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**Datasheet for the decision of 19 January 2021**

**Case Number:** T 0315/17 - 3.5.02

**Application Number:** 06786588.1

**Publication Number:** 1902505

**IPC:** H02J17/00

**Language of the proceedings:** EN

**Title of invention:**
Wireless Non-Radiative Energy Transfer

**Applicant:**
Massachusetts Institute of Technology (MIT)

**Relevant legal provisions:**
EPC Art. 123(2), 84, 56

**Keyword:**
Amendments - added subject-matter (no) - after amendment
Clarity - (yes) - after amendment
Inventive Step - (yes) - after amendment
Inventive Step - choice of closest prior art

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**Case Number: T 0315/17 - 3.5.02**

# D E C I S I O N
## of Technical Board of Appeal 3.5.02
## of 19 January 2021

**Appellant:** (Applicant)
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**Representative:**
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**Decision under appeal:**
**Decision of the Examining Division of the European Patent Office posted on 30 September 2016 refusing European patent application No. 06786588.1 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairman** R. Lord
**Members:** F. Giesen
A. Bacchin

## Summary of Facts and Submissions

I. The present appeal by the applicant (appellant) lies from the decision of the Examining Division posted on 30 September 2016 refusing European patent application No. 06786588.1 pursuant to Article 97(2) EPC.

The Examining Division had refused the present application *inter alia* on the grounds that the main and first to sixth requests then on file did not meet the requirements of Article 123(2) EPC and did not involve an inventive step within the meaning of Article 56 EPC in view of each of the documents:

D7 Stark III, J.C., "Wireless Power Transmission Utilizing a Phased Array of Tesla Coils", Masters Thesis, July 2004;

D14 Vandevoorde G. et al., "Wireless energy transfer for stand-alone systems: a comparison between high and low power applicability", Sensors and Actuators A 92 (2001), pp 305 to 311.

The Board further makes reference to:

A1 Kurs A. et al., "Wireless Power Transfer via Strongly Coupled Magnetic Resonances", Science 317, 83 (2007); pp 83 to 86DOI: 10.1126/science. 1143254.

which was filed as Appendix 1 by the appellant on 22 August 2013.

II. Oral proceedings took place before the Board, upon request of the appellant, by means of a videoconference on 19 January 2021.

At the end of the oral proceedings, the appellant requested that the impugned decision be set aside and a patent be granted on the basis of claims 1 to 5 filed as sole request during the oral proceedings.

III. Claim 1 of the sole request reads as follows: (Underlining and strike-through was added by the Board to highlight added and deleted features compared to claim 1 as originally filed.)

"*A method of transferring energy comprising: providing a first electromagnetic resonator structure receiving energy from an external power supply, said first resonator structure having a first resonant frequency $\omega_1$, resonant wavelength $\lambda_1$, resonance width $\Gamma_1$, a first Q-factor $Q_1$, and a characteristic size $L_1$, wherein said first resonator structure comprises a capacitively-loaded conducting-wire loop, where the characteristic size $L_1$ is the radius of the loop;*
*providing a second electromagnetic resonator structure being positioned distal from said first resonator structure, at closest distance D, said second resonator structure having a second resonant frequency $\omega_2$, resonant wavelength $\lambda_2$, and resonance width $\Gamma_2$, a second Q-factor $Q_2$, and a characteristic size $L_2$, wherein said second resonator structure comprises a capacitively-loaded conducting-wire loop where the characteristic size $L_2$ is the radius of the loop, wherein the two said frequencies $\omega_1$ and $\omega_2$ are close to within the narrower of the two resonance widths $\Gamma_1$ and $\Gamma_2$, and*

*transferring energy non-radiatively between said first resonator structure and said second resonator structure, said energy transfer being mediated through coupling of their resonant-field evanescent tails, and the rate of energy transfer between said first resonator and said second resonator being denoted by κ, wherein $Q_1$ > 200 and $Q_2$ > 200, and and κ/sqrt($\Gamma_1 * \Gamma_2$) > 2 and $D/L_2$ > 1,2,3,5, wherein non-radiative means D is smaller than each of the resonant wavelengths $\lambda_1$ and $\lambda_2$, wherein the second resonator structure is part of a mobile wireless receiver. ~~wherein c is the propagation speed of radiation in the surrounding medium~~*"

Claim 2 of the sole request reads:

"*An energy transfer device comprising:
a first resonator structure adapted to receive ~~receiving~~ energy from an external power supply, said first resonator structure having a first resonant frequency $\omega_1$, resonant wavelength $\lambda_1$, resonance width $\Gamma_1$, a first Q-factor $Q_1$, and a characteristic size $L_1$, wherein said first resonator structure comprises a capacitively-loaded conducting-wire loop, where the characteristic size $L_1$ is the radius of the loop; and a second resonator structure being positioned distal from said first resonator structure, at closest distance D, said second resonator structure having a second resonant frequency $\omega_2$, resonant wavelength $\lambda_2$, resonance width $\Gamma_1$, a second Q-factor $Q_2$, a characteristic size $L_2$, wherein said second resonator structure comprises a capacitively-loaded conducting-wire loop where the characteristic size $L_2$ is the radius of the loop, wherein the two said frequencies $\omega_1$ and $\omega_2$ are close to within the*

*narrower of the two resonance widths* $\Gamma_1$ *and* $\Gamma_2$, *and a load, wherein the second resonator structure is part of a mobile wireless receiver, wherein* $Q_1 > 200$ *and* $Q_2 > 200$, *and* $\kappa/sqrt(\Gamma_1 * \Gamma_2) > 2$, *and* $D/L_2 >$ *1,2,3,5, and wherein non-radiatively* [sic] *energy transfer between said first resonator structure and said second resonator structure is mediated through coupling of their resonant-field evanescent tails, and the rate of energy transfer between said first resonator and said second resonator is denoted by* $\kappa$, *wherein said resonant field in said device is electromagnetic, wherein non-radiative means D is smaller than each of the resonant wavelengths* $\lambda_1$ *and* $\lambda_2$. ~~*wherein c is the propagation speed of radiation in the surrounding medium*~~"

Claims 3 to 5 are dependent claims.

IV. The appellant argued essentially as follows:

Claim 1 of the main request met the requirements of Article 123(2) EPC. A basis for the amendments were originally filed claims 1 and 3. In order to have a proper antecedent for the feature *$D/L_2$* a definition of the characteristic size was added, for the first resonator as a matter of consistency. This feature had been present in two of the auxiliary requests filed with the statement of grounds of appeal and had not been objected to by the Board.

The subject-matter of claim 1 of the sole request was clear. The feature concerning supplying "useful working-power" was replaced by stating that the second resonator is part of a mobile wireless receiver. Claim 2 was amended such that "resonator receiving energy" from a power supply was replaced by "adapted to receive".

The subject-matter of claim 1 of the sole request involved an inventive step in view of D14. D14 did not disclose two resonators, but rather first and second coils, and also that that $Q_1 > 200$ and $Q_2 > 200$, $\kappa/sqrt(\Gamma_1 * \Gamma_2) > 2$ and $D/L_2 > 1,2,3,5$. In D14, power was transferred over a distance of 1 cm, much smaller than the coil radii of 3 cm, whereas the claimed subject-matter envisaged power transfer over distances larger than the coil radii but smaller than the resonant wavelengths which could still be several metres. D14 was rather concerned with optimising power transfer efficiency over such short distances and therefore did not provide any insight into useful parameter ranges for the distance regime as claimed. The equations for link efficiency disclosed in D14 did not suggest choosing the $Q$-factors of both resonators to be larger than 200 simultaneously. Rather it suggested that, in order to optimise the link efficiency, different values for the quality factors had to be chosen. The critical insight by the inventors was that the low efficiency associated with weak coupling $\kappa$ - for example due to relatively large distances between the coils - could be overcome by using resonators with high $Q$-factors to thereby still enable feasible wireless power transfer over these distances.

D7 did not disclose $Q_1 > 200$ and $Q_2 > 200$, or $\kappa/sqrt(\Gamma_1 * \Gamma_2) > 2$. These differences allowed the transfer of energy in an efficient manner over larger distances than those present between the coils of the Tesla coils used in D7. D7 was concerned with using many Tesla coils for building an antenna array that radiates energy in a directional manner. D7 taught setting the claimed figure of merit $\kappa/sqrt(\Gamma_1 * \Gamma_2)$ to a fixed value less than that claimed. There was therefore no suggestion of choosing the parameters in the claimed range.

## Reasons for the Decision

1. *Admissibility of the Appeal*

The appeal complies with the formal and substantive requirements of Article 108 and Rule 109 EPC and is therefore admissible.

2. *Admittance of the Main Request (Article 13(2) RPBA 2020)*

The appellant's sole request, which was filed during the appeal oral proceedings, can be considered an appropriate reaction to objections introduced for the first time and, in part, contrary to the findings of the Examining Division, by the Board in preparation of the oral proceedings concerning added subject-matter and clarity. The Board considered this procedural situation to represent special circumstances, and pointed out that the request, being a reaction to the Board's preliminary opinion, was justified by cogent reasons within the meaning of Article 13(2) RPBA. Therefore the Board admitted the sole request.

3. *Amendments (Article 123(2) EPC)*

3.1 The Board is satisfied that the amended application meets the requirements of Article 123(2) EPC.

3.2 Claim 1 according to the sole request is based on original claim 1 and claim 3 (concerning the parameter lists) and claims 14 and 20 (concerning the resonator being a capacitively loaded wire loop with the characteristic length being the radius).

Original claims 14 and 20 concerned the device, rather than the method but it is clear that the same device is described in the method claim. Furthermore, these claims were originally dependent on claim 8 expressing that the resonant field is electromagnetic. While this claim was not added verbatim, the field of a capacitively coupled wire loop is necessarily electromagnetic, so claims 1 and 3 express this limitation. In addition, claim 1 expresses that the resonators are electromagnetic, which is tantamount to saying that the resonance field is electromagnetic.

The second resonator being part of a mobile wireless receiver is disclosed originally in page 3, lines 9 to 14. It is disclosed that one resonator is supplied with external power and that this power is transferred non-radiatively to the second resonator, which supplies a load. This is reflected in claim 1.

Lastly, the deletion of the feature from claim 1 expressing that *c* denotes the propagation speed in a medium surrounding the resonator does not lead to added subject-matter because this feature does not express any information about the claimed method, the propagation speed not being used for defining any aspect of the method.

3.3 Independent device claim 2 is based on original claim 6. The same passages that serve as a basis for the amendments of claim 1 also serve as a basis for the amendments of claim 2. In addition some of the features of original claim 1 were also added to device claim 2, such as the overlap of the evanescent field tails, the fact that the resonance field is electromagnetic and that $\kappa$ denotes the energy transfer rate. Claim 1 as originally field is a basis because it is clear that features are present in the method as well as the corresponding device.

3.4 Dependent claims 3 and 4 find a basis on page 3, lines 10 to 15 and page 12, lines 6 and 7. Dependent claim 5 is based on page 1, lines 30 and 31.

4. *Clarity (Article 84 EPC)*

4.1 The Board is satisfied that claims 1 and 2 are clear within the meaning of Article 84 EPC.

4.2 Claim 1 was amended to contain all essential features, in particular that the resonators are driven close to resonance by stating that their frequencies are close to within the narrower of the resonant widths $\Gamma_1$ or $\Gamma_2$.

4.3 Claim 2 was reformulated to make it clear that the resonator is "adapted to receive" power from a power supply, thereby making it clear that the power supply is not part of the claimed energy transfer device.

4.4 The Examining Division had objected to the features "closest distance", "characteristic size", and "rate of energy transfer" as not being clear.

The objection concerning the characteristic size has been suitably addressed by the claim amendments according to which the resonators are wire loops and the characteristic sizes are their radii.

As to the objection concerning the closest distance, the Board is not convinced that this expression leads to a lack of clarity. The claim merely gives a label to the closest distance between the resonators at a given relative arrangement. This is in line with page 4, lines 5 to 8 of the application as filed. The Board acknowledges that it would be clear for a skilled person to determine what the closest distance is when given a particular arrangement of the resonator coils. In that respect, it is nonetheless apparent that "closest" is merely synonymous to minimum distance for a given arrangement.

As to the objection concerning the rate of energy transfer, the Board is also not convinced by the Examining Division's arguments. Their objection appears essentially to be based on an alleged ambiguity if the formula presented for coupled wire loops on page 7, lines 15 to 18 were used to define the energy transfer rate in the claim. However, this formula is valid for the special case where both resonators are in resonance and hence the resonance frequencies are identical, $\omega_1 = \omega_2 = \omega$. The Examining Division's argument that a skilled person would not know whether to use the geometric or the arithmetic mean in the case of detuned resonators, as allowed by claim 1, is not persuasive because it tacitly assumes that the calculation of the rate of energy transfer for detuned resonators was ambiguous. However, the Board is not convinced by this assumption. The fact that the description merely cites a special case, is not sufficient evidence that the rate of energy is not a clearly defined parameter.

5. *Inventive Step (Article 56 EPC)*

5.1 The Board has come to the conclusion that the subject-matter of claims 1 and 2 involves an inventive step within the meaning of Article 56 EPC.

5.2 Closest Prior Art

The subject-matter of claims 1 and 2 concerns a method and device for wireless non-radiative energy transfer between coils.

Document D14 is concerned with wirelessly powering an implant with about 20W over a distance of 1cm. Therefore, D14 is also concerned with non-radiative energy transfer between coils.

D7 is concerned with building a phased array of Tesla coils. According to the introduction on page 11, the

> "*thesis will explore the theory, design, and construction of a method to transmit wireless electrical power through space. To this end, the Tesla coil configuration is used as the basis to generate high voltage, high frequency electrical power. Multiple Tesla coils, synchronized in frequency, are considered to increase delivered power and provide directionality. The generated power can be* <u>*radiated*</u> *to a receiver through an*

*antenna array whose design will vary depending on the needs of the application. For some applications, a focused radiation pattern would be optimal, while for others, such as nanosensors spaced about a wide area, an omnidirectional radiation pattern would be appropriate.*"
(emphasis added)

The Tesla coils investigated in D7 are merely the dipoles of a phased array. D7 may well attempt to thoroughly characterise Tesla coils in order to gain insight into designing them, but with the goal in mind to use them as dipoles in a phased array, and not in order to transmit power from coil to coil within the Tesla coil. Starting from D7, i.e. from a phased array of Tesla coils, a skilled person would, in the course of any development that could legitimately be called obvious, end up with a phased array of Tesla coils and hence radiative energy transfer. Against this background, which is set by the choice of closest prior art, a skilled person would be motivated to optimise properties of the array, such as being able to design a radiation pattern or maximise the radiative energy transfer of the entire array. However, any reasoning intended to demonstrate how a skilled person would have arrived at the claimed subject-matter when starting from D7 in an obvious way, would have to explain why a skilled person would have been motivated to operate each single Tesla coil in a clearly sub-optimal regime, where the coils are spaced at relatively large distances, when they could simply be operated at the distance corresponding to their global maximum efficiency. Within the context of the claimed subject-matter, operating the resonator coils in a sub-optimal regime is a clear trade-off for mobility due to the wireless nature of the power transfer. But within the context of D7 as closest prior art, the idea is clearly to radiate power from an array of Tesla coils to a receiver. There is nothing to be gained by operating each individual Tesla coil away from its optimum. The fact that D7 attempts to thoroughly characterise individual Tesla coils should not be mistaken for a suggestion to arrive at the claimed invention. Rather this characterisation is performed to find the global optimum of operation of the individual Tesla coils and understand their behaviour in order to synthesise design rules. However, any suggestion that the Tesla coils could be used individually to wirelessly power a device and that the air gap between the coils was what provided the wireless nature is absent in D7.

The Board is therefore convinced that document D14, rather than document D7, is the closest prior art for the assessment of inventive step.

5.3 Distinguishing Features in View of D14

Document D14 does not disclose that $Q_1 > 200$ and $Q_2 > 200$, $\kappa/sqrt(\Gamma_1 * \Gamma_2) > 2$ and $D/L_2 > 1,2,3,5$.

The appellant contended that D14 disclosed a first coil but contested that this was a disclosure of a first resonator. The Board notes that according to A1, in the appellant's own words,

> "[s]elfresonant coils rely on the interplay between distributed inductance and distributed capacitance to achieve resonance. The coils are made of an electrically conducting wire [...] wound into a helix [...]".

The Board observes that the coils shown in figure 7 of D14 are wires wound into a helix and therefore "selfresonant" coils, in particular having a distributed capacitance due to the helix shape. The high quality factor of $Q = 100$ also speaks for a resonator. The Board further notes that this point did not have to be decided because the assessment of inventive step does not rely on it. For the sake of the further argument this feature is treated as being disclosed in D14.

5.4 Technical Effect and Technical Problem

The application discloses that with suitably chosen resonant modes non-radiative power transfer in the mid-range between two resonators is possible, where mid-range means for the case of inductive wire loop resonators that the distance between the coils is larger than their radii but limited by the distance of the evanescent tails or radiation field caustic, see e.g. page 4, lines 5 to 8 and lines 19 to 26 and page 7, line 28 to 34, which roughly corresponds to the resonant wavelength.

According to the theoretical framework disclosed in A1, a paper co-authored by the inventors and describing essentially the now claimed method and device, the efficiency of energy transfer between two resonators is given by equation (2) on page 1, third column, and is maximised when

$$\Gamma_W/\Gamma_D = [1 + (\kappa^2/\Gamma_S\Gamma_D)]^{1/2},$$

where $\Gamma$ denotes the intrinsic loss rate and the subscripts S, D, and W denote the power source, the device and the load connected to the device, respectively. $\Gamma_S$ and $\Gamma_D$ correspond to $\Gamma_1$ and $\Gamma_2$ according to claims 1 and 2. According to document A1 the key to efficient energy transfer is to have

$$\kappa^2/\Gamma_S\Gamma_D > 1,$$

which is equivalent to saying that $\kappa/\text{sqrt}(\Gamma_1 * \Gamma_2) > 1$, which is the parameter stated in claims 1 and 2 of the sole request. These claims are further restricted to this parameter being larger than 2. The physical meaning of this equation is that the energy transfer rate should be larger than the overall intrinsic loss rate.

Therefore, the objective technical problem is to enable useful ("$Q_1 > 200$ and $Q_2 > 200$, $\kappa/sqrt(\Gamma_1 * \Gamma_2) > 2$") non-radiative power transfer for distances between the radii of the resonator loops ("$D/L_2 > 1,2,3,5$") and the resonant wavelengths ("wherein non-radiative means $D$ is smaller than each of the resonant wavelengths $\lambda_1$ and $\lambda_2$").

5.5 Assessment of the Solution in View of D14

The Board notes that the parameters of claims 1 and 2 suggest that $\lambda_i > D > L_2$ whereas the distance and radii of the coils in D14 are disclosed to be 1 cm and 3 cm, respectively, see page 311, left column, last paragraph. D14 is not concerned with enabling non-radiative power transfer in the mid-range but maximising power transfer in the close range. According to D14, first page, second column, last paragraph "*[t]oday, two application fields can be distinguished: low power magnetic links and high power magnetic links. Low power magnetic links are characterised by* _*very unfavourable coil coupling conditions either caused by*_ *a large coil separation or a very small internal coil diameter.*" (emphasis added) D14 goes on to investigate the "high power magnetic link" regime. Therefore, it contains no suggestion for a skilled person to operate in the mid-range as expressed by the above inequality.

Furthermore, the appellant convinced the Board that the equations in D14 did not suggest to a skilled person to choose both $Q_1$ and $Q_2$ to be larger than 200 simultaneously. In section 2.1 of D14, link efficiencies are given for the second resonator being a series (capacitor in series with the coil) or parallel (capacitor in parallel to the coil) tank circuit as follows:

> The choice between series or parallel connection depends on the value of the internal load $R_{dc}$ for which an optimal link efficiency is reached. The total link efficiency for a parallel resonant secondary can be written as [5]
>
> $$\eta = \frac{k^2 Q_1 Q_2}{(1 + Q_2/\alpha + k^2 Q_1 Q_2)(\alpha + 1/Q_2)}$$
>
> while for a series resonant secondary, the efficiency is given by
>
> $$\eta = \frac{k^2 Q_1 \alpha}{(1 + k^2 Q_1 + 1/Q_2)(\alpha + 1/Q_2)}$$

wherein $\alpha = \omega C_2 R_L$. D14 goes on to disclose that optimal $\alpha$ values for these two cases are given by

$$\alpha_{\text{opt}} = \frac{Q_2}{\sqrt{1+X}} \quad \text{for parallel resonance}$$

$$\alpha_{\text{opt}} = \frac{\sqrt{1+X}}{Q^2} \quad \text{for series resonance}$$

where $X = k^2 Q_1 Q_2$. The maximal efficiency for both series and parallel resonance is then given by

$$\eta_{\text{m}} = \frac{X}{(1+\sqrt{1+X})^2}$$

This set of equations expresses that if the optimal alpha values $\alpha_{opt}$ are chosen, the efficiency is maximised for a given $X = k^2 Q_1 Q_2$. This maximum of the efficiency at $\alpha_{opt}$ as a function of the parameter $X$ is given by the last equation for $\eta_m = \eta(\alpha_{opt})$. This maximum link efficiency tends to 1 as $X$ goes to infinity. This would be an incentive for a skilled person to choose $X$ as large as possible and therefore, given the definition of $X$, $\kappa/sqrt(\Gamma_1 * \Gamma_2) > 2$.

However, the appellant correctly argued that achieving the optimal efficiency in the parallel case implies choosing $Q_2 = 1$. This follows from inserting the expression for $\alpha_{opt}$ for the parallel case into the equation for $\eta$ and equating it with the equation for $\eta_m$. If one wanted to maximise $\eta_m$ according to the teaching of D14, one would have to choose $X$ as large as possible but with $Q_2 = 1$. It follows that D14 does not suggest to choose $Q_1$ and $Q_2$ simultaneously larger than 200 in order to maximise the link efficiency in the parallel resonance case.

A similar argument applies to the series resonant case, where the $Q$ values are constrained at $1 = \kappa$ sqrt($Q_1$/$Q_2$), i.e. again in order to reach the maximum link efficiency, according to the equations of D14, the $Q$ values should be chosen in a particular manner but not simultaneously to be larger than 200. Furthermore, since the $Q$ factors are linked to the intrinsic loss rates by $Q = \omega/\Gamma$, D14 teaches that $\kappa$ sqrt($\Gamma_2/\Gamma_1$) = 1, and not, as claimed, $\kappa$ sqrt($\Gamma_1 * \Gamma_2$) > 2.

Therefore, the Board comes to the conclusion that starting from D14, the skilled person neither finds a suggestion to operate at coil distances in the mid-range, i.e. between the coil diameter and the resonant wavelengths, nor to choose the combination of parameters as defined in claim 1.

The Board wishes to add, that by choosing the parameters in the claimed range, the skilled person does not merely accept operating the set-up of D14 in a sub-optimal regime. Rather, the merit of the subject-matter of claim 1 is to enable useful power transfer in the mid-range and indicating how, at such coil distances, the efficiency can be maximised. Maximising the efficiency in the mid-range is different from maximising it in the near-field as disclosed in D14.

Given this finding, the further arguments submitted by the appellant as to why, in their view, the subject-matter of claims 1 and 2 involved an inventive step do not need to be addressed.

5.6 Some Remarks on D7

While D7 is a less promising starting point to arrive at the subject-matter of claims 1 and 2 in an obvious manner than D14, the Board wishes to make the following observation on the corresponding reasons in the impugned decision, which found claim 1 of the main request not to involve an inventive step in view of document D7.

In the correct application of the problem solution approach the choice of the starting point must be correctly taken into account in the ensuing assessment of the technical problem and the solution. The Examining Division's attempt to demonstrate that the choice of $\kappa/sqrt(\Gamma_1 * \Gamma_2)$ and high quality factors larger than 200 were obvious when starting from D7 is tainted by hindsight because it fails to demonstrate what would motivate a skilled person attempting to develop further a phased array of Tesla coils (a line of development fixed by the choice of D7 as closest prior art) to operate the individual coils away from a clearly identified maximum. The mere fact that in order to thoroughly characterise Tesla coils, D7 also measures the induced voltages at distances larger than the coil radius in figure 7-38 or investigates the locus of the poles of the voltage induced in the second resonator for $Q_1 = Q_2 = 1000$ in figure 3-9, is not tantamount to a motivation to operate the coils with those parameters in a phased array. The Board notes, that figure 3-9 merely shows at which frequency and damping parameters maxima occur, not what the height of the maxima, and hence the efficiency, is. D7 clearly states that the global maximum is given by a parameter choice different from that of claims 1 and 2.

D7 is never concerned with transferring power between the resonators coils of the Tesla coil as the final objective but with building a phased array of Tesla coils, using these coils as dipoles and radiating energy to the receiver. In this context, which is defined by the choice of D7 as closest prior art, there is no motivation for a skilled person to investigate at what distances power transfer between the individual resonators of each Tesla coil would still allow devices to be powered. In other words, due to the choice of D7 as a starting point for assessing inventive step, the objective technical problem of enabling power transfer at distances between the loop radii and the resonant wavelengths is in itself not a problem that a skilled person would have considered in an obvious manner. Considering this problem, the skilled person starting from D7 has already left a line of development that might legitimately be considered as obvious.

5.7 The Board wishes to remark that it would of course be satisfying to explain why D7, D14 and the application find different expressions for the energy transfer efficiency. In a perfect world, the results should be reconcilable. The physics underlying the Tesla coils of D7 and the coil link in D14 should of course be the same as that underlying the claimed arrangement. However, this fact cannot lead to the conclusion that the claimed subject-matter was obvious in view of D7 or D14. The Board notes, that in A1, the appellant has provided experimental evidence demonstrating that their theoretical insights, albeit different from those of D7 or D14, led to an experimentally verifiable regime of operation in which wireless energy transfer between the two coils with 40 to 50% efficiency was possible despite the distance being six to seven times greater than the coil radius. This, in the Board's view, demonstrates that an alternative theoretical approach - even leading to results deviating from the prior art approach - can lead to an experimentally verified markedly different power transfer operation, namely over much larger distances. This is an insight that cannot be considered to have been obvious in view of the available prior art.

6. *Remittal*

The description still needs to be extensively adapted to the amended claims, in particular since the claims are now restricted to resonant wire loops. The parts of the description concerning dielectric disks therefore have to be marked as not falling under the claims. The same applies to the various disclosed values for parameters outside of the claimed ranges. The extensive adaptation needed represents special circumstances within Article 11 RPBA 2020 justifying remittal to the examining division, to which the appellant had no objections.

## Order

**For these reasons it is decided that:**

1. The decision under appeal is set aside.

2. The case is remitted to the Examining Division with the order to grant a patent on the basis of

   claims 1 to 5 of the sole request filed at the oral proceedings on 19 January 2021

   and a description to be adapted.

The Registrar: The Chairman:

U. Bultmann R. Lord

Decision electronically authenticated