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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte TETSUYA TANIGUCHI

Appeal 2019-002336
Application 14/194,124
Technology Center 3700

Before NORMAN H. BEAMER, ADAM J. PYONIN, and GARTH D. BAER, *Administrative Patent Judges*.

BEAMER, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant[1] appeals under 35 U.S.C. § 134(a) from the Examiner's Final Rejection of claims 1 and 3–7. We have jurisdiction over the pending rejected claims under 35 U.S.C. § 6(b).

We REVERSE.

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[1] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies Konica Minolta, Inc. as the real party in interest. (Appeal Br. 2.)

THE INVENTION

Appellant's disclosed and claimed invention is directed to an ultrasound diagnostic imaging apparatus including an ultrasound probe and a transmission unit, which makes the ultrasound probe generate the transmission ultrasound by outputting a pulse signal whose drive waveform is formed of rectangular waves. (Abstract.)

Independent claim 1, reproduced below, is illustrative of the subject matter on appeal:

> 1. An ultrasound diagnostic imaging apparatus, comprising:
>
> a processor;
>
> an ultrasound probe which outputs transmission ultrasound toward a subject due to a pulse signal of four or five values being input and which outputs a received signal by receiving reflected ultrasound from the subject; and
>
> a signal transmission circuit comprising:
>
> a duty setter which sets a duty ratio of the pulse signal; and
>
> a pulse generator circuit which generates the pulse signal of four or five values whose drive waveform is formed of rectangular waves according to the duty ratio set by the duty setter,
>
> wherein the processor is configured to control the signal transmission circuit to make the ultrasound probe generate the transmission ultrasound by outputting the pulse signal generated by the pulse generator circuit,
>
> wherein the processor is further configured to control the duty setter to set the duty ratio of the pulse signal so that: (i) a frequency power spectrum of the pulse signal has intensity peaks in a frequency band that is included in a transmission frequency band at -20dB of the ultrasound probe, wherein the frequency power spectrum of the pulse signal includes an intensity peak in the transmission frequency band on a low

> frequency side of a center frequency of the transmission frequency band at -20dB of the ultrasound probe and includes an intensity peak in the transmission frequency band on a high frequency side of the center frequency of the transmission frequency band at - 20dB of tile ultrasound probe, and (ii) an intensity of an entire frequency region between the intensity peaks of the pulse signal is -20dB or greater relative to a maximum intensity value from among intensity values of the intensity peaks, whereby the duty setter sets the duty ratio so that the intensity between the intensity peaks on the low frequency side and the high frequency side of the center frequency is -20dB or greater relative to the maximum intensity value from among the intensity values of the intensity peaks;
>
> wherein the processor is further configured to control the signal transmission circuit to output a plurality of pulse signals of four or five values and of different drive waveforms on a same scanning line for a plurality of times with a time interval therebetween, and
>
> wherein the processor is further configured to perform control to (i) combine received signals obtained from the reflected ultrasound of the transmission ultrasound generated by outputting the plurality of pulse signals, and (ii) generate ultrasound image data based on a composite pulse signal.

Appeal Br. 25–26. (Claims Appendix.)

REJECTIONS

The Examiner rejected claims 1 and 3–7 under 35 U.S.C. § 103(a) as being unpatentable over Taniguchi (US 2013/0006113 A1, pub. Jan. 3, 2013), Ohnuma et al (US 2012/0310091 A1, pub. Dec. 6, 2012) (hereinafter "Ohnuma"), Takimoto (US 2006/0079779 A1, pub. Apr. 13, 2006), and Kristoffersen et al (US 2004/0254459 A1, pub. Dec. 16, 2004) (hereinafter "Kristoffersen"). (Final Act. 5.)

ISSUE ON APPEAL

Appellant's arguments in the Appeal Brief presents the following issue:[2]

Whether the Examiner erred in finding the combination of Taniguchi, Ohnuma, Takimoto, and Kristoffersen teaches or suggests the limitation of

> (ii) an intensity of an entire frequency region between the intensity peaks of the pulse signal is -20dB or greater relative to a maximum intensity value from among intensity values of the intensity peaks, whereby the duty setter sets the duty ratio so that the intensity between the intensity peaks on the low frequency side and the high frequency side of the center frequency is -20dB or greater relative to the maximum intensity value from among the intensity values of the intensity peaks,

as recited in independent claim 1, and the commensurate limitation recited in independent claim 7. (Appeal Br. 8–23.)

ANALYSIS

We have reviewed the Examiner's rejections in light of Appellant's arguments. Arguments Appellant could have made but chose not to make are deemed to be waived. *See* 37 C.F.R. § 41.37(c)(1)(iv).

In finding that the combination of Taniguchi and Ohnuma teaches or suggests the independent claim 1 limitation at issue, the Examiner relies on Taniguchi's disclosure of an ultrasound transmitting section driving an electric signal having plural frequency components and using a rectangular

[2] Rather than reiterate the arguments of Appellant and the positions of the Examiner, we refer to the Appeal Brief (filed Aug. 27, 2018); the Reply Brief (filed Jan. 24, 2019); the Final Office Action (mailed Apr. 2, 2018); and the Examiner's Answer (mailed Nov. 29, 2018) for the respective details.

wave burst having an adjustable duty cycle. (Final Act. 5–6; Taniguchi Figs. 2 and 4–7, ¶¶ 32–40 and 45–57.)

The Examiner further relies on the Ohnuma's disclosure of (i) tracking of setting a duty ratio based in part on the characteristics of the transducer such that the frequency band of the transmit frequency completely covers the frequency band of the transducer, and (ii) the frequency band of the baseband component depending on the pulse width of reflected ultrasound, regardless of the frequency of transmission ultrasound, and thereby as the pulse width decreases, the frequency of the baseband component increases. (Final Act. 6–7; Ohnuma Figs. 2–5 and 11, ¶¶ 4–8, 15, 19, 43, 46–51, 60, 68–72, and 89–94.)

Appellant argues that "the technique of Taniguchi is not preferable for B-mode imaging" because "the reception signal obtained by the waveform of the drive signal in Taniguchi has a plurality of maximum values." (Reply Br. 7; *see also* Appeal Br. 12–15 and Declaration 1–9.) Appellant contends that "the technique to which Taniguchi is directed (for calculating particle diameters based on intensity ratios) would, itself, not be improved by the modification set forth by the Examiner." (Reply Br. 8.)

Appellant further contends that "as illustrated in Fig. 11 of Ohnuma, a frequency power spectrum of a pulse signal includes only one peak. Ohnuma makes no mention nor suggestion of a frequency power spectrum having a plurality of peaks" (Reply Br. 8–9, citing Ohnuma ¶ 68, emphasis in original), so that "in Ohnuma, the focusing point of the sound pressure can exist only at one point even when the band is a broad band, and therefore a good image signal can be obtained only around the one point." (Reply Br. 10, emphasis in original.)

> We agree with Appellant. The Examiner finds that
>
> the rejection as written is over Taniguchi in view of Ohnuma, which starts with the technique of Taniguchi with multiple peaks and merely modifies the relative intensities of said peaks as suggested as beneficial in Ohnuma

and

> Ohnuma specifically indicates a well-known solution for poor distance resolution. Ohnuma in essence provides a well-known and predictable improvement for the Taniguchi method to enhance bandwidth and consequently, resolution and imaging depth of the Taniguchi method.

(Ans. 3.) It appears that the Examiner is referencing two portions of Ohnuma. The first portion states that:

> [t]he transmitting section 12 sets the duty ratio of a pulse signal so that ***one of peaks of the first step response of the transducer which is generated when a change is made to voltage of the pulse signal overlaps with one of peaks of the second step response of the transducer*** which is generated when another change is made to the voltage of the pulse signal. As a result, ***the amplitude of transmission ultrasound can be efficiently amplified and at the same time, pulse width can be decreased, and thereby the transmission ultrasound can be allowed to have a broadband to output transmission ultrasound exhibiting excellent spatial resolution and reaching depth***. Further, in the case of use of a broadband ultrasound probe, its band can be efficiently utilized and thereby the fundamental component of reflected ultrasound obtained from transmission ultrasound and ***a harmonic component due to non-linearity such as a secondary harmonic component and a baseband component generated due to traveling of transmission ultrasound in the interior of an examined subject can be efficiently received***.

(Ohnuma ¶ 89, emphasis added.) The second portion states that:

> according to the present embodiment, the transmitting section **12** outputs a pulse signal such that the frequency band characteristic of transmission ultrasound generated by the transducer ***2a*** is wider than that of the transducer ***2a.*** Thereby, ***the frequency band of a transducer can be utilized to a maximum extent***.

(Ohnuma ¶ 91, emphasis added.) Ohnuma teaches that setting the duty ratio so that "one of [the] peaks of the first step response" then "overlaps with one of [the] peaks of the second step response" results in "the amplitude of transmission ultrasound [being] efficiently amplified." (Ohnuma ¶ 89.)

However, these teachings do not meet the claim language requiring "***the intensity between the intensity peaks on the low frequency side and the high frequency side of the center frequency is -20dB or greater relative to the maximum intensity value*** from among the intensity values of the intensity peaks," as the teachings merely describes an amplified amplitude of transmission and fully utilizing the frequency band of a transducer. Additionally, the record does not establish that such one skilled in the art could reach the claim language via a "predictable improvement" made to Taniguchi.

Accordingly, we reverse the Examiner's obviousness rejection of independent claim 1, as well as independent claim 7 commensurate in scope, and all dependent claims not argued separately. *See* Appeal Br. 24.

DECISION SUMMARY

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
1, 3–7	103(a)	Taniguchi, Ohnuma, Takimoto, Kristoffersen		1, 3–7

REVERSED