United States Court of Appeals for the Federal Circuit

LSI CORPORATION, AVAGO TECHNOLOGIES U.S. INC.,
Appellants

v.

REGENTS OF THE UNIVERSITY OF MINNESOTA,
Appellee

2021-2057

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2017-01068.

Decided: August 11, 2022

KRISTOPHER L. REED, Kilpatrick Townsend & Stockton LLP, Dallas, TX, argued for appellants. Also argued by EDWARD JOHN MAYLE, Denver, CO.

PATRICK JOSEPH MCELHINNY, K&L Gates LLP, Pittsburgh, PA, argued for appellee. Also represented by MARK G. KNEDEISEN, ANNA SHABALOV, CHRISTOPHER MICHAEL VERDINI; THEODORE J. ANGELIS, Seattle, WA.

Before DYK, REYNA, and HUGHES, *Circuit Judges*.

DYK, *Circuit Judge*.

The Regents of the University of Minnesota ("UMN") sued LSI Corporation and Avago Technologies U.S. Inc. (collectively, "LSI") for infringement of U.S. Patent No. 5,859,601 ("'601 patent") in the District of Minnesota. LSI petitioned the Patent Trial and Appeal Board ("Board") for inter partes review of the '601 patent, and the Board instituted review on claims 13, 14, and 17 on anticipation theories based on two prior-art references, U.S. Patent Nos. 5,392,270 ("Okada") and 5,731,768 ("Tsang"). The Board concluded that claim 13 was unpatentable in view of Okada and that claims 14 and 17 were not shown to be unpatentable in view of either reference. In finding that LSI failed to show unpatentability of claims 14 and 17, the Board held that LSI failed to timely raise its theory that Tables 8 and 9 of Okada anticipate claims 14 and 17 and that, in any event, Tables 8 and 9 did not anticipate. As to Tsang, the Board held that the reference was not prior art because it was not "by another" under 35 U.S.C. § 102(e).[1] LSI appeals the Board's decision as to claims 14 and 17. We affirm.

BACKGROUND

I

The '601 patent addresses error rates related to recording data to computer storage devices. Some input data sequences contain "error-prone binary data patterns." '601 patent, col. 2, ll. 40–46. Dr. Jaekyun Moon, a UMN professor at the time, and Dr. Barrett J. Brickner, a UMN graduate student at the time, developed maximum transition-run ("MTR") coding to reduce these error-prone patterns, and their work became the basis for the '601 patent. *Id.* MTR coding as described in the '601 patent involves

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[1] Because the '601 patent was filed before the America Invents Act ("AIA"), we use the pre-AIA statute.

receiving sequences of input data blocks with error-prone patterns and converting (i.e., encoding) each input data block into a corresponding "codeword" that avoids the error-prone patterns. *Id.* at col. 4, l. 46–col. 5, l. 20. Dr. Moon and Dr. Brickner understood that the number of consecutive bit transitions in the input data sequence, i.e., binary bit transitions from 0 to 1 or 1 to 0, was an important source of error. Thus, MTR coding as described in the '601 patent converts input data blocks into codewords that (1) "impose[] a limit on the maximum number of consecutive transitions" that are written to a computer storage device, *id.* at col. 2, ll. 59–61, and (2) impose a limit on the maximum number of non-transitions, *id.* at col. 3, ll. 16–17; col. 10, ll. 47–59.

These two limitations on bit transitions are embodied in the claims with the 'j' constraint limiting the number of consecutive transitions and the 'k' constraint limiting the number of consecutive non-transitions. Independent claim 13 states:

> A method for encoding m-bit binary datawords into n-bit binary codewords in a recorded waveform, where m and n are preselected positive integers such that n is greater than m, comprising the steps of:
>
> receiving binary datawords; and
>
> producing sequences of n-bit codewords;
>
> imposing a pair of constraints (j;k) on the encoded waveform;
>
> generating no more than j consecutive transitions of said sequence in the recorded waveform such that j≧2; and
>
> generating no more than k consecutive sample periods of said sequences without a transition in the recorded waveform.

Id. at col. 10, ll. 47–59. Dependent claim 14 narrows claim 13 with the limitation, "wherein the consecutive transition limit is defined by the equation $2 \leqq j < 10$." *Id.* at col. 10, ll. 60–61. Claim 17 narrows claim 14 with limitations directed to an additional format for representing data and transitions. *Id.* at col. 11, ll. 1–6. Both parties treat claim 17 as standing or falling with claim 14, so we focus only on claim 14.

II

LSI contends that claim 14 in the '601 patent is anticipated by Okada and Tsang. Okada teaches converting input data blocks using two rules that eliminate the occurrence of certain patterns in the input data blocks for use with optical disks. Okada, col. 3, ll. 36–68. Okada's Rule 1 provides, "A pattern after conversion consists of at least one '0' and an even number of consecutive '1'." *Id.* at col. 3, ll. 64–65. Okada's Rule 2 provides, "A pattern after conversion includes a section consisting of '01010' and a section consisting of at least one '0' or an even number of consecutive '1'." *Id.* at col. 3, ll. 66–68. Okada's Tables 1–9 include an example mapping of all 8-bit input data blocks to 13-bit converted output data blocks based on Okada's two rules. *Id.* at col. 4, ll. 1–9. LSI originally contended that Okada's disclosure of Rule 2 itself anticipates claims 14 and 17 of the '601 patent, but later argued instead that Tables 8 and 9 were embodiments that anticipate claims 14 and 17.

III

LSI's second theory of anticipation relies on Tsang, and particularly those portions of Tsang disclosed earlier in what is known as the Seagate Annual Report. Some background on the '601 patent is necessary to understand the Tsang anticipation theory. On September 26, 1995, Dr. Moon and Dr. Brickner submitted the Seagate Annual Report about MTR coding to Seagate, an industry collaborator on their research. The material in the Seagate Annual

Report was later embodied in the '601 patent. It is not clear whether the Seagate Annual Report was publicly available before the '601 patent's priority date.

In both the Seagate Annual Report and the '601 patent, Dr. Moon and Dr. Brickner describe MTR coding that takes an input sequence of binary data and encodes or converts it in a way that eliminates error-prone patterns of consecutive bit transitions before saving or storing the encoded sequence in a computer storage device. *See* '601 patent, col. 1, ll. 16–55; col. 2, l. 40–col. 3, l. 17; J.A. 3550–57. MTR coding as described in both the '601 patent and the Seagate Annual Report includes the two limitations on consecutive bit transitions and non-transitions. '601 patent, col. 2, ll. 59–61; col. 3, ll. 16–17; col. 10, ll. 47–59; J.A. 3553, 3556. To accomplish the encoding and achieve the two limitations on transitions and non-transitions, the '601 patent and the Seagate Annual Report describe a "fixed-length block code[]" that maps every 4-bit input data block to a unique 5-bit codeword. '601 patent, col. 4, l. 61–col. 5, l. 18; *see* J.A. 3553, 3556–57. MTR coding that maps 4-bit input data blocks to 5-bit codewords is a rate 4/5 code.

Here, there is no contention that the Seagate Annual Report can be relied upon as prior art to the '601 patent since Dr. Moon and Dr. Brickner are both listed as the only authors of the Seagate Annual Report and as the only inventors of the '601 patent. Because the Seagate Annual Report has the same authors, it is not "by another" under § 102 even if it were publicly available before the priority date. Rather, LSI relies on another prior-art patent, Tsang, to anticipate claims 14 and 17.

About four months after receiving the Seagate Annual Report from Dr. Moon and Dr. Brickner and before the earliest filing date of the '601 patent (April 5, 1996), Dr. Kinhing P. Tsang, an employee at Seagate, filed an application on January 31, 1996, that would later mature into the Tsang patent. Dr. Moon and Dr. Brickner were not listed

as inventors on the Tsang patent. Under § 102(e), the Tsang patent is prior art on its face to the '601 patent because Dr. Tsang is the only listed inventor on the patent and is not a listed inventor on the '601 patent. The Tsang patent described MTR coding as previously existing in the Background section of the patent and directly referenced the Seagate Annual Report. Tsang, col. 2, ll. 22–44.

Based on the description of MTR coding by Dr. Moon and Dr. Brickner in the Seagate Annual Report, Tsang revised the MTR coding to create a specific codeword strategy that selects the codeword for a given dataword depending on the previous dataword-codeword mapping, an invention not disclosed or specifically claimed in the '601 patent.[2] This type of system is known as a state-dependent system, and it allowed Tsang to implement MTR coding with higher input-output rates, which allows for more efficient use of storage. For example, Tsang described and claimed an implementation with 6-bit input data blocks and 7-bit output codewords, i.e., a 6/7 rate, instead of the 4/5 rate described in the Seagate Annual Report and the '601 patent. Dr. Tsang described a specific implementation that built on MTR coding that limited consecutive transitions and non-transitions as described by Dr. Moon and Dr. Brickner in the Seagate Annual Report.

IV

On August 25, 2016, UMN sued LSI in the District of Minnesota for infringement of the '601 patent. The case was later transferred to the Northern District of California under 28 U.S.C. § 1406(a). *Regents of the Univ. of Minn. v.*

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[2] Because we affirm the Board's conclusion that Tsang's specific embodiments are not relevant to claims 14 and 17 for anticipation, we need not decide whether the claims of the '601 patent are sufficiently broad to cover Tsang's specific embodiments.

LSI Corp., No. 16-CV-2891 (WMW/SER), 2018 WL 6497034, at *4 (D. Minn. Feb. 1, 2018).

Within one year of the filing of the infringement action, on March 10, 2017, LSI petitioned for inter partes review of the '601 patent. Before the Board, UMN moved to dismiss LSI's petition on the ground of state sovereign immunity. The Board denied UMN's motion to dismiss, but it stayed proceedings on the merits while UMN appealed. This court affirmed the Board's sovereign-immunity decision, holding that "state sovereign immunity does not apply to these proceedings." *Regents of the Univ. of Minn. v. LSI Corp.*, 926 F.3d 1327, 1330 (Fed. Cir. 2019). The Supreme Court denied UMN's certiorari petition, and thereafter the Board lifted the stay.

In the ensuing proceedings before the Board, UMN disclaimed all challenged claims except for method claims 13, 14, and 17. The Board instituted review on the three claims, on LSI's Ground 1, alleging anticipation under 35 U.S.C. § 102(b) by Okada, and Ground 2, alleging anticipation under § 102(e) by Tsang.

On April 14, 2021, the Board issued its final written decision finding claim 13 anticipated by Okada (a determination that UMN does not contest on appeal). However, the Board determined that LSI had not shown that claims 14 and 17 were unpatentable in view of Okada or Tsang. It concluded that Okada's Rule 2 did not anticipate claims 14 and 17 because the imposed limit on consecutive transitions (the 'j' constraint in the challenged claims) from Okada is not less than 10 as required by the limitation in claim 14 that 'j' satisfy $2 \leqq j < 10$. The Board determined that LSI first raised a new theory—that Okada's partial mappings in Tables 8 and 9 independently anticipate claims 14 and 17—at oral argument and that this theory was "improper as untimely." J.A. 31. The Board then explained that, "[e]ven if [LSI]'s argument were timely," LSI had failed to explain "how each of Tables 8 and 9,

independently, comprises a complete embodiment such that Tables 8 and 9, by themselves, and without any rearrangement, anticipate." J.A. 31–32.

Turning to the Tsang ground, the Board determined that Tsang is not "by another" under § 102(e).[3] The Board found that, despite citing to various portions of Tsang, LSI's "[p]etition relies solely on material disclosed in the Seagate Annual Report for anticipation of the challenged claims." J.A. 37–38 (emphasis added). For example, the petition explained how "Dr. Tsang set forth a key finding from Seagate's research—a finding previously presented in the Seagate Annual Report: . . . 'The upper bound of the MTR=2 code rate [imposing a limit of two on consecutive bit transitions] in which $k=\infty$ has been found to be 0.8791 as indicated in the Seagate Annual Report.'" J.A. 132 (quoting Tsang, col. 2, ll. 36–38). Thus, the Board concluded that LSI had "not satisfied its burden to prove the portions of Tsang relied upon for anticipation represent the work of another to qualify as prior art under § 102(e)." J.A. 44.

LSI appeals. We have jurisdiction under 28 U.S.C. § 1295(a)(4).

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[3] Section 102(e) provides:

> A person shall be entitled to a patent unless—
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> (e) the invention was described in—(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent . . . .

DISCUSSION

We review the Board's legal determinations de novo and any underlying factual findings for substantial evidence. *Duncan Parking Techs., Inc. v. IPS Grp., Inc.*, 914 F.3d 1347, 1357 (Fed. Cir. 2019). "[W]hether a reference is a work of others . . . is, like that of inventorship, a question of law based on underlying facts." *Allergan, Inc. v. Apotex Inc.*, 754 F.3d 952, 969 (Fed. Cir. 2014) (citing *Ethicon, Inc. v. U.S. Surgical Corp.*, 135 F.3d 1456, 1460 (Fed. Cir. 1998)).

I

First, we consider whether the Board erred with respect to Okada. As noted earlier, LSI originally contended that Okada's disclosure of Rule 2 anticipates claims 14 and 17, but LSI does not now argue that Rule 2 anticipates. Rather, LSI argues that Tables 8 and 9 of Okada's example mapping of 8-bit input data blocks independently satisfy the claimed requirements. The Board concluded that this theory was both untimely (because it was raised for the first time at the Board hearing) and unpersuasive (because Tables 8 and 9 are not complete embodiments separate from Tables 1–7).

Before this court, LSI did not challenge the Board's determination that LSI's argument about Okada's Tables 8 and 9 was "improper as untimely." J.A. 31. At oral argument, LSI indeed admitted that it did not appeal the Board's untimeliness determination. However, LSI argues that it was not necessary to challenge the Board's untimeliness determination because the Board nevertheless reached the merits.

In *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, we rejected a similar contention, holding the Board's rejection of arguments on the ground that they were newly raised in a reply brief was not an abuse of discretion even

though the Board went on to address the merits. 821 F.3d 1359, 1369–70 (Fed. Cir. 2016). We explained:

> Because we conclude that the reply brief and accompanying declaration exceeded the scope of the reply under § 42.23(b), and, therefore, that the Board did not abuse its discretion in excluding those documents, we need not . . . review the Board's conclusion that, even if proper, the arguments contained in the reply brief are unpersuasive for the same reason it found the arguments in the petition unpersuasive.

Id. at 1370 (emphasis added); *see also Gen. Access Sols., Ltd. v. Sprint Spectrum L.P.*, 811 F. App'x 654, 659 n.3 (Fed. Cir. 2020) ("Because we find that the Board did not abuse its discretion in declining to address the improperly incorporated documents, we do not reach the question of whether the Board erred in its alternative holding that evaluated those materials . . . .").

We affirm the Board's conclusion of untimeliness because LSI forfeited any challenge to the untimeliness holding by failing to challenge it in its opening brief on appeal, and the Board's timeliness holding constitutes an independent ground for its decision. *E.g.*, *SmithKline Beecham Corp. v. Apotex Corp.*, 439 F.3d 1312, 1319 (Fed. Cir. 2006) ("Our law is well established that arguments not raised in the opening brief are waived.").

II

We next consider whether the Board erred in rejecting LSI's anticipation theory based on Tsang. This requires us to determine whether the relevant portions in Tsang relied upon by LSI describe an invention "by another." A claimed invention is anticipated if "the invention was described in . . . an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent." § 102(e) (emphasis

added). A patent applicant or owner may overcome anticipation under § 102(e) by "establish[ing] that the relevant disclosure [in the prior-art reference] describes their own invention," *In re Costello*, 717 F.2d 1346, 1351 (Fed. Cir. 1983), i.e., that it is not "by another," § 102(e). Determining whether a reference is "by another" involves three steps:

> [T]he Board must (1) determine what portions of the reference patent were relied on as prior art to anticipate the claim limitations at issue, (2) evaluate the degree to which those portions were conceived "by another," and (3) decide whether that other person's contribution is significant enough, when measured against the full anticipating disclosure, to render him a joint inventor of the applied portions of the reference patent.

Duncan Parking, 914 F.3d at 1358.

LSI argues that it relied on Tsang to establish anticipation (and not the Seagate Annual Report), thus satisfying the first prong of the *Duncan Parking* test, and that since (allegedly) Tsang is a species of the genus described in the '601 patent, it anticipates claims 14 and 17. LSI misunderstands the relevant test. The inquiry is not simply whether LSI relied on Tsang and whether Tsang's disclosures anticipate. The question is whether the invention of Tsang was relied upon and relevant to anticipation, or whether it was simply Tsang's summary of the earlier Seagate Annual Report that was relied upon and relevant to anticipation. Tsang's summary of, and reliance on, the earlier work of Dr. Moon and Dr. Brickner does not make Tsang an inventor of the earlier work.

In the related context of obviousness, we recently explained that "[t]he portions of the reference being considered must be relied upon *and* relevant to establishing obviousness." *Google LLC v. IPA Techs. Inc.*, 34 F.4th 1081, 1086 n.3 (Fed. Cir. 2022). "Otherwise, a party

challenging a patent could artificially alter the inventive entity for comparison by citing extraneous portions of a multi-inventor prior art reference, thereby making it 'by others' even if the portions of the reference necessary for establishing obviousness had the same inventive entity as the challenged patent." *Id.*

Here, the petition relied both on portions of Tsang that summarized the Seagate Annual Report and on additional portions of Tsang that were not merely derivative of the Seagate Annual Report—portions describing Tsang's specific invention. But those additional portions of Tsang are not relevant to anticipation. The Board properly concluded that the two Tsang embodiments, which included the specific 5/6 and 6/7 rates that were different from the 4/5 rate disclosed by Dr. Moon and Dr. Brickner in the Seagate Annual Report, were not relevant to the scope of the challenged claims because "Tsang's 5/6 and 6/7 MTR rates . . . do not refer to the values of constraints j and k," which impose limits on the number of consecutive transitions and non-transitions in the challenged claims. J.A. 38. Thus, Tsang's 5/6 and 6/7 rates address characteristics that "are not limited by the challenged claims" and are not relevant to the limitations in the challenged claims. *Id.* Indeed, LSI's briefs on appeal take pains to repeatedly remind us that the invention of Tsang is quite different from the '601 patent. Appellant's Br. 36 (Tsang's state-dependent method results "in efficiencies and higher rates that could not be realized using the block-code approach disclosed in the '601 patent specification."); *id.* at 37 (Tsang disclosed "two encoding methods that are impossible to implement using the block-code approach disclosed in the '601 patent specification," and Tsang's methods "make available additional 'valid' codewords that are not available with the block-code method."); *id.* at 38 ("Tsang's invention represents a significant advance over the simple block-code method disclosed in the specification of the '601 patent."); *id.* at 42 ("Tsang expressly explains that [Tsang's]

inventions were not made—and *could not* have been made—using a 'one-to-one block mapping' method like that disclosed in Figure 6 of the '601 Patent. . . . Tsang's method is more efficient than the block-code method because it stores data more densely on a disk."); *id.* at 42–43 (Tsang's "inventions were not made using a block-code method like the one disclosed in the specification of the '601 Patent," and "do not utilize a block code method like the 4/5 code disclosed in the '601 specification.").

It is thus undisputed that these unique features of Tsang were irrelevant to anticipation of the invention of claims 14 and 17, and that the concept of limitations on the number of consecutive transitions and non-transitions (the j and k constraints in the challenged claims) was disclosed in the Seagate Annual Report and merely repeated in Tsang's Background section. Tsang, col. 1, l. 41–col. 2, l. 63. In view of this, the Board did not err in holding that it was "persuaded that the [p]etition relies on the portions of Tsang describing MTR constraints j and k, which are also described in the Seagate Annual Report," J.A. 43, such that Tsang did not qualify as "the work of another," J.A. 44.[4]

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[4] The Board stated:

> Although we recognize the [p]etition relies on various portions of Tsang for background and context, when considering the [p]etition as a whole, we agree with Patent Owner that the [p]etition relies solely on material disclosed in the Seagate Annual Report for anticipation of the challenged claims. Throughout the [p]etition, [p]etitioner focuses on Tsang's disclosure of two embodiments "for encoding 'data words . . . having "m" successive bits' into 'code words . . . having "n" bits where "n" is greater than "m"'" as anticipating.

J.A. 37–38 (quoting J.A. 164) (emphasis added).

Contrary to LSI's contention, the Board did not find that Dr. Tsang's contribution in his patent was uninventive or that Dr. Tsang was not the inventor of his own patent. Rather, the Board properly found that the material in the Tsang patent that exceeded the disclosure of the Seagate Annual Report was not relevant to the anticipation challenge to claims 14 and 17 of the '601 patent and that summarizing the Seagate Annual Report in Tsang did not make Tsang an inventor of the material.

CONCLUSION

We affirm the Board's holdings that arguments as to Okada were untimely and that relevant teachings in Tsang were not "by another."

AFFIRMED

COSTS

Costs to UMN.