width of the grain, and

wherein the grain including at least the core wire material and a second alloy material is distributed onto the surface of the electrode wire for electro-discharge machining.

2. The electrode wire of claim 1, wherein *the core wire material is erupted together with a first alloy material, so that the grain including the core wire material, the first alloy material, and the*

second alloy material is distributed on the surface of the electrode wire for electro-discharge machining.

3. The electrode wire of claim 2, wherein the first metal includes one selected from the group consisting of copper, brass, and a copper alloy, and the second metal includes one selected from the group consisting of zinc, aluminum, tin, and an alloy thereof.

4. The electrode wire of claim 2, wherein the grain including at least the second alloy material is surrounded by the core wire material.

5. The electrode wire of claim 2, wherein the grain including the core wire material is arranged in a direction substantially perpendicular to a longitudinal direction of the electrode wire for electro-discharge machining, and has a length twice or ten times greater than a width of the grain.

9. A method of manufacturing an electrode wire for electro-discharge machining, the method comprising:

preparing an intermediate wire rod, which includes a first metal and has a first diameter, as a core wire;

plating the core wire with a second metal;

performing a heat treatment process to make the plated core wire representing tensile strength of about 500 N/mm.sup.2 or less and elongation percentage of 5 or more and to form a first alloy layer in at least a boundary region between the core wire and the second metal due to mutual diffusion between the core wire and the second metal and to form a second alloy layer on an outer

portion of the first alloy layer through diffusion of the first metal to the second metal;

forcibly twisting the electrode wire between a plurality of rollers in at least one of up, down, left, and right directions; and

forming a grain including at least a core wire material and a second alloy material on a surface of the electrode wire for electro-discharge machining by erupting the core wire material through a crack appearing on the second alloy layer when performing a fine wire process of making the electrode wire for electro-discharge machining which includes the first alloy layer, the second alloy layer, and the core wire and has a second diameter.

10. The method of claim 9, wherein, in the forming of the grain on the surface of the electrode wire for electro-discharge machining, *the core wire material is erupted together with a first alloy material, so that the grain including the core wire material, the first alloy material, and the second alloy material is formed*.

11. The method of claim 10, wherein the core wire is plated with the second metal through one of an electroplating scheme, a dip-plating scheme, and a chemical plating scheme.

12. The method of claim 10, wherein the first metal includes one selected from the group consisting of copper, brass, and a copper alloy, and the second metal includes one selected from the group consisting of zinc, aluminum, tin, and an alloy thereof.

'872 patent col. 16 l. 20–col. 18 l. 15 (emphases added).

> 16. The method of claim 9, wherein, in the forming of the grain on the surface of the electrode wire for electro-discharge machining, *the core wire material is erupted together with a first alloy material, so that the grain including the core wire material, the first alloy material, and the second alloy material is formed on the surface of the electrode wire for electro-discharge machining*.

J.A. 4614 (Seong's conditional replacement amended claim) (emphasis added).

Bedra Inc., Berkenhoff GmbH, and Powerway Group Co. Ltd. ("Bedra") filed a petition for *inter partes* review of claims 1–13 and 15 of the '872 patent on July 17, 2018, and the Board instituted review. Seong filed a Contingent Motion to Amend proposing new claim 16, which Bedra opposed. At oral argument, Seong conceded that independent claims 1 and 9 are unpatentable. *See Decision* at *13. Seong also conceded that the teachings of Tomalin and Nishioka would have been combined by a skilled artisan. *Id.* at *15. In the Board's final written decision, the Board concluded that claims 1–13 and 15 and proposed claim 16 would have been obvious in view of U.S. Patent 5,945,010 ("Tomalin") and U.S. Patent 3,326,025 ("Nishioka"). The Board found that Tomalin taught all of the claim limitations except for twisting the wire with rollers, which the Board found was taught by Nishioka. *Id.* at *14. The Board subsequently denied Seong's request for rehearing. Seong appealed, and we have jurisdiction under 28 U.S.C. § 1295(a)(4)(A).

DISCUSSION

We review the Board's legal determinations *de novo*, *In re Elsner*, 381 F.3d 1125, 1127 (Fed. Cir. 2004), but we review the Board's factual findings underlying those determinations for substantial evidence, *In re Gartside*, 203 F.3d 1305, 1316 (Fed. Cir. 2000).

The parties agree that the Board correctly construed the claim term "grain" as "a grouping of materials." *See* Appellant's Br. 11; *Decision* at *11. The Board noted that it did "not interpret this language to mean that each individual component of the 'grain,' i.e., each of the grouped core, first alloy, and second alloy materials, must all necessarily be exposed at the surface of the wire to the outside environment." *Decision* at *12. The Board instead "interpret[ed] the claim language only to require that at least one of these materials, part of the grain, is exposed at the surface of the wire, while other components may be further beneath the surface as shown in the Specification's Figure 10, where three materials are present and in a group at the surface of the wire, but potentially only one material of the group is exposed." *Id.*

Seong refers to certain claim limitations that include the term "grain" as the "grain clauses" and contends that the Board misconstrued these "grain clauses." Appellant's Br. 12–13 (citing claims 2, 10, and 16); *see supra* Background (identifying Seong's so-called "grain clauses" by emphases added to the claims listing). Seong argues that the grain clauses require that each of the core wire material, the first alloy material, and the second alloy material be on the surface of the electrode wire in a grain at least once. *See* Appellant's Br. 7, 12–13. Seong thus provides the same proposed construction for all three of the grain clauses: "the grouping of materials comprising the core wire material, the first alloy material, and the second alloy material with some of each of those three materials being on the surface of the electrode wire for electro-discharge machining." *Id.* at 13. Seong argues that the Board's construction effectively requires only one material on the surface of a wire and that this was an error central to the Board's obviousness determination because Tomalin discloses a wire with two materials on a wire's surface but not three. *See id.* at 12–13. Bedra disputes Seong's assertion regarding

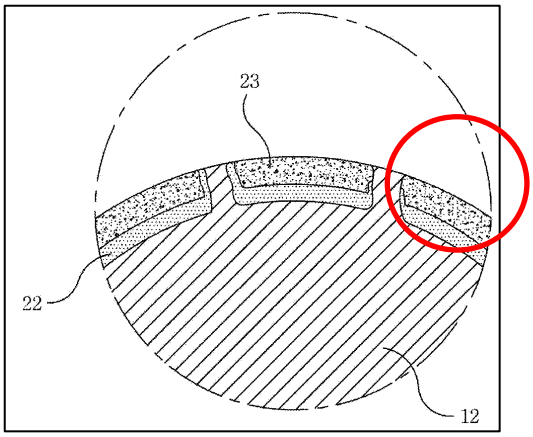
whether Tomalin teaches two or three materials on the surface of a wire. *See Decision* at *17.

Bedra responds that the Board did not err in claim construction, and that, regardless of this court's determination on the construction issue, the Board properly found the claims unpatentable. *See* Appellees' Br. 28–19. Bedra argues that the specification does not support a construction of the grain clauses requiring three materials on the surface of the wire, as confirmed by the plain language of the claims. *See id.* at 33–38. Bedra also contends that Seong's claim construction challenge is irrelevant because the claims would have been obvious based on Tomalin and Nishioka even under Seong's proposed construction. *See id.* at 2, 21. Bedra asserts that Seong's expert conceded that three materials would be on the surface of Tomalin's wire based on the wire drawing process. *See id.* at 21. Bedra further argues that the record provides substantial evidence supporting the Board's conclusions.

We reject Seong's contention that the Board erred in its claim construction determination. "Claim interpretation is a question of law." *Elmer v. ICC Fabricating, Inc.*, 67 F.3d 1571, 1574 (Fed. Cir. 1995). The claims are given their broadest reasonable interpretation consistent with the specification because the *inter partes* review petition was filed before November 13, 2018. *See Game & Tech. Co. v. Wargaming Grp. Ltd.*, 942 F.3d 1343, 1351 (Fed. Cir. 2019); *see also Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142, 195 L. Ed. 2d 423 (2016). The grain clause claim language specifies (1) that "the grain" is distributed on the surface of the electrode wire and (2) that the grain includes the core wire material, the first alloy material, and the second alloy material. The Board correctly determined that the broadest reasonable interpretation of grain does not require that all three of the core wire material, the first alloy material, and the second alloy material be distributed on the surface of the electrode wire. Seong is correct that claim 1 recites two grain materials and claim 2 recites

three grain materials, but the grain clauses do not clearly require that every component of a grain be on the surface of the electrode wire.

Seong argues that eruption of the core wire material and the first alloy material together as recited in claim 2 describes a causal event that results in both materials' presence on the surface of the wire. *See* Appellant's Br. 19–20. Claim 2's eruption limitation fails, however, to establish that the first alloy material becomes distributed on the surface of the wire. Claim 2 does not state that the materials are erupted together "onto the surface of the wire." *Id.* In contrast, claim 1 actually specifies that when the core wire material is erupted it "is erupted onto a surface of the electrode wire." '872 patent col. 16, ll. 33–40. Furthermore, as shown below, Figure 10 illustrates a grain embodiment where the first alloy material is erupted together with the core material, but the first alloy material does not reach the surface of the wire.

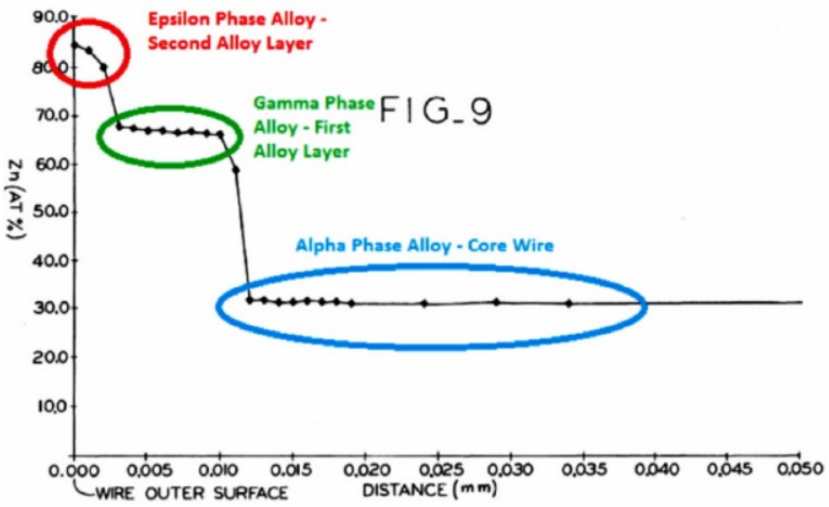


'872 patent Fig. 10 (annotated). We acknowledge that the specification contains exemplary wires with three materials distributed on their surfaces, but the claim language does not limit the claims accordingly. We therefore agree with the Board's claim construction determination.

After construing the grain limitations, the Board concluded that claims 2–5, 10–12, and 16 would have been obvious in view of the prior art combination of Tomalin and Nishioka. *See Decision* at *27. That is a factual finding subject to appellate review for substantial evidence. *In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1280 (Fed. Cir. 2015) ("What a reference teaches and the differences between the claimed invention and the prior art are questions of fact which we review for substantial evidence.") (citing *In re Baxter Int'l, Inc.*, 678 F.3d 1357, 1361 (Fed. Cir. 2012)). A finding is supported by substantial evidence if a reasonable mind might accept the evidence as adequate to support the finding. *Consol. Edison Co. v. NLRB*, 305 U.S. 197, 229 (1938).

Substantial evidence supports the Board's finding that claims 2–5, 10–12, and 16 would have been obvious in view of Tomalin and Nishioka. The Board determined that "the Tomalin-Nishioka combination teaches an electrode wire having a core material (α brass), a first alloy material (γ brass), and a second alloy material (ε brass) grouped together as a grain at the wire's surface," wherein the core material and first alloy material "are erupted together through an ε brass surface when it is cracked." *Decision* at *22–23. To support this finding, the Board relied on numerous disclosures from Tomalin, admissions made by Seong's expert, and a declaration from Dr. Dandridge Tomalin, the named inventor of the Tomalin patent.

Tomalin's Figure 9, as annotated by Dr. Tomalin, below, is a graph comparing a wire's measured content, displaying three materials in three layers:



See Decision at *17–18. The Board determined that Figure 9 is a profile of Example/Specimen 1 and is descriptive of the materials found in Example/Specimen 3. *Id.* at *18–21. Dr. Tomalin opined, and Seong's expert confirmed, that Example/Specimen 1 having the composition shown in Figure 9 would include the three alloy layers on the outside of the wire after it was drawn and cracked, with the α and γ brass layers erupting together due to strain from the cracking process. *Id.* at *20–22. The appearance of the cracks define a grain pattern. *Id.* at *22; *see also* Tomalin Figures 3, 4. The Board thus concluded that Tomalin and Nishioka teach all three materials in a grain on the surface of a wire.

Seong conceded that Tomalin discloses two materials on or grouped at the surface of an electrode wire but argues that the claims require a third material on the wire surface. *See* Appellant's Br. 2–3; *see also Decision* at *13–14, *17. Substantial evidence supports the Board's finding that the prior art teaches all three materials being on the surface. In any event, as we concluded above, however, the grain clauses of claims 2–5, 10–12 and 16 do not require that each of the core wire material, the first alloy material,

and the second alloy material be distributed on the surface of the electrode wire. Seong's argument that Tomalin does not disclose a third material on the wire surface thus does not support patentability. In view of claim construction, Seong's concessions, and the substantial evidence supporting the Board's factual findings, we affirm the Board's obviousness determination and denial of Seong's contingent motion to amend proposing new claim 16.

CONCLUSION

We have considered Seong's remaining arguments but find them unpersuasive. Accordingly, the Board's final written decision is *affirmed*.

AFFIRMED