Internal distribution code:
(A) [-] Publication in OJ
(B) [-] To Chairmen and Members
(C) [-] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 17 July 2014

Case Number: T 0857/10 - 3.5.02

Application Number: 99310298.7

Publication Number: 1017170

IPC: H03H9/56, H03H9/58

Language of the proceedings: EN

Title of invention:
A balanced filter structure

Applicant:
Nokia Corporation

Headword:

Relevant legal provisions:
EPC Art. 56
EPC R. 103(1)(a)

Keyword:
Inventive step - main request (no)
Inventive step - auxiliary requests (no)
Reimbursement of appeal fee - substantial procedural violation (no)

Decisions cited:

Catchword:

This datasheet is not part of the Decision.
It can be changed at any time and without notice.

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern
Boards of Appeal
Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 0857/10 - 3.5.02

D E C I S I O N
of Technical Board of Appeal 3.5.02
of 17 July 2014

Appellant: (Applicant)	Nokia Corporation Karakaari 7 02610 Espoo (FI)
Representative:	Berggren Oy Ab P.O. Box 16 Antinkatu 3 C 00101 Helsinki (FI)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 10 December 2009 refusing European patent application No. 99310298.7 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	M. Ruggiu
Members:	M. Léouffre
	W. Ungler

Summary of Facts and Submissions

I. The applicant has appealed against the decision of the examining division, posted on 10 December 2009, on the refusal of the European application No. 99310298.7. The statement setting out the grounds of appeal was received on 1 April 2010

II. The examining division held that the subject-matter of claim 1 of the main request and of the first and third auxiliary requests lacked an inventive step (Article 56 EPC) in the light of documents:

D1 = L. Mang & al: "ZnO Thin Film Resonator Lattice Filters", IEEE INTERNATIONAL FREQUENCY CONTROL SYMPOSIUM, 1996, pages 363 to 365, ISBN: 0-7803-3309-8; and

D2 = K. M. Lakin: "Modelling Of Thin Film Resonators And Filters", MICROWAVE SYMPOSIUM DIGEST, 1992, pages 149 to 152, ISBN: 0-7803-0611-2.

The examining division considered further that the expression "the first area is substantially different from the second area" as well as the terms "similar" or "substantially similar" rendered the subject-matter of claim 1 of each request unclear (Article 84 EPC).

III. In an annex to the summons to oral proceedings, dated 1 April 2014, the board indicated its preliminary opinion that the subject-matter of claim 1 of the main request and of the first, second and third auxiliary requests did not involve an inventive step and that the term "similar" was vague and undefinite.

IV. In a letter dated 5 June 2014, the appellant withdrew his request for oral proceedings and requested a

decision based on the state of the file. He announced also that he would not attend the oral proceedings.

V. Oral proceedings took place as scheduled on 17 July 2014 in the absence of the appellant.

VI. The appellant had requested in writing that the decision under appeal be set aside, that the appeal fee be reimbursed, and that a patent be granted on the basis of the main request or alternatively on the basis of the first, second or third auxiliary requests in the form indicated in item 1.9 of the contested decision. In view of the fact that item 1.9 of the contested decision comprises a second auxiliary request and a modified second auxiliary request, the board understands the appellant's requests that both of the aforementioned second auxiliary requests are meant to be pursued by the appellant. The claims of these requests have been filed with the letter dated 6 October 2009 for the main request and the first, second and third auxiliary request, while the claims of the modified second auxiliary requests have been filed during the oral proceedings of 13 November 2009.

VII. Claim 1 of the main request reads as follows (features indexed by the board):

a) "A filter structure, comprising:
b) - a first signal line (120), a second signal line (120), a third signal line (110), and a fourth signal line (110),
c) - a first bulk acoustic wave resonator having substantially a first area,
d) - a second bulk acoustic wave resonator having substantially a first area,
e) - a third bulk acoustic wave resonator having substantially a second area, and

f) - a fourth bulk acoustic wave resonator having substantially a second area;
g) wherein said first bulk acoustic wave resonator is connected between the first signal line (120) and the third signal line (110), said second bulk acoustic wave resonator is connected between the second signal line (120) and the fourth signal line (110), said third bulk acoustic wave resonator is connected between the first signal line (120) and the fourth signal line (110), and said fourth bulk acoustic wave resonator is connected between the second signal line (120) and the third signal line (110); and
h) wherein said first area is substantially different from said second area."

Claims 2 and 10 are dependent on claim 1.

Claim 3 reads as follows:
"A filter structure according to claim 1, characterised in that:
- the filter structure comprises a fifth signal line (120), a sixth signal line (120), a fifth bulk acoustic wave resonator, a sixth bulk acoustic wave resonator, a seventh bulk acoustic wave resonator, and an eighth bulk acoustic wave resonator; and
- said fifth bulk acoustic wave resonator is connected between the third signal line (110) and said fifth signal line (120), said sixth bulk acoustic wave resonator is connected between the fourth signal (110) line and said sixth signal line (120), said seventh bulk acoustic wave resonator is connected between the third signal line and said sixth signal line, and said eighth bulk acoustic wave resonator is connected between the fourth signal line and said fifth signal line."

Claims 4, 5 and 7 to 9 are dependent on claim 3.

Claim 6 reads as follows:
"A filter structure according to claim 3 characterised in that said fifth, sixth, seventh, and eighth bulk acoustic wave resonators have a substantially similar area."

VIII. Claim 1 of the first auxiliary request adds the following features to claim 3 of the main request:
"wherein said first (120), second (120), fifth (120), and sixth (120) signal lines are in the same electrode layer of the filter structure."

Claims 2 to 7 are dependent on claim 1. Their features correspond respectively to the features of claims 4 to 8 and 10 of the main request.

IX. Claim 1 of the second auxiliary request corresponds to claim 6 of the main request.

Claims 2 to 6 are dependent on claim 1. Their features correspond respectively to the features of claims 4 and 7 to 10 of the main request.

X. Claim 1 of the third auxiliary request adds the following feature to claim 6 of the main request:
"wherein said first (120), second (120), fifth (120), and sixth (120) signal lines are in the same electrode layer of the filter structure."

Claims 2 to 5 are dependent on claim 1. Their features correspond respectively to the features of claims 4, 7, 8 and 10 of the main request.

XI. Claim 1 of the modified second auxiliary request corresponds to claim 1 of the second auxiliary request wherein the term "substantially" is suppressed and the following feature added:
"said first area is different from said second area to make frequency response close to a passband change steeper, said frequency response being the frequency response of a lattice filter made up by said first, second, third, and fourth bulk acoustic wave resonators".

Claims 2 to 6 are dependent on claim 1. Their features correspond respectively to the features of claims 4 and 7 to 10 of the main request.

XII. The appellant argued in writing essentially as follows:

The different first and second areas of the bulk acoustic wave resonators aimed at solving the problem of "how to make the edges of the passband steeper in a filter structure based on resonators in lattice filter configuration".
It was agreed that D1 disclosed features a) to g) and contained the feature referred to by the examining division : "A zero in the transfer function can be introduced by changing the capacitance of an opposite resonator pair to a different value" (cf. D1 page 363, right-hand column, lines 15 to 17). However introducing a zero in a transfer function might have served various purposes. In general, a zero in a transfer function coincided with a notch, or an attenuated frequency in the frequency response". Said sentence in D1 was just a general note about introducing a zero somewhere in the transfer function, which did not necessarily have

anything to do with the steepness of the edges of a passband.
Moreover, said sentence in D1 did not say that in the opposite resonator pair, both resonators should have had the same capacitance values. The sentence could quite as well have been interpreted as a suggestion to increase the capacitance of one resonator and decrease the capacitance of the other. D1 did also not provide any guidance concerning whether the sentence cited above would have suggested changing the motional capacitance or the static capacitance.

Reasons for the Decision

1. The appeal is admissible.

2. *Article 84 EPC*
The feature "said fifth, sixth, seventh, and eighth bulk acoustic wave resonators have a substantially similar area" is present in claim 6 of the main request as well as in claim 4 of the first auxiliary request and claims 1 of the second, third and, with "substantially" deleted, modified second auxiliary requests. The term "similar" is vague and undefinite and renders this feature and the corresponding claims unclear, contrary to Article 84 EPC.

3. *Article 54 EPC*
The appellant agrees to consider D1 as the closest prior art and agrees with the examining division about the features a) to g) being disclosed in D1 (cf. first two sentences of item 2.1 of the grounds of appeal).

Claim 1 of each request request differs from D1 at least in that

"said first area is substantially different from said second area" (feature h)). Claim 1 of each request is therefore considered as novel (Article 54 EPC).

4. Article 56 EPC (Main request)

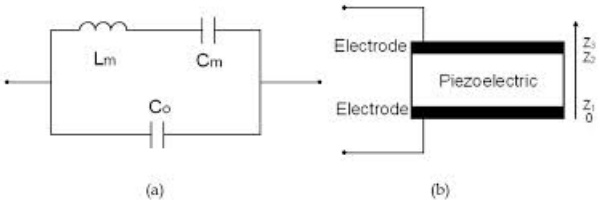
4.1 The different first and second areas of the bulk acoustic wave resonators aim at solving the problem of "how to make the edges of the passband steeper in a filter structure based on resonators in lattice filter configuration" (cf. grounds of appeal at bottom of page 3).
This feature was not considered as involving an inventive step by the examining division, which referred to the following sentence of D1 (cf. page 363, right-hand column, lines 15 to 17):
"A zero in the transfer function can be introduced by changing the capacitance of an opposite resonator pair to a different value".
The examining division concluded that "Introducing a zero in the transfer function results in a steeper passband edge of the filter characteristic".

4.2 In the referred sentence, the term "capacitance" is not further specified and the appellant doubts that it relates to the static capacitance of each of a pair of resonators of the lattice filter.

4.3 It is however considered that a person skilled in the art would have understood the cited sentence as teaching that the capacitance of each of an opposite resonator pair should be changed to a common different value differing from the common value of the capacitance of the other pair of resonators. He would also have immediately understood, from his common general knowledge, that introducing a zero in the transfer function would result in an increase of the

slope of 20db/decade in the bode plot. This, in the context of D1, suggests that edges of the transfer function of the pass-band filter could be made steeper.

4.4 The person skilled in the art would also have understood from the cited sentence that he should modified the static capacitance of each of a pair of resonators of the lattice filter for the reasons mentioned below.
A bulk acoustic wave resonator may be modelled as represented below (cf. also D2, figure 1) wherein Cm represents the motional capacitance, Lm the inductance and C0 the static capacitance. The motional capacitance Cm and the inductance Lm depend directly on the size of the piezoelectric dielectric (in particular its thickness) while the static capacitance Co depends also on the electrodes.



The resonator is usually considered as characterised by two frequencies: the resonance frequency, also called the series resonance frequency fs, and the anti-resonant frequency, also called parallel frequency fa. These frequencies depend directly on the motional capacitance Cm. The difference or distance between the two frequencies may be adjusted by adjusting the static capacitance Co. This is reflected in the following equations:

$$fs = 1/2\pi\ (Lm.Cm)^{-1/2} \text{ and } fa = 1/2\pi\ (Lm.Cm)^{-1/2}.(1+ Cm/Co)^{1/2}$$

Both frequencies may be shifted downwards by mass loading the resonator, which is the solution used in D1 to align the anti-resonance frequency fa of the loaded set of resonators to the resonant frequency fs of the unloaded set (cf. D1, page 363, right-hand column, lines 3 to 6). The mass loading process affects the motional capacitance as mentioned in the document filed by the applicant at the oral proceedings before the examining division (excerpt from "Practical RF Circuit Design for Modern Wireless Systems").
Hence, a person skilled in the art would have immediately understood that the term capacitance in the sentence "A zero in the transfer function can be introduced by changing the capacitance of an opposite resonator pair to a different value" cannot refer to the motional capacitance Cm. Actually, if modified, for instance by modifying the thickness of the crystals, the motional capacitance would have affected the frequencies and in particular the alignment of the frequencies achieved at the mass-loading step.
Therefore it should be concluded that a person skilled in the art reading D1 was taught to modify the static capacitance Co to introduce a zero in the transfer function.
Despite the fact that the static capacitance takes also account of the piezoelectric dielectric, in particular its thickness, a person skilled in the art would not have altered the thickness of the quartz for the reasons mentioned above, but the electrodes. He would not have changed the mass of the electrodes which would also have affected the mass loading and the alignment of the frequencies (cf. the excerpt from "Practical RF Circuit Design for Modern Wireless Systems"). He would have modified the size of the surface of the electrodes in contact with the quartz.

The surface of the electrodes appears to correspond to the definition of the first and second areas of the resonators given in the application (cf. section [0026]: the "area of the resonator is defined substantially by the overlapping area of the top and the bottom electrodes at the location, where the overlapping occurs").
The subject-matter of claim 1 of the main request does not therefore involve an inventive step.

5. *Article 56 (First auxiliary request)*
Claim 1 of the first auxiliary request adds the following features to claim 1 of the main request:
"- a fifth signal line (120) and a sixth signal line (120),
- a fifth bulk acoustic wave resonator, a sixth bulk acoustic wave resonator, a seventh bulk acoustic wave resonator, and an eighth bulk acoustic wave resonator;" and
"wherein said fifth bulk acoustic wave resonator is connected between the third signal line (110) and said fifth signal line (120), said sixth bulk acoustic wave resonator is connected between the fourth signal (110) line and said sixth signal line (120), said seventh bulk acoustic wave resonator is connected between the third signal line and said sixth signal line, and said eighth bulk acoustic wave resonator is connected between the fourth signal line and said fifth signal line; and
wherein said first (120), second (120), fifth (120) and sixth (120) signal lines are in the same electrode layer of the filter structure."

The supplementary features of claim 1 of the first auxiliary request define the interconnections of two cascaded lattice filters, one of which being

conventional (see section [0029] of the application as published) and not contributing to the solution of the problem of providing a pass-band filter with steeper edges which is solved by the features of claim 1 of the main request.
It is obvious to cascade two or more lattice filters for example to achieve higher order pole lattice filters (cf. D1, page 363, right-hand column, lines 11 to 13). In order to avoid a further layer in the structure of the BAW it would have been obvious for a person skilled in the art to provide said first, second, fifth and sixth signal lines in the same electrode layer of the filter structure.

6. *Article 56 (Second and third auxiliary requests)*
Claim 1 of the third auxiliary request combines the features of claims 1 of the first and second auxiliary requests whereby claim 1 of the second auxiliary request is based on claim 1 of the first auxiliary request wherein the last feature has been amended to read:
"wherein said fifth, sixth, seventh, and eighth bulk acoustic wave resonators have a substantially similar area".

Section [0029] of the published application presents the feature of having similar areas for the fifth, sixth, seventh, and eighth bulk acoustic wave resonators, as being conventional.
Hence the subject-matter of claim 1 of each of the second and third auxiliary requests does not involve an inventive step.

7. *Article 56 (modified second auxiliary request)*

7.1 The term "substantially" has been removed in claim 1 of the modified second auxiliary request for clarity reasons. It does not imply any technical feature which could involve an inventive step.

7.2 The added feature "wherein said first area is different from said second area to make frequency response close to a passband change steeper, said frequency response being the frequency response of a lattice filter made up by said first, second, third, and fourth bulk acoustic wave resonators" does not involve an inventive step for the reasons mentioned under item 4.3 and 4.4 above.

8. Reimbursement of the appeal fees

The appellant alleged a procedural violation because the examining division would not have substantiated the inventive step rejection of the appellants' third auxiliary request (cf. last sentence of item 1 of the grounds of appeal).

Claim 1 of the third auxiliary request combines the features of claims 1 of the first and second auxiliary requests.

The examining division refused the third auxiliary request also for lack of clarity of claim 1 and referred to paragraphs 2.2 and 2.3 of its own decision, wherein each of the first and second auxiliary requests was said as comprising at least one unclear expression (see also item 2 above).

Since at least one ground for the refusal of the third auxiliary request has been substantiated, no substantial procedural violation is apparent and thus the requirements for a reimbursement of the appeal fee according to Rule 103(1)(a) EPC are not fulfilled.

Order

For these reasons it is decided that:

1. The appeal is dismissed.

2. The request for reimbursement of the appeal fee is refused.

The Registrar: The Chairman:

U. Bultmann M. Ruggiu

Decision electronically authenticated