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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte LAZAR A. SHIFRIN[1]

Appeal 2015-003135
Application 13/016,733
Technology Center 3700

Before DONALD E. ADAMS, JEFFREY N. FREDMAN,
and TIMOTHY G. MAJORS, *Administrative Patent Judges*.

PER CURIAM

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 involving claims to a method for digitally controlling the gain of an ultrasonic signal which have been rejected as indefinite and obvious. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

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[1] Appellant identifies the Real Party in Interest as Supertex, Inc. (App. Br. 1.)

STATEMENT OF THE CASE

Appellant's "invention relates generally to low noise amplifiers having operatively digitally controllable gain. Specifically, the invention relates to digitally controllable variable-gain amplifiers and more particularly to such amplifiers used in ultrasound imaging." (Spec. p. 1.)

Claims 1, 3–6, and 15–20 are on appeal. Claim 1 is illustrative:

1. A method for digitally controlling the gain of an ultrasonic signal comprising the steps of:

transmitting an ultrasonic signal into an insonified object;

receiving at least one echo ultrasonic signal of the transmitted ultrasonic signal from scattering of the transmitted ultrasonic signal within different depths of the object; and

compensating the attenuation of the received echo ultrasonic signals from different depths of the object by progressively increasing the gain during the reception of the received echo ultrasonic signals as the signal penetrates deeper, wherein the compensating includes:

supplying the received echo ultrasonic signal in parallel to a plurality of N transconductor cells, wherein each of said transconductor cells comprise a differential pair of MOS transistors;

performing conversion of the received echo signal to a plurality of N binary-weighted current signals;

switching, via a T-switch of each cell of the plurality of N transconductor cells while keeping a constant bias current, the conversion ON and OFF in response to a control signal, wherein the control signal is supplied from a look-up-table (LUT);

summing the current signals over all cells to form a summed current signal; and

> converting the summed current signal to a voltage signal.

(App. Br. 8 (Claims App'x).)

The claims stand rejected as follows:

I. Claims 6 and 19 under 35 U.S.C. § 112, second paragraph, as being indefinite.

II. Claims 1, 3–6, and 15–20 under 35 U.S.C. § 103(a) over Torrence,[2] Gibson,[3] Hirvilampi,[4] Gilbert,[5] Guckenberger,[6] Tam,[7] and Brindle.[8]

REJECTION I

Claims 6 and 19 recite "wherein transconductance of a differential pair is by selecting at least one of, an appropriate bias current and transistor aspect ratio." (App. Br. 9–10 (Claims App'x).)

The Examiner determines that "the claims appear incomplete and are grammatically flawed to an extent that a skilled artisan cannot understand the meaning of the current claim language." (Final Act. 2.)

Appellant contends

> One of ordinary skill in the art, after reading the specification and file history, would understand that the phrases of claims 6 and 19 each mean that the transconductance of a differential pair is defined or determined by selecting an

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[2] Torrence, US 4,733,668, issued Mar. 29, 1988.
[3] Gibson et al., US 2002/0011897 A1, published Jan. 31, 2002.
[4] Hirvilampi et al., US 6,614,299 B2, issued Sept. 2, 2003.
[5] Gilbert, US 5,077,541, issued Dec. 31, 1991.
[6] Guckenberger et al., US 7,042,295 B2, issued May 9, 2006.
[7] Tam, US 5,910,780, issued June 8, 1999.
[8] Brindle, US 2004/0113746 A1, published June 17, 2004.

> appropriate bias current and/or transistor aspect ratio. For example, paragraph 0047 of the specification states: "[T]here are two ways to varying the transconductance of a differential pair, namely, by appropriate selecting the bias current 10 or the transistor aspect ratio W/L."

(App. Br. 5; *see also* Reply Br. 2.)

We are not persuaded.

"[D]uring patent prosecution when claims can be amended, ambiguities should be recognized, scope and breadth of language explored, and clarification imposed." *In re Zletz*, 893 F.2d 319, 321 (Fed. Cir. 1989).

As the Examiner explains, "Appellant in reading words into the claim language[,] provide[s] two alternative readings, defining and determining" and "a skilled artisan would not know if the values were actively defined or passively determined after the fact based on Appellant's arguments, claim language, and disclosure." (Ans. 2–3.)

We thus affirm the rejection of claims 6 and 19 as being indefinite.

REJECTION II

Appellant does not argue the claims separately. We select claim 1 as representative.

The Examiner finds that

> Torrence discloses a method for controlling the gain of an ultrasonic signal comprising the steps of: (a) transmitting an ultrasonic signal into an insonified object (see Figs. 2, 5, and 8, col 1 ln 30–50, col 3 ln 17–39, col 4 ln 9–33, and col 5 ln 4–54); (b) receiving echo ultrasonic signals of said transmitted ultrasonic energy signal from scattering of said transmitted ultrasonic energy signal within said object (see Figs. 2, 5, and 8, col 1 ln 30–50, col 3 ln 17–39, col 4 ln 9–33, and col 5 ln 4–54); and (c) compensating the attenuation of said echo ultrasonic signal from different depths by progressively increasing the gain

> during the reception of said echo ultrasonic signals as the signal penetrates deeper, to make the intensity of the signal propagating through the object, approximately constant (see Figs. 2, 5, and 8, col 1 ln 30–50, col 3 ln 17–39, col 4 ln 9–33, and col 5 ln 4–54).

(Final Act. 3.)

The Examiner finds that

> Gibson discloses a similar method of varying gain, wherein (c) further comprises the steps of: (a) supplying a received voltage echo signal in a parallel to a plurality of N transconductor cells wherein each of said transconductor cell comprising a differential pair of MOS transistors (see Figs. 1–3 and para 5, 12–17, 20, and 38–44, noting that MOS transistors are well known in the art and are disclosed or would be obvious in light of Gibson); (b) converting said voltage echo signal to a plurality of N binary-weighted current signals (see Figs. 1–3 and para 5, 12–17, 20, and 38–44); (c) accommodating each cell of said plurality of N transconductor cells for switching the above step of converting ON and OFF in response to a control signal (see Figs. 1–3 and para 5, 12–17, 20, and 38–44); and (d) summing said current signals over all cells to form a summed current signal (see Figs. 1–3 and para 5, 12–17, 20, and 38–44).

(*Id.* at 3–4.)

The Examiner concludes that it would have been obvious

> to have combined the teachings of Torrence with . . . Gibson because doing so would provide proper variable gain for an ultrasound device while using a circuit with minimal switches and multiplexers, thus avoiding degradation in performance. Further, the Gibson circuit provides programmable gain operation over a wide range and constant bandwidth while reducing noise and glitches.

(*Id.* at 4.)

The Examiner finds that "Gibson notes constant current bias sources are utilized (see Figs. 1–3 and para[.] 5, 12–17, 20–29, and 38–44)" and concludes that it would have been obvious "to optimize the bias currents, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art." (*Id.*)

The Examiner finds that "Gibson does not specifically enumerate the following steps[:] (e) converting the summed current signal to a voltage signal and (f) supplying said control signals to each of the transconductor cells from a look-up-table (LUT)." (*Id.*)

The Examiner determines that

> back converting the current signal to a voltage signal is well known in the art. For example, Gilbert discloses a similar circuit wherein an additional amplifier is placed after the circuit for additional amplification and conversion of the signal from current back to a voltage signal (see Figs. 1–3). It would have been obvious to a skilled artisan to have included said additional element for the purpose of additional amplification and the conversion of the signal back to a voltage signal.

(*Id.* at 5.)[9]

The Examiner finds that "Gibson discloses an enable signal but does not specifically enumerate how said signal is generated." (*Id.*)

The Examiner turns to Hirvilampi and finds that it "discloses a similar amplification method, wherein the control signal is provided using a look-up-table (LUT)." (*Id.*) According to the Examiner, the "combination of Hirvilampi and Torrence teaches to a skilled artisan to provide the LUT of Hirvilampi with the time-gain curves of Torrence." (*Id.*)

The Examiner concludes that it would have been obvious "to have combined the device of Torrence and Gibson with the further teachings of

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[9] Examiner cites Guckenberger as additional or alternative prior-art evidence for converting current and voltage signals. (Final Act. 5.)

Hirvilampi because doing so would provide accurate timing by sending a variety of control signals to account for possible operating conditions." (*Id.*)

The Examiner finds that Tam and Brindle evidence further switching features (*id*. at 6.); Appellant does not dispute these findings on appeal.[10]

The issue with respect to this rejection is: Does the evidence of record support the Examiner's conclusion that Torrence, Gibson, Hirvilampi, Gilbert, Guckenberger, Tam, and Brindle, render claim 1 obvious?

Findings of Fact

The Examiner's findings concerning the scope and content of the prior art may be found at pages 3–7 of the Final Action dated March 21, 2014. (*See also* Ans. 3–7.) We provide the following findings for emphasis.

1. Torrence teaches that

> body tissues on the average attenuate ultrasound energy at a rate of approximately 1 dB[]/mHz/cm. To compensate for this rapid attenuation, prior art ultrasound systems generally incorporate circuitry (termed "time-gain compensation" or TGC circuitry) which acts to increase receiver gain during a time period which follows the introduction of a pulse into the body. The time required for reflected pulses to return to the receiver is a direct function of the depth of a reflecting structure within the body; thus receiver gain is automatically increased for reflected pulses which originate deep within the body. The attenuation of ultrasound energy is, however, not uniform for all body tissues and structures.

(Torrence 1:30–43; *see also* Final Act. 3.)

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[10] Appellant contends only that "Gibson, Hirvilampi, Gilbert, Tam, Brindle, and Guckenberger do not discuss or apply to ultrasound devices at all." (App. Br. 6.)

2. Torrence teaches that "the gain of the receiver . . . is controlled by an electrical signal which is furnished by a time-gain control (TGC) circuit . . . to compensate for the attenuation of ultrasound energy which is reflected from structures at varying depths in the body." (Torrence 3:18–22; *see also* Final Act. 3.)

3. Torrence teaches

> the slope of the time-gain compensation applied to the receiver in a diagnostic ultrasound system is caused to vary with time to match the attenuation characteristic of tissue at depths corresponding to those times. . . . The break point . . . in the time-gain compensation curve, may, in the case of body wall compensation, be set to occur at a fixed time (following transmission of the pulse) which corresponds to the approximate thickness of the body wall. This time may be set at a nominal value determined from previous experience or may be set by reference to the echo which occurs at the interface between the body wall and the internal body tissues.

(Torrence 4:15–33; *see also* Final Act. 3.)

4. Figure 1 of Gibson is reproduced below:

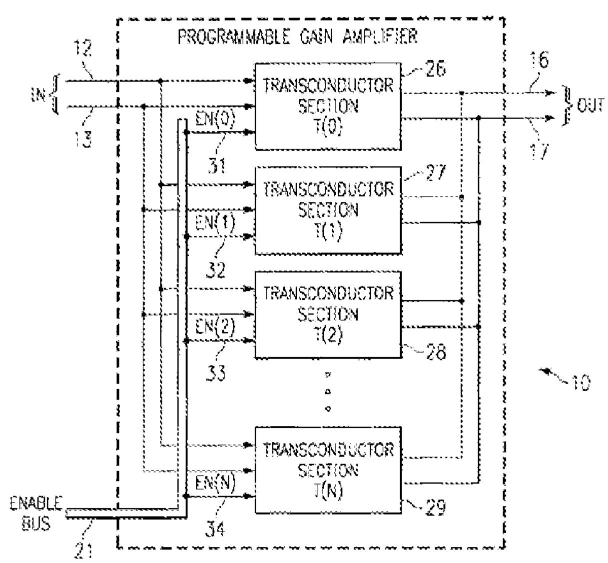

FIG. 1

Figure 1 shows

> [a] programmable gain amplifier (**10**) has a differential input (**12**–**13**), a differential output (**16**–**17**), and a plurality of enable inputs (**21**, **31**–**34**). The amplifier includes a plurality of transconductor sections (**26**–**29**), which each have input nodes coupled to the differential input, output nodes coupled to the differential output, and an enable node coupled to a respective enable signal.

(Gibson Abstract; *see also* Final Act. 3–4.)

5. Figure 2 of Gibson is reproduced below:

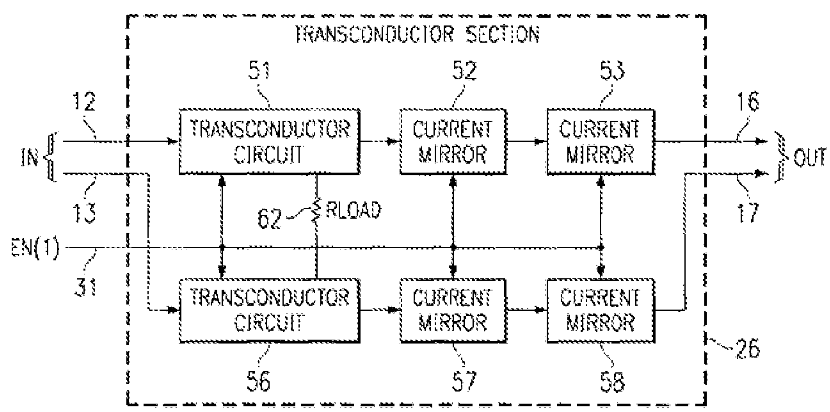

FIG. 2

Figure 2 shows that

> [t]he transconductor sections have different gains, which are respective powers of two. Each transconductor section includes a transconductor circuit (**51**, **56**) which is coupled in series with at least one current mirror circuit (**52**–**53**, **57**–**58**). Each transconductor circuit has a transistor (**121**) with a class A quiescent current that is proportional to the corresponding gain, the transistor being sized to achieve an optimum current density for its quiescent current. Each such transistor has two terminals coupled to other circuitry within the transconductor circuit, and

> a third terminal coupled only to the associated current mirror circuit.

(Gibson Abstract; *see also* Final Act. 3–4.)

6. Gibson teaches

> Each of the transconductor sections **26**–**29** is respectively enabled and disabled when the corresponding one of the lines **31**–**34** of the bus **21** respectively has logic low and logic high states. When disabled, each transconductor section **26**–**29** effectively has its output disabled, so that its output has no effect on the differential output **16**–**17**. Each of the transconductor sections **26**–**29**, when enabled, accepts a differential voltage from the differential input **12**–**13**, and outputs a differential current to the differential output **16**–**17**. Since the transconductor sections **26**–**29** each output a current rather than a voltage, the currents from the transconductor sections which are enabled are effectively summed, in order to produce the total output current that appears at the differential output **16**–**17**. In contrast, the transconductor sections which are disabled do not contribute to or affect the current produced at the differential output **16**–**17** by the enabled transconductor sections.

(Gibson ¶ 13; *see also* Final Act. 3–4.)

7. Gibson teaches that "the programmable gain amplifier **10** is implemented in the form of an integrated circuit, which facilitates fabrication of certain components such as transistors." (Gibson ¶ 17; *see also* Final Act. 3–4.)

8. Gibson teaches that "the outputs of the various transconductor sections can be directly connected together, in order to generate the final output signal, while avoiding multiplexers or other switches in the signal path, and the degradation in performance associated with them." (Gibson ¶ 41; *see also* Final Act. 3–4.)

9. Gibson teaches that "the transconductor sections **26**–**29** of **FIG. 1** each have another operational mode, in which they are disabled by the

corresponding line EN(n) of the enable bus **21**." (Gibson ¶ 42; *see also id.* at ¶ 43, Final Act. 3–4.)

10. Hirvilampi teaches

> A method and system to balance a signal through a plurality of parallel amplifier elements of an amplifier device. An input signal to the amplifier device is divided substantially equally among a plurality of parallel amplifier elements. A signal through each of the amplifier elements is measured. If any of the measured signals deviates by a predetermined threshold from a reference signal, an adjustment to an input parameter to a tuning circuit associated with the particular amplifier element is determined. The determined adjustment is applied to the particular a tuning circuit to appropriately adjust the output of the deviating amplifier element. The output of the plurality of amplifier elements is combined as the total output of the amplifier device.

(Hirvilampi Abstract; *see also* Final Act. 5.)

11. Hirvilampi teaches

> The adjustment control circuit . . . may optionally include a look up table (LUT) to store parameter values or adjustments (for transmittal to parameter tuning circuits []) correlated to differences calculated by the signal comparison circuit . . . . The look-up table may, for example, contain adjustments that are dependent upon signal frequency, power level, and/or ambient temperature. Each of the parameter tuning circuits [] then correspondingly adjusts its respective portion of the input signal that is received from the power divider [] and transmits this adjusted input signal portion to its respective amplifier element [] so as to adjust the output of that amplifier element [].

(Hirvilampi 5:59–6:4; *see also* Final Act. 5.)

DISCUSSION

We adopt the Examiner's findings of fact and reasoning regarding the scope and content of the prior art (Final Act. 3–7; Ans. 3–7; FF 1–11) and agree that claim 1 would have been obvious over Torrence, Gibson, Hirvilampi, Gilbert, Guckenberger, Tam, and Brindle. We address below Appellant's arguments.

Appellant contends that "there is no disclosure in Gibson of a received voltage echo signal. In fact, Gibson did not involve echo signals at all because its technology involved a cable modem driver and not an ultrasound imaging device." (App. Br. 5; *see also* Reply Br. 4.)

This argument is unpersuasive and fails to account for Torrence, which teaches, *inter alia*, that "[t]his time may be set at a nominal value determined from previous experience or may be set by reference to the echo which occurs at the interface between the body wall and the internal body tissues." (FF 3; *see also* FF 1–2.) "Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references []. [The reference] must be read, not in isolation, but for what it fairly teaches in combination with the prior art as a whole." *In re Merck & Co.,* 800 F.2d 1091, 1097 (Fed. Cir. 1986).

Appellant argues that Hirvilampi "does not teach using the look-up-table as the basis for turning conversions on and off, nor does it teach using a look-up-table for doing that specifically to compensate the attenuation of a received echo ultrasonic signal." (App. Br. 5; *see also* Reply Br. 5.) Appellant also contends that "Hirvilampi certainly does not teach a look up table of time-gain curves." (App. Br. 6.)

These arguments are unpersuasive. Gibson teaches that "the transconductor sections **26–29** of **FIG. 1** each have another operational mode, in which they are disabled by the corresponding line EN(n) of the enable bus **21**." (FF 9.) Gibson teaches that "[e]ach of the transconductor sections **26–29** is respectively enabled and disabled when the corresponding one of the lines **31**–**34** of the bus **21** respectively has logic low and logic high states." (FF 6; *see also* FF 4–5, 7–8; Ans. 5–6.) Torrence teaches "[t]he break point . . . in the time-gain compensation curve, may, in the case of body wall compensation, be set to occur at a fixed time (following transmission of the pulse) which corresponds to the approximate thickness of the body wall." (FF 3.) Here again, Appellant's contentions are unpersuasive because they do not adequately grapple with the rejection as presented — based on the combination of Hirvilampi with the teachings of Gibson and Torrence.

Appellant contends that "reading Torrence, Gibson, and Hirvilampi does not lead one to the solution of using a look-up table to provide a control signal for turning transconductors on and off to compensate for the attenuation of a received echo ultrasonic signal." (App. Br. 6).

We are not persuaded. As the Examiner explains,

> a skilled artisan would have found it a common place expedient to store the time-gain curves of Torrence to control the amplifier of Gibson in a LUT as taught by Hirvilampi. Essentially, Hirvilampi discloses that control data must be stored and that said data can be stored in a LUT. Storing the time-gain curves of Torrence in a LUT would have predictably stored data for later use by an amplifier circuit. The combination of references discloses storing time-gain curve data used for amplifying an ultrasound signal via the Gibson circuit in a LUT.

(Ans. 5–6.)

Appellant fails to establish an evidentiary basis on this record to show that the Examiner's rejection is something other than "the predictable use of prior art elements according to their established functions." *KSR Int'l Co. v. Teleflex Inc.,* 550 U.S. 398, 417 (2007). *See also In re Geisler,* 116 F.3d

1465, 1470 (Fed. Cir. 1997) ("[A]ttorney argument [is] not the kind of factual evidence that is required to rebut a prima facie case of obviousness").

Appellant argues that "Gibson, Hirvilampi, Gilbert, Tam, Brindle, and Guckenberger do not discuss or apply to ultrasound devices at all. Thus, they are not within the relevant field, and one of ordinary skill in the art would not have combined them together with Torrence to achieve a solution in the field of ultrasound devices." (App. Br. 6–7.)

This argument is also unpersuasive. We agree with the Examiner that

> the field of ultrasound imaging requires knowledge of myriad circuits including amplifiers. Many ultrasound devices necessarily require amplifiers to amplify faint signals and to account for time and depth dependent imaging concerns. Accordingly, a skilled artisan in the field of ultrasound imaging would necessarily have knowledge of and consider the field of amplifier circuits to be within the field of ultrasound imaging. Moreover, the cited references also appear to be solving the same problems Appellant has sought to solve in the same way. Appellant is utilizing amplifiers and other circuits to amplify and condition a signal in a circuit. Similarly, Gibson for example uses a common place circuit to predictably amplify a signal. Since amplifiers are a necessary component of ultrasound device and a skilled artisan would have considered the field of amplifiers to be included in the field of ultrasound imaging, the cited art is analogous art. Further, the cited art is related to Appellant's problem to be solved.

(Ans. 6–7.) We further observe that Appellant's Specification, in a section titled "DESCRIPTION OF THE RELATED ART" describes prior art amplifiers — some of which are not specific to ultrasound devices. (*See, e.g.,* Spec. ¶ 9 (referring to a Broadcom patent (US 7,425,866).). This is consistent with the Examiner's determination that the skilled artisan's knowledge of suitable amplifiers would not be limited to only those circuits that the art expressly discloses have been put to use in ultrasound devices.

Absent persuasive evidence or argument to the contrary, we agree with the Examiner that the skilled artisan would have predictably used or modified the amplifiers of the cited art to design improved ultrasound devices.

Appellant contends that "[a]lthough Torrence does indicate the need for amplification, it does not even hint at using the type of amplification described in claims 1 and 15, nor does it point toward the type of amplifier described in Gibson," and that "[t]he important inquiry is whether Gibson teaches an amplifier that is appropriate for the system and problem attempted to be solved by Torrence. There is nothing in the Record that suggests that is the case." (Reply Br. 4–5.)

These arguments are unpersuasive.

> [E]vidence of a motivation to combine need *not* be found in the prior art references themselves, but rather may be found in "the knowledge of one of ordinary skill in the art or, in some cases, from the nature of the problem to be solved." . . . When not from the prior art references, the "evidence" of motive will likely consist of an *explanation* of the well-known principle or problem-solving strategy to be applied.

Dystar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co., 464 F.3d 1356, 1366 (Fed. Cir. 2006) (emphases in original, quoting *In re Dembiczak,* 175 F.3d 994, 999 (Fed. Cir. 1999)). The Examiner has provided explanation and persuasive reasoning sufficient to support a *prima facie* case of obviousness. *KSR*, 550 U.S. 398, 418 (2007) (holding that the conclusion of obviousness must be supported with "some articulated reasoning with some rational underpinning.")

CONCLUSION OF LAW

We affirm the rejection of claims 6 and 19 under 35 U.S.C. § 112, second paragraph, as being indefinite.

We affirm the rejection of claims 1, 3–6, and 15–20 under 35 U.S.C. § 103(a) over Torrence, Gibson, Hirvilampi, Gilbert, Guckenberger, Tam, and Brindle.

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED