

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

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT 7,151,430**

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EXHIBIT LIST

Exhibit	Reference
1001	U.S. Patent 7,151,430 to Mattsson
1002	File History for U.S. Patent 7,151,430
1003	Declaration of Dr. Manos Tentzeris in Support of Petition
1004	CV of Dr. Manos Tentzeris
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”)
1011	Declaration of June Ann Munford
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

Exhibit	Reference
1021	U.S. Patent 6,533,189 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”)
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, Transceiver 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”)

Exhibit	Reference
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

Intel Corporation (“Petitioner”) petitions for *inter partes* review (“IPR”) of U.S. Patent 7,151,430 (“’430 patent”; INTEL-1001) claims 1-21.

I. Grounds for Standing

Petitioner certifies the ’430 patent is available for IPR and Petitioner is not barred or estopped from requesting IPR.

II. Identification of Challenge

A. Prior Art

The ’430 patent, filed August 16, 2004, claims benefit to U.S. Provisional 60/565,328, filed April 26, 2004, and U.S. Provisional 60/549,611, filed March 3, 2004. Petitioner reserves the right to challenge priority. Regardless, each applied reference was filed or published before March 3, 2004.

1. U.S. Patent Publication 2003/0063034 to Taniguchi, et al.

(“Taniguchi”; INTEL-1005), published April 3, 2003, is prior art under 35 U.S.C. §102(a).

2. U.S. Patent 6,373,447 to Rostoker, et al. (“Rostoker”; INTEL-1006),

issued April 16, 2002, is prior art under 35 U.S.C. §102(b).

3. PCT Publication WO 98/05048 to Midya, et al. (“Midya”; INTEL-

1007), published February 5, 1998, is prior art under 35 U.S.C. §102(b).

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

(“Raghavan”; INTEL-1008), filed September 19, 2003 and published April 14, 2005, is prior art under 35 U.S.C. §102(e).

5. **U.S. Patent Publication 2001/0030591 to Gardner** (“Gardner”; INTEL-1009), published October 18, 2001, is prior art under 35 U.S.C. §102(b).

6. **“Signal Integrity Issues and Printed Circuit Board Design” to Brooks** (“Brooks”; INTEL-1010) was publicly available by at least June 24, 2003. (See INTEL-1011, ¶¶6-10.)

B. Grounds For Challenge

Ground		Claims	
1	103	1, 3-5, 7, 10-11, 13-15, 17, 19-21	Taniguchi
2	103	2, 8, 11, 13-15, 17-19	Taniguchi and Rostoker
3	103	1, 3-6, 9, 11-16, 20-21	Midya and Raghavan
4	103	2, 11-16	Midya, Raghavan, and Gardner
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

III. Level of Ordinary Skill

A person of ordinary skill in the art (“POSITA”) would have had at least a master’s degree in electrical engineering, physics, or similar discipline and at least two years’ 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' experience in designing integrated circuits or inductors. Additional education might compensate for less experience and vice versa. (INTEL-1003, ¶58.)

IV. Claim Construction

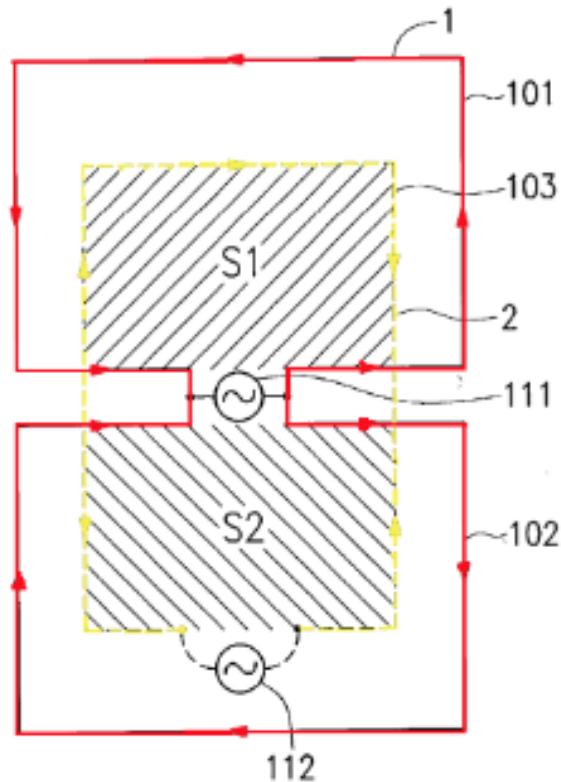
The Board need not expressly construe any term for purposes of this proceeding. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999). In co-pending United States International Trade Commission (“ITC”) investigation 337-TA-1376, the Administrative Law Judge (“ALJ”) rejected the parties’ agreement regarding the preambles, determining claim 1’s preamble is not limiting and claim 11’s preamble is only limiting to the extent needed to provide antecedent basis for “first inductor.” (INTEL-1019, 2-3.) In the prior concluded investigation (ITC-337-TA-1300), a different ALJ construed several terms. (INTEL-1020, 12-30.) The constructions are provided in the Tentzeris Declaration. (INTEL-1003, ¶61.) The claims are unpatentable regardless of the construction applied.

V. GROUND 1: Taniguchi renders claims 1, 3-5, 7, 10-11, 13-15, 17, 19-21 obvious.

A. Overview

Taniguchi relates to an “antenna for use in [a] non-contact identification apparatus” which communicates with tags using inductive coupling. (*See, e.g.*, INTEL-1005, ¶¶1, 16, 49-50.) In Taniguchi’s Figure 3 embodiment, which

provides a base for the embodiments described in Figures 7, 8, and 9/10, the apparatus's antenna layout includes an eight-shaped antenna (red) and a rectangular antenna (yellow). (INTEL-1005, ¶¶25, 28-32, 55, 66-77.) The eight-shaped antenna has two loop-shaped conductors producing magnetic fields that cancel one another, resulting in zero “residual mutual inductance” between antennas. (INTEL-1005, ¶¶57, 61 (“residual mutual inductance $M=0$ is most preferable”), 63-65, 72, Figures 4, 5; INTEL-1003, ¶¶69-80.)



Taniguchi, Annotated Figure 3

B. Independent Claims

Because claim 20 recites an “*inductor*” and claims 1/11 recite a “*layout*” including claim 20’s inductor and “*a second inductor*,” Petitioner addresses claim 20 first.

1. Claim 20

Taniguchi’s Figure 7, 8, and 9/10 embodiments independently render claim 20 obvious.

a) Preamble [20P]

Taniguchi discloses or renders obvious an “*inductor having a reduced far field*” [20P]¹ to the extent described in the ’430 specification. *Apple v. Valencell*, IPR2017-00315, Paper 45, 47-49 (PTAB May 31, 2018) (considering unpatentability over prior art despite agreeing claims are indefinite).

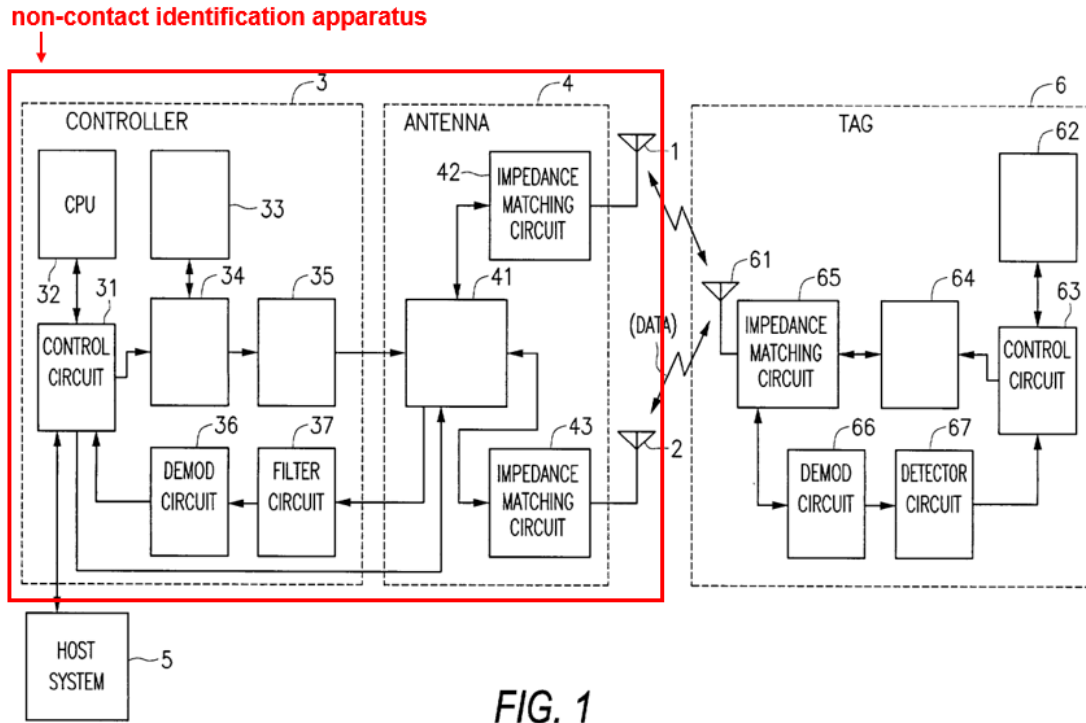
¹ Petitioner reserves the right to argue limitations are indefinite in a different forum. Neither the ’430 patent nor the ITC’s prior construction in ITC-337-TA-1300 provides guidance on the scope of the term “*reduced far field*”, including bounds to the distance of the field from the inductor or the distance of the field between the inductor and any second inductor.

(1) Taniguchi’s loop antennas are “*inductors*.”

Taniguchi’s first and second antennas are part of a “non-contact identification apparatus” using “**inductive coupling**²” for communication with tags. (INTEL-1005, ¶¶16, 49-50, Abstract, Figure 1 (below); INTEL-1003, ¶¶85-87.) Apparatus controller 3 functions “as an interrogator for reading and writing data” into tag 6. (INTEL-1005, ¶47.) Specifically, Taniguchi’s antennas generate magnetic fields, appearing as magnetic flux lines, when a current flows through them. (INTEL-1021, 7:39-40; INTEL-1005, ¶¶15-16, 55-59, 63; INTEL-1003, ¶85.) A tag antenna 61 in the magnetic field³ couples with the apparatus antennas “via **mutual inductance**,” so that when the impedance of tag antenna 61 changes, so does the impedance of non-contact identification apparatus antennas. (INTEL-1005, ¶50; INTEL-1003, ¶87.) This changing impedance is used to communicate data. (*See* INTEL-1005, ¶50.)

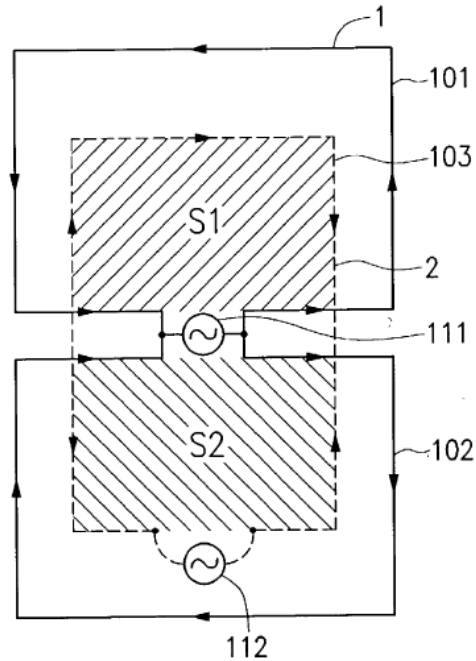
² Unless otherwise noted, all emphasis added.

³ An electromagnetic field contains an electrical field and magnetic field.
(INTEL-1010, 27.)



Taniguchi, Annotated Figure 1

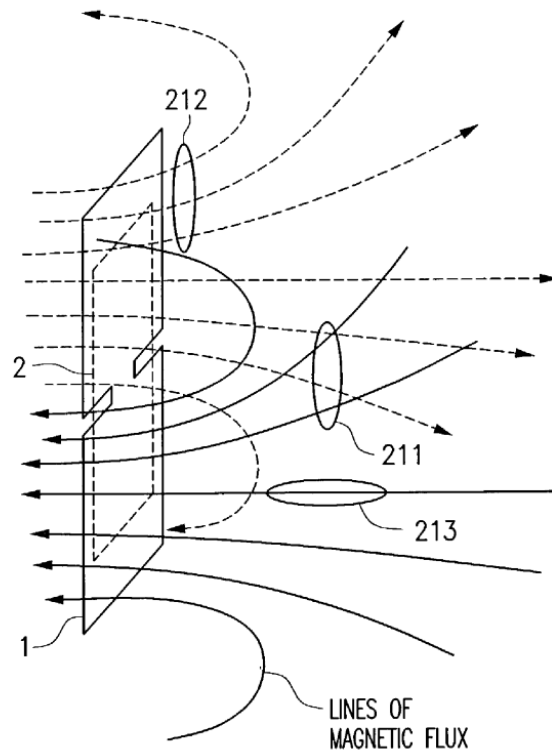
Taniguchi's Figure 7, Figure 8, and Figures 9/10 embodiments each use an eight-shaped antenna for antenna 1, like Figure 3's eight-shaped antenna (below). (INTEL-1005, ¶¶29-32, 63, 69-77; INTEL-1003, ¶90.)



Taniguchi, Figure 3

Because eight-shaped antenna 1 generates magnetic flux to communicate inductively with tags, it is an “*inductor*.” (E.g., INTEL-1005, ¶¶63-64, 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**”); INTEL-1003, ¶¶88-90, 93.) For example, Figure 4 (below) illustrates solid magnetic flux lines for the field generated by the lower loop of Figure 3’s eight-shaped antenna/inductor 1 and broken magnetic flux lines for the field generated by the upper loop. (INTEL-1005, ¶¶26, 63-64.) Tag 211 interlinks with solid and broken magnetic flux lines that “are equal in magnitude to each other and directed opposite to each other all the time.”

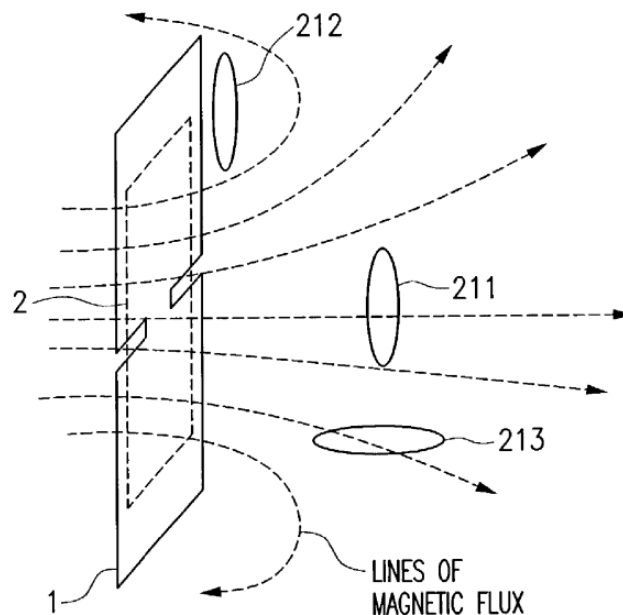
(INTEL-1005, ¶¶64.) Due to that opposition, “the induced electromotive force generated on the tag” by antenna/inductor 1 “becomes substantially zero” and “tag 211 has difficulty” communicating with antenna/inductor 1. (*Id.*) By contrast, tag 212 interlinks with only the broken lines of magnetic flux and, as a result, “can favorably make communication with the antenna 1.” (*Id.*)



Taniguchi, Figure 4

Antenna 2 in the Figure 7, 8, 9/10 embodiments is also an “*inductor.*” (INTEL-1003, ¶¶91-93.) Antenna 2 of the Figure 9/10 embodiment is Figure 3’s eight-shaped antenna rotated 90°. (INTEL-1005, ¶¶73, 76-77.) A POSITA would understand Figure 4 describes the magnetic flux generated by antenna 2 used to

communicate inductively with tags, because it has the same eight shape and current flow as antenna 1. (INTEL-1003, ¶92; INTEL-1005, ¶58, 73, 76.) Figure 3's rectangular antenna 2, used as antenna 2 in the Figure 7 and 8 embodiments, is also an "*inductor*" because it generates magnetic flux used to communicate inductively with tags. (INTEL-1003, ¶91; INTEL-1005, ¶¶29-30, 69-72.) Taniguchi's Figure 5 below, using Figure 3's rectangular antenna 2, illustrates broken **magnetic flux** lines associated with an electromagnetic field generated by antenna 2 when current is applied. (INTEL-1005, ¶¶27, 63, 65.) Tags 211, 213 interlink with the magnetic flux lines and therefore "favorably communicate with the antenna 2." (INTEL-1005, ¶65.)

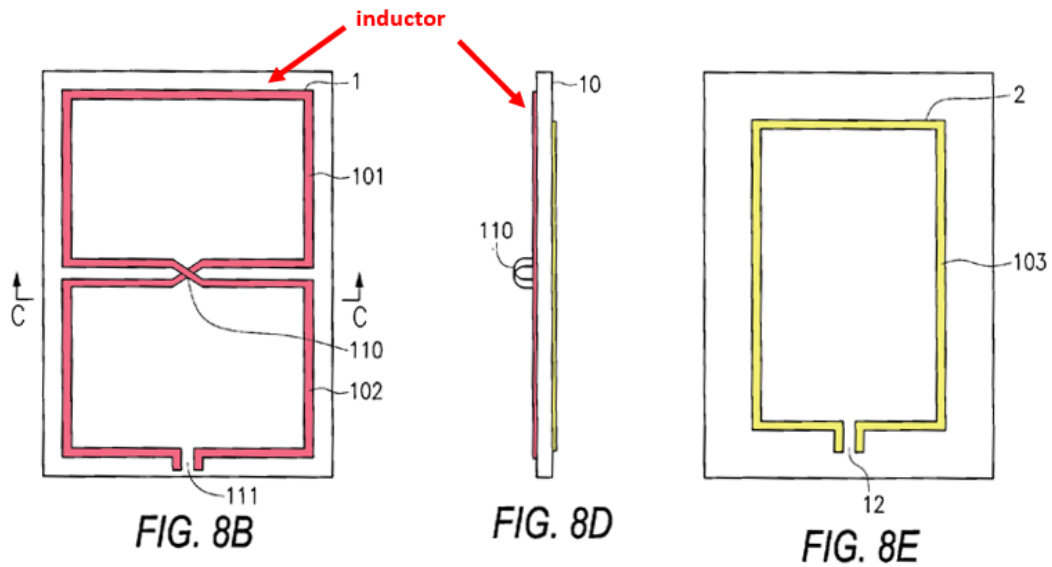


Taniguchi, Figure 5

Furthermore, loop antennas—particularly those used in inductive coupling identification applications—are understood to be inductors. (INTEL-1003, ¶93.) For example, Koo uses an inductor as the antenna for the sending-and-receiving station in a contactless data transmission system using inductive coupling for communication. (INTEL-1022, 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. (INTEL-1003, ¶93.) As another example, Gaul models its loop antenna in the transceiver of a contactless identification system as an inductor. (INTEL-1021, 1:14-26, 6:51-58, 7:39-40 (“antenna [] is modeled as an inductor L”); Figures 1, 2a.) This is consistent with the Examiner’s finding during prosecution of the EP application (EP3567614) related to the ’430 patent, that an antenna in an inductive coupling system (FR-Acher) was an inductor, which PO did not contest. (INTEL-1003, ¶¶49-56, *citing* INTEL-1016, 43-44.)

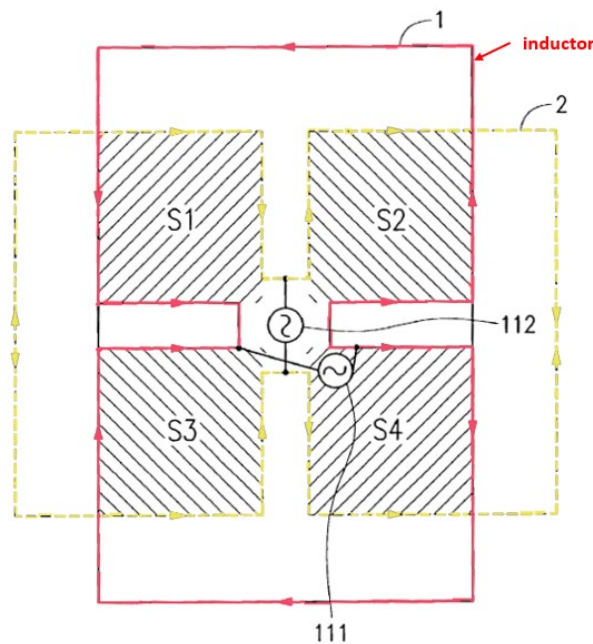
(2) Taniguchi’s embodiments disclose the preamble.

Taniguchi’s Figure 8 embodiment includes antenna/inductor 1 (“*inductor*”; red) and antenna/inductor 2 (yellow). (INTEL-1005, Figures 8B, 8D-8E (below).)

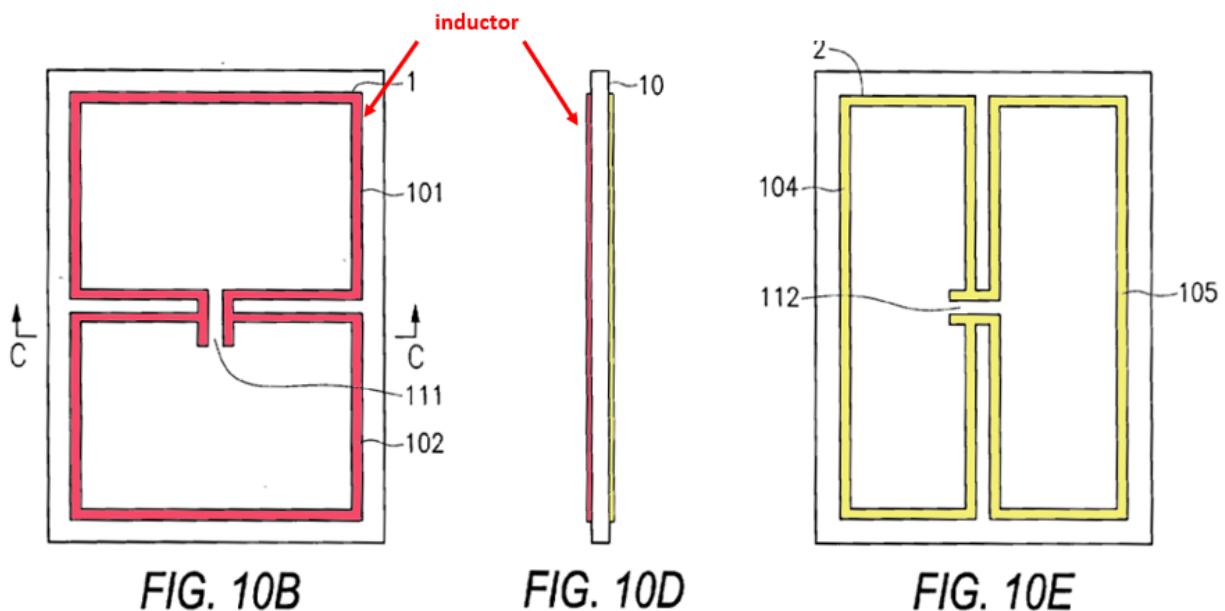


Taniguchi, Annotated Figures 8B, 8D-8E

Taniguchi's Figure 9/10 embodiment includes eight-shaped antenna/inductor 1 ("inductor"; red) and eight-shaped antenna/inductor 2 (yellow), rotated 90°. (INTEL-1005, ¶¶73; 76-77, Figures 9, 10B, 10D-E (below).).



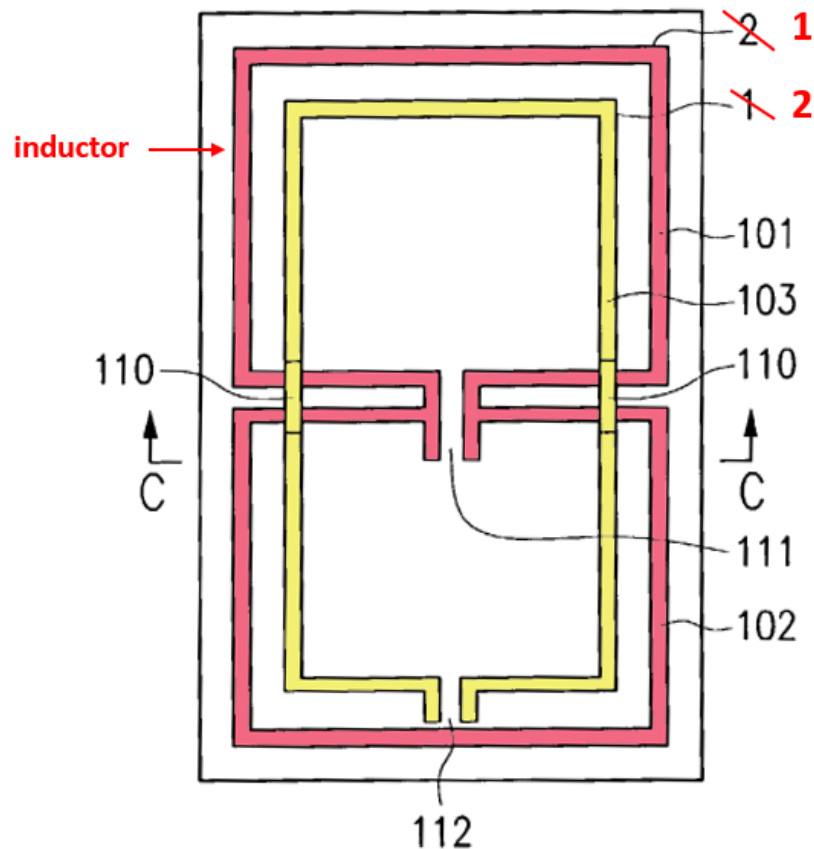
Taniguchi, Annotated Figure 9



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

Taniguchi's Figure 7 embodiment uses an eight-shaped antenna/inductor 1 ("inductor"; red) and second antenna/inductor 2 (yellow).⁴ (INTEL-1005, Figure 7 (below).)

⁴ Figure 7 includes typographical errors. Conductor 103 is labeled antenna 1 but identified as antenna 2 in the description, while conductors 101, 102 are labeled antenna 2 but identified as antenna 1 in the description. (INTEL-1005, ¶70.). Petitioner uses the description designations.

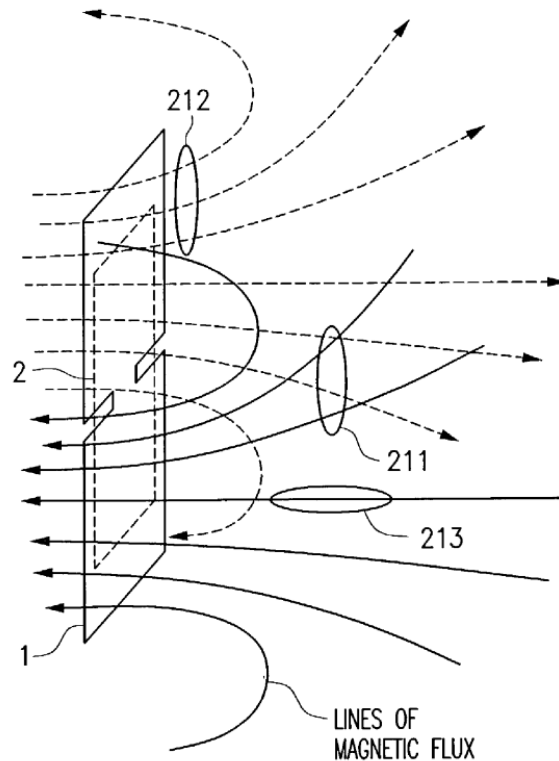


Taniguchi, Annotated Figure 7B

Regardless of what the boundaries of the “*far field*” may be, the eight-shaped antennas/inductors 1 of the Figures 7, 8, and 9/10 embodiments (“*inductor[s]*”), based on Figure 3’s eight-shaped antenna/inductor, have a “*reduced far field*” to the extent it is described in the ’430 patent specification. (INTEL-1005, ¶¶29-32, 69-73, 76-77; INTEL-1003, ¶¶94-107.) Figure 4 below depicts “lines of magnetic flux generated” from an eight-shaped antenna. (INTEL-1005, ¶26.) As shown, the flux lines of the magnetic field generated by the two

loops of the eight-shaped antenna are equal and have opposite directions⁵. (INTEL-1005, ¶¶48, 63 (flux lines indicate the “appearance of a magnetic field”), 64 (“lines of magnetic flux indicated by solid lines and the lines of magnetic flux indicated by broken line... are equal in magnitude to each other and directed opposite to each other”).) As a result, the magnetic flux lines from the two loops cancel each other, reducing the electromagnetic field generated by antenna/inductor 1. (INTEL-1010, 157 (magnetic fields having opposing polarity or phase “tend to cancel” one another); INTEL-1003, ¶96; INTEL-1005, ¶¶57-59, 73-75); *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1372-73 (Fed. Cir. 2019.) *Taniguchi* stresses that since “the current flowing to the two loops defining the 8-shape is well balanced” and as a result “the **remote electromagnetic-field intensity is much suppressed** by the figure eight-shaped antenna.” (INTEL-1005, ¶94; *see also, id.*, ¶¶55, 59 (“**the remote electromagnetic-field intensity is also controlled at an exceedingly low level**”), 95 (“**a remote electromagnetic-field intensity can also be suppressed to be small**”).)

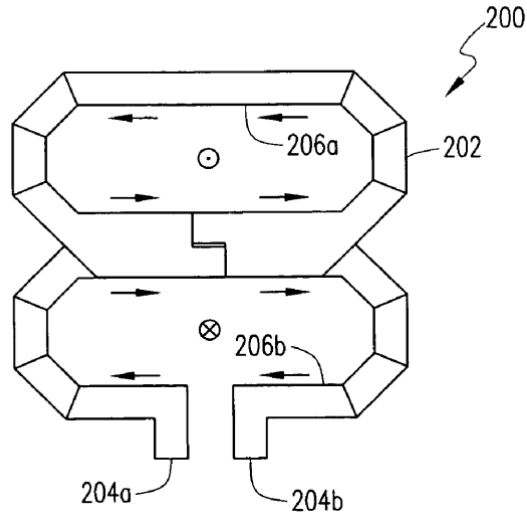
⁵ Taniguchi also refers to the equal/opposite fields generated by conductors of the eight-shaped antenna/inductor as “repulsive lines” of flux. (See INTEL-1005, ¶¶72, 64.)



Taniguchi, Figure 4

Taniguchi's eight-shaped antenna/inductor disclosure is further consistent with the '430 patent's description of "*reduced far field.*" *Apple*, IPR2017-00315, Paper 45 at 47-49. The patent states that its eight-shaped inductor 200 leads to "EM field components emanating at a certain distance from the two substantially symmetrical loops 206a and 206b" that "**have opposite directions and tend to counteract each other.**" (INTEL-1001, 4:5-17.) As a consequence, "the inductor has been found to have **a significantly reduced far field** at a certain distance from the inductor coil 202." (INTEL-1001, 4:10-25.) Thus, Taniguchi teaches or

suggests an “*inductor having a reduced far field*” [20P] to the extent described in the ’430 patent.



’430 Patent, Figure 2

Should the Board adopt a similar construction of “*reduced far field*” as claim 1 from the ITC-337-TA-1300, Taniguchi discloses the preamble. The eight-shaped antenna/inductor 1 generates counteracting electromagnetic fields that cancel each other, reducing the overall field at antenna/inductor 2, as discussed above.

(INTEL-1005, ¶¶94-95.) Taniguchi’s antennas/inductors 1 and 2 are on opposite sides of insulation 10 in the Figure 8 and 9/10 embodiments and thus are separated by a distance equal to the insulation thickness. (INTEL-1005, ¶¶55, 77 Figures 8D, 10D; INTEL-1003, ¶¶100, 104.) In the Figure 7 embodiment, antenna/inductor 2 is on the same plane, within and concentric with antenna 1 such that its sides are positioned a certain distance from the sides of antenna 1. (INTEL-1005, ¶¶55, 70

Figure 7D; INTEL-1003, ¶107.) And, PO noted during prosecution of EP3567614: “the root parent application as filed does not mandate any particular distance or relative orientation of the two inductors.” (INTEL-1016, 59.)

b) “*First loop*”/“*second loop*” [20A]-[20B]

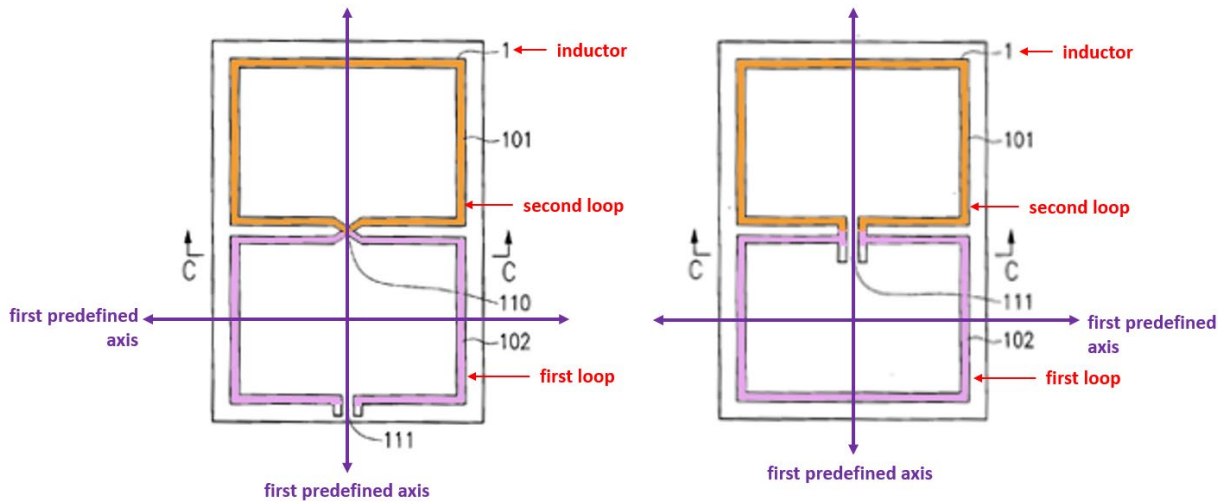
Taniguchi’s Figure 7, 8, and 9/10 embodiments disclose “*a first loop having a shape that is substantially symmetrical about a first predefined axis*” [20A] and “*a second loop having a size and shape substantially identical to the first loop*” [20B.1] to the same extent they are described in the ’430 patent. *Apple*, IPR2107-00315, Paper 45 at 47-49.⁶

(1) Limitations [20A]/[20B.1]

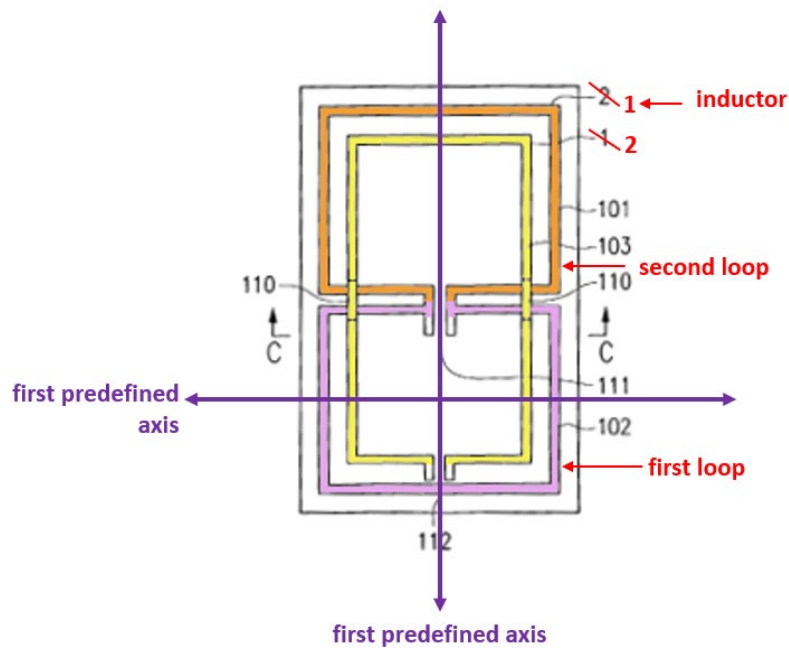
The Figure 7, 8, and 9/10 embodiments each include an eight-shaped antenna/inductor 1 having “upper and lower loops” which “defin[e] the 8-shape.” (INTEL-1005, Figure 3, ¶¶63-65, *see also*, INTEL-1005, ¶¶29-32, 69-73, 76-77 (associating Figure 3 with Figures 7, 8, and 9/10).) For each embodiment, antenna/inductor conductor 102 (pink) is a “*first loop*” and conductor 101 (orange) is a “*second loop*” as shown in Figure 8B (top left; Figure 8 embodiment), Figure

⁶ Petitioner reserves the right to argue indefiniteness of limitations claiming “*substantially symmetrical*” and “*substantially identical*” in a different forum. The ’430 patent is silent about the bounds of these terms.

10B (top right; Figure 9/10 embodiment), and Figure 7B (bottom; Figure 7 embodiment). (See INTEL-1005, ¶¶55, 73, 76-66; INTEL-1003, ¶¶110, 117, 123)



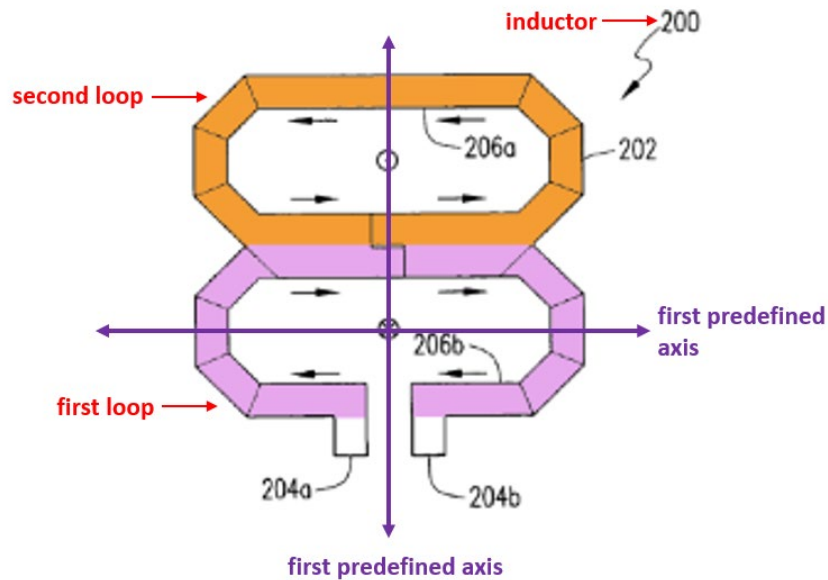
Taniguchi, Annotated Figure 8B (left), Annotated Figure 10B (right)



Taniguchi, Annotated Figure 7B

In all three embodiments, the “*first loop*” has “*a shape that is substantially symmetrical about a first predefined axis*” [20A]. (INTEL-1003, ¶¶111-112, 118-119, 123) As shown in the figures above, conductor 102 (“*first loop*”; pink) is symmetrical and therefore necessarily “*substantially symmetrical*” about the vertical axis (“*a first predefined axis*”). Reliance on the figures is proper because they clearly show the claimed structure. *See, e.g., Application of Mraz*, 455 F.2d 1069, 1072 (CCPA 1972) (“Description for the purposes of anticipation can be by drawings alone as well as by words.”); *Kingsford Prod. Co., LLC v. Creative Spark, LLC*, IPR2016-01831, Paper 32, at 32-33 (PTAB Mar. 9, 2018) (“Figures that are not drawn to scale may be relied upon to disclose qualitative relationships between measured quantities”).

Conductor 102 in each embodiment is also “*substantially symmetrical*” about the horizontal axis, despite the presence of terminals on one side, to the same extent as the ’430 patent’s description of a “*substantially symmetrical*” loop. *Apple*, IPR2107-00315, Paper 45 at 47-49; INTEL-1003, ¶¶112, 119, 123. The ’430 patent describes loops 206a [orange], 206b [pink], shown in Figure 2 (below), as “substantially symmetrical” about a “horizontal axis” despite the presence of terminals 204a, 204b on the bottom of loop 206b. (INTEL-1001, 4:5-25.) The patent explains that the terminals make “perfect symmetry between the two loops ... difficult to achieve.” (INTEL-1001, 4:25-27.)



'430 Patent, Annotated Figure 2 (right)

Taniguchi's embodiments also disclose a "*second loop having a size and shape substantially identical to the first loop*" [20B.1]. (INTEL-1003, ¶¶113, 120, 123) Taniguchi's eight-shaped antenna "is divided into upper and lower **halves** by the antenna conductors 101, 102" which by virtue of their same size generate magnetic fields "equal in magnitude to each other and directed opposite to each other." (INTEL-1005, ¶¶55, 64.) These disclosures are reflected in Figures 7B, 8B, and 10B which each illustrates conductor 101 ("*second loop*"; orange) as having a rectangular shape and size identical to conductor 102 ("*first loop*"; pink), apart from the presence of terminals connected to the "*first loop*." See, e.g., *Mraz*, 455 F.2d at 1072; *Kingsford*, IPR2016-01831, Paper 32, at 32-33; (INTEL-1005, ¶¶29-32, 55, 69-77.) Thus, the size and shape of the conductors are "*substantially*

identical” to the same extent disclosed in the ‘430 patent. (INTEL-1003, ¶¶113, 120, 123.)

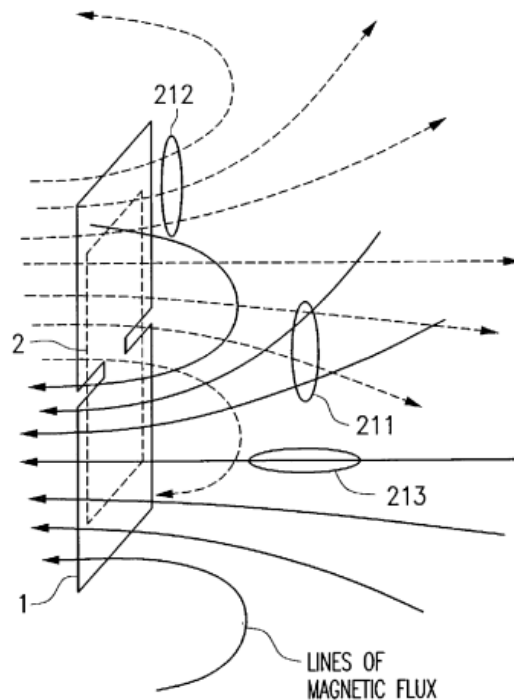
The figures and the references to “halves” of a figure-8 antenna and generation of equal/opposite fields, at a minimum, are suggestive that the loops are substantially identical and symmetrical, as disclosed by the ’430 patent, rendering these limitations obvious. (INTEL-1003, ¶¶114, 121, 123.)

(2) Limitation [20B.2].

The Figure 7, 8, and 9/10 embodiments each include upper conductor 101 (“*second loop*”; orange) “*arranged such that a magnetic field emanating therefrom tends to cancel a magnetic field emanating from the first loop* [lower conductor 102; pink]” [20B.2]. (INTEL-1003, ¶¶115-116, 122-123.) Figure 4 (below) shows “a magnetic field” in the form of “lines of magnetic flux generated from [Figure 3’s] eight-shaped antenna 1⁷.” (INTEL-1005, ¶¶26, 56, Figure 3.) The antenna has “two regions which **generate repulsive lines of magnetic flux on the antenna.**” (INTEL-1005, ¶72; *see also, id.*, ¶¶18 (“the first antenna is formed in a substantially figure eight-shape in order to generate lines of magnetic flux in

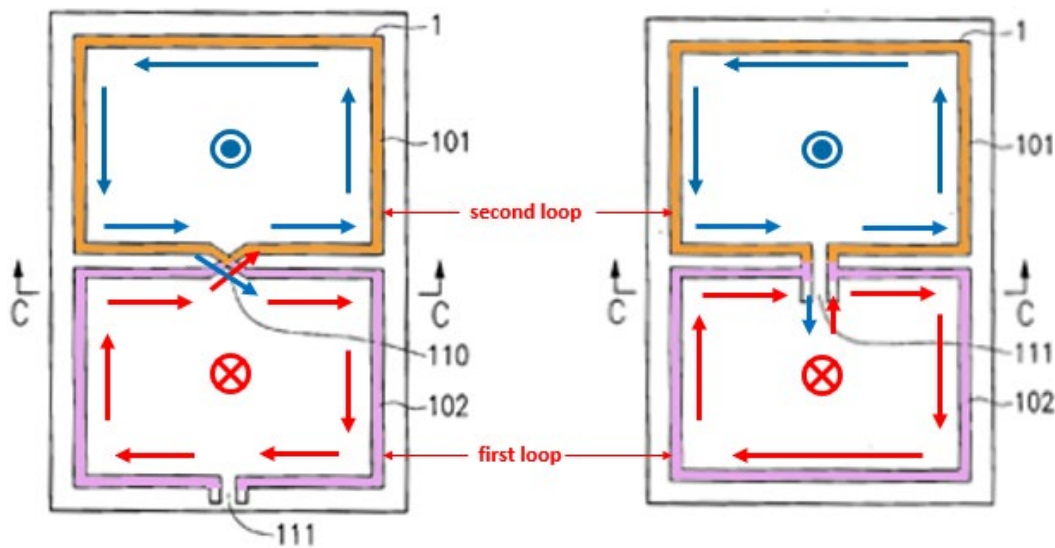
⁷ Eight-shaped antennas/inductors 1 of the Figure 7, 8, and 9/10 embodiments are based on Figure 3’s antenna/inductor 1. (INTEL-1005, ¶¶29-32, 55, 69-74, 76.)

reciprocal directions”), 26, 63-64, claim 6.) The magnetic flux lines of conductor 102 (solid lines) and the flux lines of conductor 101 (broken lines) “are equal in magnitude to each other and directed opposite to each other all the time.” (INTEL-1005, ¶64; *see also, id.*, ¶¶73-74, 77, Figure 9.) Thus, because the conductors are arranged relative to one another so that current flows through them in opposite directions, the generated fields are equal and opposite and therefore the magnetic field emanating from conductor 101 (“*second loop*”) tends to cancel the magnetic field emanating from conductor 102 (“*first loop*”). (INTEL-1003, ¶¶116, 122-123; *see also*, INTEL-1010, 157 (confirming reciprocal fields cancel); INTEL-1023, 2:33-53, 4:3-11, 4:22-28, 6:19-27; INTEL-1005, ¶¶55-57, 73-75.)



Taniguchi, Figure 4

The opposite direction of magnetic fields is illustrated below left for the Figure 8 embodiment's eight-shaped antenna and below right for the Figure 7⁸ and 9/10 embodiments' eight-shaped antenna with the blue dot indicating fields out of the paper and the red x indicating fields into the paper. (INTEL-1005, ¶¶30-32, 71-73, 76.)



Taniguchi, Annotated Figure 8B (left), Antenna 1 of Figs. 7B/10B (right)

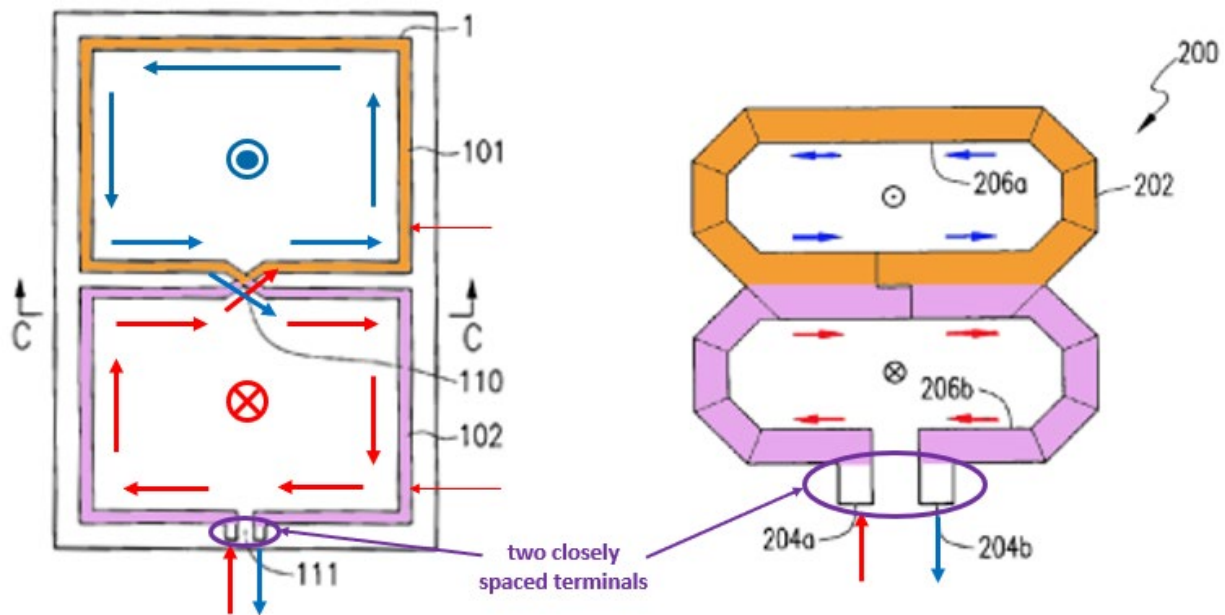
⁸ Antenna 1 of Figures 7 and 10 are identical. (Compare INTEL-1005, Figure 7B to Figure 10B.)

c) “*Two closely spaced terminals*” [20C]

(1) “[S]*upplying current to the first and second loops*”

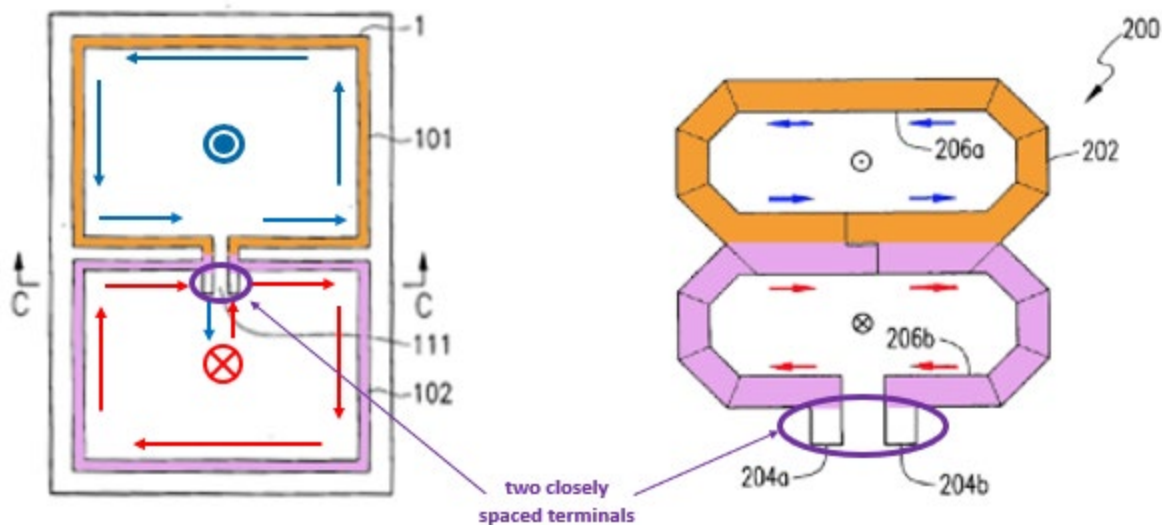
Antenna/inductor 1 in each Figure 7, 8, and 9/10 embodiment includes “*two closely spaced terminals connected to the first loop for supplying electrical current to the first and second loops.*” (INTEL-1003, ¶¶122-134.)

The eight-shaped antenna/inductor 1 of the Figure 8 embodiment has feeding point 111 connected on the lower side of conductor 102 (“*first loop*”). (INTEL-1005, ¶72; Figure 8B (below left).) As shown, feeding point 111 has a **left portion** through which current flows into antenna/inductor 1. The current travels through the left side of conductor 102, crosses to conductor 101 (“*second loop*”), travels through conductor 101, crosses back to conductor 102, travels through the right side, and exits through the **right portion** of feeding point 111. (See INTEL-1005, ¶56 (describing that antenna/inductor 1 is supplied with power via feeding point 111 “and an increase in antenna current is observed”); Figure 3 (illustrating current flow direction); INTEL-1003, ¶125.) A POSITA would understand the two portions of feeding point 111 to be “*terminals*” for antenna/inductor 1 because they act as entry/exit points for current. (INTEL-1024, 6:30-32; INTEL-1023, 6:61-7:13; INTEL-1003, ¶124); *Realtime*, 912 F.3d at 1372-73.



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

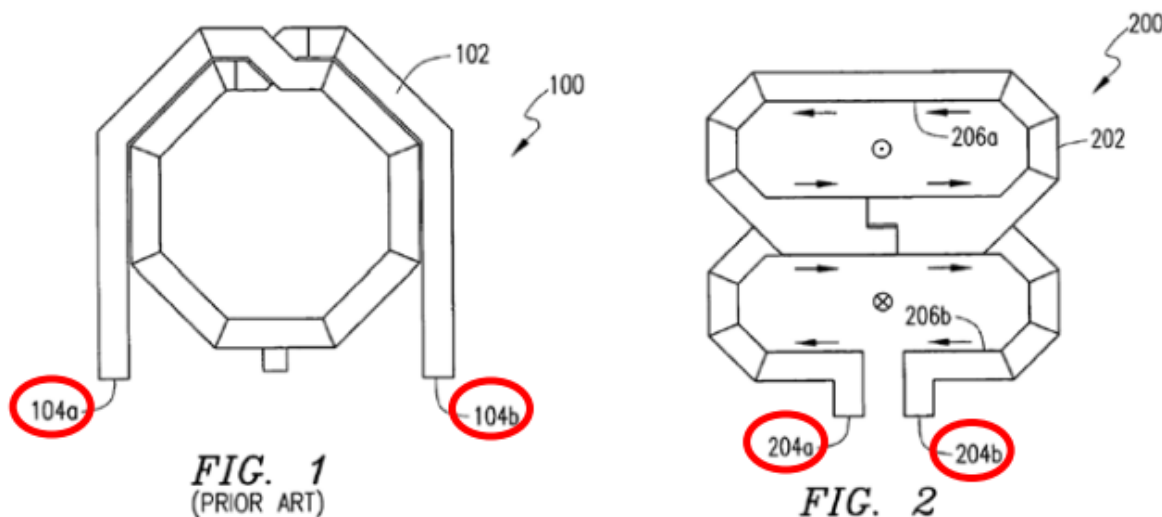
In Taniguchi's Figure 7 and Figure 9/10 embodiments, the feeding point 111 of antenna/inductor 1 is connected to the top of conductor 102 ("first loop"). (See INTEL-1005, Figure 10B, 7B (below left)). As shown, feeding point 111 has two "terminals"—a right terminal through which current flows into conductor 102 and a left terminal through which current leaves the conductor. (INTEL-1003, ¶133.) Taniguchi's feeding point 111 in both embodiments is consistent with the '430 patent which discloses current enters the loop through terminal 204a and leaves through terminal 204b. (INTEL-1001, 4:5-8; Figure 2 (above/below right)); *Apple*, IPR2107-00315, Paper 45 at 47-49.



**Taniguchi, Antenna 1 of Fig. 10B/7B (left)
'430 Patent, Annotated Fig. 2 (right)**

The two feeding point “*terminals*” of the eight-shaped antennas/inductors 1 in Taniguchi’s Figure 7, 8, and 9/10 embodiments are “*closely spaced*.” (INTEL-1003, ¶¶126, 133.) As shown in Taniguchi’s figures above left, the distance between the terminals is close, particularly relative to the width of conductor loops 101 and 102, which is consistent with what the ’430 patent indicates constitutes “*closely spaced*” in Figure 2 (above right). *See, e.g., Mraz*, 455 F.2d at 1072; *Kingsford*, IPR2016-01831, Paper 32, at 32-33. For example, ’430 patent’s Figure 1 (below left) depicts prior-art inductor terminals with a space between them greater than the width of inductor loop, while Figure 2’s terminals 204a-b (below right) are more closely spaced relative to the width of the inductor loop. This depiction is consistent with PO’s arguments during JP prosecution: “[in] cited 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.)



'430 Patent, Figures 1-2

(2) “[M]inimizing magnetic field contributions.”

The two closely spaced terminals of Taniguchi’s feeding point 111 in the Figure 7, 8, and 9/10 embodiments “*minimiz[e] magnetic field contributions from the terminals.*” A POSITA would have understood that having terminals spaced closely together (including more closely than the inductor loop width) minimizes magnetic field contributions from the terminals relative to when the terminals are placed farther apart. (INTEL-1003, ¶¶127-131, 134.) Brooks, published in 2003, summarizes this basic concept. (INTEL-1010; *Realtime*, 912 F.3d at 1372-73. Brooks describes two wires, illustrated in Figure 9-2 below, with one wire carrying

current out of the page and the other carrying current into the page. (INTEL-1010, 156-157.) When these two wires carry a signal and its return, the resultant magnetic fields of the wires will “be equal and opposite” in phase and polarity and the electromagnetic radiations from the wires “tend to cancel.” (INTEL-1010, 156-157.) Indeed, “if the wires **were very close together**, their EMI radiations **would completely cancel and would not be measurable**.” (INTEL-1010, 157.) “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).) Brooks confirms the JP Examiner’s finding that “there is no particular difficulty in configuring the distance between the two terminals to be in close proximity.” (INTEL-1015, 22.)

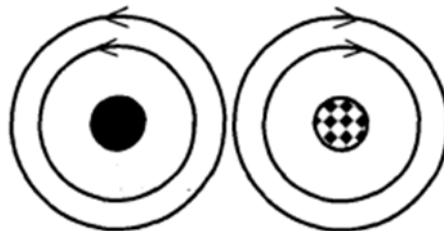


Figure 9-2 A signal and its return have magnetic fields that approximately cancel.

Taniguchi—together with the well-known basic principle articulated in Brooks—is consistent with the limited disclosure for this limitation in the '430 patent: “[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); *Apple*, IPR2107-00315, Paper 45 at 47-49. Thus, Taniguchi discloses or renders obvious limitation [20C].

Should the Board adopt the construction of “*two closely spaced terminals*” from ITC-337-TA-1300⁹, Taniguchi also teaches this limitation. As described above in §§V.B.1.c.1 and V.B.1.a.2, Taniguchi’s antenna/inductor 1 has terminals spaced apart as shown in Figures 7B, 8B, and 10B and generates an electromagnetic field that is reduced where antenna/inductor 2 is positioned. (INTEL-1003, ¶¶131, 134.) Because the fields from the terminals cancel, the electromagnetic field of Taniguchi’s eight-shaped antenna/inductor 1 is not altered by the terminals and therefore does not affect the overall magnetic field generated by the eight-shaped antenna/inductor. (*Id.*)

2. Claims 1/11

Claim 1 is directed to an “*inductor layout*,” including the “*inductor*” limitations of claim 20 and adding a “*second inductor*.” The table below identifies the overlap. (*See also*, INTEL-1003, ¶135.)

⁹ “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).” (INTEL-1020, 12.)

Claim 1	Claim 20
[1P]	
[1A]	[20P]
[1A.1]	[20A]
[1A.2a]	
[1A.2b]-[1A.2c]	[20B.1]-[20B.2]
[1A.3]	[20C]
[1B]	

Should the Board adopt the ITC-337-TA-1376 construction that claim 11’s preamble is limiting only to the extent to provide antecedent basis for “*first inductor*” (INTEL-1019, 2-3), the limitations of claim 11 generally overlap with the limitations of claim 1.

a) Preamble [1P]/[11P]

Taniguchi discloses or renders obvious an “*inductor layout having reduced mutual electromagnetic coupling*” [1P]. (INTEL-1003, ¶¶136-145.) Taniguchi also discloses the “*first inductor*” of claim 11’s preamble which provides antecedent basis for the terms in limitation [11A].¹⁰ (INTEL-1003, ¶171.)

As described above in §V.B.1.a.1, eight-shaped antenna 1 in Taniguchi’s Figure 7, 8, and 9/10 embodiments is an “*inductor*” and rectangular antenna 2

¹⁰ Ground 2 establishes obviousness of claim 11 should the Board determine the full preamble is limiting.

(Figure 7-8 embodiments) and eight-shaped antenna 2 (Figure 9/10 embodiment) are also “*inductors*.” Therefore, antenna/inductor 1 is “*a first inductor*” and antenna/inductor 2 is “*a second inductor*” [11P]. (INTEL-1003, ¶¶169, 148-150, 152, 157, 162.) These embodiments each describe the placement of antennas/inductors 1 and 2 relative to one another, i.e., an “*inductor layout*” [1P]. (INTEL-1005, ¶¶55-56, 69-70 (Figure 7), 71-72 (Figure 8), 73-74, 76-77 (Figures 9, 10); INTEL-1003, ¶137.)

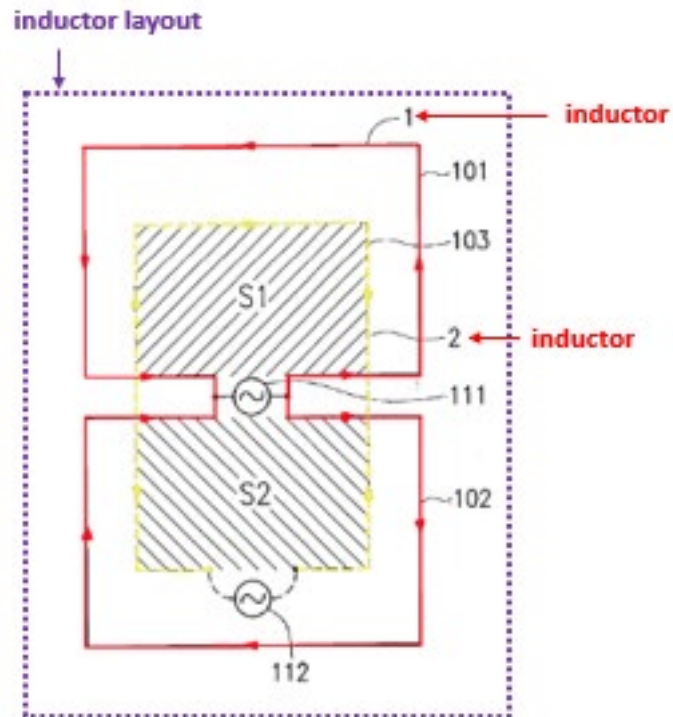
Each embodiment’s layout has “*reduced mutual electromagnetic coupling*” due to the equal and opposite magnetic fields generated by eight-shaped antenna/inductor 1 which cause “induced electromotive forces in opposite directions” in antenna/inductor 2 thereby “**decreas[ing] the sum of mutual inductances between it [antenna 2] and the first antenna.**” (INTEL-1005, ¶¶64, 95, claim 1, ¶¶14-15; INTEL-1012, 68-70.) In this way, the “**remote electromagnetic-field intensity can also be suppressed to be small,**” further contributing to reduced coupling. (INTEL-1005, ¶95; INTEL-1003, ¶¶138-144.)

In the discussion of Figure 3, Taniguchi explains the “*reduced mutual electromagnetic coupling*” resulting from a layout having an eight-shaped antenna and a second antenna. As described above in §V.B.1.a.2, when a current is applied to eight-shaped antenna/inductor 1, conductor 101 generates magnetic field (magnetic flux lines) and conductor 102 generates an equal and opposite magnetic

field (magnetic flux lines). (INTEL-1005, ¶¶63-64, Figure 4.) As a result of the equal and opposite magnetic flux, as shown in Figure 3 below, current “flow[s] [yellow] in the regions S1, S2 [of antenna 2] in opposite directions”: clockwise in S1 and counterclockwise in S2. (INTEL-1005, ¶57.) Accordingly, the induced electromagnetic force generated in these regions cancel each other, resulting in “the induced electromotive force generated on the antenna 2 as a whole become[ing] zero.” (INTEL-1005, ¶¶55-57.) As a result of zero electromotive force, the “residual mutual inductances”¹¹ of the two antennas/inductors “are put in a state of zero.” (*See id.*; *see also, id.*, ¶61; INTEL-1012, 68-79; INTEL-1023, 7:51-65; INTEL-1003, ¶¶139-141.) 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 (antennas 1 and 2 are “**inductively coupled**”), ¶55 (“second antenna 2 is **coupled in electromagnetic induction** to the

¹¹ The residual mutual inductance for antenna/inductor 1 is the total mutual inductance of antenna/inductor 1 on antenna/inductor 2; the residual mutual inductance for antenna/inductor 2 is equal to the residual mutual inductance for antenna/inductor 1. (INTEL-1003, ¶¶140-141.)

upper and lower halves of the first antenna 1”)); *Realtime Data*, 912 F.3d at 1372-73.

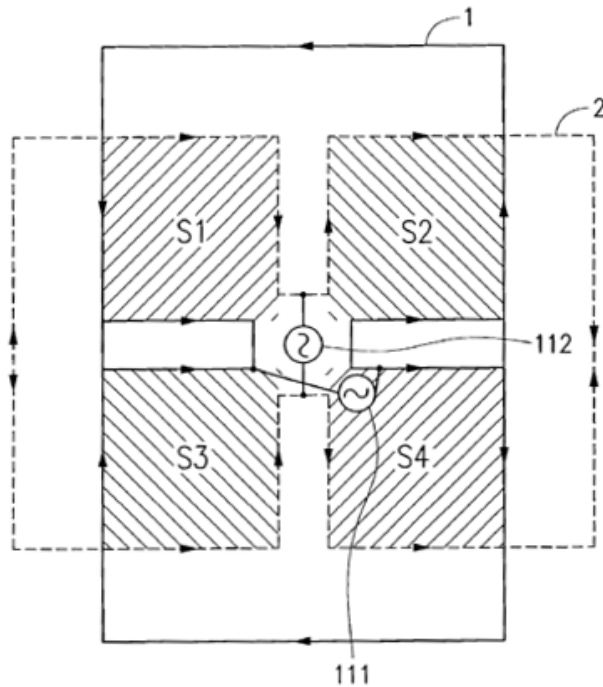


Taniguchi, Annotated Figure 3

Taniguchi’s Figure 7, 8, and 9/10 embodiments have “*reduced mutual electromagnetic coupling*” by virtue of using an eight-shaped antenna/inductor 1, like Figure 3. (E.g., INTEL-1005, ¶¶29-32, 69-73, 76-77; INTEL-1003, ¶¶142-145.) The Figure 7 and 8 embodiments use eight-shaped antenna/inductor 1 and rectangular antenna/inductor 2, like Figure 3. (INTEL-1005, ¶¶29-30.) Antenna/inductor 1 “form[s] two regions which generate repulsive lines of magnetic flux on the antenna 1”, causing the “residual mutual inductance”

generated by antenna/inductor 1 on antenna/inductor 2 to be zero. (INTEL-1005, ¶¶72, 55-57, 29-30; INTEL-1003, ¶142.) Likewise, there is no “residual mutual inductance” generated by antenna/inductor 2 on antenna/inductor 1. (INTEL-1012, 68; INTEL-1003, ¶¶141-142.) Thus, the layout of the two antennas/inductors of the Figure 7 and 8 embodiments has “*reduced mutual electromagnetic coupling.*” (INTEL-1012, 68-70; INTEL-1023, 7:51-65); INTEL-1003, ¶¶142, 144-145.)

In the Figure 9/10 embodiment, antennas 1 and 2 “overlap each other in regions S1, S2, S3 and S4.” (INTEL-1005, ¶74; Figure 9 (below).) Current flow in antenna/inductor 1 induces electromotive forces in the antenna 2 in these regions, with the induced electromotive forces in regions S3, S4 being opposite to the induced electromotive force in regions S1, S2. (INTEL-1005, ¶74.) As a result, when $S1+S2=S3+S4$, “the residual mutual inductance [for both antennas/inductors] becomes zero.” (INTEL-1005, ¶75; INTEL-1003, ¶143.) Thus, the two antennas/inductors have “*reduced mutual electromagnetic coupling*” for this reason and the reasons discussed above for Taniguchi’s Figure 7 and 8 embodiments.



Taniguchi, Figure 9

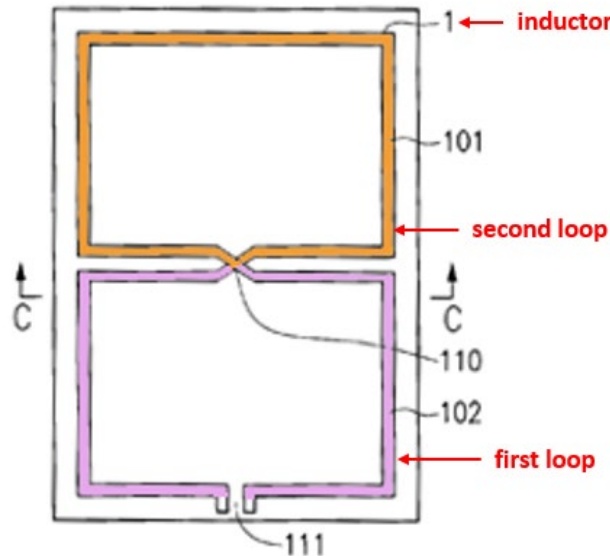
b) “First Inductor” [1A], [1A.1]-[1A.3]/[11A], [11A.1]-[11A.3]

(1) Claim 1

Claim 1’s “*first inductor*” limitations significantly overlap with limitations of claim 20. The only immaterial difference between limitations [20P]/[1A] is that [1A] recites a “*first inductor*”, rather than an “*inductor*.” Limitations [1A.1]/[1A.2b]/[1A.2c]/[1A.3] are identical to limitations [20A]/[20B.1]/[20B.2]/[20C], respectively. These limitations are disclosed or rendered obvious by Taniguchi for the reasons described above in §§V.B.1.a-c. (INTEL-1003, ¶146.)

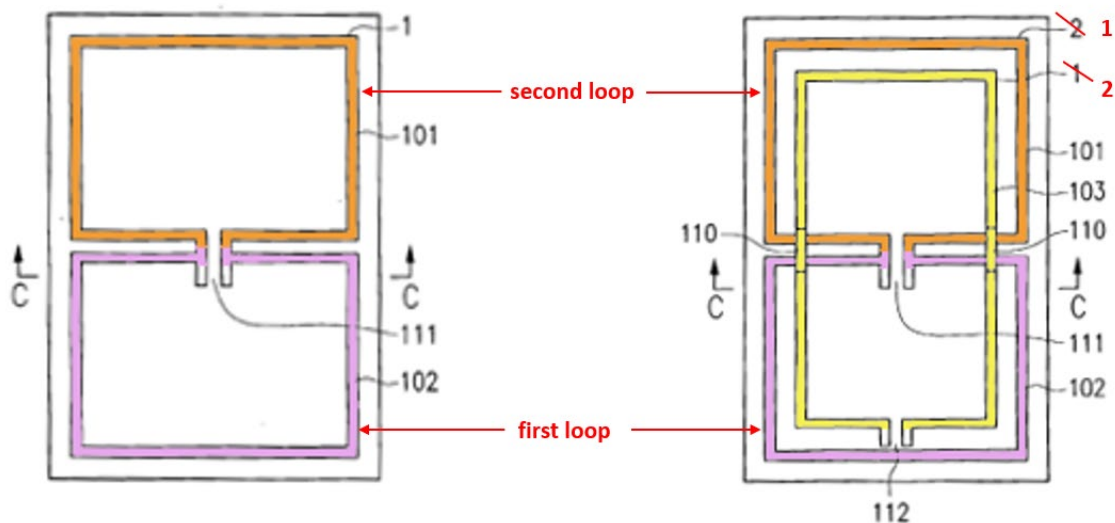
The primary difference between the “*second loop*” limitations [20B]/[1A.2] is that [1A.2] further recites a “*second loop connected to the first loop*” [1A.2a]. Each of the Figure 7, 8, and 9/10 embodiments discloses this limitation. *See, e.g.,*

Mraz, 455 F.2d at 1072; INTEL-1003, ¶¶148-150. In the Figure 8 embodiment, conductor 102 (“*first loop*”; pink) is connected to conductor 101 (“*second loop*”; orange) at a “two-level crossing center[.]” (INTEL-1005, ¶72, Figure 8B (below).)



Taniguchi, Annotated Figure 8B

Antenna/inductor 1 in the Figure 7 and 9/10 embodiments have a common configuration including conductor 102 (“*first loop*”; pink) connected to conductor 101 (“*second loop*”; orange). (INTEL-1005, Figures 10B, 7B (below); ¶¶67 (describing “connection” of conductors 101, 102 in antenna configuration identical to Figures 7B/10B), 66, 29, 73, 76.)



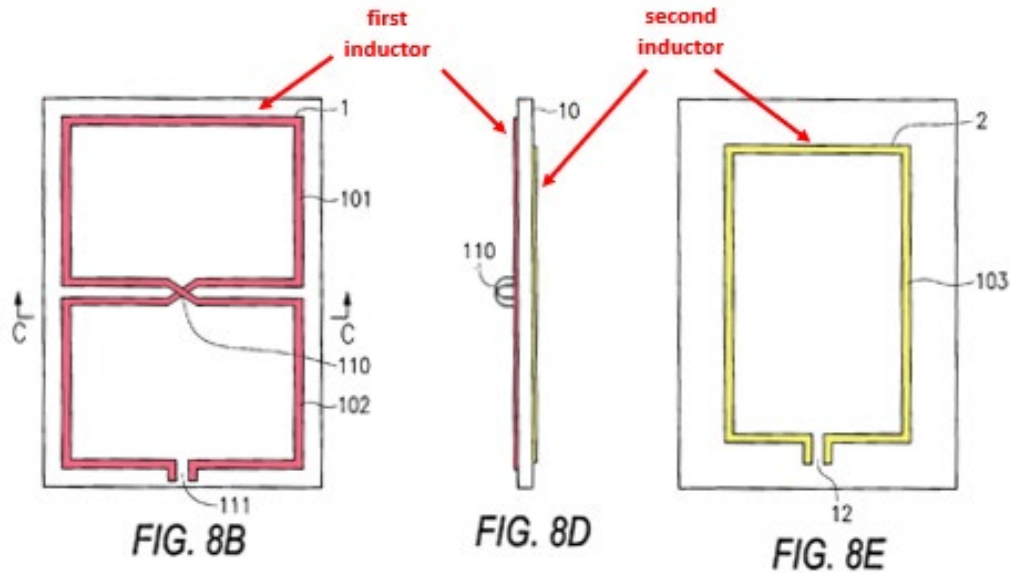
Taniguchi, Annotated Figure 10B (left), Annotated Figure 7B (right)

(2) Claim 11

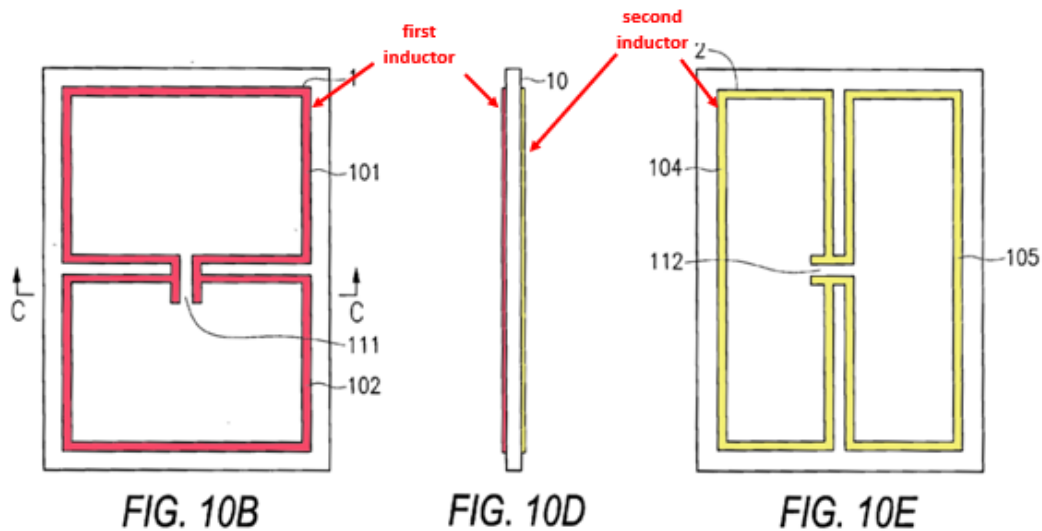
The “*first inductor*” limitations of claims 1 and 11 recite overlapping subject matter with the primary differences being claim 11 recites the claim 1 limitations as method steps (e.g., “*forming ...*”, “*orienting ...*”, and “*connecting ...*”). In each of the Figure 7, 8, 9/10 embodiments, antenna/inductor 1 “is provided **by forming** antenna conductors 101 [“*second loop*”], 102 [“*first loop*”] in a substantially figure eight shape.” (INTEL-1005, ¶¶55, 72-73, 76-77, 29; Figures 7-10.) For this reason and the reasons discussed in §§V.B.2.b.1, V.B.1.b-c, Taniguchi’s Figure 7, 8, 9/10 embodiments each discloses or renders obvious limitations [11A], [11A.1], [11A.2a]-[11A.2b], and [11A.3]. (INTEL-1003, ¶¶172-176.)

c) **“Second Inductor” [1B.1]-[1B.2]/[11B.1]-[11B.2]**

Each of Taniguchi’s Figure 7, 8, and 9/10 embodiments teaches a “*second inductor positioned at a predetermined distance from the first inductor*” [1B.1] and “*positioning a second inductor at a predetermined distance from the first inductor*” [11B.1]. (INTEL-1003, ¶¶152-153, 157-158, 175.) As discussed in §V.B.1.a.1, antenna/inductor 2 (yellow) of the Figure 8 and 9/10 embodiments, is an “*inductor.*” In both embodiments, antenna/inductor 1 (“*first inductor*”; red) and antenna/inductor 2 (“*second inductor*”; yellow) are formed on the opposite surfaces of insulation 10. (INTEL-1005, ¶¶55, 68, 71-73, 76-77, 85-86, Figures 8B, 8D-E (top), Figures 10B, 10D-E (bottom).) The thickness of insulation 10 is therefore “*a predetermined distance*” between antenna/inductor 2 (“*second inductor*”) and antenna/inductor 1 (“*first inductor*”). (INTEL-1003, ¶¶153, 158); *See, e.g., Mraz*, 455 F.2d at 1072.



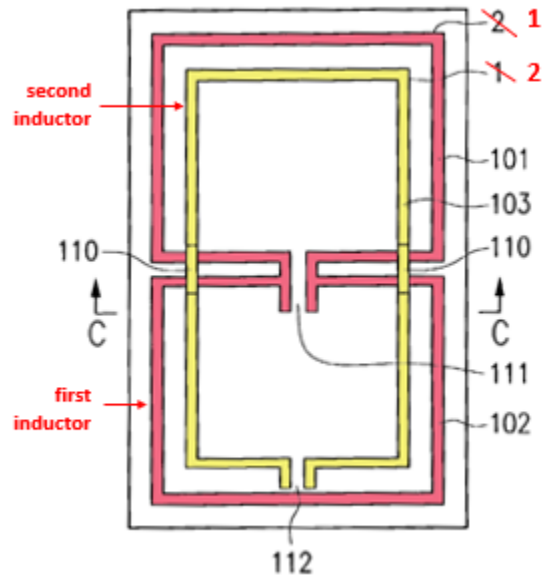
Taniguchi, Annotated Figures 8B and 8D-8E



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

The Figure 7 embodiment includes antenna/inductor 2 (yellow) formed on the same plane of insulation 10 within and concentric with antenna/inductor 1 (red). (INTEL-1005, ¶70, Figure 7B (below); §V.B.1.a.1 (establishing antenna/inductor 2 is inductor).) Due to the concentric placement, each side of

antenna/inductor 2 is placed a specific distance from the corresponding side of antenna/inductor 1. (See, INTEL-1005, Figure 7B below.) This distance is a “*predetermined distance*” between the antennas/inductors. (INTEL-1003, ¶163.)



Taniguchi, Annotated Figure 7B

Taniguchi’s teachings regarding the “*predetermined distance*” between antenna/inductors in its embodiments are consistent with PO’s statement during prosecution of EP3567614 that the “parent application ... does not mandate any particular distance or relative orientation of the two inductors.” (INTEL-1016, 59.)

Each embodiment also discloses “*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*” [1B.2]/[11B.2]. As described above in §V.B.2.a, each embodiment has “*reduced mutual electromagnetic*

coupling” between its eight-shaped antenna/inductor 1 (“*first inductor*”) and antenna/inductor 2 (“*second inductor*”).

Taniguchi further discloses the “*mutual electromagnetic coupling ... is reduced as a result of the first inductor having a reduced electromagnetic field*” [1B.2]/[11B.2]. (INTEL-1003, ¶¶154, 159, 164.) As described above in §V.B.1.a.2, eight-shaped antenna/inductor 1 in the Figure 7, 8, and 9/10 embodiments has a “*reduced far field*” which is a “*reduced electromagnetic field.*” Specifically, the two conductor loops of eight-shaped antenna/inductor 1 in each embodiment “generate repulsive lines of magnetic flux” that tend to cancel each other. (INTEL-1005, ¶72, *See also*, ¶¶18, 29-32, 63-64, 69-73, 76-77, claim 6; INTEL-1010, 157.) This figure-eight configuration “reduces a remote electromagnetic-field effect.” (Taniguchi, ¶¶55, 59 (“**the remote electromagnetic-field intensity is also controlled at an exceedingly low level**”), 94 (“the remote electromagnetic-field intensity is much suppressed by the figure eight-shaped antenna”), 95 (due to the disclosed antenna layouts “**a remote electromagnetic-field intensity can also be suppressed to be small**”).)

The “*reduced electromagnetic field*” of the eight-shaped antenna/inductor (“*first inductor*”) and positioning of the second antenna/inductor results in the reduction in “*mutual electromagnetic coupling*” in Taniguchi’s embodiments. (INTEL-1003, ¶¶156, 161, 166.) The magnetic fields generated by both loops of

the eight-shaped antenna/inductor 1 cause “electromotive forces” in antenna/inductor 2 that “cancel each other” so the “residual mutual inductance” generated by the eight-shaped antenna/inductor 1 on the antenna/inductor 2 is zero. (INTEL-1005, ¶57; *see also, id.*, ¶¶63-64, 74-75.) Thus, the reciprocal magnetic fields generated by the loops of antenna/inductor 1 cancel each other and reduce antenna/inductor 1’s overall electromagnetic field which results in reduced “*mutual electromagnetic coupling*” between the first and second inductors in each embodiment. (INTEL-1005, Abstract, ¶55; INTEL-1003, ¶¶156, 161, 166.) Taniguchi therefore discloses or renders this limitation obvious.

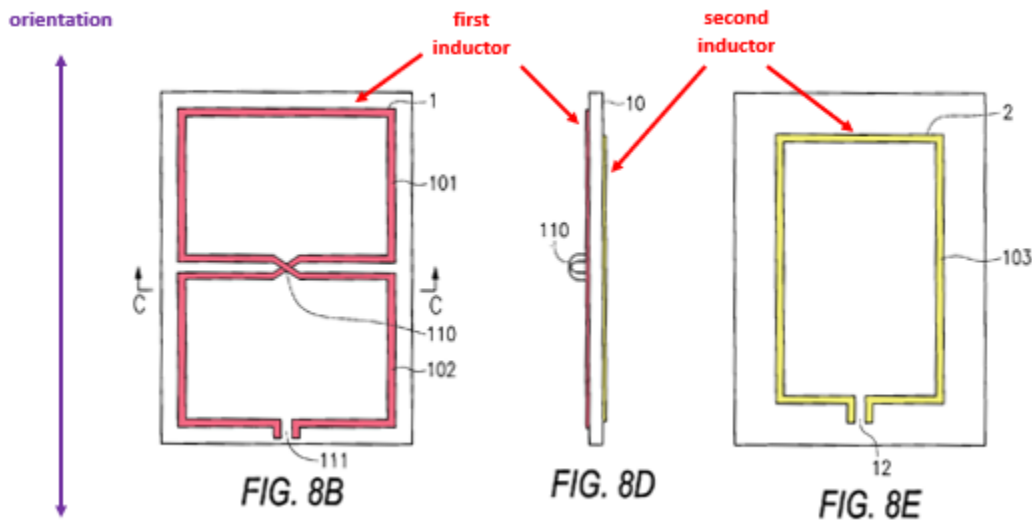
Should the Board adopt the construction of “*reduced electromagnetic field*” from ITC-337-TA-1300, each embodiment discloses the limitation. (INTEL-1003, ¶¶155, 160, 165.) As discussed in this section and §V.B.1.a.2, “the electromagnetic field emanating from the first inductor is reduced (at a certain distance from the first inductor where the second inductor is positioned).” (*Id.*)

C. Dependent Claims

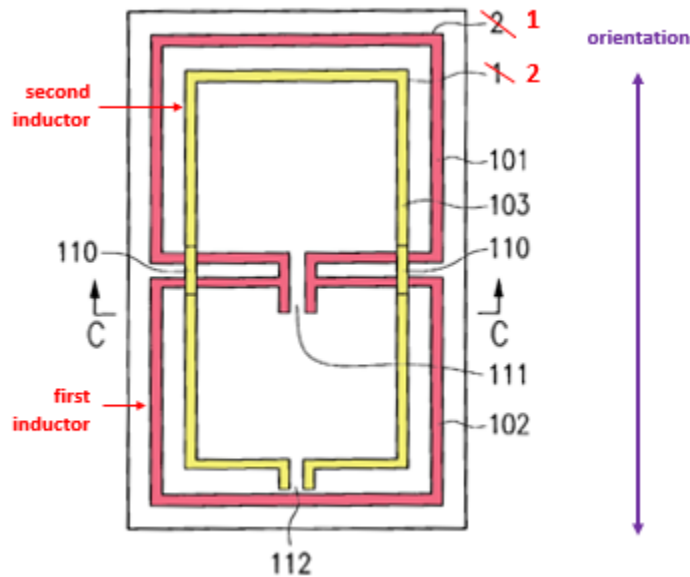
1. Claims 3/13

Taniguchi’s Figure 7 and 8 embodiments “*orient[]*” the “*first inductor*” and “*second inductor*” “*in a same direction*” and therefore render claims 3 and 13 obvious. (INTEL-1003, ¶¶176-179.)

The Figure 7 and 8 embodiments include antenna/inductor 1 (“*first inductor*”; red), having a generally rectangular overall shape, and rectangular antenna/inductor 2 (“*second inductor*”; yellow) with the length, width, and height (thickness) of both antennas/inductors oriented in the same direction. (INTEL-1005, ¶¶72, Figures 8B, 8D-8E (below top), Figure 7B (below bottom), INTEL-1003, ¶¶178-179); *see also, e.g., Mraz*, 455 F.2d at 1072. Taniguchi is therefore consistent with the ’430 patent which uses the term “*orientation*” to encompass the physical placement of an inductor, referring to no rotation or a 45- or 90-degree rotation of one inductor. (INTEL-1001, 6:58-61, 7:47-49; INTEL-1003, ¶177.)



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

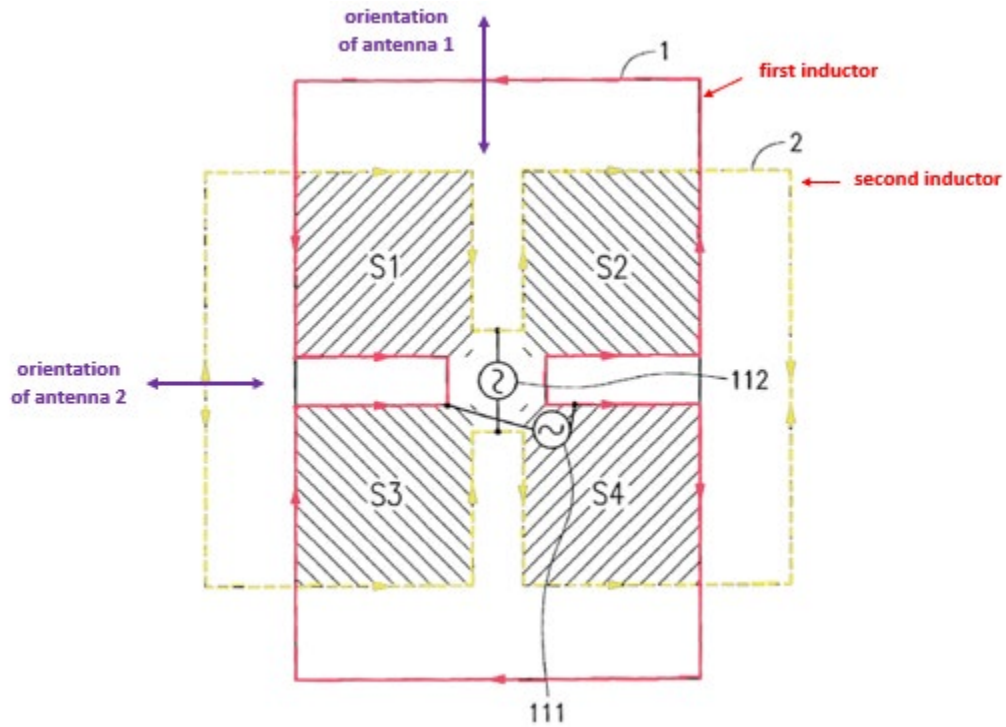


Taniguchi, Annotated Figure 7B

If the placement of the terminals (and/or current direction in/out of inductors) determines orientation, Taniguchi’s Figure 7 and 8 embodiments still render claims 3 and 13 obvious because Taniguchi’s feeding points 111, 112 have the same direction of current in/out. (INTEL-1003, ¶¶178-179.)

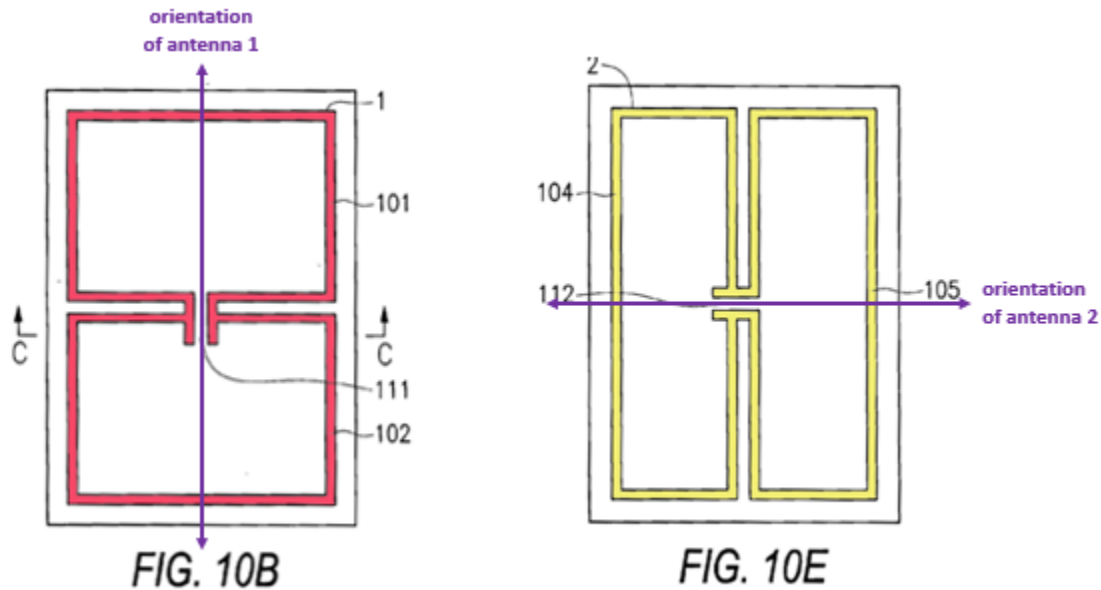
2. Claims 4/14

Taniguchi’s Figures 9/10 embodiment “*orients*” the “*first inductor*” and “*second inductor*” “*in different directions*” and therefore renders claims 4 and 14 obvious. (INTEL-1003, ¶¶180-181.) Taniguchi’s Figure 9/10 embodiment includes antenna/inductor 1 (“*first inductor*”; red) and antenna/inductor 2 (“*second inductor*”; yellow) “**turned 90°** relative to the antenna 1” and thus oriented in a different direction. (INTEL-1005, ¶77, Figure 9 (below); *see also, id.*, ¶73.)



Taniguchi, Annotated Figure 9

If the terminal placement (and/or current direction) determines orientation, Taniguchi's Figures 9/10 embodiment still renders claims 4 and 14 obvious because Taniguchi's feeding points 111, 112 have different directions, by virtue of the rotation, as illustrated in Figures 10B, 10E below. (INTEL-1003, ¶182.)

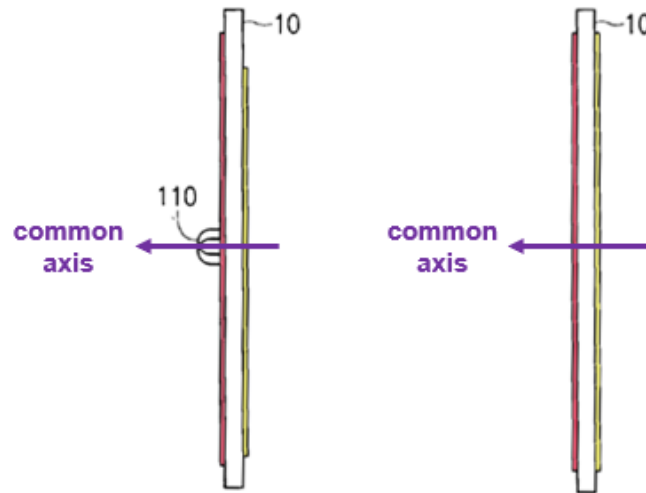


Taniguchi, Annotated Figures 10B, 10E

3. Claims 5/15

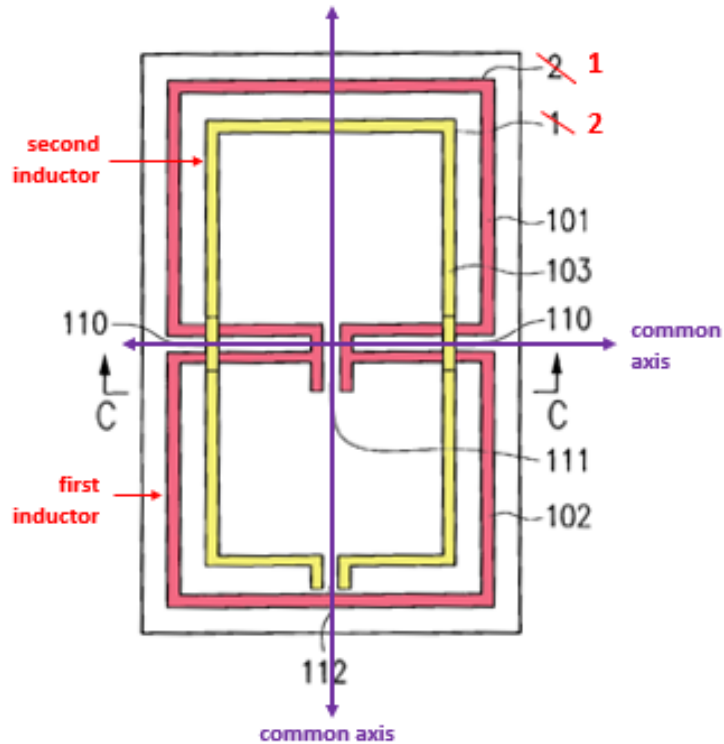
Taniguchi's embodiments each discloses the "*first inductor*" and "*second inductor*" are placed so they share "*a common axis*", and each renders claims 5 and 15 obvious. (INTEL-1003, ¶¶183-185.) In the Figure 8 and 9/10 embodiments, antenna/inductor 1 ("*first inductor*") and antenna/inductor 2 ("*second inductor*") are formed in "parallel" planes. (INTEL-1005, ¶¶55; *see also, id.*, ¶¶30-32, 71-73, 76-77.) For example, the side-views of Figures 8D (below left) and 10D (below right) show that antenna/inductor 1 (red) and antenna/inductor 2 (yellow) share a common z-axis. *See, e.g., Mraz*, 455 F.2d at 1072; *Kingsford*, IPR2016-01831, Paper 32, at 32-33. Taniguchi's specification confirms this, explaining that concentric placement of antenna 2 relative to antenna 1 creates equal overlapping regions S1 and S2 for the Figure 8 embodiment (as shown in Figure 3) and equal

overlapping regions ($S1+S2=S3+S4$) for the Figures 9/10 embodiment, resulting in zero mutual inductance. (INTEL-1005, ¶¶57, 72, 74-75, 79, Figures 3, 8-9.)



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

In the Figure 7 embodiment, antenna/inductor 2 (“*second inductor*”) is placed concentrically within antenna/inductor 1 (“*first inductor*”) on the “same plane” so that overlapping regions ($S1$ and $S2$) are equal and the residual mutual inductance between the antennas is zero. (see INTEL-1005, ¶¶55, 57, 70; Figure 7B (below), Figure 3.) Thus, the antennas/inductors share common vertical, horizontal, and z- axes. See, e.g., *Mraz*, 455 F.2d at 1072; *Kingsford*, IPR2016-01831, Paper 32, at 32-33.

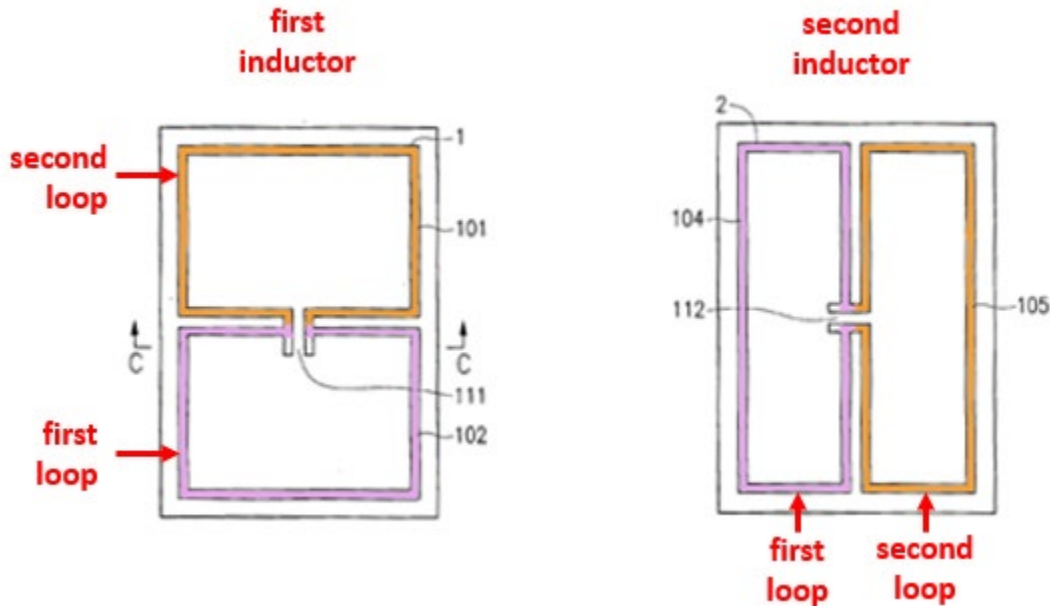


Taniguchi, Annotated Figure 7D

4. Claims 7/17

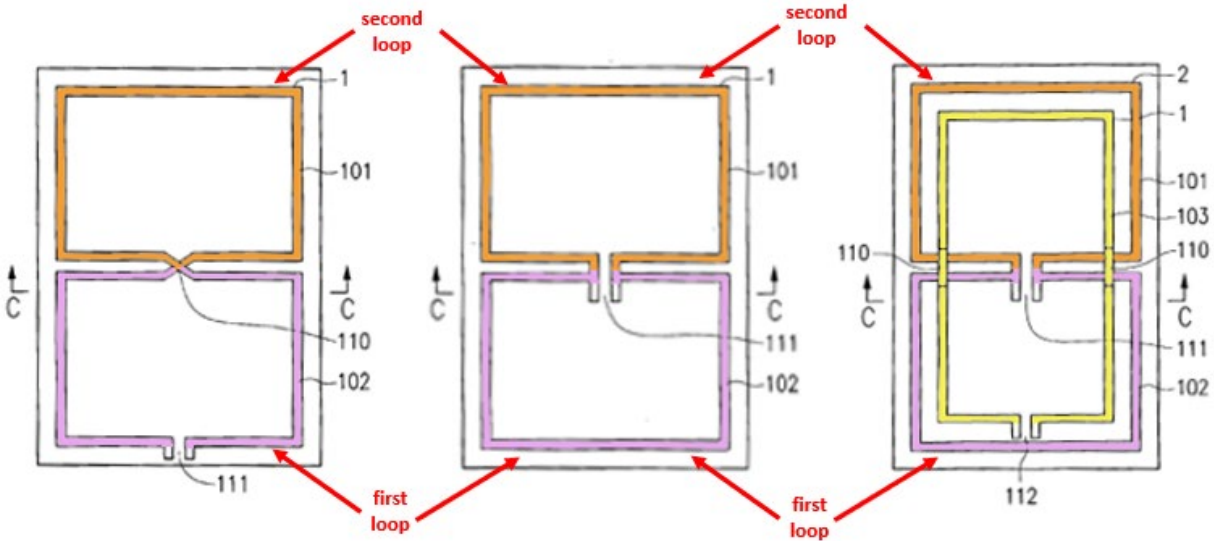
In the Figure 9/10 embodiment, “**antenna conductors 101, 102** are used to form an antenna 1 ... in a **substantially figure eight-shaped configuration**, and **antenna conductors 104, 105** are used to form an antenna 2 ... in a **substantially figure eight-shaped configuration**.” (INTEL-1005, ¶77; *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 discussed in §§V.B.1.b, V.B.2.b for the first and second loops. (INTEL-1005, ¶¶64, 94-95; *see also*, §V.B.1.b.) Thus, Taniguchi’s Figure 9/10 embodiment discloses “*the second inductor also includes two loops, and said*

first inductor and said second inductor are substantially 8-shaped” [7]. (INTEL-1003, ¶187.)



Taniguchi, Annotated Figures 10B, 10E

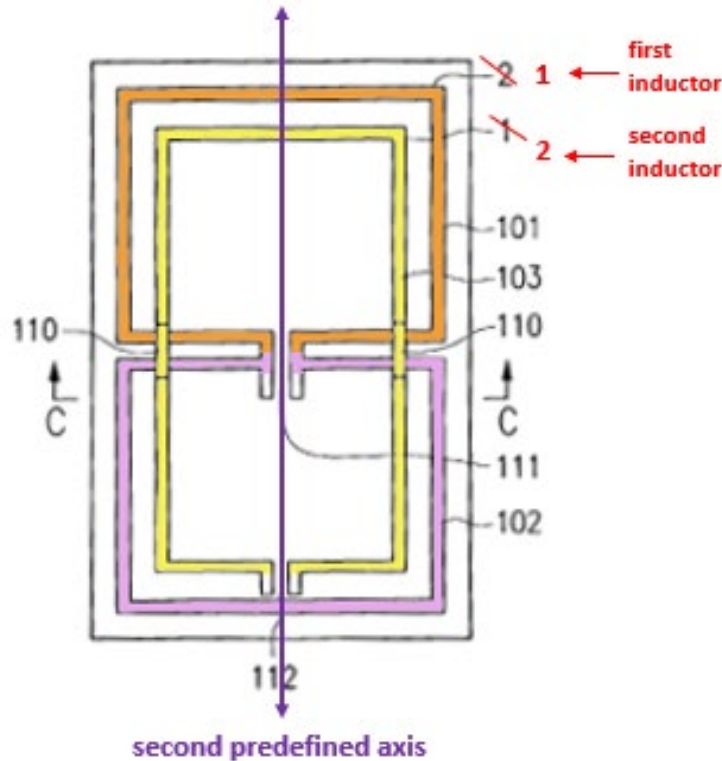
As discussed in §§V.B.1.a.2, V.B.2.b antenna/inductor 1 (red) in each of Figure 7, 8 and 9/10 embodiments is eight-shaped, as shown below. (See INTEL-1005, ¶¶55, 71, 73, 29.) Thus, Taniguchi’s embodiments disclose “*orienting the second loop in relation to the first loop includes placing the first and second loops in a substantially 8-shape*” [17]. (INTEL-1003, ¶188.)



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

5. Claims 10/19

Taniguchi discloses the “*first inductor*” and “*second inductor*” are positioned to be “*symmetrical about a second defined axis*” and thus renders claims 10 and 19 obvious. (INTEL-1003, ¶¶189-190.) As shown below, antenna/inductor 1 (“*first inductor*”) is symmetrical about the vertical (“*second predefined axis*”) and antenna/inductor 2 (“*second inductor*”; yellow) is also symmetrical about the same vertical axis because both antenna/inductor 1 and antenna/inductor 2 are formed on the same plane and antenna/inductor 2 is within and concentric with antenna/inductor 1 (“*first inductor*”; red). (INTEL-1005, ¶70; Figure 7B (below)); *see also, e.g., Mraz*, 455 F.2d at 1072.



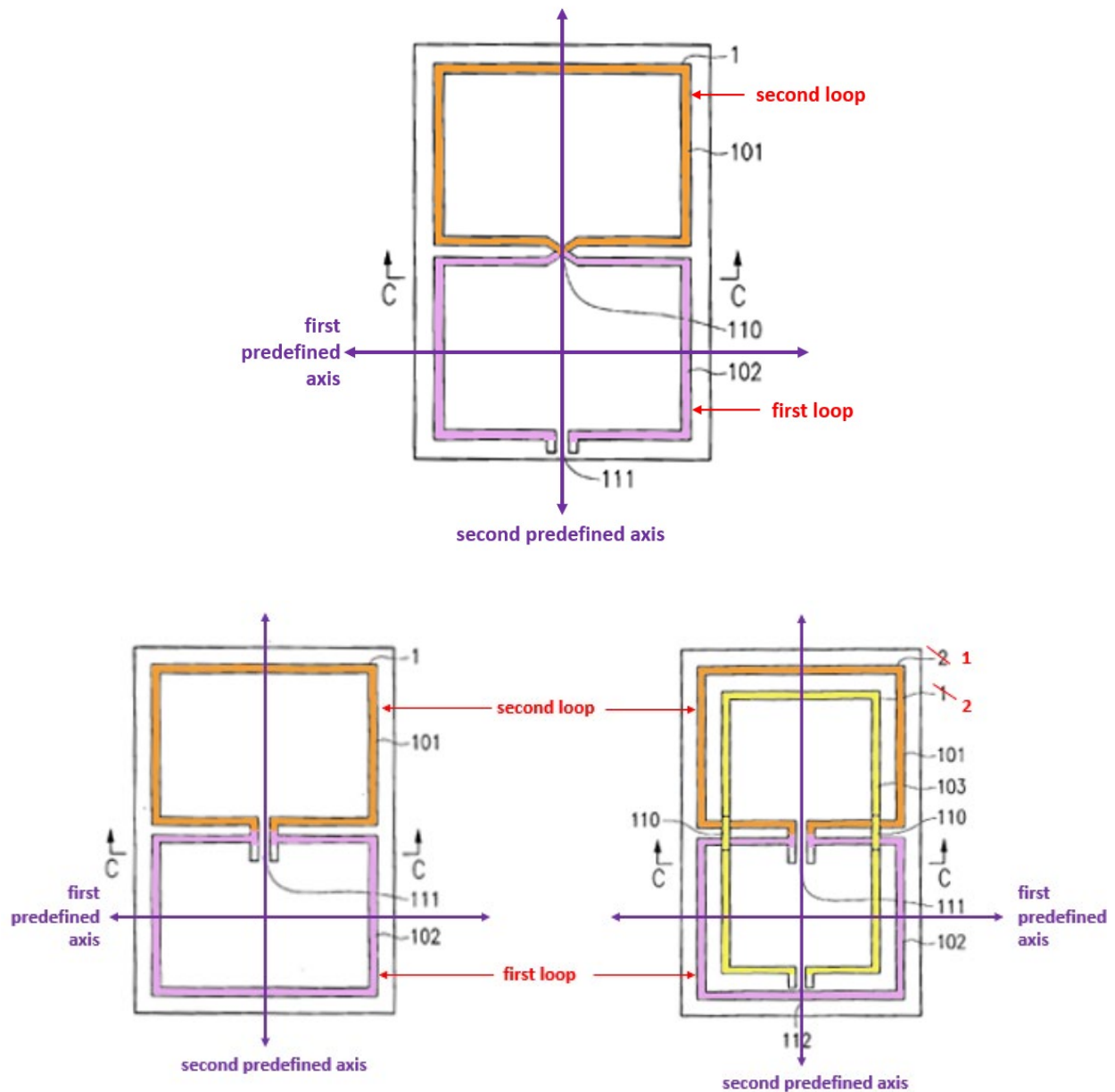
Taniguchi, Annotated Figure 7B

6. Claim 21

Taniguchi's Figure 7, 8, and 9/10 embodiments each discloses the "*first loop*" and "*second loop are substantially symmetrical about a second predefined axis*" and therefore render claim 21 obvious. (INTEL-1003, ¶¶191-195.) Taniguchi discloses this limitation, consistent with the disclosure of the '430 patent.

As described in §V.B.1.a, the Figure 7, 8 and 9/10 embodiments each 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.) As shown in the figures below from Taniguchi, when the horizontal axis is the "*first predefined axis*", the "*second*

loop” is also “*substantially symmetrical about*” the vertical axis (“*the second predefined axis*”), like the “*first loop*”, 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 Figures 8B (top), 10B (bottom left), 7B (bottom right)

VI. Ground 2: Taniguchi-Rostoker Combination Renders Claims 2, 8, 11, 13-15, 17-19 Obvious

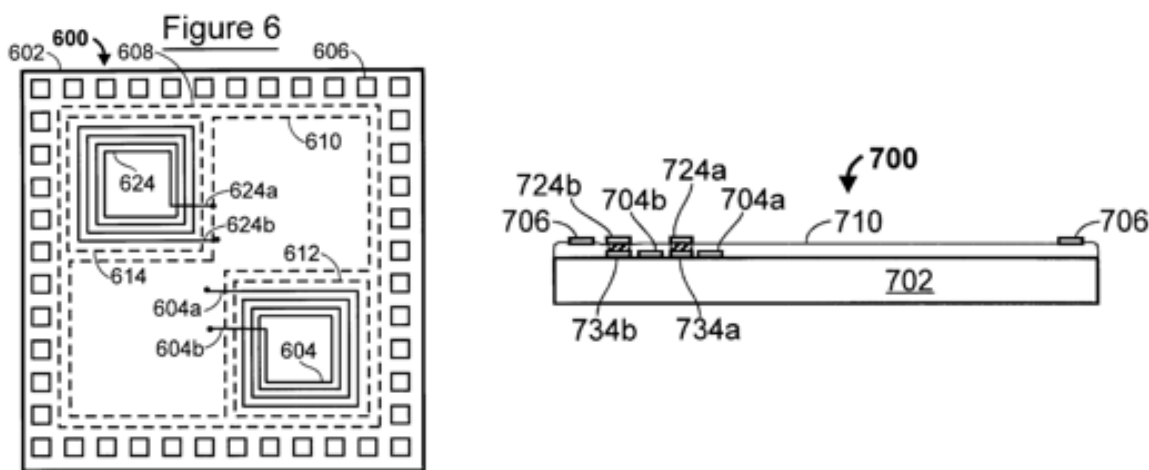
A. Combination Overview

1. Rostoker

Rostoker is directed to forming antennas on an integrated circuit chip.

(INTEL-1006, Abstract, 3:55-57, 8:64-67.) In one embodiment, two antennas are disposed on the chip's surface. (*E.g.*, INTEL-1006, 8:64-9:42, Figure 6 (left).)

Another embodiment includes stacked antennas “disposed in two different vertical planes on a single integrated circuit (IC) chip 702.” (INTEL-1006, 10:1-63, Figure 7B (right).)

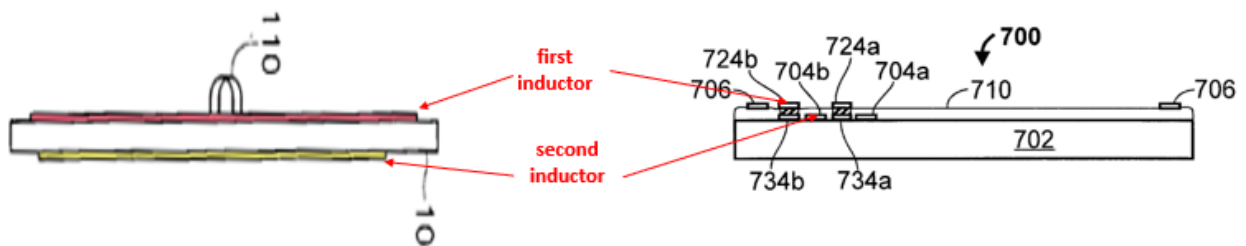


Rostoker, Figure 6 (left), Figure 7B (right)

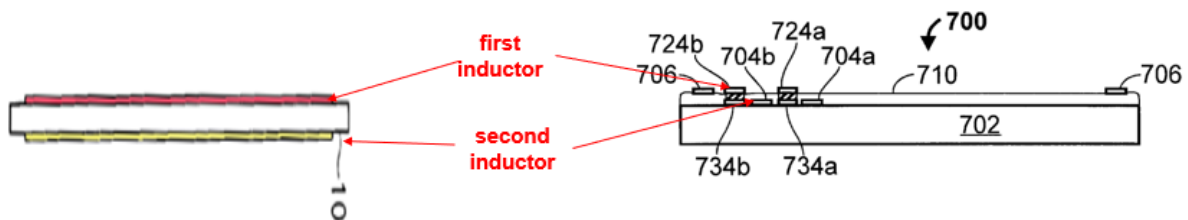
2. Motivation to Combine

A POSITA would have been motivated to implement Taniguchi's Figure 8 and 9/10 embodiments using the stacked antenna teachings of Rostoker. (INTEL-1003 ¶201.) A POSITA would have implemented Taniguchi's antenna/inductor 1

(red) in a second metallization layer and Taniguchi's antenna/inductor 2 (yellow) in a first metallization layer with an insulating layer separating the two metallization layers, as illustrated in the below figures. (INTEL-1003, ¶201; INTEL-1005, Figure 8D (top left), 10D (bottom left); INTEL-1006, Figure 7B (top/bottom right).)

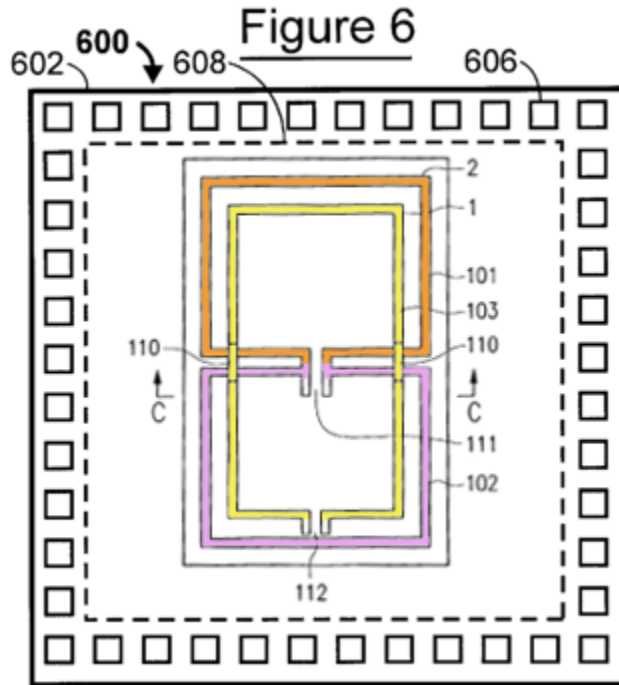


Taniguchi, Figure 8D (annotated/rotated); Rostoker, Figure 7B



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

A POSITA also would have implemented Taniguchi's Figure 7 embodiment using Rostoker's teachings of forming multiple antennas on same plane. (INTEL-1003, ¶202.) As illustrated in the figure below which superimposes the antenna layout of Taniguchi's Figure 7B on Rostoker's Figure 6, a POSITA would have implemented Taniguchi's antennas 1 and 2 in the central area of Rostoker's chip. (*Id.*)



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

Taniguchi and Rostoker 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.) A POSITA would have pursued the above combination. First, Taniguchi suggests them, 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, id.*, ¶¶86, 95.) Although Taniguchi describes an application of its antenna embodiments in gates, Taniguchi teaches use in alternative applications including “electronic coupon ticket systems.” (INTEL-1005, ¶¶1-2; INTEL-1003, ¶203.) 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 (describing a hand-held, portable RFID device); INTEL-1003, ¶¶204-205.)

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; INTEL-1003, ¶206.) 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, 26-27.) 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. (INTEL-1003, ¶206.) Indeed, Rostoker describes and incorporates by reference two prior art patents 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. (INTEL-1003, ¶206.)

Third, Taniguchi suggests other implementations for its multiple antenna arrangements, noting that the substrate need not be a printed circuit board (PCB) but “can be formed **of an insulating film and an insulating material.**” (INTEL-1005, ¶86; INTEL-1003, ¶207.) Because Taniguchi does not provide any details regarding substrate implementations other than a PCB, a POSITA would have been motivated to search for details relating to available non-PCB substrate options, which would have led to Rostoker and its teachings regarding implementation of antennas on the substrate of a semiconductor chip. (INTEL-1003, ¶207.)

Fourth, the combinations are 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. (INTEL-1003, ¶208.) Taniguchi discloses a “base” device with antennas formed on opposite sides or the same side of an insulating layer. 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. (*Id.*, *see also, e.g.*, INTEL-1025, Abstract; *see also, id.*, 1:40-48; 3:23-32, 8:32-44); *Intel Corp. v. PACT XPP Schweiz AG*, ⁶¹ F.4th 1373, 1380 (Fed. Cir. 2023).

Fifth, the combinations represent a straightforward and predictable substitution of one known element for another. (INTEL-1003, ¶209.) A POSITA would have substituted Taniguchi's PCB manufacturing technique with Rostoker's semiconductor manufacturing technique to implement Taniguchi's layouts. (*Id.*) The techniques overlap. Taniguchi teaches forming antennas/inductors on two planes separated by an insulation layer (*e.g.*, INTEL-1005, ¶¶55, 77, 86), and Rostoker similarly teaches forming antennas on metallization layers separated by an insulating layer (*e.g.*, INTEL-1006, 10:23-29, Figure 7B). Taniguchi also teaches forming antennas/inductors on the same plane (*e.g.*, INTEL-1005, ¶¶55, 70), and Rostoker similarly teaches that antennas are formed on the same surface of an IC chip (*e.g.*, INTEL-1006, 8:66-9:18).

A POSITA would have had a reasonable expectation of success of integrating Taniguchi's antennas/inductors onto Rostoker's chip and the results of the combinations would have been predictable. (INTEL-1003, ¶210.) 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

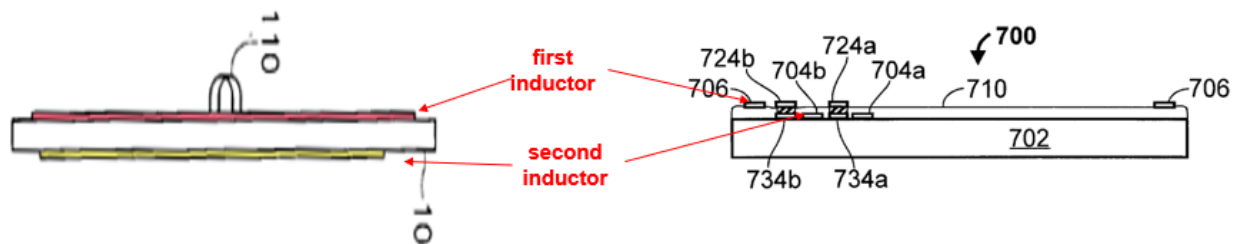
purpose when fabricating Taniguchi's antennas. (INTEL-1003, ¶210.) It was known in the prior art how to fabricate antennas (including loops) on a single chip for various applications including non-contact identification applications, like that described in Taniguchi. (*Id.*, citing INTEL-1025 Abstract, 5:33-45, 8:48-49; INTEL-1022, 1:6-32, 3:50-56; INTEL-1029, Figures 1, 3; 5:36-38.)

B. Independent Claim 11

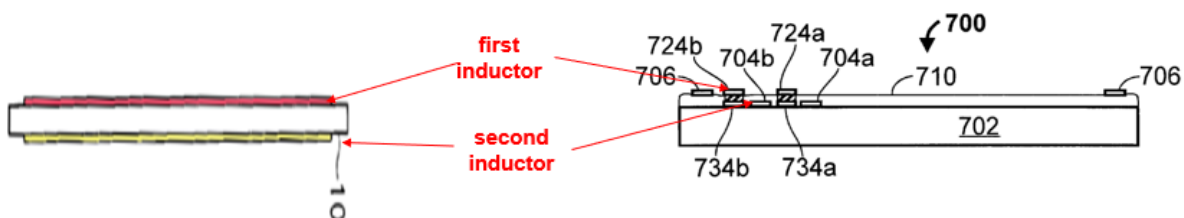
Should the Board determine the preamble recitation that the first and second inductors are "*on a semiconductor die*" is limiting, the Taniguchi-Rostoker combination renders claim 11 obvious. (INTEL-1003, ¶¶211-219.)

Rostoker discloses an embodiment with two antennas 704 and 724 "disposed in two different vertical planes on a single integrated circuit (IC) chip 702." (INTEL-1006, 10:9-12.) Antenna 704 "is formed in a first metallization layer," and antenna 724 "is formed in a second metallization layer." (INTEL-1006, 10:23-27, Figure 7B (below).) In the Taniguchi-Rostoker combination, for the Figure 8 and 9/10 embodiments, Taniguchi's antenna/inductor 1 ("*first inductor*"; red) is formed in a second metallization layer and Taniguchi's antenna/inductor 2 ("*second inductor*"; yellow) is formed in a first metallization layer, as shown in the figures

from Taniguchi and Rostoker below. (INTEL-1003, ¶¶214-215.)

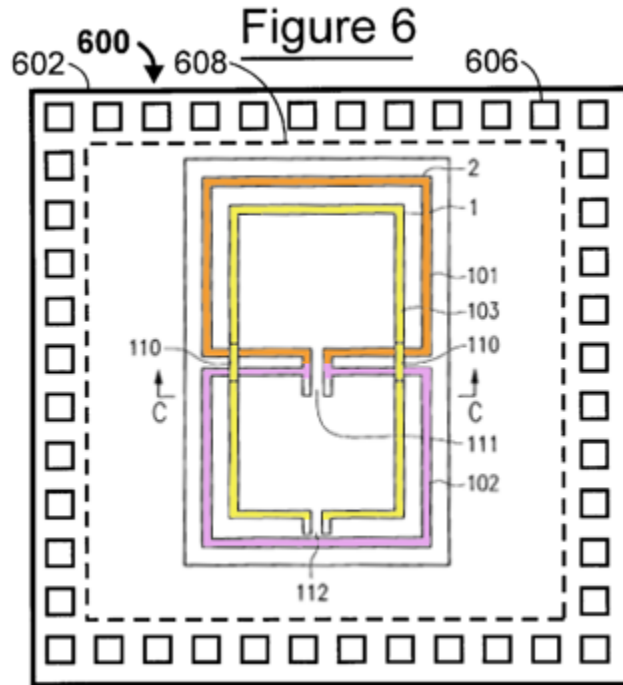


Taniguchi, Figure 8D (annotated/rotated); Rostoker, Figure 7B



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

Rostoker's Figure 6 embodiment includes two antennas on IC chip's surface. (INTEL-1006, 8:64-9:2.) Antenna 604 "is disposed within the second portion 612 of the central area 608 of the chip 602," while antenna 624 "is disposed within the third portion 614." (INTEL-1006, 9:12-18.) In the Figure 7 embodiment in the Taniguchi-Rostoker combination, Taniguchi's antenna/inductor 1 ("*first inductor*"; red) and antenna/inductor 2 ("*second inductor*"; yellow) are formed in a central area of the chip, as shown in the figures from Taniguchi and Rostoker below. (INTEL-1003, ¶218.)



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

Rostoker explains that an IC chip is a “die.” (*E.g.*, INTEL-1006, 11:8, 11:14; *see also, id.*, 12:31-32 (referring to “SCM” (single chip module)), 12:35-36 (SCM has “a single semiconductor die”).) Thus, Rostoker teaches including two antennas “*on a semiconductor die*”—either in multiple layers (Figure 7B) or on the chip surface (Figure 6). (INTEL-1003, ¶217.)

C. Dependent Claims 2, 8, 13-15, 17-18, 19

For the same reasons discussed in §§V.C.1-6, the Taniguchi-Rostoker combination renders **claims 13-15, 17, and 19** obvious. **Claims 2 and 8/18** are rendered obvious as discussed below.

1. Claim 2

The Taniguchi-Rostoker combination renders obvious the first and second inductors “*formed on a single semiconductor die*” [2] for the reasons described above in §VI.B. (INTEL-1003, ¶220.)

2. Claims 8/18

Claim 8 recites the “*substantially 8-shaped first and second inductors*” [7] include “*an inner loop within each of the two loops.*” Claim 18 recites that each loop of the “*first inductor*” has an inner loop. The Taniguchi-Rostoker combination renders both claims obvious. (INTEL-1003, ¶¶222-229.)

Rostoker describes antennas with multi-turn loops. (INTEL-1006, Abstract, Figure 2, 7:6-13.) A POSITA would understand that each “turn” is also a “*loop*.” (INTEL-1001, 9:43-47; INTEL-1003, ¶224.) A POSITA would have been motivated to increase the number of turns in each conductor of Taniguchi’s eight-shaped antennas/inductor in the Figure 7 and 8 embodiments, rendering claim 18 obvious, and in both eight-shaped antennas/inductors in the Figure 9/10 embodiment, rendering claims 8 and 18 obvious. (*Id.*) Rostoker suggests the combination, teaching that transmitting and receiving strength “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. (INTEL-1003, ¶224.)

U.S. Patent 6,137,447 to Saitoh et al. (“Saitoh”; INTEL-1023) 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. (INTEL-1003, ¶¶225-228.) Like Taniguchi, Saitoh discloses an eight-shaped transmitting antenna in an inductively coupled contactless data transmission system having two loops that generate opposing magnetic fields. (INTEL-1023, 4:3-11, 4:22-28, 6:19-31, 6:66-7:13, 7:33-67, Figures 4A-4B, 6.)

According to Saitoh, adjusting the “number of turns” in a transmitting antenna loop ensures that “magnetic field intensity is high enough inside the communication zone.” (INTEL-1023, 12:9-18; *see also, id.*, 4:28-40; 7:38-48.) Doing so also “decrease[s]” the field “outside 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.) 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. (INTEL-1003, ¶¶225-227.)

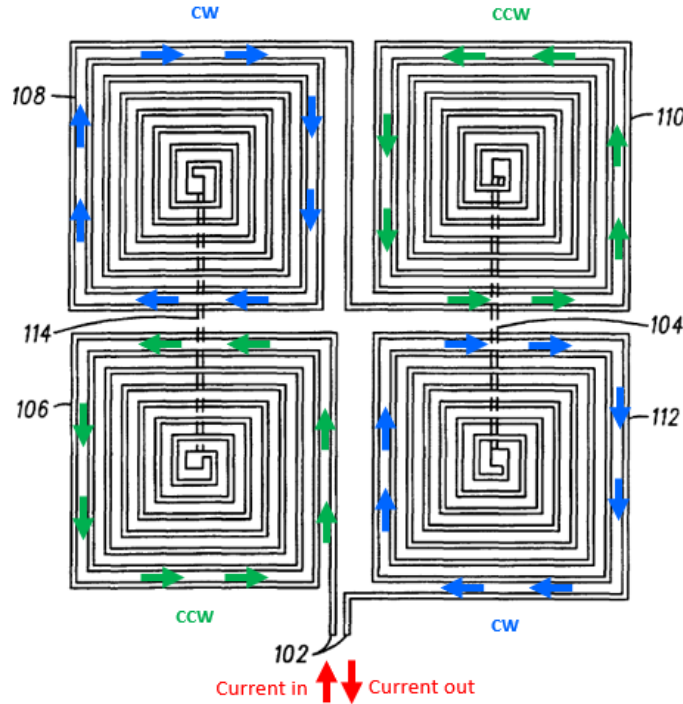
A POSITA would have had a reasonable expectation of success with predictable results when adding turns to Taniguchi's antenna loops based on Rostoker's and Saitoh's teachings. (INTEL-1003, ¶228.) As discussed in §VI.A.2, Rostoker describes fabrication of multiple antennas, including antennas with multiple turns, on a chip using "well-known" IC manufacturing processes. (*See, e.g.*, INTEL-1006, 10:16-22.)

VII. Ground 3: Midya-Raghavan Combination Renders Claims 1, 3-6, 9, 11-16, 20-21 Obvious.

A. Combination Overview

1. Midya

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 four loops 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.) Because of the cancellation, Midya refers to its inductor as a "non-interacting multiloop inductor structure." (*See, e.g.*, INTEL-1007, 11:18-25, 5:21-25, Figures 1, 26.)



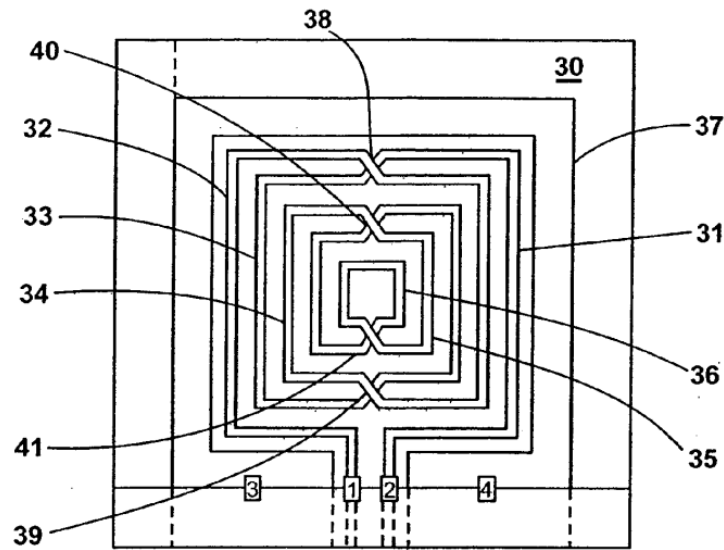
Midya, Annotated Figure 1

Midya uses the non-interacting inductor of its “present invention” in different layouts with a second inductor. For example, Midya teaches a second inductor “placed concentrically above” a 4-loop implementation of its non-interacting inductor. (INTEL-1007, 5:21-25, 11:18-25; Figure 26.) 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.)

2. Raghavan

Raghavan describes “symmetric inductors.” (INTEL-1008, ¶2.) An example inductor comprises five square windings 32, 33, 34, 35, and 36 (collectively

“inductor winding 31”) “sharing a common center of symmetry.” (INTEL-1008, ¶19.) Inductor winding 31 includes two terminals [1] and [2]. (INTEL-1008, ¶20, Figure 3 (below).) Current enters the outermost winding 32 at terminal [1] and travels clockwise through the inductor “cross[ing] over” between sides of individual square windings several times before exiting winding 32 at terminal [2]. (INTEL-1008, ¶20.)



Raghavan, Figure 3

3. Motivation to Combine

A POSITA would have been motivated to combine Midya’s non-interacting inductor teachings with Raghavan’s teaching of a symmetric inductor winding as described below. (INTEL-1003, ¶¶239-247.)

a) Combination

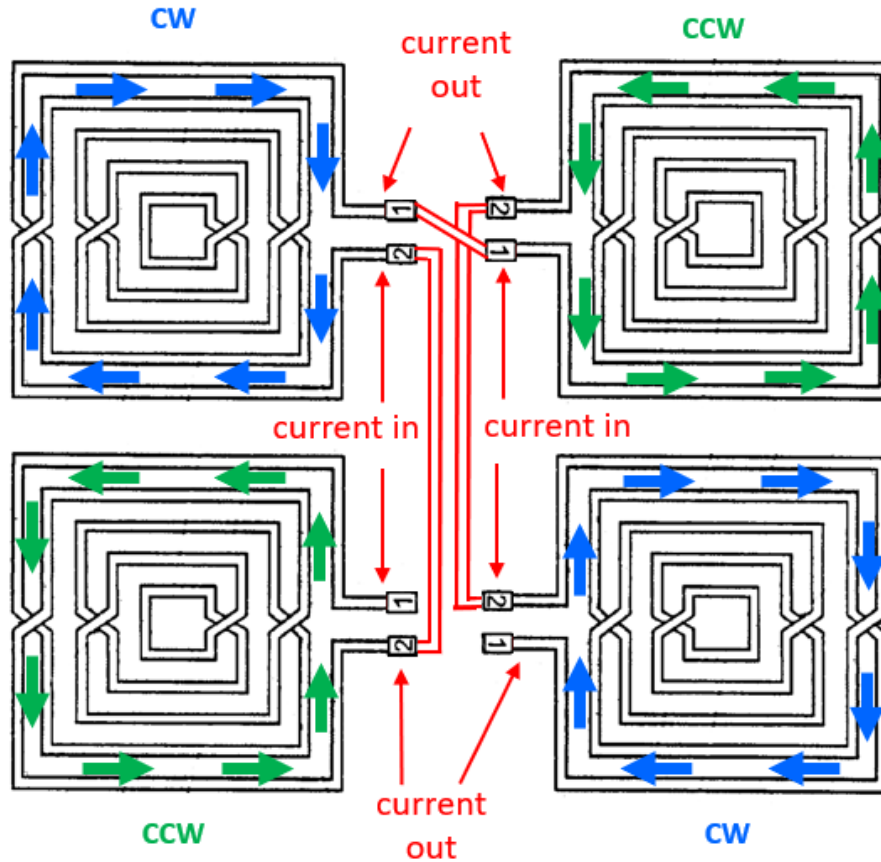
The adjacent loops of Midya's 4-loop implementation of its "present invention" have the "same predetermined structure, i.e., size and shape, to provide maximum cancellation of a moment¹² over a 360° range." (INTEL-1007, 9:1-4, 10:17-11:1; Figure 1 (below).) Each loop has two terminals, one connected 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 of the inductor, the terminals are connected to achieve opposite current flows (clockwise (**CW**) and counterclockwise (**CCW**)) in adjacent loops, as illustrated below. (INTEL-1007, 8:14-18, 10:17-11:6; INTEL-1003, ¶240.)

¹² The "moment" is the magnetic strength and orientation of an object that produces a magnetic field. (INTEL-1013, 647.)

current enters bottom left inductor structure is labeled [1]). (INTEL-1003, ¶241.)

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.

(*Id.*) 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. (*Id.*; *see also, e.g.*, INTEL-1024, Abstract, 6:17-20.)

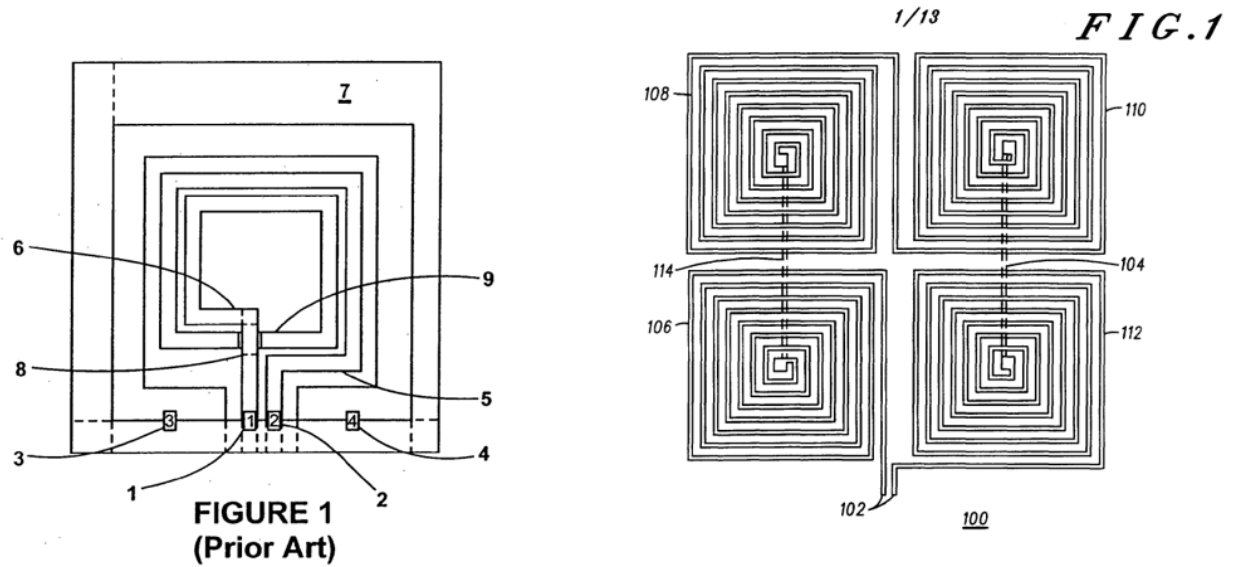


Midya-Raghavan Combination

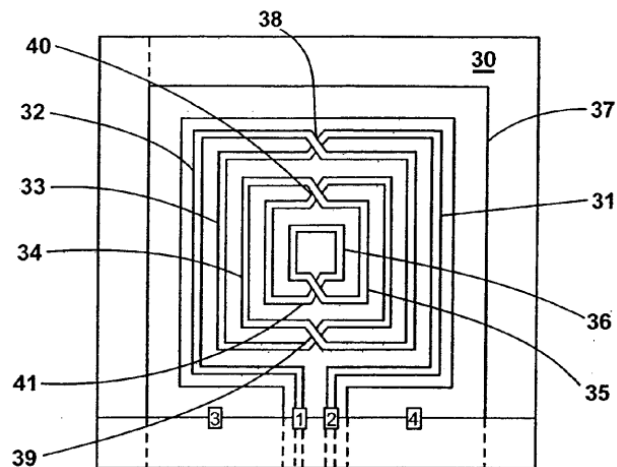
b) Motivations

Midya and Raghavan relate to 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-1007, 1:5-6, 6:11-16; INTEL-1008, ¶¶2, 26; INTEL-1003, ¶242.) A POSITA would have been motivated to combine Midya and Raghavan as described above to improve inductor performance. (INTEL-1003, ¶242-244.) Raghavan provides the motivation, explaining that a conventional spiral inductor requires conductor 8 to cross over winding 9, which adds “undesired capacitive coupling.” (INTEL-1008, ¶¶5-6; Figure 1 (below left).) Midya’s Figure

1 (below right) includes such crossovers, 104 and 114. (INTEL-1007, 11:4-6.) Use of Raghavan's symmetric inductor winding reduces the problematic crossovers, minimizing capacitive effects. (INTEL-1008, ¶¶7-8, 21; Figure 3 (bottom); INTEL-1003, ¶242.)



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



Raghavan, Figure 3

Ooi confirms this motivation, teaching a symmetric spiral inductor requires less cross-overs (*see* Figure 1 below), resulting in lower capacitive coupling which is a “major component[.]” affecting inductor quality. (INTEL-1030, 259-260, 262; INTEL-1003, ¶243)

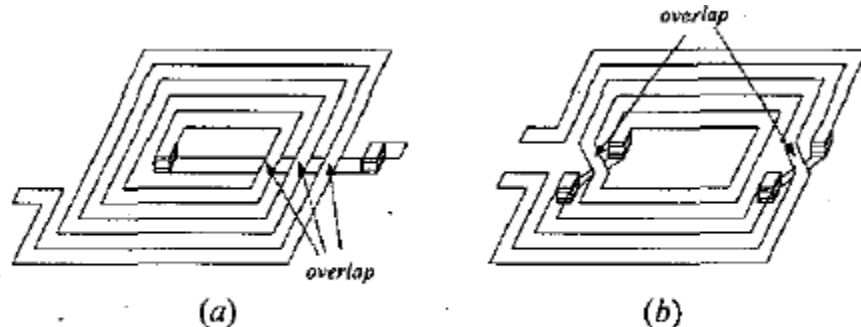


Fig. 1. (a) A non-symmetrical, spiral inductor. (b) A symmetrical, spiral inductor.

Ooi, Figure 1

Second, the combination is the simple substitution of one known element (Raghavan’s inductor winding 31) for another (Midya’s loop in a non-interacting inductor). (INTEL-1003, ¶245, *citing* INTEL-1031, 5; INTEL-1030, 259; INTEL-1032, 218; *cf* INTEL-1007, Figure 1 and INTEL-1008, Figure 5.) Third, a POSITA would have pursued the combination as the use of a known technique (Raghavan’s inductor winding) to improve similar devices (Midya’s non-interacting inductor) in the same way (minimize undesired capacitive coupling and improve quality factor of the inductor). (INTEL-1003, ¶246.)

A POSITA would have had a reasonable expectation of success in the combination with predictable results. (INTEL-1003, ¶247.) Symmetric inductors

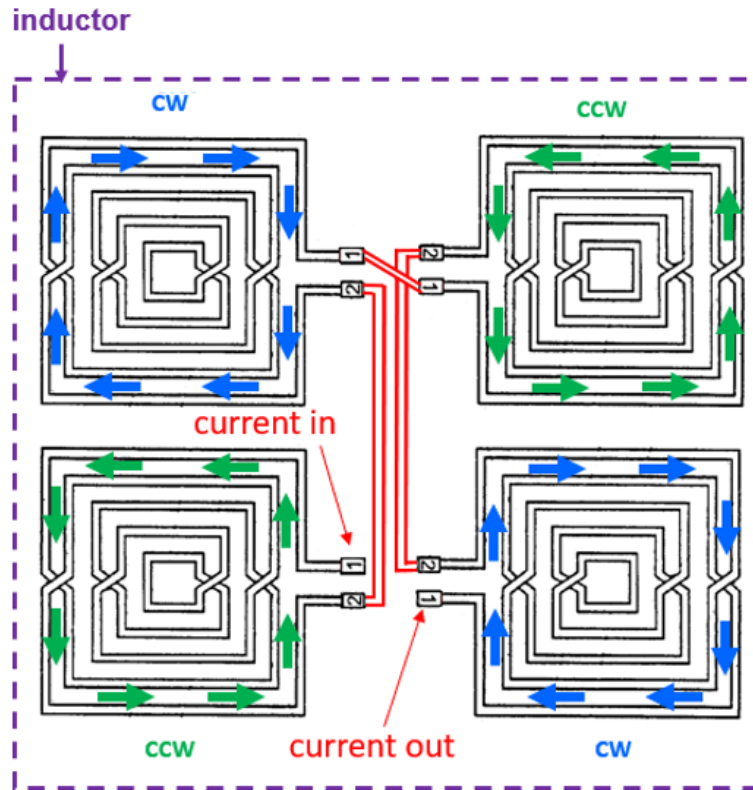
were known and used in the prior art. (INTEL-1030, 259; INTEL-1031, 5; INTEL-1032, 218.) Additionally, as explained in Raghavan, a POSITA would have understood that integrating Raghavan's inductor winding as Midya's inductor loops would have been based on known manufacturing techniques. (INTEL-1008, ¶¶3, 4, 26; INTEL-1003, ¶247.) Indeed, Raghavan states that its inductors "can be used in **any circuit** where inductors are needed." (INTEL-1008, ¶26.)

B. Independent Claims

1. Claim 20

a) Preamble [20P]

The Midya-Raghavan combination discloses an "*inductor having a reduced far field*" [20P] to the extent disclosed in the '430 patent. (INTEL-1003, ¶¶250-258.) 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 §VII.A.3; INTEL-1007, 10:14-17; INTEL-1003, ¶250.)

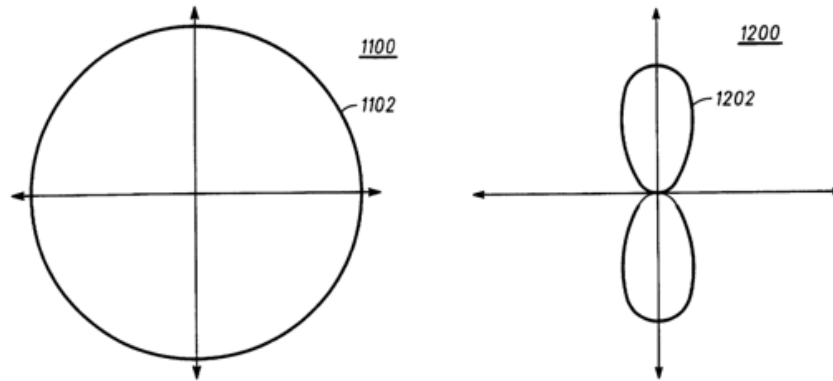


Midya-Raghavan Combination

The “inductor” of the Midya-Raghavan combination has “a reduced far field” to the same extent discussed in the ’430 patent. (INTEL-1003 ¶¶251-253.) As taught by Midya and illustrated above, the combination’s inductor has current flowing **CCW** in the bottom left/top right loops and **CW** in the top left/bottom right loops. (INTEL-1007, 11:1-4.) This arrangement “provide[s] total cancellation of a magnetic field on N axes” and “maximize[s] overall cancellation of the magnetic field.” (INTEL-1007, 10:17-11:1; *see also, id.*, 9:1-4.)

Midya illustrates the radiation patterns of the electromagnetic field “measured in the plane of the structure” (x-y plane) generated by various inductor

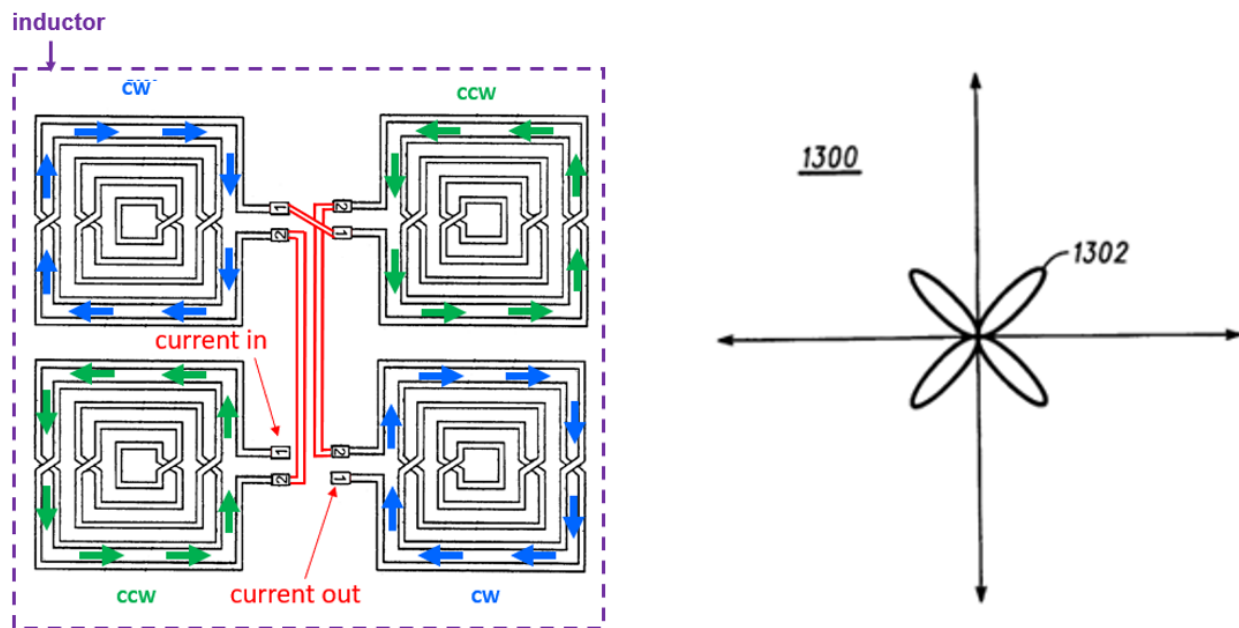
structures. (INTEL-1007, 1:5-21 (inductors radiate a magnetic field “producing EMI (electromagnetic interference)”), 14:18-15:25; INTEL-1010, 27.) The radiation patterns for prior art spiral and eight-shaped inductors are shown in Figures 11-12 (below), respectively. (INTEL-1007, 14:18-23.)



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

Figure 13 (below right) shows the radiation pattern for Midya’s four-loop non-interacting inductor. (INTEL-1007, 14:25-26, 10:14-17.) As compared to the eight-shaped inductor, the “overall magnitude of the field (1302) obtained” by Midya’s four-loop inductor “is **reduced by a factor of at least 10 in a far field.**” (INTEL-1007, 14:26-15:4.) In fact, with Midya’s four-loop non-interacting inductor, “the **far field is completely cancelled**, and the near field is nearly cancelled.” (INTEL-1007, 15:4-6, 6:20-24.) The four-loop non-interacting inductor of the Midya-Raghavan combination also has these characteristics because the combination includes loops of the “same predetermined structure, i.e., size and shape” with the same current flow directions as Midya’s Figure 1 loops. (INTEL-

1003, ¶253; INTEL-1007, 9:1-4.) Thus, the Midya-Raghavan combination discloses the preamble.

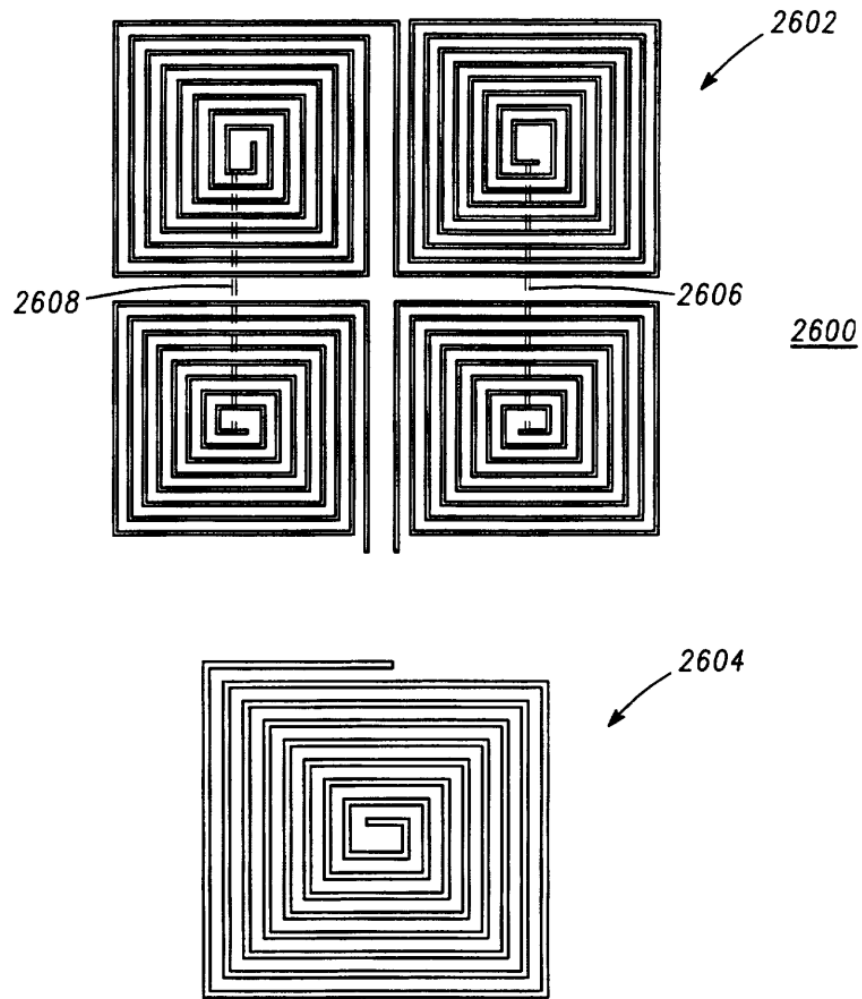


Midya-Raghavan Combination (left); Midya, Figure 13 (right)

Should the Board adopt the “*reduced far field*” construction from ITC-337-TA-1300, Midya discloses multiple layouts of its non-interacting inductor and a second inductor and therefore the Midya-Raghavan combination renders the preamble obvious. (INTEL-1003, ¶¶254-258.)

Midya’s stacked layout places a second inductor “concentrically above” the 4-loop non-interacting inductor “such that the **coupled magnetic field is substantially zero** in accordance with the present invention.” (INTEL-1007, 5:21-25, 11:18-25; Figure 26 (below).) As discussed above, with the 4-loop implementation, “the **far field is completely cancelled**, and the near field is nearly

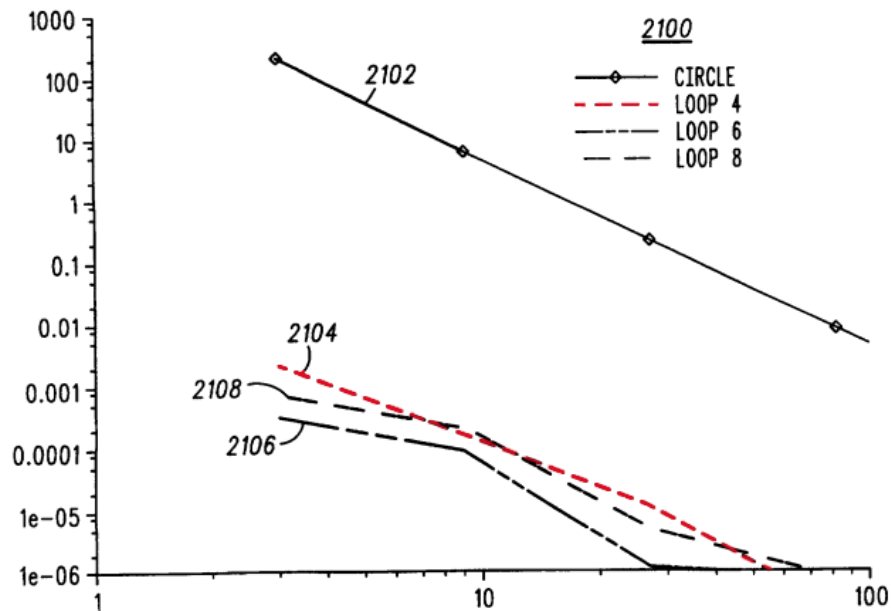
cancelled” (INTEL-1007, 15:4-6, 6:20-24) and generally, with any implementation of Midya’s inductor, adjacent loops with “the same predetermined structure, i.e., size and shape, [] provide **maximum cancellation of a moment over a 360° range.**” (INTEL-1007, 9:1-4.) In the stacked layout, the two inductors are implemented in different layers of the substrate, e.g., a “two-layer printed circuit board.” (INTEL-1007, 11:18-20, 11:8-16.) 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-1003, ¶255, *citing* INTEL-1012, 68; INTEL-1013, 612 (explaining mutual electromagnetic coupling between inductors is proportional to the strength of an inductor’s magnetic field).) PO stated during EP prosecution its specification “does not mandate any particular distance or relative orientation of the two inductors”; therefore, the limitation is met by Midya-Raghavan. (INTEL-1016, 59.)



Midya, Figure 26¹³

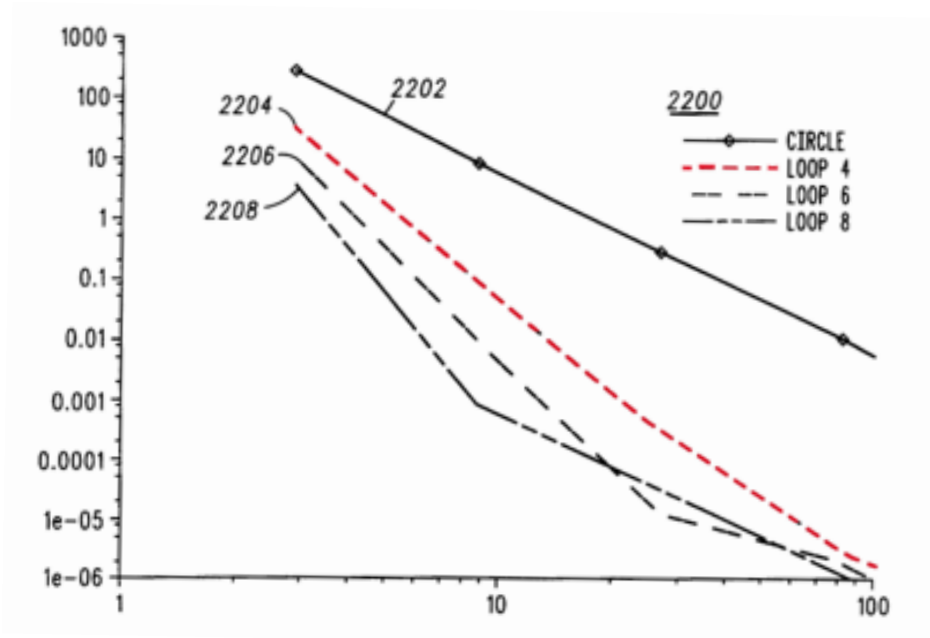
¹³ Figure 26 shows inductor 2604 below non-interacting inductor 2602. A POSITA would understand based on Midya's disclosure inductor 2604 is above inductor 2602. (INTEL-1003, ¶234.) Further, Figure 26's depiction of non-interacting inductor 2602 includes an error in its depiction of the lower right loop which, as depicted, carries current in a CCW direction; however Midya requires current flow in CW direction for that loop. (INTEL-1003, ¶235.)

In Midya's best 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 Figures 21 and 22¹⁴ below, the coupled magnetic field between the 4-loop non-interacting inductor and a test loop is **reduced** "by at least **80dB ... at 2 inductor lengths away**" [red] "compared to coupling for a simple circular loop (2102)" for the best case (INTEL-1007, 19:6-9) and "by 20dB ... at a distance of **2 inductor lengths away**" [red] "as compared to a simple loop (2202)" for the worst case (INTEL-1007, 18:18-20).



Midya, Annotated "Best Case" Figure 21

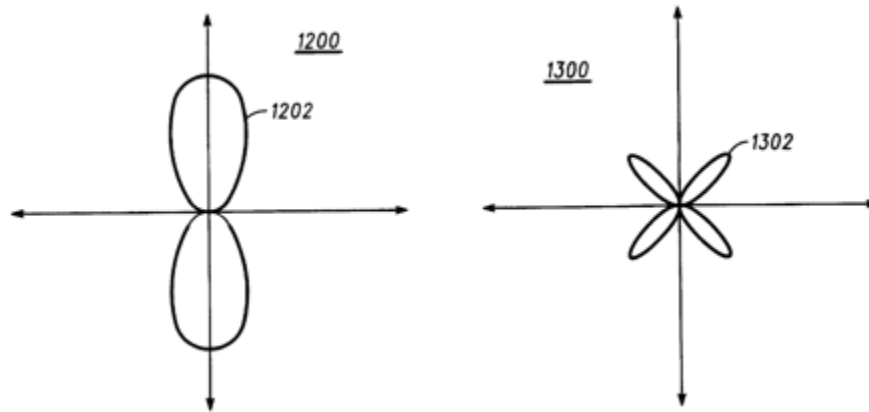
¹⁴ Horizontal axis "represents distance from the center of the multiloop structure relative to the lateral dimension of the structure." (INTEL-1007, 18:6-13.)



Midya, Annotated “Worst Case” Figure 22

The reduction in coupled magnetic field illustrated in Figures 21-22 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-1003, ¶258.) For the 4-loop implementation, 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; Figures 12-13 (below).) 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. (INTEL-1003, ¶258.)



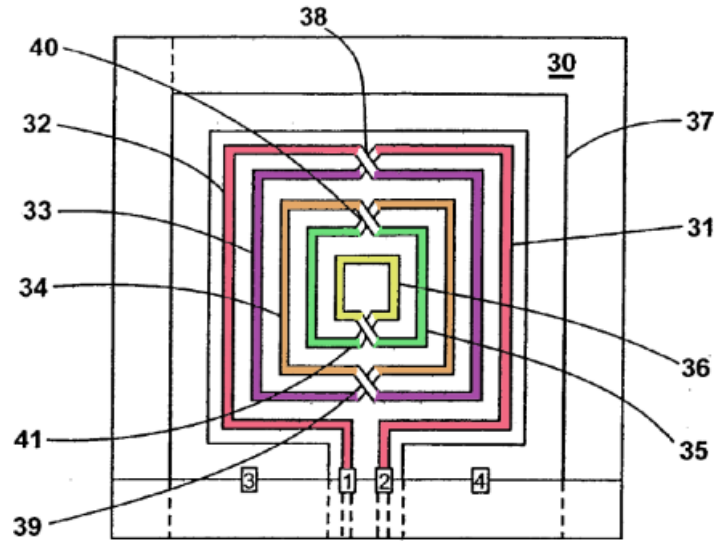
Midya, Figures 12-13

b) “*First loop*”/“*second loop*” [20A]/[20B.1]-[20B.2]

The Midya-Raghavan combination renders obvious limitations [20A]/[20B.1]-[20B.2] to the extent they are described in the ’430 patent. *Apple*, IPR2107-00315, Paper 45 at 47-49.

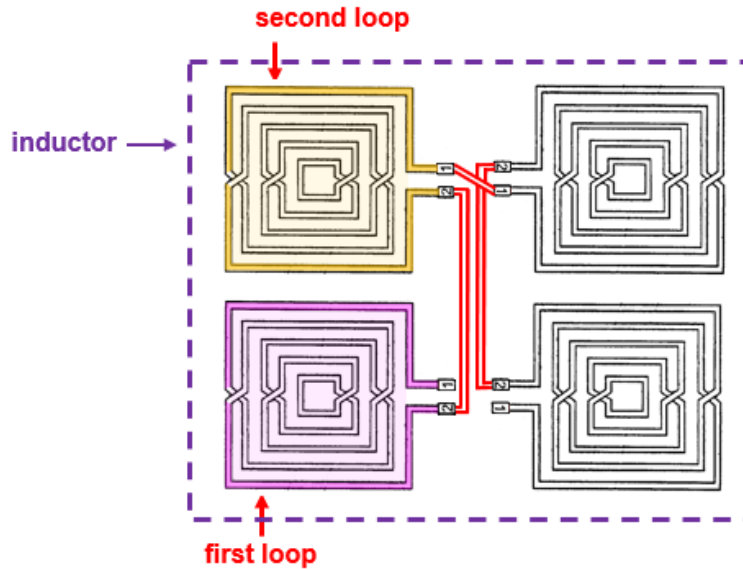
The “*inductor*” of the Midya-Raghavan combination includes a “*first loop*” and a “*second loop*.” Raghavan’s inductor winding 31, used as each loop of Midya’s inductor in the combination, includes individual “windings 32 [red], 33 [purple], 34 [orange], 35 [green] and 36 [yellow].” (INTEL-1008, ¶19.) Inductor winding 31 is the recited “*loop*” and alternatively, at least the outermost individual winding 32 (red) is the recited “*loop*.” (See, e.g., INTEL-1003, ¶¶261-262, citing

INTEL-1001, 9:43-47 (associating each turn (winding) of a symmetric multi-turn inductor with a loop).)



Raghavan, Annotated Figure 3

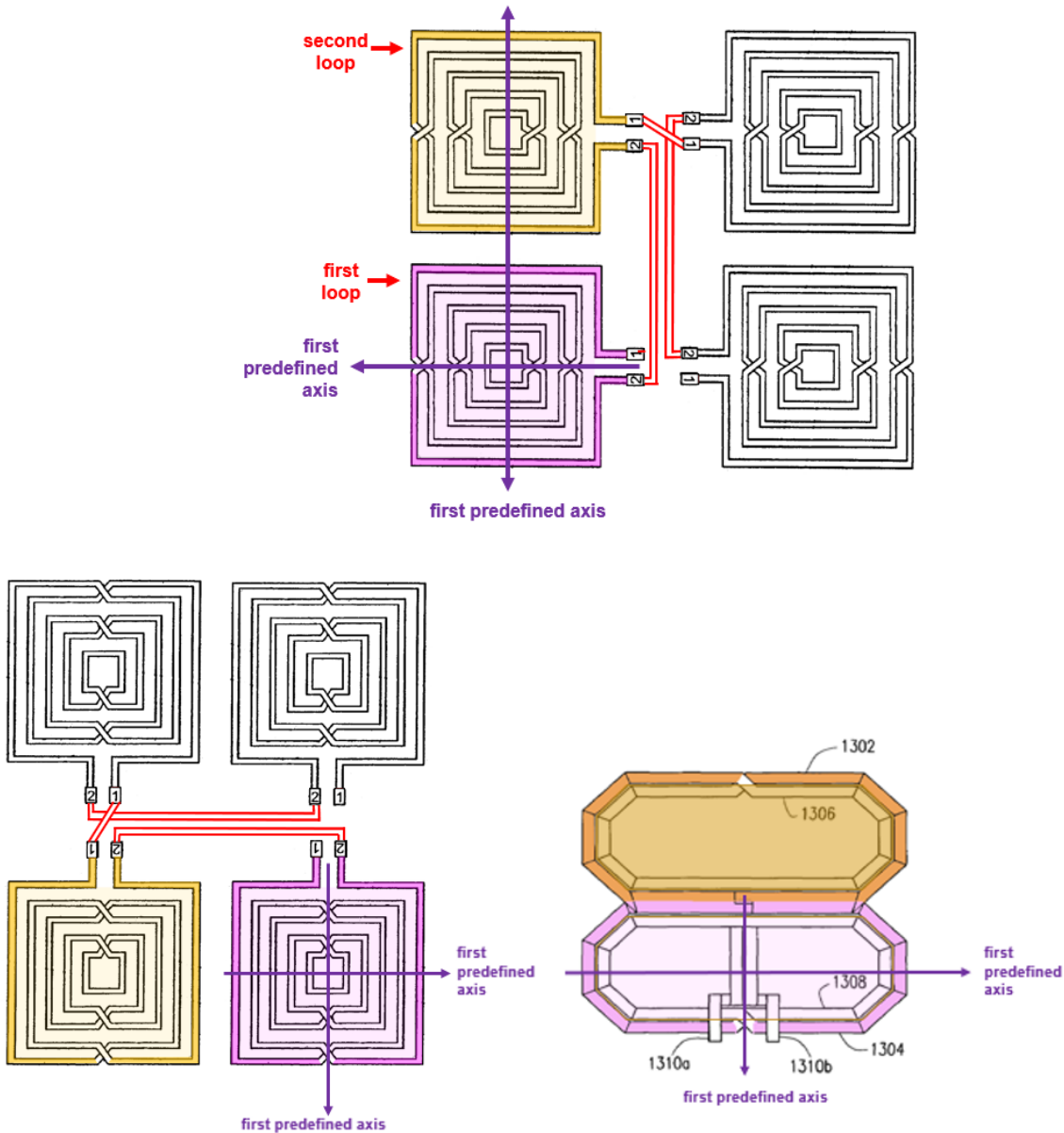
Accordingly, the “*inductor*” of the Midya-Raghavan combination provides a “*first loop*” (lower left inductor winding 31 or its outermost square winding 32; shaded pink) and a “*second loop*” (upper left inductor winding 31 or its outermost square winding 32; shaded orange). (INTEL-1003, ¶¶261-262.)



Midya-Raghavan Combination

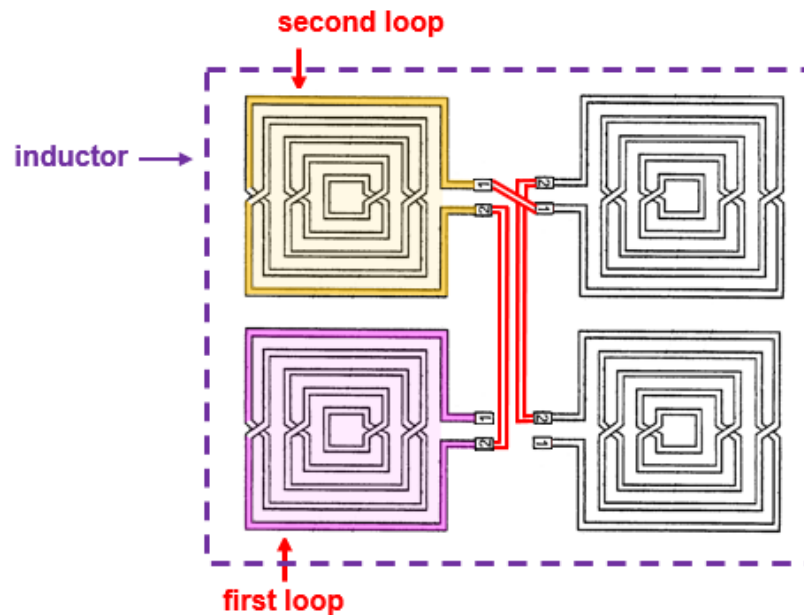
Raghavan's inductor winding 31 **"affords the inductor a symmetrical configuration."** (INTEL-1008, ¶21.) As shown in the Midya-Raghavan combination figure (top), Raghavan's outer loop (winding 32) turns into an inner loop (winding 33) which turns into another inner loop (winding 34), etc.. This configuration is consistent with the '430 patent's "two-turn inductor" of Figure 13 (bottom right) in which the inductor's outer loops 1302 and 1304 "each turn into an inner loop 1306 and 1308, respectively." (INTEL-1001, 9:43-47; cf '430 patent's Figure 2 with Midya-Raghavan Combination figure (bottom left) rotated to highlight similarities.) 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 loop's horizontal and

vertical axis (“a first predefined axis”) [20A]. (See INTEL-1001, 4:25-27, 4:35:37; INTEL-1003, ¶263.)



**Midya-Raghavan Combination (top/rotated, bottom left);
'430 Patent, Figure 13 (bottom right)**

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.) Because Raghavan’s winding 31 is symmetric, when incorporated into each loop of Midya’s non-interacting inductor, each loop has the same configuration. (INTEL-1008, ¶21; INTEL-1003, ¶264.) Therefore, as reflected in the Midya-Raghavan combination shown below, the “*second loop*” in the Midya-Raghavan combination “*ha[s] a size and shape substantially identical to the first loop*” [20B.1]. (INTEL-1003, ¶264.)



Midya-Raghavan Combination

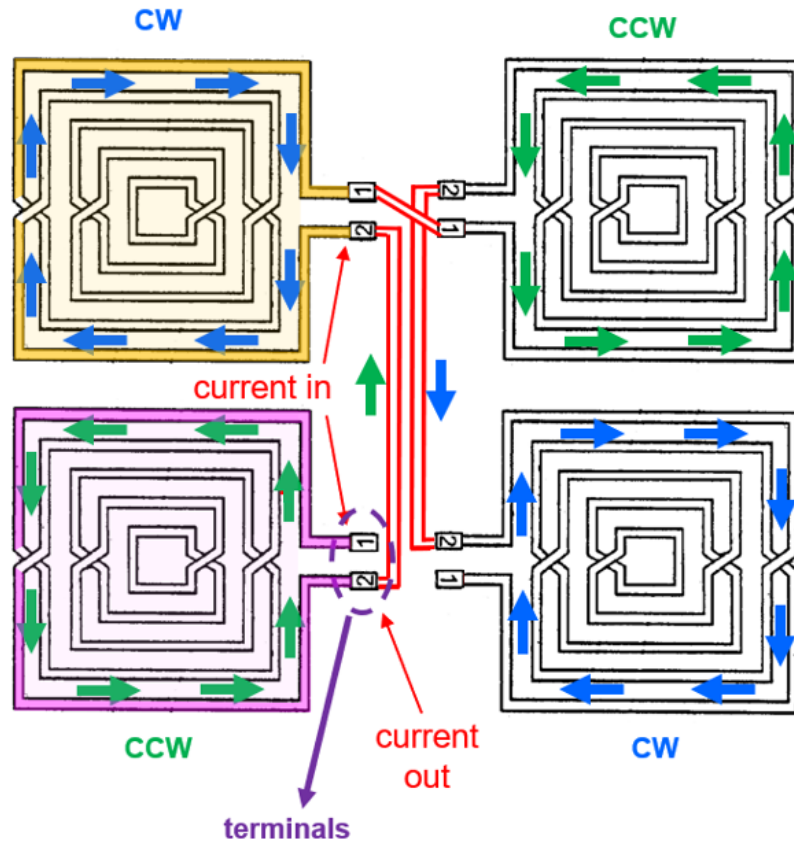
As described in §VII.A.3, the “*second loop*” (orange) in the figure above is arranged so current flows in a CW direction while current flows in the opposite CCW direction in the “*first loop*” (pink). (INTEL-1007, 11:1-4.) This opposing

current flow in adjacent loops produces a “**total cancellation of a magnetic field on N axes**” and “**maximize[s] overall cancellation of the magnetic field**” generated by the inductor. (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 so current flows in opposite directions through the loops, opposing magnetic fields are generating which cancel one another. (INTEL-1003, ¶¶265-266, *citing* INTEL-1033, 7:5-10 (describing opposing magnetic fields reduce or cancel the “net magnetic field” of the inductor), INTEL-1002, 125-126 (acknowledging loops of equal size generating opposing fields improve “cancellation”).) 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]. (*Id.*)

c) “Two closely spaced terminals” [20C]

The Midya-Raghavan combination discloses two terminals “*connected to the first loop for supplying electrical current to the first and second loops.*” (INTEL-1003, ¶267.) As shown below, two “*terminals*” (labeled [1] and [2]) are connected to the bottom left loop (“*first loop*”) of the combination’s non-interacting inductor. (§VII.A.3.a; INTEL-1008, ¶20.) As shown, current enters the “*first loop*” through terminal [1], travels CCW exiting the loop through terminal [2], and enters the upper left loop (“*second loop*”) through terminal [2] of that loop. (INTEL-1007;

7:4-6, 10:20-22, 11:1-4; *see also*, INTEL-1008, ¶20.) The terminals connected to the “*first loop*” “*supply[] electrical current to the first and second loops.*” (INTEL-1003, ¶267.)



Midya-Raghavan Combination

The “*two terminals*” of the “*first loop*” are “*closely spaced.*” (INTEL-1003, ¶268.) As shown, the distance between terminals is close, particularly relative to the width of the “*first loop.*” *See, e.g., Mraz*, 455 F.2d at 1072; *Kingsford*, IPR2016-01831, Paper 32, at 32-33. This is consistent with what the ’430 patent indicates constitutes “*closely spaced.*” (*See* §V.B.1.c.)

The two closely spaced terminals of the “*first loop*” of the Midya-Raghavan combination also “*minimiz[e] magnetic field contributions from the terminals*” because one terminal carries the current into the loop and the second carries the current out of the loop. (See, e.g., §V.B.1.c.2; INTEL-1003, ¶269, citing INTEL-1010, 156-157; INTEL-1015, 22.) Thus, the Midya-Raghavan combination renders this limitation obvious. (INTEL-1003, ¶¶269-270.)

The Midya-Raghavan combination also renders this limitation obvious should the Board adopt the construction from ITC-337-TA-1300 because, as described above in §V.B.1.c.2, a POSITA would understand because the fields generated by the closely spaced terminals of the “*first loop*” cancel, the overall electromagnetic field emanating from the multiloop inductor is not altered by the terminals, including where the second inductor is positioned. (INTEL-1003, ¶271.)

2. Claims 1/11

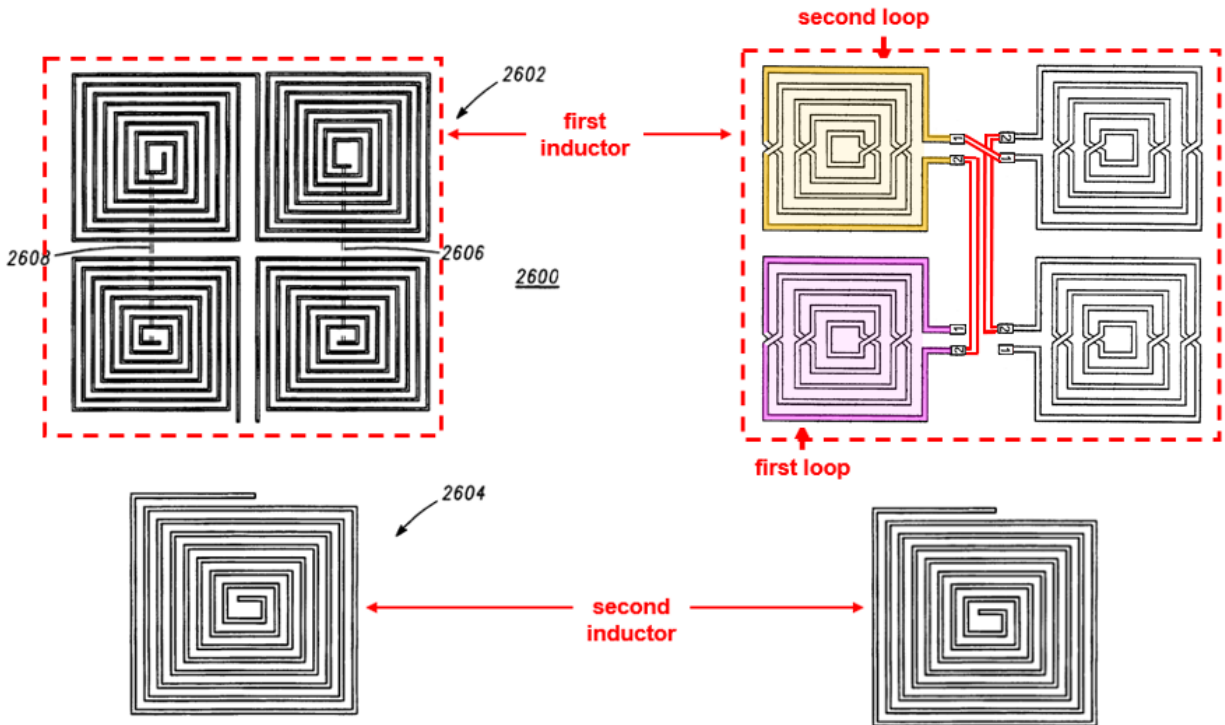
The Midya-Raghavan combination renders claim 1 obvious and also renders claim 11 obvious under the ITC-337-TA-1376 preamble interpretation. (See INTEL-1019, 2-3.)

a) Preamble [1P]/[11P]

The Midya-Raghavan combination renders obvious an “*inductor layout having reduced electromagnetic coupling*” [1P]. (INTEL-1003, ¶¶273-278.) Should the Board adopt the ITC-337-TA-1376 construction of claim 11’s

preamble, the combination also discloses the “*first inductor*” and “*second inductor*.” (INTEL-1003, ¶291.)

As discussed in §VII.B.1.a, Midya discloses multiple layouts of its non-interacting inductor and a second inductor (“*inductor layout*”). In the stacked “*inductor layout*” of the Midya-Raghavan combination shown in the figure (below right), the loops of Midya’s non-interacting inductor (“*first inductor*”) are replaced with Raghavan’s inductor winding 31 (see §VII.A.3) and inductor 2604 (“*second inductor*”) remains unchanged. In the stacked arrangement of the combination, “the coupled magnetic field is **substantially zero**” because, as discussed in §VII.A.3.a, 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.) This coupled magnetic field reduction is a reduction in mutual electromagnetic coupling from prior art inductors that “radiate a magnetic field producing EMI ... that interferes with adjacent circuitry” (INTEL-1007, 1:18-21; INTEL-1013, 612; INTEL-1003, ¶277.)

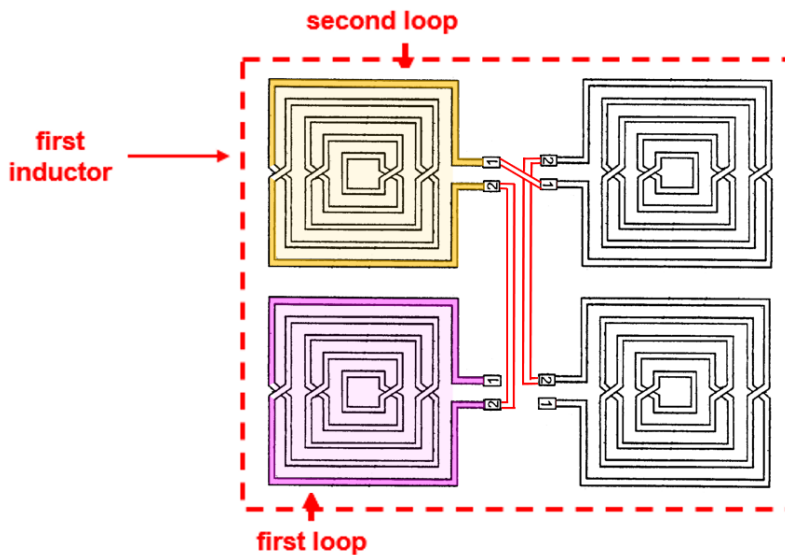


Midya, Figure 26 (left); Midya-Raghavan Combination (right)

In the best/worst case “*inductor layout[s]*”, 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.) Midya discloses the “**coupled** magnetic field”, and thus, the mutual electromagnetic coupling, between the inductors is **reduced** “by at least **80dB**” (best case) and by 20dB (worst case). (INTEL-1007, 18:6-8, 18:18-20, 19:6-9; Figures 20-21; *see also, id.*, 9:1-4; INTEL-1003, ¶278.) 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. (INTEL-1003, ¶278; §VII.A.3.a)

b) “*First inductor*” [1A], [1A.1]-[1A.3]/[11A], [11A.1]-[11A.3]

For claim 1, limitations [1A], [1A.1], [1A.2b]-[1A.2c], and [1A.3] are disclosed or rendered obvious by the Midya-Raghavan combination for the reasons described above in §§VII.B.1.a-c ([20P]/[20A]/[20B.1]-[20B.2]/[20C]). In the Midya-Raghavan combination’s non-interacting inductor (below), the second terminal [2] of the “*first loop*” (pink) is connected to the second terminal [2] of the “*second loop*” (orange) and thus the “*second loop [is] connected to the first loop*” [1A.2a]. (INTEL-1003, ¶280; *see* INTEL-1007, 11:1-6.)



Midya-Raghavan Combination

Midya teaches a “method for minimizing cancellation of a total moment” of the plurality of loops “arranged **to form**” its non-interacting inductor. (INTEL-1007, claims 3, 4.) For this reason and the reasons discussed in §VII.B.1.a-c, the

Midya-Raghavan combination discloses or renders obvious limitations [11A], [11A.1], [11A.2a]-[11A.2b], and [11A.3]. (INTEL-1003, ¶¶292-296.)

c) “*Second inductor*” [1B.1]-[1B.2]/[11B.1]-[11B.2]

The Midya-Raghavan combination’s stacked and best/worst case layouts render obvious a “*second inductor positioned at a predetermined distance from the first inductor*” [1B.1] and “*positioning a second inductor at a predetermined distance from the first inductor*” [11B.1]. (INTEL-1003, ¶¶281-284, 297.) As described above in §VII.B.1.a, in the stacked layout, the “*second inductor*” 2604 is positioned in a different layer (“*a predetermined distance*”) from the non-interacting inductor (“*first inductor*”). (INTEL-1007, 11:18-25.) In the best/worst case layouts, the “*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.)

For all layouts in the Midya-Raghavan combination, 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]. (INTEL-1003, ¶¶285-287, 297.) As described above in §VII.B.2.a, each layout has “*reduced mutual electromagnetic coupling*” between the non-interacting and second inductors. Because mutual electromagnetic coupling between two inductors is proportional to the strength of an individual inductor’s

magnetic field (INTEL-1012, 68; INTEL-1013, 612), the reduced coupling 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.)

Should the Board adopt the construction of “*reduced electromagnetic field*” from ITC-337-TA-1300, “the electromagnetic field emanating from the first inductor is reduced (at a certain distance from the first inductor where the second inductor is positioned)” is obvious for the reasons discussed in this section and §VII.B.1.a [20P]. (INTEL-1003, ¶288.)

C. Dependent Claims

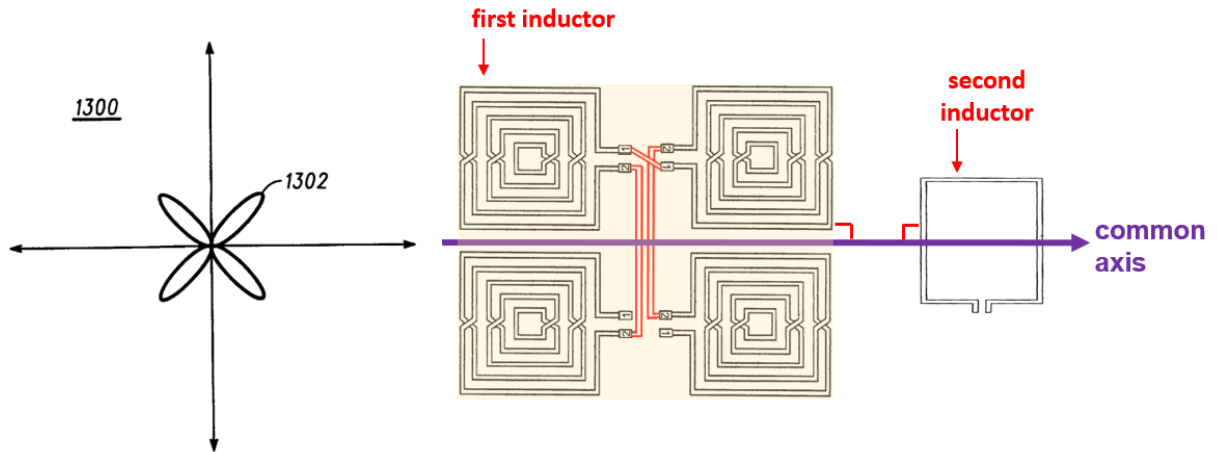
1. Claims 3/13, 4/14

The Midya-Raghavan combination renders obvious the “*first inductor*” and “*second inductor*” are oriented “*in a same direction*” [3/13] and “*in different directions*” [4]/[14]. (INTEL-1003, ¶¶298-303.) The stacked layout in the combination (illustrated below) includes two inductors oriented in the same direction, rendering claims 3 and 13 obvious. (INTEL-1003, ¶299.)

2. Claims 5/15, 6/16

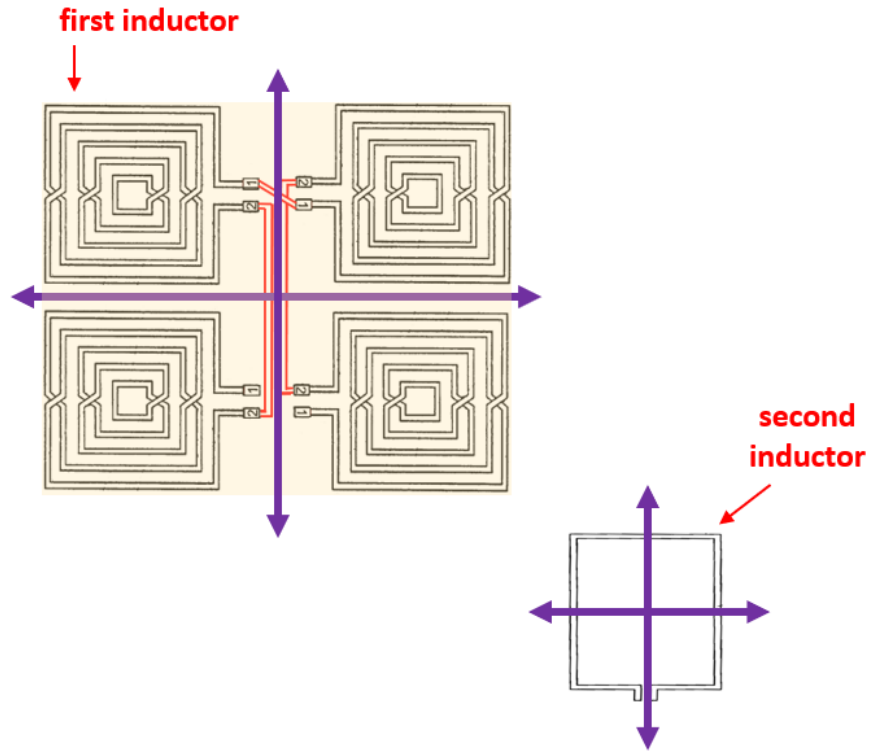
The Midya-Raghavan combination renders obvious a “*first inductor*” and “*second inductor*” placed to share “*a common axis*” [5]/[15] or “*no common axis*” [6]/[16]. (INTEL-1003, ¶¶304-313.) In the stacked layout, second inductor 2604 is “placed **concentrically** above” the non-interacting inductor. (INTEL-1007, 11:20-22) and thus, the “*first inductor*” and “*second inductor*” share a common z-axis through their center. (INTEL-1003, ¶305.)

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. (INTEL-1003, ¶¶306-307.) In Midya’s best case layout, the inductors are “perpendicular to a side of the polygon” which a POSITA would understand to mean the inductors share “*a common axis*” which intersects the center of both and is perpendicular to both inductors’ lateral dimension. (See INTEL-1007, 18:14-15, 18:6-18; INTEL-1003, ¶306.) 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]”, as shown in Figure 13 (below left). (INTEL-1007, 10:22-25, 14:25-15:6, 18:4-8; INTEL-1003, ¶307.) The following figure (right) illustrates exemplary placement of the two inductors on a shared horizontal axis. (INTEL-1003, ¶307.)



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

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. (INTEL-1003, ¶308.) In Midya’s worst case layout, the inductors are “along a diagonal of a polygon” which a POSITA would understand to mean the inductors are placed diagonally as shown in the exemplary figure below. (See INTEL-1007, 18:14-15, 18:6-18; INTEL-1003, ¶308.) 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” which provides improved cancellation but not the best case cancellation achieved when second inductor placed on the same axis. (INTEL-1007, 10:22-25, 18:4-8; INTEL-1003, ¶308.) Because the inductors are diagonally placed, they share “*no common axis*” [6]/[16].



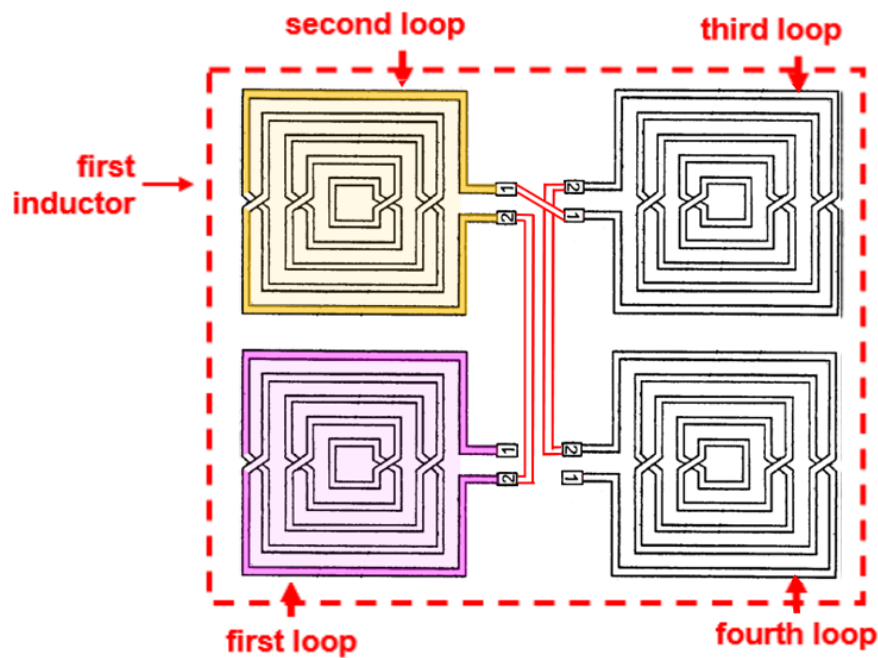
Midya-Raghavan Combination

Regardless, it would have been obvious to a POSITA to try either placing the “*second inductor*” on a common axis with the non-interacting inductor (“*first inductor*”) or not because no other option exists. A POSITA would have pursued either of these finite number of solutions to maximize use of substrate area.

(INTEL-1003, ¶309.) A POSITA would have had a reasonable expectation of success with both options which merely move one inductor relative to another because it was well-known (and in use) to place inductors in both layouts. (See INTEL-1003, ¶¶310-313, *citing* INTEL-1038, 736; INTEL-1039, 701, 705); INTEL-1040, 780, 784.)

3. Claims 9/12

The Midya-Raghavan combination renders obvious the “*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*” [9] and “*orienting the first, second, third, and fourth loops to form a substantially four-leaf clover-shape*” [12C]. (INTEL-1003, ¶315.) Midya describes a four-loop inductor which Midya refers to as a “clover”. (INTEL-1007, 5:6-19, 10:14-17, Figures 1, 23-25.) 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-1003, ¶315; INTEL-1007, 11:1-6, Figure 1.)

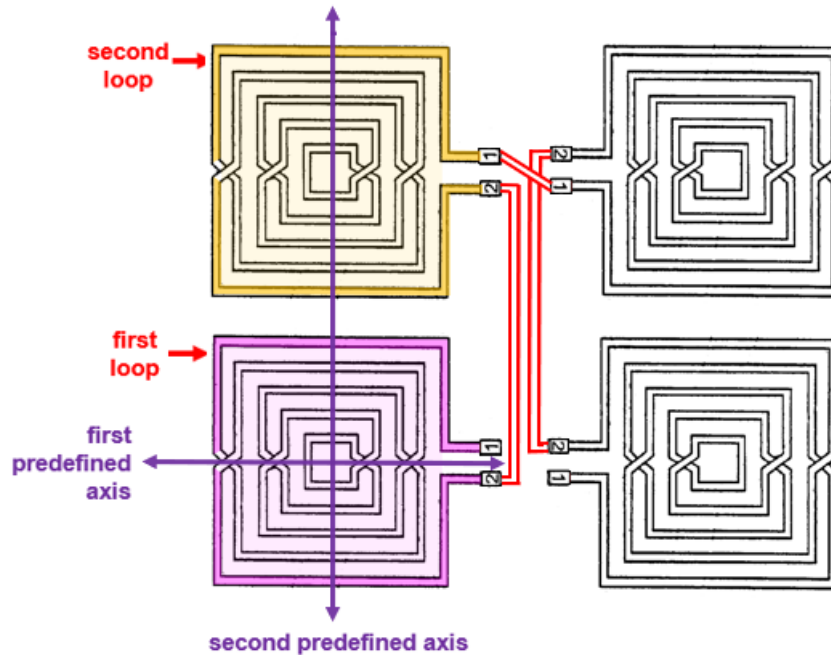


Midya-Raghavan Combination

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 discussed in §VII.B.1.b, 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]. (INTEL-1003, ¶316.)

4. Claim 21

As discussed above in §VII.B.1.b, the *“first loop”* is *“substantially symmetrical”* about horizontal and vertical axes. As shown below, the *“first loop and said second loop are substantially symmetrical about”* the vertical axis (*“a second predefined axis”*), consistent with the disclosure of the '430 patent. (See INTEL-1001, 4:25-27, 4:35-57; INTEL-1003, ¶¶317-319); See, e.g., *Mraz*, 455 F.2d at 1072; *Kingsford*, IPR2016-01831, Paper 32, at 32-33, *Apple*, IPR2107-00315, Paper 45 at 47-49A.



Midya-Raghavan Combination

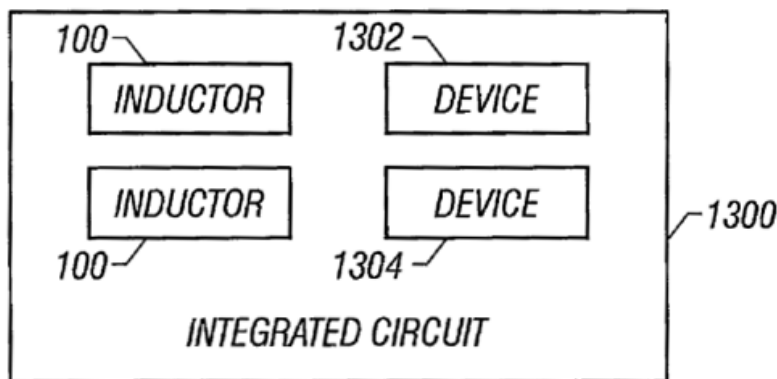
VIII. Ground 4: Midya-Raghavan-Gardner Renders Claims 2, 11-16 Obvious.

A. Independent Claim 11

Should the Board find the preamble recitation that the first and second inductors are “*on a semiconductor die*” limiting, the Midya-Raghavan-Gardner renders claim 11 obvious.

Gardner describes inductors “integrated on an integrated circuit.” (INTEL-1009, ¶¶108 (“**integrated circuit** ... fabricated with ... one or more inductors”, 30 (“**semiconductor processing** ... to form a **chip** having an inductor”), Figure 13 (below); *see also, id.*, ¶5.) Gardner describes making inductors using “semiconductor processing” and refers to fabrication on an IC or “chip,” which a

POSITA would have understood to be a die. (INTEL-1009, ¶¶5, 30, 108; INTEL-1041, 99, 322; INTEL-1003, ¶322.)



Gardner, Figure 13

A POSITA would have implemented the inductors of the Midya-Raghavan combination on a single semiconductor die (chip) as taught in Gardner for the reasons discussed below. (INTEL-1003, ¶¶323-327.) Thus, the Midya-Raghavan-Gardner combination discloses “*a first inductor and a second inductor on a semiconductor die*” [11P]. (INTEL-1003, ¶¶329-330.) As discussed in §§VII.B.2.b-c, Midya-Raghavan combination discloses the remaining claim 11 limitations. The Midya-Raghavan-Gardner combination renders independent claim 11 obvious.

Midya, Raghavan, and Gardner 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-1007, 6:11-16; INTEL-1008, ¶¶2, 26; INTEL-1009, ¶3.) Midya states that its “invention is particularly useful 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. (INTEL-1034, 6:21-24; INTEL-1003, ¶325.) Based further on this suggestion, Gardner expressly motivates the combination, disclosing inductors intended for “radio frequency (RF) ... circuitry” and teaching that fabricating the inductors “on-chip” reduces parasitic capacitance, resistance, and cost. (INTEL-1009, ¶5.)

Further, the Midya-Raghavan-Gardner combination is the simple substitution of one known element (substrate of the Midya-Raghavan combination (e.g., PCB)) with another (Gardner’s semiconductor die). (INTEL-1003, ¶326.) 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. (*Id.*) 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. (*Id.*; INTEL-1009, ¶5.)

A POSITA would have had a reasonable expectation of success in the above combination and the results would have been predictable. (INTEL-1003, ¶327.)

Raghavan discloses its inductor structure can be fabricated on an IC using known techniques. (INTEL-1008, ¶26.) Further, implementing the Midya-Raghavan “*first inductor*” on-chip would have been straightforward and required a simple direct connection of multiple structures taught in Raghavan. (INTEL-1003, ¶327.) Moreover, a POSITA would have known how to implement other inductors at a predetermined distance from the first inductor on the same or different layers in an IC. (INTEL-1034, 6:21-24 (different layers); INTEL-10009, ¶30 (same layer); INTEL-1001, prior art Figure 3.)

B. Dependent Claims 2, 12-16

The Midya-Raghavan-Gardner combination renders obvious **claim 2** which recites the “*first inductor*” and “*second inductor on a semiconductor die*” for the reasons described above in §VIII.A. For the same reasons discussed in §§VII.C.1-3, the Midya-Raghavan-Gardner also combination renders **claims 12-16** obvious.

IX. Grounds 5-8

Should the Board find that Grounds 1-4 do not disclose “*closely spaced*” 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 mirror Grounds 1-4, respectively, except that Brooks is explicitly combined. (See §II.B; INTEL-1003, ¶333.)

For Taniguchi Grounds 5-6, the two terminals in Taniguchi's Figure 7, 8, and 9/10 embodiments, as discussed in §V.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 §VIIB.1.c. Indeed, current flow through the terminals in both Taniguchi and Midya-Raghavan is consistent with the '430 patent, having the same current flow through its inductor terminals described as "wires." (INTEL-1001, 4:5-14, 3:65-4:3 (referring to "terminals" and "other metal wires"), Figure 2.)

A POSITA would have been motivated to make Taniguchi's terminals (Grounds 5-6) and Midya-Raghavan's terminals (Grounds 7-8) "*closely spaced*" 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; INTEL-1003, ¶337.) 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; INTEL-1003, ¶337.)

Combining Brooks for Grounds 5-8 is merely the use of a known technique (placing 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). (INTEL-1003, ¶338.) A POSITA would have had a reasonable expectation of success with predictable results because the terminal wires in Taniguchi and Midya-Raghavan carry current in opposite directions, and Brooks demonstrates it was known to place such wires close together to minimize EMI. (INTEL-1003, ¶339.)

For the reasons set forth in the sections below, the combinations render the challenged claims obvious.

Ground	
5	§V.B-C
6	§VI.B-C
7	§VII.B-C
8	§VII.A-B

X. Discretionary Denial Is Not Appropriate

A. 35 U.S.C. §314(a)

The *Fintiv* factors weigh heavily against discretionary denial. The patent has been asserted against Lenovo in the Eastern District of North Carolina, but that case has been stayed pending completion of co-pending ITC-337-TA-1376. The timing of the ITC investigation is not relevant. (Interim Procedure for Discretionary Denials, 5-7.)

B. 35 U.S.C. §325(d)

Advanced Bionics Part 1 is not satisfied. Midya is the only asserted reference that was cited during prosecution of the '430 patent. However, Midya was not applied by the Examiner and therefore is presented in grounds never considered by the Office. These circumstances weigh heavily against §325(d) discretionary denial. *See Oticon Medical AB v. Cochlear Ltd.*, IPR2019-00975, Paper 15, at 20 (PTAB, Oct. 16, 2019) (precedential). Nor is *Advanced Bionics* Part 2 satisfied. The Petition's evidence warrants consideration because it presents a compelling case of unpatentability never considered by the Office.

XI. Mandatory Notices

A. Real Party In Interest

The real parties in interest include Petitioner, as well as Lenovo (United States), Inc., Lenovo (Shanghai) Electronics Technology Co. Ltd., Lenovo Beijing,

Ltd., Lenovo Group, Ltd., Motorola (Wuhan) Mobility Technologies Communication Co., and Motorola Mobility LLC.

B. Related Matters

To the best of Petitioner's knowledge, the '430 patent is involved in the following ongoing litigations:

- *Electronic Devices, Including Mobile Phones, Tablets, Laptops, Components Thereof, and Products Containing Same*, No. 337-TA-1376 (ITC)
- *Telefonaktiebolaget LM Ericsson v. Lenovo (United States), Inc.*, No. 5:23-cv-00570 (E.D.N.C.).

C. Notice Of Counsel and Service Information

Pursuant to 37 C.F.R. §§42.8(b)(3), 42.8(b)(4) and 42.10(a), Intel appoints the following lead and backup counsel:

Lead Counsel	Back Up Counsel
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Intel consents to electronic service by email at the email addresses: gordon-ptab@goodwinlaw.com, sdutta@goodwinlaw.com, clarochelle@goodwinlaw.com and fpapadatos@goodwinlaw.com.

XII. Conclusion

Inter partes review is respectfully requested.

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Date: March 29, 2024

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that this Petition for *Inter Partes* Review complies with the type-volume limits of 37 C.F.R. § 42.24(a)(1)(i) because it contains 13,993 words according to the word-processing system used to prepare this Petition, excluding the words in the Table of Contents, Table of Authorities, List of Exhibits, Mandatory Notices, Certification Under §42.24(d), and Certificate of Service, and any claims listing as set forth in 37 C.F.R. § 42.24(a)(1). This word count was prepared using Microsoft Word.

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Date: March 29, 2024

CERTIFICATE OF SERVICE

The undersigned certifies that a true and correct copy of the Petition together with all exhibits identified in the above Table of Exhibits and Petitioners' Power of Attorney, have been served on the Patent Owner via Federal Express Next Business Day Delivery on the below date, at the following address:

27045 - ERICSSON INC.
6300 LEGACY DRIVE
M/S EVR 1-C-11
PLANO, TX
UNITED STATES

Courtesy copies of the foregoing documents were served by e-mail on the following counsel of record for Patent Owner in the Underlying Litigation:

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Independent Claim Appendix

[1P] An inductor layout having reduced mutual electromagnetic coupling, comprising:

[1A] a first inductor having a reduced far field, said first inductor comprising:

[1A.1] 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, [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

[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

[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.

[11P] A method of reducing mutual electromagnetic coupling between a first inductor and a second inductor on a semiconductor die, comprising:

[11A] forming the first inductor to reduce a far field, said step of forming the first inductor comprising:

[11A.1] forming a first loop having a shape that is substantially symmetrical about a first predefined axis;

[11A.2a] forming a second loop having a size and shape substantially identical to the first loop; [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

[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

[11B.1] positioning a second inductor at a predetermined distance from the first inductor, [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.

[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 said 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.