

NOTE: This disposition is nonprecedential.

**United States Court of Appeals
for the Federal Circuit**

COREPHOTONICS, LTD.,
Appellant

v.

APPLE INC.,
Appellee

**ANDREW HIRSHFELD, PERFORMING THE
FUNCTIONS AND DUTIES OF THE UNDER
SECRETARY OF COMMERCE FOR
INTELLECTUAL PROPERTY AND DIRECTOR OF
THE UNITED STATES PATENT AND TRADEMARK
OFFICE,**
Intervenor

2020-1961

Appeal from the United States Patent and Trademark
Office, Patent Trial and Appeal Board in No. IPR2019-
00030.

Decided: October 25, 2021

MARC AARON FENSTER, Russ August & Kabat, Los An-
geles, CA, argued for appellant. Also represented by NEIL

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ROBERT MCBRIDE, Office of the Solicitor, United States Patent and Trademark Office, Alexandria, VA, for intervenor. Also represented by THOMAS W. KRAUSE, MONICA BARNES LATEEF, FARHEENA YASMEEN RASHEED.

Before TARANTO, HUGHES, and STOLL, *Circuit Judges*.

TARANTO, *Circuit Judge*.

This case is closely related to *Corephotonics Ltd. v. Apple Inc.*, No. 20-1424 (Fed. Cir.), which involves Corephotonics Ltd.'s U.S. Patent No. 9,402,032 and which we decide today in an opinion (*20-1424 Decision*) on which we rely here. The present case involves Corephotonics's U.S. Patent No. 9,857,568, which issued from a second-generation continuation-in-part of the application that became the '032 patent, and which describes (as its title states) a "miniature telephoto lens assembly" for use in cell phones. Apple Inc. petitioned the Patent and Trademark Office (PTO) for an inter partes review of the '568 patent, contending that all five claims are unpatentable because their subject matter would have been obvious based on (1) U.S. Patent No. 9,128,267 (Ogino) or (2) a combination of Ogino and a paper by William S. Beich and Nicholas Turner—*Polymer Optics: A Manufacturer's Perspective on the Factors That Contribute to Successful Programs*, SPIE Proceedings Vol. 7788, Polymer Optics Design, Fabrication, and Materials (August 12, 2010) (Beich). The primary issue here is common to this matter and the matter resolved in our *20-1424 Decision*: whether Figure 6 of Ogino describes a lens assembly that has a total track length (TTL)

less than the effective focal length (EFL). The secondary issue here, unique to this matter, is whether a relevant artisan would have been motivated to select a specific rule taught in Beich and implement it in the Ogino lens assembly.

The PTO's Patent Trial and Appeal Board determined that all five claims of the '568 patent are unpatentable under 35 U.S.C § 103 for obviousness: claims 1–4 based on Ogino alone, and claims 1–5 based on Ogino in combination with Beich. *Apple Inc. v. Corephotonics Ltd.*, IPR2019-00030, 2020 WL 1696140 (P.T.A.B. Apr. 6, 2020) (*Board Decision*). Corephotonics timely appealed that decision, properly invoking our jurisdiction under 28 U.S.C. § 1295(a)(4)(A).

Besides raising challenges to the merits of the Board's decision, Corephotonics presented a challenge under the Appointments Clause of the Constitution, Art. II, § 2. After the Supreme Court resolved a similar constitutional challenge in *United States v. Arthrex, Inc.*, 141 S. Ct. 1970 (2021), we remanded this matter, while retaining jurisdiction, to give the Acting Director of the PTO the opportunity to consider reviewing the Board decision (an opportunity Corephotonics indicated it wanted). The Acting Director has now declined to review the Board decision, and Corephotonics has informed us that it does not challenge the Acting Director's denial of review, but seeks only our review of the Board's decision. We proceed to address Corephotonics's challenges to the merits of that decision. We affirm.

I

A

The '568 patent describes a camera-lens assembly with a plurality of lenses ("lens element[s]") of varying thicknesses and refractive power arranged in line along an optical axis running from an object side (*i.e.*, the side with the

object to be photographed) to an image side (*i.e.*, the side where the image of the object is formed). '568 patent, col. 1, lines 49–62. Past the last lens element, on the image side of the assembly, is an “optional glass window” and an “image plane” with an “image sensor” for “image formation.” *Id.*, col. 3, lines 37–42.

The '568 patent purports to improve on previous lens assemblies by reducing the ratio of the assembly's TTL to its EFL. *Id.*, col. 1, lines 33–45. The lens assembly's TTL is the distance “on an optical axis between the object-side surface of the first lens element and the electronic sensor” where the image captured by the lens is ultimately projected. *Id.*, col. 2, lines 1–8. The TTL affects the physical width (thickness) of the camera, while the EFL “determines how well the camera performs at capturing images of small or distant objects, as opposed to closer objects.” J.A. 2246 ¶ 38 (Declaration of Corephotonics expert, Dr. Duncan Moore). Increasing the EFL allows a lens to magnify and increase the resolution of objects at greater distances, while simultaneously narrowing the camera lens's field of view. J.A. 2246 ¶ 38 (Dr. Moore Declaration). Thus, reducing the TTL/EFL ratio results in a thin lens with the capability of capturing far-away objects in great detail. All five claims in the '568 patent require that the ratio of TTL to EFL be smaller than 1. *See* '568 patent, col. 8, lines 29–66.

The '568 patent also describes the F-number of the lens assembly, which is the ratio of the focal length of a lens to its aperture diameter. A smaller F-number means that the lens is exposed to more light and has a greater illumination. J.A. 2248 ¶ 40 (Dr. Moore Declaration). All embodiments in the '568 patent teach an F-number of less than 3.2. '568 patent, col. 2, lines 8–9.

Finally, the '568 patent includes tables providing information about each embodiment of the lens assembly and the characteristics of each lens element, including their

radii, thicknesses, and the distances between them along the optical axis. *Id.*, col. 3, lines 44–48; *see also id.*, col. 5, line 66, through col. 6, line 4; *id.*, col. 7, lines 23–28. Relevant to this appeal, Table 1 sets forth the thickness of each lens element in one particular embodiment (Figure 1A) of the lens assembly, expressing the thickness of lens element 1 as “L11,” with the first “1” referring to the lens element number and the second “1” referring to the location on the lens (*the center*) where the thickness is measured. *See id.*, col. 4, lines 13–25; *see also id.*, Fig. 1A. The same Figure 1A also shows a distance marked “L1e”—which is the “width . . . of a flat *circumferential edge* (or surface) of [the first] lens element 102.” *Id.*, col. 4, lines 28–29 (emphasis added). The ratio of L11 to L1e compares the thickness of the first lens element at its center to the width of its edge; the parties on appeal refer to this ratio as the center-to-edge thickness ratio.

The ’568 patent explains that when “ $TTL/EFL < 1.0$ and $F\# < 3.2$ ” there can be a “large ratio” (greater than 4.0) of L11 to L1e. *Id.*, col. 2, lines 30–33. Such a large L11/L1e ratio affects “negatively the manufacturability of the lens and its quality,” the patent observes. *Id.*, col. 2, lines 36–38. But, the patent continues, “the present inventors have succeeded in designing the first lens element to have a L11/L1e ratio smaller than 4, smaller than 3.5, smaller than 3.2, smaller than 3.1 . . . and even smaller than 3.0,” resulting in improved manufacturability and quality of the lens assembly. *Id.*, col. 2, lines 38–45. There are five claims in the ’568 patent, each of which corresponds to a different L11/L1e ratio. *See id.*, col. 8, lines 29–66.

Claim 1, the only independent claim in the ’568 patent, recites:

1. A lens assembly, comprising: a plurality of refractive lens elements arranged along an optical axis with a first lens element on an object side, wherein at least one surface of at least one of the

plurality of lens elements is aspheric, wherein the lens assembly has an effective focal length (EFL), a total track length (TTL) of 6.5 millimeters or less, a ratio TTL/EFL of less than 1.0, a F number smaller than 3.2 and a ratio between a largest optical axis thickness L11 and a circumferential edge thickness L1e of the first lens element of $L11/L1e < 4$.

'568 patent, col. 8, lines 29–40. Claims 2–5 depend on claim 1, requiring even smaller values for the L11/L1e ratio—less than 3.5, 3.2, 3.1, and 3.0, respectively. *Id.*, col. 8, lines 41–66. Claim 5, which claims a ratio of $L11/L1e < 3.0$, is the only dependent claim argued separately on appeal.

B

Apple's main reference, Ogino, describes several lens assemblies containing five lens elements for use in a cell phone. *See* Ogino, col. 1, line 52, through col. 2, line 18. Apple relied in particular on Example (Figure) 6 for its obviousness arguments. In Figure 6, the lens elements are labelled L1 through L5. *Id.*, col. 13, lines 1–16. Figure 6 also includes a cover glass (CG) that “may be disposed between the fifth lens [element] L5 and the imaging device 100.” *Id.*, col. 5, lines 55–57. Ogino states: “Alternatively, an effect similar to the optical member CG may be given to the fifth lens L5 or the like by applying a coating to the fifth lens L5 or the like *without using the optical member CG*. Thereby, it is possible to reduce the number of components, and to *reduce the total length*.” *Id.*, col. 5, line 65, through col. 6, line 2 (emphases added).

Ogino includes a table (Table 11) with values corresponding to the parameters in Example 6 illustrated in Figure 6. *See id.*, col. 22, lines 11–35. The table includes numbers for the thicknesses of the lens elements and the spacing between the components of the assembly. *See id.*, col. 22, lines 18–34. At the top, Table 11 states: “ $f = 4.428$, $Bf = 1.424$, $TL = 4.387$,” *id.*, col. 22, line 14, where f is “the

focal length . . . of the whole system,” Bf is “the back focal length,” and TL is “the total lens length,” *id.*, col. 14, lines 48–50. Ogino elaborates: “In addition, the back focal length Bf indicates an air-converted value, and likewise, in the total lens length TL, the back focal length portion uses an air-converted value.” *Id.*, col. 14, lines 50–53. Based on Ogino’s contemplation of an alternative that does not use a cover glass, and on Table 11 and Figure 6, Apple argued in its petition that Ogino teaches an embodiment without a cover glass where the TTL/EFL ratio is less than 1.0 (a 4.387 focal length is less than a 4.428 total lens length), meeting the key disputed element of claim 1. J.A. 153–54.

With respect to the claim limitations regarding the center-to-edge thickness ratio of the first lens element, Apple demonstrated in its petition (and in the attached declaration of its expert, Dr. José Sasián) that the L11 value in Ogino would be 0.557. *See* J.A. 155–56 (IPR Petition), 583–84 (Sasián Declaration). It did not contend that Ogino expressly teaches a value for L1e (which is derived from a formula that includes L1’s diameter). Rather, Apple relied on a statement from an optics handbook that it is “good policy” for the “center-to-edge thickness ratio” (L11/L1e) to never exceed 3.0. *See* J.A. 166 (quoting J.A. 1418). Apple used that statement to argue that the center-to-edge thickness ratio limitations in claims 1–5 would have been obvious based on Ogino alone. *See* J.A. 166, 169–72.

Apple also argued that claims 1–5 would have been obvious based on a combination of Ogino and Beich. *See* J.A. 172–97. Beich discusses the “process of creating state-of-the-art polymer optics” and reviews the tradeoffs “between design tolerances, production volumes, and mold cavitation.” J.A. 1329. Beich states that optical assemblies with “thicker parts take longer to mold than thinner parts” and that “extremely thick centers and thin edges are very challenging to mold.” J.A. 1334. To address issues of “cost and manufacturability,” Beich provides a variety of “rules of thumb” set forth in a table. *See* J.A. 1334. Those rules of

thumb, Beich explains, “interact with one another” and a “change in one area will impact another.” J.A. 1335. In a table setting forth its rules of thumb, Beich teaches a “center thickness to edge thickness ratio” of <3:1. J.A. 1334. Relying on Beich, Apple argued in its petition that a relevant artisan would have been motivated by the advantages of cost and manufacturability to apply Beich’s teachings to Ogino, such that L11/L1e would be less than 3.0. J.A. 173–77; *see also* J.A. 602–03 ¶ 56 (Sasián Declaration).

Corephotonics disputed that Ogino’s Figure 6 and Table 11 teach an embodiment where the assembly’s TTL is less than its EFL. *See* J.A. 2197–2215. Corephotonics also disputed that a relevant artisan would have been motivated to apply the Beich rule of thumb regarding the center-to-edge thickness ratio of <3:1 to Ogino’s first lens element in Figure 6, asserting that the remaining lens elements in Ogino (L2–L5) violate Beich’s other rules of thumb. J.A. 2221–27. In particular, Beich suggests that the diameter-to-center thickness ratio be less than 4:1, and lens elements L2–L5 in Ogino Figure 6 do not have such a ratio. J.A. 2225–26. On those grounds, Corephotonics argued that Apple had not shown that a relevant artisan would have been motivated to select Beich’s center-to-edge thickness rule and apply it to L1. J.A. 2226–27.

C

In its final written decision, the Board agreed with Apple on the two issues presented for review by Corephotonics in this court. The Board found that Ogino teaches a TTL less than EFL as required by claim 1 of the ’568 patent. *Board Decision*, 2020 WL 1696140, at *10–12. In a finding not disputed in this court, the Board also found that it would have been obvious to modify Ogino to meet the center-to-edge thickness limitations of claims 1–4, citing the optics textbook. *Id.* at *15–17. Based on those findings, the Board concluded that the subject matter of claims 1–4 would have been obvious over Ogino alone. *Id.* at *16–17.

For claim 5, with its requirement that $L11/L1e$ be less than 3.0, the Board found that a relevant artisan would have been motivated to implement the center-to-edge thickness ratio rule of thumb ($<3:1$) from Beich into the Figure 6 Ogino assembly. *See id.* at *18–20. The Board disagreed with Corephotonics that a relevant artisan would not look to Beich when modifying Ogino because the artisan could not in practice “implement[] each and every one of Beich’s set of rules of thumb” into the Ogino assembly. *Id.* at *19. “The reason the ordinarily skilled artisan would look to Beich,” the Board found, “is to obtain a value *not* specified by Ogino—the diameter of the first lens element L1,” whereas the remaining “rules of thumb” required changing values that were explicitly defined by Ogino. *Id.* The Board further found that a relevant artisan would have been motivated to use Beich to supply the missing diameter of L1 “because the ratio disclosed in Beich’s Table 2 constitutes the limits of fabrication in an ideal lens system.” *Id.* Based on those findings, the Board concluded, the lens assembly of claim 5 would have been obvious to a relevant artisan in light of Beich and Ogino. *Id.* at *19–20.

III

We review the Board’s legal conclusions *de novo* and its factual findings for substantial-evidence support. *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1360 (Fed. Cir. 2016). The ruling on obviousness is a legal conclusion, based on underlying determinations of fact. *PersonalWeb Techs., LLC v. Apple, Inc.*, 917 F.3d 1376, 1381 (Fed. Cir. 2019). Such factual determinations include whether a prior-art reference teaches away and whether a relevant artisan would have been motivated to make a combination of prior-art references. *Gen. Elec. Co. v. Raytheon Techs. Corp.*, 983 F.3d 1334, 1345 (Fed. Cir. 2020).

A

With respect to claims 1–4, Corephotonics’s sole contention in this court is that Ogino does not teach an

embodiment with a TTL less than EFL. Corephotonics Opening Br. at 18–29. Corephotonics’s arguments and the Board’s analysis are materially the same as those in the *20-1424 Decision*, where we upheld the Board’s determination that Ogino expressly teaches an embodiment of Figure 6 in which TTL is less than EFL. Although that decision was in the context of an anticipation challenge (rather than obviousness), Corephotonics has made no argument here that the distinction is relevant or that it warrants separate discussion. We rely on our discussion in the *20-1424 Decision* to affirm the Board’s ruling that Ogino teaches a TTL less than EFL. That conclusion requires affirmance of the obviousness conclusion as to claims 1–4 here.

B

We also affirm the Board’s conclusion of obviousness of claim 5 based on the determination, which is supported by substantial evidence, that a relevant artisan would have been motivated to make the combination of Ogino and Beich that meets the limitations of the claim.

Corephotonics contends that because four out of five lens elements in Ogino Figure 6 violate a different Beich rule of thumb (the rule suggesting a diameter-to-center thickness ratio of less than 4:1), the Board’s focus on applying the center-to-edge thickness ratio rule of thumb (a L11/L1e ratio of less than 3:1) was error. Corephotonics Opening Br. at 29–34. Corephotonics argues that modifying Figure 6 to satisfy *both* the diameter-to-center and center-to-edge ratios would “dramatically reduce the performance of the lens and defeat the stated goals of Ogino’s invention” by increasing the diameter of L5. *Id.* at 32 (citing J.A. 2290–93 ¶¶ 125–26). And, Corephotonics adds, the Board did not explain why a relevant artisan would have applied only the center-to-edge thickness ratio rule from Beich (to reduce costs and improve manufacturability), ignoring Beich’s diameter-to-thickness ratio rule. *Id.* at 32–34.

The Board rejected this contention and had substantial evidence to support the rejection. *See Board Decision*, 2020 WL 1696140, at *19. The L11/L1e ratio that is at issue is solely about the *first* lens element (L1), not the fifth lens element (L5). The Board had before it substantial evidence that manufacturing considerations would have motivated a relevant artisan to use Beich’s express rule of thumb as to the center-to-edge thickness ratio to fill in a missing piece of information about L1 in Ogino. *Id.* Corephotonics does not contend that doing so would violate Beich’s diameter-to-center thickness ratio for L1, but focuses only on what would happen if an artisan modified other lens elements, specifically L5. But the Board reasonably found that not all rules of thumb had to be applied to all lenses in an assembly in order for some to be applied to some lenses. *Id.* Beich recognizes that rules of thumb are just that—they are “useful for initial discussions,” but “can quickly break down.” J.A. 1335.

Nothing in Ogino or Beich “criticize[s], discredit[s], or otherwise discourage[s]’ investigation into,” so as to teach away from, selecting the center-to-edge thickness ratio rule of thumb for L1 without modifying other lens elements. *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1069 (Fed. Cir. 2018) (quoting *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004)). Nor does the optics handbook do so when it says that lens designers should “oversize optical elements, if possible, to a dimension considerably beyond the clear apertures.” J.A. 1419.

Corephotonics points to what it says is unrebutted testimony from its expert, Dr. Moore, that a relevant artisan would not have combined Ogino and Beich. In his declaration, Dr. Moore stated:

According to Beich, the “rules of thumb” are intended to reduce cost and improve manufacturability. Ex. 1020 at 7. But removing the cover glass from the image sensor indisputably increases costs

and reduces manufacturability If cost and manufacturability are requirements motivating use of the Beich rules of thumb, then that [relevant artisan] would not be motivated to remove the cover glass [to comply with the TTL/EFL limitations]. Conversely, if the designer is willing to incur the costs and difficulties of using sensors without cover glass, then they are unlikely to be motivated to follow the Beich “rules of thumb.”

J.A. 2294 ¶ 128. But it is a commonplace fact that design decisions entail making tradeoffs among multiple objectives. *Allied Erecting and Dismantling Co. v. Genesis Attachments, LLC*, 825 F.3d 1373, 1381 (Fed. Cir. 2016) (“A given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine.”). Beich itself recognizes the need for “tremendous flexibility” for lens designers in creating optical assemblies. J.A. 1329. The Board properly rejected Corephotonics’s blanket assertion that any willingness to incur higher costs or reduced manufacturability to choose the coverless Ogino option (a premise for which Dr. Moore did not offer concrete support) would have undermined (rather than enhanced) the motivation to save costs or improve manufacturability in other ways, such as by following Beich’s rule of thumb for the center-to-edge thickness ratio.

Thus, substantial evidence supports the Board’s determination that claim 5 would have been obvious based on Beich and Ogino.

III

For the foregoing reasons, the decision of the Board is affirmed.

AFFIRMED