

Petition for *Inter Partes* Review of
U.S. Patent No. 6,508,122 B1

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NINTENDO CO., LTD., and
NINTENDO OF AMERICA INC.,
Petitioners

v.

AMERICAN GNC CORPORATION,
Patent Owner

Case No. IPR2024-00667
U.S. Patent No. 6,508,122 B1
Issue Date: January 21, 2003

Title: Microelectromechanical System for Measuring Angular Rate

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 6,508,122 B1**

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List of Exhibits

Exhibit No.	Description of Document
1001	U.S. Patent No. 6,508,122 B1 to Hiram McCall, et al. (filed Sept. 15, 2000, issued Jan. 21, 2003) (“122” or “122 patent”)
1002	Declaration of Darrin Young, Ph.D. (with exhibits)
1003	U.S. Patent No. 5,945,599 A to Motohiro Fujiyoshi, et al. (filed Dec. 12, 1997, issued Aug. 31, 1999) (“Fujiyoshi”)
1004	International Patent Publication No. WO 99/14,557 to Kevin Townsend (filed Sept. 17, 1998, published March 25, 1999) (“Townsend”)
1005	U.S. Patent No. 5,604,311 to Lalit Kumar, et al. (filed June 7, 1995, issued February 18, 1997) (“Kumar”)
1006	U.S. Patent No. 3,838,346 to Donald Clyde Cox (filed Nov. 1, 1973, issued Sept. 24, 1974) (“Cox”)
1007	Japanese Patent Application Publication No. 9[1997]-42973 (filed Aug. 1, 1995, published Feb. 14, 1997) (“Mitamura”)
1008	Excerpts from Shmuel Merhav, <i>Aerospace Sensor Systems and Applications</i> (1996)
1009	Certified English Translation of Exhibit 1007
1010	Excerpts from Ljubisa Ristic (ed.), <i>Sensor Technology and Devices</i> (1994)
1011	Excerpts from J.M. Slater, <i>Inertial Guidance Sensors</i> (1964)
1012	Excerpts from Myron Kayton, <i>Avionics Navigation Systems</i> (2d Ed. 1997)

List of Exhibits

Exhibit No.	Description of Document
1013	Excerpts from David Irwin, <i>The Industrial Electronics Handbook</i> (1997)
1014	Excerpts from Anthony Lawrence, <i>Modern Inertial Technology</i> (1993)
1015	Excerpts from Connie L. McClure, <i>Theory of Inertial Guidance</i> (1960)
1016	Declaration of Ingrid Hsieh-Yee, Ph.D. (with exhibits)
1017	Proof of Service of Summons and Complaint, ECF No. 10, dated March 8, 2023, filed in <i>American GNC Corp. v. Nintendo Co., Ltd., et al</i> , Case No. 2:23-cv-00302-TL (W.D. Wash.)
1018	Patent Owner's Opening Claim Construction Brief, ECF No. 55, dated March 2, 2021, filed in <i>American GNC Corp. v. OnePlus Tech. (Shenzhen) Co., Ltd.</i> , Case No. 6:20-cv-00171-ADA (W.D. Tex.)
1019	Patent Owner's Reply Claim Construction Brief, ECF No. 57, dated April 6, 2021, filed in <i>American GNC Corp. v. OnePlus Tech. (Shenzhen) Co., Ltd.</i> , No. 6:20-cv-00171-ADA (W.D. Tex.)
1020	Patent Owner's Opening Claim Construction Brief, ECF No. 92, dated January 30, 2018, filed in <i>American GNC Corp. v. LG Electronics Inc., et al</i> , No. 3:17-CV-1090-BAS-BLM (S.D. Cal.)
1021	Patent Owner's Responsive Claim Construction Brief, ECF No. 97, dated February 13, 2018, filed in <i>American GNC Corp. v. LG Electronics Inc., et al</i> , No. 3:17-CV-1090-BAS-BLM (S.D. Cal.)
1022	Patent Owner's Opening Claim Construction Brief, ECF No. 111, dated February 21, 2018, filed in <i>American GNC Corp. v. ZTE (USA) Inc., et al</i> , Case No. 4:17-cv-00620-ALM-KPJ (E.D. Tex.)

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List of Exhibits

Exhibit No.	Description of Document
1023	Patent Owner’s Reply Claim Construction Brief, ECF No. 122, dated March 14, 2018, filed in <i>American GNC Corp. v. ZTE (USA) Inc., et al</i> , No. 4:17-cv-00620-ALM-KPJ (E.D. Tex.)
1024	File history for U.S. Patent No. 6,508,122 B1
1025	Additional pages from Shmuel Merhav, <i>Aerospace Sensor Systems and Applications</i> (1996) (not included with EX1008)
1026	Petitioner’s Preliminary Claim Constructions and Extrinsic Evidence, dated January 29, 2024, in <i>American GNC Corp. v. Nintendo Co., Ltd.</i> , No. 2:23-cv-00302-TL (W.D. Wash.)

Petitioner respectfully requests institution of *inter partes* review of claims 1 and 3 of U.S. Patent No. 6,508,122 (the “’122 patent”), as shown below.

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

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

Nintendo Co., Ltd. and Nintendo of America Inc. (collectively, “Petitioner”) are the real parties-in-interest to this IPR petition.

B. Related Matters Under §42.8(b)(2)

The ’122 patent is the subject of the following pending litigation involving Petitioner: *American GNC Corporation v. Nintendo Co.*, No. 2:23-cv-00302-TL (W.D. Wash.). Petitioner was served on March 8, 2023. (EX1017.)

The ’122 patent was formerly the subject of the following actions: *American GNC Corporation v. ZTE Corporation.*, No. 2:17-cv-00107 (E.D. Tex.) (terminated September 5, 2017); *American GNC Corporation v. ZTE Corporation.*, No. 4:17-cv-00620 (E.D. Tex.) (terminated September 12, 2018); *American GNC Corporation v. LG Electronics Inc.*, No. 2:17-cv-00119 (E.D. Tex.) (terminated June 17, 2017); *American GNC Corporation v. LG Electronics Inc.*, No. 3:17-cv-01090 (S.D. Cal.) (terminated February 20, 2019); *American GNC Corporation v. GoPro, Inc.*, No. 3:18-cv-00968 (S.D. Cal.) (terminated November 6, 2018); *American GNC Corporation v. GoPro, Inc.*, No. 4:18-cv-06778 (N.D. Cal.) (terminated February 19, 2019); *American GNC Corporation v. OnePlus Technology (Shenzhen) Co., Ltd.*, No. 6:20-cv-00171 (W.D. Tex.) (terminated June 23, 2021).

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

Petitioner provides the following designation of counsel.

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D. Service Information

This Petition is being served by Federal Express to the attorneys of record for the '122 patent, DAVID AND RAYMOND PATENT FIRM, 108 N. Ynez Ave, Suite 128, Monterey Park, CA 91754. This Petition is also being served on litigation counsel identified in the Certificate of Service. Petitioner consents to electronic service at the addresses provided above for lead and back-up counsel.

E. Power of Attorney

Filed concurrently per 37 C.F.R. § 42.10(b).

II. FEE PAYMENT

Petitioner requests review of two claims, with a \$41,500 payment.

III. REQUIREMENTS UNDER §§ 42.104 AND 42.108 AND CONSIDERATIONS UNDER §§ 314(A) AND 325(D)

A. Standing

Petitioner certifies that the '122 patent is available for IPR and that Petitioner is not barred or otherwise estopped.

B. Identification of Challenge

Petitioner requests institution of IPR based on the following grounds:

Ground	Claims	Basis under §103
1	1, 3	Fujiyoshi, Kumar, Cox, Townsend
2	1, 3	Mitamura, Townsend

Submitted with this Petition is the Declaration of Darrin J. Young (**EX1002**) (“Young”), a qualified technical expert (Young, ¶¶4-10, Ex. A), and the Declaration of Ingrid Hsieh-Yee (**EX1016**).

C. §§314 and 325(d)

No basis exists under either §314(a) or §325(d) for discretionary denial.

§314(a): The *General Plastic* factors do not apply because Petitioner has not previously filed an IPR petition against the '122 patent. With respect to the *Fintiv* factors, the pending litigation is in early stages and no claim construction rulings have issued. A trial date has been set for May 19, 2025. Mindful of the Board’s limited resources, this Petition challenges only two claims, corresponding to the claims asserted in the pending litigation. To allay concerns regarding duplication of

efforts, Petitioner provides a *Sotera* stipulation that, in the event of IPR institution, Petitioner will not pursue in district court any grounds of invalidity against the challenged claims that were or reasonably could have been asserted in IPR.

§325(d): None of the prior art cited in the grounds identified in **Part III.B** above was previously presented during prosecution.

IV. POSITA DEFINITION AND PRIOR ART OVERVIEW

A. Level of Ordinary Skill in the Art

A skilled artisan would have possessed a bachelor's degree in electrical engineering or similar degree, with two to three years of practical experience designing and/or implementing systems that include sensors for measuring movement, including rotation. (Young, ¶¶12-15.) A skilled artisan could also have had more formal education and less practical experience, or vice versa. (*Id.*, ¶14.)

B. Date Qualification of Prior Art

Each of the relied-upon references qualifies as prior art under pre-AIA rules. Kumar and Cox qualify as prior art under §102, because they are patents issuing more than one year before the earliest application to which the '122 patent claims priority. Fujiyoshi qualifies as prior art under §102(e) because it issued from an application filed before the earliest application for the '122 patent. Townsend qualifies as prior art under § 102(a) (pre-AIA) because it was published before the earliest application for the '122 patent.

Mitamura qualifies as prior art under at least §102(b) because it is a Japanese

patent application published more than one year before the earliest application for the '122 patent. Because Mitamura (**EX1007**) was originally published in Japanese, Petitioner has provided a certified English translation (**EX1009**). All citations to Mitamura below refer to the certified English translation.

Petitioner has cited to other documents (**EX1008, EX1010-1015, 1025**), not to supply limitations missing from the prior art but to confirm the knowledge and understanding of skilled artisans. These references nevertheless qualify as prior art because they were published before the earliest application for the '122 patent.

V. CLAIM CONSTRUCTION

No claim construction rulings have issued in the pending litigation between Petitioner and Patent Owner. Patent Owner has proposed constructions in past litigations, but no claim construction has taken place. (**EX1018-EX1023**.) Petitioner does not believe any term requires express construction at this time because, as shown below, the claims are obvious even if the Board adopted the prior constructions proposed in district court.

VI. THE CHALLENGED CLAIMS ARE UNPATENTABLE

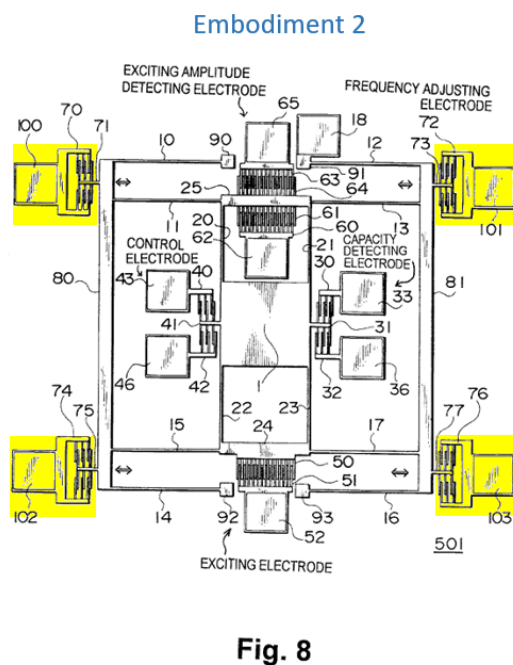
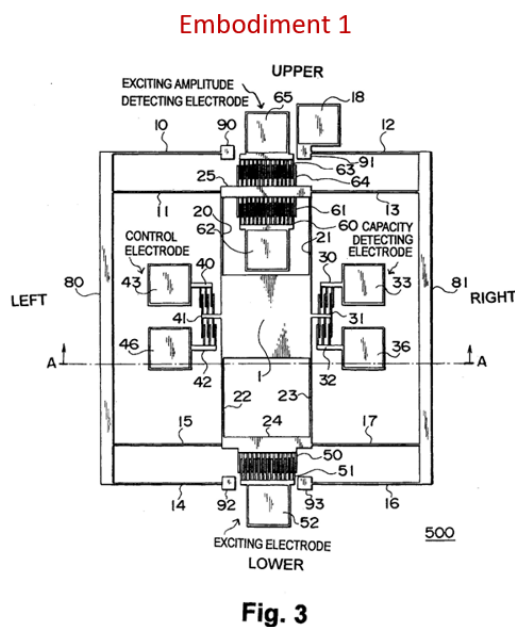
A. Ground 1: Claims 1 and 3 Are Obvious Over Fujiyoshi in View of Kumar, Cox, and Townsend

Petitioner's obviousness analysis below relies on various embodiments in Fujiyoshi. Federal Circuit law is clear that "[c]ombining two embodiments disclosed adjacent to each other in a prior art patent does not require a leap of inventiveness."

Boston Sci. v. Cordis, 554 F.3d 982, 991 (Fed. Cir. 2009). Nevertheless, as shown below, all limitations of claim 1 are disclosed or rendered obvious by Fujiyoshi's *second* embodiment as well as his *seventh* embodiment—a differential configuration using two instances of Fujiyoshi's *second* embodiment. (Fujiyoshi, 24:33-63; Young, ¶107.) Additionally, some of the descriptions in Fujiyoshi's *first* embodiment are relevant to the *second* and *seventh* embodiments, which is substantially similar to Fujiyoshi's *second* embodiment, including in that both are microelectromechanical (MEMS) systems. (Young, ¶107.)

Because Fujiyoshi states that its seventh embodiment is nothing more than “two angular velocity sensors **501** as shown in the **embodiment 2**” connected via connecting portion **116**, Fujiyoshi's teachings regarding its second embodiment are applicable to the seventh embodiment. (Fujiyoshi, 24:38-42 (emphasis added).) To the extent Ground 1 combines disclosures from Fujiyoshi's second and seventh embodiments to meet the claim limitations, therefore, it would have been natural and obvious to combine these disclosures about Fujiyoshi's second and seventh embodiments, for example, by implementing the seventh embodiment using circuitry and components from the second embodiment shown in Figure 9. (Young, ¶108; Fujiyoshi, 24:38-42.) It would also have been obvious that Fujiyoshi's seventh and second embodiments would have used the same circuitry and components. (Young, ¶108.)

Further, a POSITA would have considered Fujiyoshi's teachings related to its first embodiment to apply to its second and seventh embodiments. To the extent any obviousness analysis is necessary, it would have been obvious to combine Fujiyoshi's teachings about its first embodiment with disclosures about its second and seventh embodiments. (Young, ¶109.) Fujiyoshi's first embodiment is substantially similar to the second embodiment, with additional frequency adjusting hardware being the main difference. (Fujiyoshi, 17:45-49; Young, ¶109.) This is shown in the below side-by-side comparison of Fujiyoshi's Figures 3 and 8, where differences between the two embodiments are highlighted:



(Fujiyoshi, Figs. 3, 8 (highlighting and annotations added); Young, ¶109.) As Figures 3 and 8 also indicate, there are many common and commonly numbered elements between Fujiyoshi's first and second embodiments. For these elements a

POSITA would have understood that Fujiyoshi's descriptions regarding its first embodiment would have been applicable to its second (and therefore seventh) embodiments. (Young, ¶109.) A POSITA would have understood that the commonly numbered elements function the same or substantially the same in both embodiments, so Fujiyoshi's descriptions for the first embodiment are equally applicable to the second embodiment. (*Id.*)

1. Claim 1

The preamble recites “[a] **microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising.**” If limiting, the preamble is disclosed by Fujiyoshi. (Young ¶¶110-16.)

Fujiyoshi's embodiments, including the second and seventh embodiments, are **microelectromechanical system[s]**. (Young, ¶¶111-13.) Fujiyoshi's embodiments use “micro machine technology for silicon.” (Fujiyoshi, 11:57-59, Figs. 6A-E, 13:57-14:40.) The '122 patent indicates that micromechanical systems are constructed via micromachining on a silicon wafer. ('122, 6:15-17, 6:24-25, 1:41-43; 1:46-50.) Similarly, Fujiyoshi discloses fabricating its embodiments “using a micro machine technology for silicon” in which its sensor architecture “float[s] on a substrate surface.” (Fujiyoshi, 11:57-62, Young, ¶111.)

Fujiyoshi is directed to embodiments of a sensor **for measuring angular rate.** (Young, ¶114.) For example, Fujiyoshi discloses a second embodiment that is an

“angular velocity sensor.” (Fujiyoshi, Fig. 8, 17:42-44; *see also* Fig. 9, 20:28-34 (describing outputting “angular velocity”).) Fujiyoshi also discloses a seventh embodiment—which contains two instances of Fujiyoshi’s second embodiment in a differential arrangement—that outputs “angular velocity.” (Fujiyoshi, 24:54-57.) A POSITA would have understood “angular velocity” to be the same as “angular rate.” (Young, ¶114.)

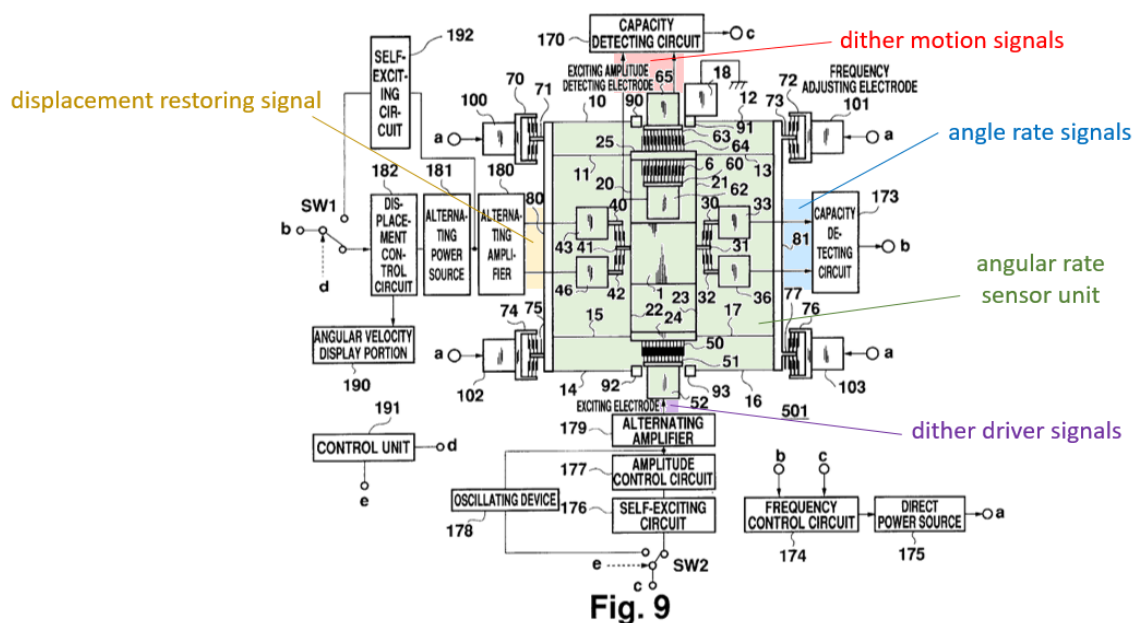
Fujiyoshi also discloses that its embodiments can measure angular rate of a **carrier**. (Young, ¶115.) Fujiyoshi discloses that its embodiments can be used to detect angular rate “acting on a vehicle such as an automobile [or] airplane.” (Fujiyoshi, 1:7-9.) Specifically, Fujiyoshi teaches that its embodiments can be “mounted on vehicles or the like.” (*Id.*, 18:10-13.) Consistent with the ’122 disclosures regarding vehicle applications, Fujiyoshi thus teaches that its sensor embodiments can measure angular rate of a carrier—*i.e.*, an automobile or airplane that carries the sensor. (’122, 2:54-57; Young, ¶115.)

- (a) **“an angular rate sensor unit receiving dither driver signals, capacitive pickoff excitation signals and a displacement restoring signal and outputting angle rate signals in response to motion of said carrier and dither motion signals” (Claim 1[a])**

This limitation would have been obvious based on Fujiyoshi alone or in light of Kumar. (Young, ¶¶117-54.)

The following annotated version of Fujiyoshi’s Figure 9 circuit shows how

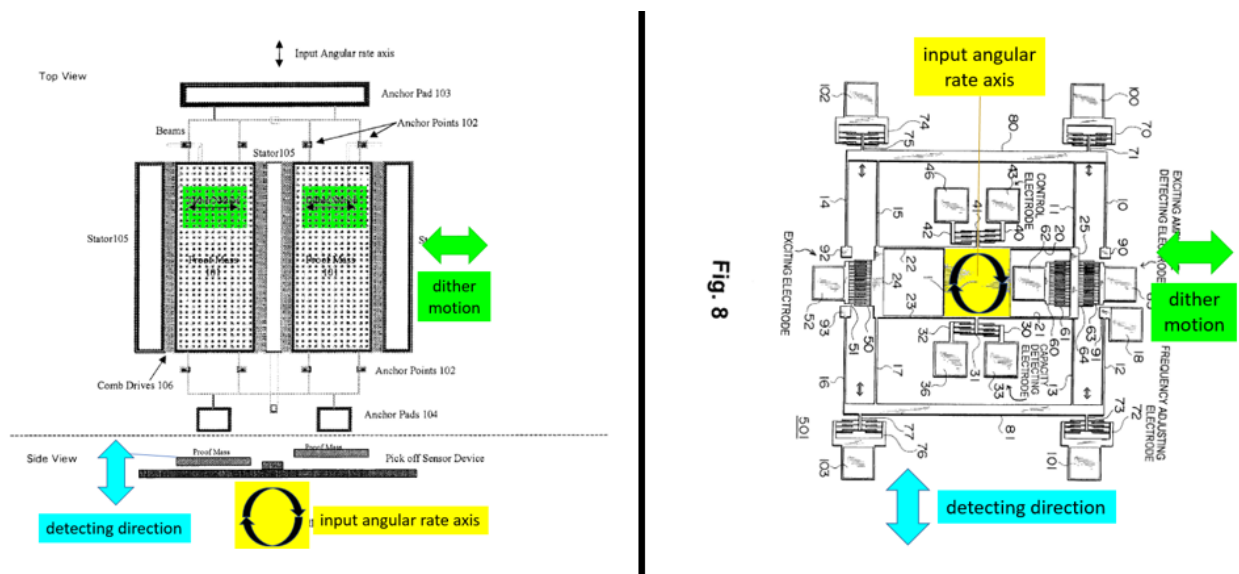
Fujiyoshi's second embodiment discloses limitations of claim 1[a]:



(Fujiyoshi, Fig. 9 (highlighting and annotations added); Young, ¶118.)

Fujiyoshi discloses an **angular rate sensor unit**. (Young, ¶119.) Fujiyoshi discloses embodiments—including its first, second, and seventh embodiments—for measuring angular rate. (Fujiyoshi, 17:42-44; *see also* Figs. 9, 17; 20:28-34, 24:38-57.) This angular rate sensing is performed by the green-highlighted hardware shown in Figure 9, which vibrates mass portion 1 in the vertical direction, leading to a Coriolis force that displaces the mass portion 1 in the horizontal direction when the system undergoes an angular rotation. (*Id.*, 19:63-20:34; Young, ¶119.) The green-highlighted hardware senses the magnitude of that displacement—indicating angular rate. (Fujiyoshi, 20:28-34; Young, ¶119.) Accordingly, the green-highlighted components in Figure 9 constitute an **angular rate sensor unit**.

Fujiyoshi discloses an angular rate sensor unit that **receiv[es] dither driver signals**. The '122 patent indicates that “dither” motion is vibration back and forth of an inertial element in **one axis** such that when the system undergoes **angular rotation**, the Coriolis force will move the inertial element in a **different axis**. ('122, Fig. 2, 5:6-20 (“vibrating (dither)”), 4:65-66.) This effect is shown in annotated versions of Figure 2 of the '122 patent and Figure 8 of Fujiyoshi below:



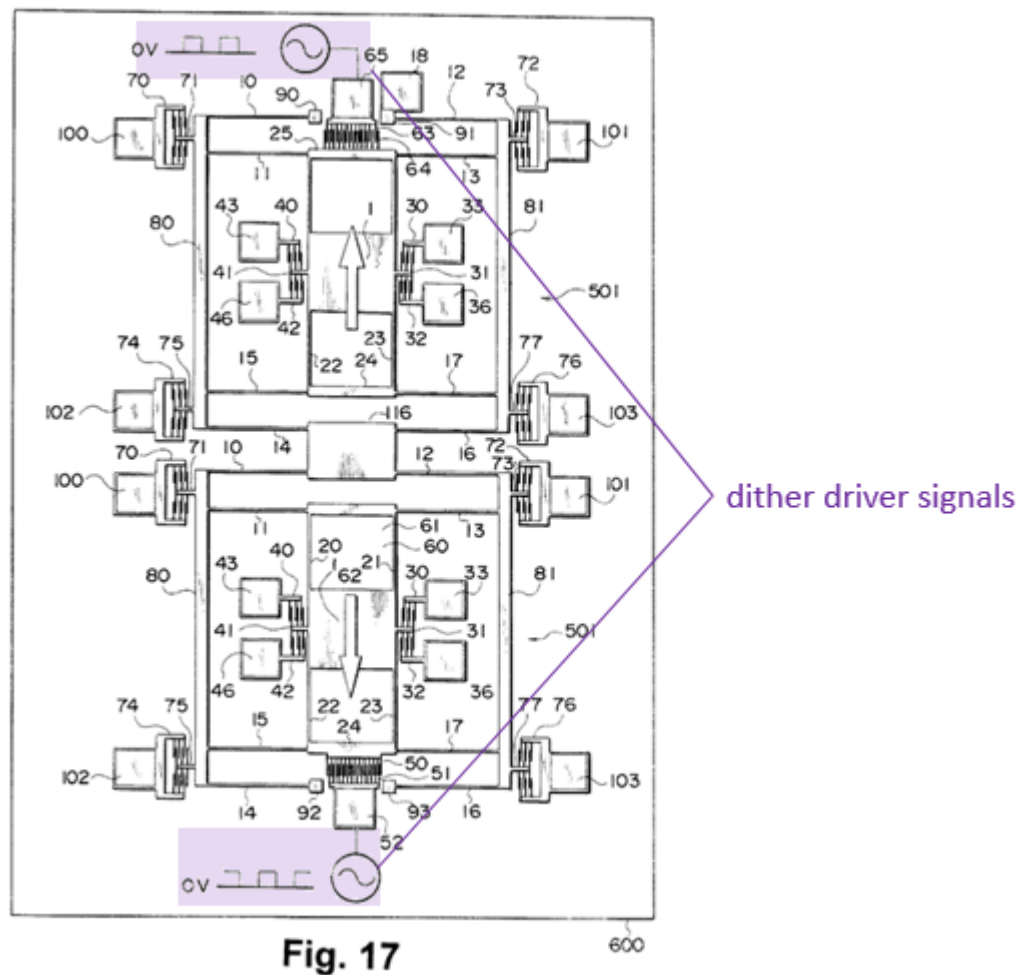
(Young, ¶¶120-21; '122, Fig. 2 (annotations and highlighting added); Fujiyoshi, Fig. 8 (rotated; annotations and highlighting added).)

Similar to the '122 patent, Fujiyoshi discloses that its second and seventh embodiments contain inertial elements (mass portions **1**) that are vibrated back-and-forth along one axis (the “exciting direction”) so that when the system undergoes angular rotation, the inertial elements are displaced along a different axis (the “detecting direction”) by the Coriolis force. (Fujiyoshi, 19:63-20:19; Young, ¶121.)

The angular rate sensor unit in Fujiyoshi's second and seventh embodiments **receiv[es] dither driver signals** to drive the dither motion of mass portion **1**. (Young, ¶122.) The dither vibration of the mass portion **1** in Fujiyoshi's Figure 9 circuit is controlled by "[a]lternating voltage supplied through an amplitude control circuit **177** and an alternating amplifier **179** from the self-exciting circuit **176** [] applied to the exciting electrode **51**, so that the mass portion **1** is vibrated to the exciting direction." (Fujiyoshi, 19:63-67, 12:35-44, 21:29-33.) The dither vibration is controlled via an alternating voltage (the **dither driver signals**) "applied to the exciting electrode **52**," as highlighted in purple in annotated Figure 9 above. (*Id.*, 21:29-33.) Similar to the language of claim 1, Fujiyoshi describes the alternating voltage as controlling the "[d]rive" of the angular velocity sensor. (*Id.*, 19:55-59, 10:49-52, 24:47-50; Young, ¶122.) Since exciting electrodes **51** and **52** are part of the angular rate sensor unit in Fujiyoshi's second and seventh embodiments (green-highlighted components in annotated Figure 9), the **angular rate sensor unit receiv[es] dither drive signals**. (See, e.g., Fujiyoshi, Fig. 8 (including exciting electrode **52**), 10:32-34 (describing Fig. 8 as "view which shows a resonance type angular velocity sensor").)

To the extent there is any argument that claim 1 of the '122 patent requires plural **dither driver signals**, Fujiyoshi's second and seventh embodiments satisfy this requirement. Over time, the alternating voltage applied to electrode **52** in

Fujiyoshi's second embodiment is multiple signals, because it changes over time in response to the dither motion of mass portion **1** “in such a manner as to make the amplitude of the vibration constant on the basis of the excitation control signal.” (Fujiyoshi, 20:4-11; Young, ¶123.) Further, Fujiyoshi's seventh embodiment has two alternating voltage dither driver signals for dither driving:



(Fujiyoshi, Fig. 17 (highlighting and annotations added); Young, ¶147.)

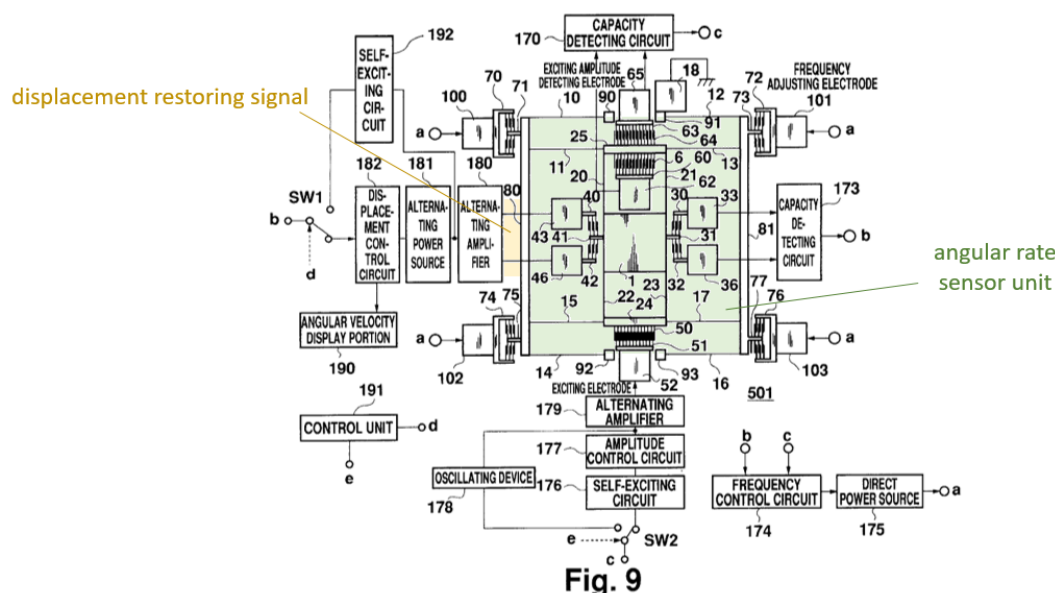
Patent Owner's construction for “dither driver signals” in prior litigation further supports that the alternating voltage applied to exciting electrode **52** in

Fujiyoshi's second and seventh embodiments satisfies this limitation. (Young ¶125.) In multiple district court cases, Patent Owner proposed that "dither driver signals" should be construed as "signals used to oscillate, or vibrate, an inertial element in the angular rate sensor unit." (*Id.*) The mass portion **1** in Fujiyoshi's second and seventh embodiments is an "inertial element." (Young, ¶125.) The mass portion **1** is similar to the "proof masses" disclosed by the '122 patent, which it discusses as "inertial elements." ('122, 8:3-6, 10:25-28, 11:3-6; *see also id.*, Fig. 2, 2:58-3:6, 5:6-20, 5:47-67.) Further, as discussed, the alternating voltage applied to exciting electrode **52** in Fujiyoshi's second and seventh embodiments comprises "signals used to oscillate, or vibrate" mass portion **1**. Accordingly, Fujiyoshi meets Patent Owner's previously proposed construction for "dither driver signals."

Fujiyoshi discloses an **angular rate sensor unit** that receiv[es] a **displacement restoring signal**. (Young, ¶¶126-34.) The '122 patent indicates that a displacement restoring signal is derived from the signals indicating the displacement of an inertial element caused by the Coriolis force, and the displacement restoring signal is used to drive the inertial element. ('122, 8:40-9:4.) While the '122 patent does not explicitly define the term displacement restoring signal, a POSITA would have understood that a **displacement restoring signal** is a signal used to restore the position of an inertial element to its approximate original (*i.e.*, pre-Coriolis force) location following the displacement of the inertial element

by the Coriolis force. (Young, ¶126.)

Per this understanding, Fujiyoshi’s second and seventh embodiments include an angular rate sensor that receives a **displacement restoring signal**. (Young, ¶127.) The angular rate sensor unit in Fujiyoshi’s second and seventh embodiments receives a “control voltage” from alternating amplifier **180** that “make[s] the displacement of the mass portion **1** zero on the basis of the detected output” from the capacity detecting circuit **173** (discussed further below). (Fujiyoshi, 20:20-27; *see also id.*, 13:21-24, 16:33-36; Young, ¶127.) This control voltage from alternating amplifier **180** constitutes a **displacement restoring signal**, since it restores mass portion **1** to its original position—after displacement of mass portion **1** by the Coriolis force. (Young, ¶¶127, 132.) Fujiyoshi’s displacement restoring signal is shown in the annotated Figure 9 below:



(Fujiyoshi, Fig. 9 (highlighting and annotations added); Young, ¶127.) Also, similar

to the '122 patent's disclosures regarding the displacement restoring signal, the yellow-highlighted signal in annotated Figure 9 above is derived from the displacement of the inertial element (mass portion 1) caused by the Coriolis force. (Fujiyoshi, 20:12-27; Young, ¶128.)

The displacement restoring signal in Fujiyoshi's second and seventh embodiments is further receiv[ed] by the **angular rate sensor unit**, which is shown in green highlighting in the annotated Figure 9 above. (Young, ¶129.) The control voltage from alternating amplifier 180 is received by electrode pads 43 and 46, which are part of the angular rate sensor unit as shown by the green highlighting in the annotated Figure 9 above. (See Fujiyoshi, Fig. 8, 10:32-34, 20:20-27, 13:13-21; Young, ¶129.)

To the extent there is any question that Fujiyoshi's second embodiment receives a **displacement restoring signal**, either of the two signals received from alternating amplifier 180 is a **displacement restoring signal**. (Young, ¶130.) Further, Fujiyoshi's seventh embodiment satisfies the **displacement restoring signal** limitation. (*Id.*, ¶131.) Either of the two constituent sensors (each according to Fujiyoshi's second embodiment) receives the control voltage from alternating amplifier 180. (Fujiyoshi, Fig. 17.)

Fujiyoshi meets the construction of "displacement restoring signal" Patent Owner proposed in prior litigation: "signal that is used to restore displacement of

the inertial element(s).” (Young, ¶133.) The control voltage from alternating amplifier **180** in Fujiyoshi’s second and seventh embodiments restores mass portion **1** to its original position—after displacement of mass portion **1** by the Coriolis force. (Fujiyoshi, 20:12-19; Young, ¶133.)

Fujiyoshi also meets the construction that Petitioners have proposed in the pending district court litigation against Patent Owner: “electrical signal used to oppose displacement of inertial element(s) caused by angular rotation.” (**EX1025**.) The control voltage from alternating amplifier **180** constitutes electrical signals (voltage) used to oppose displacement of mass portion **1** caused by angular rotation, since it restores mass portion **1** to its original position—after displacement of mass portion **1** by the Coriolis force. (Fujiyoshi, 20:12-19; Young, ¶134.)

Fujiyoshi teaches or renders obvious **an angular rate sensor unit that receiv[es] capacitive pickoff excitation signals**. (Young, ¶¶135-48.) The concept of “capacitive pickoff excitation signals” was not an invention of the ’122 patent, but well-known in the field of angular rate sensors such as gyroscopes. (*Id.*, ¶135.) For example, the textbook J.M. Slater, *Inertial Guidance Sensors* (1964) (“Slater”, EX1011), in a chapter entitled “Gyros,” teaches that “[c]apacitor pickoff systems typically include as the sensing element a differential-type capacitor of variable effective area or (and more usually) variable gap.” (Slater at 72.) Based on the ’122 patent, capacitive pickoff excitation signals can include oscillator signals provided

to variable capacitors to measure how the capacitance changes over time. ('122, 5:10-17, 5:35-38, 8:20-22; Young, ¶135.)

Fujiyoshi does not explicitly use the term “capacitive pickoff excitation signals” in describing signals received by the **angular rate sensor unit**. But these signals would have been obvious based on Fujiyoshi’s disclosures about its capacitive sensing mechanism. (Young, ¶136.) Fujiyoshi teaches that the angular rate sensor units in its second and seventh embodiments include capacity detecting electrodes **30, 32, 33, and 36**. (See Fujiyoshi, Figs. 5, 8, 17; 20:42-45; Young ¶136.) Fujiyoshi discloses that the capacitance of these electrodes is detected via a capacity detecting circuit as the capacitance changes over time due to the motion of the mass portion **1**. (Fujiyoshi, 20:42-48, 19:67-20:8, 16:25-28, 13:34-40, 13:66-14:4.) Capacity detecting circuit is shown in Figure 9 as receiving signals from electrodes **33** and **36**:

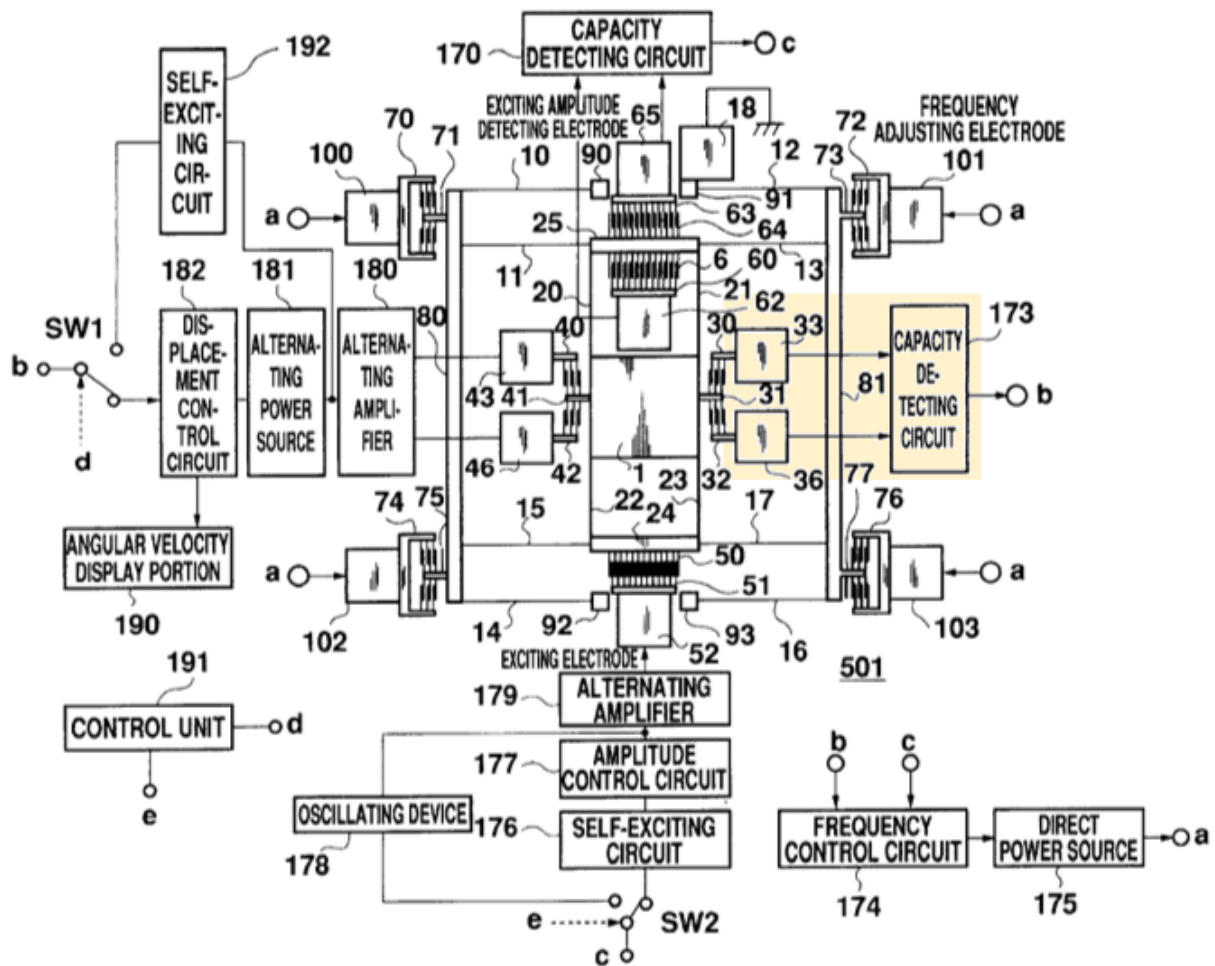


Fig. 9

(Fujiyoshi, Fig. 9 (highlighting added); Young, ¶136.)

It would have been known and obvious to implement Fujiyoshi's capacity detecting circuit by using the conventional technique of providing a high frequency signal to electrodes 30 and 32 that would get modulated by the change in capacitance. (Young, ¶137.) A POSITA would have known that measuring this modulated signal would have indicated the change in capacitance—and therefore the motion of mass portion 1—over time. (*Id.*)

As noted above, Slater's textbook from 1964 teaches that "[c]apacitor pick-off systems typically include as the sensing element a differential-type capacitor of variable effective area or (and more usually) variable gap." (Slater at 72.) Further, Slater teaches "[t]he carrier voltage excitation for the pick-off may be either in the audio- or radio-frequency range." (*Id.* at 73; Fig. 3.6; Young, ¶138.) Slater shows that it was well-established as early as the 1960s to implement a capacitive sensor like Fujiyoshi discloses by providing an oscillating signal to the capacitive sensor. (Young, ¶138.) Slater further shows that it would have long been familiar to a POSITA that capacitive sensing like Fujiyoshi discloses is referred to as a "pickoff" system and high frequency signals provided to it are "excitation" signals. (Slater at 73; Young, ¶138.)

Similarly, the textbook Ljubisa Ristic (ed.), *Sensor Technology and Devices* (1994) ("Ristic," EX1010) indicates that "[a]ny of the capacitive sensing techniques used in a micromachined structure require an ac voltage across the capacitor being measured." (Ristic at 429.) Ristic discloses the following examples of capacitive sensing circuits, each with an AC signal provided to the variable capacitor to measure the capacitance change over time, highlighted below:

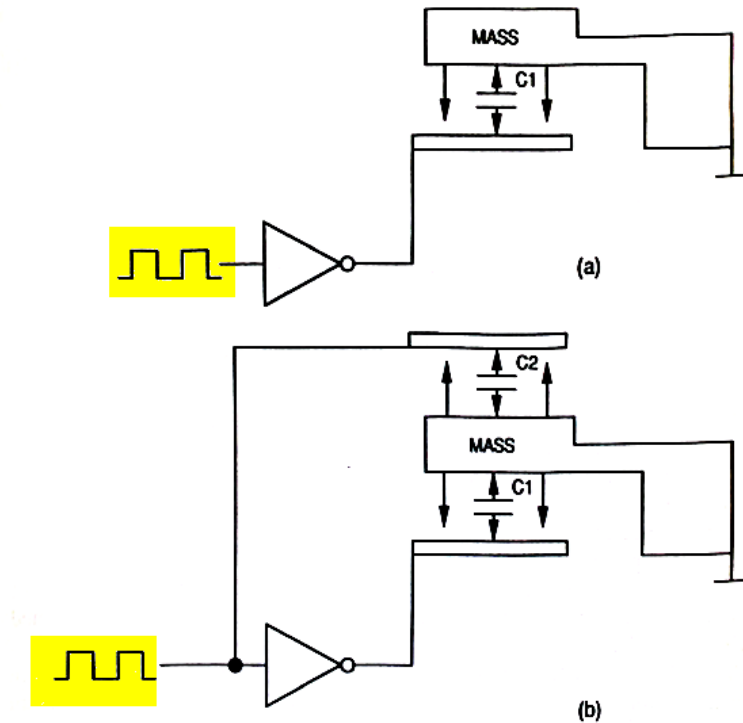


Figure 12.7 Capacitive sensing with electrostatic forces: (a) single-sided capacitive cantilever structure; (b) a movable plate between two fixed plates.

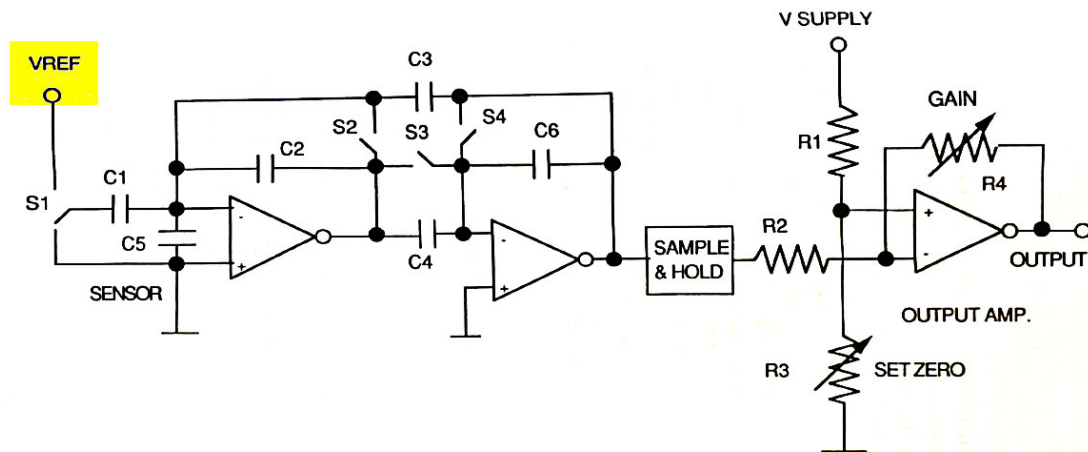


Figure 12.8 Single capacitor sensing block diagram.

(*Id.* at 430-31 (highlighting added); Young, ¶139.)

A POSITA would have known that a change in capacitance in Fujiyoshi's second and seventh embodiments would have been measured by applying AC

signals to electrodes **30** and **32**. (Young, ¶140.) Based on the disclosures of the '122 patent, such signals constitute **capacitive pickoff excitation signals**. ('122 patent, 8:20-22, 5:35-38.) Alternating-current signals provided over time to electrodes **30** and **32** to detect a change in capacitance are **capacitive pickoff excitation signals**, since they relate to a change in capacitance, they excite the capacitors, and they serve to “pick off” the capacitance at electrodes **30** and **32** with respect to the mass portion **1** at a given point in time. (Young, ¶140.)

To the extent there is any question that a POSITA would have understood that Fujiyoshi would have involved **capacitive pickoff excitation signals**, it would have been obvious to use such signals in Fujiyoshi’s system based on Kumar. (Young, ¶¶141-47.)

Kumar discloses a vibrating gyro system that has control loop circuitry for both the driven vibrating motion and sensing motion caused by the Coriolis force—similar to Fujiyoshi. (*See, e.g.*, Kumar, Fig. 2a, 3:50-4:45; Young, ¶142.) Like Fujiyoshi, Kumar senses such motion of an inertial element by measuring a capacitance change as the distance between a “central member” (the vibrating inertial element) and a “pickoff electrode” that forms a “parallel plate capacitor” with the central member. (Kumar, 3:62-65; Young, ¶142.) Kumar discloses that “[s]ince a DC bias voltage is present on the central member’s electrically conductive layer **47**, the varying capacitance,” due to the distance between the central member

and the pickoff electrode changing, “causes a variation in the electrical signal” that gets output as a motion sensing signal. (Kumar, 3:62-4:2, 4:19-25.) Further, Kumar discloses that “other types of oscillation sensors may be employed, such as high frequency carrier signal capacitive pickoffs (which operate without a DC bias voltage).” (*Id.*, 6:29-34.) In light of Kumar, it would have been obvious to implement Fujiyoshi’s capacity detecting circuits 170 and 173 using a DC bias voltage or AC carrier signal provided to the angular rate sensor unit in Fujiyoshi’s second and seventh embodiments. (Young, ¶142.) The Fujiyoshi-Kumar combination renders obvious **an angular rate sensor unit receiving capacitive pickoff excitation signals**. (Young, ¶142.)

Rationale and Motivation to Combine (Fujiyoshi with Kumar): A POSITA would have been motivated to combine Fujiyoshi with Kumar, in the manner described above, predictably resulting in the angular rate sensor unit of Fujiyoshi receiving capacitive excitation pickoff signals, as described in Kumar. (Young, ¶¶143-48.)

Fujiyoshi and Kumar are analogous references. (Young, ¶144.) Both are in the same field as the ’122 patent. (*Id.*) Like Fujiyoshi, Kumar relates to the design of vibrating gyroscopes and associated control circuitry. (Kumar, 1:7-9, 3:50-4:45.)

A POSITA would have been motivated to combine Fujiyoshi with Kumar to detect inertial element movement in a sensor design that is highly similar to

Fujiyoshi's. (Young, ¶145.) Fujiyoshi only provides high-level disclosures about its capacitive sensing systems—disclosing “capacity detecting circuit[s],” but not describing how these circuits work at a granular level. (Fujiyoshi, Fig. 9, 20:12-19.) Kumar provides further detail for how a POSITA would have been motivated to implement capacity detecting circuits to detect the motion of an inertial element. (Kumar, 3:62-4:2.) A skilled artisan would thus have found the disclosures in Kumar helpful in understanding how to implement Fujiyoshi's capacitive sensing systems. (Young, ¶145.)

To the extent there is any argument that claim 1 requires plural capacitive pickoff excitation signals, a POSITA would have considered an AC carrier signal supplied over time to Fujiyoshi's angular rate sensor unit to be plural capacitive pickoff excitation signals in Fujiyoshi's second and seventh embodiments. (Young, ¶147.) A POSITA would have further been motivated to use Kumar's AC carrier signal—rather than a DC bias—for Fujiyoshi's capacitive pickoff excitation signals. (Young, ¶147.) A POSITA would have understood that the use of an AC carrier signal allows for better elimination of noise than a DC carrier signal. (*See, e.g.,* Ristic at 429-431 (**EX1010**); Slater at 72-73.) Additionally, a POSITA would have considered Fujiyoshi's seventh embodiment in combination with Kumar to have plural capacitive pickoff excitation signals, because each of the two mass portions **1** (in the two constituent instances of Fujiyoshi's second embodiment) would have

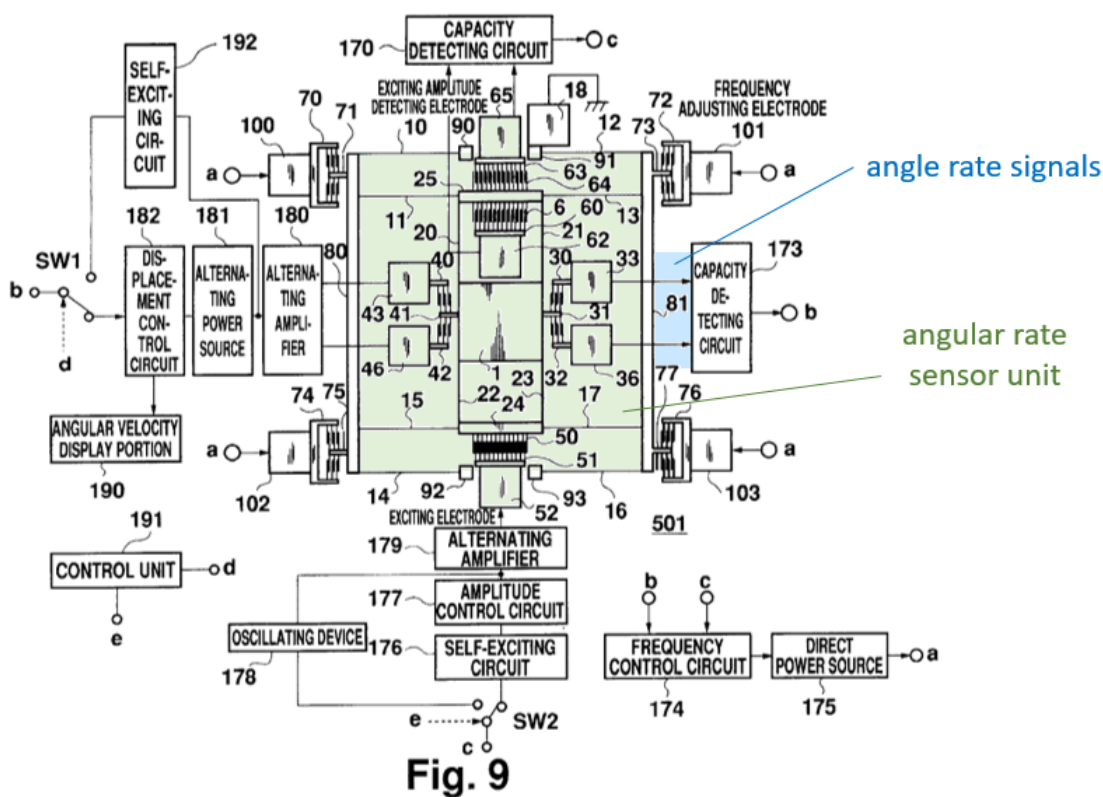
received separate capacitive pickoff excitation signals. (Young, ¶146.) Additionally, Fujiyoshi's second embodiment includes two capacity detecting circuits **170** and **173**. (See, e.g., Fujiyoshi, Fig. 9.) A POSITA would have understood that the angular rate sensor would receive a *separate* capacitive pickoff excitation signal from *each* of these capacity detecting circuits—comprising multiple **capacitive pickoff excitation signals** in Fujiyoshi's second and seventh embodiments. (Young, ¶147.)

Fujiyoshi meets the construction of “capacitive pickoff excitation signals” Patent Owner proposed in prior litigation: “electrical signals that provide electrical energy (i.e. excitation) into the angular rate sensor unit's pickoff capacitors.” (Young, ¶148.) Under this construction, AC or DC signals provided to the comb electrodes **31** in Fujiyoshi's second and seventh embodiments constitute “capacitive pickoff excitation signals,” since any such signals would provide electrical energy into the capacitors formed by the comb electrodes. (Young, ¶148.)

Moving on, Fujiyoshi discloses an **angular rate sensor unit** that **output[s] angle rate signals in response to motion of said carrier**. The '122 patent indicates that angle rate signals reflect or are derived from the displacement of the inertial element due to the Coriolis force when the carrier undergoes angular rotation motion. (Fujiyoshi, 4:57-62, 5:10-18; Young, ¶149.) The '122 patent also indicates that angle rate signals are a preliminary form of angular rate signals, which are

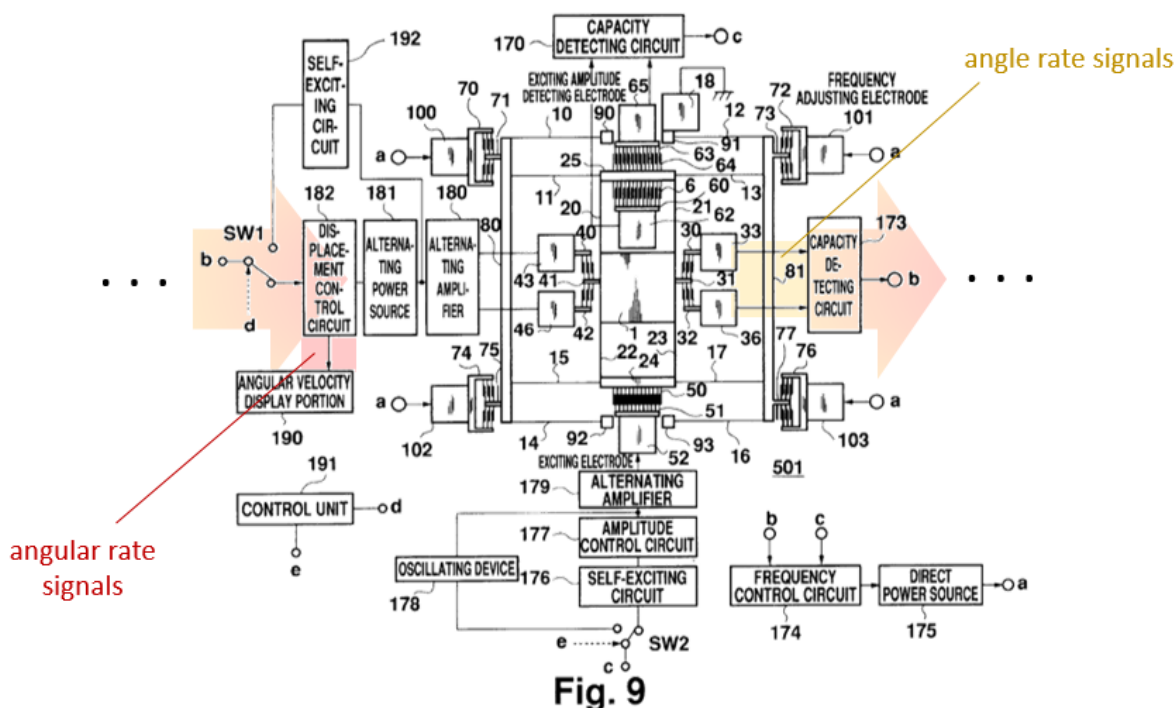
derived from the angle rate signals. (Fujiyoshi, 8:40-9:4; Young, ¶149.)

Fujiyoshi teaches that its **angular rate sensor unit output[s] angle rate signals** in line with the '122 patent's disclosures. Fujiyoshi discloses that signals are transmitted from capacity detecting circuit 173 to capacity detecting electrodes 30 and 32. (Fujiyoshi, 20:12-19.) These signals, shown in the annotated figure below, constitute Fujiyoshi's **angle rate signals**:



(Fujiyoshi, Fig. 9 (highlighting and annotations added); Young, ¶150.) The blue-highlighted signals reflect the motion of mass portion 1 in the horizontal “detecting” direction caused by angular rotation. (Fujiyoshi, 20:12-19.) And Fujiyoshi teaches that these signals are used to derive angular rate signals, as shown in the annotated

figure below:



(Fujiyoshi, Fig. 9 (highlighting and annotations added), 20:20-27; Young, ¶151.)

Fujiyoshi’s **angle rate signals** are also **output[]** in response to motion of said **carrier**. (Young, ¶152.) Fujiyoshi indicates that angle rate signals are output based on “the Coriolis force due to the angular velocity.” (Fujiyoshi, 20:12-19.)

Fujiyoshi also teaches an **angular rate sensor unit** that **output[s] dither motion signals**. (Young, ¶153.) In Fujiyoshi’s second and seventh embodiments, the dither vibration (*i.e.*, vertically up and down in Figure 9) is “detected by a capacity detecting circuit 170 through the exciting amplitude detecting electrodes 60 and 63[.]” (Fujiyoshi, 19:67-20:2.) The signals provided from electrodes 60 and 63 are **dither motion signals**, since they reflect the dither (*i.e.*, vibration) motion of

mass portion 1. (Young, ¶153.)

- (b) “a central circuitry receiving said angle rate signals in response to said motion of said carrier and said dither motion signals and outputting angular rate signals and digital low frequency inertial element displacement signals” (Claim 1[b])

A POSITA would have found this limitation obvious based on Fujiyoshi in light of Townsend. (Young, ¶¶155-175.)

Fujiyoshi discloses a central circuitry receiving said angle rate signals in response to said motion of said carrier and said dither motion signals. (Young, ¶¶156-58.) The '122 patent indicates that the central circuitry consists of two distinct circuit blocks—one related to dither motion and the other related to motion due to the Coriolis force:

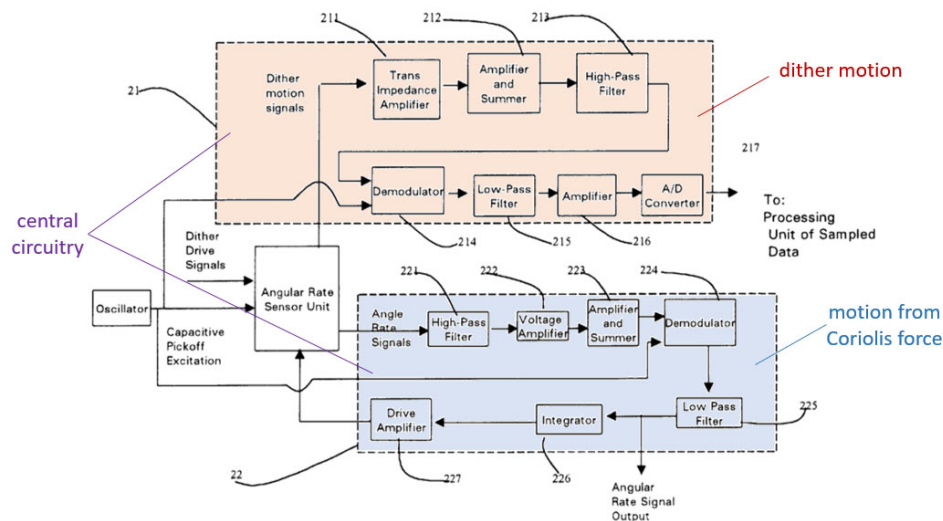


Figure 6

(’122, Fig. 6 (annotations and highlighting added), 7:61-63; Young, ¶156.) On the dither motion side, the central circuitry is centrally located between the angular rate

dither motion (top and bottom of the above Figure 9) is centrally located between the angular rate sensor and the **digital signal processing unit** (discussed for claim 1[c] below), and the central circuitry related to Coriolis force motion is centrally located between the angular rate sensor and the **angular rate signals** output (shown in **green** highlighting above). (Young, ¶157.) Fujiyoshi also discloses that the **dither motion signals** and **angle rate signals** discussed above for claim 1[a] are received by components of the **central circuitry** highlighted in **orange** in the above annotated figure. (Fujiyoshi, 19:67-20:8, 20:12-19; Young, ¶158.)

Fujiyoshi further teaches that its **central circuitry output[s] angular rate signals**. (Young, ¶¶159-62.) Fujiyoshi discloses that displacement control circuit **182** in its second and seventh embodiments “calculates the . . . angular velocity” and “output[s] [it] to the angular velocity display portion **190**[.]” (Fujiyoshi, 20:32-34.) These angular rate signals are derived from the angle rate signals discussed above. (Fujiyoshi, 20:20-27; Young, ¶160.) The ’122 patent similarly discloses that angular rate signals are derived from angle rate signals. (’122, Fig. 6, 8:40-64; Young, ¶160.)

To the extent there is any argument that the **central circuitry** must output plural **angular rate signals**, the angular velocity output from displacement control circuit **182** in Fujiyoshi’s second embodiment constitutes plural angular rate signals, because it changes over time, therefore constituting multiple signals as it changes. (See, e.g., Fujiyoshi, 18:10-18, 3:44-62; Young, ¶161.) Further, each of the two

constituent sensors in Fujiyoshi's seventh embodiment outputs its own angular rate signal—yielding multiple angular rate signals. (Fujiyoshi, 24:54-57; Young, ¶162.)

It would have been obvious that the **central circuitry** in Fujiyoshi's second and seventh embodiments would output **digital low frequency inertial element displacement signals** in light of Townsend. (Young, ¶¶163-65.) Details of the Fujiyoshi-Townsend combination are provided below for claim 1[c]. (Young, ¶¶178-86.)

The Fujiyoshi-Townsend combination would have involved passing dither motion signals through sample-and-hold devices, which would have generated **low frequency inertial element displacement signals**. (Young, ¶165.) Townsend discloses that sample-and-hold devices “average or integrate the input waveform over the sample period,” providing “a high degree of noise rejection.” (Townsend at 18; *see also id.*, Fig. 4, 12-13.) Understanding dither motion signals from which high-frequency information like noise has been removed as “low frequency inertial element displacement signals” is consistent with the disclosures of the '122 specification. (*See* '122, Fig. 6, 8:27-34; Young, ¶165.) Further, the Fujiyoshi-Townsend combination would Petitioner's proposed construction for “inertial element displacement signals” in the district court litigation—“electrical signals reflecting dither motion of inertial element(s)” —because the identified signals would be derived from dither motion signals. (Young, ¶165.)

To the extent there is any dispute that Townsend's sample-and-hold devices would have resulted in **low frequency inertial element displacement signals**, it would have been obvious to incorporate a low-pass filter into the sample-and-hold devices of the Fujiyoshi-Townsend combination in light of Cox. (Young, ¶¶166-74.)

Cox discloses a "sample and hold circuit" incorporating a low-pass filter via "a resistive arrangement in association with the holding capacitor." (Cox, Abstract, 1:27-30, 3:50-4:8.) It would have been obvious to implement the sample-and-hold devices in the Fujiyoshi-Townsend combination based on Cox's disclosures to function as low-pass filters. (Young, ¶167.) In the resulting combination, the Fujiyoshi-Cox sample-and-hold devices/low-pass filters would output **low frequency inertial elements displacement signals**. (See '122, Fig. 6, 8:27-31; Young, ¶167.)

Rationale and Motivation to Combine (Fujiyoshi with Townsend and Cox):

A POSITA would have been motivated to combine Fujiyoshi and Townsend with Cox, in the manner described above. (Young, ¶¶168-74.) As explained for limitation 1[c] below, like Fujiyoshi, Townsend is also an analogous reference.

Fujiyoshi and Cox are analogous references. (Young, ¶169.) Both are in the same field as the '122 patent. Like Fujiyoshi, Cox discloses circuitry for manipulating and detecting AC signals, including by using capacitors and feedback

loops. (E.g., Cox, Figs, 1-2, 2:14-25, 3:19-28.)

A POSITA would have been motivated to implement sample-and-hold devices based on Cox to eliminate more noise from the system. (Young, ¶170.) Both Fujiyoshi and Townsend indicate that reduction of noise is important for sensor performance. (Townsend at 18; Fujiyoshi, 6:50-53; 12:60-64.) A POSITA would have understood that adding low-pass filtering would have further reduced noise and improved sensor performance. (Young, ¶170.)

A POSITA would have been further motivated to incorporate Cox's low-pass filter into the Fujiyoshi-Townsend combination's sample-and-hold devices to reduce aliasing by the analog-to-digital converters. For example, the textbook David Irwin, *The Industrial Electronics Handbook* (1997) ("Irwin"; EX1013.) indicates that low-pass filtering prior to analog-to-digital conversion is commonplace to avoid "distortions" in the digitized signal. (Irwin at 139; Young, ¶171.)

A POSITA would have been further motivated to use Cox's design to minimize the number of components in the system. (Cox, 3:68-4:8; Young, ¶172.) A POSITA would have been motivated to minimize the total number of components needed, for example, to reduce system cost. (Young, ¶172.)

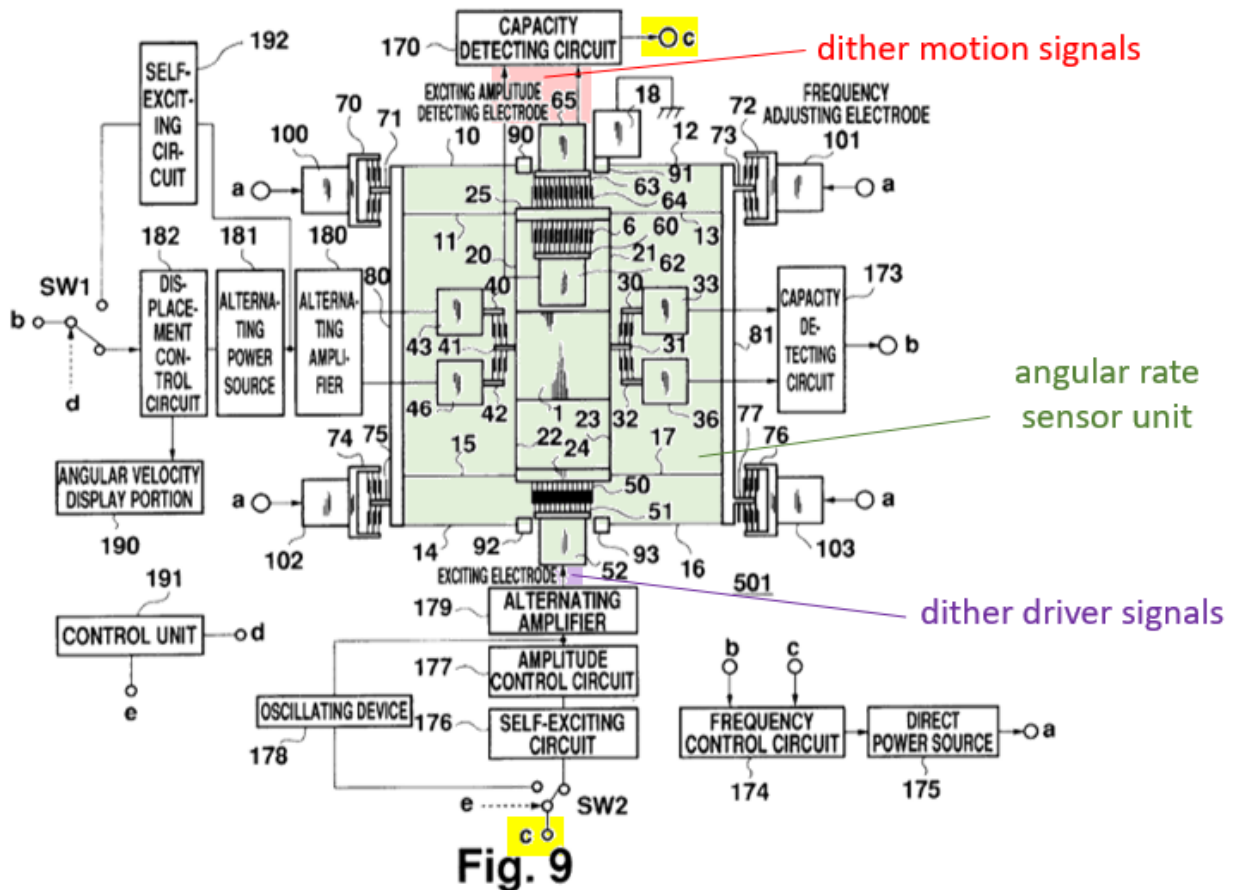
Further, **a central circuitry outputting *digital* low frequency inertial element displacement signals** would have been obvious based on Fujiyoshi in light of Townsend (or, in the alternative, Fujiyoshi in light of Townsend and Cox).

(Young, ¶174.) As discussed below, it would have been obvious that, in the Fujiyoshi-Townsend combination, an analog-to-digital converter would convert the analog low frequency inertial element displacement signals into *digital* signals formatted for Townsend’s digital processing unit. (*Id.*, ¶¶178-86.)

(c) **“a digital signal processing system analyzing said digital low frequency inertial element displacement signals and feeding back said dither driver signals to said angular rate sensor unit” (Claim 1[c])**

This limitation would have been obvious based on Fujiyoshi in light of Townsend. (Young ¶¶176-86.)

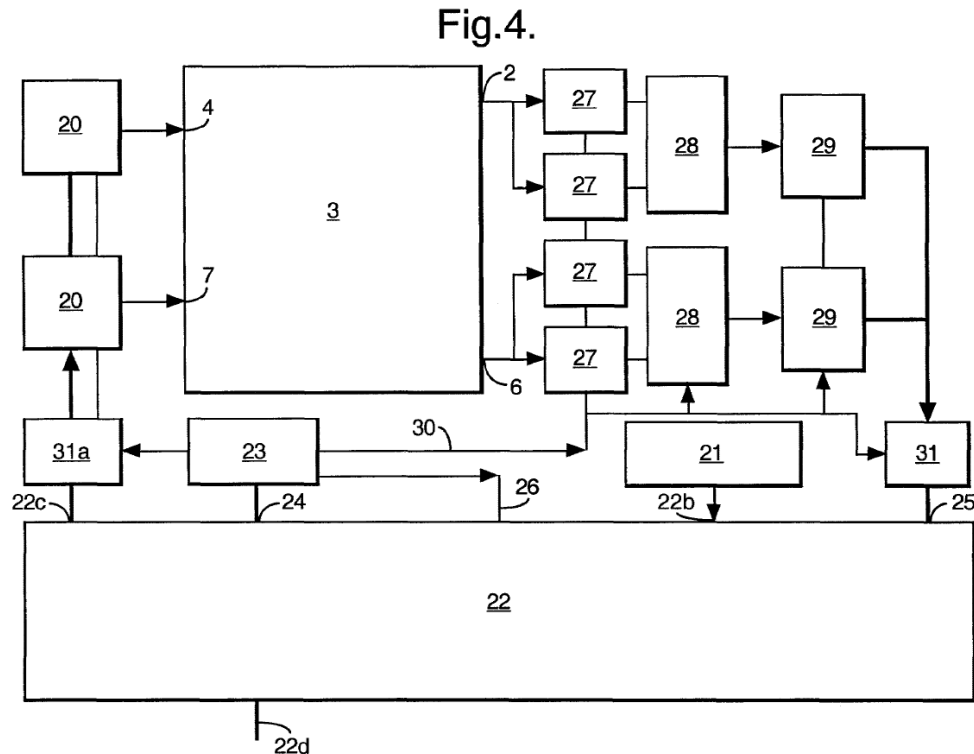
Fujiyoshi discloses **feeding back said dither driver signals to said angular rate sensor unit**. (Young, ¶177.) Fujiyoshi discloses that its dither motion control system involves a “feedback loop,” where dither motion signals are used in forming the dither driver signals. (Fujiyoshi, 20:2-11; Young, ¶177.) This is shown in the annotated version of Fujiyoshi’s Figure 9 below, which shows that dither motion signals connect to the circuitry for generating dither driver signals through node “c”:



(Fujiyoshi, Fig. 9 (highlighting and annotations added); Young, ¶177.)

Townsend discloses a digital control system for a vibrating structure gyroscope like Fujiyoshi discloses. (Townsend at 1; Young, ¶178.) Also, like Fujiyoshi, Townsend discloses that such gyroscopes are conventionally designed with two circuit loops: (1) a primary loop for exciting the vibrating structure and (2) a secondary loop for damping. (Townsend at 1-2; Young, ¶178.) Townsend discloses that digital implementations of these loops have many advantages over analog implementations, since analog implementations come with various drawbacks, including difficulty with specification, design, and integration into small

low cost systems; difficulty with calibration and compensation; and the requirement of “modern systems” for outputs available in digital format. (Townsend at 3; Young, ¶178.) Accordingly, Townsend discloses embodiments using a digital processing unit, including the embodiment shown in Figure 4:

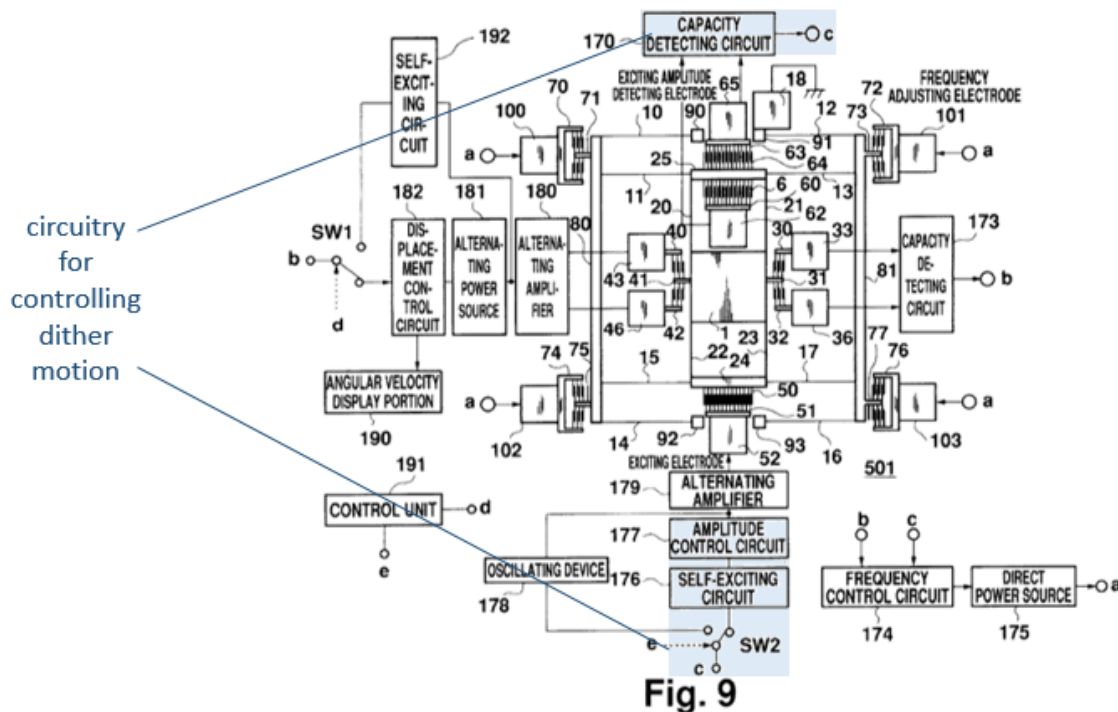


(Townsend, Fig. 4.) Analog signals from the vibrating structure **3** enter sample-and-hold devices **27**, are converted to digital signals **29**, are stored in buffer **31** and input to digital processing unit **22**. (*Id.* at 12-13.) Data processing unit **22** outputs signals, which are stored in buffer **31a**, converted to analog signals via digital-to-analog converters **20**, and fed back into vibrating structure. (*Id.* at 3.)

It would have been obvious to incorporate a digital signal processing system—*e.g.*, the data processing unit and related circuitry disclosed by

Townsend—into Fujiyoshi’s system for controlling the dither motion and sensing (Coriolis force) motion of Fujiyoshi’s mass portion(s) in its second and seventh embodiments. (Young, ¶179.)

A POSITA would have been motivated to connect the dither motion control circuitry in Fujiyoshi’s second and seventh embodiments to a digital signal processing system like Townsend teaches. The annotated version of Fujiyoshi’s Figure 9 below shows the circuitry for controlling dither motion in Fujiyoshi’s second and seventh embodiments:



(Fujiyoshi, Fig. 9 (highlighting and annotations added); Young, ¶180.) It would have been obvious to connect the highlighted dither motion control circuitry in the above annotated version of Fujiyoshi’s Figure 9 to a digital signal processing system

like that disclosed by Townsend. (Young, ¶180.)

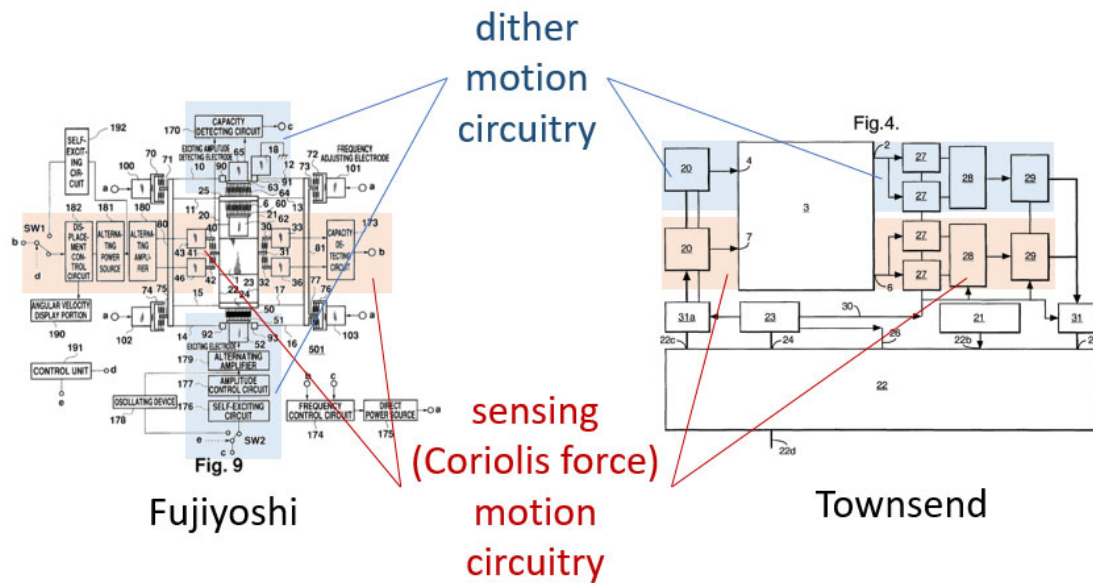
For example, a POSITA would have also been motivated to connect node “c” at the top of Fujiyoshi’s Figure 9 system in the circuitry for controlling dither motion to a sample-and-hold device, analog-to-digital converter, buffer, and digital processing unit as disclosed by Townsend. (Young, ¶181.) Further, the digital processing unit would, in one example, have been connected to node “c” at the bottom of Fujiyoshi’s Figure 9 circuit through a buffer and digital-to-analog converter as disclosed by Townsend. (*Id.*) Alternatively, it would have been obvious that amplitude control circuit 177 disclosed in Fujiyoshi’s Figure 9 circuit would have contained some or all of the digital signal processing system like that disclosed by Townsend. (*Id.*)

Rationale and Motivation to Combine (Fujiyoshi with Townsend): A POSITA would have been motivated to combine Fujiyoshi with Townsend, in the manner described above. (Young, ¶¶182-86.) The combination would have predictably resulted in Fujiyoshi’s circuitry for controlling dither motion incorporating a digital processor and circuitry (*e.g.*, sample-and-hold devices, analog-to-digital converters, and digital-to-analog converters) for converting between analog signals used in Fujiyoshi’s circuits and digital signals input to or output from digital processor. (*Id.*, ¶182.)

Fujiyoshi and Townsend are analogous references. Both are in the same field

as the '122 patent. (Young, ¶183.) Like Fujiyoshi, Townsend relates to the design of vibrating gyroscopes. (*E.g.*, Townsend at 1-2; Young, ¶183.)

A POSITA would have been motivated to combine Fujiyoshi with Townsend because Fujiyoshi describes embodiments of a vibrating structure gyroscope and circuit loops for (1) controlling vibration of the vibrating element and (2) controlling motion caused by the Coriolis force when the system undergoes an angular rotation. (Fujiyoshi, 19:63-20:34; Young, ¶184.) Townsend describes analogous circuit loops in the form of its (1) “primary or excitation loop” (which “excite[s] the vibrating structure 3 at its natural resonant frequency”) and (2) its “secondary or damping loop” (which involves a “signal [] proportional to the applied angular rate” and which “provide[s] damping for the high Q rate response” of the vibrating structure gyroscope. (Townsend at 1-2, 4.) A POSITA would have understood that the circuit loops of Fujiyoshi and Townsend correspond as shown in the diagram below:



(Young, ¶184.) Accordingly, a POSITA would have understood that the teachings of Townsend are applicable to the control circuit loops of Fujiyoshi. (Young, ¶184.)

A POSITA would have been motivated to combine Townsend with Fujiyoshi because Townsend describes digital implementations of vibrating structure gyroscope circuitry that improve upon prior art analog approaches. (Young, ¶185.) Townsend discloses that analog circuitry has drawbacks when used for the control loops of vibrating structure gyroscope circuitry, because such circuitry is “notoriously difficult to specify, design and integrate into small low cost systems (i.e. ASICS)”; it is “difficult to apply calibrations and compensations to systems based on analogue circuits”; and “modern systems require the sensor outputs to be available in digital format to simplify system integration and enable further compensations to be applied to enhance performance.” (Townsend at 3.) Faced with

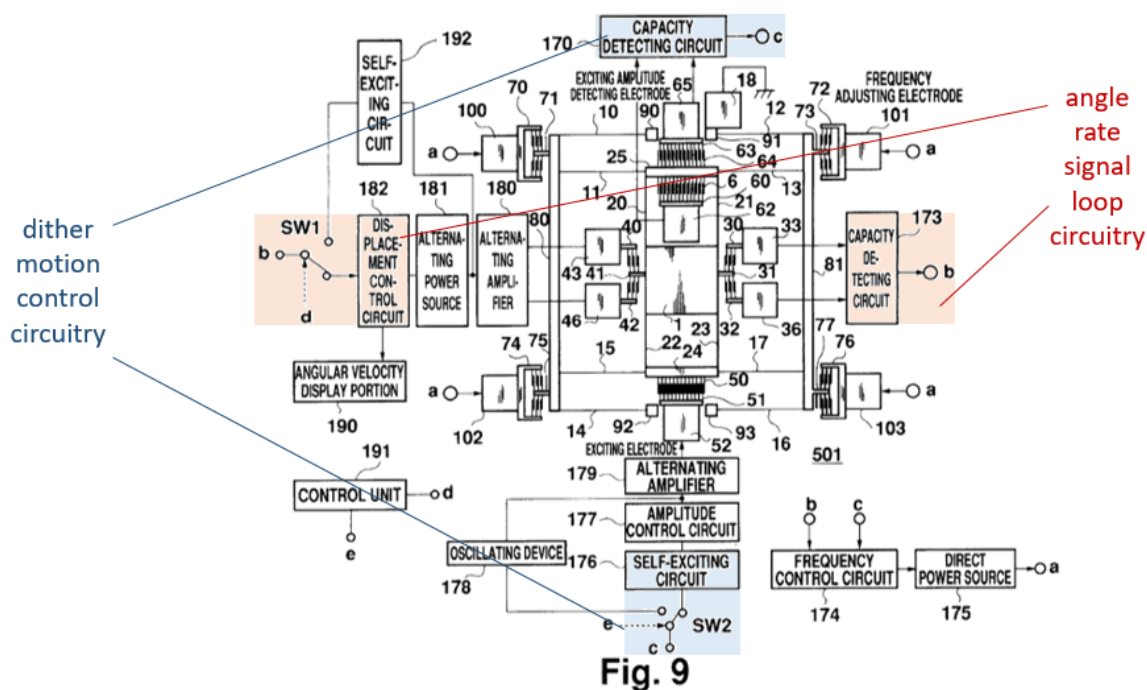
Townsend's teachings about the limitations of analog circuitry when used for control circuit loops for vibrating structure sensors, a POSITA would have looked to Townsend's digital implementation for Fujiyoshi's control circuitry. (Young, ¶185.)

In addition to incorporating a digital signal processor from Townsend into Fujiyoshi's second and seventh embodiments, a POSITA would have been motivated to incorporate other circuitry from Townsend used in converting between analog and digital signals. (Young, ¶186.) A POSITA would have been motivated to incorporate digital-to-analog and analog-to-digital converters into Fujiyoshi's circuit, since Townsend indicates that these are necessary for converting between analog and digital circuitry. (Townsend at 12-13; Young, ¶186.) Further, a POSITA would have been motivated to incorporate sample and hold devices into Fujiyoshi's second and seventh embodiments, because Townsend indicates that sample and hold devices "provide a high degree of noise rejection" by "averag[ing] or integrat[ing] the input waveform over the sample period." (Townsend at 18; Young, ¶186.) A POSITA would have been motivated based on Fujiyoshi's disclosures to incorporate circuitry for rejecting noise. (Young, ¶186.) For example, Fujiyoshi discloses mechanisms for "lower[ing] noise (cross-talk)" such that "sensor resolution can be improved." (Fujiyoshi, 6:50-53; 12:60-64.) A POSITA would look for further means for reducing noise in Fujiyoshi's second and seventh embodiment—like the sample and hold devices disclosed by Townsend—so as to further improve sensor

performance. (Young, ¶186.)

2. Claim 3

Per the requirements of claim 3, Fujiyoshi discloses a **micromechanical system**, as recited in claim 1, wherein said central circuitry comprises a **dither motion control circuitry** and an **angle rate signal loop circuitry**. (Young ¶¶187-91.) As shown in the annotated version of Fujiyoshi's Figure 9 below, the central circuitry identified above for claim 1[b] can be divided between **dither motion control circuitry** and **angle rate signal loop circuitry**:



(Fujiyoshi, Fig. 9 (highlighting and annotations added); Young, ¶190.) The blue-highlighted circuitry in the above diagram is **dither motion control circuitry**, because it is involved in detecting dither motion of mass portion 1 and generating dither driver signals to vibrate mass portion 1. (Fujiyoshi, 19:63-20:11; Young,

¶190.) The red-highlighted circuitry in the above diagram is **angle rate signal loop circuitry**, because it is involved in detecting lateral displacement of mass portion 1 caused by angle rate of the system. (Fujiyoshi, 20:12-34; Young, ¶190.) This circuitry is also a **loop**, because the angle rate signals are fed back into the system as displacement the displacement restoring signal. (Fujiyoshi, 20:20-27; Young, ¶190.)

B. Ground 2: Claims 1 and 3 are Obvious Over Mitamura and Townsend

1. Claim 1

The preamble recites “[a] **microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising.**” If limiting, the preamble is disclosed by Mitamura. (Young, ¶¶192-99.)

Mitamura teaches **a microelectromechanical system (MEMS)**. (Young, ¶¶193-94.) The ’122 patent indicates that microelectromechanical systems are “small electrical/mechanical devices.” (’122, 1:38-39.) Mitamura discloses that its third embodiment contains a “vibrating mass” (a mechanical component) and “opposing electrodes” (electrical components) with a thickness “in the range of a few micrometers.” (Mitamura, [0042]; *see also id.*, [0043], [0012]; Young, ¶193.) A POSITA would have understood Mitamura’s third embodiment to be sufficiently “small” to be a microelectromechanical system—particularly since a device made of components as small as a few **micrometers** is clearly a **microelectromechanical** system. (Young, ¶193.)

The '122 patent further indicates that MEMS involves “Microelectronics”—the “development of electronic circuitry on silicon chips”—and “Micromachining”—the “fabricat[ion of] tiny sensors and actuators on silicon chips.” ('122, 1:41-43, 1:46-50.) Similarly, Mitamura discloses that its third embodiment “can be fabricated using a known technique and monocrystalline or polycrystalline silicon.” (Mitamura, [0042].) Mitamura further describes various processes for fabricating its embodiments on silicon chips. (Mitamura, Figs. 8-10, [0019]-[0022]; *see also id.*, [0041]; Young, ¶194.) Mitamura’s disclosures regarding the fabrication of its third embodiment on silicon chips—similar to the '122 patent’s teachings of MEMS-related techniques—provide further support that Mitamura’s third embodiment is a microelectromechanical system (MEMS). (Young, ¶194.)

Mitamura teaches that its third embodiment is **for measuring angular rate**. (Young, ¶¶195-96.) Mitamura describes its third embodiment as an “angular velocity sensor.” (Mitamura, [0042], p. 25 (discussing “angular velocity detection circuit in the third embodiment”).) Mitamura further discloses that the “detection circuit” for its third embodiment provides “[o]utput proportional to the angular velocity.” (*Id.*, [0045].) A POSITA would have understood that “angular rate” and “angular velocity” are the same—since both refer to the change in angular rotation over time. (Young, ¶195.)

Mitamura further teaches that when the vibrating mass in its sensor embodiments “is rotated” around a particular axis, the “angular velocity” around that axis is measured. (Mitamura, Fig. 19, [0013], [0043], [0027]; *see also id.*, [0001], [0012], Title (“Angular Velocity Sensor”); Young, ¶196.)

Mitamura further teaches that its third embodiment is for measuring angular rate **of a carrier**. (Young, ¶¶197-98.) Mitamura teaches that its vibrating mass 72 is “connected to supports 73,” which are “secured to the substrate by securing sections 74.” (Mitamura, [0043].) The substrate thus serves as a carrier for vibrating mass 72, since vibrating mass 72 is carried by the substrate. Since rotation of the carrier substrate causes vibrating mass 72 to rotate, and Mitamura discloses that angular rate is measured when the vibrating mass “is rotated,” a POSITA would have understood that its third embodiment measures angular rate of a carrier. (Mitamura, [0013]; Young, ¶197.)

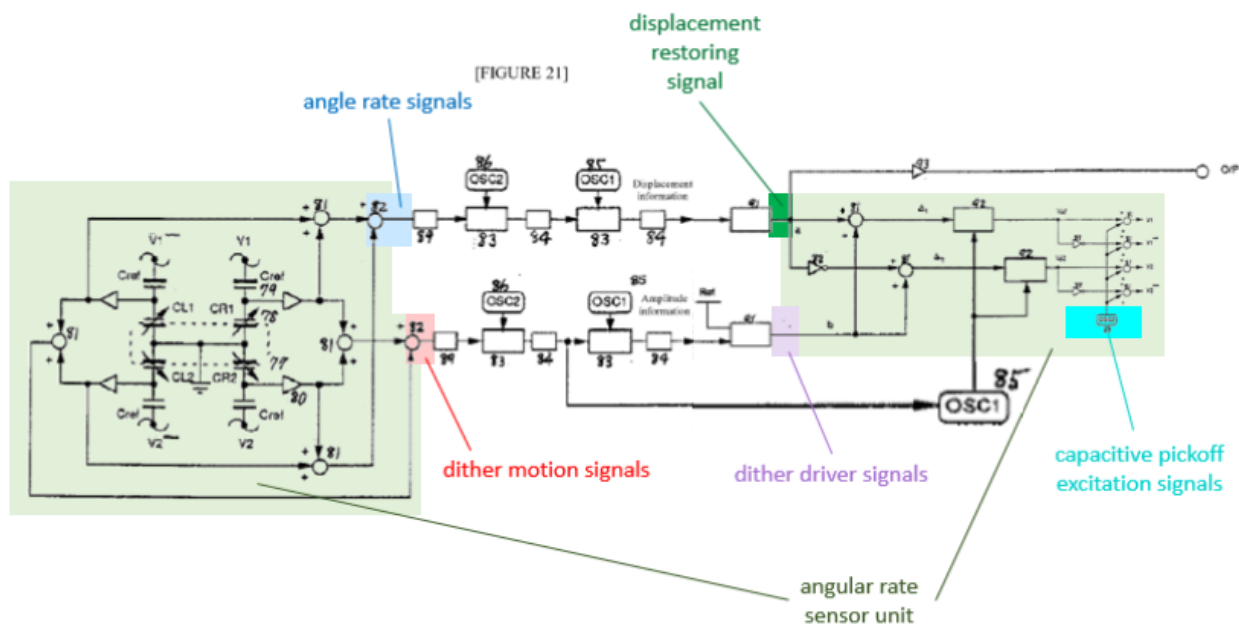
To the extent there is any question as to whether the substrate in Mitamura’s third embodiment is a carrier, it would have been obvious to mount a sensor according to Mitamura’s third embodiment to a carrier like an automobile or an aircraft for safety, control, or tracking purposes. (Young, ¶198.) For example, the applicant on the Mitamura application is Nissan Motor Co., Ltd., which a POSITA would have recognized as a manufacturer of vehicles including automobiles. (Mitamura, Cover; Young, ¶198.) A POSITA would have been particularly

motivated to mount Mitamura's "compact and lightweight" sensors on a vehicle.
(Mitamura, [0071].)

(a) an angular rate sensor unit receiving dither driver signals, capacitive pickoff excitation signals and a displacement restoring signal and outputting angle rate signals in response to motion of said carrier and dither motion signals (Claim 1[a]);

Mitamura discloses claim 1[a]. (Young ¶¶200-20.)

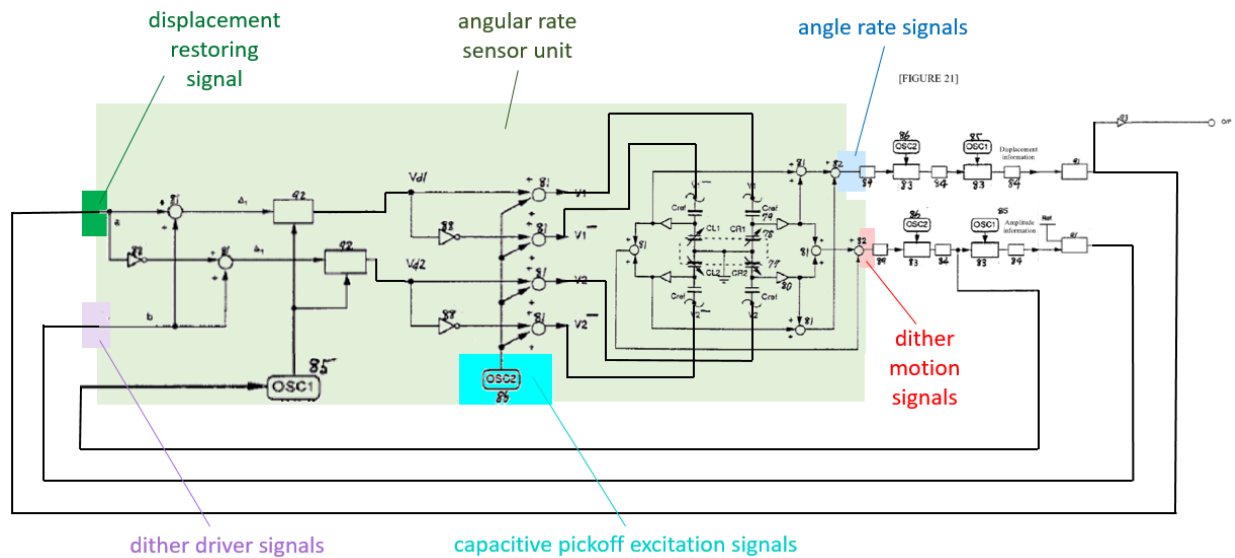
The below annotated version of Mitamura's Figure 21 circuit (which replaces Mitamura's control circuit 87 with the example implementation disclosed in Mitamura's Figure 26) identifies the elements of Claim 1[a] in Mitamura's third embodiment.



(Mitamura, Figs. 21, 26 (annotations and highlighting added); Young ¶201.) Figure 26 shows an "example configuration of a control circuit used in the angular velocity detection circuit shown in Figure 21." (Mitamura at 25; *see also id.*, Fig. 21

(indicating control circuit 87), Fig. 26 (indicating control circuit 87); Young, ¶201.)

another view of the Mitamura Figure 21 circuit with the angular rate sensor unit components consolidated is shown below:



(Mitamura, Figs. 21, 26 (annotations and highlighting added); Young, ¶201.)

Mitamura discloses that the green-highlighted circuitry in the annotated Figure 21 shown above combined with the example control circuitry of Figure 26 constitutes an **angular rate sensor**. (Young, ¶202.) Mitamura discloses that the green-highlighted components and circuitry on the left side of the first annotated Figure 21 above includes a vibrating mass driven to vibrate using electrostatic forces generated by comb electrodes, which can sense Coriolis forces (along a perpendicular axis from the dither vibrations) using those same comb electrodes when the system undergoes angular rotation. (Mitamura, Fig. 21, [0041]-[0042].) The green-highlighted circuitry on the right side of the first annotated Figure 21

above is part of control circuitry 87 that provides signals for controlling the motion of vibrating mass 72 through the comb electrodes, which is necessary for its sensing functionality. (*Id.*, Fig. 26, [0046].) A POSITA would have understood that a vibrating mass sensor like Mitamura discloses can only sense if it is vibrating (*i.e.*, dithering), so a POSITA would have considered the green-highlighted motion control circuitry on the right side of the first annotated Figure 21 above to be an integral part of the angular rate sensor unit. (*See, e.g., id.*, [0057] (“The Coriolis force which is produced is proportional to the vibration velocity of the vibrating mass[.]”); Young, ¶202.) The ’122 patent similarly discloses drive and sensing electronics as part of the angular rate sensor unit. (’122, Figs. 2-4, 6:1-14.)

Mitamura discloses that the **angular rate sensor unit receiv[es] dither driver signals**. (Young, ¶¶203-205.) Based on the ’122 patent’s disclosures, dither driver signals are signals used in driving the dither motion (discussed above for Ground 1) of an inertial element. (’122, Fig. 2, 5:6-20, 4:65-66.) Mitamura discloses such dither motion signals in its third embodiment. Mitamura indicates that the green-highlighted angular rate sensor unit receives the purple-highlighted signals from arithmetic unit 91. Mitamura refers to the magnitude of these signals as “b.” (Mitamura, Fig. 26, [0046].) These signals are summed and used to modulate other signals before being input into the comb electrodes for controlling the motion of vibrating mass 72. (*Id.*, Fig. 26, [0046].) Ultimately, Mitamura indicates that the

following equation indicates the vibrating force generated on vibrating mass 72 using the electrostatic force:

$$F_d \cong \epsilon_0 m t \cdot (CV^0)^2 / d \cdot (1 + 2b)$$

(Mitamura, [0063].) This equation shows that the magnitude of the force exerted on vibrating mass 72 to cause that mass to vibrate (dither) depends on the magnitude of “b”—the purple-highlighted signals from arithmetic unit 91. (Young, ¶203.) In other words, the purple-highlighted signals from arithmetic unit 91 are **dither driver signals receiv[ed] by the angular rate sensor unit.** (*Id.*)

Further, the “b” output by arithmetic unit 91 constitutes plural **dither driver signals** to the extent that is considered to be a requirement of claim 1. The “b” output by arithmetic unit 91 changes over time, including when the device undergoes acceleration that impacts the dither amplitude. Accordingly, “b” comprises plural signals when considered over time. (Young, ¶204.)

In multiple district court cases, Patent Owner proposed that the term “dither driver signals” should be construed as “signals used to oscillate, or vibrate, an inertial element in the angular rate sensor unit.” (Young, ¶205.) The “b” output by arithmetic unit 91 is used to oscillate, or vibrate, vibrating mass 72 in Mitamura’s angular rate sensor unit, including because it appears as a term in the equation that describes the vibrating force applied to vibrating mass 72. (Mitamura, [0063]; Young, ¶205.)

Further, Mitamura discloses that the **angular rate sensor unit receiv[es] capacitive pickoff excitation signals**. (Young, ¶¶206-207.) As discussed above for Ground 1, the '122 patent indicates that capacitive pickoff excitation signals can be oscillator signals applied to variable capacitors such that they are modulated by the changing capacitance. ('122, 5:10-17, 5:35-38, 8:20-22.)

The oscillator signals provided by OSC2 function similarly to the capacitive pickoff excitation signals discussed by the '122 patent. (Young, ¶206.) OSC2 is added to the outputs of control circuit 87, producing a sum of signals that is applied to comb electrodes R1, R2, L1, and L2 on the vibrating mass 72. (Mitamura, [0045], [0050], [0054], [0056].) Accordingly, like the '122 patent contemplates, the oscillator signals from OSC2 are applied to variable capacitors on the vibrating mass 72. (*Id.*) Mitamura discusses using OSC2 as a “detection power supply,” which is used in determining the “y-axis displacement due to the Coriolis force[.]” (*Id.*, [0032].) Mitamura further teaches that oscillator 86 (which outputs the OSC2 signals) can be used to “carry[] out synchronous detection . . . using the demodulator 83[.]” (*Id.*, [0045], [0054].) A POSITA would have understood from these disclosures that the OSC2 signals from oscillator 86 is being used as capacitive pickoff excitation signals as the '122 patent contemplates. (Young, ¶206.) The OSC2 signals provide “excitation” to the comb electrode capacitors by providing a high frequency signal. (Mitamura, [0050].) And they conform to a POSITA's

understanding of what “capacitive pickoff” signals are, as discussed above for Ground 1. (*See, e.g.*, Slater at 72; Young, ¶206.)

In prior litigation, Patent Owner argued that “capacitive pickoff excitation signals” should be construed as “electrical signals that provide electrical energy (i.e. excitation) into the angular rate sensor unit’s pickoff capacitors.” (Young, ¶207.) Mitamura satisfies Patent Owner’s prior construction. (*Id.*) The OSC2 signals are electrical signals (AC signals) that provide electrical energy into the angular rate sensor unit’s pickoff capacitors, per Patent Owner’s prior construction. (*Id.*) A POSITA would have understood Mitamura’s capacitors to be “pickoff capacitors,” since they detect the motion of an inertial element based on changing capacitance. (*Id.*) This understanding is consistent with decades-old textbooks. (*See, e.g.*, J.M. Slater, *Inertial Guidance Sensors* (1964) (EX1011) at 172-73.)

Mitamura further discloses that the **angular rate sensor unit receiv[es] a displacement restoring signal**. (Young, ¶¶208-10.) The ’122 patent indicates that a “displacement restoring signal” is a signal that is used to restore a proof mass to approximately its original position on the sensing axis (*i.e.*, perpendicular to the dither axis) when that position is changed due to the Coriolis force caused by angular rotation. (’122, 8:40-9:4.) Similar to the ’122 patent discussion, Mitamura indicates that the green-highlighted angular rate sensor unit in the annotated Figure 21 above receives a signal “a” from the uppermost arithmetic unit 91 which reflects the

displacement of vibrating mass 72 caused by the Coriolis force. (Mitamura, Fig. 26, [0046], [0058].) Mitamura indicates that signal “a” is used to “compensate” for the Coriolis force. (*Id.*, [0060]-[0064].) Mitamura discloses the following equation for the force “Fc” necessary to compensate for the Coriolis force, which includes the magnitude of signal “a” as a term:

$$F_c \equiv \varepsilon_0 m \cdot (CV^0)^2 / d^2 \cdot 2a$$

(Mitamura, [0062]; Young, ¶208.) This equation indicates that signal “a” is used in generating the force necessary to oppose the Coriolis force and to return vibrating mass 72 to approximately its original position. Based on the disclosures of the ’122 patent, signal “a” is therefore a **displacement restoring signal receiv[ed]** by the **angular rate sensor unit** (Young, ¶208.)

To the extent there is any argument that “a” is not a displacement restoring force because it cancels out the Coriolis force, this argument is misplaced. A POSITA would have understood that the design of Mitamura’s system requires the Coriolis force to move vibrating mass 72 before the compensating force can counteract that force. (Young, ¶209.)

In Patent Owner’s pending district court litigation against Petitioners, Petitioners have proposed that the term “displacement restoring signal” should be construed as “electrical signal used to oppose displacement of inertial element(s) caused by angular rotation.” (Young, ¶210.) Signal “a” at the output of arithmetic

unit 91 in Mitamura's third embodiment is an electrical signal used to oppose displacement of inertial element(s) caused by angular rotation, because it is an electrical signal used to generate the force that compensates for or counteracts the Coriolis force that acts on vibrating mass 72 when the system undergoes angular rotation. (Mitamura, [0060]-[0064]; Young, ¶210.)

Further, Mitamura discloses **an angular rate sensor unit outputting angle rate signals in response to motion of said carrier**. The green-highlighted angular rate sensor in the annotated Figure 21 above outputs the blue-highlighted angle rate signals reflecting the displacement of vibrating mass 72. This is similar to the '122 patent's discussion of the elements in Claim 1[b]. (Young, ¶211.) For example, the '122 patent discloses that *angle* rate signals are an intermediate form of angular rate signals that are output from the angular rate sensor unit and indicate the motion of proof masses due to the Coriolis force. ('122, Fig. 6, 6:9-12, 8:40-67.)

Similar to the disclosures of the '122 patent, Mitamura teaches that the identified **angle rate signals** (shown in annotated Figure 21 of Mitamura above) indicate motion of the vibrating mass in the angular rate sensor unit due to the Coriolis force. (Young, ¶212.) Mitamura discloses that in the upper path shown in Figure 21 (labeled "Displacement information"), "[t]he displacement y of the vibrating mass due to the Coriolis force is found[.]" (Mitamura, [0057].) The voltages across the two upper detecting capacitors (VL1 and VR1) on vibrating mass

72 are summed at 81—and then the sum of the voltages across the two lower detecting capacitors (VL2 and VR2) is subtracted at 82. (*Id.*, [0058].) Mitamura indicates that the result (*i.e.*, the blue-highlighted signals in the annotated version of Figure 21 above) can be represented by equation (20), reproduced below:

$$(VR1 + VL1) - (VR2 + VL2) = 4A / B \cdot y / d \cdot vc$$

(*Id.*) In this equation, “y” represents the displacement of vibrating mass 72 in the vertical (up-and-down) direction shown in Figure 21, “d” is the distance of the gap between detecting comb electrodes, “A” and “B” are factors related to the settings of various capacitors shown in Figure 21, and “vc” is the output of oscillator 86 (OSC2). (*Id.*, [0051], [0053], [0055].) In other words, the voltage of the blue-highlighted “angle rate signals” in the annotated version of Figure 21 above is representative of the vertical displacement “y” of vibrating mass 72 caused by the Coriolis force. (*Id.*, [0027]; Young, ¶212.) Accordingly, the **angle rate signals** identified in Mitamura’s Figure 21 circuit is similar to the angle rate signals discussed in the ’122 patent—*i.e.*, it is a signal output by the angular rate sensor unit representing the displacement of an inertial element caused by the Coriolis force, which can then be processed into angular rate signals. (Young, ¶212.)

Further, the blue-highlighted signals in the annotated version of Figure 21 above are plural **angle rate signals** to the extent that is considered to be a requirement of claim 1. (Young, ¶213.) The blue-highlighted signals vary as the

angular rotation of the carrier changes—so it comprises plural signals when considered over time. (*Id.*)

Mitamura further discloses **an angular rate sensor unit outputting dither motion signals**. (Young, ¶¶214-16.) The red-highlighted dither motion signals in the annotated version of Mitamura’s Figure 21 above reflect the dither motion (*i.e.*, vibrating motion in the horizontal direction in Figure 21) of vibrating mass 72. (Young, ¶214.) The ’122 patent indicates that “dither motion” refers to vibration of a proof mass in the plane of the chip wafer (and perpendicular to the Coriolis force) that is driven by “comb drives” controlled by the sensor’s electronics. (’122, 5:6-20.) The dither motion signals reflect the motion of a proof mass in the dither axis. (*Id.*, Fig. 6, 7:64-8:6.)

Similar to the ’122 patent’s discussion, Mitamura discloses that the red-highlighted **dither motion signals** in Figure 21 reflect the vibration motion of vibrating mass 72 in the dither axis perpendicular to the Coriolis force sensing axis. (Young, ¶215.) Mitamura indicates that the red-highlighted signals result after the voltages VR1 and VR2 (which varies with the capacitance of the rightmost position-sensing capacitors for vibrating mass 72) are added, and the voltages VL1 and VL2 (which varies with the capacitance of the leftmost position-sensing capacitors) are subtracted from the sum. (Mitamura, [0055].) Mitamura teaches that the voltage of the red-highlighted signals varies in accordance with equation (19) reproduced

below:

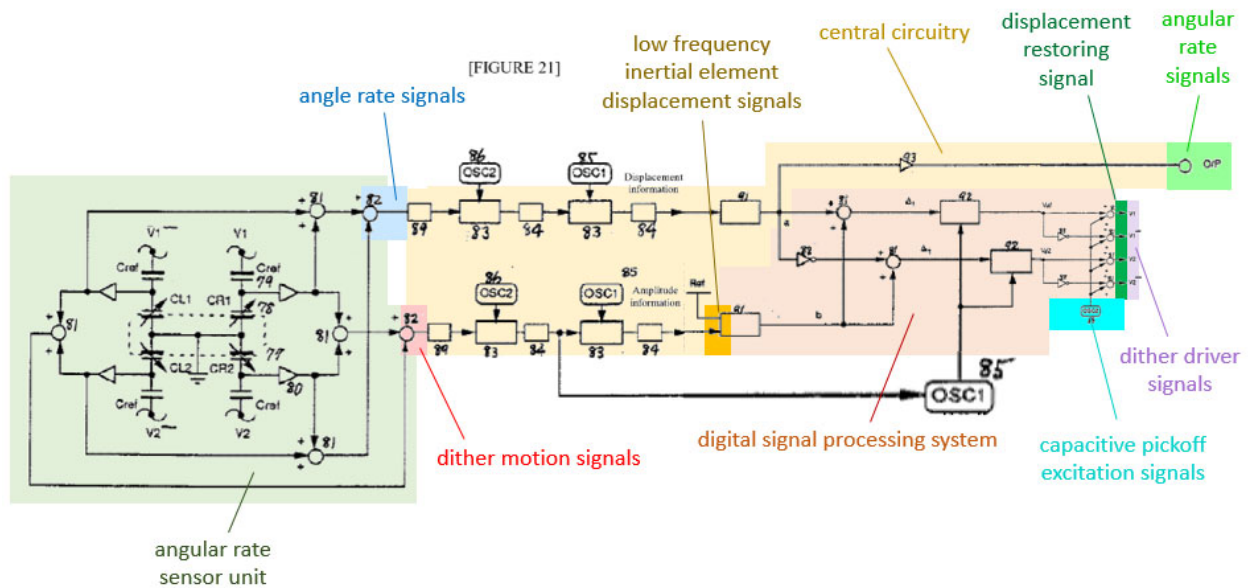
$$(VR1 + VR2) - (VL1 + VL2) = 4 / B \cdot (vd - A \cdot x / L \cdot vc)$$

(Mitamura, [0056].) In this equation, “x” represents the displacement of vibrating mass 72 in the horizontal (dither) direction shown in Figure 21, “L” indicates the overlap of the sensing comb electrodes when at rest, “A” and “B” are factors related to the settings of various capacitors shown in Figure 21, “vd” is the output of oscillator 85 (OSC1), and “vc” is the output of oscillator 86 (OSC2). (*Id.*, [0051], [0053], [0055], [0056]; Young, ¶215.) In other words, the voltage of the red-highlighted signals in Figure 21 is representative of (*i.e.*, it varies, with an offset, in proportion to) “x”—the horizontal position of vibrating mass 72 in the dither axis. (Young, ¶215.) As a result, the red-highlighted signals in Mitamura’s Figure 21 is like the dither motion signals discussed by the ’122 patent.

Additionally, the red-highlighted signals in the annotated version of Mitamura’s Figure 21 above are plural **dither motion signals** to the extent that is considered to be a requirement of claim 1. (Young, ¶216.) The red-highlighted signals vary as the amplitude of the vibrating (dither) motion of vibrating mass 72 varies—so it comprises plural signals when considered over time. (*Id.*)

To the extent there is any argument that “a” and “b” in Mitamura are not the displacement restoring signal and dither driver signals, respectively, because there is additional processing and signal components that determine the signals used to

drive the vibrating mass 72, the Mitamura Figures 21 and 26 circuit could be alternatively split up such that it would meet the requirements of claim 1[a] regardless. (Young, ¶217.) An annotated version of Figure 21 is reproduced below that shows this alternative way of splitting up the Mitamura Figures 21 and 26 circuit:



(Mitamura, Fig. 21 (annotations and highlighting added), Fig. 26 (same); Young, ¶217.)

In this alternative understanding of Mitamura's Figure 21 circuit, the **angular rate sensor unit** includes only the vibrating mass 72 and its output circuitry, as shown in green highlighting. (Mitamura, Figs. 17-18, 20, [0042]; Young, ¶¶218-19.) Otherwise, the main change from the analysis above for purposes of claim 1[a] is that the **displacement restoring signal** and **dither driver signals** are components

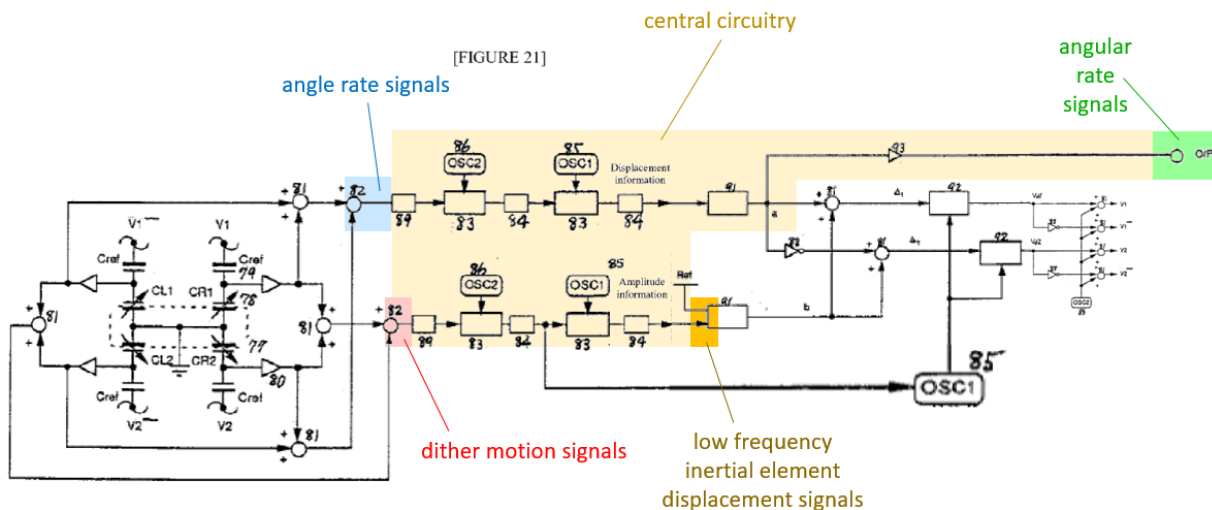
of the combination of signals V1, V1-, V2, and V2-, which are input into the angular rate sensor to control the dither drive and displacement compensation. (Mitamura, [0044], [0046]-[0063]; Young, ¶218.) Mitamura discloses that these four signals contain all components for dither driving and Coriolis force compensation. (Mitamura, [0062]-[0063]; Young, ¶218.)

Accordingly, Mitamura discloses the limitations of claim 1[a].

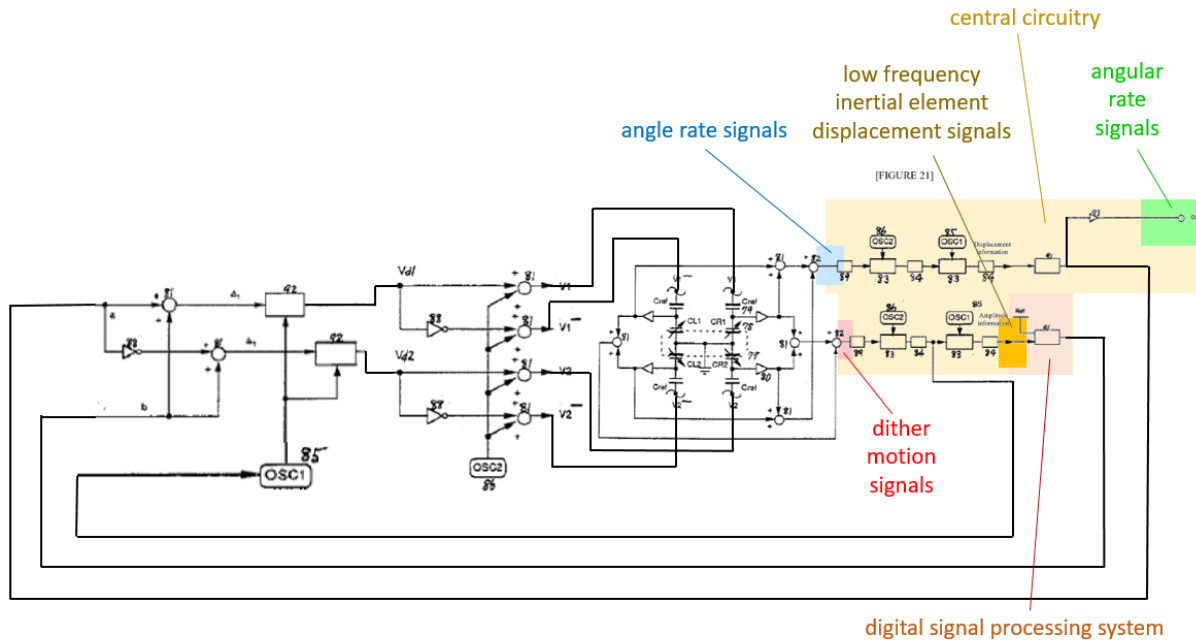
(b) a central circuitry receiving said angle rate signals in response to said motion of said carrier and said dither motion signals and outputting angular rate signals and digital low frequency inertial element displacement signals (Claim 1[b]);

Mitamura discloses claim 1[b] or this limitation would have been obvious based on Mitamura alone or in light of Townsend. (Young ¶¶ 221-233.)

In the below annotated version of Mitamura's Figure 21 circuit in which module 87 is replaced with the circuitry shown in Figure 26, the elements corresponding to the limitations of claim 1[b] are identified:



(Mitamura, Fig. 21 (annotations and highlighting added), Fig. 26 (same); Young, ¶222.) In annotated Figures 21 and 26 below, the angular rate sensor unit components are consolidated:



(Mitamura, Fig. 21 (annotations and highlighting added), Fig. 26 (same); Young, ¶222.)

Mitamura discloses **central circuitry receiving angle rate signals in response to said motion of said carrier and outputting angular rate signals.** (Young, ¶¶223-27.) The **yellow**-highlighted central circuitry in the annotated Figure 21 above receives the **blue**-highlighted angle rate signals reflecting the displacement of vibrating mass 72 and processes those signals into the **green**-highlighted angular rate signals, which are output from the system. (Mitamura, Figs. 21, 26; [0045]-[0046], [0051], [0053], [0055], [0057]-[0058]; Young, ¶223.) This is similar to the

'122 patent's discussion of the elements in Claim 1[b]. For example, the '122 patent discloses that angular rate signals are the system output indicating its rate of angular rotation. ('122, Fig. 6, 8:40-67.) These *angular* rate signals result from processing of *angle* rate signals—which indicate the motion of proof masses due to the Coriolis force. (*Id.*, Fig. 6, 6:9-12, 8:40-67.) For example, Figure 6 of the '122 patent, which is reproduced below in an annotated version, indicates that *angle* rate signals go through high-pass filter, demodulator, and low-pass filter stages before being output as *angular* rate signals:

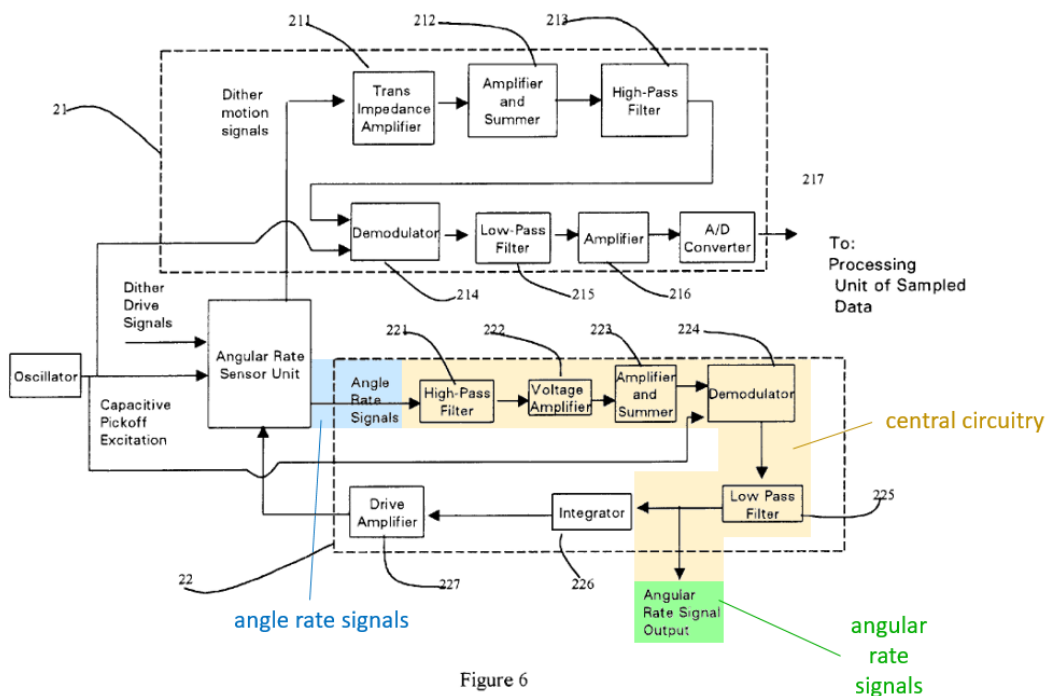


Figure 6

('122, Fig. 6 (annotations and highlighting added), 8:40-67; Young, ¶223).

Similar to the disclosures of the '122 patent, Mitamura teaches that the identified **angle rate signals** (shown in annotated Figure 21 of Mitamura above)

indicate motion of the vibrating mass in the angular rate sensor unit due to the Coriolis force, and the angle rate signals go through processing stages in the **central circuitry** to result in the outputted **angular rate signals**. (Young, ¶224.) Mitamura discloses that in the upper path shown in Figure 21 (labeled “Displacement information”), “[t]he displacement *y* of the vibrating mass due to the Coriolis force is found[.]” (Mitamura, [0057].) The voltages across the two upper detecting capacitors (VL1 and VR1) on vibrating mass 72 are summed at 81—and then the sum of the voltages across the two lower detecting capacitors (VL2 and VR2) is subtracted at 82. (*Id.*, [0058].) Mitamura indicates that the result (*i.e.*, the blue-highlighted signals in the annotated version of Figure 21 above) can be represented by equation (20), reproduced below:

$$(VR1 + VL1) - (VR2 + VL2) = 4A / B \cdot y / d \cdot vc$$

(*Id.*) In this equation, “*y*” represents the displacement of vibrating mass 72 in the vertical (up-and-down) direction shown in Figure 21, “*d*” is the distance of the gap between detecting comb electrodes, “*A*” and “*B*” are factors related to the settings of various capacitors shown in Figure 21, and “*vc*” is the output of oscillator 86 (OSC2). (*Id.*, [0051], [0053], [0055]; Young, ¶224.) In other words, the voltage of the blue-highlighted “angle rate signals” in the annotated version of Figure 21 above is representative of (*i.e.*, proportional to) the vertical displacement “*y*” of vibrating mass 72 caused by the Coriolis force. (Mitamura, [0027]; Young, ¶224.)

Accordingly, the **angle rate signals** identified in Mitamura's Figure 21 circuit is similar to the angle rate signals discussed in the '122 patent—*i.e.*, these are signals output by the angular rate sensor unit representing the displacement of an inertial element caused by the Coriolis force, which can then be processed into angular rate signals. (Young, ¶224.)

Mitamura's **angular rate signals** resulting from processing via the **central circuitry** of the **angle rate signals** are also similar to what the '122 patent discloses. (Young, ¶225.) The blue-highlighted angle rate signals in annotated Figure 21 are input into high-pass filter 89, demodulators 83, low-pass filters 84, and control circuit 87, which provides the green-highlighted angular velocity output through amplifier 93. (Mitamura, Figs. 21, 26; [0045]-[0046], [0057]-[0058].) Similarly, the '122 patent discloses high-pass filter 221, amplifiers 222 and 223, demodulator 224, and low-pass filter 225 between “angle rate signals” and “angular rate signals” in Figure 6. ('122, Fig. 6, 8:40-67.)

To the extent there is any argument that claim 1 of the '122 patent requires plural angle rate signals and/or angular rate signals, Mitamura satisfies any such requirement. The blue-highlighted and green-highlighted signals in annotated Figure 21 change over time as the angular rotation of the system changes. (Young, ¶226-27.) Thus, when considered over time, the blue-highlighted and green-highlighted circuit receives multiple angle rate *signals* and angular rate *signals*,

respectively. (*Id.*)

Mitamura also renders obvious **a central circuitry receiving said dither motion signals and outputting digital low frequency inertial element displacement signals**—either based on Mitamura alone or in light of Townsend. (Young, ¶¶228-33.) The red-highlighted dither motion signals in the annotated version of Mitamura’s Figure 21 above reflect the dither motion (*i.e.*, vibrating motion in the horizontal direction in Figure 21) of vibrating mass 72. (*Id.*, ¶228.) Further, these dither motion signals are processed via central circuitry and output as the orange-highlighted digital low frequency inertial element displacement signals. (*Id.*)

The identified dither motion signals and digital low frequency inertial element displacement signals are similar to the ’122 patent’s discussion of these signals. (Young, ¶229.) The ’122 indicates that “dither motion” refers to vibration of a proof mass perpendicular to the Coriolis force that is driven by “comb drives” controlled by the sensor’s electronics. (’122, 5:6-20.) The dither motion signals reflect the motion of a proof mass in the dither axis. (*Id.*, Fig. 6, 7:64-8:6.) These signals then pass through various stages in the central circuitry—for example, high-pass filter 213, demodulator 214, low-pass filter 215, and an A/D converter—before being output as digital low frequency inertial element displacement signals. (*Id.*, Fig. 6, 8:14-39.) The process disclosed by the ’122 patent for receiving dither motion

signals via central circuitry and outputting digital low frequency inertial element displacement signals is shown in the annotated version of the '122 patent's Figure 6 below:

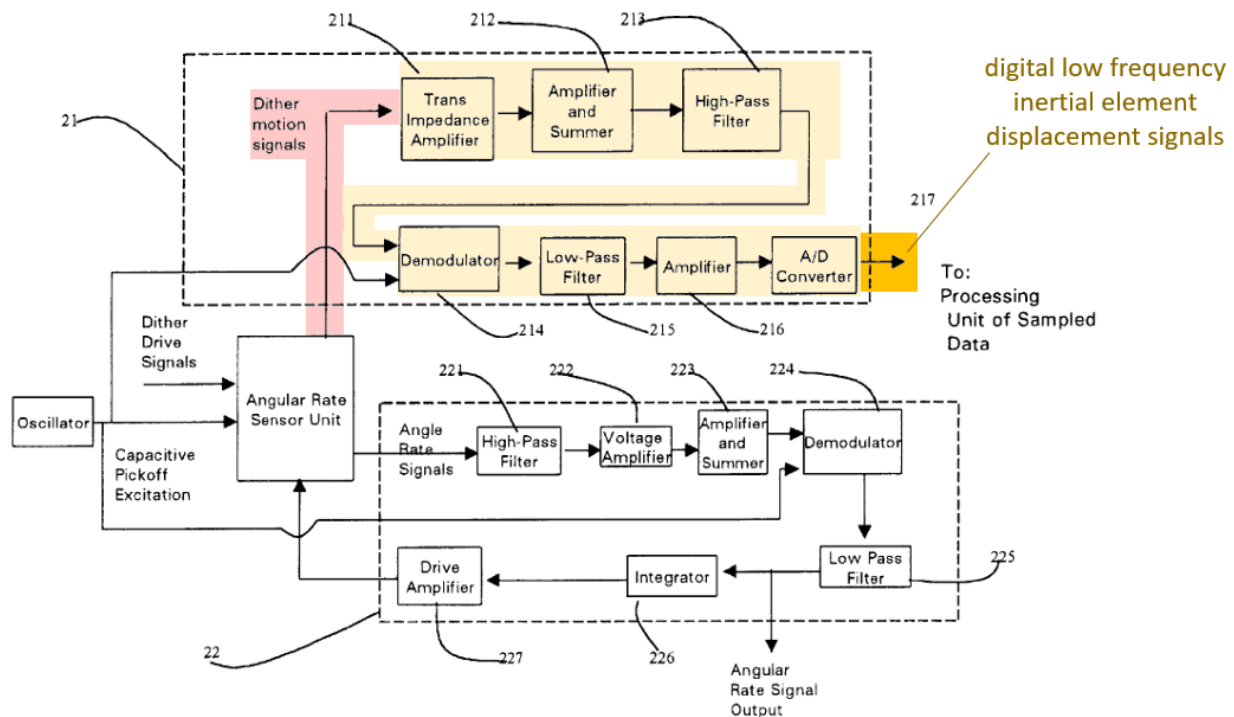


Figure 6

('122, Fig. 6 (annotations and highlighting added); Young, ¶229.) The '122 patent discloses that “inertial element displacement signals” are output following demodulation of dither motion-related signals. (*Id.*, 8:19-26.) The '122 patent further discloses that these signals become “*low frequency* inertial element displacement signal[s]” once they are passed through a low-pass filter, which “remov[es] high frequency noise from the inertial element displacement signal input to form a low frequency inertial element displacement signal.” (*Id.*, 8:27-31.) Further, the '122 patent discloses that these signals become “*digitized* low frequency

inertial element displacement signals” once they pass through a A/D converter. (*Id.*, 8:36-39.)

Similar to the '122 patent's discussion, Mitamura discloses that the red-highlighted **dither motion signals** in Figure 21 reflect the vibration motion of vibrating mass 72 in the dither axis perpendicular to the Coriolis force sensing axis. (Young, ¶230.) Mitamura indicates that the red-highlighted signals result after the voltages VR1 and VR2 (which varies with the capacitance of the rightmost position-sensing capacitors for vibrating mass 72) are added, and the voltages VL1 and VL2 (which varies with the capacitance of the leftmost position-sensing capacitors) are subtracted from the sum. (Mitamura, [0055].) Mitamura teaches that the voltage of the red-highlighted signals varies in accordance with equation (19) reproduced below:

$$(VR1 + VR2) - (VL1 + VL2) = 4 / B \cdot (vd - A \cdot x / L \cdot vc)$$

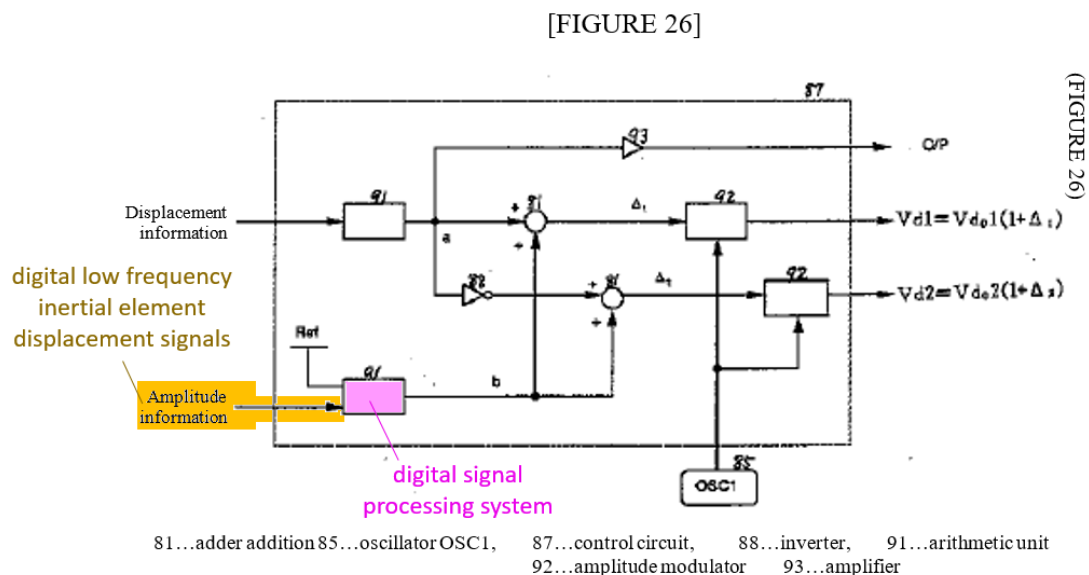
(Mitamura, [0056].) In this equation, “x” represents the displacement of vibrating mass 72 in the horizontal (dither) direction shown in Figure 21, “L” indicates the overlap of the sensing comb electrodes when at rest, “A” and “B” are factors related to the settings of various capacitors shown in Figure 21, “vd” is the output of oscillator 85 (OSC1), and “vc” is the output of oscillator 86 (OSC2). (*Id.*, [0051], [0053], [0055], [0056].) In other words, the voltage of the red-highlighted signals in Figure 21 is representative of (*i.e.*, it varies, with an offset, in proportion to) “x”—

the horizontal position of vibrating mass 72 in the dither axis. As a result, the red-highlighted signals in Mitamura's Figure 21 is like the dither motion signals discussed by the '122 patent. (Young, ¶230.)

Mitamura's disclosures about the **low frequency inertial element displacement signals** are also similar to what the '122 patent discloses regarding these signals. (Young, ¶231.) Mitamura discloses that the orange-highlighted signals in Figure 21 result from the red-highlighted dither motion signals passing through high-pass filter 89, demodulators 83, and low-pass filters 84 before being output to control circuit 87. (Mitamura, Figs. 21, 26, [0056].) Like the "inertial element displacement signals" discussed by the '122 patent, the orange-highlighted signals in Figure 21 have been demodulated. (*Id.*; '122, 8:19-26.) Further, similar to the '122 patent's disclosures, the orange-highlighted signals in Figure 21 have passed through low-pass filtering stages, so it comprises "low frequency" signals from which high-frequency noise has been removed. (Mitamura, Fig. 21, [0056]; '122, 8:27-31.) Also, Mitamura discloses that the orange-highlighted signals in Figure 21 have an "amplitude is proportional to the drive amplitude of the vibrating mass," so they are clearly reflective of dither motion, similar to the digital low frequency inertial element displacement signals in the '122 patent. (Mitamura, Fig. 21, [0056]; '122, Fig. 6, 7:64-8:39.) Further, the orange-highlighted signals satisfy Petitioner's proposed construction of "inertial element displacement signals" before

the district court: “electrical signals reflecting dither motion of inertial element(s)[.]” (Young, ¶231.)

Mitamura further renders obvious that the orange-highlighted signals in Figure 21 are **digital** low frequency inertial element displacement signals. (Young, ¶232.) The orange-highlighted signals are “input into the control circuit 87,” where they are provided to arithmetic unit 91 in the example control circuit implementation shown in Figure 26:



(Mitamura, Fig. 26 (annotations and highlighting added); Young, ¶232.) Based on the disclosures of Mitamura, it would have been obvious to implement arithmetic unit 91 as a digital signal processing system, as discussed further for Claim 1[c]. (Young, ¶¶237-245.) Further, while it is not explicitly disclosed, a POSITA would have understood that the low frequency inertial element displacement signals would

have to be converted into a digital format to be input into the arithmetic unit 91 if it is implemented digitally. Accordingly, it would have been obvious to incorporate an analog-to-digital (A/D) converter at the input of digital signal processing system, which would convert the low frequency inertial element displacement signals into **digital low frequency inertial element displacement signals**. (Young, ¶237.) Such an implementation would be similar to how the '122 patent discusses the process of forming these signals—low frequency inertial element displacement signals are formed, and then they are converted to digital low frequency inertial element displacement signals by passing through an A/D converter. ('122, Fig. 6, 8:27-39.) A POSITA would have been motivated to use an analog-to-digital converter at the input to the pink-highlighted arithmetic unit 91 such that the system would operate. (Young, ¶232.) A POSITA would have understood the low frequency inertial element displacement signals at the input to arithmetic unit 91 to be analog signals—and a POSITA would have understood that such analog signals would need to be converted into a digital format before they could be used by arithmetic unit 91 if it is implemented digitally. (Mitamura, [0056] (describing “smooth[ing]” of signal at input of arithmetic unit 91); Young, ¶237.)

To the extent there is any dispute that **a central circuitry outputting digital low frequency inertial element displacement signals** would have been obvious based on Mitamura alone, it would have been obvious to implement arithmetic unit

91 as a digital signal processing system, or to separately incorporate a system into the Mitamura Figure 21 and 26 circuits based on Townsend. (Young, ¶233.) Obviousness analysis for the Mitamura-Townsend combination is provided for claim 1[c] below. As discussed below, in the Mitamura-Townsend combination, it would have been obvious to incorporate an analog-to-digital converter at the input to the digital signal processing system, yielding digital low frequency inertial element displacement signals. (Young, ¶¶237-245.)

(c) a digital signal processing system analyzing said digital low frequency inertial element displacement signals and feeding back said dither driver signals to said angular rate sensor unit (Claim 1[c]).

Claim 1[c] would have been obvious based on Mitamura alone or in light of Townsend. (Young, ¶¶234-47.)

Mitamura discloses that a **signal processing system analyzing said low frequency inertial element displacement signals and feeding back said dither driver signals to said angular rate sensor unit**. (Young, ¶¶235-36.) Mitamura discloses that arithmetic unit 91 outputs a signal that is used for control of the angular rate sensor—in other words, the output signal from arithmetic unit 91 is fed back into the angular rate sensor unit. (Mitamura, Fig. 26, [0046], [0060]-[0062].) Mitamura discloses that arithmetic unit 91 outputs a signal “b”. (Mitamura, Fig. 26, [0046].) Ultimately, Mitamura discloses that the force with which the vibrating mass 72 is driven “Fd” is determined by the value of “b” output by arithmetic unit 91:

$$F_d \doteq \epsilon_0 m t \cdot (CV^0)^2 / d \cdot (1 + 2b)$$

(Mitamura, [0063].) Accordingly, “b” constitutes **dither driver signals**—since it determines the magnitude of the driving force used to vibrate (dither) mass 72. (Young, ¶235.) Further, arithmetic unit 91 **feed[s] back said dither driver signals to said angular rate sensor unit**, since “b” is output to angular rate sensor unit and “b” is derived from the dither motion signals of angular rate sensor unit—leading to a feedback loop. (Mitamura, [0063].)

Further, the “b” output by arithmetic unit 91 constitutes plural **dither driver signals** to the extent that is considered to be a requirement of claim 1. (Young, ¶236.) The “b” output by arithmetic unit 91 varies as the vibrating (dither) amplitude of vibrating mass 72 varies—so it comprises plural signals when considered over time. (*Id.*)

Mitamura discusses inputting the **orange**-highlighted low frequency inertial element displacement signals in its Figure 21 and 26 circuits into an arithmetic unit 91. (Young, ¶237.) It would have been obvious to implement arithmetic unit 91 as a **digital signal processing system analyzing said digital low frequency inertial element displacement signals**. (*Id.*, ¶¶237-38.) Mitamura discloses that in arithmetic unit 91, “the amplitude information [is] calculated as modulation amounts of the drive voltage, . . . based on a deviation from a set reference level for the amplitude information.” (Mitamura, [0046].) It would have been obvious that a

module that performs “calculat[ion]” and has a “set reference level” would be implemented as a digital unit like a processor. (Young, ¶237.) A POSITA would have understood that performing calculations and setting reference levels would have been simpler, less time-consuming, and less expensive via a digital system than an analog one. (*Id.*) A POSITA would have further understood that more complex calculations could be feasibly implemented via a digital system than an analog one. (*Id.*) Further, a POSITA would have understood that a digital system would have been more flexible to adjustment than an analog system, since digital systems allow for reprogramming, whereas redesigning analog systems tends to involve more time-consuming, expensive, and difficult physical engineering. (*Id.*) Mitamura’s reference to a “set reference level” would have particularly motivated a POSITA to implement arithmetic unit 91 as a digital system, since such a system would have allowed for a simple reference level setting interface. (*Id.*) Accordingly, it would have been obvious based on Mitamura alone to implement calculating unit 91 as a **digital signal processing system**. In such an implementation, the digital signal processing system would perform “calculat[ion]” of amplitude information as “modulation amounts of the drive voltage, . . . based on a deviation from a set reference level.” (Mitamura, [0046].) A POSITA would have understood such calculations to involve **analyzing said digital low frequency inertial element displacement signals**.

It would have also been obvious to incorporate circuitry necessary to accommodate a digital signal processing system into Mitamura's Figure 21 and 26 circuits—including an analog-to-digital converter at the input of the processing system and a digital-to-analog converter at the output. (Young, ¶238.) A POSITA would have been motivated to make these adjustments to convert signals between the digital signal processing system and the other circuitry of Mitamura, which is implemented in analog circuitry. (*Id.*)

To the extent there is any dispute that a digital signal processing system would have been obvious based on Mitamura alone, it would have been obvious in light of **Townsend**. (Young, ¶¶239-45.)

It would have been obvious to incorporate a digital signal processing system into the dither motion detection and control circuitry of Mitamura's Figure 21 and 26 circuits (*i.e.*, the lower path shown in Mitamura's Figure 21 and 26 circuits) based on Townsend's Figure 4 block diagram. (Young, ¶240.) It would have been obvious to implement Mitamura's arithmetic unit 91 in the dither motion detection and control path as a digital processing unit 22 like Townsend discloses. (*Id.*) Further, it would have also been obvious to incorporate a digital processing unit 22 like Townsend discloses elsewhere in Mitamura's circuit—for example, downstream from arithmetic unit 91 in control circuit 87 within the dither motion detection and control path. (*Id.*) It would also have been obvious to incorporate other components

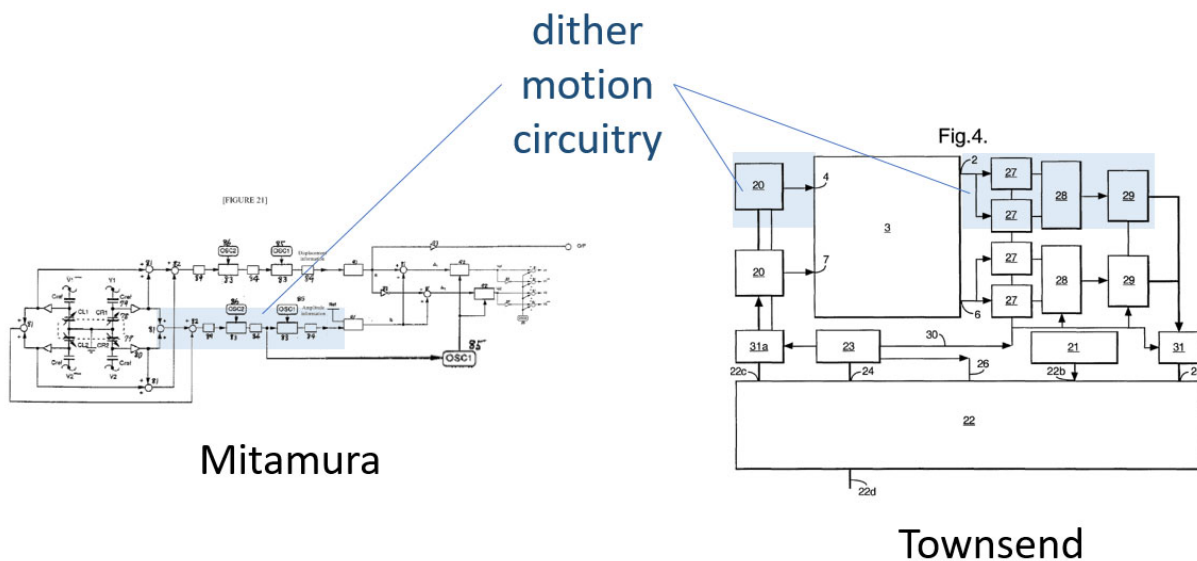
disclosed in Townsend's Figure 4 circuit—*e.g.*, the sample-and-hold devices, buffers, analog-to-digital converters, and digital-to-analog converters—to incorporate Townsend's digital processing unit 22 into Mitamura's circuit. (*Id.*)

Rationale and Motivation to Combine (Mitamura with Townsend): A POSITA would have been motivated to combine Mitamura with Townsend, in the manner described above. (Young, ¶¶241-45.) The combination would have predictably resulted in Mitamura's circuitry for controlling dither motion incorporating a digital processor and circuitry (*e.g.*, sample-and-hold devices, analog-to-digital converters, buffers, and digital-to-analog converters) for converting between analog signals used in Mitamura's circuits and digital signals input to or output from digital processor. (*Id.*, ¶241.)

Mitamura and Townsend are analogous references. (Young, ¶242.) Both are in the same field as the '122 patent. Like Mitamura, Townsend relates to the design of vibrating gyroscopes and associated control circuitry. (*E.g.*, Townsend at 1-2, Young, ¶242.)

A POSITA would have been motivated to combine Mitamura with Townsend because Mitamura describes embodiments of a vibrating structure gyroscope and circuit loops for (1) controlling vibration of the vibrating element and (2) controlling motion caused by the Coriolis force when the system undergoes an angular rotation. (*See, e.g.*, Mitamura, Fig. 21, [0064]; Young, ¶243.) Townsend describes analogous

circuit loops in the form of its (1) “primary or excitation loop” (which “control[s] the amplitude of the resultant signal at the primary pick off means 2 which in effect is the amplitude of the resultant vibration”) and (2) its “secondary or damping loop” (which involves a “signal [] proportional to the applied angular rate” and which “provide[s] damping for the high Q rate response” of the vibrating structure gyroscope). (Townsend at 1-2, 4; Young, ¶243.) A POSITA would have understood that the circuit loops of Mitamura and Townsend correspond as shown in the diagram below:



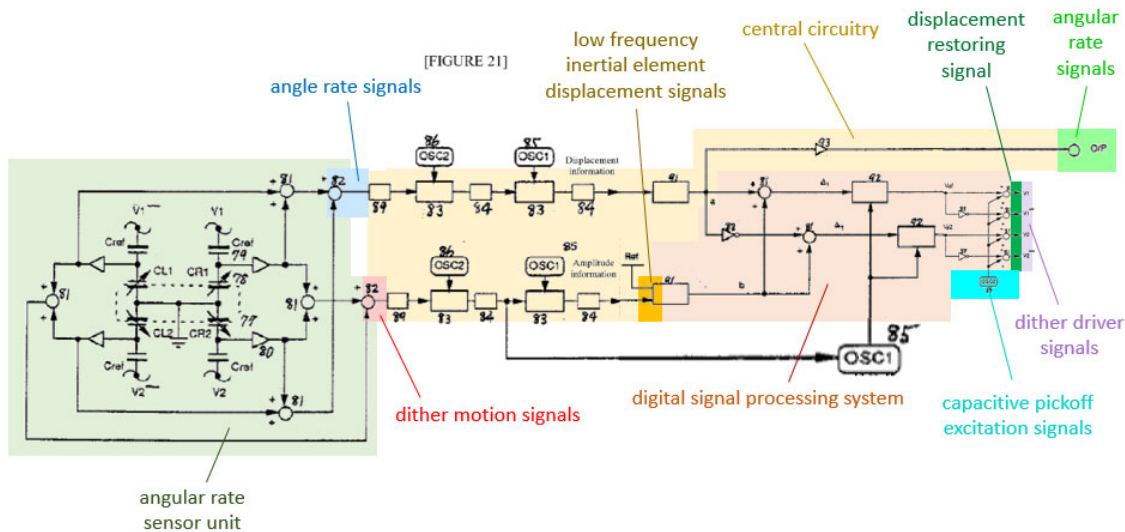
(Mitamura, Fig. 21 (annotations and highlighting added); Townsend, Fig. 4 (annotations and highlighting added); Young, ¶243.) Accordingly, a POSITA would have understood that the teachings of Townsend are applicable to the control circuit loops of Mitamura, including the dither motion control loop. (Young, ¶243)

A POSITA would have been motivated to combine Townsend with Mitamura because Townsend describes digital implementations of vibrating structure gyroscope circuitry that improve upon prior art analog approaches. (Young, ¶244.) Townsend discloses that analog circuitry has drawbacks when used for the control loops of vibrating structure gyroscope circuitry, because such circuitry is “notoriously difficult to specify, design and integrate into small low cost systems (i.e. ASICS)”; it is “difficult to apply calibrations and compensations to systems based on analogue circuits”; and “modern systems require the sensor outputs to be available in digital format to simplify system integration and enable further compensations to be applied to enhance performance.” (Townsend at 3.) Faced with Townsend’s teachings about the limitations of analog circuitry when used for control circuit loops for vibrating structure sensors, a POSITA would have looked to Townsend’s digital implementation for Mitamura control circuitry. (Young, ¶244.)

In addition to incorporating a digital processor from Townsend into Mitamura’s third embodiment, a POSITA would have been motivated to incorporate other circuitry from Townsend used in converting between analog and digital signals. (Young, ¶245.) A POSITA would have been motivated to incorporate digital-to-analog and analog-to-digital converters into Mitamura’s circuit, since Townsend discloses that these are necessary for converting between analog signals input to/output from the vibrating structure sensor and digital signals input to/output

from the digital processor. (Townsend at 12-13; Young, ¶245.) Further, a POSITA would have been motivated to incorporate sample and hold devices into Mitamura’s third embodiment, because Townsend indicates that sample and hold devices “provide a high degree of noise rejection” by “averag[ing] or integrat[ing] the input waveform over the sample period.” (Townsend at 18; Young, ¶245.) A POSITA would look for further means for reducing noise in Mitamura’s third embodiment—which includes filtering—so as to further improve sensor performance. (Young, ¶245.)

To the extent there is any argument that “b” in Mitamura does not constitute the dither driver signals, because there is additional processing and signal components that determine the signals used to drive the vibrating mass 72, the Mitamura Figures 21 and 26 circuit could be alternatively split up such that it would meet the requirements of claim 1[c] regardless. (Young, ¶¶246-47.) An annotated version of Figure 21 is provided below that shows this alternative way of splitting up the Mitamura Figures 21 and 26 circuit:



(Mitamura, Fig. 21 (annotations and highlighting added), Fig. 26 (same); Young, ¶246.)

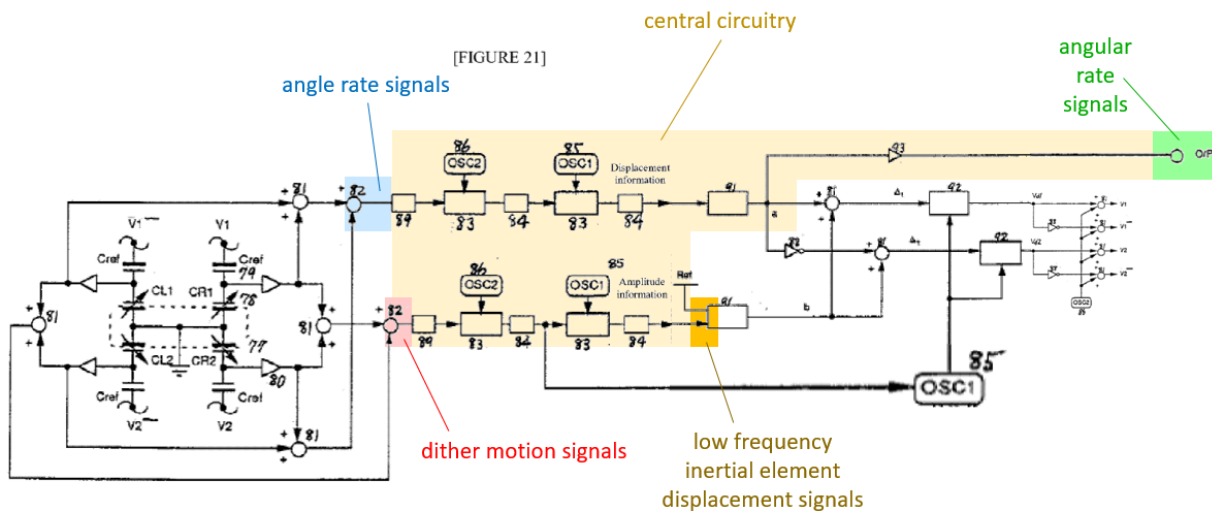
The main change from the primary mapping for this limitation is that the **digital signal processing system** is expanded to include arithmetic unit 91 and subsequent circuitry that generates signals V_1, V_1-, V_2 , and V_2- . (Young, ¶247.) This circuitry can be considered part of the digital signal processing system (if arithmetic unit 91 is implemented digitally, as discussed above). The pink-highlighted circuitry in the above annotated diagram processes signals (including by summing and modulating them) and includes a digital component (arithmetic unit 91, if implemented digitally). (Mitamura, [0048], [0058]-[0061].) Accordingly, the pink-highlighted is a **digital signal processing system**.

2. Claim 3

Per the requirements of claim 3, Mitamura discloses a **micromechanical**

system, as recited in claim 1, wherein said central circuitry comprises a dither motion control circuitry and an angle rate signal loop circuitry. (Young ¶¶248-50.)

The following annotated version of Mitamura's Figure 21 (with control circuit 87 replaced with the example configuration shown in Figure 26), shows the yellow-highlighted central circuitry identified for Claim 1[b]:



(Mitamura, Fig. 21 (annotations and highlighting added); *id.*, Fig. 26; Young, ¶250.)

The upper yellow-highlighted path comprises an **angle rate signal loop circuitry**, because it is part of the circuitry that detects the angular rotation of the carrier and feeds it back (in a feedback loop) into the comb electrode drive circuitry to compensate for the Coriolis force. (Mitamura, Figs. 21, 26; [0045]-[0046], [0057]-[0058]; Young, ¶250.) Further, the lower yellow-highlighted path comprises **dither motion control circuitry**, because it is part of the circuitry that processes signals

related to the vibrating (dither) motion of mass 72. (Mitamura, Figs. 21, 26; [0055]-[0056]; Young, ¶250.)

VII. CONCLUSION

Petitioner respectfully requests institution of review on the challenged claims.

Dated: March 7, 2024

Respectfully submitted,

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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 **13,989** 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: March 7, 2024

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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. 6,508,122 B1**, including all exhibits (**EXS1001-1026**) and related documents, are being served via Federal Express on the 7th day of March, 2024, 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 Federal Express upon the following counsel for Patent Owner in *American GNC Corp. v. Nintendo Co., Ltd., et al.*, in the United States District Court, Western District of Washington, Case No. 2:23-cv-00302-TL as follows:

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