

Petition for *Inter Partes* Review of
U.S. Patent No. 11,835,421 B2

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

REVVO TECHNOLOGIES, INC.,
Petitioner

v.

CEREBRUM SENSOR TECHNOLOGIES, INC.,
Patent Owner

IPR2025-00632

U.S. Patent No. 11,835,421 B2
Issue Date: December 5, 2023

Title: SENSOR ASSEMBLIES AND SYSTEMS FOR MONITORING A DYNAMIC OBJECT

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,835,421 B2**

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Ex. No.	Description of Document
1001	U.S. Patent No. 11,835,421 to Keith George Ferry (filed October 29, 2020, issued December 5, 2023) (“’421 patent”)
1002	File History of the ’421 patent
1003	Declaration of Isaac Davenport, Ph.D.
1004	U.S. Patent Application No. 16/671,105 (“’105 application”)
1005	U.S. Patent Application Publication No. 2019/0184773 to Toshiaki Saito (filed February 22, 2019, published June 20, 2019) (“Saito”)
1006	U.S. Patent Application Publication No. 2021/0370727 to Shigeru Yamaguchi (PCT application filed July 19, 2019, published December 2, 2021) (“Yamaguchi-727”)
1007	U.S. Patent Application Publication No. 2021/0394566 to Shigeru Yamaguchi (PCT application filed July 19, 2019, published December 23, 2021) (“Yamaguchi-566”)
1008	U.S. Patent No. 6,769,319 to William G. McDonald et al. (filed July 9, 2001, issued August 3, 2004) (“McDonald”)
1009	WO/2020036859 to Sunjay Dodani and Andrew Wing-Hong (filed August 12, 2019, published February 20, 2020) (“Dodani-859”)
1010	<i>Reserved</i>
1011	U.S. Patent No. 7,009,506 to Paul Wilson et al. (filed July 9, 2002, issued March 7, 2006) (“Wilson-506”)
1012	<i>Reserved</i>
1013	U.S. Patent No. 8,373,551 to David Norman Laird et al. (filed July 29, 2009, issued February 12, 2013) (“Laird”)
1014	Patent Owner’s Supplemental Initial Infringement Contentions served on November 7, 2024 in <i>Cerebrum Sensor Techs., Inc. and Tire Stickers LLC v. Revvo Techs., Inc.</i> , C.A. No. 24-245 (JLH) (SRF) (D. Del.)

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Ex. No.	Description of Document
1015	Exhibit 3 to Patent Owner’s Supplemental Initial Infringement Contentions served on November 7, 2024 in <i>Cerebrum Sensor Techs., Inc. and Tire Stickers LLC v. Revvo Techs., Inc.</i> , C.A. No. 24-245 (JLH) (SRF) (D. Del.)
1016	Joint Claim Construction Chart (Dkt. No. 84), <i>Cerebrum Sensor Techs., Inc. and Tire Stickers LLC v. Revvo Techs., Inc.</i> , C.A. No. 24-245 (JLH) (SRF) (D. Del.)
1017	Exhibits A-J to Joint Claim Construction Chart (Dkt. No. 84-1), <i>Cerebrum Sensor Techs., Inc. and Tire Stickers LLC v. Revvo Techs., Inc.</i> , C.A. No. 24-245 (JLH) (SRF) (D. Del.)
1018	Listing of Challenged Claims
1019	PCT/JP2019/028506
1020	PCT/JP2019/028502
1021	U.S. Patent No. 10,836,222 to Stewart et al. (filed October 26, 2018, issued November 17, 2020) (“Stewart”)
1022	WO 2005/049339 to Zaroor et al. (filed November 18, 2004, published June 2, 2005) (“Zaroor”)
1023	Proof of Service of Complaint (Dkt. No.6) in <i>Cerebrum Sensor Techs., Inc. and Tire Stickers LLC v. Revvo Techs., Inc.</i> , C.A. No. 24-245 (JLH) (SRF) (D. Del.)
1024	Joint Stipulation to Suspend All Deadlines Pending Mediation (Dkt. No. 96) in <i>Cerebrum Sensor Techs., Inc. and Tire Stickers LLC v. Revvo Techs., Inc.</i> , C.A. No. 24-245 (JLH) (SRF) (D. Del.)
1025	Order Granting Joint Stipulation to Suspend All Deadlines Pending Mediation (Dkt. No. 97) in <i>Cerebrum Sensor Techs., Inc. and Tire Stickers LLC v. Revvo Techs., Inc.</i> , C.A. No. 24-245 (JLH) (SRF) (D. Del.)

I. INTRODUCTION

Petitioner Revvo Technologies, Inc. respectfully submits this Petition for *Inter Partes* Review of claims 1, 2, 5, 7–12, 20–24, 28, 31–34, 41, 43, 44, 48, and 50–53 of U.S. Patent No. 11,835,421 B2 (“’421 patent”) (EX1001). Petitioner requests institution of *Inter Partes* review (“IPR”) and a finding that challenged claims 1, 2, 5, 7–12, 20–24, 28, 31–34, 41, 43, 44, 48, and 50–53 are unpatentable.

II. MANDATORY NOTICES UNDER §42.8(A)(1)

A. Real Party-In-Interest Under §42.8(b)(1)

Revvo Technologies, Inc. is the real party-in-interest.

B. Related Matters Under §42.8(b)(2)

The ’421 patent is the subject of pending litigation involving Petitioner and Patent Owner: *Cerebrum Sensors Technologies Inc. v. Revvo Technologies, Inc.*, Case No. 1:24-cv-00245-JLH (D. Del. Feb. 23, 2024). The Complaint in this related litigation was first served on February 23, 2021. (EX1023.) Petitioner is also filing an IPR petition challenging the asserted claims of U.S. Patent No. 11,124,027.

C. Lead and Back-Up Counsel (§42.8(b)(3))

Petitioner provides the following designation of counsel:

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Petition for *Inter Partes* Review of
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D. Service Information

This Petition is being served by Federal Express to the attorneys of record for the '421 patent: 125632 - Snell & Wilmer (LA), c/o Grant T. Langton, 1 East Washington Street, Suite 2700, Phoenix AZ 85004. This Petition is also being served on litigation counsel for Patent Owner identified in the Certificate of Service.

Please send all correspondence to the lead and backup counsel at the addresses shown above. Petitioner consents to electronic service at the addresses provided above for lead and back-up counsel.

III. FEE PAYMENT (§42.103)

Petitioner requests review of 27 claims, with a \$61,745 payment.

IV. REQUIREMENTS UNDER §§42.104 AND 42.108

A. Grounds for Standing

Petitioner certifies that the '421 patent is available for IPR and that Petition is not barred or otherwise estopped.

B. Identification of Challenge and Statement of Precise Relief Requested

Petitioner requests IPR institution based on:

Ground	Claim(s)	Basis for Challenge Under § 103
1	1, 2, 7-9, 11, 12, 20-24	Yamaguchi-727
2	5, 28, 31-33, 41, 43, 44, 48, 50-52	Yamaguchi-727 in view of Yamaguchi-566
3	34, 53	Yamaguchi-727 in view of Yamaguchi-566 in further view of Dodani-859
4	10	Yamaguchi-727 in view of McDonald

Submitted with this Petition is the Declaration of Isaac Davenport, Ph.D. (EX1003) (“Davenport”), a qualified technical expert. (Davenport-¶¶1-9, Appx. A.)

C. Considerations Under §§ 314(a) and 325(d)

§314(a): The *General Plastic* factors are not relevant as this is the first IPR petition filed against the ’421 patent. Nor do the *Fintiv* factors support discretionary denial. The pending litigation against Petitioner is in its early stage, no claim construction rulings have occurred, and all deadlines are currently stayed. (EX1024; EX1025.) The Petition was filed before the one-year deadline under §315(b).

§325(d): This Petition does not raise §325(d) concerns because it relies on new prior art that was not considered during prosecution. Nor are Petitioner’s cited prior art cumulative. The applicant distinguished the closest prior art reference (Saito) from the Challenged Claims because its sensor components were fully

encapsulated in resin, whereas Petitioner relies primarily on Yamaguchi-727 and Yamaguchi-566 that lack Saito's fully potted configuration.

V. OVERVIEW OF THE '421 PATENT

A. Specification and Claims

The '421 patent relates to “sensor assemblies and systems for monitoring dynamic objects” like vehicle tires. ('421, 8:28-30, 8:56-57.) “[I]n 2007 the U.S. government mandated use of direct tire-pressure monitoring systems (TPMS) technology in nearly all motor vehicles.” (*Id.*, 2:52-54.) According to the '421 patent, then-existent TPMS solutions were “impractical or inadequate” due in relevant part to “[e]xcessive sizing and weight[,]” “[d]ifficulty of affixing to all tire inner surfaces,” and “[l]imited functionality and reporting of total tire performance parameters[.]” (*Id.*, 3:45-57.) The purported invention “seek[s] to fulfill the shortcomings of [] traditional TPMS systems[.]” (*Id.*, 8:57-58.)

FIG. 6 depicts an embodiment of a sensor assembly **80** below.

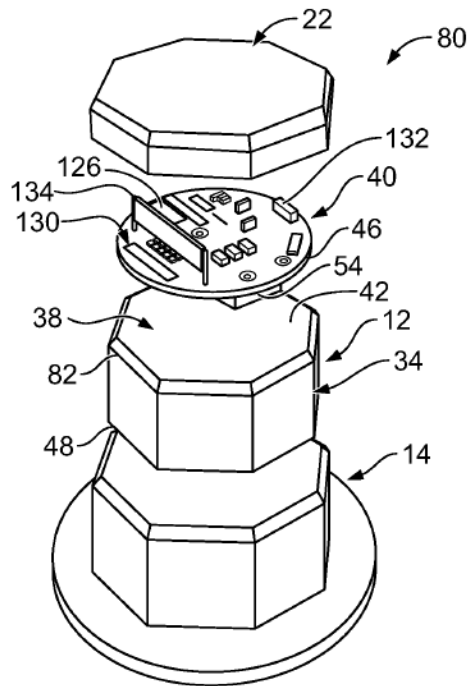


FIG. 6

(’421, FIG. 6.)

Sensor assembly **80** includes a housing **12**, electrical sensor **40**, and retainer **14**. The housing **12** “comprises a wall structure **34** and bottom section **48** that is provided in an assembled state” and a “top cover **22** that is configured to attach over an opening **82** of [a] housing inside cavity **38**[.]” (*Id.*, 12:7-9, 12:22-24.) While not shown, the ’421 patent explains that inside cavity **38** “is configured having one or more surface features... that engage an underside of the electrical sensor device **40** peripheral edge **46** to fix axial displacement of electrical sensor device **40** within the inside cavity **38**[.]” such as “one or more ribs or tabs that project outwardly a distance from the wall structure inside surface **42**.” (*Id.*, 12:15-22.) In an example,

sensor assembly **80** “is assembled by inserting the electrical sensor device **40** into the housing inside cavity **38** until the surface features engage the electrical sensor device **40** to fixedly limit its axial displacement therein.” (*Id.*, 12:25:29.)

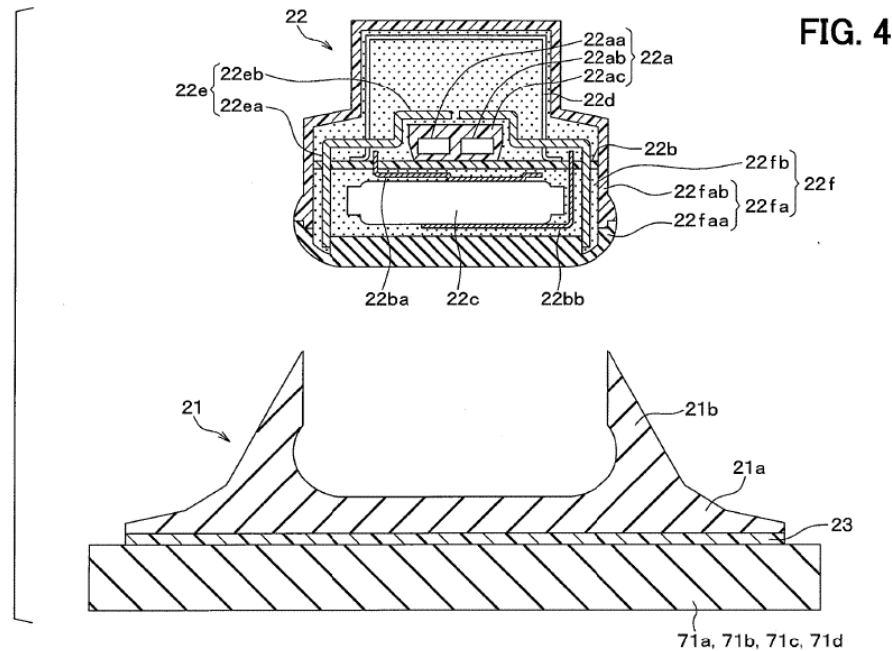
The electrical sensor device “is configured to sense, transmit and/or receive information regarding surrounding conditions, orientation and/or location when the sensor assembly is attached with a dynamic object” like a tire. (’421, 4:34-38.) The sensor element within the device “is configured to sense one or more variables selected from the group consisting of air pressure, temperature, acceleration, or orientation or location of the environment[.]” (*Id.*, 4:34-41.)

The Challenged Claims are appended to this Petition as **EX1018**.

B. Relevant Prosecution History

During prosecution of the underlying application that matured into the issued ’421 patent, the applicant received a non-final rejection to its originally-drafted claims as anticipated by U.S. Patent Application No. 2019/0184773 to Saito (“Saito”) [EX1005]. (*See* EX1002, pp. 399-430 (November 23, 2022 Non-Final Rejection).) Saito describes a “tire-mounted sensor” to “be mounted to an inner wall surface of a tire” that includes an acceleration sensor integrated into a sensor chip mounted to a circuit board, along with an antenna for data transmission, the board being fully potted within a housing. (*See, e.g.*, Saito, Abstract, [0003], [0015], [0029]-[0031], [0033], [0035], [0036], [0037], [0040], [0045], [0048], [0049], FIGs.

3, 4.) FIG. 4 depicts Saito's fully potted acceleration sensor (**22aa**) in an accommodation structure (**22f**) of a housing (**22**), contoured to fit a corresponding rubber bracket (**21**) affixed to an inner wall surface of a tire.



(Saito, FIG. 4; *see also id.*, [0024]-[0026], [0029], [0030].)

In response to the Examiner's rejection, the applicant amended claim 1 to specify that "the internal cavity comprises an unfilled open space above or below the electrical sensor device in the housing." (EX1002 at 251 (Applicant's May 22, 2023 Claim Amendment).) The applicant distinguished Saito's fully potted accelerometer configuration from its claims because Saito discloses that "the sensor components are encapsulated within the accommodation structure by the resin

sealing portion.” (*Id.* at 266 (Applicant’s May 22, 2023 Remarks).) The Examiner found the applicant’s amendments and corresponding arguments persuasive and allowed the claims over Saito. (*Id.* at 65-68 (July 27, 2023 Notice of Allowance).)

VI. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art (“POSA”) as of the alleged priority date would have had at least an B.S. in electrical engineering or mechanical engineering (or equivalent degree) and at least one-to-two years of experience in sensor system design, such as TPMS or related sensor technology. A person could also have qualified with more formal education and less technical experience, or vice versa. (Davenport-¶¶11-16.)

VII. CLAIM CONSTRUCTION

Petitioner accepts Patent Owner’s proposed constructions from the underlying district court litigation for purposes of this proceeding:

Disputed Term	Patent Owner’s Proposed Construction
“(a) housing”	a protective cover
“internal cavity”	an open space inside of the housing
“enclosed” / “enclosed within the housing”	surrounded within the housing
“unfilled open space” / “open space”	space without filling agents or materials
“surface feature[s]”	structure[s] on or of a surface

Disputed Term	Patent Owner’s Proposed Construction
“fixed”/“having a fixed placement”	not displaceable in at least one direction
“the housing includes an outer structure that defines the internal cavity”	the space inside the housing structure is the internal cavity

(See EX1017, Exhibit A at 5-7, 10; *id.*, Exhibit B at 10-15.)

Petitioner’s proposed grounds and analysis of how the prior art teaches or renders obvious the limitations of the claims would be unchanged even if the Board decides not to adopt Patent Owner’s constructions.

VIII. SUMMARY OF PRIOR ART

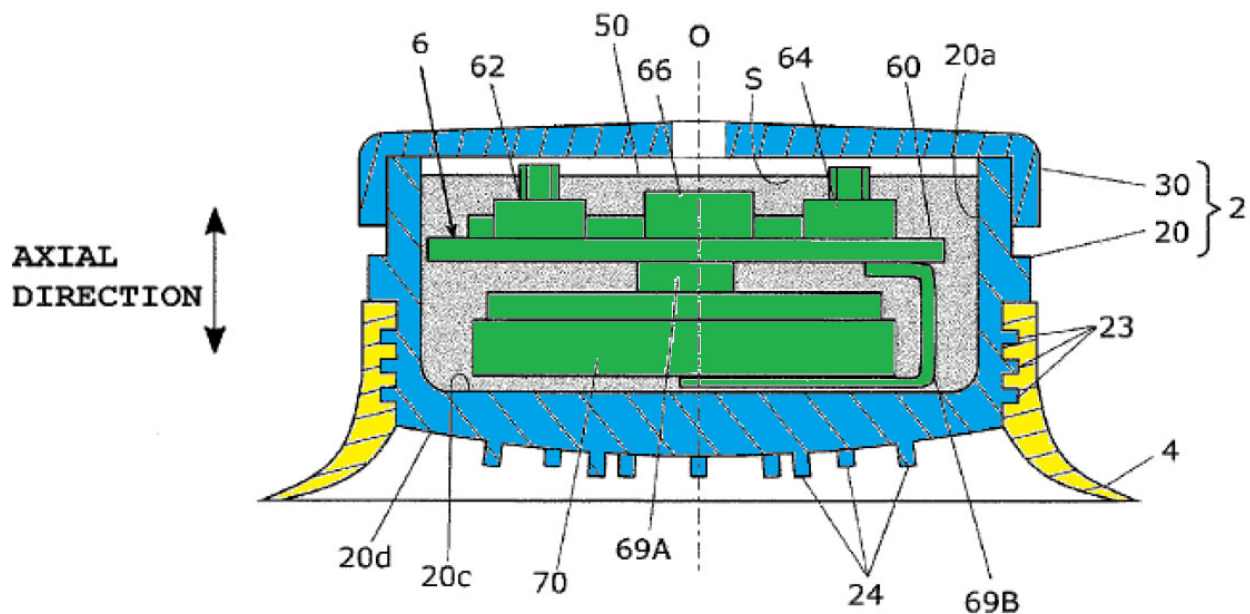
1. Yamaguchi-727 [EX1006]

Yamaguchi-727 [EX1006] is a published patent application whose PCT application, PCT/JP2019/028506 [EX1019], was filed on July 19, 2019, and qualifies as prior art under AIA 35 U.S.C. § 102(a)(2).

Like the ’421 patent, Yamaguchi-727 identifies several issues with pre-existing tire sensor assemblies, including weight that “tends to be high due to a size, a shape and an internal structure of the patch[.]” (Yamaguchi-727, [0004].) As a technical solution, Yamaguchi-727 proposes a similar design to the purported invention in the ’421 patent, namely a “functional component in which an electronic component capable of acquiring information inside a tire is housed and which is

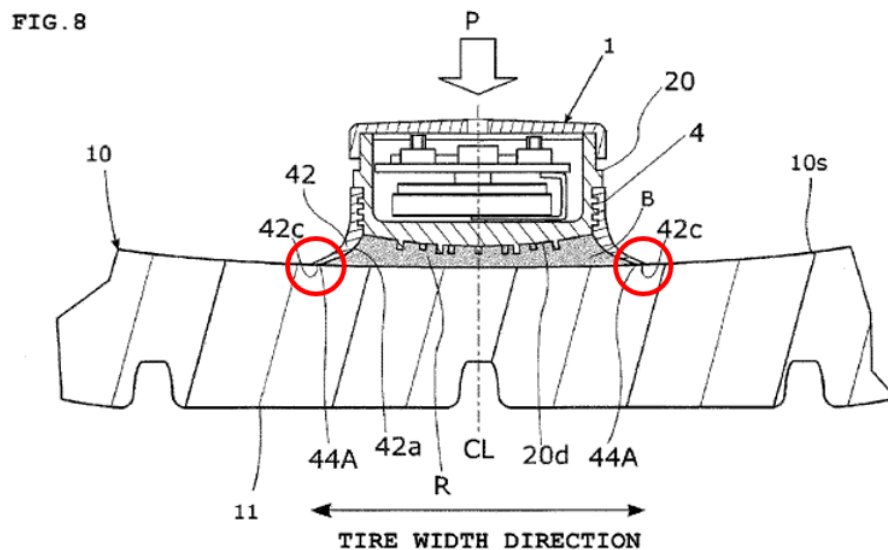
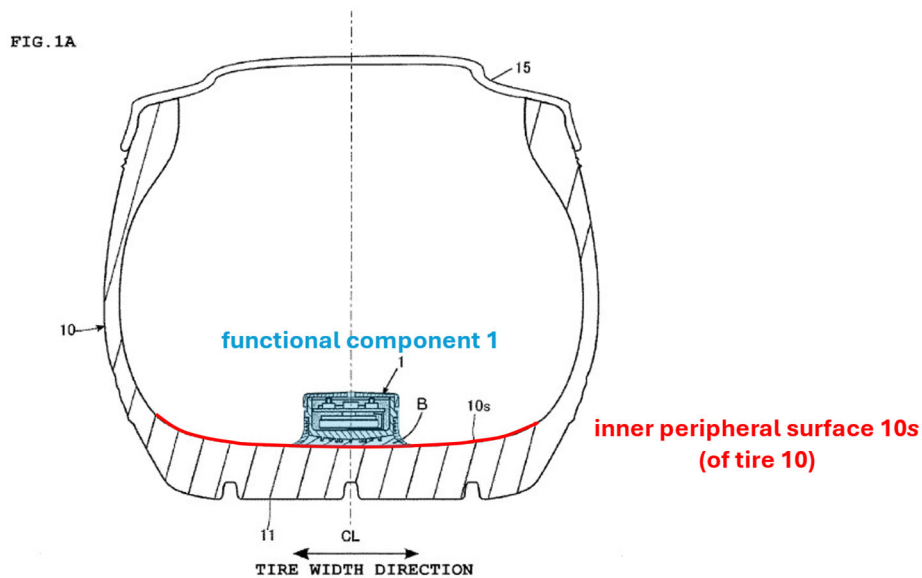
attachable to an inner peripheral surface of the tire[.]” (*Id.*, [0006].)

Yamaguchi-727 teaches a functional component **1** that includes: (1) a housing **2** comprising a housing cap **30** and housing case **20**; (2) a module **6** disposed within an internal housing space *S* of the housing **2** and comprising a circuit board **60** with various sensors (**62**, **64**, **66**) and other components, a battery **70**, and other related circuitry; and (3) a skirt **4** that attaches with housing **2** by complimentary features between the two structures (*i.e.*, annular recess **43** of skirt **4** with annular convex parts **23** of housing case **20**). (Yamaguchi-727, [0027], [0028], [0036], [0040]-[0048], FIGs. 3A, 3C, 4A, 4B, 4C, 5.) FIG. 5 below depicts an exemplary arrangement of these subcomponents of functional component **1**, where housing **2** is in blue, module **6** in green, and skirt **4** in yellow.



(*Id.*, FIG. 5.)

Skirt **4** attaches functional component **1** to inner peripheral surface **10s** of a tire **10** at flat surface **42c** and through use of adhesive agent **B** that fills a cavity space **R** between skirt **4**, housing case **20**, and inner peripheral surface **10s**. (Yamaguchi-727, [0052]-[0054], FIGs. 1A, 7, 8.) FIGs. 1A and 8 depict this arrangement.

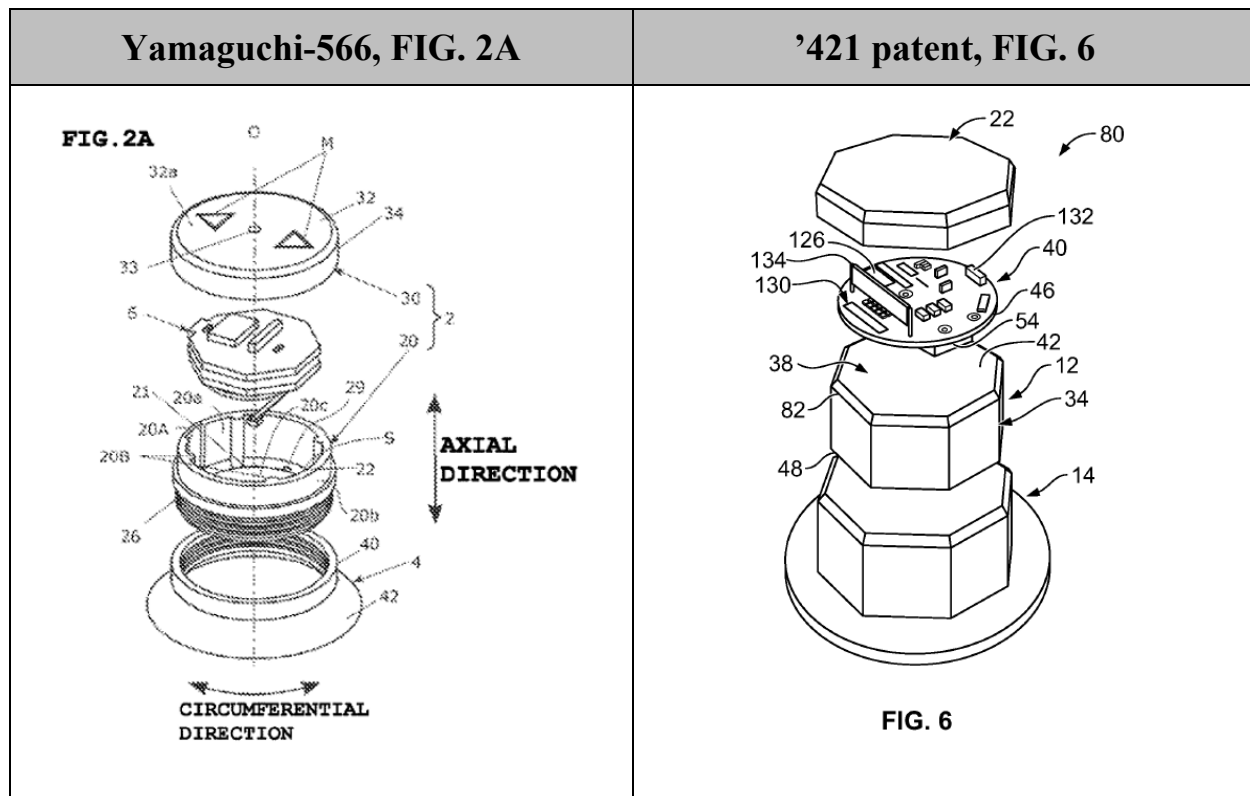


(*Id.*, FIGs. 1A, 8.)

2. Yamaguchi-566 [EX1007]

Yamaguchi-566 [EX1007] is a published patent application whose PCT application, PCT/JP2019/028502 [EX1020], was filed on July 19, 2019, the same day as Yamaguchi-727, and qualifies as prior art under AIA 35 U.S.C. §102(a)(2).

Yamaguchi-566 shares disclosures with Yamaguchi-727 in its teachings on “[a] functional component to be attached inside a tire, for detecting a state of the tire as information.” (Yamaguchi-566, Abstract, [0006].) Like Yamaguchi-727, Yamaguchi-566’s functional component includes a housing **2** with a housing case **20** having a housing space *S* for the module **6** and enclosed by a housing cap **30**, attached to a skirt **4** that adheres to an inner peripheral surface of a tire. (*Id.*, [0017], [0018], [0020], [0024], [0027], FIGs., 1A, 2A, 2B.) Yamaguchi-566 also includes FIG. 2A that depicts an exploded view of its functional component that is near-identical to the sensor assembly disclosed in FIG. 6 of the ’421 patent:



3. Dodani-859 [EX1009]

Dodani-859 [EX1009], filed on August 12, 2019, qualifies as prior art under AIA 35 U.S.C. §102(a)(2).

Like Yamaguchi-727 and Yamaguchi-566, Dodani-859 also describes a tire sensor device “that is adapted to be mounted to a tire without invasive mounting requirements” and includes, *e.g.*, “a plurality of sensors beyond a TPMS, including, optionally, a high-frequency accelerometer, a microphone, and/or a temperature sensor.” (Dodani-859, [0024].) The tire sensor is “adapted to capture, measure, and analyze data from the tire using the plurality of sensors.” (*Id.*) Dodani-859 explains that “[b]y using a high-frequency accelerometer, for example, characteristics of

individual rotations of each tire (e.g., the tires ‘footprint’) can be determined.” (*Id.*; *see also id.*, [0034].) Dodani-859 then teaches multiple use cases for collected accelerometer data. (*See, e.g., id.*, [0081]-[0087].)

4. McDonald [EX1008]

McDonald [EX1008] issued on August 3, 2004 and qualifies as prior art under AIA 35 U.S.C. §102(a)(1).

McDonald teaches a commonly-used technique of using a filter in a tire-mounted sensor assembly to “block potentially corrosive elements or media from the exterior environment while still permitting the unhindered transmission of pressure from the exterior environment to the sensor element inside the component.” (McDonald, 2:57-63; *see also id.*, 7:1-10.) McDonald describes multiple configurations for the filter within the sensor assembly. (*See, e.g., id.*, 6:24-27, FIG. 6.)

IX. THE CHALLENGED CLAIMS ARE OBVIOUS

A. Overview of Grounds

The Challenged Claims attempt to lay claim to traditional TPMS assemblies with accelerometer capabilities that were well-known. This Petition relies primarily on Yamaguchi-727 (EX1006), which describes a tire-mounted sensor assembly similar to the ’421 patent where a sensor device that includes an accelerometer is positioned in a housing with partial potting material, and the housing is attached with

complementary features to a skirt that is bonded to the inner surface of a tire. Yamaguchi-727 is a strong reference that discloses the majority of the limitations of the Challenged Claims. The Petition adds Yamaguchi-566 (EX1007) in **Ground 2** primarily to address a potential challenge from Patent Owner for the “**surface features**” limitations in the Challenged Claims, and for certain functionality related to receiving data/instructions from an external receiver. Yamaguchi-566 complements Yamaguchi-727 and fills in these obvious implementation details.

Dodani-859 (EX1009) and McDonald (EX1008) are cited for standard functionality and structures of tire sensor assemblies that, although not expressly described in Yamaguchi-727, were well-known. *See, e.g., Spectra-Physics, Inc. v. Coherent, Inc.*, 827 F.2d 1524, 1534 (Fed. Cir. 1987) (“A patent need not teach, and preferably omits, what is well known in the art.”) **Ground 3** adds to Ground 2 by citing Dodani-859 for uses of accelerometer data to calculate certain tire operating parameters/conditions. **Ground 4** adds to Ground 1 by referring to McDonald for the use of a filter in the air path to a sensor to prevent exposure to corrosive media.

B. Ground 1: Claims 1, 2, 7-9, 11, 12, and 20-24 Over Yamaguchi-727

As explained below, Yamaguchi-727’s functional component **1** discloses and renders obvious “[a] **sensor assembly**.” The following table summarizes Petitioner’s mapping for key limitations in Ground 1 for ease of reference.

Claim Element	Summary of Prior Art Disclosures
“object that is rotated in use”	(inner peripheral surface 10s of) tire 10
“housing”	housing 2 comprising housing case 20 and housing cap 30
“electrical sensor device”	module 6 comprising circuit board 60 with electrical components (<i>e.g.</i> , sensors 62 , 64 , 66), battery 70 , and related circuitry
“internal cavity”	housing space <i>S</i>
“retaining member”	skirt 4
“display features or indicia”	attachment marks <i>M</i>
“receiver that is external to the object”	wireless circuit of a main unit provided in a vehicle

1. Claim 1

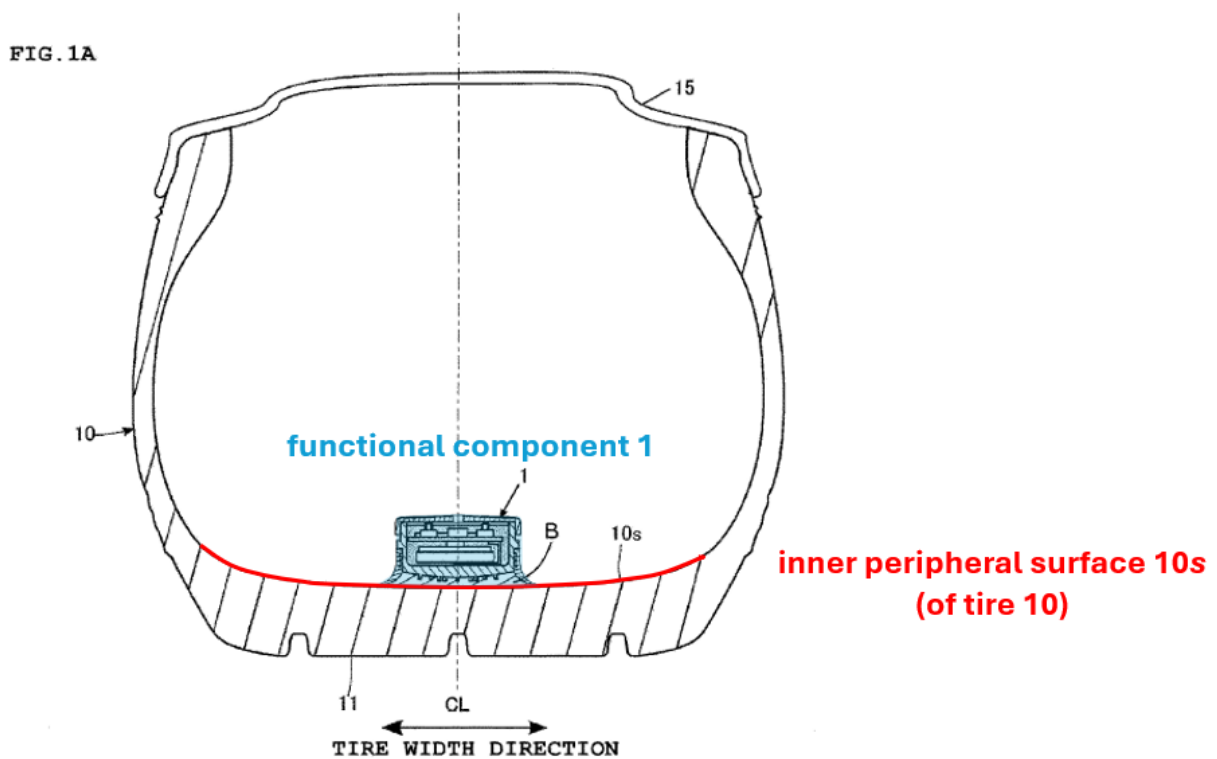
(a) Claim 1[pre]: “A sensor assembly configured for attachment with an object that is rotated in use, the sensor assembly comprising:”

Yamaguchi-727 teaches “[a] functional component [**1**] in which an electronic component capable of acquiring information inside a tire is housed and which is attachable to an inner peripheral surface of the tire[.]” (Yamaguchi-727, Abstract; *see also id.*, [0025]-[0027], [0040], FIG. 1A.)

The described functional component **1** is a “**sensor assembly**,” as it contains

a module **6** that “is provided with a circuit board **60**” that “includes the electronic component which are, for example, a plurality of sensors... each of which functions as a state acquiring means that acquires a state inside the tire[.]” (*Id.*, [0040]; *see also id.*, FIG. 5 (depicting module **6** provided with circuit board **60** that includes sensors **62**, **64**, and **66**).) (Davenport-¶¶74-75.)

Functional component **1** is also “**configured for attachment with an object that is rotated in use.**” Yamaguchi-727 describes how functional component **1** is attached to a tire **10**, which is an “**object that is rotated in use,**” as contemplated by the ’421 patent specification. (*See, e.g.*, ’421, 8:38-57.) Functional component **1** is “fixed by an adhesive agent B to an inner surface (inner peripheral surface **10s**) of the tire **10** and is disposed in the center in a width direction of the inner peripheral surface **10s** that is a back side of a tread **11**,” (Yamaguchi-727, [0026]), as shown in FIG. 1A.

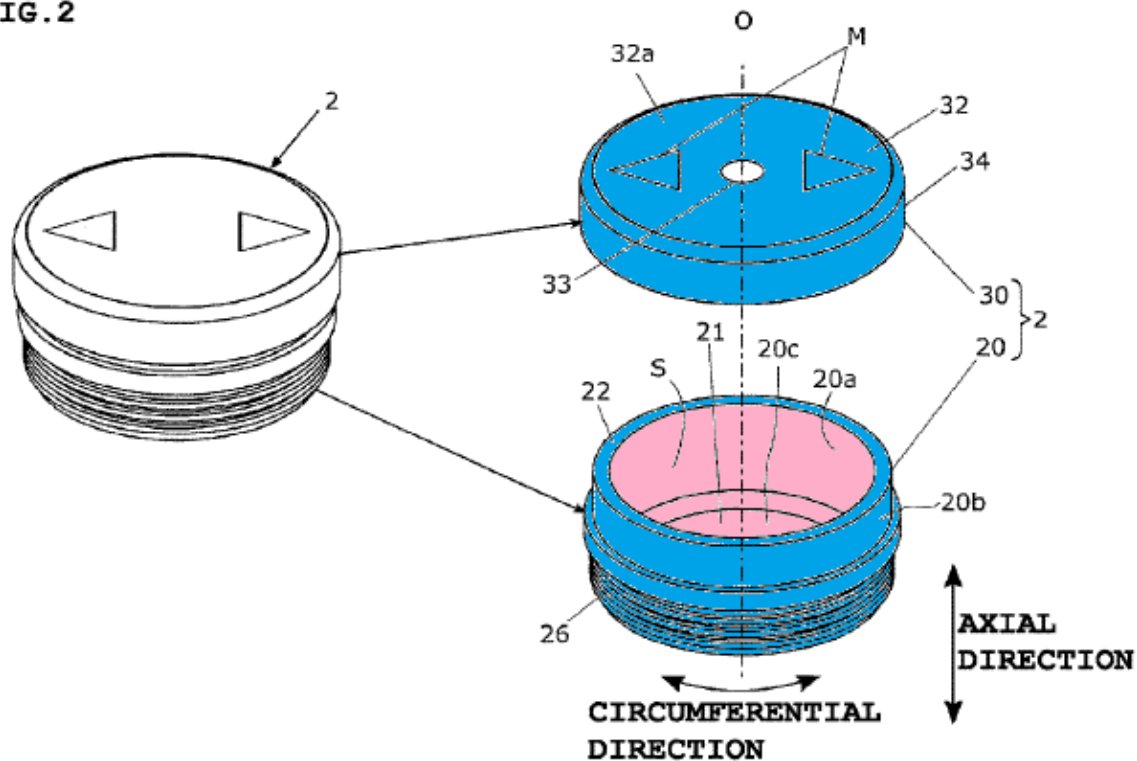


(*Id.*, FIG. 1A.)

- (b) **Claim 1[a]: “a housing comprising an outer surface and an internal cavity that is enclosed within the housing;”**

Yamaguchi-727 has a “**housing comprising an outer surface**” in housing 2, defined by housing case 20 and housing cap 30. (Yamaguchi-727, [0028].) Housing case 20 forms a housing space *S*, which is an “**internal cavity that is enclosed within the housing**” when housing cap 30 covers housing case 20. (*Id.*, [0029].) FIG. 2 below depicts housing 2 in an exploded view of housing case 20 and housing cap 30 (in blue) to show how housing case 20 forms a housing space *S* (in pink). (Davenport-¶76.)

FIG. 2



(Yamaguchi-727, FIG. 2.)

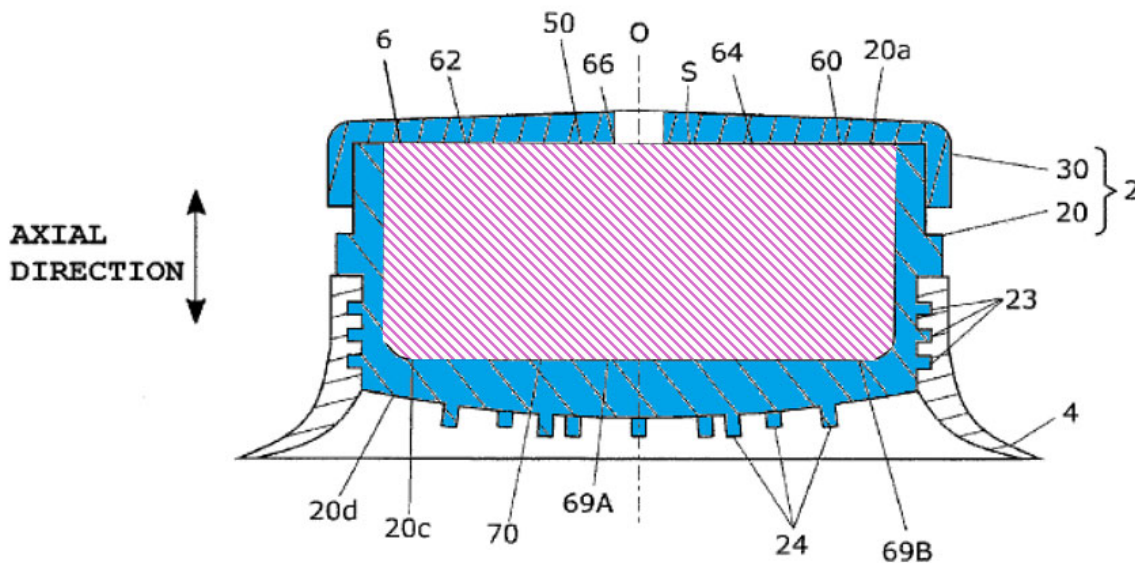
Yamaguchi-727 describes how housing case **20** is formed “by a circular bottom part **21** and a peripheral wall part **22** extending along the outer periphery from the outer peripheral edge of the bottom part **21** and rising annularly from the bottom part **21**.” (Yamaguchi-727, [0029].) Housing space *S* is an “**internal cavity that is enclosed within the housing**” defined by housing case **20** and housing cap **30**. It is “formed by an inner bottom surface **20c** of the bottom part **21** and an inner peripheral surface **20a** of the peripheral wall part **22**[,]” (*id.*), and a “cap **30** functioning as a lid member for the housing case **20**” (*id.*, [0028]), to enclose the

internal cavity. Yamaguchi-727 also satisfies claim 1[a] under Patent Owner's proposed constructions:

“housing”: Patent Owner construes this term as “a protective cover.” (EX1017, Exhibit A at 5.) Yamaguchi-727's housing **2** satisfies Patent Owner's interpretation of “housing,” as housing case **20** and cap **30** act as a protective cover over module **6**, the electrical sensor device within functional component **1**. (*See, e.g.,* Yamaguchi-727, [0028], [0029], FIG. 5; Davenport-¶79.)

“internal cavity”: Patent Owner claims the plain meaning for “internal cavity” is “an open space inside of the housing.” (EX1017, Exhibit A at 5-6.) Housing space *S* in Yamaguchi-727 discloses this interpretation of “internal cavity,” as it is an open space within housing case **20** and housing cap **30**. (*See, e.g.,* Yamaguchi-727, [0028], [0029], FIG. 2; Davenport-¶80.)

“enclosed within the housing”: Patent Owner proposes this term means “surrounded within the housing” (EX1017, Exhibit A at 6), which is present in Yamaguchi-727 when housing case **20** is covered by cap **30**. (*See, e.g.,* Yamaguchi-727, [0028], [0029], FIG. 2.) In FIG. 5 below the **“housing”** (in blue) in Yamaguchi-727 surrounds the **“internal cavity”** (in pink crosshatch) on all sides.

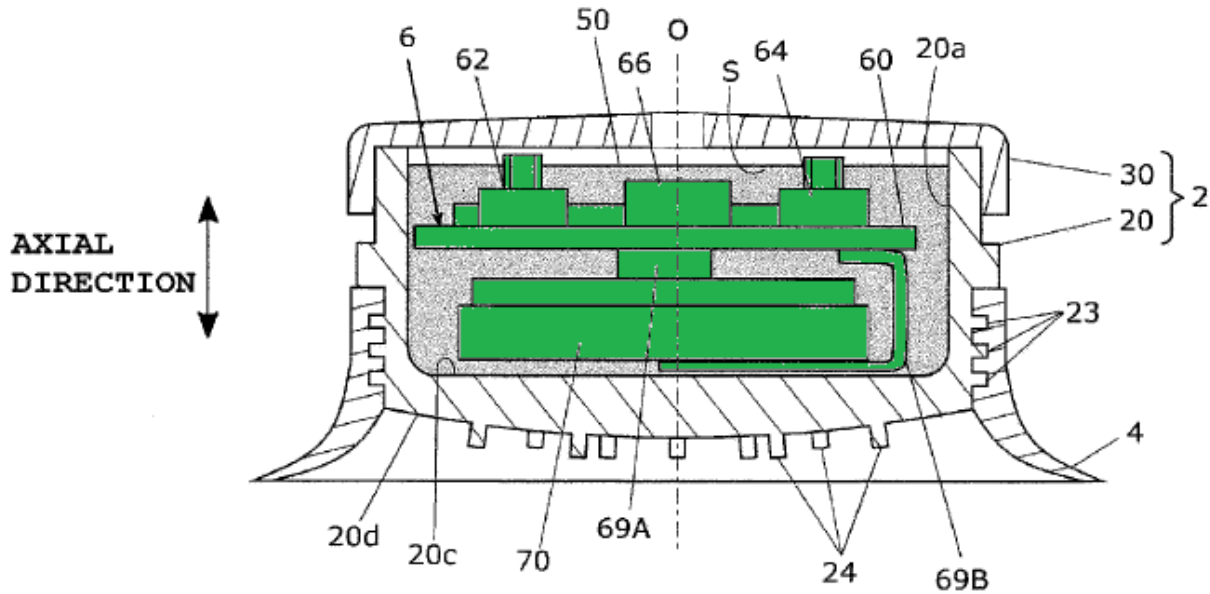


(*Id.*, FIG. 5; Davenport-¶81.)

- (c) **Claim 1[b]: “an electrical sensor device that is disposed within the internal cavity and attached therein to prevent movement of the device within the internal cavity,”**

The “**electrical sensor device**” in Yamaguchi-727 is represented by module **6** and includes circuit board **60**. Circuit board **60** further includes “electronic components which are, for example, a plurality of sensors such as a temperature sensor **62**, a pressure sensor **64** and an acceleration sensor **66** and the like...” (Yamaguchi-727, [0040] (underlining added).) Module **6** is green in FIG. 5, and “**disposed within the internal cavity**” represented by housing space *S*.

FIG. 5



(*Id.*, FIG. 5; Davenport-¶82.)

Circuit board **60** is “**attached... to prevent movement of the device within the internal cavity.**” While not shown in its figures, Yamaguchi-727 teaches “circuit board **60** and the housing case **20** are provided with *a positioning means*, which is not shown in the figure, *that are mutually fitted with each other*. Whereby, a measurement direction of the acceleration sensor 66 relative to the housing case **20** is defined.” (Yamaguchi-727, [0042].) The “positioning means” that serves to “mutually fit” circuit board **60** and housing case **20** together ensures that the accelerometer on circuit board **60** is properly oriented within the housing and prevents at least radial movement about axis O within housing space *S*. (*Id.*, [0042];

Davenport-¶82.)

After the circuit board **60** is placed within housing space *S* using the mutually fitting “positioning means,” the housing space *S* is filled with a potting material **50**, shown in grey shading in FIG. 5 above. (*Id.*, [0048].) Potting material **50** “eliminate[s] a gap between the module **6** [containing circuit board **60**] and the inner bottom surface **20c** and the inner peripheral [surface] **20a** forming the housing space *S*” and further serves to attach the circuit board **60** within the housing’s internal cavity (*S*) to prevent movement of the module **6** and, in particular, circuit board **60**. (*Id.*, [0048]; Davenport-¶83.)

As noted in Yamaguchi-727, “urethane-silicone resin or epoxy resin” are preferable materials for potting material **50**, such that they can retain the electrical components in place and “maintain sufficient resistance to forces received from the battery **70** and the circuitry board **60** even when the tire **10** is rotating, especially when the tire **10** is rotating at high speed.” (*Id.*) This further demonstrates that the potting material **50** is used to prevent movement of the components of module **6** (e.g., circuit board **60**) within the internal cavity of the housing case **20**. (Davenport-¶84.)

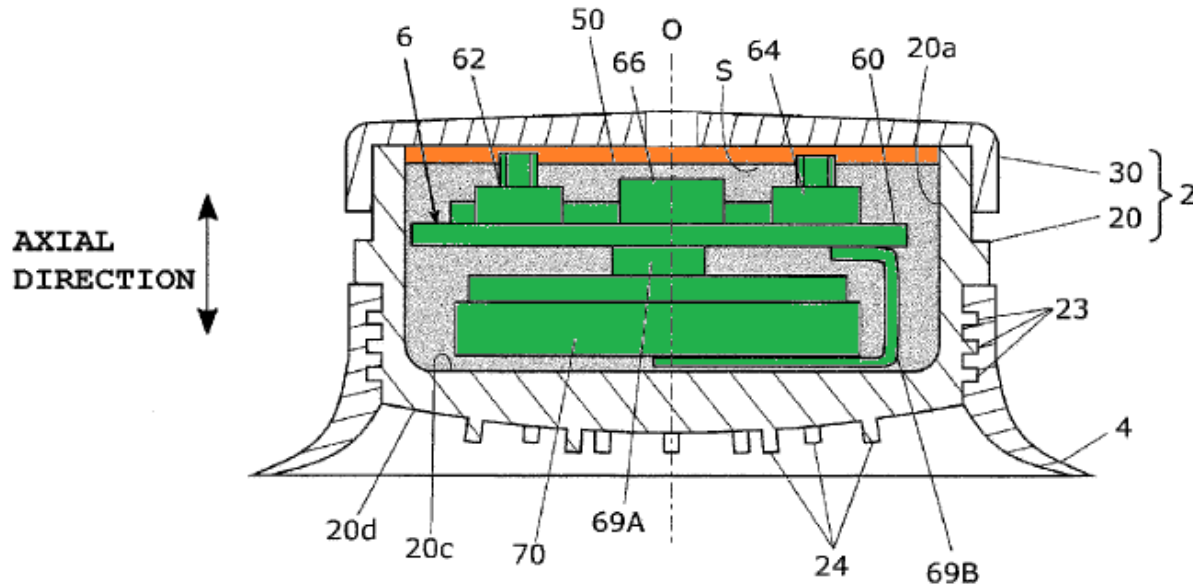
Additionally, the ’421 admits this known use of potting material within sensor assemblies serves to prevent the movement of sensor boards within the automotive industry, just like Yamaguchi-727. (*See* ’421, 13:56-60.)

While sufficient to retain the placement of module 6 and circuit board 60, Yamaguchi-727 discloses that potting material 50 does not completely fill housing space *S*. Rather, “even in the state of being filled with the potting material 50, the communication between respective measurement parts of the temperature sensor 62 and the pressure sensor 64 and the tire air chamber is maintained,” (Yamaguchi-727, [0048]), as indicated by the free path from the outside of the housing through the hole centered at “O” and passing into the housing space *S* above the top level of the potting material and with direct fluid communication with the temperature sensor 62, a pressure sensor 64 (and as depicted in orange in the image in the following claim element 1[c]). (Davenport-¶85.)

- (d) **Claim 1[c]: “wherein the internal cavity comprises an unfilled open space above or below the electrical sensor device in the housing,”**

FIG. 5 depicts an “**internal cavity**” (housing space *S*) that “**comprises an unfilled open space**” (in orange) and positioned “**above ... the electrical sensor device in the housing**” (*i.e.*, module 6 within housing 2, in green).

FIG. 5



(Yamaguchi-727, FIG. 5.)

Temperature sensor **62** and pressure sensor **64** protrude above the portion of housing space *S* (above module **6**) that is not filled by potting material **50** (in orange above). Yamaguchi-727 specifically describes how, “even in the state of being filled with the potting material **50**, the communication between respective measurement parts of the temperature sensor **62** and the pressure sensor **64** and the tire air chamber is maintained[.]” (Yamaguchi-727, [0048]; *see also id.*, [0043]; Davenport-¶¶86-87.)

Yamaguchi-727 further discloses claim 1[c] under Patent Owner’s proposed construction for “**unfilled open space**” as “**space without filling agents or**

materials.” (EX1017, Exhibit A at 6.) The unfilled portion of housing space *S* (orange in FIG. 5 above) lacks any filling agents or materials to “maintain” communication between the protruding sensors **62** and **64** and the tire air chamber (via the opening in housing cap **30**). (Davenport-¶88.)

- (e) **Claim 1[d]: “wherein the electrical sensor device is configured to sense, transmit and/or receive information regarding surrounding conditions, orientation and/or location when the sensor assembly is attached with the object and the object is rotated in use; and”**

Module **6** in Yamaguchi-727 is “**configured to sense, transmit and/or receive information**” related to the tire when functional component **1** is mounted to the interior peripheral surface **10s** of tire **10**. (Davenport-¶89.)

Module **6** includes circuit board **60** with “electronic components which are, for example, a plurality of sensors such as a temperature sensor **62**, a pressure sensor **64** and an acceleration sensor **66** and the like...” (*Id.*, [0040].) Each sensor within circuit board **60** demonstrates that module **6** is configured to “**sense**” and “**receive information regarding surrounding conditions, orientation and/or location when the sensor assembly is attached**” within the tire and the tire is rotated in use. Yamaguchi-727 teaches that its sensors **62**, **64**, and **66** “each ... functions as a state acquiring means that acquires a state inside the tire[.]” (*Id.*) The specification further describes how “[t]he temperature sensor **62** and the pressure sensor **64**

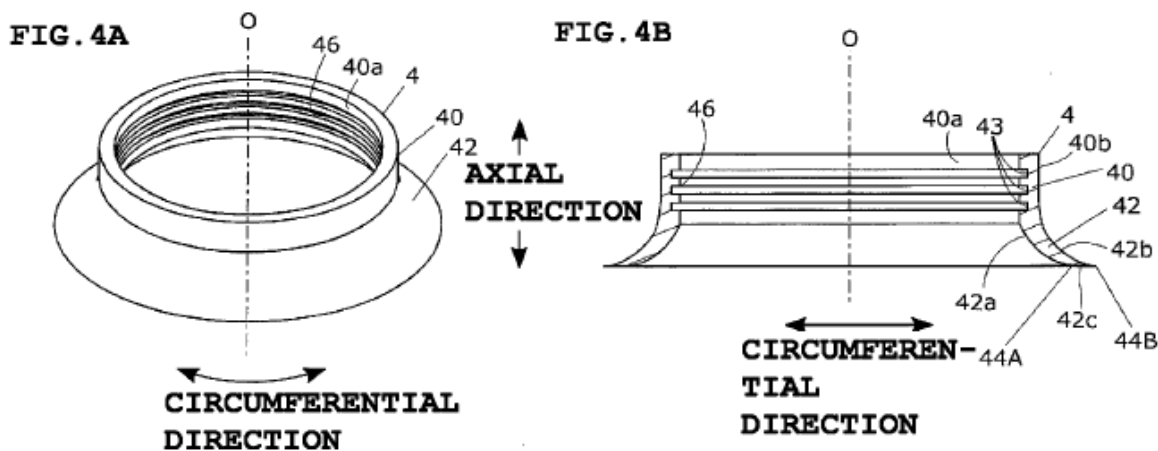
measure, ... a temperature and a pressure in the tire air chamber, respectively.” (*Id.*, [0043].) Measurements of temperature and pressure from sensors **62** and **64**, respectively, constitute “**information regarding surrounding conditions**” within the tire air chamber. Similarly, acceleration sensor **66** in Yamaguchi-727 is a “sensor capable of measuring acceleration in three axial directions, ... and is mounted so that each measurement direction faces a predetermined direction relative to the circuit board **60**.” (*Id.*, [0044].) The acceleration measurements constitute “**information regarding... orientation and/or location**” within the tire air chamber. (Davenport-¶90.)

Module **6** is also configured to “**receive**” the information collected from the sensors. Yamaguchi-727 explains that circuit board **60** of module **6** includes “a memory means that stores histories of the detected values detected by each of the sensors **62**, **64**, and **66**[.]” (Yamaguchi-727, [0040]; *see also id.*, [0046].)

Finally, module **6** is configured to “**transmit**” information its sensors collect from within the tire. Yamaguchi-727 describes how circuit board **60** within module **6** includes a transmitting means “for outputting detected values detected by each of the sensors **62**, **64** and **66** to the outside of the tire[.]” (Yamaguchi-727, [0040].) The transmitting means is “mounted on the circuit board as a transmitting circuit and transmits... to the outside of the tire via an antenna.” (*Id.*, [0045].)

- (f) **Claim 1[e]: “a retaining member that is configured to accommodate attachment of the housing therewith, wherein the retaining member has an outside surface configured for attachment to rotate with the object when the object is rotated in use.”**

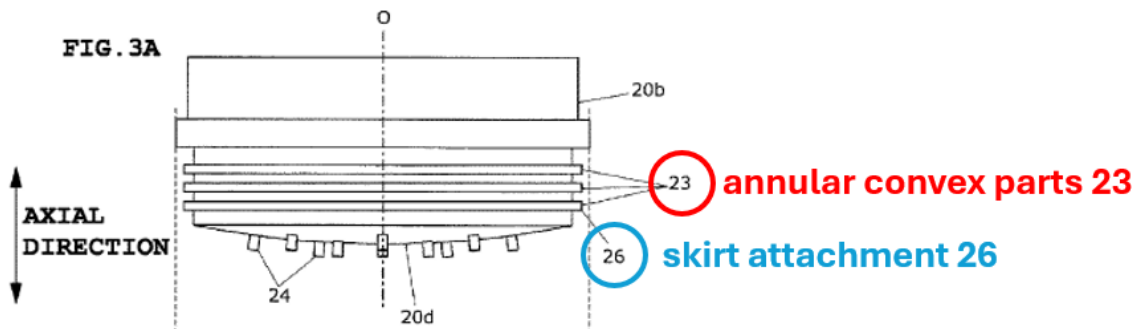
Yamaguchi-727 describes a “**retaining member**” in skirt **4** that “is attached to the [] skirt attachment part **26** formed in the housing case **20**, and extends from the outer bottom surface **20d** of the housing **2** toward the inner peripheral surface **10s** side of the tire **10**.” (Yamaguchi-727, [0035].) Skirt **4** is below.



(*Id.*, FIGs. 4A, 4B; *see also id.*, [0035], [0037], [0038].)

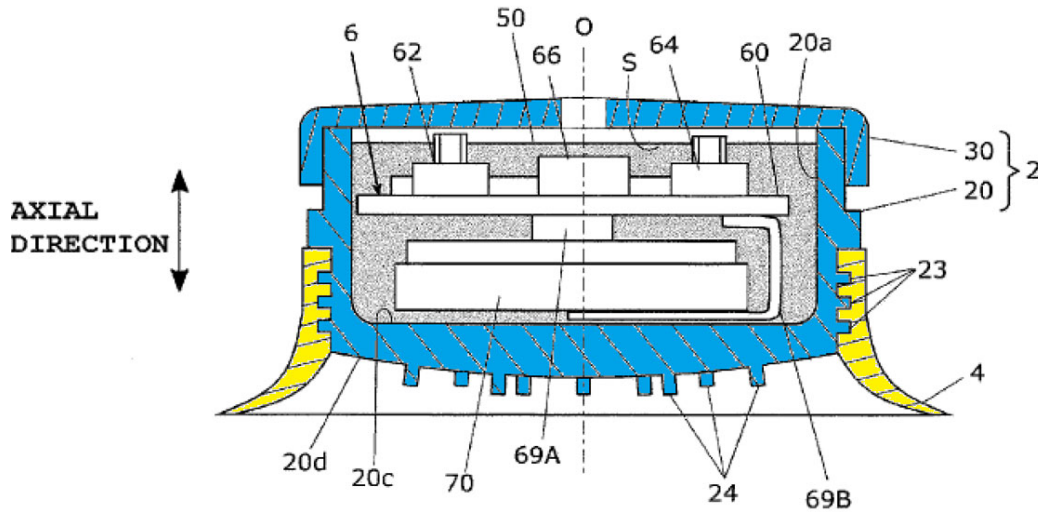
Skirt **4** includes annular recesses **43** that are “**configured to accommodate attachment**” of housing **2** through complimentary fitment with annular convex parts **23** of skirt attachment part **26** within housing case **20** (part of housing **2**). The specification describes with reference to FIGs. 3A-3C how housing **2** includes “a skirt attachment part **26**, to which a skirt **4** described later can be attached, is formed

on an outer peripheral surface **20b** of the peripheral wall part **22**.” (Yamaguchi-727, [0030].) FIG. 3A shows skirt attachment part **26** “configured by a plurality of annular convex parts **23** formed on a lower half of the peripheral wall part **22**.” (*Id.*)



(*Id.*, FIG. 3A.)

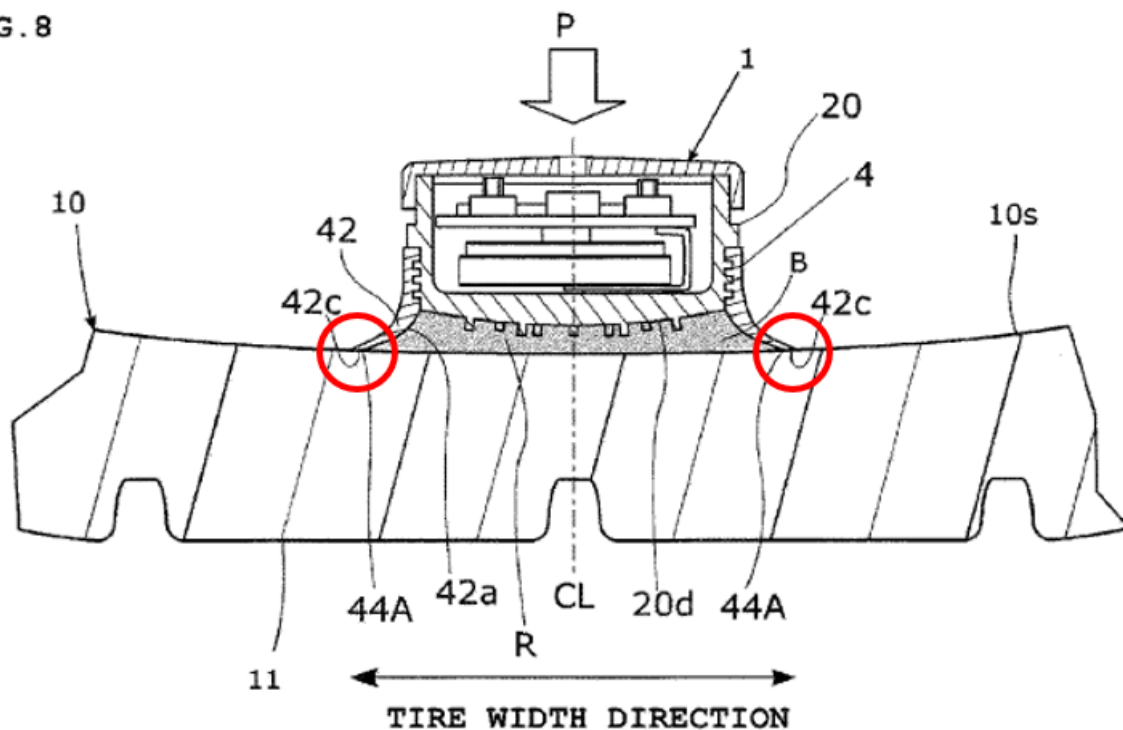
Yamaguchi-727 teaches that annular recesses **43** in skirt **4** “extend[] over the inner peripheral surface **40a** all the way around ... to be able to be mated with the annular convex part **23** provided in the housing case **20**.” (Yamaguchi-727, [0036].) FIG. 5 depicts how annular convex parts **23** mate with annular recesses **43** to attach housing **2** (in blue) to skirt **4** (in yellow).



(Yamaguchi-727, FIG. 5; *see id.*, FIG. 4C, [0035]; Davenport-¶¶93-95.)

Skirt 4 also “**has an outside surface configured for attachment to rotate with the object when the object is rotated in use.**” Yamaguchi-727 describes how functional component 1 is mounted to tire 10 through an adhesive agent B that fills a space defined by the peripheral surface 42 of skirt 4. (Yamaguchi-727, [0054].) FIG. 8 depicts the above-configuration and how skirt 4 includes an “**outside surface configured for attachment**” at item 42c, encircled in red below.

FIG. 8



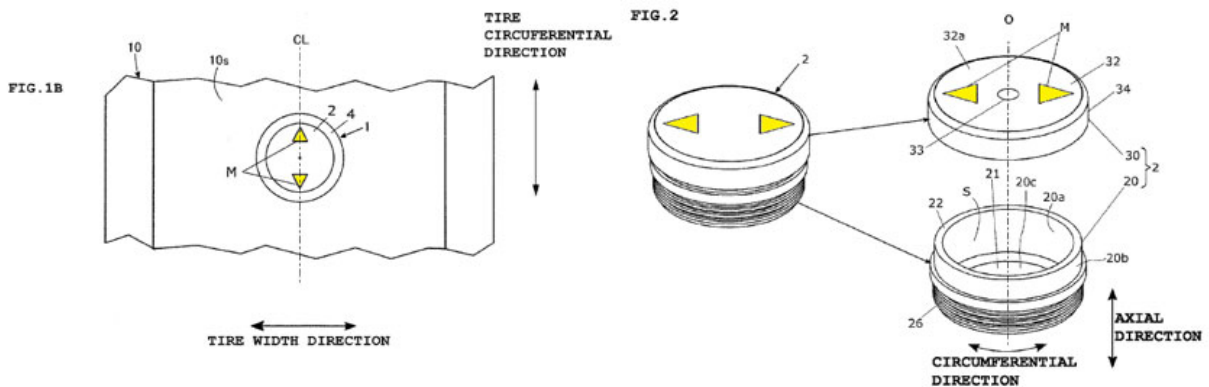
(*Id.*, FIG. 8.) The specification confirms the function of the outer surface at item **42c**, noting “the end part of the tubular part is abutted against the inner peripheral surface of the tire.” (Yamaguchi-727, [0007]; Davenport-¶96.)

Yamaguchi-727 discloses how skirt **4**, including its outside surface, is configured “**to rotate with the object when the object is rotated in use**” by being mounted to the inner side **10s** of the tire. When tire **10** rotates while the vehicle is in use, so too would item **42c** of skirt **4**. (See Yamaguchi-727, [0007], FIG. 1A.)

2. Claim 2

Attachment marks on Yamaguchi-727’s housing cap **30** disclose claim 2. Yamaguchi-727 describes how its housing cap **30** (part of housing **2**) has a circular

ceiling part **32** that includes an outer side surface **32a** where “attachment marks **M** are formed to indicate a direction for attaching the functional component **1** to the tire **10**.” (Yamaguchi-727, [0034].) The attachment marks “**M**” are outwardly visible to a user from the face of the cap **30** as shown by yellow arrows in FIGs. 1B and 2.



(Yamaguchi-727, FIGs. 1B, 2; Davenport-¶99.)

3. Claim 7

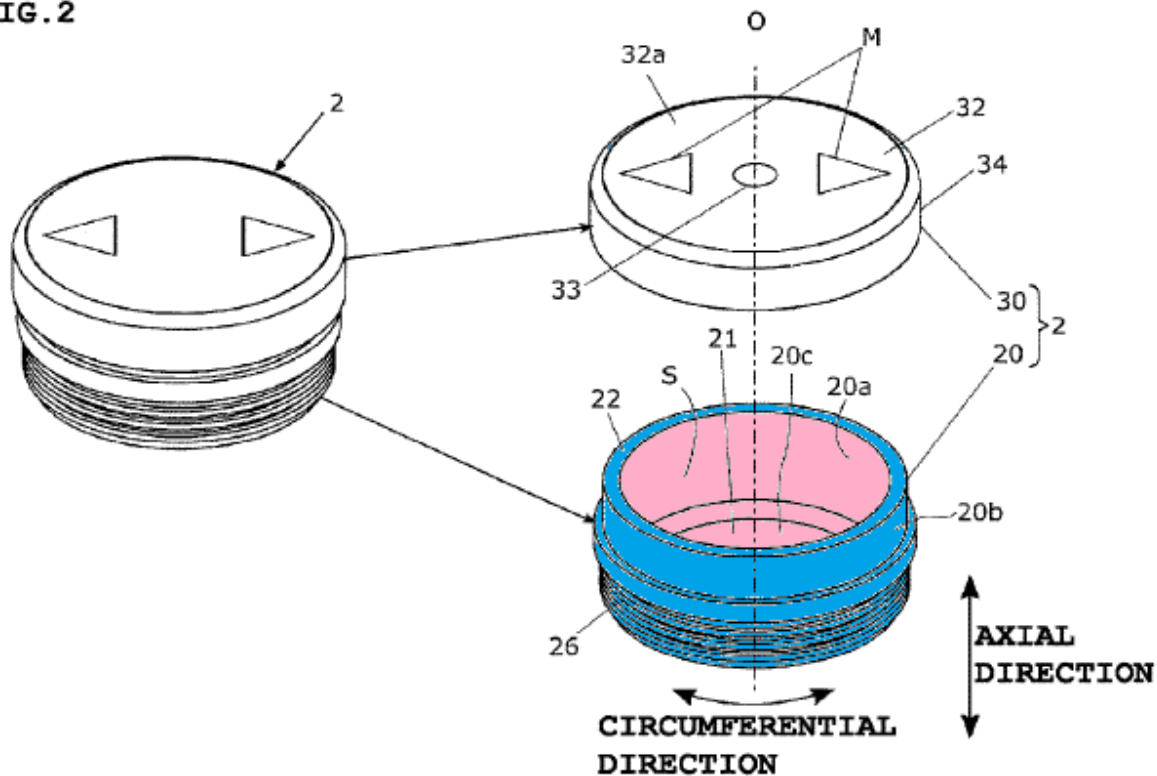
Yamaguchi-727 discloses claim 7 for the same reasons described for claim 1[e], incorporated here. (Davenport-¶100.)

4. Claim 8

Yamaguchi-727 teaches that housing **2** includes housing case **20**. (Yamaguchi-727, [0028].) Housing case **20** “**comprises a wall structure**,” as it is formed “by a circular bottom part **21** and a peripheral wall part **22** extending along the outer periphery from the outer peripheral edge of the bottom part **21** and rising annularly from the bottom part **21**.” (*Id.*, [0029].) Wall part **22** “**surrounds the**

internal cavity” represented by housing space S . (*Id.*) FIG. 2 below depicts how wall part **22** of housing case **20** (in blue) surrounds housing space S (in pink).

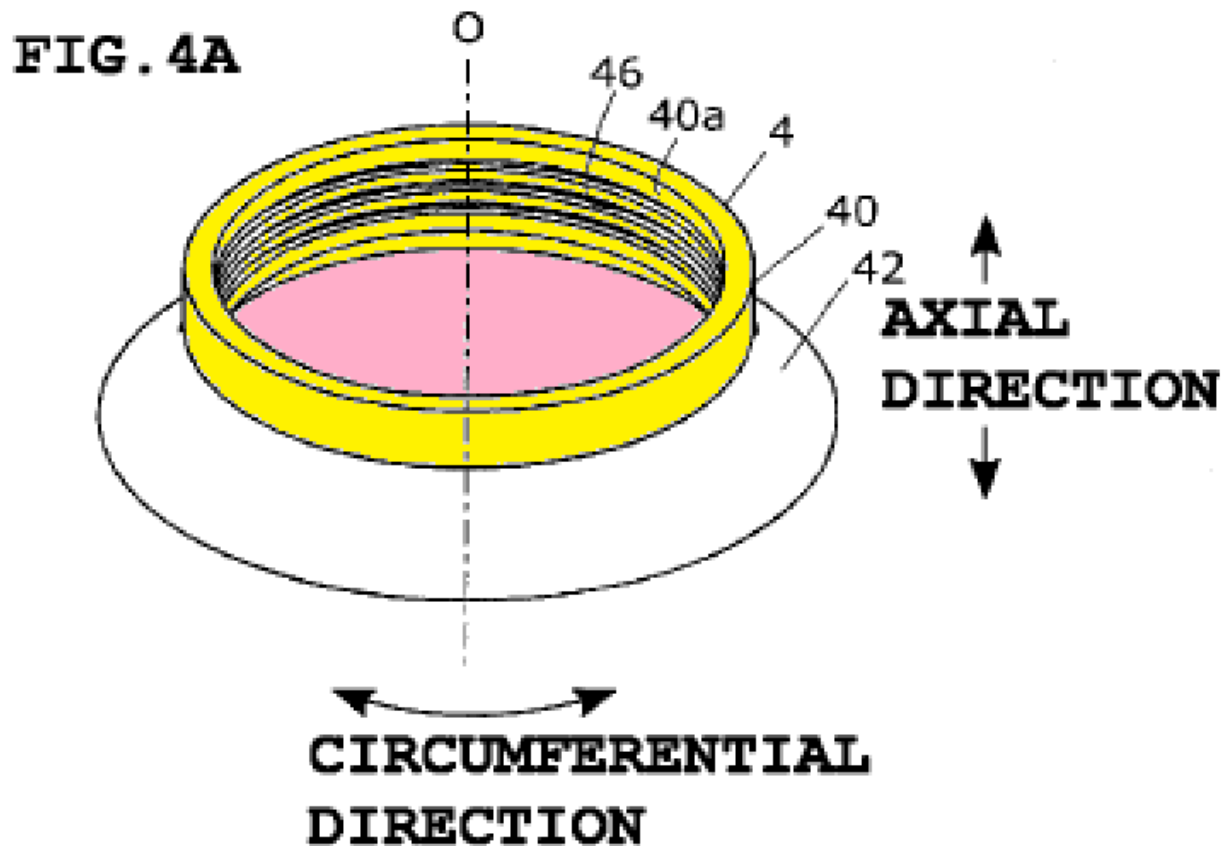
FIG. 2



(*Id.*, FIG. 2; Davenport-¶102.)

Yamaguchi-727's skirt **4** also **“comprises a wall structure having an open chamber that is configured to accommodate the housing wall structure therein to provide attachment therewith,”** as discussed for claim 1[e] incorporated here. Skirt **4** **“has an annular tubular part **40**”** that **“is formed in a cylindrical shape enclosing the skirt attachment part **26**”** of housing case **20**. (Yamaguchi-727, [0036]). FIG. 4A shows tubular part **40** (in yellow) forming a wall structure that

includes an open chamber (in pink) to accommodate skirt attachment part 26.



(Yamaguchi-727, FIG. 4A; Davenport-¶103.)

5. Claim 9

Yamaguchi-727 describes how its skirt 4 is “preferably made of an elastic material, for example, such as rubber or elastomer[.]” (Yamaguchi-727, [0039].) Coupled with the problems Yamaguchi-727 sought to solve (*id.*, [0004]), a POSA would have understood that the skirt 4, being made of an elastic material such as rubber or an elastomer, inherently acts to mitigate transmission of shock forces from the tire. (Davenport-¶106.) Patent Owner confirmed this understanding in

admissions in its infringement contentions that a rubber dock satisfies claim 9. (*See* EX1015, pp. 56, 62; Davenport-¶107.)

6. Claim 11

The electrical sensor device in Yamaguchi-727 is mounted within a tire, an “**object.**” Yamaguchi-727 also describes how circuit board **60** within its electronic sensor device includes a transmitting means “for outputting detected values detected by each of the sensors **62**, **64**, and **66** to the outside of the tire[.]” (Yamaguchi-727, [0040].) The transmitting means is “mounted on the circuit board as a transmitting circuit and transmits... to the outside of the tire via an antenna.... Signals... transmitted wirelessly from the transmitting means are received, for example, by a wireless circuit of a main unit provided in a vehicle.” (*Id.*, [0045].) The “wireless circuit of a main unit” described in Yamaguchi-727 is a “**receiver that is external from the object**” and receives the sensor data from the transmitting means of circuit board **60**. (Davenport-¶109.)

7. Claim 12

Yamaguchi-727 discloses that an acceleration sensor **66** is mounted to circuit board **60** within module **6**. (Yamaguchi-727, [0041].) A POSA would have understood that acceleration sensor **66** is an “**accelerometer sensor,**” as Yamaguchi-727 describes that acceleration sensor **66** is “a sensor capable of measuring acceleration in three axial directions[.]” (*Id.*, [0044]; Davenport-¶111.)

Circuit board **60** within module **6** is “**configured to send data from the accelerometer sensor wirelessly to the external receiver.**” Yamaguchi-727 discloses that circuit board **60** includes a “transmitting means ... for outputting detected values detected by each of the sensors **62**, **64** and **66** to the outside of the tire[.]” (Yamaguchi-727, [0040].) Transmission of accelerometer data is wireless and directed to a wireless circuit of a main unit in the vehicle that is external to the tire. (*Id.*, [0045]; Davenport-¶112.)

8. Claim 20

Yamaguchi-727’s module **6**’s discloses all constituent parts of claim 20.

“**a printed circuit board**”: Module **6** “is provided with a circuit board **60** having electronic components mounted thereon[.]” (Yamaguchi-727, [0040].)

“**a portable power source**”: Yamaguchi-727 also discusses how circuit board **60** in module **6** is powered by battery **70**, potentially in the form of a “disk-shaped button battery” that a POSA would have understood as a portable power source. (Yamaguchi-727, [0040], [0041], [0047]; Davenport-¶115.) This mapping is consistent with the “**portable power source**” that Patent Owner points to in its infringement contentions. (*See* EX1015, pp. 85-86.)

“**sensor element**”: Multiple sensors are mounted to circuit board **60**, “for example, a plurality of sensors such as a temperature sensor **62**, a pressure sensor **64** and an acceleration sensor **66** and the like[.]” (Yamaguchi-727, [0040].)

“an antenna for receiving and/or transmitting information from the electrical sensor device”: Module **6** includes a “transmitting means, ... for outputting detected values detected by each of the sensors **62**, **64** and **66** to the outside of the tire[.]” (Yamaguchi-727, [0040].) The transmitting means “is mounted on the circuit board as a transmitting circuit and transmits the measured temperature, the pressure, and the acceleration and so on to the outside of the tire via an antenna[.]” (*Id.*, [0045].)

9. Claim 21

Circuit board **60** of module **6** includes “a memory means that stores histories of the detected values detected by each of the sensors **62**, **64** and **66**[.]” that a POSA would have understood to constitute a **“storage element.”** (Yamaguchi-727, [0040]; Davenport-¶118.)

10. Claim 22

Acceleration sensor **66** is mounted to circuit board **60** within module **6**. A POSA would have understood that acceleration sensor **66** is an **“accelerometer sensor,”** as Yamaguchi-727 describes it as “a sensor capable of measuring acceleration in three axial directions[.]” (Yamaguchi-727, [0044]; Davenport-¶119.)

11. Claim 23

The **“sensor element”** in Yamaguchi-727 comprises a temperature sensor **62**, pressure sensor **64**, or acceleration sensor **66** mounted to circuit board **60**.

(Yamaguchi-727, [0040].) These sensors “**sense one or more variables**,” as Yamaguchi-727 notes that sensors **62**, **64**, and **66** “each ... functions as a state acquiring means that acquires a state inside the tire[.]” (*Id.*; Davenport-¶120.)

“The temperature sensor **62** and the pressure sensor **64** measure, ... a temperature and a pressure in the tire air chamber, respectively.” (Yamaguchi-727, [0043].) Sensor measurements of temperature and pressure are of the interior air tire chamber that a POSA would have understood is “**the environment**.” (Davenport-¶122.) Acceleration sensor **66** “measur[es] acceleration ... and is mounted so that each measurement direction faces a predetermined direction relative to the circuit board **60**.” (Yamaguchi-727, [0044].) The measured acceleration is of the “**sensor assembly**.” (Davenport-¶123.)

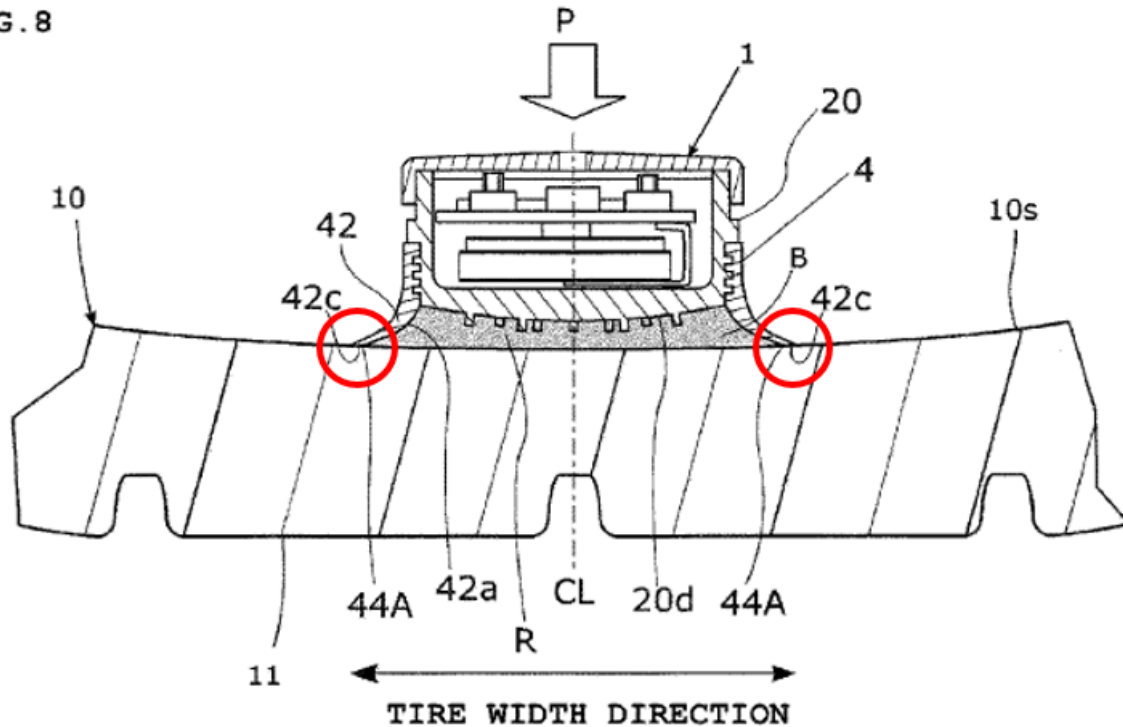
12. Claim 24

Yamaguchi-727 teaches that the “**object**” its functional component attaches to is a “**vehicle tire**.” (*E.g.*, Yamaguchi-727, FIGs. 1A, 1B, [0025]-[0027], [0085].) The vehicle tires are composed of “**vulcanized rubber**.” (*Id.*, [0050], [0055], [0056], [0057]; Davenport-¶125.)

Yamaguchi-727 also discloses that “**the retaining member is attached to an inside surface of the vehicle tire**.” Yamaguchi-727 describes how functional component **1** is attached to inner peripheral surface **10s** of tire **10** through an adhesive agent **B** that fills a space defined by the peripheral surface **42** of skirt **4**.

(Yamaguchi-727, [0054].) FIG. 8 depicts this configuration and how skirt 4 is attached to the inner peripheral surface 10s of tire 10 at item 42c, encircled in red.

FIG. 8



(*Id.*, FIG. 8; Davenport-¶126.) The specification confirms the function of the outer surface at item 42c. (*Id.*, [0007] (“there may be provided a structure for attaching, to a tire, the functional component described above, in which the end part of the tubular part is abutted against the inner peripheral surface of the tire, ...”).)

C. Ground 2: Claims 5, 28, 31-33, 41, 43, 44, 48, and 50-52 are Obvious Over Yamaguchi-727 in view of Yamaguchi-566

1. Motivation to Combine

A POSA would have found it obvious to combine Yamaguchi-727 with Yamaguchi-566’s teachings regarding the use of convex parts, or ribs, on the inner

peripheral surface of housing case **20** to constrain radial movement of its electrical sensor device (circuit board **60** of module **6**) within the housing cavity. Yamaguchi-727 as modified by Yamaugchi-566 would have predictably resulted in the attachment of circuit board **60** of module **6** in Yamaguchi-727 to the inner peripheral wall of the housing case **20** through surface contact and mutual fitment between circuit board **60** of module **6** and convex parts **20B** of peripheral wall part **22** of housing case **20**. (Davenport-¶129.)

A POSA reviewing Yamaguchi-727 would have looked to Yamaguchi-566 to improve Yamaguchi-727's functional component **1**. Yamaguchi-727 and Yamaguchi-566 are analogous references in the same field of the alleged invention related to sensor design, particularly for the attachment of sensor assemblies to the inner wall of a tire to monitor tire conditions and other operating parameters. (*See, e.g.,* Yamaguchi-727, [0001], [0006]; Yamaguchi-566, [0001], [0006].) Yamaguchi-727 and Yamaguchi-566 share the same applicant, inventor, and assignee, and are partially coextensive (and complimentary) in their disclosures. (*Compare, e.g.,* Yamaguchi-727, item (71), item (72), item (73), FIGs. 1A, 1B, [0025]-[0029], [0034]-[0037], [0040], [0043], [0045], [0046], *with* Yamaguch-566, item (71), item (72), item (73), FIGs. 1A, 1B, [0020], [0021], [0023]-[0029], [0032], [0033], [0035], [0037], [0040].) These two references were also filed at the same time and are directed to different aspects of the same invention. A POSA would

have naturally consulted additional materials from Shigeru Yamaguchi to understand, and seek to improve, the functional component in Yamaguchi-727. (Davenport-¶129.)

A POSA would have been motivated to combine Yamaguchi-727 with Yamaguchi-566 because Yamaguchi-566's teachings build upon and refine the functional component design in Yamaguchi-727. (Davenport-¶130.) Yamaguchi-566 shares many disclosures with Yamaguchi-727 and provides additional details on the functionality of functional component **1** not already present in Yamaguchi-727, including (1) use of ribs and grooves within the housing to position circuit board **60** of module **6** within the housing space *S* of housing case **20** (Yamaguchi-566, [0022], FIG. 2A); and (2) the capability for module **6** to include functionality to both transmit and receive data/instructions from a receiver external to functional component **1** (*id.*, [0034]-[0038], [0042]). A POSA would have modified Yamaguchi-727 with Yamaguchi-566 to take advantage of these additional features, as Yamaguchi-566 describes a functional component design complimentary to what is disclosed in Yamaguchi-727. (Davenport-¶130.)

A POSA would have had a reasonable expectation that the combination would have been successful. The disclosures in Yamaguchi-727 and Yamaguchi-566 were conceived and reduced to practice by the same inventor, were commonly owned by Bridgestone, and as previously described, contain coextensive disclosures regarding

the design, functionality, and operation of a tire sensor assembly mounted to the inner peripheral surface of a tire to monitor tire conditions and other operating parameters. These connections would have led a POSA to believe that Yamaguchi-566's more detailed teachings regarding use of convex parts on the inner surface of the housing case for attachment would naturally apply, and be combinable with, Yamaguchi-727. (Davenport-¶131.)

The combination would have entailed only the routine application of conventional fabrication techniques to integrate these convex parts into the inner peripheral surface of the housing case, particularly because Yamaguchi-727 *already* contemplates use of a positioning means to restrict radial movement of circuit board **60** of module **6** within housing space *S* of housing case **20**. (See Yamaguchi-727, [0042].) A POSA would have found it inherent to Yamaguchi-727 that some surface feature exists within housing case **20** that used complimentary fitment between housing case **20** and circuit board **60** to constrain radial movement of circuit board **60** about axis O. Yamaguchi-566 simply provides more granular details for the positioning means already expressly disclosed in Yamaguchi-727. (Davenport-¶131.)

The convex parts, or ribs, described in Yamaguchi-566 are not novel surface features for the position and retention of sensor components within a housing. By October 2019, it was common industry practice to secure placement of sensor

components within a housing assembly through mutually fitting and/or mechanically mated components. (*See, e.g.*, Stewart [EX1021] 4:50-65, 5:46-51, FIGs. 1A-1B, 4A-4C (vertical rib within a sidewall of a sensor mount to accommodate and secure placement of an RFID chip within a sensor assembly); Zaroor [EX1022], [0028], FIGs. 3A-3C (horizontal shelves in housing aligned with mating tabs protruding outwardly from a circuit board assembly to fix and retain circuit board assembly within the housing); Davenport-¶132.)

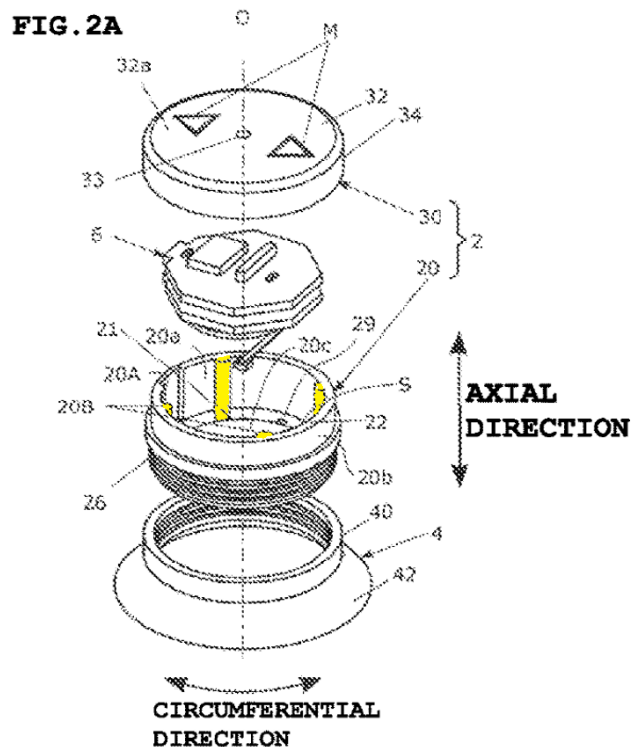
2. Claim 5

While not shown in any of its figures, Yamaguchi-727's description of mutual fitment between circuit board **60** and housing case **20** requires that housing case **20** include surface features to ensure that the circuit board was appropriately positioned within the housing. (Yamaguchi-727, [0042].) The positioning means in Yamaguchi-727 assists with the function of permitting module **6** to “**retain its position**” within the internal cavity through contact. (Davenport-¶133.)

Yamaguchi-727 also discloses claim 5 under Patent Owner's proposed construction for “**surface feature[s]**” as “**structure[s] on or of a surface.**” (EX1017, Ex. A at 6.) Yamaguchi-727 notes that housing case **20** is “*provided* with a positioning means” to ensure mutual fitment with circuit board **60**. (Yamaguchi-727, [0042].) Achieving positioning for the circuit board **60** through mutual fitment requires that housing case **20** have a structure on or of its surface for the circuit board

60 to fit with/into. (Davenport-¶134.)

Patent Owner may argue that a more particularized description of “**one or more surface features**” is necessary. To the extent Yamaguchi-727’s disclosures are insufficient, the combination of Yamaguchi-727 and Yamaguchi-566 render claim 5 obvious. Yamaguchi-566 teaches that housing case **20** includes ribs on its inner peripheral wall surface to prevent radial movement of module **6** in housing space *S*, the internal cavity formed in part by housing case **20**. (Yamaguchi-566, [0022].) These ribs and groove, described as convex parts **20B** and concave parts **20A**, are depicted in FIG. 2A below with the “ribs” highlighted yellow.



(*Id.*, FIG. 2A; Davenport-¶135.) A POSA would have understood convex parts **20B**

and concave parts **20A** are “**one or more surface features within the cavity.**” Yamaguchi-566 expressly recognizes that its convex parts **20B** and concave parts **20A** are “[o]n the inner peripheral surface **20a** of the peripheral wall part **22**[.]” (Yamaguchi-566, [0022]; Davenport-¶136.)

Yamaguchi-566 further discloses that its convex parts **20B** and concave portions **20A** “**contact the electrical sensor device to retain its position therein.**” Substrates in module **6** “are formed in a roughly octagonal shape, for example, so as to correspond to the concave part **20A** and the plurality of convex parts **20B** provided in the housing case **20**[.]” (Yamaguchi-566, [0030].) This shape allows module **6** “to be housed in the housing case **20** by bringing the peripheral edges of the substrates **60** and **80** into contact with the convex portions **20B**, and making protruding pieces **60z** and **80z** each protruding from a part of each of the peripheral edges to coincide with the concave portion **20A.**” (*Id.*; Davenport-¶137.)

Petitioner’s mapping of “**surface features**” to the convex portions, or ribs, and concave portions, or groove, in Yamaguchi-566 is consistent with examples of surface features from the ’421. FIG. 3 in the ’421 patent depicts a recessed groove in the housing as a surface feature, and additionally provides that “rather than a recessed groove, the surface feature can be provided in the form [of] ribs or tabs or the like that extend radially outwardly a distance from the wall structure inside surface **42** and that are positioned and configured to engage the electrical sensor

device **40** peripheral edge **46** to secure placement of the electrical sensor device **40** within the housing internal cavity **38**.” (’421, 10:40-46; Davenport-¶138.)

The combination of Yamaguchi-727 and Yamaguchi-566 would have resulted in the inclusion of convex or concave surface features being designed into the inner peripheral surface of housing case **20** that mutually fitted with circuit board **60** of module **6** and fixed radial movement of circuit board **60** within housing space *S* of housing case **20**, relative to axis O. (Davenport-¶139.)

3. Claim 28

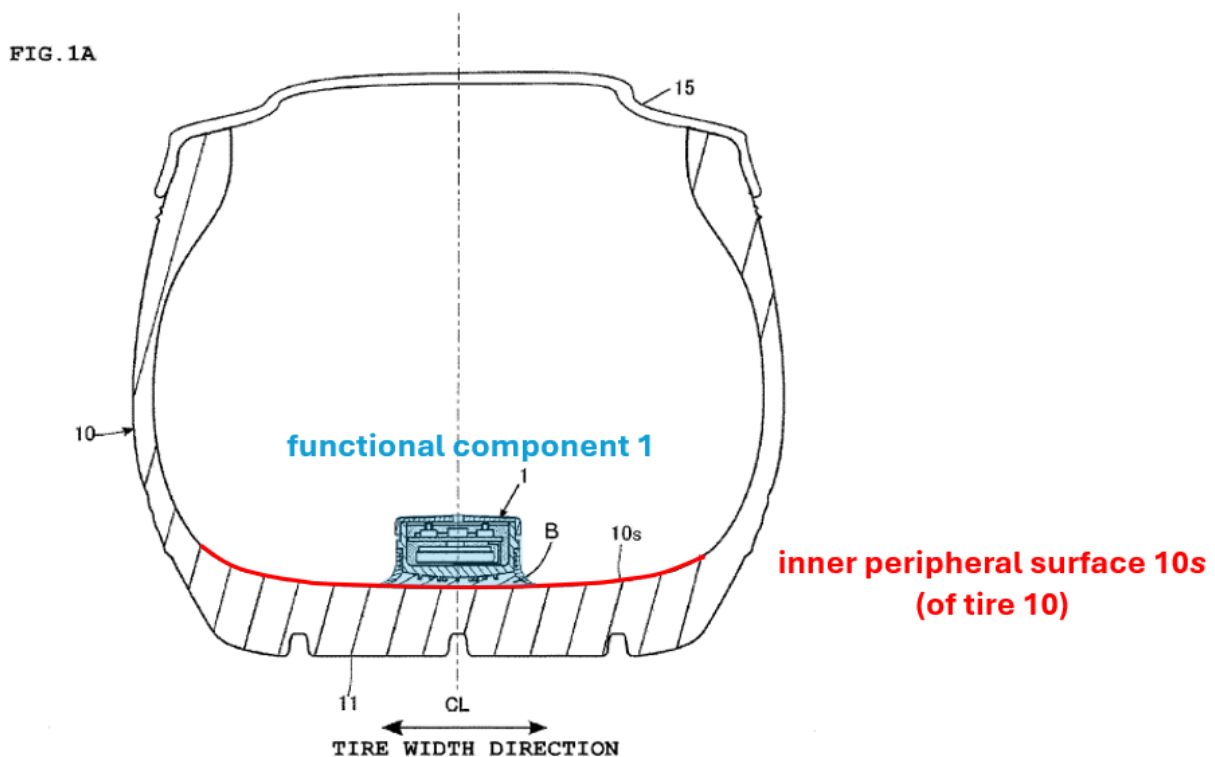
(a) Claim 28[pre]: “A sensor assembly and sensing system for use with an object that rotates in use comprising:”

Yamaguchi-727 teaches “[a] functional component [**1**] in which an electronic component capable of acquiring information inside a tire is housed and which is attachable to an inner peripheral surface of the tire[.]” (Yamaguchi-727, Abstract; *see also id.*, [0025]-[0027], [0040], FIG. 1A.) The information acquired by functional component **1** from within the tire is wirelessly transmitted to a wireless circuit disposed in the main unit of a vehicle, outside of the tire. (Davenport-¶140.)

The described functional component **1** is a “**sensor assembly**,” as it contains a module **6** that “is provided with a circuit board **60**” that “includes the electronic component which are, for example, a plurality of sensors... each of which functions as a state acquiring means that acquires a state inside the tire.” (Yamaguchi-727,

[0040]; *see also id.*, FIG. 5 (depicting module **6** provided with circuit board **60** that includes sensors **62**, **64**, and **66**.) Functional component **1** is also a “**sensing system**” as contemplated by the ’421 patent (*see* ’421, 22:23-40), as its module **6** includes a transmission means that wirelessly transmits information about the states of the tire collected from its sensors to “a wireless circuit of a main unit provided in a vehicle,” external to the tire. (Yamaguchi-727, [0045]; Davenport-¶141.)

Functional component **1** is “**for use with an object that rotates in use.**” Yamaguchi-727 describes how functional component **1** is attached to a tire **10**, which is an “**object that rotates in use.**” (*See, e.g.*, Yamaguchi-727, 8:38-57.) Functional component **1** is “fixed by an adhesive agent B to an inner surface (inner peripheral surface **10s**) of the tire **10** and is disposed in the center in a width direction of the inner peripheral surface **10s** that is a back side of a tread **11**,” (Yamaguchi-727, [0026]), as shown in FIG. 1A below.



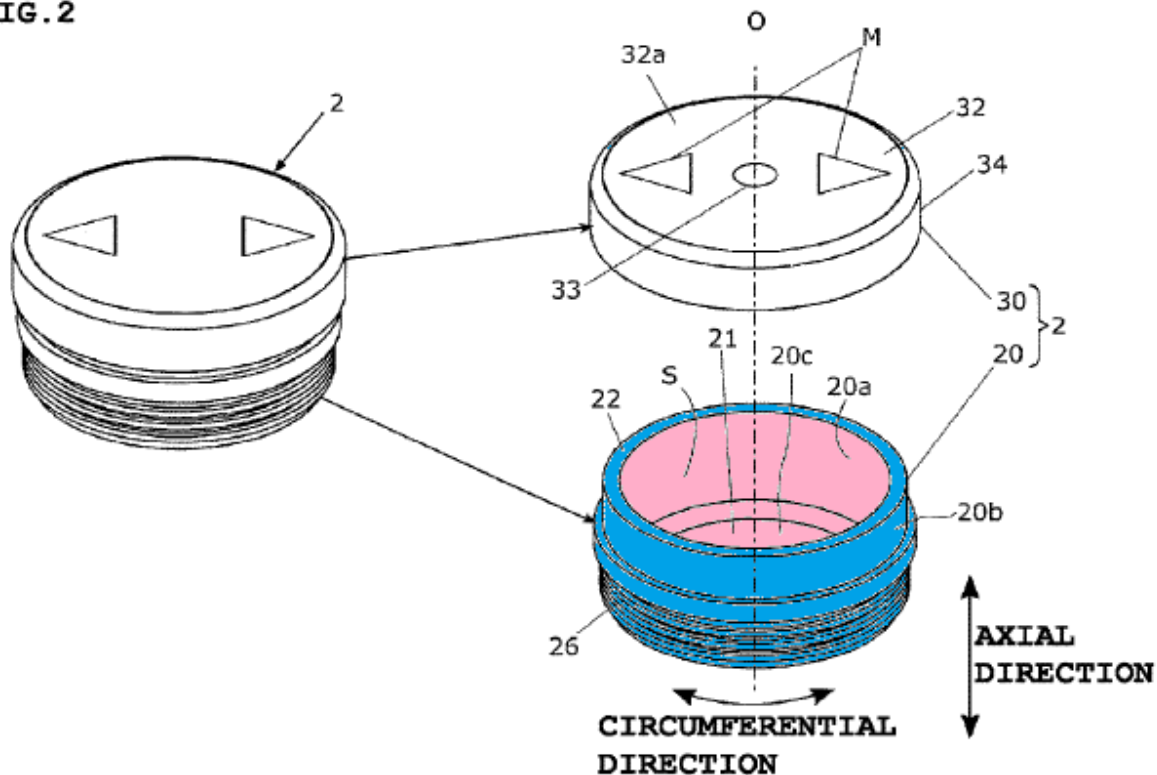
(*Id.*, FIG. 1A; Davenport-¶142.)

(b) **Claim 28[a]: “a housing comprising an outer structure that defines an open internal cavity therein,”**

Yamaguchi-727 discloses claim 28[a] for the same reasons described for claim 1[a] in Ground 1, incorporated here. Specifically, housing 2 includes a housing case 20 (“a housing comprising an outer structure”) “having a housing space *S* (housing part) for a module 6[.]” (Yamaguchi-727, [0028].) Yamaguchi-727 teaches this housing case 20 “defines an open internal cavity therein,” explaining that “[i]n the housing case 20, a housing space *S* that can house the module 6 is formed by an inner bottom surface 20c of the bottom part 21 and an

inner peripheral surface 20a of the peripheral wall part 22.” (*Id.*, [0029].) FIG. 2 below depicts how housing case 20 is an outer structure (in blue) that defines the open internal cavity of housing space S (in pink).

FIG. 2



(*Id.*, FIG. 2; Davenport-¶143.)

- (c) **Claim 28[b]: “an electrical sensor device disposed within the internal cavity and having a fixed placement therein by one or more surface features of the housing configured to contact the electrical sensor device”**

To start, Yamaguchi-727 discloses the element of “**an electrical sensor device disposed within the internal cavity**” recited in claim 28[b] for the same

reasons described for claim 1[b] in Ground 1, incorporated here.

Yamaguchi-727 also teaches that its module **6** (“**electrical sensor device**”) has a “**fixed placement therein by one or more surface features of the housing configured to contact the electrical sensor device.**” Patent Owner has (1) proposed a construction in the reserved disputed terms list for “**fixed placement**” as “**not displaceable in at least one direction**” (EX1017, Exhibit B at 10); and (2) taken the position in its infringement contentions that holes in a printed circuit board of a sensor assembly that are mutually aligned with posts in a housing are sufficient to satisfy this limitation. (*See* EX1015, pp. 111-113.) Yamaguchi-727, alone or combined with Yamaguchi-566, renders obvious claim 28[b] under Patent Owner’s proposal(s). (Davenport-¶145.)

Yamaguchi-727 describes how “circuit board **60** and the housing case **20** are provided with a positioning means, ..., that are mutually fitted with each other.” (Yamaguchi-727, [0042].) This positioning means fixes module **6** radially about axis O within housing space *S*. (*See id.*, FIG. 2.) While not shown in any of its figures, use of one or more surface features of the housing (via housing case **20**) would be inherent to Yamaguchi-727’s disclosures of a positioning means. The inherent disclosures from Yamaguchi-727 are confirmed by express teachings from Yamaguchi-566 that disclose the use of ribs and a groove on the inner surface of housing case **20** to position the circuit board. (Davenport-¶146.)

Yamaguchi-566 expressly teaches the use of ribs and a groove on the inner peripheral wall surface of housing case **20** to “**fix placement**” of module **6** within housing space *S* and restricting its radial movement about axis O. (Yamaguchi-566, [0022] (describing “a concave part **20A** recessed outwardly in the radial direction relative to the axis O and a plurality of convex parts **20B** protruding toward the direction of the axis O and extending along the axis O are formed so as to position the module **6** housed in the housing space *S* at a predetermined position.”), FIG. 2A.) A POSA would have understood convex parts **20B** and concave part **20A** are “**one or more surface features of the housing configured to contact the electrical sensor device**” for the same reasons described for claim 5, incorporated here. (Davenport-¶¶147-151.)

Patent Owner points in its infringement contentions to positioning posts in a housing as the “**one or more surface features**” enabling fixed placement of the sensor board. (See EX1015, pp. 111-113.) That Yamaguchi-566 discloses this claim is confirmed by Patent Owner’s understanding of its scope. The ribs and groove in Yamaguchi-566 are not functionally different than the positioning posts identified in Patent Owner’s infringement contentions, preventing radial displacement of module **6** about axis O. (See Yamaguchi-566, [0022], FIG. 2A; Davenport-¶152.)

- (d) **Claim 28[e]: “a retaining member having an outside surface configured for attaching with a surface of the object or an element connected with the object to rotate with the object in use, wherein the retaining member is configured to accommodate placement a portion of the housing therein to provide an attachment between the housing and the retaining member; and”**

Yamaguchi-727 describes a “**retaining member**” in skirt **4** that “is attached to the [] skirt attachment part **26** formed in the housing case **20**, and extends from the outer bottom surface **20d** of the housing **2** toward the inner peripheral surface **10s** side of the tire **10**[.]” (Yamaguchi-727, [0035].) Skirt **4** has “**an outside surface configured for attaching with a surface of the object or an element connected with the object to rotate with the object in use**” for the same reasons described for claim 1[e] in Ground 1, incorporated here. (Davenport-¶155-156; Yamaguchi-727, [0007], [0008], [0054], FIGs. 1A, 8.) Skirt **4** is also “**configured to accommodate placement [of] a portion of the housing therein to provide an attachment between the housing and the retaining member**” for the same reasons described for claim 7 in Ground 1, incorporated here. (Davenport-¶157; Yamaguchi-727, [0035], [0036], FIGs. 5, 4C.)

- (e) **Claim 28[c]: “wherein the electrical sensor device is configured to monitor and transmit and/or receive information regarding surrounding conditions, orientation and/or location”**
- (f) **Claim 28[d]: “wherein the electrical sensor device comprises: a portable power source; a sensor; and an antenna for transmitting and/or receiving information relating to the operating parameter being monitored by the sensor;”**
- (g) **Claim 28[f]: “a receiver external from the object that is configured to receive information from the electrical sensor device wirelessly.”**

The combination of Yamaguchi-727 and Yamaguchi-566 disclose claims 28[c], 28[d], and 28[f] for the same reasons described for claim 1[d], 20, and 11, respectively in Ground 1, incorporated here. (Davenport-¶¶153-154, 158.)

4. Claims 31-33

The combination of Yamaguchi-727 and Yamaguchi-566 claims 31-33 for the same reasons described for claim 1[c], 9, and 12, respectively, in Ground 1, incorporated here. (Davenport-¶¶159-161.)

5. Claim 41

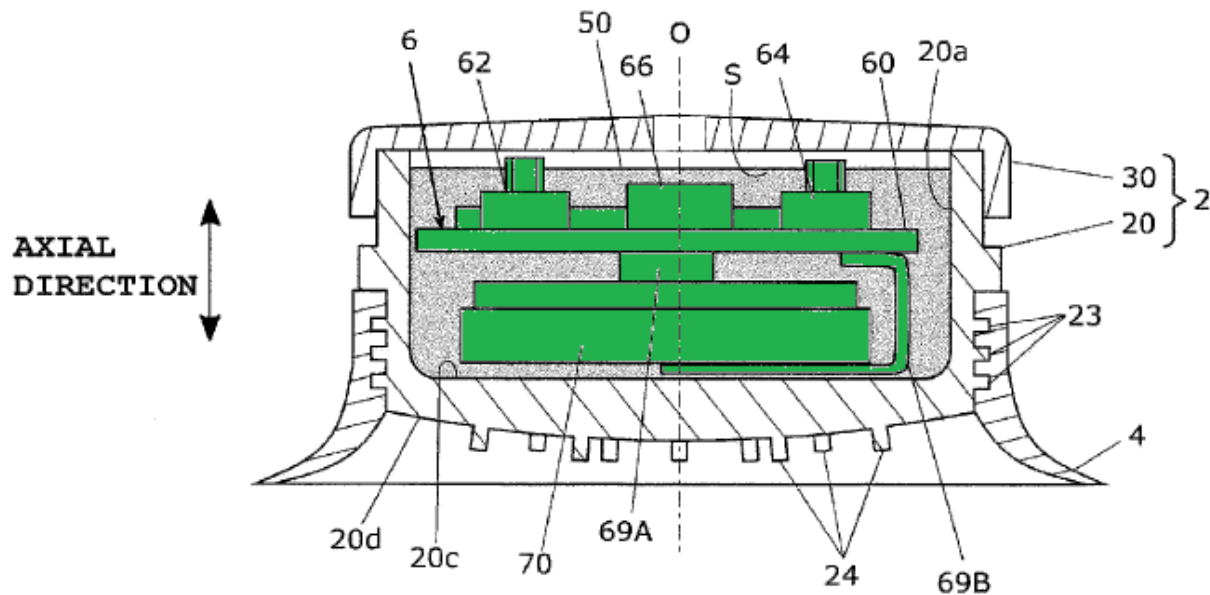
- (a) **Claim 41[pre]: “A method for using a sensor assembly and sensing system with an object that rotates in use comprising the steps of:”**

The combination of Yamaguchi-727 and Yamaguchi-566 discloses claim 41[pre] for the same reasons described for claim 28[pre], incorporated here.

(b) Claim 41[a]: “installing an electrical sensor device within an internal cavity of a housing, wherein the housing includes an outer structure that defines the internal cavity, and”

The combination of Yamaguchi-727 and Yamaguchi-566 discloses **“installing an electrical sensor device within an internal cavity of a housing.”** The **“electrical sensor device”** in Yamaguchi-727 is represented by module **6** that includes circuit board **60**. Circuit board **60** further includes “electronic components which are, for example, a plurality of sensors such as a temperature sensor **62**, a pressure sensor **64** and an acceleration sensor **66** and the like...” (Yamaguchi-727, [0040].) This electrical sensor device (in green below) is installed within an internal cavity of a housing based on its placement within housing space *S* in FIG. 5 below.

FIG. 5



(Yamaguchi-727, FIG. 5; Davenport-¶163.) Installation of module 6 within the internal cavity of the housing is inherent to Yamaguchi-727's device, as Yamaguchi-727 explains that "module 6 is configured to be able to be housed in the housing space S of the above-mentioned housing case 20." (*Id.*, [0040]; Davenport-¶163.)

The combination of Yamaguchi-727 and Yamaguchi-566 also discloses that “the housing includes an outer structure that defines the internal cavity” for the same reasons described for claim 28[a], incorporated here. (Davenport-¶164.)

Yamaguchi-727’s disclosures satisfy Patent Owner’s proposed construction for “**the housing includes an outer structure that defines the internal cavity**” that clarifies that “**the space inside of the housing structure is the internal cavity[.]**”

(EX1017, Exhibit B at 10.) Yamaguchi-727 teaches that its housing space *S* is a **“space inside of the housing structure”** of housing case **20** for the reasons stated above. (Yamaguchi-727, [0028], [0029], FIG. 2; Davenport-¶165.)

- (c) **Claim 41[b]: “wherein the electrical sensor device comprises a sensor, a portable power source, an antenna, a printed circuit board, and related electrical circuitry,”**

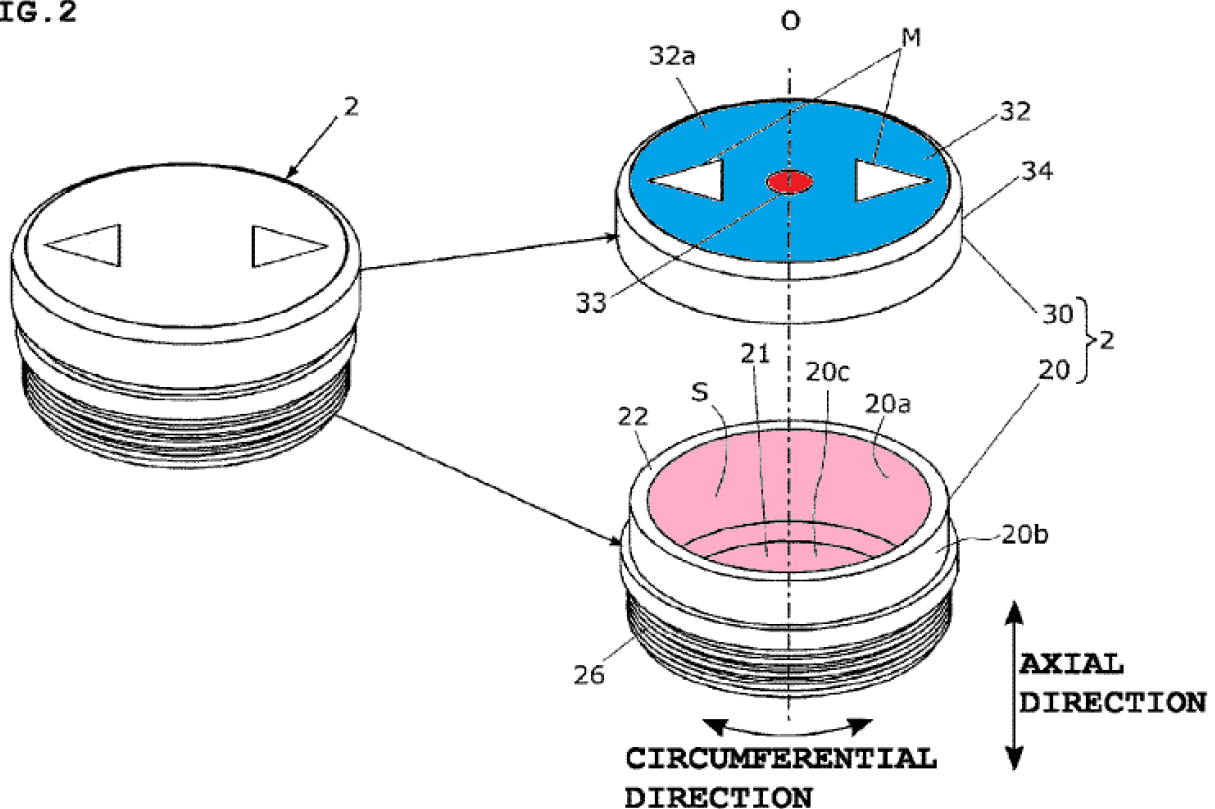
The combination of Yamaguchi-727 and Yamaguchi-566 discloses claim 41[b] for the same reasons discussed for claim 20, incorporated here. (Davenport-¶¶166-170.) In addition, Yamaguchi-727 discloses **“related electrical circuitry,”**: Yamaguchi-727 describes how its circuit board includes, beyond its mounted sensors, a transmission means, a control means, a memory means, and metal terminals **69A** and **69B** for supplying power from the battery **70** to the electrical components on the circuit board. (Yamaguchi-727, [0040]; Davenport-¶170.)

- (d) **Claim 41[c]: “wherein the housing comprises an opening extending from an outer surface of the housing to the internal cavity;”**

Yamaguchi-727 describes how its housing cap **30** has a circular ceiling part **32** that includes side surface **32a** forming **“an outer surface of the housing.”** (Yamaguchi-727, [0034].) A “hole **33** penetrating in the axis O direction is formed in the ceiling part **32**” and “allows for communication between housing space *S* of

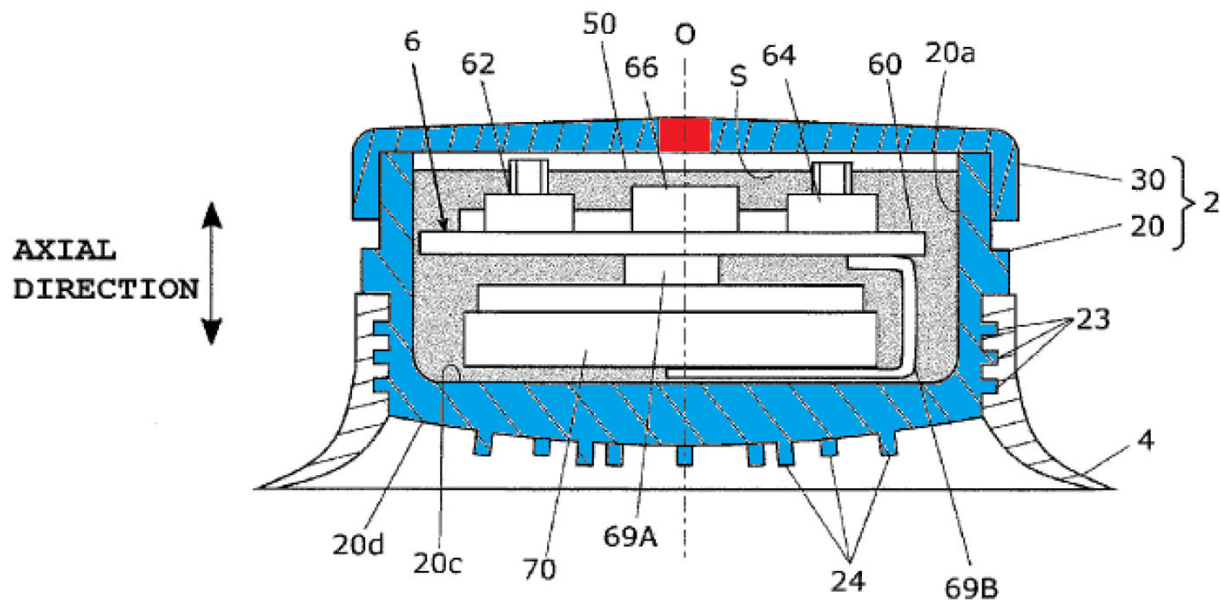
the housing case **20** and the outside when the opening of the housing case **20** is closed by the cap **30**.” (Yamaguchi-727, [0034].) FIG. 2 below depicts hole **30** (“an opening” – in red) that extends from side surface **32a** of housing cap **30** (in blue) to the housing space *S* (“internal cavity” – in pink).

FIG. 2



(*Id.*, FIG. 2; Davenport-¶171.)

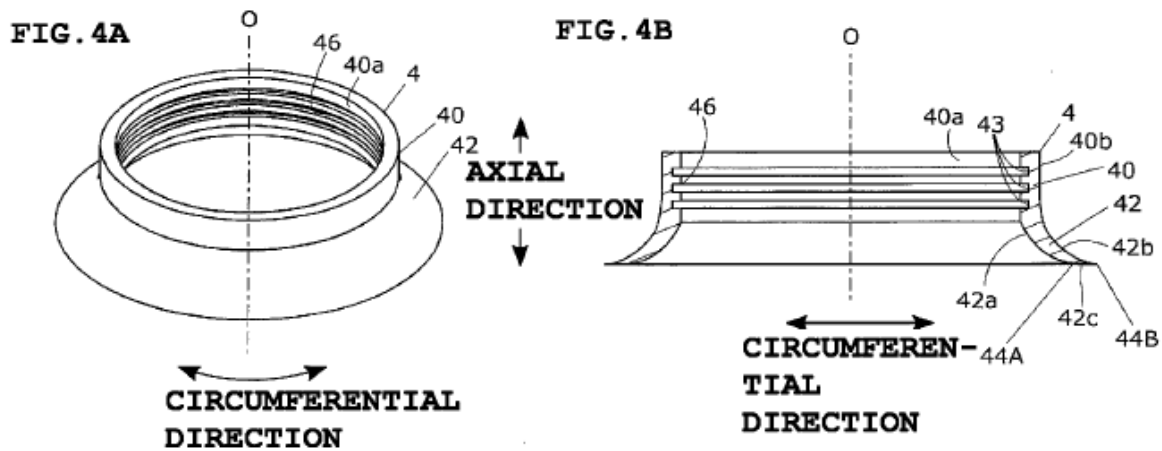
FIG. 5 depicts how hole **30** (in red) of housing cap **32** extends from the outer surface of housing **2** (in blue) to the internal cavity of housing space *S*.



(Yamaguchi-727, FIG. 5; Davenport-¶172.)

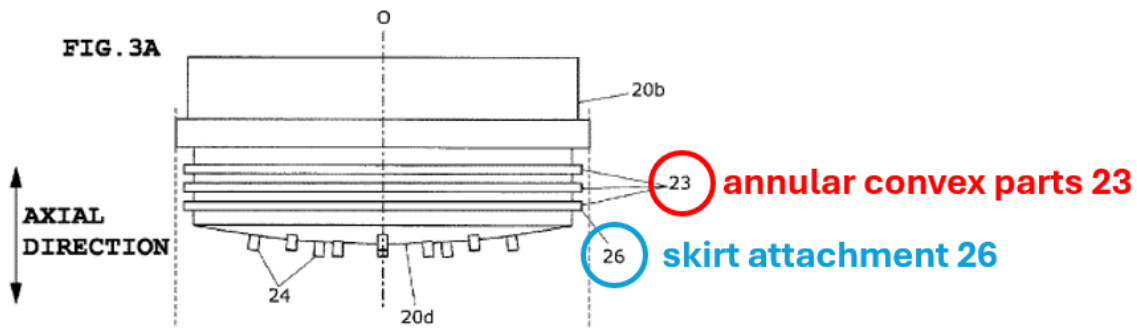
- (e) **Claim 41[d]: “attaching the housing after the step of installing to a retaining member, wherein the retaining member is configured to accommodate attachment with the housing by mechanical or bonding technique, wherein the retaining member is connected with the object before or after formation of the object; and”**

The specification describes a “**retaining member**” in skirt **4** that “is attached to the [] skirt attachment part **26** formed in the housing case **20**, and extends from the outer bottom surface **20d** of the housing **2** toward the inner peripheral surface **10s** side of the tire **10**.” (Yamaguchi-727, [0035].) Skirt **4** is shown in FIGs. 4A and 4B.



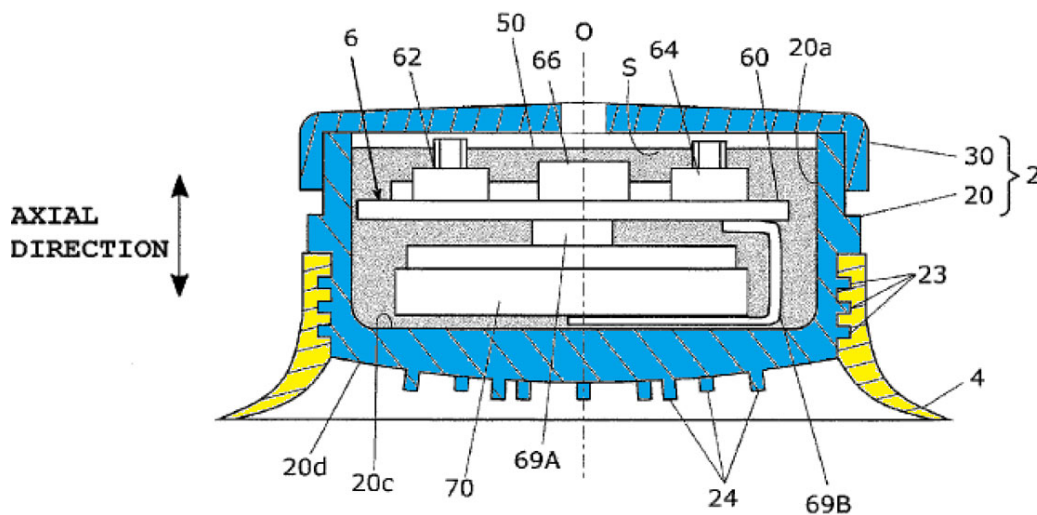
(*Id.*, FIGs. 4A, 4B; *see also id.*, [0035], [0037], [0038]; Davenport-¶173.)

Skirt 4 includes annular recesses 43 that are “**configured to accommodate attachment with the housing by mechanical ... technique,**” namely through complimentary fitment with annular convex parts 23 of skirt attachment part 26 within housing case 20 (part of housing 2). The specification describes with reference to FIGs. 3A-3C how housing 2 includes “a skirt attachment part 26, to which a skirt 4 described later can be attached, is formed on an outer peripheral surface 20b of the peripheral wall part 22.” (Yamaguchi-727, [0030].) FIG. 3A below shows how skirt attachment part 26 “is configured by a plurality of annular convex parts 23 formed on a lower half of the peripheral wall part 22.” (*Id.*)



(*Id.*, FIG. 3A; Davenport-¶174.)

Yamaguchi-727 teaches that the annular recesses **43** in skirt **4** “extend[] over the inner peripheral surface **40a** all the way around ... to be able to be mated with the annular convex part **23** provided in the housing case **20**.” (Yamaguchi-727, [0036].) FIG. 5 depicts how the annular convex parts **23** mate with the annular recesses **43** to attach housing **2** (in blue) to skirt **4** (in yellow).



(Yamaguchi-727, FIG. 5; *see id.*, FIG. 4C (housing **2** attached to skirt **4**), [0035]; Davenport-¶175.)

Yamaguchi-727 discloses “**attaching the housing after the step of installing to a retaining member attached.**” FIG. 6A describes “attachment processing” as coming *after* “functional component preparation processing” by virtue of the arrowhead in the process step description. “Attachment processing” in Yamaguchi-727 includes the “attaching the housing” step in claim 41[d], whereas the “functional component preparation processing” includes the “installing” step in claim 41[d], where the step of installing refers to installing the electrical sensing device into the housing. (See Yamaguchi-727, FIG.6A; *id.* [0052] (describing the “functional component preparation process” in FIG. 7 where the electrical sensing device is already installed in the housing); Davenport-¶176.)

Yamaguchi-727 also discloses how “**the retaining member is connected with the object ... after formation of the object.**” To start, Yamaguchi-727 describes a process for attaching its functional component **1** that occurs *after* the tire (“**object**”) has been formed. (See Yamaguchi-727, [0049].) FIG. 6A is a work process diagram that demonstrates that attachment process for functional component **1** (including skirt **4**—the “**retaining member**”) occurs after tire pretreatment. Per FIG. 6B, tire pretreatment additionally includes a mold release agent removal process, a ridge treatment process, and a cleaning process that prepare the inner peripheral surface of the tire for attachment and occurs after “**formation**” of the tire.

FIG. 6A

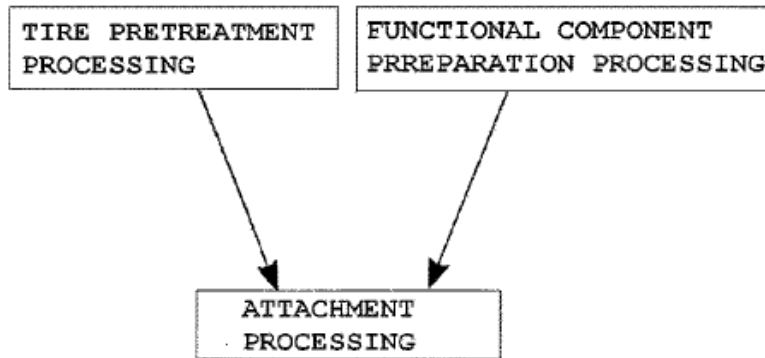
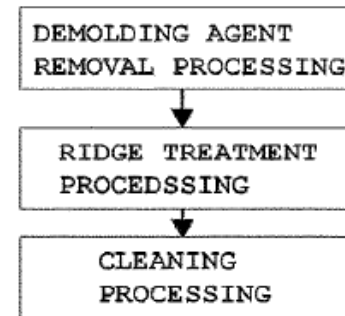


FIG. 6B



(*Id.*, FIGs. 6A, 6B; Davenport-¶176.) Skirt 4 is connected at item 42c with inner peripheral surface 10s of tire 10 for the same reasons described for claim 28[e], incorporated here. (Davenport-¶177.)

- (f) **Claim 41[e]: “monitoring an operating parameter of the object through the use of the electrical sensing device, wherein information related to the operating parameter is wirelessly transmitted from the electrical sensing device to a receiver that is external from the sensor assembly.”**

Yamaguchi-727 describes how module 6 “**monitor[s] an operating parameter of the object**” through multiple sensors (*e.g.*, temperature, pressure, acceleration), “each of which functions as a state acquiring means that acquires a state inside the tire[.]” (Yamaguchi-727, [0040].) The memory means “records the history” of measurements from the sensors. (*Id.*, [0046].) The control means “executes a predetermined program” based on the basis of information on the state

inside the tire measured by the sensors, and then “controls the operation of the transmitting means” that transmits that information outside of the sensor assembly. (*Id.*; Davenport-¶¶178-179.) The “**information related to the operating parameter**” collected from Yamaguchi-727’s sensors is “**wirelessly transmitted**” from module 6 to “**a receiver that is external from the sensor assembly**” for the same reasons described for claim 11 in Ground 1, incorporated here. (Davenport-¶180.)

6. Claim 43

The combination of Yamaguchi-727 and Yamaguchi-566 discloses claim 43 for the same reasons described for claim 5, incorporated here.

7. Claim 44

While Yamaguchi-727 discusses in its attachment process that one would fill a cavity space **R** with adhesive agent **B** to adhere the functional component to the tire, it does not require that the adhesive agent fill the cavity space after skirt **4** has been fixed to housing **2**. A POSA would have understood that, during the attachment process, skirt **4** could be placed in the inner peripheral surface of the tire, adhesive agent fill the internal cavity of the skirt, and then housing **2** be placed within the cavity to fix to skirt **4** while also pressing base of housing case **20** to the adhesive agent. (Davenport-¶183.) This method was well-known by the 2019 time period, especially where, as here, curing occurs at relatively lower temperatures. (*Compare*

Yamaguchi-727, [0057] (describing how “it is preferable that the adhesive agent B is cured by heating with a dryer at a heating temperature of 60° C or higher for one minute or more”) *with* Wilson-506 [EX1011], 4:23-25 (curing at 45° C); Davenport-¶183.)

A POSA would have further identified this method as advantageous over what is disclosed in Yamaguchi-727, as Yamaguchi-727 itself cautions with respect to its technique that “care should be taken to avoid overflow of the adhesive more than necessary due to too much of the pressing force” when affixing the functional component 1 with skirt 4 to the inner peripheral surface of the tire. (Yamaguchi-727, [0053].) Such concerns would be circumscribed by first placing and curing skirt 4 to the inner peripheral surface of the tire.

Moreover, it would have been obvious to try, as there are finite and known options for attaching these components to the inner tire through use of adhesive or other bonding agents. (Davenport-¶183.) It was well-established in the art that attachment in either order is acceptable at lower-cure temperatures. (*Id.*; *see, e.g.*, Wilson-506, 5:11-16 (“Since the rubber patch assembly can be attached to the tire using an air cure or low temperature cure, it is understood that the sequence of assembling the tag assembly into the rubber patch housing may be accomplished either before or after the rubber patch is attached to the tire innerliner.”).)

The ’421 patent confirms such elementary understanding that one may reverse

the order of the steps for attaching the housing to the retaining member and step of attaching the retaining member to the object or tire, explaining that “a desired feature of the retainer 14 and housing 12 mechanical attachment configuration illustrated in FIGS. 1, 6 and 7 is that such permits the removal of the housing 12 from the retainer 14.” (’421, 18:41-44; Davenport-¶183.)

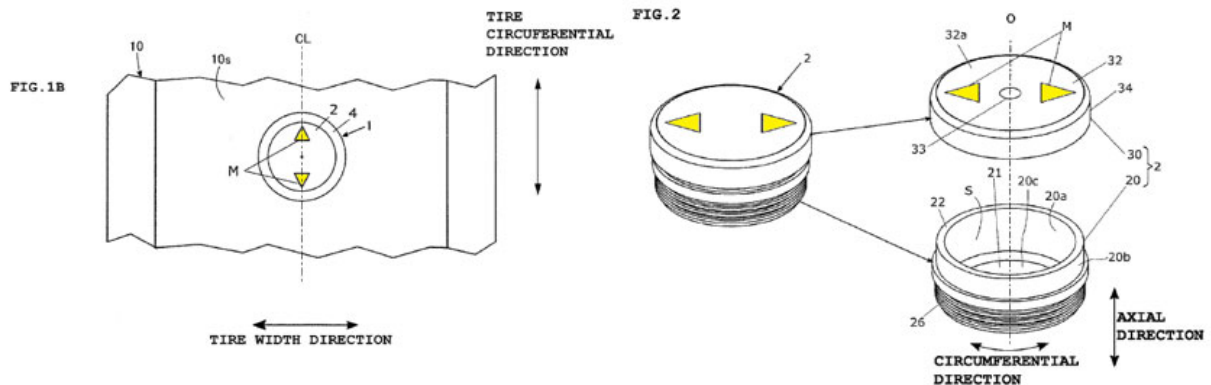
The remaining elements of claim 44 are disclosed in Yamaguchi-727 as discussed for claim 24 for Ground 1, incorporated here. (Davenport-¶184.)

8. Claim 48

The combination of Yamaguchi-727 and Yamaguchi-566 discloses claim 48 for the same reasons described for claim 24 in Ground 1, incorporated here.

9. Claim 50

Yamaguchi-727 describes how its housing cap **30** (part of housing **2**) has a circular ceiling part **32** that includes an outer side surface **32a** where “attachment marks M are formed to indicate a direction for attaching the functional component **1** to the tire **10**.” (Yamaguchi-727, [0034].) As shown in FIGs. 1B and 2, attachment marks M (in yellow) are a “**display feature that is positioned on the housing.**”



(*Id.*, FIGs. 1B, 2; Davenport-¶187.)

These attachment marks M direct how the housing ought to be “**positioned relative to the retaining member**,” as Yamaguchi-727 explains that they “show that the functional component 1 is to be attached on the inner peripheral surface 10s of the tire 10 in such a manner that the arrows are oriented in the tire circumferential direction.” (Yamaguchi-727, [0034].) A POSA would have understood (1) that the retaining member would be placed in a fixed position relative to the inner peripheral surface of the tire; and (2) that the attachment marks M provide a specific orientation for the housing when fitted to the retaining member to ensure components like its acceleration sensor are properly oriented within the tire to collect accurate tire information. (*See id.* (“The direction indicated by the attachment marks M may be set appropriately in accordance with a detection direction of the module 6.”); Davenport-¶188.)

Patent Owner may argue that Yamaguchi-727 fails to disclose how attachment

marks M indicate that the housing should be positioned relative to the retaining member but instead indicate how the housing should be positioned relative to the inner peripheral surface of the tire. This distinction is without a difference because the relative positioning of housing to retaining member is the same as functional component to tire surface—the purpose is to ensure the sensor assembly is disposed in an orientation that permits accurate measurements of tire information. While Yamaguchi-727 discusses in its attachment process that one would fill a cavity **R** with adhesive agent **B** to adhere the functional component to the tire, it does not require the adhesive agent fill the cavity after skirt **4** has been fixed to housing **2**. (Davenport-¶189.)

For the reasons discussed for claim 44, incorporated here, a POSA would have understood that, during the attachment process, skirt **4** could be placed in the inner peripheral surface of the tire, adhesive agent fill the internal cavity of the skirt, and then housing **2** be placed within the cavity to fix to skirt **4** while also pressing base of housing case **20** to the adhesive agent. (Davenport-¶190.)

Attachment marks M, along with annular convex parts **23** of skirt attachment part **26** on housing **2**, are also display features that describe how the housing should be “**positioned relative to the retaining member**” in a top-to-bottom orientation. As attachment marks M are etched on the top of the housing, and annular convex parts **23** are a structural component visible to the outer surface of housing **2**, they

each are “a **“display feature that is positioned on the housing.”** Both provide to the user an indication of the top-to-bottom orientation of housing **2** relative to skirt **4**—attachment marks **M** should be on the top of the housing, skirt attachment part **26** should be directionally at the bottom for attachment to the skirt via annular convex parts **23**. That is, a POSA would have understood by Yamaguchi-727’s teachings for these two display features that, during the attachment step that housing **2** should be positioned with the skirt attachment part **26** to be inserted into the cavity of skirt **4** such that its annular convex parts **23** mate with annular recesses **43** of skirt **4**. (Yamaguchi-727, [0030], [0036], FIGs. 3A, 5; Davenport-¶191.)

Petitioner’s mapping of attachment marks **M** and/or annular convex parts **23** to the recited **“display feature”** is consistent with the ’421. The ’421 describes how a “display feature” “may be provide[d] in the form of different shapes, objects, signs, figures and the like” and that “it is to be understood that the display feature [] may be positioned at different locations on the housing[] that is viewable by a user and that all such other placement positions are intended to be within the scope[.]” (’421, 9:54-56, 10:3-8; Davenport-¶192.)

Additionally, Petitioner’s mapping of annular convex parts **23** as a **“display feature”** is also consistent with Patent Owner’s interpretation of claim 50. Patent Owner points to an “empty notch space on the bottom of the Sensor” as a **“display feature”** that can be positioned relative to the retaining member.



(EX1015, pp. 244.) Yamaguchi-727's annular convex parts **23** are materially indistinct from the “empty notch space” as a housing display feature. (Davenport-¶193.)

10. Claim 51

The combination of Yamaguchi-727 and Yamaguchi-566 discloses its “**sensor monitors operating parameters**” for the reasons discussed for claim 41[e], incorporated here.

Patent Owner has taken the position in its infringement contentions that data accumulated from an accelerometer and pressure sensor is sufficient to satisfy this

claim element, noting that Petitioner's products "include an accelerometer and a pressure sensor inside the yellow housing which senses air pressure from through a pressure hole." (EX1015, pp. 245.) Based on Patent Owner's interpretation of claim 51's scope, Yamaguchi-727's functional component **1** discloses sensors that monitor **"one or more of operating conditions, orientation, and location."** Module **6** includes a circuit board **60** that comprises a temperature sensor **62**, pressure sensor **64**, or acceleration sensor **66** mounted to circuit board **60**. (Yamaguchi-727, [0040].) Sensors **62**, **64**, and **66** "each ... functions as a state acquiring means that acquires a state inside the tire," *i.e.*, **"operating conditions"** for the tire. (*Id.*; *see also id.*, [0043], [0044]; Davenport-¶195.)

The sensor data containing information on the operating conditions of the tire is **"transmit[ted] by use of the antenna information related to the monitored operating parameter to the receiver"** for the reasons discussed for claim 41[e], incorporated here. (Yamaguchi-727, [0040], [0041], Davenport-¶196.)

Yamaguchi-566 teaches that the **"electrical device is configured to receive information transmitted from an external device to change one or more features of the electrical sensor device."** Yamaguchi-566's module **6** includes a reception section **69** that consists of a reception circuit **69A** and a reception antenna **69B**. (Yamaguchi-566, [0034], FIG. 4B.) Reception section **69**, "when a predetermined radio wave is input to the reception antenna **69B** from a functional

component management device, ... judges that the reception circuit **69A** has received the radio wave, opens a communication circuit from the outside to the control processing unit **70**, and outputs the input information to the control processing unit 70.” (*Id.*, [0036].) The described process discloses that reception circuit **69A** “**receive[s] information transmitted from an external device,**” the functional component management device, that is outside the functional component. (Davenport-¶197.)

The information received at the reception circuit **69A** is meant to “**change one or more features of the electrical sensor device.**” Yamaguchi-566 describes how “[t]he control processing unit **70**, when the communication circuit to the reception section **69** is opened, outputs, updates, or adds the information stored in the memory means **72** on the basis of commands input by means of radio waves from the functional component management device... that manages the functional component **1.**” (Yamaguchi-566, [0042].) Memory means **72** includes “a memory in which programs or the like are stored,” (*id.*, 0037]) such that a POSA would have understood that information received at the reception section **69** to update and/or add information to what is stored in the memory means would change feature(s) of the functional component **1**. This is made plain by Yamaguchi-566’s specific disclosures of the information contained within memory means **72**. (*Id.*, [0038] (“The memory means **72** stores,... a program for controlling the operations of the

temperature sensor 62 and the pressure sensor 64,...”); Davenport-¶198.)

11. Claim 52

The combination of Yamaguchi-727 and Yamaguchi-566 discloses claim 52 for the same reasons described for claim 12 in Ground 1, incorporated here.

D. Ground 3: Claims 34 and 53 Over Yamaguchi-727 and Yamaguchi-566 and Dodani-859

1. Motivation to Combine

A POSA would have been motivated to combine Yamaguchi-727 and Yamaguchi-566 with the teachings of Dodani-859 discussed above regarding the use of sensor data to determine various tire operating parameters. In particular, the “main unit provided in a vehicle” in Yamaguchi-727 would be able to process sensor data obtained from the accelerometer and use it to calculate road conditions and vehicle camber and/or toe alignment in accord with Dodani-859’s disclosures.

A POSA would have regarded the teachings of Dodani-859 as naturally combinable with the sensor system discussed in Yamaguchi-727 as modified by Yamaguchi-566. Yamaguchi-727, Yamaguchi-566, and Dodani-859 are analogous references in the same field as the alleged invention related to sensor design and implementation within automotive applications, particularly for the attachment of sensor assemblies to the inner wall of a tire to monitor tire conditions and other operating parameters. (*See, e.g.*, Yamaguchi-727, [0001], [0006]; Yamaguchi-566,

[0001], [0006]; Dodani-859, [0002], [0005]; Davenport-¶203.) Yamaguchi-727, Yamaguchi-566, and Dodani-859 are reasonably pertinent to the problem faced by the inventor of providing a tire monitoring system with enhanced functionality and reporting of total tire performance parameters that indicates when to initiate proper tire maintenance for safety. (See Yamaguchi-727, Abstract, [0040], [0045]; Yamaguchi-566, Abstract, [0031]-[0033], [0035], [0041]; Dodani-859 ([0003], [0007], [0079], [0081]-[0086], [0090]-[0093], [0098]-[0099]; Davenport-¶203.)

A POSA would have been motivated to combine Yamaguchi-727 and Yamaguchi-566 with Dodani-859. While Yamaguchi-727's disclosures are more particularly directed towards effective attachment of a sensor assembly to the inner peripheral surface of a tire, the purpose of that functional component is nevertheless to obtain state information about tire operating conditions and/or parameters and transmit that information outside of the tire to a "main unit provided in the vehicle" for display to a user. (Yamaguchi-727, [0045]; Yamaguchi-566, [0035]; Davenport-¶204.) Whereas Yamaguchi-727 and Yamaguchi-566 teach that sensor data can be sent from the functional component to another unit outside of the tire for a user to interface with, Dodani-859's teachings on how that data can be used would have provided a POSA with a deeper understanding of how specific information collected from particular sensors may be processed to determine specific conditions related to a tire's operation. (Dodani-859, [0079], [0081]-[0087]; Davenport-¶204.) A POSA

would have been motivated to incorporate Dodani-859's teachings on sensor data processing into the capabilities of Yamaguchi-727's main unit to enhance a user's capabilities to monitor various aspects of the vehicle's tire conditions. (Davenport-¶204.)

A POSA would have had a reasonable expectation that the combination would have been successful. Dodani-859 teaches that its disclosures "are not intended to be exhaustive" and that "[m]any modifications and variations are possible in view of" its teachings. (Dodani-859, [00104].) The embodiments chosen and described were meant "to best explain the principles and their practical applications" and "enable others skilled in the art to best utilize the embodiments and various embodiments with various modifications as are suited to the particular use contemplated." (*Id.*) Here, a POSA would have not perceived any teaching from Yamaguchi-727 or Yamaguchi-566 that would discourage incorporation of Dodani-859's principles on the use of accelerometer sensor data from the tire sensor(s) attached to the inside tire tread(s). Rather, the combination would have entailed only the routine application of conventional software programming techniques to integrate the processing functionality for the accelerometer sensor data into Yamaguchi-727's main unit to determine road conditions and vehicle camber and/or toe alignment for the tire(s). (Davenport-¶206.)

2. Claim 34

A POSA would have known that the collected accelerometer data from the combination of Yamaguchi-727 and Yamaguchi-566, while transmitted to an outside receiver, would be used in some manner to analyze the state of the tire but the Yamaguchi references do not detail specifically how the accelerometer data may be used. For that implementation detail, a POSA would have looked to Dodani-859's teachings that such data can be used to “**determine**” at least “**road conditions**” and “**vehicle camber and/or toe alignment.**” (Davenport-¶206.)

Generally, Dodani-859 describes how its accelerometer is “adapted to detect and/or measure changes in the motion of the tire, for example, as the tire is driven on a road surface.” (Dodani-859, [0034].) The accelerometer data can be used to determine “**road conditions**” by sensing high-frequency vibrations in a tire. (*Id.*, [0081].) These vibrations “can be used to understand the road surface, and/or the friction between the tire and the road surface” by “using the data from the plurality of sensors acquired at the frequency greater than the frequency of rotation of the tire[.]” (*Id.*)

Dodani-859 also describes how “**vehicle camber and/or toe alignment**” may be determined from the accelerometer data. A POSA would have understood vehicle camber and/or toe alignment to generally describe the alignment (or misalignment) of a vehicle's wheel and tire relative to the road surface. (Davenport-¶¶208.)

Dodani-859 notes that “determining that the tire is mounted to a misaligned wheel includes analyzing motion (e.g., wobble) of the tire as determined by data from the accelerometer...” (Dodani-859, [0083].) Discussing a three-axis accelerometer similar to that present in Yamaguchi-727 and Yamaguchi-566, Dodani-859 provides that “determining that the tire is mounted to a misaligned wheel includes detecting that data from the accelerometer include periodic motion of the tire along an axis of rotation of the tire (e.g., at the frequency of rotation of the tire).” (*Id.*)

Yamaguchi-727 and Yamaguchi-566 as modified by Dodani-859 would have resulted in the main unit in the vehicle being able to calculate additional state information based on the accelerometer data received at the wireless circuit from Yamaguchi-727’s functional components in the tires. (Davenport-¶¶209.)

3. Claim 53

The combination of Yamaguchi-727, Yamaguchi-566, and Dodani-859 disclose claim 53 for the same reasons described for claim 34, incorporated here.

E. Ground 4: Claim 10 is Obvious Over Yamaguchi-727 in View of McDonald

1. Motivation to Combine

It would have been obvious to a POSA to combine Yamaguchi-727 with McDonald, predictably resulting in the use of a filter within the hole **33** to filter air from outside of housing **2** into housing space *S*, in communication with sensors **62**

and **64**. This combination would involve the straightforward incorporation of a filter within opening **30** of functional component **1** to filter air passing from outside the housing into the internal cavity of the housing, thereby preventing the sensors from being exposed to corrosive media. (Davenport-¶212.)

Yamaguchi-727 and McDonald are analogous references in the same field as the alleged invention related to sensor design and implementation within automotive applications, particularly for the attachment of sensor assemblies to the inner wall of a tire to monitor tire conditions and other operating parameters. (*See, e.g.,* Yamaguchi-727, [0001], [0006]; McDonald, 2:61-65; Davenport-¶213.)

A POSA would have been motivated to combine Yamaguchi-727 with McDonald because, as noted, use of a filter or permeable membrane to maintain fluid communication between sensors and the outside environment of the sensor assembly was well-known since the 1990s. (Davenport-¶214 .) McDonald notes that physical sensor components used in automotive applications had to be protected from “the potentially corrosive environments in which the pressure sensors operate.” (McDonald, 1:20-26.) A “common failure mechanism” for pressure sensors occurs where interfacing with these hostile environments causes the pressure sensor to “corrode from the direct exposure to the corrosive media.” (*Id.*, 1:35-40.) A POSA would have understood, as one of only a limited number of potential solutions, that a filter could be used to “protect[] a sensor element from corrosion in various

potentially corrosive environments such as, for example, tire mounting paste, tire mounting and general purpose lubricants, tire de-mounting fluid, brake fluid, degreaser, wheel cleaner, and mineral oil.” (*Id.*, 7:5-10.) These substances have long been used in the mounting, maintenance, and de-mounting of tires, and a POSA would have known that any tire-mounted sensor assembly would have to include a solution to protect sensors from exposure to such corrosive material. It would have been obvious to try using a filter, among other limited solutions available to prevent exposure of sensors to corrosive material. (*See* McDonald, 1:20-30 (describing use of elastic gels, polymers, diaphragms, membranes, and other protective coatings or encapsulants to protect pressure sensors from corrosive materials); Laird [EX1013], FIG. 2 (pressure transducer 104 used to measure pressure in compartment 112 through conduit 116), 5:54-6:9 (use of diaphragm with pressure transducer 104, along with epoxy encasement); Davenport-¶214.)

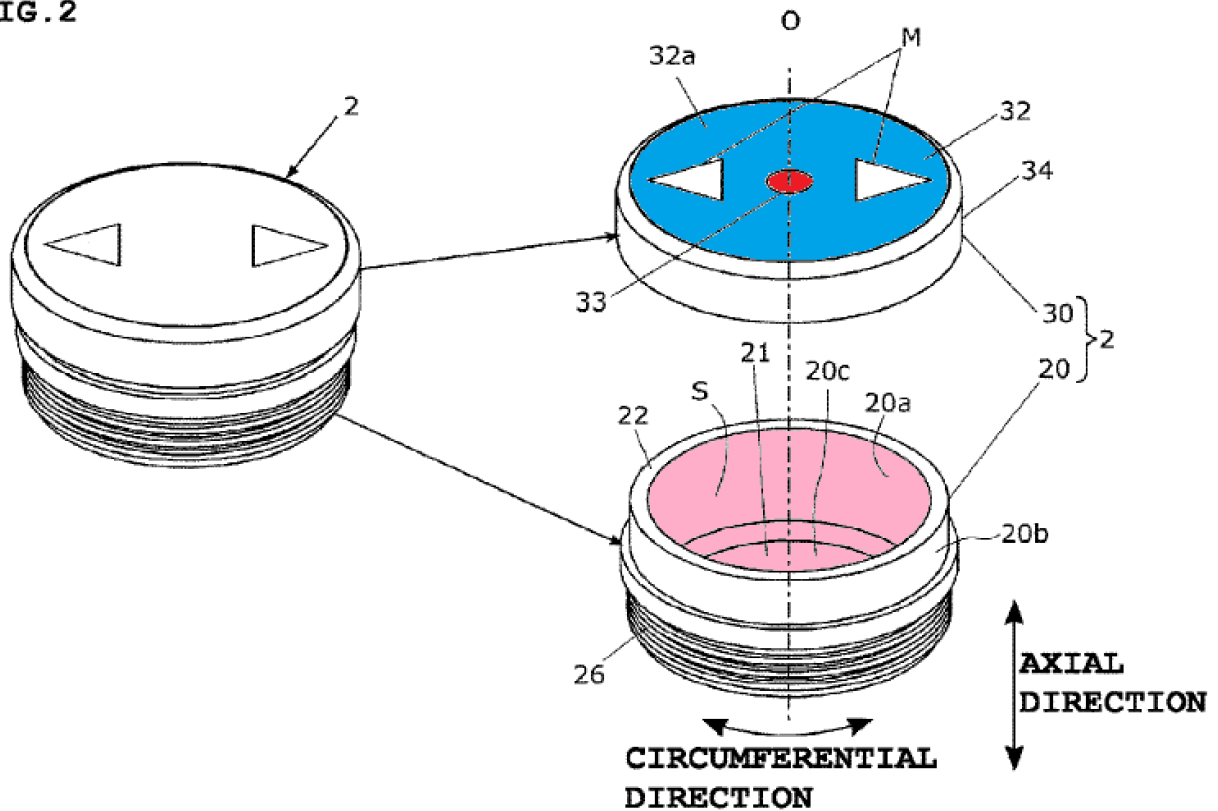
A POSA would have also had a reasonable expectation of success. The filter described in McDonald is a standard structure used in TPMS systems that would have been part of a POSA’s background knowledge. (*See, e.g.*, Laird, 1:36-44 (“To protect against corrosion..., some tire pressure sensors have a housing for encasing the sensor electronic components and circuitry. An opening is provided in the housing and a filter covers the opening.”).) McDonald also notes the adaptability of its filter teachings, noting that “it will be understood by those skilled in the art that

various changes may be made without departing from the spirit or scope of the invention.” (McDonald, 11:20-22; *see also id.*, 11:22-31 (providing examples of potential modifications and applications), 11:45-47.) A POSA would have found the disclosures in Yamaguchi-727 and McDonald sufficiently detailed to implement the filter without undue experimentation. (Davenport-¶215.)

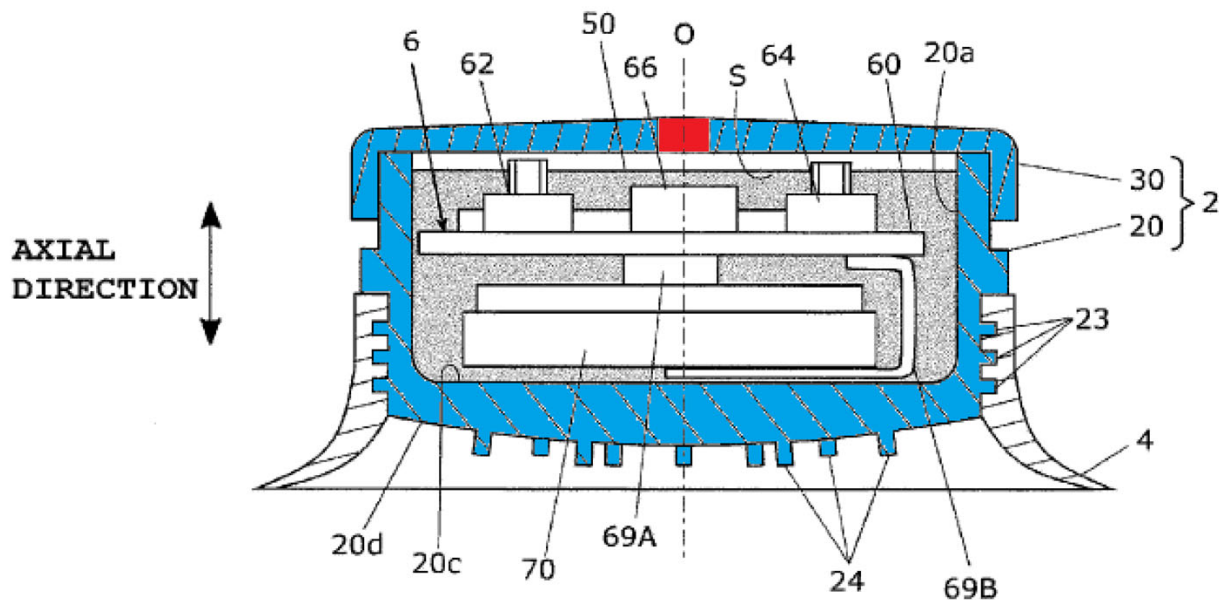
2. Claim 10

Yamaguchi-727 discloses that the “**housing includes an opening through the outside surface to the internal cavity**,” by describing how its housing cap **30** has a circular ceiling part **32** that includes side surface **32a** and a “hole **33** penetrating in the axis O direction is formed in the ceiling part **32**” and “allows for communication between the housing space *S* of the housing case **20** and the outside when the opening of the housing case **20** is closed by the cap **30**.” (Yamaguchi-727, [0034].) FIG. 2 below depicts hole **30** (“**an opening**” – in red) that extends from side surface **32a** of housing cap **30** (in blue) to the housing space *S* (“**internal cavity**” – in pink).

FIG. 2



(*Id.*, FIG. 2; Davenport-¶216.) FIG. 5 below provides a cross-sectional view that depicts how hole 30 (in red) of housing cap 32 extends from the outer surface of housing 2 (in blue) to the internal cavity of housing space S.



(Yamaguchi-727, FIG. 5.) Yamaguchi-727 does not appear to expressly disclose use of **“a filter ... to filter air passing into the internal cavity”** before reaching the sensors on its circuit board. But this structure would have been a trivial addition that was well-known to a POSA. (Davenport-¶¶216-217.)

Use of a filter in this manner is disclosed by McDonald, which like Yamaguchi-727, describes physical sensor components used in automotive applications, including tire-mounted TPMS sensor assemblies. (McDonald, 1:20-22, 2:61-65.) McDonald explains that a filter “can block potentially corrosive elements or media from the exterior environment while still permitting the unhindered transmission of pressure from the exterior environment to the sensor element inside the component.” (McDonald, 2:57-63; *see also id.*, 7:1-10 (describing efficacy of using a filter to protect against various corrosive compounds

placement of a filter in opening **30** that would filter air passing from outside functional component **1** into the unfilled portion of housing space *S* that is in communication with Yamaguchi-727's sensors **62** and **64**. (Davenport-¶218.)

X. CONCLUSION

Petitioner respectfully requests IPR institution.

Dated: February 21, 2025

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CERTIFICATE OF COMPLIANCE WITH WORD COUNT

Pursuant to 37 C.F.R. §42.24(d), I certify that this petition complies with the type-volume limits of 37 C.F.R. §42.24(a)(1)(i) because it contains 13,576 words, according to the word-processing system used to prepare this petition, excluding the parts of this petition that are exempted by 37 C.F.R. §42.24(a) (including the table of contents, a table of authorities, mandatory notices, a certificate of service or this certificate word count, appendix of exhibits, and claim listings).

DATED: February 21, 2025

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CERTIFICATE OF SERVICE

I hereby certify, pursuant to 37 C.F.R. Sections 42.6 and 42.105, that a complete copy of the attached **PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 11,835,421 B2**, including all exhibits (**Nos. 1001-1025**) and related documents, are being served via FEDERAL EXPRESS on February 21, 2025, the same day as the filing of the above-identified document in the United States Patent and Trademark Office/Patent Trial and Appeal Board, upon Patent Owner by serving the correspondence address of record with the USPTO as follows:

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And, via electronic mail upon counsel of record for Patent Owner in the litigation pending before the U.S. District Court for the District of Delaware entitled *Cerebrum Sensors Technologies Inc. v. Revvo Technologies, Inc.*, Case No. 1:24-cv-00245-JLH (D. Del.) as follows:

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