

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,
Petitioner

v.

Telefonaktiebolaget L M Ericsson (publ)
Patent Owner.

IPR2024-00728

U.S. Patent 7,151,430

**DECLARATION OF MANOS TENTZERIS, PHD
IN SUPPORT OF INTER PARTES REVIEW OF U.S. PATENT 7,151,430**

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I, Dr. Manos Tentzeris, declare as follow:

1. I have been retained on behalf of Intel Corporation (“Petitioner”), to provide this Declaration concerning technical subject matter relevant to the petition for Inter Partes Review (“Petition”) of U.S. Patent 7,151,430 to Mattson (“the ’430 patent”). It is my understanding that the ’430 patent is currently assigned to Telefonaktiebolaget L M Ericsson (publ) (“Patent Owner”).

2. I am over 18 years of age. I have personal knowledge of the facts stated in this Declaration and could testify competently to them if asked to do so. I have reviewed and am familiar with the specification and the claims of the ’430 patent. In general, I will cite to the specification of a United States patent using the following formats: (Patent No., Col:Line Number(s)) or (Patent No., Paragraph Number(s)). For example, the citation (’430 patent, 1:1-10) points to the ’430 patent specification at column 1, lines 1-10. Also, for convenience, I use italics to denote limitations from the challenged claims.

3. All of the opinions contained in this Declaration are based on the documents I reviewed and my knowledge and professional judgment. In forming the opinions expressed in this Declaration, I reviewed the documents listed in the attached Appendix. I have also reviewed and am familiar with any other document referred to in this Declaration.

4. I have been asked to provide my technical opinions regarding how a person of ordinary skill in the art (“POSITA”) would have understood the claims of the ’430 patent at the time of the alleged invention. For purposes of whether the teachings of the prior art render the claims of the ’430 patent obvious in the analysis applied in this document, I have been asked to assume the date of March 3, 2004, the date of U.S. Provisional 60/549,611. However, except as noted herein, my opinion would not change if the priority date of the ’430 patent within a year earlier or later. I have also been asked to provide my technical opinions on how concepts in the ’430 patent specification relate to claim limitations of the ’430 patent. In reaching the opinions provided herein, I have considered the ’430 patent, its prosecution history, and the references cited in Attachment A, and have drawn as appropriate on my own education, training, research, knowledge, and personal and professional experience.

I. Qualifications

5. In formulating my opinions, I have relied on my knowledge, training, and experience in the relevant field, which I will summarize briefly. A more detailed summary of my background, education, experience, and publications is set forth in my curriculum vitae (“CV”), which is provided as INTEL-1004.

6. I have personal knowledge of the facts and opinions set forth in this declaration and believe them to be true. If called upon to do so, I would testify competently thereto. I have been warned that willful false statements and the like are punishable by fine or imprisonment, or both.

7. I am being compensated for my time at my standard consulting rate. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study and analysis, the substance of my opinions, or the outcome of any proceeding involving the Challenged Claims. I have no financial interest in the outcome of this matter or in any litigation involving the '430 patent.

8. I am currently Ed and Pat Joy Chair Professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology. I received my Bachelor of Science degree in Electrical Engineering from the National Technical University of Athens in Greece in 1992. I received my Master's degree and Ph.D. from the University of Michigan at Ann Arbor in 1994 and 1998, respectively. A complete list of my academic positions, activities, and publications is set out in my CV.

9. Between 1991 and 1992, I was a research assistant in the Microwave Lab at the National Technical University of Athens, Greece. From 1992 to 1998, I

was a research assistant in the Radiation Laboratory at the University of Michigan, Ann Arbor. I became an assistant professor at the School of Electrical and Computer Engineering at Georgia Technical Institute in 1998, lasting until I became an Associate Professor in the same School in 2004. I then served as Associate Professor until my promotion to Professor in 2010, a title I have held since then. Also in 2016, I was appointed as the Ken Byers Professor in Flexible Electronics.

10. As described in my CV, I have more than 30 years of industry and academic experience. I have experience with antennas, RF passives and modules, and RF/wireless circuit design for these systems. As a professor of Electrical and Computer Engineering, I have taught courses relating to antenna and electromagnetic technologies. A complete list of my teaching positions, honors, and classes taught is set out in my CV. As a professor, I collaborated with over 130 Undergraduate, Masters and Doctoral students, as well as visiting students, post-doctoral fellows, and other researchers.

11. Throughout my career, I have received a variety of awards. I am a Fellow of IEEE, a member of the MTT-15 Committee, an Associate Member of European Microwave Association (EuMA), a Fellow of the Electromagnetics Academy, and a member of Commission D, URSI and of the Technical Chamber

of Greece. In recognition of my world-leading achievements in the area of antennas and miniaturized/fractal RF structures, I served as an IEEE C-RFID (Committee on RFID technologies) Distinguished Lecturer from 2016-2022 and I served as an IEEE MTT Distinguished Microwave Lecturer (DML) from 2010-2012, while I am currently an IEEE EPS (Electronic Packaging Society) Distinguished Lecturer. I have won awards for my contributions in developing various technologies, including numerous multiband antenna topologies operating at different frequencies and integrated RF modules up to sub-THz frequencies.

12. In Google scholar, there are over 28,940 citations to my work and my work has an h-index of 83. An h-index represents the number of papers with the same number of citations, meaning I have over 83 papers with 83 citations.

13. I have authored or contributed to over 30 books and 850 refereed journal and conference papers; spoke in over 140 presentations, many of which relate to antennas, antenna arrays, RFID systems, RF passives and miniaturized RF modules, and other modes of wireless communication and electronics design. A complete list of my publications and conference presentations is included in my CV.

14. I am a named inventor on 20 patents in the U.S. and in Europe. In particular, I am a named inventor on patents relating to antenna design, RF

systems, and means of reducing signal interference in RF applications. A complete list of my patents and published applications is included in my CV.

15. In addition to gaining expertise via my academic training, professional experiences, and research accomplishments described above, I have kept abreast of various sub-disciplines within the antennas space, by reading technical literature, attending and presenting at conferences, and attending and presenting at symposia. I have served as an editor for various journals and participated in the peer review process for various technical journals and conferences, and have reviewed manuscripts submitted by other scholars relating to antenna topologies. I have contributed further to the profession by chairing conference committees and planning conferences and panels. Furthermore, I have collaborated with or have communicated with many of the scholars and engineers in the field of antennas systems.

II. Understanding of Relevant Legal Principles

16. I am not a lawyer, and I will not provide any legal opinions. Although I am not a lawyer, I have been advised certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims.

17. I understand that a patent claim is invalid if it is anticipated or obvious in view of the prior art, and that a claim can be unpatentable even if all of the requirements of the claim cannot be found in a single prior-art reference. I further understand that invalidity of a claim requires that the claim be anticipated or obvious from the perspective of a person of ordinary skill in the art at the time the invention was made.

18. I have been informed that a patent claim is invalid if it would have been obvious to a person of ordinary skill in the art. In analyzing the obviousness of a claim, I understand the following factors may be taken into account: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims; (3) the level of ordinary skill in the art; and (4) any so called “secondary considerations” of non-obviousness, if they are present. I am not aware of any evidence of secondary considerations of non-obviousness relevant to the ’430 patent. I reserve the right to supplement this Declaration if Patent Owner (“PO”) introduces evidence of secondary considerations of non-obviousness.

19. I understand that to prove that prior art or a combination of prior art renders a patent obvious, it is necessary to:

- (1) identify the particular references that, singly or in combination, make the patent obvious;

- (2) specifically identify which elements of the patent claim appear in each of the asserted references; and
- (3) explain why a person of ordinary skill in the art would have combined the references, and how they would have done so, to create the inventions claimed in the patent. I further understand that exemplary rationales that may support a conclusion of obviousness include:
 - combining prior art elements according to known methods to yield predictable results;
 - simple substitution of one known element for another to obtain predictable results;
 - use of known technique(s) to improve similar devices (methods or products) in the same way;
 - applying a known technique to a known device (method or product) ready for improvement to yield predictable results;
 - “obvious to try” – choosing from a finite number of identified, predictable solutions with a reasonable expectation of success;
 - known work in one field of endeavor may prompt variations of the work for use in either the same field or a different field based on design

incentives or other market forces if the variations are predictable to a person of ordinary skill in the art; and

- some teaching, suggestion, or motivation in the prior art that would have led a person of ordinary skill in the art to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

20. I have been informed that, in considering obviousness, hindsight reasoning derived from the patent-at-issue may not be used

III. '430 Patent – Technical Background and Overview

21. The '430 patent titled “Method of and Inductor Layout for Reduced VCO Coupling” to Thomas Mattsson was filed on August 16, 2004. The '430 patent claims priority to Provisional Application 60/565,328, filed on April 26, 2004, and Provisional Application 60/549,611, filed on March 3, 2004. Solely for purposes of this IPR, I assume March 3, 2004 as the earliest priority date claimed on the face of the '430 patent. However, my opinion set forth herein would not change if the priority date was determined to be April 26, 2004 or August 16, 2004.

22. The '430 patent provides “an inductor design and method of implementing the same where mutual EM coupling is reduced.” ('430 patent, 3:4-

6.) The inductor design “reduce[s] the EM field at a certain distance from the inductor (i.e., the far field), at least in some directions, by using inductor shapes that are substantially symmetrical.” (INTEL-1001, 3:6-10.) “This reduced far field may then be used to reduce the mutual coupling between two inductors.” (INTEL-1001, 3:11-13.) These concepts were well-known in the art before the earliest priority date claimed on the face of the ’430 patent.

A. Technical Background

1. Electromagnetic Fields

23. Every moving charge, i.e., flow of current, is associated with a **magnetic field**, illustrated in Figure 4.1 of the “RFID Handbook: Fundamentals and Applications in Contactless Smart Cards and Identification” to Finkenzeller (“Finkenzeller”; INTEL-1012). (INTEL-1012, 61.) As shown in Figure 4.1, a conductive wire generates a magnetic field (represented by lines of magnetic flux) when a current flows through it.

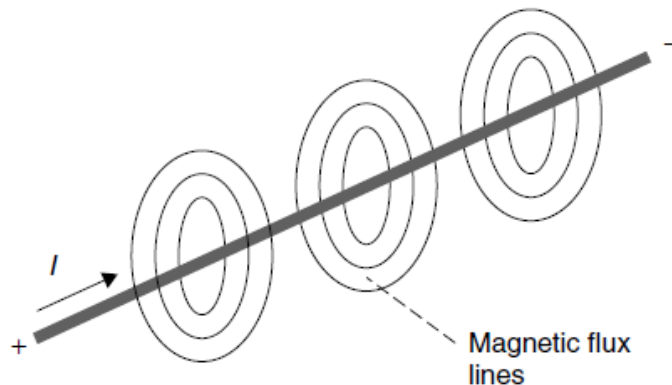


Figure 4.1 Lines of magnetic flux are generated around every current-carrying conductor

24. The strength of the magnetic field is directly proportional to the amount of current flowing through the wire conductor and inversely proportional to the distance from the wire. The direction of magnetic field generated by the wire conductor can be described in accordance with the right-hand rule, which is a visual mnemonic used to identify magnetic field direction relative to the flow of electric current. The right-hand rule can be applied as follows: point your right thumb in the direction of the current flow and wrap your right-hand fingers around the wire conductor. Your fingers will point in the direction of the magnetic field generated from the wire conductor. The application of the right-hand rule is illustrated below in Figure 22.14 of Serway (“Principles of Physics,” 2nd Edition, 1998 by Serway (“Serway”; INTEL-1013)):

- *Magnetic field due to a long, straight wire*

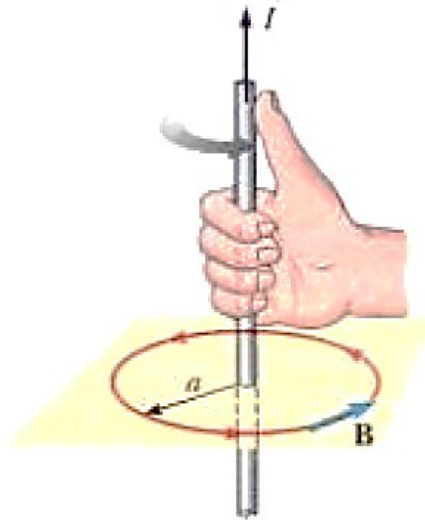
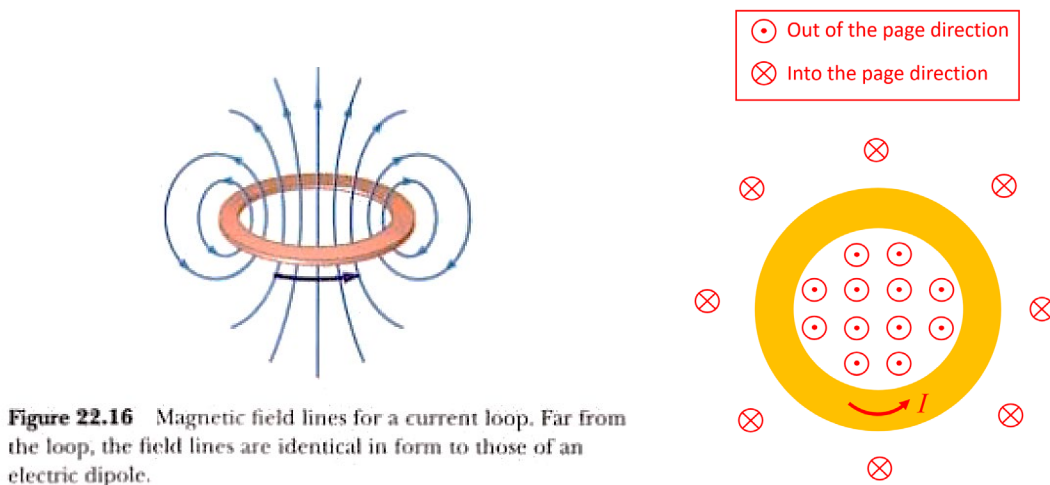


Figure 22.14 The right-hand rule for determining the direction of the magnetic field surrounding a long, straight wire carrying a current. Note that the magnetic field lines form circles around the wire.

Serway, Figure 22.14

25. When the wire conductor is formed in the shape of a circular loop, the magnetic field lines are as shown below (left) in Figure 22.16 of Serway. (INTEL-1013, 650.) The directions of the magnetic lines follow the right-hand rule described above. For a circular loop conductor, the right-hand rule can alternatively be applied where the four right-hand fingers follow the current direction in the loop and the thumb would point in the direction of the magnetic

field within the loop. The magnetic field direction is opposite outside the loop. In the drawing (below right), I illustrate the directions of the magnetic field lines for the loop of Figure 22.16. Note that my drawing is only intended to illustrate the directions of the magnetic field lines, and placements of the magnetic field lines are not intended to depict the magnetic field strength.



Serway, Figure 22.16 (left); directions of magnetic field lines (right)

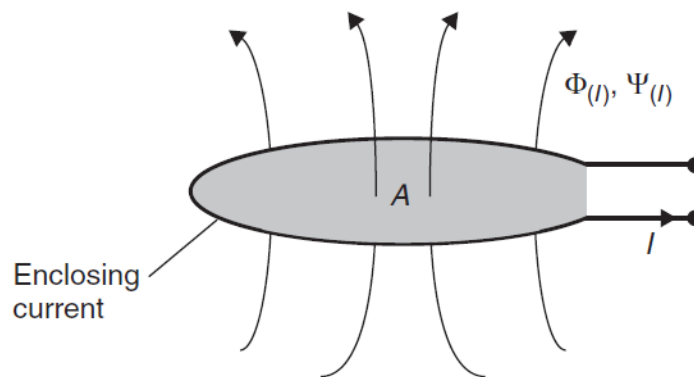
26. When an element is placed within the magnetic field, the total amount of magnetic field penetrating through this element is **magnetic flux** which is denoted by the symbol Φ . Simply put, magnetic flux is the number of magnetic field lines passing through a given closed surface. Magnetic flux density is therefore an alternative term for magnetic field. (INTEL-1014, 187.)

27. If a conducting loop having surface area A is placed in a uniform magnetic field $\mathbf{B}$, the magnetic flux through the conducting loop is determined by

$\Phi = BA \cos \theta$. When the surface of the conducting loop physically aligns with the same plane of the uniform magnetic field $\mathbf{B}$, the angle θ (the angle between the normal direction of the surface and the magnetic field) equals 90° and $\cos \theta = 0$. Therefore, the magnetic flux through the conducting loop is 0. In contrast, if the plane of the conducting loop is perpendicular to the uniform magnetic field $\mathbf{B}$, the angle θ equals 0° and $\cos \theta = 1$, and the magnetic flux equals to $\Phi = BA$.

2. Inductor Fundamentals

28. A magnetic field, and thus a magnetic flux Φ , “will be generated around a conductor of any shape”, as illustrated in Figure 4.7 of Finkenzeller (reproduced below). (See INTEL-1012, 67.) “This will be particularly intense if the conductor is in the form of a loop (coil).” (*Id.*) Therefore, inductors are often in the form of one or more loops (coils).



Finkenzeller, Figure 4.7

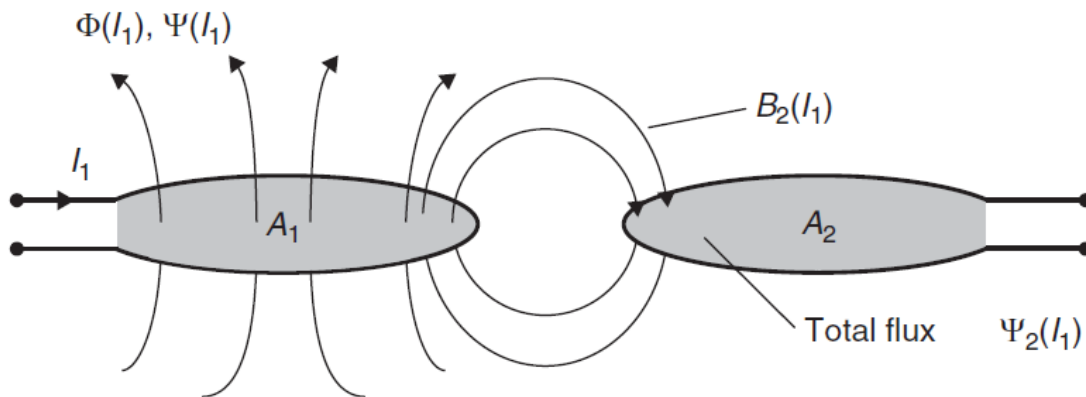
a. Self-Inductance

29. Self-inductance is a property of an inductor that measures how well it resists or opposes the change of current flowing through it. (INTEL-1013, 684.) This property is crucial in the functioning of inductors, as it governs how they respond to changes in magnetic field and hence affects their behavior in circuits. The self-inductance of a device “depends on the geometric features of the circuit and other physical characteristics.” (*Id.*)

b. Mutual Inductance

30. Mutual inductance describes the coupling of two circuits by the medium of a magnetic field. (INTEL-1012, 68.) Essentially, the changing magnetic field created by an inductor induces a voltage in a neighboring inductor. A change in the current of a first inductor induces a voltage in an adjacent secondary inductor, and vice versa, due to the magnetic linkage there between. The induced voltage is also referred to as induced **electromotive force** (abbreviated as emf). (INTEL-1013, 612.) This effect is quantified by the mutual inductance M , which is a measure of the efficiency of this coupling between adjacent inductors. In other words, the magnitude of the mutual inductance is an indicator of the level of interaction between two adjacent inductors.

31. For example, if a second conductor loop with Area A_2 is located in the vicinity of conductor loop 1 with Area A_1 through which a current is flowing (shown in Figure 4.8 below), the second conductor loop “will be subject to a proportion of the total magnetic flux Φ flowing through A_1 . (INTEL-1012, 68.) The two loops “are connected by this partial flux or coupling flux. (*Id.*) The magnitude of the coupling flux depends on the geometric dimensions of both loops in relation to one another and the magnetic properties of the medium. (*Id.*)



Finkenzeller, Figure 4.8

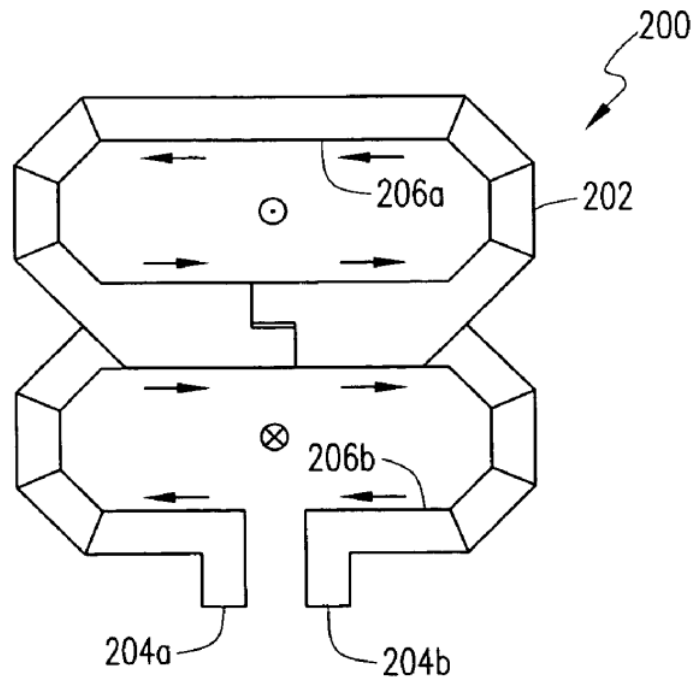
32. The mutual inductance of loop 2 in relation to loop 1 is defined by the ratio of the partial flux enclosed by conductor loop 2, to the current I_1 in conductor loop 1. Specifically, current I_2 flows through the conductor loop 2, determining the coupling flux Ψ_{12} in loop 1. (INTEL-1012, 68.) Accordingly, the following relationship applies:

$$M = M_{12} = M_{21}$$

(INTEL-1012, 68.)

B. '430 Patent Overview

33. An exemplary embodiment of an inductor described by the '430 patent is illustrated in Figure 2 (reproduced below). (INTEL-1001, 4:5.) Inductor 200 has coil 202 and terminals 204a and 204b, “and has been designed so that it is substantially symmetrical about a horizontal axis X.” (INTEL-1001, 4:5-8.) Coil 202 “is in the form of a single-turn 8-shaped structure with an upper loop 206a and a lower loop 206b.” (INTEL-1001, 4:8-10.) The '430 patent provides no details regarding how the upper and lower loops are connected other than noting that by virtue of the figure-8 shape, current in upper loop 206a travels in a direction (e.g., counterclockwise, see arrows) that is opposite to current in the lower loop 206b (e.g., clockwise). (INTEL-1001, 4:10-14.)



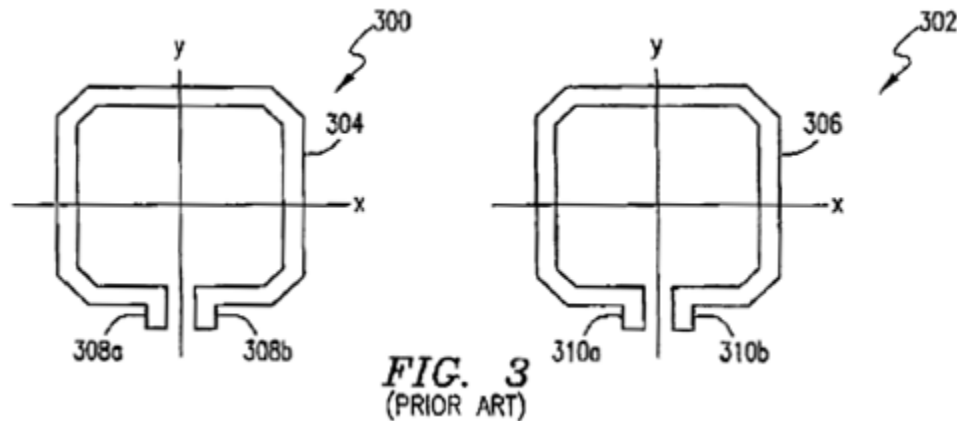
'430 Patent, Figure 2

34. The '430 patent states that “[a]s a **result**¹ [of the configuration of the inductor], the EM field components emanating at a certain distance from the two substantially symmetrical loops 206a and 206b also have opposite directions and tend to counteract each other.” (INTEL-1001, 4:14-17.) “[B]y making the two loops 206a and 206b substantially symmetrical, cancellation of a significant amount of far field on either side of the horizontal symmetry axis X may be achieved.” (INTEL-1001, 4:22-25.)

¹ Unless otherwise noted, all emphasis has been added.

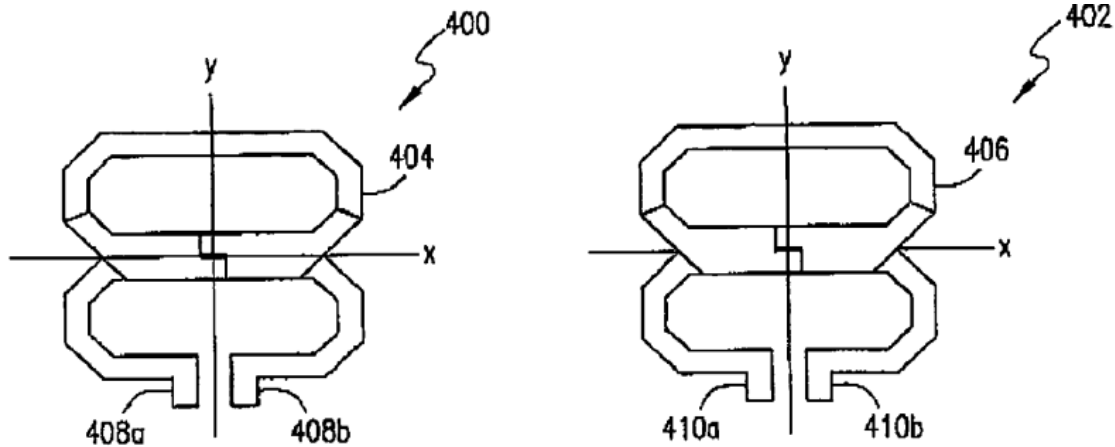
35. The '430 patent further describes several exemplary arrangements of the 8-shaped inductor of Figure 2 with a second inductor. (*See, e.g.*, INTEL-1001, Figures 3-5, 7.) In designing the layout for two inductors, “[c]hoosing a substantially symmetrical shape (e.g., a figure-8 or a four-leaf clover shape) for the first inductor helps reduce the EM field at far distances” which “in turn, reduce[s] mutual EM coupling to the second inductor, regardless of its shape.” (INTEL-1001, 3:19-23.) “If the second inductor also has a similar or substantially identical shape, the tendency of the second inductor to pick up the EM field from the first inductor is also reduced via the same mechanisms.” (INTEL-1001, 3:23-26.)

36. The '430 patent describes a prior art arrangement of two inductors, illustrated in Figure 3 (reproduced below). (INTEL-1001, 2:49-50.) In this **prior art** arrangement, “two inductors 300 and 302 are placed side-by-side and have rectangular inductor coils 304 and 306.” (INTEL-1001, 4:51-54) Thus, the '430 patent acknowledges that it was known in the prior art to arrange two inductors side-by-side, sharing a common axis (the horizontal axis).



'430 Patent, Figure 3

37. In another arrangement, illustrated in Figure 4 (reproduced below), the two inductors (400, 402) “have 8-shaped inductor coils 404 and 406.” (INTEL-1001, 4:67-5:1.) “Each individual inductor 400 and 402 has a reduced far field by virtue of the 8-shaped inductor coil 404 and 406.” (INTEL-1001, 5:4-6.) There is a “reduction in the mutual coupling between the two inductors 400 and 402” because “the same mechanism that causes the radiated EM field from the first inductor to be reduced also causes the ‘EM field receive sensitivity’ of the second inductor to be reduced.” (INTEL-1001, 5:7-11.)



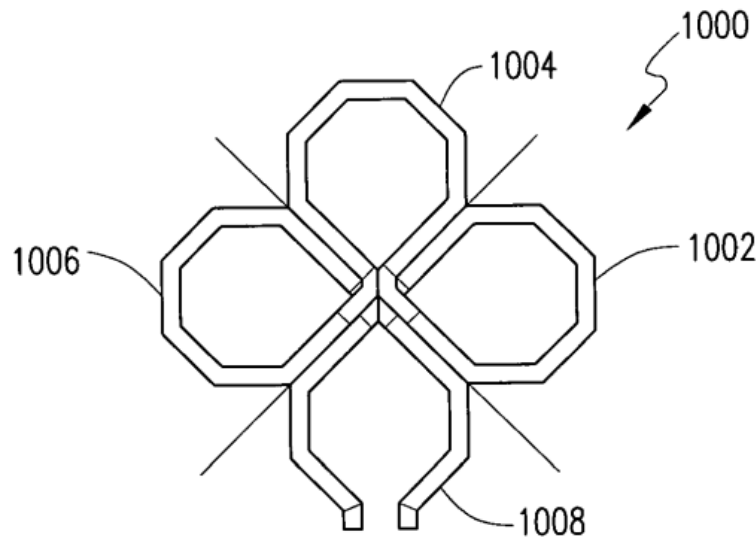
'430 Patent, Figure 4

38. In other inductor arrangements, one of the inductors is rotated (e.g., 90° clockwise or counterclockwise). (See INTEL-1001, 5:23-31; Figure 5.) Table 1 “shows a summary of the simulation results for the mutual coupling between different coil shapes and orientations for two inductors at a center distance of 1 mm.” (INTEL-1001, 6:58-61.) The “notation ‘8_shape_90’ represents a figure-8 shaped inductor that has been rotated 90 degrees and the notation ‘8_shape_-90’ represents a figure-8 shaped inductor that has been rotated by -90 degrees.” (INTEL-1001, 6:61-64.) As shown in the table below, “making one of the inductors 8-shaped was shown to reduce the mutual coupling by up to 20 dB” and “[m]aking both of them 8-shaped was shown to improve the isolation by up to 30 dB.” (INTEL-1001, 7:13-16.)

TABLE 1

Inductor 1	Inductor 2	L1 [nH]	Q1	Gvdd [dB]	Att [dB]	K
O-shape	O-shape	0.841	16.93	-54.0	reference	0.002077
8-shape	O-shape	1.216	15.20	-75.6	21.6	0.000173
8-shape_90	O-shape	1.218	15.63	-74.9	20.9	0.000187
8-shape	8-shape	1.216	15.84	-86.5	32.5	0.000049
8-shape_90	8-shape	1.216	15.19	-89.7	35.7	0.000034
8-shape_90	8-shape_-90	1.217	15.69	-92.8	38.8	0.000024

39. The '430 patent also describes “more complex inductor designs that are symmetrical in more than one dimension” such as the four-leaf clover design shown in Figure 10, reproduced below. In this design, “four loops 1002, 1004, 1006, and 1008 of the inductor 1000 are connected in such a way that the magnetic field emanating from any two adjacent loops have opposite directions and tend to cancel one another.” (INTEL-1001, 8:57-60.) I note that the '430 patent provides no details regarding “the way” in which the loops are connected in this embodiment.



'430 patent, Figure 10

C. Prosecution History

40. The '430 patent has an extensive family, including counterparts in Europe and Japan. In this section, I discuss the prosecution of the '430 patent in front of the USPTO and the prosecutions of JP2007526642 and EP3567614.

1. U.S. Patent Prosecution

41. In the first non-final office action (after a restriction requirement), the Examiner allowed independent prosecution claims 25 and 26 and their dependent prosecution claims 2-7, 10, 13-17 and 20 based on the recitation of “*a second inductor positioned at a distance from the first inductor, wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.*”

(INTEL-1002, 113.) The Examiner however rejected independent prosecution claim 21² (and its dependent prosecution claim 22) as anticipated by U.S. Patent 6,194,987 to Zhou, et al (“Zhou”). (INTEL-1002, 112-113.) Independent prosecution claim 21 is reproduced below.

An inductor having a reduced far field, comprising:

 a first loop having a shape that is substantially symmetrical about a first predefined axis;

 a second loop having a size and shape substantially identical to the first loop, said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and

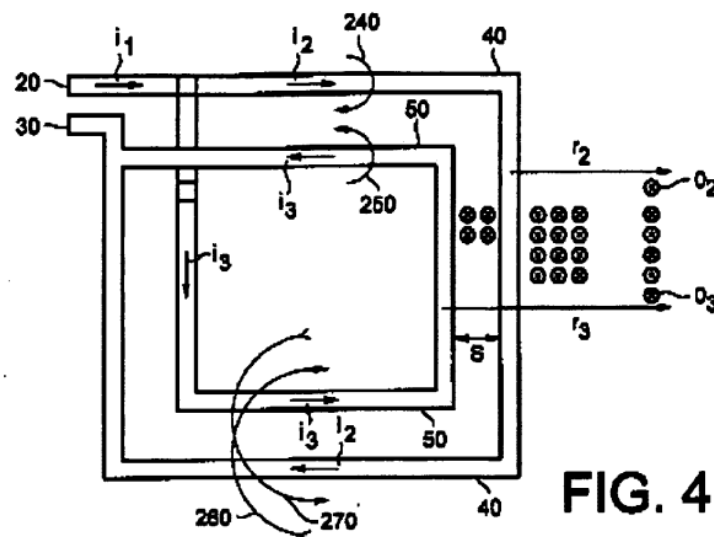
 two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.

42. In the rejection, the Examiner found Zhou’s Figure 4 (reproduced below) disclosed the limitations of claim 21. (INTEL-1002, 112-113.) To address this rejection, Applicant acknowledged that the current in the two loops of Zhou flows in opposite directions, resulting in reduced far field “to some extent.” (INTEL-1002, 125.) However, Applicant (PO) alleged that in Zhou “the loop areas are completely different (6:1 ratio as shown) so the reduction is marginal.”

² Prosecution claim 21 corresponds to issued claim 20.

(INTEL-1002, 125.) Applicant (PO) further alleged that the “claimed invention makes the two loops more equal in size to significantly improve cancellation of the far magnetic field while maintaining a good Q-factor.” (INTEL-1002, 125.)

Applicant (PO) concluded its arguments by stating that “[n]one of the embodiments described in Zhou teach or suggest an inductor configuration that combines a large far field reduction with a good inductor Q-factor” and in particular, “does not teach or suggest an inductor having a reduced far field in which the inductor includes first and second loops of substantially identical size and shape, and in which the second loop is arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop.” (INTEL-1002, 126.)



Zhou, Figure 4

43. The Examiner subsequently allowed the claim but identified the “*two closely spaced terminals connected to the first loop*” limitation of prosecution claim 21 as a reason for allowance. (INTEL-1002, 136.) The Examiner did not elaborate on the prior art of record with respect to this claim.

2. Foreign Prosecution

44. The '430 patent has numerous foreign counterparts. I discuss the prosecution histories of JP2007526642 and EP3567614 in this section.

a. JP2007526642

45. JP2007526642 was filed with substantially similar claims as the '430 patent. I reproduce originally filed claim 1 below. (*See* INTEL-1015, 1.)

An inductor layout having reduced mutual electromagnetic coupling, comprising:

a first inductor having a reduced far field; and

a second inductor positioned leaving a predetermined distance from the first inductor,

the first inductor provided with:

a first loop that is a substantially symmetrical shape relative to a first predetermined axis;

a second loop connected to the first loop and having a substantially same size and shape as the first loop, the second loop being disposed such that a magnetic field generated from the second loop has an inclination that negates a magnetic field generated from the first loop; and

two terminals having an interval left at a near position, the two terminals being connected to the first loop to provide a current to the first loop and the second loop, and suppressing a contribution to a magnetic field from the two terminals to a minimum, wherein, the mutual electromagnetic coupling

between the first inductor and the second inductor is reduced as a result of the electromagnetic field of the first inductor being reduced.

46. In the first Notice of Refusal, the Examiner found that the claims “could have been easily invented prior to the present application by a person having ordinary skill in the field of art pertaining to the inventions” based “on the invention described in” the JP equivalent to Einzinger (JP 2005-534184), among other references. (*See* INTEL-1015, 4-5.) The WO counterpart to JP 2005-534184 is provided as INTEL-1017.

47. In response, Applicant (PO) amended claim 1 to recite “the two terminals having an interval left at a near position such that a distance between the two terminals is smaller than a width of the first loop.” (INTEL-1015, 8.) In the second Notice of Refusal, the Examiner identified 3 references that “teach matters concerning the ‘two terminals’ of the inventions of claims 1, 11, 19, and 21.” (INTEL-1015, 15.) The Examiner then found “the inventions of claims 1 and 11 of the amended present application could easily have been conceived by a person skilled in the art based” on the disclosures of, e.g., Einzinger-JP³ and the newly

³ Einzinger-JP corresponds to PCT Publication WO 2004/012213 to Einzinger (“Einzinger-US”; INTEL-1017.)

identified references. (INTEL-1015, 15.) In response, Applicant (PO) argued that in “cited document 2 [Einzinger], the two terminals are placed at an interval that is greater than the width of the winding loop, and the configuration is the exact opposite of the invention stated in claim 1 of the present application.” (INTEL-1015, 19.)

48. In the final Decision of Refusal, the Examiner found that “in terms of ‘suppressing a far field by the positioning of two terminals’ as asserted by the applicant, the invention taught in” Einzinger-JP “and the invention of claim 1 of the amended present application are the same.” (INTEL-1015, 22.) The Examiner acknowledged that Einzinger-JP “and the invention of claim 1 of the amended present application differ in regard to whether the distance between the two terminals is in close proximity.” (INTEL-1015, 22.) The Examiner however found that “configuring the distance between the two terminals to be in close proximity is well-known art in the technical field” and “determining the position of the terminals of the inductor is a matter that can be appropriately selected by a person skilled in the art, and there is no particular difficulty in configuring the distance between the two terminals to be in close proximity.” (INTEL-1015, 22.)

b. EP3567614

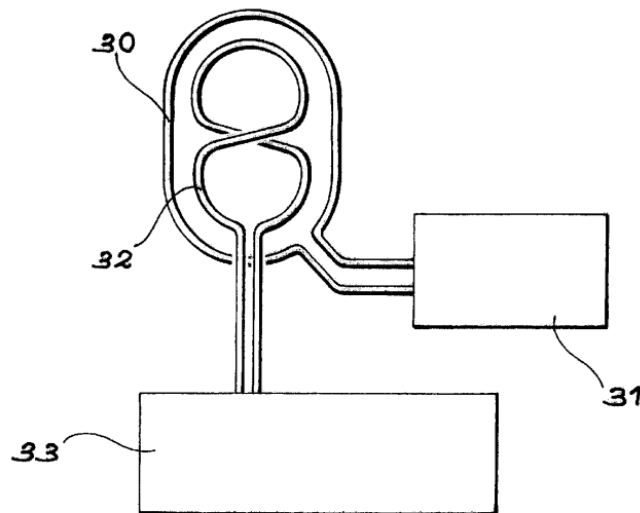
49. EP3567614 was filed on July 2, 2019 with a single independent claim (reproduced below). (INTEL-1016, 22.)

1. A radio-frequency transceiver, comprising:
a first inductor (200, 1300), which is substantially symmetric about a symmetry axis, the first inductor (200, 1300) comprising terminals (204a, 204b; 1310a, 1310b), a first loop (206a), and a second loop (206b), wherein the first loop (206a; 1004) and the second loop (206b) are arranged such that current in the first loop (206a) travels in a direction that is opposite to current in the second loop (206b) such that electromagnetic field components emanating from the first loop (206a) and the second loop (206b) also have opposite directions and tend to counteract each other; and wherein the terminals (204a, 204b; 1301a, 1310b) are connected to the second loop (206b).

The EP claim set further included a dependent claim reciting that the transceiver “is integrated on a semiconductor chip.” (INTEL-1016, 23.)

50. The EP Examiner rejected EP prosecution claims 1-6, 8 and 9 as not novel or inventive based on FR 2805618 to Acher, et al. (“FR-Acher”), published August 31, 2001; claims 4, 8 and 9 as not novel over the combination of WO 2004/012213 to Einzinger (“Einzinger-US”) and FR-Acher; and claim 6 as not novel over the combination of FR-Acher and WO 98/05048 to Midya (“Midya”). (INTEL-1016, 33-34.)

51. U.S. Patent 6,708,880 to Acher, et al. (“US-Acher”; INTEL-1018) is the counterpart to FR-Acher and includes the same disclosure. I briefly discuss US-Acher (FR-Acher) here to provide context to understand Applicant’s (PO’s) argument during EP prosecution. The embodiment from FR-Acher relied upon by the EP Examiner depicts a detection device, illustrated in Figure 4 below. (INTEL-1018, 6:12.) The detection device includes single loop antenna 30 which emits an alternating magnetic field and a second antenna 32 with an 8-shaped winding. (INTEL-1018, 6:12-19.) The EP Examiner found that the second antenna 32 was an inductor because it “actuates” in “an alternative magnetic field of 70 Hz emitted by inductor (30).” (INTEL-1016, 33.)



US-Acher, FR-Acher, Figure 4

52. In its Reply, Applicant (PO) amended the independent claim to recite that the first inductor is “integrated on a semiconductor chip.” (INTEL-1016, 39.) In the next communication, the Examiner rejected the amended claims as lacking an inventive step because the “problem to be solved by these differing features is not defined” and “[t]herefore, these features are considered merely one of several straightforward possibilities which the skilled person would select without exercising inventive skill.” (INTEL-1016, 43.) The Examiner further found that the specification “discloses these differing features being part of the prior art as providing the same advantages as in the present application.” (INTEL-1016, 44; *citing* filed specification, 5:30-6:2 and Figure 3 (corresponding to 4:51-62 and Figure 3 of the ’430 patent).) According to the Examiner, the “skilled person would therefore regard it as a normal design to include these differing features in the transceiver described” in FR-Acher. (INTEL-1016, 44.)

53. Applicant (PO) then argued that the element relied upon by Examiner in FR-Acher is an antenna with “a certain size dictated by its intended use.” (INTEL-1016, 45-46.) Applicant (PO) further argued that the size of the antenna in FR-Acher is more than 3cm in the horizontal direction and more than 10 cm in the vertical direction. (INTEL-1016, 46.) Based on these dimensions, Applicant concluded that “antenna 32 is several orders of magnitude larger than what is

feasible to integrate on semiconductor chip.” (INTEL-1016, 46.) Notably, Applicant (PO) did not contend that the antenna of FR-Acher is not an “inductor” and thus tacitly acknowledged that an antenna that produces magnetic flux when current is applied to it or that actuates in the presence of magnetic flux is an “inductor.” (See § III.A.1 (discussion of magnetic flux).)

54. In the subsequent rejection, the Examiner found that certain claimed subject matter “extends beyond the content of the earlier applications as filed.” (INTEL-1016, 50.) For example, the Examiner found the “[t]wo inductors as presently claimed are only disclosed in a specific arrangement which reduces mutual coupling between them” and “[n]o base exists for the unspecific arrangement of the two inductors on a semiconductor chip as presently claimed.” (INTEL-1016, 50.)

55. In response to the EP Examiner’s rejection, Applicant (PO) stated “[t]he reduction of electromagnetic coupling between the first and second inductor (compared with two O-shaped inductors) is a **technical effect** of the shape of the first inductor.” (INTEL-1016, 59.) Applicant continued: “Although the distance between the inductors has an influence on the total amount of coupling (*see e.g.* Fig. 6), it is still significantly reduced compared with two O-shaped inductors at the same distance. Hence, no particular distance between the two inductors is

mandated in the description.” (INTEL-1016, 59.) In summary, Applicant stated “it is submitted that the root parent application as filed does not mandate any particular distance or relative orientation of the two inductors.” (INTEL-1016, 59.)

56. I understand that this application remains pending.

D. Level Of Ordinary Skill In The Art

57. I understand that certain issues relating to the validity of the ’430 patent must be judged from the perspective of a person of ordinary skill in the relevant art, as I discuss below. I have been asked to define the level of a “person of ordinary skill in the art” or “POSITA” at the time the alleged invention as claimed was made. In deciding the level of ordinary skill, I have considered the following factors, which I have been informed are relevant to the determination of ordinary skill in the art.

- levels of education and experience of persons working in the field;
- types of problems encountered in the art;
- prior art solutions to these problems;
- rapidity with which innovations are made; and
- sophistication of the technology.

58. In my opinion, a POSITA at the time of the alleged invention of the ’430 patent would have had at least a master’s degree in electrical engineering,

physics, or a similar discipline and at least two years of experience in designing integrated circuits or inductors or a bachelor's degree in electrical engineering, physics, or a similar discipline and at least four years of experience in designing integrated circuits or inductors. Additional education might compensate for less experience and vice versa.

E. Claim Construction

59. I understand that “claim construction” is the process of determining a patent claim’s meaning. I understand the same claim construction standard used in district courts which seeks to give claim terms their plain and ordinary meaning to a POSITA at the time of the claimed invention in view of the claims, specification, and prosecution history applies in IPR proceeding. I also understand that if the patent applicant gave a term a special meaning in the specification or during prosecution, then the special meaning should be used.

60. I understand that PO asserted the ’430 patent in a co-pending investigation before the United States International Trade Commission (“ITC”), styled ITC-337-TA-1376. I understand the Administrative Law Judge (“ALJ”) in that investigation determined that “for the ’430 patent, the preamble of claim 11 provides antecedent basis for the term ‘first inductor’” but “it is not clear that the recitation of ‘on a semiconductor die’ in claim 11 of the ’430 patent is properly

understood as a limitation.” (INTEL-1019, 2-3.) The ALJ further found that “the parties’ agreement that the preamble of claim 1 of the ’430 patent is limiting is not accepted” and “the parties’ agreement on the other preambles is accepted only to the extent needed to provide antecedent basis or to give meaning to the claims”. (INTEL-1019, 2-3.)

61. I understand that PO also asserted the ’430 patent in an earlier concluded ITC investigation, styled ITC-337-TA-1300. I further understand that a different ALJ in that investigation issued an Order construing certain terms in the ’430 patent. (INTEL-1020, 12-30.) I reproduce the adopted constructions in the table below:

Term	Adopted Construction
“An inductor layout having reduced mutual electromagnetic coupling” (claim 1)/ “A method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die” (claim 11)	preamble limiting
“two closely spaced terminals” (claims 1 and 11)	Plain and ordinary meaning applies, which is “two terminals in proximity to each other (such that the electromagnetic field at a certain distance from the first inductor (where the second inductor is positioned) is reduced)”

“a first inductor having a reduced far field” (claim 1)	“(reduced/reduce) the electromagnetic field at a certain distance from the first inductor (where the second inductor is positioned)”
“forming the first inductor to reduce a far field” (claim 11)	
“reduced electromagnetic field” (claims 1 and 11)	Plain and ordinary meaning applies, which is “the electromagnetic field emanating from the first inductor is reduced (at a certain distance from the first inductor where the second inductor is positioned)”

(*See id.*)

62. In my declaration, I use the claim construction standard applied by the district court. In my view, no claim terms require explicit construction in this proceeding to resolve patentability of the claims. However, I demonstrate in my analysis below the challenged claims are unpatentable if the preambles are limiting or not limiting and show the claims are also unpatentable should the ITC-337-TA-1300 constructions be adopted in this proceeding.

IV. GROUND 1: Taniguchi Renders Claims 1, 3-5, 7, 10-11, 13-15, 17, 19-21 Obvious.

A. Overview of Taniguchi

63. U.S. Patent Publication 2003/0063034 to Taniguchi, et al. (“Taniguchi”; INTEL-1005) was filed on September 26, 2002 and published on April 3, 2003 which are both before the earliest priority date claimed on the face of

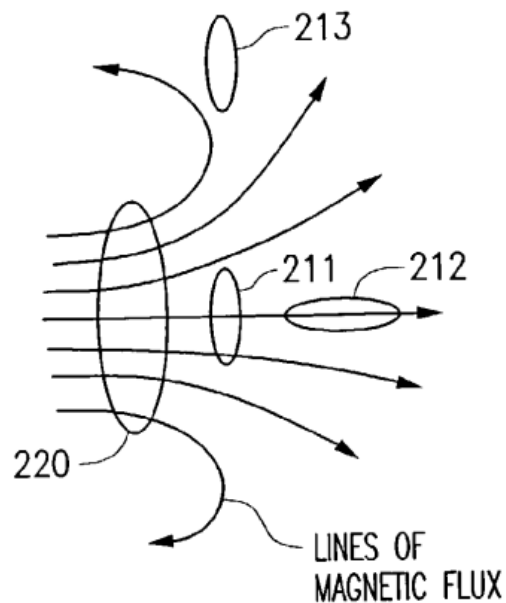
the '430 patent (March 3, 2004). Taniguchi also claims priority to a Japanese application filed on September 28, 2001.

64. Taniguchi relates “to a radio guidance antenna for use in non-contact identification apparatus such as physical distribution systems, electronic coupon ticket systems, and the like, a data communication method, and a non-contact data communication apparatus, which make use of such antenna.” (INTEL-1005, ¶1.) Specifically, Taniguchi presents a “radio guidance antenna in which the sum of mutual inductances of antennas is minimized.” (INTEL-1005, Abstract.)

1. Background

65. In an exemplary application described in Taniguchi, tags are attached to commodities to be managed and data are transmitted by the tags and received at the non-contact identification apparatus “using mutual inductance coupling between antennas for transmission and reception and loop antennas 203, 204 formed in the tags 201, 202.” (INTEL-1005, ¶¶3-4.) The mutual inductance between a single transmission loop antenna of the non-contact identification apparatus and a loop antenna on a tag (e.g., tag 211, tag 212 or tag 213) is illustrated in Figure 22 (reproduced below). (INTEL-1005, ¶7.) The “lines of magnetic flux emitted from a transmission antenna 220 are indicated by solid lines with arrows” and “the more lines of magnetic flux per unit area, the larger

magnetic flux density.” (*Id.*) The “magnetic flux density, at which magnetic flux generated by current through the transmission antenna 220 passes through an antenna loop of a tag,” is in proportion to the mutual inductance (M) between the transmission antenna and the tag antenna. (*Id.*) The “more the number of lines of magnetic flux passing through the loop of the tag, the larger the mutual inductance M.” (*Id.*)

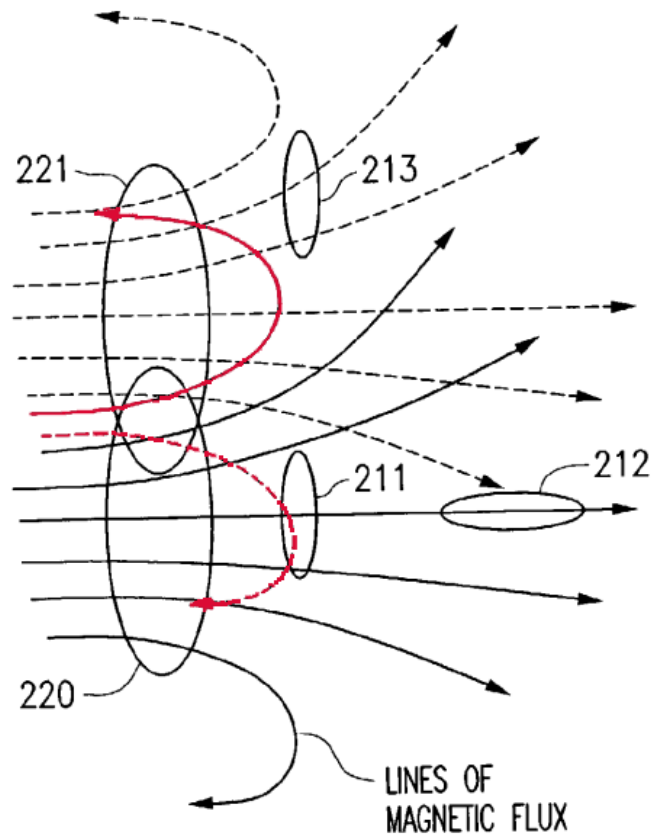


Taniguchi, Figure 22

66. In the example of Figure 22 above, tag 211 “is disposed on the same axis as” antenna 220 so that a transmission antenna loop and the tag loop are in parallel. (INTEL-1005, ¶8.) As a result, “the number of interlinkages of lines of magnetic flux generated by the transmission antenna 220” with tag 211 “is large

and the mutual inductance M is large.” (*Id.*) However, the loop of tag 212 is perpendicular to the transmission antenna loop so the “lines of interlinking magnetic flux become 0”, making the mutual inductance zero. (*Id.*) Tag 213 is parallel to antenna 220 but offset and therefore “the number of lines of magnetic flux making interlinkage with the tag 213 is very small and the mutual inductance M becomes small.” (INTEL-1005, ¶9.)

67. Figure 23 (reproduced below) illustrates a system having two overlapping transmission loop antennas. (INTEL-1005, ¶10.) In this example, “magnetic field radiated from a transmission antenna 221 provided in addition to the transmission antenna 220 is represented by lines of magnetic flux indicated by broken lines with arrows.” (*Id.*) The “magnetic flux generated by the transmission antenna 221 pass[es] through tags 212, 213” creating sufficient mutual inductance between transmission antenna 221 and tags 212, 213. (*Id.*) Thus, the more transmission loop antennas included in the system, “the more complex the magnetic field, so that there is an increased probability that communication will be enabled irrespective of directions and positions of tags.” (*Id.*)



Taniguchi, Annotated Figure 23

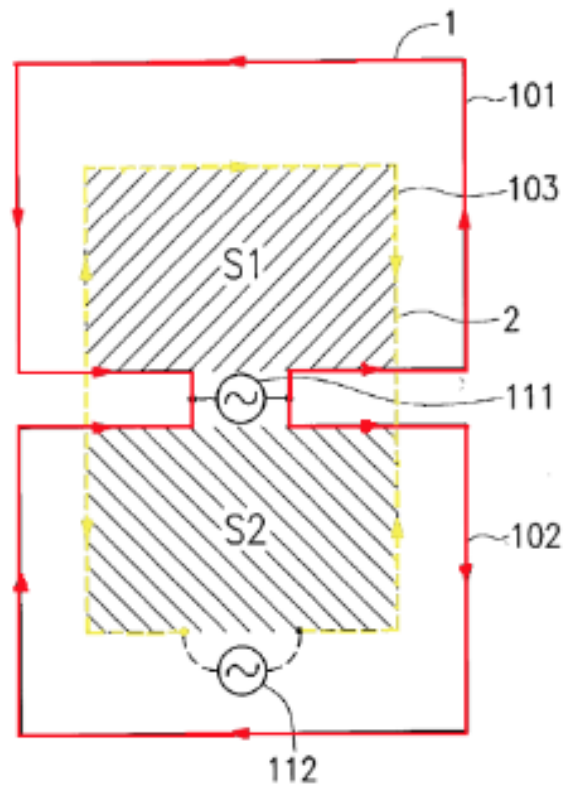
68. Taniguchi recognized a problem with the arrangement of transmission loop antennas shown in Figure 23. (INTEL-1005, ¶11.) Specifically, “many lines of magnetic flux make interlinkage with the transmission antennas 220, 221” (illustrated in red above) increasing the mutual inductance between the transmission antennas. (*Id.*) Because of this increased mutual inductance, “a part of the electric power supplied to transmission antenna 220 disadvantageously increases the remote electromagnetic-field intensity from the transmission antenna 221.” (*Id.*) Prior art systems addressed this problem by arranging antennas “with

particular distances therebetween so that mutual inductance between the antennas becomes small.” (INTEL-1005, ¶12.)

2. Taniguchi’s Layout of Transmission Loop Antennas

69. To obtain the benefit of multiple antennas and address the problem identified above when the antennas are overlapped, an object of Taniguchi “is to provide a radio guidance antenna **in which the sum of mutual inductances of antennas is small.**” (INTEL-1005, ¶14.) In the “preferred embodiment” illustrated in Figure 3 (reproduced below with annotations), Taniguchi discloses a layout having two antennas. (INTEL-1005, ¶¶25, 28-32, 55, 66-67.) A first antenna 1 (shaded red) “is provided by forming antenna conductors 101, 102 in a substantially figure eight shape, which reduces a remote electromagnetic-field effect.” (INTEL-1005, ¶55.) Antenna 1 “is supplied with electric power from a first feeding point 111.⁴” (INTEL-1005, ¶56.) The second antenna 2 (shaded yellow) “is composed of an antenna conductor 103 formed on the same plane as or a plane parallel to the plane on which the first antenna 1 is formed, but is not connected to the first antenna 1 at any point.” (INTEL-1005, ¶55.)

⁴ The arrows in Figure 3 indicate the direction of current at a certain point of time. (INTEL-1005, ¶56.)



Taniguchi, Annotated Figure 3

70. Taniguchi explains that “the directions of induced electromotive forces⁵ generated on the antenna 2 are such that induced current is caused to flow in the regions S1, S2 in opposite directions.” (INTEL-1005, ¶57.) When $S1/S2=1$ ($S1=S2$), “the induced electromotive force generated on the antenna 2 as a whole

⁵ Electromotive force is the voltage induced in an adjacent inductor by the magnetic field generated by a first inductor. (See §III.A.2.b (Background-Mutual Inductance).)

becomes zero.” (*Id.*) “That is, residual mutual inductances⁶ of the antenna 1 and the antenna 2 are put in a state of zero.” (*Id.*, *see also*, ¶¶61 (“residual mutual inductance $M=0$ is most preferable”), 63-65, 72, Figs. 4, 5.) A POSITA would understand that both antennas have equal residual mutual inductances because mutual inductance is reciprocal between two inductors. (*See* INTEL-1012, 68-70; *see also*, §III.A.2.b (background).)

71. Taniguchi discusses the “residual mutual inductance” of antenna 1 as the difference in value “between a first mutual inductance M_1 and a second mutual

⁶ In Taniguchi, the residual mutual inductance of antenna 1 is the total mutual inductance between antenna 1 and antenna 2. Because antenna 1 is eight-shaped with two loops (conductors 101 and 102), the residual mutual inductance is the sum of (i) the mutual inductance of conductor 101 (M_1) on antenna 2 and (ii) the mutual inductance of conductor 102 on antenna 2 (M_2). (*See* Taniguchi, ¶60; *see also*, Finkenzeller, 68 (Equation 4.13 (mutual inductance contributions for all segments in an inductor are combined to obtain total mutual inductance).) Because the current flows in opposite direction in conductors 101 and 102, one of the mutual inductances is negative which is why Taniguchi subtracts M_2 from M_1 in the equation in paragraph 60. I describe this further in this section.

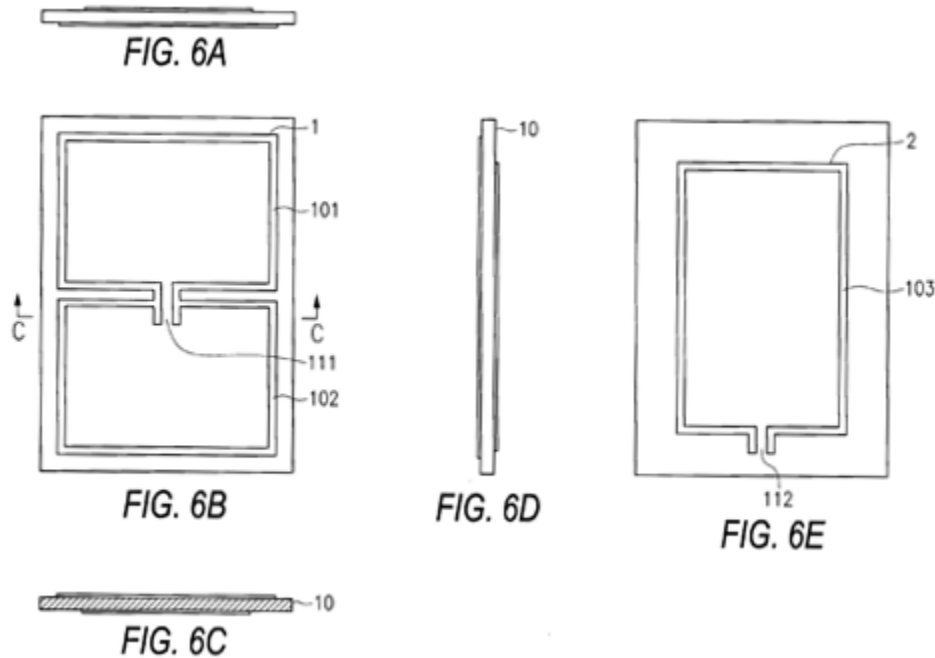
inductance M_2 ⁷, which generate opposite induced electromotive forces on the antenna 2 with electromagnetic induction from the antenna 1.” (INTEL-1005, ¶60.) That is, because conductors 101 and 102 of antenna 1 generate magnetic fields that have opposite directions at antenna 2, their generated magnetic fluxes are also opposite in polarity (i.e., one being positive and one being negative). Therefore, mutual inductances M_1 and M_2 are also opposite in polarity. Because M_1 and M_2 are opposite in polarity, the sum of the mutual inductances for an 8-shaped inductor equals the difference between the absolute values of M_1 and M_2 (i.e., $|M_1| - |M_2|$). (*Id.*) The difference (the “residual”) represents the remaining total mutual inductance (if any) from antenna 1 on antenna 2. The residual mutual inductance is therefore the total mutual inductance from antenna 1 onto antenna 2.

72. The total mutual inductance from antenna 1 to antenna 2 (i.e., M_{12}) and the total mutual inductance from antenna 2 to antenna 1 (i.e., M_{21}) are symmetrical with the following relationship: $M = M_{12} = M_{21}$. (See INTEL-1012, 68.)

⁷ That is, M_1 is the mutual inductance between antenna 1’s conductor 101 and antenna 2 and M_2 is the mutual inductance between antenna 1’s conductor 102 and antenna 2.

73. Taniguchi teaches that “a residual mutual inductance $M=0$ is most preferable.” (INTEL-1005, ¶61.) That is, the residual mutual inductance (i.e., the total mutual inductance M_{12}) from antenna 1 onto antenna 2 is zero. Because there is no residual mutual inductance (total mutual inductance M_{12}) from antenna 1 onto antenna 2, there is no residual mutual inductance (total mutual inductance M_{21}) from antenna 2 to antenna 1 because of the symmetrical relationship of mutual inductance. (*See* INTEL-1012, 68.)

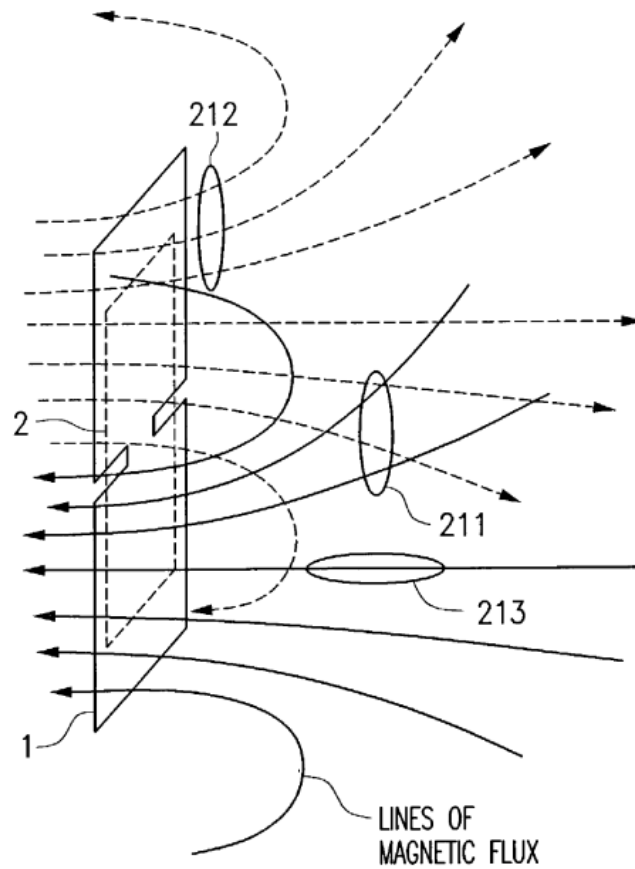
74. A construction of the antennas of Taniguchi’s Figure 3 is illustrated in Figures 6A-6E (reproduced below). (INTEL-1005, ¶66.) As shown, the feeding point 111 “is provided at a connection of the antenna conductors 101, 102” which are disposed on one of the main surfaces of insulation 10. (INTEL-1005, ¶67.) Conductor 103 is disposed on the other main surface. (*Id.*)



Taniguchi, Figures 6A-6E

75. The magnetic flux generated from an eight-shaped antenna (such as used in Figure 3 and its corresponding construction of Figure 6) is illustrated in Figure 4 below. (INTEL-1005, ¶¶63-64.) The lines of magnetic flux indicated by solid lines are generated by the lower loop and the lines of magnetic flux indicated by the broken lines are generated from the upper loop. (INTEL-1005, ¶64.) As shown in Figure 4 below, for tag 211, the lines of magnetic flux indicated by solid lines and the lines of magnetic flux indicated by broken lines, through tag 211, are substantially the same in number, equal in magnitude to each other, and “directed opposite to each other all the time.” (*Id.*) “Therefore, the induced electromotive

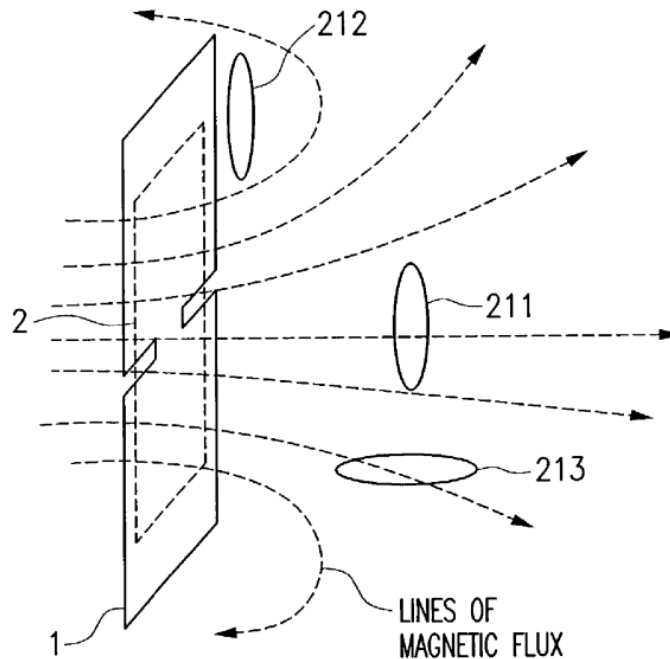
force generated on the tag 211 becomes substantially zero and so the tag 211 has difficulty remaining in continual communication with the antenna 1.” (*Id.*)



Taniguchi, Figure 4

76. The magnetic flux generated from antenna 2 is illustrated in Figure 5 below. (INTEL-1005, ¶¶63, 65.) As shown in Figure 5, many lines of magnetic flux from antenna 2 through tag 211 and tag 213, allowing for favorable communication between tags 211 and 213 and antenna 2. Thus, as a result of using multiple antennas arranged as shown in Figure 3 and its corresponding

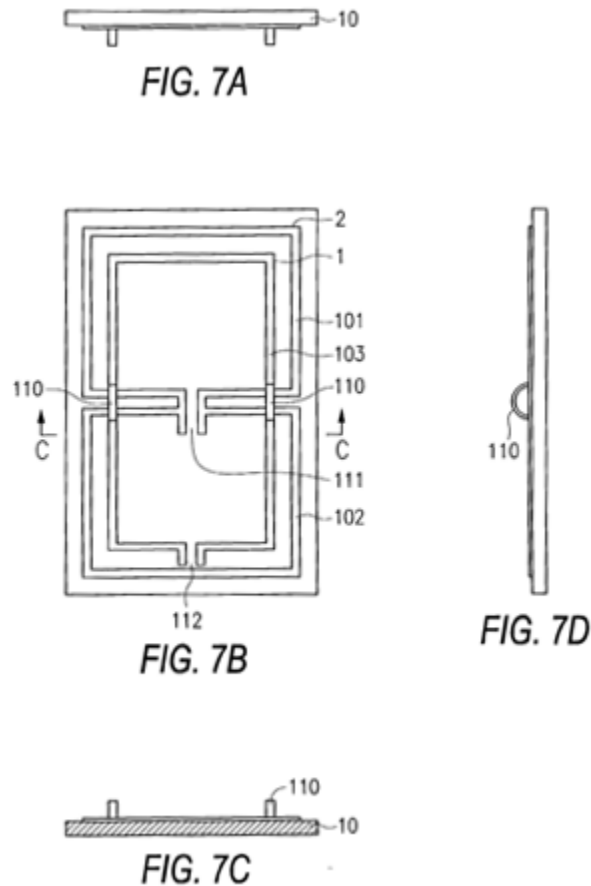
construction of Figure 6, favorable communication between the non-contact identification apparatus which acts as an interrogator (reader) and tags having a variety of orientations is achieved.



Taniguchi, Figure 5

77. Taniguchi presents several modifications to the antennas of Figure 3 and its construction shown in Figure 6. (INTEL-1005, ¶¶28-32, 69-77, Figures 6A-6E, 7A-7D, 8A-8E, 9, 10A-10E.) I therefore refer to the Figure 3/6 embodiment as the “base embodiment.” In the first modification, illustrated in Figures 7A to 7D (reproduced below), “antennas 1 and 2 are arranged on either of same planes of an insulation 10.” (INTEL-1005, ¶70; *see* INTEL-1005, ¶29 (“FIGS. 7A to 7D are

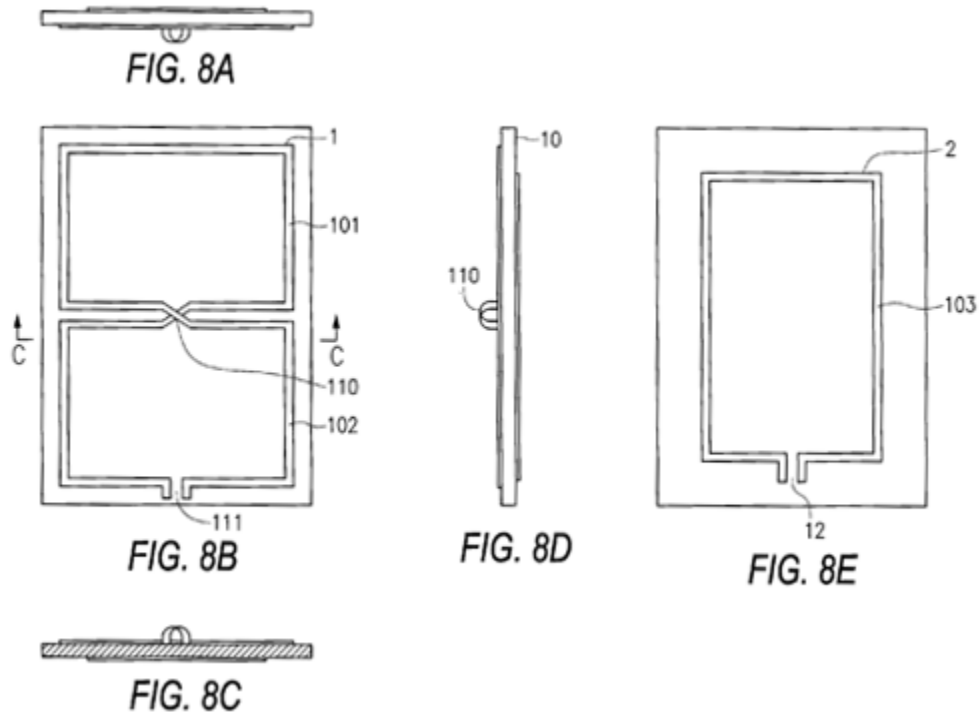
views showing another construction of the antenna shown in FIG. 3”).) That is, both antennas are either on the front plane or on the back plane. I refer to this embodiment herein as the “same plane” embodiment or Figure 7 embodiment.



Taniguchi, Figures 7A-7D

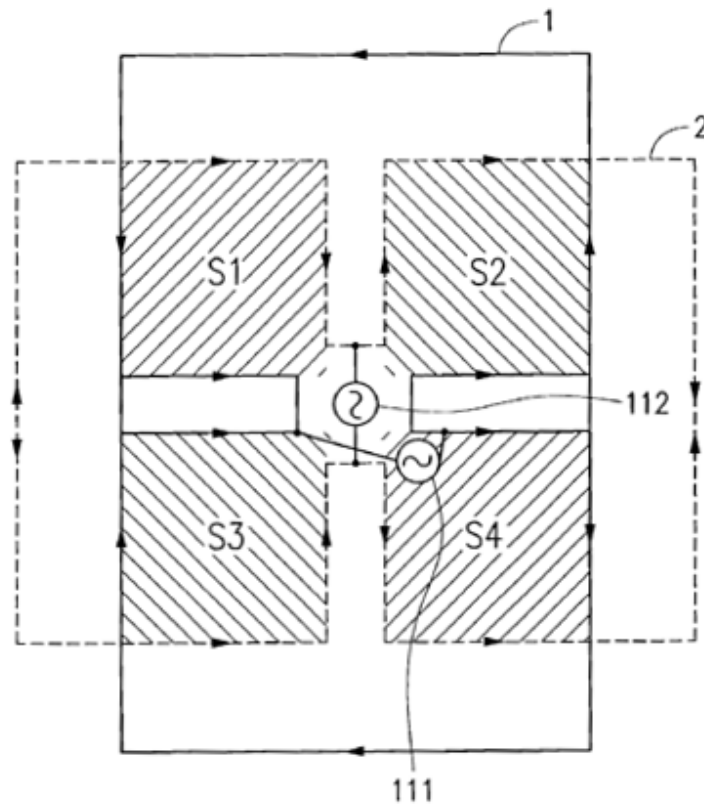
78. The second modified configuration, shown in FIGS. 8A to 8E (reproduced below), is “substantially the same in antenna configuration as that shown in FIG. 3 except that a first feeding point 111 and a second feeding point 12 are disposed on a lower side of an insulation 10.” (INTEL-1005, ¶72.) I note that

Figure 8 mislabels the second feeding point as 12 in Figure 8E. However, Taniguchi refers to this as feeding point 112 in the description (INTEL-1005, ¶72) and the other embodiments also label the feeding point of the second antenna as 112. I therefore refer to Figure 8's second feeding point as 112 consistent with the disclosures in the other embodiments. I refer to this embodiment as the lower feeding point embodiment or Figure 8 embodiment. The arrangement of Figure 8 “is realized by two-level crossing centers of the antenna 1 having a substantially figure eight-shaped region, thereby forming two regions which generate repulsive lines of magnetic flux on the antenna 1.” (*Id.*)



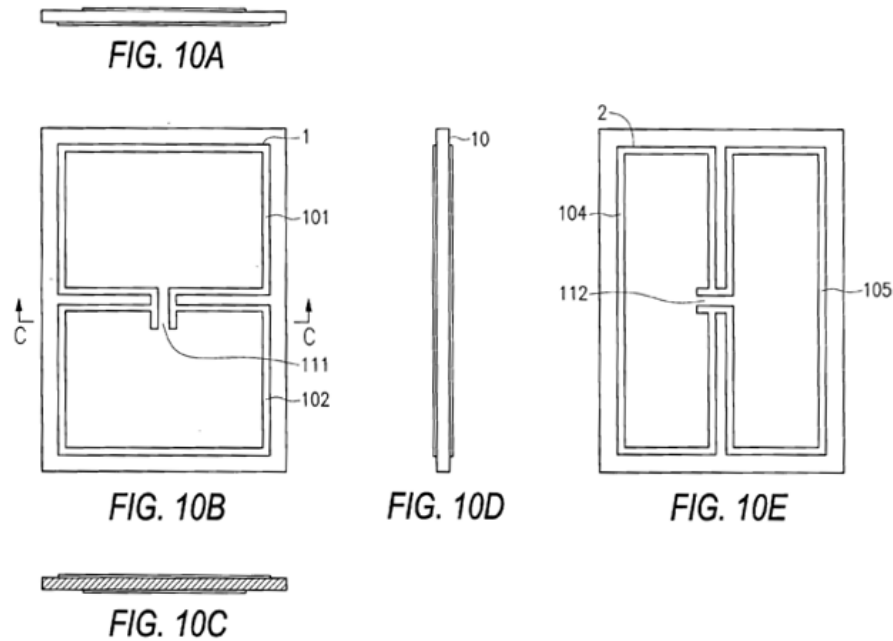
Taniguchi, Figures 8A-8E

79. In the example modification of Figure 9 (reproduced below), “antenna 1 is substantially figure eight-shaped in the same manner as that shown in FIG. 3” and “antenna 2 is turned 90° relative to the antenna 1.” (INTEL-1005, ¶73.) I refer to this embodiment as the rotated eight-shaped embodiment or Figure 9/10 embodiment. In this example, “antenna 1 and the antenna 2 overlap each other in regions S1, S2, S3 and S4.” (INTEL-1005, ¶74.) “If an increase in antenna current in directions shown by arrows is observed in the antenna 1, then mutual inductances attributable to the regions S1 to S4 generate induced electromotive forces in the antenna 2 tending to make antenna current flow in directions shown by arrows, respectively.” (*Id.*) “Directions of the induced electromotive forces are such that the regions S1, S2 generate an electromotive force in the antenna 2 tending to make antenna current flow in the same direction and the induced electromotive force attributable to the regions S3, S4 is opposite to the induced electromotive force attributable to the regions S1, S2.” (*Id.*) When regions $S1+S2=S3+S4$, “the residual mutual inductance becomes zero” and “the induced electromotive force generated on the antenna 2 by the antenna 1 becomes apparently zero.” (INTEL-1005, ¶75.)



Taniguchi, Figure 9

80. Figures 10A-10E, which I reproduce below, show “a more concrete structure of the antenna shown in FIG. 9.” (INTEL-1005, ¶76.) As shown, “antenna conductors 101, 102 are used to form an antenna 1 on one of main surfaces of an insulation 10 in a substantially figure eight-shaped configuration, and antenna conductors 104, 105 are used to form an antenna 2 on the other of the main surfaces of the insulation 10 in a substantially figure eight-shaped configuration, the antenna 2 being turned 90° relative to the antenna 1.” (INTEL-1005, ¶77.)



Taniguchi, Figure 10

B. Independent Claims.

81. Ground 1 challenges independent claims 1, 11, and 20. Claim 20 is directed to an “*inductor*” and claim 1 recites the “*inductor*” limitations of claim 20 and merely adds a “*a second inductor.*” Claim 11 recites overlapping subject matter with claim 1 with the primary difference being that (1) the preamble of claim 11 specifies that the first inductor and second inductor are “on a semiconductor die” and (2) claim 11 recites the apparatus limitations of claim 1 as method steps (e.g., “forming ...”, “orienting ...”, “connecting ...”, and “positioning ...”). However, as I noted in §III.E (Claim Construction), the ALJ in ITC-337-TA-1376 determined the preamble was not limiting except to the extent

needed to provide antecedent basis or meaning to the rest of the claim, and further indicated that it is not clear that the term “*on a semiconductor*” die in claim 11’s preamble is limiting. For ease of discussion, I start my analysis with broader claim 20.

1. Independent Claim 20

82. Taniguchi discloses three embodiments, the lower feeding point embodiment of Figure 8, the rotated eight-shaped embodiment of Figures 9/10, and the same plane embodiment of Figure 7, which independently render claim 20 obvious. I reproduce claim 20 below with labels.

[20P] An inductor having a reduced far field, comprising:

[20A] a first loop having a shape that is substantially symmetrical about a first predefined axis;

[20B.1] a second loop having a size and shape substantially identical to the first loop,

[20B.2] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and

[20C] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.

a. Preamble

[20P] <i>An inductor having a reduced far field</i>

83. Taniguchi's lower feeding point (Figure 8), rotated eight-shaped (Figures 9/10), and same plane (Figure 7) embodiments each discloses or renders obvious an "*inductor having a reduced far field*" [20P] to the extent this term is described in the '430 patent.

84. The '430 patent does not provide guidance regarding the bounds of the term "*reduced far field*." As I discussed in the claim construction section, the ALJ in the prior investigation ITC-337-TA-1300 construed the nearly identical term, "first inductor having a reduced far field" of claim 1 as "(reduced/reduce) the electromagnetic field at a certain distance from the first inductor (where the second inductor is positioned)." (*See* INTEL-1020, 19.) The statement from the specification and the ALJ's construction provide no description or insight into where the "far field" may be located, including because there are no bounds to the distance of the field from the inductor, or distance of the field between the inductor and position of any second inductor, for this limitation to be met. Regardless of what the boundaries of the "far field" may be, Taniguchi discloses this term to the extent that it is described in the '430 patent specification.

(i) Taniguchi's loop antennas are inductors.

85. As I explain below, Taniguchi's antenna 1 and antenna 2 both generate magnetic flux when a current flows through them and therefore are both

inductors. (*See, e.g.*, INTEL-1005, ¶¶15-16, 55-59, 63; INTEL-1021, 7:39-40.)

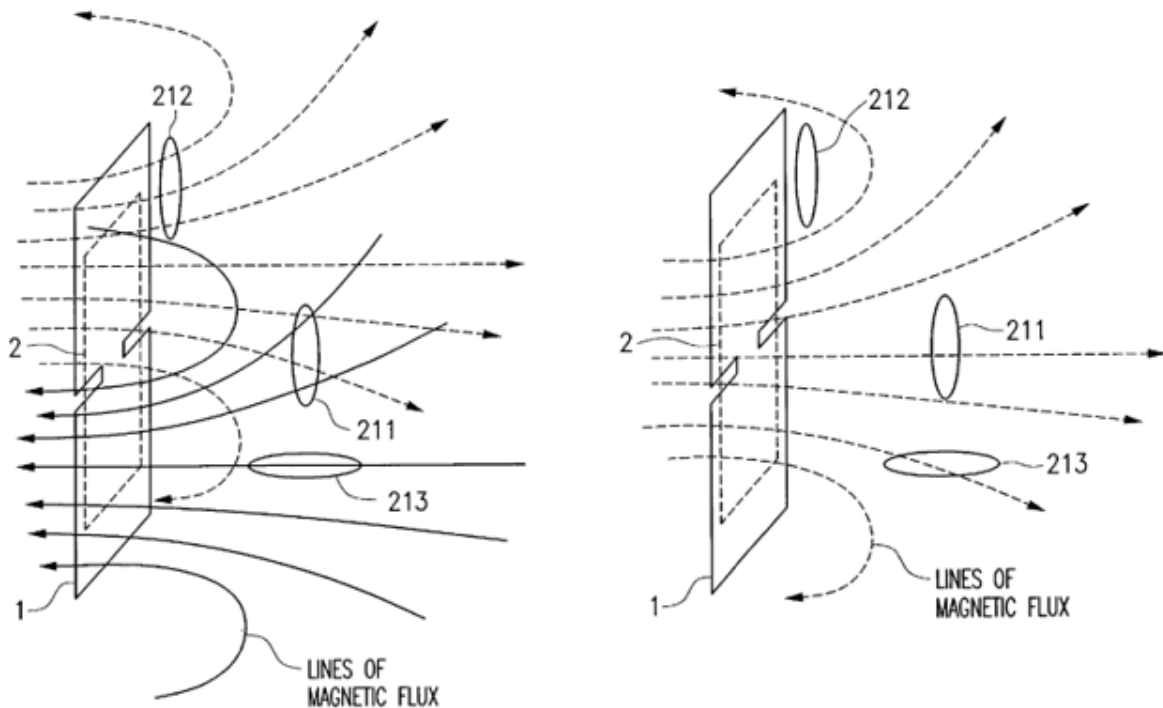
Every moving charge, i.e., flow of current, is associated with a magnetic field.

(INTEL-1012, 61.) In Taniguchi, the supply of electrical current into antennas 1 and 2 generate magnetic flux⁸. Specifically, electric power is supplied to first antenna 1 and “an increase in antenna current” for antenna 1 is observed. (INTEL-1005, ¶56.) Antenna 2 can similarly be “supplied with electric power.” (INTEL-1005, ¶58.) The electric currents in antennas 1 and 2 generate magnetic fields by converting “electric power supplied to the antennas [] to an electromagnetic field⁹.” (INTEL-1005, ¶59.) Taniguchi’s Figure 4 shows the magnetic field generated by antenna 1 as “lines of magnetic flux generated from the antenna 1” and Figure 5 shows the magnetic field generated by antenna 2 as “lines of

⁸ Magnetic field appears at an element as magnetic flux. (*See* INTEL-1005, ¶63; *see also*, § III.A.1 (Background).)

⁹ An electromagnetic field contains an electrical field and a magnetic field. (*See, e.g.*, INTEL-1010, 27 (“When a current flows along a wire or trace, it generates an electromagnetic field around the conductor” and “[t]here are two components to this electromagnetic field, an electrical field and a magnetic field”).)

magnetic flux generated from the antenna 2.” (INTEL-1005, ¶¶15-16, 55-59, 63; *see*, INTEL-1021, 7:39-40; *see also*, § III.A.1 (Background).) In fact, Taniguchi’s non-contact identification system relies on the magnetic flux generated by the antennas for communication with tags. (*See, e.g.*, INTEL-1005, ¶¶1, 15, 63-65.)



Taniguchi, Figure 4 (left), Figure 5 (right)

86. Taniguchi’s antenna 1 and antenna 2 are part of a “non-contact identification apparatus”, illustrated in Figure 1 (reproduced below). (INTEL-1005, ¶47.) A controller in the non-contact identification apparatus functions “as an interrogator for reading and writing data into a storage circuit 62 of a tag 6.” (*Id.*) I therefore also refer to the non-contact identification apparatus as an “interrogator.”

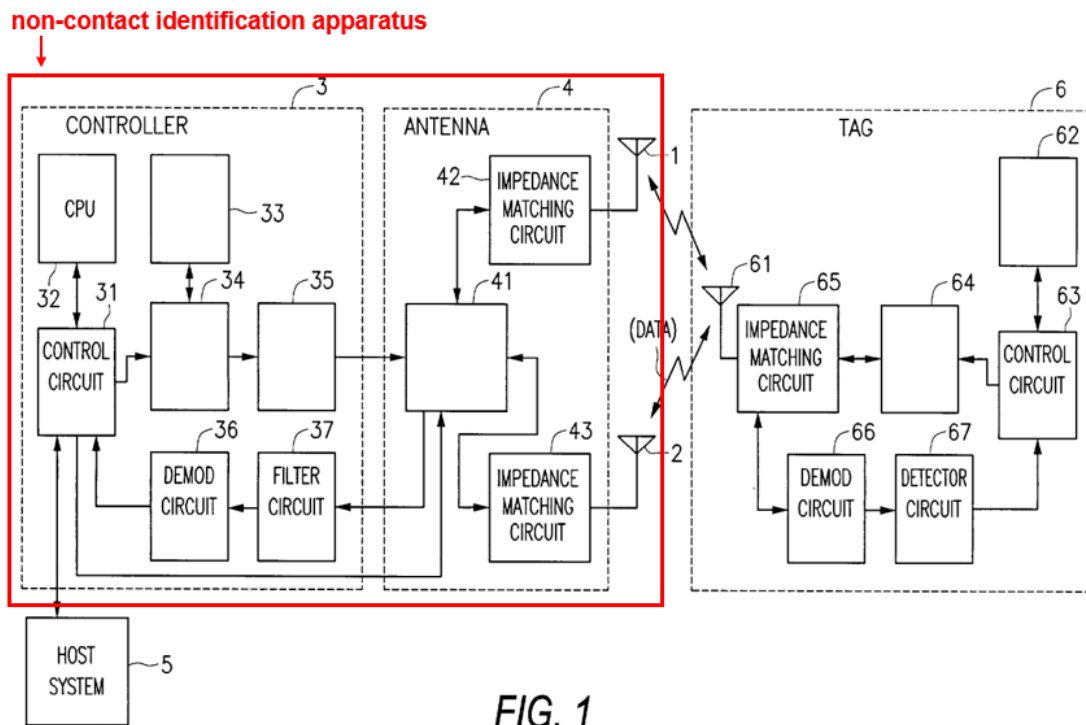


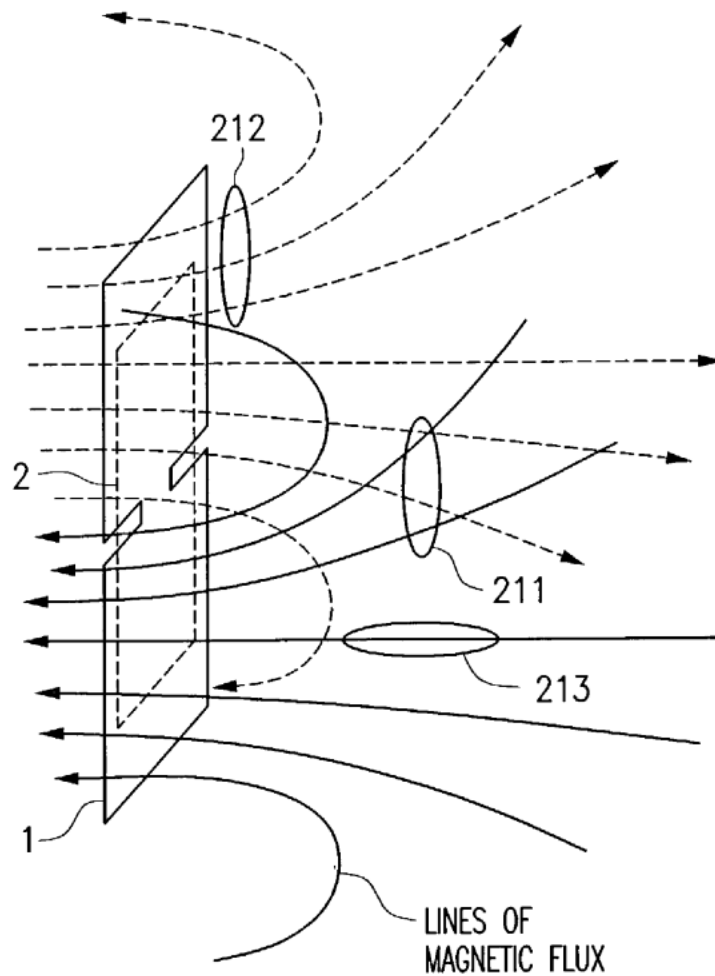
FIG. 1

Taniguchi, Annotated Figure 1

87. The reading and writing operations of the non-contact identification system described in Taniguchi use the principle of inductive coupling. (See INTEL-1005, ¶¶16, 49-50, Abstract, Figure 1.) Tag antenna 61 “and the antenna 1 or 2 of the non-contact identification apparatus are coupled to each other via **mutual inductance**, so that when the impedance of the antenna 61 of the tag 6 is changed, the antenna impedance on the side of the non-contact identification apparatus changes.” (INTEL-1005, ¶50; See §III.A.2.b (Background-Mutual Inductance).) Specifically, to communicate data to the interrogator, the control circuit of the tag changes the impedance of the tag antenna 61 with the modulation

circuit 64. (INTEL-1005, ¶50.) This causes the antenna impedance on the non-contact identification apparatus to change. (*Id.*)

88. Each embodiment of Taniguchi's non-contact identification system uses an eight-shaped antenna for antenna 1. (*See* INTEL-1005, ¶¶29-32, 63, 69-77, Figures 3, 6-10.) The eight-shaped antenna 1 in Taniguchi's non-contact identification system is an "*inductor*." Taniguchi explains that an eight-shaped antenna generates a magnetic field which appears as magnetic flux. (INTEL-1005, ¶26, 63-64.) Specifically, as shown in Figure 4 below, "lines of magnetic flux indicated by solid lines are ones generated from a lower loop among two upper and lower loops of the antenna 1, and lines of magnetic flux indicated by broken lines are ones generated from the upper loop." (INTEL-1005, ¶64.) In the example of Figure 4, the "lines of magnetic flux indicated by solid lines and the lines of magnetic flux indicated by broken lines, which are substantially the same in number, make interlinkage with a tag 211, and the lines of magnetic flux indicated by solid lines and the lines of magnetic flux indicated by broken lines, which make such interlinkage, are equal in magnitude to each other and directed opposite to each other all the time." (*Id.*)



Taniguchi, Figure 4

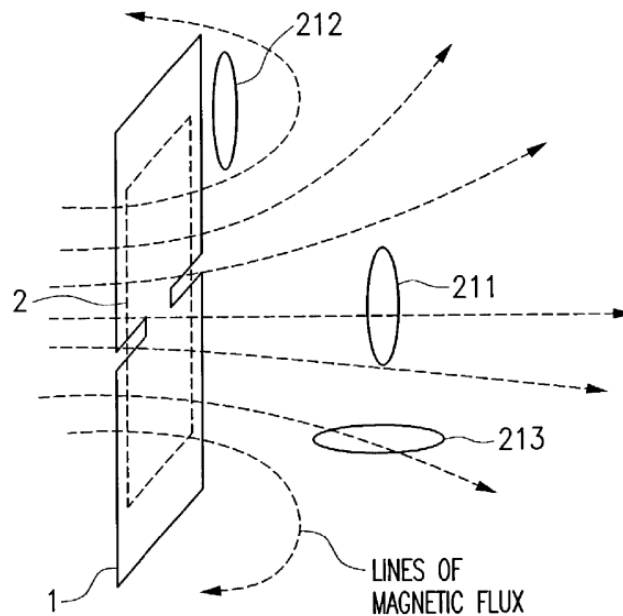
89. For tag 211, “the induced electromotive force generated on the tag” by antenna 1 “becomes substantially zero and so the tag 211 has difficulty remaining in continual communication with the antenna 1.” (INTEL-1005, ¶64.) However, “tag 212 makes interlinkage with many lines of magnetic flux indicated by broken lines” and therefore “can favorably make communication with the antenna 1.” (*Id.*) Because Taniguchi’s antenna 1 generates magnetic flux used to communicate

inductively with tags, Taniguchi's eight-shaped antenna 1 is an "*inductor*." (*See also, e.g.,* INTEL-1005, ¶¶63, 96 ("data are sent to the tag from one of the first and second antennas with **electromagnetic induction**, and the other of the first and second antennas receives data sent from the tag with **electromagnetic induction**").)

90. Taniguchi uses an eight-shaped inductor as the first inductor in the lower feeding point (Figure 8) embodiment, the rotated eight-shaped (Figures 9/10) embodiment and the same plane (Figure 7) embodiment. (*See* INTEL-1005, Figures 7-10, ¶¶29 (linking Figure 7 to Figure 3), 30 (linking Figure 8 to Figure 3), 73 (linking Figure 9 to Figure 3), 76 (linking Figure 10 to Figure 9), 63 (linking Figures 4-5 to Figure 3).) Thus, the eight-shaped inductor in each of these embodiments is an "*inductor*."

91. Antenna 2 in each of these embodiments is also an "*inductor*." Taniguchi's Figure 5, reproduced below, illustrates **magnetic flux** (dashed lines) associated with the electromagnetic field generated from a rectangular loop antenna 2 used to communicate inductively with tags. (INTEL-1005, ¶¶27, 29-30, 63, 65 ("many lines of magnetic flux make interlinkage with the tag 211 and the tag 213" allowing favorable communication with the antenna 2), 69-72.) The same plane embodiment of Figure 7 and lower feeding point embodiment of Figure 8

each use the rectangular loop antenna of Figure 5 and therefore antenna 2 in these embodiments is an “inductor.” (See INTEL-1005, Figures 7-8; ¶¶29 (relating Figure 7 to Figure 3), 30 (relating Figure 8 to Figure 3), 27 (relating Figure 5 to Figure 3).)



Taniguchi, Figure 5

92. The rotated eight-shaped antenna (Figures 9/10) embodiment uses an eight-shaped antenna, rotated by 90 degrees, for antenna 2. (See INTEL-1005, Figures 9-10; ¶¶ 29-32, 58, 73, 76-77.) The magnetic flux for an eight-shaped antenna is shown in Figure 4. A POSITA would understand Figure 4 is applicable to eight-shaped antenna 2 of Figures 9/10 because the shape and flow of current is identical. Because Taniguchi’s antenna 2 generates magnetic flux when a current is

applied in the same manner as described in Taniguchi's Figure 4 and this magnetic flux is used to communicate inductively with tags, the rotated eight-shaped antenna 2 is also an "*inductor*." (*See also, e.g.,* INTEL-1005, ¶¶27, 29-30, 63, 65, 69-72, 96 ("data are sent to the tag from one of the first and second antennas with **electromagnetic induction**, and the other of the first and second antennas receives data sent from the tag with **electromagnetic induction**"); *see also, § III.A.2* (Background).)

93. Further, loop antennas, particularly those used in inductive coupling identification applications, are understood to be inductors. For example, U.S. Patent 5,345,231 to Koo ("Koo"; INTEL-1022), published a decade before the '430 patent, uses an inductor as the antenna coil for the sending-and-receiving station in a contactless data transmission system using inductive coupling. (*See, e.g.,* INTEL-1022, Figure 1 (illustrating antenna coil 8 as an inductor), 2:42-45, 2:54-59, 2:63-68, 5:47-6:2, 6:31-39, 7:7-9, claim 9 ("said inductor is an antenna").) Koo's sending-and-receiving station is akin to Taniguchi's non-contact identification apparatus. As a further example, U.S. Patent 6,533,178 to Gaul et al. ("Gaul") models a loop antenna 6 of a data transceiver 1 of a contactless identification system as an inductor. (*See* INTEL-1021, 1:14-26, 6:51-58, 7:39-40 ("antenna [] is modeled as an inductor L"); Figures 1, 2a.) I further note that this

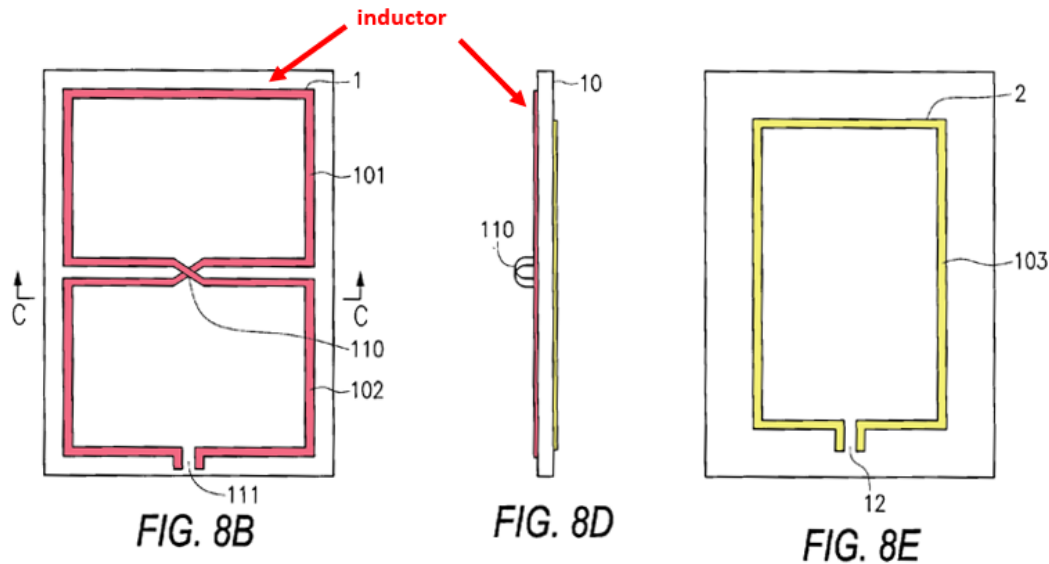
understanding is consistent with the understanding applied by the EP Examiner during prosecution of EP3567614, finding an antenna in an inductive coupling system (FR-Acher) was an inductor, as I discussed in §III.C.2.b. Applicant (PO) in that proceeding did not traverse the Examiner's understanding.

(ii) Lower Feeding Point (Figure 8) Embodiment discloses the preamble.

94. The lower feeding point (Figure 8) embodiment includes an eight-shaped antenna, like that of Figure 3. (*See* INTEL-1005, ¶30 (“FIGS. 8A to 8E are views showing another modification of the antenna shown in FIG. 3”).) The eight-shaped antenna (shaded red below) and the loop antenna (shaded yellow) of the lower feeding point embodiment are “inductors” for the reasons I discussed above. (INTEL-1005, ¶72 (“examples shown in FIGS. 8A to 8E **are substantially the same in antenna configuration as that shown in FIG. 3** except that a first feeding point 111 and a second feeding point 112 are disposed on a lower side of an insulation 10”); INTEL-1005, ¶26 (“FIG. 4 is a view showing only lines of magnetic flux generated from the antenna 1 shown in FIG. 3 at a certain point of time”).)

95. An eight-shaped antenna (antenna 1; shaded red) has a “*reduced far field*” to the extent it is described in the ’430 patent specification. Antenna 1 of the lower feeding point (Figure 8) embodiment (illustrated in Figures 8B, 8D, and 8E

below) “is realized by two-level crossing centers of the antenna 1 having a substantially figure eight-shaped region, **thereby forming two regions which generate repulsive lines¹⁰ of magnetic flux.**” (INTEL-1005, ¶72.)



Taniguchi, Annotated Figures 8B, 8D-8E

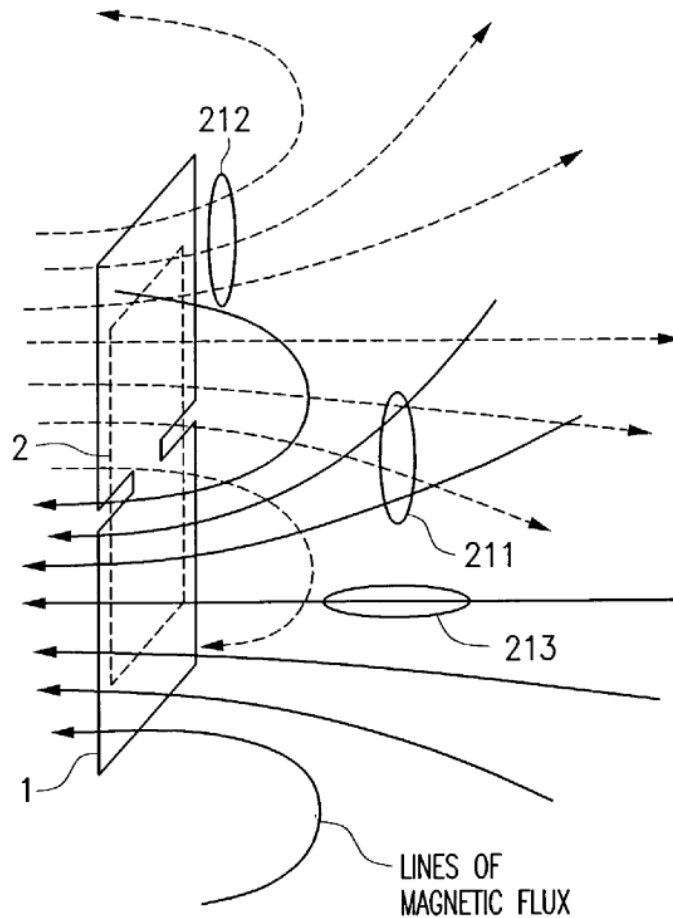
96. By virtue of its configuration, the eight-shaped antenna “reduces a remote electromagnetic-field effect.” (INTEL-1005, ¶¶29-32, 55, 59 (“electric power supplied to the antennas can be converted to an electromagnetic field with high efficiency and a plurality of antennas can be installed, while the **remote**

¹⁰ Taniguchi’s reference to “repulsive lines” reflects the disclosure that magnetic flux is equal and opposite for the two conductors of the eight-shaped antenna. (INTEL-1005, ¶64.)

electromagnetic-field intensity is also controlled at an exceedingly low level”), 69-73, 76-77, 94 (“the remote electromagnetic-field intensity is much suppressed by the figure eight-shaped antenna”), 95 (explaining that the disclosed antenna layouts “enable[] electric power to be efficiently converted to electromagnetic field with a simple construction and **a remote electromagnetic-field intensity can also be suppressed to be small**”).) More specifically, the electromagnetic (“EM”) field components generated by the two loops in Taniguchi’s eight-shaped antenna have opposite directions.

97. This is illustrated in Figure 4 (below) showing the flux lines of the magnetic field generated by loop 101 and loop 102 of antenna 1 which flow through antenna 2 as equal and opposite. (INTEL-1005, ¶¶48 (“waves are discharged into the air as an electromagnetic field from [] antenna 1”), 63 (flux lines indicate the “appearance of a magnetic field”), 64 (“the lines of magnetic flux indicated by solid lines and the lines of magnetic flux indicated by broken lines ... are equal in magnitude to each other and directed opposite to each other all the time”).) As a result, the field components from the two loops counteract each other, and thus, the electromagnetic field emanating from antenna/inductor 1 is reduced. (*See, e.g.*, INTEL-1010, 157 (teaching that when fields have opposite phase or polarity, “they tend to cancel”), 27 (“[t]here are two components to this

electromagnetic field, an electrical field and a magnetic field”); INTEL-1005,
¶¶57-59, 73-75.)



Taniguchi, Figure 4

98. These equal and opposite magnetic fields generated by eight-shaped antenna 1 result in reduced mutual inductance between antenna 1 and antenna 2. As described in the context of Figure 3, the placement of antenna 2 relative to antenna 1 is “such that induced current [caused by the magnetic fields of antenna 1] is caused to flow in the regions S1, S2 in opposite directions.” (INTEL-1005,

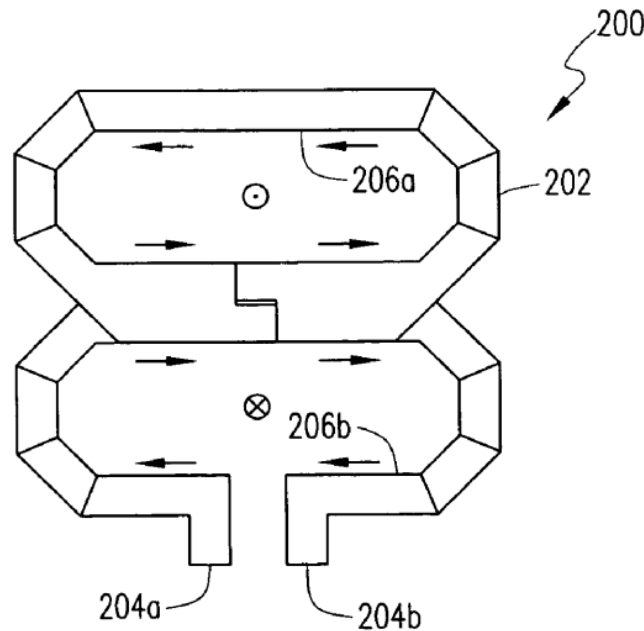
¶57.) “[I]n the case of $S1/S2=1$ ($S1=S2$), the induced electromotive force¹¹ generated on the antenna 2 as a whole becomes zero. That is, residual mutual inductances of the antenna 1 and the antenna 2 are put in a state of zero.” (*Id.*)

99. Taniguchi’s disclosure is also consistent with the limited discussion in the ’430 patent of “reduced far field”. When describing exemplary inductor 200 of Figure 2 (below), the ’430 patent states:

By virtue of the figure-8 shape, current in the upper loop 206 a travels in a direction (e.g., counterclockwise, see arrows) that is opposite to current in the lower loop 206 b (e.g., clockwise). **As a result**, the **EM field components emanating at a certain distance from the two substantially symmetrical loops 206a and 206b also have opposite directions and tend to counteract each other**. The directions of the EM field components are indicated by conventional notation in the middle of each loop 206a and 206b. **Consequently, the inductor 200 has been found to have a significantly reduced far field** at a certain distance from the inductor coil 202. Thus, by making the two loops 206a and 206b substantially symmetrical, cancellation of a significant amount of far field on either side of the horizontal symmetry axis X may be achieved.

(INTEL-1001, 4:10-25.)

¹¹ The electromotive force is the voltage induced in antenna 2 by the magnetic field generated by antenna 1. (See §III.A.2.b (Background).) The electromotive force is zero in this instance because the magnetic field (flux) for the two conductors of antenna 1 are equal and opposite.



'430 Patent, Figure 2

100. Should a similar construction as claim 1 from ITC-337-TA-1300¹² be adopted in this proceeding, Taniguchi's lower feeding point (Figure 8) embodiment discloses the preamble. Specifically, as I discussed above, the magnetic field component of the electromagnetic field emanating from the first antenna/inductor is reduced at the distance from the first antenna/inductor where

¹² As I discussed in §III.E, the ALJ determined in ITC-337-TA-1300 that the term "*a first inductor having a reduced far field*" of claim 1 should be construed as "(reduced/reduce) the electromagnetic field at a certain distance from the first inductor (where the second inductor is positioned)."

the second antenna/inductor is positioned by virtue of its figure-8 shape in which the two loops generate counteracting magnetic flux. As I mentioned above, Taniguchi stresses its figure-8 shape antenna allows for “remote electromagnetic-field intensity” to be “suppressed to small.” (INTEL-1005, ¶¶94-95.) Taniguchi discloses that antenna 2 is on the opposite side of insulation 10 which is a “certain distance” from antenna 1. (See INTEL-1005, ¶¶55, 77, Figure 8D, 10D.) This is further consistent with Applicant’s (PO’s) statement during prosecution of EP3567614 when addressing the Examiner’s rejection regarding lack of support: “it is submitted that the root parent application as filed does not mandate any particular distance or relative orientation of the two inductors.” (INTEL-1016, 59.)

101. Thus, the lower feeding point embodiment (Figure 8) discloses “*an inductor having a reduced far field*” [20P] to the extent disclosed in the ’430 patent and/or under the ITC-337-TA-1300 construction of “*far field*.”

(iii) Rotated Eight-Shaped (Figures 9/10) Embodiment discloses the preamble.

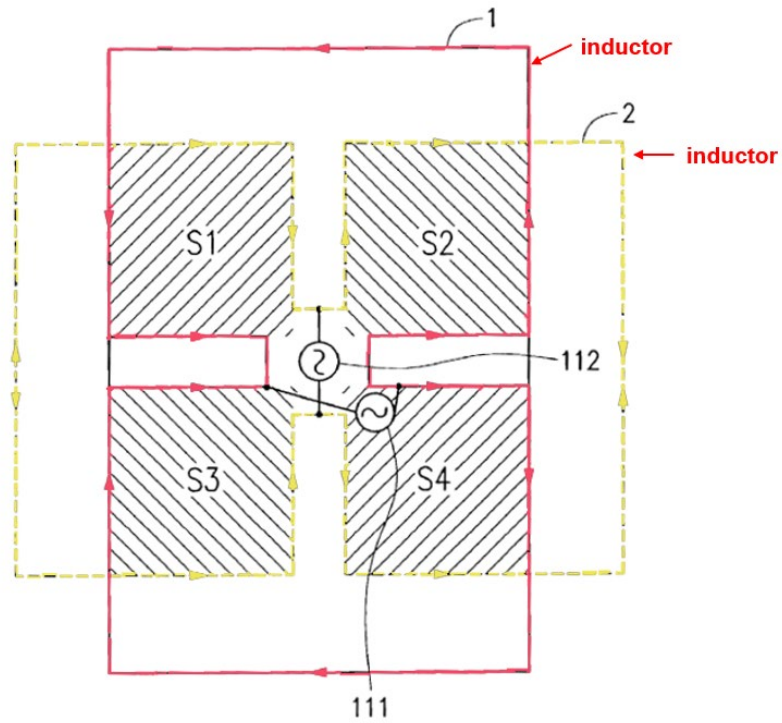
102. The rotated eight-shaped (Figures 9/10) embodiment uses an eight-shaped antenna with a center feeding point, like the eight-shaped antenna of Figure 3. (INTEL-1005, ¶73 (In the example provided in Figure 9 (which I reproduce below), “antenna 1 [shaded red] is substantially figure eight-shaped **in the same manner as that shown in FIG. 3**” and “antenna 2 [shaded yellow] is turned 90°

relative to the antenna 1”); INTEL-1005, ¶26 (“FIG. 4 is a view showing only lines of magnetic flux generated from the antenna 1 shown in FIG. 3 at a certain point of time”); *see also*, INTEL-1005, ¶¶76-77.) The eight-shaped antenna 1 and the eight-shaped antenna 2 in the rotated eight-shaped inductor embodiment are each an “inductor” for the reasons I discussed above.

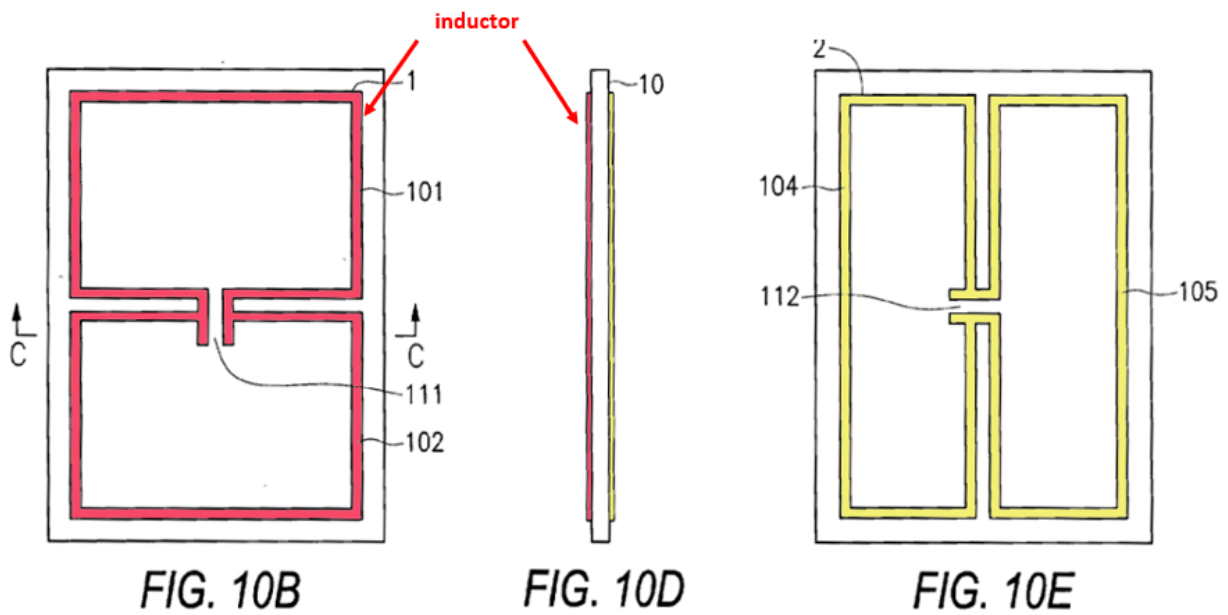
103. As I discussed in § IV.B.1.a.ii (lower feeding point embodiment), an eight-shaped antenna has a “*reduced far field*” to the same extent disclosed in the ’430 patent specification. This reduced electromagnetic field in turn results in zero residual mutual inductance between the antennas. Specifically, in this embodiment, the placement of antenna 2 relative to antenna 1 creates regions S1-S4 such that $S1+S2=S3+S4$ (which is illustrated in Figure 9) and “the **residual mutual inductance**¹³ **becomes zero** and so the induced electromotive force generated on the antenna 2 by the antenna 1 becomes apparently zero.” (INTEL-1005, ¶¶74, 75, 59 (“electric power supplied to the antennas can be converted to an electromagnetic field with high efficiency and a plurality of antennas can be

¹³ As I discussed in §IV.A, the residual mutual inductance of antenna 1 is the total mutual inductance of antenna 2 due to antenna 1; the residual mutual inductance of antenna 2 is equal to the residual mutual inductance of antenna 1.

installed, while the **remote electromagnetic-field intensity is also controlled at an exceedingly low level**”), 95 (explaining that the disclosed antenna layouts “enable[] electric power to be efficiently converted to electromagnetic field with a simple construction and **a remote electromagnetic-field intensity can also be suppressed to be small**”).) Thus, for these reasons and the reasons I discussed above for an eight-shaped antenna of the lower feeding point (Figure 8) embodiment, the electromagnetic field emanating from antenna/inductor 1 is reduced by virtue of its configuration in which the two loops generate counteracting electromagnetic fields, consistent with the disclosure of the ’430 patent. This results in zero residual mutual inductance between antenna 1 and 2, as discussed above.



Taniguchi, Annotated Figure 9



Taniguchi, Annotated Figure 10

104. Should a similar construction as claim 1 from ITC-337-TA-1300 be adopted in this proceeding, Taniguchi's rotated eight-shaped (Figures 9/10) embodiment discloses the preamble. Specifically, as I discussed above, the electromagnetic field emanating from the first antenna/inductor is reduced at the distance from the first antenna/inductor where the second antenna/inductor is positioned. Taniguchi discloses that antenna 2 is on an opposite side of insulation 10 which is a "certain distance" from antenna 1. (*See* INTEL-1005, Figure 10D; ¶55 (describing that antennas can be placed on parallel planes).) This is further consistent with Applicant's (PO's) statement during prosecution of EP3567614 when addressing the Examiner's rejection regarding lack of support: "it is submitted that the root parent application as filed does not mandate any particular distance or relative orientation of the two inductors." (INTEL-1016, 59.)

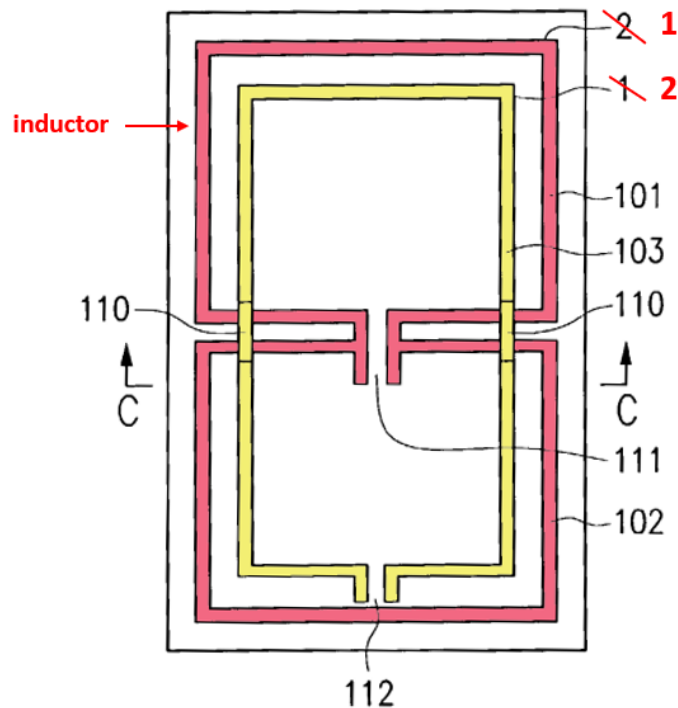
105. Thus, the rotated eight-shaped (Figures 9/10) embodiment discloses "*an inductor having a reduced far field*" [20P] to the extent disclosed in the '430 patent and/or under the ITC-337-TA-1300 construction of "*far field*."

(iv) Same Plane (Figure 7) Embodiment¹⁴ discloses the preamble.

106. The same plane (Figure 7) embodiment uses an eight-shaped antenna (shaded red) with a center feeding point and a loop antenna (shaded yellow), like the antennas of Figure 3. (INTEL-1005, ¶29 (“FIGS. 7A to 7D are views showing **another construction of the antenna shown in FIG. 3**”); INTEL-1005, ¶26 (“FIG. 4 is a view showing only lines of magnetic flux generated from the antenna 1 shown in FIG. 3 at a certain point of time”).) The eight-shaped antenna (misabeled as 2 in Figure 7) and the loop antenna (misabeled as 1) in the same plane embodiment are each an “inductor” for the reasons I discussed in §IV.B.1.a.i. For the reasons I discussed above for the eight-shaped antenna of the lower feeding point (Figure 8) embodiment and the rotated eight-shaped (Figures 9/10) embodiment, the electromagnetic field emanating from antenna/inductor 1 (the recited “*inductor*”) is reduced. Thus, same plane embodiment (Figures 7) also

¹⁴ Figure 7 includes typographical errors. Conductor 103 is labeled antenna 1 in the Figure but identified as antenna 2 in the description. (See INTEL-1005, ¶70.) Similarly, conductors 101 and 102 are labeled antenna 2 in the Figure but identified as antenna 1 in the description. In my analysis, I refer to conductor 103 as antenna 2 and conductors 101/102 collectively as antenna 1.

discloses “an inductor having a reduced far field” [20P] to the extent disclosed in the ’430 patent specification.



Taniguchi, Annotated Figure 7

107. Should a similar construction as claim 1 from ITC-337-TA-1300 be adopted in this proceeding, Taniguchi’s same plane embodiment discloses the preamble. Specifically, for the reasons I discussed above for the eight-shaped antenna of the lower feeding point (Figure 8) embodiment and rotated eight-shaped (Figures 9/10) embodiment, the electromagnetic field emanating from the 8-shaped inductor is reduced at the distance from the first antenna/inductor where the second antenna/inductor is positioned by virtue of antenna 1’s configuration in which the

two loops generate counteracting electromagnetic fields. Therefore, the electromagnetic field is reduced even when the second antenna/inductor is positioned in the same plane as the antenna 1. Antenna 2 is placed within and concentric with antenna 1 such that the two antennas share common horizontal, vertical, and z- axes. Each side of antenna 2 is therefore a certain distance from each sides of antenna 1 and the field is reduced by virtue of this placement. Thus, the same plane (Figure 7) embodiment discloses “*an inductor having a reduced far field*” [20P] to the extent disclosed in the ’430 patent and/or under the ITC-337-TA-1300 construction of “*far field*.”

b. “First loop” and “Second loop” limitations [20A]-[20B]

[20A] *a first loop having a shape that is substantially symmetrical about a first predefined axis*

[20B.1] *a second loop having a size and shape substantially identical to the first loop,*

[20B.2] *said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop*

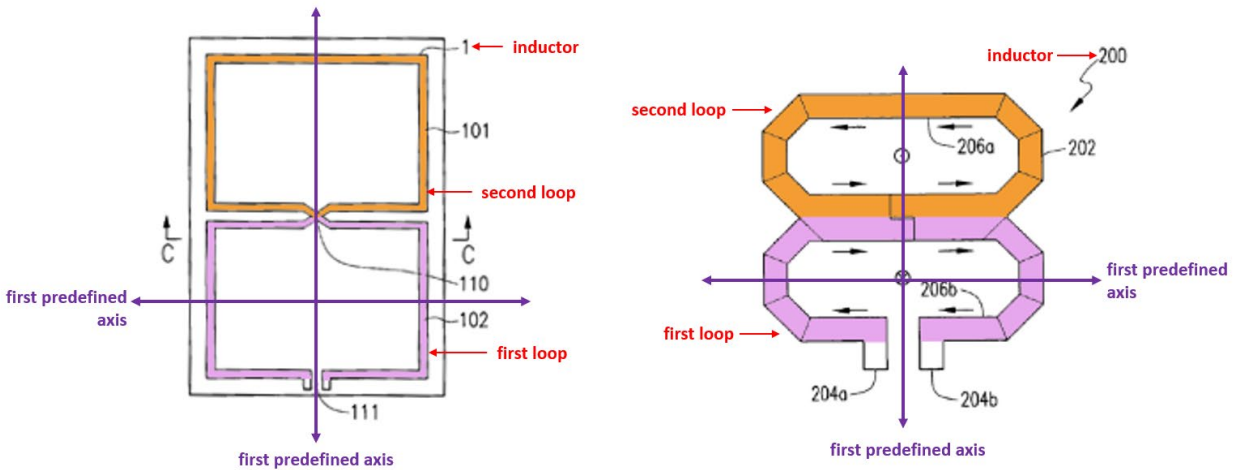
108. The ’430 patent does not provide guidance as to the scope of the term “*a first loop having a shape that is substantially symmetrical about a first predefined axis*” [20A] because it does not describe the boundaries of “*substantially*.” However, the lower feeding point (Figure 8) embodiment, the rotated eight-shaped (Figures 9/10) embodiment, and the same plane (Figure 7)

embodiment each discloses this limitation to the same extent it is described in the '430 patent.

109. The '430 patent also does not provide guidance as to the scope of the term “*a second loop having a size and shape substantially identical to the first loop*” [20B.1] because it does not describe the boundaries of “*substantially*.” However, the lower feeding point (Figure 8) embodiment, the rotated eight-shaped (Figures 9/10) embodiment, and the same plane (Figure 7) embodiment each discloses this limitation to the same extent it is described in the '430 patent.

(i) Lower Feeding Point (Figure 8) Embodiment

110. As explained for the configuration of Figure 3, antenna 1 is “provided by forming antenna conductors 101, 102 in a substantially figure eight shape.” (INTEL-1005, ¶55 (antenna 1 “is divided into upper and lower halves by the antenna conductors 101, 102”); *see also*, INTEL-1005, ¶72 (associating the embodiment of Figure 8 with Figure 3).) Antenna conductor 102 (shaded pink), illustrated in Figure 8B below left, is a “*first loop*” and conductor 101 (shaded orange) is a “*second loop*.” (See INTEL-1005, ¶¶63-64 (describing that antenna 1 of Figure 3 has “upper and lower loops”); 94 (“two loops defin[e] the 8-shape”).)



Taniguchi, Annotated Fig. 8B (left); '430 Patent, Annotated Fig. 2 (right)

111. As shown in annotated Figure 8B above, conductor 102 (“*first loop*”) is symmetric about the vertical axis (“*a first predefined axis*”). Because it is symmetric, it is necessarily “*substantially symmetric*[].” Accordingly, Taniguchi discloses that conductor 102 of the lower feeding point (Figure 8) embodiment has “*a shape that is substantially symmetrical about*” a vertical axis (“*a first predefined axis*”) [20A], regardless of the boundaries of “*substantially*.”

112. Alternatively, Taniguchi’s conductor 102 also has symmetry about the horizontal axis except for the presence of terminals at bottom. However, Taniguchi’s structure is consistent with the structure for Figure 2 in the ’430 patent (above right). The ’430 patent states that “by making the two loops 206a and 206b substantially symmetrical, cancellation of a significant amount of far field on either

side of the horizontal symmetry axis X may be achieved.” (INTEL-1001, 4:22-25.) The ’430 patent notes that “perfect symmetry between the two loops 206a and 206b may be difficult to achieve given the presence of the terminals 204a and 204b.” (INTEL-1001, 4:25-27.) Thus, consistent with the disclosure of the ’430 patent regarding a “substantially symmetrical” loop, conductor 102 (“*first loop*”) also has “*a shape that is substantially symmetrical about*” a horizontal axis (“*a first predefined axis*”) [20A].

113. Conductor 101 (“*second loop*”; shaded orange) has a rectangular shape with the same size as the rectangular conductor 102, as illustrated in Taniguchi, Figure 8B above. Taniguchi teaches that conductors 101 and 102 have the same size and shape, describing that the first antenna 1 “is divided into upper and lower **halves** by the antenna conductors 101, 102.” (INTEL-1005, ¶55.) By virtue of having the same size and shape, the two conductors generate magnetic fields that “are equal in magnitude to each other and directed opposite to each other all the time.” (INTEL-1005, ¶¶55, 64.) Because the same current flows through both conductors, if the size and/or shape of one conductor differed from the other, the fields would no longer be equal. Consistent with the disclosure of the ’430 patent that perfect symmetry is difficult to achieve due to the presence of terminals (INTEL-1001, 4:25-27), conductor 101 (“*second loop*”) of Taniguchi’s

eight-shaped antenna 1 has “*a size and shape substantially identical to the first loop*” [20B.1].

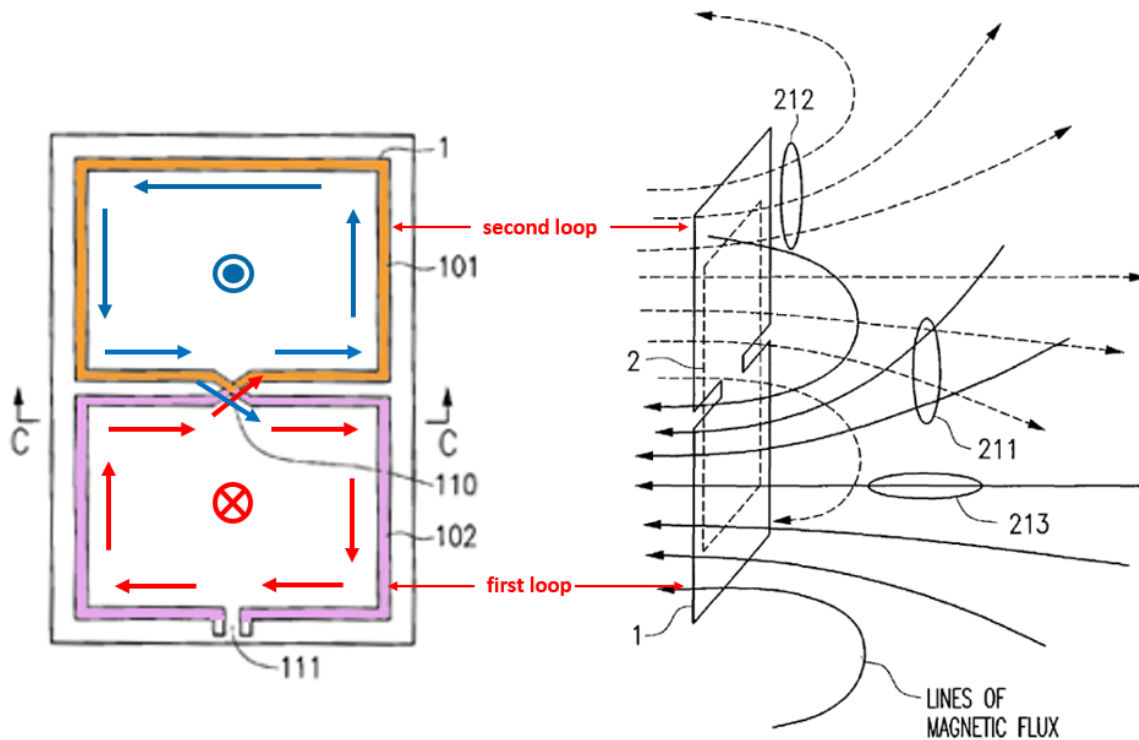
114. The disclosures that Taniguchi’s eight-shaped antenna “is divided into upper and lower **halves** by the antenna conductors 101, 102” (INTEL-1005, ¶55) which generate equal and opposite fields “all the time” (INTEL-1005, ¶64) combined with the depiction of the fields and eight-shaped antenna structure in the figures (Figure 3-4, 8) would have been at a minimum suggestive to a POSITA that the loops are substantially identical and symmetrical, as disclosed by the ’430 patent, rendering “*a first loop having a shape that is substantially symmetrical about a first predefined axis*” [20A] and “*a second loop having a size and shape substantially identical to the first loop*” [20B.1] obvious.

115. The second conductor 101 (“*second loop*”) in Figure 8 is “*arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop*” [20B.2]. Taniguchi teaches that its eight-shaped antenna has a feeding point 111 which is located on the lower side of conductor 102. (See INTEL-1005, ¶72; Figures 8A-8E.) The “first antenna is supplied with electric power from [the] first feeding point.” (INTEL-1005, Abstract.) When the antenna is supplied with power, “an increase in antenna current for the first antenna 1 is observed.” (INTEL-1005, ¶¶26, 56; ¶71 (relating eight-shaped antenna

of Figure 8 to eight-shaped antenna of Figure 3).) As a result of this flow of current through conductors 101 and 102, a magnetic field is generated by conductor 101 and conductor 102. (*See, e.g.*, INTEL-1005, ¶¶48, 59, 63.)

116. Taniguchi explains that antenna 1 has “a substantially figure eight-shaped region, thereby forming two regions which **generate repulsive lines of magnetic flux on the antenna 1.**” (INTEL-1005, ¶72; *see also*, INTEL-1005, ¶18 (“the invention has a feature in that the first antenna is formed in a substantially figure eight-shape in order to generate lines of magnetic flux **in reciprocal directions**”), 26, 63-64, claim 6 (“the first antenna is formed in a substantially figure eight shape in order to generate lines of magnetic flux **in reciprocal directions**”).) I note that Taniguchi using the language “reciprocal” and “repulsive” to refer to the equal and opposite magnetic flux lines generated by the two loops of the eight-shaped antenna. The magnetic flux lines generated by an eight-shaped antenna such as Figure 8’s antenna 1 are illustrated in Figure 4. (*See* INTEL-1005, ¶72 (Figure 8 antennas “are substantially the same in antenna configuration as that shown in FIG. 3 except that a first feeding point 111 and a second feeding point 112 are disposed on a lower side of an insulation 10”); INTEL-1005, ¶26 (“FIG. 4 is a view showing only lines of magnetic flux generated from the antenna 1 shown in FIG. 3 at a certain point of time”).) The lines of

magnetic flux indicated by solid lines are generated by the lower loop (conductor 102) and the lines of magnetic flux indicated by the broken lines are generated from the upper loop (conductor 101). (INTEL-1005, ¶64.) The solid lines of magnetic flux and the broken lines of magnetic flux “are **equal in magnitude to each other** and directed **opposite to each other all the time.**” (*Id.*) Because the generated fields are **equal** and **opposite**, the magnetic field emanating from conductor 101 (“*second loop*”) tends to cancel the magnetic field emanating from conductor 102 (“*first loop*”). (*See also*, INTEL-1010, 157 (teaching that when fields have opposite phase or polarity, “they tend to cancel”); INTEL-1023, 2:33-53, 4:3-11, 4:22-28, 6:19-27.) That is, conductor 101 (“*second loop*”) is oriented or arranged relative to conductor 102 (“*first loop*”) to form a figure-eight shape so that the current in conductor 101 flows in an opposite direction than the current in conductor 102 which results in the magnetic field from the second loop “tend[ing] to cancel” the magnetic field emanating from the first loop. (INTEL-1005, ¶¶55-57, 63-64, Figure 3 (showing current flow through conductors 101, 102).)



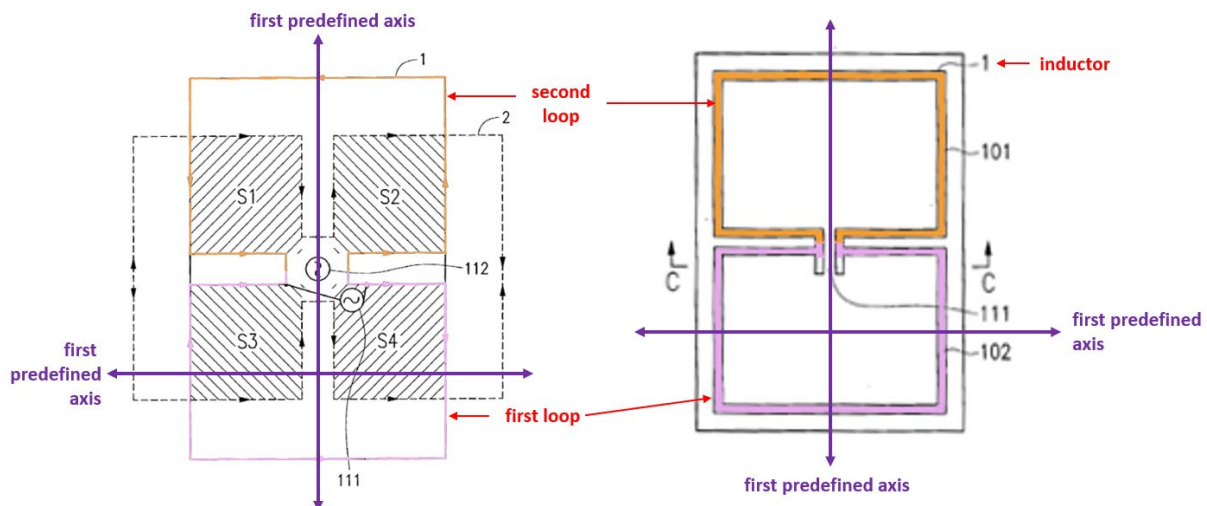
Taniguchi, Annotated Figure 8B (left), Figure 4 (right)

(ii) Rotated Eight-Shaped (Figures 9/10) Embodiment

117. Antenna 1 in the rotated eight-shaped inductor embodiment (Figures 9/10) has the same eight shape as antenna 1 of the Figure 8 embodiment except the feeding point of eight-shaped antenna 1 in Figure 9/10 is at the upper side of conductor 102 instead of on the lower side of conductor 102. Antenna 1 is “provided by forming antenna conductors 101, 102 in a substantially figure eight shape.” (INTEL-1005, ¶55; *see also*, INTEL-1005, ¶¶73 (relating Figure 9 to Figure 3), 76 (relating Figure 10 to Figure 9).) First antenna 1 “is divided into

upper and lower halves by the antenna conductors 101, 102.” (INTEL-1005, ¶55.)

The lower antenna conductor (shaded pink), illustrated in Figure 9 below left and Figure 10B below right, is a “*first loop*” and the upper conductor (shaded orange) is a “*second loop*.” (See INTEL-1005, ¶¶63-64 (describing that antenna 1 of Figure 3 has “upper and lower loops), 94 (“two loops defin[e] the 8-shape”).)



Taniguchi, Annotated Figure 9 (left); Annotated Figure 10B (right)

118. As shown in Figure 9 and Figure 10B above, conductor 102 (“*first loop*”) is symmetric about the vertical axis (“*a first predefined axis*”). Because it is symmetric, it is necessarily “*substantially symmetric[]*”, regardless of the boundaries of “*substantially*.” Accordingly, Taniguchi discloses that conductor 102 of the rotated eight-shaped inductor embodiment has “*a shape that is substantially symmetrical about*” a vertical axis (“*a first predefined axis*”) [20A].

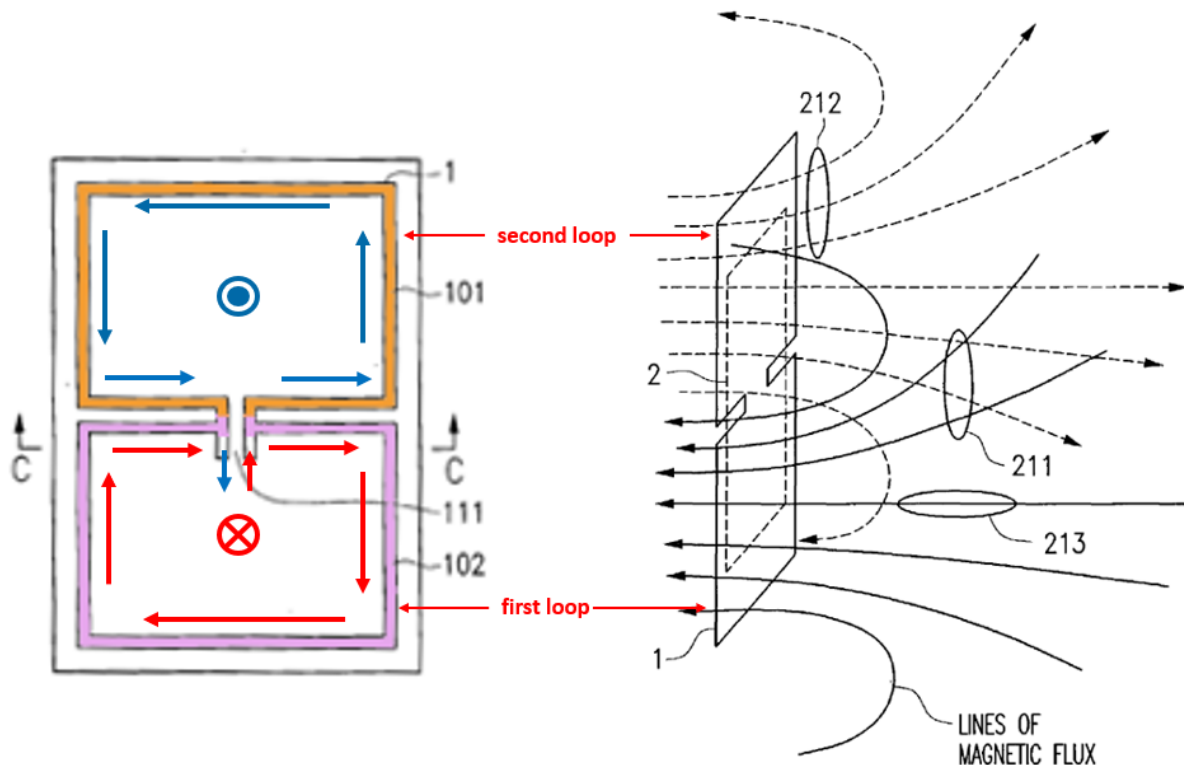
119. Alternatively, Taniguchi's conductor 102 also has symmetry about the horizontal axis except for the presence of terminals at the top of conductor 102. However, Taniguchi's structure is consistent with the '430 patent which states that "perfect symmetry between the two loops 206a and 206b may be difficult to achieve given the presence of the terminals 204a and 204b." (INTEL-1001, 4:25-27.) Thus, consistent with the disclosure of the '430 patent disclosure regarding a "substantially symmetrical" loop, conductor 102 (*"first loop"*) also has *"a shape that is substantially symmetrical about"* a horizontal axis (*"a first predefined axis"*) [20A].

120. Conductor 101 (*"second loop"*; shaded orange) has a rectangular shape with the same size as the rectangular conductor 102, as illustrated in Taniguchi, Figures 9 and 10B above. Taniguchi teaches that conductors 101 and 102 have the same size and shape, describing that the first antenna 1 "is divided into upper and lower **halves** by the antenna conductors 101, 102." (INTEL-1005, ¶55.) Consistent with the disclosure of the '430 patent that perfect symmetry is difficult to achieve due to the presence of terminals (INTEL-1001, 4:25-27), conductor 101 in Taniguchi's eight-shaped antenna 1 of Figures 9/10 has *"a size and shape substantially identical to the first loop [conductor 102]"* [20B.1].

121. The disclosures that Taniguchi's eight-shaped antenna "is divided into upper and lower **halves** by the antenna conductors 101, 102" (INTEL-1005, ¶55) which generate equal and opposite fields "all the time" (INTEL-1005, ¶64) combined with the depiction of the fields and eight-shaped antenna structure in the figures (Figure 3-4, 9, 10) would have been at a minimum suggestive to a POSITA that the loops are substantially identical and symmetrical, as disclosed by the '430 patent, rendering "*a first loop having a shape that is substantially symmetrical about a first predefined axis*" [20A] and "*a second loop having a size and shape substantially identical to the first loop*" [20B.1] obvious.

122. As illustrated in annotated Figure 10B below, current flows in the same direction in conductors 101 and 102 of Figures 9/10 as in conductors 101 and 102 of Figures 3 and 8. (See INTEL-1005, ¶¶56, 73-74, 76, Figures 3, 9 (showing current flow through conductors 101, 102).) As such, conductors 101 and 102 generate repulsive lines of magnetic flux, as shown in Figure 4 below right. (See INTEL-1005, ¶¶26, 63-64.) For the reasons discussed above for the eight-shaped antenna of Figure 8 (and Figure 3), the upper conductor ("*second loop*") is oriented or arranged relative to the lower conductor ("*first loop*") to form a figure-8 shape so that current flows in opposite directions in conductors 101 and 102, generating equal and opposite magnetic fields which tend to cancel one another. (INTEL-

1005, ¶¶73-74, 77, Fig. 9 (showing current flow in conductors 101, 102); INTEL-1010, 157.) Thus, upper conductor 102 is “*arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop*” [20B.2].



Taniguchi, Annotated Figure 10B (left); Figure 4 (right)

(iii) Same Plane (Figure 7) Embodiment

123. Taniguchi’s antenna 1 (“*inductor*”) in the same plane embodiment (Figure 7; illustrated below) has the same configuration as antenna 1 in the rotated eight-shaped embodiment of Figures 9 and 10. (See INTEL-1005, ¶29 (associating

[20C] *two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals*

Taniguchi, Annotated Figure 7

c. “Two closely spaced terminals” limitation [20C]

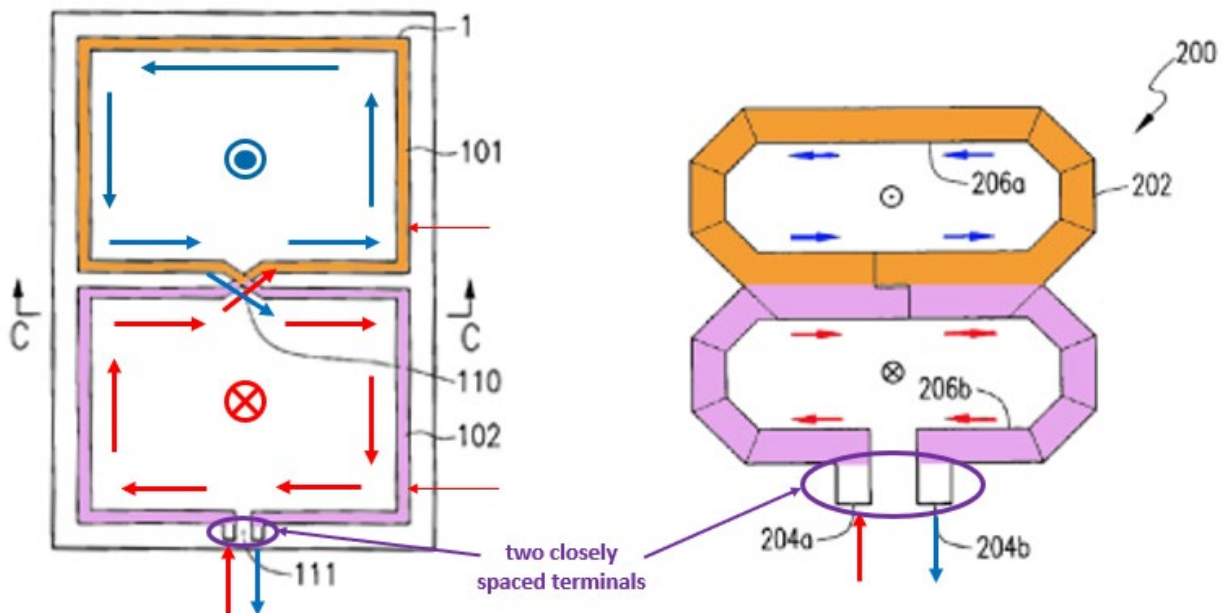
[20C] *two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals*

(i) Lower Feeding Point (Figure 8) Embodiment

124. Taniguchi's antenna layout of Figure 8 provides "*two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops.*" As illustrated in Taniguchi's Figure 8B (below left), eight-shaped antenna 1 has a feeding point disposed on the lower side of conductor 102 (the "*first loop*"). (See INTEL-1005, ¶72.) The "first antenna is supplied with electric power from [the] first feeding point 111, and an increase in antenna current for the first antenna 1 is observed." (INTEL-1005, Abstract, ¶¶56, 71.) As such, feeding point 111 has a portion attached to the left side of conductor 102 through which current is fed into the antenna and a portion attached to the right side of conductor 102 through which current leaves the antenna. (See INTEL-1005, Figure 8B (below with annotations).) A POSITA would understand these two portions of feeding point 111 to be "*terminals*" for the antenna. (See INTEL-1024, 6:30-32; INTEL-1023, 6:61-7:13.) Taniguchi's feeding point 111 is consistent with the '430 patent which discloses current enters the inductor through terminal 204a and leaves through terminal 204b. (See INTEL-1001, Figure 2 (reproduced below left).)

125. The current supplied through one terminal of the feeding point 111 (e.g., left terminal), travels through the left side of conductor 102 and crosses to conductor 101 travels through conductor 101 and crosses back to conductor 102,

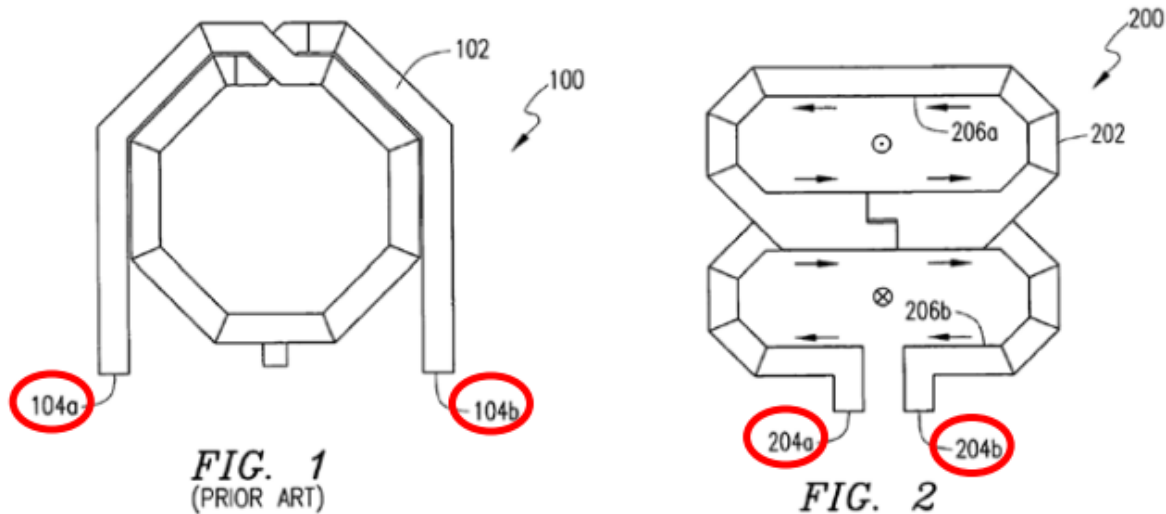
travels through the right side of conductor 102, and exits through the second terminal of feeding point 111. (See, e.g., INTEL-1005, Figure 3 (illustrating current flow through eight-shaped antenna); ¶56 (“[a]rrows shown on the antenna 1 indicate a direction of antenna current”).) Thus, the “two terminals” of feeding point 111 are “connected to the first loop [conductor 102]” and “supply[] electrical current to the first and second loops.”



Taniguchi, Annotated Fig. 8B (left); '430 Patent, Annotated Fig. 2 (right)

126. As shown in Figure 8B (above left), the two “terminals” of Taniguchi’s eight-shaped antenna of Figure 8 are “closely spaced.” The distance between the terminals is close, relative to the width of conductor loops 101 and 102. Thus, Taniguchi is consistent with what the '430 patent indicates constitutes

as closely spaced. I note that prior art Figure 1 of the '430 patent (below at left) depicts a prior art inductor with terminals having a spacing that is greater than the width of inductor loop whereas Figure 2 (reproduced below right) has terminals 204a and 204b which are more closely spaced relative to the width of the inductor loop than the inductor of Figure 1. This depiction is consistent with the arguments made during JP prosecution that I discussed in §III.C.2.a: Specifically, Applicant (PO) argued that in “document 2 [JP-Einzinger], the two terminals are placed at an interval that is greater than the width of the winding loop, and the configuration is the exact opposite of the invention stated in claim 1 of the present application.” (INTEL-1015, 19.) Thus, as illustrated above in Taniguchi’s Figure 8 (at left), Taniguchi’s lower feeding point (Figure 8) embodiment provides “*two closely spaced terminals*” consistent with the disclosure of the '430 patent.



'430 Patent, Annotated Figures 1-2

127. The two closely spaced terminals of Taniguchi's feeding point 111 "*minimiz[e] magnetic field contributions from the terminals*" due to the opposing currents flowing through the wires of the terminals, that is the current entering the left terminal wire and the current exiting the right terminal wire as shown in annotated Figure 8B above. Prior to the earliest priority date claimed on the face of the '430 patent, a POSITA would have understood that a consequence of having terminals spaced closely together (and more closely than the width of the inductor loop) is a minimization of magnetic field contributions from the terminals relative to the field contributions when the terminals are placed farther apart. The book, "Signal Integrity Issues and Printed Circuit Board Design" by Douglas Brooks ("Brooks"; INTEL-1010), published in 2003, summarizes this basic concept.

Brooks describes two wires, illustrated in Figure 9-2 (reproduced below) in which one wire carries current coming of the page and the other carries current going into the page. (INTEL-1010, 156-157.) When these two wires carry a signal and its return current, the “currents will be equal and opposite” and “the magnetic fields will also be equal and opposite.” (INTEL-1010, 156-157.)

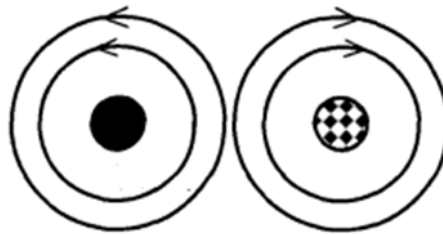


Figure 9-2 A signal and its return have magnetic fields that approximately cancel.

Brooks, Figure 9-2

128. Brooks further explains that if the reader considers themselves “as positioned off to the right-hand side of this page,” the right-most wire (with the current going into the page) is closer to the reader and therefore the “EMI radiation from that wire will be greater than that from the other.” (INTEL-1010, 157.)

However, “if we move the two wires closer together, then you, as an observer off to the right, would begin to see radiations from each wire that are more equal” and because “they are opposite in phase, or polarity, they tend to cancel.” (*Id.*) And “if the wires **were very close together**, their EMI radiations **would completely**

cancel and would not be measurable.” (*Id.*) “Here is one of our **most basic principles**: *If you want to minimize EMI radiation, keep the signals and their returns close together.*” (*Id.* (emphasis by italics in original).)

129. Brooks accordingly confirms the finding of the JP Examiner that “configuring the distance between the two terminals to be in close proximity is well-known art in the technical field” and “determining the position of the terminals of the inductor is a matter that can be appropriately selected by a person skilled in the art, and there is no particular difficulty in configuring the distance between the two terminals to be in close proximity.” (INTEL-1015, 22.)

130. Taniguchi, as informed by the basic principle articulated in Brooks which would have been well-known to a POSITA prior to the earliest priority date claimed on the face of the ’430 patent, is consistent with the limited disclosure for this limitation in the ’430 patent. The ’430 patent provides one sentence addressing this concept, stating only that “[f]or example, positioning the two terminals 204a and 204b as close to each other as possible helps make the field contributions from the two parts of the inductor 200 identical.” (INTEL-1001, 4:29-32.) Additionally, the terminals in the ’430 patent are shown in Figure 2 as having wires with opposing currents. (INTEL-1001, 4:5-14; *see also* INTEL-1001, 3:65-4:3 (distinguishing “terminals” from “other metal wires”).) The ’430 patent does not

provide any details regarding how “closely” the terminals must be spaced or how the magnetic field contributions vary based on terminal spacing. Thus, Taniguchi’s eight-shaped antenna of the lower feeding point embodiment (Figure 8) discloses or renders obvious “*two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.*”

131. Should the construction of “*two closely spaced terminals*” in ITC-337-TA-1300 (“two terminals in proximity to each other (such that the electromagnetic field at a certain distance from the first inductor (where the second inductor is positioned) is reduced)”) be adopted, Taniguchi’s lower feeding point (Figure 8) embodiment meets this construction. As I discussed in §IV.B.1.b.i, antenna 1 of Taniguchi’s lower feeding point (Figure 8) embodiment, which has terminals spaced as shown in Figure 8B, has a configuration such that the electromagnetic field emanating from antenna 1 at the distance where antenna 2 is positioned is reduced. Because the terminals are placed closely together, the electromagnetic fields due to the terminals cancel or are not measurable. (*See* INTEL-1010, 157.) Because the fields from the terminals cancel, the electromagnetic field of the eight-shaped inductor is not altered by the terminals. Thus, Taniguchi’s Figure 8 embodiment discloses “two terminals in proximity to

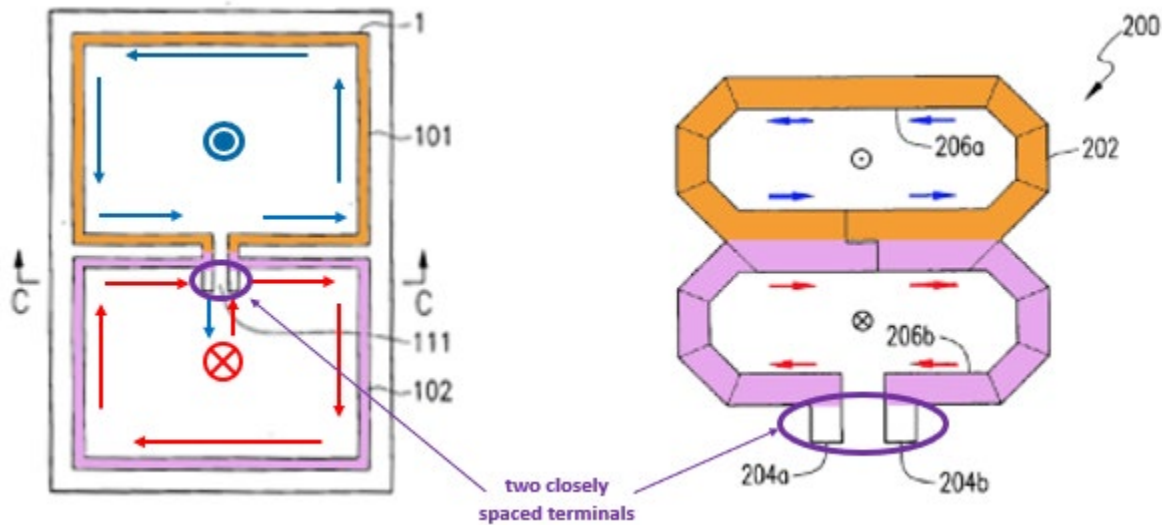
each other (such that the electromagnetic field at a certain distance from the first inductor (where the second inductor is positioned) is reduced).” (See §IV.B.1.a ([20P]).)

(ii) Rotated Eight-Shaped (Figures 9/10) Embodiment and Same Plane (Figure 7) Embodiment

132. As I discussed above in ¶¶IV.B.1.b.ii-iii, antenna 1 of Taniguchi’s rotated eight-shaped (Figures 9/10) embodiment and antenna 1 of the same plane (Figure 7) embodiment have the same configuration with a feeding point 111 placed at the top of conductor 102 (“*first loop*”). (See INTEL-1005, Figure 10B, Figure 7B.) I therefore address both embodiments together in this section.

133. Like the feeding point 111 of Figure 8, a POSITA would understand the two portions of feeding point 111, which are spaced more closely than the width of the conductor, to be “*terminals*.” (See INTEL-1024, 6:30-32; INTEL-1023, 6:61-7:13.) Antenna 1 is supplied “with electric power from a first feeding point 111, and an increase in antenna current for the first antenna 1 is observed.” (INTEL-1005, ¶¶56, 29, 73, 76.) As such, feeding point 111 has a portion attached to the right side of conductor 102 through which current is fed into the antenna and a portion attached to the left side of conductor 102 through which current leaves the antenna. As shown below, conductor 102 is connected to conductor 101. Current therefore flows into both conductors 101 and 102 through feeding point

111. Thus, the “two closely spaced terminals” of feeding point 111 are connected to conductor 102 (“first loop”) and “supply electrical current to the first and second loops.”



Taniguchi, Annotated Fig. 10B/7B (left); '430 Patent, Annotated Fig. 2 (right)

134. The two closely spaced terminals of Taniguchi’s feeding point 111 “minimiz[e] magnetic field contributions from the terminals” for the same reasons as I discussed in the analysis of the lower feeding point embodiment (Figure 8). (See, e.g., INTEL-1010, 156-157.) Thus, Taniguchi’s eight-shaped antenna of the rotated eight-shaped (Figures 9/10) embodiment and the eight-shaped antenna of the same plane (Figure 7) embodiment each provides “two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.”

2. Independent Claim 1

135. Claim 1 is directed to an “*inductor layout*” incorporating the “*inductor*” limitations of claim 20 and adding a “*second inductor.*” As I highlight in the table below, claim 1 has overlapping limitations with claim 20. I address the claim differences in this section.

Claim 1	Claim 20
[1P] An inductor layout having reduced mutual electromagnetic coupling, comprising:	
[1A] a first inductor having a reduced far field, said first inductor comprising:	[20P] An inductor having a reduced far field, comprising:
[1A.1] a first loop having a shape that is substantially symmetrical about a first predefined axis;	[20A] a first loop having a shape that is substantially symmetrical about a first predefined axis;
[1A.2a] a second loop connected to the first loop,	
[1A.2b] said second loop having a size and shape substantially identical to the first loop,	[20B.1] a second loop having a size and shape substantially identical to the first loop;
[1A.2c] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and	[20B.2] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from said first loop; and
[1A.3] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing	[20C] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing

magnetic field contributions from the terminals; and	magnetic field contributions from the terminals.
[1B] a second inductor positioned at a predetermined distance from the first inductor, wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.	

a. Preamble

[1P] *An inductor layout having reduced mutual electromagnetic coupling*

136. Taniguchi discloses or renders obvious an “*inductor layout having reduced mutual electromagnetic coupling*” [1P]. As I discussed in §§ V.B.1.a.1-2 for claim 20, the eight-shaped antenna 1 in each of Taniguchi’s lower feeding point (Figure 8) embodiment, rotated eight-shaped (Figures 9/10) embodiment and same plane (Figure 7) embodiment is an “*inductor*” and is therefore the recited “*inductor*” of claim 1’s preamble.

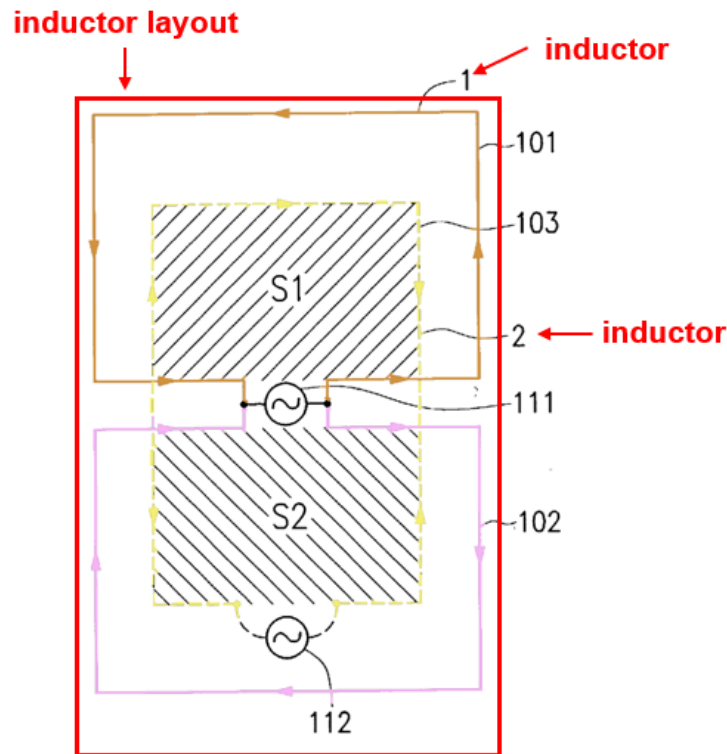
137. The lower feeding point (Figure 8) embodiment, rotated eight-shape (Figures 9/10) embodiment, and same plane (Figure 7) embodiment each describes the placements of antennas 1 and 2 relative to one another in a non-contact identification system. The placement of antennas 1 and 2 in each of these

embodiments is an “*inductor layout*.” (See INTEL-1005, ¶¶55-56 (Figure 3), 69-70 (Figure 7), 71-72 (Figure 8), and 73-74, 76-77 (Figures 9/10).)

138. The “*inductor layout*” of each embodiment has “*reduced mutual electromagnetic coupling*” by virtue of the eight-shaped configuration of antenna 1 and the positioning of antenna 2. (See, e.g., INTEL-1005, claim 1 (“first and second antennas, wherein the first antenna has at least two regions for generating lines of magnetic flux in reciprocal directions, and the second antenna has first and second mutual inductances for generating induced electromotive forces in opposite directions due to electromagnetic induction from the first antenna, the second antenna **being arranged so that the sum of mutual inductances between it and the first antenna is minimized**”); ¶15.) Indeed, a “primary object” of Taniguchi “is to provide a radio guidance antenna in which the **sum of mutual inductances of antennas is small**.” (INTEL-1005, ¶14.)

139. Taniguchi describes the reduced electromagnetic coupling that results from the layout including an eight-shaped antenna and a second antenna in its discussion of Figure 3. (See §IV.A.1 (Taniguchi background).) This basic eight-shaped antenna is used in the lower feeding point (Figure 8) embodiment, the rotated eight-shaped (Figures 9/10) embodiment, and the same plane (Figure 7) embodiment. (See, e.g., INTEL-1005, ¶¶29-32, 73, 76.) As I discussed in

§III.B.1.b, when a current is applied to eight-shaped antenna 1, conductor 101 generates a magnetic field (represented as magnetic flux lines) and conductor 102 generates an equal and opposite magnetic field (represented as magnetic flux lines). (See INTEL-1005, ¶¶63-64, Fig. 4.) As a result of the equal and opposite magnetic flux from conductors 101 and 102, “the directions of induced electromotive forces generated on the antenna 2 are such that induced current is caused to flow in the regions S1, S2 in opposite directions.” (INTEL-1005, ¶57.) When $S1/S2=1$ ($S1=S2$), “the induced electromotive force generated on the antenna 2 as a whole becomes zero.” (*Id.*) “That is, residual mutual inductances of the antenna 1 and the antenna 2 are put in a state of zero.” (*Id.*; see also, *id.*, ¶61; INTEL-1012, 68-79; INTEL-1023, 7:51-65.)



Taniguchi, Annotated Figure 3

140. Taniguchi discusses the “residual mutual inductance” of antenna 1 as the difference in value “between a first mutual inductance M_1 and a second mutual inductance M_2 ¹⁵, which generate opposite induced electromotive forces on the antenna 2 with electromagnetic induction from the antenna 1.” (INTEL-1005, ¶60.)

¹⁵ M_1 is the mutual inductance between antenna 1’s conductor 101 and antenna 2 and M_2 is the mutual inductance between antenna 1’s conductor 102 and antenna 2.

That is, because conductors 101 and 102 of antenna 1 generate magnetic fields that have opposite directions at antenna 2, their generated magnetic fluxes are also opposite (i.e., one being positive and one being negative). Therefore, mutual inductances M_1 and M_2 are also opposite in polarity. Because M_1 and M_2 are opposite in polarity, the sum of the mutual inductances for an 8-shaped inductor equals the difference between the absolute values of M_1 and M_2 (i.e., $|M_1| - |M_2|$). (*Id.*) This difference (the “residual”) represents the remaining (if any) total mutual inductance from antenna 1 on antenna 2. The residual mutual inductance is therefore the total mutual inductance from antenna 1 onto antenna 2.

141. For eight-shaped antenna 1, the mutual inductance from antenna 1 onto antenna 2 is zero. (INTEL-1005, ¶57.) Because there is no mutual inductance from antenna 1 onto antenna 2, there is no mutual inductance from antenna 2 to antenna 1. (See INTEL-1012, 68 (explaining that the total mutual inductance from antenna 1 to antenna 2 (i.e., M_{12}) and the total mutual inductance from antenna 2 to antenna 1 (i.e., M_{21}) are symmetrical with the following relationship: $M = M_{12} = M_{21}$); see §III.A.2.b (Background).) Because mutual inductance describes the coupling of two circuits by the medium of magnetic field (INTEL-1012, 68), the reduction in mutual inductance as a result of the electromagnetic field reduction is also a reduction of the mutual electromagnetic coupling between antenna 1 and

antenna 2. (*See, e.g.*, INTEL-1005, Abstract (antenna 1 and antenna 2 are “inductively coupled), ¶55 (“second antenna 2 is coupled in electromagnetic induction to the upper and lower halves of the first antenna 1”).)

142. The same layout of antennas of Figure 3 is used in the lower feeding point (Figure 8) embodiment. (*See* INTEL-1005, ¶30.) Taniguchi explains in its discussion of Figure 8 that the eight-shaped antenna 1 has “two regions which generate repulsive lines of magnetic flux on the antenna 1.” (INTEL-1005, ¶72, 55-57, 29-30.) As I discussed above, these repulsive lines of magnetic flux cause the “induced electromotive force generated on the antenna 2 as a whole” to become zero which puts the residual mutual inductance to a state of zero. (*See* INTEL-1005, ¶¶57, 30 (relating Figure 8 to Figure 3); *see also*, INTEL-1012, 68-70; INTEL-1023, 7:51-65.) As I discussed in my analysis of [20P], the eight-shaped antenna has a reduced electromagnetic field which necessarily results in the magnetic coupling of the field with the second inductor to be reduced. For these reasons and the reasons discussed above for Figure 3, the layout of Figure 8 has “*reduced mutual electromagnetic coupling.*”

143. Regarding the rotated eight-shaped embodiment (Figures 9/10; reproduced below), “antenna 1 and the antenna 2 overlap each other in regions S1, S2, S3 and S4.” (INTEL-1005, ¶74.) “If an increase in antenna current in directions

shown by arrows is observed in the antenna 1, then mutual inductances attributable to the regions S1 to S4 generate induced electromotive forces in the antenna 2 tending to make antenna current flow in directions shown by arrows, respectively.” (*Id.*) “Directions of the induced electromotive forces are such that the regions S1, S2 generate an electromotive force in the antenna 2 tending to make antenna current flow in the same direction and the induced electromotive force attributable to the regions S3, S4 is opposite to the induced electromotive force attributable to the regions S1, S2.” (*Id.*) When regions $S1+S2=S3+S4$, “the residual mutual inductance becomes zero.” (INTEL-1005, ¶75.) For these reasons and the reasons discussed above for Figure 3, this layout also has “*reduced mutual electromagnetic coupling.*”

of antenna 2: “according to the invention, the first antenna has at least two regions for generating lines of magnetic flux in reciprocal directions, and the second antenna has first and second mutual inductances for generating induced electromotive forces in opposite directions due to an action of **electromagnetic induction** from the first antenna, the **second antenna being arranged to decrease the sum of mutual inductances¹⁶ between it and the first antenna.**” (INTEL-1005, ¶95.) “Doing so enables electric power to be efficiently converted to electromagnetic field with a simple construction and **a remote electromagnetic-field intensity can also be suppressed to be small**, so that it is possible to realize a radio guidance antenna, which is small-sized, lightweight and excellent in quality of communication.” (*Id.*)

b. “First Inductor” Limitation [1A], [1A.1]-[1A.3]

Claim 1	Claim 20
[1A] a first inductor having a reduced far field, said first inductor comprising:	[20P] An inductor having a reduced far field, comprising:

¹⁶ Because M_1 and M_2 are opposite in polarity, the sum of the mutual inductances for an 8-shaped inductor equals the difference between the absolute values of M_1 and M_2 (i.e., $|M_1| - |M_2|$).

[1A.1] a first loop having a shape that is substantially symmetrical about a first predefined axis;	[20A] a first loop having a shape that is substantially symmetrical about a first predefined axis;
[1A.2a] a second loop connected to the first loop,	
[1A.2b] said second loop having a size and shape substantially identical to the first loop,	[20B.1] a second loop having a size and shape substantially identical to the first loop;
[1A.2c] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and	[20B.2] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from said first loop; and
[1A.3] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals; and	[20C] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.

146. The “*first inductor*” limitations of claim 1 substantially overlap with the preamble and limitations [A]-[C] of claim 20. The preamble of claim 20 is substantially the same as limitation [1A] with the only difference being limitation [1A] recites a “***first inductor***” rather than an “*inductor*”—which is an immaterial difference. Limitations [1A.1], [1A.2b], [1A.2c] and [1A.3] are identical to limitations [20A], [20B.1], [20B.2], and [20C]. Thus, for the reasons I discussed in §§IV.B.1.b-c, Taniguchi’s lower feeding point (Figure 8), rotated eight-shape

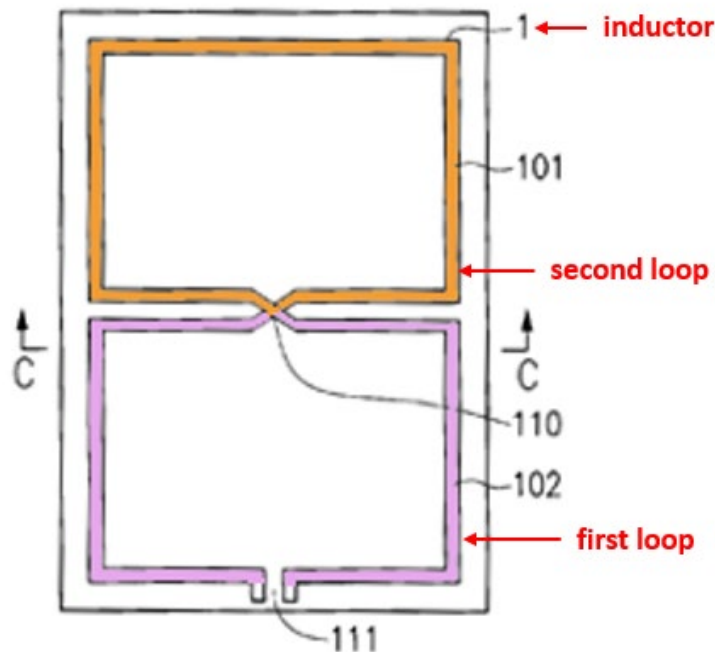
(Figures 9/10), and same plane (Figure 7) embodiments disclose limitations [1A], [1A.1], [1A.2b], [1A.2c] and [1A.3].

147. The primary difference between the “*second loop*” limitation [20B] of claim 20 and the “*second loop*” limitation [1A.2] of claim 1 is that claim 1 adds the limitation that the “*second loop [is] connected to the first loop*” [1A.2a]. Each of the lower feeding point (Figure 8) embodiment, the rotated eight-shaped (Figures 9/10) embodiment, and the same plane (Figure 7) embodiment discloses this limitation.

(i) Taniguchi’s Lower Feeding Point (Figure 8) Embodiment

148. Taniguchi’s antenna layout of Figure 8 (“*inductor layout*”) includes antenna 1 which is the recited “*first inductor*” [1A]. In the lower feeding point embodiment illustrated in Figure 8B (below), conductor 102 (shaded orange) is connected to conductor 101 (shaded pink) at a “two-level crossing center[.]”. (See INTEL-1005, ¶72.) Therefore, Taniguchi’s antenna 1 (“*first inductor*”) has “*a second loop [conductor 101] connected to the first loop [conductor 102].*”

Accordingly, for this reason and the reasons I discussed in §IV.B.1.b for limitation [20B.1], Taniguchi’s lower feeding point (Figure 8) embodiment discloses limitation [1A.2a].

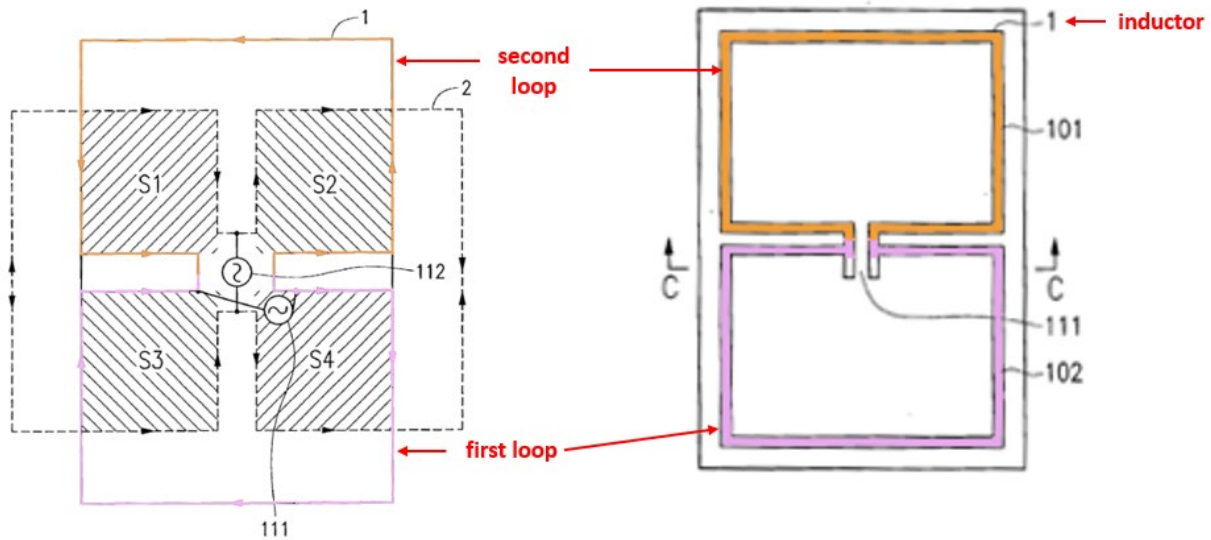


Taniguchi, Annotated Figure 8B

(ii) Taniguchi's Rotated Eight-Shaped (Figures 9/10) Embodiment

149. Taniguchi's antenna layout of Figures 9/10 ("*inductor layout*") includes antenna 1 which is the recited "*first inductor*" [1A]. (See §IV.B.1.a.i.) This is shown in Figures 9 and 10B (below) which depicts the lower antenna conductor 102 ("*first loop*"; shaded pink) connected to upper antenna conductor 101 ("*second loop*"; shaded orange). I note that antenna 1 of Figure 10 has the same construction as antenna 1 of Figure 6 which is a construction of Figure 3's antenna 1. (See INTEL-1005, ¶66, *cf* Figure 6B with Figure 10B.) In this configuration, "feeding point 111 is provided at a connection of antenna

conductors 101, 102.” (INTEL-1005, ¶67.) Thus, Taniguchi’s antenna 1 (“*first inductor*”) has “*a second loop [conductor 101] connected to the first loop [conductor 102]*” [1A.2a].

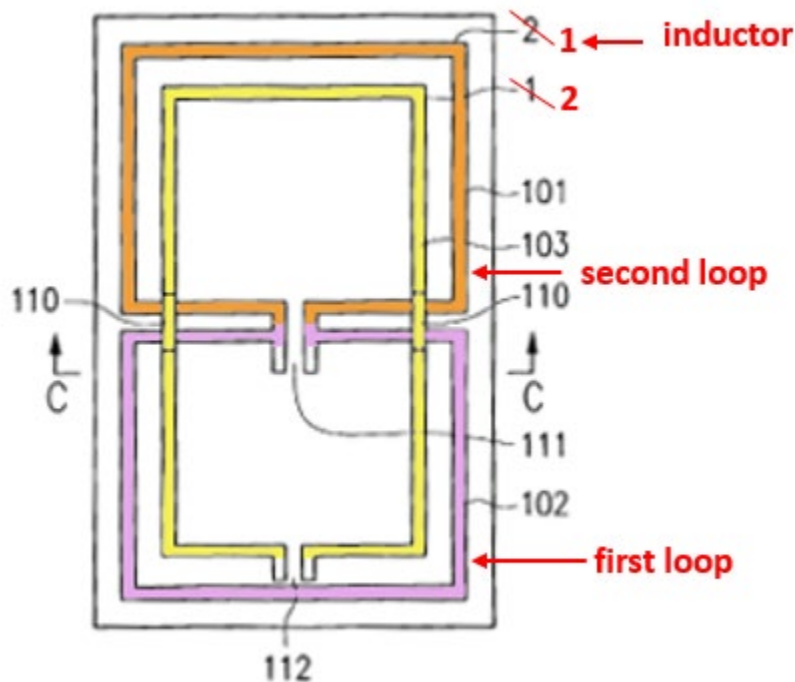


Taniguchi, Annotated Figure 9 (left); Annotated Figure 10B (right)

(iii) Taniguchi’s Same Plane (Figure 7) Embodiment

150. Taniguchi’s antenna layout of Figure 7B (“*inductor layout*”) includes an eight-shaped antenna (misabeled as 2 in Figure 7B) which is the recited “*first inductor*” [1A]. (See §§IV.B.a-b.) The configuration of antenna 1 of Figure 7B is identical to the configuration of antenna 1 of Figures 9/10. As shown in Figure 7B (below), lower antenna conductor 102 (“*first loop*”; shaded pink) is connected to upper antenna conductor 101 (“*second loop*”; shaded orange). I note that antenna 1 of Figure 7B has the same construction as antenna 1 of Figure 6B which is a

construction of Figure 3's antenna 1. (See INTEL-1005, ¶66, *cf* Figure 6B with Figure 7B.) In this configuration, "feeding point 111 is provided at a connection of antenna conductors 101, 102." (INTEL-1005, ¶67.) Thus, Taniguchi's antenna 1 ("first inductor") has "a second loop [conductor 101] connected to the first loop [conductor 102]" [1A.2a].



Taniguchi, Annotated Figure 7B

c. "Second Inductor" limitations [1B.1]-[1B.2]

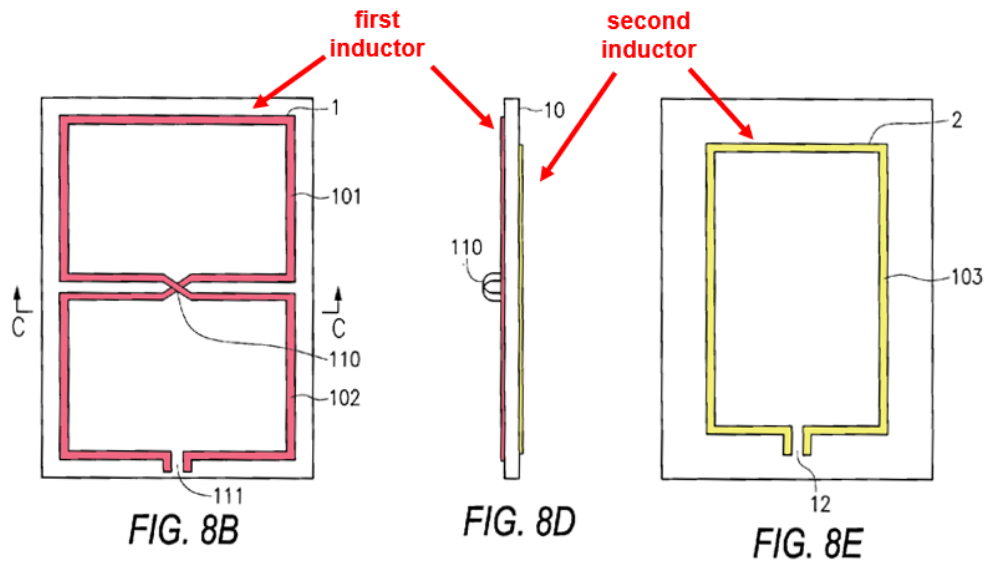
[1B.1] *a second inductor positioned at a predetermined distance from the first inductor,*

[1B.2] *wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field*

151. Taniguchi discloses an “*inductor layout having reduced mutual electromagnetic coupling*” [1P] between a first antenna (“*the first inductor*”) and a second antenna. (INTEL-1005, Abstract; *See* §IV.B.2.a.) The layouts of Taniguchi’s lower feeding point (Figure 8) embodiment, rotated eight-shaped (Figures 9/10) embodiment and same plane (Figure 7) embodiment each has “*a second inductor positioned at a predetermined distance from the first inductor*” [1B.1] as I discuss below.

(i) Taniguchi’s Lower Feeding Point (Figure 8) Embodiment

152. The “*inductor layout*” of the lower feeding point embodiment includes a second antenna 2 (shaded yellow) “composed of an antenna conductor 103.” (INTEL-1005, ¶¶55; 72, Figures 8B, 8D, 8E (reproduced below with annotations).) Antenna 2 is the recited “*second inductor*” for the reasons discussed in §IV.B.1.a ([20P]).



Taniguchi, Annotated Figures 8B and 8D-8E

153. As shown in Figure 8D above (middle), antenna 1 (shaded red) is formed on a first surface of insulation 10 and antenna 2 is formed on the opposite surface of insulation 10. (See INTEL-1005, Figures 8B, 8D-E, ¶¶55, 71-73, 68, 76-77; see also, e.g., INTEL-1005, ¶¶85-86 (describing PCB embodiment having antenna 1 and antenna 2 on opposite surfaces of the PCB).) The thickness of insulation 10 therefore represents “a predetermined distance” between the second antenna and the first antenna. Thus, Taniguchi’s lower feeding point embodiment (Figure 8) discloses a “*second inductor positioned at a predetermined distance from the first inductor*” [1B.1]. I note that Taniguchi’s teachings are consistent with Applicant’s (PO’s) statement during prosecution of EP3567614 when addressing the Examiner’s rejection regarding lack of support: “it is submitted that

the root parent application as filed does not mandate any particular distance or relative orientation of the two inductors.” (INTEL-1016, 59.)

154. Taniguchi further discloses that the “*mutual electromagnetic coupling between the first inductor and the second inductor*” of the lower feeding point embodiment “*is reduced as a result of the first inductor having a reduced electromagnetic field*” [1B.2]. An eight-shaped antenna, such as eight-shaped antenna 1 of Figure 8, has a “*reduced electromagnetic field*” for the reasons I discussed in my analysis of [20P] for “*reduced far field*.” (See, e.g., §IV.B.1.a.) In summary, the two conductors of an eight-shaped antenna “generate repulsive lines of magnetic flux on the antenna 1” which tend to cancel each other. (INTEL-1005, ¶72; see also, *id.*, ¶¶18, 29-32, 63-64, 69-73, 76-77, claim 6; INTEL-1010, 157.) By virtue of this figure-8 configuration, antenna 1 “reduces a remote electromagnetic-field effect.” (INTEL-1005, ¶¶55, 59 (“electric power supplied to the antennas can be converted to an electromagnetic field with high efficiency and a plurality of antennas can be installed, while the **remote electromagnetic-field intensity is also controlled at an exceedingly low level**”), 71 (relating lower feeding point embodiment of Figure 8 to Figure 3), 94 (“the remote electromagnetic-field intensity is much suppressed by the figure eight-shaped antenna”), 95 (explaining that the disclosed antenna layouts “enable[] electric

power to be efficiently converted to electromagnetic field with a simple construction and **a remote electromagnetic-field intensity can also be suppressed to be small**".)

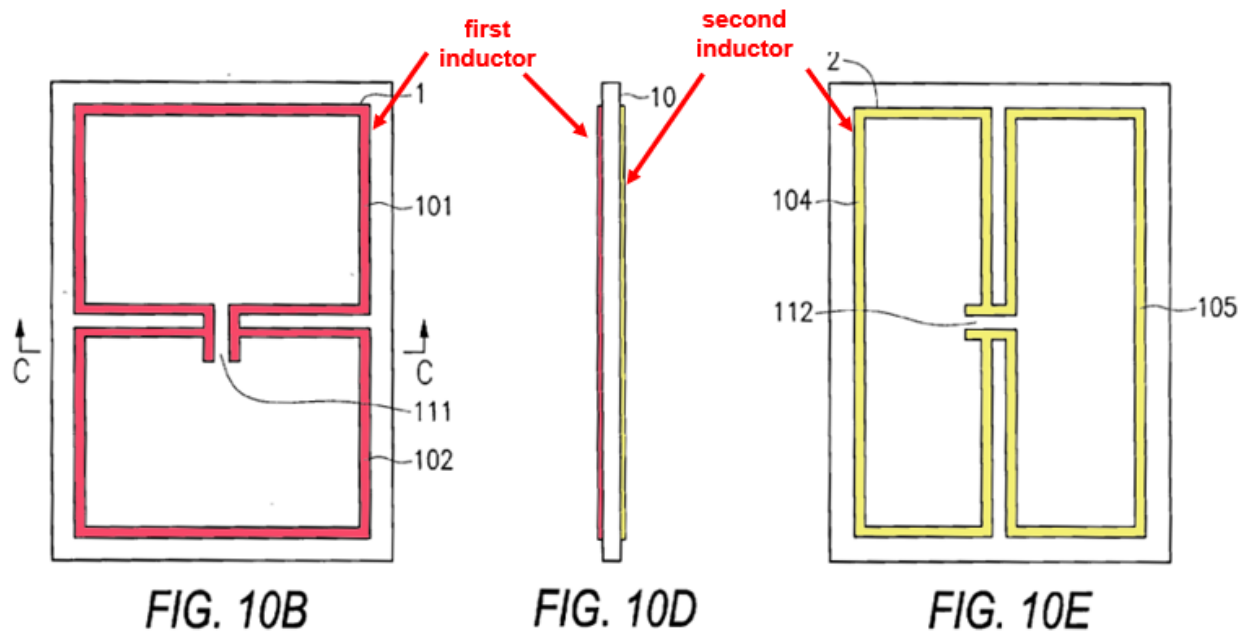
155. Should the construction of "*reduced electromagnetic field*" from ITC-337-TA-1300 be adopted in this proceeding, each embodiment discloses the limitation. As discussed in this section and §IV.B.1.a [20P], in the lower feeding point (Figure 8) embodiment, "the electromagnetic field emanating from the first inductor is reduced (at a certain distance from the first inductor where the second inductor is positioned)."

156. As I discussed in §IV.B.2.a, the "*inductor layout*" of each embodiment has "*reduced mutual electromagnetic coupling*" by virtue of the eight-shaped configuration of antenna 1 having a "*reduced electromagnetic field*" and the position of antenna 2. (See, e.g., INTEL-1005, claim 1 ("first and second antennas, wherein the first antenna has at least two regions for generating lines of magnetic flux in reciprocal directions, and the second antenna has first and second mutual inductances for generating induced electromotive forces in opposite directions due to electromagnetic induction from the first antenna, the second antenna being arranged **so that the sum of mutual inductances between it and the first antenna is minimized**"), ¶15.) Specifically, when discussing the layout

of antennas 1 and 2, Taniguchi explains that “the directions of induced electromotive forces generated on the antenna 2” by the magnetic field generated by antenna 1 “are such that induced current is caused to flow in the regions S1, S2 in opposite directions.” (INTEL-1005, ¶¶57, 63-64; *see also*, ¶30 (relating Figure 8 to Figure 3).) When $S1/S2=1$ ($S1=S2$), “the induced electromotive force generated on the antenna 2 as a whole becomes zero.” (INTEL-1005, ¶¶57, 30.) Accordingly, the “residual mutual inductances of the antenna 1 and the antenna 2 are put in a state of zero.” (INTEL-1005, ¶¶57, 30.) Because mutual inductance describes the coupling of two circuits by the medium of magnetic field (INTEL-1012, 68), the reduction in mutual inductance as a result of the electromagnetic field reduction is also a reduction on the mutual electromagnetic coupling between antenna 1 and antenna 2. (*See, e.g.*, INTEL-1005, Abstract (antenna 1 and antenna 2 are “inductively coupled”), ¶55 (“second antenna 2 is coupled in electromagnetic induction to the upper and lower halves of the first antenna 1”).) As I discussed in my analysis of [20P], the eight-shaped antenna has a reduced electromagnetic field which necessarily results in the magnetic coupling of the field with the second inductor to be reduced. For these reasons and the reasons discussed above for Figure 3, this layout has reduced “*mutual electromagnetic coupling*” as “*a result of the first inductor having a reduced electromagnetic field*” [1B.2].

(ii) Taniguchi's Rotated Eight-Shaped (Figures 9/10) Embodiment

157. The “*inductor layout*” of rotated eight-shaped inductor embodiment includes a second antenna 2 (shaded yellow) which is formed with antenna conductors 104, 105 “in a substantially figure eight-shaped configuration.” (INTEL-1005, ¶¶77, 73, 76; Figures 10B, 10D, 10E (reproduced below with annotations).) Antenna 2 is the recited “*second inductor*” for the reasons discussed in §IV.B.1.a ([20P]).



Taniguchi, Annotated Figures 10B, 10D-10E

158. As shown in Figure 10D above (middle), antenna 1 (shaded red) is formed on a first surface of insulation 10 and antenna 2 is formed on the opposite surface of insulation 10. (See INTEL-1005, Figure 10D, ¶¶55, 77, 68; see also,

INTEL-1005, ¶¶85-86 (describing PCB embodiment having antenna 1 and antenna 2 on opposite surfaces of the PCB.) The thickness of insulation 10 therefore represents a “predetermined distance” between the second antenna and the first antenna. Thus, Taniguchi’s rotated eight-shaped embodiment (Figures 9/10) discloses a “*second inductor positioned at a predetermined distance from the first inductor*” [1B.1]. I note that Taniguchi’s teachings are consistent with Applicant’s (PO’s) statement during prosecution of EP3567614 when addressing the Examiner’s rejection regarding lack of support: “it is submitted that the root parent application as filed does not mandate any particular distance or relative orientation of the two inductors.” (INTEL-1016, 59.)

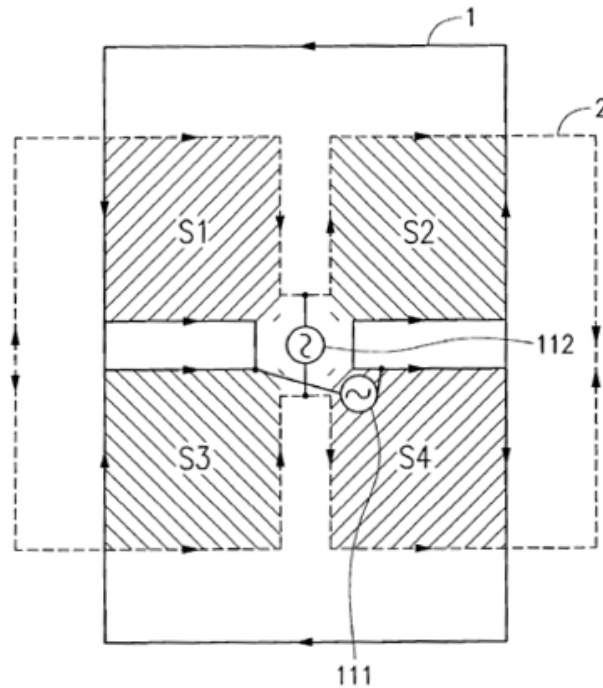
159. Taniguchi further discloses that the “*mutual electromagnetic coupling between the first inductor and the second inductor*” of the rotated eight-shaped embodiment “*is reduced as a result of the first inductor having a reduced electromagnetic field*” [1B.2]. The rotated eight-shaped embodiment uses an eight-shaped antenna with a center feeding point for antenna 1, like the eight-shaped antenna of Figure 3. (INTEL-1005, ¶73 (In the example provided in Figure 9, “antenna 1 [shaded red] is substantially figure eight-shaped **in the same manner as that shown in FIG. 3**” and “antenna 2 [shaded yellow] is turned 90° relative to the antenna 1”).) Therefore, the eight-shaped antenna 1 in the rotated eight-shaped

embodiment has a “*reduced electromagnetic field*” for the reasons I discussed above in my analysis of the lower feeding point embodiment.

160. Should the construction of “*reduced electromagnetic field*” from ITC-337-TA-1300 be adopted in this proceeding, the rotated eight-shaped (Figures 9/10) embodiment discloses the limitation. As discussed in this section and §IV.B.1.a [20P], in the rotated eight-shaped (Figures 9/10) embodiment, “the electromagnetic field emanating from the first inductor is reduced (at a certain distance from the first inductor where the second inductor is positioned).”

161. As I discussed in §IV.B.2.a, the “*inductor layout*” of each embodiment has “*reduced mutual electromagnetic coupling*” by virtue of the eight-shaped configuration of antenna 1 having a “*reduced electromagnetic field*” and the position of antenna 2. (*See, e.g.,* INTEL-1005, claim 1, ¶15.) Specifically, as shown in Figure 9 below, “[i]f an increase in antenna current in directions shown by arrows is observed in the antenna 1, then mutual inductances attributable to the regions S1 to S4 generate induced electromotive forces in the antenna 2 tending to make antenna current flow in directions shown by arrows, respectively.” (INTEL-1005, ¶74.) “Directions of the induced electromotive forces are such that the regions S1, S2 generate an electromotive force in the antenna 2 tending to make antenna current flow in the same direction and the induced electromotive force

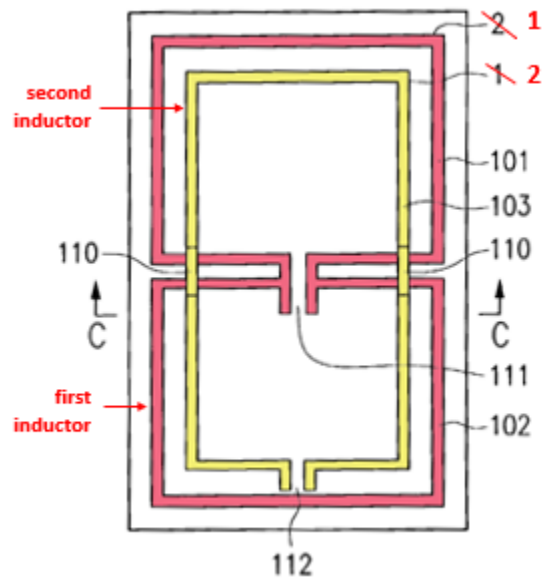
attributable to the regions S3, S4 is opposite to the induced electromotive force attributable to the regions S1, S2.” (*Id.*) When regions $S1+S2=S3+S4$, “the residual mutual inductance becomes zero.” (INTEL-1005, ¶75.) Because mutual inductance describes the coupling of two circuits by the medium of magnetic field (INTEL-1012, 68), the reduction in mutual inductance as a result of the electromagnetic field reduction is also a reduction on the mutual electromagnetic coupling between antenna 1 and antenna 2. (*See, e.g.*, INTEL-1005, Abstract (antenna 1 and antenna 2 are “inductively coupled), ¶55 (“second antenna 2 is coupled in electromagnetic induction to the upper and lower halves of the first antenna 1”).) As I discussed in my analysis of [20P], the eight-shaped antenna has a reduced far field which necessarily results in the magnetic coupling of the field with the second inductor to be reduced. For these reasons and the reasons discussed above for Figure 3, this layout has reduced “*mutual electromagnetic coupling*” as “*a result of the first inductor having a reduced electromagnetic field*” [1B.2].



Taniguchi, Figure 9

(iii) Taniguchi’s Same Plane (Figure 7) Embodiment

162. The “*inductor layout*” of the same plane embodiment includes a second antenna (shaded yellow) formed from antenna conductor 103. (INTEL-1005, ¶70; Figure 7B (reproduced below with annotations).) The rectangular antenna is the recited “*second inductor*” for the reasons discussed in §IV.B.1.a ([20P]).



Taniguchi, Annotated Figure 7B

163. In the same plane embodiment of Figure 7, “antennas 1 and 2 are arranged on either of same planes of an insulation 10”, as shown in Figure 7D. (INTEL-1005, ¶70.) That is, antennas 1 and 2 are either on the front surface of insulation 10 or on the back surface of insulation 10. In this example, the distance from antenna 1 to antenna 2 is zero in the z-direction. However, antenna 2 is further placed concentrically within antenna 1 such that the two antennas share common horizontal axis, vertical axis, and z-axis. As shown above, each side of antenna 2 is placed the same fixed distance from the corresponding side of antenna 1. As I discuss below, this concentric arrangement is necessary to achieve zero mutual inductance between the antennas. Thus, Taniguchi’s same plane

embodiment discloses a “*second inductor positioned at a predetermined distance from the first inductor*” [1B.1]. I note that Taniguchi’s teachings are consistent with Applicant’s (PO’s) statement during prosecution of EP3567614 when addressing the Examiner’s rejection regarding lack of support: “it is submitted that the root parent application as filed does not mandate any particular distance or relative orientation of the two inductors.” (INTEL-1016, 59.)

164. Taniguchi further discloses that the “*mutual electromagnetic coupling between the first inductor and the second inductor*” of the same plane embodiment (Figure 7) “*is reduced as a result of the first inductor having a reduced electromagnetic field*” [1B.2]. The same plane embodiment uses an eight-shaped antenna with a center feeding point as antenna 1, like the eight-shaped antenna of Figure 3. (INTEL-1005, ¶29 (“FIGS. 7A to 7D are views showing **another construction of the antenna shown in FIG. 3**”); INTEL-1005, ¶26 (“FIG. 4 is a view showing only lines of magnetic flux generated from the antenna 1 shown in FIG. 3 at a certain point of time”).) Therefore, the eight-shaped antenna 1 in the same plane embodiment has a “*reduced electromagnetic field*” for the reasons that I discussed in my analysis of the lower feeding point embodiment.

165. Should the construction of “*reduced electromagnetic field*” from ITC-337-TA-1300 be adopted in this proceeding, the same plane (Figure 7)

embodiment discloses the limitation. As discussed in this section and §IV.B.1.a [20P], in the same plane (Figure 7) embodiment, “the electromagnetic field emanating from the first inductor is reduced (at a certain distance from the first inductor where the second inductor is positioned).”

166. As I discussed in §IV.B.2.a, the “*inductor layout*” of each embodiment has “*reduced mutual electromagnetic coupling*” by virtue of the eight-shaped configuration of antenna 1 having a “*reduced electromagnetic field*” and the position of antenna 2. (*See, e.g.*, INTEL-1005, claim 1, ¶15.) Because the eight-shaped antenna of Figure 7 has two loops which generate repulsive lines of magnetic flux and antenna 2 is positioned concentrically within antenna 1, antenna 1 has a residual mutual inductance of zero with antenna 2. (INTEL-1005, ¶¶64, 29, 63.) Because mutual inductance describes the coupling of two circuits by the medium of magnetic field (INTEL-1012, 68), the reduction in mutual inductance as a result of the electromagnetic field reduction is also a reduction on the mutual electromagnetic coupling between antenna 1 and antenna 2. (*See, e.g.*, INTEL-1005, Abstract (antenna 1 and antenna 2 are “inductively coupled), ¶55 (“second antenna 2 is coupled in electromagnetic induction to the upper and lower halves of the first antenna 1”).) Thus, the reciprocal (and cancelling) magnetic fields of the two loops of antenna 1 which cause the reduced far field also cause reduced mutual

electromagnetic coupling between the antennas, even when the antennas are on the same plane. For these reasons and the reasons discussed above for Figure 3, this layout has reduced “*mutual electromagnetic coupling*” as “*a result of the first inductor having a reduced electromagnetic field*” [1B.2].

3. Independent Claim 11

167. Claim 11 is directed to a “*method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die*” [11P]. I understand that the ALJ in ITC-337-TA-1368 found the preamble for claim 11 provides antecedent basis for the term “*first inductor*” but is otherwise not limiting. (INTEL-1019, 2-3.) If the preamble of claim 11 is only limiting to the extent needed to provide antecedent basis for “*first inductor*”, Taniguchi also renders claim 11 obvious. Should the preamble be determined to be limiting, the combination of Taniguchi and Rostoker (Ground 2), discussed in §V.B, renders the claim obvious.

168. I note that the body of claim 11 recites overlapping subject matter with claim 1 with the primary differences being that claim 11 recites the apparatus limitations of claim 1 as method steps (e.g., “*forming ...*”, “*orienting ...*”, “*connecting ...*”, and “*positioning ...*”), as illustrated in the table below. For the

reasons discussed in §IV.B.2 for claim 1 and below, Taniguchi renders claim 11 obvious.

Claim 1	Claim 11
[1P] An inductor layout having reduced mutual electromagnetic coupling, comprising:	[11P] A method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die, comprising
[1A] a first inductor having a reduced far field, said first inductor comprising:	[11A] forming the first inductor to reduce a far field, said step of forming the first inductor comprising:
[1A.1] a first loop having a shape that is substantially symmetrical about a first predefined axis;	[11A.1] forming a first loop having a shape that is substantially symmetrical about a first predefined axis;
[1A.2a] a second loop connected to the first loop,	
[1A.2b] said second loop having a size and shape substantially identical to the first loop,	[11A.2a] forming a second loop having a size and shape substantially identical to the first loop;
[1A.2c] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and	[11A.2b] orienting the second loop in relation to the first loop such that a magnetic field emanating from the second loop tends to cancel a magnetic field emanating from the first loop; and
[1A.3] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals; and	[11A.3] connecting two closely spaced terminals to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals; and

Claim 1	Claim 11
[1B.1] a second inductor positioned at a predetermined distance from the first inductor,	[11B.1] positioning a second inductor at a predetermined distance from the first inductor,
[1B.2] wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.	[11B.2] wherein the mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.

169. For the reasons I discussed in §IV.2.b, Taniguchi’s lower feeding point (Figure 8) embodiment, rotated eight-shaped (Figures 9/10) embodiment and same plane (Figure 7) embodiment discloses “*a first inductor.*” And for the reasons I discussed in §IV.2.c, these embodiments also disclose “*a second inductor.*” Further, for the reasons I discussed in §IV.2.c [1B.2], the “*mutual electromagnetic coupling between the first inductor and the second inductor is reduced.*”

170. Limitation [11A] recites “*forming the first inductor to reduce a far field*” whereas limitation [1A] recites a “*first inductor having a reduced far field.*” Taniguchi teaches that “antenna 1 is provided **by forming** antenna conductors 101, 102 in a substantially figure eight shape, which reduces a remote electromagnetic-field effect.” (INTEL-1005, ¶¶55; 72 (example of Figure 8 is “substantially the same in antenna configuration as that shown in FIG. 3 except that a first feeding point ... is disposed on a lower side of an insulation”), 72 (“antenna 1 having a

substantially figure eight-shaped region”), 73 (example of Figure 9 is “substantially figure eight-shaped in the same manner as that shown in FIG. 3”), 76 (“FIGS. 10A to 10E are views showing a more concrete structure of the antenna shown in FIG. 9”); 77; 29 (associating Figure 7 to Figure 3).) For this reason and the reasons I discussed in §IV.B.2.b for limitation [1A], Taniguchi discloses “*forming the first inductor to reduce a far field*” [11A] for Taniguchi’s lower feeding point (Figure 8) embodiment, rotated eight-shaped (Figures 9/10) embodiment and same plane (Figure 7) embodiment.

171. Limitation [11A.1] recites “*forming a first loop having a shape that is substantially symmetrical about a first predefined axis*” whereas limitation [1A.1] recites “*a first loop having a shape that is substantially symmetrical about a first predefined axis.*” Taniguchi teaches that “antenna 1 is provided **by forming antenna conductors 101, 102** in a substantially figure eight shape.” (INTEL-1005, ¶¶55; 72 (example of Figure 8 is “substantially the same in antenna configuration as that shown in FIG. 3 except that a first feeding point ... is disposed on a lower side of an insulation”), 73 (example of Figure 9 is “substantially figure eight-shaped in the same manner as that shown in FIG. 3”), 76 (“FIGS. 10A to 10E are views showing a more concrete structure of the antenna shown in FIG. 9”), 29 (FIGS. 7A to 7D are view showing another construction of the antenna shown in

FIG. 3”), 77 (“**antenna conductors 101,102** are used to form an antenna 1 on one of main surfaces of an insulation 10 in a substantially figure eight-shaped configuration”).) Thus, for this reason and the reasons I discussed in §IV.B.2.b for limitation [1A.1], Taniguchi’s lower feeding point (Figure 8) embodiment, rotated eight-shaped (Figures 9/10) embodiment and same plane (Figure 7) embodiment disclose “*forming a first loop having a shape that is substantially symmetrical about a first predefined axis*” [11A.1].

172. Limitation [11A.2a] recites “*forming a second loop having a size and shape substantially identical to the first loop*” whereas limitation [1A.2b]¹⁷ recites “*said second loop having a size and shape substantially identical to the first loop.*” Taniguchi teaches that “antenna 1 is provided **by forming antenna conductors 101, 102** in a substantially figure eight shape.” (INTEL-1005, ¶¶55; 72 (example of Figure 8 is “substantially the same in antenna configuration as that shown in FIG. 3 except that a first feeding point ... is disposed on a lower side of an insulation”), 73 (example of Figure 9 is “substantially figure eight-shaped in the same manner as that shown in FIG. 3”), 76 (“FIGS. 10A to 10E are views showing a more concrete structure of the antenna shown in FIG. 9”), 29 (FIGS. 7A to 7D are view

¹⁷ Claim 11 does not recite a limitation similar in scope to limitation [1A.2a].

showing another construction of the antenna shown in FIG. 3”), 77 (“**antenna conductors 101,102** are used to form an antenna 1 on one of main surfaces of an insulation 10 in a substantially figure eight-shaped configuration”).) Thus, for this reason and the reasons I discussed in §IV.B.1.2 for limitation [1A.2], Taniguchi’s lower feeding point (Figure 8) embodiment, rotated eight-shaped (Figures 9/10) embodiment and same plane (Figure 7) embodiment disclose “*forming a second loop having a size and shape substantially identical to the first loop*” [11A.2a].

173. Limitation [11A.2b] recites “*orienting the second loop in relation to the first loop such that a magnetic field emanating from the second loop tends to cancel a magnetic field emanating from the first loop*” whereas limitation [1A.2c] recites “*said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop.*” As I discussed above in §IV.B.2.b, the loops of antenna 1 are oriented to be eight-shaped such that current flows in opposite directions in the loops. As a result of this shape, the magnetic field from the second loop cancels the magnetic field from the first loop. Thus, for this reason and the reasons I discussed in §IV.B.2.b for limitation [1A.2], Taniguchi’s lower feeding point (Figure 8) embodiment, rotated eight-shaped (Figures 9/10) embodiment and same plane (Figure 7) embodiment discloses “*orienting the second loop in relation to the first loop such that a magnetic field*

emanating from the second loop tends to cancel a magnetic field emanating from the first loop” [11A.2b].

174. Limitation [11A.3] recites “*connecting two closely spaced terminals to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals*” whereas limitation [1A.3] recites “*two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.*” As discussed in §IV.B.1.c, Taniguchi’s feeding point 111 in each of the lower feeding point (Figure 8) embodiment, the rotated eight-shaped (Figures 9/10) embodiment and the same plane (Figure 7) embodiment includes “*two closely spaced terminals*” which are connected to the “*first loop.*” Thus, for the reasons discussed in that section, Taniguchi’s lower feeding point (Figure 8) embodiment, rotated eight-shaped inductor (Figures 9/10) embodiment and same plane (Figure 7) embodiment disclose “*connecting two closely spaced terminals to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.*”

175. Limitation [11B.1] recites “*positioning a second inductor at a predetermined distance from the first inductor*” whereas limitation [1B.1] recites

“a second inductor positioned at a predetermined distance from the first inductor.”

Limitations [1B.2] and [11B.2] are identical. Thus, for the reasons discussed in §IV.B.2.c for limitations [1B.1]-[1B.2], Taniguchi’s lower feeding point (Figure 8) embodiment, rotated eight-shaped (Figures 9/10) embodiment and same plane (Figure 7) embodiment disclose *“positioning a second inductor at a predetermined distance from the first inductor”* [11B.1] and *“wherein the mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field”* [11B.2].

C. Dependent Claims

1. Claims 3 and 13

176. Claims 3 and 13 are directed to same subject matter, as illustrated in the following table. Taniguchi renders claims 3 and 13 obvious.

Claim 3	Claim 13
The inductor layout according to claim 1, wherein said first inductor and said second inductor are oriented in a same direction.	The method according to claim 11, wherein the step of positioning the second inductor includes orienting said first inductor and said second inductor in a same direction.

177. The ’430 patent use of the term *“orientation”* encompasses the physical placement of inductors. The ’430 patent states that “Table 1 [reproduced below] shows a summary of the simulation results for the mutual coupling between

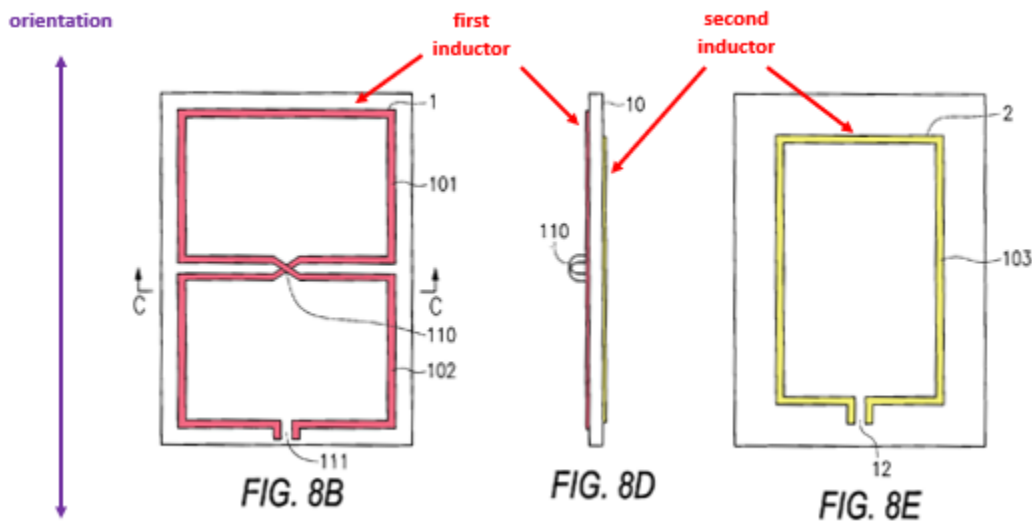
different coil shapes and **orientations for two inductors** at a center distance of 1 mm.” (INTEL-1001, 6:58-61.) For example, the ’430 patent refers to an orientation having no rotation or a 45- and 90- degree rotation of one inductor relative to the other. (See INTEL-1001, 6:61-65; *see also*, 7:47-49 (“With this arrangement, some degradation of the inductor isolation was observed, but even at a 1 mm offset, which corresponds to **an orientation of 45 degrees**”).)

TABLE 1

Inductor 1	Inductor 2	L1 [nH]	Q1	Gvdd [dB]	Att [dB]	K
O-shape	O-shape	0.841	16.93	-54.0	reference	0.002077
8-shape	O-shape	1.216	15.20	-75.6	21.6	0.000173
8-shape_90	O-shape	1.218	15.63	-74.9	20.9	0.000187
8-shape	8-shape	1.216	15.84	-86.5	32.5	0.000049
8-shape_90	8-shape	1.216	15.19	-89.7	35.7	0.000034
8-shape_90	8-shape_-90	1.217	15.69	-92.8	38.8	0.000024

178. The example antenna layout illustrated in Figures 8A-8E (Figures 8B, 8D, 8E reproduced below) of the lower feeding point (Figure 8) embodiment “are substantially the same in antenna configuration as that shown in FIG. 3 except that a first feeding point 111 and a second feeding point 112 are disposed on a lower side of an insulation 10.” (INTEL-1005, ¶72.) As shown in Figures 8B and 8E below, both antenna 1 and antenna 2 have a general overall rectangular shape with the length, width, and height (thickness) of antenna 1 oriented in the same direction as the length, width, and height of antenna 2. If positioning of terminals (and/or

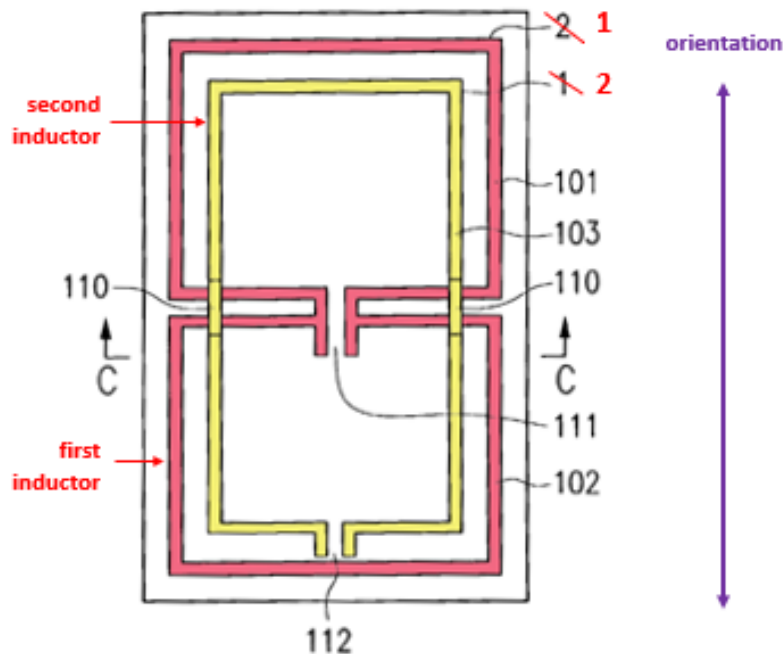
direction of current flow in/out of the inductor) determines orientation, I note that Taniguchi's Figure 8 embodiment discloses the feeding points 111 and 112 [misabeled 12] are disposed on the lower side of both antennas with the same direction of current in/out of the antennas. (See INTEL-1005, Figures 8B, 8E (below).) Thus, Taniguchi's lower feeding point (Figure 8) embodiment discloses the antenna 1 ("first inductor") and antenna 2 ("second inductor") "are oriented in a same direction" [3] and the "step of positioning the second inductor includes orienting said first inductor and said second inductor in a same direction" [13].



Taniguchi, Annotated Figures 8B, 8D-8E

179. As shown in Figure 7B (below) of the same plane (Figure 7) embodiment, both antenna 1 and antenna 2 have a generally rectangular shape with length, width, and height (thickness) of both antennas oriented in the same

direction. If positioning of terminals (and/or direction of current flow in/out of the inductor) determines orientation, Taniguchi's Figure 7 embodiment discloses the feeding points 111 and 112 are disposed with the same direction of current in/out of the antennas. Thus, Taniguchi's same plane (Figure 7) embodiment discloses the eight-shaped antenna ("*first inductor*") and rectangular antenna ("*second inductor*") of the same plane embodiment "*are oriented in a same direction*" [3] and "*the step of positioning the second inductor includes orienting said first inductor and said second inductor in a same direction*" [13].



Taniguchi, Annotated Figure 7B

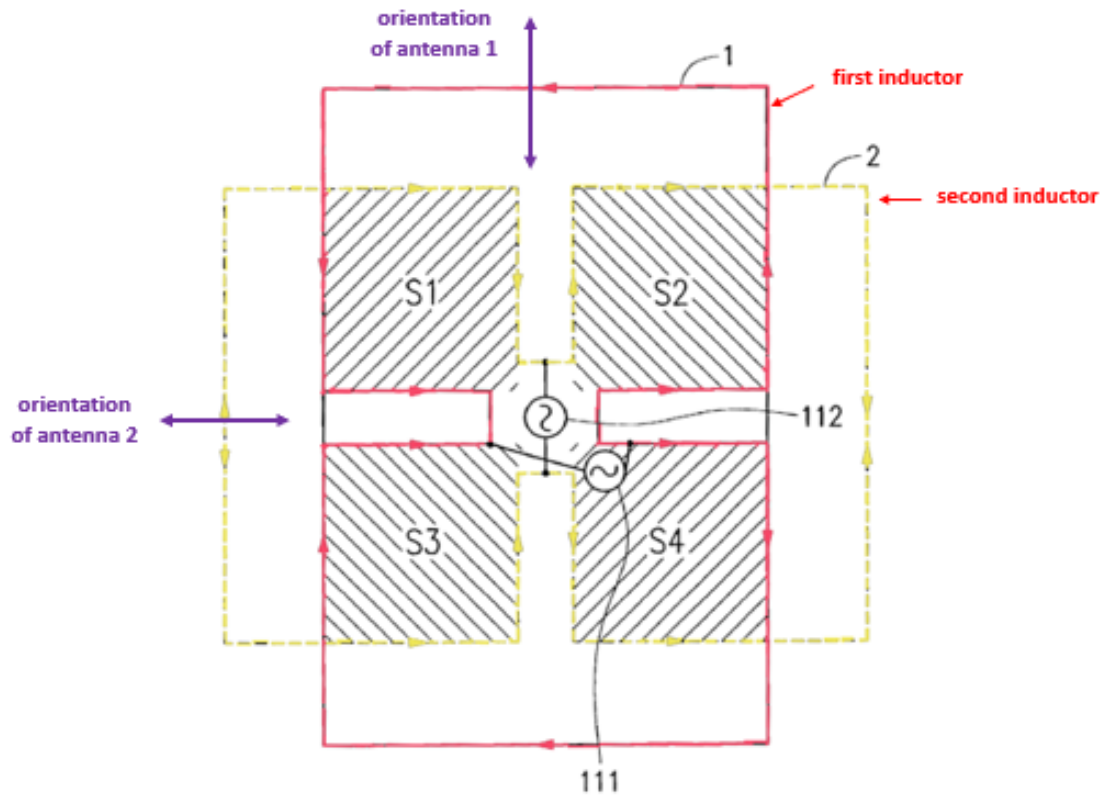
2. Claims 4 and 14

180. Claims 4 and 14 are directed to the same subject matter, as illustrated in the table below. Taniguchi renders claims 4 and 14 obvious.

Claim 4	Claim 14
The inductor layout according to claim 1, wherein said first inductor and said second inductor are oriented in different directions.	The method according to claim 11, wherein the step of positioning the second inductor includes orienting said first inductor and said second inductor in different directions.

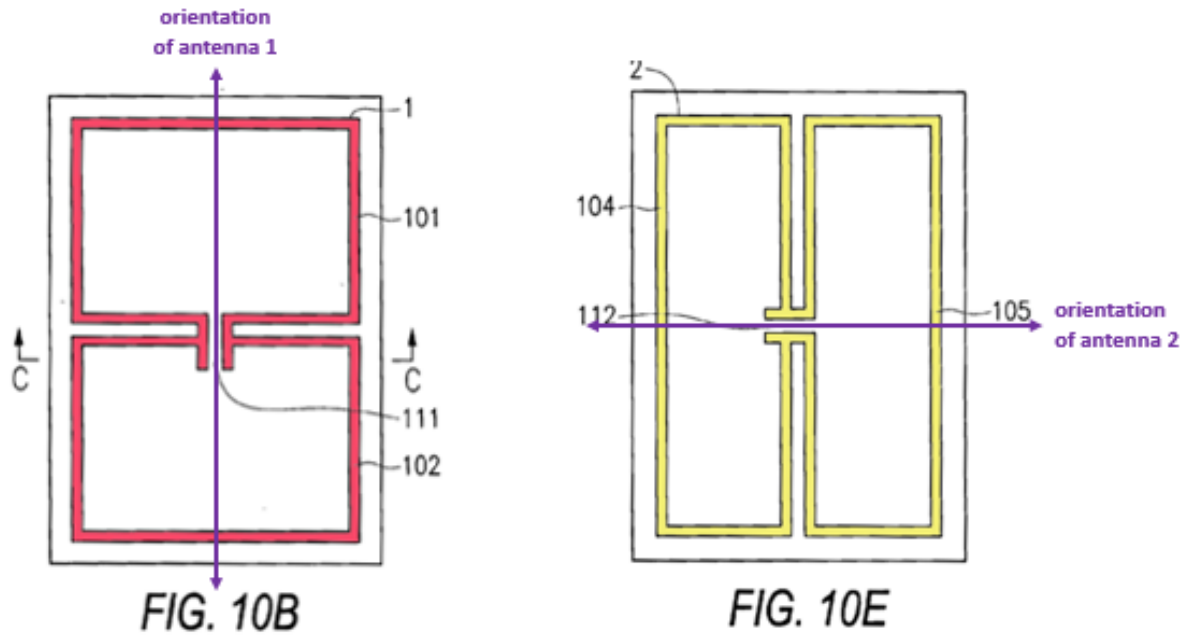
181. In the example antenna layout of the rotated eight-shaped (Figures 9/10) embodiment, illustrated in Figure 9 (reproduced below), “antenna conductors 101, 102 are used to form an antenna 1 on one of main surfaces of an insulation 10 in a substantially figure eight-shaped configuration, and antenna conductors 104, 105 are used to form an antenna 2 on the other of the main surfaces of the insulation 10 **in a substantially figure eight-shaped configuration.**” (INTEL-1005, ¶73 (“antenna 1 is substantially figure eight-shaped in the same manner as that shown in FIG. 3, and an antenna 2 **is turned 90°** relative to the antenna 1”); *see also*, INTEL-1005, ¶77.) Thus, Taniguchi’s rotated eight-shaped (Figures 9/10) embodiment discloses antenna 1 (“*first inductor*”) and antenna 2 (“*second inductor*”) “*are oriented in different directions*” [4] and “*the step of positioning the*

second inductor includes orienting said first inductor and said second inductor in different directions” [14].



Taniguchi, Annotated Figure 9

182. If positioning of terminals (and/or direction of current flow in/out of the inductor) determines orientation, in Taniguchi’s rotated eight-shaped embodiment, feeding point 111 of antenna 1 has a vertical direction and feeding point 112 of rotated antenna 2 has a horizontal direction, by virtual of the 90-degree rotation, as illustrated in Figures 10B and 10E below. Thus, the Figures 9/10 embodiment renders claims 4 and 14 obvious under this interpretation.



Taniguchi, Annotated Figures 10B, 10E

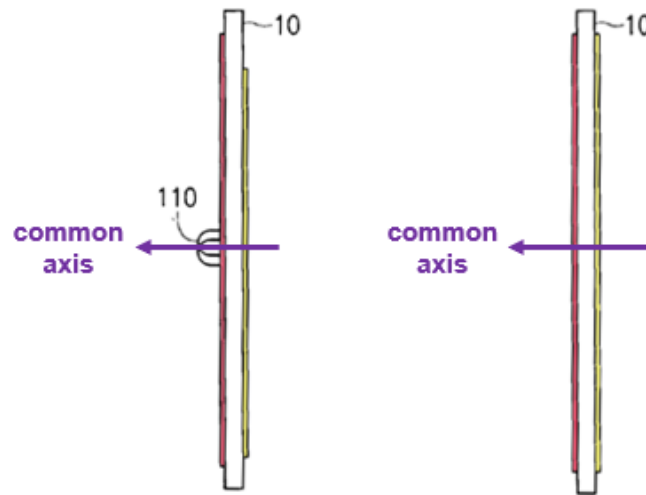
3. Claims 5 and 15

183. Claims 5 and 15 are directed to the same subject matter, as illustrated in the table below. Taniguchi renders claims 5 and 15 obvious.

Claim 5	Claim 15
The inductor layout according to claim 1, wherein said first inductor and said second inductor share a common axis.	The method according to claim 11, wherein the step of positioning the second inductor includes placing said first inductor and said second inductor on a common axis that is shared by said first inductor and said second inductor.

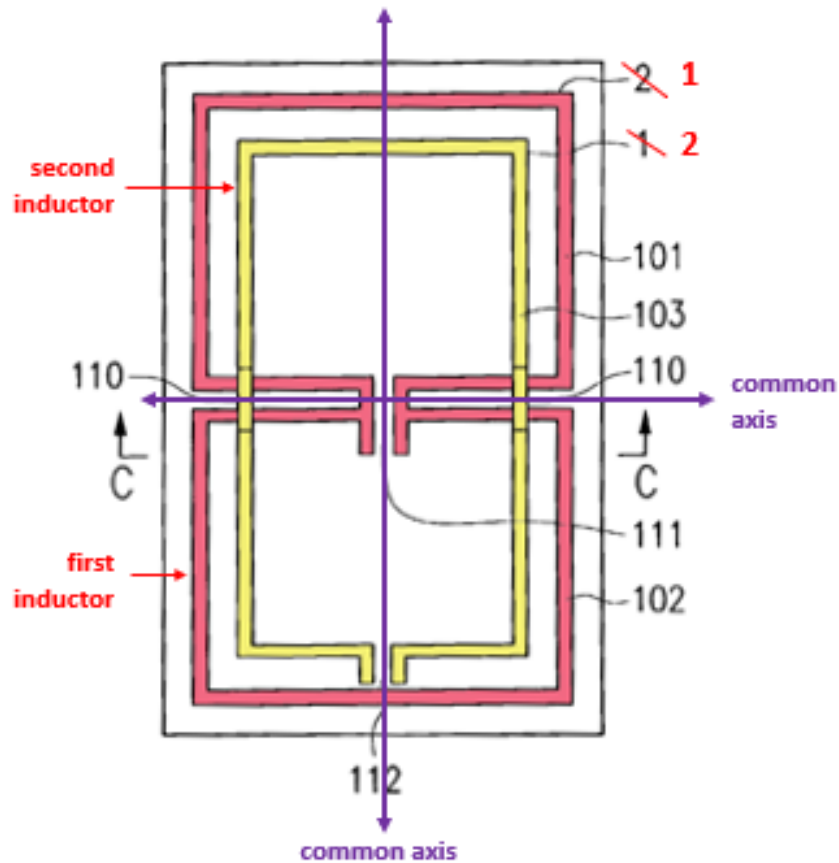
184. In both Taniguchi's lower feeding point (Figure 8) embodiment and rotated eight-shaped (Figures 9/10) arrangement, antenna 2 ("second inductor") is

formed in a plane parallel to the plane on which antenna 1 (*“first inductor”*) is formed. (INTEL-1005, ¶¶30-32, 55, 71-73, 76-77.) As illustrated in Figure 8D (left) for the Figure 8 embodiment and Figure 10D (right) for the Figures 9/10 embodiment, antenna 1 (shaded red) and antenna 2 (shaded yellow) share the z-axis. (See INTEL-1005, ¶¶57, 72, 74-75, 79, Figures 3, 8-9.) This is confirmed by Taniguchi’s specification which describes concentric placement of antenna 2 in the Figure 8 embodiment having a rectangular second antenna so that overlapping regions S1 and S2 are equal ($S1=S2$) and in the Figures 9/10 embodiment having an eight-shaped antenna 2 so that overlapping regions S1 and S2 equal regions S3 and S4 ($S1+S2=S3+S4$). (INTEL-1005, ¶¶57, 72 (associating Figure 8 with Figure 3), 74-75, 79 (discussing Figure 9); Figures 8-10.) Thus, Taniguchi’s lower feeding point (Figure 8) embodiment and rotated eight-shaped (Figures 9/10) embodiment each discloses that the *“first inductor and said second inductor share a common axis”* [5] and *“placing said first inductor and said second inductor on a common axis that is shared by said first inductor and said second inductor”* [15].



Taniguchi, Annotated Figure 8D (left); Annotated Figure 10D (right)

185. In Taniguchi’s same plane arrangement (Figure 7), antenna 2 (“*second inductor*”) is formed in the same plane as the plane on which antenna 1 (“*first inductor*”) is formed. (See INTEL-1005, ¶70; Figure 7B (reproduced below with annotation).) As illustrated in Figure 7B below, the inductors are placed concentrically in the same plane, and the overlapping regions S1 and S2 are equal, resulting in zero mutual inductance. (see INTEL-1005, ¶¶55, 57, 70; Figure 3). Therefore, antennas 1 and 2 share a common vertical axis, horizontal axis, and z-axis. Taniguchi’s same plane (Figure 7) embodiment thus also discloses that the “*first inductor and said second inductor share a common axis*” [5] and “*placing said first inductor and said second inductor on a common axis that is shared by said first inductor and said second inductor*” [15].



Taniguchi, Annotated Figure 7D

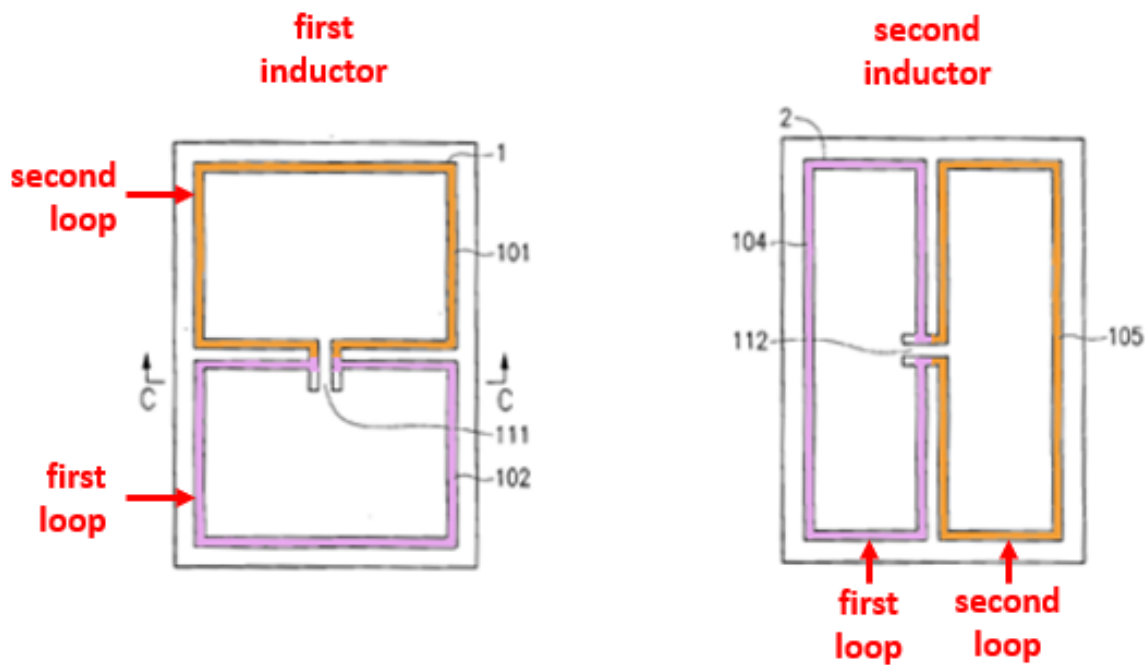
4. Claims 7 and 17

186. Taniguchi renders claim 7 obvious. Claim 17 is directed to similar subject matter as claim 7, except claim 17 recites that the first inductor is substantially 8-shaped whereas claim 7 recites that both inductors are substantially 8-shaped. Taniguchi also renders claim 17 obvious.

Claim 7	Claim 17
The inductor layout according to claim 1, wherein the second inductor also includes two loops, and said first	The method according to claim 11, wherein the step of orienting the second loop in relation to the first loop

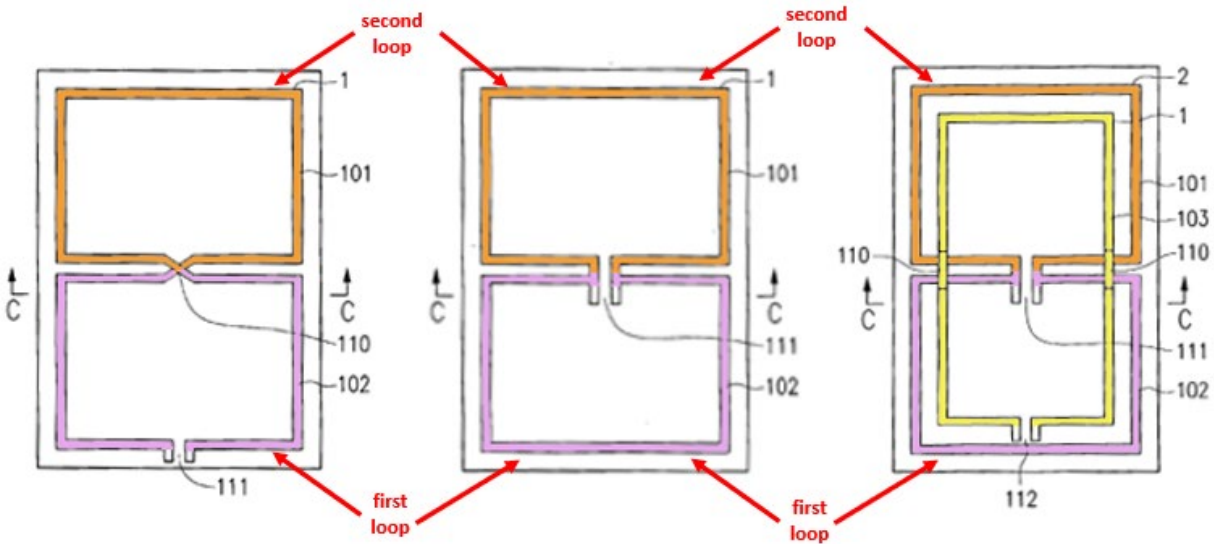
inductor and said second inductor are substantially 8-shaped.	includes placing the first and second loops in a substantially 8-shape.
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187. In the antenna layout of the rotated eight-shaped (Figures 9/10) embodiment, “**antenna conductors 101, 102** are used to form an antenna 1 on one of main surfaces of an insulation 10 in a **substantially figure eight-shaped configuration**, and **antenna conductors 104, 105** are used to form an antenna 2 on the other of the main surfaces of the insulation 10 in a **substantially figure eight-shaped configuration**.” (INTEL-1005, ¶77; *see also*, Figures 9, 10A-10E.) Antenna conductors 104 and 105 are each a loop as shown below in Figure 10E for the same reasons as I discussed in §IV.B.1.b for the first and second loops. (INTEL-1005, ¶¶64, 94-95; *see also*, §IV.B.1.b (discussion of first and second loops).) Thus, Taniguchi’s Figure 9/10 layout discloses “*the second inductor also includes two loops, and said first inductor and said second inductor are substantially 8-shaped*” [7].



Taniguchi, Annotated Figures 10B, 10E

188. As I discussed in my analysis of claims 1, 11, and 20, antenna 1 in each of the lower feeding point (Figure 8), rotated eight-shaped (Figures 9/10), and same plane (Figure 7) embodiments are eight-shaped, as shown below. (See INTEL-1005, ¶¶55, 71, 73, 29.) Thus, Taniguchi’s embodiments disclose “orienting the second loop in relation to the first loop includes placing the first and second loops in a substantially 8-shape” [17].



Taniguchi, Annotated Figure 8B (left), 10B (center) and 7B (right)

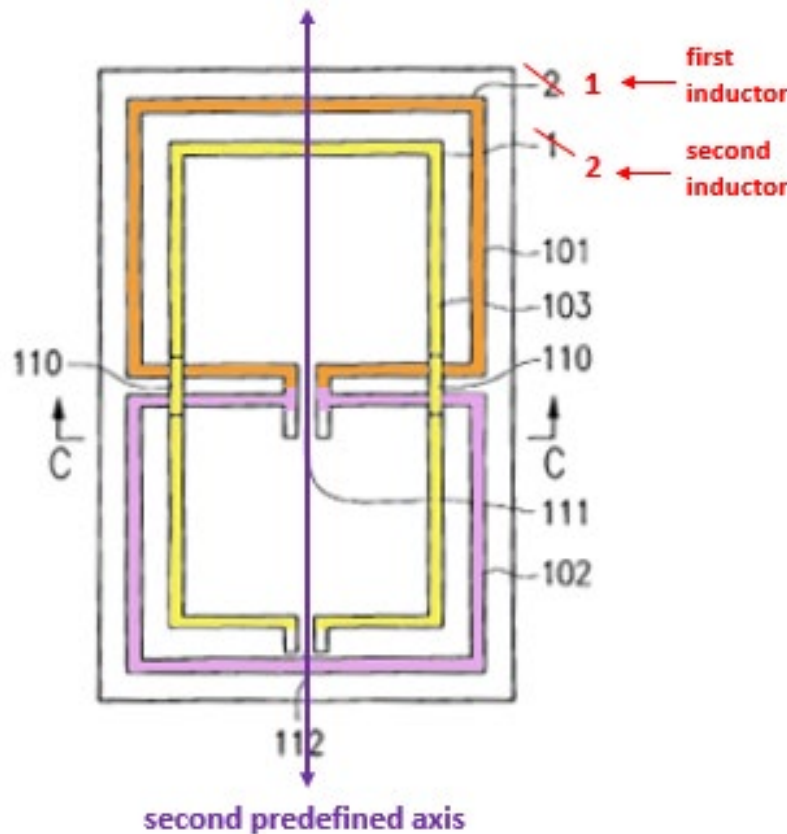
5. Claims 10 and 19

189. Claims 10 and 19 are directed to the same subject matter, as highlighted in the table below. Taniguchi renders claims 10 and 19 obvious.

Claim 10	Claim 19
The inductor layout according to claim 1, wherein said first inductor and said second inductor are symmetrical about a second predefined axis.	The method according to claim 11, wherein the step of positioning the second inductor includes positioning said first inductor and said second inductor so that they are symmetrical about a second predefined axis.

190. Taniguchi’s same plane (Figure 7) embodiment discloses the “*first inductor and said second inductor*” are positioned to be “*symmetrical*” about the vertical axis (“*a second predefined axis*”). As shown below, antenna 1 (“*first inductor*”) is symmetrical about the vertical (y-axis) and antenna 2 (“*second*

inductor”) is also symmetrical about the same vertical (y-axis) because both antenna 1 and antenna 2 are formed on the same plane and antenna 2 is placed within antenna 1. (INTEL-1005, ¶70; Figure 7B (below).) As I noted previously, this concentric placement is necessary to create overlapping regions of the same size so that the residual mutual inductance between antennas 1 and 2 is zero. Thus, for the same plane (Figure 7) embodiment, Taniguchi discloses or renders obvious that the “*first inductor and said second inductor are symmetrical about a second predefined axis*” [10] and “*the step of positioning the second inductor includes positioning said first inductor and said second inductor so that they are symmetrical about a second predefined axis*” [19].



Taniguchi, Annotated Figure 7B

6. Claim 21

191. Taniguchi discloses the subject matter of claim 21, which is reproduced below:

21. The inductor according to claim 20, wherein said first loop and said second loop are substantially symmetrical about a second predefined axis.

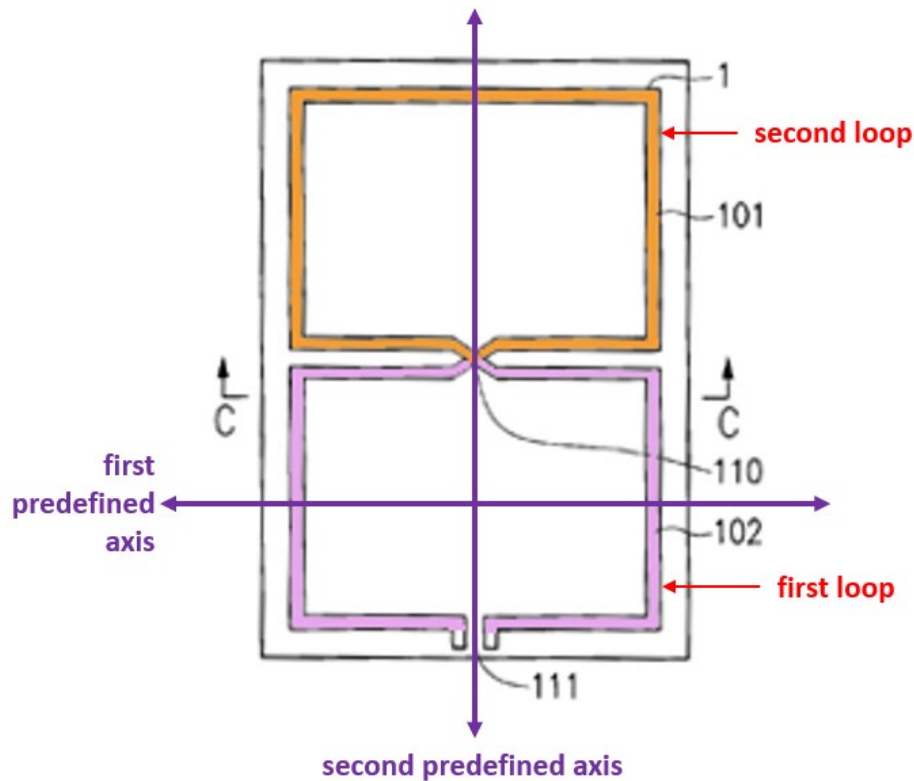
192. The '430 patent does not provide guidance as to the scope of the term *“said first loop and said second loop are substantially symmetrical about a second*

predefined axis” because it does not describe the boundaries of “*substantially*.”

Taniguchi discloses this limitation, consistent with the disclosure of the ’430 patent.

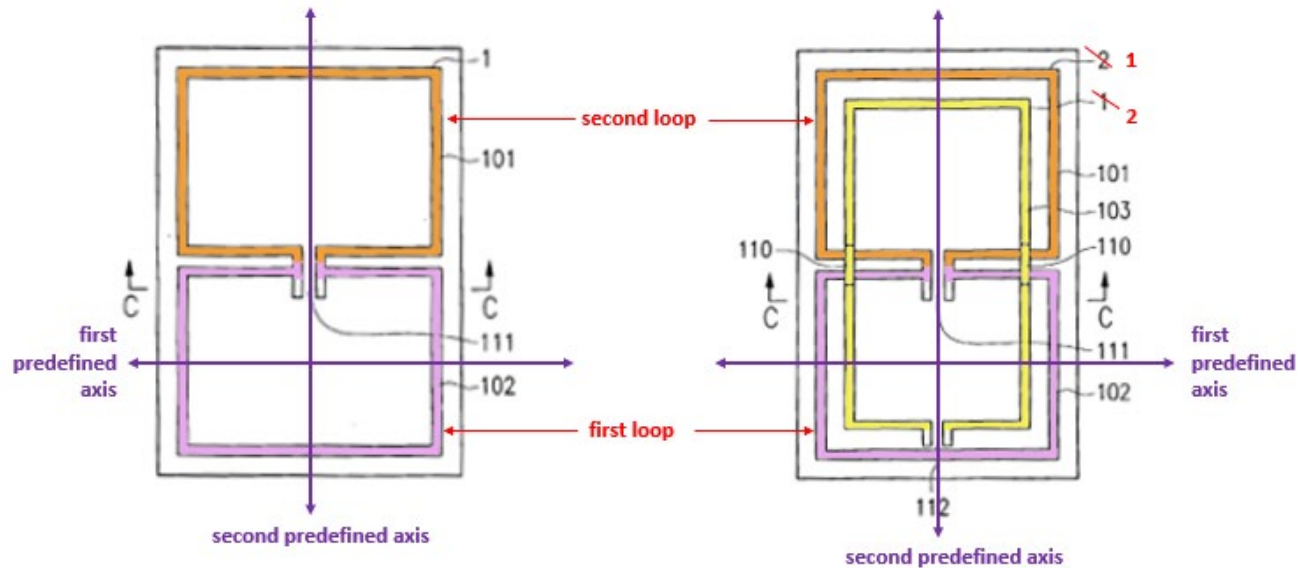
193. As discussed in my analysis of limitation [20A] in §IV.B.1.b, each of the lower feeding point (Figure 8), rotated eight-shape (Figures 9/10), and same plane (Figure 7) disclose the “*first loop*” of eight-shaped antenna 1 is “*substantially symmetrical about*” both the horizontal and vertical axes, consistent with the disclosure of the ’430 patent. (See INTEL-1001, 4:25-27.)

194. For the lower feeding point (Figure 8) embodiment, illustrated in Figure 8B below, when the horizontal axis is the “*first predefined axis*” and the vertical axis is the “*second predefined axis*,” the “*second loop*” is also “*substantially symmetrical about*” the vertical axis (like the “*first loop*”), consistent with the disclosure of the ’430 patent, because antenna 1 “is divided into upper and lower **halves** by the antenna conductors 101, 102.” (INTEL-1005, ¶¶55, 72.)



Taniguchi, Annotated Figure 8B

195. Similarly, for rotated eight-shape (Figures 9/10) and same plane (Figure 7) embodiments (shown in Figure 10B and 7B above) which share the same configuration for antenna 1, when the horizontal axis is the “*first predefined axis*” and the vertical axis is the “*second predefined axis*,” the “*second loop*” is also “*substantially symmetrical about*” the vertical axis, consistent with the disclosure of the ’430 patent, because antenna 1 “is divided into upper and lower **halves** by the antenna conductors 101, 102.” (INTEL-1005, ¶¶55, 29, 72-73, 76.)



Taniguchi, Annotated Figure 10B (left), Figure 7B (right)

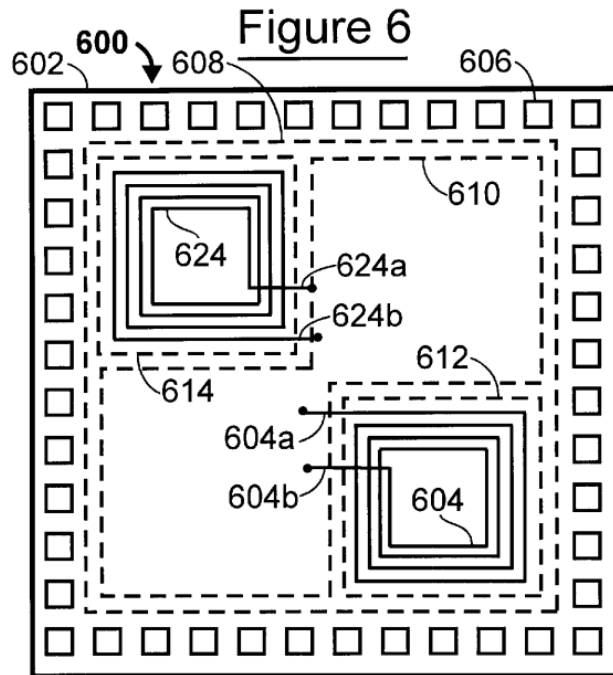
V. GROUND 2: The combination of Taniguchi and Rostoker renders claims 2, 8, 11, 13-15, and 17-19 obvious.

A. Overview of the Combination

1. Overview of Rostoker

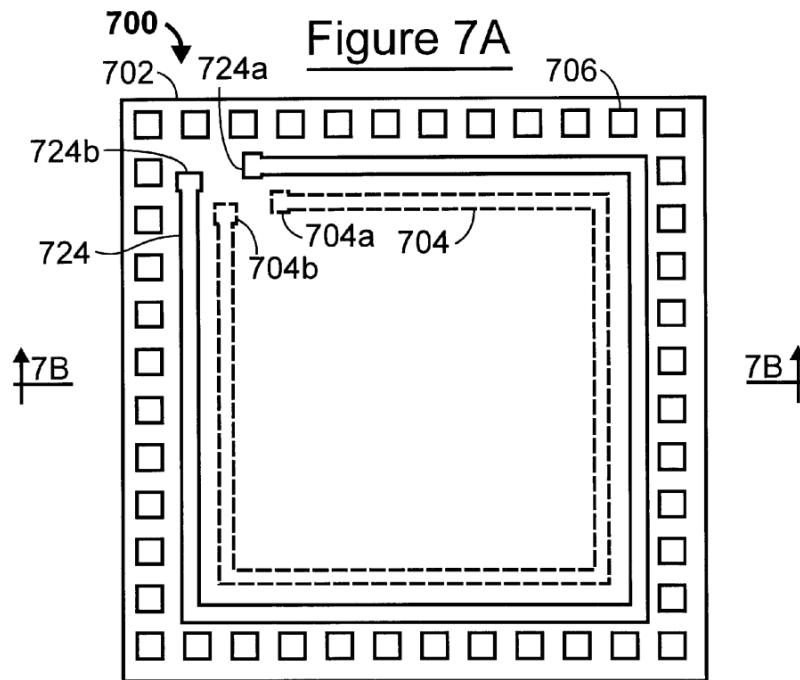
196. U.S. Patent 6,373,447 to Rostoker, et al. (“Rostoker”; INTEL-1006) issued on April 16, 2002 which is more than one year before the earliest priority date claimed on the face of the ’430 patent. Rostoker is directed to the formation of one or more antennas on an integrated circuit (IC) chip. (INTEL-1006, Abstract; *see also*, INTEL-1006, 3:55-57 (“Another object of the invention is to provide techniques for integrating multiple antennas on an integrated circuit (IC) chip”).)

197. Rostoker discloses embodiments where “two or more antennas are formed on an integrated circuit (IC) chip.” (INTEL-1006, 8:64-67.) In the embodiment depicted in Figure 6 (below), two antennas are disposed on the surface of a single IC chip. (*See, e.g.*, INTEL-1006, 8:64-9:42.) In this embodiment, “antenna 604 is disposed within the second portion 612 of the central area 608 of the chip 602, the antenna 624 is disposed within the third portion 614 of the central area 608 of the chip 602, and related circuitry (not shown) is disposed within the first portion 610 of the central area 608 of the chip 602.” (INTEL-1006, 9:12-18.) The “area 612 occupied by the antenna 604 could extend to one or two or three (but not all four) edges of the chip 602” and “the area 614 occupied by the antenna 624 could extend to one or two or three (but not all four) edges of the chip 602” provided there are no bond pads (606) in those areas. (INTEL-1006, 9:36-42.)



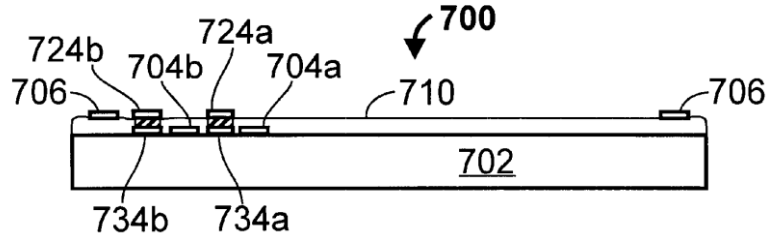
Rostoker, Figure 6

198. Rostoker also describes an embodiment having stacked antennas, illustrated in Figure 7A below. In this embodiment, two antennas 704 and 724 “are disposed in two different vertical planes on a single integrated circuit (IC) chip 702.” (INTEL-1006, 10:9-12.) As explained by Rostoker, it was “well known in integrated circuit manufacturing processes to have two or more metallization layers, separated from one another by an insulating layer, and to pattern the metallization layers to have lines, and to interconnect one metallization layer to another by metal-filled ‘vias’ which are openings through an insulating layer.” (INTEL-1006, 10:16-21.)



Rostoker, Figure 7A

199. In the stacked antenna embodiment, first antenna 704 “is formed in a first metallization layer.” (INTEL-1006, 10:23-25.) The ends of the first antenna labeled 704a and 704b are used to couple the antenna to other components and therefore act as the first antenna’s terminals. (See INTEL-1006, 6:3-5 (“By way of background, a single-turn loop antenna is a metallic conductor bent into the shape of circle or square, with a gap in the conductor to form the **terminals**”).) A second antenna 724 “is formed in a second metallization layer.” (INTEL-1006, 10:25-27.) “An insulating layer 710 is disposed between the first and second metallization layers.” (INTEL-1006, 10:27-29.)



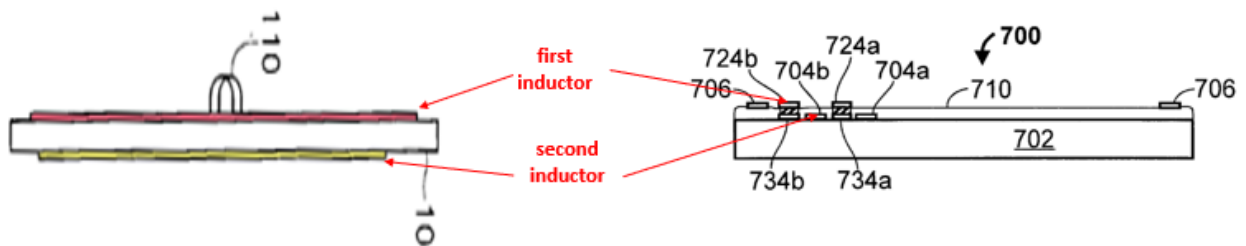
Rostoker, Figure 7B

200. In the “stacked loops” embodiment, the two antennas 704 and 724 are not connected and therefore “function independently, such as one antenna being a receiving antenna and the other antenna being a transmitting antenna.” (INTEL-1006, 10:47-51.) Although Figures 7A and 7B illustrate single loop antennas, Rostoker does not limit the type of antenna used, explicitly stating that the antennas “can be formed as any of the types of antennas described herein.” (INTEL-1006, 10:60-63.) For example, Rostoker teaches that the antennas can be multi-turn loop or square spiral antennas. (INTEL-1006, 9:19-21.) In addition to loop, multi-turn loop and square spiral antennas, Rostoker describes long-wire antennas, dipole antennas, and multiple segment antennas. (*See, e.g.*, INTEL-1006, 7:18-8:59, 4:11-13.)

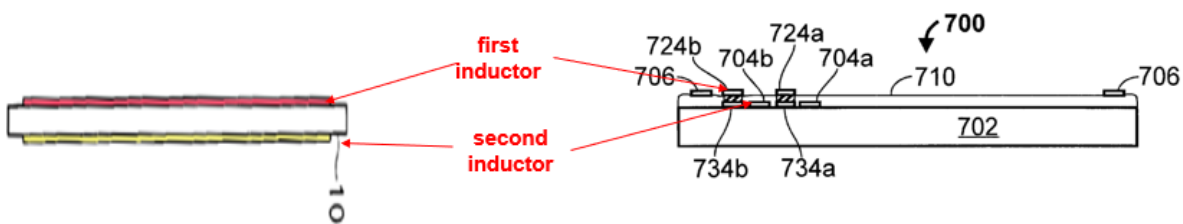
2. Motivation to Combine

201. A POSITA would have been motivated to implement each of Taniguchi’s lower feeding point embodiment (Figure 8) and rotated eight-shaped embodiment (Figure 9/10) using the stacked antenna teachings of Rostoker.

Specifically, as illustrated in annotated Taniguchi Figure 8D and annotated Rostoker Figure 7B (below top) and annotated Figure 10D and Rostoker Figure 7B (below bottom), a POSITA would have been motivated to implement Taniguchi's antenna 1 (shaded red) in a second metallization layer and Taniguchi's antenna 2 (shaded yellow) in a first metallization layer with an insulating layer separating the two metallization layers.



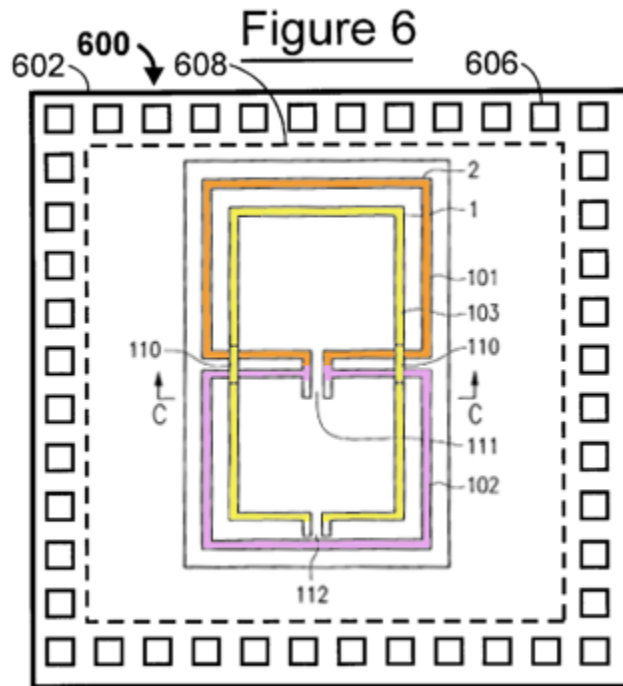
Taniguchi, Figure 8D (annotated/rotated); Rostoker, Figure 7B



Taniguchi, Figure 10D (annotated/rotated); Rostoker, Figure 7B

202. A POSITA would have further been motivated to implement Taniguchi's same plane embodiment (Figure 7) using the multiple antennas on same plane teachings of Rostoker. Specifically, as illustrated in the figure below in

which I excerpt the antenna layout of Taniguchi's Figure 7B and superimpose it on Figure 6 of Rostoker, a POSITA would have been motivated to implement Taniguchi's antennas 1 and 2 in the central area of the chip.



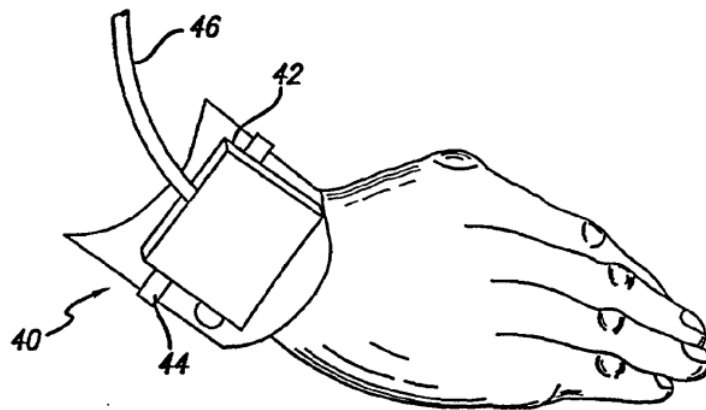
**Excerpts of Annotated Taniguchi, Figure 7B superimposed
on Rostoker, Figure 6**

203. Taniguchi and Rostoker share the same field as the '430 patent and are reasonably pertinent to the same problem as the '430 patent—efficient circuit design. (INTEL-1001, Abstract, 3:4-18; INTEL-1005, Abstract, ¶¶1, 3; INTEL-1006, Abstract, 3:55-57, 8:64-67.) A POSITA would have been motivated to make the above combinations for numerous reasons. First, Taniguchi suggests the combinations described above, repeatedly stating the goal of “mak[ing] a data

communication apparatus which is **small-sized**, lightweight and high in performance.” (INTEL-1005, ¶22; *see also*, INTEL-1005, ¶¶86, 95.) Although Taniguchi describes an application of its embodiments in gates, Taniguchi also teaches use in alternative applications including “electronic coupon ticket systems.” (INTEL-1005, ¶¶1-2.) A POSITA would have understood that it is beneficial for such applications, which often use hand-held or wearable interrogators, to integrate as many components as possible, including the antennas, on a single die to achieve a small form factor device. (*See, e.g.*, INTEL-1022, 1:6-32, 3:50-56 (describing a single chip “sending-and-receiving station” for use in a contactless inductively coupled system); INTEL-1025, 1:29-2:65 (describing a single chip radio), 1:40-48, 8:11-55; INTEL-1026, ¶¶3, 18-19 (describing a wrist mounted RFID device); INTEL-1027, 6:54-61, 7:43-46 (describing a hand-held, portable RFID device).) I describe two of these devices below.

204. As a first example, U.S. Patent Publication 2002/0044058 to Heinrich, et al (“Heinrich”; INTEL-1026) is directed to “a wrist or hand-mounted RFID antenna or combined reader and antenna that allows an operator to read or identify RFID tagged items without using the hands.” (INTEL-1026, ¶3.) As shown in Figure 2 from Heinrich (reproduced below), a housing 42 affixed to an operator’s wrist includes both the RFID reader and antenna. (INTEL-1026, ¶18.) The RFID

scanner 40 reads “RFID tags automatically as they come into proximity with the scanner, without physical intervention by the operator.” (INTEL-1026, ¶19.) A POSITA would have understood that integrating components (including the antenna) onto a single chip would enable a small form factor interrogator like the one described in Heinrich.



Heinrich, Figure 2

205. As a further example, U.S. Patent 6,970,088 to Kovach (“Kovach”), describes a method “for tracking and handling people and articles at an airport using Radio-Frequency Identification (‘RFID’) tags.” (INTEL-1027, Abstract.) The tag “may be made part of a passenger's identifying means, such as a credit card or frequent-flyer card”, “may also be made an integral part of baggage tags, passenger tickets, passports, boarding passes, and other travel documents”, or “may be affixed to packages being shipped by air.” (INTEL-1027, 2:21-27.) Kovach discloses that “security personnel may carry **hand-held scanners** to

perform random passenger checks at step 125 by simply coming into proximity to the RFID tags carried by passengers.” (INTEL-1027, 6:54-57.)

206. Second, Rostoker also suggests the combinations, teaching that a need exists in systems having low power (range) requirements “to have an antenna structure integrated onto single semiconductor devices.” (INTEL-1006, 1:10-14.) Non-contact identification systems using inductive coupling, such as disclosed by Taniguchi, were known to have low read/write ranges (e.g., less than 1 m). (*See*, INTEL-1012, 22-23 (describing that inductive (magnetic) coupling systems have write and read ranges up to 1 m), 26-27 (describing a range of 5-10 cm for a ticketing system).) Therefore, based on Rostoker’s suggestion, a POSITA would have been motivated to implement Taniguchi’s antenna structures on a single chip as taught by Rostoker. Indeed, Rostoker describes and incorporates by reference two prior art patents, Koo and U.S. Patent 4,724,427 to Carroll (“Carroll”; INTEL-1028), directed to non-contact identification systems with one or more antennas integrated on a chip. (*See, e.g.*, INTEL-1022, 1:6-32, 3:50-56 (describing single chip implementation of the sending-and-receiving station), Figure 7; INTEL-1028, 11:7-22 (describing single chip implementation of a transponder).) Rostoker therefore contemplates application of its antenna integration teachings to inductively coupled non-contact identification systems.

207. Third, Taniguchi suggests other implementations for its multiple antenna arrangements, noting that the “substrate used in the present invention is not limited to the printed board 21 but can be formed **of an insulating film and an insulating material**, on which a metallic paste is applied to provide an equivalent function to that of the board.” (INTEL-1005, ¶86.) Taniguchi however does not provide any details regarding other non-PCB implementations of the substrate. A POSITA would have therefore been motivated to search of details regarding other non-PCB substrate implementations and would have been led to Rostoker.

208. Fourth, the combination is merely the application of a known technique (Rostoker’s forming antennas in metallization layers on a chip substrate) to a known device (Taniguchi’s stacked antennas or same plane antennas) ready for improvement to yield predictable results. Taniguchi contains a “base” device with antennas formed on opposite sides of an insulating layer or on the same side of the insulating layer upon. A POSITA would have considered forming the stacked antennas in metallization layers of an IC chip substrate or on the surface of an IC substrate as an “improvement” because it would have reduced the size of the interrogator, solving the known problem of making smaller form-factor devices, as Taniguchi seeks to do. U.S. Patent 7,088,964 to O (“O”; INTEL-1025) describes problems with multi-chip (hybrid) communications devices, including higher

assembly costs, degraded reliability and increased power consumption and describes a single-chip radio with integrated antennas as an improvement over these hybrid systems. (*See, e.g.*, INTEL-1025, 1:40-48, Abstract, 3:23-32, 8:32-44.) Indeed, O contemplates use of its single chip solution in “RFID applications” like the non-contact identification system of Taniguchi. (*See* INTEL-1025, 8:48-49.)

209. Fifth, the combinations represent a straightforward and predictable substitution of one known element for another. A POSITA would have substituted Taniguchi’s PCB manufacturing technique with Rostoker’s semiconductor manufacturing technique to implement Taniguchi’s layouts. The techniques overlap. Taniguchi teaches that the antennas/inductors are formed on two planes separated by an insulation layer (*see, e.g.*, INTEL-1005, ¶¶55, 77, 86) and Rostoker similarly teaches that the antennas are formed on metallization layers separated by an insulating layer (Rostoker’s Figure 7B) (INTEL-1005, ¶¶55, 77, 86; INTEL-1006, 10:23-29, Figure 7B.) Taniguchi also teaches that the antennas/inductors are formed on the same plane (*see, e.g.*, INTEL-1005, ¶¶55, 70) and Rostoker similarly teaches that antennas are formed on the same surface of an IC chip (Rostoker’s Figure 6). (INTEL-1005, ¶¶55, 70; INTEL-1006, 8:66-9:18.)

210. A POSITA would have had a reasonable expectation of success and the results of the combination would have been predictable. Rostoker describes fabrication of multiple antennas of various types on a chip using “well-known” IC manufacturing processes. (*See, e.g.*, INTEL-1006, 10:16-22.) A POSITA would have understood that Rostoker would be used for its intended purpose when fabricating Taniguchi’s antennas. Prior to the ’430 patent, it was known in the prior art how to fabricate antennas (including loops) on a single chip for various applications including non-contact identification applications, like that described in Taniguchi. For example, U.S. 7,088,964 to O (“O”; INTEL-1025) indicates that its single-chip implementation is contemplated for RFID applications, like that described in Taniguchi. (INTEL-1025, Abstract, 8:48-49.) U.S. Patent 7,057,514 to Mickle (“Mickle”) also discloses RFID devices having multiple antennas on a single IC chip. (*See, e.g.*, INTEL-1029, Figures 1, 3; 5:36-38; *see also*, INTEL-1022, 1:6-32, 3:50-56.)

B. Independent Claim 11

211. The combination of Taniguchi and Rostoker renders claim 11 obvious. I reproduce independent claim 11 again below with labels. As I discussed in §IV.B.3, Taniguchi discloses every limitation in the body of claim 11 and the recited “*first*” and “*second inductor[s]*” of the preamble. Taniguchi, however, does

not explicitly disclose that the “*first inductor*” and “*second inductor*” are “*on a semiconductor die.*” This feature is disclosed by Rostoker. Thus, the combination of Taniguchi and Rostoker described in §V.A.2 (motivation to combine) discloses or renders obvious every limitation of claim 11.

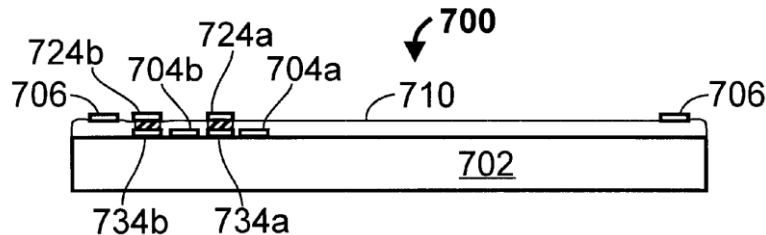
Claim 1	Claim 11
[1P] An inductor layout having reduced mutual electromagnetic coupling, comprising:	[11P] A method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die, comprising
[1A] a first inductor having a reduced far field, said first inductor comprising:	[11A] forming the first inductor to reduce a far field, said step of forming the first inductor comprising:
[1A.1] a first loop having a shape that is substantially symmetrical about a first predefined axis;	[11A.1] forming a first loop having a shape that is substantially symmetrical about a first predefined axis;
[1A.2a] a second loop connected to the first loop,	
[1A.2b] said second loop having a size and shape substantially identical to the first loop,	[11A.2a] forming a second loop having a size and shape substantially identical to the first loop;
[1A.2c] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and	[11A.2b] orienting the second loop in relation to the first loop such that a magnetic field emanating from the second loop tends to cancel a magnetic field emanating from the first loop; and
[1A.3] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing	[11A.3] connecting two closely spaced terminals to the first loop for supplying electrical current to the first and second loops while minimizing

Claim 1	Claim 11
magnetic field contributions from the terminals; and	magnetic field contributions from the terminals; and
[1B] a second inductor positioned at a predetermined distance from the first inductor, wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.	[11B] positioning a second inductor at a predetermined distance from the first inductor, wherein the mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.

212. The combination of Taniguchi and Rostoker discloses a “*method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die*” [11P]. As discussed in §IV.B.3, the dual antenna layouts of Taniguchi’s lower feeding point embodiment (Figure 8), rotated eight-shaped embodiment (Figures 9/10) and same plane embodiment (Figure 7) “*reduc[e] mutual electromagnetic coupling*” between antenna 1 (“*first inductor*”) and antenna 2 (“*second inductor*”).

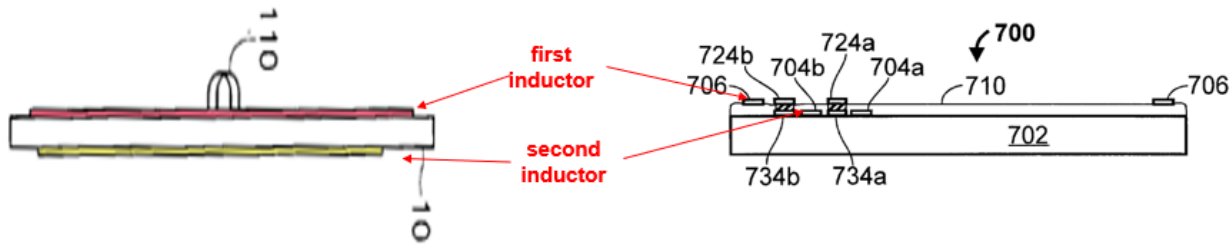
213. The combined structure of Taniguchi and Rostoker discloses that the “*first inductor*” and “*second inductor*” are “*on a semiconductor die*” [11P]. Rostoker discloses a layout where two antennas 704 and 724 “are disposed in two different vertical planes on a single integrated circuit (IC) chip 702.” (INTEL-1006, 10:9-12.) A first antenna 704 “is formed in a first metallization layer” of the

chip and a second antenna 724 “is formed in a second metallization layer” of the chip, as shown in Figure 7B below. (INTEL-1006, 10:23-27.)



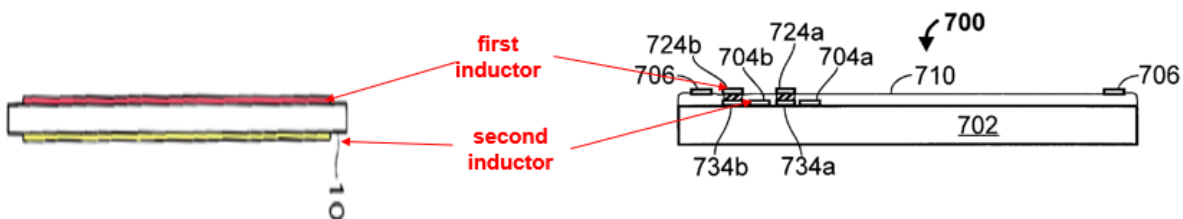
Rostoker, Figure 7B

214. In the combination of Taniguchi and Rostoker (§V.A.2), for the antenna layout of the lower feeding point (Figure 8) embodiment, Taniguchi’s antenna 1 is formed in a second metallization layer and Taniguchi’s antenna 2 is formed in a first metallization layer, as highlighted by the exemplary side-by-side figures from Taniguchi and Rostoker reproduced below. As established in §§IV.B.2.b-c, Taniguchi’s antenna 1 (shaded red) is a “*first inductor*” and Taniguchi’s antenna 2 (shaded yellow) is a “*second inductor.*” Thus, for Taniguchi’s Figure 8 antenna layout, the combination of Taniguchi and Rostoker discloses “*a first inductor and a second inductor on a semiconductor die.*”



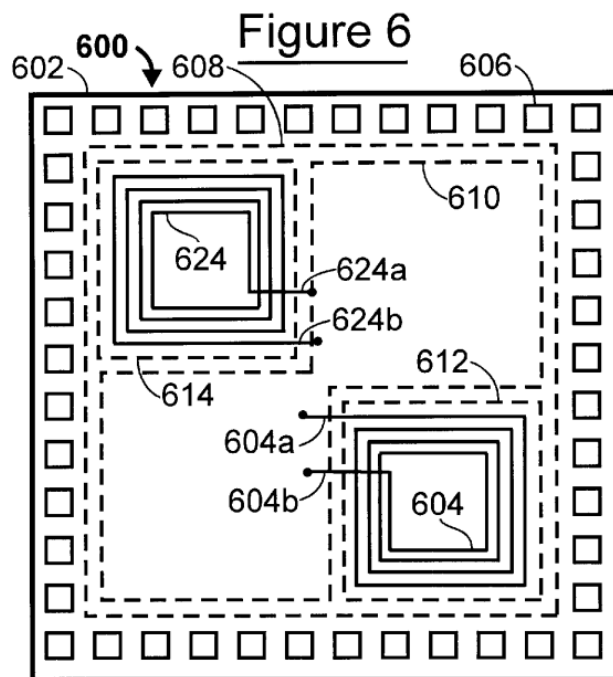
Taniguchi, Figure 8D (annotated/rotated); Rostoker, Figure 7B

215. In the combination of Taniguchi and Rostoker (§V.A.2), for the antenna layout of the rotated eight-shaped (Figures 9/10) embodiment, Taniguchi’s antenna 1 is formed in a second metallization layer and Taniguchi’s antenna 2 is formed in a first metallization layer, as highlighted by the exemplary side-by-side figures from Taniguchi and Rostoker reproduced below. As established in §§IV.B.2.b-c, Taniguchi’s antenna 1 (shaded red) is a “*first inductor*” and Taniguchi’s antenna 2 (shaded yellow) is a “*second inductor.*” Thus, for Taniguchi’s Figures 9/10 embodiment, the combination of Taniguchi and Rostoker discloses “*a first inductor and a second inductor on a semiconductor die.*”



Taniguchi, Figure 10D (annotated/rotated); Rostoker, Figure 7B

216. In the layout depicted in Rostoker's Figure 6 (below), two antennas are disposed on the surface of a single IC chip. (See INTEL-1006, 8:64-9:2.) In this embodiment, "antenna 604 is disposed within the second portion 612 of the central area 608 of the chip 602, the antenna 624 is disposed within the third portion 614 of the central area 608 of the chip 602, and related circuitry (not shown) is disposed within the first portion 610 of the central area 608 of the chip 602." (INTEL-1006, 9:12-18.)

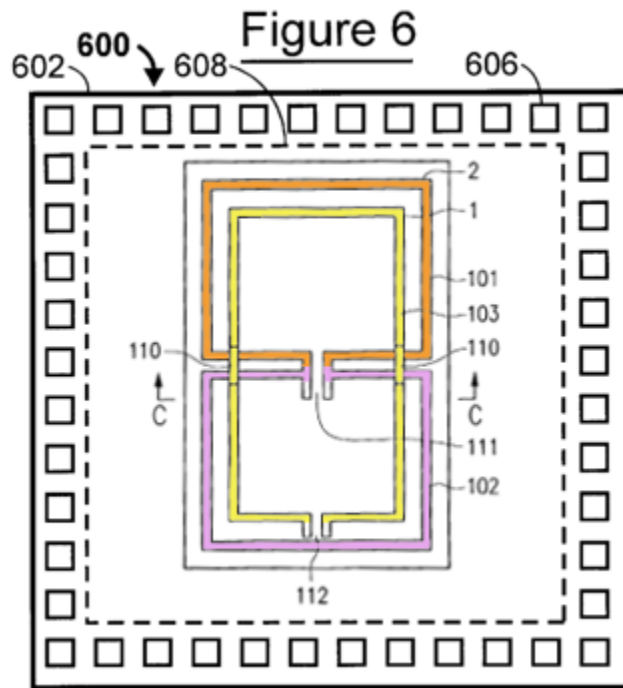


Rostoker, Figure 6

217. Rostoker refers to an IC chip as an IC "die." (See, e.g., Rostoker, 11:8 (referring to IC die 802) and 11:14 (referring to IC chip 802); see also, Rostoker, 12:31-32 (noting that invention "may be advantageously utilized in SCM [single

chip module]” and 12:35-36 (describing that a SCM has “a single semiconductor die in a single package body”).) Thus, Rostoker discloses including two antennas “*on a semiconductor die*”, either in multiple layers (Figure 7B) or on the surface (Figure 6).

218. In the combination of Taniguchi and Rostoker (§V.A.2), for the antenna layout of the same plane (Figure 7) embodiment, Taniguchi’s antenna 1 and antenna 2 are formed in a central area of the chip, as highlighted by the exemplary side-by-side figures from Taniguchi and Rostoker reproduced below. As established in §§IV.B.2.b-c, Taniguchi’s antenna 1 (shaded red) is a “*first inductor*” and Taniguchi’s antenna 2 (shaded yellow) is a “*second inductor*.” Thus, for Taniguchi’s same plane (Figure 7) embodiment, the combination of Taniguchi and Rostoker discloses “*a first inductor and a second inductor on a semiconductor die*.”



**Excerpts of Annotated Taniguchi, Figure 7B superimposed
on Rostoker, Figure 6**

219. Rostoker explains that an IC chip is a “die.” (*E.g.*, INTEL-1006, 11:8, 11:14; *see also*, INTEL-1006, 12:31-32 (referring to “SCM” (single chip module)), 12:35-36 (SCM has “a single semiconductor die”).) Thus, for the above reasons and the reasons I discussed in §IV.B.3, the combination of Taniguchi and Rostoker discloses a “*method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die*” [11P] for Taniguchi’s lower feeding point (Figure 8) embodiment, rotated eight-shaped (Figures 9/10) embodiment and same plane (Figure 7) embodiment. And for the reasons discussed

in §IV.B.3, the combination of Taniguchi and Rostoker discloses or renders obvious the remaining limitations of claim 11.

C. Dependent Claims 2, 8, 13-15, and 17-19

1. Claim 2, 13-15, 17, and 19

220. The subject matter of claim 2 is the same as the recitation in the preamble of claim 11 (“*a first inductor and a second inductor on a semiconductor die*”). Thus, for the reasons I discussed in §V.B for [11P], the combination of Taniguchi and Rostoker discloses the subject matter of claim 2.

2. The inductor layout according to claim 1, wherein said first inductor and said second inductor are formed on a single semiconductor die.

221. For the same reasons discussed in §§IV.C.1-5, the Taniguchi-Rostoker combination renders **claims 13-15, 17, and 19** obvious.

2. Claims 8 and 18

222. Claims 8 and 18 are directed to similar subject matter, except claim 18 requires only the first inductor to have an inner loop whereas claim 8 requires both inductors to have inner loops. The combination of Taniguchi and Rostoker renders these claims obvious.

Claim 8	Claim 18
The inductor layout according to claim 7, further comprising an inner loop within each of the two loops of said substantially 8-shaped first and second inductors.	The method according to claim 17, further comprising forming an inner loop within each of the two loops of said substantially 8-shaped first inductor.

223. The 8-shaped antennas in Taniguchi's rotated eight-shaped antenna embodiment do not include an inner loop. Rostoker, however, discloses this limitation.

224. Rostoker describes antennas with multi-turn loops. (*See* INTEL-1006, Abstract, Figure 2, 7:6-13.) Although the terminology is different, a POSITA would have understood that a turn in Rostoker is equivalent to a loop. (*See, e.g.*, INTEL-1001, 9:43-47 (equating a turn to a loop).) A POSITA would have been motivated to increase the number of turns in each conductor of Taniguchi's eight-shaped antennas/inductor in the same plane (Figure 7) and lower feeding point (Figure 8) embodiments, rendering claim 18 obvious, and in both eight-shaped antennas/inductors in the rotated eight-shaped (Figures 9/10) embodiment, rendering claims 8 and 18 obvious. Rostoker suggests the combination, teaching the transmitting and receiving strength of the antennas "is proportional to the number of turns and area of the loop." (INTEL-1006, 6:36-38.) Put another way, adding turns would have increased transmitting and receiving strength which is

desirable to improve and extend the communication range between the antennas and the tags.¹⁸

225. Saitoh confirms the motivation, identifying several advantages to increasing the number of loop turns in an eight-shaped antenna and a second antenna to which it is magnetically coupled. Like Taniguchi, Saitoh teaches a receiving antenna oriented relative to an eight-shaped transmitting antenna having two loops that generate opposite and cancelling magnetic fields. (*See, e.g.*, INTEL-1023, 4:3-11, 4:22-28, 6:19-31, 6:66-7:13, 7:33-67; Figures 4A-4B, 6.) In addition, Saitoh's non-contact data carrier system resembles Taniguchi's non-contact identification apparatus. (*See e.g.*, INTEL-1023, 2:33-39 (The invention provides "a non-contact data carrier system comprised of the interrogator and a transponder, the antenna for reader/writer of the interrogator comprising a transmitting antenna for transmitting a signal to the transponder and a receiving antenna for receiving a signal from the transponder").)

¹⁸ The increase in transmission strength does not impact the reduction in electromagnetic field or electromagnetic coupling between antenna 1 and antenna 2 because the eight-shaped antenna generates equal and opposite magnetic fields in its two loops, even when transmission strength is increased.

226. Saitoh discloses adjusting the “number of turns” for the loops of a transmitting antenna such that its “magnetic field intensity is high enough inside the communication zone.” (INTEL-1023, 12:9-18; *see also*, INTEL-1023, 4:28-40, 7:38-48.) The number of turns of the loop coil can be set to any integer greater than 1 (e.g., 2 or 3). (*See, e.g.*, INTEL-1023, 6:27-31 (“N is the number of turns in a loop” for a transmitting or receiving antenna), 11:1-3; Table 1.) Altering the number of turns of the loops of the transmitting antenna “decrease[s]” the field “outside the communication zone” more greatly “than inside the communication zone” and helps zero out “mutual inductance” between the two antennas, which is the same objective as Taniguchi. (INTEL-1023, 7:38-67, 1:5-8, 2:46-62, 4:3-11, 4:22-28, 6:19-31, 6:66-7:13; INTEL-1005, ¶¶55, 57, 59, 74-75, 94-95.)

227. Saitoh further explains that the “the coil parameters” of the receiving antenna can be set “so that the mutual inductance between the loop coil of the receiving antenna 3 and the loop coil 2a of the transmitting antenna may be equal in value but opposite in polarity to the mutual inductance between the loop coil of the receiving antenna 3 and the loop coil 2b of the transmitting antenna” such that “they cancel out each other in the receiving antenna 3.” (INTEL-1023, 7:57-65, 6:27-31.) Setting the “coil parameters” includes increasing the number of turns in a loop. (INTEL-1023, 11:1-20). The cancellation of mutual magnetic fields between

transmitting and receiving antennas is similarly an objective of Taniguchi. (INTEL-1005, ¶¶ 14-15, 55, 57 (“residual mutual inductances ... are put in a state of zero”), 59, 74, 75 (“residual mutual inductance becomes zero”), 94-95; *see also*, §IV.A.2.) Thus, a POSITA would have been motivated to add turns to Taniguchi’s antenna loops given the known benefits of (a) adding turns to a transmitting antenna to adjust the amount of magnetic field intensity and electromagnetic interference and (b) adding turns to a receiving antenna to cancel out mutual inductance, which is a primary objective of Taniguchi’s antenna layouts. Given the similarities between Saitoh’s and Taniguchi’s antennas, using multiple turns would have provided Taniguchi’s system with the same benefits described in Saitoh.

228. A POSITA would have had a reasonable expectation of success with predictable results in seeking to add turns to Taniguchi’s antenna loops. Rostoker teaches that it was known in the art to have multiple turns in an antenna loop. Saitoh teaches that adjusting the number of turns in an antenna loop was also a known technique before the earliest priority date claimed on the face of the ’430 patent. Further, both Taniguchi and Saitoh teach similar non-contact data systems with similar antenna arrangements having a receiving antenna relative to an eight-shaped transmitting antenna that results in canceled magnetic fields from the transmitting antenna as well as canceled mutual inductance between the antennas.

(INTEL-1023, 1:5-8, 2:46-62, 4:3-11, 4:21-27, 6:19-31, 6:66-7:13, 7:33-67;

Figures 4A, 4B, 6; INTEL-1005, ¶¶1, 55-57, 63-63, 94-95; Figs. 3-4.)

229. The combination of Taniguchi and Rostoker accordingly discloses “*an inner loop within each of the two loops of said substantially 8-shaped first and second inductors*” [7] and “*forming an inner loop within each of the two loops of said substantially 8-shaped first inductor*” [18].

VI. GROUND 3: The combination of Midya and Raghavan renders claims 1, 3-6, 9, 11-16, and 20-21 obvious.

A. Overview of the Combination

1. Midya

230. PCT International Publication WO 98/05048, titled “Low Radiation Planar Inductor/Transformer and Method”, to Midya, et al. (“Midya”; INTEL-1007) published on February 5, 1998, more than six years prior to the earliest priority date claimed on the face of the ’430 patent. Midya relates “to induction and, more particularly, to substantially planar inductors.” (INTEL-1007, 1:5-6.) More specifically, Midya “provides a method and planar inductor/transformer that maximizes cancellation of a moment¹⁹ of the plurality of loops/spiral conductor

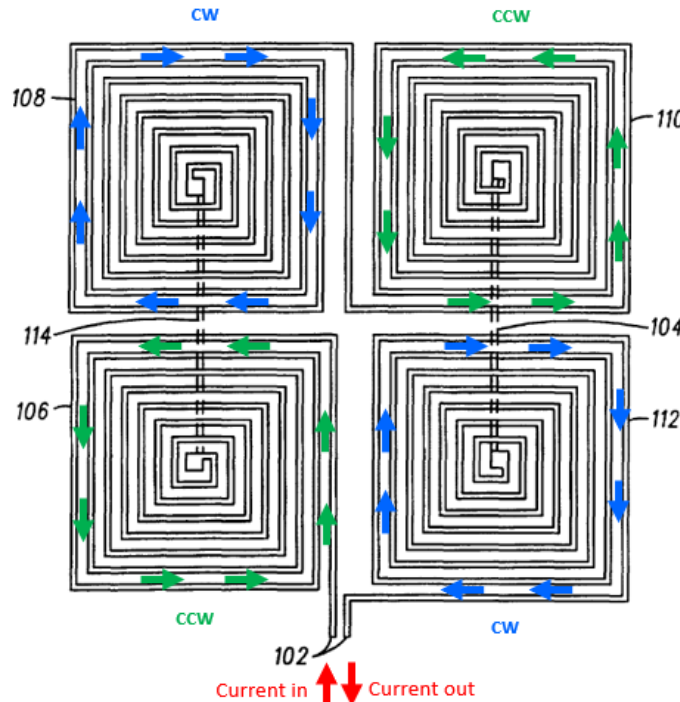
¹⁹ The “moment” is the magnetic strength and orientation of an object that produces a magnetic field. (See INTEL-1013, 647.)

coils over a predetermined range such that interference with external and adjacent circuitry is minimized.” (INTEL-1007, 6:11-15.)

231. According to Midya, “[p]lanar inductors that are unshielded by magnetic material tend to radiate a magnetic field producing EMI (electromagnetic interference) that interferes with adjacent circuitry.” (INTEL-1007, 1:18-21.) Therefore, a need exists “for a method and planar inductor/transformer that maximizes cancellation of a moment of the plurality of loops/spiral conductor coils over a predetermined range.” (INTEL-1007, 1:23-26.) This planar inductor “may be oriented to allow placement of EMI-sensitive circuitry in the predetermined range.” (INTEL-1007, 1:26-2:2.)

232. Midya’s “present invention” “provides a planar magnetic field inductor/transformer” having “at least three planar adjacent loops/spiral conductor coils arranged after another in a simple/compound loop fashion.” (INTEL-1007, 7:1-4.) Midya’s Figure 1 (below) illustrates a 4-loop implementation of the multiloop inductor “in accordance with the present invention.” (INTEL-1007, 10:14-17.) The illustrated 4-loop (106, 108, 110, 112) inductor “carr[ies] a current produced by a signal source” (not shown). (INTEL-1007, 10:20-22.) “The even number of planar adjacent loops/spiral conductor coils are arranged to provide total cancellation of a magnetic field on N axes and to maximize overall cancellation of

the magnetic field.” (INTEL-1007, 10:22-25.) Specifically, the coils are arranged and connected such that current flows counterclockwise (CCW) in the two diagonally located coils (106, 110) and clockwise (CW) in the other two diagonally located coils (108, 112). (INTEL-1007, 11:1-4.) The inductor has two terminals (102) and two crossovers (104, 114) that connect the centers of each of the two pairs of spirals. (INTEL-1007, 11:4-6.)

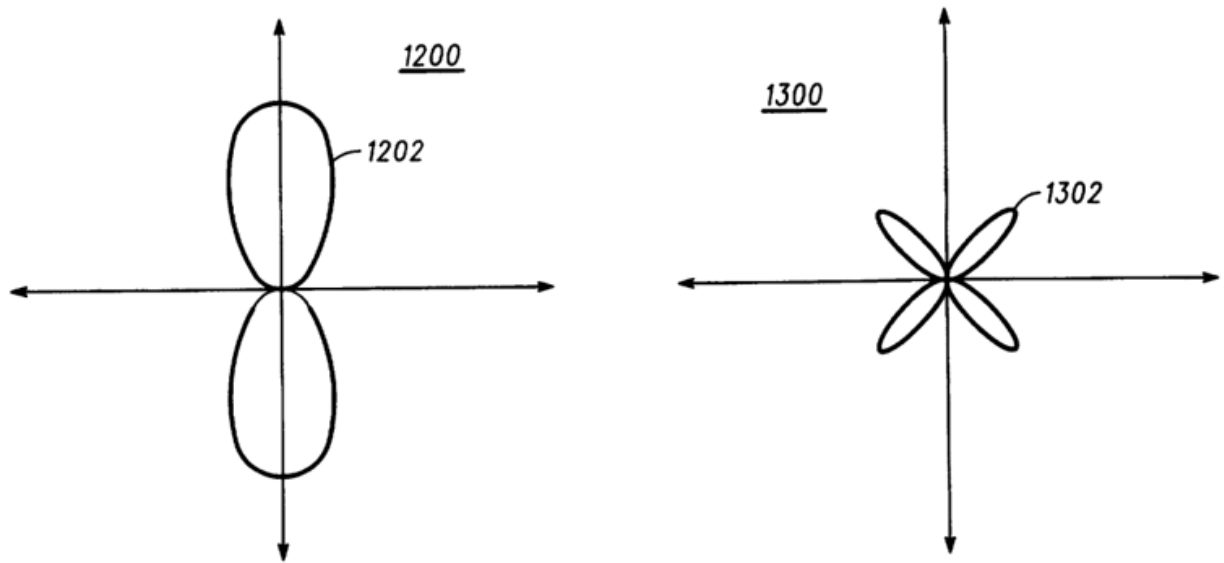


Midya, Annotated Figure 1

233. The radiation pattern for the inductor of Figure 1 is illustrated in Figure 13 (below right). (INTEL-1007, 14:25-26.) As shown in Figure 13, the magnetic field is completely cancelled on the horizontal and vertical axes.

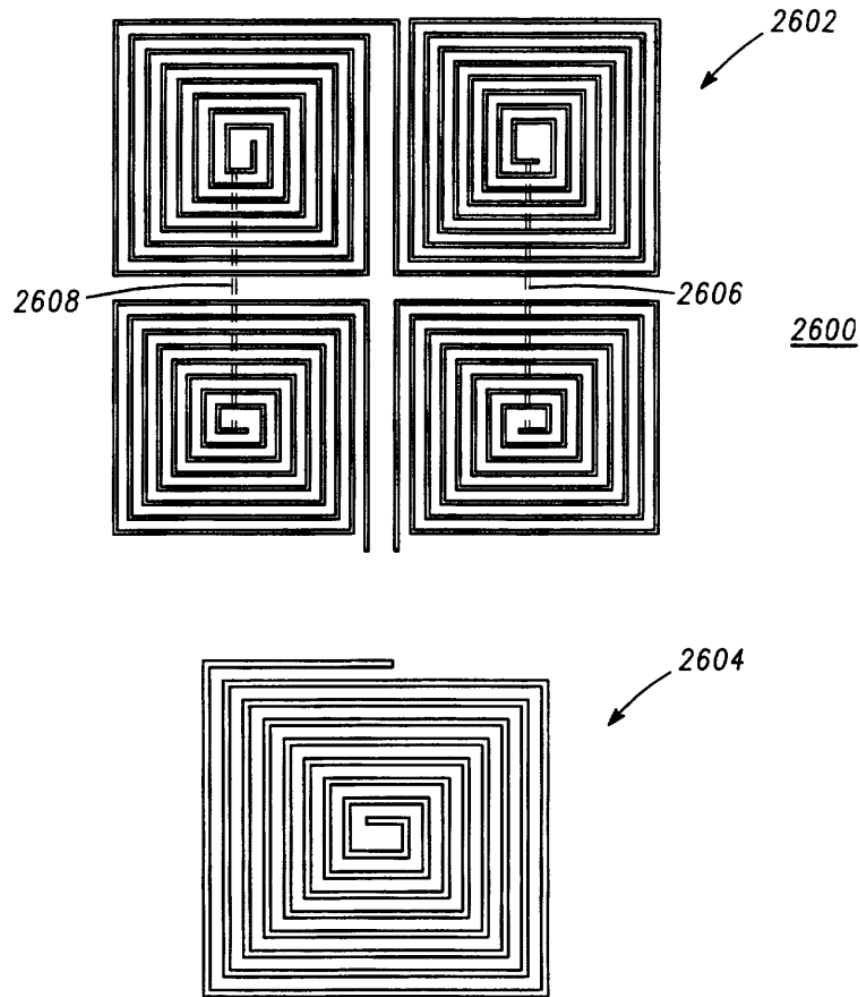
(INTEL-1007, 10:22-25 (“total cancellation of a magnetic field on N axes”).)

Additionally, the overall magnitude of the field for the inductor of Figure 1 “is reduced by a factor of at least 10 in a far field when compared with the magnitude of the field” obtained from structures of the prior art (e.g., the field of an eight-shaped inductor illustrated in Figure 12 (below left)). (INTEL-1007, 14:26-15:4; *see also*, INTEL-1007, 14:22-23.) I note that the eight-shaped inductor features an already very reduced electromagnetic field (Figure 12) compared to the conventional spiral and the 4-loop inductor of Midya further reduces that field even further. Thus, with the 4-loop inductor, “the far field is completely cancelled, and the near field is nearly cancelled.” (INTEL-1007, 15:4-6.) Because of the cancellation, Midya refers to its inductors as “non-interacting multiloop inductor structure[s].” (*See, e.g.*, INTEL-1007, 11:18-25, 5:21-25, *compare* inductor 2602 of Figure 26, described in paragraph 234 below, *with* inductor 100 of Figure 1.)



Midya, Figure 12 (left); Figure 13 (right)

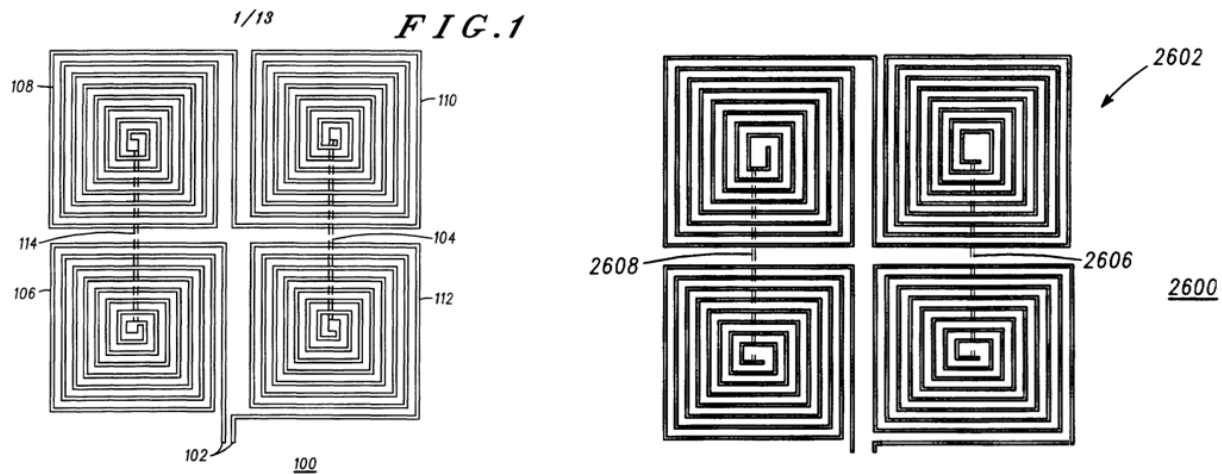
234. Midya uses the non-interacting inductor of its “present invention” in different layouts with a second inductor. In the stacked inductors layout, a “spiral inductor [] is placed concentrically above a non-interacting multiloop inductor structure such that the coupled magnetic field is substantially zero.” (INTEL-1007, 5:21-25.) A “diagrammatic representation” of this arrangement is illustrated in Midya’s Figure 26 (reproduced below). (See INTEL-1007, 5:21-25.) Although the single loop (spiral) inductor 2604 is depicted in Figure 26 as below the non-interacting multiloop inductor 2602 for illustrative purposes, a POSITA would have understood that it is placed in a layer above the non-interacting multiloop inductor 2602 based on Midya’s disclosure that the spiral inductor “is placed **concentrically above**” inductor 2602. (INTEL-1007, 11:18-25.)



Midya, Figure 26

235. I note that Figure 26 includes an error in its depiction of inductor 2602. Figure 26 depicts the loop in the bottom right corner as carrying current in a CCW direction. However, the specification teaches that bottom right corner loop carries current in a CW direction. (See Midya, 11:18-25; *see also*, 10:22-11:4.) Accordingly, a POSITA would understand that the direction of the spiral in the bottom right loop must be altered so that the current flows in a CW direction as in

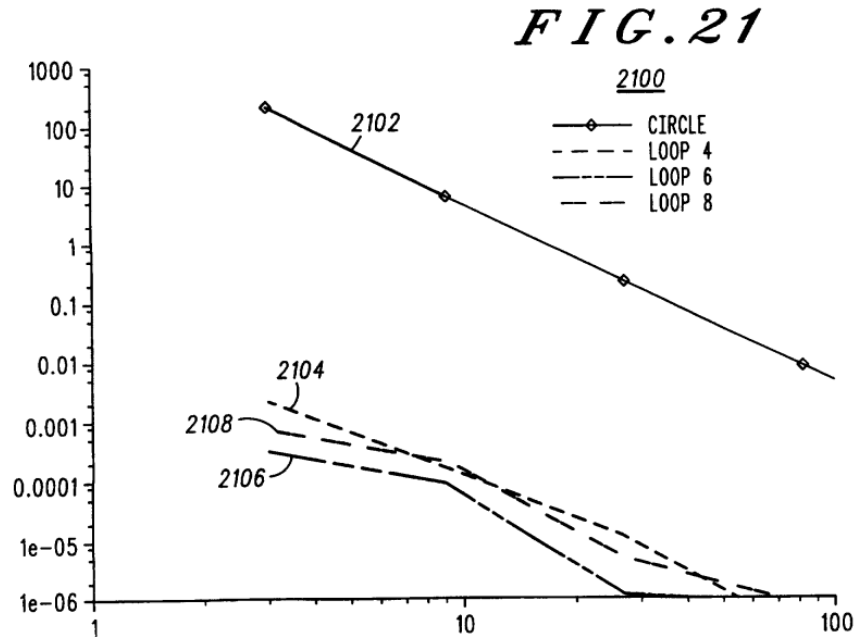
Figure 1 of Midya (below right) so that inductor 2602 is “non-interacting” with “maximize[d] overall cancellation of the magnetic field” as characterized by Midya.” (INTEL-1007, 10:20-25, 11:20-22.) I have created a corrected version of Figure 26 (below).

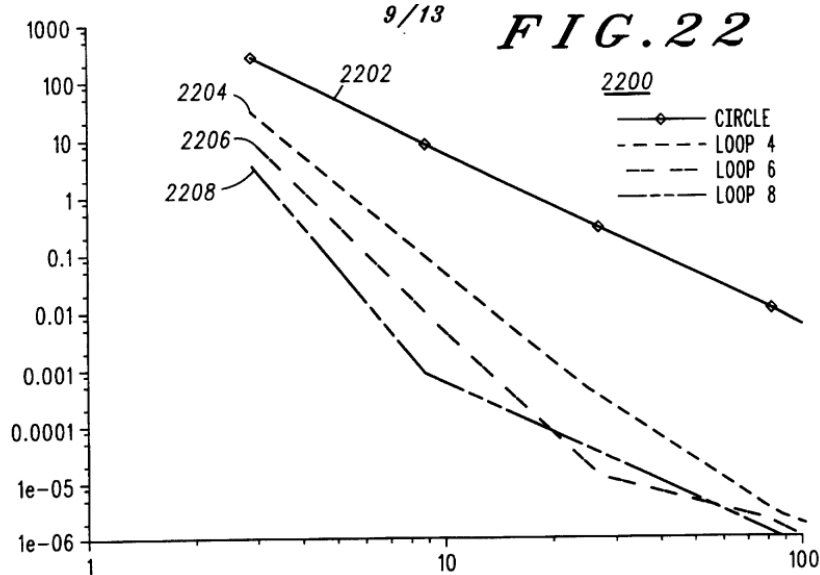


Midya, Figure 1 (left); Corrected Top Inductor of Figure 26 (right)

236. Midya further describes placement of a second inductor (“test loop”) in a best case (Figure 21) position and a worst case (Figure 22) position relative to a 4-loop, 6-loop, and 8-loop implementation of its non-interacting inductor. (INTEL-1007, 18:4-19:9.) More specifically, Midya computes the “coupled magnetic field in the plane of the” a 4-loop, 6-loop, and 8-loop non-interacting structure. (INTEL-1007, 18:4-6.) Midya explains that the “coupling depends on the direction.” (INTEL-1007, 18:13-14.) With the best (“perpendicular to a side of a polygon”) case shown in Figure 21 (below top), “coupling is reduced by at least

80dB for the 4-loop (2104), 6-loop (2106) and 8-loop (2108) structures at 2 inductor lengths away and beyond compared to coupling for a simple circular loop (2102).” (INTEL-1007, 18:14-15, 19:6-9.) With the worst (“along a diagonal of a polygon”) case shown in Figure 22 (below bottom), “coupling is reduced by 20dB for a 4-loop (2204) structure at a distance of 2 inductor lengths away, as compared to a simple loop (2202).” (INTEL-1007, 18:15-20.)





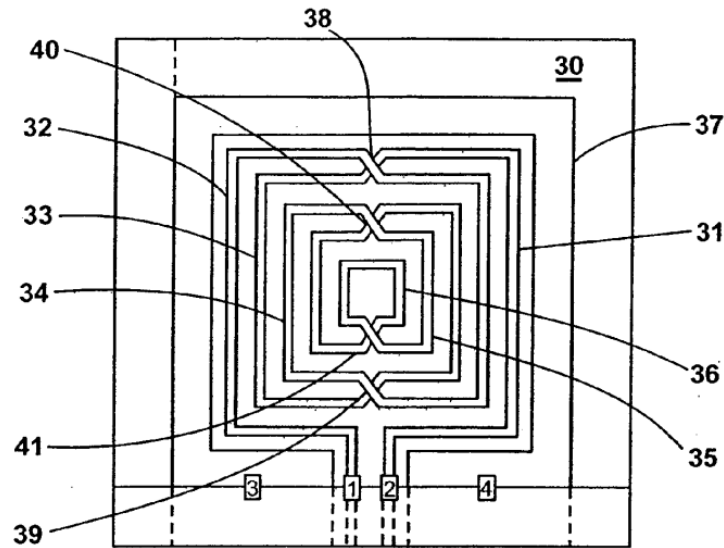
Midya, Figures 21-22

2. Raghavan

237. U.S. Patent Publication 2005/0077992 to Raghavan, et al.

(“Raghavan”; INTEL-1008) was filed on September 19, 2003, and claims priority to U.S. Provisional 60/412,283, filed September 20, 2002. Raghavan “relates to symmetric inductors.” (INTEL-1008, ¶2.) An exemplary symmetric inductor 30 is illustrated in Figure 3 (reproduced below). (INTEL-1008, ¶19.) The inductor comprises 5 square windings 32, 33, 34, 35, and 36 “sharing a common center of symmetry.” (INTEL-1008, ¶19.) Raghavan refers to the collective structure of square windings 32-36 as winding 31. (INTEL-1008, ¶19.) I refer to this collective winding as an “inductor winding.” Inductor winding 31 further includes two

terminals labeled [1] and [2] coupled to square winding 32. (See INTEL-1008, Figure 3, ¶20.)



Raghavan, Figure 3

238. In Raghavan, current enters the outermost square winding 32 of inductor winding 31 and travels “through the left half of winding 32, to then cross over at conductor crossover 38, to the right half of winding 33.” (INTEL-1008, ¶20.) After crossing over at cross over 39 to the left half of winding 34, the current continues to cross over 40. (INTEL-1008, ¶20.) “After crossing over, the current travels through the right half of winding 35 to cross over 41 where is [sic] crosses over to the innermost winding 36.” (INTEL-1008, ¶20.) The current travels through winding 36 back to crossover 41 where it crosses under to the left half of winding 35. INTEL-1008, ¶20.) The current crosses under at cross over 40 to

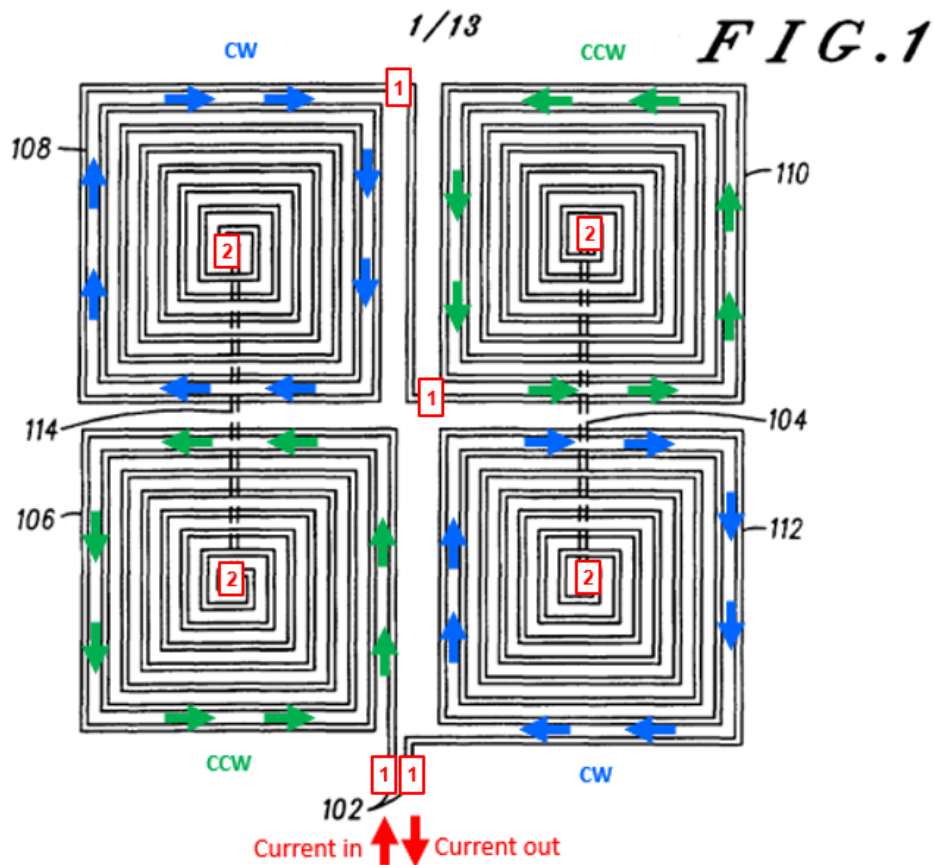
travel through the right half of winding 34, to cross under at cross over 39 to the left half of winding 33. (INTEL-1008, ¶20.) After crossing under at cross over 38, the current travels through the right half of winding 32 to finally reach terminal [2] where it exits inductor winding 31. (INTEL-1008, ¶20.)

3. Motivation to Combine

239. A POSITA would have been motivated to combine Midya's non-interacting inductor teachings with Raghavan's teaching of a symmetric inductor winding as I discuss in further detail below.

240. The adjacent loops of Midya's 4-loop implementation of its "present invention" have the "same predetermined structure, i.e., size and shape, to provide maximum cancellation of a moment over a 360° range." (INTEL-1007, 9:1-4, 10:17-11:1; Figure 1 (below); INTEL-1013, 647 (explaining that the "moment" is the magnetic strength and orientation of an object that produces a magnetic field).) Each of Midya's four loops has two terminals, one connected to the outside of the loop (labeled [1]) and one connected to the inside of the loop (labeled [2]). (See INTEL-1007, 8:8-12.) To achieve cancellation of the magnetic field, Midya connects the inner terminal [2] of the bottom left loop with the inner terminal [2] of the top left loop, the outer terminal [1] of the top left loop to the outer terminal [1] of the top right loop, and the inner terminal [2] of the top right loop to the inner

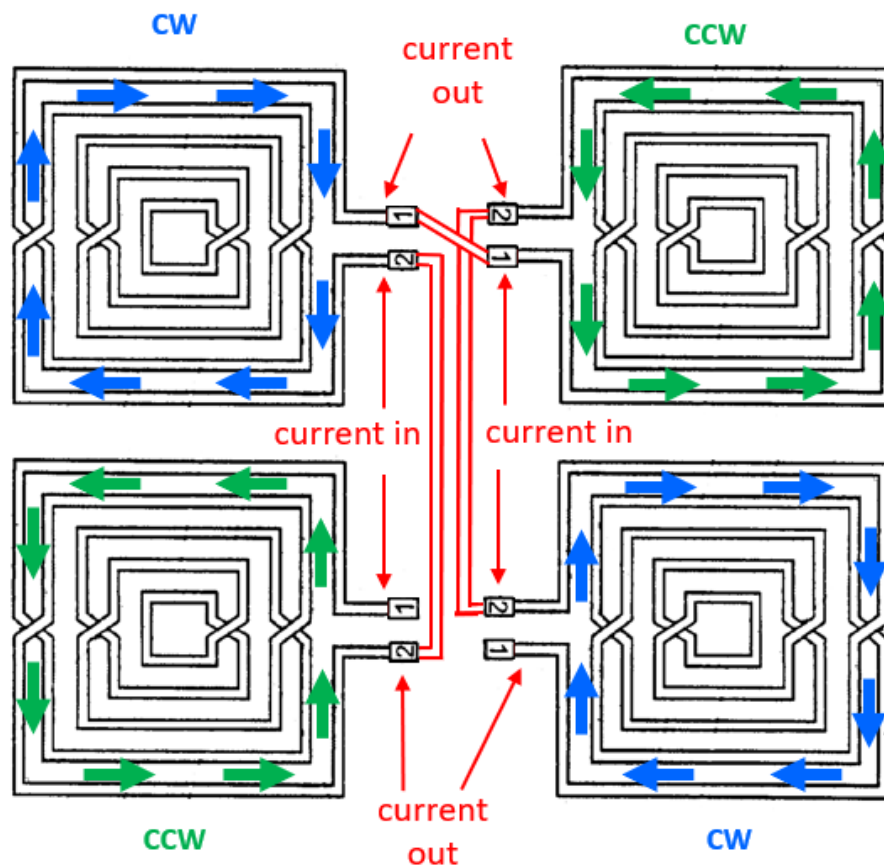
terminal [2] of the bottom right loop. (INTEL-1007, 10:17-11:6; Figure 1 (reproduced below).) This connection achieves opposite currents in adjacent coils as illustrated below—current flows in a **CCW** direction in bottom left spiral, **CW** direction in the top left spiral, **CCW** direction in the top right spiral, and **CW** direction in the bottom right spiral, which results in cancellation of the magnetic field of the inductor. (INTEL-1007, 8:14-18, 10:17-11:6.)



Midya, Annotated Figure 1

241. A POSITA would have been motivated to use Raghavan's symmetric inductor winding as each loop in Midya's non-interacting multiloop inductor for the reasons I discuss below. To achieve Midya's field cancellation, a POSITA would have been motivated to connect the terminals of Raghavan's inductor windings as necessary to replicate the current flow directions in Midya's Figure 1, illustrated in the figure below depicting Petitioner's combination. For the reader's convenience, Raghavan's terminal labels have been reversed to align with Midya's connections (e.g., winding terminal in which current enters bottom left inductor structure is labeled [1]). The size of the interconnections and spacing between left and right side loops is illustrative to show the specific connections between the loops. As would be appreciated by a POSITA, the loops would be more closely spaced in practice. Additionally, as would be understood by a POSITA, because the interconnection lines between the lower and upper inductors are close together and carry opposing currents, the fields generated by the interconnections substantially cancel (INTEL-1010, 157) and therefore do not alter the cancellation obtained by the adjacent loop arrangement. (*See, e.g.*, INTEL-1024, Abstract, 6:17-20.) As shown below in the combined 4-loop non-interacting inductor, current enters in the bottom left loop via terminal [1] and flows in a CCW direction, leaves the bottom left loop via terminal [2], enters the upper left loop via terminal [2] and

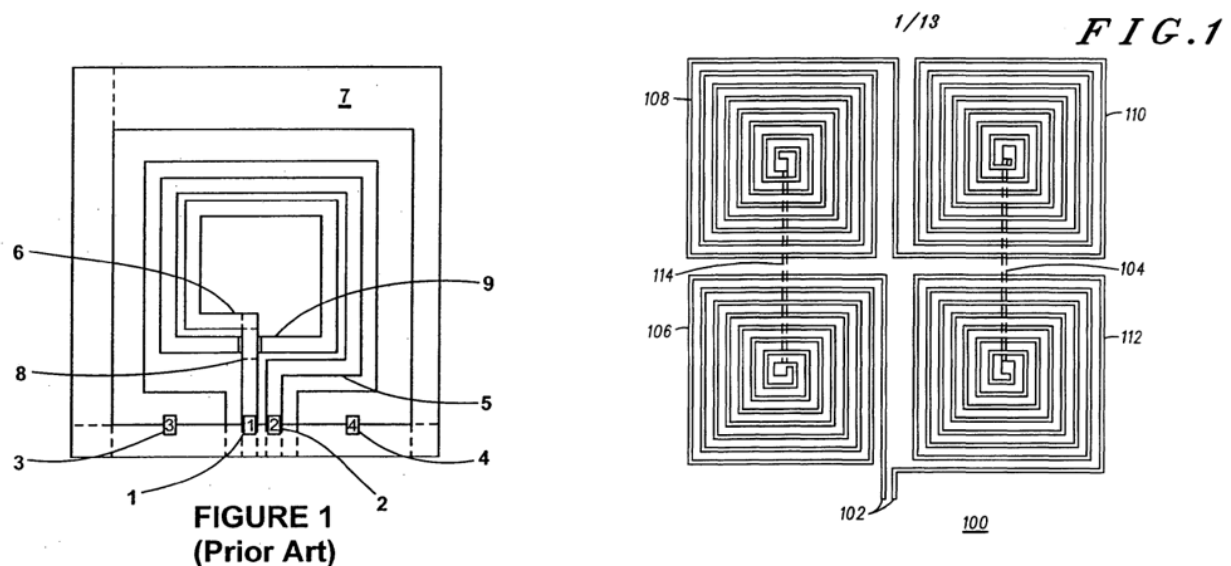
flows in a CW direction, leaves the upper left loop via terminal [1], enters the upper right loop via terminal [1] and flows in a CCW direction, leaves the upper right loop via terminal [2], enters the lower right loop via terminal [2] and flows in a CW direction, and exits the lower right loop via terminal [1].



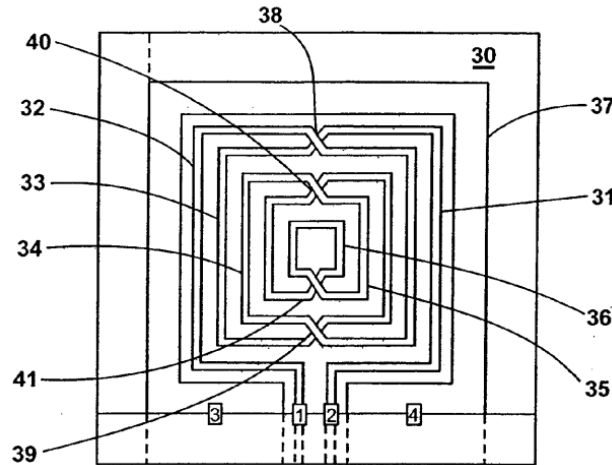
Combination of Midya and Raghavan

242. Both Midya and Raghavan are in the same field of endeavor as the '430 patent and are reasonably pertinent to the same problem as the '430 patent—efficient circuit design. (INTEL-1001, Abstract, 3:4-18; INTEL-1007, 1:5-6, 6:11-16; INTEL-1008, ¶¶2, 26.) A POSITA would have been motivated to

combine to improve performance of the inductor. In fact, Raghavan explicitly provides the motivation. When describing a conventional planar spiral inductor, Raghavan explains that the configuration “requires the conductor 8 leading to the center of the spiral to cross over (or under) the intervening winding(s) 9” which adds “undesired capacitive coupling.” (INTEL-1008, ¶5-6; Figure 1 (below left).) As illustrated in the below side-by-side figures, Midya’s conventional spiral inductor (below right) also includes a similar cross overs 104 and 114 that will add capacitive coupling to each loop in its inductor. As shown in Figure 3 (below bottom), Raghavan’s symmetric inductor does not have a conductor coupled to the center which crosses over (or under) intervening windings of the inductor. Use of Raghavan’s symmetric inductor winding reduces the problematic crossovers, minimizing capacitive effects. (INTEL-1008, ¶¶7-8, 21; Figure 3 (bottom).)



Raghavan, Figure 1 (left); Midya, Figure 1 (right)



Raghavan, Figure 3

243. The paper, “A Comprehensive Explanation On the High Quality Characteristics of Symmetrical Octagonal Spiral Inductor” to Ooi (“Ooi”; INTEL-1030), et al confirms this motivation. Ooi explains that the quality factor (Q) of an on-chip inductor is “seriously affected by three major components”—“crossover capacitance [capacitive coupling], the capacitance between the spiral and substrate, and lastly, the substrate capacitance.” (INTEL-1030, 259.) As shown in Figure 1 of Ooi, “for the same inner dimension, width, spacing, and number of turns of a spiral inductor, the symmetric spiral inductor needs one less overlap than the traditional, non-symmetrical spiral inductor.” (INTEL-1030, 259.) As such, the capacitance caused by the overlaps in the symmetrical spiral inductor “will be 1/n times smaller than that in the non-symmetrical spiral inductor.” (INTEL-1030, 259-260, 262; see

also, 262.) The reduction in capacitance results “in an enhancement of the overall quality factor of the spiral inductor.” (INTEL-1030, 260.)

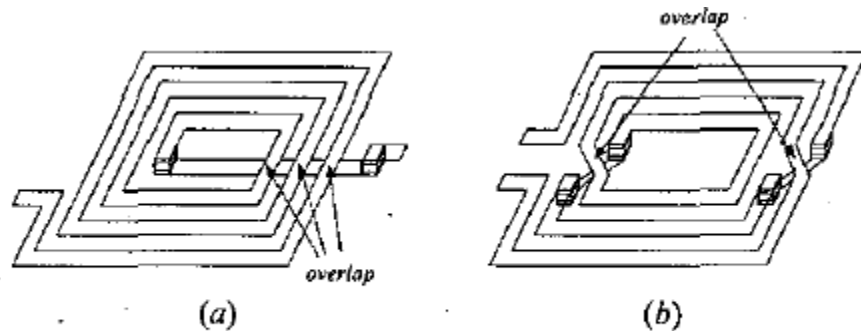


Fig. 1. (a) A non-symmetrical, spiral inductor. (b) A symmetrical, spiral inductor.

Ooi, Figure 1

244. Thus, a POSITA would have been motivated to use Raghavan’s inductor winding 31 as each loop in Midya’s non-interacting inductor to remove this “**undesired** capacitive coupling” and improve the quality factor of the inductor.

245. Second, the combination of Midya and Raghavan is the simple substitution of one known element (Raghavan’s symmetric inductor winding 31) for another (Midya’s loop in a non-interacting inductor). Midya describes an inductor with at least three loops, each having an asymmetric spiral. Symmetric inductors and their functions were known in the art before the earliest priority date claimed on the face of the ’430 patent. (See INTEL-1031, 5 (describing an “area efficient and symmetric dual-layer spiral inductor”); INTEL-1030, 259; INTEL-

1032 (“A Q-Factor Enhancement Technique for MMIC Inductors”), 218.) As I discuss in further detail at the end of the section, a POSITA would have had a reasonable expectation of success in the combination and the results of the substitution would have been predictable to the POSITA.

246. Third, the combination of Midya and Raghavan is the use of a known technique (Raghavan’s symmetric inductor winding) to improve similar devices (Midya’s inductor) in the same way (minimize undesired capacitive coupling and improve quality factor of the inductor). Midya describes a “base” device (a multiloop inductor using asymmetric spirals) upon which the use of Raghavan’s symmetric winding would have been understood by a POSITA to be an improvement because of the reduction of capacitive coupling and improved quality factor that I described above, for example. Raghavan describes a symmetric inductor which reduces capacitive coupling. As I discuss below, the POSITA would have had a reasonable expectation of success and the results would have been predictable to a POSITA.

247. A POSITA would have had a reasonable expectation of success and the results of the combination would have been predictable because symmetric inductors were known and in use before the earliest priority date claimed on the face of the ’430 patent. (See INTEL-1030, 259 (“To increase the overall Q-factor

of the silicon spiral inductor, one usually has to resort to the use of symmetrical spiral inductor”); INTEL-1031, 5; INTEL-1032, 218.) A POSITA would have understood that integrating Raghavan’s inductor winding as Midya’s inductor loops would have been based on known manufacturing techniques. (INTEL-1008, ¶¶3, 4, 26.) Indeed, Raghavan states that its inductors “can be used in **any circuit** where inductors are needed.” (INTEL-1008, ¶26.) Both Raghavan and Midya form inductors on substrate surfaces and therefore a POSITA would have understood that integrating Raghavan’s inductor winding into each loop of Midya’s non-interacting inductor would not incur any additional manufacturing complexity. (See INTEL-1008, ¶¶3 (“Patents relating to inductors abound in the prior art”), 4 (“Planar spiral inductors have been used for integrated circuits since the early 1970’s”), 26 (“The inductors shown in FIGS. 2 and 3 are manufactured in the same manner other inductors that are part of integrated circuits are manufactured. For example, the inductor may be manufactured by defining a pattern in photoresist, then plating the windings and using a lift off technique to define windings (except for the portion crossing over at the crossovers)”)).)

B. Independent Claims

248. Ground 3 challenges independent claims 1, 11, and 20. Claim 20 is directed to an “*inductor*” and claim 1 recites the “*inductor*” limitations of claim 20

and merely adds a “*a second inductor.*” Claim 11 recites overlapping subject matter with claim 1 with the primary difference being that (1) the preamble of claim 11 specifies that the first inductor and second inductor are “on a semiconductor die” and (2) claim 11 recites the apparatus limitations of claim 1 as method steps (e.g., “forming ...”, “orienting ...”, “connecting ...”, and “positioning ...”). However, as I noted in §III.E (Claim Construction), the ALJ in ITC-337-TA-1376 determined the preamble was not limiting except to the extent needed to provide antecedent basis or meaning to the rest of the claim, and further indicated that it is not clear that the term “*on a semiconductor*” die in claim 11’s preamble is limiting. For ease of discussion, I start my analysis with broader claim 20.

1. Claim 20

249. The combination of Midya and Raghavan discloses every limitation of independent claim 20 (reproduced with labels below).

[20P] An inductor having a reduced far field, comprising:

[20A] a first loop having a shape that is substantially symmetrical about a first predefined axis;

[20B.1] a second loop having a size and shape substantially identical to the first loop,

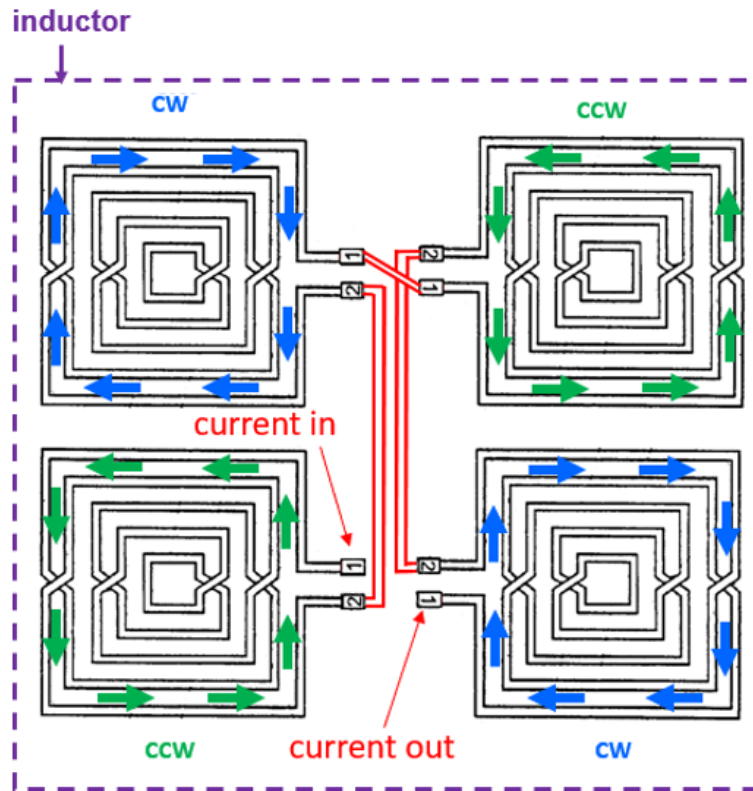
[20B.2] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and

[20C] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.

a. Preamble

[20P] <i>An inductor having a reduced far field</i>

250. The combination of Midya and Raghavan discloses an “*inductor having a reduced far field*” [20P] to the extent this term is described in the ’430 patent. Midya discloses a 2N-loop “single layer **planar inductor**, where 2N is selected to be 4.” (INTEL-1007, 10:14-17.) The four-loop implementation of Midya’s non-interacting inductor (INTEL-1007, Figure 1), used in the Midya-Raghavan combination, illustrated below is an “*inductor.*” (See INTEL-1007, 10:14-17.)

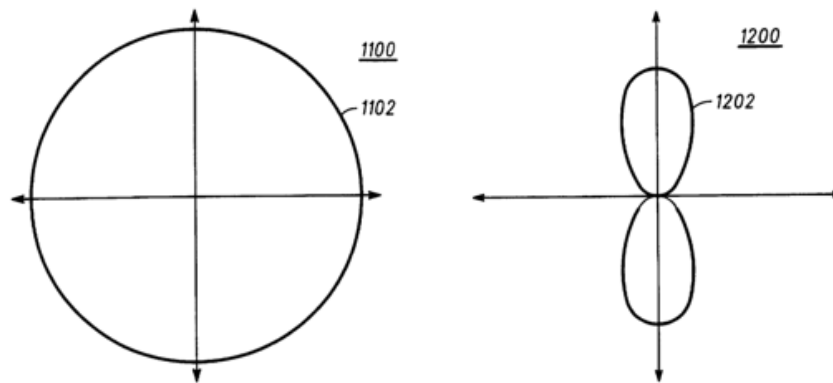


Combination of Midya and Raghavan

251. The “inductor” of the combination of Midya and Raghavan has “a reduced far field” to the extent disclosed in the ’430 patent. As taught by Midya and illustrated in the figure above, the inductor in the combination of Midya and Raghavan has current flowing **CCW** in two diagonally located loops (bottom left and top right) and **CW** in the other two diagonally located loops (top left and bottom right). (See, e.g., INTEL-1007, 11:1-4.) And like Midya, the adjacent loops have the “same predetermined structure, i.e., size and shape to provide maximum cancellation of a moment over a 360° range.” (INTEL-1007, 9:1-4.) This

arrangement of an even number of planar adjacent loops having the same structure “provide[s] total cancellation of a magnetic field on N axes” and “maximize[s] overall cancellation of the magnetic field.” (See INTEL-1007, 10:17-11:1; *see also*, *id.*, 9:1-4.)

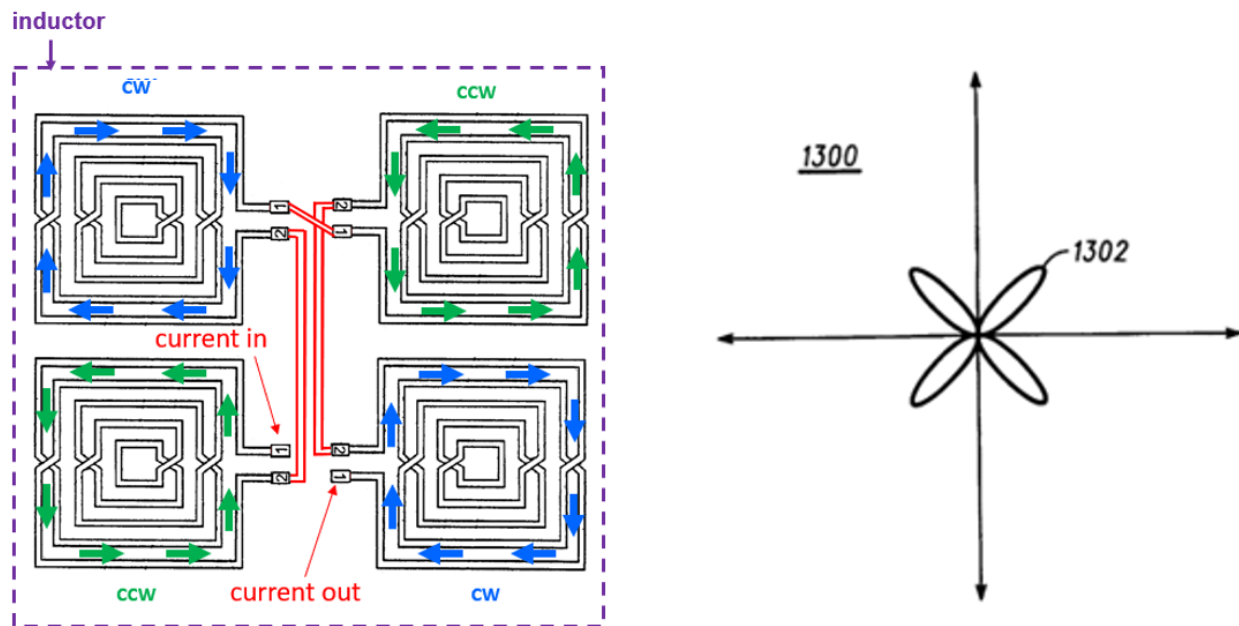
252. Midya presents figures illustrating radiation field patterns of the electromagnetic field generated by a variety of inductor structures “measured in the plane of the structure” (x-y plane). (See INTEL-1007, 14:18-15:25, 1:5-21 (inductors radiate a magnetic field “producing EMI (electromagnetic interference”); INTEL-1010, 27 (electromagnetic field contains an electrical field and magnetic field).) Figure 11 (below left) represents the radiation field pattern for a single prior art spiral inductor and Figure 12 (below right) represents the radiation field pattern for a prior art eight-shaped inductor. (INTEL-1007, 14:18-23.)



Midya, Figure 11 (left), Figure 12 (right)

253. The radiation pattern for the 4-loop non-interacting inductor of Midya's Figure 1 is illustrated in Figure 13 below right. (See INTEL-1007, 14:25-26, 10:14-17.) As explained by Midya, the "overall magnitude of the field (1302) obtained" using Midya's 4-loop non-interacting inductor "is **reduced by a factor of at least 10 in a far field** when compared with the magnitude of the field (1202) obtained" as compared to the prior art figure eight inductor whose radiation pattern is illustrated in Figure 12 (above right). (INTEL-1007, 14:26-15:4.) "Thus, the **far field is completely cancelled**" with Midya's 4-loop inductor "and the near field is nearly cancelled." (INTEL-1007, 15:4-6; *see also*, INTEL-1007, 6:20-24 ("The present invention **reduces interference by at least an order of magnitude** in comparison with the prior art").) The 4-loop non-interacting inductor of the combination of Midya and Raghavan has a similar radiation pattern as Figure 1 of Midya with the same cancellation effect because, like Midya's Figure 1, the loops

in the combination have the “same predetermined structure, i.e., size and shape” and current flows CCW in two diagonal loops and flows CW in the other two diagonal loops. The combination of Midya and Raghavan therefore discloses an “inductor having a reduced far field” [20P].



Combination of Midya/Raghavan (left); Midya, Figure 13 (right)

254. Should a similar construction of “*reduced far field*” as claim 1 from ITC-337-1300²⁰ be adopted in this proceeding, the combination of Midya and

²⁰ As I discussed in §IV.B.1.a, in ITC-337-TA-1300, the ALJ determined the term “*a first inductor having a reduced far field*” of claim 1 should be construed as

Raghavan discloses the preamble. As I discussed in the Midya overview, Midya teaches different layouts for placement of a second inductor relative to the non-interacting inductor.

255. In the stacked inductor layout, a “spiral inductor [] is placed concentrically above a non-interacting inductor structure **such that the coupled magnetic field is substantially zero** in accordance with the present invention.” (INTEL-1007, 5:21-25.) More specifically, the stacked inductor is “implemented on a two-layer printed circuit board” with the spiral inductor in the top layer and the non-interacting inductor in the bottom layer. (INTEL-1007, 11:8-16, 11:18-20 (relating layers of Figure 2 to Figure 26 implementation).) As I discussed above, with the 4-loop implementation of Midya’s non-interacting inductor, “the **far field is completely cancelled**, and the near field is nearly cancelled” (INTEL-1007, 15:4-6, 6:20-24) and generally, with any implementation of Midya’s inductor, the adjacent loops with “the same predetermined structure, i.e., size and shape, [] provide **maximum cancellation of a moment over a 360° range**.” (INTEL-1007, 9:1-4.) That is, the spiral inductor is placed at a certain distance from the non-

“(reduced/reduce) the electromagnetic field at a certain distance from the first inductor (where the second inductor is positioned).”

interacting inductor (equal to the distance between layers) where the coupled magnetic field is zero. Thus, the electromagnetic field emanating from the non-interacting inductor in a first layer is reduced at a “certain distance” (distance between the layers) where the second inductor is positioned. (INTEL-1012, 68; INTEL-1013, 612 (explaining mutual electromagnetic coupling between inductors is proportional to the strength of an inductor’s magnetic field).)

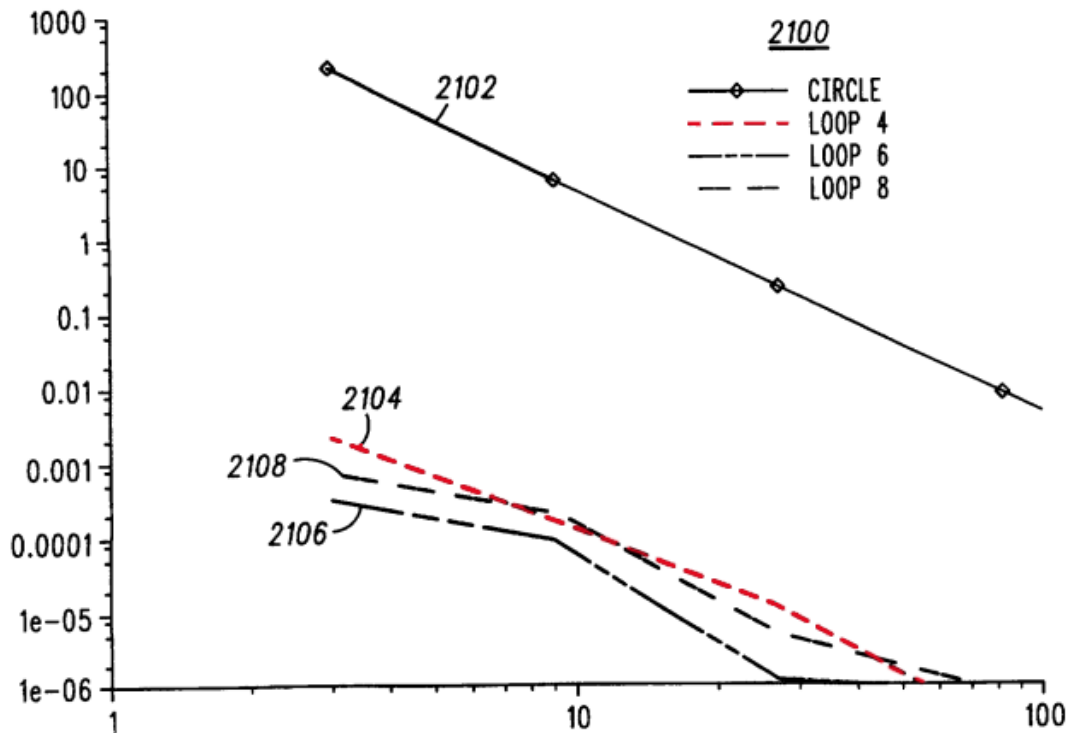
256. Midya’s disclosure is consistent with Applicant’s (PO’s) statement during prosecution of EP3567614: “it is submitted that the root parent application as filed does not mandate any particular distance or relative orientation of the two inductors.” (INTEL-1016, 59.) Accordingly, the stacked inductor arrangement discloses that the electromagnetic field emanating from the non-interactive multiloop inductor is reduced (canceled) at a certain distance from the non-interacting multiloop inductor (where the spiral inductor is positioned).

257. In Midya’s “best case” and “worst case” layouts, Midya positions a “test loop” at different locations relative to the 4-loop non-interacting inductor. (INTEL-1007, 18:4-16.) As illustrated in Figure 21 (below top), the coupled magnetic field between the 4-loop non-interacting inductor and a test loop in the “best case” layout is **reduced** “by at least 80dB for the 4-loop (2104), 6-loop (2106) and 8-loop (2108) structures at 2 inductor lengths away and beyond

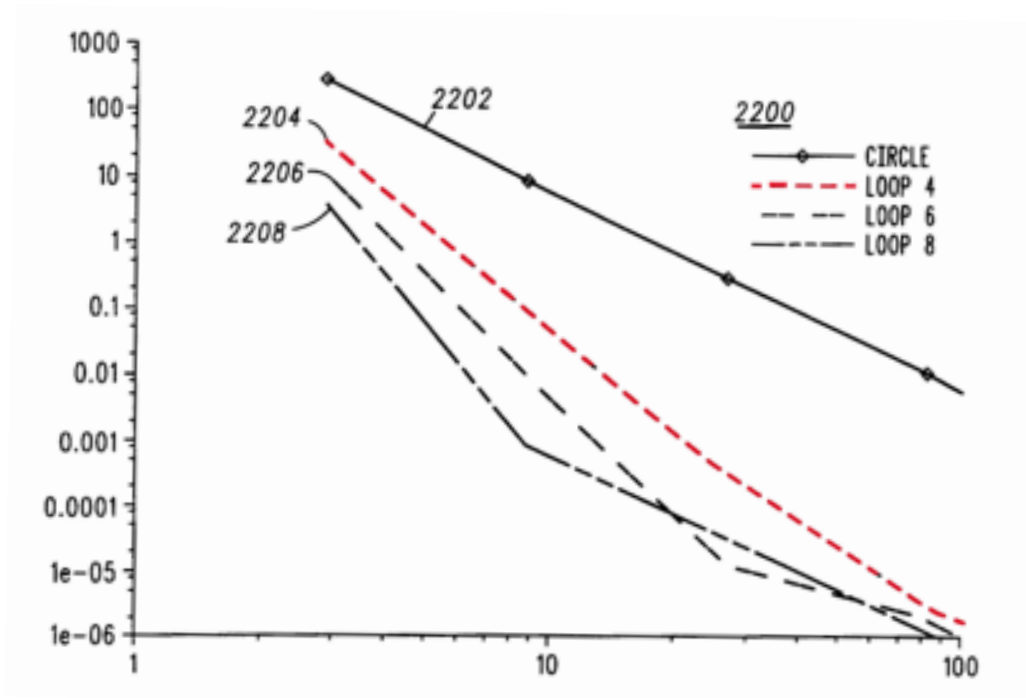
compared to coupling for a simple circular loop (2102).” (INTEL-1007, 19:6-9.)

As illustrated in Figure 22 (below bottom), the coupled magnetic field between the 4-loop non-interacting inductor and a test loop in the “worst case” layout is

reduced “by 20dB for a 4-loop (2204) structure at a distance of 2 inductor lengths away, as compared to a simple loop (2202).” (INTEL-1007, 18:18-20.) I highlight the 4-loop results with red in Figure 21-22 below.



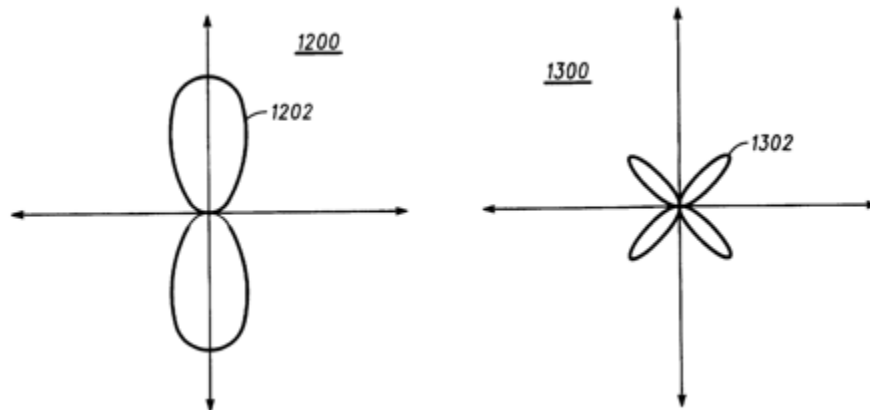
Midya, Annotated “Best Case” Figure 21



Midya, Annotated “Worst Case” Figure 22

258. The reduction in coupled magnetic field illustrated in Figures 21 and 22 for Midya’s non-interacting inductor with a second inductor is a result of “total cancellation of a magnetic field on N axes and” the “maximiz[ation of] overall cancellation of the magnetic field” achieved by Midya’s non-interacting inductor. (INTEL-1007, 10:22-25; *see also*, INTEL-1007, 9:1-4 (non-interacting inductor “provide[s] maximum cancellation of a moment over 360° range”); INTEL-1010, 27.) Referring to Figure 13 (below right), Midya explains that for the 4-loop implementation its non-interacting inductor, the “overall magnitude of the field (1302) obtained using the present invention is **reduced by a factor of at least 10**

in a far field when compared with the magnitude of the field (1202) obtained from the structure of the prior art.” (INTEL-1007, 14:25-15:4.) This result is illustrated in the radiation patterns for a prior art eight-shaped inductor and Midya’s 4-loop non-interacting inductor, reproduced below. Figure 12 “represents a radiation field patter for a figure 8 shape (1202) as is known in the art.” (INTEL-1007, 14:22-23.) Figure 13 shows the reduced field for the 4-loop non-interacting inductor used in the best and worst case layouts. (INTEL-1007, 14:25-15:4, 18:4-6 (relating Figures 21 and 22 to the 4-loop implementation of Figure 3), 2:13-15 (relating Figure 3 to a representation of 4-loop inductor “in accordance with the present invention”, 2:6-8 (associating Figure 1 with the 4-loop inductor “in accordance with the present invention”).) Thus, the best/worst case layouts disclose the electromagnetic field emanating from the non-interacting inductor is reduced at a certain distance (e.g., 2 inductor lengths or more) from the non-interacting inductor where the second inductor (test loop) is positioned.



Midya, Figure 12 (left); Figure 13 (right)

b. “First loop” and “Second loop” limitations [20A]-[20B]

[20A] *a first loop having a shape that is substantially symmetrical about a first predefined axis*

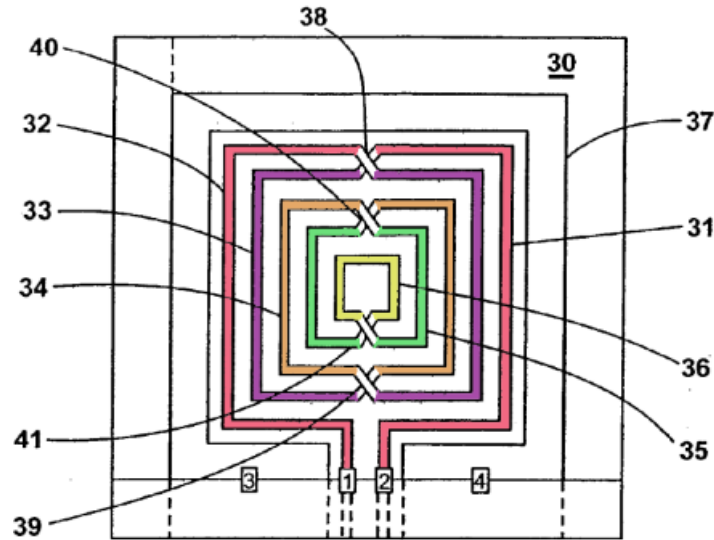
[20B.1] *a second loop having a size and shape substantially identical to the first loop,*

[2B.2] *said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop*

259. As I mentioned in my analysis of limitations [20A] and [20B] of the Taniguchi ground, the '430 patent does not provide guidance as to the scope of the term “a first loop having a shape that is substantially symmetrical about a first predefined axis” [20A] because it does not describe the boundaries of “substantially.” However, the combination of Midya and Raghavan discloses a “first loop” limitation to the same extent it is described in the '430 patent.

260. The '430 patent also does not provide guidance as to the scope of the term “*a second loop having a size and shape substantially identical to the first loop*” [20B.1] because it does not describe the boundaries of “*substantially*.” However, the combination of Midya and Raghavan discloses a “*second loop*” limitation to the same extent it is described in the '430 patent.

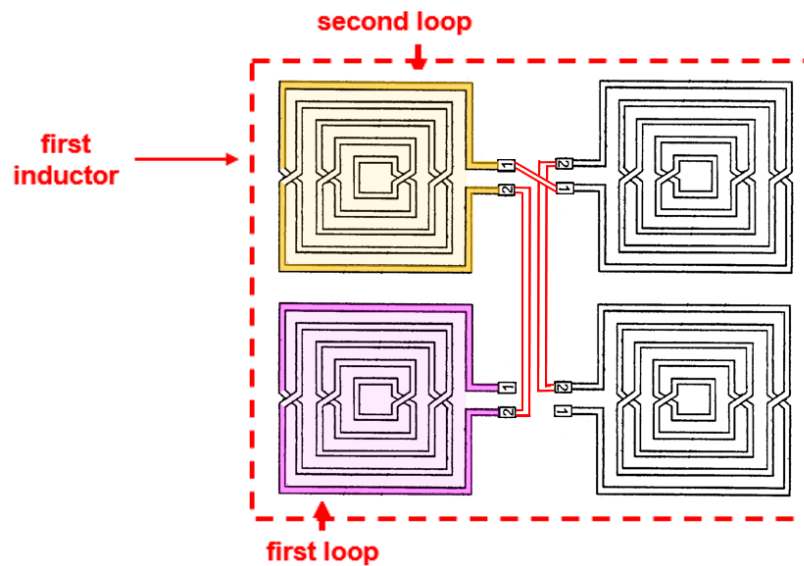
261. The “*inductor*” of the combination of Midya and Raghavan includes “*a first loop*” [20A] and “*a second loop*” which is illustrated in the figure below paragraph 262. Raghavan’s inductor winding 31, which is used as each loop of Midya in the combination, “comprises 5 square windings 32 [shaded red], 33 [shaded purple], 34 [shaded orange], 35 [shaded green] and 36 [shaded yellow].” (INTEL-1008, ¶19.) The inductor winding 31 having the collection of square windings 32-36 is a “*loop*.” The individual square windings 32-36, having a left half and right half, are also each a loop and therefore the outermost winding is also the recited “*loop*.”



Raghavan, Annotated Figure 3

262. This understanding is consistent with the discussion of a multi-turn inductor from the '430 patent. The '430 patent describes a “two-turn 8-shaped inductor”, illustrated in Figure 13. (INTEL-1001, 9:42-49.) The two-turn 8-shaped inductor of Figure 13 is a symmetric inductor, like that disclosed by Raghavan because Raghavan indicates a symmetric inductor can have shapes other than square windings. (See, e.g., INTEL-1008, ¶23 (“Although described in the case of circular and square windings, any concentric arrangement of arbitrarily symmetric shapes may be used. Such other shapes may include, but are not limited to, hexagons, rectangles, ellipses, etc.”).) In the “two-turn 8-shaped” inductor, “the two outer loops 1302 and 1304 of the inductor 1300 each turn into an inner loop 1306 and 1308, respectively.” (INTEL-1001, 9:43-47.) That is, the '430 patent

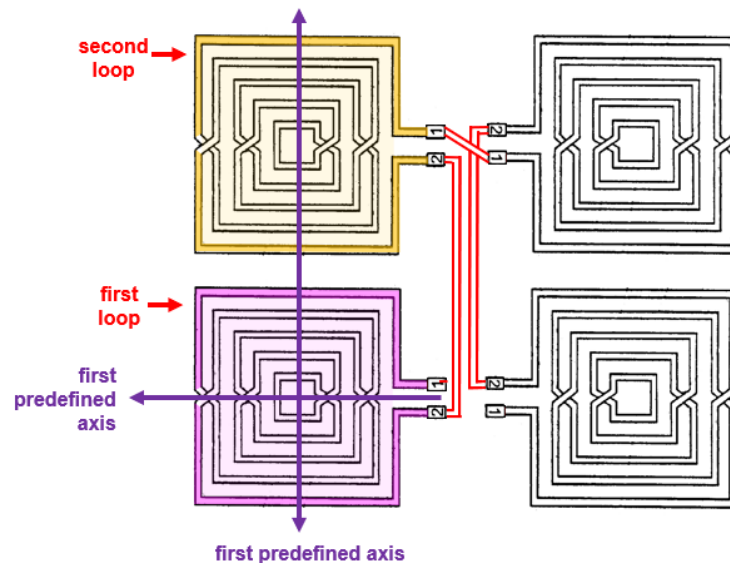
associates a winding of a symmetric inductor with a loop. Accordingly, the “*inductor*” of the combination of Midya and Raghavan provides a “*first loop*” (inductor winding 31 of lower left loop or its outermost square winding 32; shaded pink) and a “*second loop*” (inductor winding 31 of upper left loop or its outermost square winding 32; shaded orange).

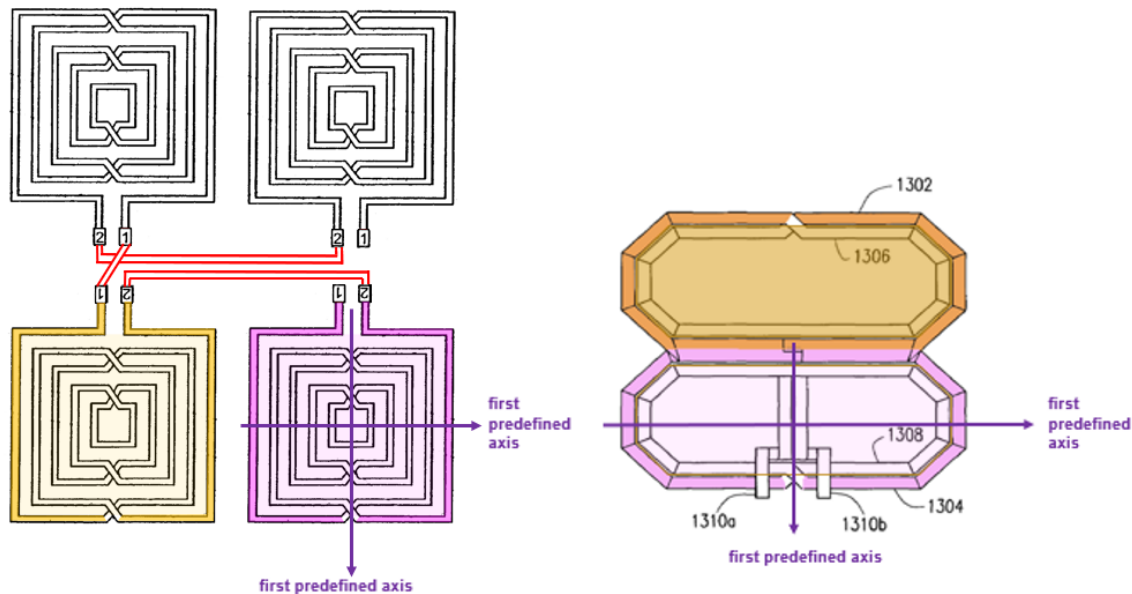


Combination of Midya/Raghavan (right)

263. Raghavan teaches that the “use of square windings which share a common center, **affords the inductor a symmetrical configuration.**” (INTEL-1008, ¶21.) Further, “in the case of square windings, the crossovers are preferably placed on an axis intersecting the conductor crossovers and the center of the conductor”— “[i]n this way, **the symmetry of the inductor is preserved.**” (INTEL-1008, ¶21.) As shown in the figure of the combination of Midya and

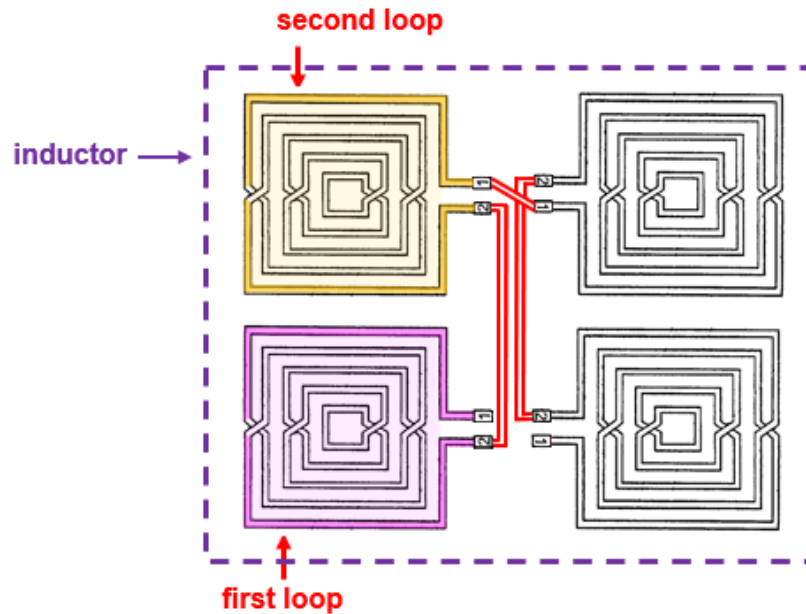
Raghavan (below left), Raghavan's outer loop (winding 32) turns into an inner loop (winding 33) which turns into another inner loop (winding 34), etc. This configuration is consistent with the '430 patent's "two-turn inductor" of Figure 13 (below right) that I described above in which "the two outer loops 1302 and 1304 of the inductor each turn into an inner loop 1306 and 1308, respectively." (INTEL-1001, 9:43-47.) In the figures below, I have rotated the figure illustrating the combination of Midya and Raghavan below at bottom left to highlight the similarities between the structures. Thus, consistent with the '430 patent's disclosure, the "*first loop*" of the Midya-Raghavan combination has or at a minimum renders obvious "*a shape that is substantially symmetrical about*" the horizontal and vertical axis of the loop ("*a first predefined axis*") [20A].





Midya-Raghavan Combination (top)
Rotated Midya-Raghavan Combination (bottom left); '430 Patent, Annotated
Fig. 13 (right)

264. Midya teaches that its adjacent loops have the “**same predetermined structure, i.e., size and shape**, to provide maximum cancellation of a moment over a 360° range.” (INTEL-1007, 9:1-4, 10:25-11:1, Figure 1 (illustrating 4 adjacent loops having the same size and shape).) Raghavan’s inductor windings are symmetric, as I discussed above. (See INTEL-1008, ¶21.) Accordingly, when Raghavan’s inductor windings are incorporated into the loops of Midya, each has the same configuration in the combination—each of the loops (inductor windings) has the **same size and shape**. Therefore, as reflected in the Midya-Raghavan combination shown below, the “*second loop*” in the Midya-Raghavan “*ha[s] a size and shape substantially identical to the first loop.*” [20B.1].



Combination of Midya and Raghavan

265. In the combination of Midya and Raghavan, the “*second loop*” (shaded orange) is connected to the “*first loop*” in a manner so that current flows through it in a CW direction and flows in the opposite CCW direction in “*first loop*” (shaded pink) as taught by Midya. (See, e.g., INTEL-1007, 11:1-4.) This arrangement of adjacent loops produces a “**total cancellation of a magnetic field on N axes**” and “**maximize[s] overall cancellation of the magnetic field.**” (See INTEL-1007, 10:22-25, 8:14-18.) Therefore, by placing the “*second loop*” and “*first loop*”, which have the same size and shape, adjacent to one another and connecting the loops such that current flows in opposite directions through the loops, opposing magnetic fields are generating which cancel one another. (INTEL-

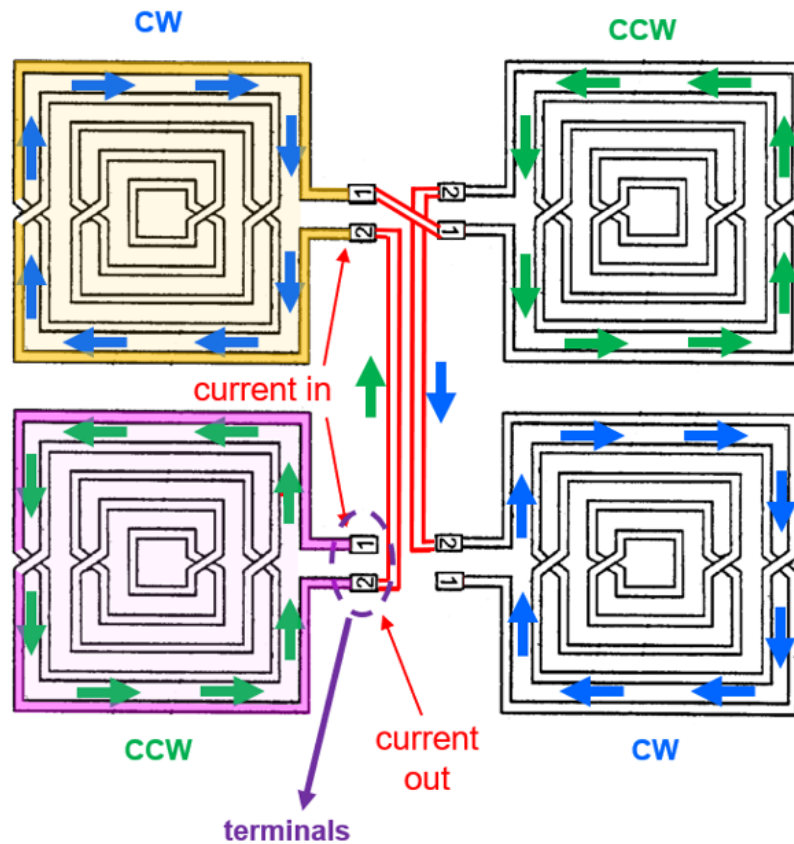
1033, 7:5-10 (describing that opposing magnetic fields reduce or cancel the “net magnetic field” of the inductor).)

266. As I discussed in the prosecution history section, the Examiner rejected a prosecution claim corresponding to independent claim 20 over U.S. Patent 6,194,987 to Zhou, et al (“Zhou”; INTEL-1033). To address this rejection, Applicant (PO) acknowledged that the current in the two loops of Zhou flows in opposite directions, resulting in reduced far field “to some extent.” (INTEL-1002, 125.) However, Applicant (PO) alleged that in Zhou “the loop areas are completely different (6:1 ratio as shown) so the reduction is marginal.” (INTEL-1002, 125.) Applicant further alleged that the “claimed invention makes the two loops **more equal in size to significantly improve cancellation of the far magnetic field** while maintaining a good Q-factor.” (INTEL-1002, 125.) Thus, Applicant (PO) acknowledged the fact that loops of equal size generating opposing fields improve “cancellation” of the overall field. Thus, the “*second loop*” in the combination of Midya-Raghavan is “*arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from said first loop*” [20B.2].

c. “Two closely spaced terminals” limitation [20C]

[20C] <i>two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals</i>

267. The combination of Midya and Raghavan discloses “*two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals*” [20C]. As shown in the figure below depicting the combination that I described in §VI.A.3, the bottom left loop (“*first loop*”) of the non-interacting inductor is connected to two terminals, labeled terminal [1] and terminal [2]. (See, e.g., INTEL-1008, ¶20.) In the combination, current enters the bottom left loop (“*first loop*”) through terminal [1] of the loop, travels CCW through the loop, exits the loop through terminal [2], enters the upper left loop (“*second loop*”) through terminal [2] of that loop. (See INTEL-1007, 7:4-6, 10:20-22, 11:1-4; INTEL-1008, ¶20.) Thus, terminals [1] and [2] are “*connected to the first loop*” and “*supply[] electrical current*” to both “*the first and second loops.*”



Combination of Midya and Raghavan

268. The “two terminals” of the lower left loop (“first loop”) are “closely spaced.” The distance between the terminals is close, relative to the width of loops. (See, e.g., INTEL-1008, Figure 3.) Thus, spacing between the terminals (as shown in Raghavan’s Figure 3 and reflected in the combination figure above) in the combination of Midya and Raghavan is consistent with what the ’430 patent indicates constitutes closely spaced which I discussed in my analysis of this limitation in the Taniguchi ground (§IV.B.1.c). Thus, the combination of Midya and Raghavan provides “two closely spaced terminals.”

269. The two closely spaced terminals of the “*first loop*” of the combination of Midya and Raghavan “*minimiz[e] magnetic field contributions from the terminals.*” As I discussed in §IV.B.1.c, a POSITA would have understood that a consequence of having terminals spaced more closely than the width of the inductor loop is a minimization of magnetic field contributions from the terminals relative to the field contributions when the terminals are placed farther apart. Brooks summarizes this as “one of our basic **most basic principles**: *If you want to minimize EMI radiation, keep the signals and their returns close together.*” (INTEL-1010, 156-157 (emphasis by italics in original).) Brooks confirms the finding of the JP Examiner that “configuring the distance between the two terminals to be in close proximity is well-known art in the technical field” and “determining the position of the terminals of the inductor is a matter that can be appropriately selected by a person skilled in the art, and there is no particular difficulty in configuring the distance between the two terminals to be in close proximity.” (INTEL-1015, 22.)

270. The combination of Midya and Raghavan, as informed by the basic principle articulated in Brooks, which would have been well-known to a POSITA, is consistent with the limited disclosure for this limitation in the ’430 patent. The ’430 patent provides one sentence addressing this concept, stating only that “[f]or

example, positioning the two terminals 204a and 204b as close to each other as possible helps make the field contributions from the two parts of the inductor 200 identical.” (INTEL-1001, 4:29-32.) Additionally, the terminals in the ’430 patent are shown in Figure 2 as having wires with opposing currents. (INTEL-1001, 4:5-14; *see also* INTEL-1001, 3:65-4:3 (distinguishing “terminals” from “other metal wires”).) Thus, the combination of Midya and Raghavan discloses or renders obvious “*two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.*”

271. Should the construction of “*two closely spaced terminals*” from ITC-337-TA-1300 (“two terminals in proximity to each other (such that the electromagnetic field at a certain distance from the first inductor (where the second inductor is positioned) is reduced)”) be adopted, the combination of Midya and Raghavan meets this construction. Because the terminals are placed closely together, the electromagnetic fields due to the terminals cancel or are not measurable. (*See* INTEL-1010, 157.) Because the fields from the terminals cancel, the electromagnetic field of the non-interacting inductor is not altered by the terminals. Thus, the combination of Midya and Raghavan provides “two terminals in proximity to each other (such that the electromagnetic field at a certain distance

from the first inductor (where the second inductor is positioned) is reduced).” (See §VI.B.1.a [20P].)

2. Independent Claim 1

272. Claim 1 is directed to an “*inductor layout*” incorporating the “*inductor*” limitations of claim 20 and adding a “*second inductor*” limitation. As I highlight in the table below, claim 1 has overlapping limitations with claim 20. I address the claim differences in this section.

Claim 1	Claim 20
[1P] An inductor layout having reduced mutual electromagnetic coupling, comprising:	
[1A] a first inductor having a reduced far field, said first inductor comprising:	[20P] An inductor having a reduced far field, comprising:
[1A.1] a first loop having a shape that is substantially symmetrical about a first predefined axis;	[20A] a first loop having a shape that is substantially symmetrical about a first predefined axis;
[1A.2a] a second loop connected to the first loop,	
[1A.2b] said second loop having a size and shape substantially identical to the first loop,	[20B.1] a second loop having a size and shape substantially identical to the first loop;
[1A.2c] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and	[20B.2] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from said first loop; and

[1A.3] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals; and	[20C] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.
[1B] a second inductor positioned at a predetermined distance from the first inductor, wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.	

a. Preamble

[1P] *An inductor layout having reduced mutual electromagnetic coupling*

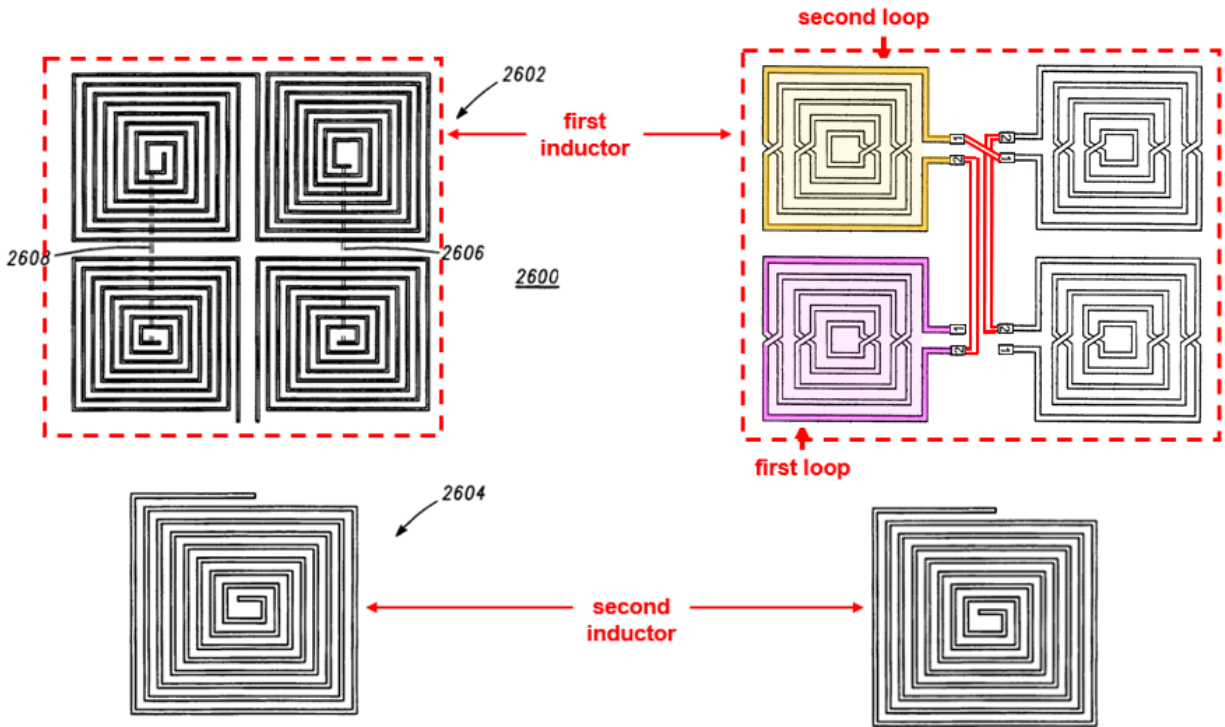
273. The combination of Midya and Raghavan discloses or renders obvious an “*inductor layout having reduced mutual electromagnetic coupling*” [1P].

274. Midya teaches that its “invention provides a method and planar inductor/transformer that maximizes cancellation of a moment of the plurality of loops/spiral conductor coils over a predetermined range such that **interference with external and adjacent circuitry is minimized.**” (INTEL-1007, 6:11-17.) More specifically, the loops of Midya’s non-interacting multiloop inductor that have the same predetermined structure “provide maximum cancellation of a

moment over a 360° range.” (INTEL-1007, 9:1-6.) Because of this cancellation, Midya teaches different layouts for a second inductor relative to its non-interacting inductor.

275. Midya’s Figure 26 (below left) is a “diagrammatic representation” of an exemplary stacked inductor layout in which “a spiral inductor (2604) is placed concentrically above²¹ a non-interacting multiloop/spiral inductor structure (2602).” (INTEL-1007, 11:20-25, 5:21-25.) In the combination Midya and Raghavan, each of the loops of Midya’s inductor structure 2602 are replaced with Raghavan’s symmetrical inductor winding 31, as shown in the figure below on the right. The second spiral inductor 2604 remains unchanged in the combination.

²¹ As I mentioned in the overview of Midya, Figure 26 shows inductor 2604 below non-interacting multiloop inductor 2602 for illustrative purposes. A POSITA would understand based on Midya’s discussion that inductor 2604 is placed in a layer above inductor 2602.



Midya, Figure 26; Combination of Midya and Raghavan

276. The non-interacting multiloop inductor of the combination of Midya and Raghavan is the “*first inductor*” as highlighted in the figure above right and the spiral inductor (at bottom in the figure above right) is a second inductor. The arrangement of the first and second inductors of Midya and Raghavan is therefore an “*inductor layout*.”

277. The “*inductor layout*” of the combination of Midya and Raghavan with stacked inductors has “*reduced mutual electromagnetic coupling*.” As I discussed in §VI.B.1.a for claim 20, the arrangement of the loops in the non-interacting multiloop inductor of the combination of Midya and Raghavan

“provide[s] **total cancellation of a magnetic field on N axes**” and “maximize[s] overall cancellation of the magnetic field.” (See Midya, 10:22-25.) In the layout of Figure 26, the spiral inductor 2604 (“*second inductor*”) “is placed concentrically above a non-interacting multiloop/ inductor structure (2602) such that the **coupled magnetic field is substantially zero.**” (INTEL-1007, 5:21-25; *see also*, INTEL-1007, 6:11-15 (“present invention provides a method and planar inductor/transformer that maximizes cancellation of a moment of the plurality of loops/spiral conductor coils over a predetermined range such that interference with external and adjacent circuitry is minimized”), 9:1-4.) The mutual electromagnetic coupling is proportional to the strength of the magnetic field generated by the inductor. (INTEL-1013, 612.) Because the magnetic field generated by the multi-loop inductor structure is “substantially zero” and the magnetic moment is cancelled over a predetermined range, the mutual electromagnetic coupling is also substantially zero as taught by Midya. As taught by Midya, this represents a reduction in mutual electromagnetic coupling from prior art planar inductors that “radiate a magnetic field producing EMI ... that interferes with adjacent circuitry” (INTEL-1007, 1:18-21; *see also*, INTEL-1013, 612). In the stacked arrangement of the combination, as I discussed in §VI.A.3 (motivation to combine), the magnetic fields generated by opposing currents carried by the interconnections between

upper and lower loops substantially cancel and do not materially impact the cancellation achieved due to the arrangement of adjacent loops. (INTEL-1007, 5:21-25; *see also, id.*, 6:11-15, 9:1-4; INTEL-1010, 157; INTEL-1024, Abstract.) Thus, the combination of Midya and Raghavan having a stacked inductors discloses an “*inductor layout having reduced mutual electromagnetic coupling*” [1P].

278. In Midya’s “best case” and “worst case” arrangements, a “test loop” (“*second inductor*”) is positioned at different locations relative to a 4-loop non-interacting inductor (“*first inductor*”). (INTEL-1007, 18:4-16.) The arrangement of the “test loop” inductor and the 4-loop non-interacting inductor is an “*inductor layout*” in both the best and worst case arrangements. The coupled magnetic field between the 4-loop non-interacting inductor and a test loop in the “best case” layout is **reduced** “by at least 80dB for the 4-loop (2104), 6-loop (2106) and 8-loop (2108) structures at 2 inductor lengths away and beyond compared to coupling for a simple circular loop (2102).” (INTEL-1007, 19:6-9.) The coupled magnetic field between the 4-loop non-interacting inductor and a test loop in the “worst case” layout is **reduced** “by 20dB for a 4-loop (2204) structure at a distance of 2 inductor lengths away, as compared to a simple loop (2202).” (INTEL-1007, 18:18-20; Figures 20-21; *see also, id.*, 9:1-4.) As discussed above, this reduction of

mutual electromagnetic coupling is achieved with the combination because the magnetic fields generated by the interconnections substantially cancel and do not materially impact the cancellation achieved by the adjacent loop arrangement. (*See* §VI.A.3 (motivation to combine).) The best and worst case arrangements therefore both provide a reduction in mutual electromagnetic coupling from prior art inductors (e.g., a simple loop).

b. “First inductor” limitations [1A], [1A.1]-[1A.3]

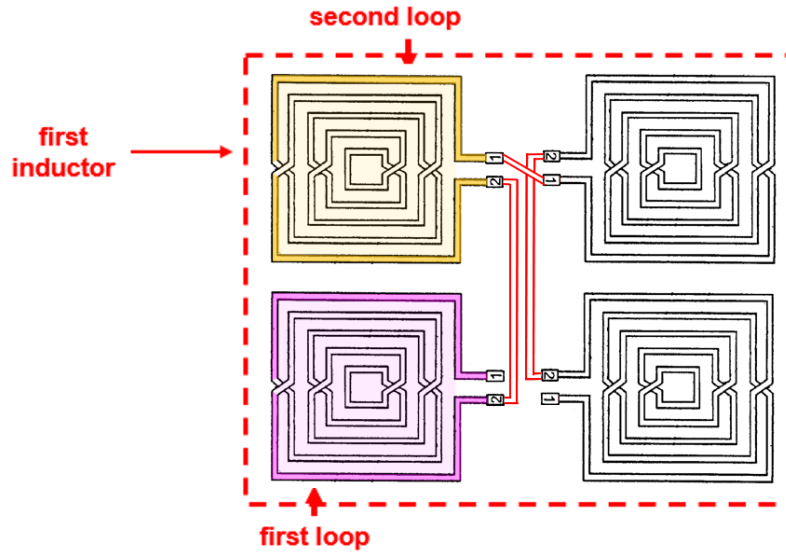
Claim 1	Claim 20
[1A] a first inductor having a reduced far field, said first inductor comprising:	[20P] An inductor having a reduced far field, comprising:
[1A.1] a first loop having a shape that is substantially symmetrical about a first predefined axis;	[20A] a first loop having a shape that is substantially symmetrical about a first predefined axis;
[1A.2a] a second loop connected to the first loop,	
[1A.2b] said second loop having a size and shape substantially identical to the first loop,	[20B.1] a second loop having a size and shape substantially identical to the first loop;
[1A.2c] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and	[20B.2] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from said first loop; and
[1A.3] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing	[20C] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing

magnetic field contributions from the terminals; and	magnetic field contributions from the terminals.
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279. The “*first inductor*” limitations of claim 1 substantially overlap with the limitations of claim 20. The preamble of claim 20 is substantially the same as limitation [1A] with the only difference being limitation [1A] recites a “*first inductor*” rather than an “*inductor*”—which is an immaterial difference.

Limitations [1A.1], [1A.2b], [1A.2c] and [1A.3] are identical to limitations [20A], [20B.1], [20B.2], and [20C]. Thus, for the reasons discussed in §§VI.B.1.a-c, the combination of Midya and Raghavan discloses or renders obvious these limitations.

280. The primary difference between the “*second loop*” limitation [20B] of claim 20 and the “*second loop*” limitation [1A.2] of claim 1 is that claim 1 adds the limitation that the “*second loop [is] connected to the first loop*” [1A.2a]. In the non-interacting multiloop inductor of the combination of Midya and Raghavan (illustrated below), the second terminal [2] of the “*first loop*” (lower left loop) is connected to the second terminal [2] of the “*second loop*” (upper left loop) as I discussed in §VI.A.3 (motivation to combine). (See, e.g., INTEL-1007, 11:1-6.) Thus, the combination of Midya and Raghavan discloses “*a second loop connected to the first loop*” [1A.2a].



Combination of Midya and Raghavan

c. “Second inductor” limitation [1B]

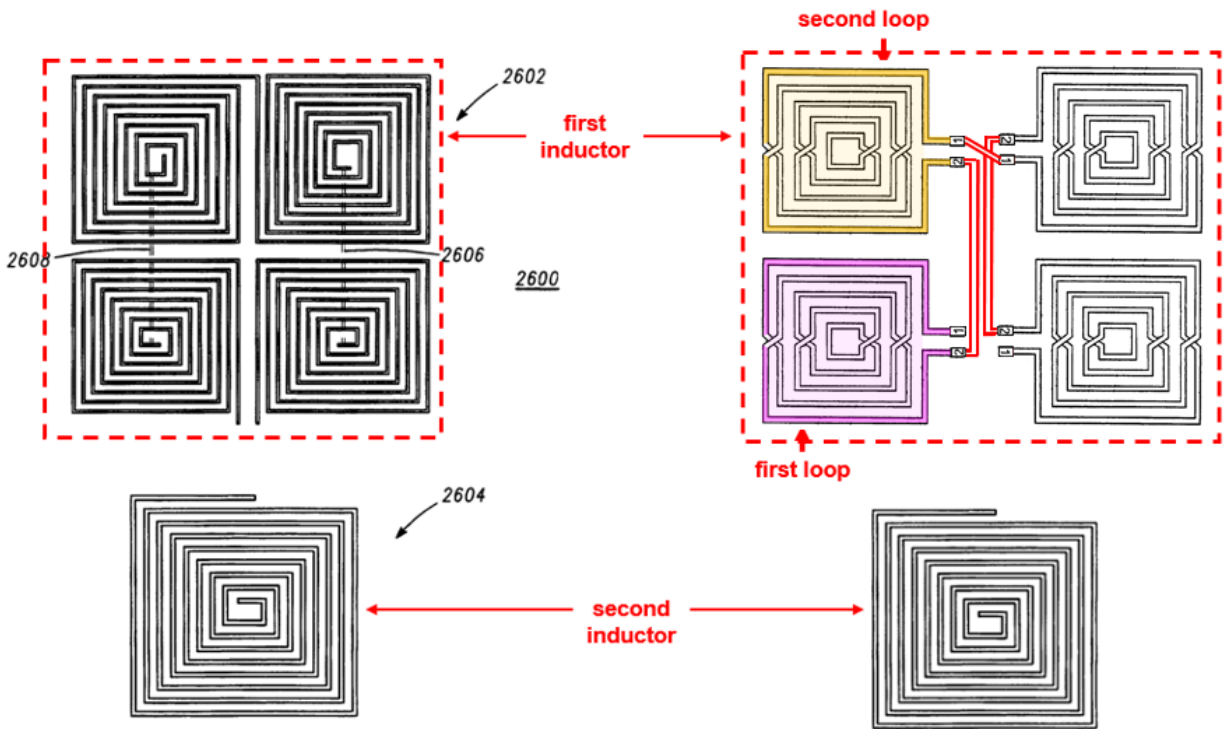
[1B.1] a second inductor positioned at a predetermined distance from the first inductor,

[1B.2] wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field

281. The combination of Midya and Raghavan discloses “a second inductor positioned at a predetermined distance from the first inductor, wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field” for both the stacked inductor layout and the best/worst case inductor layouts. As I have discussed previously, the arrangement of the loops in

the non-interacting multiloop inductor (“*first inductor*”) of the combination of Midya and Raghavan “provide[s] **total cancellation of a magnetic field on N axes**” and “maximize[s] **overall cancellation** of the magnetic field.” (See INTEL-1007, 10:22-25.) Therefore, because of the resulting minimized interference, Midya provides flexibility in the placement of additional circuitry, including other inductors. (See INTEL-1007, 6:11-15.)

282. In the stacked layout, the spiral inductor (2604) of Figure 26 (reproduced below) is a “*second inductor*.” In this layout, the “spiral inductor [] is placed concentrically above a non-interacting multiloop inductor structure.” (INTEL-1007, 5:21-25.) More specifically, the stacked inductor is “implemented on a two-layer printed circuit board” with the spiral inductor in the top layer and the non-interacting inductor in the bottom layer. (INTEL-1007, 11:8-16, 11:18-20 (relating layers of Figure 2 to Figure 26 implementation).) That is, the spiral inductor (“*second inductor*”) is positioned in a different layer (a predetermined distance) from the non-interacting multiloop inductor (“*the first inductor*”). Thus, in the stacked layout, “*a second inductor positioned at a predetermined distance from the first inductor.*”



Midya, Figure 26 (left); Combination of Midya and Raghavan (right)

283. In Midya’s “best case” and “worst case” layouts, Midya positions a “test loop” at different locations relative to the 4-loop non-interacting inductor. (INTEL-1007, 18:4-16.) For example, Midya explains that the coupled magnetic field between the 4-loop non-interacting inductor and a test loop in the “best case” layout is reduced “by at least 80dB for the 4-loop (2104), 6-loop (2106) and 8-loop (2108) structures at **2 inductor lengths** away and beyond compared to coupling for a simple circular loop (2102).” (INTEL-1007, 19:6-9.) And the coupled magnetic field between the 4-loop non-interacting inductor and a test loop in the “worst case” layout is reduced “by 20dB for a 4-loop (2204) structure at a distance of **2**

inductor lengths away, as compared to a simple loop (2202).” (INTEL-1007, 18:18-20.) Thus, in the best and worst case layouts, the test loop (“*second inductor*”) is positioned at the predetermined distance (e.g., “**2 inductor lengths**”) from the non-interacting inductor (“*first inductor*”). (INTEL-1007, 18:4-16, 18:18-20, 19:6-9.)

284. I note that Midya’s disclosures are consistent with Applicant’s (PO’s) statement during prosecution of EP3567614: “it is submitted that the root parent application as filed does not mandate any particular distance or relative orientation of the two inductors.” (INTEL-1016, 59.) Accordingly, the stacked inductor arrangement discloses that the electromagnetic field emanating from the non-interactive multiloop inductor is reduced (canceled) at a certain distance from the non-interacting multiloop inductor (where the spiral inductor is positioned).

285. For all layouts (stacked and best/worst case), the “*mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field*” [1B.2]/[11B.2]. As I discussed in §VI.B.2.a, each “*inductor layout*” has “*reduced mutual electromagnetic coupling*” by virtue of the non-interacting inductor having a “*reduced electromagnetic field*” and the position of second inductor. As explained by Midya, the “overall magnitude of the field (1302) obtained” using a

non-interacting inductor in any layout “is **reduced by a factor of at least 10 in a far field** when compared with the magnitude of the field (1202) obtained” from the prior art figure eight inductor. (See INTEL-1007, 14:26-15:4.) In the stacked inductor arrangement, a “spiral inductor [] is placed concentrically above a non-interacting multiloop inductor structure **such that the coupled magnetic field is substantially zero.**” (INTEL-1007, 5:21-25.)

286. In the stacked arrangement of the non-interacting inductor and a second inductor, the second inductor is placed “**such that the coupled magnetic field is substantially zero** in accordance with the present invention.” (INTEL-1007, 5:21-25.) As I discussed above, the coupled magnetic field between the 4-loop non-interacting inductor and a test loop in the “best case” layout is reduced “by at least 80dB ... at **2 inductor lengths** away and beyond compared to coupling for a simple circular loop (2102)” (INTEL-1007, 19:6-9) and the coupled magnetic field between the 4-loop non-interacting inductor and a test loop in the “worst case” layout is reduced “by 20dB for a 4-loop (2204)” (INTEL-1007, 18:18-20.)

287. As I discussed previously, mutual electromagnetic coupling is proportional to the strength of the magnetic field generated by the inductor. (See INTEL-1012, 68; INTEL-1013, 612.) Therefore, the reduced coupling achieved with Midya’s layouts is a result of “total cancellation of a magnetic field on N axes

and” the “maximiz[ation of] overall cancellation of the magnetic field” achieved by Midya’s non-interacting inductor. (INTEL-1007, 10:22-25; *see also*, INTEL-1007, 14:26-15:6 (“far field is **completely cancelled**, and the near field is **nearly cancelled**”), 9:1-4 (non-interacting inductor “provide[s] maximum cancellation of a moment over 360° range”); INTEL-1010, 27.). Thus, the combination of Midya and Raghavan discloses or renders obvious that the “*mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.*”

288. Should the construction of “*reduced electromagnetic field*” from ITC-337-TA-1300 be adopted in this proceeding, “the electromagnetic field emanating from the first inductor is reduced (at a certain distance from the first inductor where the second inductor is positioned)” for the reasons discussed in this section and §VI.B.1.a (20P).

3. Independent Claim 11

289. Claim 11 is directed to a “*method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die*” [11P]. I understand that the ALJ in ITC-337-TA-1368 found the preamble for claim 11 provides antecedent basis for the term “*first inductor*” but is otherwise not limiting. (INTEL-1019, 2-3.) If the preamble of claim 11 is only limiting to the

extent needed to provide antecedent basis for “*first inductor*”, the combination of Midya and Raghavan also renders claim 11 obvious. Should the preamble be determined to be limiting, the combination of Midya, Raghavan, and Gardner (Ground 4) renders the claim obvious.

290. I note that the body of claim 11 recites overlapping subject matter with claim 1 with the primary differences being that claim 11 recites the apparatus limitations of claim 1 as method steps (e.g., “*forming ...*”, “*orienting ...*”, “*connecting ...*”, and “*positioning ...*”), as illustrated in the table below. For the reasons discussed in §VI.B for claim 1 and below, the combination of Midya and Raghavan renders claim 11 obvious.

Claim 1	Claim 11
[1P] An inductor layout having reduced mutual electromagnetic coupling, comprising:	[11P] A method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die, comprising
[1A] a first inductor having a reduced far field, said first inductor comprising:	[11A] forming the first inductor to reduce a far field, said step of forming the first inductor comprising:
[1A.1] a first loop having a shape that is substantially symmetrical about a first predefined axis;	[11A.1] forming a first loop having a shape that is substantially symmetrical about a first predefined axis;
[1A.2a] a second loop connected to the first loop,	

Claim 1	Claim 11
[1A.2b] said second loop having a size and shape substantially identical to the first loop,	[11A.2a] forming a second loop having a size and shape substantially identical to the first loop;
[1A.2c] said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop; and	[11A.2b] orienting the second loop in relation to the first loop such that a magnetic field emanating from the second loop tends to cancel a magnetic field emanating from the first loop; and
[1A.3] two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals; and	[11A.3] connecting two closely spaced terminals to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals; and
[1B.1] a second inductor positioned at a predetermined distance from the first inductor,	[11B.1] positioning a second inductor at a predetermined distance from the first inductor,
[1B.2] wherein a mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.	[11B.2] wherein the mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field.

291. For the reasons I discussed in §VI.B.2.b, the stacked and best/worst case layouts of the combination of Midya and Raghavan provide “*a first inductor.*” And for the reasons I discussed in §VI.B.2.c, these layouts also disclose “*a second inductor.*” Further, for the reasons I discussed in §VI.B.2.c [1B.2], in each layout,

the “*mutual electromagnetic coupling between the first inductor and the second inductor is reduced.*”

292. Limitation [11A] recites “*forming the first inductor to reduce a far field*” whereas limitation [1A] recites a “*first inductor having a reduced far field.*” As I discussed in §VI.B.2.b, the combination of Midya and Raghavan discloses a “*first inductor having a reduced far field.*” Although “*forming*” such an inductor is obvious from the disclosure of the inductor, Midya teaches a “method for maximizing cancellation of a total moment of the plurality of loops/spiral conductor coils arranged **to form** an inductor/transformer.” (INTEL-1007, claim 3; *see also*, INTEL-1007, claim 4 (“A method for maximizing cancellation of a magnetic field over a predetermined range for the plurality of loops/spiral conductor coils arranged **to form** an inductor/transformer”).) For this reason and the reasons I discussed in §VI.B.2.b for limitation [1A], the combination of Midya and Raghavan discloses or renders obvious “*forming the first inductor to reduce a far field*” [11A].

293. Limitation [11A.1] recites “*forming a first loop having a shape that is substantially symmetrical about a first predefined axis*” whereas limitation [1A.1] recites “*a first loop having a shape that is substantially symmetrical about a first predefined axis.*” As I mentioned above, Midya teaching forming an inductor by

arranging a plurality of loops. (See INTEL-1007, claims 3 and 4.) Thus, for this reason and the reasons I discussed in §VI.B.2.b for limitation [1A.1], the combination of Midya, and Raghavan discloses or renders obvious “*forming a first loop having a shape that is substantially symmetrical about a first predefined axis*” [11A.1].

294. Limitation [11A.2a] recites “*forming a second loop having a size and shape substantially identical to the first loop*” whereas the limitation [1A.2b] recites “*said second loop having a size and shape substantially identical to the first loop.*” As I mentioned above, Midya teaching forming an inductor by arranging a plurality of loops. (See INTEL-1007, claims 3 and 4.) Thus, for this reason and the reasons I discussed in § VI.B.2.b for limitation [1A.2], the combination of Midya, Raghavan, and Gardner discloses or renders obvious “*forming a second loop having a size and shape substantially identical to the first loop*” [11A.2a].

295. Limitation [11A.2b] recites “*orienting the second loop in relation to the first loop such that a magnetic field emanating from the second loop tends to cancel a magnetic field emanating from the first loop*” whereas limitation [1A.2c] recites “*said second loop arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop.*” Thus, for this reason and the reasons I discussed in § VI.B.2.b for limitation [1A.2c], the

combination of Midya and Raghavan discloses or renders obvious “*orienting the second loop in relation to the first loop such that a magnetic field emanating from the second loop tends to cancel a magnetic field emanating from the first loop*” [11A.2b].

296. Limitation [11A.3] recites “*connecting two closely spaced terminals to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals*” whereas limitation [1A.3] recites “*two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.*” As discussed in § VI.B.2.b, the lower left loop in the non-interacting multiloop inductor includes “*two closely spaced terminals*” which are connected to the “*first loop.*” Thus, for the reasons discussed in that section, the combination of Midya and Raghavan discloses or renders obvious “*connecting two closely spaced terminals to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals.*”

297. Limitation [11B.1] recites “*positioning a second inductor at a predetermined distance from the first inductor*” whereas limitation [1B.1] recites “*a second inductor positioned at a predetermined distance from the first inductor.*”

Limitations [1B.2] and [11B.2] are identical. Thus, for the reasons discussed in §VI.B.2.c for limitations [1B.1]-[1B.2], the combination of Midya and Raghavan discloses or renders obvious “*positioning a second inductor at a predetermined distance from the first inductor*” [11B.1] and “*wherein the mutual electromagnetic coupling between the first inductor and the second inductor is reduced as a result of the first inductor having a reduced electromagnetic field*” [11B.2].

C. Dependent Claims

1. Claims 3, 4, 13 and 14

298. Claims 3 and 13 are directed to same subject matter, as illustrated in the following table:

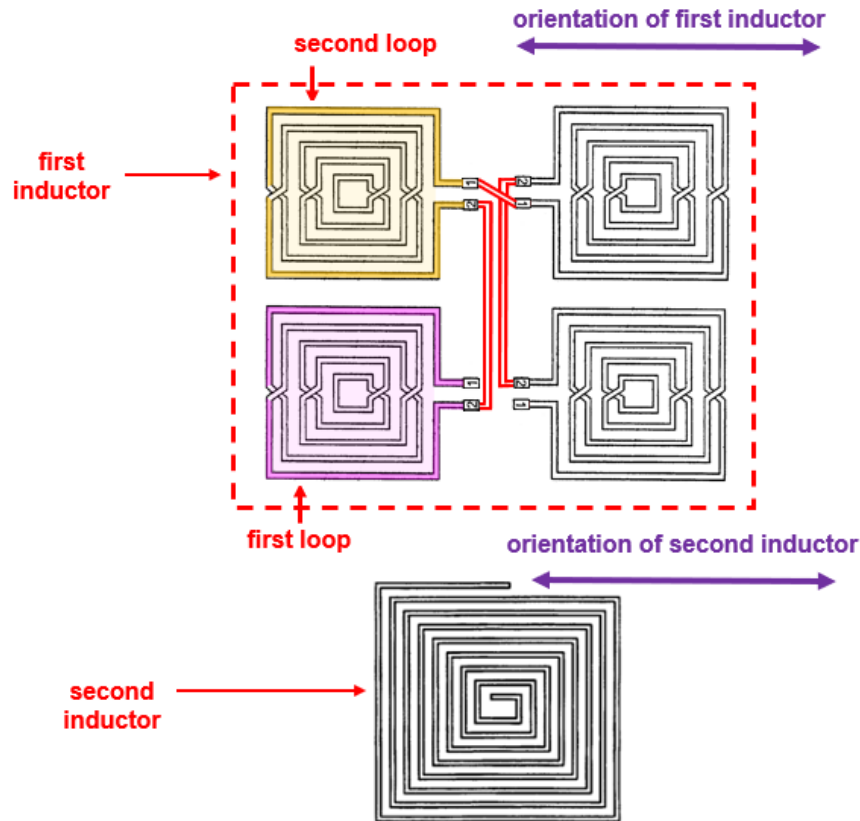
Claim 3	Claim 13
The inductor layout according to claim 1, wherein said first inductor and said second inductor are oriented in a same direction.	The method according to claim 11, wherein the step of positioning the second inductor includes orienting said first inductor and said second inductor in a same direction.

Claims 4 and 14 are directed to the same subject matter, as illustrated in the table below. The combination of Midya and Raghavan renders claims 3, 4, 13 and 14 obvious.

Claim 4	Claim 14
The inductor layout according to claim 1, wherein said first inductor and said	The method according to claim 11, wherein the step of positioning the

second inductor are oriented in different directions.	second inductor includes orienting said first inductor and said second inductor in different directions.
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299. The combination of Midya and Raghavan discloses “*said first inductor and said second inductor are oriented in a same direction*” [3] and “*positioning the second inductor includes orienting said first inductor and said second inductor in a same direction*” [13]. The stacked layout in the combination (illustrated below) includes two inductors oriented in the same direction. If the positioning of terminals (and/or direction of current flow in/out of the inductor) determines orientation, the direction of current flow in/out of the non-interacting inductor (“*first inductor*”) is the same as the spiral inductor (“*second inductor*”).



Combination of Midya and Raghavan

300. Additionally, positioning two inductors to be oriented in different directions would have been obvious to try to a POSITA rendering the “*first inductor and said second inductor are oriented in different directions*” [4] and “*positioning the second inductor includes orienting said first inductor and said second inductor in different directions*” [14] obvious.

301. As would be recognized by a POSITA, and even by a lay person, long prior to the earliest priority date claimed on the face of the '430 patent, a primary goal of designers of electronic devices (including RF transmitters) has been to

reduce the size (or miniaturize) the device. (*See, e.g.*, INTEL-1007, 6:15-17 (Midya’s teachings apply to devices that have “a size constraint” and allow for “adjacent circuitry”); INTEL-1034, 1:12-13; *see also*, INTEL-1036, 515; INTEL-1037, 48.) To achieve size reduction, fewer chips (or even a single chip) are used requiring electronic components to be placed on a substrate in an efficient manner to maximize use of the available area. (*See, e.g.*, INTEL-1031, 5 (“in order for the monolithic inductors to ... be accepted by the consumer application RF IC designers, it can be said that, the **area efficiency** is far more critical issue that needs to be resolved than the quality factor”).) Thus, a recognized need existed in the art to arrange components on a substrate to efficiently use the substrate area.

302. Only two options exist for the general orientation of two components such as the “*first inductor*” and “*second inductor*” relative to one another: (1) the two components (inductors) are oriented in the **same** direction and (2) the two components (inductors) are oriented in **different** directions. Because of design goal of optimizing area efficiency of components on a substrate, a POSITA would have had a reason to pursue both options. For example, orienting the inductor in different directions changes the location of the terminals. This in turn allows the designer to optimize the location of the terminals for connection to other circuit components which allows for a more flexible layout of device components.

303. A POSITA would have been able to pursue the two known options with a reasonable expectation of success because inductor orientation is merely a matter of rotating the device, no process changes are required. Thus, the combination of Midya and Raghavan therefore renders obvious that the “*first inductor and said second inductor are oriented in a same direction*” [3], the “*first inductor and said second inductor are oriented in different directions*” [4], “*positioning the second inductor includes orienting said first inductor and said second inductor in a same direction*” [13]” and “*positioning the second inductor includes orienting said first inductor and said second inductor in different directions.*”

2. Claims 5/15, 6/16

304. Claims 5 and 15 are directed to the same subject matter, as illustrated in the table below:

Claim 5	Claim 15
The inductor layout according to claim 1, wherein said first inductor and said second inductor share a common axis.	The method according to claim 11, wherein the step of positioning the second inductor includes placing said first inductor and said second inductor on a common axis that is shared by said first inductor and said second inductor.

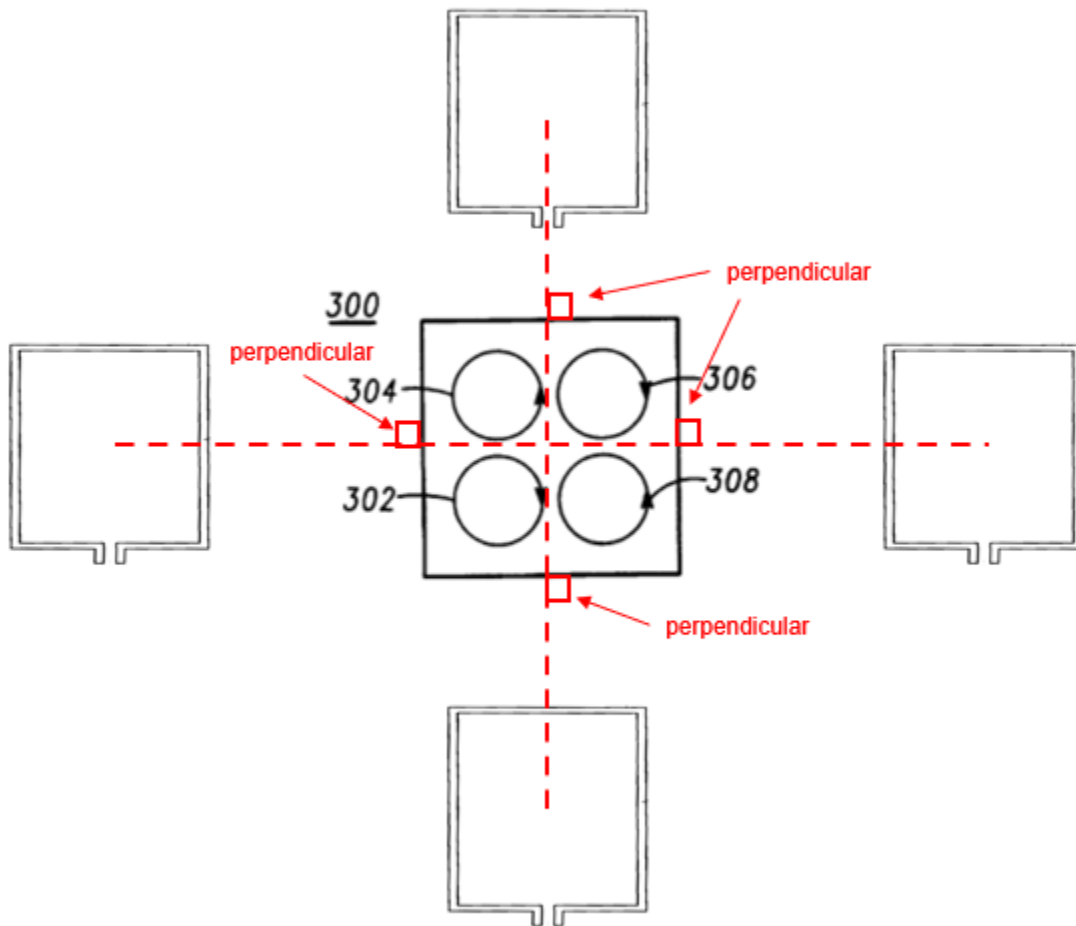
Claims 6 and 16 are directed to the same subject matter, as illustrated in the table below. The combination of Midya and Raghavan renders claims 5, 6, 15, and 16 obvious.

Claim 6	Claim 16
The inductor layout according to claim 1, wherein said first inductor and said second inductor share no common axis.	The method according to claim 11, wherein the step of positioning the second inductor includes placing said first inductor and said second inductor so that they share no common axis.

305. The combination of Midya and Raghavan discloses “*said first inductor and said second inductor share a common axis*” [5] and “*positioning the second inductor includes placing said first inductor and said second inductor on a common axis that is shared by said first inductor and said second inductor*” [15]. In the stacked layout, second inductor 2604 is “placed **concentrically** above” the non-interacting inductor. (INTEL-1007, 11:20-22) and thus, the “*first inductor*” and “*second inductor*” share a common z-axis through their center.

306. Midya’s “best case” layout (Figure 21) teaches or at least suggests placement of the “*second inductor*” on “*a common axis*” with the non-interacting inductor. Regarding the line graphs of both Figures 21 (best case coupling) and 22 (worst case coupling), Midya states that “[t]he horizontal axis represents **distance**

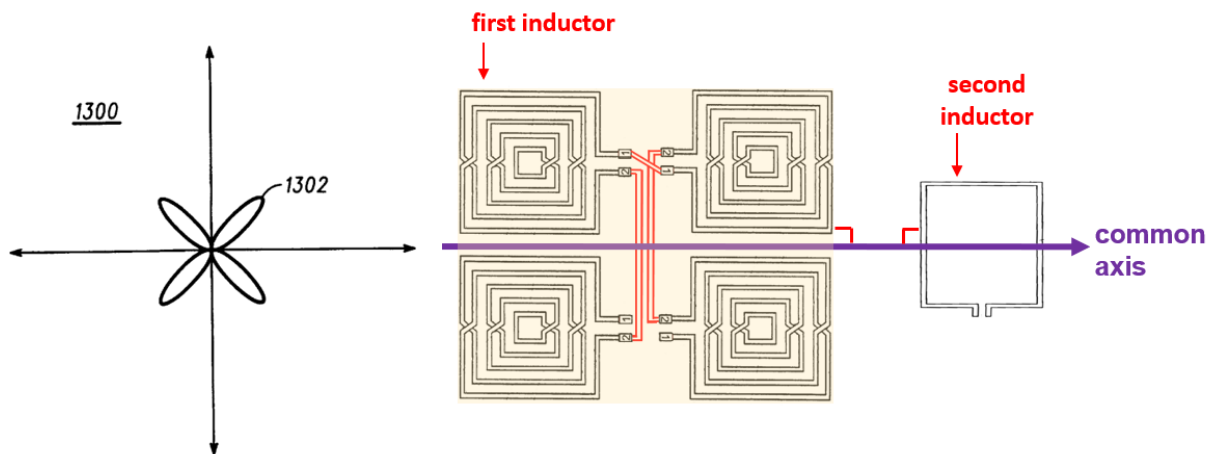
from the center of the multiloop structure relative to the lateral dimension of the structure.” (INTEL-1007, 18:6-8, 18:14-16.) Midya further teaches that “[t]he vertical axis represents the measure of mutual inductance with the test loop” so that the “coupled magnetic field of the multiloop structure [with the test loop] is plotted as a function of **distance from the center**.” (INTEL-1007, 18:9-13.) Midya further teaches that in the best case the inductors are “perpendicular to a side of the polygon.” (INTEL-1007, 18:9-15.) A POSITA would understand to mean the two inductors share “*a common axis*” which intersects the center of both inductors and is perpendicular to the lateral dimension of both. (INTEL-1007, 18:14-15, 18:6-18.) I illustrate this understanding using Figure 3 (which is a representation of the 4-loop non-interacting inductor showing current flow). (INTEL-1007, 12:1-6.) Placing the inductors perpendicular allows for placement of the second inductor on the vertical axis (above or below the non-interacting inductor) or on the horizontal axis (to the right or left of the non-interacting inductor.)



Midya, Annotated Figure 3

307. This understanding is consistent with or suggested by Midya's disclosure that the 4-loop non-interacting inductor "provide[s] total cancellation of a magnetic field on N axes [horizontal and vertical]" of the structure, as shown in Figure 13 (below left). (INTEL-1007, 10:22-25, 14:25-15:6, 18:4-8.) A POSITA would understand that "best case" reduction in coupling occurs by placing the second inductor where "total cancellation" occurs, i.e., on one of the two axes

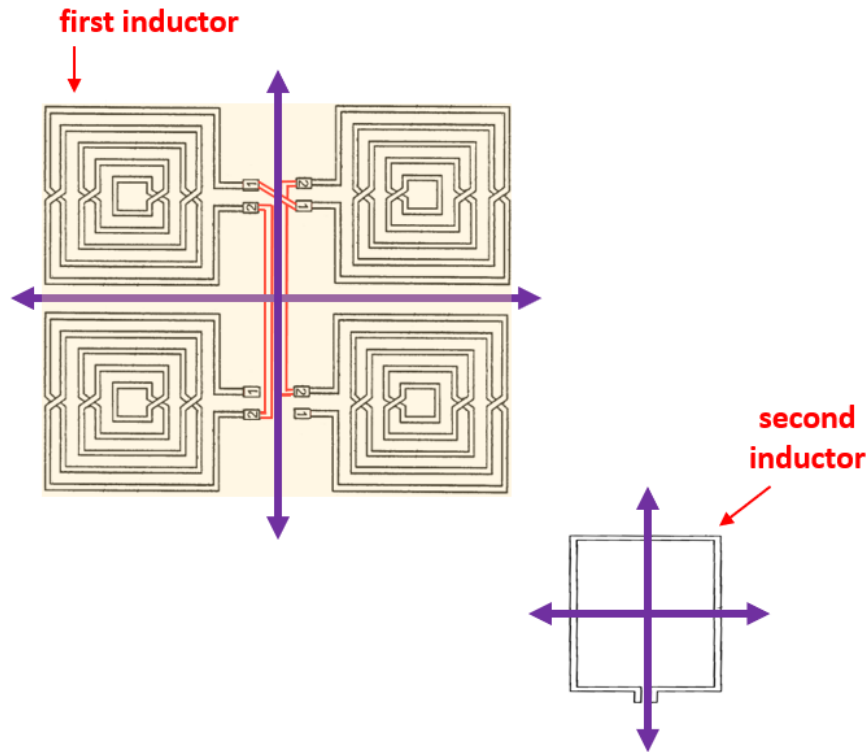
(horizontal or vertical). The following figure (below right) illustrates placement of the non-interacting inductor and the second inductor on the same horizontal axis which has cancelled field (as shown in Figure 13 at left). Thus, the best case layout of two inductors in the combination of Midya and Raghavan discloses or renders obvious “*said first inductor and said second inductor share a common axis*” [5] and “*positioning the second inductor includes placing said first inductor and said second inductor on a common axis that is shared by said first inductor and said second inductor*” [15].



Midya, Figure 13 (left), Best Case Midya-Raghavan Combination (right)

308. Midya’s “worst case” layout (Figure 22) teaches or at least suggests placement of the “*second inductor*” on a different axis than the non-interacting inductor. Midya teaches that in the worst case the inductors are “along a diagonal of a polygon.” (INTEL-1007, 18:14-16, 18:6-8.) A POSITA would understand to

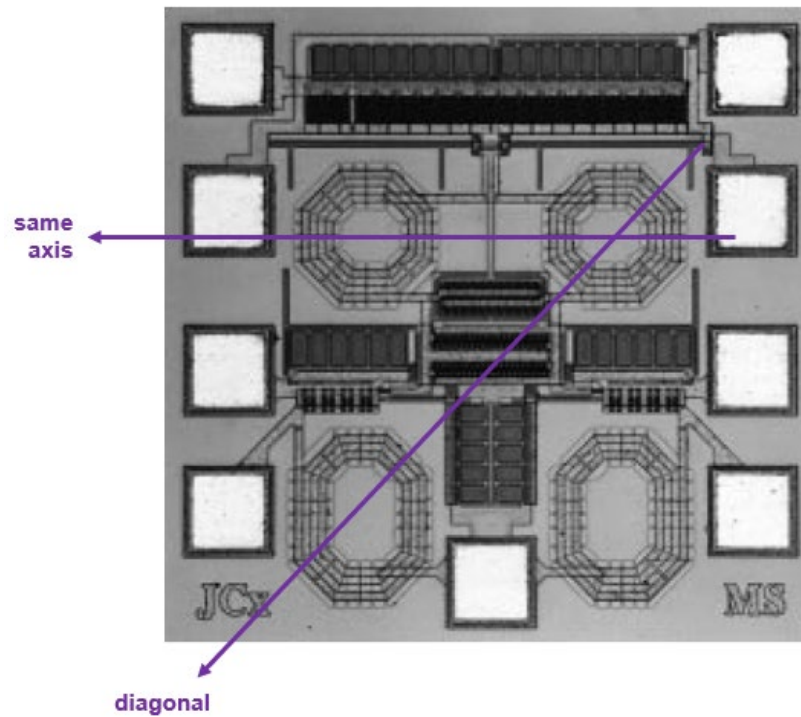
mean the two inductors are placed diagonally as shown in the exemplary figure below. This understanding is consistent with or suggested by Midya's disclosure that the 4-loop non-interacting inductor "maximize[s] **overall** cancellation of the magnetic field" of the structure which provides improved cancellation but not the best case cancellation as when second inductor placed on the same axis where total cancellation is achieved. (INTEL-1007, 10:22-25, 18:4-8.) Thus, the worst case layout of the combination of Midya and Raghavan discloses or renders obvious "*said first inductor and said second inductor share no common axis*" [6] and "*positioning the second inductor includes placing said first inductor and said second inductor so that they share no common axis*" [16].



Combination of Midya and Raghavan

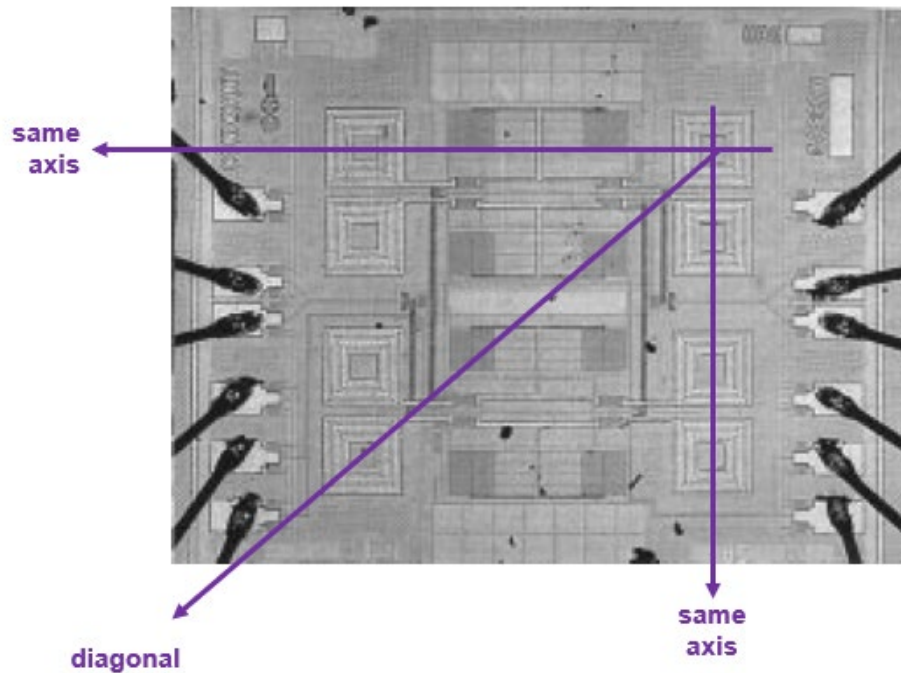
309. Additionally, placing two inductors such that they (1) “*share a common axis*” or (2) do not share a common axis (“*no common axis*”) would have been obvious to a POSITA to try. As I discussed in §VI.C.1, a recognized need existed in the art to arrange components on a substrate to efficiently use the substrate area. Like claims 3, 4, 13, and 14, only two options exist for placement of a second inductor relative to a first inductor—either the two share a common axis or they do not share a common axis. A POSITA would have pursued either of this finite number of solutions to maximize the use of available substrate area.

310. A POSITA would have had a reasonable expectation of success with both options because both merely involve moving one inductor relative to another. Moreover, it was known (and in use) to place two inductors either on the same axis or off-axis from one another before the earliest priority date claimed on the face of the '430 patent. For example, the following figure from the paper, “A 1.8-GHz Low-Phase-Noise CMOS VCO Using Optimized Hollow Spiral Inductors” by Craninckx, et al. (“Craninckx”; INTEL-1038) illustrates an integrated circuit chip for a transmitter including a voltage-controlled oscillator (“VCO”) with multiple inductors on the same plane and a measurement output buffer having two inductors on the same plane used as loads. (INTEL-1038, 742.) As shown in Figure 11 (reproduced below) the IC die has two inductors which share a common axis and two inductors diagonally positioned.



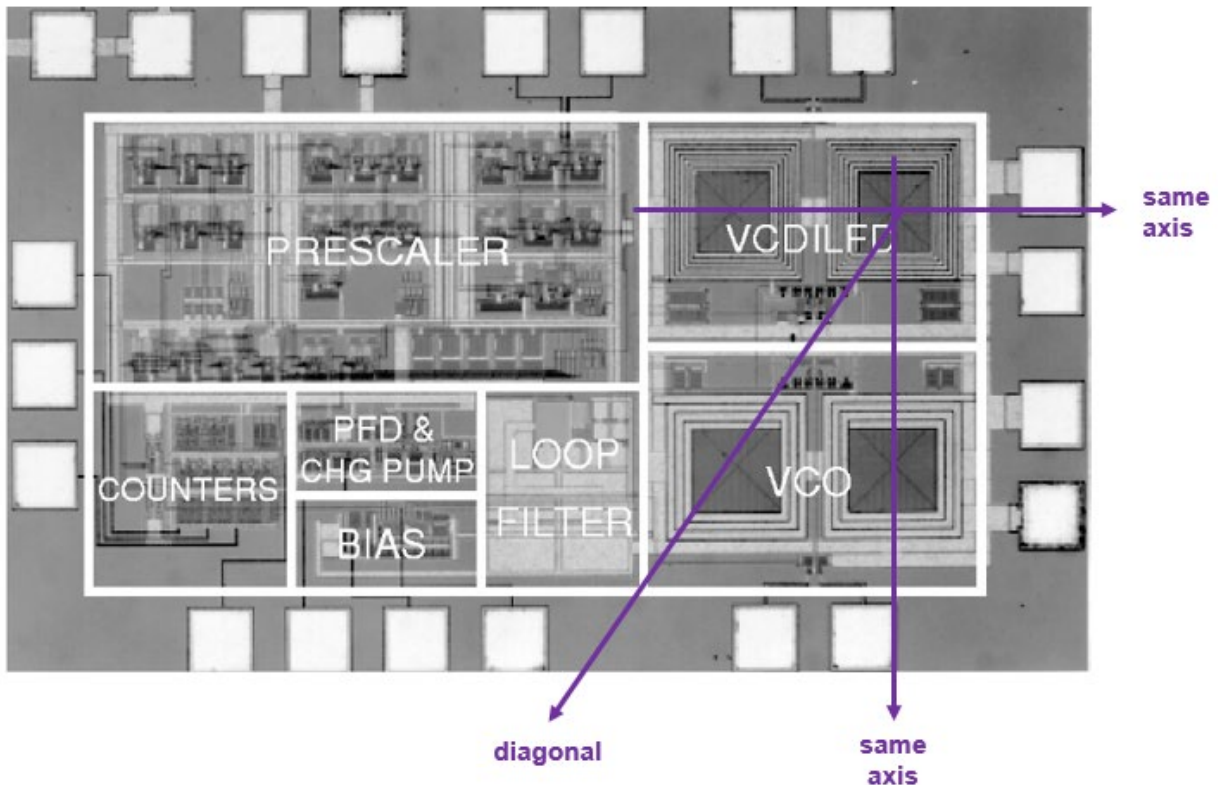
Craninckx, Annotated Figure 11

311. As another example, the paper “Low-Phase-Noise LC Quadrature VCO Using Coupled Tank Resonators in a Ring Structure” by ElSayed, et al. (“ElSayed”; INTEL-1039) also describes the architecture of a VCO. (See INTEL-1039, 701.) Figure 9, reproduced below, illustrates an IC die having a VCO with two inductors on the same axis and two inductors placed diagonally. (INTEL-1039, 705.)



ElSayed, Annotated Figure 9

312. In another example, the paper “A CMOS Frequency Synthesizer with an Injection-Locked Frequency Divider for a 5-GHz Wireless LAN Receiver” to Rategh, et al. (“Rategh”; INTEL-1040) describes a frequency synthesizer used in an RF communication device. (*See* INTEL-1040, 780.) Figure 8 shows a VCO and an infection-locked frequency divider (ILFD) on a die with two inductors on the same axis and two inductors positioned diagonally. (INTEL-1040, 784.)



Rategh, Annotated Figure 8

313. Thus, the combination of Midya and Raghavan renders obvious “*said first inductor and said second inductor share a common axis*” [5], “*said first inductor and said second inductor share no common axis*” [6], “*positioning the second inductor includes placing said first inductor and said second inductor on a common axis that is shared by said first inductor and said second inductor*” [15], and “*positioning the second inductor includes placing said first inductor and said second inductor so that they share no common axis*” [16]

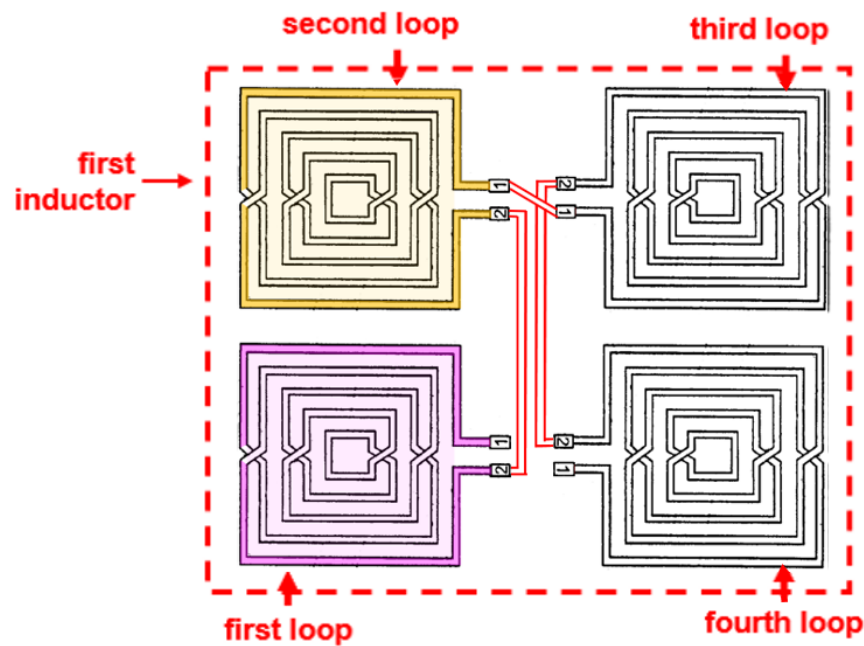
3. Claims 9 and 12

314. Claims 9 and 12 (reproduced below) are both directed to a “four-leaf clover-shaped inductor.” The combination of Midya and Raghavan renders both claims obvious.

Claim 9	Claim 12
The inductor layout according to claim 1, wherein said first inductor also includes a third loop connected to the second loop and a fourth loop connected to the third loop and to the first loop, wherein the first inductor is substantially four-leaf clover-shaped.	The method according to claim 11, wherein the step of forming the first inductor also includes: [12A] forming a third ioop [sic] having a size and shape substantially identical to the first and second loops; [12B] forming a fourth loop having a size and shape substantially identical to the first, second, and third loops; and [12C] orienting the first, second, third, and fourth loops to form a substantially four-leaf clover-shape.

315. Midya describes “a 2N-loop, N a predetermined integer, single layer planar inductor, **where 2N is selected to be 4.**” (INTEL-1007, 10:14-17, 5:6-19, Figure 1.) Midya refers to its 4-loop non-interacting inductor as a “clover.” (See INTEL-1007, Figure 23-25.) As I discussed in §VI.A.3 (motivation to combine), current enters terminal [1] of the first loop, travels CCW and exits through terminal [2] of the first loop, enters the second loop through its terminal [2], travels CW and exits through terminal [1] of the second loop, enters the third loop through its

terminal [1], travels CCW and exits through terminal [2] of the third loop, enters through terminal [2] of the fourth loop, travels CW and exits through terminal [1] of the fourth loop. In the exemplary four-loop inductor of the Midya-Raghavan combination, the “*third loop*” is connected to the “*second loop*,” and the “*fourth loop*” is connected to the “*third loop*” and to the “*first loop*” (via the second and third loops). (INTEL-1007, 11:1-6, Figure 1.)



Combination of Midya and Raghavan

316. Midya’s non-interacting inductor has adjacent loops with the “**same predetermined structure, i.e., size and shape**” (INTEL-1007, 9:1-4, 10:25-11:1, Figure 1) and Raghavan’s winding 31 is symmetric (INTEL-1008, ¶21). Therefore, for the reasons I discussed in §VI.B.1.b (second loop limitation), the Midya-

Raghavan combination renders obvious “*forming a third loop having a size and shape substantially identical to the first and second loops*” [12A] and “*forming a fourth loop having a size and shape substantially identical to the first, second, and third loop*” [12B].

4. Claim 21

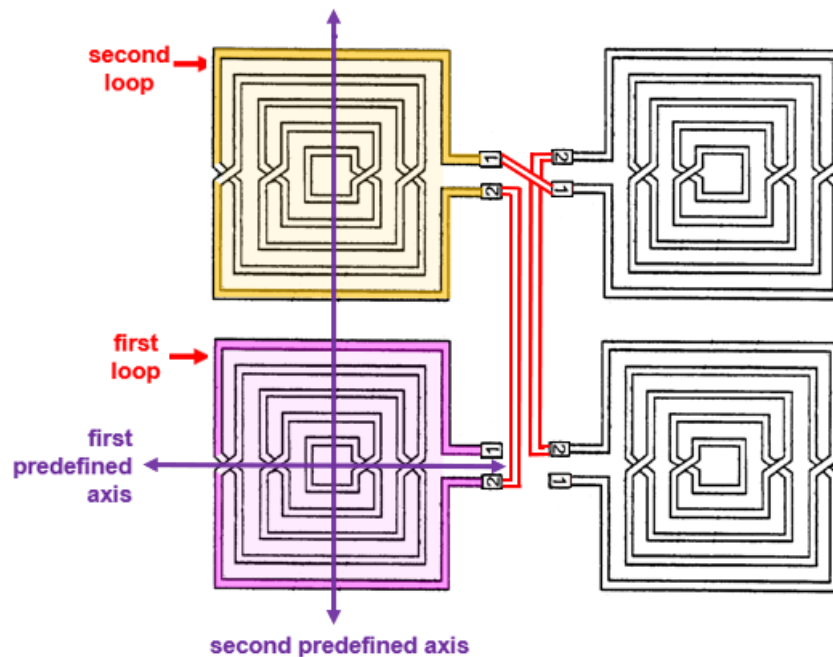
317. The combination of Midya and Raghavan renders obvious the subject matter of claim 21, which is reproduced below:

21. The inductor according to claim 20, wherein said first loop and said second loop are substantially symmetrical about a second predefined axis.

318. The '430 patent does not provide guidance as to the scope of the term “*said first loop and said second loop are substantially symmetrical about a second predefined axis*” because it does not describe the boundaries of “*substantially*.” The combination of Midya and Raghavan discloses this limitation, consistent with the disclosure of the '430 patent.

319. Raghavan teaches that the “use of square windings which share a common center, **affords the inductor a symmetrical configuration.**” (Raghavan, ¶21.) As I discussed in §VI.B.1 (claim 20), either the horizontal or vertical axis is a “*first predefined axis*” for the “*first loop*.” In the combination of Midya and Raghavan, as taught by Midya, each loop has the same structure and an even

number of loops are arranged to be adjacent in the manner illustrated in the Figure 1 below (right). Both the “*first loop*” and “*second loop*” have symmetry about the vertical axis, consistent with the disclosure of the ’430 patent. (INTEL-1001, 4:25-27 (“perfect symmetry between the two loops 206a and 206b may be difficult to achieve given the presence of the terminals 204a and 204b”).) Thus, the combination of Midya and Raghavan discloses “*first loop and said second loop are substantially symmetrical about a second predefined axis.*”



Combination of Midya and Raghavan (left)

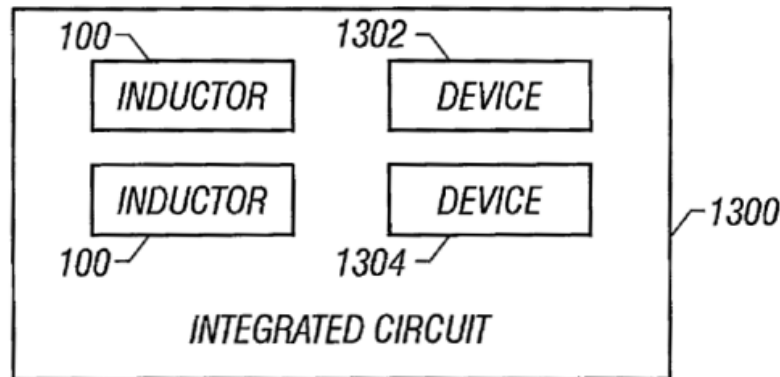
VII. GROUND 4: The combination of Midya, Raghavan, and Gardner renders claims 2 and 11-16 obvious.

A. Overview of the Combination

1. Overview of Gardner

320. U.S. Patent Publication 2001/0030591 to Gardner (“Gardner”; INTEL-1009) published on October 18, 2001, more than one year before the earliest priority date claimed on the face of the ’430 patent. Gardner “relates to the field of electrical inductors for integrated circuits (ICs) and IC packages.” (INTEL-1009, ¶3.) Gardner discloses that “inductors **are preferably fabricated on-chip**, that is either integrated on an integrated circuit and/or in a package housing an integrated circuit” because “discrete inductive devices result in losses, for example, due to parasitic capacitance and resistance in connecting them to an integrated circuit and because discrete inductive devices incur a relatively high cost for assembly, inductors.” (INTEL-1009, ¶5.)

321. Gardner’s integrated circuit 1300 includes multiple inductors 100 and one or more integrated circuit devices 1302 and 1304. (INTEL-1009, ¶108, Figure 13 (reproduced below).) Although Figure 13 is illustrated as comprising two inductors 100, “integrated circuit 1300 may be fabricated with any suitable number of one or more inductors 100.” (INTEL-1009, ¶108.)



Gardner, Figure 13

322. Gardner teaches inductors “fabricated on-chip” (INTEL-1009, ¶5), an “integrated circuit ... fabricated with ... one or more inductors” (INTEL-1009, ¶108), and “semiconductor processing ... to form a chip having an inductor” (INTEL-1009, ¶30). Thus, Gardner’s inductors are manufactured using “semiconductor die” because they are fabricated on an IC or “chip” using “semiconductor processing.” (INTEL-1009, ¶¶5, 30, 108.) As explained in the Illustrated Dictionary of Electronics, a POSITA would have understood that an IC is made “by processing distinct areas of a chip” and a chip is a “small slab, wafer, or die.” (INTEL-1041, 112, 371.)

2. Motivation to Combine

323. A POSITA would have been motivated to combine Midya and Raghavan as discussed above in §VI.A.3. A POSITA would have been further been motivated to implement the first and second inductors of the combination of

Midya and Raghavan using Gardner’s teaching of forming inductors in a semiconductor die (chip).

324. Each of Midya, Raghavan, and Gardner are in the same field of endeavor as the ’430 patent and are reasonably pertinent to the same problem as the ’430 patent—efficient circuit design. (INTEL-1001, Abstract, 3:4-18; INTEL-1007, 6:11-16; INTEL-1008, ¶¶2, 26; INTEL-1009, ¶3.) A POSITA would have been motivated to make the above combination for numerous reasons. Midya suggests the combination, stating the “invention is particularly useful for **switched power converters** and inductors in **RF transmitters** which have a **size constraint**.” (INTEL-1007, 6:15-17.) Based on this suggestion, a POSITA would have been expressly motivated to pursue the above combination to meet the known demand for device miniaturization and satisfy Midya’s desire to implement inductors in RF transmitters with size constraints. (*See, e.g.*, INTEL-1034, 6:21-24.)

325. Based further on Midya’s suggestion, Gardner expressly motivates the combination, disclosing inductors intended for “radio frequency (RF) ... circuitry.” (INTEL-1009, ¶5.) Gardner provides an consistent motivation for implementing inductors on-chip, teaching that “[b]ecause discrete inductive devices result in losses, for example, due to parasitic capacitance and resistance in connecting them

to an integrated circuit and because discrete inductive devices incur a relatively high cost for assembly, inductors **are preferably fabricated on-chip**, that is either integrated on an integrated circuit and/or in a package housing an integrated circuit.” (INTEL-1009, ¶5.)

326. The combination of Midya, Raghavan, and Gardner is the simple substitution of one known element (substrate of Midya/Raghavan combination (e.g., PCB)) with another (Gardner’s semiconductor die). In addition, the Midya-Raghavan-Gardner combination merely applies a known technique (Gardner’s implementation of multiple inductors in a single chip) to a known device (Midya’s inductors) ready for improvement. The Midya-Raghavan combination provides a “base” device (e.g., Midya’s non-interacting inductor and second inductor on a semiconductor substrate (e.g., PCB)) that a POSITA would have improved by forming both inductors in a single IC chip to reduce parasitic capacitance, resistance, and cost. (INTEL-1009, ¶5.)

327. A POSITA would have had a reasonable expectation of success in the above combination and the results of the combination would have been predictable because it was known to implement inductors on-chip. Raghavan teaches “that there are many techniques used to manufacture inductors as part of integrated circuits.” (INTEL-1008, ¶26.) Further, manufacturing the Midya-Raghavan “first

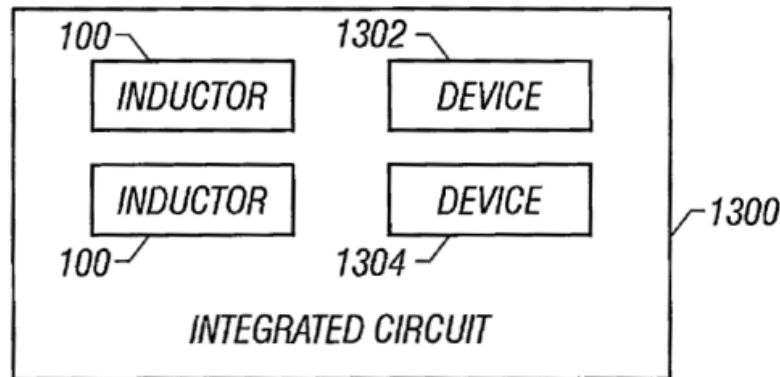
inductor” on a single semiconductor chip would have involved merely making a direct connection between several of the inductor structures that are described in Raghavan, which would have been straightforward for a POSITA. Moreover, as reflected in the teachings of Mizoguchi and Gardner, as well as the prior art described in the ’430 patent, a POSITA would have known how to implement other inductors at a predetermined distance from a first inductor whether on different IC layers (Mizoguchi) or the same layer (Gardner, the prior art described in the ’430 patent). (INTEL-1034, 6:21-24; INTEL-1009, ¶30; INTEL-1001, Fig. 3.)

B. Independent Claim 11

328. The combination of Midya, Raghavan and Gardner renders claim 11 obvious. I reproduce independent claim 11 again below with labels. As I discussed in §VI.B.3, the combination of Midya and Raghavan discloses every limitation in the body of claim 11 and the recited “*first*” and “*second inductor[s]*” of the preamble. The combination, however, does not explicitly disclose that the “*first inductor*” and “*second inductor*” are “*on a semiconductor die.*” This feature is disclosed by Gardner. Thus, the combination of Midya, Raghavan, and Gardner described in §VII.A.2 (motivation to combine) discloses or renders obvious every limitation of claim 11.

329. The combination of Midya, Raghavan, and Gardner discloses a “*method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die*” [11P]. As discussed in §VI.B.3, the stacked and best/worst case inductor layouts “*reduc[e] mutual electromagnetic coupling*” between the non-interacting inductor (“*first inductor*”) and a “*second inductor*.”

330. The combination of Midya, Raghavan, and Gardner discloses that the “*first inductor*” and “*second inductor*” are “*on a semiconductor die*.” Gardner describes integrating multiple inductors in an integrated circuit 1300 with one or more integrated circuit devices, such as integrated circuit devices (e.g., devices 1302 and 1304). (INTEL-1009, ¶108, Figure 13 (reproduced below).) Although Figure 13 is illustrated as comprising two inductors 100, “integrated circuit 1300 may be fabricated with any suitable number of one or more inductors 100.” (INTEL-1009, ¶108; *see also*, INTEL-1009, ¶3 (“relates to the field of electrical inductors for integrated circuits (ICs) and IC packages”).) Thus, in the combination of Midya, Raghavan, and Gardner the “*first inductor*” and “*second inductor*” are “*on a semiconductor die*” [11P].



Gardner, Figure 13

331. Thus, for the above reasons and the reasons I discussed in §VI.B.3 and VII.A, the combination of Midya, Raghavan, and Gardner discloses or renders obvious the remaining limitations of claim 11.

C. Dependent Claim 2, 12-16

332. The subject matter of claim 2 is the same as the recitation in the preamble of claim 11 (“*a first inductor and a second inductor on a semiconductor die*”). Thus, for the reasons I discussed in §VII.B for [11P], the combination of Midya, Raghavan, and Gardner discloses the subject matter of claim 2. For the same reasons discussed in §§VI.C.1-3, the combination of Midya, Raghavan, and Gardner renders **claims 12-16** obvious.

VIII. GROUNDS 5-8

333. Should the Board find that Grounds 1-4 do not disclose “*two closely spaced terminals*” or “*minimizing magnetic field contributions from the terminals*”

of claims 1, 11, and 20, it would have been obvious to combine Brooks in each to render those limitations obvious. Grounds 5-8, spelled out below, mirror Grounds 1-4, respectively, except Brooks is explicitly combined.

Ground		Claims	
5	103	1, 3-5, 7, 10-11, 13-15, 17, 19-21	Taniguchi and Brooks
6	103	2, 8, 11, 13-15, 17-19	Taniguchi, Rostoker, and Brooks
7	103	1, 3-6, 9, 11-16, 20-21	Midya, Raghavan, and Brooks
8	103	2, 11-16	Midya, Raghavan, Gardner, and Brooks

A. Overview of the Combination

1. Overview of Brooks

334. Brooks, which is a book entitled “Signal Integrity Issues and Printed Circuit Board Design,” was published in 2003. Brooks describes two conductors, illustrated in Figure 9-2 (reproduced below) in which one conductor carries current coming of the page and the other carries current going into the page. (INTEL-1010, 156-157.) When these two wires carry a signal and its return current, the “currents will be equal and opposite” and “the magnetic fields will also be equal and opposite.” (INTEL-1010, 156-157.)

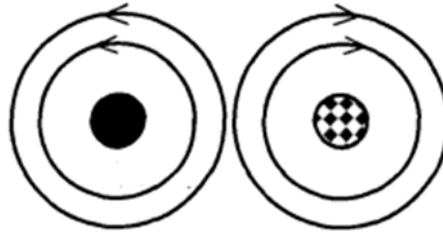


Figure 9-2 A signal and its return have magnetic fields that approximately cancel.

335. Brooks further explains that if the reader considers themselves “as positioned off to the right-hand side of this page,” the right-most wire (with the current going into the page) is closer to the reader and therefore the “EMI radiation from that wire will be greater than that from the other.” (INTEL-1010, 157.) However, “if we move the two wires closer together, then you, as an observer off to the right, would begin to see radiations from each wire that are more equal” and because “they are opposite in phase, or polarity, they tend to cancel.” (INTEL-1010, 157.) And “if the wires **were very close together**, their EMI radiations **would completely cancel and would not be measurable.**” (Brooks, 157.) “Here is one of our **most basic principles**: *If you want to minimize EMI radiation, **keep the signals and their returns close together.***” (INTEL-1010, 157 (emphasis by italics in original).)

2. Motivation to Combine

336. For Taniguchi Grounds 5-6, the two terminals in Taniguchi’s Figure 7, 8, and 9/10 embodiments, as discussed in §IV.B.1.c.2, carry the same current

(that flows through antenna/inductor 1) over wires in opposite directions. That is the same for Midya-Raghavan Grounds 7-8 with the two terminals in the Midya-Raghavan inductor, as discussed in §VI.B.1.c. Indeed, current flow through the terminals in both Taniguchi and Midya-Raghavan is consistent with the '430 patent, which shows the same current flow in Figure 2 through its terminals which are described as “wires.” (INTEL-1001, 4:5-14, 3:65-4:3 (referring to “terminals” and “other metal wires”).).

337. A POSITA would have been motivated to make Taniguchi’s terminals (Grounds 5-6) and Midya-Raghavan’s terminals (Grounds 7-8) “*closely spaced*” so as to “*minimiz[e] magnetic field contributions from the terminals*” because Brooks provides an express teaching, characterized as a “most basic principle[,]” to keep two wires carrying current in opposite directions close together to “**minimize** EMI radiation.” (INTEL-1010, 157, 155 (electromagnetic field includes magnetic field).) Indeed, Brooks is clear that EMI is a problem for circuit designs. (INTEL-1010, 50, 152, 156.) A POSITA would have also been motivated to combine Brooks to further Taniguchi’s goal (Grounds 5-6) in “lessening an effect of interfering electromagnetic waves on other equipment” (INTEL-1005, ¶94) and Midya’s goal (Grounds 7-8) in ensuring “that interference with external and adjacent circuitry is minimized.” (INTEL-1007, 6:11-17.)

338. Combining Brooks for Grounds 5-8 is also merely the use of a known technique (making wires close together) to improve similar devices (Taniguchi's embodiments (Grounds 5-6) or Midya-Raghavan's inductor (Grounds 7-8)) in the same way (avoid problems by minimizing EMI).

339. A POSITA would have had a reasonable expectation of success with predictable results because the terminal wires in Taniguchi and Midya-Raghavan already carry current in opposite directions, and Brooks shows that it was known to make such wires close together so that EMI is minimized. Taniguchi, Rostoker, Midya, Raghavan, Gardner and Brooks share the same field and are reasonably pertinent to the same problem as the '430 patent—efficient circuit design. (INTEL-1001, Abstract, 3:4-18; INTEL-1005, Abstract, ¶¶1, 3; INTEL-1006, Abstract, 3:55-57, 8:64-67; INTEL-1007, 6:11-16; INTEL-1008, ¶¶2, 26; INTEL-1009, ¶3; INTEL-1010, 155-157.)

B. Independent Claims 1, 11, 20

340. As I discussed above in §IV.B, Taniguchi discloses all limitations of independent claims 1, 11, and 20. As I discussed in §V.B, the combination of Taniguchi and Rostoker discloses all the limitations of independent claim 11. As I discussed in §VI.B, the combination of Midya and Raghavan discloses all the limitations of claims 1, 11, and 20. And as I discussed in §VII.B, the combination

of Midya, Raghavan, and Gardner discloses all the limitations of independent claim 11. Should the Board determine any of these combinations fails to disclose “two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals” [1A.3]/[20C] or “connecting two closely spaced terminals to the first loop for supplying electrical current to the first and second loops while minimizing magnetic field contributions from the terminals” [11A.3], Brooks discloses these limitations.

341. Brooks discloses placing two conductors that have opposing currents and magnetic fields “**very close together**” so “their EMI radiations **would completely cancel and would not be measurable.**” (Brooks, 157.) Brooks also describes that “[i]f you want to minimize EMI radiation, ***keep the signals and their returns close together.***” (Brooks, 157 (emphasis by italics in original).) In the combination of Taniguchi and Brooks, the two terminals of eight-shaped antenna 1 in Taniguchi’s same plane inductor embodiment (Figure 7), lower feeding point embodiment (Figure 8), and rotated eight-shaped embodiment (Figure 9/10) would have been “*closely spaced*” and “*minimiz[ed] magnetic field contributions from the terminals.*”

342. The combination of Taniguchi and Brooks renders obvious independent claims 1, 11, and 20 for the above reasons and the reasons I discussed above in §IV.B relating to Taniguchi alone.

343. The combination of Taniguchi, Rostoker, and Brooks renders obvious independent claim 11 for the above reasons and the reasons I discussed above in §V.B relating to the combination of Taniguchi and Rostoker.

344. The combination of Midya, Raghavan and Brooks renders obvious independent claims 1, 11, 20 for the above reasons and the reasons I discussed above in §VI.B relating to Midya and Raghavan.

345. The combination of Midya, Raghavan, Gardner and Brooks renders obvious independent claim 11 for the above reasons and the reasons I discussed above in §VII.B relating to Midya, Raghavan, and Gardner.

C. Dependent Claims

346. For the reasons in the sections set forth in the following table, the combinations render the dependent claims obvious.

	Claims		
5	3-5, 7, 10, 13-15, 17, 19, 21	Taniguchi and Brooks	§§IV.C.1-6
6	2, 8, 13-15, 17-19	Taniguchi, Rostoker, and Brooks	§§V.C.1-2

	Claims		
7	3-6, 9, 12-16, 21	Midya, Raghavan, and Brooks	§§VI.C.1-4
8	2, 12-16	Midya, Raghavan, Gardner, and Brooks	§VII.C

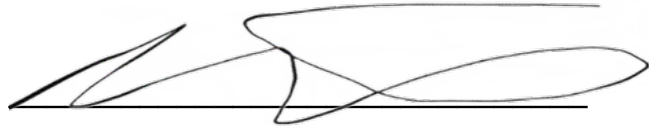
IX. Conclusion

347. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed this 29th day of March in Atlanta, Georgia

Respectfully submitted,

A handwritten signature in black ink, consisting of a series of loops and strokes, positioned above a horizontal line.

Manos M. Tentzeris, Ph.D.

EXHIBIT LIST

Exhibit	Reference
1001	U.S. Patent 7,151,430 to Mattsson
1002	File History for U.S. Patent 7,151,430
1005	U.S. Patent Publication 2003/0063034 to Taniguchi, et al (“Taniguchi”)
1006	U.S. Patent 6,373,447 to Rostoker, et al (“Rostoker”)
1007	PCT Publication WO 98/05048 to Midya, et al (“Midya”)
1008	U.S. Patent Publication 2005/0077992 to Raghavan, et al (“Raghavan”)
1009	U.S. Patent Publication 2001/0030591 to Gardner (“Gardner”)
1010	“Signal Integrity Issues and Printed Circuit Board Design,” to Brooks (“Brooks”)
1012	“RFID Handbook: Fundamentals and Applications in Contactless Smart Cards and Identification” to Finkenzeller (Wiley, Second Edition)
1013	“Principles of Physics,” to Serway, 2nd Edition (“Serway”)
1014	“Fundamentals of Applied Electromagnetics” to Ulaby (“Ulaby”)
1015	Certified Translation of Excerpts from prosecution of JP2007526642
1016	Excerpts from the EP prosecution of EP3567614
1017	PCT Publication WO 2004/012213 to Einzinger (“Einzinger-US”)
1018	U.S. Patent 6,708,880 to Acher, et al (“US-Acher”)
1019	ITC-337-TA-1376 Claim Construction Order
1020	ITC-337-TA-1300 Claim Construction Order
1021	U.S. Patent 6,533,178 to Gaul (“Gaul”)
1022	U.S. Patent 5,345,231 to Koo (“Koo”)
1023	U.S. Patent 6,137,447 to Saitoh, et al (“Saitoh”)
1024	U.S. Patent 6,320,491 to Gevorgian, et al (“Gevorgian”)
1025	U.S. Patent 7,088,964 to O (“O”)

Exhibit	Reference
1026	U.S. Patent Publication 2002/0044058 to Heinrich, et al (“Heinrich”)
1027	U.S. Patent 6,970,088 to Kovach (“Kovach”)
1028	U.S. Patent 4,724,427 to Carroll (“Carroll”)
1029	U.S. Patent 7,057,514 to Mickle (“Mickle”)
1030	“A Comprehensive Explanation On the High Quality Characteristics of Symmetrical Octagonal Spiral Inductor” to Ooi, et al (“Ooi”)
1031	“Design and Analysis of Symmetric Dual-Layer Spiral Inductors for RF Integrated Circuits” to Lee, et al (“Lee”)
1032	“A Q-Factor Enhancement Technique for MMIC Inductors” to Danesh, et al (“Danesh”)
1033	PCT Publication WO 99/49513 to Zhou, et al. (“Zhou”)
1034	U.S. Patent 5,583,474 to Mizoguchi (“Mizoguchi”)
1035	Reserved
1036	“A Single-Chip 900-MHz Spread-Spectrum Wireless Transceiver in 1-up CMOS – Part 1: Architecture and Transmitter Design” by Ahmadreza Rofougaran et al., IEEE Journal of Solid-State Circuits, Vol. 33, No. 4 (April 1998)
1037	“A Single-Chip CMOS Transceiver for DCS-1800 Wireless Communication” by Michiel Steyaert, et al. ISSCC98, Session 3, Transceivers and Power Amplifiers (1998)
1038	“A 1.8-GHz Low-Phase-Noise CMOS VCO Using Optimized Hollow Spiral Inductors” by Craninckx, et al. (“Craninckx”)
1039	“Low-Phase-Noise LC Quadrature VCO Using Coupled Tank Resonators in a Ring Structure” by ElSayed, et al. (“ElSayed”)
1040	“A CMOS Frequency Synthesizer with an Injection-Locked Frequency Divider for a 5-GHz Wireless LAN Receiver” to Rategh, et al. (“Rategh”)
1041	“Illustrated Dictionary of Electronics” to Gibilisco, Eighth Edition