

Petitioners Nintendo Co., Ltd. and Nintendo of America Inc.'s Demonstratives

IPR2024-00667
IPR2024-00668

May 28, 2025

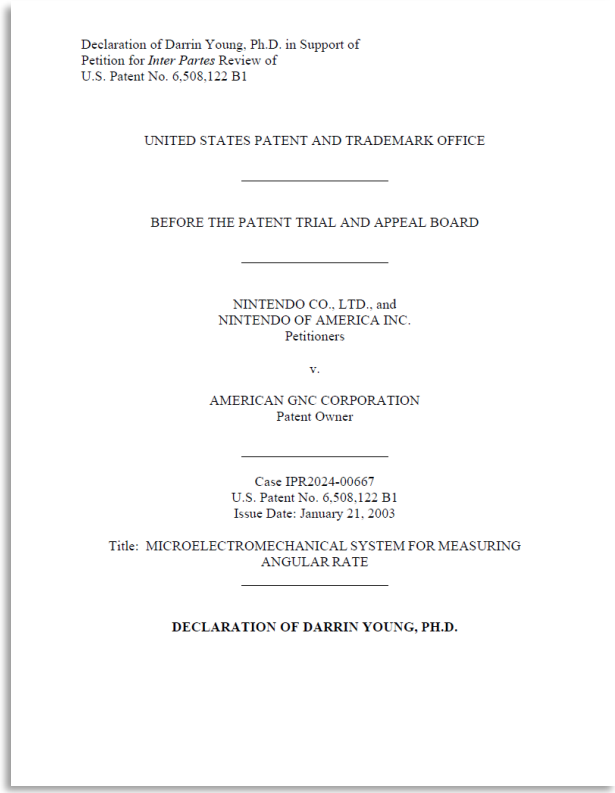
DEMONSTRATIVE EXHIBIT

NOT EVIDENCE

Nintendo Exhibit 1074
IPR2024-00667

Petitioner's expert - Dr. Young

- 2009-Present: Professor in Electrical and Computer Engineering Department at University of Utah
- 1999-2009: Professor in Electrical Engineering and Computer Science Department at Case Western Reserve University
- 1999: PhD from UC Berkeley in Electrical Engineering and Computer Sciences



Declaration of Darrin Young, Ph.D. in Support of
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

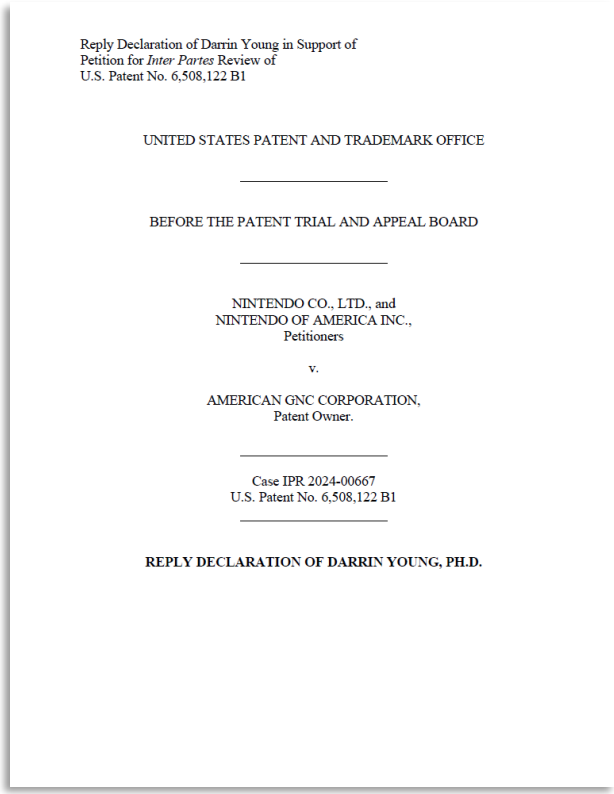
v.

AMERICAN GNC CORPORATION
Patent Owner

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

Title: MICROELECTROMECHANICAL SYSTEM FOR MEASURING ANGULAR RATE

DECLARATION OF DARRIN YOUNG, PH.D.



Reply Declaration of Darrin Young in Support of
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 IPR 2024-00667
U.S. Patent No. 6,508,122 B1

REPLY DECLARATION OF DARRIN YOUNG, PH.D.

EX1002 (Young decl.), ¶¶4-10, Appx. A

Dr. Young worked on mixed signal MEMS inertial sensors years before the alleged priority date

MR. JOHANNINGMEIER:
Q. Mm-hmm. And I -- from looking at your CV, I understand that some of that work early on was in RF MEMS; is that right?
MR. LAUPPE: Object to form.
THE WITNESS: The very first part of my research was looking at design and the simulation of a sigma-delta modulator to interface MEMS inertia sensor, for example, accelerometer. And, you know, design simulator sigma-built modulator --
(Whereupon, the reporter asks for clarification.)
THE WITNESS: Of a -- of a sigma-delta modulator that was used to interface MEMS sensors -- for example, MEMS accelerometer -- to detect the moveable plates we called the "proof mass," and also move -- the moveable fingers when the structure is under -- under force.
For example, in an incoming acceleration. And the sigma-delta modulator outputs a one-bit digital feedback to provide force-balancing mechanism to -- to restore the displacement of the moveable structure of the MEMS device.
MR. JOHANNINGMEIER:
Q. And is that research -- when did that research occur?
A. That occurred between 1993/1994 time frame.

5. I started my research work in MEMS as a graduate research student at the University of California at Berkeley between 1993 and 1994. I worked on design and simulation of a Sigma-Delta modulator architecture to interface with a capacitive MEMS accelerator. The Sigma-Delta architecture produces a one-bit digital output, which can be used to provide a digital force feedback signal to control the position of a MEMS accelerometer's proof mass at its nominal position. The one-bit digital force feedback signal further helps achieve a linear system performance. The Sigma-Delta architecture suppresses the quantization noise in the low-frequency region, where an incoming acceleration signal typically resides, thus achieving an improved signal-to-noise ratio (SNR). I also applied a digital decimation filter to the one-bit digital output to determine the incoming acceleration signal amplitude and the minimum detectable signal level. After this project, I

EX2020 (Young depo. tr.), 23:17-24:19 (highlighting added); EX1045 (Young reply decl.), ¶5 (highlighting added)

’122 patent

Overview of grounds

'122

- Ground 1: Fujiyoshi/Kumar/Townsend/Cox
- Ground 2: Mitamura/Townsend

Overview

'122

- Grounds 1 and 2
  - Are the "digital" limitations obvious?
  - Is the "analyzing" limitation anticipated or obvious?
- Ground 1
  - Is the "low frequency" limitation obvious?
  - Are "capacitive pickoff excitation signals" anticipated or obvious?

Claims at issue

'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

3. The microelectromechanical system, as recited in claim **1**, wherein said central circuitry comprises a dither motion control circuitry and an angle rate signal loop circuitry.

EX1001 ('122 patent), cls. 1, 3 (highlighting added)

Person of ordinary skill

'122

Petitioner

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.)

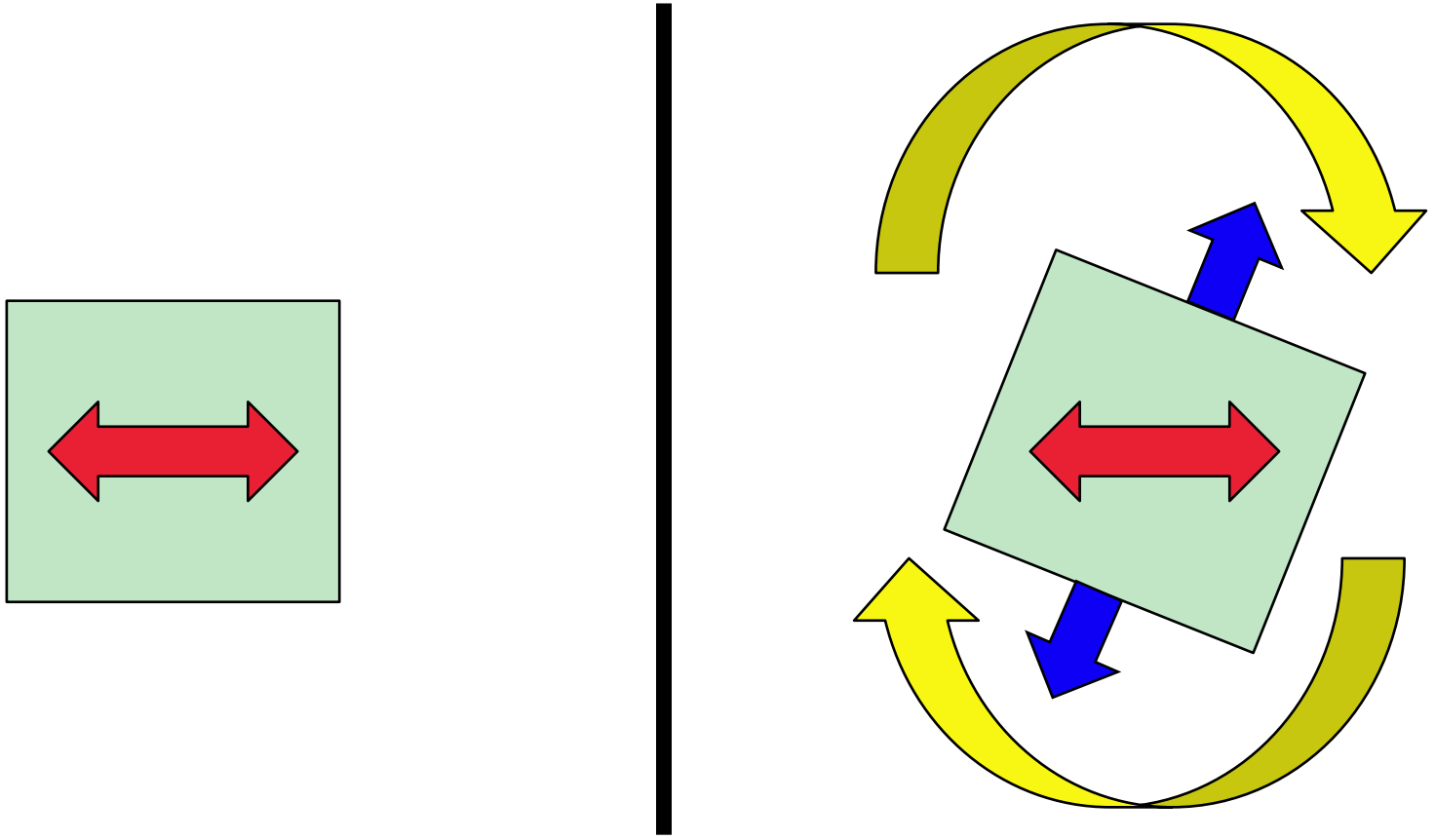
Pet., p. 5; EX1002 (Young decl.), ¶¶12-15

Patent Owner

A person of ordinary skill in the art with respect to the '122 Patent would have at least a "Master's Degree in Electrical or Electronics Engineering, and approximately five years of relevant experience in the development of control systems for inertial navigation, MEMS semiconductor processing, and analog circuit design." EX2019, ¶57.

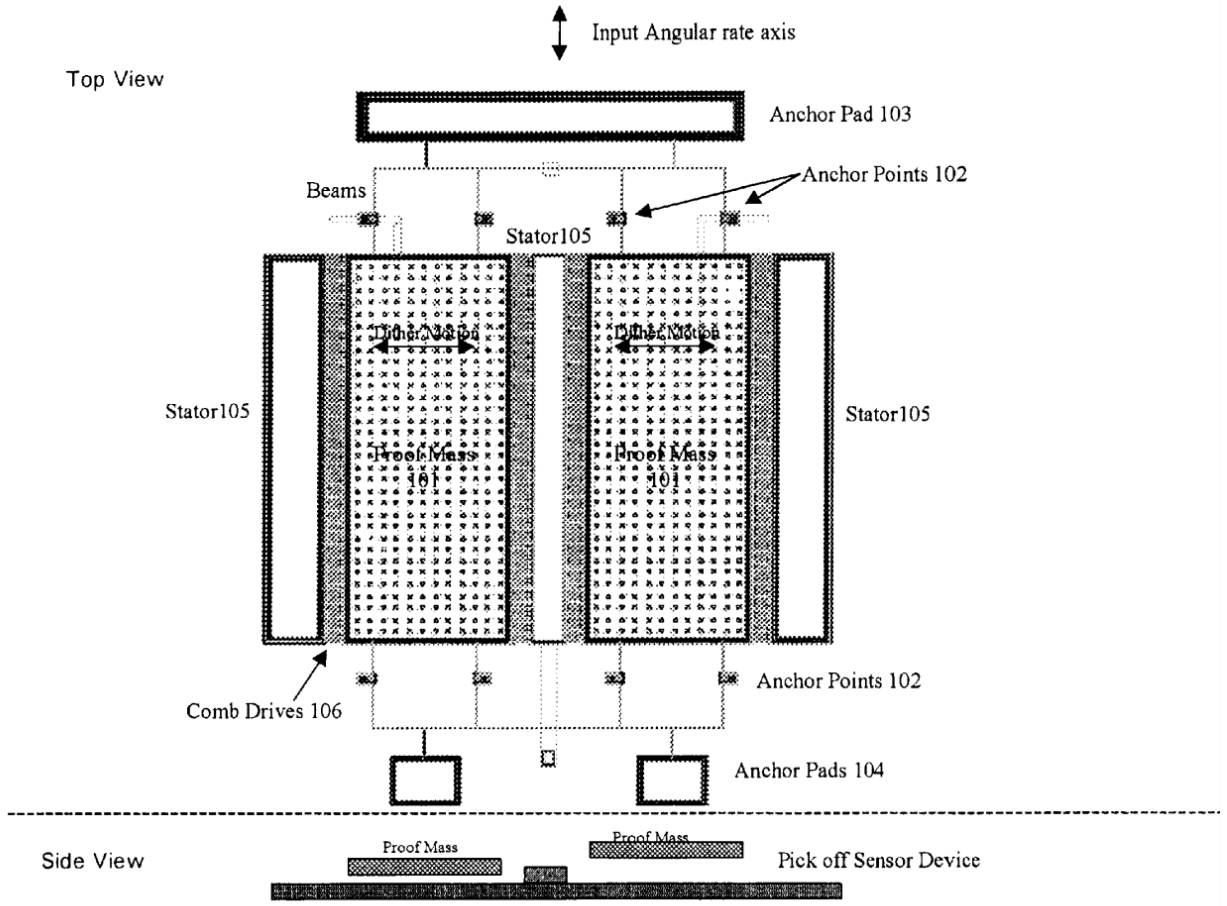
POR, p. 18; EX2008 (Larson decl.), ¶57

Coriolis force



EX1002 (Young decl.), ¶¶44-45; Pet., p. 12

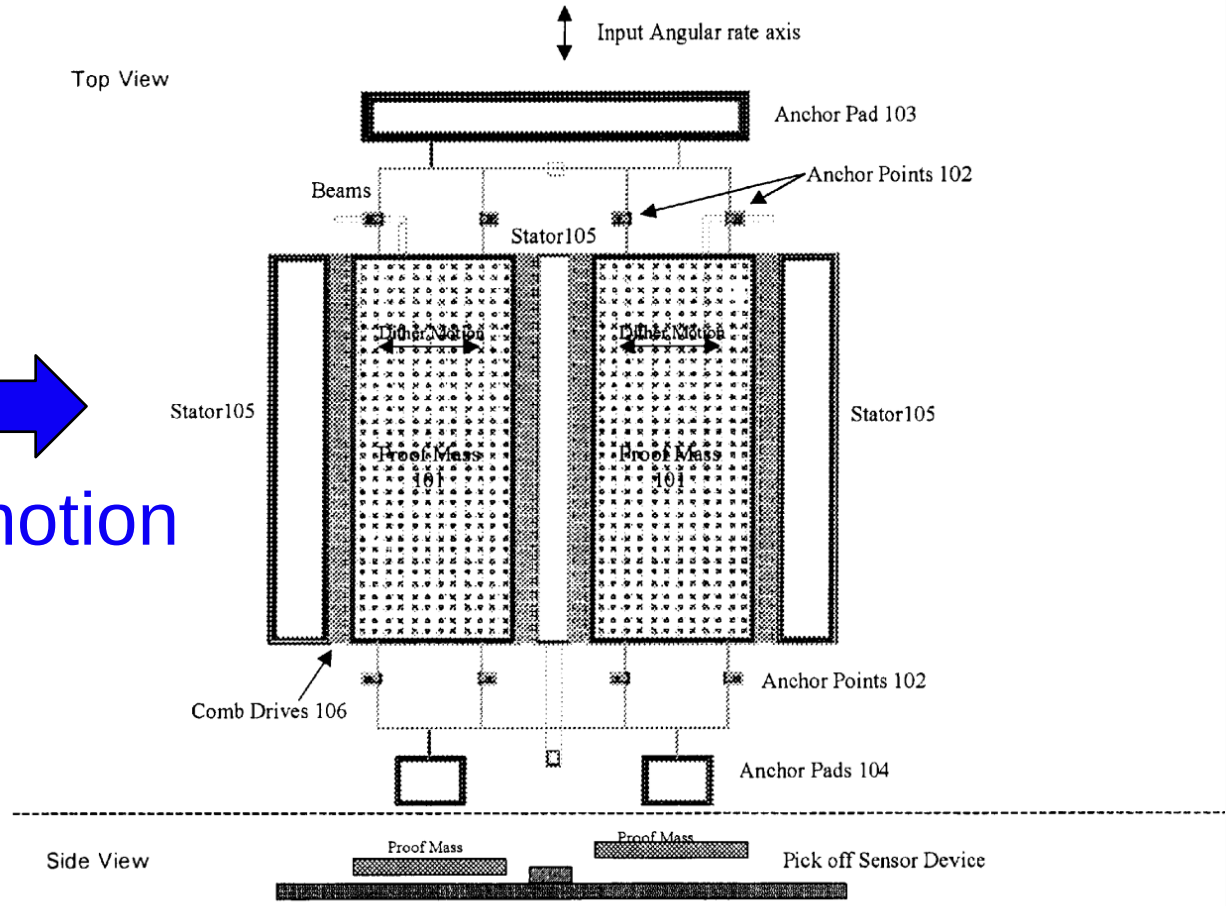
’122 patent



EX1001 (’122 patent), Fig. 2

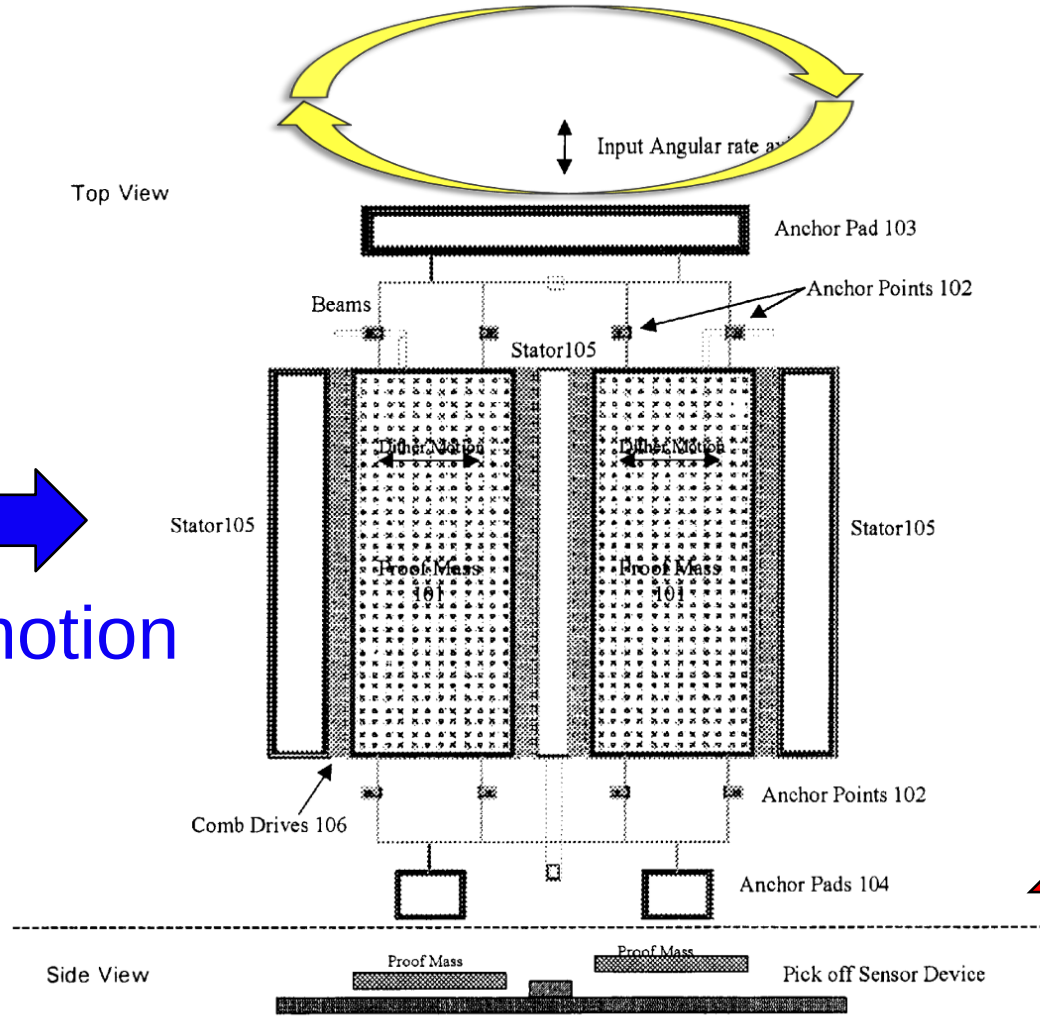
’122 patent

Dither motion



EX1001 (’122 patent), Fig. 2 (annotations added); EX1002 (Young decl.), ¶45; Pet., p. 12

’122 patent



Dither motion

Inertial displacement

EX1001 (’122 patent), Fig. 2 (annotations added); EX1002 (Young decl.), ¶45; Pet., p. 12

’122 patent

’122

Dither motion

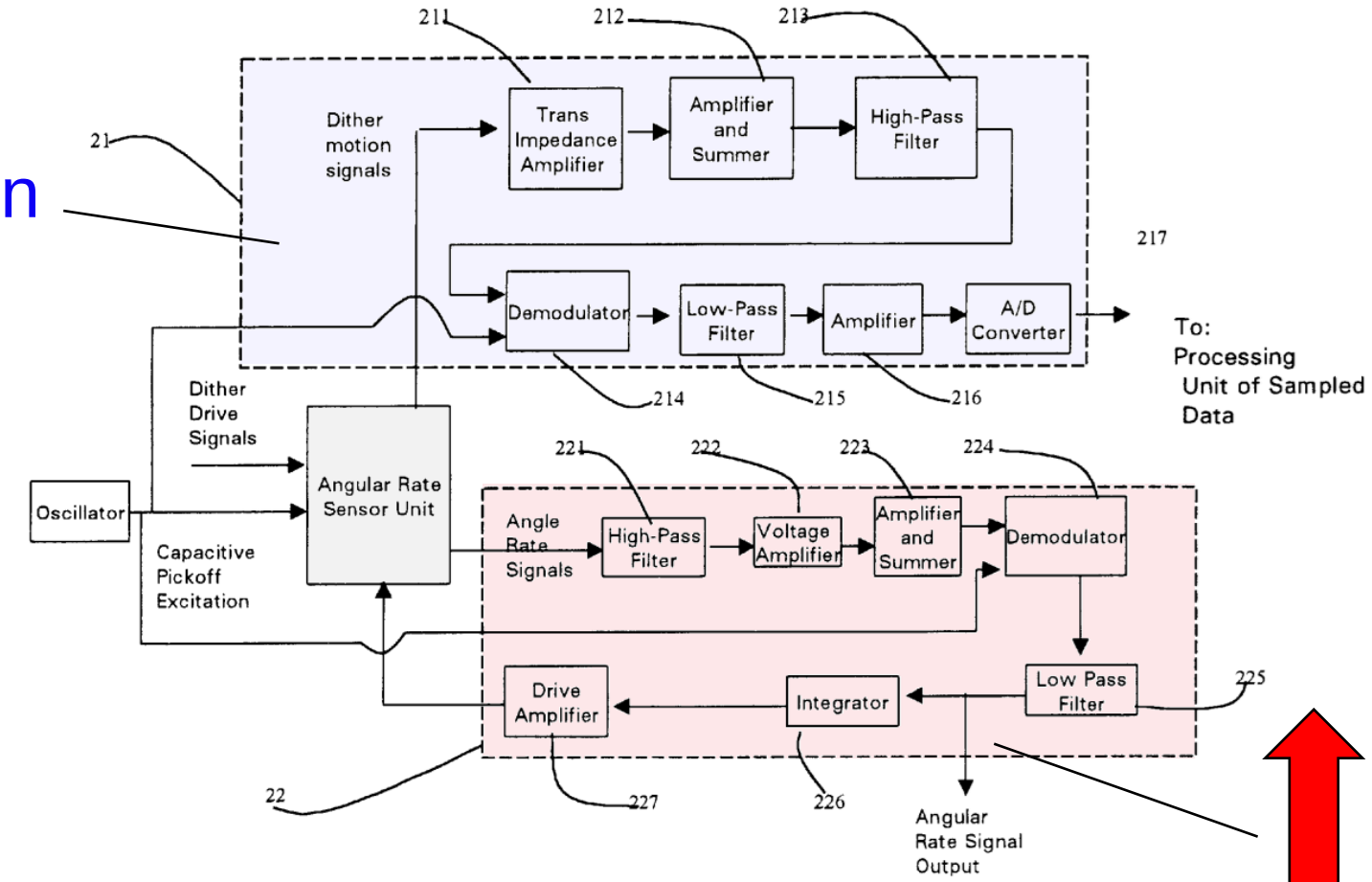


Figure 6

Inertial displacement

EX1001 (’122 patent), Fig. 6 (annotations added); ; EX1002 (Young decl.), ¶46; Pet., p. 12

’122 patent

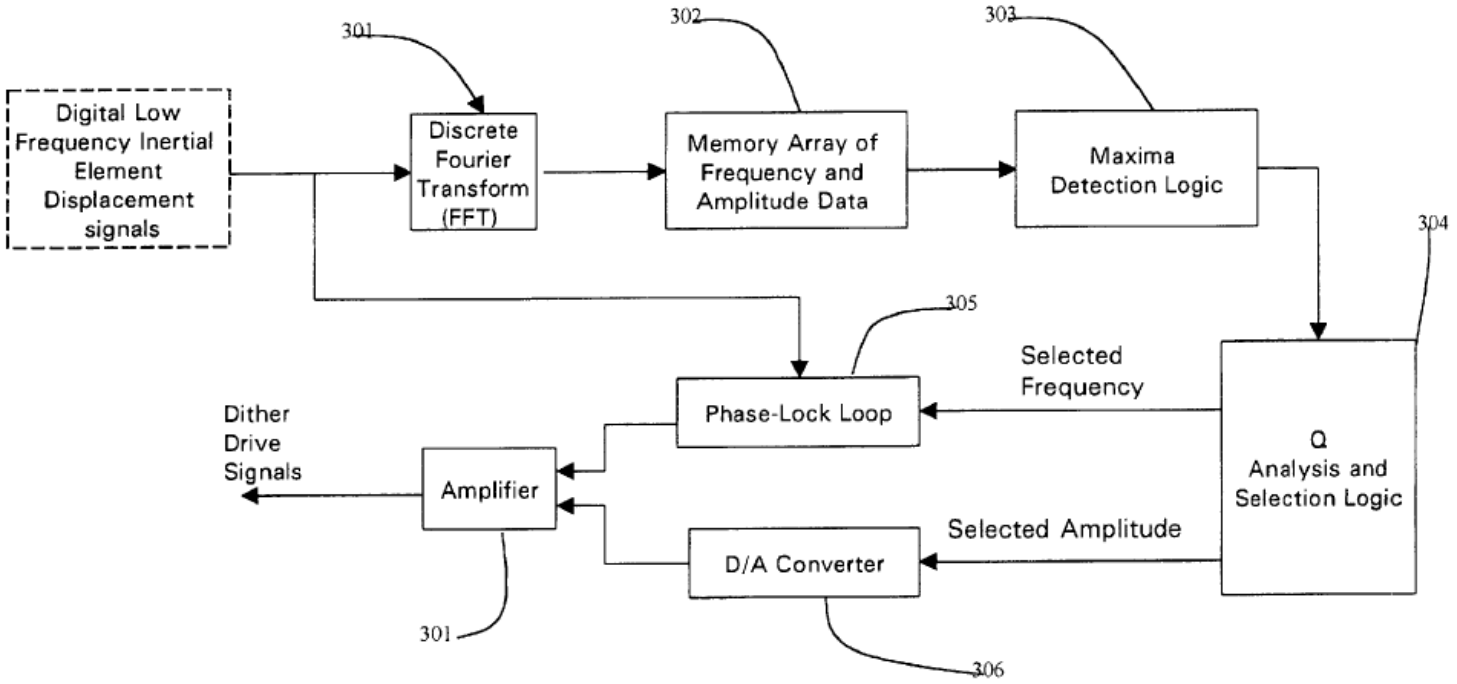
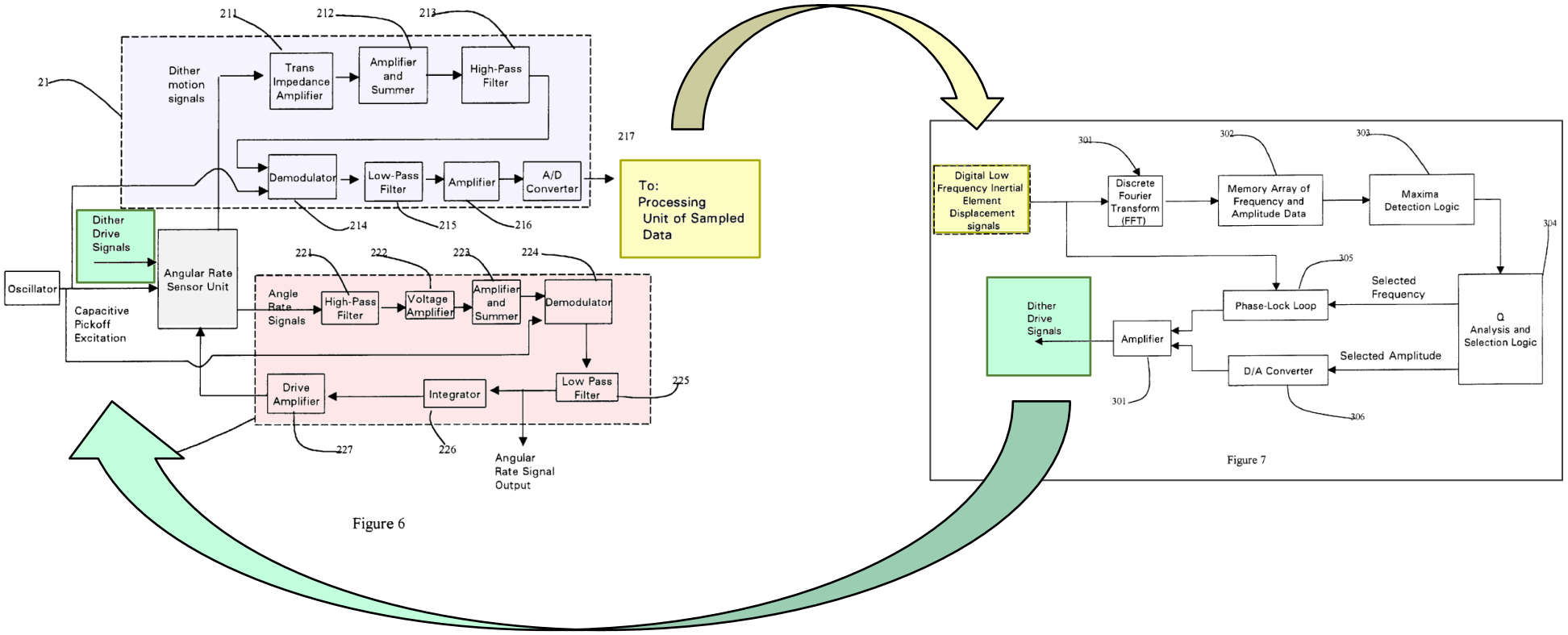


Figure 7

EX1001 (’122 patent), Fig. 7; EX1002 (Young decl.), ¶48

’122 patent

’122



EX1001 (’122 patent), Figs. 6, 7 (annotations added); EX1002 (Young decl.), ¶¶46, 48

Ground 1

Fujiyoshi, Kumar, Townsend, and Cox

’122 patent and Fujiyoshi

’122

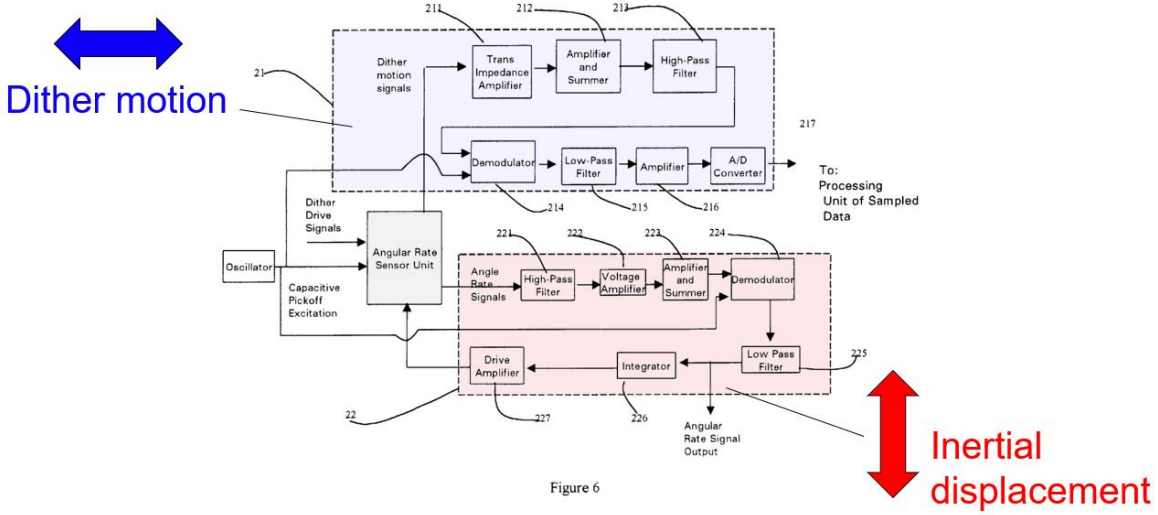


Figure 6

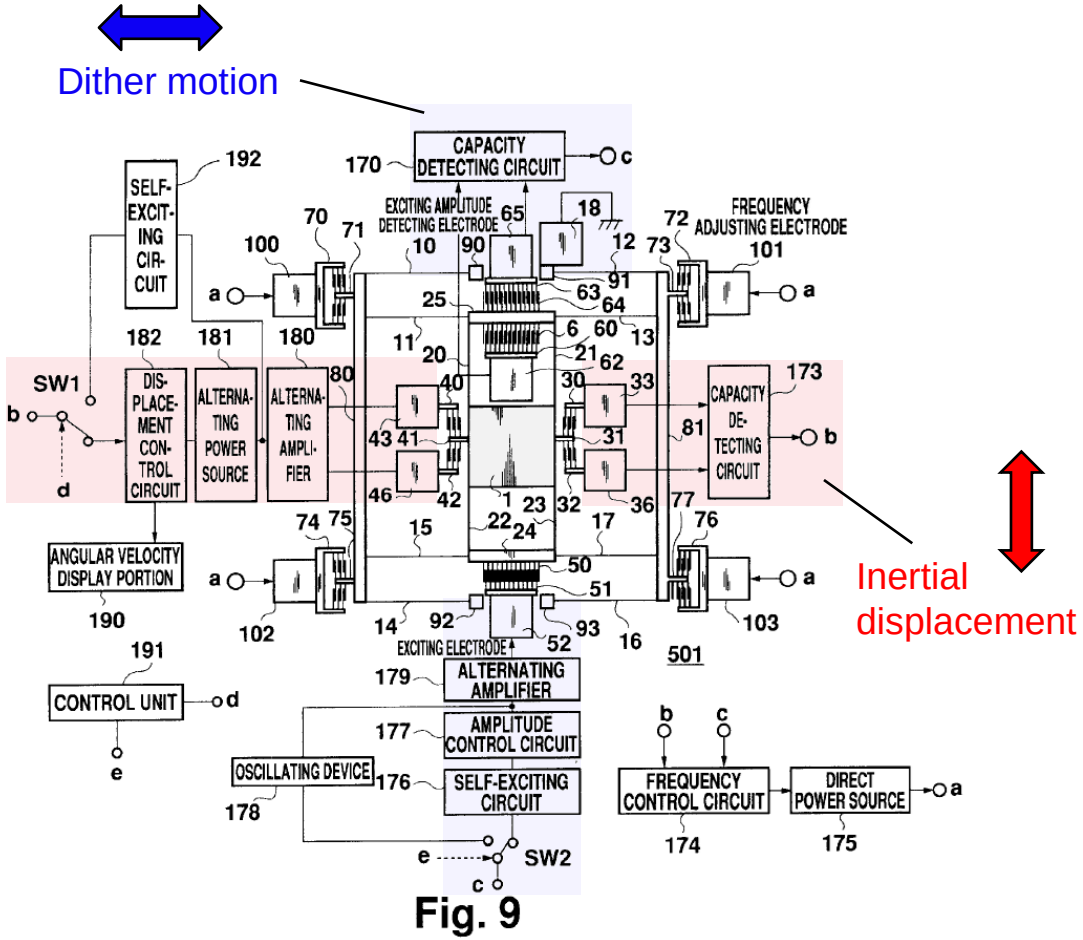


Fig. 9

EX1001 (’122 patent), Fig. 6 (annotations added); EX1002 (Young decl.), ¶156; Pet., p. 29

EX1003 (Fujiyoshi), Fig. 9 (annotations added); EX1002 (Young decl.), ¶190; Pet., p. 43

Claim 1[p]: Fujiyoshi

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

The angular velocity sensor of embodiment 1 is a fine angular velocity sensor manufactured using a micro machine technology for silicon. In this angular velocity sensor **500**, a mass portion **1** is supported on by a mass excitation supporting beam and a mass displacement supporting beam in such a manner as to float on a substrate surface.

Embodiment 1

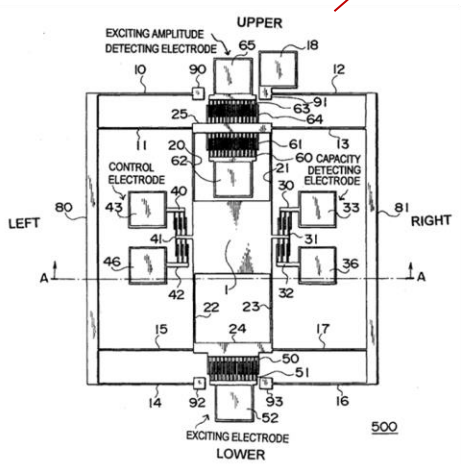


Fig. 3

Embodiment 2

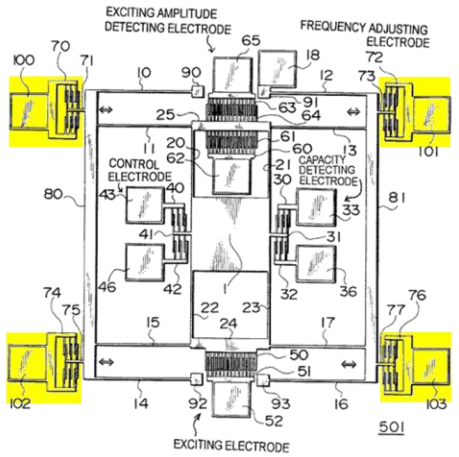


Fig. 8

EX1003 (Fujiyoshi), Figs. 3, 8, 11:57-62 (annotations added); EX1002 (Young decl.), ¶¶110-116; Pet., pp. 9-10

Claim 1[a]: Fujiyoshi

’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

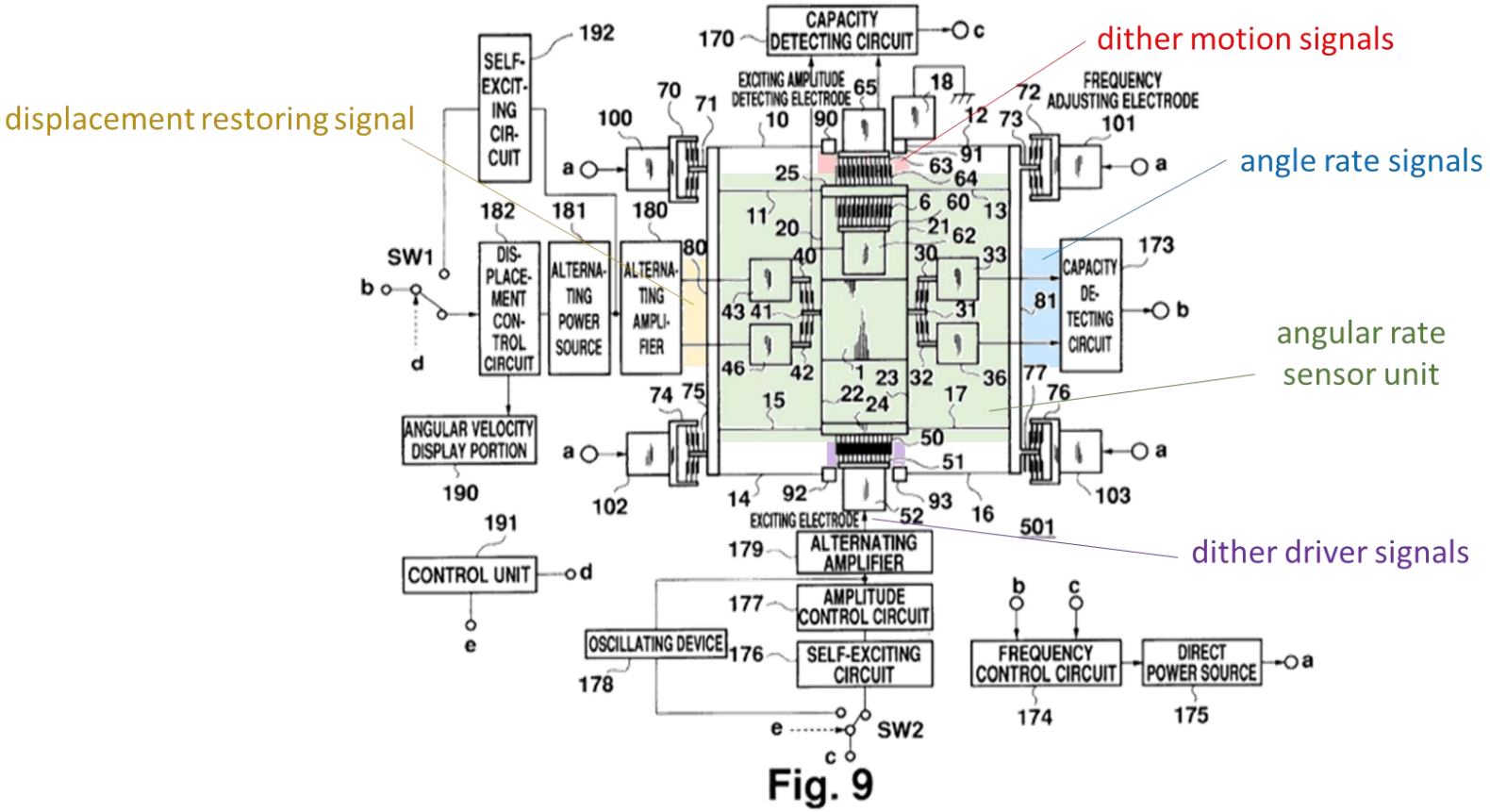


Fig. 9

EX1003 (Fujiyoshi), Fig. 9; EX1002 (Young decl.), ¶¶117-140; Pet., pp. 10-29

Claim 1[a]: “capacitive pickoff excitation signals”

’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

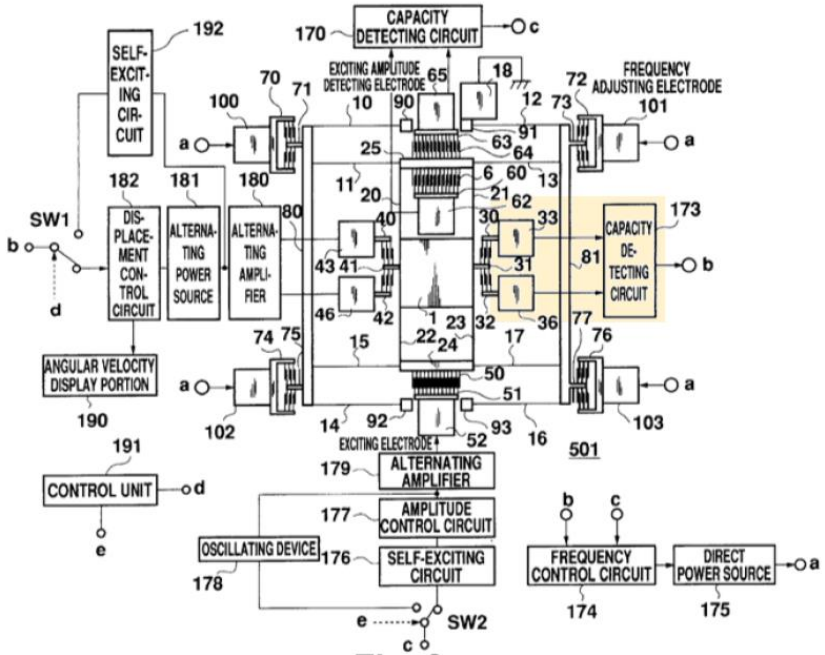


Fig. 9

An electrostatic capacity between the capacity detecting electrodes **30** and **32** and the projecting electrode **31** is changed due to the vibration of the mass portion **1** to the detecting direction. Accordingly, information concerning the

EX1003 (Fujiyoshi), Fig. 9, 16:25-28 (highlighting added); EX1002 (Young decl.), ¶¶135-140; Pet., pp. 18-23, 26

Claim 1[a]: “capacitive pickoff excitation signals”

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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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; and

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.

Knowledge of a POSITA

Ristic

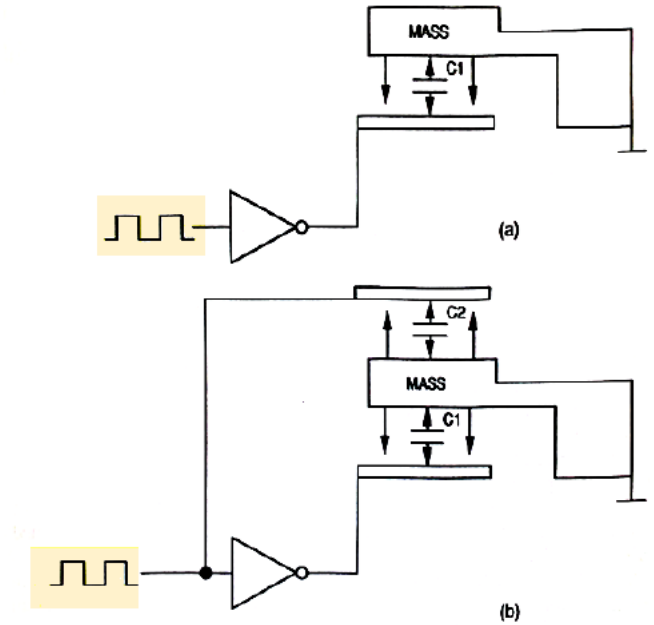


Figure 12.7 Capacitive sensing with electrostatic forces: (a) single-sided capacitive cantilever structure; (b) a movable plate between two fixed plates.

EX1010 (Ristic), Fig. 12.7 (highlighting added); EX1002 (Young decl.), ¶¶138-139; Pet., pp. 20-23

Claim 1[a]: “capacitive pickoff excitation signals”

’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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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.

Kumar

(see FIG. **2***a*). The pickoff electrode **54***a* and the central member **34** also form a parallel plate capacitor whose capacitance varies as the distance between the pickoff electrode **54***a* and the central member **34** varies. Since a DC bias voltage is present on the central member's electrically conductive layer **47**, the varying capacitance causes a variation in the electrical signal sent to the oscillation controller **42**.

processing). Furthermore, although oscillation sensing is accomplished with DC biased capacitive pickoffs in the preferred embodiment, other types oscillation sensors may be employed, such as high frequency carrier signal capacitive pickoffs (which operate without a DC bias voltage) and tunneling current displacement sensors. Such variations and

EX1005 (Kumar), 3:62-4:2, 6:29-34 (highlighting added); EX1002 (Young decl.), ¶¶141-142; Pet. pp. 23-26

Claim 1[b]: Fujiyoshi

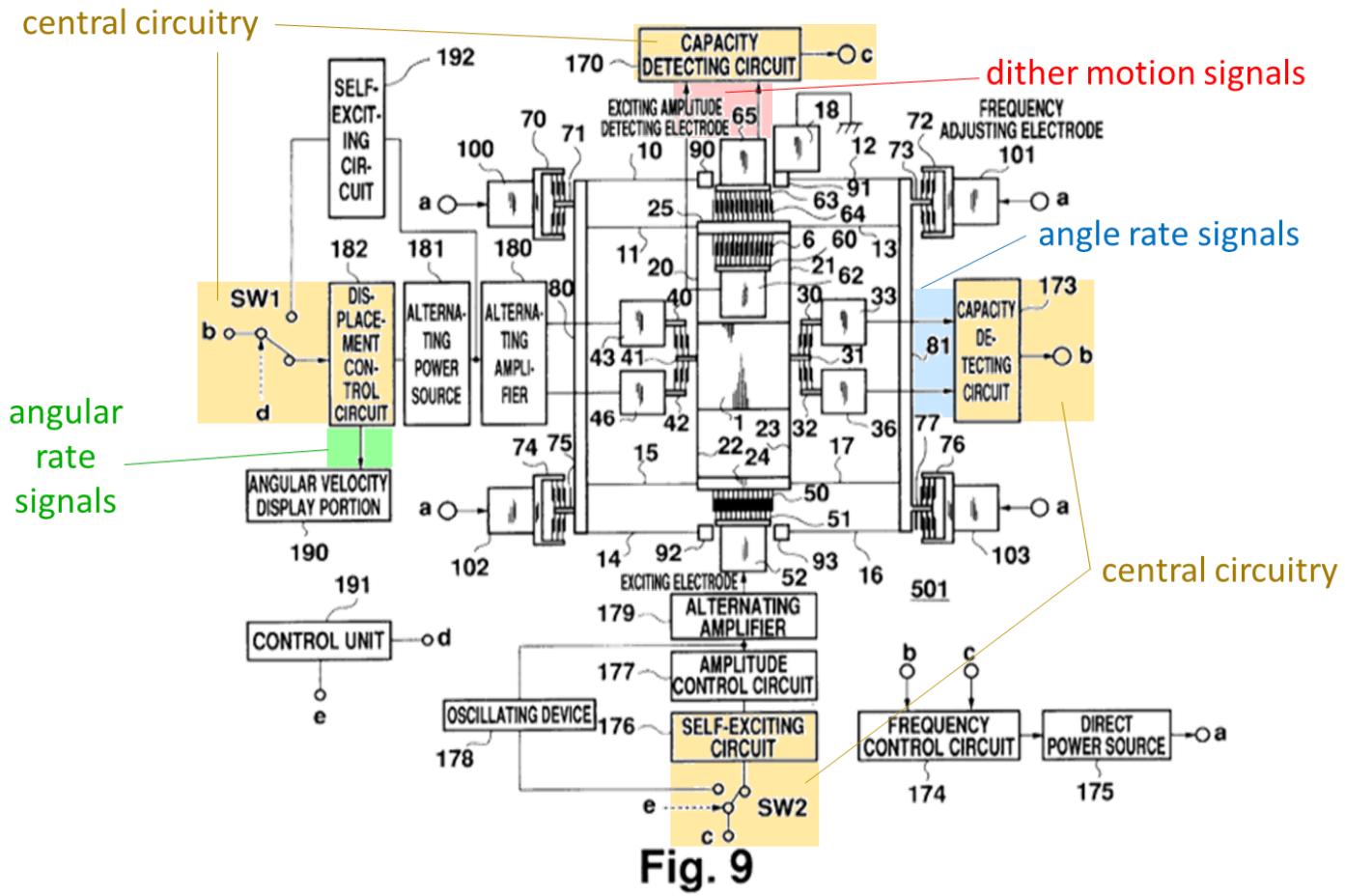
'122

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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.



EX1003 (Fujiyoshi), Fig. 9 (annotations added); EX1002 (Young decl.), ¶¶155-167; Pet., pp. 29-35

“digital” limitations

’122

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3. The microelectromechanical system, as recited in claim **1**, wherein said central circuitry comprises a dither motion control circuitry and an angle rate signal loop circuitry.

EX1001 (’122 patent), cls. 1, 3 (annotations added)

Dr. Young worked on mixed signal MEMS inertial sensors years before the alleged priority date

'122

MR. JOHANNINGMEIER:
Q. Mm-hmm. And I -- from looking at your CV, I understand that some of that work early on was in RF MEMS; is that right?
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THE WITNESS: The very first part of my research was looking at design and the simulation of a sigma-delta modulator to interface MEMS inertia sensor, for example, accelerometer. And, you know, design simulator sigma-built modulator --
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5. I started my research work in MEMS as a graduate research student at the University of California at Berkeley between 1993 and 1994. I worked on design and simulation of a Sigma-Delta modulator architecture to interface with a capacitive MEMS accelerator. The Sigma-Delta architecture produces a one-bit digital output, which can be used to provide a digital force feedback signal to control the position of a MEMS accelerometer's proof mass at its nominal position. The one-bit digital force feedback signal further helps achieve a linear system performance. The Sigma-Delta architecture suppresses the quantization noise in the low-frequency region, where an incoming acceleration signal typically resides, thus achieving an improved signal-to-noise ratio (SNR). I also applied a digital decimation filter to the one-bit digital output to determine the incoming acceleration signal amplitude and the minimum detectable signal level. After this project, I

EX2020 (Young depo. tr.), 23:17-24:19 (highlighting added); EX1045 (Young reply decl.), ¶5 (highlighting added); Reply, p. 17

Dr. Larson's 1988 article discloses motivations to combine analog circuitry with digital signal processing

'122



State-of-the-Art and Future Prospects for Analogue Signal Processing -A Tutorial

Gabor C. Temes, Lawrence E. Larson and Kenneth W. Martin

University of California
Los Angeles, CA 90024, USA

ABSTRACT

Despite the proliferation of VLSI digital integrated circuits, the development of analog interface circuits continues to advance rapidly. This paper outlines the major trends in analog integrated signal processing. A/D and D/A converters are becoming the dominant analog components in major systems, and converters that rely on digital post-processing and error correction are becoming increasingly popular. These, and other trends, will be highlighted.

INTRODUCTION

Even though predictions in the rapidly changing area of integrated circuits are risky, certain tendencies are clearly visible. Signal processing, switching and control functions increasingly use digital techniques. This is due to the accuracy, flexibility, programmability and modularity of digital systems, in addition to the high levels of integration achievable in modern digital integrated circuits. As a result, in many signal processors with analog inputs and outputs, the majority of the components are becoming digital, with only a relatively few functions remaining in analog form. These analog circuits usually include the S/H, preamplifier, input/output buffers, pre- and post-filter, equalizers, multiplexer/demultiplexer stages, and A/D and D/A converters. These circuits are necessary for conditioning an analog input signal for digital manipulation, or a digital output signal for analog transmission [1].

In addition to A/D and D/A conversion tasks, analog interface systems are increasingly used for high-speed data transmission, in disk drive systems, and linear fiber-optic ICs for inter-board communications.

A development interesting for those of us who earn their living by designing the circuits performing these functions is that, despite the increased use of digital techniques, R & D activities in the analog area are intensifying, rather than diminishing. One measure of the continuing evolution of analog integrated circuits is the relative number of sessions devoted to analog and digital circuits at the ISSCC. At the 1988 conference, five sessions were devoted to analog techniques, and eight to digital.

The accelerating evolution of analog integrated circuits occurs in part, because as digital integrated circuit technology improves the performance of the analog interface modules must also improve in terms of increased speed and accuracy, as well as reduced chip area and power dissipation. This is made more difficult by the changes (primarily the reduced supply voltage) aimed at improving the reliability, power dissipation, speed and density of the digital circuitry. With the current trend towards low-voltage (3 V) single-supply IC's, the prospect of a dual-supply arrangement is becoming attractive for mixed analog-digital chips.

Overall, especially for parallel digital systems or systems where signals can be stored and post-processed digitally in non-real time, the analog interface is often the bottleneck in mixed analog-digital signal processing. In addition, while the simulation, design and testing of digital logic circuitry has been well supplied with CAD tools, the CAD of analog circuits is still not mature. Because of the wide range and large number of design parameters (such as frequency range, dynamic range, process variables, accuracy, supplies, signal levels, etc.) the development of fully automated analog design techniques, or even of a complete library of pre-designed modules, is very unlikely. Thus, analog circuit design is likely to remain, for the foreseeable future, an art rather than an automated menial task. (It should, however, be noted that with the reduction of device dimensions to the submicron range, high-speed digital circuit design is also becoming a similarly sophisticated task - in fact it is becoming essentially analog circuit design!)

Finally, even for some "purely digital" ICs, such as dynamic and static RAMs, major improvements in speed have been obtained due to faster analog components (bus drivers, sense amplifiers, etc.)

In the next sections, recent developments in some of the most important analog signal processing circuits will be briefly discussed. The discussion will be restricted to circuits realized in MOS and GaAs technologies, since the writers' interest and experience is mostly in these fields.

DATA CONVERTERS

In terms of importance, variety, sophistication and difficulty, A/D and D/A converters represent perhaps the greatest challenge for today's circuit designer.

ISCAS'88 CH2458-8/88/0000-1655$1.00 © 1988 IEEE

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Even though predictions in the rapidly changing area of integrated circuits are risky, certain tendencies are clearly visible. Signal processing, switching and control functions increasingly use digital techniques. This is due to the accuracy, flexibility, programmability and modularity of digital systems, in addition to the high levels of integration achievable in modern digital integrated circuits. As a result, in many signal processors with analog inputs and outputs, the majority of the components are becoming digital, with only a relatively few functions remaining in analog form. These analog circuits usually include the S/H, preamplifier, input/output buffers, pre- and post-filter, equalizers, multiplexer/demultiplexer stages, and A/D and D/A converters. These circuits are necessary for conditioning an analog input signal for digital manipulation, or a digital output signal for analog transmission [1].

EX1044 (Larson *et al* article), p. 1655 (highlighting added); Reply, p. 6

Dr. Larson testified to the flexibility of digital signal processing

'122

Q And how is programmability an advantage of digital systems?

A Well, as I mentioned before, you know, digital systems are kind of -- their operation can be changed under software or firmware control, and so I think programmability there is kind of a euphemism for the ability to software or firmware or even perhaps a simple mask change to control their function.

EX1046 (Larson depo. tr.), 41:22-42:4 (highlighting added); Reply, p. 14

Dr. Larson indicates preexisting high performance MEMS control circuits

'122

19 Q So high-performance MEMS devices and control
20 circuits existed for at least ten years before the
21 priority date of the '122 and '648 patents; is that
22 correct?
23 A Well, I had the experienced... yes. Yes, I
24 believe so.

EX1046 (Larson depo. tr.), 23:19-24 (highlighting added); Reply, p. 1

Digital processing in control loops of MEMS gyroscopes was well known in the prior art

'122

Clark (1997)

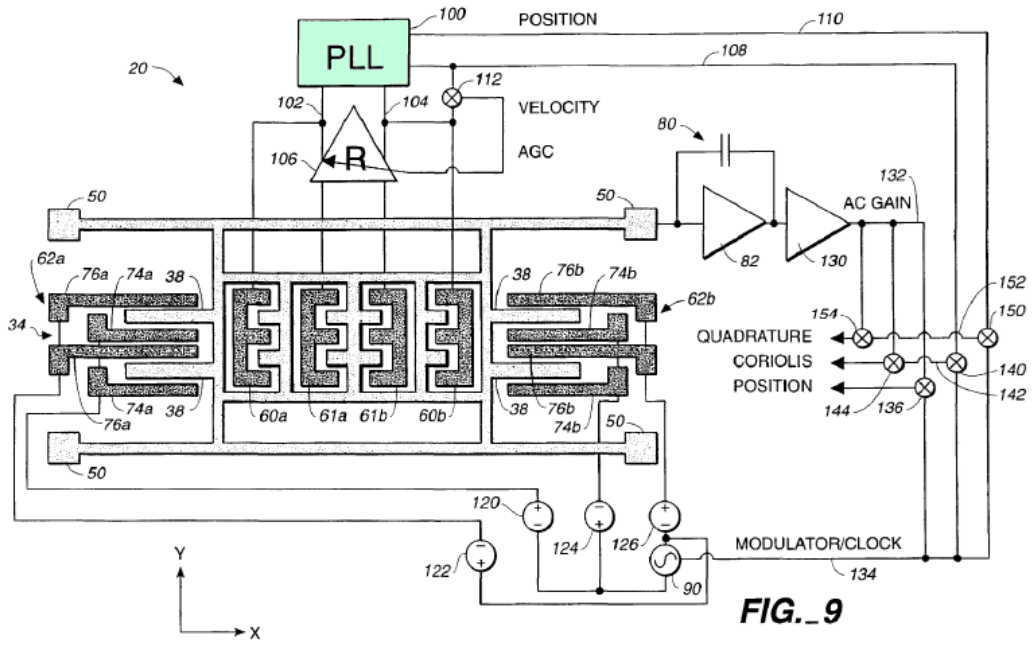


FIG._9

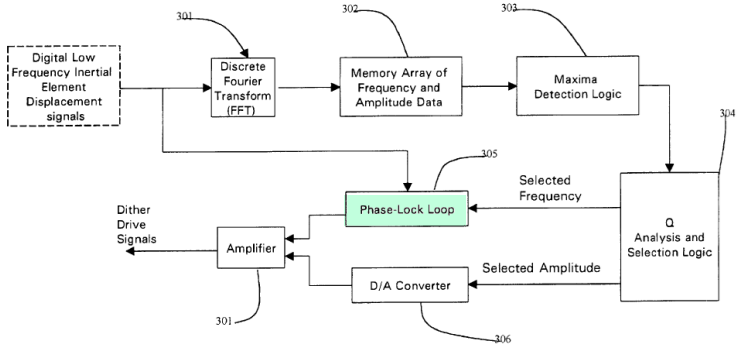


Figure 7

Patent Owner's Expert Dr. Larson

47. Claim 1 of the '122 patent requires that the digital signal processor receive and analyze the "digital low frequency inertial element displacement signals." *Id.*, 9:46-54. The patent describes, and Figure 7 shows, various examples of the analysis that can be performed on the digital signals:

Claim 1 does not require a particular analysis from these disclosed options, but does require converting signals to digital, analyzing them, and "feeding back" dither drive signals to the angular rate sensor. *Id.*, 9:51-54. I understand that the inventors of

EX1057 (Clark), Fig. 9 (highlighting added); EX1045 (Young reply decl.), ¶52;
EX2019 (Larson decl.), ¶47 (highlighting added); EX1001, Fig. 7; Reply, p. 12

Digital processing in control loops of MEMS gyroscopes was well known in the prior art

'122

Juneau (1998)

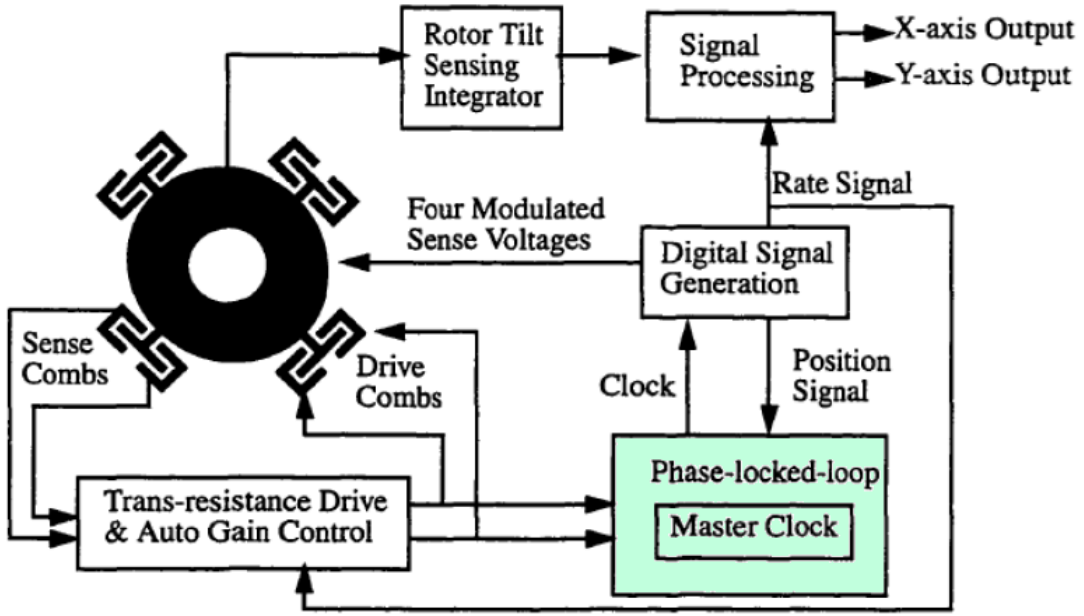


Figure 4-1. *System level schematic showing entire dual-axis gyroscope electronics.*

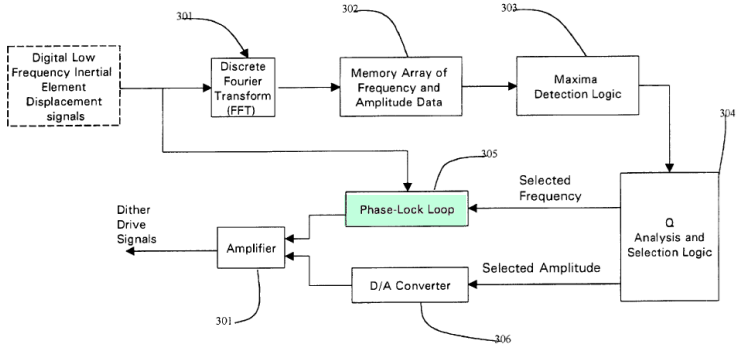


Figure 7

Patent Owner's Expert Dr. Larson

47. Claim 1 of the '122 patent requires that the digital signal processor receive and analyze the "digital low frequency inertial element displacement signals." *Id.*, 9:46-54. The patent describes, and Figure 7 shows, various examples of the analysis that can be performed on the digital signals:

Claim 1 does not require a particular analysis from these disclosed options, but does require converting signals to digital, analyzing them, and "feeding back" dither drive signals to the angular rate sensor. *Id.*, 9:51-54. I understand that the inventors of

EX1037 (Juneau), Fig. 4-1 (highlighting added); EX1045 (Young reply decl.), ¶52;
EX2019 (Larson decl.), ¶47 (highlighting added); EX1001, Fig. 7; Reply, p. 12

AGNC's challenge to Nintendo's properly responsive reply evidence is unfounded

'122

Anacor Pharms., Inc. v. Iancu,
889 F.3d 1372, 1380-81 (Fed. Cir. 2018)

"[T]he petitioner in an inter partes review proceeding **may introduce new evidence after the petition stage if the evidence is a legitimate reply to evidence introduced by the patent owner**, or if it is used 'to document the knowledge that skilled artisans would bring to bear in reading the prior art identified as producing obviousness.'"

(emphasis added) (citation omitted); Opp'n to PO Mot. to Exclude, pp. 4, 5, 7

AGNC's challenge to Nintendo's properly responsive reply evidence is unfounded

'122

Apple Inc. v. Universal Secure Registry, LLC,
IPR2018-00813, Paper 46 at 14-15 (PTAB Oct. 8, 2019)

"[Petitioner's expert reply] declaration **responds directly** to [Patent Owner's expert] declaration and, thus, is a **proper reply declaration**."

(emphasis added); Opp'n to PO Mot. to Exclude, pp. 5, 6

“digital” limitations

’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

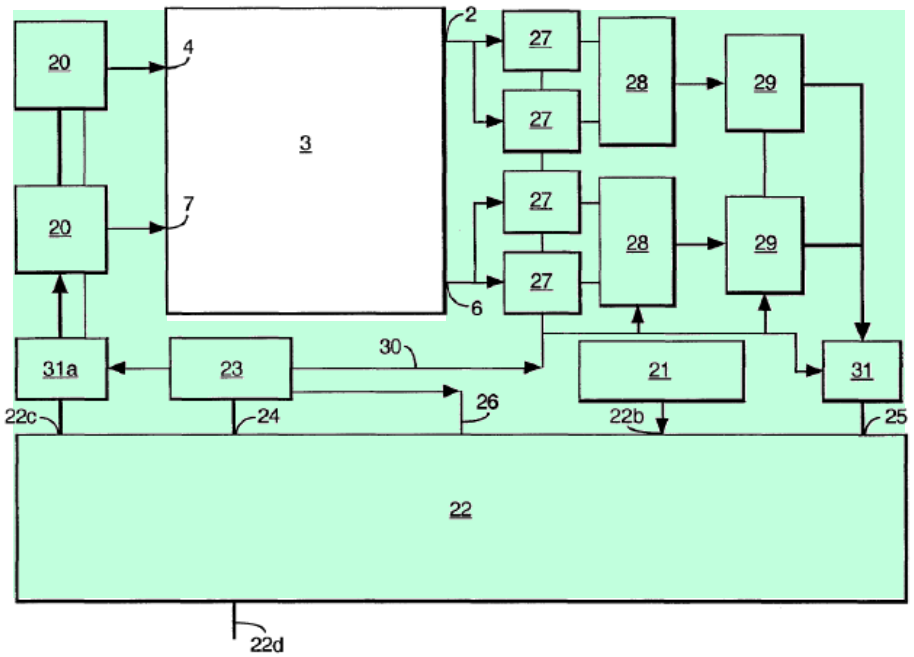
an angular rate sensor unit receiving dither driver signals, capacitive pickoff excitation signals and a displacement restoring signal and outputting angle rate signals in response to motion of said carrier and dither motion signals;

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; and

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.

Townsend

Fig.4.



EX1004 (Townsend), Fig. 4 (highlighting added); EX1002 (Young decl.), ¶¶178-186; Pet. 35-43

Fujiyoshi + Townsend

'122

Fujiyoshi

Further, since the centers of gravity of the two sensors are always fixed as a tuning fork due to their inverted phase vibration, little energy of the vibration leaks outward. As a

Townsend

This invention relates to a digital control system for a vibrating structure gyroscope of the kind having a vibrating structure, primary and secondary drive means for putting and maintaining the vibrating structure in vibratory resonance and primary and secondary pick-off means for detecting vibration of the vibrating structure.

Known vibrating structure gyroscopes have been constructed using a variety of different mechanical vibratory structures. These include beams, tuning forks, cylinders, hemispherical shells and rings. A common feature in all

EX1003 (Fujiyoshi), 24:58-60 (highlighting added); EX1004 (Townsend), p. 1 (highlighting added); EX1002 (Young decl.), ¶183; Pet., pp. 39-40

“digital” limitations

’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

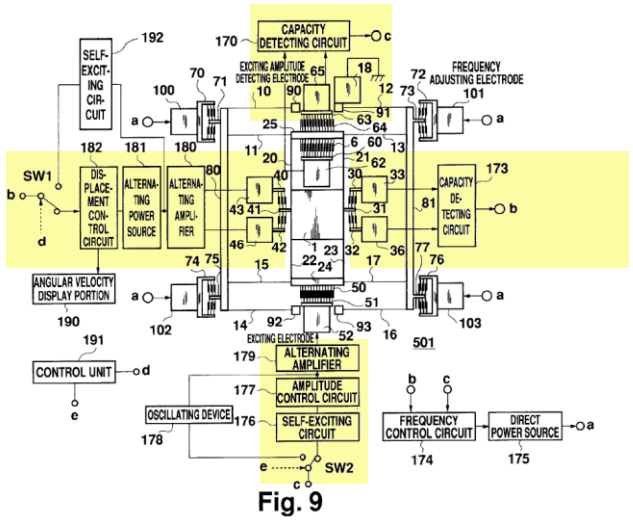
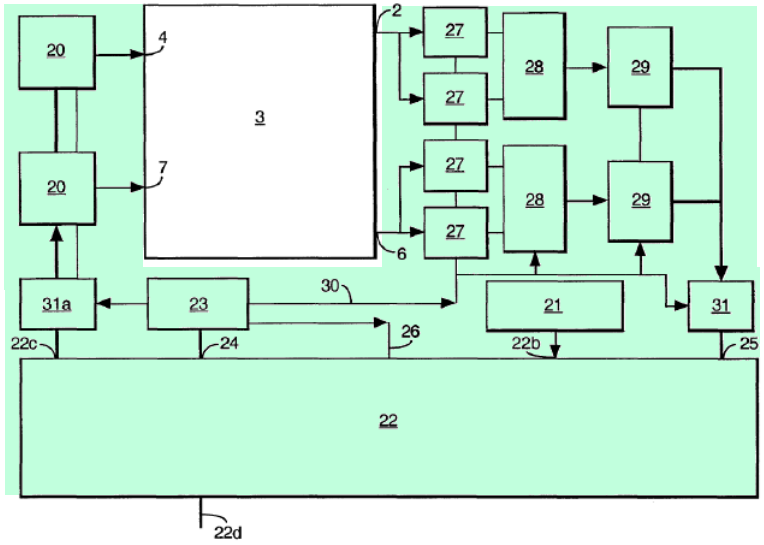


Fig. 9

Fig.4.

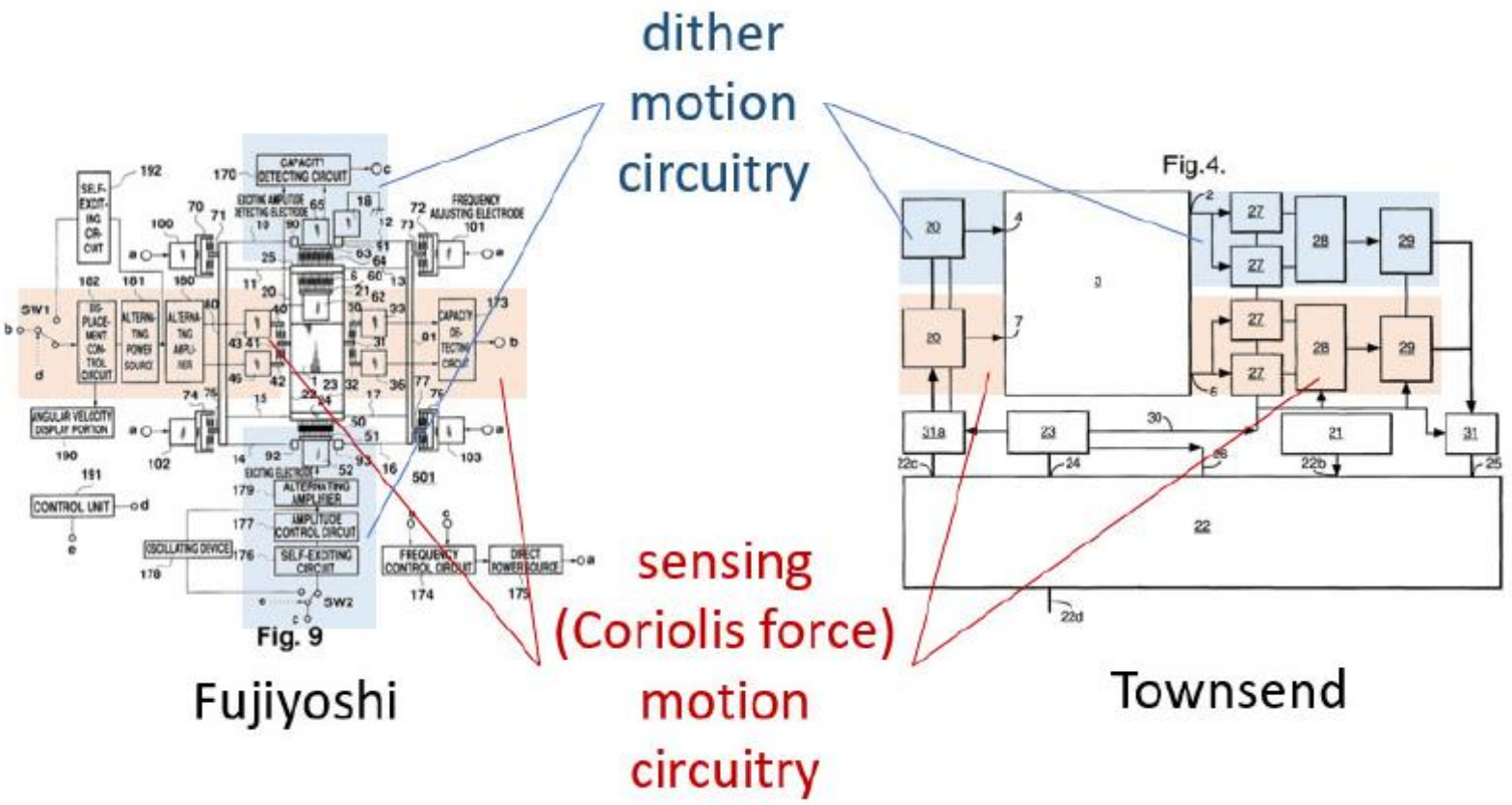


179. It would have been obvious to a POSITA to incorporate a digital signal processing system—e.g., the data processing unit and related circuitry (e.g., analog-to-digital and digital-to-analog converters, sample-and-hold devices) disclosed by Townsend—into Fujiyoshi’s system for controlling the dither motion and sensing (Coriolis force) motion of Fujiyoshi’s mass portion(s) in its second and seventh embodiments. Accordingly, a POSITA would have found it obvious based on

EX1002 (Young decl.), ¶179; EX1003 (Fujiyoshi), Fig. 9 (highlighting added); EX1004, Fig. 4 (highlighting added); Pet., pp. 36-43

Fujiyoshi + Townsend

’122



EX1002 (Young decl.), ¶184; EX1003 (Fujiyoshi), Fig. 9 (annotations added); EX1004 (Townsend), Fig. 4 (annotations added); Pet., pp. 40-41

Fujiyoshi + Townsend

'122

185. 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. 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.

186. 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. A POSITA would have been motivated to incorporate digital-to-analog and analog-to-digital converters into Fujiyoshi'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.) 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." (*Id.* at 18.) A POSITA would have been

EX1002 (Young decl.), ¶¶185-186; Pet., pp. 41-43

Motivations to combine disclosed by Townsend

'122

Traditionally the control loops for these sensors are implemented using precision analogue electronic circuits which are notoriously difficult to specify, design and integrate into small low cost systems (i.e. ASICS). It is also difficult to apply calibrations and compensations to systems based on analogue circuits. In addition, 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.

There is thus a need for a digital electronic based implementation of the loops 1 and 5 in order to facilitate ASIC development, system integration and provide a route to higher performance by enabling more complex and "in loop" compensations to be applied. Unfortunately on a signal at 20kHz a 0.5 degree phase resolution is equivalent to a sampling delay of 70 nanoseconds. This puts very high demands on any conventional precision digitisation and processing system required to resolve to the desired accuracy.

EX1004 (Townsend), pp. 3-4 (highlighting added); EX1002 (Young decl.), ¶¶75, 185; Pet., pp. 39-43

Motivations to combine disclosed by Townsend

'122

Figure 4 of the accompanying drawings shows in more detail an implementation of the block diagram of Figure 3. In Figure 4 the sample/convert or analogue to digital converters 19 are arranged to sample, or integrate the signal over each quarter cycle (80kHz) of the input waveform received from the means 2 or 6. Two sample and hold devices 27 are required for each channel, i.e. each output channel from the means 2 and means 6 making a total of four devices 27. Two devices per channel enables interleaving of the samples to ensure no loss of information. A multiplexer 28

To provide a high degree of noise rejection it is preferable to use sample and hold devices which average or integrate the input waveform over the sample period. The

EX1004 (Townsend), pp. 12, 18 (highlighting added); EX1002 (Young decl.), ¶186; Pet., pp. 39-43

Claim 1[b]: Fujiyoshi + Townsend

’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

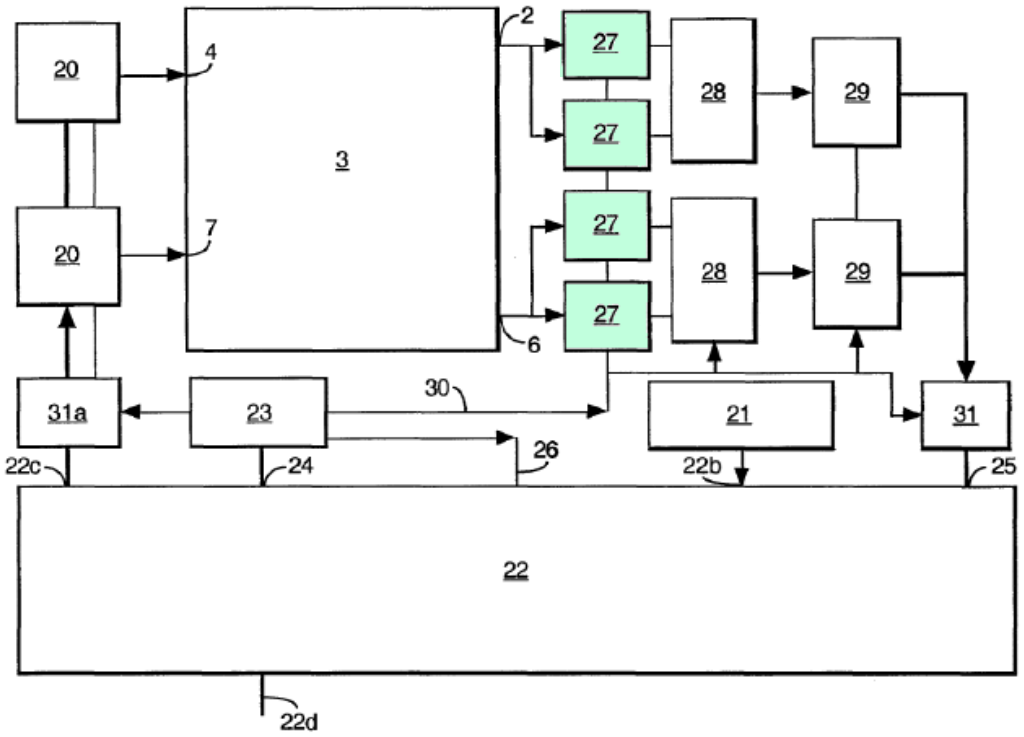
an angular rate sensor unit receiving dither driver signals, capacitive pickoff excitation signals and a displacement restoring signal and outputting angle rate signals in response to motion of said carrier and dither motion signals;

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; and

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.

Townsend

Fig.4.



EX1004 (Townsend), Fig. 4 (highlighting added); EX1002 (Young decl.), ¶¶164-165; Pet., pp. 32-35, 39-43

Claim 1[b]: Fujiyoshi + Townsend

’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

Dr. Young

165. It is my opinion that the sample-and-hold devices in the Fujiyoshi-Townsend combination would have generated **low frequency inertial element displacement signals**. 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.) As I discuss below, the Fujiyoshi-Townsend combination would have involved outputting Fujiyoshi’s dither motion signals into sample-and-hold devices. Based on the disclosures of Townsend, a POSITA would have understood that such sample-and-hold devices would have output a low frequency form of those dither motion signals, because the “averag[ing] or integrat[ing]” operation of the sample-and-hold devices would have led to the removal of high-frequency noise. (*Id.* at 18; *see also id.*, Fig. 4, 12-13.) Understanding dither motion signals from which high-frequency information 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.) Further,

EX1002 (Young decl.), ¶165 (highlighting added); Pet., p. 32

In response to Petitioner's expert evidence, PO's mere attorney argument is insufficient

'122

ParkerVision v. Vidal,
88 F.4th 969, 982 (Fed. Cir. 2023)

"Attorney argument is not evidence."

Reply, pp. 3, 7

Claim 1[b]: Fujiyoshi + Townsend + Cox

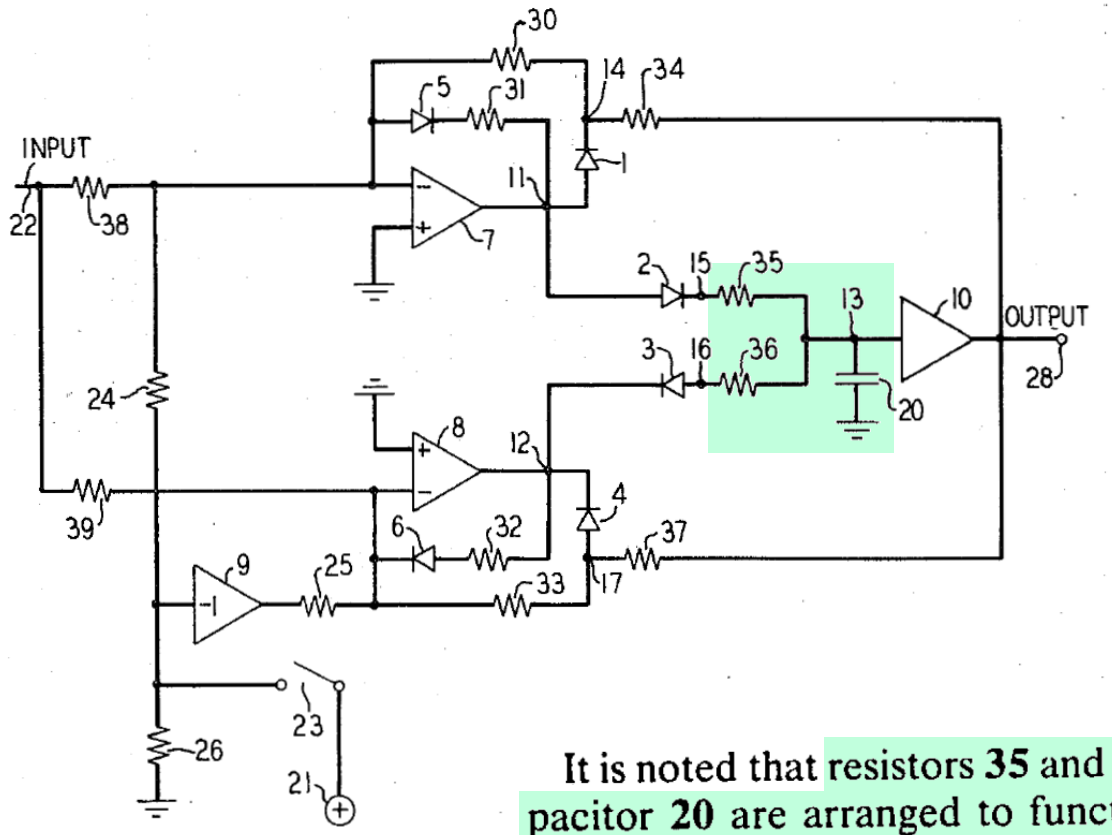
'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.



It is noted that resistors **35** and **36** and the holding capacitor **20** are arranged to function as a low-pass RC filter. These two resistors may be set equal to zero with-

EX1006 (Cox), Fig. 1, 3:50-52 (highlighting added); EX1002 (Young decl.), ¶¶166-175; Pet., pp. 33-35

Fujiyoshi + Townsend + Cox

'122

170. A POSITA would have been motivated to implement the sample-and-hold devices in the Fujiyoshi-Townsend combination to function as low-pass filters according to Cox's disclosures in order to eliminate more noise from the system. 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 functionality to the sample-and-hold devices would have further reduced noise and improved sensor performance.

171. A POSITA would have been further motivated to incorporate Cox's low-pass filter functionality 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 "[a] low-pass filter is also referred to as an anti-aliasing filter" in the context of analog-to-digital conversion, because "LP filtering removes unnecessary higher frequency components and enables us to choose a sampling rate that avoids any 'distortions' in the digitized signal." (Irwin at 139.)

EX1002 (Young decl.), ¶¶170-171 (highlighting added); Pet., pp. 33-35

Dr. Larson testified to importance of filtering in analog to digital conversion

'122

Q So what does this mean by, These circuits are necessary for conditioning an analog input signal for digital manipulation or a digital output signal for analog transmission?

A Well, when you convert an analog signal into digital form, you have to be very careful not to corrupt the signal as part of that process. And there are a variety of ways that it could be corrupted.

The most common, I think, is something called aliasing where higher frequency signals get -- can kind of corrupt low frequency signals. And so before the signals themselves get converted into digital form, these high frequency signals have to be removed. And those are done with the analog circuits.

EX1046 (Larson depo. tr.), 44:21-45:9 (highlighting added); Reply, pp. 7-8

Claim 1[c]: "analyzing said digital low frequency inertial element displacement signals"

'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

185. 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. 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.

EX1002 (Young decl.), ¶185 (highlighting added); Pet., pp. 39-43

Claim 1[c]: "analyzing said digital low frequency inertial element displacement signals"

'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

direction. The vibration is detected by a capacity detecting circuit **170** through the exciting amplitude detecting electrodes **60** and **63** and the detected output from the capacity detecting circuit **170** is supplied to the self-exciting circuit **176**, which generates a self-exciting signal on the basis of the above detected output and further the amplitude control circuit **177** controls in such a manner as to make the amplitude of the vibration constant on the basis of the excitation control signal. Then, in accordance with the above

EX1003 (Fujiyoshi), 19:67-20:8 (highlighting added);
EX1002 (Young decl.), ¶123; Pet., pp. 13-14

Claim 1[c]: "analyzing said digital low frequency inertial element displacement signals"

'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

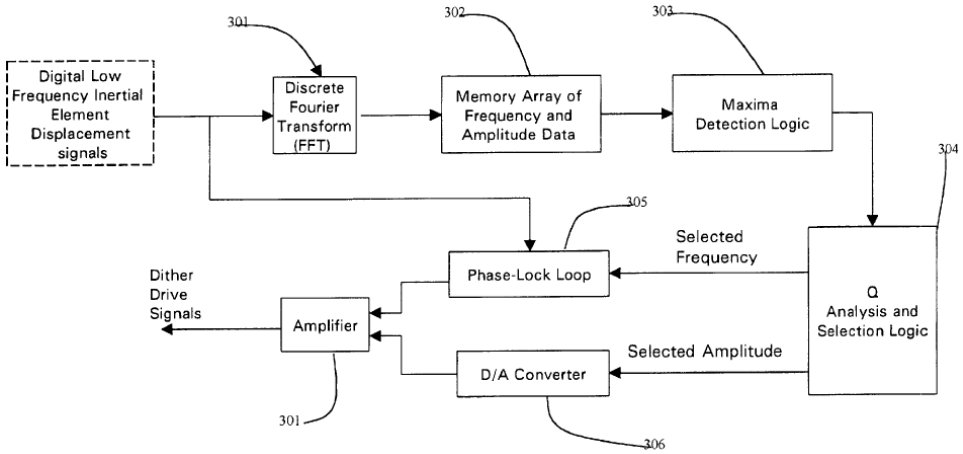


Figure 7

Patent Owner's Expert Dr. Larson

Claim 1 does not require a particular analysis from these disclosed options, but does require converting signals to digital, analyzing them, and "feeding back" dither drive signals to the angular rate sensor. *Id.*, 9:51-54. I understand that the inventors of

EX2019 (Larson decl.), ¶47 (highlighting added); EX1001 ('122 patent), Fig. 7; Reply, p. 12

Claim 1[c]: "analyzing said digital low frequency inertial element displacement signals"

'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

Patent Owner's Expert Dr. Larson

In the context of these, you know, inertial systems that we're talking about here, the control system requirements are very sophisticated. You have to have a correct frequency. You have to correct for various errors. And these, these errors and the frequency changes evolve over time. They evolve with temperature. And so a sophisticated digital control algorithm is a very useful thing to be able to effectively control these systems. So the two examples that I gave are, you know, communication system and then these inertial systems.

EX1046 (Larson depo. tr.), 39:15-25 (highlighting added); Reply, p. 6

Claim 1[c]

’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

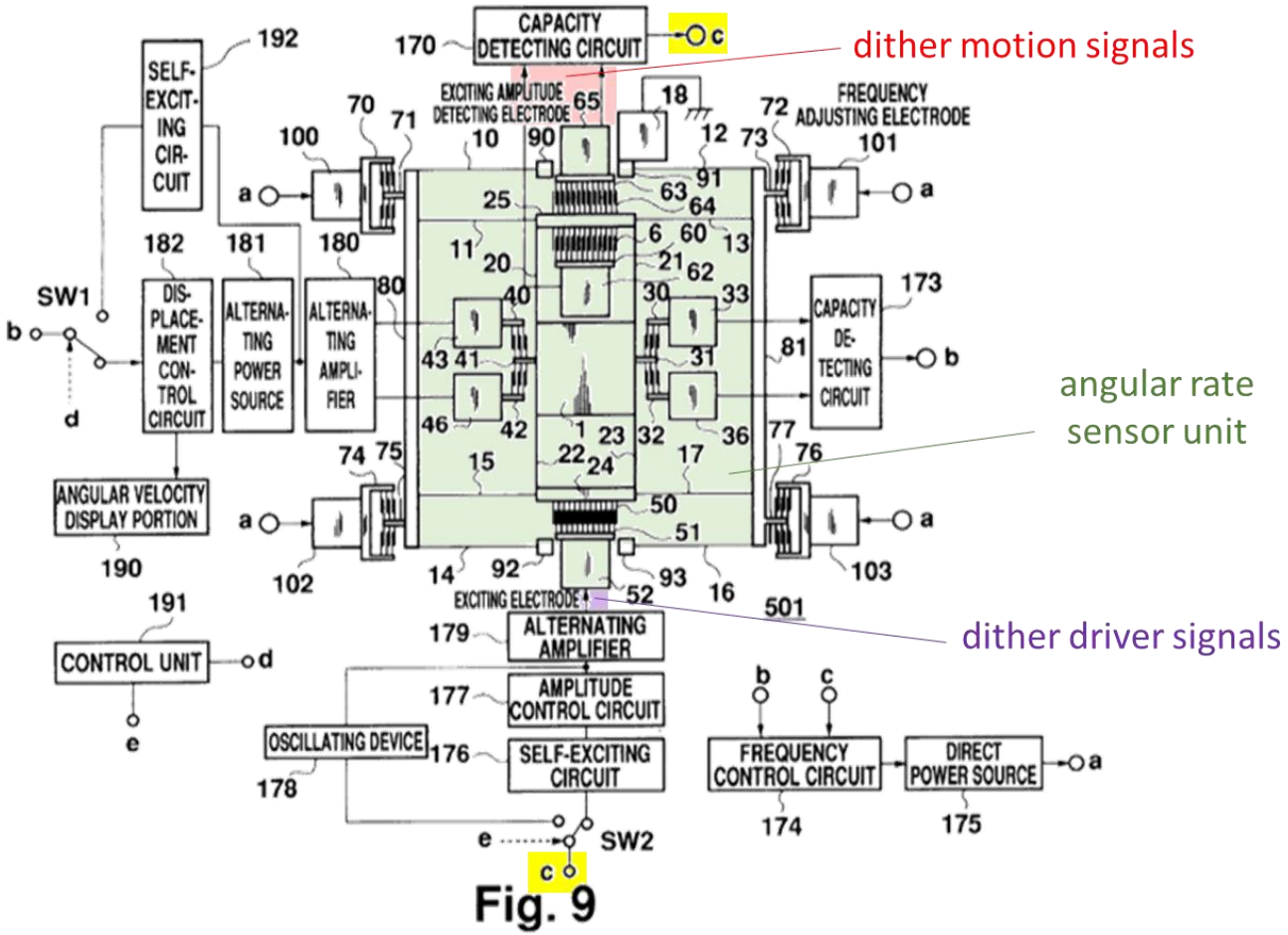


Fig. 9

EX1003 (Fujiyoshi), Fig. 9 (annotations added); Pet., 35-39; EX1002 (Young decl.), ¶¶176-181.

Claim 3

’122

3. The microelectromechanical system, as recited in claim 1, wherein said central circuitry comprises a dither motion control circuitry and an angle rate signal loop circuitry.

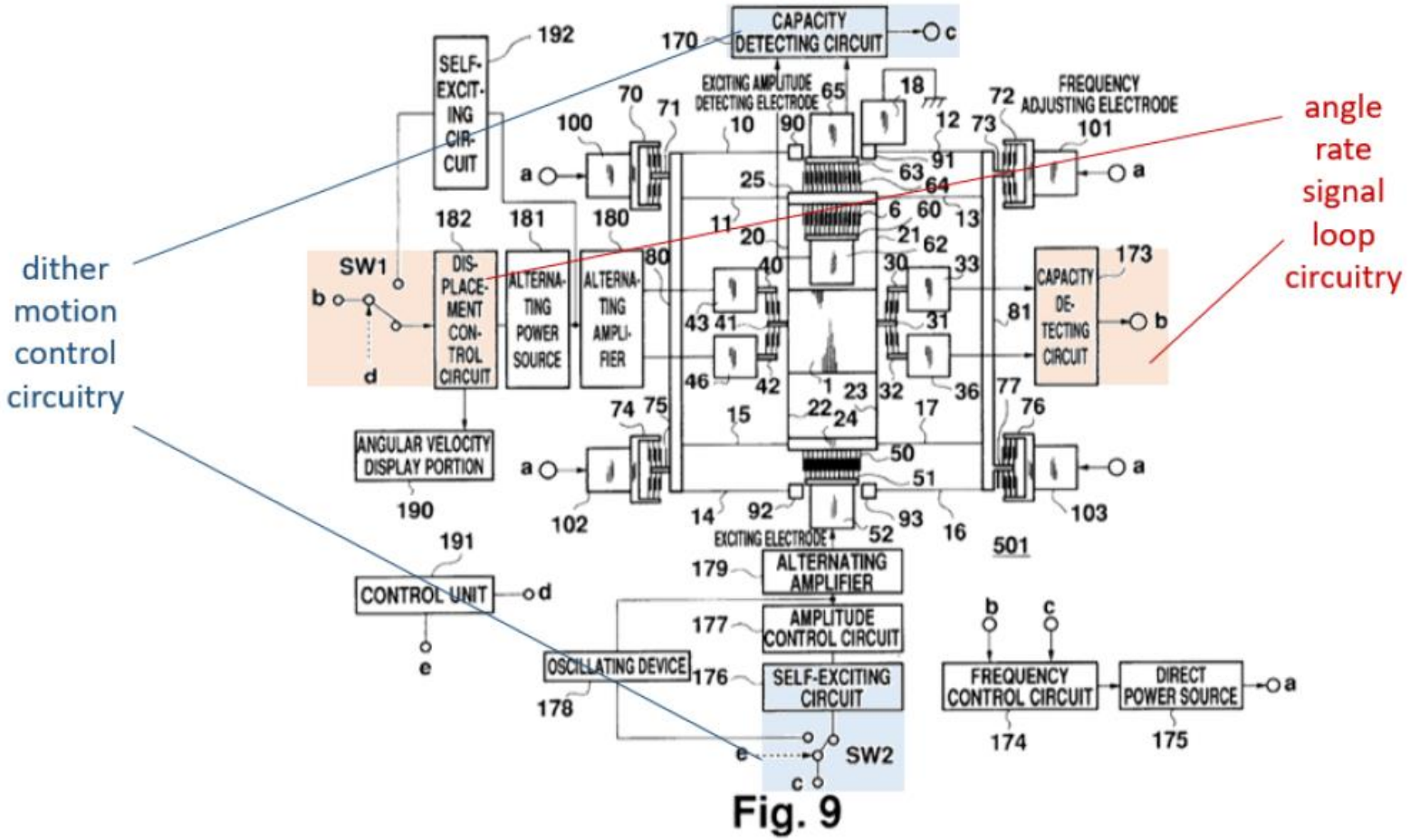


Fig. 9

EX1003 (Fujiyoshi), Fig. 9; Pet., 43-44; EX1002 (Young decl.), ¶¶188-191.

Ground 2

Mitamura/Townsend

’122 patent and Mitamura

’122

Dither motion

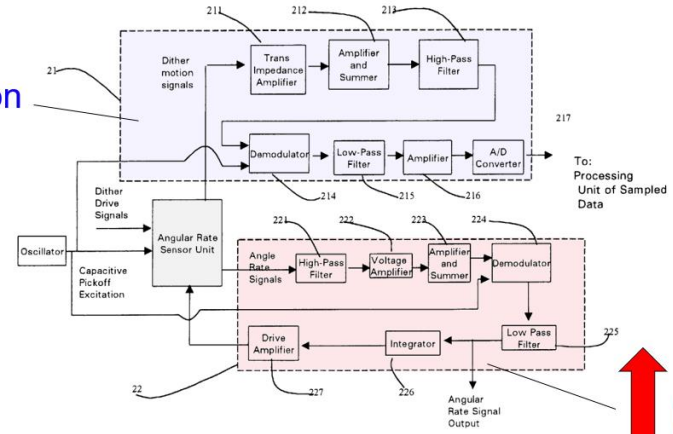
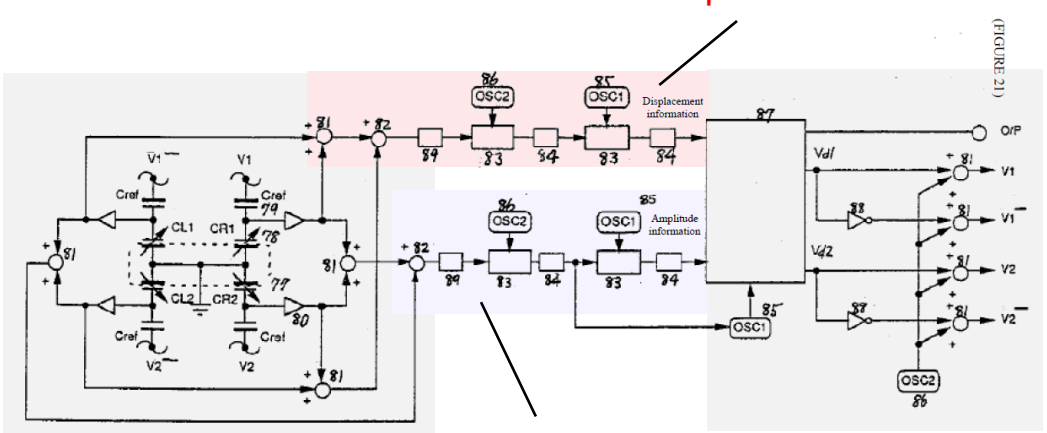


Figure 6

Inertial displacement

EX1001 (’122 patent), Fig. 6 (annotations added); EX1002 (Young decl.), ¶156; Pet., p. 29

Inertial displacement



Dither motion

EX1009 (Mitamura), Fig. 21 (annotations added); EX1002 (Young decl.), ¶243; Pet., pp. 74-75

Claim 1[p]

’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

electrostatic capacitances with the vibrating mass. The vibrating mass and opposing electrodes shown in the diagrams can be fabricated using a known technique and monocrystalline or polycrystalline silicon. The thickness of the vibrating mass and opposing electrodes is typically in the range of a few micrometers.

EX1009 (Mitamura), [0042] (highlighting added); Pet., pp. 44-47; EX1002 (Young decl.), ¶¶192-199

Claim 1[p]

'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

[0042] The third embodiment is first described with respect to the state of the comb electrode pairs making up the vibrating mass-side electrodes and fixed-side electrodes, with reference to Figures 17 and 18. These figures show plan schematic diagrams of the vibrating mass and opposing (fixed) electrodes of the angular velocity sensor formed from a thin-film structural material. In the figures, 66 is the vibrating mass which is

circuit 87 as amplitude information of the vibrating mass. Output proportional to the angular velocity is output by the control circuit 87, and a voltage signal synced to the oscillator 85 is also output. Part of the

EX1009 (Mitamura), [0042], [0045] (highlighting added); Pet., pp. 44-47; EX1002 (Young decl.), ¶¶192-199

Claim 1[p]

'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.

film structural material. The four corners of the vibrating mass 72 are connected to supports 73 formed from the same thin film structural material and having the same spring constants in the x- and y-axis directions (the supports are shown schematically). The supports are arranged symmetrically to the x- and y-axes. The other ends of the supports are secured to the substrate by securing sections 74 and are also electrically connected to a conductive material (the wiring is not shown in the drawings for the sake of simplicity).

EX1009 (Mitamura), [0043] (highlighting added); Pet., pp. 44-47; EX1002 (Young decl.), ¶¶192-199

Claim 1[a]

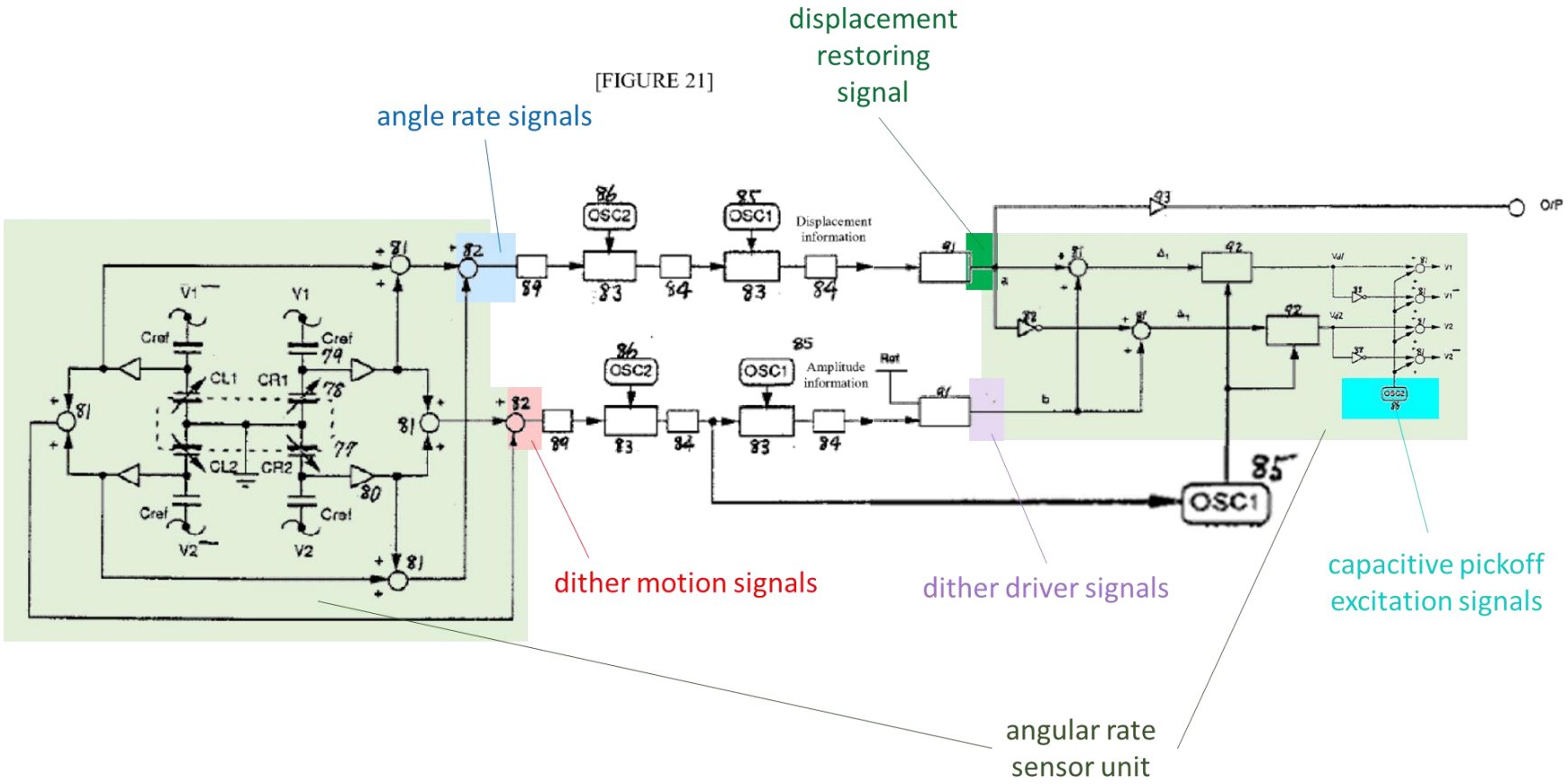
'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.



EX1009 (Mitamura), Figs. 21, 26 (annotations added); Pet., pp. 47-57; EX1002 (Young decl.), ¶¶200-216

Claim 1[b]

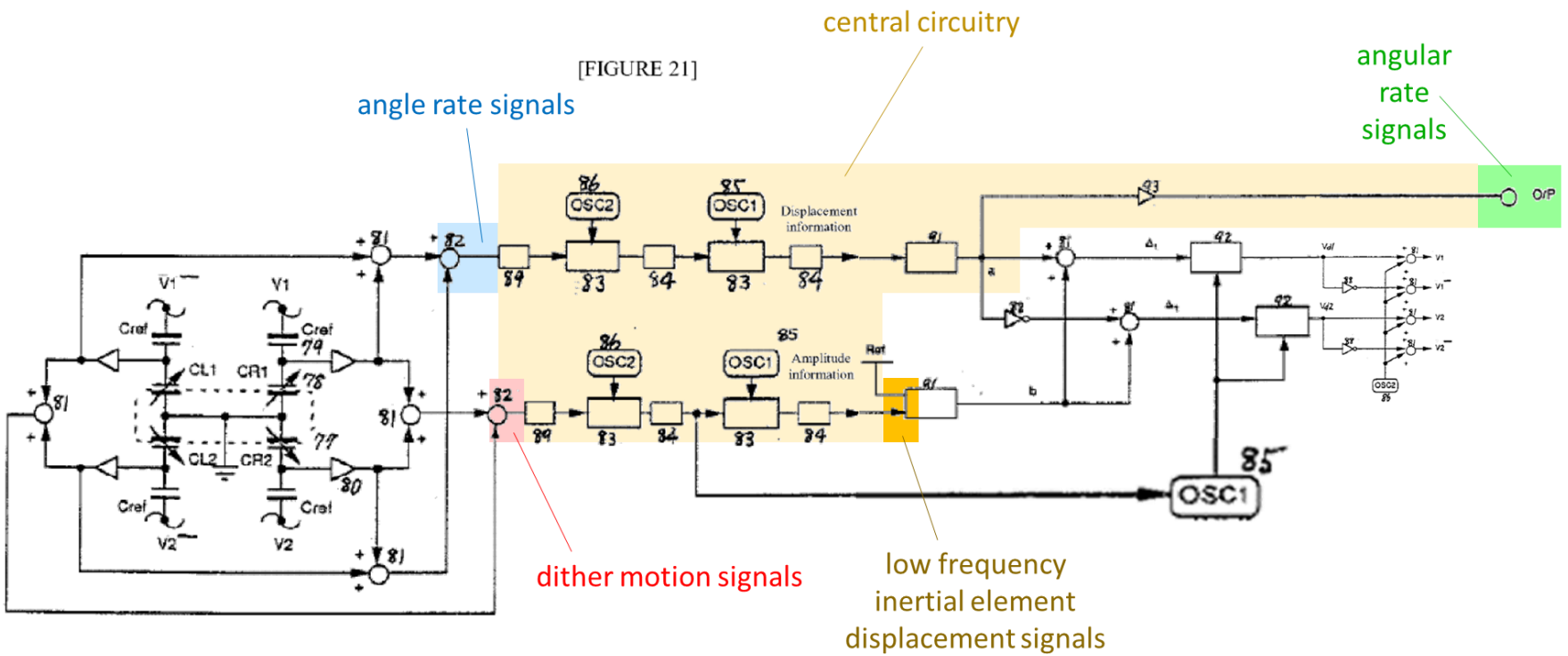
'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.



EX1009 (Mitamura), Figs. 21, 26 (annotations added); Pet., pp. 59-70; EX1002 (Young decl.), ¶¶221-232

Claim 1[b]

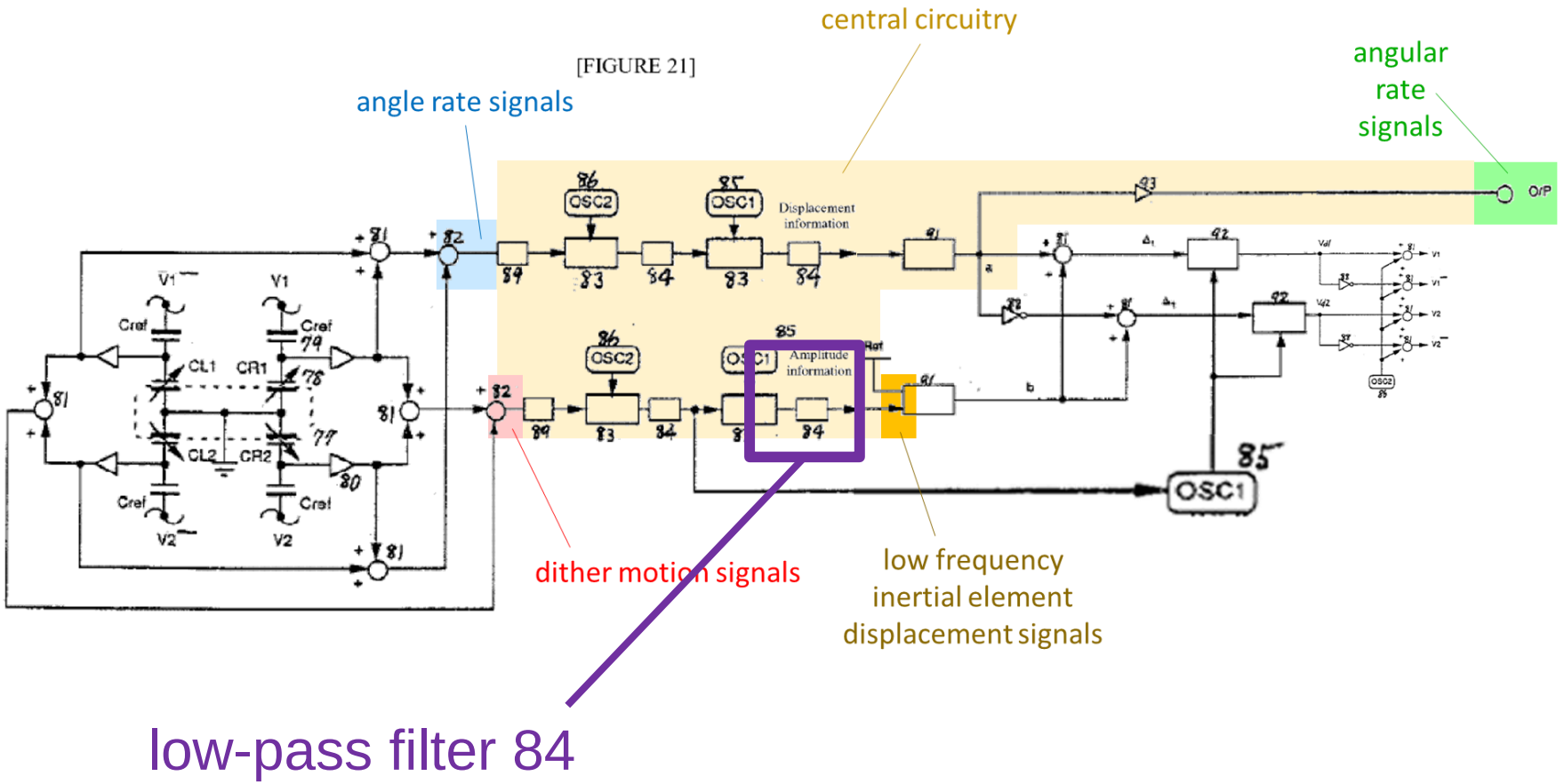
'122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.



EX1009 (Mitamura), Figs. 21, 26 (annotations added); Pet., pp. 59-70; EX1002 (Young decl.), ¶¶221-232

Claim 1[c]

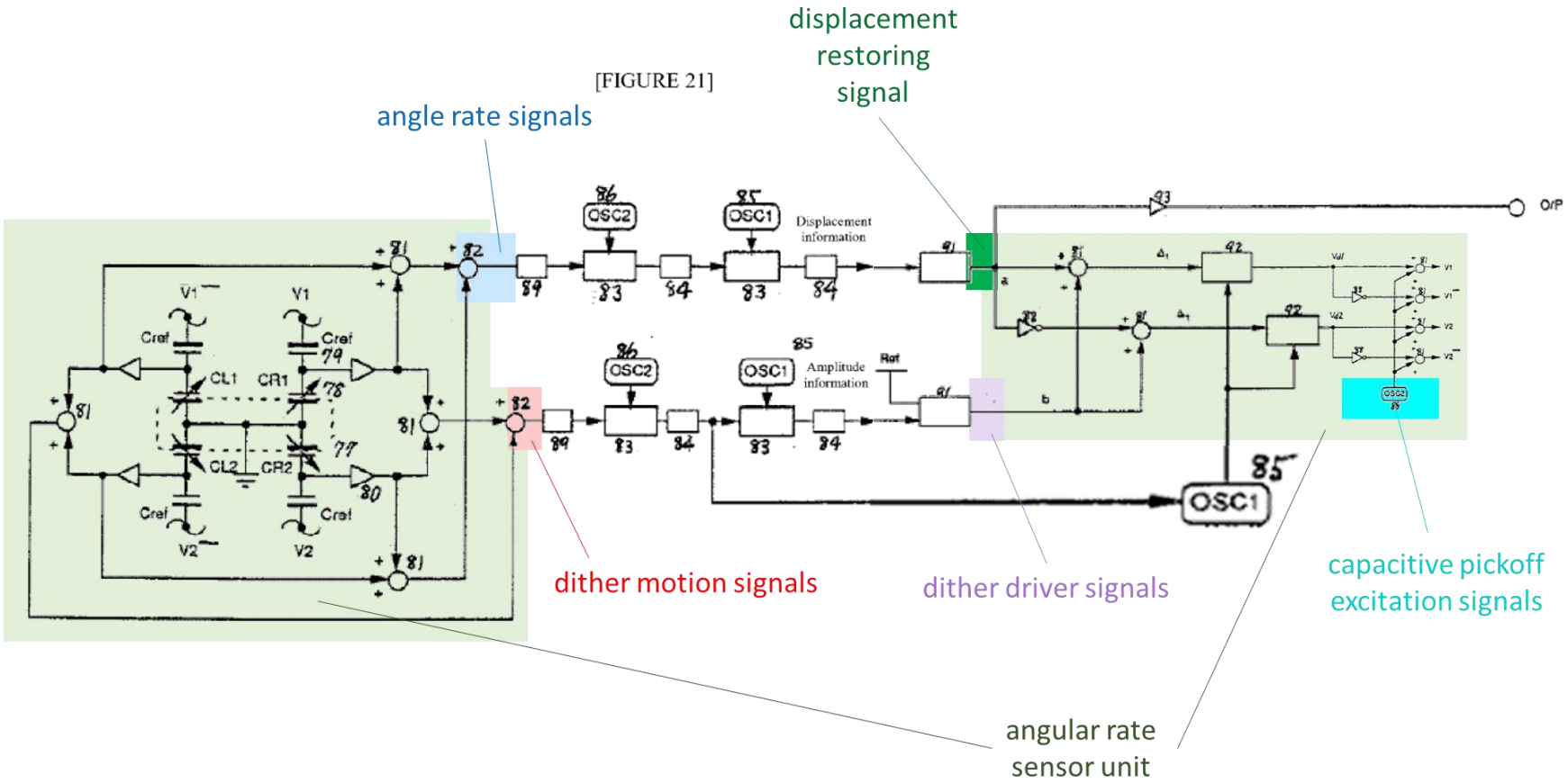
’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

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;

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; and

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.



EX1009 (Mitamura), Figs. 21, 26 (annotations added); Pet., pp. 47-57; EX1002 (Young decl.), ¶¶200-216, 235

“digital” limitations

’122

1. A microelectromechanical system (MEMS) for measuring angular rate of a carrier, comprising:

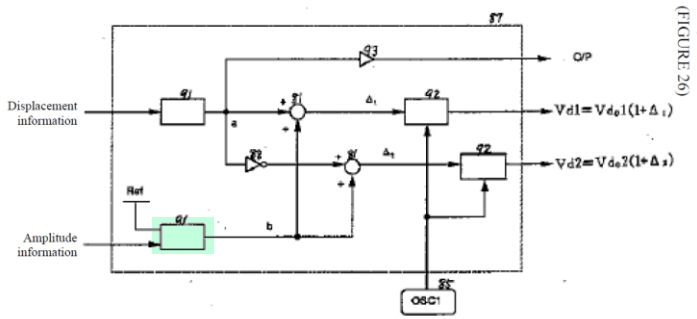
an angular rate sensor unit receiving dither driver signals, capacitive pickoff excitation signals and a displacement restoring signal and outputting angle rate signals in response to motion of said carrier and dither motion signals;

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; and

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.

Mitamura

[FIGURE 26]



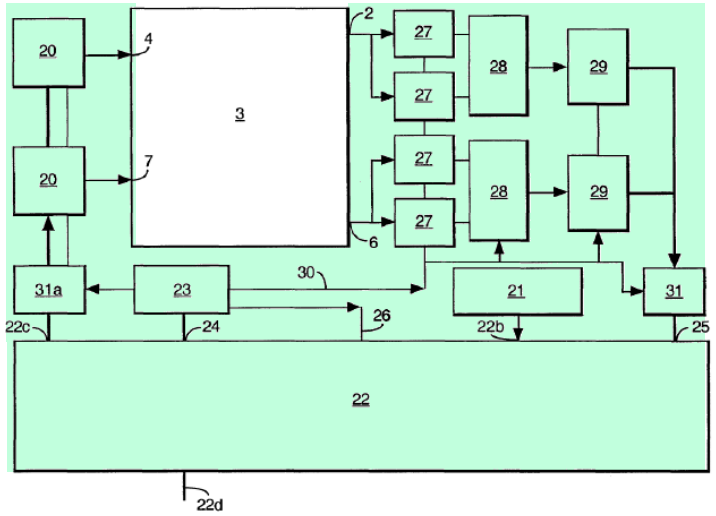
(FIGURE 26)

81…adder addition 85…oscillator OSC1, 87…control circuit, 88…inverter, 91…arithmetic unit 92…amplitude modulator 93…amplifier

or

Townsend

Fig.4.



EX1009 (Mitamura), Fig. 26 (highlighting added); EX1004 (Townsend), Fig. 4 (highlighting added); EX1002 (Young decl.), ¶¶235-247; Pet., pp. 70-78

Mitamura

'122

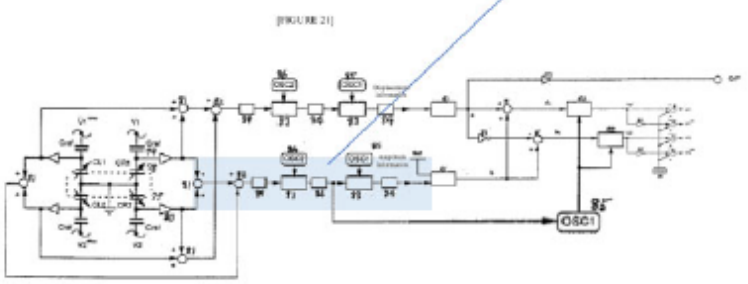
inertial element displacement signals. Mitamura discloses that in arithmetic unit 91, "the amplitude information [is] calculated as modulation amounts of the drive voltage, . . . based on a deviation from a set reference level for the amplitude information." (Mitamura, [0046].) It would have been obvious to a POSITA that a module that performs "calculat[ion]" and has a "set reference level" would be implemented as a digital unit like a processor. (*Id.*) 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. A POSITA would have further understood that more complex calculations could be feasibly implemented via a digital system than an analog one. 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. Mitamura's reference to a "set reference level" would have particularly motivated a POSITA to implement arithmetic unit 91 as a digital system—which would allow for a simple interface for performing reference level setting—rather than an analog system—which would require more sophisticated engineering to adjust a reference level setting. Accordingly, it is my opinion that it would have been obvious to a POSITA 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." (*Id.*, [0046].) A POSITA would have understood such calculations to involve **analyzing said digital low frequency inertial element displacement signals**.

EX1002 (Young decl.), ¶¶237-238 (highlighting added); Pet., pp. 68-70

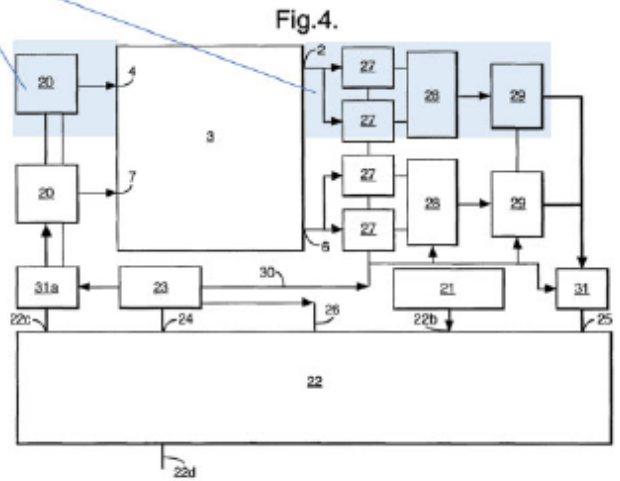
Mitamura + Townsend

’122

dither
motion
circuitry



Mitamura



Townsend

EX1002 (Young decl.), ¶243; Pet., p. 75; EX1009 (Mitamura), Figs. 21, 26; EX1004 (Townsend), Fig. 4 (highlighting added)

Mitamura + Townsend

'122

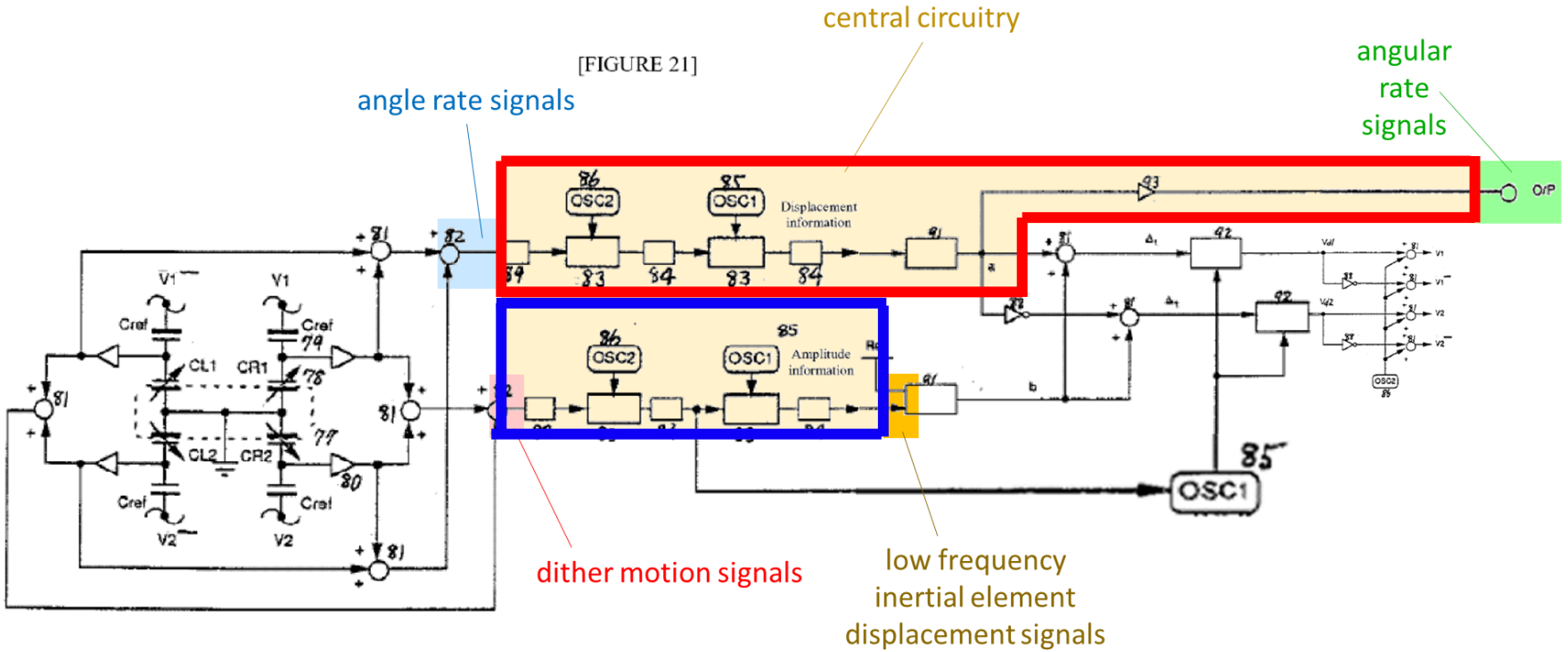
244. A POSITA would have been motivated to combine Townsend with Mitamura because Townsend describes digital implementations of vibrating structure gyroscope circuitry that improve upon prior art analog approaches. Townsend discloses that analog circuitry has drawbacks when used for the control loops 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.

245. 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. 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.) 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." (*Id.* at 18.) 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.

EX1002 (Young decl.), ¶¶244-245 (highlighting added); Pet., pp. 76-77

Claim 3

3. The microelectromechanical system, as recited in claim 1, wherein said central circuitry comprises a dither motion control circuitry and an angle rate signal loop circuitry.



EX1009 (Mitamura), Figs. 21, 26; Pet., pp. 78-80; EX1002 (Young decl.), ¶¶248-250

Secondary Considerations

Secondary considerations requires nexus

Fox Factory, Inc. v. SRAM, LLC,
944 F.3d 1366, 1374 (Fed. Cir. 2019)

PO must show "the evidence of secondary considerations is the 'direct result of the unique characteristics of the claimed invention.'"

(citation omitted); Reply, p. 15

Deficiencies with AGNC's alleged secondary considerations

- No evidence of commercial success
- No nexus
  - No evidence "coremicro" product embodies any claim
  - No evidence that alleged commercial success attributable to claimed features

Reply, pp. 15-17

Mr. McCall testified that up to 20 patents might relate to the "coremicro" IMU product

Q. Are those the only patents that relate to American GNC's coremicro IMU product?

A. There are several patents. Whether or not they're the only ones, I just don't remember. I haven't reviewed a lot of the other patents.

Q. What other patents are you referring to?

A. Well, there's a total of 20 patents that I did at AGNC, and so if you take these two out, that would leave 18. I haven't reviewed all of those, and I don't -- I don't remember whether this was referred to in those patents or not.

EX1048 (McCall depo. tr.), 16:15-25 (highlighting added)

Mr. McCall did not apply the POSITA standard in his declaration—instead referencing an “ordinary engineer”

Q. Okay. Understood. So in your declaration, you have used the term "ordinary engineer," so when you use that term in your declaration, what do you mean by "an ordinary engineer in the field at the time"?

A. I would say it would be a person who has engineering background and engineering experience but likely not to be worked in a very specific area and likely not to be many, many years in a very specific area.

EX1048 (McCall depo. tr.), 15:7-15 (highlighting added); Reply, p. 16

Dr. Larson never designed a MEMS inertial sensor

Q Do you have experience with MEMS designed for inertial navigation?

A Yeah, I've never designed a MEMS device for inertial navigation applications.

EX1046 (Larson depo. tr.), 24:15-18; Reply, p. 17

Dr. Larson's experience is in the unrelated field of RF MEMS

Q What commercial products on the market using MEMS technology from that time are you aware of?

A So in my own field of RF MEMS, there were quite a few little start-ups that were very active during this time frame. And, you know, one in particular that I know

Q And so am I correct that RF MEMS devices are not designed to perform inertial navigation; is that correct?

A Yeah, RF MEMS devices do not perform -- that's not their function to perform inertial navigation. They perform other functions.

EX1046 (Larson depo. tr.), 26:1-5, 24:10-14; Reply, p. 17 n.2

’648 patent

‘648 patent

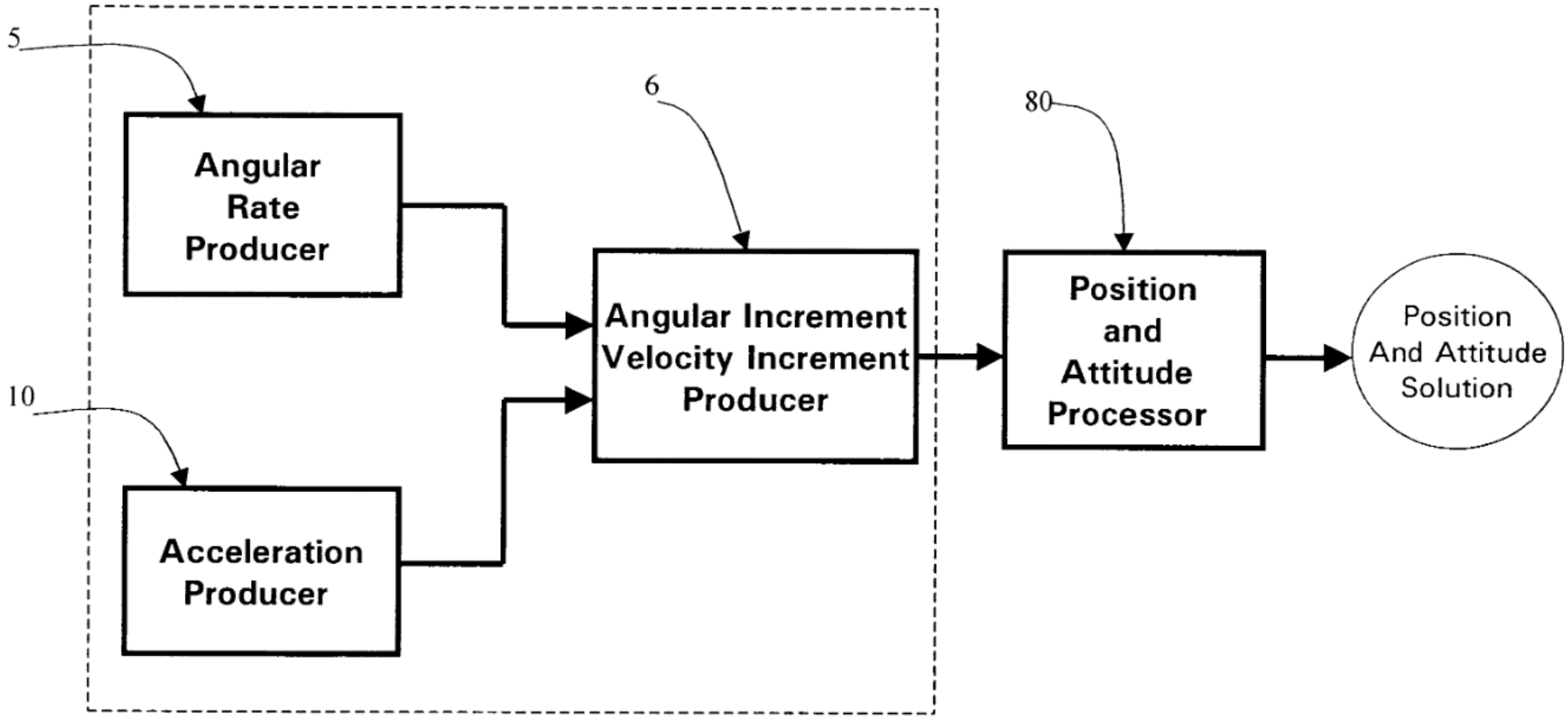


Figure 1

EX1001 (’648 patent), Fig. 1

Claims at issue

’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

4. A micro inertial measurement unit, as recited in claim **1**, wherein said X axis, Y axis and Z axis angular rate electrical signals produced from said angular producer are analog angular rate voltage signals directly proportional to angular rates of a carrier carrying said micro inertial measurement unit, and said X axis, Y axis and Z axis acceleration electrical signals produced from said acceleration producer are analog acceleration voltage signals directly proportional to accelerations of said vehicle.

EX1001 (’648 patent), cls. 1, 4

Disputed issues

'648

- Is the Preamble limiting?
  - If so, would it have been obvious to use MEMS accelerometers and gyroscopes in an IMU?
- Should "angular rate electrical signals" and "angular rate voltage signals" be construed?
  - If so, do the references render obvious these limitations under Patent Owner's new proposed construction?

Overview of grounds

'648

- Ground 1: Smith/Chan/Bernstein (Claim 1)
- Ground 2: Smith/Chan/Bernstein/Irwin/Merhav (Claim 4)
- Ground 3: Tingleff/Chan/Bernstein (Claims 1 and 4)
- Ground 4: Yamawaki/Chan/Bernstein/Saubolle (Claims 1 and 4)

Claim Construction

Preamble of Claim 1 is not limiting

'648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

- Structurally complete invention
  - Elements do not refer back to the "micro inertial measurement unit"
- Preamble only states a purpose or intended use for the invention

Pet., pp. 9-11; Reply, pp. 1-2

"angular rate electrical signals" and "angular rate voltage signals"

'648

- AGNC's changing positions:
  - *District Court*: No construction needed
  - *POR*:
    - "directly measure and reflect angular rate" – POR, p. 24
  - *Sur-reply*:
    - "reflect angular rate" – Sur-reply, p. 7
    - "reflect a measure of angular rate" – Sur-reply, p. 7
    - "directly reflect angular rate" – Sur-reply, p. 19

"angular rate electrical signals" and "angular rate voltage signals"

'648

- Compare:
  - 1. A micro inertial measurement unit, comprising:
    - an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal,
- With
  - 4. A micro inertial measurement unit, as recited in claim 1, wherein said X axis, Y axis and Z axis angular rate electrical signals produced from said angular producer are analog angular rate voltage signals directly proportional to angular rates of a carrier carrying said micro inertial measurement unit . . .

"angular rate electrical signals" and "angular rate voltage signals"

'648

Existing MEMS technologies, which are employed into the micro size angular rate producer, use vibrating inertial elements (a micromachine) to sense vehicle angular rate via the Coriolis Effect. The angular rate sensing principle of Coriolis Effect is the inspiration behind the practical vibrating angular rate sensors.

The Coriolis Effect can be explained by saying that when an angular rate is applied to a translating or vibrating inertial element, a Coriolis force is generated. When this angular rate is applied to the axis of an oscillating inertial element, its tines receive a Coriolis force, which then produces torsional forces about the sensor axis. These forces are proportional to the applied angular rate, which then can be measured.

EX1001 ('648 patent), 16:46-59 (highlighting added)

Ground 1

Smith/Chan/Bernstein

Claim 1[p]

’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

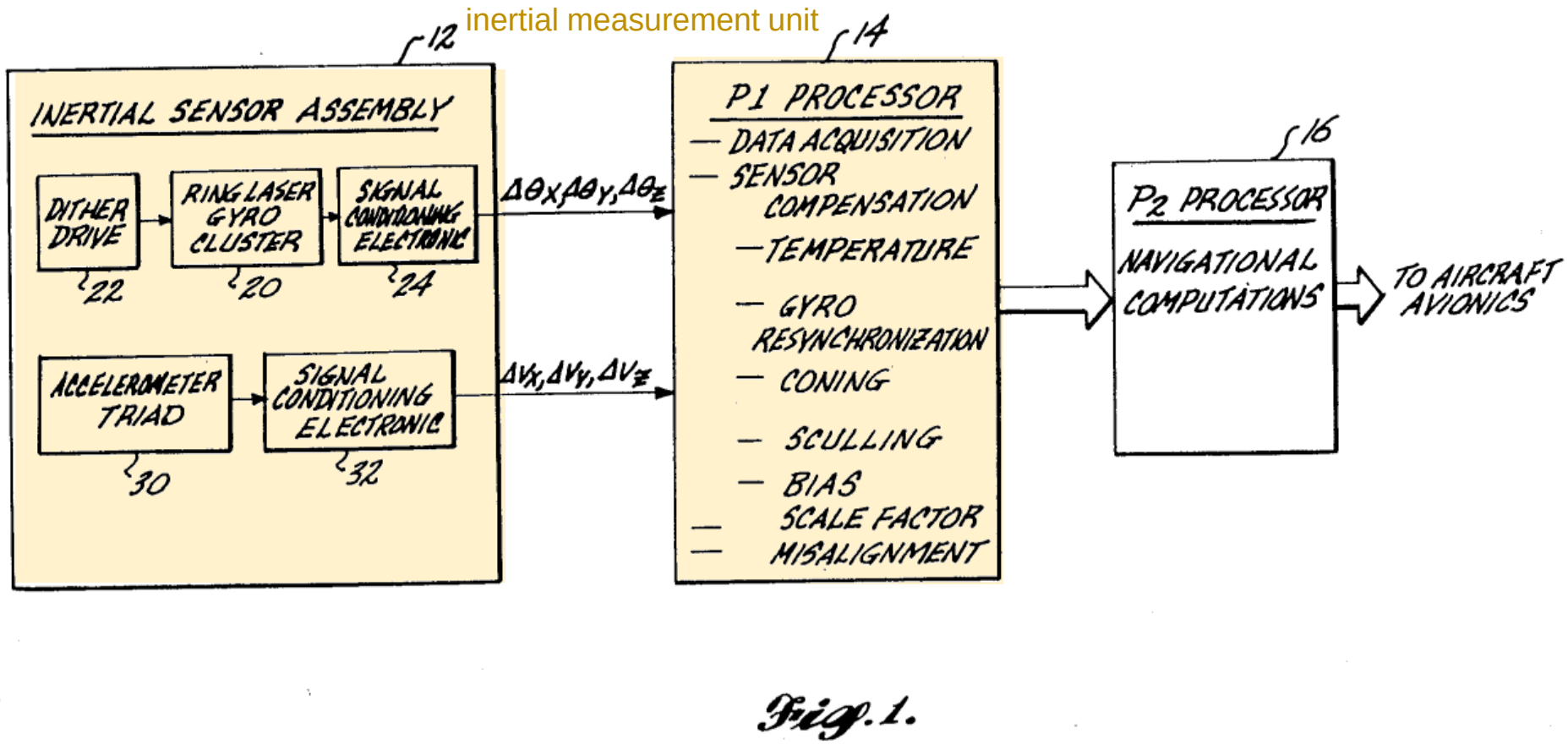


Fig. 1.

EX1003 (Smith), Fig. 1 (annotations added); Pet., pp. 11-13; EX1002 (Young decl.), ¶¶89-92

Claim 1[p]

’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

- Obvious to use MEMs devices in an inertial measurement unit (IMU)
  - MEMS accelerometers widely known and used
  - MEMS gyroscopes widely known and used
  - Incorporation of MEMS devices into IMUs would have been known by a POSITA

Pet., pp. 13-18; Reply, pp. 1-2

Claim 1[p]

’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

Prolific MEMS angular rate sensor approaches have been developed to meet the need for inexpensive yet reliable angular rate sensors in fields ranging from automotive to consumer electronics. Single input axis MEMS angular rate sensors are based on either translational resonance, such as tuning forks, or structural mode resonance, such as vibrating rings. Moreover, dual input axis MEMS angular rate sensors may be based on angular resonance of a rotating rigid rotor suspended by torsional springs. Current MEMS angular rate sensors are primarily based on an electronically-driven tuning fork method.

More accurate MEMS accelerometers are the force rebalance type that use closed-loop capacitive sensing and electrostatic forcing. Draper’s micromechnical accelerometer is a typical example, where the accelerometer is a monolithic silicon structure consisting of a torsional pendulum with capacitive readout and electrostatic torquer. Analog Device’s MEMS accelerometer has an integrated polysilicon capacitive structure fabricated with on-chip BiMOS process to include a precision voltage reference, local oscillators, amplifiers, demodulators, force rebalance loop and self-test functions.

Although the MEMS angular rate sensors and MEMS accelerometers are available commercially and have achieved micro chip-size and low power consumption, however, there is not yet available high performance, small size, and low power consumption IMUs.

EX1001 (‘648 patent), 2:25-51 (highlighting added); Pet., p. 13; EX1002 (Young decl.), ¶94

Claim 1[p]

’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

Over the years, various microelectromechanical systems ("MEMS") have arisen which require the necessity to sense temperature, pressure, strain, acceleration, rotation, infrared radiation, chemical properties of liquids and gases, and other physical inputs. Accordingly, various types of microsensors have been developed which receive analog and digital electrical inputs and also sense or measure these other physical inputs, e.g., acceleration, pressure, temperature, strain.

EX1005 (Chan) (emphasis added), 1:12-21; Pet., pp. 13-15; EX1002 (Young decl.), ¶¶93-97

Claim 1[p]

’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

Micromechanical gyroscopes which are micromachined from a single silicon substrate are now well known in the art. Such devices typically have a gimbaled structure which includes an inner gimbal ring having a set of flexures coupled to a mass. The inner gimbal ring serves as the sense axis. The inner gimbal

This invention features a micromechanical gyroscope including a mass symmetrically supported about both drive and sense axes, for detecting rotational movement about an input axis. The gyroscope includes an inertial

EX1006 (Bernstein), 1:11-16; 1:48-51 (emphasis added); Pet., pp. 14-15; EX1002 (Young decl.), ¶¶95-97

Obvious to combine MEMS sensor references

’648

Allied Erecting & Dismantling v. Genesis Attachments,
825 F.3d 1373, 1381 (Fed. Cir. 2016)

“The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference[.]”

(citation omitted); Reply, p. 15

Person of ordinary skill

’648

Petitioner

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.)

Pet., p. 5; EX1002 (Young decl.), ¶¶12-15

Patent Owner

A person of ordinary skill in the art with respect to the ’122 Patent would have at least a “Master’s Degree in Electrical or Electronics Engineering, and approximately five years of relevant experience in the development of control systems for inertial navigation, MEMS semiconductor processing, and analog circuit design.” EX2008, ¶57.

POR, p. 18; EX2008 (Larson decl.), ¶57

Motivations to combine

'648

- MEMS sensors serve the same purpose and provide the same information:
  - "[M]icromechanical accelerometers and gyroscopes are, after all, accelerometers and gyroscopes that serve the same purposes and provide the same types of velocity and angular position information as their non-micromechanical counterparts." (Inst. Dec., p.33 (quoting EX1002, ¶99).)

PO's expert acknowledged the similarities

'648

Q What were the types of control systems for inertial navigation?

A Well, I'm not sure what you mean by the types. I mean, the types of control systems were -- were and are, I think still, intermittently related to the mechanism that you're using for -- the physical mechanism that you're using for inertial control. You know, there are ring laser gyros, and there are tuning fork gyros. And there are these MEMS as well.

EX1046 (Larson depo. tr.), 20:23-21:15 (highlighting added)

PO's expert acknowledged the similarities

'648

And so each of them has their own kind of unique control system, you know, and, you know, various second order effects that they're trying to compensate for that would reduce the accuracy. But generally, you know, they all have some mechanism for, you know, sensing rotation and then -- creating rotation and then sensing that rotation and then taking that sense data and using it to make some kind of inference about acceleration, velocity and position.

EX1046 (Larson depo. tr.), 20:23-21:15 (highlighting added)

Motivations to combine

’648

- Known benefits of using MEMs include:
  - Size
  - Weight
  - Cost
- Used in the same field, including the same fields as the ’648 patent

> Another objective of the present invention is for the micro IMU to function as aircraft inertial avionics, which has the following unique features:

EX1001 (’648 patent), 3:42-44; Pet., pp. 15-18; EX1002 (Young decl.), ¶¶98-105

Smith + Chan + Bernstein

'648

Smith

The present invention, therefore, is directed to an improved inertial reference system. This improved inertial reference system may be constructed in a small enclosure and is designed to minimize the use of expensive components, thereby reducing overall cost. In ad-

Chan

Examples of applications for microsensors for acceleration or accelerometers include air bag systems, anti-lock braking systems, and ride suspension systems for automobiles and in-flight aircraft monitoring systems for aircraft. Each of these applications requires small, inexpensive, and reliable acceleration devices.

Bernstein

Micromechanical gyroscopes which are micromachined from a single silicon substrate are now well known in the art. Such devices typically have a gimbaled structure which includes an inner gimbal ring having a set of flexures coupled to a mass. The inner gimbal ring serves as the sense axis. The inner gimbal

EX1003 (Smith), 2:56-59 (emphasis and highlighting added); EX1005 (Chan), 1:33-38 (emphasis and highlighting addedd); EX1006 (Bernstein), 1:11-13 (emphasis added); Pet., pp. 14-18; EX1002 (Young decl.), ¶¶97-105

Further evidence supporting motivation to combine: MEMS in avionics inertial navigational systems

'648

Gyroscopes and accelerometers have been utilized in avionics inertial navigation systems to provide information concerning the orientation of the airplane with respect to a reference plane, typically the local level ground coordinates. Avionics display and flight control attitude, heading, rotation rate, and acceleration data to provide angular speed information regarding changes in the plane's orientation. This information is typically provided by an attitude heading reference system (AHRS). Modern, state of the art, AHRS systems utilize precision solid state inertial sensors to measure rotation rates, in place of the spinning wheel gyroscopes and spring-and-mass mechanical accelerometers used in older systems. These precision solid state inertial sensors may include fiber optic rotation sensors also referred to as fiber optic gyros and quartz or silicon micromachined accelerometers. For example, U.S. Pat. No. 5,606,415 describes such a solid state fiber optic gyro capable of the accuracy required for AHRS applications, and high accuracy quartz accelerometers are commercially available. Other sensor technologies may also be used, in AHRS applications, such as the micromachined quartz gyros, which are also commercially available.

EX1014 (Doty), 1:15-36 (highlighting added); Pet., p. 17; EX1002 (Young decl.), ¶102

Further evidence supporting motivation to combine: MEMS and IMUs

'648

The present invention relates to micromachined devices used for measuring angular rate and acceleration.

Inertial measurement units (IMUs) are critical to the proper operation of inertial navigation and guidance systems. Such systems are used on ships, aircraft, spacecraft, etc.

surface of the substrate **16**. In an illustrative embodiment of this invention, the assembly **18** mounts the substrate **16** at a compensating angle with respect to the axis of the housing shell **12**, whereby the sensor **10** and thus, the input axes **38** of the accelerometers **32***a* and *b* may be precisely oriented with respect to the vehicle or aircraft carrying the sensor **10** of this invention.

EX1013 (Hulsing), 1:10-11, 1:36-39; 8:44-50 (highlighting added); Pet., p. 17; EX1002 (Young decl.), ¶102

Further evidence supporting motivation to combine: MEMS and IMUs

'648

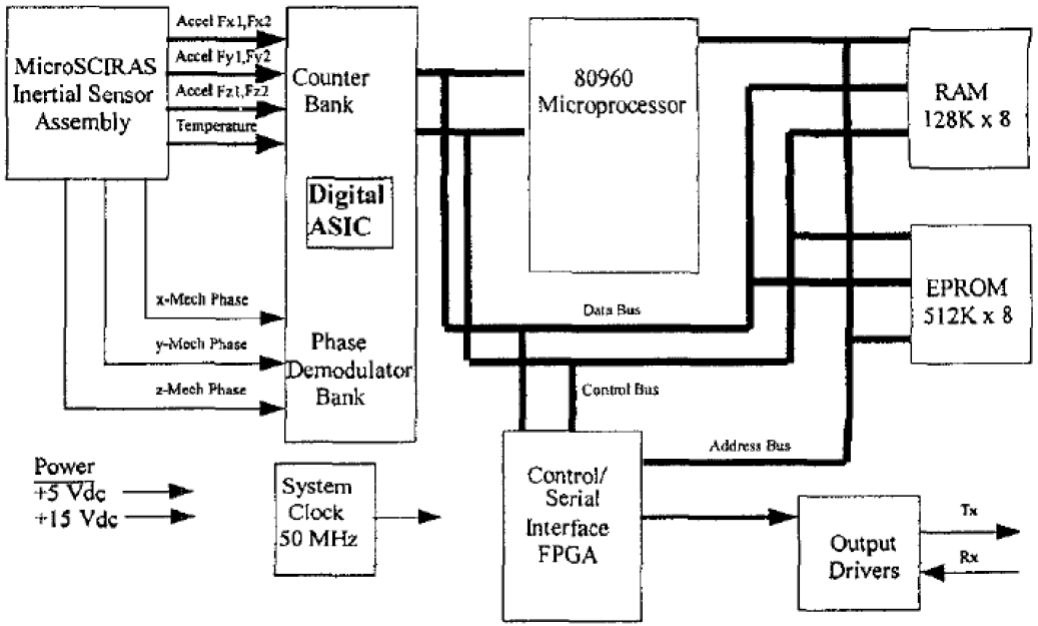


Fig. 5. Microprocessor

Development of the μSCIRAS™ (pronounced micro-Cyrus) multisensor for a period of over six years has produced a practical MEMS Inertial Measurement Unit (IMU). Using only three silicon sensors, a full-up IMU suitable for tactical grade navigation and guidance applications has been achieved. Iterative improvements in silicon sensor design and bulk micromachining processes have matured to the point where an IMU with an attractive price/performance ratio is now producible. This paper summarizes the design features and test results for an IMU with < 100 deg/hr performance. Test results are shown for rate bias and acceleration bias over temperature.

EX1047 (Hulsing), p. 17, Fig. 5 (emphasis and highlighting added); Reply, pp. 7-8; EX1045 (Young reply decl.), ¶45

Further evidence supporting motivation to combine: MEMS and IMUs

'648

This paper presents an alternative approach using a small, low cost, integrated GPS receiver and MEMS-IMU embedded in the missile/rocket to provide (via telemeter link) accurate position, velocity, attitude, and time information of the missile/rocket during test flights. An introduction to the problem and the challenges faced in placing a GPS/MEMS-IMU on a small, high g, high roll rate platform is presented. A description of the integrated GPS/MEMS-IMU is presented along with simulated performance results. Finally, the benefits of using the integrated GPS/MEMS-IMU in the test and evaluation environment is discussed.

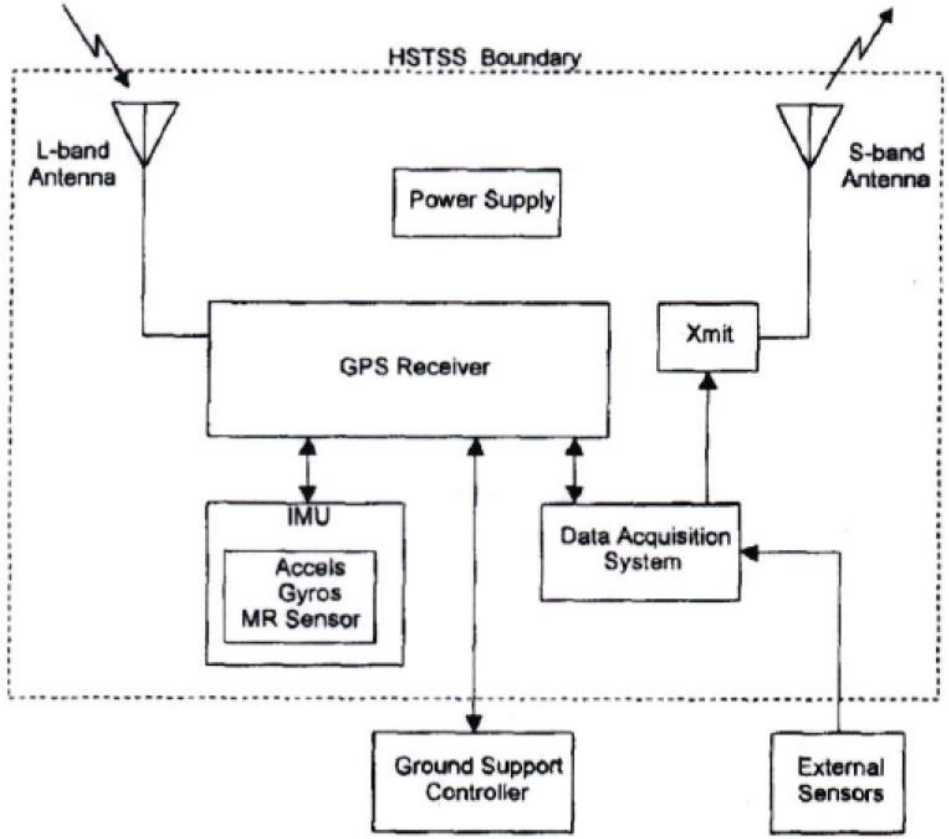


Figure 1 HSTSS Architectural Diagram.

EX1038 (Minor), p. 602 (emphasis added), Fig. 1; Reply, pp. 6-7; EX1045 (Young reply decl.), ¶45

Person of ordinary skill

'648

Petitioner

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.)

Pet., p. 5; EX1002 (Young decl.), ¶¶12-15

Patent Owner

A person of ordinary skill in the art with respect to the '122 Patent would have at least a "Master's Degree in Electrical or Electronics Engineering, and approximately five years of relevant experience in the development of control systems for inertial navigation, MEMS semiconductor processing, and analog circuit design." EX2008, ¶57.

POR, p. 18; EX2008 (Larson decl.), ¶57

Knowledge of one of ordinary skill

'648

Q And so you mentioned here development of control systems for inertial navigation. Can you elaborate on what you mean by development of control systems for inertial navigation?

A Yeah, well, inertial navigation systems are these very complicated electromechanical systems that -- you know, they use rotating bodies and multiple frames of reference to determine angular rotation in perhaps multiple axes, and they require pretty sophisticated, you know, kind of controls to maintain their accuracy and, you know, robustness to vibration.

And so I guess that's what I meant by that. There's a whole, you know, domain of control system mathematics and theory and practice that is -- has been developed to make these devices work.

EX1046 (Larson depo. tr.), 11:18-12:7 (highlighting added); EX2008 (Larson decl.), ¶57

PO's expert acknowledged that control circuits for MEMS devices existed well before the '648 patent

'648

Q So high-performance MEMS devices and control circuits existed for at least ten years before the priority date of the '122 and '648 patents; is that correct?

A Well, I had the experienced... yes. Yes, I believe so.

EX1046 (Larson depo. tr.), 23:19-24 (highlighting added)

Motivations to combine

'648

- Accounting for the technical differences between MEMS and non-MEMS sensors "would have been regarded as a routine implementation to a skilled artisan[,]" particularly in light of prior art knowledge and commercial availability of MEMS inertial sensors. (Pet., pp. 15-19; EX1002 (Young decl.), ¶99; Reply, pp. 9-10; EX1045 (Young reply decl.), ¶¶20-24, 28-44.)

Dr. Larson has "never designed a MEMS device for inertial navigation applications"

'648

sensors. *E.g.*, EX2007 at ¶¶16-37. Based on this, and on my understanding as detailed here, integration of MEMS rate and acceleration sensors into an IMU at the time of the American GNC Patents was a difficult challenge beyond the capabilities of one of only ordinary skill, in what was a rapidly developing art.

EX2008 (Larson decl.), ¶78

15 Q Do you have experience with MEMS designed for
16 inertial navigation?
17 A Yeah, I've never designed a MEMS device for
18 inertial navigation applications.

EX1046 (Larson depo. tr.), 24:15-18 (highlighting added)

Alleged difficulties not claimed

'648

77. In my opinion, Professor Young severely underestimates the knowledge, skill, and level of re-design that would be required to make this substitution of sensor technology type. Changing one type of sensor for another would require non-trivial re-design of the manufacturing process and associated control circuits, as Professor Young appears to acknowledge. EX1002 ('648 Petition), ¶99. And in particular, MEMS sensors at the time required complicated electronic circuitry to reliably control, as the '648 Patent described and taught. *See* '648 Patent, Abstract, 17:19-36.

EX2008 (Larson decl.), ¶77 (highlighting added)

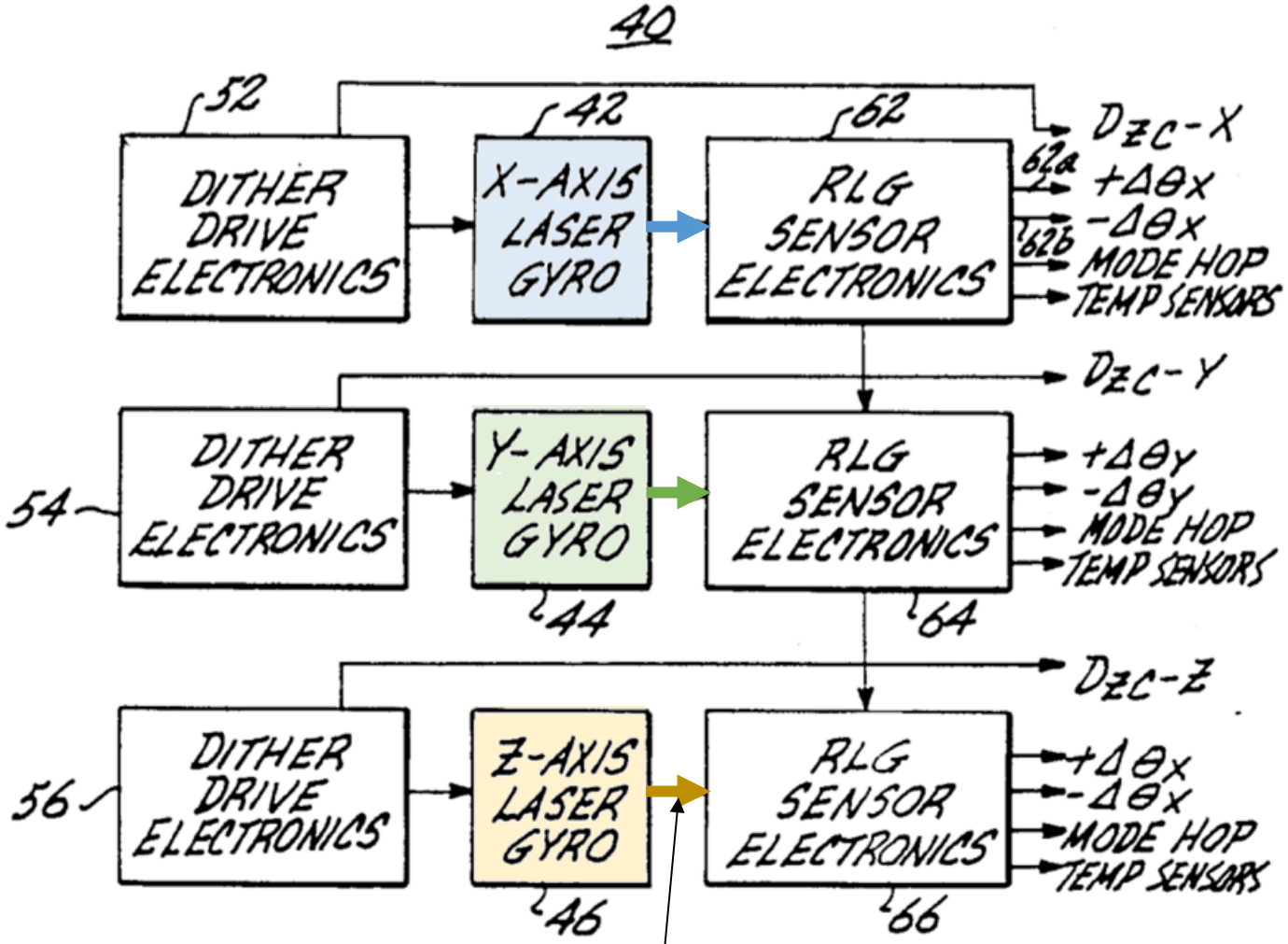
Claim 1[a]

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.



EX1003 (Smith), Fig. 2 (annotations added); Pet., pp. 18-20; EX1002 (Young decl.), ¶¶106-109

“angular rate electrical signal”

’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

Each ring laser gyro **42**, **44**, and **46** produces an output digital signal having a pulse repetition rate proportional to the rate of angular displacement of each gyro **42**, **44**, and **46** about its coordinate axis. These signals

EX1003 (Smith), 8:3-6; Pet., pp. 18-20; EX1002 (Young decl.), ¶¶106-109; Reply, pp. 4-5; EX1045 (Young reply decl.), ¶51.

position. The voltage required to rebalance the gyroscope about the X axis is the measured output of the gyroscope, and is proportional to the input rate.

EX1006 (Bernstein), 3:3-5; Pet., p. 39; Reply, p. 5; EX1045 (Young reply decl.), ¶52

Claim 1[b]

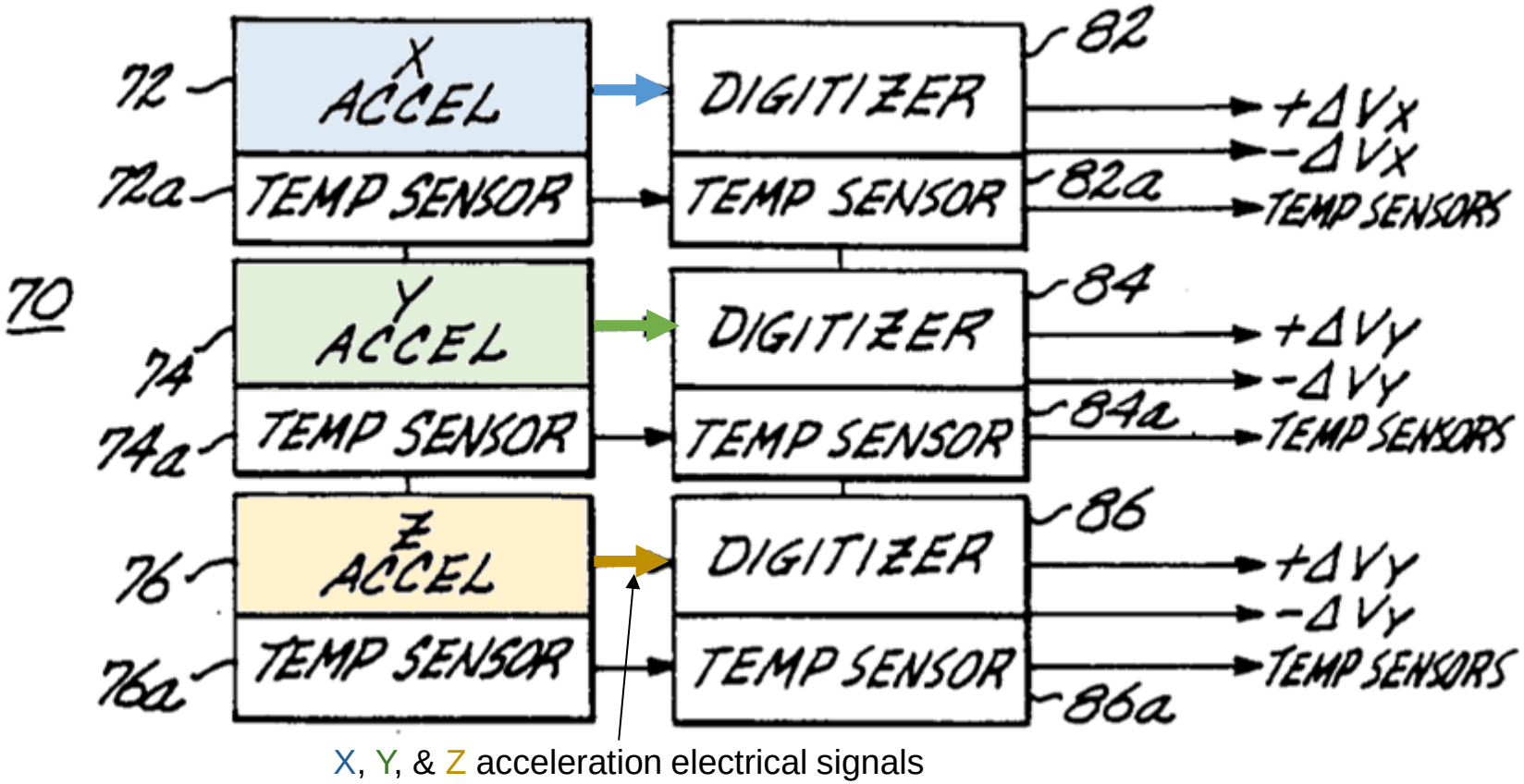
’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.



EX1003 (Smith), Fig. 2 (annotations added); Pet., pp. 20-22; EX1002 (Young decl.), ¶¶110-113

Claim 1[c]

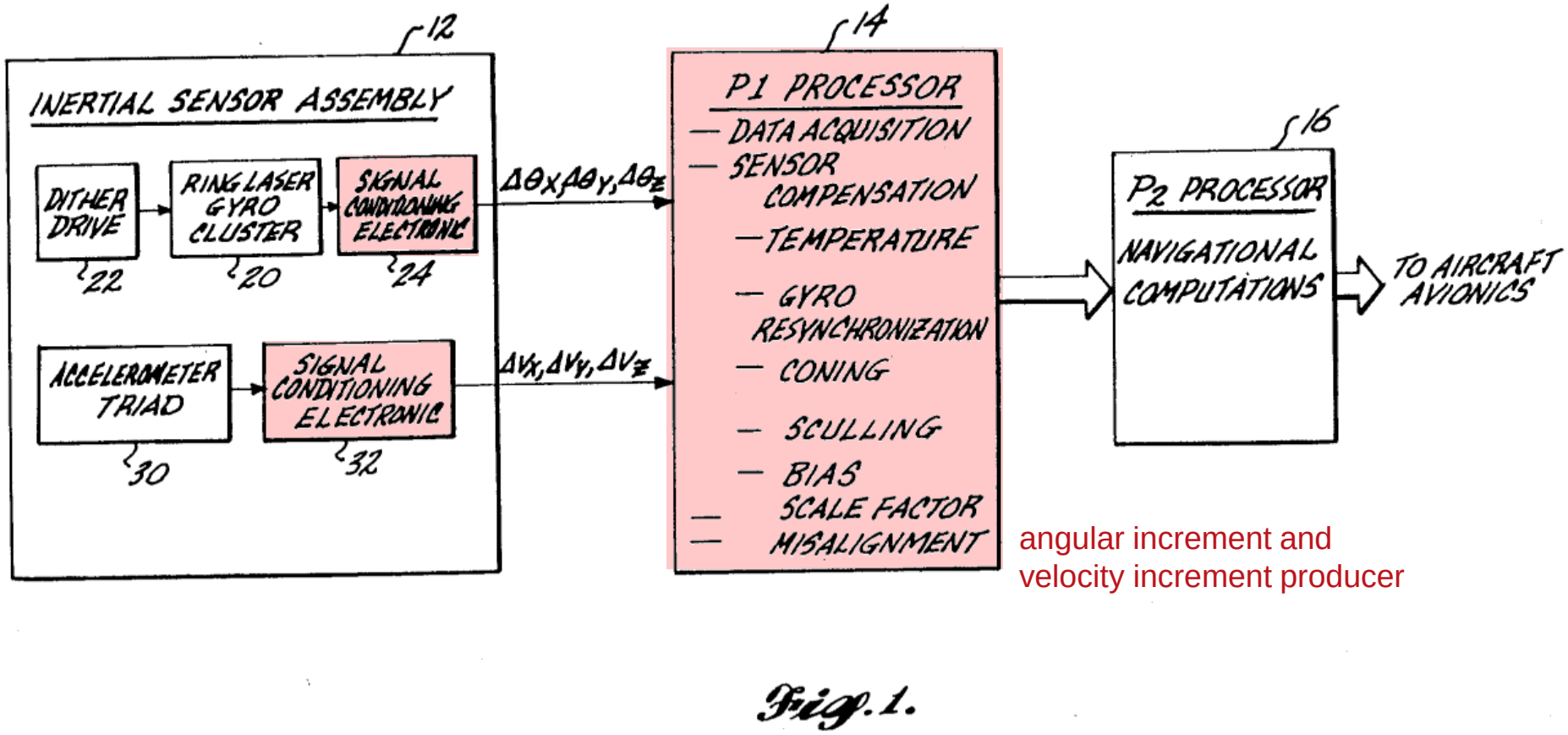
'648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.



angular increment and velocity increment producer

Fig. 1.

EX1003 (Smith), Fig. 1 (annotations added); Pet., pp. 22-23; EX1002 (Young decl.), ¶114

Claim 1[c]

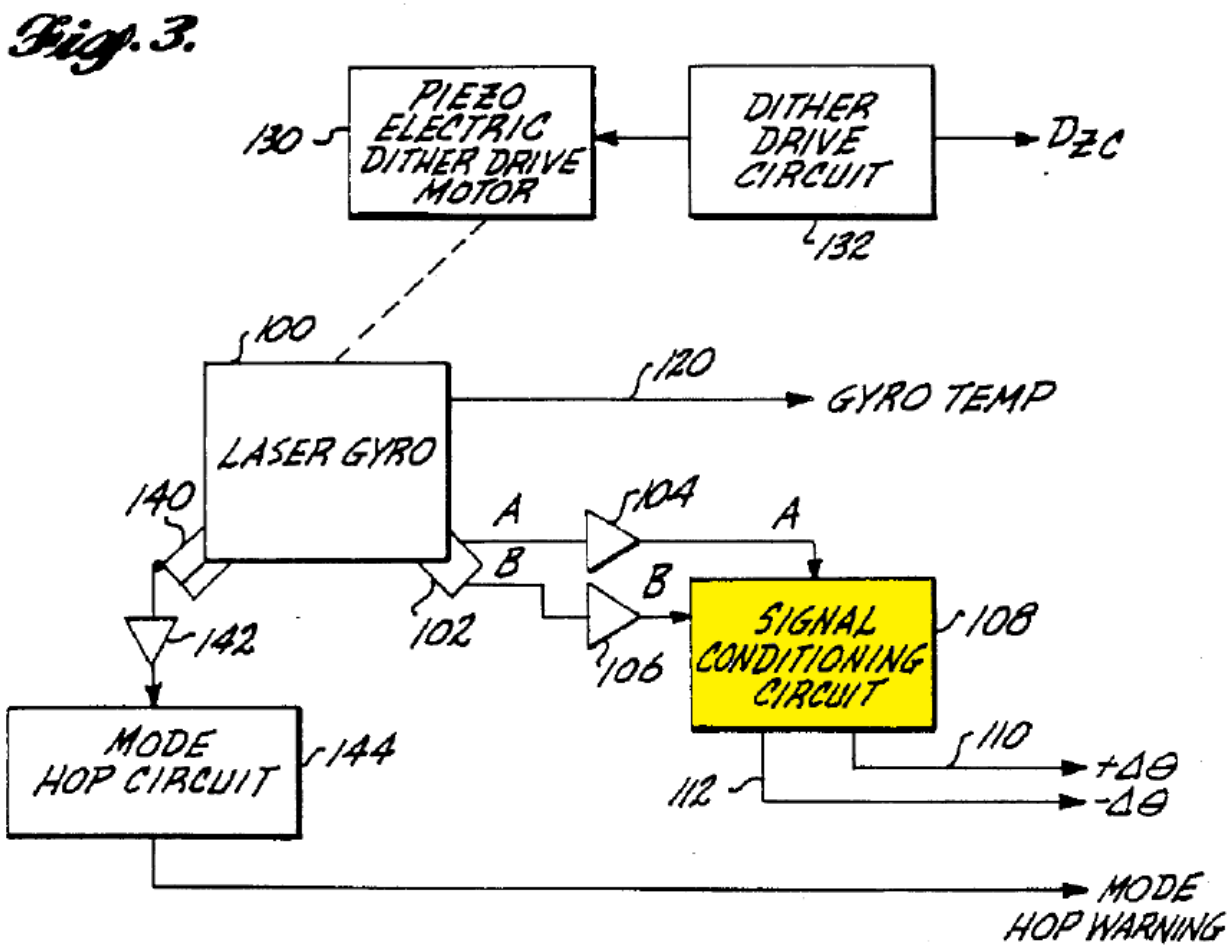
’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.



EX1003 (Smith), Fig. 3; Pet., pp. 22-24; EX1002 (Young decl.), ¶¶115-116

Claim 1[c]

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

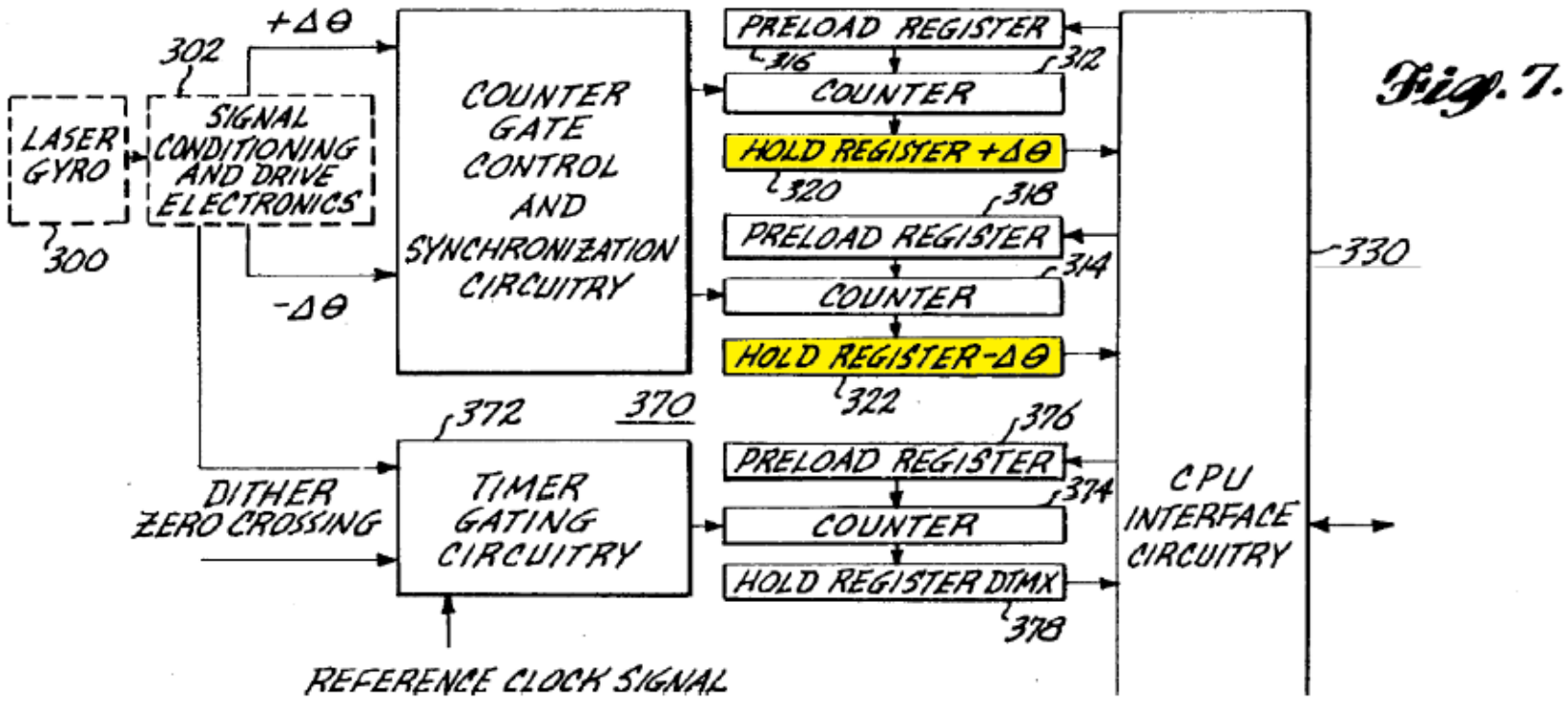


Fig. 7.

EX1003 (Smith), Fig. 7; Pet., pp. 25-32; EX1002 (Young decl.), ¶¶117-125

Claim 1[c]

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

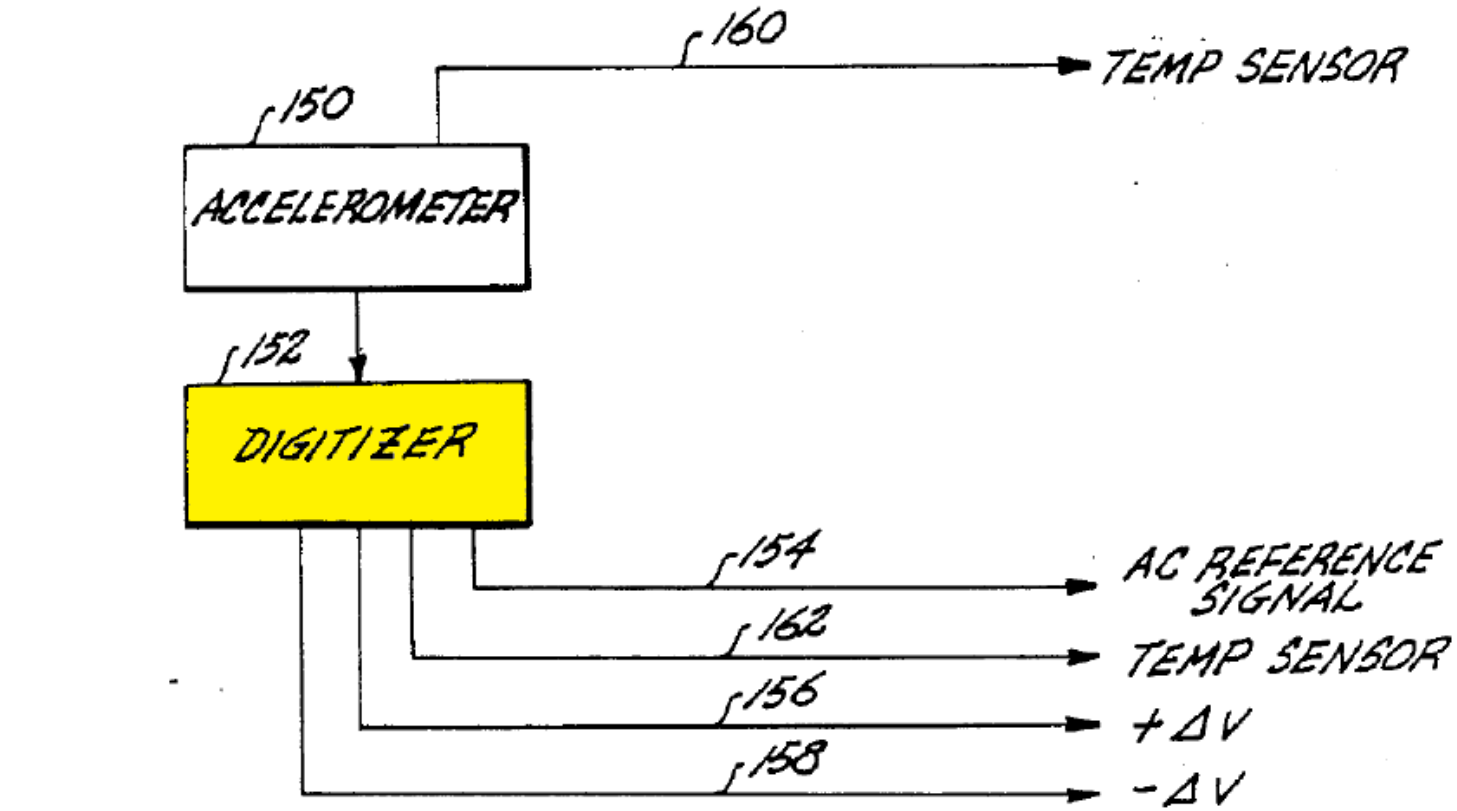


Fig. 4.

EX1003 (Smith), Fig. 4; Pet., pp. 32-34; EX1002 (Young decl.), ¶¶126-127

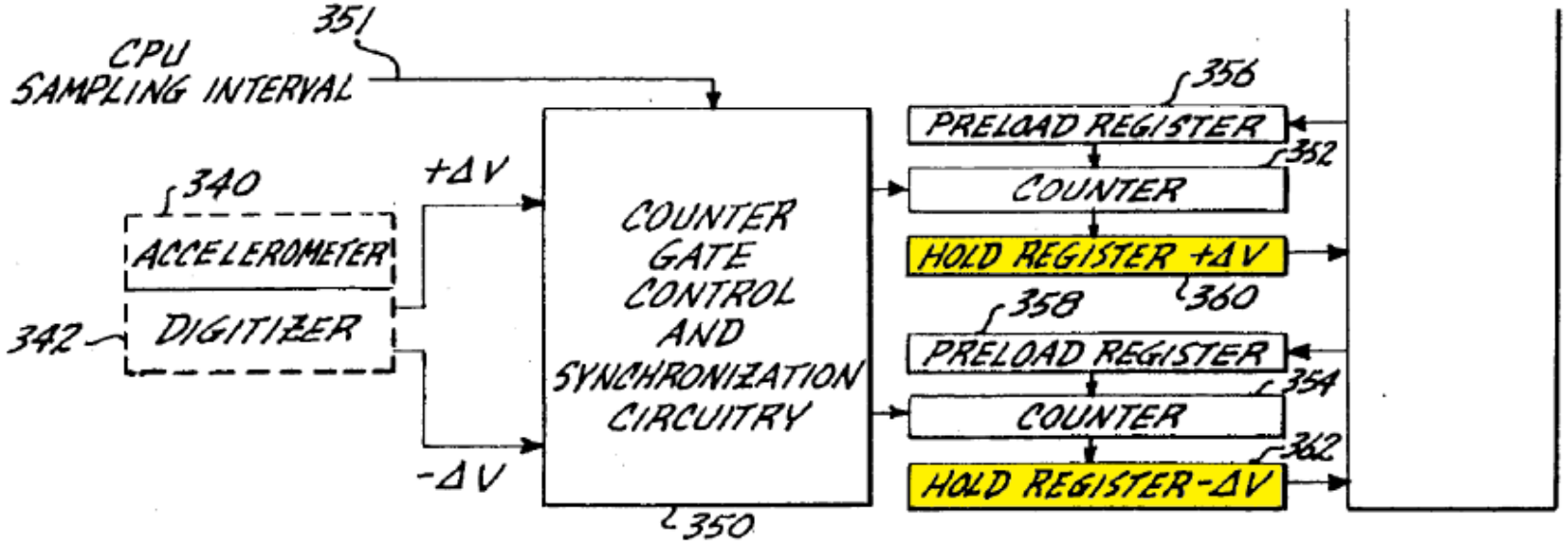
Claim 1[c]

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.



EX1003 (Smith), Fig. 7; Pet., pp. 34-37; EX1002 (Young decl.), ¶¶128-136

Ground 2

Smith/Chan/Bernstein/Irwin/Merhav

Claim 4

'648

4. A micro inertial measurement unit, as recited in claim 1, wherein said X axis, Y axis and Z axis angular rate electrical signals produced from said angular producer are analog angular rate voltage signals directly proportional to angular rates of a carrier carrying said micro inertial measurement unit, and said X axis, Y axis and Z axis acceleration electrical signals produced from said acceleration producer are analog acceleration voltage signals directly proportional to accelerations of said vehicle.

sometimes called) or *digital*. Until the 1960s, virtually all electronic circuitry was analog. Analog signals are very common today in certain applications. For example, in a stereo, an audio signal, which is actually a time-varying current, moves the cone of a speaker back and forth, reproducing the appropriate sound. Almost all of observable nature is analog, with continuously varying parameters such as temperature, pressure, light intensity, etc. Therefore, many systems receive as their input an analog signal representing an analog parameter. The electronic signal generally originates from a sensor or transducer which provides an analog signal proportional to the parameter it's designed to measure. Table 7.1 provides a partial list of analog parameters that various types of electronic sensors can measure. Many of the outputs from electronic systems are also analog, such as audio and video images. Therefore, many electronic systems contain: (1) one or more sensors which convert a measurement parameter to an electronic signal, (2) a signal processor which may use analog or digital electronics to modify the signal, and (3) an output device as illustrated in Fig. 7.3.

EX1007 (Irwin), § 7.3, p. 242 (emphasis added); Pet., pp. 37-40; EX1002 (Young decl.), ¶¶140-144

Claim 4

'648

4. A micro inertial measurement unit, as recited in claim 1, wherein said X axis, Y axis and Z axis angular rate electrical signals produced from said angular producer are analog angular rate voltage signals directly proportional to angular rates of a carrier carrying said micro inertial measurement unit, and said X axis, Y axis and Z axis acceleration electrical signals produced from said acceleration producer are analog acceleration voltage signals directly proportional to accelerations of said vehicle.

Table 7.1 Analog parameters measurable by electronic sensors

Pressure	Temperature
Light Intensity	Magnetic Fields
Electric Fields	Proximity
Position	Acoustic Waves
Seismic Vibrations	Humidity/Dew Point
Acceleration/Vibration	Force
Rotation	Radiation
Gas Concentrations	Gas Flow
Acidity (pH)	Imaging (visible/IR)
Biopotentials	Ion Concentrations
Gas Composition	Torque
Tactile/Touch	

Assume the voltage signal from an electric guitar is 20 millivolts in amplitude, and must be amplified in order to provide 100 watts of power to an 8-ohm speaker. Let us determine the required *rms* sinusoidal voltage across the speaker.

EX1007 (Irwin), Table 7.1 (emphasis added), pp. 241, 243; Pet., p. 38; EX1002 (Young decl.), ¶140

Claim 4

4. A micro inertial measurement unit, as recited in claim 1, wherein said X axis, Y axis and Z axis angular rate electrical signals produced from said angular producer are analog angular rate voltage signals directly proportional to angular rates of a carrier carrying said micro inertial measurement unit, and said X axis, Y axis and Z axis acceleration electrical signals produced from said acceleration producer are analog acceleration voltage signals directly proportional to accelerations of said vehicle.

As the intensity fringes cross a diode, a corresponding sinusoidal signal is generated. Two diodes are required in order to determine whether Ω is clockwise or counter-clockwise. The diodes are placed at 90^0 with respect to each other in the coordinates of the fringe angle γ. With this arrangement, it is possible to determine which of the two diodes precedes the other. Digital pulse conditioning and logic convert the sinusoidal outputs into a train of pulses whose frequency is directly proportional to Ω and whose accumulated count represents the angle θ. The pulse size depends on the wavelength λ and the path length between mirrors. Thus, the RLG, in conjunction with its output logic, performs as a digital rate integrating gyro. As such, its null point is always dictated by the point at which the θ counter is initialized. This is precisely what is needed to implement a strapdown digital attitude reference system, commonly used in modern inertial navigation units.

EX1008 (Merhav), p. 381 (emphasis added); Pet., pp. 40-42; EX1002 (Young decl.), ¶¶145-146

Ground 3

Tingleff/Chan/Bernstein

Claim 1[p]

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

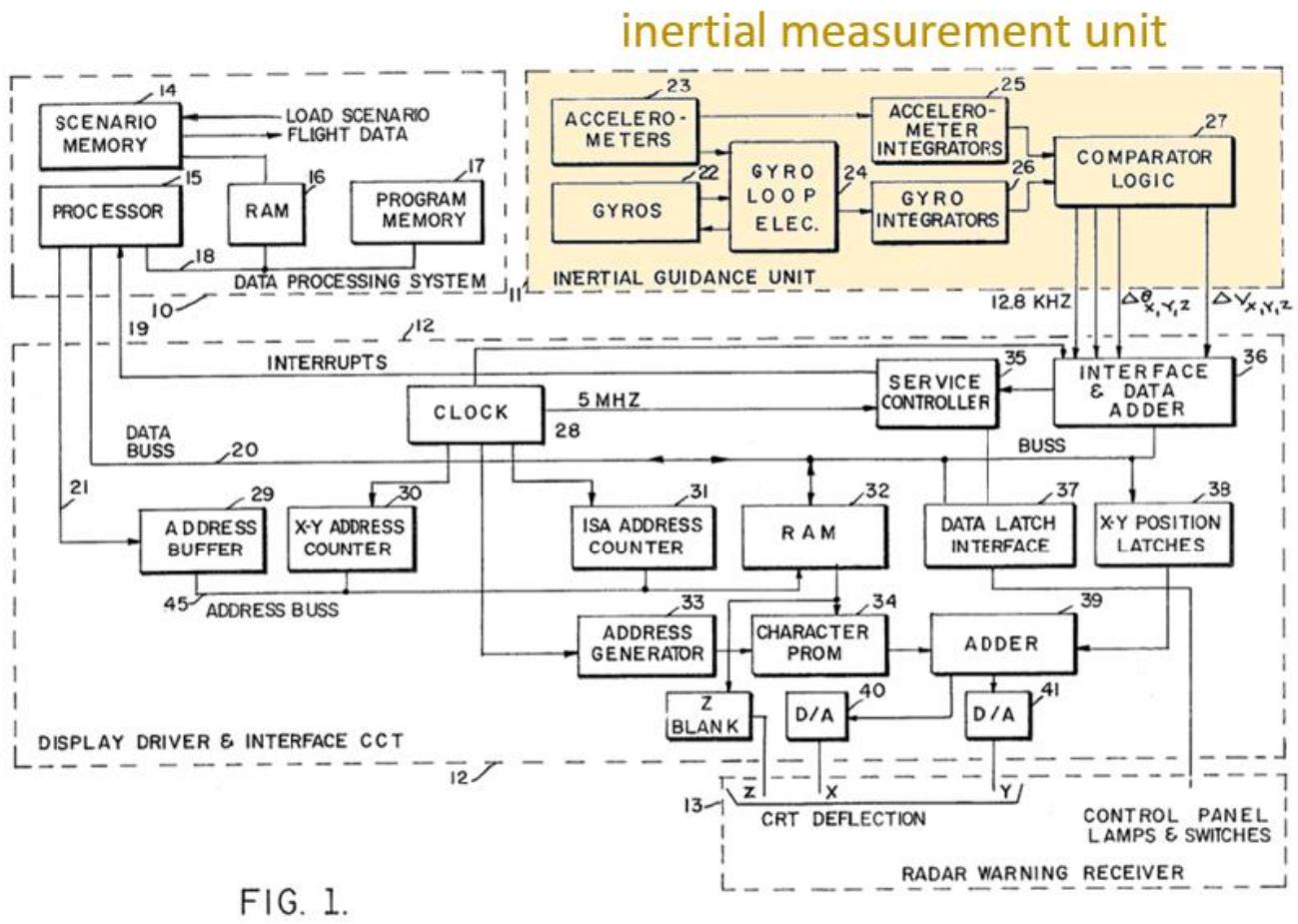


FIG. 1.

EX1004 (Tingleff), Fig. 1; Pet., pp. 44-45; EX1002 (Young decl.), ¶¶153-157

Tingleff + Chan + Bernstein

'648

Tingleff

With the preferred embodiment of the invention disclosed herein, an inflight RWR simulator is provided which is relatively small and self-contained; is easily programmed on the ground for an infinite variety of training scenarios which may duplicate combat and reconnaissance missions in complexity and time duration; is utilized at operations bases within the aircraft; and is used to provide frequent, realistic inflight training. The preprogrammed RWR simulator is quickly and easily exchanged for the plug-in processor module of the RWR equipment within the aircraft and the crew receives training in their own assigned aircraft without being temporarily reassigned to remote bases for training.

Chan

Examples of applications for microsensors for acceleration or accelerometers include air bag systems, anti-lock braking systems, and ride suspension systems for automobiles and in-flight aircraft monitoring systems for aircraft. Each of these applications requires small, inexpensive, and reliable acceleration devices.

Bernstein

Micromechanical gyroscopes which are micromachined from a single silicon substrate are now well known in the art. Such devices typically have a gimbaled structure which includes an inner gimbal ring having a set of flexures coupled to a mass. The inner gimbal ring serves as the sense axis. The inner gimbal

EX1004 (Tingleff); 3:11-21 (emphasis and highlighting added); EX1005 (Chan), 1:33-38 (emphasis and highlighting addedd); EX1006 (Bernstein), 1:11-13 (emphasis added); Pet., pp. 45-46; EX1002 (Young decl.), ¶¶156-157

In the prior art, equipment for providing training for particular aircraft systems have generally been simulators located on the ground at training facility locations. There are only a few training locations at which a limited number of expensive simulators are located and these locations are remote from most operational aircraft bases which are located all over the world. In addition to there being an insufficient number of simulators to provide frequent training to all air crew members, the aircraft crew members to be trained must leave their operations units in order to receive such training. In many cases reduction in aircrew manpower for even a few days of training is unacceptable.

Prior art ground based simulators can provide only a small amount of realism and cannot provide the realism of an actual flight.

EX1004 (Tingleff); 1:9-24 (emphasis added); Pet., pp. 45-46; EX1002 (Young decl.), ¶¶156-157

Claim 1[a]

'648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

X, Y, & Z angular rate electrical signals

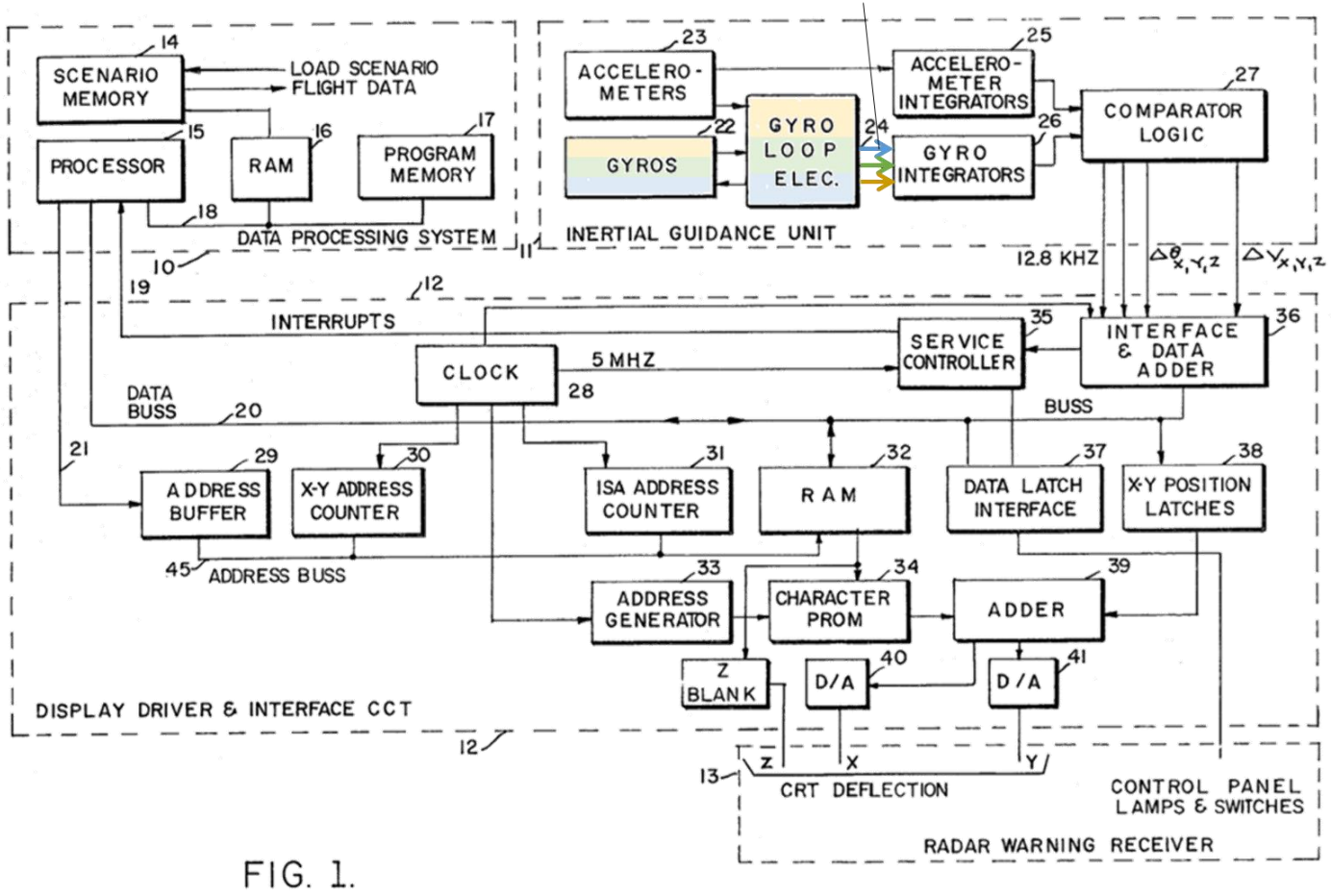


FIG. 1.

EX1004 (Tingleff), Fig. 1; Pet., pp. 46-49; EX1002 (Young decl.), ¶¶158-161

Claim 1[b]

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

X, Y, & Z acceleration electrical signals

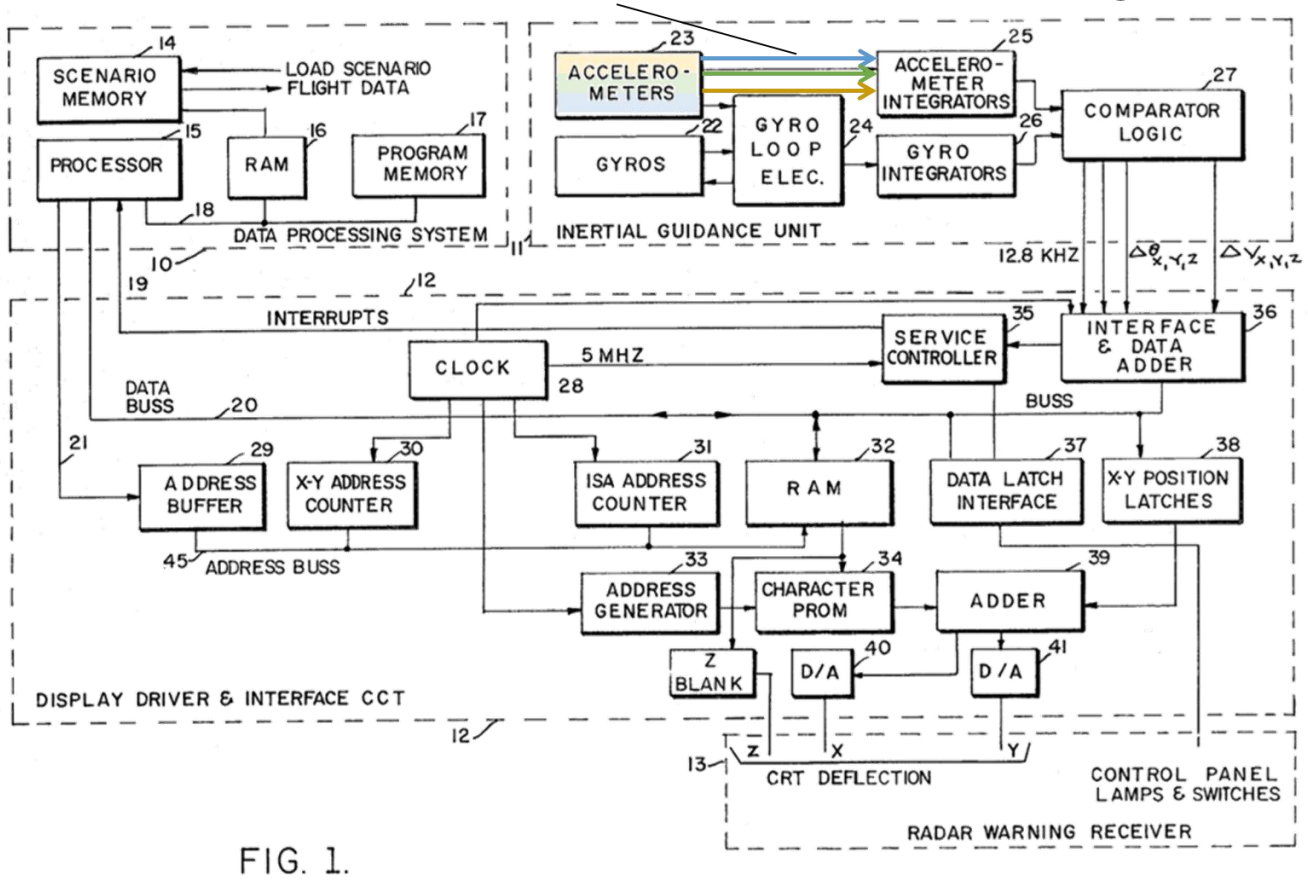


FIG. 1.

EX1004 (Tingleff), Fig. 1; Pet., pp. 49-51; EX1002 (Young decl.), ¶¶162-165

Claim 1[c]

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

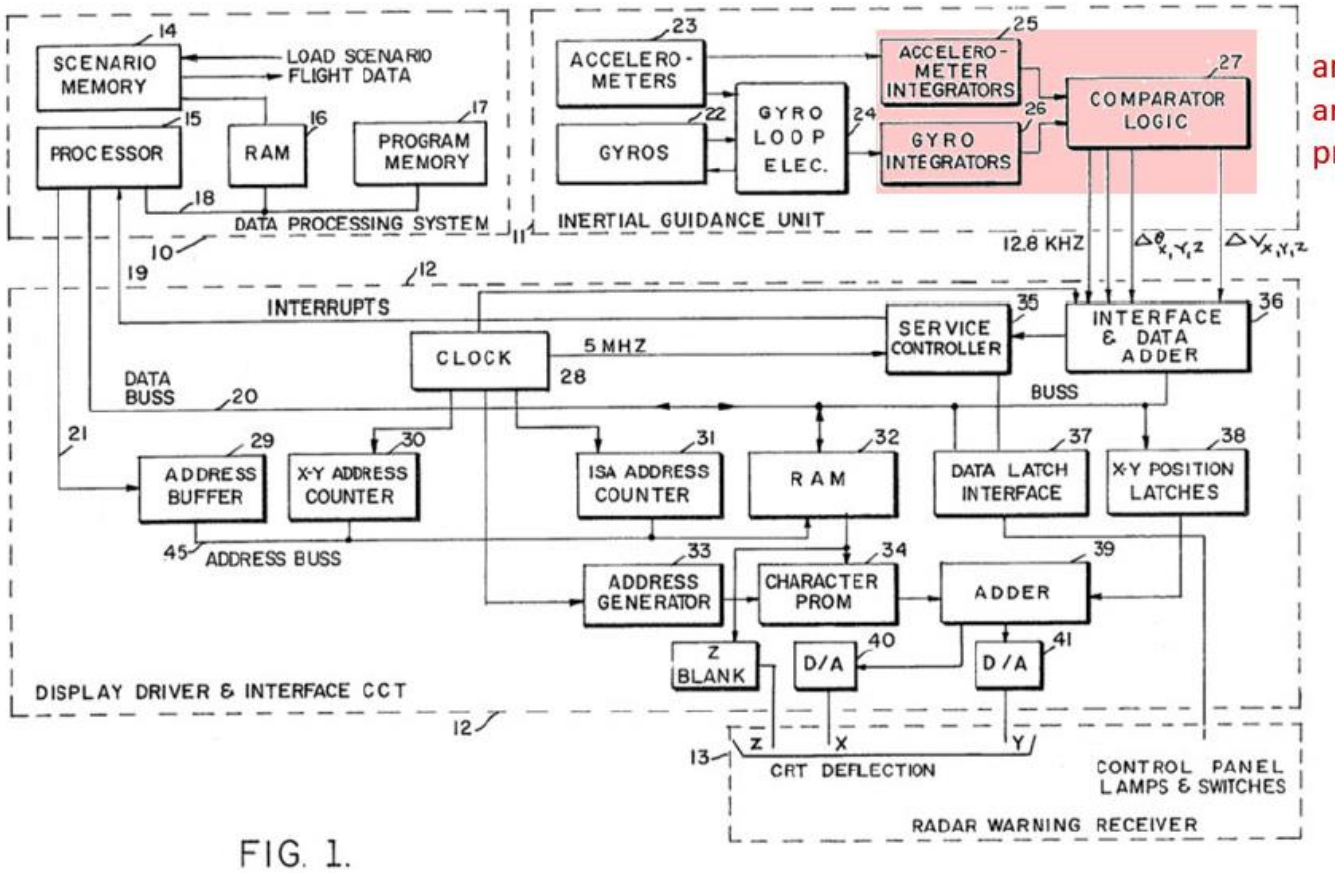


FIG. 1.

angular increment and velocity increment producer

EX1004 (Tingleff), Fig. 1; Pet., pp. 51-53; EX1002 (Young decl.), ¶¶166-168

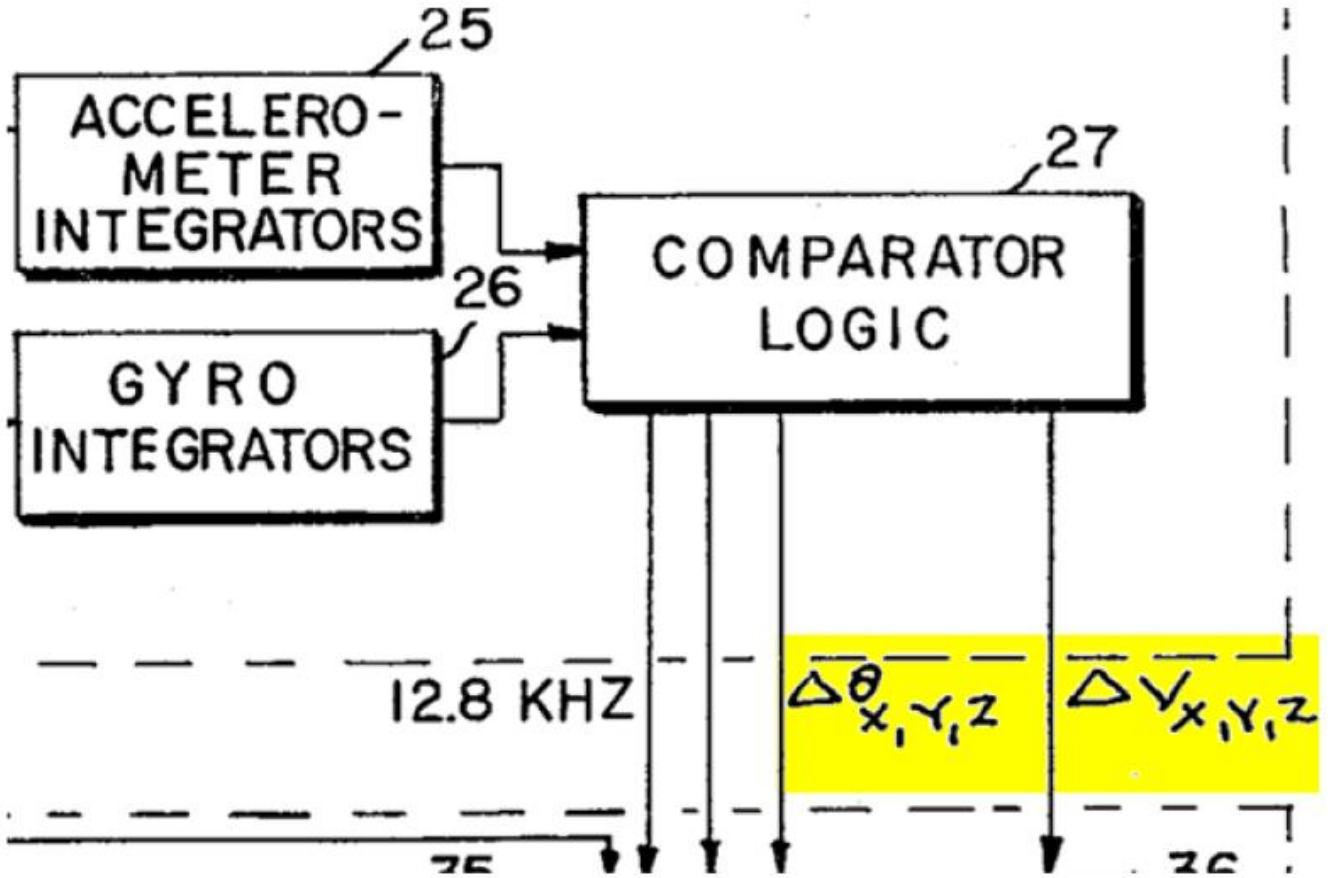
Claim 1[c]

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.



EX1004 (Tingleff), Fig. 1; Pet., pp. 53-55; EX1002 (Young decl.), ¶¶169-172

Claim 4

'648

4. A micro inertial measurement unit, as recited in claim 1, wherein said X axis, Y axis and Z axis angular rate electrical signals produced from said angular producer are analog angular rate voltage signals directly proportional to angular rates of a carrier carrying said micro inertial measurement unit, and said X axis, Y axis and Z axis acceleration electrical signals produced from said acceleration producer are analog acceleration voltage signals directly proportional to accelerations of said vehicle.

nates. As motion of the aircraft is sensed by inertial guidance unit **11**, the error signals from gyros **22** and accelerometers **23** are applied to gyro-loop electronics **24** which attempts to hold the accelerometer pendulum and gyro gimbal nulled in a manner well known in the art. These signals are also used as the analog rate signals within unit **11**. Accelerometer integrator **25** and gyro integrator **26** convert the respective analog signals input thereto from units **23** and **24** into digital pulse trains that are input to comparator logic **27**. Comparator logic circuit **27** adds the pulse trains from integrators **25** and **26** to a 12.8 KHz reference signal. The 12.8 KHz reference signal is needed to provide an accurate time base for the data sampling interval. These pulse trains then represent the incremental changes in attitude $\delta\theta_{X, Y, Z}$ and incremental changes in velocity $\delta V_{X, Y, Z}$ experienced by the inertial guidance platform.

EX1004 (Tingleff), 7:2-11 (emphasis and highlighting added); Pet., pp. 55-56; EX1002 (Young decl.), ¶¶174-180

Ground 4

Yamawaki/Chan/Bernstein/Saubolle

Claim 1[p]

’648

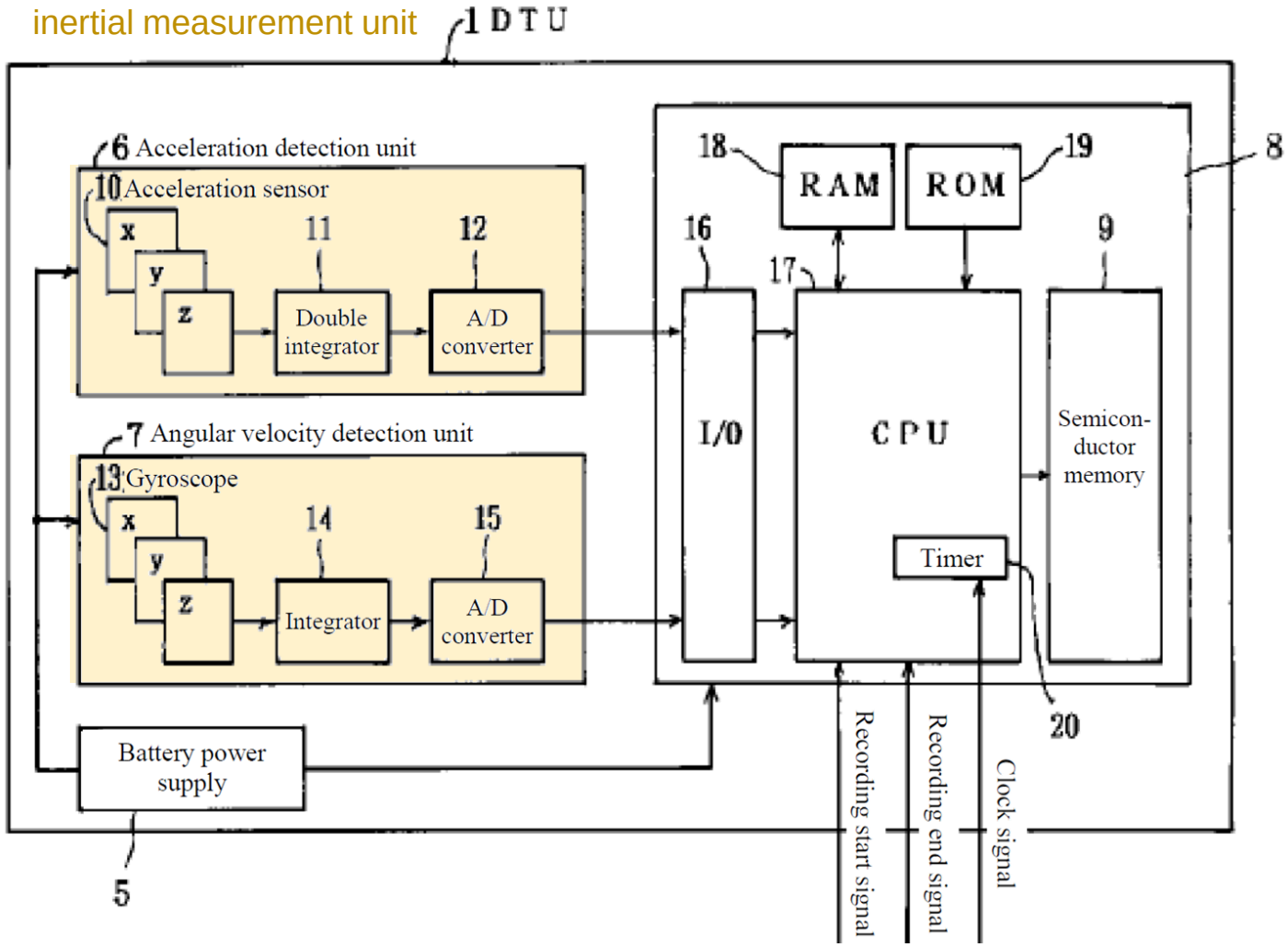
1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

[FIGURE 1]



EX1010 (Yamawaki), Fig. 1 (annotations added); Pet., pp. 57-59; EX1002 (Young decl.), ¶¶182-187

Yamawaki + Chan + Bernstein

'648

Yamawaki

[0005] The present invention has been devised in light of the above problems, and has as an object to provide a portable, user-friendly, and inexpensive mobile data collection device for an underwater moving body and a diving training system capable of accurately reproducing a movement path by analyzing data with a computer after a dive.

[0014] Specifically, the DTU 1 is a portable device in which a device body 1a, which makes up an outer housing thereof, is configured to have a relatively high degree of watertightness, with all components compactly accommodated in the device body 1a, which can be worn in an appropriate place on the diver's body and can be removed, and detects the movement distance and movement direction of the diver.

Chan

Examples of applications for microsensors for acceleration or accelerometers include air bag systems, anti-lock braking systems, and ride suspension systems for automobiles and in-flight aircraft monitoring systems for aircraft. Each of these applications requires small, inexpensive, and reliable acceleration devices.

Bernstein

Micromechanical gyroscopes which are micromachined from a single silicon substrate are now well known in the art. Such devices typically have a gimbaled structure which includes an inner gimbal ring having a set of flexures coupled to a mass. The inner gimbal ring serves as the sense axis. The inner gimbal

EX1010 (Yamawaki), [0005], [0014] (emphasis added); EX1005 (Chan), 1:33-38 (emphasis and highlighting added); EX1006 (Bernstein), 1:11-13 (emphasis added); Pet., p. 59; EX1002 (Young decl.), ¶187

Claim 1[a]

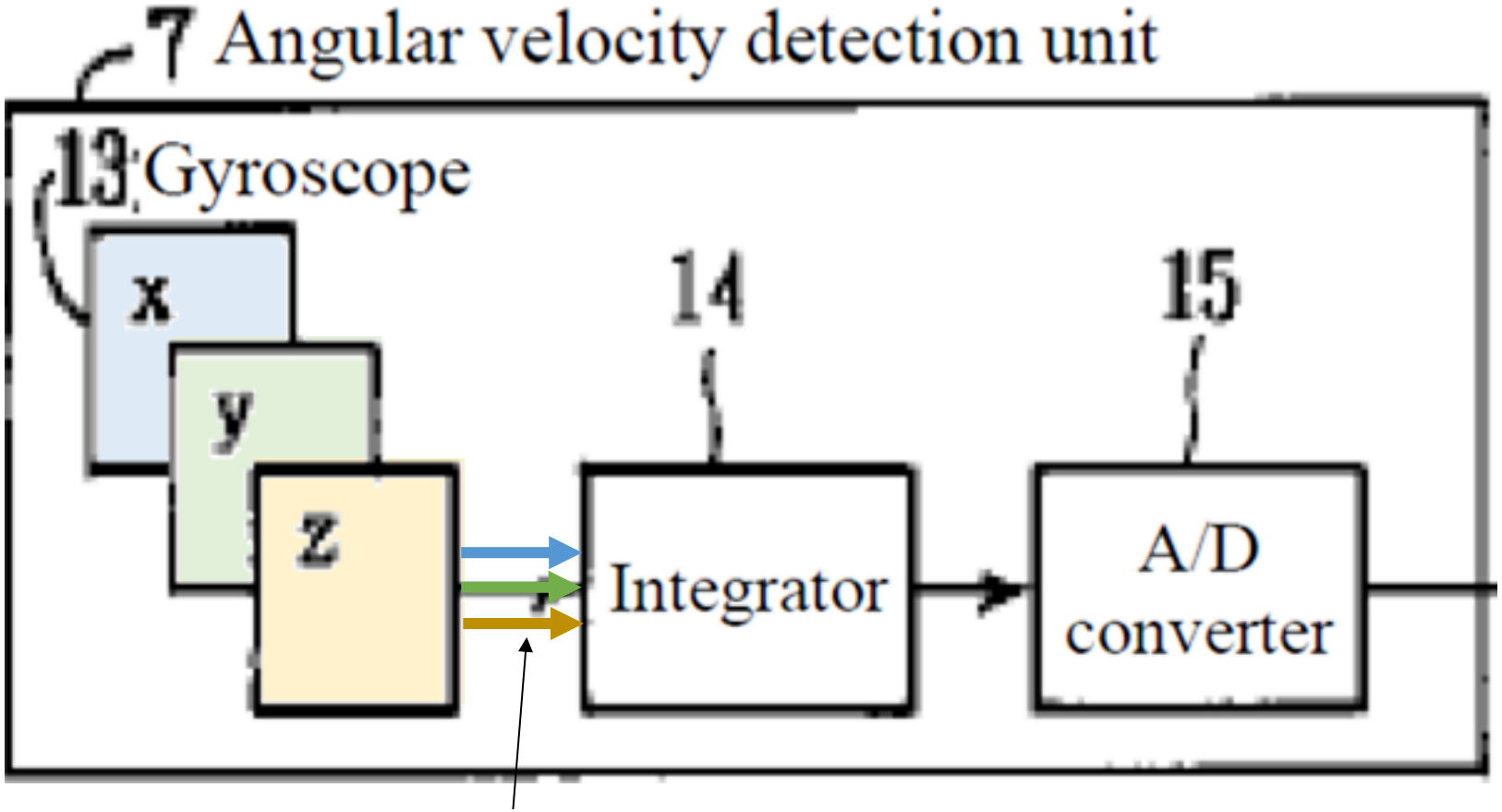
'648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.



EX1010 (Yamawaki), Fig. 1 (annotations added); Pet., pp. 59-61; EX1002 (Young decl.), ¶¶188-190

Claim 1[b]

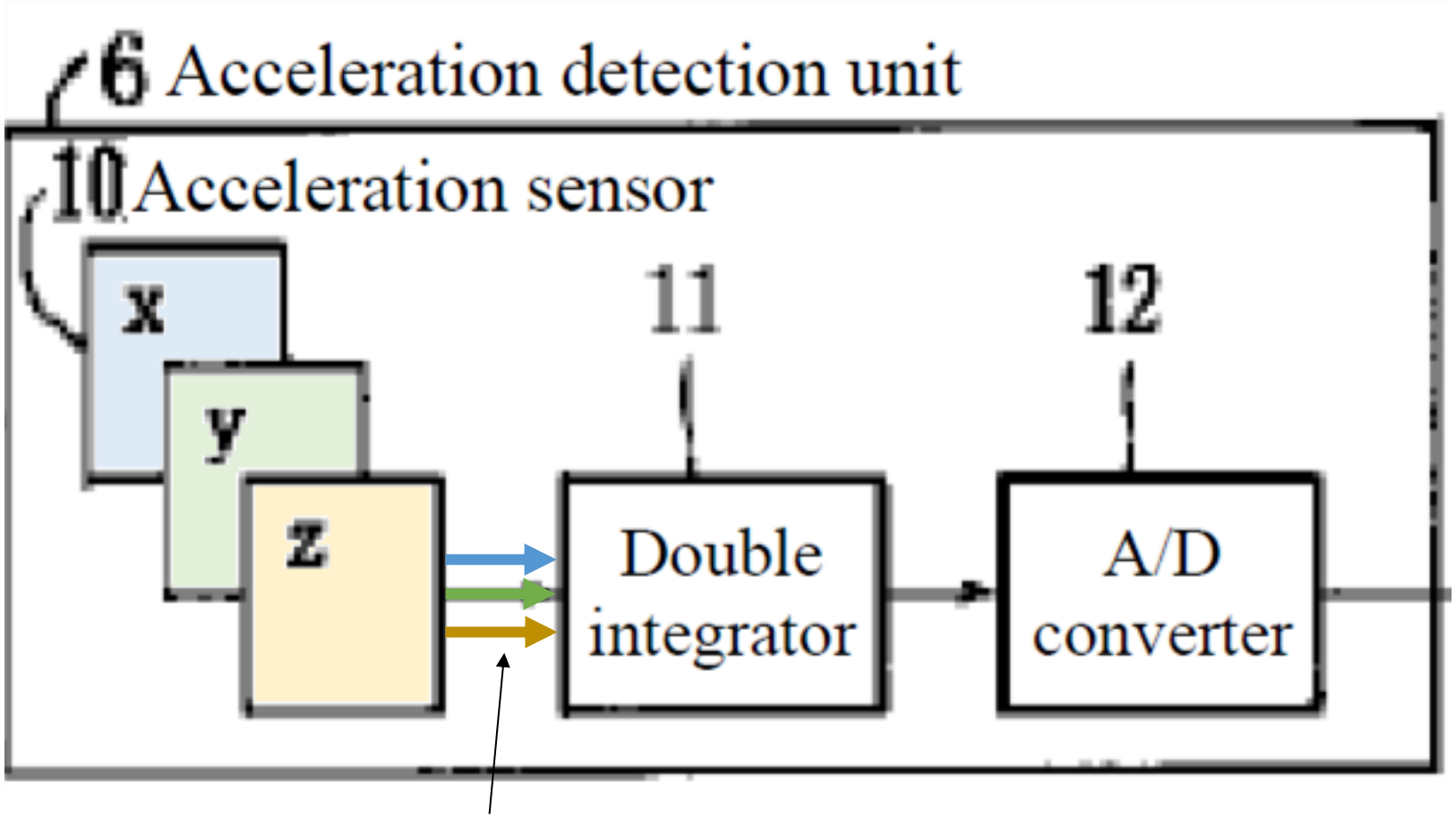
'648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.



EX1010 (Yamawaki), Fig. 1 (annotations added); Pet., pp. 61-63; EX1002 (Young decl.), ¶¶191-193

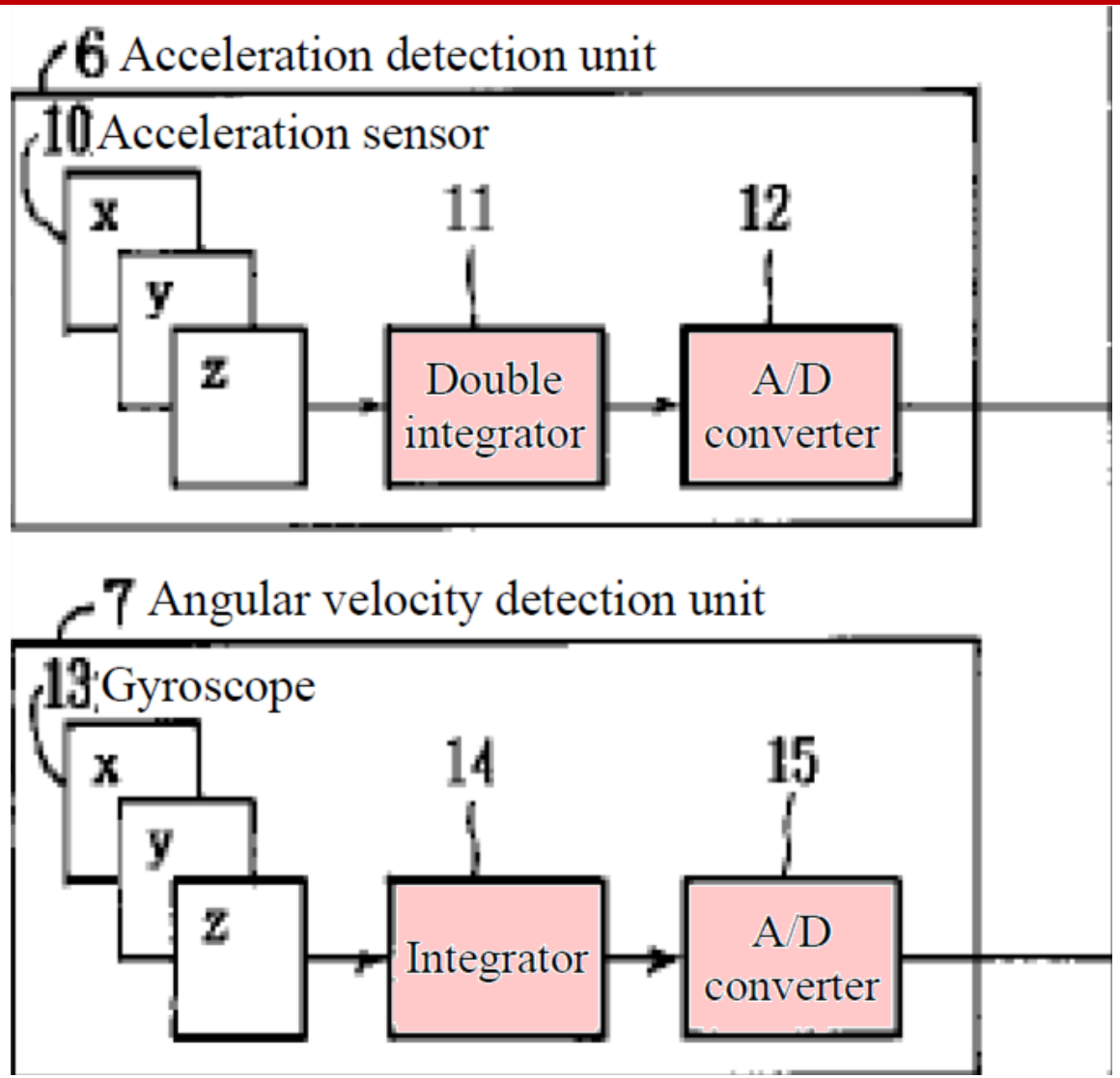
Claim 1[c]

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.



angular increment and velocity increment producer

EX1010 (Yamawaki), Fig. 1 (annotations added); Pet., pp. 63-65; EX1002 (Young decl.), ¶¶194-196

Claim 1[c]

’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

[0030] Assuming that the diver rotates underwater $\triangle\theta$xy in the X-Y plane during the time $\triangle$t, the angular rate $\triangle\omega$xy in the X-Y plane is expressed as $\triangle\omega xy = \triangle\theta/\triangle t$.

Therefore, the angle of rotation (change in movement direction) can be calculated by using with the integrator 14 to integrate the data obtained chronologically from the gyroscope over time.

EX1010 (Yamawaki), [0030]; Pet., pp. 65-67; EX1002 (Young decl.), ¶¶197-198

Claim 1[c]

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

[0026] An example is shown in Figure 4. In this drawing, when the diver is at point P in an underwater 3D coordinate system at time t_0 and moves a very small distance $\triangle L$ to reach point Q at time t_1 after a minute of time $\triangle t$ has elapsed, looking at the X-direction component $\triangle x$ of the movement distance $\triangle L$,

the elapsed time $\triangle t$ is defined as $\triangle t = t_1 - t_0$

the amount of change in speed in X direction $\triangle Vx$ is expressed as $\triangle Vx = \triangle x/\triangle t$

and the acceleration αx in the X direction is expressed as $\alpha x = \triangle Vx/\triangle t$.

EX1010 (Yamawaki), [0026]; Pet., pp. 67-69; EX1002 (Young decl.), ¶¶199-202

Claim 1[c]

’648

1. A micro inertial measurement unit, comprising:

an angular rate producer comprising a X axis angular rate detecting unit which produces a X axis angular rate electrical signal, a Y axis angular rate detecting unit which produces a Y axis angular rate electrical signal, and a Z axis angular rate detecting unit which produces a Z axis angular rate electrical signal;

an acceleration producer comprising a X axis accelerometer which produces a X axis acceleration electrical signal, a Y axis accelerometer which produces a Y axis acceleration electrical signal, and a Z axis accelerometer which produces a Z axis acceleration electrical signal; and

an angular increment and velocity increment producer, which is electrically connected with said X axis, Y axis and Z axis angular rate detecting units and said X axis, Y axis and Z axis accelerometers, receiving said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals from said angular rate producer and said acceleration producer respectively, wherein said X axis, Y axis and Z axis angular rate electrical signals and said X axis, Y axis and Z axis acceleration electrical signals are converted into are digital angular increments and digital velocity increments respectively.

This invention relates to a device for monitoring the rate of ascent of divers or similar applications.

Divers using underwater breathing apparatus for diving must control their rate of ascent towards the water surface, if they are not to suffer dangerous, unpleasant and possibly fatal decompression effects, commonly referred to as the “bends”. There is a need for a

A principal object of the present invention is to provide a rate of ascent or descent monitor which is inexpensive to manufacture and simple to use, thus rendering it suitable for widespread use and fulfilling a need for such a device at a sufficiently low price to be attractive to recreational divers.

EX1011 (Saubolle), 1:5-11; 1:66-2:3 (emphasis added); Pet., pp. 68-69; EX1002 (Young decl.), ¶¶201-202

Yamawaki + Saubolle

'648

Yamawaki

[0005] The present invention has been devised in light of the above problems, and has as an object to provide a portable, user-friendly, and inexpensive mobile data collection device for an underwater moving body and a diving training system capable of accurately reproducing a movement path by analyzing data with a computer after a dive.

[0014] Specifically, the DTU 1 is a portable device in which a device body 1a, which makes up an outer housing thereof, is configured to have a relatively high degree of watertightness, with all components compactly accommodated in the device body 1a, which can be worn in an appropriate place on the diver's body and can be removed, and detects the movement distance and movement direction of the diver.

EX1010 (Yamawaki), [0005], [0014] (emphasis and highlighting added); Pet. p. 59; EX1002 (Young decl.), ¶187.

Saubolle

A principal object of the present invention is to provide a rate of ascent or descent monitor which is inexpensive to manufacture and simple to use, thus rendering it suitable for widespread use and fulfilling a need for such a device at a sufficiently low price to be attractive to recreational divers.

EX1011 (Saubolle), 1:66-2:3 (emphasis and highlighting added); Pet. pp. 68-69; EX1002 (Young decl.), ¶202

Yamawaki + Saubolle

'648

Yamawaki

[0002]

[Prior Art] In recent years, diving with an aqualung (trademark) has become popular, but divers engage in underwater diving which always entails danger due to the effects of ocean currents and water depth, thus making it essential for beginners to receive training. In addition, even those divers who have mastered basic diving techniques require training in order to master more advanced diving techniques.

[0035] The full dive path obtained by analyzing the data collected in the semiconductor memory 9 of the DTU 1 is displayed and reproduced chronologically and dynamically on the 3D map in the display of the reproduction device 4, and a student diver can receive guidance from an instructor while viewing the screen.

EX1010 (Yamawaki), [0002], [0035] (emphasis and highlighting added); Pet. pp. 69-72; EX1002 (Young decl.), ¶¶203-208.

Saubolle

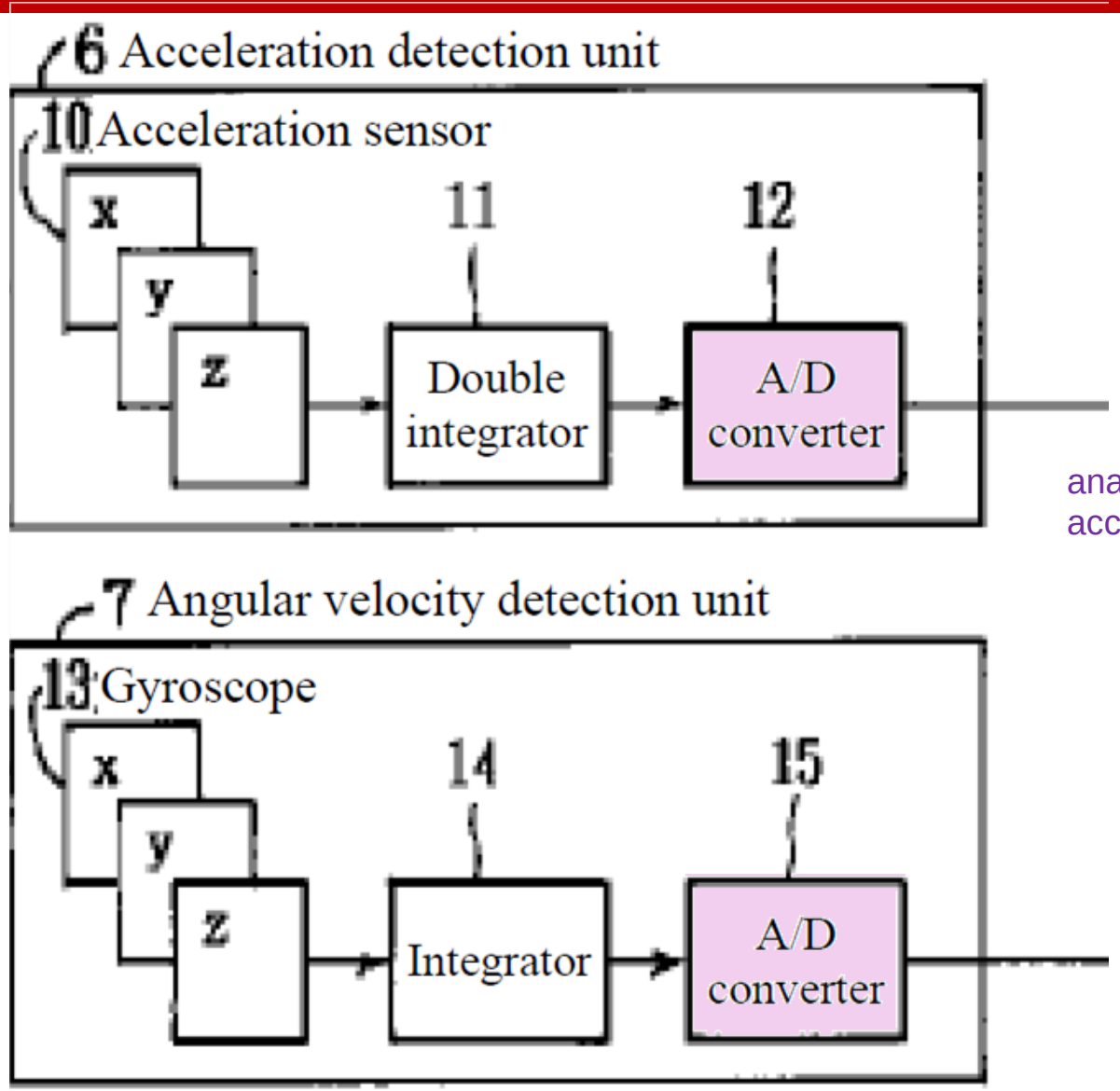
Divers using underwater breathing apparatus for diving must control their rate of ascent towards the water surface, if they are not to suffer dangerous, unpleasant and possibly fatal decompression effects, commonly referred to as the "bends". There is a need for a

Divers may also become disoriented, and become unaware of whether they are ascending or descending, and a device that would provide an easy and immediate indication of a diver's direction of vertical movement would therefore be useful. There are also other circum-

EX1011 (Saubolle), 1:7-27 (emphasis added); Pet. pp. 69-72; EX1002 (Young decl.), ¶¶203-208

Claim 4

4. A micro inertial measurement unit, as recited in claim 1, wherein said X axis, Y axis and Z axis angular rate electrical signals produced from said angular producer are analog angular rate voltage signals directly proportional to angular rates of a carrier carrying said micro inertial measurement unit, and said X axis, Y axis and Z axis acceleration electrical signals produced from said acceleration producer are analog acceleration voltage signals directly proportional to accelerations of said vehicle.



analog angular rate and acceleration voltage signals

EX1010 (Yamawaki), Fig. 1 (annotations added); Pet., pp. 72-74; EX1002, ¶¶210-216

Nintendo's Petitions are not Time Barred

35 U.S.C. § 315(a)-(b)

§ 315. Relation to other proceedings or actions

(a) Infringer's Civil Action.-

(1) Inter partes review barred by civil action.-An inter partes review may not be instituted if, before the date on which the petition for such a review is filed, the petitioner or real party in interest filed a civil action challenging the validity of a claim of the patent.

(2) Stay of civil action.-If the petitioner or real party in interest files a civil action challenging the validity of a claim of the patent on or after the date on which the petitioner files a petition for inter partes review of the patent, that civil action shall be automatically stayed until either-

(A) the patent owner moves the court to lift the stay;

(B) the patent owner files a civil action or counterclaim alleging that the petitioner or real party in interest has infringed the patent; or

(C) the petitioner or real party in interest moves the court to dismiss the civil action.

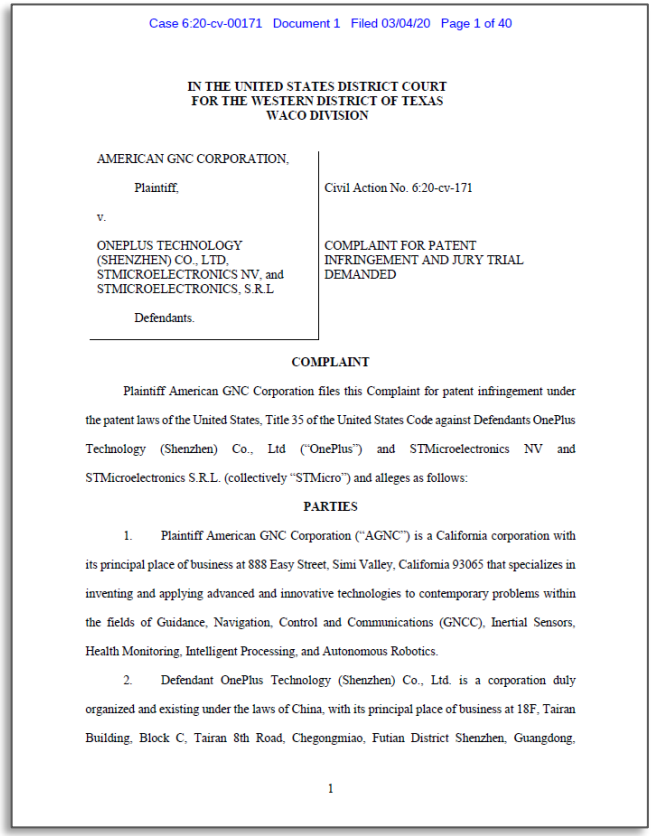
(3) Treatment of counterclaim.-A counterclaim challenging the validity of a claim of a patent does not constitute a civil action challenging the validity of a claim of a patent for purposes of this subsection.

(b) Patent Owner's Action.-An inter partes review may not be instituted if the petition requesting the proceeding is filed more than 1 year after the date on which the petitioner, real party in interest, or privy of the petitioner is served with a complaint alleging infringement of the patent. The time limitation set forth in the preceding sentence shall not apply to a request for joinder under subsection (c).

35 U.S.C. § 315(b)

An inter partes review may not be instituted if the petition requesting the proceeding is filed more than 1 year after the date on which the petitioner, real party in interest, or privy of the petitioner is served with a complaint alleging infringement of the patent.

AGNC admitted STMicro was not accused of infringing the ’122 or ’648 patents



Case 6:20-cv-00171 Document 1 Filed 03/04/20 Page 1 of 40

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

AMERICAN GNC CORPORATION, Plaintiff, v. ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD, STMICROELECTRONICS NV, and STMICROELECTRONICS, S.R.L Defendants.	Civil Action No. 6:20-cv-171 COMPLAINT FOR PATENT INFRINGEMENT AND JURY TRIAL DEMANDED

COMPLAINT

Plaintiff American GNC Corporation files this Complaint for patent infringement under the patent laws of the United States, Title 35 of the United States Code against Defendants OnePlus Technology (Shenzhen) Co., Ltd ("OnePlus") and STMicroelectronics NV and STMicroelectronics S.R.L. (collectively "STMicro") and alleges as follows:

PARTIES

1. Plaintiff American GNC Corporation ("AGNC") is a California corporation with its principal place of business at 888 Easy Street, Simi Valley, California 93065 that specializes in inventing and applying advanced and innovative technologies to contemporary problems within the fields of Guidance, Navigation, Control and Communications (GNCC), Inertial Sensors, Health Monitoring, Intelligent Processing, and Autonomous Robotics.

2. Defendant OnePlus Technology (Shenzhen) Co., Ltd. is a corporation duly organized and existing under the laws of China, with its principal place of business at 18F, Tairan Building, Block C, Tairan 8th Road, Chegongmiao, Futian District Shenzhen, Guangdong,

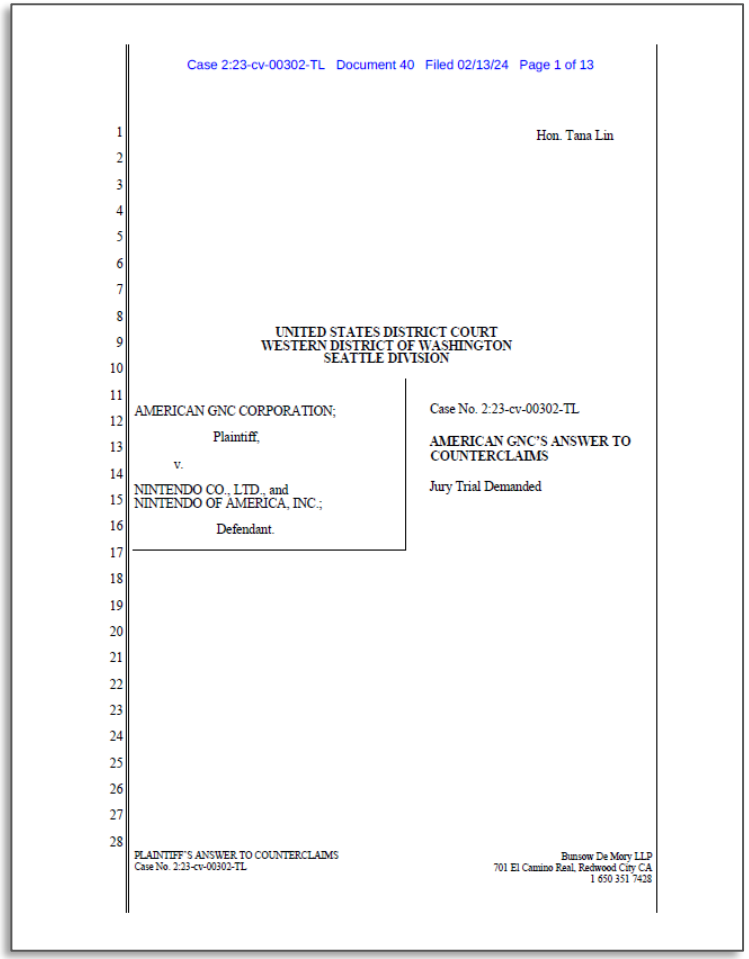
1

48. AGNC asserts that STMicro has infringed, directly and by inducement, at least the following claims of the Patents-in-Suit in this District and elsewhere in the United States:

- ’555 Patent - claim 49; and
- ’758 Patent – claim 1.

Reply, p. 20; EX2012, ¶48

AGNC was not accused of infringing the ’122 or ’648 patents



Case 2:23-cv-00302-TL Document 40 Filed 02/13/24 Page 1 of 13

Hon. Tana Lin

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
SEATTLE DIVISION

AMERICAN GNC CORPORATION;

Plaintiff,

v.

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

Defendant.

Case No. 2:23-cv-00302-TL

AMERICAN GNC’S ANSWER TO COUNTERCLAIMS

Jury Trial Demanded

PLAINTIFF’S ANSWER TO COUNTERCLAIMS
Case No. 2:23-cv-00302-TL

Bunsow De Mory LLP
701 El Camino Real, Redwood City CA
1 650 351 7428

13. American GNC admits that it did not include allegations of infringement of the ’122 patent and the ’648 patent by STMicro in the 171 case. Except as expressly admitted, American GNC denies the remaining allegations of paragraph 13.

Reply, p. 20; EX1049, ¶13

Notice is not enough

IPDatatel v. ICN Acquisition,

IPR2018-01823, 2019 WL 1753603, at *5 (P.T.A.B. Apr. 17, 2019)

"[P]roper 'service' is unequivocally notice, but **mere 'notice' is not 'legally effective' 'service**.'"

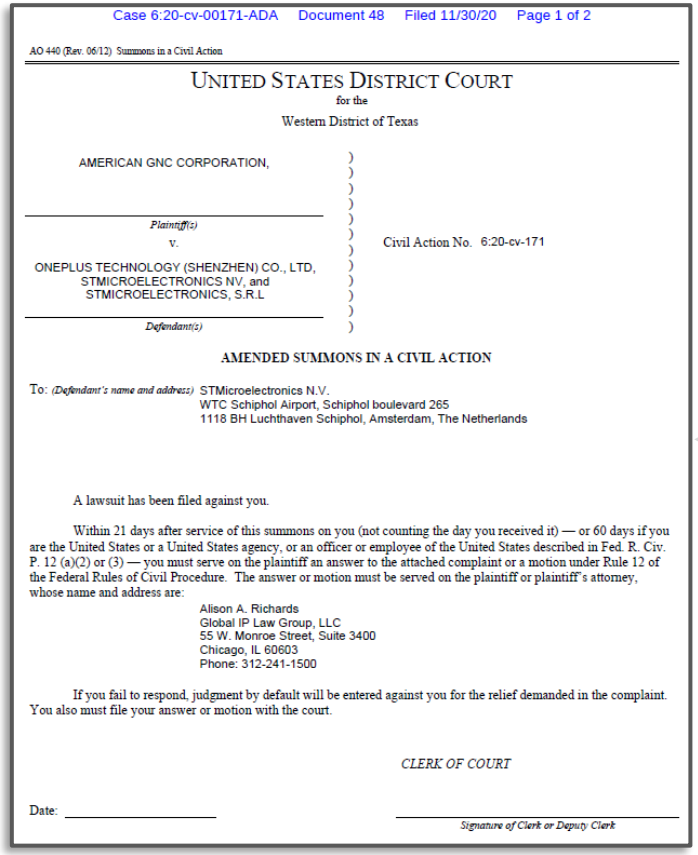
(emphasis added)

Patent Owner has not established service

11/30/2020	48	REQUEST FOR ISSUANCE OF SUMMONS by American GNC Corporation. *STMicroelectronics N.V.* (Richards, Alison) (Entered: 11/30/2020)
11/30/2020	49	Summons Issued as to STMicroelectronics NV. (am) (Entered: 11/30/2020)
12/04/2020	50	NOTICE *of Dismissal of Only STMicroelectronics NV and STMicroelectronics S.R.L. without Prejudice* by American GNC Corporation (Richards, Alison) (Entered: 12/04/2020)

American GNC Corp. v. OnePlus Tech. (Shenzhen) Co., Ltd., 6-20-cv-00171 (W.D Tex.) (Docket)

Patent Owner has not established service



Case 6:20-cv-00171-ADA Document 48 Filed 11/30/20 Page 1 of 2

AO 440 (Rev. 06/12) Summons in a Civil Action

UNITED STATES DISTRICT COURT
for the
Western District of Texas

AMERICAN GNC CORPORATION,

Plaintiff(s)

v.

ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD, STMICROELECTRONICS NV, and STMICROELECTRONICS, S.R.L

Defendant(s)

Civil Action No. 6:20-cv-171

AMENDED SUMMONS IN A CIVIL ACTION

To: *(Defendant's name and address)* STMicroelectronics N.V.
WTC Schiphol Airport, Schiphol boulevard 265
1118 BH Luchthaven Schiphol, Amsterdam, The Netherlands

A lawsuit has been filed against you.

Within 21 days after service of this summons on you (not counting the day you received it) — or 60 days if you are the United States or a United States agency, or an officer or employee of the United States described in Fed. R. Civ. P. 12 (a)(2) or (3) — you must serve on the plaintiff an answer to the attached complaint or a motion under Rule 12 of the Federal Rules of Civil Procedure. The answer or motion must be served on the plaintiff or plaintiff's attorney, whose name and address are:

Alison A. Richards
Global IP Law Group, LLC
55 W. Monroe Street, Suite 3400
Chicago, IL 60603
Phone: 312-241-1500

If you fail to respond, judgment by default will be entered against you for the relief demanded in the complaint. You also must file your answer or motion with the court.

CLERK OF COURT

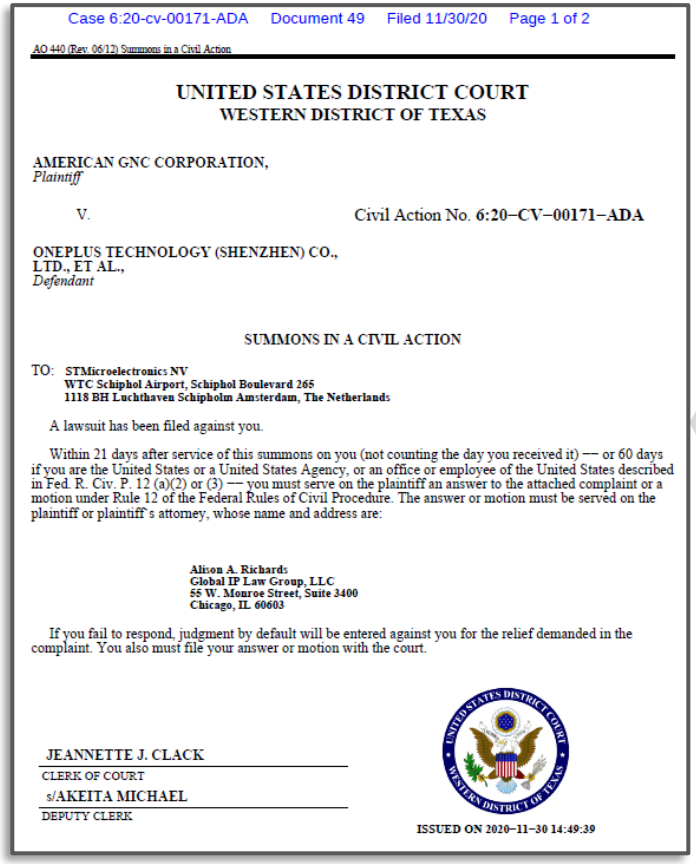
Date: _____

Signature of Clerk or Deputy Clerk

To: *(Defendant's name and address)* STMicroelectronics N.V.
WTC Schiphol Airport, Schiphol boulevard 265
1118 BH Luchthaven Schiphol, Amsterdam, The Netherlands

EX1070 (in '122 patent IPR), p. 1; EX1071 (in '648 patent IPR), p. 1

Patent Owner has not established service



Case 6:20-cv-00171-ADA Document 49 Filed 11/30/20 Page 1 of 2

AO 440 (Rev. 06/12) Summons in a Civil Action

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF TEXAS

AMERICAN GNC CORPORATION,
Plaintiff

V. Civil Action No. **6:20−CV−00171−ADA**

ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD., ET AL.,
Defendant

SUMMONS IN A CIVIL ACTION

TO: **STMicroelectronics NV**
WTC Schiphol Airport, Schiphol Boulevard 265
1118 BH Luchthaven Schipholm Amsterdam, The Netherlands

A lawsuit has been filed against you.

Within 21 days after service of this summons on you (not counting the day you received it) — or 60 days if you are the United States or a United States Agency, or an office or employee of the United States described in Fed. R. Civ. P. 12 (a)(2) or (3) — you must serve on the plaintiff an answer to the attached complaint or a motion under Rule 12 of the Federal Rules of Civil Procedure. The answer or motion must be served on the plaintiff or plaintiff's attorney, whose name and address are:

Alison A. Richards
Global IP Law Group, LLC
55 W. Monroe Street, Suite 3400
Chicago, IL 60603

If you fail to respond, judgment by default will be entered against you for the relief demanded in the complaint. You also must file your answer or motion with the court.

JEANNETTE J. CLACK
CLERK OF COURT

s/AKEITA MICHAEL
DEPUTY CLERK

ISSUED ON 2020−11−30 14:49:39

SUMMONS IN A CIVIL ACTION

TO: **STMicroelectronics NV**
WTC Schiphol Airport, Schiphol Boulevard 265
1118 BH Luchthaven Schipholm Amsterdam, The Netherlands

A lawsuit has been filed against you.

ISSUED ON 2020−11−30 14:49:39

EX1071 (in '122 patent IPR), p. 1; EX1072 (in '648 patent IPR), p. 1

Patent Owner has not established service

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

AMERICAN GNC CORPORATION,

Plaintiff,

v.

ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD., STMICROELECTRONICS NV, and STMICROELECTRONICS S.R.L.,

Defendants.

Civil Action No. 6:20-cv-00171-ADA

JURY TRIAL DEMANDED

NOTICE OF DISMISSAL OF STMICROELECTRONICS NV AND STMICROELECTRONICS S.R.L. WITHOUT PREJUDICE

Pursuant to Rule 41(a)(1)(A)(i) of the Federal Rules of Civil Procedure, Plaintiff American GNC Corporation hereby notices the immediate dismissal, without prejudice, of this action as to Defendants STMicroelectronics NV and STMicroelectronics S.R.L. only.

Dated: December 4, 2020

Respectfully submitted,

/s/ *Alison A. Richards*

David Berten
IL Bar # 6200898
dberten@giplg.com
Alison Aubry Richards

Pursuant to Rule 41(a)(1)(A)(i) of the Federal Rules of Civil Procedure, Plaintiff American GNC Corporation hereby notices the immediate dismissal, without prejudice, of this action as to Defendants STMicroelectronics NV and STMicroelectronics S.R.L. only.

Dated: December 4, 2020

Respectfully submitted,

EX1072 (in '122 patent IPR), p. 1; EX1073 (in '648 patent IPR), p. 1

No RPI relationship exists

Luminex Int'l. Co., Ltd. v. Signify Holdings B.V., IPR2024-00101, Paper 20 at 11-13 (PTAB Nov. 21, 2024)

"[A] customer-indemnitee's **request for indemnification** by a manufacturer-indemnitor under a standard, non-exclusive, manufacturer-customer indemnification agreement relating to patent infringement **[cannot] be sufficient** to support a finding of real party in interest and trigger the one-year time bar."

Opp'n to PO Mot. for Discovery, p. 14 (emphasis added)