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Datasheet for the decision of 13 February 2025

Case Number: T 2301/22 - 3.4.01

Application Number: 15176636.7

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Language of the proceedings: EN

Title of invention:
SENSOR DEVICES AND METHODS FOR USE IN SENSING CURRENT THROUGH A CONDUCTOR

Applicant:
Aclara Meters LLC

Headword:
Utility meter / Aclara Meters

Relevant legal provisions:
EPC Art. 54(1), 54(2), 56, 84
RPBA 2020 Art. 13(1)

Keyword:

Novelty - main request (no)
Inventive step - auxiliary requests 1 and 2 (no)
Claims - clarity - auxiliary request 1 and 2 (no)
Amendment to appeal case - auxiliary requests 3 and 4 - amendment gives rise to new objections (yes)

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Case Number: T 2301/22 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 13 February 2025

Appellant: (Applicant)	Aclara Meters LLC 945 Hornet Drive Hazelwood MO 63042 (US)
Representative:	Ipsilon Benelux 76, rue de Merl 2146 Luxembourg (LU)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 2 May 2022 refusing European patent application No. 15176636.7 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	P. Scriven
Members:	T. Zinke
	C. Almberg

Summary of Facts and Submissions

I. The Examining Division refused the application for lack of novelty in the light of document D1 (EP-A-2 568 300). This applied to all the then pending requests (the main request and auxiliary requests 1 and 2).

II. The applicant appealed that decision, seeking the grant of a patent based on one of said three claim requests.

III. The Board summoned the appellant to oral proceedings. In a communication under Article 15(1) RPBA, the appellant was informed of the Board's preliminary opinion on the main issues, i.e. novelty and inventive step of all requests (Article 52(1) EPC), and clarity (Article 84 EPC). Documents D2 (Sueker, Keith H., Power Electronics Design, A Practitioner's Guide, Elsevier Science & Technology, 2005, pages 260-261) and D3 ("Magnetic Core", Wikipedia entry of 27 December 2013, retrieved on 2 December 2024) were introduced by the Board. D2 was introduced as evidence of the skilled person's common general knowledge with regard to Rogowski coils; and D3 of the skilled person's understanding of the term "air core".

IV. In response, the appellant filed further auxiliary requests 3 and 4.

V. Oral proceedings were held as scheduled, in the presence of the appellant. Their final requests were as follows.

That the appealed decision should be set aside and a patent granted based on the claims of one of the main request and auxiliary requests 1 and 2, all subject of the appealed decision; and auxiliary requests 3 and 4, both filed in response to the Board's communication issued under Article 15(1) RPBA.

VI. Claims 1 and 11 of the main request read as follows:

1. A utility meter (10) for use in transmitting electrical energy from a power source to a user, said utility meter (10) comprising:
a sensor device (12) positionable at least partially around a conductor (14) to sense current flowing through said conductor (14) and to output a signal representative of said sensed current, said sensor device (12) comprising:
a non-magnetic substrate;
a coil (104) comprising a plurality of turns wound about said substrate (102), said coil (104) defining an aperture (110) through which said conductor (14) is to be received; and
a dielectric material (108) having a dielectric constant and positioned adjacent to said coil (104) and at least partially within said aperture (110) such that said dielectric material (108) is between said coil (104) and said conductor (14) when said

conductor (14) is received through said aperture (110); and
a meter control board (17) in communication with said sensor device (12) to receive said signal representative of said sensed current from said sensor device (12) and to determine an amount of electricity transmitted through said conductor (14) from the power source to the user over time;
wherein said dielectric constant of said dielectric material (108) is selected to reduce a capacitive coupling between said coil (104) and said conductor (14) and to consequently reduce a sensitivity of said sensor device (12) such that said meter control board (17) comprises only one calibration coefficient for calibrating said sensor device (12) over a current range; and
wherein said current range is approximately 2.0A to approximately 25,000A, characterized in that
said non-magnetic substrate (102) comprises a plurality of bobbins (124-134), at least one of said plurality of turns of said coil (104) being wound about each of said plurality of bobbins (124-134), and in that said coil has an air core which does not become saturated, so that the sensor device (12) functions continuously as an inductor without the possibility of saturation or oversaturation.

11. A method of fabricating a utility meter (10) for use in transmitting electrical energy from a power source to a user, said method comprising:

providing a sensor device (12) positionable at least partially around a conductor (14) to sense current flowing through said conductor (14) and to output a signal representative of said sensed current, wherein providing said sensor device (12) comprises:

forming a coil (104) comprising a plurality of turns wound about a non-magnetic substrate (102) comprising a plurality of bobbins (124-134) with at least one of said plurality of turns being wound about each of said plurality of bobbins (124-134), each of said bobbins (124-134) having a circular area about which said coil (104) is wrapped, said coil (104) defining an aperture (110) through which said conductor (14) is to be received, and said coil having an air core which does not become saturated for said sensor device (12) to function continuously as an inductor without saturating or oversaturating; and

positioning a dielectric (108) adjacent to said coil (104) and at least partially within said aperture (110) such that said dielectric material (108) is between said coil (104) and said conductor (14) when said conductor (14) is received through said aperture (110); and

connecting a meter control board (17) with said sensor device (12) to receive said signal representative of said sensed current from said sensor device (12) and to determine an amount of electricity transmitted through said conductor (14) from the power source to the user over time; selecting said dielectric material (108) such that a dielectric constant

of said dielectric material reduces a capacitive coupling between said coil (104) and said conductor (14) and consequently reduces a sensitivity of said sensor device (12) such that said meter control board (17) comprises only one calibration coefficient for calibrating said sensor device (12) over a current range; and
wherein said current range is approximately 2.0 A to approximately 25,000 A.

VII. Independent claims 1 and 10 of auxiliary request 1 differ from claims 1 and 11 of the main request by an additional feature at the end which reads:

...
each of said bobbins has a toroidal shape, a circular area about which said coil (104) is wrapped, and an air core.

VIII. Independent claims 1 and 10 of auxiliary request 2 differ from claims 1 and 10 of auxiliary request 1 by an additional feature at the end which reads:

...
wherein the air core provides voltage independence of the sensing device.

IX. Claims 1 and 11 of auxiliary request 3 differ from claims 1 and 11 of the main request as follows (additions underlined; deletions struck-through):

1. A utility meter (10) for use in transmitting electrical energy from a power source to a user, said utility meter (10) comprising:

a sensor device (12) positionable at least partially around a conductor (14) to sense current flowing through said conductor (14) and to output a signal representative of said sensed current, said sensor device (12) comprising:

a non-magnetic substrate;

a coil (104) comprising a plurality of turns wound about said substrate (102), said coil (104) defining an aperture (110) through which said conductor (14) is to be received; and

an enclosure (112) comprising a dielectric material (108) having a dielectric constant and positioned adjacent to said coil (104) and at least partially within said aperture (110) such that said dielectric material (108) is at least partially between said coil (104) and said conductor (14) when said conductor (14) is received through said aperture (110); and

a meter control board (17) in communication with said sensor device (12) to receive said signal representative of said sensed current from said sensor device (12) and to determine an amount of electricity transmitted through said conductor (14) from the power source to the user over time;

wherein said dielectric constant of said dielectric material (108) is ~~selected~~ of at least 3.0 F/m at 10-1000 Hz to reduce a capacitive coupling between said coil (104)

and said conductor (14) and to consequently reduce a sensitivity of said sensor device (12) such that said meter control board (17) comprises only one calibration coefficient for calibrating said sensor device (12) over a current range; and
wherein said current range is approximately 2.0A to approximately 25,000A, ~~characterized in that~~
wherein said non-magnetic substrate (102) comprises a plurality of bobbins (124-134), ~~at least one of said plurality of turns of~~ said coil (104) being wound ~~about~~ with multiple turns of the plurality of turns on each of said plurality of bobbins (124-134)~~, and~~; characterized in that
said coil has an air core in each of said plurality of bobbins (124-134) ~~which does not become saturated, so that the sensor device (12) functions continuously as an inductor without the possibility of saturation or oversaturation~~ which provides a voltage independence of the sensor device (12), and
the voltage is measured at a different location from the sensor device (12).

11. A method of fabricating a utility meter (10) for use in transmitting electrical energy from a power source to a user, said method comprising:
providing a sensor device (12) positionable at least partially around a conductor (14) to sense current flowing through said conductor (14) and to output a signal representative of

said sensed current, wherein providing said sensor device (12) comprises:

forming a coil (104) comprising a plurality of turns wound about a non-magnetic substrate (102) comprising a plurality of bobbins (124-134) with ~~at least one~~ multiple turns of said plurality of turns being wound about each of said plurality of bobbins (124-134), each of said bobbins (124-134) having a circular area about which said coil (104) is wrapped, said coil (104) defining an aperture (110) through which said conductor (14) is to be received, and said coil having an air core in each of said plurality of bobbins (124-134), ~~which does not become saturated for said sensor device (12) to function continuously as an inductor without saturating or oversaturating;~~ which provides a voltage independence of the sensor device (12); and

positioning an enclosure (112) comprising a dielectric (108) adjacent to said coil (104) and at least partially within said aperture (110) such that said dielectric material (108) is at least partially between said coil (104) and said conductor (14) when said conductor (14) is received through said aperture (110); and

connecting a meter control board (17) with said sensor device (12) to receive said signal representative of said sensed current from said sensor device (12) and to determine an amount of electricity transmitted through said conductor (14) from the power source to the user over time; ~~selecting~~ said dielectric material (108) ~~such that~~ has a dielectric

constant of is [sic] of at least 3.0 F/m at 10-1000 Hz ~~said dielectric material~~ to reduce~~s~~ a capacitive coupling between said coil (104) and said conductor (14) and to consequently reduce~~s~~ a sensitivity of said sensor device (12) such that said meter control board (17) comprises only one calibration coefficient for calibrating said sensor device (12) over a current range;

wherein said current range is approximately 2.0 A to approximately 25,000 A; and

measuring the voltage at a different location from the sensor device (12).

X. Claims 1 and 11 of auxiliary request 4 differ from claims 1 and 11 of auxiliary request 3 by the removal of a part of the definition of the dielectric constant as follows (deletions struck-through):

1. ... over time;

wherein said dielectric constant of said dielectric material (108) is of [sic] a least 3.0 F/m at 10-1000 Hz ~~to reduce a capacitive coupling between said coil (104) and said conductor (14) and to consequently reduce a sensitivity of said sensor device (12) such that said meter control board (17) comprises only one calibration coefficient for calibrating said sensor device (12) over a current range; and~~

~~wherein said current range is approximately 2.0A to approximately 25,000A,~~

wherein said non-magnetic substrate ...

11. ... over time;
said dielectric material (108) has a dielectric constant of is [sic] of at least 3.0 F/m at 10-1000 Hz ~~to reduce a capacitive coupling between said coil (104) and said conductor (14) and to consequently reduces a sensitivity of said sensor device (12) such that said meter control board (17) comprises only one calibration coefficient for calibrating said sensor device (12) over a current range; and~~
~~wherein said current range is approximately 2.0A to approximately 25,000A~~; and
measuring the voltage at a different location from the sensor device (12).

XI. The applicant's arguments and submissions, insofar as they are relevant to the decision, are discussed in the Reasons, below.

Reasons for the Decision

Main request - Novelty

1. In the decision under appeal, the Examining Division held that independent claims 1 and 11 lacked novelty over document D1 (decision, II. Reasons, section 10.1).

2. The Examining Division also pointed out that D1 disclosed all the figures and embodiments of the

application and that most of the detailed descriptions of the invention were identical (decision, section 10.3.1).

3. With the statement of grounds of appeal, the appellant counter-argued and stated that the feature

> *the coil wound about each of the plurality of bobbins has an air core which does not become saturated, so that the sensor device functions continuously as an inductor without the possibility of saturation or oversaturation*

was not disclosed in D1 (statement of grounds, section 1.1, first hyphen).

4. In its preliminary opinion, the Board effectively pointed out that, due to the nearly identical description and figures of the present application and document D1, it was possible to compare the subject-matter of claim 1 to D1 with regard to novelty, despite the claim's clarity problems (preliminary opinion, paragraph 2).

5. The term *air core* is not used in D1, but the Examining Division nevertheless held that air cores were disclosed in D1, because Rogowski coils (which D1 did disclose) implicitly had air cores (see appealed decision, paragraph 10.1.1, last bullet point; D1, fig. 5, fig.6, [0026], [0029], [0043]).

6. In written proceedings, the appellant provided three counter-arguments:

(a) The Examining Division did not provide evidence of the skilled person's understanding of the term *Rogowski coil* (statement of grounds, section 1.1, second hyphen, second paragraph).

(b) D1 did not disclose an air core, because it did not disclose a *central cavity filled with air*, *in the bobbins*. Other materials must necessarily be present as dielectric material (statement of grounds, page 2, fourth full paragraph) or as other, unidentified, material in figure 5 in the bobbins, which was represented by arrows in the figure at the bottom of page 2 in the statement of grounds (statement of grounds, end of page 2).

(c) The Examining Division did not provide any evidence that the term *air core* should be interpreted in terms of its magnetic properties, i.e. that a bobbin comprising a solid cylinder would also be considered as an air core (statement of grounds, page 3, first hyphen).

7. This is not persuasive.

8. Document D2, representing the common general knowledge, shows that a Rogowski coil is characterised, amongst other things, by including an air core.

9. According to document D3, the term *air core* is understood by the skilled person as consisting of any non-magnetic material.

10. Hence, the skilled person understands that *air core* does not mean a *cavity filled with air*, but includes that the core is not magnetic.

11. Therefore, with its disclosure of Rogowski coils, D1 also discloses air cores in the coils.

12. During oral proceedings, the appellant further argued that claim 1 defined two different components of the coils, i.e. a non-magnetic substrate, comprising a plurality of bobbins about which the turns of the coils were wound and - in addition - an air core. The use of two different terms, i.e. non-magnetic substrate and air core, would be interpreted by the skilled person as a teaching that the air core is not the non-magnetic substrate, but rather a "cavity filled with air". Such a cavity filled with air, however, was not disclosed in D1. In particular, the appellant referred to Figure 5 of D1, which did not disclose such a cavity filled with air in the bobbins.

13. However, this argument is also not persuasive. First, the term *cavity filled with air* is used nowhere in the application as filed. Hence, there is no hint to the skilled person that another understanding of the term air core was envisaged in the application as filed than in the common understanding, as evidenced by D3. Second, the use of different terms does not necessarily mean that different materials are envisaged. Here, the term non-magnetic *substrate* implies that there is a mechanical support for winding the turns of the coil about it, and the term air core defines the non-magnetic properties of the whole coil. The definition in the claim encompasses different non-magnetic materials for the support together with an air core (including the use of a cavity filled with air), but it also encompasses the same non-magnetic materials for the support and the air core.

14. Therefore, the subject-matter of claims 1 and 11 is not novel over D1. As the main request fails to comply with Article 54(1) and (2) EPC, it is not allowable.

Auxiliary request 1 - Inventive step over D1

15. The independent claims of auxiliary request 1 differ from those of the main request by including this additional feature:

> *each of said bobbins has a toroidal shape, a circular area about which said coil is wrapped, and an air core.*

16. The Examining Division held that D1 disclosed cylindrical, hollow bobbins 124 having a toroidal shape (see appealed decision, II. Reasons, section 11; D1, fig.5, fig.6, [0027]).

17. The appellant argued that D1 did not disclose that each of the bobbins had a circular area around which the coil is wrapped.

18. The Board notes that D1 discloses, instead, that "Each bobbin 124-134 has a substantially circular cross-section ..." (D1, column 8, lines 33 to 34). Circular is less generic than "substantially circular" and, hence, might be considered novel over D1. However, it was plainly obvious to the skilled person to use bobbins with a circular cross-section instead of a substantially circular one.

19. Auxiliary request 1 is, therefore, not inventive over D1 (Article 56 EPC).

Auxiliary request 1, clarity and conciseness

20. Both independent claims include a *dielectric material*. However, it is unclear, whether this *dielectric material* has a particular form or structure, or whether it is distributed in parts over the whole sensor device.

21. The location of the dielectric material (108) in the utility meter is defined as *positioned adjacent to said coil (104) and at least partially within said aperture (110) such that said dielectric material (108) is between said coil and said conductor (14) when said conductor (14) is received through said aperture (110)*. It is unclear, whether the complete dielectric material has to be located between the coil and the conductor or (for example) only the part that is within the aperture.

22. The dielectric constant of the dielectric material is defined as being *selected to reduce a capacitive coupling between said coil and said conductor*. However, any possible dielectric material between the coil and the conductor would reduce their capacitive coupling. Hence, it is not clear, how the dielectric material is further defined by this feature and the claim is therefore not concise (Article 84 EPC).

23. In the claims, the choice of the dielectric constant is further defined as being selected *to consequently reduce a sensitivity of said sensor device such that said meter control board comprises only one calibration coefficient for calibrating said sensor device (12) over a current range*. Without defining how such calibration coefficient(s) are used at all, and what accuracy is intended with this calibration

coefficient(s), this definition does not impose any clear restriction on the dielectric constant.

24. The definition *at least one of said plurality of turns of said coil being wound about each of said plurality of bobbins* is not clear. It means that each bobbin can have one turn, with the remaining turns being elsewhere; and it is unclear where that might be. The intention was, conceivably, to define the coil such that each bobbin comprises at least one turn and that all the turns are wound about one or other of the bobbins, but that is not what the claim now says.

25. The feature *said coil has an air core* does not specify whether the air core is in the bobbins or anywhere else in the coil.

26. Since it is inherent to air cores that they do not become saturated, the feature *an air core that does not become saturated* is redundant, and renders the claim inconcise (Article 84 EPC).

27. Since the independent claims of auxiliary request 1 thus lack clarity and concision, this request is not allowable (Article 84 EPC).

Auxiliary request 2 - Inventive step over D1; clarity

28. The independent claims of auxiliary request 2 differ from those of auxiliary request 1 by including this additional feature:

> *wherein the air core provides voltage independence of the sensing device.*

29. The Board agrees with the Examining Division that this additional feature is an implicit effect or consequence of the presence of an air core in the Rogowski coil disclosed in D1 (see appealed decision, II. Reasons, section 2; D1, fig.5, fig. 6, [0026], [0029], [0043]). Hence, it is also disclosed by D1, and the subject-matter of claims 1 and 10 of auxiliary request 2 is not inventive over D1 (Article 56 EPC).

30. The appellant's arguments with regard to auxiliary request 2 are based on the interpretation of the term *air core*. As explained above, *air core* is synonymous with non-magnetic core and is present in any Rogowski coil, as disclosed in D1.

31. The objections under Article 84 EPC to auxiliary request 1 equally apply to auxiliary request 2, since the same wording is used.

32. Auxiliary request 2 is thus not allowable.

Auxiliary requests 3 and 4 - Consideration

33. Auxiliary requests 3 and 4 were first filed in response to the Board's communication, including its preliminary opinion, that was issued under Article 15(1) RPBA. Their admission into the proceedings is at the Board's discretion, under all relevant parts of Article 12 and 13 RPBA.

34. The amendments appearing in auxiliary requests 3 and 4 addressed the clarity, concision and novelty objections in the Board's preliminary opinion.

35. With regard to the novelty objections, the appellant added the feature "the voltage is measured at a different location of the sensor device (12)" to the independent claims and argued that this feature was not disclosed in D1 (submission of 30 January 2025, page 3, section 2.2).

36. While the Board accepts that, with the amendments appearing in auxiliary requests 3 and 4, the clarity and concision objections to auxiliary requests 1 and 2 prima facie are overcome, the amendments prima facie give rise to a new objection (see Article 13(1), first sentence, and fourth sentence, last two factors mentioned, RPBA): the added feature regarding the different location of the voltage measurement prima facie lacks clarity (Article 84 EPC).

37. It is unclear, where the voltage is measured. In particular, it is unclear, how the measurement at a different location from the sensor device can define the claimed utility meter of independent claim 1 or the method of fabricating a utility meter of independent claim 11 of auxiliary requests 3 and 4. There is no indication in this definition as to whether this different location is meant to be in the utility meter - separated from the sensor device - or outside the utility meter. Hence, this amendment can neither define the utility meter nor the method of fabricating a utility meter in a clear and concise way.

38. Due to this new objection, neither of these requests is prima facie allowable and, therefore, neither is admitted into the appeal proceedings (Article 13(1) RPBA).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chair:

D. Meyfarth P. Scriven

Decision electronically authenticated