NOTE: This disposition is nonprecedential.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

2020-1424

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2018-01140.

Decided: October 25, 2021

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

RUBIN.

ANGELA OLIVER, Haynes & Boone, LLP, Washington, DC, argued for appellee. Also represented by ANDREW S. EHMKE, DEBRA JANECE MCCOMAS, Dallas, TX; MICHAEL SCOTT PARSONS, Plano, TX.

FARHEENA YASMEEN RASHEED, Office of the Solicitor, United States Patent and Trademark Office, Alexandria, VA, argued for intervenor. Also represented by MICHAEL S. FORMAN, THOMAS W. KRAUSE, MAUREEN DONOVAN QUELER.

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

TARANTO, *Circuit Judge*.

Corephotonics, Ltd. owns U.S. Patent No. 9,402,032, which describes and claims optical lens assemblies. In May 2018, Apple Inc. successfully petitioned the Patent and Trademark Office (PTO) for an inter partes review of four claims of the '032 patent under 35 U.S.C. §§ 311–319. Apple argued (1) that U.S. Patent No. 9,128,267 (Ogino) anticipated claims 1 and 13 of the '032 patent and (2) that claims 14 and 15 of the '032 patent would have been obvious to a relevant artisan based on a combination of Ogino and U.S. Patent No. 8,233,224 (Chen). The PTO's Patent Trial and Appeal Board agreed. For claims 1 and 13, it found that Ogino teaches an embodiment that meets all the claim requirements, including the requirement of a lens assembly with an effective focal length (EFL) that exceeds its total track length (TTL). *Apple Inc. v. Corephotonics, Ltd.*, IPR2018-01140, 2019 Pat. App. LEXIS 13253, at *20–31 (P.T.A.B. Dec. 3, 2019) (*Board Decision*). For claims 14 and 15, the Board found that a relevant artisan would have been motivated to use a meniscus lens, as taught by Chen, as the second lens element in the assembly, replacing

Ogino's biconcave second lens, and that doing so would have been obvious. *Id.* at *31–45.

Corephotonics timely appealed, and we have jurisdiction under 28 U.S.C. § 1295(a)(4). 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 '032 patent describes a lens assembly intended for use as a telephoto lens (a high-resolution lens) in "a portable electronic product such as a cellphone." '032 patent, col. 1, lines 16–19. The assembly includes 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). *See id.*, col. 2, line 61, through col. 3, line 9. Past the last lens element, on the image side of the assembly, is an "image sensor" and "image plane" for capturing the image. *Id.*, col. 3, lines 13–15. Some embodiments include a cover glass element between the last lens element and the image sensor. *Id.*, col. 3, lines 11–13. All embodiments of the lens assembly described in the '032 patent include a "second plastic lens element" (starting from

the object side) "having a meniscus convex object-side surface." *Id.*, col. 2, lines 65–67. A meniscus lens is a lens with one convex side and one concave side. J.A. 487.

The '032 patent purports to improve on previous lens assemblies by reducing the ratio of the assembly's TTL to its EFL. '032 patent, col. 1, lines 30–38. The TTL of a miniature lens assembly measures distance along the assembly's optical axis and "determines how long or thick a camera will be," while the EFL "determines how well the camera performs at capturing images of small or distant objects, as opposed to closer objects." J.A. 1668 ¶ 34 (Declaration of Corephotonics expert, Dr. Duncan Moore). A greater EFL gives the camera a narrower "field of view," which yields an image that "can resolve precise features like . . . tree branches" for "objects at greater distances." J.A. 1668 ¶ 34. Reducing the TTL/EFL ratio results in a thin lens with the capability of capturing far-away objects in great detail. J.A. 1668–69 ¶¶ 34–35. "In all embodiments [described in the '032 patent], TTL is smaller than the EFL, i.e., the TTL/EFL ratio is smaller than 1.0." '032 patent, col. 1., lines 63–65.

Table 1 of the '032 patent provides details about the lens elements in one particular embodiment of the assembly, including the elements' radii of curvature, their diameters, their thicknesses, and the space between them along the optical axis. *Id.*, col. 3, lines 17–37; *see also id.*, col. 4, lines 2–17 (Table 1). The embodiment described in Table 1 has an EFL of 6.90 mm and a TTL of 5.904 mm, resulting in a TTL/EFL ratio of 0.855. *Id.*, col. 4, lines 35–37.

Claim 1, the only independent claim at issue, recites:

> 1. A lens assembly, comprising: a plurality of refractive lens elements arranged along an optical axis, 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), and wherein the lens assembly has a total

> track length (TTL) of 6.5 millimeters or less and ***a ratio TTL/EFL of less than 1.0***, wherein the plurality of lens elements comprises, in order from an object side to an image side, a first lens element with positive refractive power and a second lens element with negative refractive power, wherein a focal length fl of the first lens element is smaller than TTL/2.

Id., col. 7, lines 43–53 (emphasis added). Claim 13 depends on claim 1; on appeal, Corephotonics does not challenge the Board's finding that Ogino teaches claim 13's additional limitation. Claims 14 and 15 add limitations, only one of which is at issue on appeal: "wherein the first lens element has a convex object-side surface and a convex or concave image-side surface and wherein the second lens element is a meniscus lens having a convex object-side surface." *Id.*, col. 8, lines 46–49; *id.*, col. 8, lines 50–51.

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 anticipation argument. In Figure 6, the lens elements are labelled L1 through L5, and the second lens element (L2) "has a biconcave shape." *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 47–53. Corephotonics's expert, Dr. Moore, explained: "the TL replaces the physical thickness of the optical member [cover glass] with a value equal to its thickness divided by the ratio of the [cover glass's] index of refraction to that of air." J.A. 1684 ¶ 66. 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 (a 4.387 focal length is less than a 4.428 total lens length), meeting the key disputed element of claim 1 for purposes of anticipation. J.A. 129.

Apple also argued that claims 14 and 15 of the '032 patent would have been obvious to a relevant artisan in view of Ogino and Chen. Chen relates to a lens assembly, like Ogino. But unlike Ogino, whose second lens is biconcave, Chen teaches a second lens element "having a convex object-side surface 111 and a concave image-side surface 112"—*i.e.*, a meniscus lens. Chen, col. 6, line 51, through col. 7, line 4; *see also* J.A. 478 ¶ 56 (Declaration of Apple expert, Dr. José Sasián). Apple argued that a relevant artisan would be motivated to substitute Chen's second lens for Ogino's, relying on testimony of its expert, Dr. Sasián.

According to Dr. Sasián, an advantage of a meniscus lens is that it reduces "vignetting," J.A. 482 ¶ 61, which "is the blocking of rays on or near the outer edges of a lens system," J.A. 475 ¶ 51, and is undesirable for "lens systems

designed for cellular telephones," for which "relative illumination . . . greater than 50%" is sought, J.A. 479–80 ¶ 58; *see also* J.A. 1060 (identifying desirable specifications for cellphone lenses). Dr. Sasián explained that a relevant artisan, using common design software (*e.g.*, Zemax), would have understood that the biconcave shape of the second lens element in Ogino's Figure 6 produced a relative illumination under 50%, J.A. 479–81 ¶¶ 58–60, and that use of a meniscus lens would raise that figure by reducing vignetting, J.A. 483 ¶ 62. Dr. Sasián also stated that a relevant artisan would be motivated to use a meniscus lens to reduce both "ray aberration," J.A. 482–85 ¶¶ 60–64, and the "chief ray angle (CRA)" to levels desired for mobile phone lenses, J.A. 476–77 ¶ 53. Dr. Sasián concluded that substituting Chen's meniscus lens into Figure 6 was "a routine lens adjustment" that a relevant artisan would have been motivated to make. J.A. 479–81 ¶¶ 58–60.

Corephotonics disputed Apple's contentions. With respect to the anticipation argument based on the "TL" number in Ogino's Table 11, Corephotonics responded that the Table 11 "TL" number was based on a "theoretical" air-converted value, not an actual total track length of an embodiment that omitted the cover glass—which would require information not in Ogino about where the coverless sensor would be located. J.A. 1140–42. With respect to Apple's obviousness argument, Corephotonics responded that Ogino encourages the use of a biconcave lens to reduce image aberrations and that a relevant artisan would not have been motivated to replace the second lens element with a meniscus lens out of the "'near-infinite'" possibilities for modification. *Board Decision*, 2019 Pat. App. LEXIS 13253, at *38 (quoting Patent Owner Response).

C

The Board ruled for Apple. In agreeing that Ogino teaches a lens assembly that anticipates claims 1 and 13, the Board found that the "TL" value listed in Table 11 does

teach an actual total track length in an embodiment without the cover glass, calculated by adding (a) the widths of the five lenses and the spacing between them as listed in the table and (b) "the back focal length Bf given in Table 11 as 1.424 mm," a value that represented the distance between the final lens and the image plane. *Id.* at *26. The Board noted that "Ogino explicitly discloses that the cover glass CG can be removed," *id.*, and cited the recognition by Corephotonics's expert, Dr. Moore, that "cover glass is optional" and "if it is not present, it need not be counted in the TTL measurement," *id.* at *27 (citing J.A. 1916 (Tr. at 70:2–22) (Dr. Moore Deposition)). The Board found that the air-converted value indicates the distance at which the image sensor must be placed from the final lens when the cover glass is omitted. *Id.* at *28–29. On this basis, the Board found that Ogino teaches a TTL/EFL of less than 1, resolving the key issue for anticipation. *Id.*

As to obviousness, the issue for claims 14 and 15 of the '032 patent, the Board agreed with Apple that a relevant artisan would have been motivated and found it obvious to replace the biconcave second lens element in Ogino with the corresponding meniscus lens in Chen. *Id.* at *31–45. The Board credited Dr. Sasián's opinion that vignetting would be undesirable in a telephoto lens and that replacing Ogino's second lens with Chen's second lens would reduce vignetting, mitigate ray aberration, reduce the chief ray angle, and increase "relative illumination" to over 50%, motivating a relevant artisan to make the replacement for a cellphone lens system. *Id.* at *36–38. The Board rejected Corephotonics's argument that the proposed substitution would require selecting such a change out of a "near infinite" number of possible modifications, pointing out that both experts agreed that relevant artisans in this field often begin with a lens assembly of "suitable design" and then use software to "modify it based on teachings of other systems or existing knowledge." *Id.* at *40–43. Therefore, a relevant artisan would have found it "routine" to change

one element of a lens system to improve a desired element (with the software doing the rest of the work) and would have been motivated to make the change to a meniscus lens in order to reduce vignetting and reduce ray aberration. *Id.* at *41–42.

II

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 anticipation is a factual determination. *Wasica Finance GmbH v. Continental Automotive Sys., Inc.*, 853 F.3d 1272, 1278 (Fed. Cir. 2017). 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

For a reference to anticipate a claim under 35 U.S.C. § 102, "each claim element must be disclosed, either expressly or inherently, in a single prior art reference, and the claimed arrangement or combination of those elements must also be disclosed, either expressly or inherently, in that same prior art reference." *Therasense, Inc. v. Becton, Dickinson & Co.*, 593 F.3d 1325, 1332–33 (Fed. Cir. 2010). Here, the anticipation issue comes down to whether Ogino teaches a lens assembly in which the cover glass is omitted and the resulting total track length is 4.387 mm (the TL number in Table 11). If it does, that number is undisputedly less than the effective focal length (4.428 mm), satisfying the claim 1 requirement of TTL/EFL < 1.0—the only contested issue now regarding anticipation of claims 1 and 13.

The Board found that Ogino teaches an embodiment of Figure 6 that does not include a cover glass and for which the 4.387 TL value in Table 11 represents a physical length expressing the total track length of that embodiment. *Board Decision*, 2019 Pat. App. LEXIS 13253, at *25–29. Ogino supports the finding. After describing its assembly and the inclusion of a cover glass element, 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*.

Ogino, col. 5, line 65, through col. 6, line 2 (emphases added). That language contemplates an embodiment of Ogino's lens assembly without a cover glass element and further recognizes that removing that element will reduce the assembly's total length, *i.e.*, the "total lens length," *id.*, col. 14, line 50. The Board could have reasonably found that the reduction is a reduction to the TL value in Table 11, in what the '032 patent calls the total track length. As Dr. Sasián explained, summing the values in Table 11 where the cover glass is included (D2–D13) results in a track length of 4.489 mm; and when Figure 6 is considered *without* the cover glass, the total track length is obtained by summing the thicknesses of the lens elements and their distances from one another (values D2–D10), while excluding the thickness of and space in front of the cover glass (values D11–13), but adding in a back-focal-length value to represent the spacing in front of the coverless sensor. *See* J.A. 502; 1441–42 (Tr. 103:18–104:1), 2071 (Tr. 67:11–18); Ogino, Table 11; *see also Board Decision*, 2019 Pat. App. LEXIS 13253, at *25–26. This calculation adds 2.963 mm (for D2–D10) to 1.424 mm (the back focal length, Bf) to result in a track length of 4.387 mm—which is the TL value stated in Table 11. Ogino, Table 11. This evidence permitted the Board to find that the 4.387 mm value represents a

total track length of a coverless embodiment, supporting the anticipation finding for claims 1 and 13.

B

With respect to claims 14 and 15 of the '032 patent, Corephotonics contends that the Board erred by determining that a relevant artisan would have been motivated to replace the biconcave lens from Ogino—which it describes as an "essential feature" of the second lens element—with the meniscus lens from Chen. Corephotonics Opening Br. at 42–43. Corephotonics focuses on the statement in Ogino that the second lens must be biconcave to reduce the assembly's track length, *see* Ogino, col. 7, lines 39–42, and contends that a relevant artisan who would be motivated to remove the cover glass in Figure 6 to reduce the total track length would not counteract that decision by selecting a meniscus lens that would not similarly reduce the track length, *see* Corephotonics Opening Br. at 42–43. Corephotonics also argues that the Board erred by accepting the motivation that Apple has offered for the combination of Chen and Ogino—specifically, that a relevant artisan would have sought to reduce vignetting by implementing a meniscus lens—because vignetting is not inherently undesirable and because nothing in Chen discusses the use of a meniscus lens as the cause of reduced vignetting. *Id.* at 44–45.

Corephotonics does not address the Board's finding that a relevant artisan "would have been further motivated to modify Ogino in view of [Chen]'s teachings concerning its second lens element, in order to reduce aberration and reduce the [chief ray angle]." *Board Decision*, 2019 Pat. App. LEXIS 13253, at *37–38 (citing J.A. 476 ¶ 53 (Dr. Sasián Declaration)). Those further motivations appear to be independent bases for the Board's finding of a motivation to combine Ogino and Chen, sufficing by themselves to affirm the Board's motivation-to-combine analysis (the only meaningfully contested aspect of the obviousness

conclusion). *See Impax Labs. Inc. v. Lannett Holdings Inc.*, 893 F.3d 1372, 1377–78 (Fed. Cir. 2018); *SmithKline Beecham Corp. v. Apotex Corp.*, 439 F.3d 1312, 1319 (Fed. Cir. 2006). But even as to what Corephotonics does challenge in this court, the Board had before it substantial evidence to support its finding.

The Board found, based on evidence that Apple presented from an optics textbook, *see* J.A. 761, that vignetting is a well-known "issue" and that a relevant artisan would have been motivated to correct Ogino by using a meniscus lens because the artisan would have understood that such a lens would not only reduce vignetting but would also "result in relative illumination over 50%, which is known to be desirable," *Board Decision*, 2019 Patent App. LEXIS 13253, at *36–37 (citing J.A. 475–79 ¶¶ 51, 57). The evidence supports that finding. J.A. 475–79 ¶¶ 51–58; *see also* J.A. 1060 (article suggesting relative illumination of more than 50%). Indeed, Ogino itself states that it is "advantageous to reduce 'deterioration in the light receiving efficiency and occurrence of color mixture due to increase of incident angle' [i]n order 'to achieve optimum optical performance.'" *Board Decision*, 2019 Patent App. LEXIS 13253, at *37–38 (quoting Ogino, col. 7, lines 21–25).

Further, despite language in Ogino explaining that the rationale for using a biconcave second lens element is to reduce track length, Ogino, col. 7, lines 39–42, nothing in Ogino "would have the effect of discrediting or discouraging the use of a meniscus shaped lens." *Board Decision*, 2019 Patent App. LEXIS 13253, at *38–40; *see also In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) ("The prior art's mere disclosure of more than one alternative does not constitute a teaching away from any of these alternatives because such disclosure does not criticize, discredit, or otherwise discourage the solution claimed . . . ."). Ogino states that "the present invention is not limited to the above-mentioned embodiments" and that the lens elements' "values of the radius of curvature" and "aspheric surface

coefficient[s]" may be modified. Ogino, col. 16, lines 11–19. Substituting a biconcave lens element for a meniscus one would be one way to make such modifications. *See* J.A. 481–82 (Dr. Sasián Declaration); J.A. 605, 613–17 (optics textbook).

Nor is the modification to Ogino based on Chen a result of "impermissible hindsight" as Corephotonics suggests. Corephotonics Opening Br. at 46–48. The Board found that both experts agreed that when seeking to improve a lens assembly, a relevant artisan "would have . . . start[ed] with a suitable design and then look[ed] to modify it based on teachings of other systems or existing knowledge." *Board Decision*, 2019 Pat. App. LEXIS 13253, at *41–42; *see also* J.A. 476 ¶ 53, 481–82 ¶ 60 (Dr. Sasián Declaration), 1905 (Tr. 27:19–29:3) (Dr. Moore Deposition). The Board credited Dr. Sasián's testimony that switching a biconcave lens for a meniscus lens "'would be a routine lens adjustment'" for a relevant artisan, and that such an artisan "would have understood that the undesirable vignetting of Ogino would be mitigated by modifying the shape of the second lens." *Board Decision*, 2019 Pat. App. LEXIS 13253, at *41–42 (quoting J.A. 147); *see also* J.A. 481–82 ¶ 60. There is thus substantial evidence supporting the Board's finding that a relevant artisan would have been motivated to combine Ogino's Figure 6 with Chen's second lens to arrive at the challenged claims.

III

For the foregoing reasons, the judgment of the Patent Trial and Appeal Board is affirmed.

AFFIRMED