

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VIVINT, INC.,
Petitioner,

v.

FRACTUS, S.A.,
Patent Owner,

Patent No. 8,994,604 to Puente Baliarda et al.
Issue Date: March 31, 2015
Title: COUPLED MULTIBAND ANTENNAS

Inter Partes Review No.: IPR2024-00089

Petition for *Inter Partes* Review of U.S. Patent No. 8,994,604
Under 35 U.S.C. §§311–319 and 37 C.F.R. §42.100 *et seq.*

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1001	U.S. Patent No. 8,994,604
1002	Declaration of Dr. Manos Tentzeris
1003	<i>Curriculum Vitae</i> of Manos M. Tentzeris
1004	Joint Claim Construction Statement from <i>Fractus, S.A. v. ADT, LLC</i> , 2:22-cv-00412 (E.D. Tex) (Oct. 5, 2023)
1005	U.S. Patent No. 6,239,765 (“Johnson”)
1006	U.S. Patent No. 6,509,882 (“McKivergan”)
1007	Excerpt from Prosecution History of the ’604 Patent
1008	Docket Control Order from <i>Fractus, S.A. v. ADT, LLC</i> , 2:22-cv-00412 (E.D. Tex) (Feb. 3, 2023)
1009	Expert Declaration of Stuart A. Long from <i>Fractus, S.A. v. ADT, LLC</i> , 2:22-cv-00412 (E.D. Tex) (Oct. 5, 2023)

I. INTRODUCTION

Pursuant to 35 U.S.C. §§311–19 and 37 C.F.R. §42.100 *et seq.*, Petitioner, Vivint, Inc. (“Petitioner”), requests *Inter Partes* review of Claims 1, 3, 4, 9, and 13 (the “Challenged Claims”) of U.S. Patent No. 8,994,604 (the “’604 Patent,” EX1001). The Challenged Claims should be found unpatentable and canceled.

II. MANDATORY NOTICES

A. Real Party-In-Interest

Petitioner identifies Vivint, Inc. (Petitioner) as a real party-in-interest (“RPI”). Petitioner is a wholly owned subsidiary of NRG Energy, Inc., but Petitioner does not believe NRG Energy is an RPI for this Petition. Further, Petitioner does not believe that NRG Energy has been involved in any action with respect to the Challenged Claims and is solely being brought to the attention Board based on its ownership status.

B. Related Matters

The ’604 Patent is the subject of the following matter, which may be affected by a decision in this proceeding: *Fractus, S.A. v. Vivint, Inc.*, 2:22-cv-413 (E.D. Tex.) filed on Oct. 21, 2022.

Petitioner is not aware of any post-grant proceeding before the Office involving the ’604 Patent. *See* 37 C.F.R. §§42.8(b)(3), 42.8(b)(4), 42.10(a), and 42.10(b).

C. Lead Counsel, Back-Up Counsel, and Service Information

Pursuant to 37 C.F.R. §§42.8(b)(3) and 42.10(a), Petitioner designates Jared J. Braithwaite (Reg. No. 63,308) as lead counsel and R. Whitney Johnson (Reg. No. 62,997) as back-up counsel.

Pursuant to 37 C.F.R. §42.10(b), Petitioner has filed a power of attorney for the above-designated counsel.

D. Service Information

Per 37 C.F.R. §42.8(b)(4), Petitioner provides the following service information for designated counsel:

Lead Counsel	Back-Up Counsel
Jared J. Braithwaite Reg. No. 63,308 FOLEY & LARDNER LLP 95 S. State Street Suite 2500 Salt Lake City, UT 84111 801-401-8900 jbraithwaite@foley.com	R. Whitney Johnson Reg. No. 62,997 FOLEY & LARDNER LLP 95 S. State Street Suite 2500 Salt Lake City, UT 84111 801-401-8900 whit.johnson@foley.com

Petitioner consents to service via email at the addresses listed above.

III. PAYMENT OF FEES

The required fee is paid by credit card, with authorization to charge any fee deficiencies and credit overpayments to Deposit Acct. No. 19-0741 (Customer No. 22428).

IV. GROUNDS FOR STANDING

Pursuant to 37 C.F.R. §42.104(a), Petitioner certifies that the '604 Patent is available for *Inter Partes* review and that Petitioner is not barred or estopped from requesting *Inter Partes* review on the Grounds identified herein.

V. PRECISE RELIEF REQUESTED

A. Identification of Challenge

Pursuant to 37 C.F.R. §§42.22(a)(1) and 42.104(b), the precise relief sought by Petitioner is that the Board review and cancel Claims 1, 3, 4, 9, and 13 of the '604 Patent as being unpatentable under 35 U.S.C. §§ 102 or 103, as set forth by this Petition and supported by the Declaration of Dr. Manos Tentzeris (EX1002), under the following Grounds:

Ground No.	Challenged Claims	References
1	1, 3, 4, 9 and 13	U.S. Patent No. 6,239,765 ("Johnson")
2	1, 4, and 13	U.S. Patent No. 6,509,882 ("McKivergan")

Petitioner establishes below that the Challenged Claims are unpatentable under the Grounds identified above, including by identifying where each claim element is found in the prior art, to demonstrate that Petitioner has at least a reasonable likelihood of prevailing on these Grounds.

B. Prior Art Patent Application Publications

1. Johnson

Johnson (EX1005) issued May 29, 2001, and is prior art under at least 35 U.S.C. §102(a)-(b). Johnson was not referenced during prosecution of the '604 Patent.

Johnson “relates to an antenna assembly for wireless communication devices, such as a cellular telephone” and, in particular, “to a compact asymmetric dipole antenna assembly” that is “effective over two or more resonance frequency bands.” EX1001, 1:13-18.

As shown in Figure 1, antenna assembly 20 of Johnson is designed to fit within a wireless communication device such as a cellular phone. EX1001, 3:63-65.

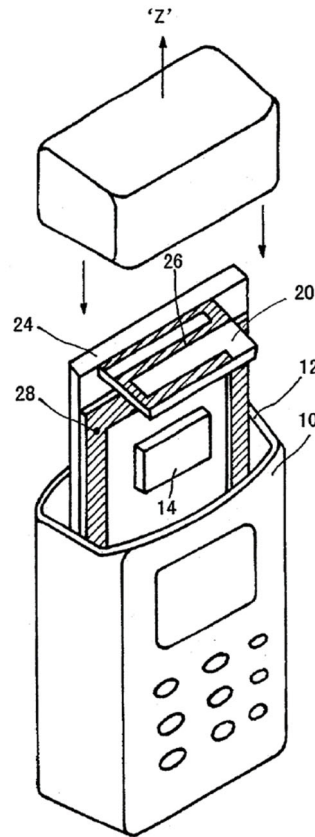


FIG. 1

As shown in Figure 3, antenna assembly 20 of Johnson “first and second planar elements 22, 24 disposed in substantially perpendicular relationship.” EX1001, 4:7-9. Johnson further explains that “[a] first conductor trace 26 is disposed upon the first planar element 22, and a second conductor trace 28 is disposed upon the second planar element 24” and that “[t]he first conductor trace 26 is disposed upon a major surface of the first planar element 22 and directed in a direction ‘Z’ away from the second conductor trace 28.” EX1001, 4:9-17. Johnson goes onto

explain that “first and second planar elements 22, 24” may be “printed wiring boards” and that preferably, “the second conductor trace 28 is the printed ground plane circuit of the transceiver 14.” EX1001, 4:18-25.

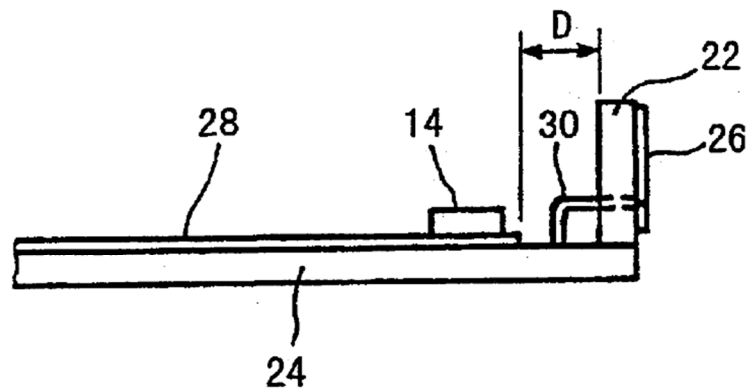


FIG. 3

As shown in Figure 7, Johnson discloses “a dual band antenna assembly.” EX1001, 3:27-28. In the dual band antenna assembly of Figure 7, there are “pair of feedpoints 32a, b between the first conductive trace 26 and the transceiver electronics 14” with “feedpoint 32a” being for “high frequency band” and “feedpoint 32b” being for “low frequency band. EX1001, 5:23-27. Johnson further explains that “[a] ground connection is not required for the high frequency portion.” EX1001, 5:27-28.

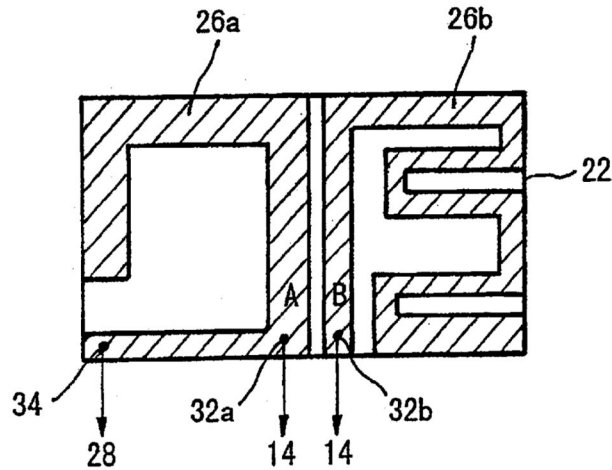


FIG. 7

2. McKivergan

McKivergan (EX1006) published June 20, 2002, and is prior art under at least 35 U.S.C. §102(a) and §102(e). McKivergan was referenced during prosecution of the '604 Patent. *See* EX1007, 54-55. However, McKivergan was not cited in any rejection that pertains to the Challenged Claims.

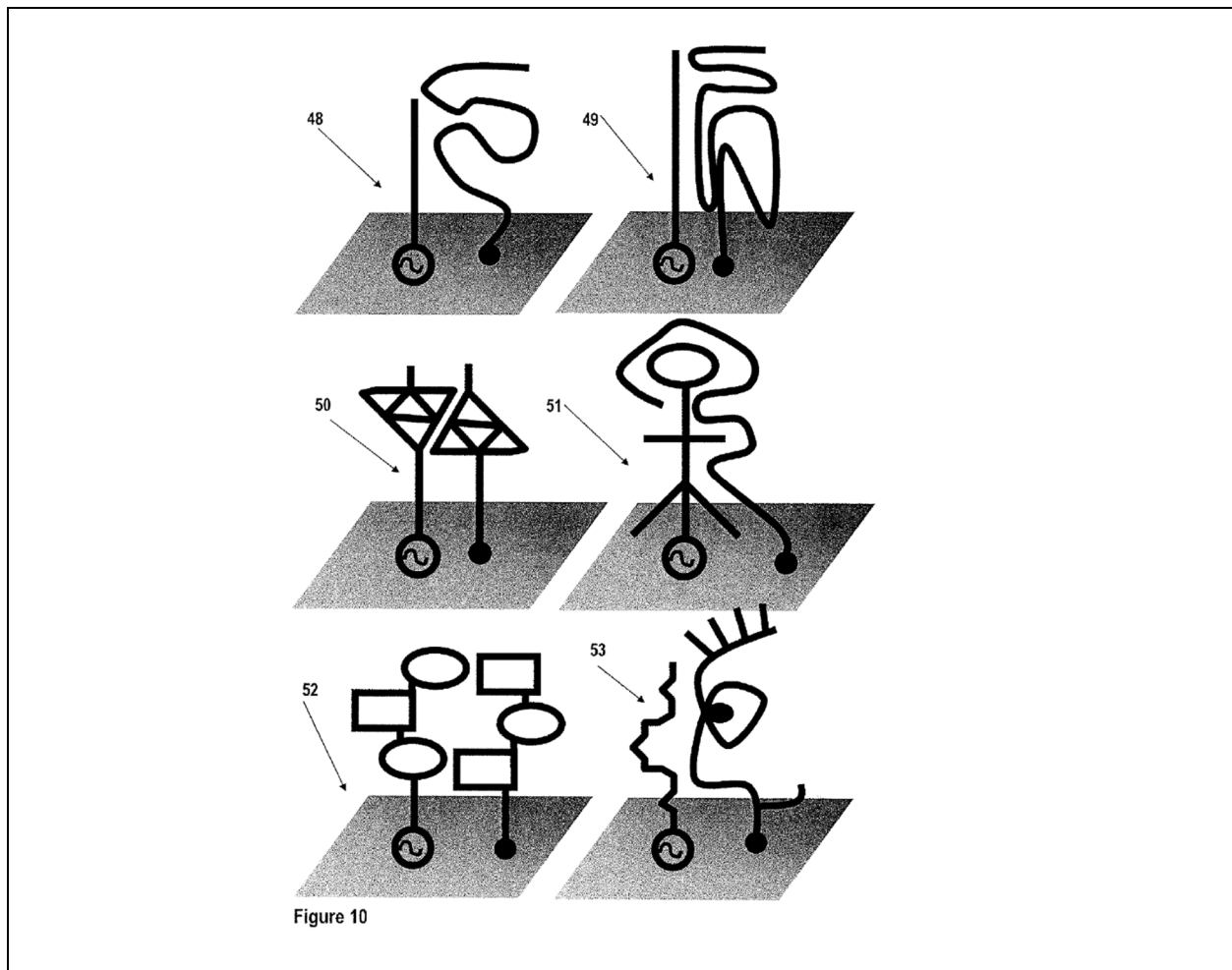
VI. BACKGROUND

A. '604 Patent

The '604 Patent, titled "Coupled Multiband Antennas," was filed on December 5, 2007 and issued on March 31, 2015. EX1001. The '604 patent issued from United States Patent Application No. 11/950,835, and claims priority to United States Patent Application No. 11/075, 980 filed on September 10, 2002.

The '604 Patent is directed to “an antenna comprising at least two radiating structures, said radiating structures taking the form of two arms, said arms being made of or limited by a conductor[] ... said two arms being coupled to each other through a region on first and second arms such that the combined structure of the coupled two-arms forms a small antenna with a broadband behavior, a multiband behavior or a combination of both effects.” EX1001, 2:57-65. Coupling between the two radiating arms, in the context of the '604 patent, “is obtained by means of the shape and spatial arrangement of said two arms, in which at least one portion on each arm is placed in close proximity to each other ... to allow electromagnetic fields in one arm being transferred to the other through said specific close proximity regions.” EX1001, 2:65-3:5.

The '604 Patent further explains that “[p]articular examples of coupled antennas using complex configuration and designs are [shown] in Drawings 48 to 53 in FIG. 10, but it appears clear to any skilled in the art that many other geometries could be used instead within the same spirit of the invention.” EX1001, 9:18-25 (emphasis added). Accordingly, as expressly noted in the '604 patent, “[t]he shape and size of the arms [of the claimed antennas] could be of any type.” EX1001, 9:26.



EX1001, Figure 10.

B. Prosecution History

During prosecution the '604 patent, the Examiner rejected claims as anticipated or obvious. *See* EX1007. And that the applicant amended the claims and proposed several new claims to overcome the Examiner's rejections. EX1007. Petitioner notes that the Examiner rejected claims based on McKivergan relatively early in the prosecution of the '604 patent. EX1007, 54-55. In response, the applicant canceled all pending claims in response to the Examiner's rejection based on

McKivergan and proposed new claims. EX1007, 60-65. The Examiner did not again substantively consider McKivergan during prosecution of the '604 patent, including with regard to the Challenged Claims of the '604 Patent.

The Examiner issued a notice of allowance for the Challenged Claims in January 2015. The Examiner's reasons for allowance specifically focuses on the Examiner's belief that the prior art of record did not "teach, nor render obvious, [the claimed] orthogonal projection of the line segment onto a plane of the ground plane structure[, which] does not intersect the ground plane structure;" and "the first radiating arm, the second radiating arm, and the close proximity region [that] are configured to simultaneously provide the bandwidth required for the antenna system to operate in the multiple frequency bands[.]" EX1007, 203-04.

The prior art, however, including at least Johnson and McKivergan, does in fact teach and/or render obvious each and every limitation recited in the Challenged Claims, as described below.

VII. LEVEL OF ORDINARY SKILL IN THE ART

According to the Patent Owner in the Parallel Litigation, a person of ordinary skill in the art ("POSITA") as of the earliest claimed priority date of September 10,

2002^[1] would have had “at least a bachelor’s degree in electrical engineering, computer science, or a similar degree and at least four years of experience in applied electromagnetics with an emphasis on antennas” or “[a]lternatively, the person of ordinary skill in the art would have a master’s degree in electrical engineering (or similar discipline) and at least two years of similar experience.” Ex. 1009, ¶32.

VIII. CLAIM CONSTRUCTION

A claim is construed in an IPR proceeding using the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1316-1317 (Fed. Cir. 2005) (*en banc*). 37 C.F.R. §42.100(b). Except as discussed specifically below, Petitioner submits that the Board need not specially construe any terms of the Challenged Claims to institute IPR because they are shown to be anticipated and/or obvious regardless of construction. *Toyota Motor Corp. v. Cellport Sys., Inc.*, IPR2015-00633, Paper 11, 16 (PTAB Aug. 14, 2015). Petitioner reserves all rights to raise claim construction and related challenges under 35 U.S.C. §112 in other proceedings.

A. “tip”

For purposes of this proceeding, Petitioner adopts the Patent Owner’s position in the parallel litigation. Petitioner does not, however, concede that the Patent

^[1] While not disputed for purposes of the asserted Grounds, Petitioner reserves the right to dispute the priority claim of the Challenged Claims in other proceedings.

Owner's position correctly interprets the claim language regarding the "first-radiating-arm second tip." In the alternative, even under a narrower interpretation of "tip," each of the Challenged Claims is still rendered unpatentable at least in view of Johnson, as explained below. *Supra* IX.A.1.iv.

IX. GROUNDS OF UNPATENTABILITY

As established below, all features of the Challenged Claims were well known in the prior art.

A. Ground 1: Claims 1, 3, 4, 9, and 13 are Rendered Unpatentable by Johnson

Johnson anticipates and/or renders obvious each and every limitation recited in claims 1, 3, 4, 9, and 13 EX1002, ¶¶42-86.

1. Claim 1

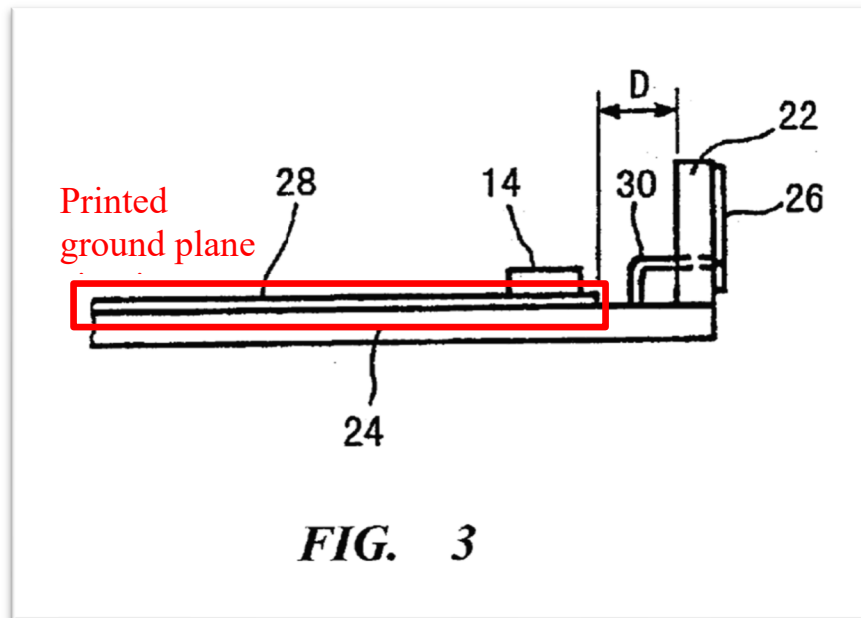
i. 1[pre]: "A wireless portable device comprising:"

The "antenna assembly" of Johnson is designed to be used in "wireless portable device[s]" such as "cellular telephones." For example, as Johnson explains, the disclosed "antenna assembly" is "effective over two or more resonance frequency bands" "for [] wireless communication devices, such as a cellular telephone." EX1005, 1:13-18.

ii. 1[a]: “a printed circuit board comprising a ground plane structure”

The “second conductor trace 28” of Johnson is the claimed “printed circuit board.” Johnson discloses a device comprising conductive traces “printed on any number of conventional dielectric materials having a low to moderate dielectric loss such as plastics and fiberglass.” EX1005, 2:45-48.

Specifically, Johnson discloses an antenna assembly 20 with a second conductor trace 28 or circuit ground trace 28, which “is the printed ground plane circuit of the [antenna assembly].” EX1005, 2:18-26. For example, as can be seen in annotated FIG. 3 (below), Johnson depicts the printed ground plane circuit 28 of the disclosed antenna assembly. EX1005, FIG. 3 (annotated).

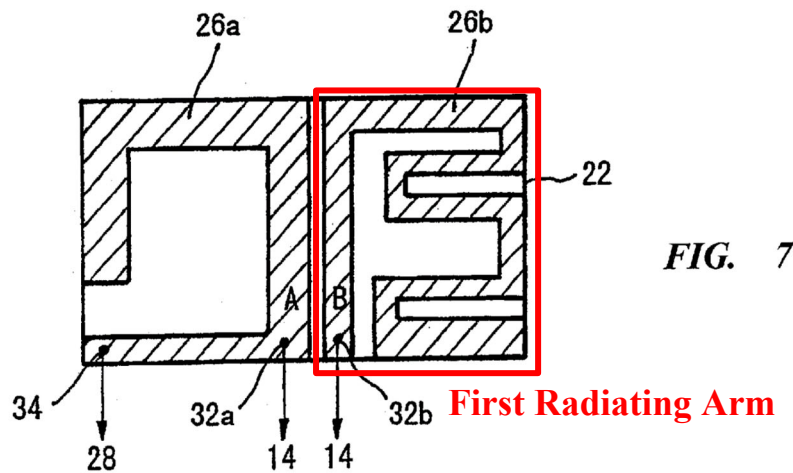


iii. 1[b]: “an antenna system operating in multiple frequency bands, the antenna system comprising:”

Johnson discloses that antenna assembly 20 operates in multiple frequency bands. *See, e.g.*, EX1005, 1:28-29 (“FIG. 7 illustrates a front elevational view of a dual band antenna assembly”) (emphasis added), 5:25-27 (“feedpoint 32a is for high frequency band, while the feedpoint 32b is for a lower frequency band”); EX1002, ¶46. In fact, Johnson explains that antenna assembly 20 can operate within “multiple frequency wireless communication devices, for instance devices operating over the GPS (1575 MHz), cellular telephone (824–890 MHz and 860-890 MHz), PCS device (1710–1880 MHz, 1750–1870MHz, and 1850–1990 MHz), cordless telephone (902-928MHz), or BLUETOOTH specification (2.4-2.5 GHz) frequency ranges.” 1:48-55 (emphasis added).

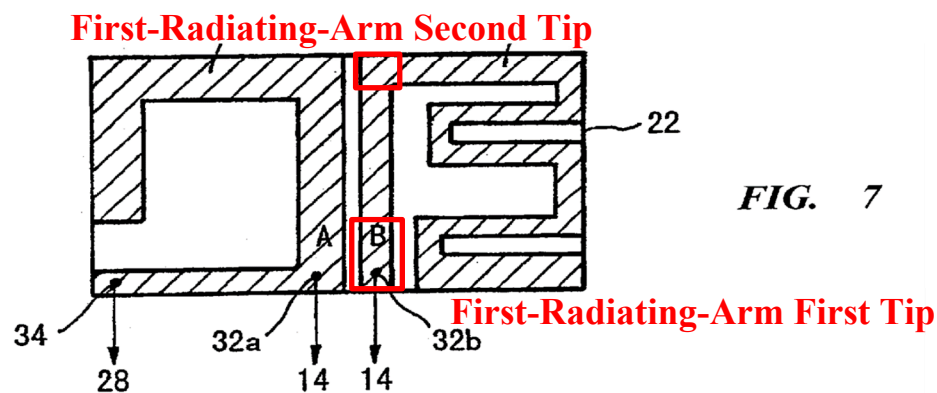
iv. 1[c]: “a first radiating arm comprising a first-radiating-arm first tip, a first-radiating-arm second tip, and a feeding terminal connected to the first-radiating-arm first tip, wherein the first radiating arm is not connected to the ground plane structure through a grounding terminal”

Johnson’s low-frequency conductive trace 26b constitutes the claimed first radiating arm. Specifically, Johnson describes an antenna device that “functions across a pair of frequency bands for dual band transceiver devices.” EX1005, 5:16-18. The device includes a low-frequency conductive trace 26b configured for the “lower frequency band” of the antenna’s operating frequency. EX1005, 5:16-28.

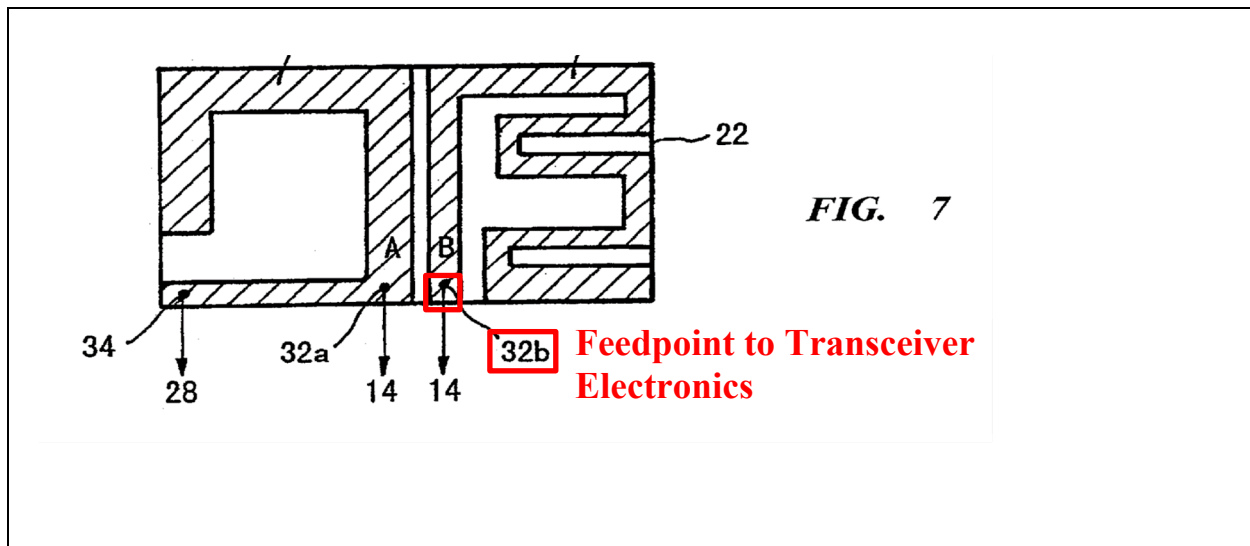


First, Johnson’s low-frequency conductive trace 26b also has the claimed first and second “radiating arm tips.” As explained previously and in the declaration of Dr. Tentzeris, a POSITA would understand the term “radiating arm tip” as recited by the claims to mean a terminal portion or extremity of an antenna. *Supra* VIII. The ’604 patent does not provide any definition for “radiating arm tip.” EX1002, ¶¶47-55. Indeed, the word “tip” only appears twice in the specification of the ’604 patent both of which comport with this definition of “radiating arm tip.” EX1001, 3:14-15 (“the antenna [of Drawing 4] is mounted on a ground-plane (112) and it is fed at one of the tips (102) of arm (110)”), 3:24-25 (“The antenna system [of Drawing 5] is mounted on a ground-plane (112) and it is fed at one of the tips (102) or arm (100)”).

Accordingly, using the Patent Owner’s position regarding the construction of “tip” in the Parallel Litigation, annotated figure 7 below show that Johnson’s antenna system includes a first-radiating-arm first tip and a first-radiating-arm second tip as recited in claim 1.

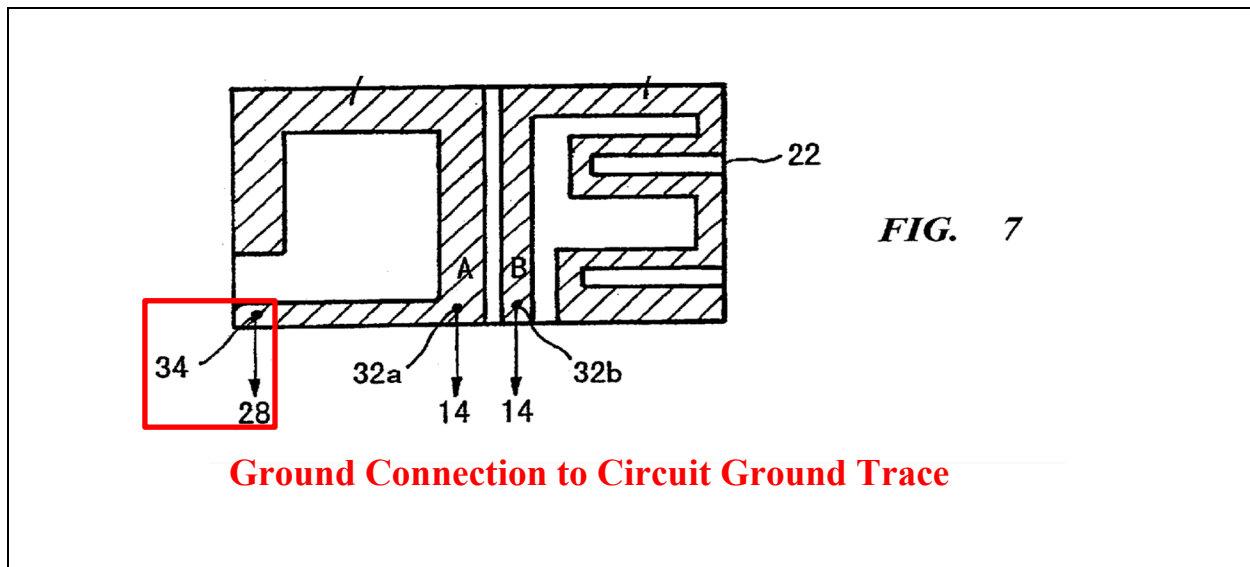


Second, a feeding terminal is connected to first tip of the low-frequency conductive trace 26b (“first radiating arm”). Specifically, Johnson’s low-frequency conductive trace 26b includes a “feedpoint[.]” at 32b, which is a connection “between the first conductive trace 26[b] and the transceiver electronics 14.” EX1005, 5:24-26; *see also* EX1002, ¶50.



Thus, Johnson discloses a “feeding terminal connected to the first-radiating-arm first tip” as recited in claim 1. EX1002, ¶¶48-50.

Third, the low-frequency conductive trace 26b (“first radiating arm”) is not connected to the ground plane structure through a grounding terminal. As can also be seen in FIG. 7, the low-frequency conductive element 26b is only connected, at the feedpoint 32b to transceiver electronics 14 without any connection to the “circuit ground trace 28” (“ground plane structure”) or “ground connection 34” to “circuit ground trace 28.” See EX1005, 5:1-5; 3:45-46. The high-frequency conductive trace 26a, however, *is connected* to the ground plane structure (“circuit ground trace 28”) via the ground connection 34. And, as explained above, the “circuit ground trace 28” is the “ground plane structure” recited in the claims. *Supra* IX.A.1.ii.

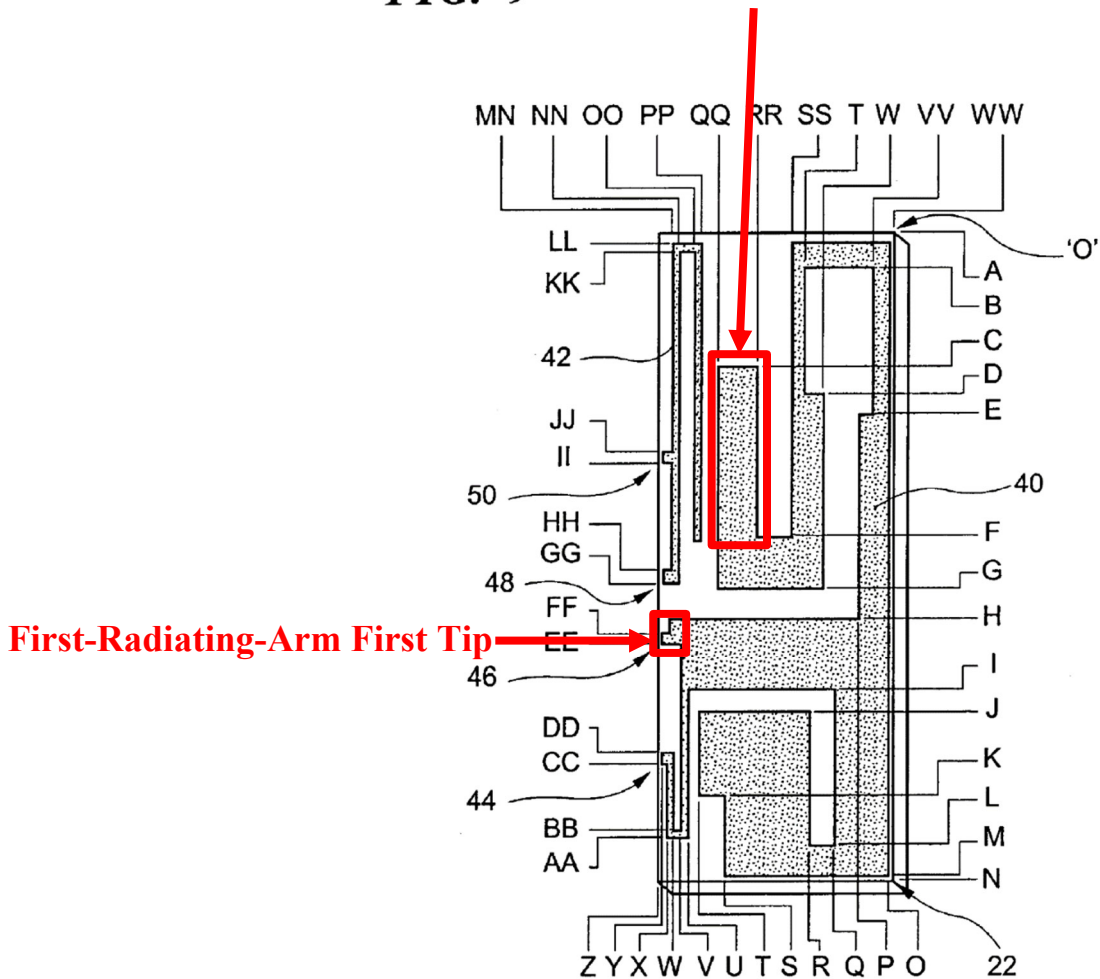


Thus, according to the Patent Owner’s position regarding the construction of “tip” in the Parallel Litigation, Johnson discloses “wherein the first radiating arm is not connected to the ground plane structure through a grounding terminal” as recited in Claim 1 of the ’064 Patent. *See* EX1002, ¶¶52-53.

Alternatively, a POSITA would have considered the embodiment shown in Johnson’s Figure 9, including the first radiating arm and first-radiating-arm tips, as indicated in annotated Figure 9 below. EX1002, ¶¶54-55.

FIG. 9

First-Radiating-Arm Second Tip

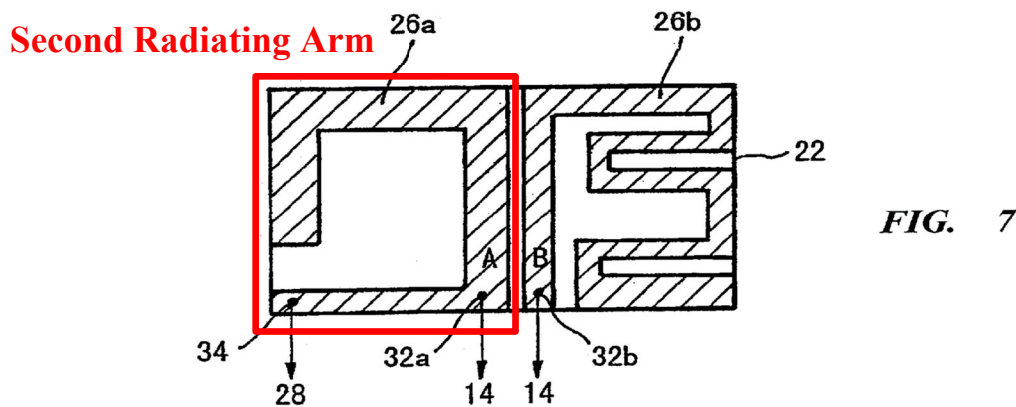


A POSITA would consider using the particular trace design shown in Figure 9, including the first and second first-radiating-arm tips shown in annotated Figure 9 above, because of the greater bandwidth provided by that arrangement of the two antenna arrangements and omitting the ground connection to the high-frequency trace 42, as disclosed by Johnson. EX1001, 5:27-28 (“A ground connection is not

required for the high frequency portion [of the antenna assembly 20]”) (emphasis added).

- v. **1[d]: “a second radiating arm comprising a second-radiating-arm first tip, a second-radiating-arm second tip, and a grounding terminal connected to the second-radiating-arm first tip, wherein the second radiating arm does not include a contact point with first radiating arm, wherein:”**

Johnson’s high-frequency conductive trace 26a constitutes the claimed second radiating arm. *See, e.g.*, EX1002, ¶¶56-57; EX1005, FIG. 7. The antenna device shown in figure 7 includes a second conductive trace 26a configured for a “high frequency band” of the dual band antenna’s operating frequency. EX1005, 5:16-28.



First, Johnson’s high-frequency conductive trace 26a includes a second-radiating-arm first tip and a second-radiating-arm second tip. As shown below, and according to the Patent Owner’s position regarding the construction of “tip” in the

Parallel Litigation (discussed above), Figure 7 discloses the first and second second-radiating-arm tips.

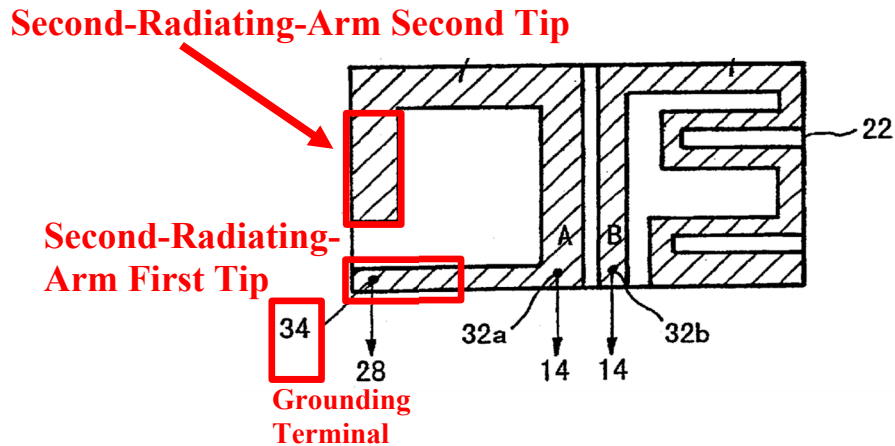
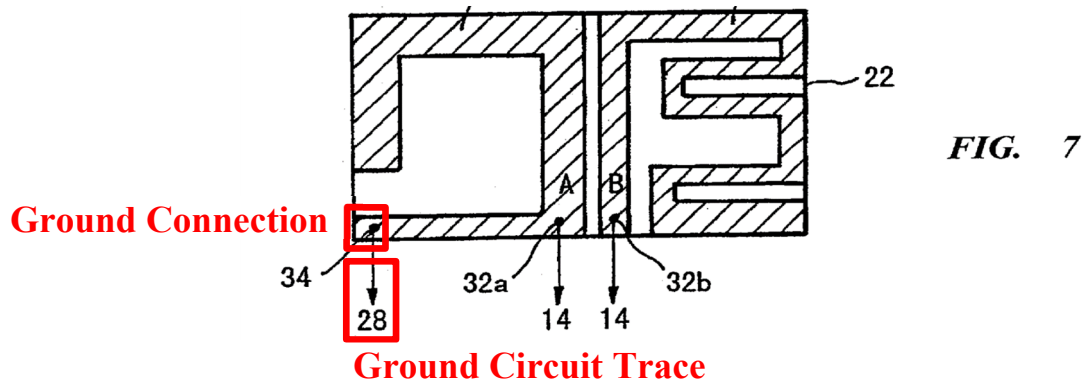


FIG. 7

Second, a grounding terminal is connecting to the first tip of high-frequency conductive trace 26a (“second radiating arm”). Specifically, the grounding terminal 34 shown in Figure 7 is the connection between the tip of the high-frequency conductive trace 26a and the ground circuit trace 28, which is the “ground plane structure” recited by the claims (as explained above *supra* IX.A.1.ii). EX1002, ¶58; EX1005, annotated Figure 7 (below).



Third, high-frequency conductive trace 26a (“second radiating arm”) does not include a contact point with low-frequency conductive element 26b (“first radiating arm”). Johnson’s high-frequency conductive trace 26a includes a “ground connection 34” to “circuit ground trace 28” which is a connection between the second conductive trace 26a and the “the ground plane of the second planar element 24[.]” EX1005, 4:59-60 and 5:24-26 *see also* EX1002, ¶¶59-60. As can also be seen in annotated figure 7 (above), Johnson discloses “a grounding terminal connected to the second-radiating-arm first tip” as recited in claim 1. EX1002, ¶¶59-60.

Moreover, the high-frequency conductive element 26a includes only one other connection, which is to the transceiver electronics 14 via the feedpoint 32a. The high-frequency conductive element 26a does not include any connection to the physically separate low-frequency conductive element 26b. Thus, Johnson meets the “the second radiating arm does not include a contact point with first radiating arm” element of Claim 1. EX1005, ¶60.

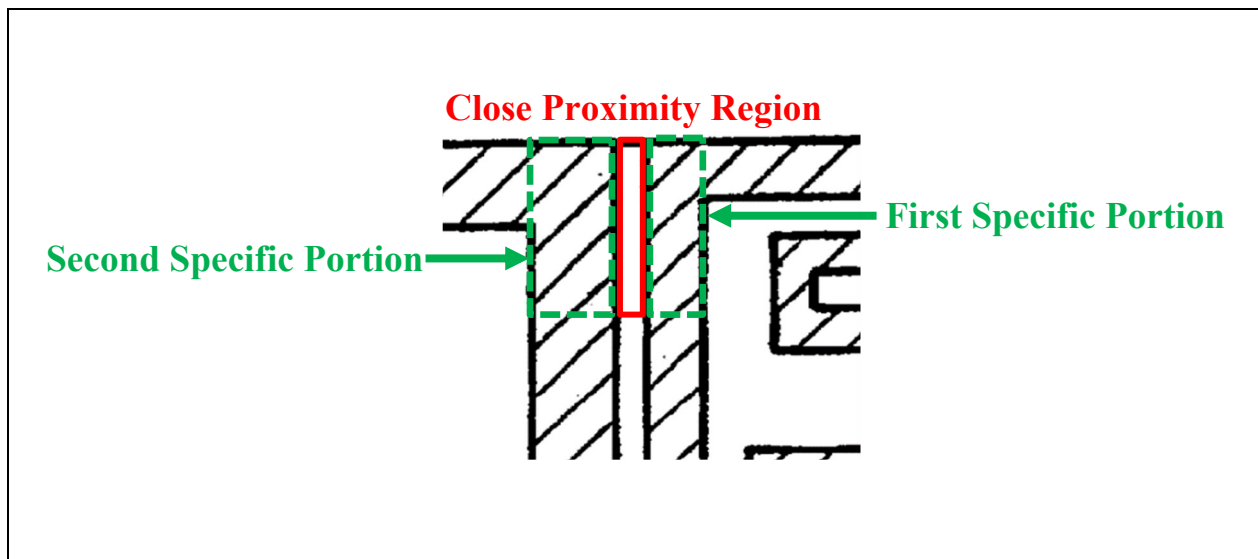
- vi. **1[e]: “the first radiating arm and the second radiating arm are coupled through a close proximity region from a first specific portion of the first radiating arm and from a second specific portion of the second radiating arm”**

Johnson discloses that the low-frequency conductive trace 26b (“first radiating arm”) and high-frequency conductive trace 26a (“second radiating arm”) are coupled through the claimed “close proximity region.” EX1002, ¶61. For purposes of this petition, Petitioner adopts the Patent Owner’s position in the Parallel Litigation regarding the construction of the “coupled through a close proximity region” and “close proximity range” recited in Challenged Claims. Petitioner understands the Patent Owner’s position to be that these terms are not indefinite and do not require specific construction. EX1004, 47, 69.

With this understanding, Petitioner notes that the ’604 Patent describes the close proximity region as being “a portion on each [radiating] arm [that are] placed in close proximity to each other (for instance, at a distance smaller than a tenth of the longest free-space operating wavelength) to allow electromagnetic fields in one arm being transferred to the other through said specific close proximity regions.” EX1001, 3:1-5 (emphasis added). Accordingly, being small enough to “allow electromagnetic fields in one arm [to be] transferred to the other” is the primary feature of the “close proximity region.” EX1001, 3:1-5. Moreover, the “specific portion” of the radiating arms is merely that portion of the radiating arm where at

least a portion of electromagnetic fields are transferred from one radiating arm to the other. *Id.* Thus, as can be seen in Johnson's Figure 7, the close proximity region between the high-frequency conductive trace 26a and the low-frequency conductive trace 26b is small enough to allow coupling of electromagnetic waves between the two traces 26a, 26b.

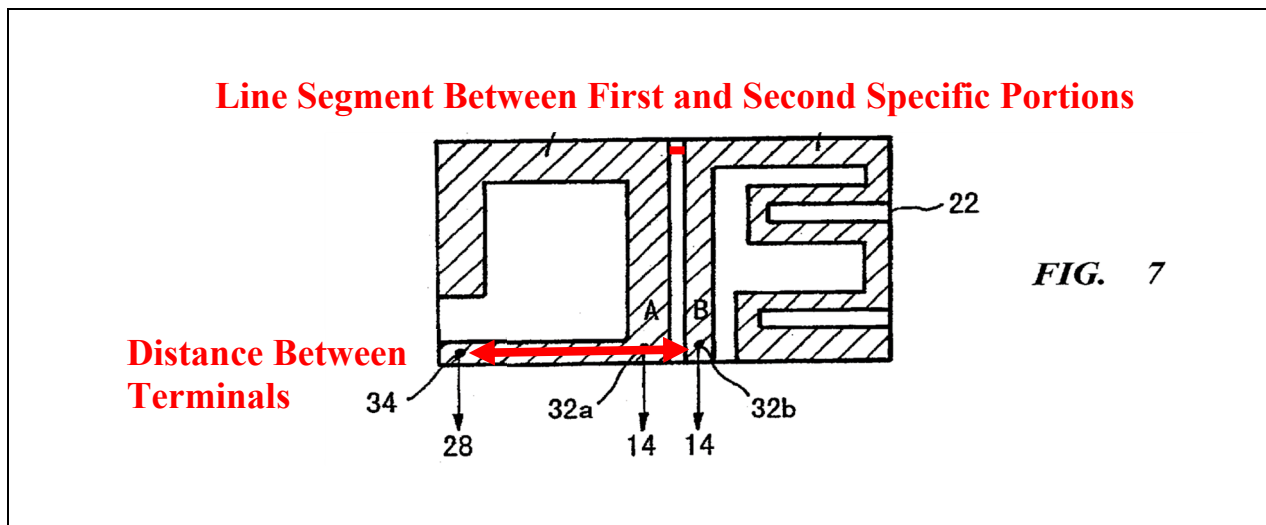
As discussed above (and shown below), Figure 7 depicts a multiband antenna device with two radiating arms disposed in close proximity and configured to operate in tandem. EX1005; *see also* EX1002, ¶62.



- vii. 1[f]: “a length of a line segment between a point of the first specific portion and a point of the second specific portion is shorter than a distance between the feeding terminal and the grounding terminal;”

In Johnson, the length of a line segment between the first and second specific portions of conductive elements (26a, 26b) is shorter than the distance between the

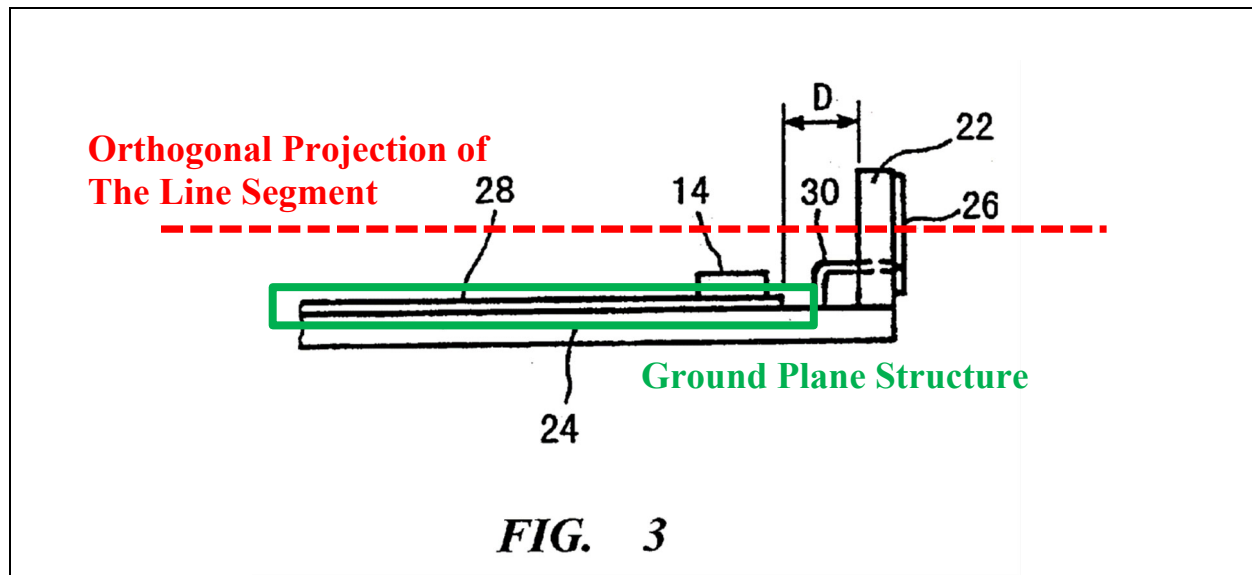
feedpoint 32b (“feeding terminal”) and the ground connection 34 (“grounding terminal”). To illustrate this, the following lines have been added to Figure 7 (below): (1) a line connecting the first specific portion of the of the first radiating arm to the second portion of the of the second radiating arm and (2) a line connecting feedpoint 32b (“feeding terminal”) and the ground connection 34 (“grounding terminal”).



As can easily be seen, the distance between the terminals is far greater than the distance between the first and second specific portions. Thus, as shown above, a length of a line segment between a point of the first specific portion and a point of the second specific portion is shorter than a distance between the feeding terminal and the grounding terminal.

viii. 1[g]: “an orthogonal projection of the line segment onto a plane of the ground plane structure does not intersect the ground plane structure; and”

An orthogonal projection of the line segment (discussed above) onto a plane of the printed ground plane circuit (28) (“ground plane structure”) does not intersect the printed ground plane circuit (28). EX1002, ¶¶66-67. The orthogonal projection of the line segment (shown below in annotated Figure 3) is a projection of the line segment, rotated 90 degrees (e.g., orthogonal to the line segment shown above in annotated Figure 7) on the same plane as the printed ground structure (*i.e.*, along the same dimension on which the printed ground circuit 28 is oriented). As mentioned previously, the ground circuit trace 28 is the claimed “ground plane structure.” Accordingly, Johnson discloses the antenna assembly shown in Figure 3 with the planar element 22 that is shown in Figure 7 oriented perpendicular to the ground circuit trace 28. Stated differently, the planar element 22, where the conductive elements 26a and 26b are located, is disposed in an orthogonal orientation relative to the ground plane structure 28. *See* EX1005, 4:35-37; EX1002, ¶67. Accordingly, Figure 3 meets this limitation, as shown in annotated Figure 3, below.



- ix. 1[h]: “the first radiating arm, the second radiating arm and the close proximity region are configured to simultaneously provide the bandwidth required for the antenna system to operate in the multiple frequency bands”

Johnson discloses this limitation. *See, e.g.*, EX1005, 1:28-29 (“FIG. 7 illustrates a front elevational view of a dual band antenna assembly”) (emphasis added), 5:25-27 (“feedpoint 32a is for high frequency band, while the feedpoint 32b is for a lower frequency band”); EX1002, ¶¶46, 68. Additionally, Johnson’s antenna assembly 20 can operate within “multiple frequency wireless communication devices, for instance devices operating over the GPS (1575 MHz), cellular telephone (824–890 MHz and 860-890 MHz), PCS device (1710–1880 MHz, 1750–1870MHz, and 1850–1990 MHz), cordless telephone (902-928MHz), or BLUETOOTH

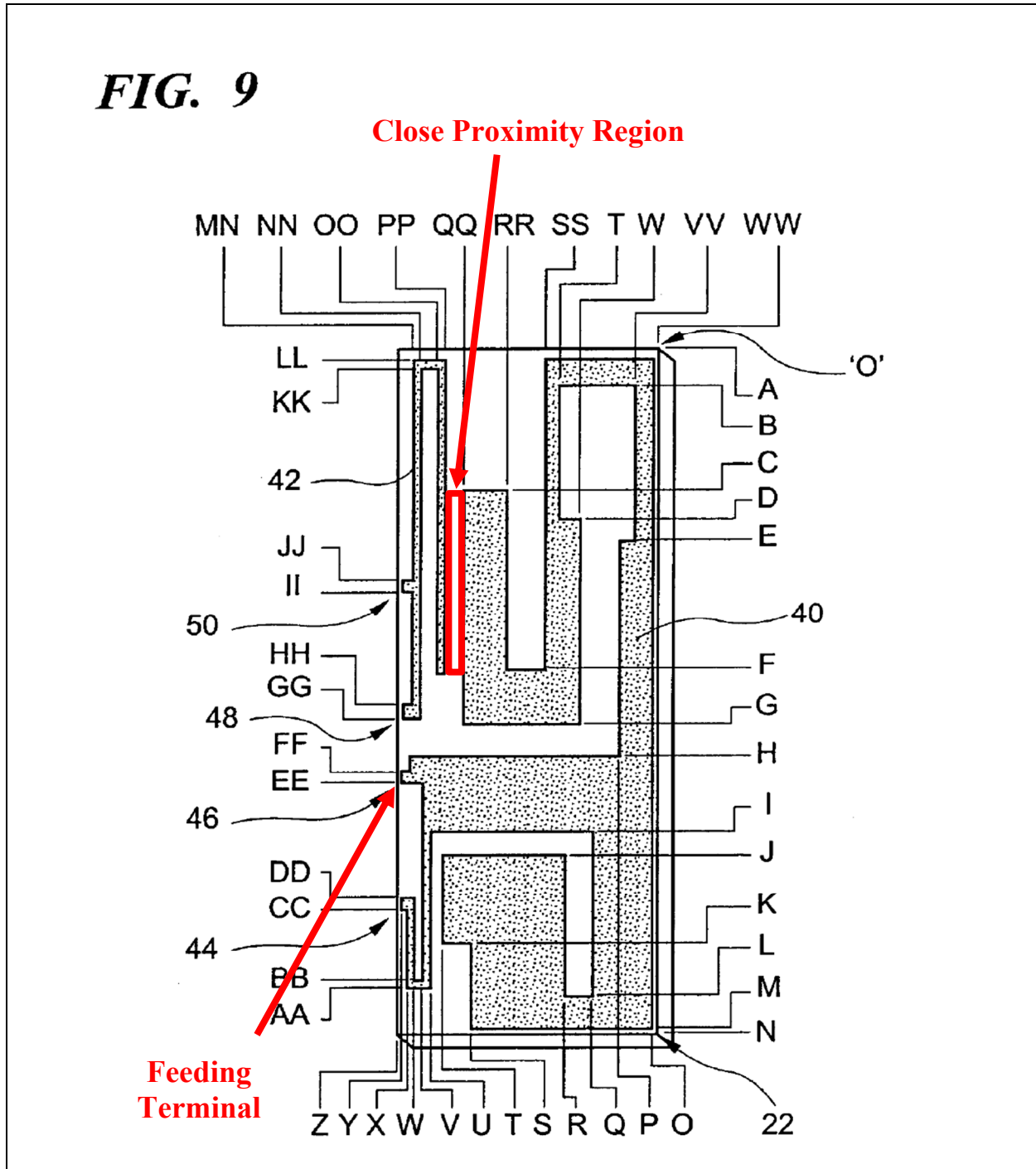
specification (2.4-2.5 GHz.) frequency ranges.” 1:48-55 (emphasis added). Thus, Johnson’s antenna device meets this limitation.

2. Claim 3

- i. **“The wireless portable device of claim 1, wherein the close proximity region is located at a distance from the feeding terminal that is longer than $1/40$ of the longest free-space operating wavelength of the antenna system.”**

Johnson discloses the sizing the antenna elements that are needed for the desired applications. EX1005, 3:57-62. More specifically, Johnson explains that its disclosure includes alternative versions of the antenna assembly 20 described above that are “scaled in proportion to provide operation at other frequencies[.]” EX1005, 3:57-60. Moreover, Johnson teaches the use of an impedance matching network with a length that is based on a fraction of the operating wavelength of the antenna device (20). EX1005, 5:1-8. As described above, Johnson discloses Figure 9, which depicts an antenna assembly with a proximity region that is located a distance from the feeding terminal (feedpoint 46) that is more than $1/40$ of the longest free-space operating wavelength of the antenna system 20. *See* EX1002, ¶¶69-71; EX1005, 5:35-50, TABLE 1, and FIG. 9. Specifically, the distance from the proximity region is the distance from point FF of Figure 9 to point F. EX1002, ¶70. Based on the values given in TABLE 1, the distance from FF to F can equal 0.145161 meters and $1/40^{\text{th}}$ of the longest wavelength of operation, or 824Mhz, is approximately 0.00910

meters, which is less than 0.145161 meters or the distance from the feedpoint to the close proximity region (shown in annotated Figure 9) disclosed by Figure 9 and Table 1 of Johnson. EX1002, ¶70.

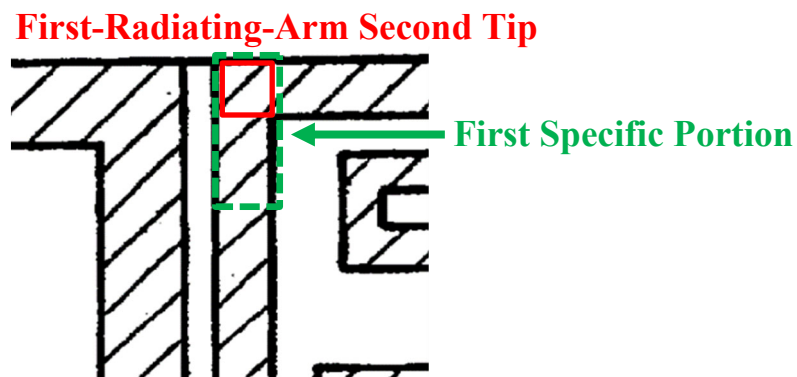


Accordingly, a POSITA would have considered a scaled version of the antenna device 20 shown in Figure 7 that is scaled according to the dimensions of the embodiment explicitly disclosed in Figure 9. EX1002, ¶¶69-71.

3. Claim 4

- i. “The wireless portable device of claim 1, wherein the first specific portion of the first radiating arm includes the first-radiating-arm second tip.”**

Johnson discloses this limitation in Figure 7. *Supra* IX.A.1.iv-vi. As can be seen below, the “first-radiating-arm second tip” is within the “first specific portion of the first radiating arm”

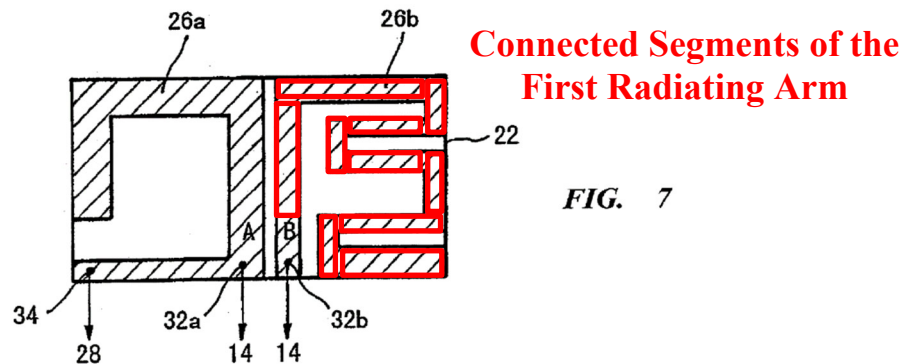


Accordingly, Johnson’s Figure 7 meets this limitation.

4. **Claim 9**

- i. **“The wireless portable device of claim 1, wherein the first radiating arm comprises a portion formed by ten or more connected segments, each of the connected segments forming an angle with its neighboring connected segment, the angle being smaller than 180 degrees, and the segments being shorter than $\frac{1}{8}$ of the longest free-space operating wavelength of the antenna system.”**

Johnson’s low-frequency conductive trace 26b shown in Figure 7 meets this limitation. As shown in annotated Figure 7 (below), Johnson’s low-frequency conductive trace 26b is a “meandering first conductor trace” and consists of ten segments, which are each connected at a 90-degree angle. EX1002, ¶¶77-78. Moreover, as explained in Dr. Tentzeris’ declaration, the total length of the low-frequency conductive trace 26b would be, at most, $\frac{1}{4}$ of the longest free-space wavelength for the antenna. EX1002, ¶¶77-78. Because the low-frequency trace 26b is made up of 10 segments that, together, equal $\frac{1}{4}$ the length of the longest wavelength, each of the ten segments is likewise equal to approximately $\frac{1}{10}$ of $\frac{1}{4}$ (or $\frac{1}{40^{\text{th}}}$) of the longest operating wavelength. EX1002, ¶¶77-78. Thus, each of the ten segments that makeup the low-frequency conductive trace 26b is shorter than $\frac{1}{8}$ of the longest free-space operating wavelength. EX1002, ¶¶77-78; EX1005, 4:21-22, Figure 7.



Additionally, as discussed above, Johnson describes that, for the antenna device (20), the distance between feedpoint 32 and ground trace 28 can be “approximately 0.03” times “a wavelength within the range of [the] antenna operating frequencies.” EX1005, 5:4-8. Thus, the smaller lengths of the connected segments (shown above in red) would necessarily be much shorter than $1/8^{\text{th}}$ or 0.125 times the relevant wavelength.

5. Claim 13

i. 13[pre]: “A wireless portable device comprising:”

This limitation is disclosed for at least the same reasons discussed with respect to Claim 1 above. *See* Section IX.A.1.i.

ii. 13[a]: “a printed circuit board comprising a ground plane structure”

This limitation is disclosed for at least the same reasons discussed with respect to Claim 1 above. *See* Section IX.A.1.ii.

- iii. **13[b]: “an antenna system operating in multiple frequency bands and included within the wireless portable device, the antenna system comprising:”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.A.1.i-IX.A.1.iii; EX1005, 3:63-65 (“FIG. 1 illustrates an antenna assembly 20 disposed within a wireless communication device”).

- iv. **13[c]: “a first radiating arm comprising a first-radiating-arm first tip, a first-radiating-arm second tip, a feeding terminal connected to the first-radiating-arm first tip, and a first-radiating-arm first point; and”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.A.1.iv.

- v. **13[d]: “a second radiating arm comprising a second-radiating-arm first tip, a second-radiating-arm second tip, and a grounding terminal connected to the second-radiating-arm first tip, wherein: the second radiating arm does not include a contact point with the first radiating arm”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.A.1.v.

- vi. **13[e]: “the first radiating arm and the second radiating arm are coupled through a close proximity region formed by a portion including the first-radiating-arm first point and the second-radiating-arm second tip;”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.A.1.vi.

- vii. **13[f]: “a length of a line segment between the first-radiating-arm first point and the second-radiating-arm second tip is shorter than a distance between a point of the feeding terminal and a point of the grounding terminal;”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.A.1.vii.

- viii. **13[g]: an orthogonal projection of the line segment onto a plane of the ground plane structure does not intersect the ground plane structure; and”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.A.1.viii.

- ix. **13[h]: “the first radiating arm, the second radiating arm and the close proximity region are configured to simultaneously provide a bandwidth required for the antenna system to operate in the multiple frequency bands.”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.A.1.ix.

B. Ground 2: Claims 1, 3, 4, and 13 are Rendered Unpatentable by McKivergan

McKivergan teaches and/or renders obvious each and every limitation recited in claims 1, 3, 4, and 13. EX1002, ¶¶87-107.

1. Claim 1

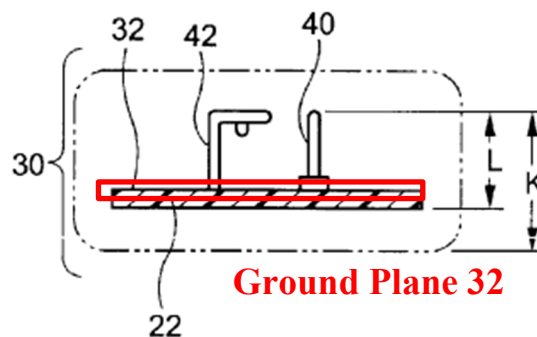
i. 1[pre]: “A wireless portable device comprising:”

McKivergen discloses a broadband antenna assembly that is designed to be used in “wireless communication devices.” *See, e.g.*, EX1006, 2:25-27.

ii. 1[a]: “a printed circuit board comprising a ground plane structure”

McKivergen teaches an antenna assembly on a “printed wiring board (PWB) 22” and used within “a wireless communications device (10),” which is depicted in FIG. 1. EX1006, 5:10-20. Moreover, McKivergen’s antenna assembly 30 includes a ground plane 32, which may be carried by the printed PWB 22[,]” such as the one shown in annotated Figure 6a below.

FIG. 6a



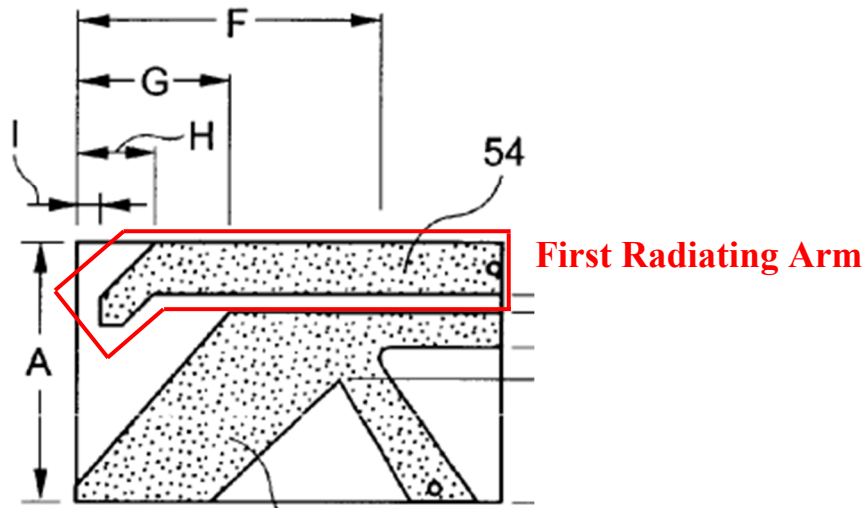
iii. 1[b]: “an antenna system operating in multiple frequency bands, the antenna system comprising:”

McKivergan’s antenna assembly operates at multiple frequency bands and, as a result, satisfies this limitation. More specifically, it discloses antennas for operation across a bandwidth of 1710–2500MHz. Correspondingly, the ground plane 32 has dimensions of approximately $0.45\lambda \times 0.25\lambda$, also where λ is the wavelength of the lowest frequency (1710 MHz) in the bandwidth of 1710–2500 MHz, which is a bandwidth that includes multiple different frequency bands. EX1006, 7:34-40 (disclosing “an antenna [that can] be configured to cover the U.S. cell band (824–894) MHz, PCS/DCS bands (1710–1990) MHz and Bluetooth frequency band (2.4–2.5)GHZ.” 7:34-40.

iv. 1[c]: “a first radiating arm comprising a first-radiating-arm first tip, a first-radiating-arm second tip, and a feeding terminal connected to the first-radiating-arm first tip, wherein the first radiating arm is not connected to the ground plane structure through a grounding terminal”

This limitation is met by Figure 4a of McKivergan. More specifically, the driven element (54) of McKivergan Figure 4a, which is shown in annotated Figure 6a below, constitutes the first radiating arm, as recited in the claims.

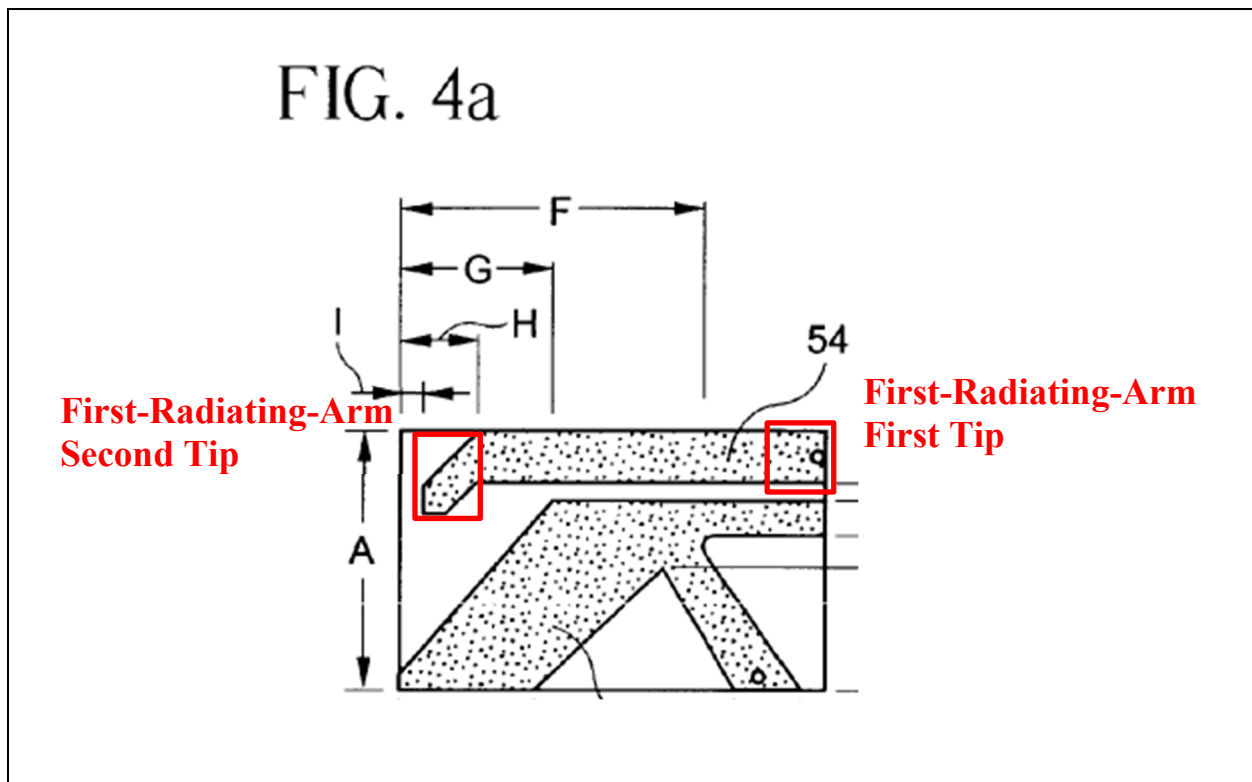
FIG. 4a



As explained previously and in the declaration of Dr. Tentzeris, a POSITA would understand the term “radiating arm tip” as recited by the claims to mean a terminal portion or extremity of an antenna. *Supra* VIII. The ’604 patent does not provide any definition for “radiating arm tip.” EX1002, ¶91. Indeed, the word “tip” only appears twice throughout the specification of the ’604 patent both of which comport with this definition of “radiating arm tip.” EX1001, 3:14-15 (“the antenna [of Drawing 4] is mounted on a ground-plane (112) and it is fed at one of the tips (102) of arm (110)”), 3:24-25 (“The antenna system [of Drawing 5] is mounted on a ground-plane (112) and it is fed at one of the tips (102) or arm (100)”).

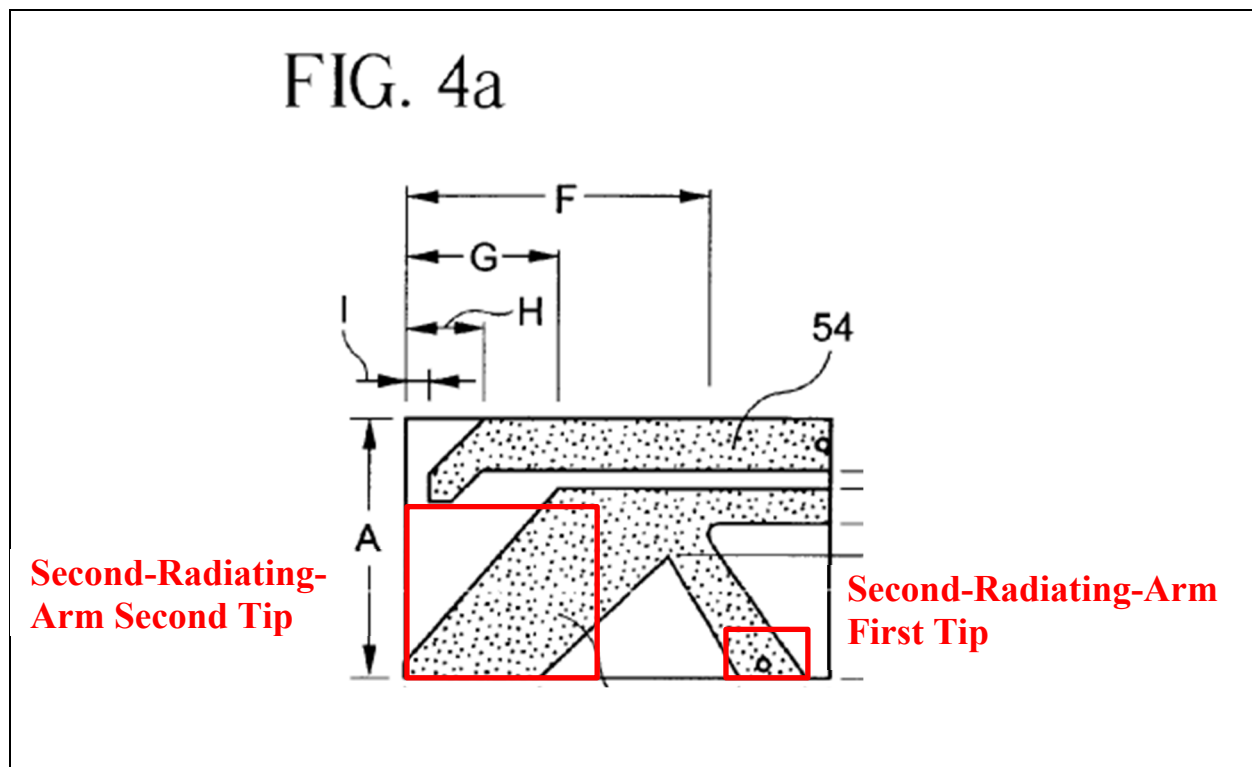
Regardless, Figures 4a and 6a satisfy this limitation. McKivergan expressly discloses a first tip of the driven element (54) at a feed point (62) and a second tip

(60) at the opposing end (58) of the driven element (54) shown in annotated Figure 6a below. EX1006, 5:21-36 (disclosing that “[t]he driven element 54, illustrated in this embodiment as a trace 54, includes opposing ends 56, 58 with one end including a tip 60 and the other end including a feed point 62”) (emphasis added). And the driven element (54) does not include a connection to the ground plane (unlike parasitic element (70)), as can be seen in the annotated Figure 6a below.



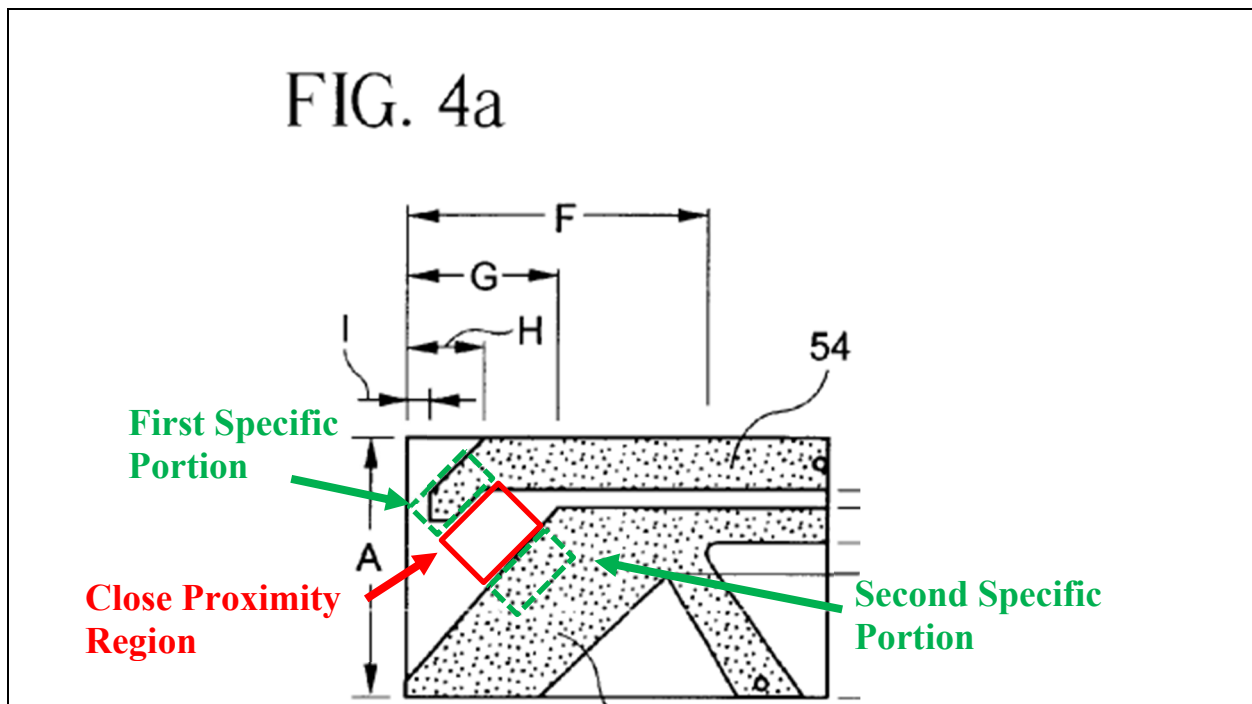
- v. 1[d]: “a second radiating arm comprising a second-radiating-arm first tip, a second-radiating-arm second tip, and a grounding terminal connected to the second-radiating-arm first tip, wherein the second radiating arm does not include a contact point with first radiating arm, wherein:”

McKivergan teaches this limitation. *See, e.g.*, EX1002, ¶¶93-95; EX1006, Figures 2, 4a, 6a. In particular, the antenna device shown in figure 2 includes a second parasitic trace (70) comprising a second-radiating-arm first tip (second segment 74) and a second-radiating-arm second tip (third segment 76), and a grounding terminal (grounding connection point 78) that is connected to the second-radiating-arm first tip and, as can be seen, the parasitic element (70) does not include any contact point with the driven element (54) . EX1006, 5:21-36.



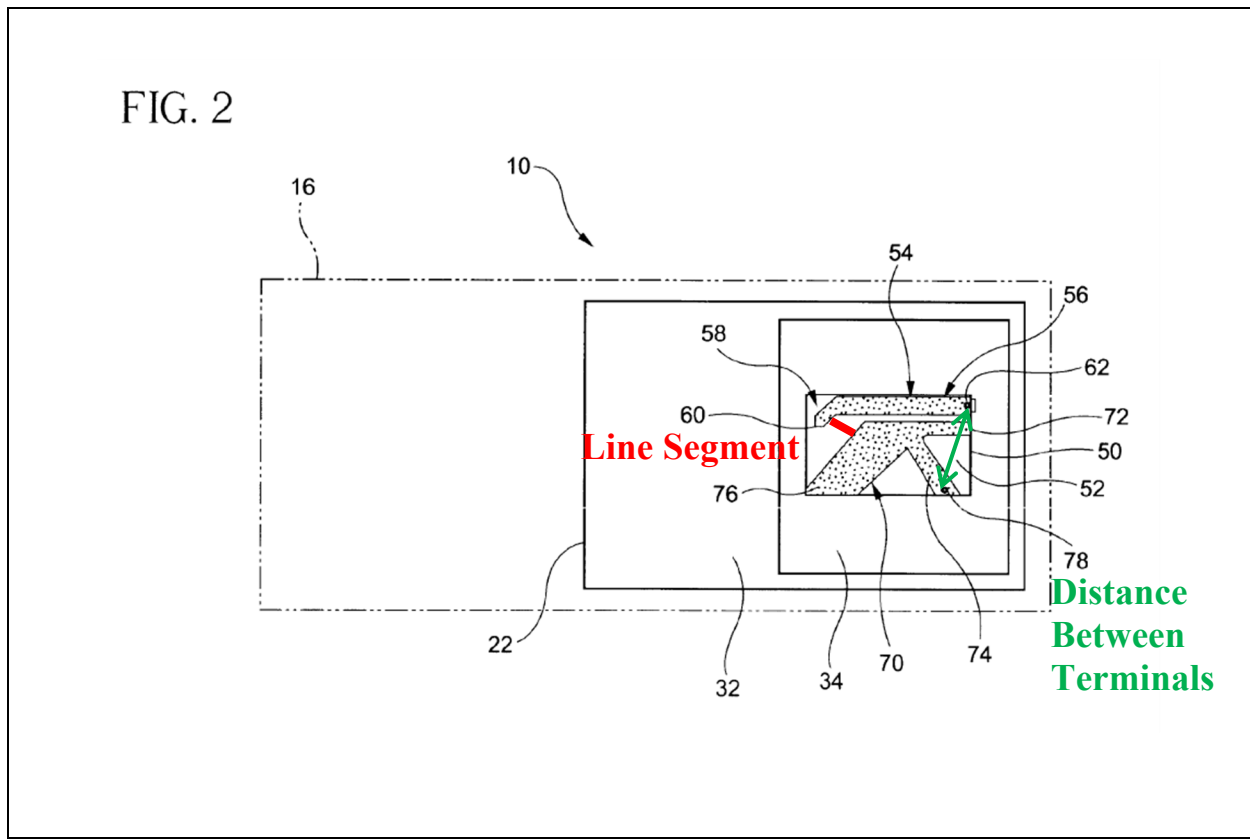
- vi. 1[e]: “the first radiating arm and the second radiating arm are coupled through a close proximity region from a first specific portion of the first radiating arm and from a second specific portion of the second radiating arm”

McKivergan satisfies this limitation as shown in annotated Figure 4a, below.



- vii. 1[f]: “a length of a line segment between a point of the first specific portion and a point of the second specific portion is shorter than a distance between the feeding terminal and the grounding terminal;”

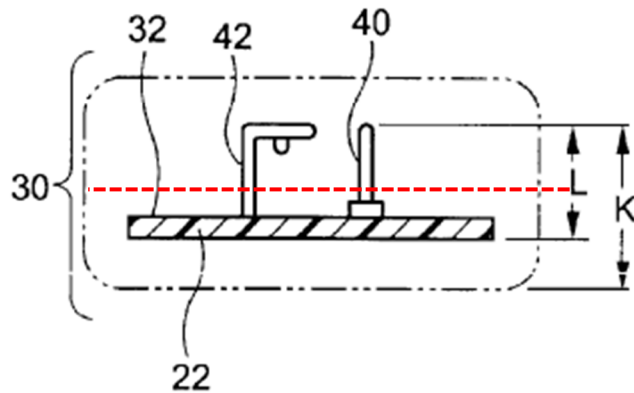
McKivergan likewise satisfies this limitation, as shown in annotated Figure 2 below.



- viii. 1[g]: “an orthogonal projection of the line segment onto a plane of the ground plane structure does not intersect the ground plane structure; and”

McKivergan meets this limitation as shown in annotated Figure 6a below.

FIG. 6a



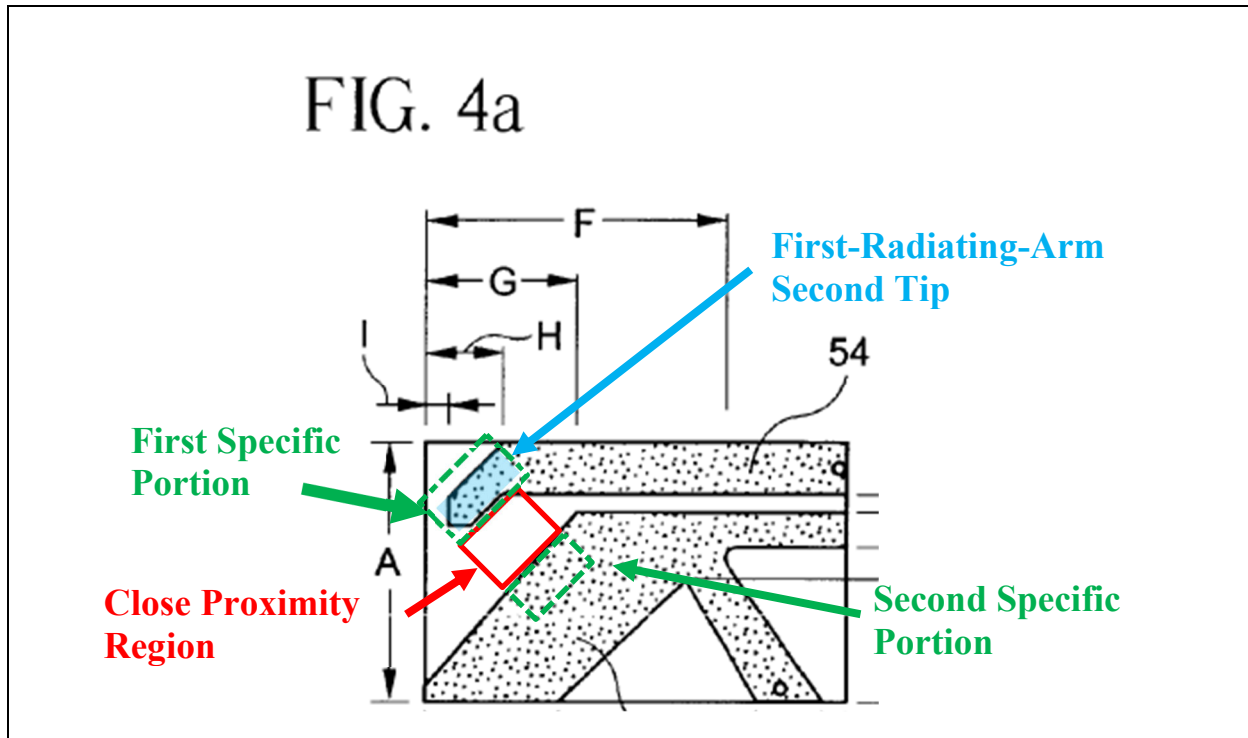
Alternatively, a POSITA would consider the structure disclosed in Johnson and combine it with McKivergan's antenna assembly for the same reasons discussed above. *Supra* Section IX.A.1.viii.

- ix. **1[h]: “the first radiating arm, the second radiating arm and the close proximity region are configured to simultaneously provide the bandwidth required for the antenna system to operate in the multiple frequency bands.”**

As discussed above, McKivergan's antenna assembly is configured to operate in multiple different frequency bands and, as a result, satisfies this limitation. *Supra* Section IX.B.1.iii; EX1002, ¶¶89, 98.

2. **Claim 4:** “The wireless portable device of claim 1, wherein the first specific portion of the first radiating arm includes the first-radiating-arm second tip.”

McKivergan meets this limitation as shown in annotated Figures 4a below.



Accordingly, as shown in Annotated Figure 4a above, McKivergan satisfies this limitation. EX1002, ¶99.

3. **Claim 13**

- i. **13[pre]:** “A wireless portable device comprising:”

This limitation is disclosed for at least the same reasons discussed with respect to Claim 1 above. *See* Section IX.B.1.i.

ii. 13[a]: “a printed circuit board comprising a ground plane structure”

This limitation is disclosed for at least the same reasons discussed with respect to Claim 1 above. *See* Section IX.B.1.ii.

iii. 13[b]: “an antenna system operating in multiple frequency bands and included within the wireless portable device, the antenna system comprising:”

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.A.1.i-IX.B.1.iii.

iv. 13[c]: “a first radiating arm comprising a first-radiating-arm first tip, a first-radiating-arm second tip, a feeding terminal connected to the first-radiating-arm first tip, and a first-radiating-arm first point; and”

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.B.iv.

v. 13[d]: “a second radiating arm comprising a second-radiating-arm first tip, a second-radiating-arm second tip, and a grounding terminal connected to the second-radiating-arm first tip, wherein: the second radiating arm does not include a contact point with the first radiating arm”

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.B.1.v.

- vi. **13[e]: “the first radiating arm and the second radiating arm are coupled through a close proximity region formed by a portion including the first-radiating-arm first point and the second-radiating-arm second tip;”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.B.1.vi.

- vii. **13[f]: “a length of a line segment between the first-radiating-arm first point and the second-radiating-arm second tip is shorter than a distance between a point of the feeding terminal and a point of the grounding terminal;”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.B.1.vii.

- viii. **13[g]: an orthogonal projection of the line segment onto a plane of the ground plane structure does not intersect the ground plane structure; and”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.B.1.viii.

- ix. **13[h]: “the first radiating arm, the second radiating arm and the close proximity region are configured to simultaneously provide a bandwidth required for the antenna system to operate in the multiple frequency bands.”**

This limitation is met for at least the same reasons discussed with respect to claim 1 above. *See* Section IX.B.1.ix.

X. NO BASIS TO DENY PETITION UNDER 35 U.S.C. §§325(D) OR 314(A)

As established above, the merits of the Petition are compelling, and the Board should institute trial. The facts do not support the Board exercising its discretion to deny institution.

A. Denial Under §325(d) Is Inappropriate

In applying §325(d), “the Board uses the following two-part framework: (1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.” *Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GMBH*, IPR2019-01469, Paper 6, 8 (PTAB Feb. 13, 2020) (precedential).

Prongs 1 and 2 are evaluated by analyzing the Factors set forth in *Becton, Dickinson and Company v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8, 17–18 (PTAB Dec. 15, 2017) (informative, precedential as to Section III.C.5, first para.). Factors A, B, and D are typically handled under Prong 1, while Factors C, E, and F are typically handled under Prong 2.

First, the prior art relied on for Ground 1, Johnson, was not cited at all during the prosecution of the '604 Patent. Further, none of the prior art references cited during prosecution were substantially similar to Johnson.

Second, while the prior art relied on for Ground 2, McKivergan was cited in one non-final rejection during prosecution, McKivergan was not cited in an office action against any of the Challenged Claims. In the first non-final rejection issued during the prosecution of the '835 Application, the examiner cited McKivergan as anticipating original claims 1, 16, and 18. EX1007, 54-55. In response to this rejection, Patent Owner canceled all of the pending claims and added entirely new claims. EX1007, 60-65. Thereafter, the examiner did not cite McKivergan again.

B. Denial under §314(a) is Inappropriate

Denial under *Fintiv* is also inappropriate. *Apple Inc. v. Fintiv Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) ("*Fintiv*").

i. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;

Petitioner intends to move the court to stay the Parallel Litigation after filing this Petition. Petitioner has filed IPR petitions against each unexpired asserted claim in the Parallel Litigation such that, based on the grounds for invalidity asserted herein, there will be no asserted claim for which a stay would prejudice the Patent Owner in any way if the case were stayed. The stage of the Parallel Litigation and

potential simplification (resulting from the Board finding claims unpatentable) weighs against the exercise of discretion. At worst, this factor is neutral because the Board “will not attempt to predict” how the district court will proceed. *Sand Revolution II, LLC v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24, 7 (PTAB Jun. 16, 2020).

ii. proximity of the court’s trial date to the Board’s projected statutory deadline for a final written decision;

While the Court has initially set the trial date in the Parallel Litigation for July 8, 2024, trial dates are notoriously unreliable and should be an insufficient basis upon which to deny institution. *See* EX1008. In the context of a motion to transfer venue, the Federal Circuit has explained that “[a] court’s general ability to set a fast-paced schedule is not particularly relevant.” *In re Apple Inc.*, 979 F.3d 1332, 1344 (Fed. Cir. 2020); *see also DISH Network L.L.C. v. Broadband iTV, Inc.*, IPR2020-01280, Paper 17 at 13-16 (PTAB Feb. 4, 2021). The Federal Circuit found error in the Board’s reliance on the case’s scheduled trial date. *See Apple Inc.*, 979 F.3d at 1343. It would be error for the Board to speculatively rely upon the current schedule. The Board has repeatedly been persuaded by the uncertainty in litigation timelines. *Sand Revolution*, Paper 24 at 8-9; *see also* IPR2021-00255, Paper 22 at 11-12 (PTAB Aug. 23, 2021). These same uncertainties are present here.

iii. investment in the parallel proceeding by the court and the parties;

Investment in the Parallel Litigation is not significant. No depositions have been taken, claim construction has not occurred, and discovery is in its early phases. Thus, this factor weighs in favor of institution. *See, e.g., Nokia of America Corp and Ericsson Inc. v. IPCOM, GMBH & Co. KG*, IPR2021-00533, Paper 10 at (PTAB Aug. 12, 2021) (“If, at the time of institution, the district court has not issued substantive orders related to the patent at issue in the petition, this fact weighs against exercising discretion to deny institution.”).

iv. overlap between issues raised in the petition and in the parallel proceeding;

The issues raised in this petition are among those raised in the Parallel Litigation. This factor, however, should be neutral weighed insofar as, the Patent Owner/Plaintiff will almost certainly narrow the asserted claims, from the almost 45 asserted claims across six asserted patents.

v. whether the petitioner and the defendant in the parallel proceeding are the same party;

The Petitioner here and the defendant in the Parallel Litigation are the same.

vi. other circumstances that impact the Board’s exercise of discretion, including the merits.

As shown above, the merits are strong such that this factor weighs heavily against discretionary denial.

XI. CONCLUSION

Petitioner respectfully requests that *Inter Partes* review be instituted and that Claims 1, 3, 4, 9, and 13 of the '604 Patent be canceled.

Respectfully submitted,

Dated: October 24, 2023

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APPENDIX: CHALLENGED CLAIM LISTING

Claim No.	Limitation
1[pre]	A wireless portable device comprising:
1[a]	a printed circuit board comprising a ground plane structure;
1[b]	an antenna system operating in multiple frequency bands, the antenna system comprising:
1[c]	a first radiating arm comprising a first-radiating-arm first tip, a first-radiating-arm second tip, and a feeding terminal connected to the first-radiating-arm first tip, wherein the first radiating arm is not connected to the ground plane structure through a grounding terminal; and
1[d]	a second radiating arm comprising a second-radiating-arm first tip, a second-radiating-arm second tip, and a grounding terminal connected to the second-radiating-arm first tip, wherein the second radiating arm does not include a contact point with first radiating arm, wherein:
1[e]	the first radiating arm and the second radiating arm are coupled through a close proximity region from a first specific portion of the first radiating arm and from a second specific portion of the second radiating arm;
1[f]	a length of a line segment between a point of the first specific portion and a point of the second specific portion is shorter than a distance between the feeding terminal and the grounding terminal;
1[g]	an orthogonal projection of the line segment onto a plane of the ground plane structure does not intersect the ground plane structure; and
1[h]	the first radiating arm, the second radiating arm and the close proximity region are configured to simultaneously provide the bandwidth required for the antenna system to operate in the multiple frequency bands.
3	The wireless portable device of claim 1, wherein the close proximity region is located at a distance from the feeding terminal that is longer than 1/40 of the longest free-space operating wavelength of the antenna system.
4	The wireless portable device of claim 1, wherein the close proximity region is located at a distance from the feeding terminal that is longer than 1/40 of the longest free-space operating wavelength of the antenna system.

9	The wireless portable device of claim 1, wherein the first radiating arm comprises a portion formed by ten or more connected segments, each of the connected segments forming an angle with its neighboring connected segment, the angle being smaller than 180 degrees, and the segments being shorter than $\frac{1}{8}$ of the longest free-space operating wavelength of the antenna system.
13[pre]	A wireless portable device comprising:
13[a]	a printed circuit board comprising a ground plane structure;
13[b]	an antenna system operating in multiple frequency bands and included within the wireless portable device, the antenna system comprising:
13[c]	a first radiating arm comprising a first-radiating-arm first tip, a first-radiating-arm second tip, a feeding terminal connected to the first-radiating-arm first tip, and a first-radiating-arm first point; and
13[d]	a second radiating arm comprising a second-radiating-arm first tip, a second-radiating-arm second tip, and a grounding terminal connected to the second-radiating-arm first tip, wherein: the second radiating arm does not include a contact point with the first radiating arm;
13[e]	the first radiating arm and the second radiating arm are coupled through a close proximity region formed by a portion including the first-radiating-arm first point and the second-radiating-arm second tip;
13[f]	a length of a line segment between the first-radiating-arm first point and the second-radiating-arm second tip is shorter than a distance between a point of the feeding terminal and a point of the grounding terminal;
13[g]	an orthogonal projection of the line segment onto a plane of the ground plane structure does not intersect the ground plane structure; and
13[h]	the first radiating arm, the second radiating arm and the close proximity region are configured to simultaneously provide a bandwidth required for the antenna system to operate in the multiple frequency bands.

CERTIFICATE UNDER 37 C.F.R. §42.24(D)

The undersigned certifies that the foregoing Petition for *Inter Partes* Review, excluding any table of contents, mandatory notices under 37 C.F.R. §42.8, certificates of service or word count, or appendix of exhibits, contains 7,196 words according to the word-processing program used to prepare this document (Microsoft Word), which is less than the 14,000 allowed under 37 C.F.R. §42.24(a)(1)(i).

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing Petition for *Inter Partes* Review together with all exhibits and other papers filed therewith was served on Patent Owner, by USPS Express Mail or an equivalent next-day delivery service, directed to the attorneys of record for the patent at the following address:

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Dated: October 24, 2023

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