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Datasheet for the decision of 25 January 2023

Case Number: T 2158/14 - 3.4.01

Application Number: 09004040.3

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Title of invention:
Ultrasound diagnosis apparatus

Applicant:
Toshiba Medical Systems Corporation

Headword:
Ultrasound diagnosis apparatus / Toshiba Medical Systems

Relevant legal provisions:
EPC Art. 84, 56
RPBA 2020 Art. 13, 25

Keyword:
Inventive step - main request (no) - auxiliary request I (no)
Claims - clarity - auxiliary requests II and III (no)
Admissibility of requests

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Case Number: T 2158/14 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 25 January 2023

Appellant: (Applicant)	Toshiba Medical Systems Corporation 1385, Shimoishigami, Otawara-Shi, Tochigi-Ken 324-8550 (JP)
Representative:	Kramer Barske Schmidtchen Patentanwälte PartG mbB European Patent Attorneys Landsberger Strasse 300 80687 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 23 June 2014 refusing European patent application No. 09004040.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	P. Scriven
Members:	T. Zinke
	D. Rogers

Summary of Facts and Submissions

I. The Examining Division refused the application, for the reasons that claim 1 of the sole request included amendments extending beyond the content of the application as filed (Article 123(2) EPC), lacked clarity (Article 84 EPC), and defined subject-matter lacking an inventive step in light of document D3 (US-B-6 231 511) and the skilled person's common general knowledge.

II. The applicant appealed the decision.

III. With the statement setting out the grounds of appeal, the appellant requested that the decision under appeal be set aside and - as a main request - that a patent be granted on the basis of the set of claims submitted by fax on 2 June 2014 at 18:35. This was identical to the sole request on which the appealed decision was based. Alternatively, the appellant requested that a patent be granted on the basis of one of auxiliary requests I to III, submitted with the statement of grounds. As a final alternative, the appellant requested oral proceedings.

IV. The Board arranged to hold (first) oral proceedings on 3 April 2020. In a first communication issued under Article 15(1) RPBA 2007 on 16 December 2019 together with the summons, the appellant was informed of the Board's preliminary opinion. In particular, the Board agreed with the Examining Division's objections of

added matter and lack of inventive step. With regard to clarity, the Board accepted the appellant's counter-argument, but raised a new clarity issue. With regard to auxiliary requests I to III, the Board raised issues under Article 123(2) EPC, and saw lack of clarity (Article 84 EPC) and lack of inventive step. For the discussion of inventive step of auxiliary requests I to III, the Board introduced, of its own motion, documents D7 (US-2005/0222506) and D8 (Calliada et al.: "Ultrasound contrast agents Basic Principles", European Journal of Radiology, vol. 27, Elsevier, 1998, pages S157 to S160).

V. With a (first) reply, the appellant replaced its requests with a revised main request and revised auxiliary requests I to III. The appellant also indicated a basis, in the original application, for these amended texts, and provided arguments with regard to the issues raised in the Board's communication.

VI. The oral proceedings were cancelled due the safety measures then in place because of COVID-19.

VII. The Board arranged to hold (second) oral proceedings. In a second communication, issued under Article 15(1) RPBA 2020 on 5 October 2020 together with the summons, the appellant was informed of the Board's preliminary opinion. In particular, the Board informed the appellant that the newly-filed requests were not yet admitted into the appeal proceedings. The Board, however, set out some preliminary thoughts about the amended requests, i.e. that clarity was improved and that the amendments seemed to be allowable under

Article 123(2) EPC. However, the Board also explained why, in its view, the subject matter defined by the independent claims of all requests still lacked an inventive step.

VIII. With a second reply, the appellant withdrew its request for oral proceedings and requested that the proceedings be conducted in writing and that the Board issue a decision on the basis of the written submission. With this reply, the appellant filed amended, replacement claim sets for the main request and auxiliary request I. The appellant also gave its view on where in the original disclosure a basis was to be found for the amendments, and provided arguments with regard to inventive step.

IX. The (second) oral proceedings were cancelled.

X. Independent claim 1 of the main request, submitted with the appellant's second reply reads as follows:

An ultrasound diagnosis apparatus (100) adapted to generate image data based on reception signals acquired through an ultrasound transmission/reception to and from an object, the ultrasound diagnosis apparatus comprising:
an ultrasound probe (4) including a plurality (Mx) of transmitting transducer groups (TG1, TG2,..., TGx) and a receiving transducer group (RG1; RG2; RG3; RG4; RG5), each group including a plurality (Mt, Mr)

of transducers respectively defining a plurality (Mt, Mr) of channels;
a transmission unit (2) adapted to successively drive each of the plurality of transmitting transducer groups (TG1, TG2,..., TGx) in order to emit focusing wave-fronts (Wt1, Wt2,..., Wtx) or propagation wave-fronts (Wt1, Wt2,..., Wtx) and respectively form hypothetical point sound sources (Ft1, Ft2,..., Ftx) at different positions, which are a distance (Df) apart from the central transducer of the corresponding transmitting transducer group (TG1, TG2,..., TGx) in the depth direction, for the object;
a receiving phase compensation/summation unit (53) adapted to perform, for each hypothetical point sound source (Ft1, Ft2,..., Ftx), a receiving phase compensation for focusing receiving signals acquired through the plurality of channels of the receiving transducer group (RG1; RG2; RG3; RG4; RG5) and reflected from an observing point (Px), which is located a distance (Dx) apart from the corresponding hypothetical point sound source (Ft1, Ft2,..., Ftx) in the object, and to perform summation of the compensated receiving signals;
a receiving signals memory unit (61) adapted to store the phase compensated and summed receiving signals together with position data of the respective hypothetical point sound source;
a transmission wave-front phase compensation/summation unit (6) adapted to

perform a compensation by correcting, in respect of the phase compensated and summed receiving signals stored together with the position of the point sound source in the receiving signals memory unit (61), the relative transmitting delays due to differences of the propagation distances (Dx) from each of the respective hypothetical point sound sources (Ft1, Ft2,..., Ftx) to the observing point (Px), and to perform summation thereof after said correction;
a scanning control unit (11) adapted to perform ultrasound scans of the object by controlling directions for the ultrasound transmissions/receptions; and
an image processing unit (8) adapted to generate ultrasound image data based on the phase compensated and summed receiving signals acquired through the ultrasound scans.

XI. Independent claim 1 of auxiliary request I, submitted with the appellant's second reply reads:

An ultrasound diagnosis apparatus (100) adapted to generate image data based on receiving signals of transducers acquired through an ultrasound transmission/ reception to and from an object, the ultrasound diagnosis apparatus comprising:
an ultrasound probe (4) including a plurality (MO) of transducers arrayed in an azimuth direction wherein the transducers

are configured to convert drive signals to transmission ultrasound and echo of the ultrasound wave to receiving signals;
a transducer selection unit (3) adapted to select a transmitting transducer group (TG1, TG2,..., TGx) for the ultrasound transmission among the plurality (M0) of transducers arrayed in the azimuth direction and to select a plurality of receiving transducer groups (RG1, RG2, RG3, RG4, RG5) for the ultrasound reception among the plurality (M0) of transducers arrayed in the azimuth direction, each of the plurality of receiving transducers groups being associated with a corresponding one of a plurality of observing points (Px1, Px2, Px3, Px4, Px5) in the object, wherein the transmitting transducer group (TG1, TG2,..., TGx) consists of a plurality (Mt) of transducers and each of the receiving transducer groups (RG1, RG2, RG3, RG4, RG5) consists of a plurality (Mr) of transducers;
a transmission unit (2) adapted to drive the selected transmitting transducer group (TG1, TG2,..., TGx) in order to emit a focusing wave-front (Wt1, Wt2,..., Wtx) or a propagation wave-front (Wt1, Wt2,..., Wtx) and to form a hypothetical point sound source for the object at a transmitting focus point (Ft1, Ft2,..., Ftx) corresponding to the selected transmitting transducer group (TG1, TG2,..., TGx); and
wherein the transducer selection unit (3) is adapted to successively renew the position of the hypothetical point sound

source by selecting the transmitting transducer group with shifting the same along an arrayed direction of the plurality (M0) of the transducers arrayed in the azimuth direction;
a pre-process unit (51) including an orthogonal phase detection circuit for performing orthogonal phase detection of the receiving signals or a Hilbert transformation circuit for performing Hilbert transformation of the receiving signals;
a receiving phase compensation/summation unit (53) adapted to perform, for each of the plurality of receiving transducer groups (RG1, RG2, RG3, RG4, RG5), receiving phase compensation for focusing and summation of a plurality of the receiving signals pre-processed in the pre-process unit (51) and acquired through the respective receiving transducer group (RG1, RG2, RG3, RG4, RG5) based on transmission ultrasounds from the transmitting focus point (Ft1, Ft2,..., Ftx) corresponding to the selected transmitting transducer group (TG1, TG2,..., TGx) and reflected from the corresponding observing point (Px1, Px2, Px3, Px4, Px5) in the object,
wherein the receiving signals pre-processed in the pre-process unit (51) have relative reception delays due to differences of the propagated distances from the corresponding observing point (Px1, Px2, Px3, Px4, Px5) to each of the transducers comprised in the respective receiving transducer groups (RG1, RG2, RG3, RG4, RG5), and

the receiving phase compensation/summation unit (53) is configured to, for each receiving transducer group (RG1, RG2, RG3, RG4, RG5), give delay times to the receiving signals pre-processed in the pre-process unit (51) for correcting the reception delays with respect to the transducers in the transducer group, and to sum the receiving signals for which the reception delays are corrected such that a reception focus point is formed at the corresponding observing point (Px1, Px2, Px3, Px4, Px5), thereby generating a plurality of phase compensated/summed receiving signals corresponding to the observing point;
a transmission wave-front compensation and summation unit (6) comprising a receiving signals memory unit (61), a transmitting wave-front delays correction unit (62), and a summation unit (63), wherein
the receiving signals memory unit (61) is configured to store the plurality of phase compensated/summed receiving signals for the plurality of receiving transducer groups (RG1, RG2, RG3, RG4, RG5) with attaching respective position data of a plurality of transmitting focus points (Ft1, Ft2,..., Ftx) as an affix data, and
the transmission wave-front phase compensation/summation unit (6) is adapted to perform wave-front phase compensation and summation using the plurality of phase compensated/summed receiving signals stored in the receiving signals memory unit (61),

wherein the phase compensated/summed receiving signals have relative transmission delays due to the differences of propagation distances (Dx) from each of the transmitting focusing points (Ft1, Ft2,..., Ftx) to the observing point (Px1, Px2, Px3, Px4, Px5) corresponding to the respective receiving transducer group, the transmitting wave-front delays correction unit (62) is configured to read the phase compensated/summed receiving signals stored in the receiving signal memory unit (61), and to give delay times to the phase compensated/summed receiving signals corresponding the observing point (Px1, Px2, Px3, Px4, Px5) for correcting the transmission delays, and the summation unit (63) is configured to sum the phase compensated/summed receiving signals for the transmission delays are corrected and which correspond to the observing point (Px1, Px2, Px3, Px4, Px5); a scanning control unit (11) adapted to control the transducer selection unit (3); and an image processing unit (8) adapted to generate ultrasound image data based on the phase compensated/summed receiving signals that were subject to the transmitting wave-front compensation and summation.

XII. Independent claim 1 of auxiliary request II, submitted with the reply to the Board's first communication differs from claim 1 of auxiliary request I submitted with the appellant's second reply in three aspects:

- A feature is added defining that the object includes an ultrasound contrast agent.

- A feature is added defining that "the hypothetical point source is formed at an outside transmission focusing point (Ft) from the object at an opposite direction to the propagating direction of the transmission ultrasound based on the transmission ultrasounds emitted from the transmitting transducers group".

- Auxiliary requests I and II, submitted with the appellant's first reply were identical, apart from these two added features. Since no amended auxiliary request II was filed in reply to the Board's second communication, the amendments made to claim 1 of auxiliary request I are not present. These amendments concerned the definition of the receiving phase compensation/summation unit (38) and the transmission wave-front compensation and summation unit (6), which read, in claim 1 of auxiliary request II (with the amendments as compared to auxiliary request I emphasized by the Board):

  ...
  a receiving phase compensation/summation unit (53) adapted to perform, for each of the plurality of receiving transducer groups (RG1, RG2, RG3, RG4, RG5), receiving phase compensation for focusing and summation of a plurality of the receiving signals pre-processed in the pre-process unit (51) and acquired through the respective receiving transducer group (RG1, RG2, RG3, RG4, RG5) based on transmission

ultrasounds from the transmitting focus point (Ft1, Ft2,..., Ftx) corresponding to the selected transmitting transducer group (TG1, TG2,..., TGx) and reflected from the corresponding observing point (Px1, Px2, Px3, Px4, Px5) in the object,
wherein the receiving signals pre-processed in the pre-process unit (51) have relative reception delays due to differences of the propagated distances from the corresponding observing point (Px1, Px2, Px3, Px4, Px5) to each of the transducers comprised in the respective receiving transducer group ~~groups~~ (RG1, RG2, RG3, RG4, RG5), and
the receiving phase compensation/summation unit (53) is configured to~~, for each receiving transducer group (RG1, RG2, RG3, RG4, RG5),~~ give delay times to the receiving signals pre-processed in the pre-process unit (51) for correcting the reception delays ~~with respect to the transducers in the transducer group,~~ and to sum the receiving signals for which the reception delays are corrected such that a reception focus point is formed at the corresponding observing point (Px1, Px2, Px3, Px4, Px5), thereby generating ~~a plurality of~~ phase compensated/summed receiving signals corresponding to the observing point;
a transmission wave-front compensation and summation unit (6) comprising a receiving signals memory unit (61), a transmitting wave-front delays correction unit (62), and a summation unit (63), wherein

the receiving signals memory unit (61) is configured to store the plurality of phase compensated/summed receiving signals for each of the plurality of receiving transducer groups (RG1, RG2, RG3, RG4, RG5) with attaching respective position data of a plurality of transmitting focus points (Ft1, Ft2,..., Ftx) as an affix data, and the transmission wave-front phase compensation/summation unit (6) is adapted to perform wave-front phase compensation and summation using the plurality of phase compensated/summed receiving signals for each of the plurality of receiving transducer groups (RG1, RG2, RG3, RG4, RG5) ~~stored in the receiving signals memory unit (61),~~

wherein the phase compensated/summed receiving signals have relative transmission delays due to the differences of propagation distances (Dx) from each of the transmitting focusing points (Ft1, Ft2,..., Ftx) to the observing point (Px1, Px2, Px3, Px4, Px5) corresponding to the respective receiving transducer group,

...

XIII. Independent claim 1 of auxiliary request III, submitted with the appellant's first reply differs from claim 1 of auxiliary request II in that the two added features mentioned above with regard to auxiliary request II are not present, but instead it is defined

...
whereby the transmission ultrasounds are focused ahead of the plurality of transducers arrayed in one dimension when a tissue harmonic imaging method is applied for using harmonics components of the received signals, and the transmission ultrasounds are focused behind the plurality of transducers arrayed in one dimension when a contrast harmonic imaging method is applied with restraining the harmonics components of the receiving signals;
...

Reasons for the Decision

Main request - Admission

1. The main request, submitted with the appellant's second reply, was filed after notification of the summons to second oral proceedings. Its admission is at the Board's discretion under Article 13 RPBA 2020.

2. The Board is satisfied that the amendments made as compared to the sole request that was the basis of the appealed decision (which also was the main request in the statement setting out the grounds of appeal) are a genuine attempt at overcoming objections under Article 84 EPC, raised for the first time in the Board's first communication and at overcoming inventive step objections raised in the Board's second communication.

Furthermore, the amendments are straightforward, and not detrimental to procedural economy.

3. Hence, the Board admitted the main request (Article 13 RPBA 2020).

Main request - Amendments

4. With the amendments to the main request, the feature *as if the focusing wave-fronts (Wt1, Wt2,..., Wtx) or propagation wave-fronts (Wt1, Wt2,...,Wtx) were simultaneously emitted emitted from the hypothetical point sound sources (Ft1, Ft2,..., Ftx) and converged at the observing point (Px)* - which was the basis of the objection under Article 123(2) EPC in the decision under appeal (reasons, section 14.1) - was removed. A further amendment defining that the transmission wave-front phase compensation/summation unit performs the compensation in respect of the phase compensated and summed receiving signals stored together with the position of the point sound source in the receiving signals memory unit is originally disclosed in paragraphs [0066] and [0071]. An additional amendment removed the term "a pair" from the feature *a pair of a plurality of transmitting transducer groups and a receiving transducer group*, which was considered unclear in the Board's first communication (section 3.4). Since - as the Board also pointed out - the skilled person would understand from the original disclosure that the term "a pair" with regard to "a plurality of transmitting transducer groups" does not make sense, the removal of this term is accepted. Hence, the claimed subject-matter does not extend beyond the content of the application as filed (Article 123(2) EPC).

Main request - Clarity

5. In the appealed decision an objection was raised, under Article 84 EPC, that an essential feature was missing from claim 1 (i.e. the distance Df). The Board does not agree. Due to the storage of the position data of the respective hypothetical point sound source in the receiving signals memory unit (61), the distance Df (being the distance from the transducer array to the hypothetical point sound source) is also stored, at least implicitly.

6. The clarity issue raised by the Board in its first communication (section 3.4) with regard to a possible discrepancy between the claim wording and the description (due to the use of the term "a pair", cf. discussion above under amendments) has been solved by amendment.

7. Hence, claim 1 of the main request is clear and concise and supported by the description.

Main request - Inventive step

8. In the appealed decision, the Examining Division held that document D3 disclosed nearly all features of claim 1 of the main request then on file. Only the order of carrying out the double summation of the transmission wave-front compensation and the receiving phase compensation was different (cf. decision, Reasons, section 16.1).

9. With the amendments made in the appeal proceedings, clarity has been improved, but the technical features of the claimed subject-matter have not been changed.

10. With the statement setting out the grounds of appeal, the appellant identified a further distinguishing feature. Since D3 disclosed a different order of the summation, D3 did not disclose the

> *receiving signals memory unit (61) adapted to store the phase compensated and summed receiving signals together with the position data of the respective hypothetical point sound source*

or that this particular memory unit yielded a "parallel simultaneous receiving process" (statement of grounds, section 2.2).

11. The main issue in dispute, with regard to inventive step, throughout the appeal proceedings, was whether the change in the order of carrying out the calculations and a possible adaptation of the memory unit is based on an inventive step or not.

12. In the appealed decision (Reasons, section 16.1, last paragraph) the Examining Division held with regard to document D3 that

> *Since the double sum expressed in equation (9) is linear, the order in which the sum is carried out is irrelevant. Consequently, the subject-matter of claim 1 lacks an inventive step over the disclosure of D3 in combination with common general knowledge (Article 56 EPC).*

13. The Board concurs. The skilled person is well aware of the algebra underlying finite nested summations.

14. With the statement setting out the grounds of appeal and in its two replies, the appellant provided arguments as to why the change of the order would provide advantages and that these advantages would provide an indication that the change of order would not have been obvious for the skilled person.

15. The Board is not persuaded.

16. With the statement of grounds, as well as with its two replies, the appellant argued that when using the order as defined in claim 1, a "parallel simultaneous receiving process" would be possible (statement of grounds, for instance page 5, 4th paragraph; first reply, page 5, first full paragraph to page 6, first paragraph; second reply, section 2.2).

17. The explanation of the "simultaneous reception" given by the appellant (cf. for instance, "shown in the embodiment in Fig.12, a plurality of observing points Px1 to Px5 are detected/processed in parallel", first submission, page 5, first full paragraph, and explained in more detail in the second reply with regard to auxiliary request II, section 2.2), is apparently based on the assumption that the different receiving transducer groups (RG1 etc.) can, at the same time, receive and store signals received from different observation points. Since the receiving transducer groups actually might include the same transducers (cf. for instance the overlap of the receiving transducer groups depicted in Fig. 12), it is necessary to define the timings of the signals in order to achieve the alleged advantage of "simultaneous reception". For instance, it should be defined, how the pulses transmitted by the transmitting transducer groups are timed, whether the transmitting focal points are

present simultaneously or sequentially and at what points in time the different receiving transducer groups are operational.

18. Such definitions, however, are lacking in claim 1 and, consequently, the alleged advantage of "simultaneous reception" is not a result of the claimed apparatus.

19. Further, the claimed "memory unit" is not a suitable basis for establishing an inventive step for a further reason. The data used in a computer algorithm have to be stored in memory. If it is obvious to change the order of the steps in an algorithm, it is equally obvious to make the concomitant changes to the data that are stored. Further, a memory unit is always present when a processor processes data according to an algorithm, even for storing intermediate results. The data that can be stored therein do not distinguish one memory unit from another, although this might be different if it were particularly adapted to some specific form of data (there is no indication of this, in the application).

20. With its first submission in appeal proceedings, the appellant further argued, with regard to the (then) new main request that a "two-step phase compensation/ summation is not taught by D3" (submission of 2 March 2020, page 3, second full paragraph).

21. However, the double sum in equation 9 of D3, involves two summation processes, an inner sum (for taking into account transmission delays) and an outer sum (for taking into account phases of receiving signals). For calculating such a sum, in a first step the inner sum has to be calculated and in a second step the outer sum. Hence, also D3 discloses a two-step process. The

order of summation is different, but since the sum is linear, using a different order of summation is not considered to be based on an inventive step.

22. Claim 1 of the main request lacks an inventive step over document D3 in combination with common general knowledge.

Main request - Conclusion

23. The main request is not allowable.

Auxiliary request I - Admission

24. Auxiliary request I submitted with the appellant's second reply was filed after notification of the second summons to oral proceedings. Its admission is at the Board's discretion under Article 13 RPBA 2020.

25. The Board is satisfied that the amendments made as compared to the original auxiliary request I are a genuine attempt to overcome objections raised in the Board's first and second communications. Furthermore, the amendments are straightforward, and not detrimental to procedural economy.

26. Hence, the Board admitted this auxiliary request.

Auxiliary Request I - Amendments

27. The Board is satisfied that the amendments made in claim 1 of the auxiliary request I overcome the Board's objections, raised for the first time in its first

communication, against the then pending auxiliary request I, i.e. that it was not defined whether the plurality of receiving transducer groups receive signals from the same or from different observation points (first communication, section 4.3). With the amendments, it is now defined that the transducer selection unit is adapted to select a transmitting transducer group and to select a plurality of receiving transducer groups, each of the plurality of receiving transducer groups being associated with a respective one of a plurality of observing points in the object. This is originally disclosed in the embodiment shown in Fig. 12, together with the corresponding description in paragraphs [0111] to [0116]. The Board also accepts the appellant's argument that the skilled person immediately recognizes that the number of receiving transducer groups is not necessarily five (as in Fig. 12), but can be any appropriate number that can be processed in an appropriate processing time (cf. first reply, section 2.1), since the particular number (5) is only an example and does not play any special role in this embodiment. Hence, the corresponding objection in the first communication (section 4.6) is not upheld. Other amendments made to auxiliary request 1 are also originally disclosed in this embodiment. Hence, the amendments do not extend the subject-matter beyond the content of the application as filed (Article 123(2) EPC).

Auxiliary request I - Clarity

28. The clarity issue raised by the Board in its first communication (section 4.7) is solved by amendment. As explained above, it is now clear that each of the plurality of receiving transducer groups is associated

with a respective one of a plurality of observing points in the object.

29. Hence, claim 1 of the auxiliary request I is clear and concise and supported by the description.

Auxiliary request I - Inventive step

30. Independent claim 1 of the auxiliary request I includes more implementation details than independent claim 1 of the main request.

31. There are two groups of features not disclosed in document D3.

32. The first group of distinguishing features is the use of orthogonal or Hilbert transformations in a pre-processing unit and the corresponding adaptations. The second group is the different order of carrying out the summations, which is reflected by restrictions to the transmission wave-front phase compensation/summation unit, the receiving signals memory unit and the receiving phase compensation/summation unit.

33. The two groups of distinguishing features have distinct technical objectives. The appellant identified no advantage in the combination of these two feature groups beyond the advantages each brings alone. They are evaluated separately for inventive step.

34. With regard to the first group of distinguishing features, as already pointed out in the Board's first communication (section 4.8), the use of orthogonal transformations in ultrasound apparatuses was known (see for instance, document D7, paragraph [0056]). No

particular technical effect is given in the application, so that this feature is just a known possibility of analysing ultrasound signals, which is not suited to establishing an inventive step. The appellant did not dispute this.

35. As already discussed in detail above with regard to the main request, the second groups of distinguishing features, referring to the different order of carrying out the summations, does not establish an inventive step.

36. With the statement of grounds, the appellant provided further arguments with regard to document D3, taking into account the more detailed features of claim 1 of original auxiliary request I as compared to the main request (section II.B.).

37. In substance, however, the appellant did not identify any further distinguishing feature than the different order of calculation and the different phase compensation/summation units and memory units that are necessary in order to implement this different order (cf. statement of grounds, section II.B.3), which do not involve an inventive step, as for the main request (see above).

38. When the appellant (see statement of grounds, section II.B.3.1) argues that D3 needs a larger memory than the invention (apparently considering a same resolution of the final image), this is an assumption that seems to rely on a particular way of implementing a method performed by the claimed apparatus. However, as with the main request discussed above, claim 1 of auxiliary request I does not define a time schedule for the receiving phase compensation/summation, the storage of

the result and the transmission wave-front compensation/summation. Claim 1 does not exclude that, first, all signals are measured and the calculation carried out only afterwards, meaning that a memory with the same size as in D3 would be needed. Hence, there is no additional technical effect with regard to the memory size derivable from the claimed apparatus as compared to D3, which could be used to establish an inventive step.

39. Claim 1 of auxiliary request I lacks inventive step over D3 in combination with common general knowledge.

Auxiliary request I - Conclusion

40. Auxiliary request I is not allowable.

Auxiliary request II - Admission

41. Auxiliary request II, submitted with the appellant's first reply, was filed after notification of the summons to oral proceedings dated 16 December 2019. Its admission is at the Board's discretion under Article 13 RPBA 2007, which has to be applied under Article 25(3) RPBA 2020.

42. The Board is satisfied that the amendments, as compared to original auxiliary request II are a genuine attempt to overcome objections raised in the Board's first communication. Furthermore, the amendments are straightforward and not detrimental to procedural economy.

43. Hence, the Board admitted this auxiliary request.

Auxiliary request II - Amendments

44. The Board is satisfied that the amendments made in claim 1 of the auxiliary request II overcome the Board's objection, raised in its first communication, against the then pending auxiliary request II, since the objections and corresponding amendments are the same as for auxiliary request I. Hence, the amendments do not extend the subject-matter beyond the content of the application as filed (Article 123(2) EPC).

Auxiliary request II - Clarity

45. In the Board's first communication, a clarity objection was raised against the added feature of "using an ultrasound contrast agent", as not being a feature of the claimed apparatus, but only describing its use (Board's first communication, section 5.2).

46. The appellant neither commented on this objection in its reply nor amended the feature.

47. The Board sees no reason to change its view.

48. Claim 1 of the auxiliary request II lacks clarity (Article 84 EPC).

Auxiliary request II - Conclusion

49. Auxiliary request II is not allowable.

Auxiliary request III - Admission

50. Auxiliary request request III, submitted with the appellant's first reply, was filed after notification of the summons to oral proceedings. Its admission is at the Board's discretion under Article 13 RPBA 2007, which has to be applied under Article 25(3) RPBA 2020.

51. The Board is satisfied that the amendments made as compared to the auxiliary request III submitted with the statement of grounds are a genuine attempt to overcome objections raised in the Board's first communication. Furthermore, the amendments are straightforward, and not detrimental to procedural economy.

52. Hence, the Board admitted this auxiliary request.

Auxiliary request III - Amendments

53. The Board is satisfied that the amendments made in claim 1 of the auxiliary request III overcome the Board's objection raised in its first communication against the then pending auxiliary request III, since the objections and corresponding amendments are the same as for auxiliary request I. Hence, the amendments do not extend the subject-matter beyond the content of the application as filed (Article 123(2) EPC).

Auxiliary request III - Clarity

54. In the Board's first communication, a clarity objection was raised against the added feature of "harmonics components of the receiving signals" that should be

"used" or "restrained" without any specification of the transmitting and/or receiving signals that might give rise to such "harmonics components" (Board's first communication, section 6.2).

55. The appellant neither commented on this objection nor amended the feature.

56. The Board sees no reason to change its view.

57. Claim 1 of the auxiliary request III lacks clarity (Article 84 EPC).

Auxiliary request III - Conclusion

58. Auxiliary request III is not allowable.

Conclusion

59. Since none of the main request and auxiliary requests I to III is allowable, the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Meyfarth P. Scriven

Decision electronically authenticated