

Internal distribution code:

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

**Datasheet for the decision
of 21 January 2021**

Case Number: T 0877/14 - 3.4.01

Application Number: 09764592.3

Publication Number: 2384445

IPC: G01R33/28

Language of the proceedings: EN

Title of invention:

CONTINUOUS MECHANICAL TUNING OF TRANSFORMERS INSERTED IN RF-SAFE TRANSMISSION LINES FOR INTERVENTIONAL MRI

Applicant:

Koninklijke Philips N.V.
Philips Intellectual Property & Standards GmbH

Headword:

RF-safe transmission line for interventional MRI / Philips

Relevant legal provisions:

EPC Art. 83, 84, 54, 56, 123(2)
EPC R. 42(1)(e)
PCT Art. 15(3), R. 33.3
RPBA 2020 Art. 11

Keyword:

Claims - clarity - main request (no) - support in the
description - main request (no) - clarity - auxiliary request
(yes) - support in the description - auxiliary request (yes)
Amendments - added subject-matter - auxiliary request (no)
Sufficiency of disclosure - auxiliary request (yes)
Inventive step - main request (yes)



Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 0877/14 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 21 January 2021

Appellant:
(Applicant 1)

Koninklijke Philips N.V.
High Tech Campus 52
5656 AG Eindhoven (NL)

Appellant:
(Applicant 2)

Philips Intellectual Property & Standards GmbH
Lübeckertordamm 5
20099 Hamburg (DE)

Representative:

van Velzen, Maaïke Mathilde
Philips Intellectual Property & Standards
High Tech Campus 5
5656 AE Eindhoven (NL)

Decision under appeal:

**Decision of the Examining Division of the
European Patent Office posted on 22 November
2013 refusing European patent application No.
09764592.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

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

Summary of Facts and Submissions

- I. The applicant lodged an appeal against the Examining Division's decision to refuse the European patent application 09 764 592.
- II. In its decision, the Examining Division found that the claims lacked clarity and support by the description (Article 84 EPC) and that the invention was insufficiently disclosed (Article 83 and Rule 42(1)(e) EPC).
- III. The appellant requested that the decision be set aside and that a patent be granted on the basis of a set of claims according to a main request, or of a first or second auxiliary request. All were filed for the first time with the statement of grounds of appeal.
- IV. In support of its arguments, the appellant submitted, with the statement of grounds, several pieces of evidence of the common general knowledge.
- V. The appellant further referred to the documents that were cited in the search report:

D1: A. Krafft et al: *B₁ field-insensitive transformers for RF-safe transmission lines*, Magnetic Resonance Materials in

Physics, Biology and Medicine, Vol.19,
November 2006

D2: P. Vernickel et al. *A Safe Transmission
Line for MRI*, IEEE Transactions on
Biomedical Engineering, Vol.52, No.6, June
2005

D3: S. Weiss et al. *Transmission Line for
Improved RF Safety of Interventional
Devices*, Magnetic Resonance in Medicine,
Vol.54, Issue 1, June 2005

- VI. In a communication under Rule 100(2) EPC, the appellant was informed of the Board's preliminary opinion, according to which the main request failed for lack of clarity. The Board suggested a number of amendments to the claims that might overcome the clarity objections and lead to allowable claims.
- VII. In reply to the Board's communication, the appellant submitted "auxiliary request 0", ranked between the main request and the first auxiliary request.
- VIII. In its reply, the appellant did not comment on the Board's objections to the main request. Oral proceedings were requested in the event that the Board considered none of the substantive requests allowable.

IX. Claims 1, 6, and 7 of the main request read:

1. A transformer line (46) for use in any of a variety of catheters (30) of a magnetic resonance system (10), the transformer line (46) comprising:

at least one pair of transformer windings (28) which inductively couple transmission line segments (48) of the transformer line (46) disposed in the catheter (30);

characterized by

movable tuning element (50, 64), disposed adjacent to the transformer windings (28) and configured to adjust a geometry of the transformer windings (28), wherein the tuning element (50, 64) is configured to deform the transformer windings (28) as the tuning elements (50, 64) is moved mechanically relative to the transformer windings (28).

6. The catheter according to claim 6 [sic], wherein the transformer line further includes:

an access port (60) defined through the catheter (30) adapted to receive a turning tool (62, 68) inserted to rotate the tuning element, the access port being sealable to cover the deforming element (50, 64).

7. The catheter according to claim 7 [sic], wherein the transformer line further includes:

a shaft (52) extending from the movable tuning element (50) and extending to an exterior of the catheter (30).

X. Independent claim 9 of the main request corresponds to claim 1 and defines a method of using a transformer line, wherein the tuning elements that deform the transformer windings are further defined as "eccentric elements" that are "rotatably disposed in the transformer windings" or as "pushing and pulling elements".

XI. Claim 10 reads:

The method according to claim 10 [sic], wherein the tuning element (50, 64) is disposed internally in the catheter (30) and an access port (60) is defined through the interventional instrument, the method comprising:

inserting a tool (62) through the port and moving the tuning element (50, 64) to deform the transformer windings (28);

removing the tuning tool (62); and,

sealing the access port (60).

XII. Claim 11 starts:

*The method according to any one of claims
10-11 [sic] ...*

XIII. Claims 1 - 7 of "auxiliary request 0" read:

*1. A transformer line (46) for use in any
of a variety of catheters (30) of a
magnetic resonance system (10), the
transformer line (46) being disposable in
the catheter (30) and comprising:*

*at least one pair of transformer windings
(28) which inductively couple transmission
line segments (48) of the transformer line
(46);*

characterized by

*a respective tuning element (50, 64),
disposed adjacent to each pair of the
transformer windings (28) and configured to
deform the transformer windings (28) as it
is moved mechanically relative to them,
thereby tuning the frequency
characteristics of the transformer line
(46).*

*2. The transformer line (46) according to
claim 1, wherein each tuning element
includes an eccentric element (50, 64)
rotatably disposed in the transformer
windings (28).*

3. The transformer line according to claim 1 or 2, wherein:

the transformer windings (28) are made of a resilient material or mounted with a resilient material which exerts a physical force in a direction opposite to a direction of deformation by the tuning elements.

4. The transformer line according to claim 1, wherein the tuning elements are configured to mechanically adjust a spacing between the transformer windings (28) and/or to mechanically adjust a radius of the transformer windings.

5. A catheter of a magnetic resonance system (10) comprising:

a coil (32) for receiving magnetic resonance signals disposed adjacent a tip end of the catheter;

a transformer line (46) according to any one of claims 1-5, electrically connected to the coil (32) and extending through the catheter from the coil (32) to a point of electrical connection with associated electronic equipment (24', 26).

6. The catheter according to claim 5, wherein the transformer line further includes:

an access port (60) for each tuning element defined through the catheter (30) adapted to receive a turning tool (62, 68) inserted to rotate the tuning element, the access port being sealable to cover the deforming element (50, 64).

7. The catheter according to claim 6, wherein the transformer line further includes:

a shaft (52) for each tuning element extending from the movable tuning element (50) and extending to an exterior of the catheter (30).

XIV. Claims 9 - 11 read:

9. A method of using a transformer line which includes at least a pair of transformer windings (28) which transformer windings (28) inductively couple transmission line segments (48) of the transformer line (46), the method comprising:

installing the transformer line (46) in a catheter (30) of a magnetic resonance system (10);

adjusting a geometry of each pair of the transformer windings (28) in order to tune the frequency characteristics of the transformer line (46),

characterized in that adjusting the geometry of each pair of the transformer windings includes one of:

rotating a respective eccentric element (50, 64), wherein the eccentric element is rotatably disposed in the transformer windings (28) and mechanically deforms at least one of the transformer windings (28) as it is rotated; or

pushing or pulling respective pushing and pulling elements (68) which mechanically deform at least one of the transformer windings as they are pulled or pushed.

10. The method according to claim 9, wherein the at least one tuning element (50, 64) is disposed within the catheter (30) and an access port (60) through the catheter is provided for each tuning element, the method comprising:

inserting a tool (62) through at least one of the ports and moving the respective tuning element (50, 64) to deform the transformer windings (28);

removing the tuning tool (62); and,

sealing the access port (60).

11. The method according to any one of claims 9-10, wherein the magnetic resonance

system (10) is a magnetic resonance imaging system, the method further including:

positioning a subject in the examination region of the magnetic resonance imaging system;

using the catheter (30) within the examination region of the magnetic resonance imaging system;

performing magnetic resonance imaging while the catheter is located in the examination region of the magnetic resonance imaging system.

XV. The further auxiliary requests are not relevant to the present decision.

XVI. The appellant's arguments, in so far as relevant, are set out in the Reasons, below.

Reasons for the Decision

Main request - Clarity and support by the description

1. In claim 1, the expression "disposed in the catheter" creates an ambiguity as to whether the catheter is part of the claimed subject-matter or not. The appellant has not commented on this point.

2. In contrast to the appellant's argumentation, the word "tuning" in line 6 of claim 1 does not necessary relate to a frequency but could mean the adjustment of another control parameter of the transformer line, although the latter would not be supported by the description. It is essential for the correct determination of the scope of protection that the skilled person understand that the purpose of the tuning element is the tuning of the frequency characteristics, in particular the common-mode resonances of the transformer line. This is not clear in this version of claim 1, or, similarly, in claim 9.
3. In claim 1, it is not clear whether there should be a single movable tuning element adjacent to all windings, or one for each pair of windings. In the first case, it is not clear whether the single tuning element is configured to adjust *all* windings or only one pair. A similar problem applies in claim 9. According to the appellant, the claim wording implies that there is one tuning element for each pair of windings. However, the Board cannot derive that meaning from the claim wording.
4. Interpreting claim 1, in line with the description, as meaning that more than one tuning element can be present, claims 6 and 7, which only refer to a single tuning element, are unclear regarding the number of ports or shafts when more than one tuning element is present. The appellant has not commented on this point.
5. In claim 10, the expression "interventional instrument" has no antecedent. Although the interpretation provided by the appellant, according to which the instrument refers to the catheter, is plausible, other interpretations that are not supported by the

description cannot be ruled out. Further, the claim only refers to one tuning element and one port, which leads to a similar clarity problem as in claims 6 and 7.

6. Claims 6, 7, 10, and 11 each contain references to themselves. This is obviously a mistake, but the intended references, and thereby the scope of the claims, are not clear.
7. The embodiment on page 7, lines 22 - 23, does not seem to lie within the scope of the claims, since it does not comprise movable tuning elements configured to deform the transformer windings. It therefore engenders doubt regarding the intended scope of protection. The appellant has not commented on this point.
8. As a consequence, the main request is not allowable for lack of clarity and lack of support by the description (Article 84 EPC).

Auxiliary request 0 - Amendments

9. The claims of auxiliary request 0 are based on those of the main request and include clarifying amendments regarding the reference to a catheter and to the number, arrangement and purpose of the tuning elements.
10. The particular examples on page 6, lines 22 to 23 and page 6, line 29 to page 7, line 2 of the application as published, teach, in the context of the whole application, that there is a respective tuning element for each transformer. The passages on page 7, lines 18 to 19 together with page 6, lines 27 to 29 teach the

tuning of the frequency characteristics. Those passages provide a basis for the amendments in claims 1 and 9.

11. The amendments to claims 6, 7, and 10 are based on Figures 4 and 5, respectively, together with the corresponding description passages.
12. Without having made it part of their reasons for refusing the application, the Examining Division also objected to an amendment on page 7 as having no basis in the application as filed. Page 7 of auxiliary request 0 no longer includes the problematic passages and the objection no longer applies.
13. The Board has not identified any added subject-matter in auxiliary request 0 (Article 123(2) EPC).

Auxiliary request 0 - Sufficiency of disclosure

14. The Examining Division's basic argument as to disclosure is that the application merely provided general concepts but failed to disclose specific examples that taught the skilled person how to overcome the technical difficulties involved in the realization of the embodiments. In particular, it was not disclosed how, for each possible catheter (and, especially for small, intravascular catheters), transformers and movable tuning elements could be made that would fit. Further objections related to the positioning of cams, to the connection of the windings, to protruding wires, and to a realization with irreversible deformation of the windings.
15. The Board follows the appellant's arguments and fails to see any insufficiency in the disclosure of the

invention (Article 83 EPC) or any lack of a specific example (Rule 42(1)(e) EPC). The difficulties involved in the realization of the embodiments with dimensions to fit into a typical catheter of 1 - 5 mm diameter are not an undue burden on the skilled person. She would use known micro-mechanical fabrication techniques or techniques known from watchmaking to realize the tuning elements in the necessary dimensions. The elements could be fixed to a substrate, similar to the printed circuit board used in D2.

Auxiliary request 0 - Clarity and support by the description

16. The Examining Division presented a large number of "exemplary deficiencies" regarding clarity and support by the description, under item 1 of the decision. Although raised against a set of claims that is no longer part of the proceedings, some of these objections would also apply to auxiliary request 0.
17. The Board follows the applicant and considers the claims in question to be both clear and supported by the description.
18. The person skilled in the art of catheters for use with nuclear magnetic resonance devices knows that the lines that transmit electrical signals, typically to and from the tip of the catheters, can be subject to common mode resonances excited by the external RF fields. She also knows, for example from documents D1, D2, and D3 (the contents of which are summarized below), that the excitation and the resulting tissue heating can be reduced by dividing the transmission line into segments that are coupled to each other by inductive transformers, thereby forming a transformer line.

19. Claim 1 defines the transformer line as "disposable" in a catheter, the catheter being "any of a variety of catheters" "of a magnetic resonance system". These definitions are vague, but sufficient for the skilled person to establish the context of the problems the invention addresses, and so mean that the transformer line must be suitable to be inserted in a variety of common catheters with the effect that they be usable in a magnetic resonance system; in other words, in the presence of RF fields. From her basic knowledge in electronics, the skilled person also understands that the inductive coupling between the line segments acts as a high-pass filter, the frequency characteristics of which depend on the geometry of the pairs of windings, amongst other things.
20. Claim 1 defines the transformer line as comprising at least two transmission line segments. The claim further implies that adjacent line segments are inductively coupled by respective windings. Each pair of windings can be deformed by the mechanical movement of a respective, particularly designated "tuning element", thereby tuning the frequency characteristics of the transformer line. The interpretation of elements that could potentially deform the windings unintentionally, like a cover sheet of the transformer line that is bent by force, are not interpreted as "tuning elements", because they are not configured for performing any tuning. Hence, there is no need for the description to support any such elements.
21. The skilled person is also capable of understanding how, as defined by claim 2, the rotation of an eccentric element disposed in a winding is meant to deform that winding in order to change its coupling characteristics. She also understands that claim 3

defines windings that are designed resiliently to return to their original shape, if not forced otherwise by the tuning elements. Further, the change in separation of the coils as defined in claim 4 is one particular way of deforming the pair of windings as defined in claim 1. Claim 1 does not define that each winding must be deformed, and therefore the two claims are in agreement.

22. Claim 5 defines a catheter with a coil, wherein the coil can be attached to outside electronic equipment through the transformer line. The skilled person does not have a problem with this definition. Nor does she have one with claims 6 and 7, which define the access to the tuning elements of the transformer line in the catheter via ports or shafts. It is self-evident that this access is not used when the catheter is disposed in a patient. Further, the description does not emphasize a particular arrangement or geometry of the ports and the skilled reader would not have problems imagining ports different from the round apertures in the sheath of the catheter, shown exemplarily in Figure 5. Hence, the ports defined in claim 6 are supported by the description.
23. Independent method claim 9 corresponds to claim 1 and additionally defines particular tuning elements for deforming the windings. It is self-evident that the transformer line needs to be installed in a catheter before the catheter is used in a patient. It is also evident to the skilled reader that the frequency tuning takes place when the catheter is outside the patient, as the tuning elements are not accessible otherwise. Even if not used in an active magnetic resonance system, the advantage remains that the frequency characteristics of the transformer line are tuned such

that it can be used in such an environment. The description is not restricted to a tuning in an active magnetic resonance environment and leaves open where exactly the frequency characteristics are adjusted. The Board does not identify any lack of support or clarity problem in claim 9.

24. Claim 10 defines the use of the access ports to move "the" tuning elements for deforming the windings. It follows from the common purpose of deforming the windings for performing a tuning that the expression "tuning element" encompasses the eccentric elements or the pushing and pulling elements defined in claim 10. The skilled reader will also understand that the tuning will remain fixed after the tool is removed and the access port is sealed.
25. Claim 11 defines the performance of magnetic resonance imaging while using the catheter. The transformer line prevents excessive heating of the tissue next to the catheter. The question of whether the whole transformer line is within the examination region is irrelevant.
26. As a consequence of the above, the subject-matter of the claims is clear and supported by the description (Article 84 EPC).

Auxiliary request 0 - Examination of patentability

27. In its decision, Examining Division did not examine novelty and inventive step. Under Article 111(1) EPC, the Board has the authority to perform this examination, but will not use it, if special reasons apply (Article 11 RPBA 2020).

28. In its role as International Searching Authority, the EPO carried out a search on the basis of the claims as filed "with due regard to the description and the drawings" and "with particular emphasis on the inventive concept" (Article 15(3) and Rule 33.3 PCT). The Search Division did not indicate any restriction on the search, although it could have done so, if it had considered the invention so poorly described that a complete search was not possible. The Board, therefore, presumes that the search was complete.
29. The present claims define the initially described invention in clear language, without deviating from the idea as initially described. Hence, the Board considers the documents on file suitable for examination of patentability and sees no special reasons in the sense of Article 11 RPBA 2020 that would prevent it from issuing a decision on patentability.

Auxiliary request 0 - Novelty

30. Document D2 discloses a safe transmission line for use in intravascular guide wires and cables during MRI. It addresses the problem of tissue heating, caused by excitation of a common mode resonant frequency in the transmission line by the external RF field, and proposes the solution of dividing the transmission line into short, off-resonance sections, coupled by transformers. Due to the shorter line lengths, the resonance frequency can be shifted well above the Larmor frequency of about 64 MHz. In the design of the transmission line, a trade off between good common mode suppression and signal attenuation is found by choosing the number of transformers, the distances between them, and their geometry, which influences the stray

capacitance. For this task, D2 calculates models and tests prototypes.

31. Document D3 is very similar to D2.
32. Document D1 builds on D2 and D3. It also discloses a safe transmission line for use in catheters or needles during MRI. Although the use of transformers to divide the transmission line into shorter segments will shift the resonance frequency of the line to well above the external RF frequencies, a problem might still arise from a resonant coupling with loop-shaped transformer coils, due to the stray capacitance. D1 addresses this problem by using figure-of-eight-shaped coils. The coils themselves are designed with a size and distance selected for a low signal attenuation and a good common-mode suppression. No later tuning or other change of the coils is foreseen.
33. None of D1, D2, or D3 discloses a movable tuning element configured to deform the transformer windings. In D2 and D3, the coils are designed according to the requirements and fabricated on a multilayer PCB, without any possibility for later adjustment. In D1, the transformer is assembled on a standard circuit board according to specifications, and the distance between the coils is given by the thickness of the circuit board. No subsequent adjustment is foreseen.
34. Hence, the subject-matter of independent claims 1 and 9 is novel (Article 54 EPC).

Auxiliary Request 0 - Inventive step

35. Document D2 is selected as the most promising starting point for assessing inventive step, because it has the same purpose of improving safety of transformer while considering the effects of the transformer geometry on the common mode resonant frequency. D3 describes the same device and method as D2, but in less detail, whereas D1 is a less promising starting point, because there is little reason for the skilled person to deform the particularly designed geometry of the figure-of-eight shaped coils.
36. The technical effect of the movable tuning elements lies in the possibility of adjusting the frequency response of the transmission line to local conditions. The problem can be seen as providing a transformer line in which the compromise between safety and attenuation can be adapted to the situation.
37. The skilled person knows, from section I of D2, that the catheter and the surrounding tissue alter the common mode frequency response of the transformer line, which is, therefore, hard to predict. The skilled person also knows, from section IV-A.3 of D2, that increased safety comes at the expense of higher attenuation. In order to find a good compromise between safety and attenuation, the skilled person would foresee a large safety margin by shifting the common mode resonance to a frequency "far above" the Larmor frequency (D2 section IV-A.4) but also keeping the attenuation and number of transformers reasonable by avoiding an excessive shift of the common mode resonance.

38. Nothing in any of D1 - D3 suggests that a better compromise is possible or that the individual transformer couplings might be tuned after assembly. There is no evidence that this was part of the skilled person's general knowledge.
39. Hence, the subject-matter of independent claims 1 and 9 involves an inventive step (Article 56 EPC).

Consequence

40. It follows from the above that the main request is not allowable for lack of clarity and lack of support by the description, whereas the claims of auxiliary request 0 meet the requirements for the grant of a patent.

Order

For these reasons it is decided that:

The decision under appeal is set aside. The case is remitted to the Examining Division with the order to grant a patent on the basis of

- claims 1 - 11 as filed with letter of 15 December 2020 as "Auxiliary Request 0",
- the drawings as originally published, and
- a description to be adapted, based on pages 1, 3 - 5 and 8 as originally filed, pages 2 and 2a as filed with letter of 24 July 2013, and pages 6 and 7 as filed with letter of 24 November 2020.

The Registrar:

The Chairman:



D. Meyfarth

P. Scriven

Decision electronically authenticated